Watershed Management Division

2022-2023 Water Quality Monitoring and Assessment Summary Report

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION

WATERSHED MANAGEMENT DIVISION

VERMONT

This report supplements our obligations to EPA under Sections 303(d), 305(b), and 314 of the federal Clean Water Act.

Contents

1. Introduction

The Watershed Management Division 2022-2023 Water Quality Monitoring and Assessment Summary Report summarizes the Division's monitoring and assessment efforts, highlights recent changes in waterbody listing status, and describes several Division monitoring and assessment priorities. Portions of this report fulfill narrative requirements of the federal Integrated Water Quality Assessment Report, the 305(b) Report; Appendix (Table A2) also supplies links to information for additional 305(b) reporting elements that have not been specifically called out in this report. Most of the data associated with the biennial 305(b) Report has been submitted electronically to the federal Environmental Protection Agency. This data can be accessed through EPA's "How's My Waterway?" application as both a statewide summary and at local watershed scale.

2. Division Mission, Vision, & Goals

The Division's Mission is to efficiently and effectively manage Vermont's surface waters through a comprehensive, integrated and holistic watershed-based system. This mission is expressed through our four goals to protect, maintain, enhance, and restore Vermont's surface waters, including wetlands, lakes and ponds, and rivers and streams. Inherent in this effort is the support of both healthy ecosystems and public uses in and on these surface waters.

Mission: To manage Vermont's surface water resources efficiently and effectively through a comprehensive, integrated, and holistic watershed-based system.

Vision: To achieve full support of both healthy ecosystems and public uses in all Vermont's surface waters.

Goals:

1. Protect Vermont's very high quality or "special" waters from deleterious change over the long-term through proactive protection tools, such as reclassification and protective easements.

2. Maintain the current high quality of Vermont's surface waters through regulations and permitting, technical assistance, and outreach.

3. Enhance and restore the condition of Vermont's surface waters by implementing regulations, and targeting technical, outreach, and funding resources.

3. How We Work

The interrelationship of land use impacts and the connectivity of surface water resources are the primary reasons why monitoring, assessment, management, and restoration are most effective when conducted at a watershed scale. This concept of holistic watershed management is foundational to our division's structure and methods. The Division includes three media-based programs – Wetlands, Lakes and Ponds, and Rivers – focused on resource-specific management through monitoring and assessment, outreach and technical assistance, and regulatory programs. The Division also administers three federally delegated permitting programs – Stormwater, Wastewater, and CAFO (Concentrated Animal Feeding Operations) – that regulate discharges to surface waters. Two additional programs provide cross-divisional support – the Monitoring and Assessment Program, focused on integrated assessment and biomonitoring; and BOSS (Business Operational and Support Services), which provides administrative, financial, and compliance services for the Division. In total, the Division employs nearly 100 permanent staff and approximately 15 temporary staff. The Division also benefits from several partnership positions with organizations such as Lake Champlain Sea Grant, NEIWPCC, and ECO AmeriCorps.

***Figure 3.1**. Programs of the Watershed Management Division.*

Given the physical nature of watersheds, the consideration of land-based activities affecting watersheds, and the synergy between the individual watershed elements (e.g., rivers, lakes, and wetlands), a corresponding organizational structure is the most predictable and comprehensive means of ensuring clear, efficient, and effective surface water management. The central goal driving the composition and design of the [Division's organizational structure] is to better leverage the concept of holistic watershed management.

An Overview of Vermont Water Quality Standards

As required by the federal Clean Water Act, the Vermont Water Quality Standards establish designated uses, which must be protected and maintained. In Vermont, the designated uses are:

- Aquatic biota and wildlife that may utilize or are present in the waters;
- Aquatic habitat to support aquatic biota, wildlife, or plant life;
- The use of waters for swimming and other primary contact recreation;
- The use of waters for boating and related recreational uses;
- The use of waters for fishing and related recreational uses;
- The use of waters for the enjoyment of aesthetic conditions;
- The use of the water for public water source; and
- The use of water for irrigation of crops and other agricultural uses.

A surface water is classified for each designated use. The class of the water determines the management objectives and the minimum water quality criteria. There are four possible classes of Vermont surface waters: Class A(1) – waters in their natural condition that have significant ecological value; Class B(1) – waters in which one or more uses are of demonstrably and consistently higher quality than Class B(2) waters; Class B(2) – good quality waters that support all designated uses; and A(2) – waters that are suitable for a public water source with filtration and disinfection or other required treatment.

The state legislature established that all waters above 2,500 are Class A(1), unless they are a public water source, in which case they are Class A(2). All other waters are Class B(2) unless they have been reclassified. Reclassification is proposed through rulemaking by the Agency of Natural Resources Secretary pursuant to 10 V.S.A. § 1253 or the public may petition the Agency to reclassify a waterbody for any of the designated uses. In 2017, all surface waters in the wilderness areas of Green Mountain National Forest were reclassified to A(1), along with three streams in or near Ripton, Vermont in 2022 for the designated uses of aquatic biota and wildlife, aquatic habitat, and aesthetics. As of April 2023, 139 waters currently meet the data standard for reclassification (Figure A1 and Table A4 in the Appendix).

If a surface water meets or exceeds the minimum water quality criteria for its designated use and class – A(1), B(1), B(2), or A(2) – it is a high quality water. A surface water may be high quality for only some parameters (for example, a surface water may meet minimum criteria for all parameters except for total phosphorus). If it meets the minimum criteria, then the designated use is an existing use. Existing uses must always be protected and maintained. If it does not meet the minimum criteria, the surface water is impaired, and a restoration plan must be developed and implemented.

In addition to designated uses and the minimum water quality criteria necessary to protect and maintain them, the Vermont Water Quality Standards include the Antidegradation Policy. The Clean Water Act requires that states establish an Antidegradation Policy in their Water Quality Standards and the methodology to implement it. The Antidegradation Policy ensures the protection of water quality in outstanding resource waters (“Tier 3”); the protection and maintenance of water quality in high quality waters (“Tier 2”); protection of existing uses (“Tier 1”).

States are required to update their water quality standards at least every three years. This process is called a triennial review. In Vermont, updates to the Water Quality Standards are proposed through rulemaking. Once a rule is final, it then gets submitted to the Environmental Protection Agency for approval. The most recent Vermont Water Quality Standards Rule was adopted November 15, 2022.

As of April 2023, 139 waters currently meet the data standard for reclassification (Figure A1 and Table A4 in the Appendix). To protect the waters of the State of Vermont, the Watershed Management Division (WSMD) can initiate rulemaking to reclassify surface waters to maintain a higher standard. The public may also petition the Division to request the initiation of rulemaking.

4. Program Overviews

Business and Operational Support Services (BOSS) Program

The Business and Operational Support Services (BOSS) Program provides administrative and technical assistance for the division's permitting and resource-based programs, as well as advanced operational support. The BOSS team administratively reviews and processes permit applications, tracks permit compliance, performs permit billing and accounts receivable functions, and coordinates database and website development. BOSS staff support the division in achieving the overall mission of protecting, maintaining, enhancing, and restoring Vermont's surface water resources by promoting efficiency and consistency, and leveraging technology.

Concentrated Animal Feeding Operation (CAFO) Program

The Concentrated Animal Feeding Operation Program regulates agricultural point source discharges through inspections, investigations, formal and informal enforcement, and by administering National Pollutant Discharge Elimination System (NPDES) permits for agricultural operations that meet a certain animal population threshold or, regardless of population, are determined to be a significant contributor of pollutants to waters of the United States.

Lakes and Ponds Management and Protection Program

The Lakes and Ponds Management and Protection Program works to protect, maintain, enhance, and restore the health of Vermont lakes and the public uses that healthy lake ecosystems provide, such as swimming, boating, and fishing. Lakes and Ponds staff conduct education and outreach, assessment and monitoring, and administer regulatory programs. A current focus is to preserve or restore the natural lakeshore to protect and improve water quality, aquatic and terrestrial wildlife habitat, and lake ecosystem functions into the future.

Monitoring and Assessment Program (MAP)

The Monitoring and Assessment Program (MAP) integrates essential components of the division's strategy to prevent water pollution through water quality sampling and assessment. MAP measures water quality indicators, uses monitoring data to assess the condition of surface waters, and maintains a comprehensive water quality database for surface waters statewide.

Rivers Program

The Rivers Program provides technical and regulatory assistance for projects affecting the flows and physical integrity of streams, rivers, river corridors, and floodplains. Two primary objectives guide this work: (1) to avoid and mitigate flood and erosion hazards, and (2) to restore and protect stream processes, floodplain functions, and critical habitat. The Rivers Program carries out stream geomorphic assessments and river corridor planning to support river diagnostics, river corridor easements, channel maintenance and restoration designs, and technical assistance during flood recovery operations. The program also maintains and restores natural stream flows by regulating water withdrawals and hydropower projects, and manages the National Flood Insurance Program (NFIP) for Vermont.

Stormwater Program

The Stormwater Program provides regulatory oversight and technical assistance to ensure proper design and construction of stormwater treatment and control practices, as well as construction-related erosion prevention and sediment control practices, necessary to minimize the adverse impacts of stormwater runoff to surface waters throughout Vermont. Stormwater Program regulations address discharges from new and existing development, roads, industrial sites, municipal stormwater systems, and construction sites.

Wastewater Program

The Wastewater Program is responsible for protecting Vermont's surface waters from discharges of industrial and municipal wastewater and other direct discharges. These discharges can carry chemicals, toxics, and pathogens that are harmful to water quality, fish and wildlife habitat, and public health. If not properly treated and controlled, these discharges can negatively impact surface water quality and limit recreational opportunities.

Wetlands Program

Wetlands, commonly called swamps, marshes, or bogs, are transitional areas between open water and land. Wetlands provide important ecosystem services such as flood protection, water quality improvement, and wildlife habitat. The mission of the Wetlands Program is to identify, monitor, and protect wetlands that provide significant functions and values; to encourage the restoration and enhancement of impaired wetlands; and to teach Vermonters about wetland issues and the importance of wetland stewardship. The program also has a goal of no net loss of wetland acreage, function, or value.

5. Monitoring and Assessing Vermont's Surface Waters

The Watershed Management Division has monitored and assessed Vermont's surface waters since 1977. Monitoring and assessment are the foundation of the division's science-based decision-making used to implement regulations, identify surface water protection and restoration strategies and priorities, and evaluate effectiveness.

Division scientists and community volunteers monitor annually an average of 1,300 sites statewide, including wetlands, lakes and ponds, rivers and streams, and their surrounding watersheds. Monitoring and assessment are conducted in collaboration with federal, state, and local partners to leverage resources, increase geographic coverage, and promote consistency in monitoring and assessment methods and results reporting.

Monitoring and assessment enable the division to:

- Determine water quality status and trends of individual surface waters relative to Vermont Water Quality Standards, as well as water quality status and trends of waters statewide, and compare our waters regionally and nationally.

- Assess cumulative impacts to surface waters to inform actions necessary to protect, maintain, enhance, and restore water quality.

- Provide water quality assessment information to support the identification of restoration or protection priorities.

- Inform and ensure compliance with permit conditions.

- Identify and track known and emerging stressors that threaten the integrity and uses of Vermont surface waters.

- Respond to public concerns and local emergencies regarding Vermont's surface waters.

Monitoring and assessment strategies and priorities drive the development of short- and long-term monitoring projects. A cross-programmatic monitoring team meets regularly to review annual monitoring and assessment priorities and track progress implementing longer-term strategies. Project objectives determine the sampling parameters, design, and sites selected. Watershed Management Division scientists measure:

- Chemical parameters, such as nutrients, conductivity, salinity, pH, and priority metals.

- Physical parameters, such as lake shoreline condition, stream geomorphic condition, water levels and stream flow, and land use type and conversion.

- Biological parameters, such as macroinvertebrates, algae, fish species, and fish tissue contaminants.

Background on Vermont's Surface Waters

Vermont has 7,100 miles of rivers and streams based on EPA's Total Waters Database which uses 1:100,000 scale maps. Currently, the State of Vermont uses this scale to account for assessed and unassessed stream miles. Vermont has approximately 230,900 acres of lakes, reservoirs, and ponds and approximately 300,000 acres of freshwater wetlands (Table 5.1). Vermont water resources and related spatial data can be accessed on the Vermont Natural Resources Atlas.

Table 5.1. Information on the State of Vermont and surface water resources.

State population (December 1, 2017)	623,989
State population change (since 2010)	+0.01%
State surface area	9,616 square miles
State population density	65 persons/square mile

Miles of perennial rivers & streams	7,100
Border miles of shared rivers and streams	262 (238 with New Hampshire along the Connecticut River, 24 miles along the Poultney River with New York)
Longest river in the state, not including the Connecticut River	Otter Creek (100 miles)
Largest river watershed in the state, not including the Connecticut River	Winooski River Watershed (1,080 square miles)
Number of lakes, reservoirs & ponds over 20 acres	280
Number of significant lakes, reservoirs & ponds less than 5 acres	206
Deepest inland lake	Lake Willoughby (337 feet)
Greatest depth of Lake Champlain	Off Thompson's Point (394 feet)
Acres of lakes, reservoirs & ponds	242,219 acres, including 171,967 acres of Lake Champlain in Vermont
Acres of freshwater wetlands	300,000

Monitoring by Design

Monitoring designs are selected to achieve specific objectives, such as assessing waters against Vermont Water Quality Standards, understanding water quality trends and climate change impacts, identifying stressors, or establishing permit conditions. A few examples are:

- Targeted, fixed station monitoring: Fixed stations are selected to better understand status and trends of individual lakes, ponds, wetlands, rivers and streams. Within this category, the division conducts:
  - Long-term monitoring projects: Extensive lake, river, and stream monitoring networks designed to assess status and trends.
  - Special and TMDL studies: Used for stressor identification and when more data is necessary to develop a restoration plan called a TMDL or Total Maximum Daily Load.
  - Rotational basin monitoring: Systematic, comprehensive monitoring and assessment of select watersheds on a rotational basis, with statewide coverage achieved every five years.
  - Probability-based monitoring: Conducted in coordination with EPA, randomly generated sites provide a statistically valid determination of statewide water quality conditions by surface water type.

Assessment of the Condition of Vermont Waters

In accordance with the federal Water Pollution Control Act (also known as the *Clean Water Act*), the Watershed Management Division periodically assesses the quality of Vermont's surface waters relative to the [Vermont Water Quality Standards]() as described in the [Surface Water Assessment and Listing]()

Methodology. Through the assessment process, program scientists interpret water quality monitoring information from sites within an area of interest, and, where appropriate, relate that information to causes of observed problems and sources of pollutants.

Vermont Priority Waters List

For the purposes of identifying and tracking important water quality problems where the Vermont Water Quality Standards (VTWQS) 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 that are either impaired or altered:

Impaired

Part A (303d list): These waters are assessed as impaired due to one or more pollutants for which a TMDL is required to be developed. This list is developed in even-numbered years and submitted to EPA for approval according to federal Clean Water Act regulations.

Part B: These waters are assessed as impaired by a pollutant but because other pollution control mechanisms are in place, no TMDL is required to be developed. Water Quality Remediation Plans are one potential tool for addressing impairments.

Part D: These waters are assessed as impaired by a pollutant and have a completed TMDL that has been approved by EPA.

Altered

Part E: These waters are assessed as altered where aquatic habitat and/or other designated uses are not supported due to the extent of aquatic invasive species.

Part F: These waters are assessed as altered due to hydrologic factors. These often include a lack of flow, water level or flow fluctuations or some other modified hydrologic condition.

Changes to waterbody assessments between the 2020 and 2022 listing cycles are given in the Appendix.

Water Quality Remediation Plans

Pursuant to 40 C.F.R. §130.7(b), the State may use a Water Quality Remediation Plan (WQRP) in lieu of a TMDL for an impaired water when the State determines that the pollution control requirements of the WQRP are stringent enough to meet State Water Quality Standards within a reasonable period of time. The WQRP procedure is described here.

Lakes Monitoring and Assessment

Inland Lake Assessment Program

The primary function of the Lake Assessment Program is to monitor the status and trends of Vermont's inland lakes. Sampling conducted at spring turnover (through the Spring Phosphorus Program) since 1977 is used to monitor inland lake water quality trends. To assess the status or current condition of Vermont's inland lakes, the program conducts summer sampling as part of the National Lake Assessment and Vermont Next Generation Lake Assessment. Additional special studies may focus on a particular stressor or a particular lake, or aid in the development of new methodologies to measure Vermont Water Quality Standards or in interpreting status or trend data.

Vermont Lay Monitoring Program

The Lay Monitoring Program is a statewide, volunteer lake monitoring program that has sampled more than 100 inland lakes and 40 stations on Lake Champlain since 1979.

From Memorial Day through Labor Day, Lay Monitors follow a strict protocol to measure Secchi transparency and collect water samples that are tested for the nutrient Total Phosphorus and Chlorophyll-a, the green pigment in algae. Results characterize a lake's trophic status and allow us to track water quality trends over time. Lay monitoring data is used to assess compliance with Vermont's Water Quality Standards and to identify lakes eligible for upwards reclassification or impairment designations.

Vermont Lakes Score Card

The Vermont Inland Lake Score Card is a user-friendly interface developed by the Vermont Lakes and Ponds Management and Protection Program (VLPP) to share available data on overall lake health with lake users. Using Google Earth, viewers can select from more than 800 lakes in the state and learn about four key aspects of lake health: nutrients, aquatic invasive species, shoreland and lake habitat, and mercury pollution. Links embedded in the Score Card open deeper views into the underlying data and point to steps Vermonters can take to protect their lakes.

The Vermont Inland Lake Score Card aims to answer the question "how is a lake doing?" with easy-to-interpret graphics and images. The Lake Scores are based on the best available data and information the Vermont Lakes and Ponds Program (VLPP) has currently. While the data upon which a score is based is empirically derived, the actual thresholds differentiating lake scores were based on best professional judgement. Final scores were reviewed by VLPP scientists.

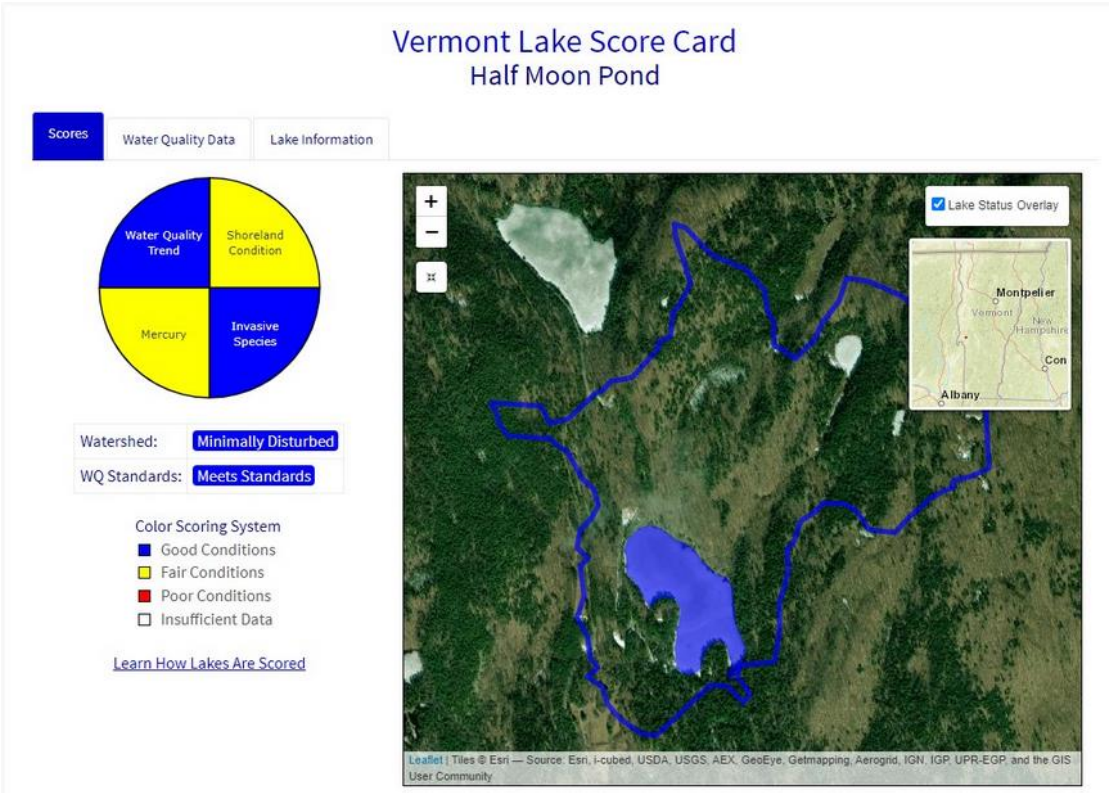

Figure 5.2*. An example of data displayed on the Vermont Lakes Scorecard.*

Cyanobacteria Monitoring and Tracking

Vermont DEC staff monitor the prevalence of cyanobacteria blooms on lakes and ponds throughout the summer and fall months, provide weekly updates on the status of all affected waters, and perform taxonomic analyses of cyanobacteria samples in a laboratory. Volunteer cyanobacteria monitors around the State help track the status and presence of cyanobacteria blooms. The Vermont Department of Heath maintains a Cyanobacteria Tracker website, where you can report blooms and where you can see recent reports of blooms around the state. Our volunteer monitors take visual observations of lake conditions every week, whether or not there is a bloom present. These observations help us to better understand how common blooms are in different locations, and to better compare bloom severity across years.

Lake Champlain Long-Term Water Quality and Biological Monitoring Project

The Lake Champlain Long-Term Water Quality and Biological Monitoring Project surveys the quality of Lake Champlain waters on a bi-weekly basis, at 15 locations throughout the lake. Twenty-one major tributaries are sampled on an event-basis as well. The program's large physico-chemical parameter list includes: species of phosphorus, nitrogen and organic carbon; chlorophyll-a; base cations and alkalinity; TSS; dissolved oxygen; conductivity; and pH. The project also performs biological sampling, which is primarily aimed at assessing phytoplankton, zooplankton, and macroinvertebrate communities.

***Figure 5.3**. A Division scientist collects samples on Lake Champlain.*

National Lakes Assessment

Division scientists participate in the National Lakes Assessment, which is a survey of the condition of the nation's lakes, ponds and reservoirs.

Vermont Long-Term Monitoring (VLTM) of Acid Sensitive Lakes

The VT Department of Environmental Conservation has been monitoring the chemistry of low ionic strength lakes in Vermont since the winter of 1980. In 1983, the US EPA Long-Term Monitoring Project was initiated within the National Acid Precipitation Assessment Program (NAPAP). Since then, the VLTM project has been conducted in cooperation with the US EPA. This cooperative project consists of six federal/state agencies and universities in different regions of the U.S. and is managed by the US EPA's Clean Air Markets Division. Currently, Vermont monitors the chemistry of 12 lakes. Each lake has been monitored under the current VLTM project from 28 to 32 years, making it one of the oldest lake monitoring programs designed specifically to assess acidification.

Rivers Monitoring and Assessment

Biomonitoring

Biomonitoring is the use of biological community surveys to assess stream health. Biological communities, such as fish, mussels, and macroinvertebrates, are influenced by the range of physical and chemical conditions in a stream over time and integrate impacts from stressors at the local and watershed scale. As a direct measure of aquatic ecosystems, biological communities are a powerful tool for providing a holistic assessment of stream health. Water chemistry data and physical habitat observations are typically collected to help interpret the biological condition. Biomonitoring is a primary tool of the Vermont Department of Environmental Conservation (VTDEC) Watershed Management Division (WSMD) for evaluating the status of Vermont's wadeable streams and informing management decisions.

Figure 5.4. *A Division scientist collects macroinvertebrate samples from a stream.*

Ambient Biomonitoring Network (ABN)

The Ambient Biomonitoring Network (ABN) program was established by the Vermont DEC in 1985 to:

- monitor long-term trends in water quality as revealed in changes over time to ambient aquatic fish and macroinvertebrate communities,
- to evaluate site-specific impacts of point and non-point discharges to aquatic biological communities, and
- to establish baseline data to assist the Department in establishing Vermont-specific biological criteria for water quality classification attainment determinations in rivers and streams.

Biomonitoring program staff monitor over 150 stream sites annually to assess attainment status with Vermont Water Quality Standards and identify streams that are impaired or are very high quality. All chemical and biological monitoring results can be accessed via the [Vermont Integrated Watershed Information System].

Probabilistic Stream Monitoring

The majority of WSMD biomonitoring resources are directed towards streams that have a specific management interest. Examples of this targeted monitoring include the bracketing of point-source discharges, tracking the restoration efficacy of impaired streams, and the collection of long-term data from reference sites to understand the effects of climate change. In 2002, the Watershed Management Division (WSMD) began to integrate probabilistic monitoring into its biomonitoring program, a design that focuses on randomly selected sites. Site locations are provided by the U.S. Environmental Protection Agency (EPA) and are selected from the National Hydrography Dataset using a random design stratified by stream order. Unlike the targeted approach, this allows for an unbiased assessment of the overall biological condition of Vermont's wadeable streams. Probabilistic monitoring is one method that the WSMD can use to evaluate progress towards achieving its goals of protecting, maintaining, enhancing, and restoring Vermont's waters.

Results from probabilistic monitoring sites are used to calculate estimates for the percent of all Vermont stream miles in each assessment category for two biological community types: macroinvertebrates and fish. These estimates were used to determine the overall biological condition of Vermont's wadeable streams during the survey period from 2018-2020. This is the fourth probabilistic stream survey to be completed by VTDEC, and the first using the three-year rolling average design. Each of the four probabilistic surveys estimate that approximately 50% or more of Vermont wadeable stream miles are Very High Quality (*Very Good* or *Excellent* assessment rating) for at least one biological community, and approximately 70% or more of Vermont wadeable stream miles support at least one community in *Good* or better condition. This is strong evidence that the majority of wadeable stream miles in Vermont meet or exceed Vermont Water Quality Standards (VWQS) for at least one biological community. Streams that fail to meet VWQS (*Poor* or *Fair* assessment rating) typically account for a smaller percentage (less than 30%) than the other assessment categories but are important indicators of stressors impacting water quality and stream health in Vermont.

Figure 5.5. *Estimate for percent of stream miles in each assessment category for macroinvertebrates and fish from the 2018-2020 probabilistic survey of wadeable streams.*

National Rivers and Streams Assessment

Division scientists participate in the National Rivers and Streams Assessment, which is a survey of the condition of the nation's rivers and streams.

Stream Geomorphic Assessment

The Rivers Program provides technical assistance to conduct geomorphic assessments of streams and their watersheds. The Vermont Stream Geomorphic Assessment Handbooks have been developed as tools to use in assessing, understanding, and evaluating the condition of the river system. The information gathered can be used for basin planning; river and riparian corridor protection, management, and restoration projects; aquatic and riparian habitat assessment; and hazard assessments to reduce property loss and damage from riverine erosion during floods.

Water Quality Monitoring

WSMD scientists collect thousands of water quality samples each year to monitor status and trends in lakes, rivers, and wetlands. Commonly analyzed water chemistry parameters include total and dissolved phosphorus, total nitrogen, nitrate, nitrite, alkalinity, pH, temperature, chloride, conductivity, sodium, calcium, potassium, magnesium, iron, aluminum, and turbidity. Regular water chemistry monitoring is conducted throughout the state. Monitoring and Assessment Program staff work with the Stormwater, Wastewater, and CAFO Programs to collect water chemistry information that informs permitting decisions. Waters that receive direct discharges from wastewater treatment facilities and CAFOs are monitored for additional water chemistry parameters such as total metals and dissolved organic carbon. Stormwater impacted streams are monitored frequently for chloride and conductivity. When resources allow, high-frequency data loggers are deployed in streams to collect continuous water quality data that provide detailed information about water temperature, chloride, and/or conductivity. These are frequently deployed in stormwater-impacted streams or to bracket a specific event such as a dam removal. Select surface waters are also monitored for PFAS. All water quality data are available via the Vermont Integrated Watershed Information System.

LaRosa Partnership Program

The LaRosa Partnership Program (LPP) is a community-science initiative that empowers watershed organizations and monitoring groups with access to water quality sampling. Each summer, approximately 30 partner organizations monitor over 250 sites across the state for priority parameters, including nutrients and chloride. Since 2003, this program has allowed community members to engage with their local streams and rivers firsthand, learn about water quality issues, and use water testing to identify where impacts are present. Significant program improvements have been implemented in the past few years that have streamlined the process for partners, removed barriers to participation, and more closely aligned monitoring efforts with Division priorities.

LPP focuses on five monitoring categories with the following objectives: characterize water quality conditions upstream of wastewater treatment facilities; identify potentially high-quality waters; sample lake tributaries to assess their contribution to nutrients and chloride loading in lakes; identify stressed or impaired waters and/or refine the extent and source of the stressor; and evaluate the effectiveness of remediation efforts.

Wetlands Monitoring and Assessment

Wetlands Monitoring

Division scientists conduct monitoring and mapping efforts to identify and characterize wetlands throughout the state. The Wetlands Program has developed a Vermont Rapid Assessment Method for Wetlands, which informs further bioassessment monitoring and mapping efforts. The Program utilizes three different survey types which are reflective of the EPA's Level 1, 2, and 3 approach to wetland monitoring. All three levels may be applied at any given site. Level 1 is a broad landscape-scale assessment performed as a desktop review using GIS, LiDAR and aerial imagery; Level 2 is a rapid field assessment at the wetland scale and are to be validated by and calibrated to Level 3 assessments; Level 3 is a site-intensive biological assessment using multi-metric indices. Chemical and physical data are collected as well. The condition, function, value, and quality of a variety of wetland types are assessed with the goal of improving wetland protection and restoration.

Figure 5.6. *A Division scientist collects data in a wetland.*

National Wetlands Condition Assessment

Division scientists participate in the National Wetlands Condition Assessment, which is a survey of the condition of the nation's wetlands.

Wetland Mapping

The Wetlands Program is prioritizing the improvements to the statewide wetland maps. Simply put, we cannot target our protection and restoration efforts without a good sense of where wetlands are on the landscape. In recognition of the regulatory status and importance of wetlands, the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) has been producing wetland maps and geospatial data since themid-1970s to document the location and extent of wetlands, and to analyze wetland trends over time. About half of the NWI wetland mapping in Vermont was created in the 1970s and 1980s. Our initial efforts to update the NWI in Vermont have yielded vast improvements to our knowledge of wetland location and quality. NWI mapping was updated Missisquoi Basin in Northwestern Vermont in 2019 which increased identified wetland area by 38%. The Program's plan is to have the entire state wetland mapping updated by the end of 2025.

As mapping is updated throughout the state, analysis will be conducted to predict wetland function at a level 1 scale (landscape). Wetland function prediction will be based on each wetlands landscape position, landform, and water flow path (LLWW) classifications following Tiner (2011a)[1] and appropriate Vermont-specific updates to the method. The Program's plan is to have an analysis for the entire state by the end of 2027.

Class I Wetlands

Class I wetlands are exceptional or irreplaceable in their contribution to Vermont's natural heritage. They provide unmatched environmental functions and values and therefore merit the highest level of protection. Approximately 2,500 acres of wetland have been protected in Vermont through the Class I designation. There are over 40 wetlands identified as needing further study for Class I designation or candidate Class I. Because there are so many potential Class I's already identified, the Program is focusing on compiling existing data for those currently identified potential Class Is to aid in reclassification. Refer to Table A.3 in the Appendix for a list of current and proposed Class I wetlands.

6. Division Focus Areas

Monitoring and assessment results, combined with analysis of existing stressor mitigation tools, provide the basis for identifying division strategies and priorities, including additional monitoring and assessment needs. The Vermont Water Quality Monitoring Program Strategy, Vermont Surface Water Management Strategy, and Watershed Management Division Strategic Plan describe this work.

In addition to the core monitoring and assessment programs described above, the Division is focused on the following areas:

- PFAS
- Chloride
- Cyanobacteria

PFAS

Act No. 21 of 2019 required the Vermont Agency of Natural Resources (ANR) to develop a plan for the adoption of surface water quality standards for per- and polyfluoroalkyl substances (PFAS). In February 2020, ANR's Department of Environmental Conservation (DEC) released the State of Vermont Plan for Deriving Ambient Water Quality Standards for the Emerging Chemicals of Concern: Per- and Polyfluoroalkyl Substances (PFAS). The plan includes collecting fish tissue contaminant data to develop human health criteria, creating programs to limit sources of PFAS to wastewater treatment plants, and working with EPA and state partners to develop aquatic biota standards. Additionally, Act 21 requires that ANR file a final rule to adopt PFAS surface water quality standards no later than January 1, 2024.

To implement the plan outlined in the 2020 report, DEC's Watershed Management Division (WSMD) initiated a monitoring in 2021 to collect PFAS data in surface waters and fish tissue around Vermont. The goal of this work is to establish a baseline understanding of PFAS concentrations and to identify major

[1] Tiner, R.W. 2011a. Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors: Version 2.0. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Northeast Region, Hadley, MA.

contributors to contamination. Common sources of PFAS include municipal wastewater treatment plants, airports, industrial waste dischargers, and areas with significant urban runoff.

Ambient Monitoring for PFAS in Surface Waters

The WSMD has conducted monitoring of surface water and fish tissue in 2021 and 2022. In 2021, WSMD collected surface water samples at 19 sites in northern Vermont that were located near potential PFAS hotspots. Ten of the sites were within the Lake Memphremagog watershed, with the goal of investigating potential impacts from the NEWSVT landfill in Coventry, VT. The other nine sites were chosen to assess water quality impacts from municipal wastewater treatment facilities and the Vermont Air National Guard Base. In coordination with Vermont Fish and Wildlife, WSMD also collected fish tissue samples at eight of the 19 sites.

Highlights from the 2021 monitoring results include:

- All surface water sites were below the VT Drinking Water Advisory for the five Vermont-regulated PFAS (PFOA, PFOS, PFHxS, PFNA, and PFHpA).
- The highest PFAS surface water concentrations were observed at the mouth of the Muddy Brook and at the Winooski River below Allen Brook (both in South Burlington, upstream of the Air National Guard Base), which are areas with significant urban inputs.
- The highest PFAS fish tissue concentrations were observed at the mouth of the Winooski River and the mouth of the Otter Creek, which are downstream of urban areas and multiple wastewater treatment discharges.
- PFAS concentrations in all monitoring locations were low compared to results from national studies and similar to other regional studies conducted in Maine and New Hampshire.

Monitoring efforts have continued in 2022, with further sampling at the sites with the highest observed fish tissue PFAS concentrations, as well as at locations upstream and downstream of known industrial and municipal discharges on the Winooski River and Otter Creek to assess point source impacts. WSMD is also targeting new sites close to industrial discharges on the Missisquoi River.

In 2023, the Vermont Department of Environmental Conservation will use ARPA (American Rescue Plan Act) funding to test influent, effluent, and septage received at municipal Wastewater Treatment Facilities for PFAS/PFAS precursor compounds. The project will be carried out in two phases:

- Phase 1: Collection of quarterly influent and effluent data from all direct discharge municipal facilities with all samples analyzed for PFAS via isotope dilution and all influent samples also analyzed using the Total Oxidizable Precursor Assay. Septage received by at least 5 wastewater facilities will also be assessed for PFAS levels on a quarterly basis. Sampling is expected to begin in June 2023
- Phase 2: Based on results from phase 1, focused sewershed studies to determine sources of PFAS loading to municipal WWTFs.

WSMD regularly collaborates with several partners as part of its PFAS monitoring and assessment program. Staff are working with the Vermont Department of Health to determine data needs for the development of a fish consumption advisory. Additionally, Vermont Fish and Wildlife is an important partner for collecting and analyzing fish tissue samples. Finally, WSMD participates in several PFAS-focused workgroups, including the Fish Contaminant Monitoring Committee, which is comprised of representatives from multiple Vermont government agencies, as well as regional and national organizations to learn from colleagues in other states about their PFAS programs.

The department has been working on PFAS since 2016 when widespread groundwater contamination was discovered in Bennington. Review the PFAS Road Map, which outlines strategic priorities relating to PFAS and summarizes the actions taken by DEC to address PFAS in Vermont. For the latest information on PFAS, see the VTDEC PFAS webpage.

Chloride

Current Chloride Standards

Chloride pollution enters Vermont's surface waters and groundwater mainly through runoff from impervious surfaces containing road salt (sodium chloride). Other sources of chloride include agricultural runoff, septic systems, wastewater treatment facilities, and water softeners.

The Vermont Water Quality Standards (VTWQS) have chloride specific criteria for both acute and chronic exposures. These criteria were recommended to states by the US Environmental Protection Agency (USEPA) in 1988 for adoption as their WQS. States can set more stringent standards if warranted, however, the process to develop them is very resource intensive. The acute exposure criterion is 860 mg/l as a one-hour average not to be exceeded every three years. The chronic criterion is 230 mg/l as a four-day average not to be exceeded every three years. Neither the USEPA nor the VTWQS have recommended water quality criteria for sodium.

Currently (2022), the Watershed Management Division (WSMD) has identified seven streams impaired due to high chloride concentrations and another four where chloride is suspected as a contributing factor of aquatic biota impairment, but sufficient data has not yet been collected. An additional three streams will likely be listed as impaired for chloride in 2024. Additionally, two lakes and ponds have been found to have average chloride concentrations greater than the chronic criterion of 230 mg/L.

Impacts below water quality standards criteria

There is evidence that negative impacts still occur below the VTWQS criteria concentrations. Macroinvertebrate community health in Vermont streams appears to be negatively impacted at chloride levels as low as 50 mg/l. Chloride at lower concentrations can especially stress aquatic biota communities when combined with other stressors (e.g., sediment, nutrients, toxics).

Scientific literature also suggests that negative impacts to lake zooplankton may also occur at concentrations near 50 mg/l.

As a reference, chloride concentrations in streams of mostly forested watersheds are normally less than 10 mg/l in Vermont. A USGS report on stream chemistry along the Appalachian Mountains (Argue et al, 2001) presents the median chloride value of 1.75 mg/L in the Taconics and southern Green Mountains and 2.07 mg/L in the Vermont New Hampshire Uplands. There is no significant natural source of chloride in Vermont bedrock or soils.

USEPA is currently in the process of reviewing more recent toxicity studies regarding chloride impacts to aquatic biota, but any future recommendations to revise the VTWQS are still several years away.

Chloride reduction approaches

The WSMD currently does not have a universal approach to reduce road salt application and subsequent runoff to surface waters. However, a few limited approaches are in place and include:

- In Municipal Separate Storm Sewer System (MS4) communities where a chloride impaired waterbody has been documented, Towns, and VTrans are required to develop and implement Chloride Response Plans as part of permit requirements. These typically include strategies to reduce the amounts of road salt applied by utilizing well maintained and calibrated spreading equipment and focusing applications at temperatures when road salt is most effective.
- Facilities covered under the stormwater Multi-Sector General Permit are required to cover salt storage piles.
- The WSMD has worked with Act 250 permittees required to develop chloride reduction plans as part of permit requirements.
- The WSMD is actively working with several ski areas to direct monitoring and assess impacts chloride is having on the aquatic biota in streams. This work helps them to realize impacts and to focus their chloride reduction efforts.

Chloride in Vermont surface waters

Chloride is routinely sampled in lakes, wetlands, and streams as part of several monitoring programs conducted by the WSMD and in 2022, 122 lakes and 365 streams were sampled for chloride concentration. Targeted chloride monitoring is also conducted in streams of known/suspected elevated concentrations. Targeted monitoring creates a more robust and extensive dataset to properly document chloride impaired waters.

The following figures illustrate the extent of chloride concentrations in our lakes and streams.

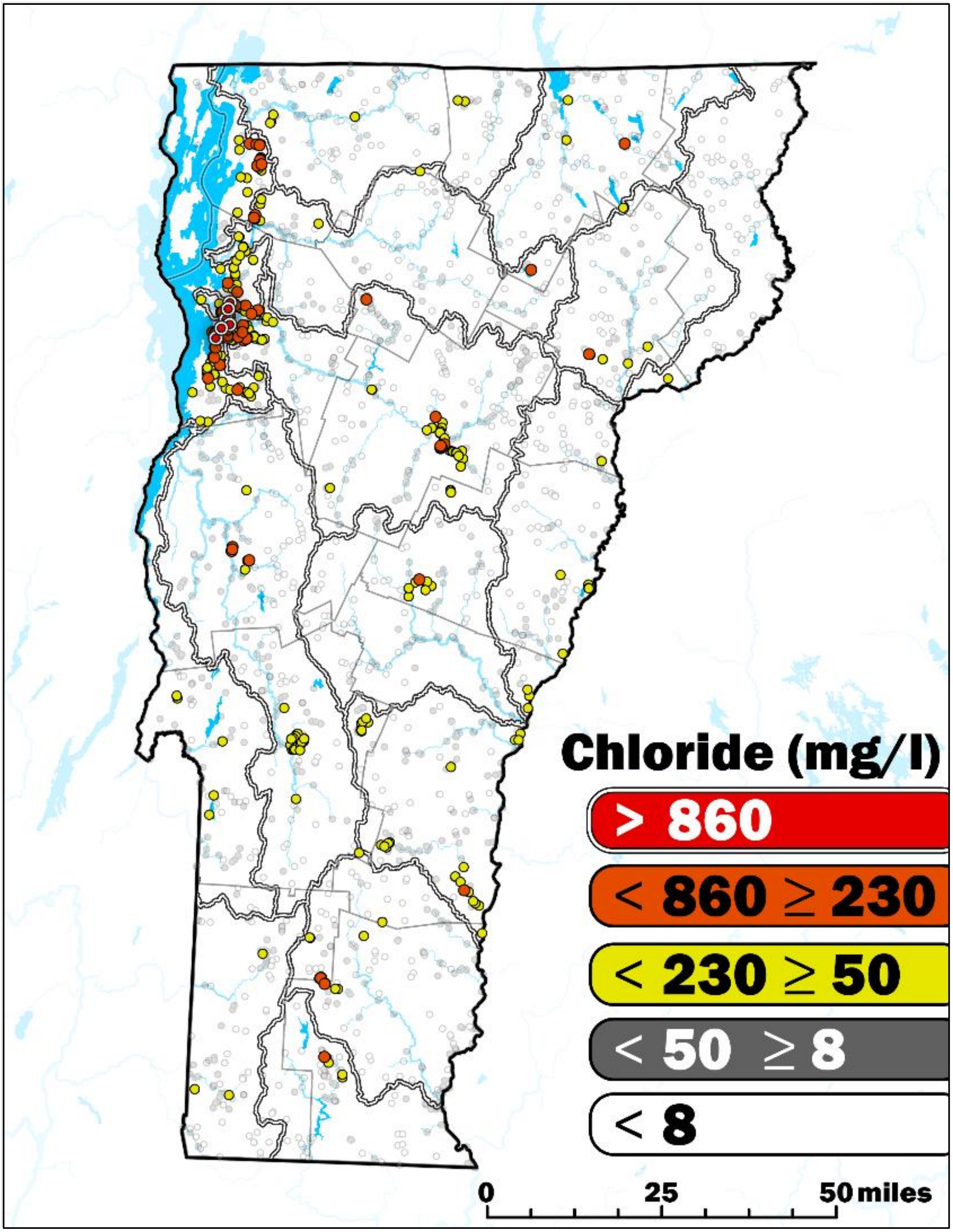

Figure 6.1. *Distribution of chloride concentrations in streams of Vermont. These data points represent single observations of the maximum observed chloride concentrations but do not necessarily represent streams determined to be impaired or otherwise. Sufficient data needs to be collected to make impairment determinations according to assessment methodologies supportive of the water quality standards. Where elevated levels exist however, there is a greater chance of impairment existing.*

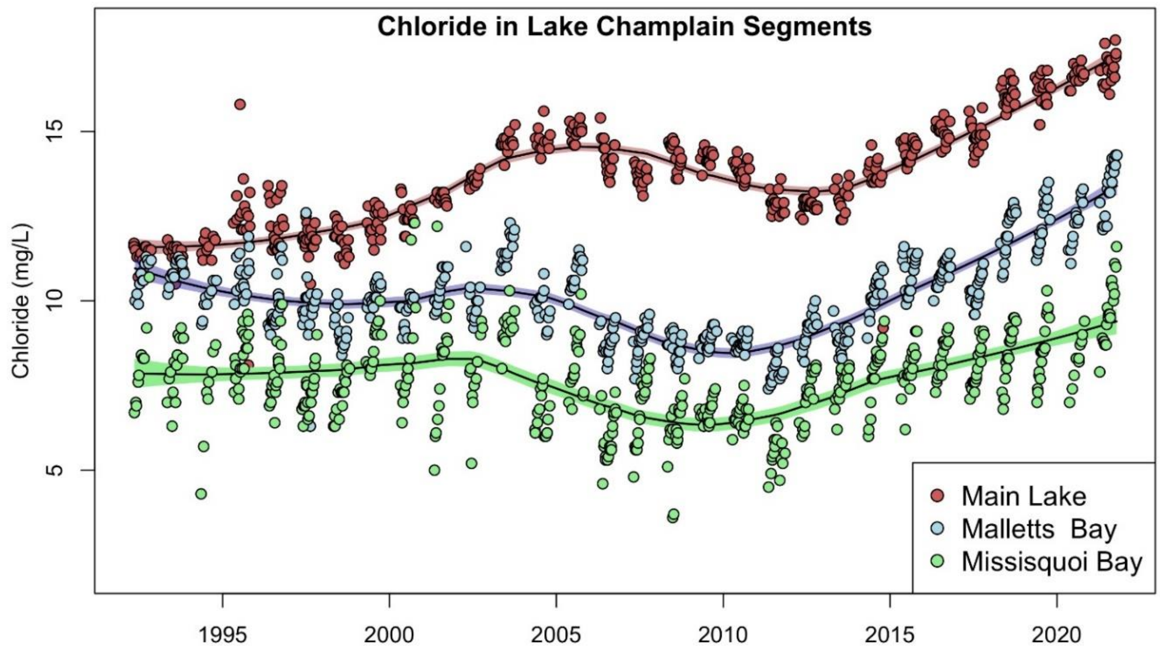

Figure 6.2. *Total chloride in three basins of Lake Champlain. Points are individual observations from the Lake Champlain Long-term Monitoring Program. Hypolimnion samples are omitted. Shaded areas around the trend line represent a 95% confidence interval around the estimate of the mean concentration. All lake segments have significant increasing trends (p<0.05) over the monitoring period.*

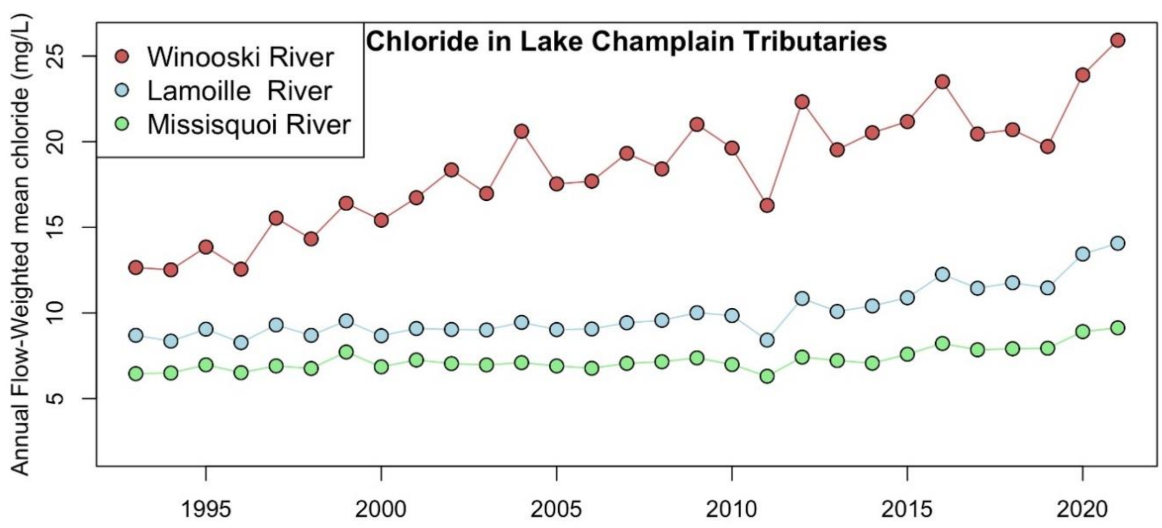

Figure 6.3*. Annual flow-weighted mean concentrations (FWMC) of chloride from three large Vermont rivers draining to Lake Champlain. FWMCs are calculated as annual load divided by annual discharge. If everything coming out of a tributary in a year was collected in a large bucket, the concentration of a solute in that bucket would be equivalent to the FWMC. FWMC is increasing significantly (p<0.001) in all rivers shown here.*

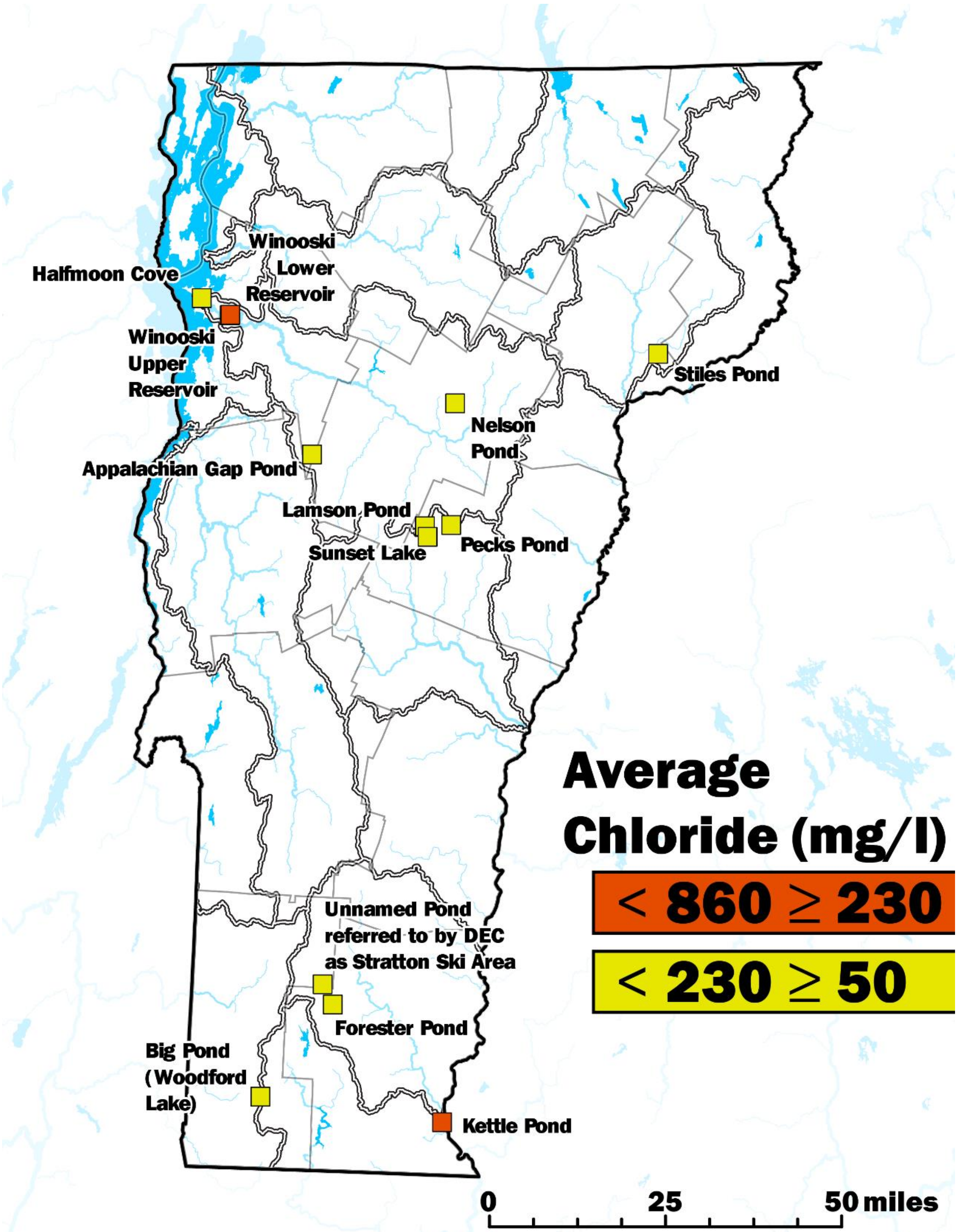

Figure 6.4. *Distribution of elevated chloride concentrations in lakes of Vermont. A total of 468 inland lakes and ponds have been monitored for chloride at least once. Of these, mean chloride concentrations exceed 50 mg/L at 13 lakes and ponds, including six that have exceeded 230 mg/L. For 62 lakes, sufficient data exist to determine whether there has been a statistically significant, increasing chloride trend. Of these, 9 lakes have significantly increasing trends.*

Cyanobacteria Monitoring on Lake Champlain and Vermont Inland Lakes

The Cyanobacteria Monitoring Project is a partnership between Vermont Department of Environmental Conservation (VTDEC), the Vermont Department of Health (VDH), and the Lake Champlain Committee (LCC). The project consists of three main components: 1) a network of volunteer monitors and program staff making visual observation of cyanobacteria bloom conditions; 2) a centralized, interactive reporting website where bloom observations are vetted by trained staff and viewable by the public; and 3) collection of samples for toxin analyses and cyanobacterial cell counts. VTDEC is principally responsible for the 3rd component of this program (being responsible for cell counts and, beginning in 2023, cyanotoxin analyses), together with project coordination, data analysis, and reporting. Additionally, VTDEC staff assist with volunteer coordination (particularly in inland VT lakes outside of the Lake Champlain basin) and with vetting of visual observations based on submitted photos. The DEC portion of the cyanobacteria monitoring program in carried out by one staff member, with the assistance of a UVM intern for 3 months from mid-May through mid-August.

Summary of 2022 Activities

In 2022, community science volunteers, staff, and the general public submitted 2548 site-specific visual reports (fig. 1), with 1877 from Lake Champlain and 671 from other lakes in Vermont. In total, there were reports of blooms in 36 inland lakes in Vermont apart from Champlain. This number of inland lakes has generally increased over the past 10 years. In addition, 73 samples were tested for analysis of microcystins, and 69 for anatoxins. There was one sample from a bloom in Lake Carmi with microcystin concentrations exceeding VDH recreational guidelines, and no anatoxin samples above detection limits. In addition, microscopic cyanobacteria cell counts were performed on 118 samples, the majority of which were from Lake Champlain, with several from Lake Carmi, Lake Memphremagog, and Ticklenaked Pond.

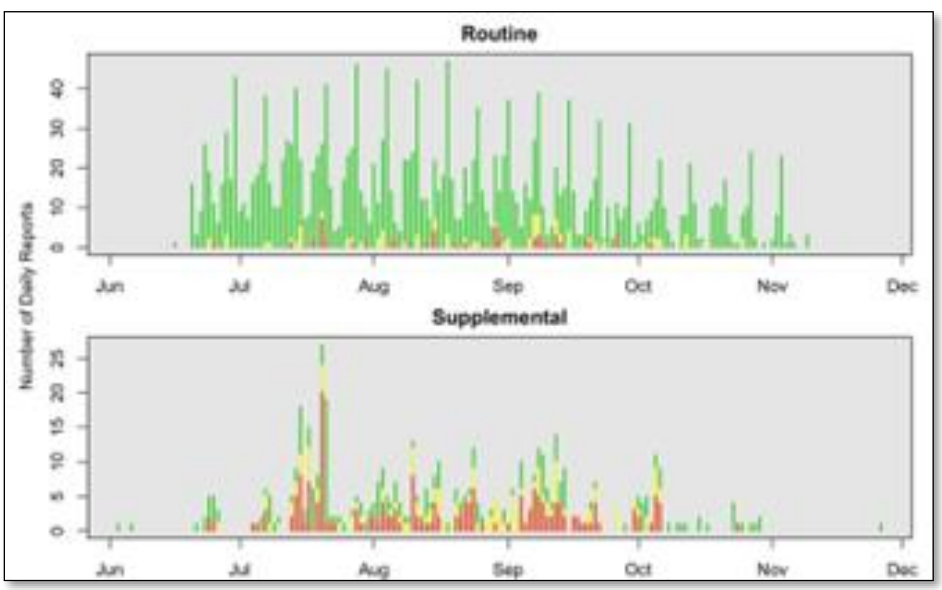

Figure 6.5. *Number of visual reports of generally safe (green), low alert (yellow) or high alert (red) blooms in 2022 from routine weekly reports (top) and supplemental reports (bottom)*

Summary of Conditions in 2022

2022 was in general a relatively normal year for bloom activity. There were several strong blooms reported in Lake Champlain, including a notable bloom around Burlington in mid-July and persistent blooms in St. Albans Bay throughout August. The most unusual occurrence in 2022 was the emergence of a strong and prolonged bloom in Lake Morey composed of the benthic filamentous cyanobacterium *Microseira wollei.* Microseira is observed in lakes in Vermont relatively frequently, but blooms of this magnitude have not been reported here previously. There were also cyanobacteria blooms reported in Joe's Pond in Danvillle, which has rarely been observed in the past.

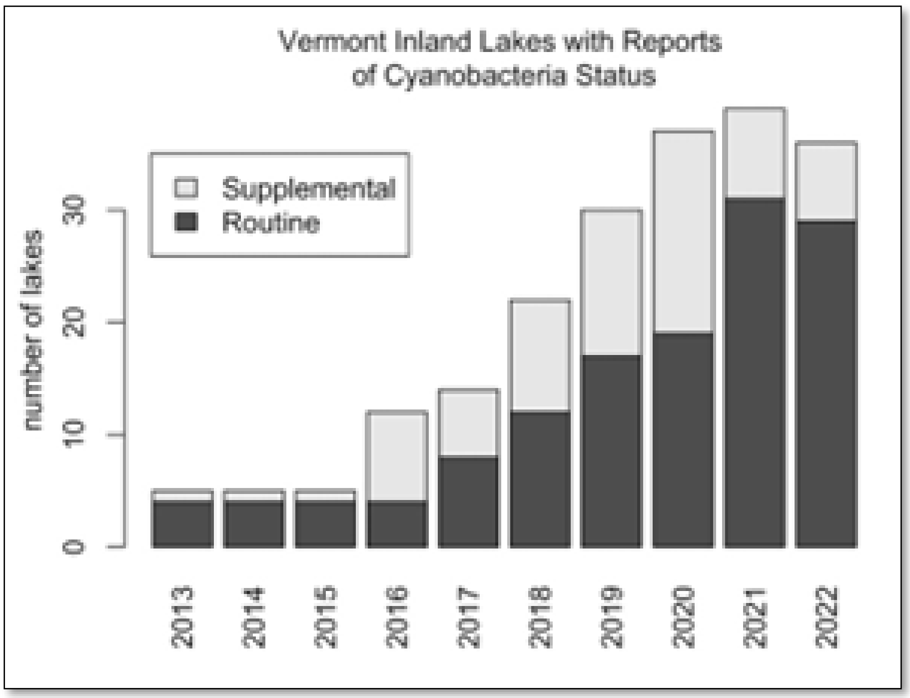

***Figure 6.6**. Number of Vermont lakes (excluding Champlain) with reports of cyanobacteria conditions. Dark bar represents lakes with regular (usually weekly) reporting, light gray bars represent lakes with "supplemental" reports.*

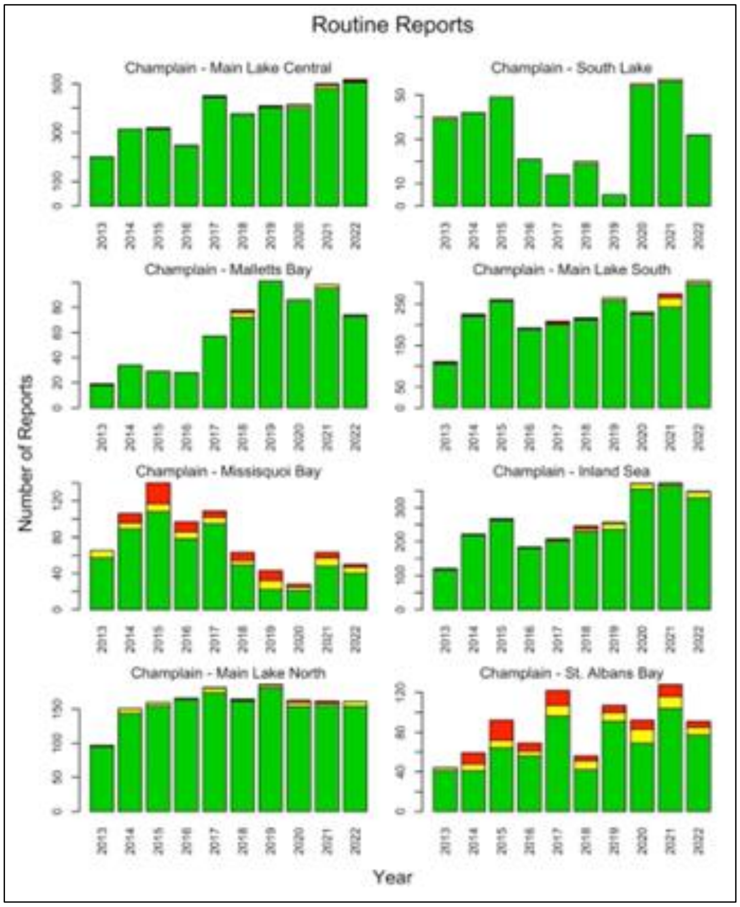

Figure 6.7. *Number of reports of generally safe (green), low alert (yellow) or high alert (red) conditions observed in the basins of Lake Champlain between 2013 and 2022*

Anticipated changes in 2023

In 2023, DEC is taking over management of cyanotoxin testing as part of the Cyanobacteria Monitoring Program from VDH, with the influx of one-time funds to the LCBP earmarked for cyanotoxin testing from NOAA, which will be administered by DEC and should cover expanded cyanotoxin testing for 2-3 years. In addition to continuing quality assurance sampling as outlined in the project QAPP, the extra testing capacity over 2-3 years will be used to target as many observed bloom events as possible (current sampling is on a regular schedule and captures mostly non-bloom conditions), and will cover expanded testing to four groups of cyanotoxins (microcystins, anatoxins, cylindrospermopsins, and saxitoxins). Of these, the last is of note because it is known to be produced by Microseira, which formed the majority of the bloom in Lake Morey, and for which we have no prior testing data. Saxitoxins are a group of toxin most frequently associated with paralytic shellfish poisoning (associated with "red tides" in coastal settings). It is unclear where the funding for cyanotoxin analyses will come from after the 2024 or 2025 season, but with cyanotoxin analyses now taking places at the VAEL lab rather than VDH, it is likely that DEC will continue to coordinate the cyanotoxin testing in the future.

Appendix

Summary of Priority Waters Listing Changes

***Table A.1**. summary changes to the Vermont Priority Waters List between the 2020 and 2022 listing cycles. The "From" column identifies the 2020 assessment or listing status and the "To" column identifies the assessment or listing status in 2022. RM=river mile.*

Waterbody ID	Name	From	To	Reason
Previously impaired waters now in compliance with Water Quality Standards				
VT08-12.04	West Branch Little River, RM 7.5 to 8.0	Part B	Full support	Macroinvertebrate data shows aquatic biota use now in compliance with water quality standards.
VT01-05L12	Lye Brook north	Part D	Full support	This waterbody no longer exists as a lake, so all previous assessments are not relevant.
VT01-05L11	Lye Brook south	Part D	Full support	This waterbody no longer exists as a lake, so all previous assessments are not relevant.
VT12-04L02	Lost Pond (Glastenbury)	Part D	Full support	This waterbody no longer exists as a lake, so all previous assessments are not relevant.
VT15-01.02	Passumpsic River below Great Falls	Part F	Full support	FERC license issued to bring flows into water quality standards compliance.
VT08-05.04	Bypass below Middlesex #2 dam on the Winooski River	Part F	Full support	Water quality certification issued to bring flows into water quality standards compliance.
VT08-05.02	Winooski River impoundment above Middlesex #2 dam (2 miles)	Part F	Full support	Water quality certification issued to bring flows into water quality standards compliance.
Newly identified impaired waters (2022)				
VT03-09L01	Jerome Pond	Full support	Part A	Impaired aesthetics use caused by excessive phosphorus concentrations.
VT01-03.08	Walloomsac River, New York State border upstream to RM 9.2	Full support	Part A	Impaired aquatic biota use caused by excessive phosphorus concentrations below Bennington WWTF.

Waterbody ID	Name	From	To	Reason
VT01-03.09	Jewett Brook from its mouth upstream to Fuller Road	Full support	Part A	Impaired aquatic biota use caused by excessive phosphorus concentrations.
VT08-12.10	Little Spruce Brook	Full support	Part A	Impaired aquatic biota use caused by excessive chloride and sediment.
VT03-07.07	Little Otter Creek from RM 4.2 (Route 7) to RM 7.0 (Echo Rd)	Full support	Part A	Impaired aquatic biota use caused by excessive nutrients and sediment.
VT02-02L02	Sunrise Pond	Full support	Part E	Abundant Eurasian watermilfoil growth
VT08-02.07	Unnamed Tributary to Winooski River	Part B	Part A	Impairment of aquatic habitat remains, caused by iron and arsenic at South Burlington landfill. Part B management efforts have not returned the stream to compliance in a timely manner.
VT08-08.01	Muddy Brook (0.1 Mile)	Part B	Part A	Impairment of aquatic habitat remains, caused by cadmium at Central Vermont landfill. Part B management efforts have not returned the stream to compliance in a timely manner.

305(b) Report Requirements

The majority of the Section 305(b) reporting requirements are fulfilled by the State of Vermont via data uploads to EPA's ATTAINS (Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System) and through portions of this report. The uploaded data can be accessed through EPA's "How's My Waterway?" application as both a statewide summary and at local watershed scale. Table A.2. supplies additional information requirements not contained in this report.

***Table A.2**. Links to information for additional 305(b) reporting elements that not specifically called out in this report.*

Section 305(b) Reporting Element	**Information source**	**Link to information**
Water Pollution Control Program		
An estimate of the extent and costs to which CWA control programs have improved water	The Water Investment Division produces an annual Performance Report that summarizes clean water efforts and demonstrates how	https://dec.vermont.gov/water-investment/cwi/reports

	investments are making a difference in water quality of Vermont's rivers, lakes, and wetlands the details	
Surface Water Monitoring and Assessment		
Description of the surface water monitoring program	The Watershed Management Division (WSMD) produces the Water Quality Monitoring Program Strategy to detail the various monitoring approaches used for surface waters.	https://dec.vermont.gov/watershed/map/monitor
Description of data and information used to make attainment determinations	The WSMD produces the Surface Water Assessment and Listing Methodology that describes the decision-making process used for surface water assessments.	https://dec.vermont.gov/watershed/map/assessment
Ground Water Monitoring and Assessment		
Description of the nature and extent of ground-water pollution and recommendations of State plans or programs needed to maintain or improve ground-water quality	The Vermont Groundwater Management Plan lays out three high level objectives: • improve information available for GW management decisions, • protect public health and safety and the environment, and • C) expand communications.	https://dec.vermont.gov/water/groundwater
Public Participation		
Description of required public participation process, comments received, and responsiveness summary related to 303(d) listing process	The WSMD posts the comments received, response summary and EPA approval documentation for the latest 303(d) listing cycle.	https://dec.vermont.gov/watershed/map/assessment

Table A.3. *Class I Wetland candidates and wetlands proposed for further study.*

Wetland	Status
Batten Kill, Walloomsac Hoosic	
Pownal Bog	Candidate
Batten Kill Headwaters	Proposed for Study

Maple Grove Swamp	Proposed for Study
Middle Pownal Road Swamp	Proposed for Study
Black and Ottauquechee Rivers	
Eshqua Bog	Class I
Black Pond Wetlands	Proposed for Study
Beaver Pond Wetlands	Proposed for Study
Killington Flats	Proposed for Study
Lake Ninevah Wetlands	Proposed for Study
Deerfield River and adjacent CT River	
Black Gum Swamps	Candidate
Lily Pond	Proposed for Study
Atherton Meadows	Proposed for Study
Sadawaga Pond Floating Bog	Proposed for Study
Lamoille	
Sandbar Wetlands	Class I
Belvidere Bog	Proposed for Study
Molly Bog	Proposed for Study
Flagg Pond Cedar Swamp	Proposed for Study
Missisquoi Bay	
Missisquoi Delta	Candidate
Fairfield Swamp	Proposed for Study
Franklin Bog	Proposed for Study
Northern Lake Champlain	
Colchester Bog	Candidate
Munson Flats	Candidate
Northshore Wetlands	Class I
Sandbar Wetlands	Class I
LaPlatte River Marsh	Class I
Thorp Brook	Proposed for Study
Mud Creek	Proposed for Study
Ompompanoosuc, Stevens, Waits and Wells Rivers	
Peacham Bog	Class I
Stoddard Swamp	Proposed for Study
Otter Creek	
Otter Creek Wetland Complex	Candidate
Tinmouth Channel	Class I
Beaver Meadows	Class I
Passumpsic, Upper Connecticut	
Victory Basin Wetlands	Candidate
Yellow Bogs	Candidate
Dennis and Mud Pond Wetlands	Class I
Moose Bog	Proposed for Study

Southern Lake Champlain	
Dorset Marsh	Class I
Wards Marsh within Lower Poultney River Floodplain Forest	Class I
South Fork of East Creek	Proposed for Study
West, Williams, Saxtons Rivers & adjacent CT River Tribs	
Eddy Brook Wetlands	Proposed for Study
Winhall River Headwaters Wetlands	Proposed for Study
Putney's Sand Hill Road Complex	Proposed for Study
Herrick's Cover, Rockingham	Proposed for Study
Athens Dome Wetland Complex	Proposed for Study
White River	
Turnpike Fen	Candidate
Nyes Swamp	Proposed for Study
Winooski	
Chickering Fen	Class I
Derway Island	Proposed for Study
Shelburn Pond	Proposed for Study
Essex Alder Brook	Proposed for Study
Upper Gleason	Proposed for Study
Kettle Pond	Proposed for Study
Lanesboro Bog	Proposed for Study
Mud Pond	Proposed for Study

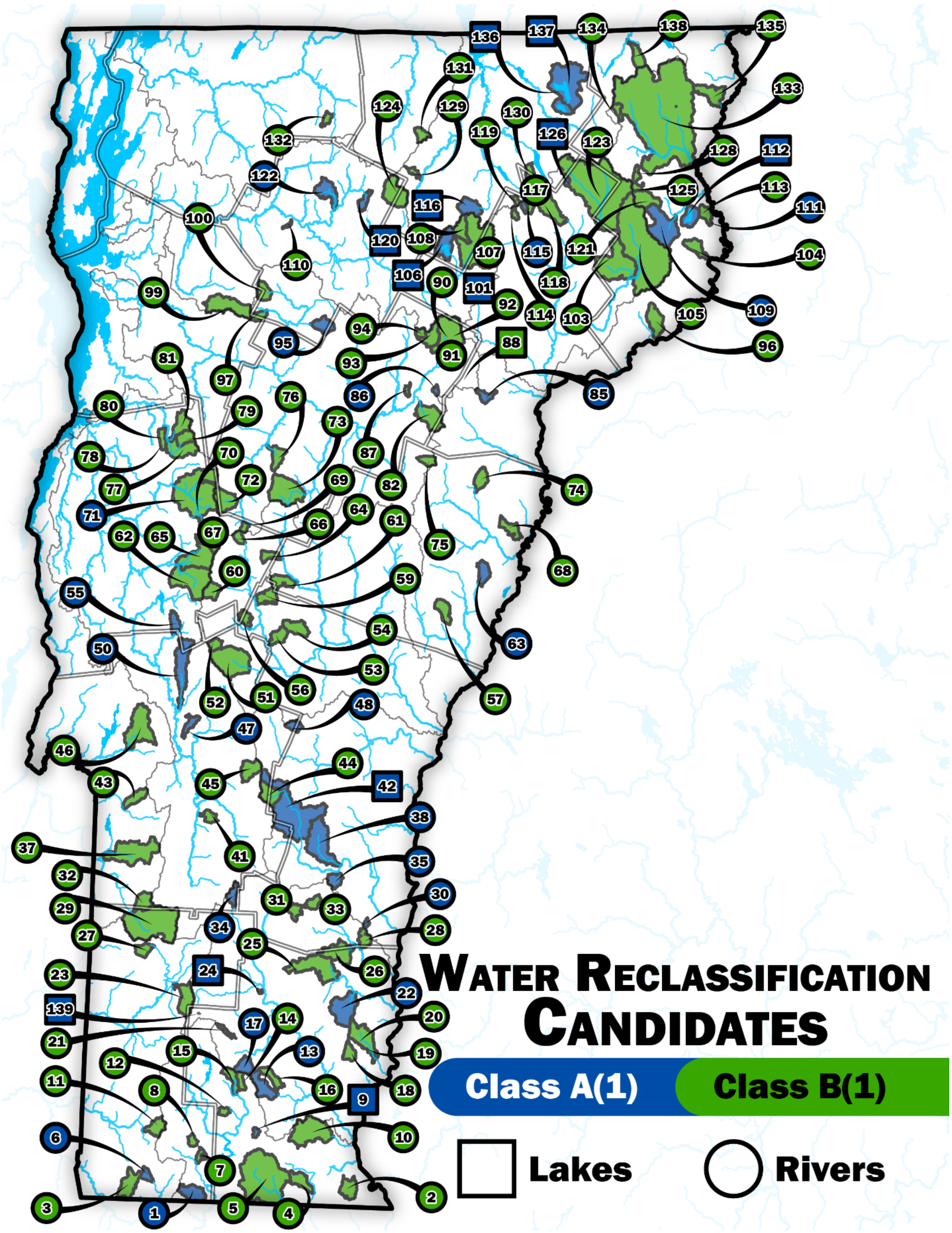

Figure A.1. Lake and river reclassification candidates.

Table A.4. Lake and river reclassification candidates.

Map ID	Location Name	Proposed Class	Town	Lake Area (Acres)
LAKES				
9	RAPONDA	A1	WILMINGTON	578
24	COLE	A1	LONDONDERRY, JAMAICA	163
42	RESCUE	A1	PLYMOUTH, SHREWSBURY, READING, MOUNT HOLLY, LUDLOW	23754
101	COLES	A1	STANNARD, WALDEN	777
106	CASPIAN	A1	GREENSBORO	4402
112	MAIDSTONE	A1	FERDINAND, GRANBY, MAIDSTONE	3048
116	SHADOW (GLOVER)	A1	GLOVER	3414
120	SOUTH (EDEN)	A1	HYDE PARK, EDEN	1514
126	NEWARK	A1	WESTMORE, NEWARK	519
136	ECHO (CHARTN)	A1	HOLLAND, MORGAN, CHARLESTON	15122
137	SEYMOUR	A1	HOLLAND, MORGAN, CHARLESTON	12893
139	STRATTON	A1	STRATTON	48
Map ID	**Location Name** (number indicates river miles from downstream confluence)	**Proposed Class**	**Town**	**Length (Miles)**
RIVERS				
1	South Branch Deerfield River, 1.3	A1	READSBORO, STAMFORD	15
6	Cardinal Brook, 0.1, Cardinal Brook, 1.1	A1	STAMFORD	7
13	Rock River, 10.8	A1	WARDSBORO, NEWFANE, DOVER	16
17	Waite Brook, 0.8	A1	WARDSBORO, DOVER	12
22	Bull Creek, 2.0	A1	GRAFTON, TOWNSHEND, WESTMINSTER, ROCKINGHAM, ATHENS	37
30	Chester Brook Trib #4, 0.2	A1	SPRINGFIELD	1
34	Mount Tabor Brook, 1.4	A1	MOUNT TABOR, WESTON	7
35	Great Brook, 6.9	A1	CHESTER, CAVENDISH, BALTIMORE	6
38	Twenty Mile Stream, 0.6	A1	PLYMOUTH, READING, CAVENDISH, LUDLOW	44
47	Warner Brook, 1.3	A1	PITTSFORD, PROCTOR, RUTLAND TOWN	6
48	North Branch Ottauquechee Trib #15, 0.1	A1	KILLINGTON, BRIDGEWATER	6
50	Sugar Hollow Brook, 3.0, Sugar Hollow Brook, 4.2	A1	GOSHEN, CHITTENDEN, BRANDON, PITTSFORD	33

55	Leicester Hollow Brook, 0.1	A1	GOSHEN, LEICESTER, BRANDON	9
63	Middle Brook, 6.3	A1	WEST FAIRLEE	10
71	New Haven River Trib 27, 0.5	A1	BRISTOL, LINCOLN	6
85	Mud Pond Brook, 0.6	A1	PEACHAM	3
86	Turtlehead Pond Trib #1, 0.2	A1	MARSHFIELD	1
95	Gold Brook, 3.0	A1	STOWE, WORCESTER	18
109	Granby Stream, 0.1	A1	FERDINAND, EAST HAVEN, GRANBY	29
111	Rich Brook, 0.1	A1	MAIDSTONE	3
115	Calendar Brook Trib 22, 0.4	A1	SHEFFIELD	3
122	Wild Brook, 0.3	A1	BELVIDERE, JOHNSON, EDEN	24
2	Fall River, 15.2	B1	GUILFORD, VERNON	13
3	Broad Brook, 2.4	B1	POWNAL, STAMFORD	20
4	Green River Trib 6, 1.7	B1	HALIFAX, GUILFORD	11
5	East Branch North River, 11.7	B1	WILMINGTON, MARLBORO, WHITINGHAM, HALIFAX	75
7	Lamb Brook, 0.1	B1	READSBORO	5
8	West Branch Deerfield River Trib 7, 1.8	B1	SEARSBURG, READSBORO	6
10	Whetstone Brook, 10.7	B1	DUMMERSTON, MARLBORO, BRATTLEBORO	31
11	City Stream, 2.0	B1	WOODFORD	10
12	Haystack Brook, .1, Haystack Brook, 0.3	B1	WILMINGTON	6
14	Ellis Brook, 2.9	B1	WARDSBORO, DOVER	5
15	Blue Brook, 0.7	B1	STRATTON, WARDSBORO, DOVER	13
16	Adams Brook, 0.8	B1	WARDSBORO, NEWFANE, DOVER	10
18	Sacketts Brook, 4.8	B1	WESTMINSTER, BROOKLINE, PUTNEY	11
19	East Putney Brook, 3.4	B1	WESTMINSTER, PUTNEY, ATHENS	39
20	East Putney Brook, 3.8	B1	WESTMINSTER, PUTNEY, ATHENS	37
21	Bear Creek, 0.7	B1	JAMAICA, STRATTON	6
23	Bourn Brook, 1.6	B1	WINHALL, MANCHESTER, SUNDERLAND, STRATTON	17
25	Saxtons River, 14.1	B1	GRAFTON, WINDHAM	46
26	Hall Brook, 0.7	B1	GRAFTON, CHESTER	23
27	Goodman Brook, 0.6	B1	RUPERT, DORSET, MANCHESTER	9
28	Skunk Hollow Brook, 0.4	B1	SPRINGFIELD, ROCKINGHAM	10
29	Mettawee River, 32.5	B1	DANBY, RUPERT, DORSET	69
31	Andover Branch, 4.4	B1	ANDOVER	8
32	Sykes Hollow Brook, 0.9	B1	PAWLET, DANBY, RUPERT, DORSET	10
33	Chase Brook, 0.7	B1	ANDOVER, CHESTER, LUDLOW	6

37	Wells Brook, 1.3	B1	PAWLET, DANBY, TINMOUTH, WELLS	40
41	Button Brook, 0.6, Button Brook, 0.1	B1	SHREWSBURY, WALLINGFORD, CLARENDON	9
43	Lavery Brook, 0.3	B1	POULTNEY, MIDDLETOWN SPRINGS, IRA	14
44	Great Roaring Brook, 0.1	B1	PLYMOUTH, SHREWSBURY	14
45	Sargent Brook, 1.6	B1	SHREWSBURY, MENDON	10
46	North Breton Brook, 1.5, North Breton Brook, 0.6	B1	HUBBARDTON, CASTLETON, IRA, PITTSFORD, WEST RUTLAND	38
51	West Branch Tweed River, 1.9	B1	PITTSFIELD, CHITTENDEN	40
52	Chittenden Brook, 2.4	B1	CHITTENDEN	5
53	Breakneck Brook, 0.2	B1	ROCHESTER, BETHEL, PITTSFIELD, STOCKBRIDGE	9
54	Camp Brook, 2.5	B1	ROCHESTER, BETHEL	14
56	Wing Brook, 0.2	B1	HANCOCK, ROCHESTER	6
57	Abbott Brook Trib #3, 0.6	B1	STRAFFORD, THETFORD	12
59	Marsh Brook, 1.0	B1	ROCHESTER, BRAINTREE	11
60	Robbins Branch, 1.4	B1	HANCOCK	10
61	Riford Brook, 0.9	B1	ROCHESTER, BRAINTREE	12
62	South Branch Middlebury River, 1.0	B1	RIPTON, HANCOCK, SALISBURY, GOSHEN	58
64	Brackett Brook, 0.1	B1	BRAINTREE, GRANVILLE	6
65	Middle Branch Middlebury River, 0.2	B1	RIPTON, HANCOCK	34
66	Deer Hollow Brook, 0.9	B1	GRANVILLE	7
67	New Haven River, 21.8	B1	LINCOLN, RIPTON, GRANVILLE	34
68	Roaring Brook, 2.0, Roaring Brook, 4.4	B1	NEWBURY, BRADFORD	10
69	Bear Wallow Brook, 0.2	B1	GRANVILLE	4
70	New Haven River, 13.7	B1	STARKSBORO, FAYSTON, BRISTOL, LINCOLN, RIPTON, GRANVILLE, WARREN	150
72	Lincoln Brook, 0.9	B1	LINCOLN, WARREN	25
73	Dog River, 14.8	B1	NORTHFIELD, WAITSFIELD, ROXBURY, WARREN	41
74	Tabor Branch Trib 5, 0.4	B1	TOPSHAM	12
75	Nelson Brook, 2.3	B1	ORANGE	6
76	Pine Brook, 0.5	B1	NORTHFIELD, WAITSFIELD	18
77	Lewis Creek, 24.0, Lewis Creek, 26.4	B1	STARKSBORO, BRISTOL	36
78	Hogback Brook, 1.7	B1	STARKSBORO, MONKTON	2

79	Hillsboro Brook, 0.5	B1	STARKSBORO	12
80	Hogback Brook, 0.1	B1	STARKSBORO, MONKTON	5
81	High Knob Brook, 0.7	B1	STARKSBORO	20
82	Nasmith Brook, 2.7	B1	MARSHFIELD, GROTON, PLAINFIELD	20
87	Guernsey Brook, 0.9	B1	MARSHFIELD	3
90	Winooski River, 84.7	B1	WALDEN, WOODBURY, CABOT	59
91	Winooski River, 85.1	B1	WALDEN, WOODBURY, CABOT	40
92	Winooski River, 85.3	B1	WALDEN, WOODBURY, CABOT	38
93	Jug Brook, 1.4	B1	WOODBURY, CABOT	15
94	Jug Brook, 3.0	B1	WOODBURY	3
96	Scales Brook, 0.9	B1	LUNENBURG, CONCORD	13
97	Michigan Brook, 0.1	B1	UNDERHILL, STOWE, BOLTON, WATERBURY	7
99	Lee River, 2.8	B1	UNDERHILL, STOWE, JERICHO, BOLTON	25
100	Ranch Brook, 1.5	B1	UNDERHILL, STOWE	15
103	Bog Brook, 0.1, Bog Brook, 0.2	B1	EAST HAVEN, BURKE, VICTORY, KIRBY	43
104	Washburn Brook, 1.0	B1	GRANBY, GUILDHALL	8
105	Moose River, 26.8, Moose River, 25.7	B1	EAST HAVEN, GRANBY, GUILDHALL, VICTORY, LUNENBURG, CONCORD	115
107	Lamoille River, 80.8, Lamoille River, 80.2	B1	GLOVER, SHEFFIELD, GREENSBORO, WHEELOCK, STANNARD	55
108	Sawmill Brook, 1.8	B1	GLOVER, GREENSBORO	7
110	Smith Brook, 0.9	B1	CAMBRIDGE, JOHNSON	2
113	Taylor Brook, 0.1	B1	MAIDSTONE	5
114	Nation Brook Trib 3, 0.8	B1	SHEFFIELD	2
117	Clark Brook, 0.2	B1	SUTTON, SHEFFIELD	5
118	Sutton River, 0.1	B1	SUTTON, BURKE	30
119	Duck Pond Brook Trib # 3, 0.2	B1	SHEFFIELD	3
121	Madison Brook, 0.8	B1	FERDINAND, EAST HAVEN	9
123	East Branch Passumpsic River, 8.9	B1	BRIGHTON, WESTMORE, FERDINAND, NEWARK, EAST HAVEN, BURKE	154
124	Wild Branch, 11.2	B1	CRAFTSBURY, EDEN	26
125	North Branch Paul Stream, 2.7	B1	FERDINAND	2
128	Murphy Brook, 3.1	B1	FERDINAND	3
129	Shalney Branch, 1.3	B1	LOWELL, ALBANY	6
130	Wheeler Mountain Brook, 0.1, Wheeler Mountain Brook, 0.5	B1	WESTMORE, SUTTON	5
131	Mineral Spring Brook, 5.0	B1	IRASBURG, LOWELL	5
132	Tamarack Brook, 1.6	B1	MONTGOMERY	7

133	Nulhegan River, 0.3	B1	AVERILL, LEMINGTON, AVERYS GORE, LEWIS, BLOOMFIELD, BRIGHTON, FERDINAND, BRUNSWICK	232
134	Clay Hill Brook, 6.2	B1	AVERYS GORE, LEWIS, BRIGHTON	9
135	Blodgett Brook, 0.7	B1	LEMINGTON	17
138	Number Five Brook, 0.7	B1	NORTON, AVERYS GORE	15