Northern Lake Champlain Direct Drainages

Basin 5

Tactical Basin Plan

September 2024 | DRAFT FOR PUBLIC COMMENT

Tactical Basin Plan was prepared in accordance with 10 VSA § 1253(d), the Vermont Water Quality Standards[1], the Federal Clean Water Act and 40 CFR 130.6, and the Vermont Surface Water Management Strategy.

Approved:

Jason Batchelder, Commissioner — Date

Department of Environmental Conservation

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Agency of Natural Resources

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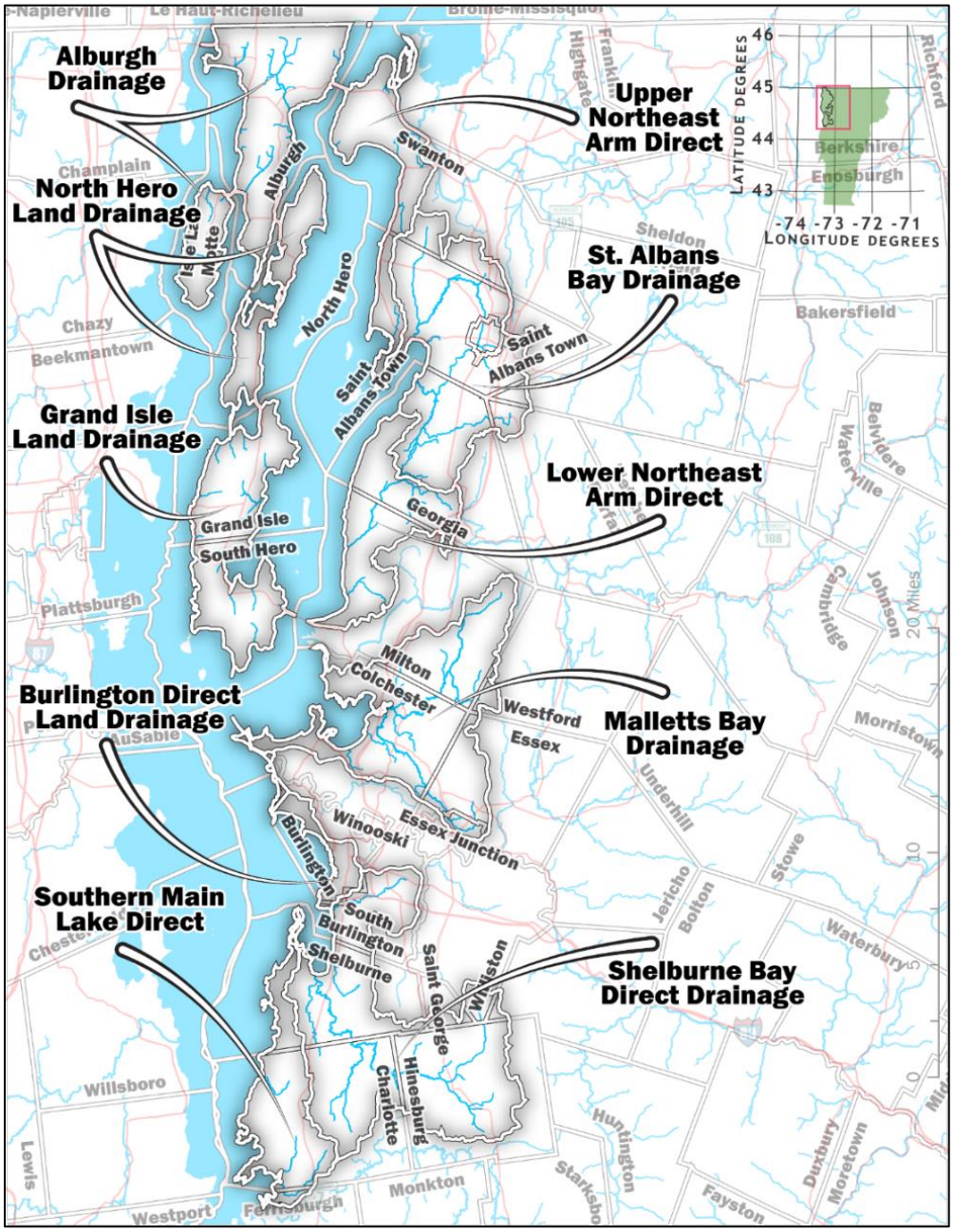
Cover Photo: Karen E. Bates

North Lake Basin Towns

Alburgh
Burlington
Charlotte
Colchester
Essex Junction
Essex Town
Fairfield*
Ferrisburgh*
Georgia
Grand Isle
Hinesburg
Isle Le Motte
Milton
North Hero
St. Albans City
St. Albans Town
St. George*
Shelburne
South Burlington
South Hero
Swanton
Williston*
Westford*

**Only partially included in basin*



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Executive Summary

The North Lake basin (Basin 5) covers approximately 543 square miles, and accounts for 6 percent of Vermont's land area. The basin occupies major parts of Chittenden, Grand Isle Counties and lesser parts of Franklin and Addison Counties. The entire watershed includes 23 towns and is roughly 37% forest, 35% agriculture, and 13% developed area including roads with the remainder including surface waters. This Tactical Basin Plan (TBP) provides a detailed description of current watershed conditions and identifies water quality focused strategies to protect and restore the Basin's surface waters.

Although many surface waters monitored meet or exceed the Vermont water quality standards, there are waters in need of restoration and continued monitoring. In addition to Lake Champlain, segments of 14 rivers are impaired and identified for restoration. In addition, two inland lakes and Lake Champlain have aquatic invasive species at the nuisance level and one in-land lake has increasing nutrient levels. Chapter 3 also includes progress reporting and target setting for Phase 3 of the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) Implementation Plan. Only the North Lake basin's contribution to Lake Champlain is addressed in this TBP.

Sector-based strategies are proposed to meet overall protection and restoration goals, as well as strategies to achieve targets of the Lake Champlain Phosphorus TMDL, with a focus on voluntary participation and project implementation by watershed partners and the Basin's Clean Water Service Provider. Fifty detailed strategies (summarized in Table 1) and 24 monitoring priorities are recommended for the next five years. Monitoring priorities have been identified to fill data gaps, track changes in water quality condition, and identify waters for reclassification and Class I wetland designation.

Table 1. Focus areas and priority strategies for restoration and protection (see Acronyms on page 153)

	Focus Areas	Priority Strategies
Agriculture	Mud Creek, St. Albans Bay and Swanton shoreline, Jewett Brook, Lake Champlain, LaPlatte River, Hoisington Brook, and HUC 12 watersheds with lagging TMDL reduction targets (Figure 30)	• Support nutrient management planning (NMP). • Target field Best Management Practice implementation. • Support case manager models, conservation equipment programs, soil health assessments, and farmer participation in whole farm assessment program. • Coordinate with agricultural service providers to provide trainings and track progress. • Identify and implement CWSP Formula grant-eligible projects on non-RAP farms

	Focus Areas	Priority Strategies
Developed Lands – Stormwater	Public swimming access and public water system inlet point watersheds and other DEC-identified regions	• Develop, design, and implement stormwater management Stormwater Master Plans, stormwater mapping reports, or other assessments. • Support landowners in meeting three-acre general permit requirements. • Promote social marketing-based programs and technical assistance to facilitate adoption of residential stormwater management. • Assist road crews and contractors in adopting winter ice management that results in reduced use of Chlorides (also below)
Developed Lands – Roads	Hydrologically connected road segments	• Assist municipalities in updating Road Erosion Inventory (REI) and prioritizing and implementing roads projects to meet the Municipal Roads General Permit. • Pilot a GIS road segmentation and private REI methodology to identify, prioritize, develop, and implement private road restoration projects.
Wastewater	Hinesburg, South Burlington Villages in Ferrisburgh, Georgia, St. Albans Town, South Hero Lake Iroquois, Lake Champlain Islands and Northeast Arm, Town Farm Bay, Champlain Islands	• Support municipalities addressing wastewater treatment facility permit requirements. • Provide technical assistance and funding to towns interested in exploring and implementing village wastewater systems and septic replacement. • Promote septic system maintenance in communities.
Rivers	Projects identified in Stream Geomorphic Assessments and Basin wide	• Identify and implement river corridor restoration and protection projects • Enhance riparian buffers establishment of woody vegetation. • Pilot the identification, development, and implementation of low-tech, process-based restoration projects to improve stream equilibrium. • Support municipalities in updating flood hazard bylaws and considering adoption of river corridor protections with new Federal Emergency Management Agency maps. • Scope, develop, and implement priority culvert upgrade and dam removal projects. • Encourage riparian stewardship through established social marketing campaigns, e.g., Stream Wise.

	Focus Areas	Priority Strategies
Lakes	Grand Isle County, Lake Champlain shoreline, Northeast arm, Malletts Bay, Town Farm Bay, Lake Iroquois, and other areas with community support and water quality threats	• Support Lake Wise assessments and development of Lake Watershed Action Plans • Develop and implement priority projects identified during Lake Wise or Lake Watershed Action Plan assessment. • Maintain and build the capacity for existing aquatic invasive species management and prevention programs.
Wetlands	Class I wetland candidates, VRAM-assessed wetlands, RCPP-identified wetland restoration priorities	• Support wetland restoration and conservation, especially for 10-50-acre projects. • Publicizing updated wetland mapping and support local efforts to support reclassification.
Forests	State lands, town forests, high phosphorus loading watersheds in Phase II TBP plan including Mill River, Malletts Creek, LaPlatte River and Drinking water Source Protection Areas	• Support forest road inventories and implement priority projects on state, municipal, and potentially private lands. • Identify and implement feasible forest erosion projects identified with emerging forest erosion mapping tools. • Increase the use of skidder bridges. • Assist interested landowners with forest conservation and Use Value Appraisal enrollment.

The 2020 North Lake basin plan identified 53 strategies that addressed phosphorus reduction goals as well as an additional 2 that addressed aquatic invasive species goals. Of the 55 strategies, nine are complete, 42 are ongoing, 3 are in progress, and one is discontinued, (Figure 1). The Agency reports to EPA on progress towards addressing strategies in the plan twice during the lifetime of the plan. The interim report card was published in the Vermont Clean Water Initiative 2023 Performance Report . The North Lake basin's final report card, to be included in the upcoming Vermont Clean Water Initiative 2024 Performance Report will provide a detailed description of each strategy's status.

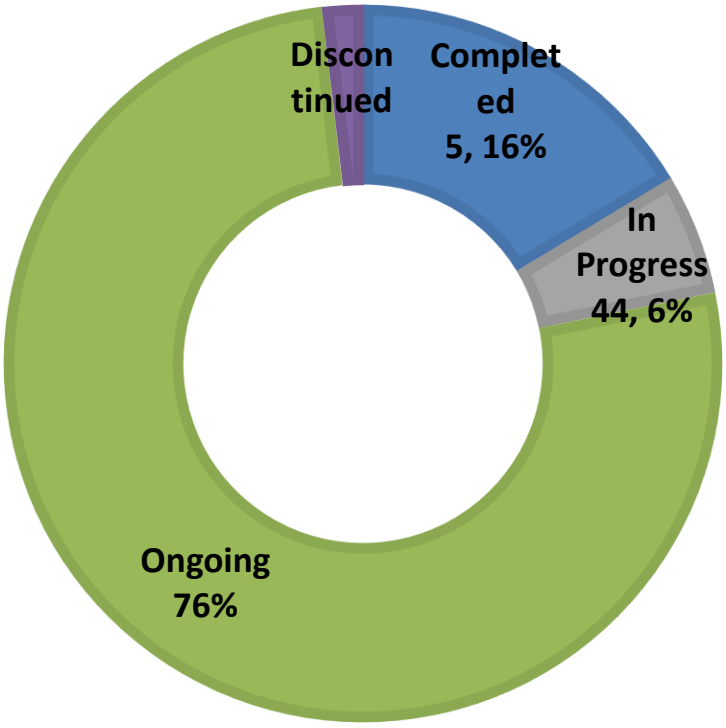


Figure 1. Status of strategies from the 2020 North Lake TBP

What is a Tactical Basin Plan?

A Tactical Basin Plan (TBP) is a strategic guidebook produced by the Vermont Agency of Natural Resources (ANR) to protect and restore Vermont's surface waters. The agency develops these watershed plans for each of the 15 major basins in the State of Vermont. TBPs target strategies and prioritize resources to those actions that will have the greatest influence on surface water protection or restoration.

Figure 2. Policy requirements of Tactical Basin Planning

Figure 3. Five-year basin planning cycle

TBPs are integral to meeting a broad array of both state and federal requirements including the U.S Environmental Protection Agency's 9-element framework for watershed plans (Environmental Protection Agency, 2008), US Clean Water Act Section 303(e) for state-level water quality planning, and state statutory obligations including those of the Vermont Clean Water Act, and 10 VSA § 925 and 10 VSA § 1253 (Figure 2).

Tactical basin planning is carried out by the Water Investment Division in collaboration with the Watershed Management Division and in coordination with other state agencies and watershed partners. A successful basin planning process depends on a broad base of partnerships with other state, federal, regional, and local government agencies, and other stakeholders, including community and non-profit groups and academic institutions. The partnerships support and strengthen the Agency's programs by proposing new ideas and input, increasing understanding of water quality issues, and building commitment to implementing solutions.

Basin-specific water quality goals, objectives, strategies, and projects described in this Plan aim to protect public health and safety, ensure public use and enjoyment of Vermont waters and their ecological health as set forward in the Vermont Surface Water Management Strategy and protected

by the Vermont Water Quality Standards. The TBP process shown in Figure 3, allows for the issuance of plans for Vermont's 15 basins every five years.

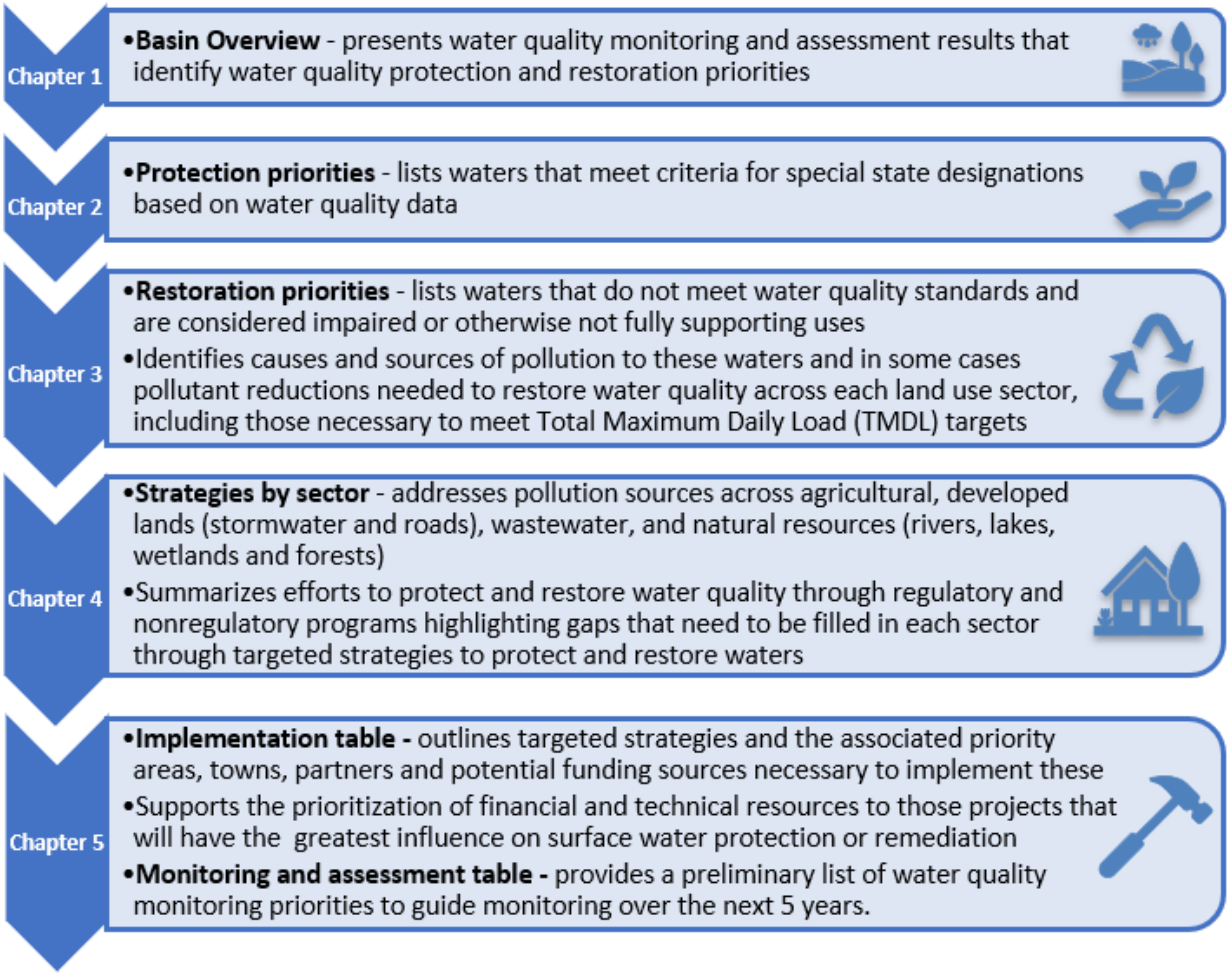


Figure 4. Chapters of Tactical Basin Plans.

Chapters 1 through 4 in the TBP describe water quality in the Basin, protection and restoration priorities, and efforts to protect and restore water quality for each sector. This information supports the targeted strategies listed in the implementation table in Chapter 5.

Tactical Basin Plans identify strategies that help ANR, and its partners, prioritize activities for the next five years. These strategies inform individual projects that are identified and tracked in the Watershed Projects Database and the Watershed Projects Explorer. The Project Database and Explorer are found on ANR's Clean Water Portal and are regularly updated to capture project information throughout the TBP process.

Chapter 1 – Basin Description and Conditions

A. Basin Overview

The 543 square-mile Northern Lake Champlain Direct Drainages (North Lake basin) include the direct drainages to the lake, beginning just south of the Ferrisburgh and Charlotte town-line and ending at the Canadian border and exclude the three-major river watersheds that drain directly into this section of the Lake (Figure 5). The Agency of Natural Resources (ANR) has completed separate basin plans for those three major river watersheds: the Lamoille, the Winooski and the Missisquoi. The Pike and Rock Rivers and direct drainages to the Missisquoi Bay, although originally included as part of the North Lake Basin, are addressed in the Missisquoi Bay tactical basin plan[1].

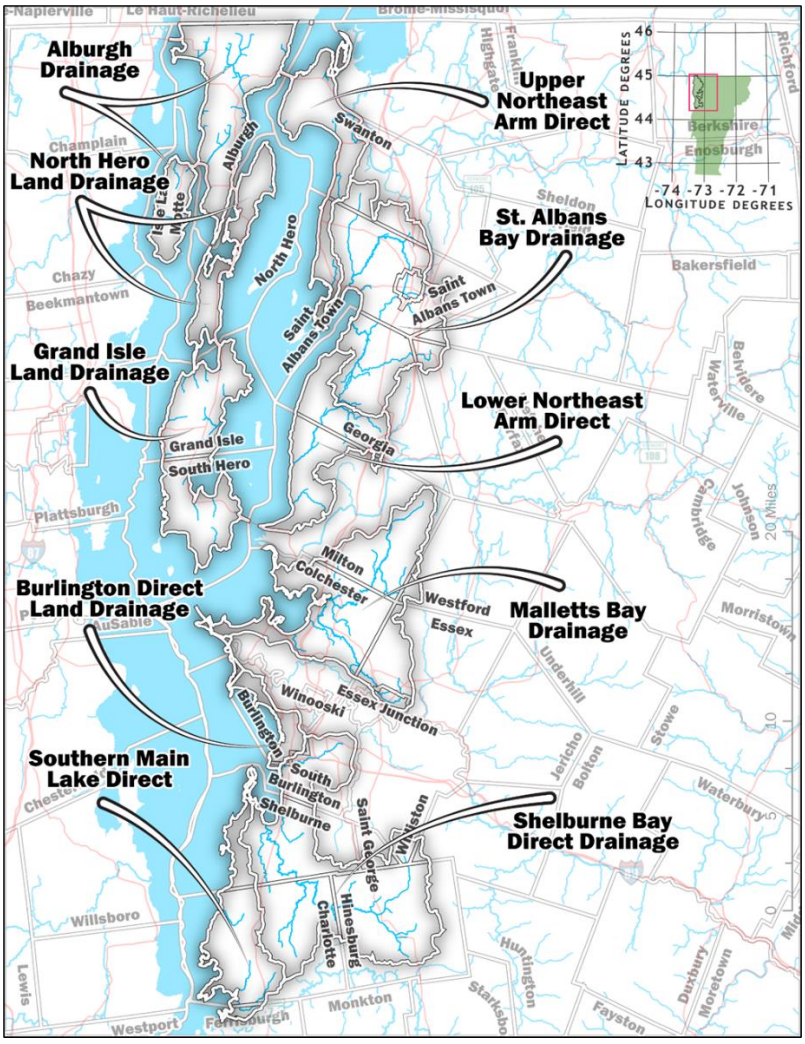


Figure 5. Northern Lake Champlain Drainages (North Lake basin or Basin 5) towns and subbasins.

[1] see http://dec.vermont.gov/water-investment/watershed-planning/basins-and-planners/basin6

Land Use and Land Cover

The North Lake basin is only about 37% forested, a much lower percentage than other basins in Vermont (Figure 6). Historically, the Basin has been heavily farmed and 35% of the basin is still in agricultural use. Developed land, including transportation infrastructure, occupies approximately 13%, a higher percent than seen in other Vermont basins. The remaining 15% includes waterbodies.

The landscape in the northern half of the Basin (Grand Isle and Franklin Counties) is predominantly agricultural, whereas the southeastern end of the Basin from Malletts Creek to the LaPlatte River watershed contains the highest percentage of forested land. In between and sitting along the western edge are the urbanized communities of Burlington, South Burlington, Colchester, Milton, Essex Junction and Shelburne.

Land cover and land use are primary determinants of surface water quality. Large areas of properly managed forests, riparian buffers, and wetlands are principally responsible for good water quality in Vermont. Significant conversion from natural lands to developed or agricultural lands will likely contribute to increased nutrient levels in surface waters. However, where good management practices and quality local stewardship exist on agricultural and developed lands, good water quality does too.

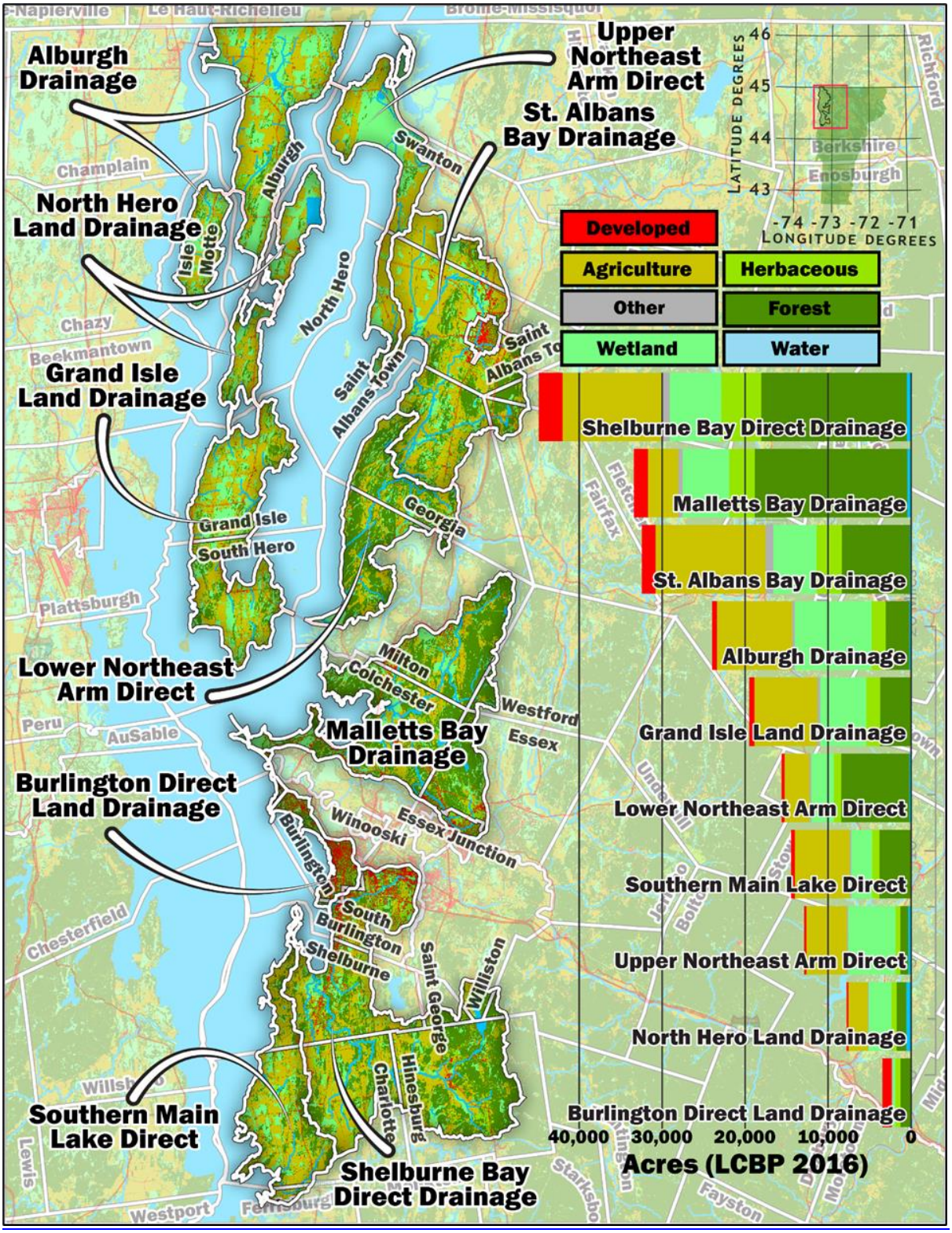


Figure 6. Landcover based on the 1-meter Lake Champlain land cover dataset produced by the University of Vermont spatial analysis laboratory and the Lake Champlain Basin program. The bar graph is a summary based on the Vermont WBID subwatersheds of the tactical basin.

Climate Change Implications for Water Resource Management

Vermont is experiencing climate-related events each year as evidenced by flooding in the summer of 2023 and 2024. Climate-related events are projected to increase in frequency, complexity, and severity. It is imperative that Vermont and Vermonters adapt to threats posed by climate change now and build resilience for the storms that we will inevitably face in coming decades (ANR, 2021).

Adapting how we manage and use our surface waters in the face of climate change is one of the chief overarching challenges for basin planning. Climate is defined by long-term weather patterns, which in turn influence human and natural systems. In Vermont, climate change is causing increases in storm intensity and total precipitation (Betts, 2011) (National Oceanic and Atmospheric Administration, 2013). These increases will likely lead to a rise in flooding, water quality and ecosystem impairments, and reduced water-based recreational availability (Pealer & Dunnington, 2011). Of the many natural hazards that impact Vermont, flooding poses the greatest risk to Vermont infrastructure and communities.

The 2021 Vermont Climate Assessment established state-level climate change information with implications for local surface waters. Vermont's average annual temperature has increased by almost 2°F (1.11°C) since 1900 with warming occurring twice as fast in winter (Galford, 2021). The latter results in earlier thaw dates for rivers, lakes and ponds, and mountain snowpack. Common fish species such as trout and salmon, and warm-water fish like smallmouth bass rely on groundwater discharges for cooler refuges during summer seasons. These refugia will decrease in availability as groundwater temperature is expected to increase over time (Neidhardt & Shao, 2023). Fish are heavily reliant on their physical landscape and connectivity to migrate, move through different environments at different life stages, and take advantage of multiple habitat types. Infrastructure such as roads and dams have severely hampered the mobility of aquatic species and form barriers to fish migrating or seeking cold refuge during hot spells.

The 2021 Vermont Climate Assessment suggests extreme weather events such as droughts and floods are expected to continue to increase with climate change. Vermont experiences 2.4 more days of heavy precipitation than in the 1960s, typically in summer. Average annual stream flows are increasing, which is expected to continue in the future. High flows now happen more frequently, leading to increased inundation flooding and stream-related erosion, which can be exacerbated or alleviated by land-use management decisions. Aquatic habitats affected by increased runoff and streamflow could experience increases in sediment mobilization, nutrients and scouring in addition to increased water temperature. In response, local freshwater plant and animal species may shift their geographic ranges and alter their abundance and seasonal activities (Stamp et al., 2020).

The Vermont Climate Assessment highlights five key messages for water resources in Vermont:

- Due to extreme variation in precipitation with our changing climate, periods of prolonged dry-spells and drought, coupled with higher water usage in snowmaking and agriculture could exacerbate low water availability.

- Increases in overall precipitation, and extreme precipitation, have caused average annual streamflow's to rise since 1960. Climate change will further this pattern, although the overall increase in streamflow comes with disruptions in seasonal flows cycles.

- Increases in heavy precipitation jeopardize water quality in Vermont. Storms produce large runoff events that contribute to erosion and nutrient loading. Combined with warm temperatures, this creates favorable conditions for cyanobacteria blooms.

- Increased occurrence of high streamflow increases the risk of flooding that causes damage to many roads and crossing structures. Risk reduction requires addressing outdated and unfit structures.

- Nature-based solutions are an effective, low-cost approach to climate change adaptation. River corridor, floodplain, and wetland protection dampen flood impacts and improve water quality along with green infrastructure.

Protective measures, such as strategic land acquisition and limitations on development in riparian areas, may be the most economical solution to address the challenges presented by climate change and to achieve healthy surface waters (Watson, Ricketts, Galford, Polasky, & O'Niel-Dunne, Quantifying flood mitigation services: The economic value of Otter Creek wetlands and floodplains to Middlebury, VT, 2016) (Weiskel, 2007). But where pollution from historic and current land use occurs, strategies are identified in this plan that will complement protective measures, such as river corridor easements, riparian area plantings, floodplain and wetland restoration, dam removals, and agriculture, forestry, and stormwater best management practices.

Ongoing efforts to strengthen ecological resilience and the role of natural infrastructure in protecting built communities can be found on the Climate Change in Vermont website. This website also details the 2020 Global Warming Solutions Act (Act 153), which sets Vermont greenhouse gas emissions reduction goals, establishes a Climate Council tasked with developing and updating the VT Climate Action Plan and requires the Agency of Natural Resources to adopt rules consistent with the plan.

Additionally, recently passed "The Flood Safety Act" (Act 121, 2024) relating to the regulation of river corridor development, wetlands, and dam safety. The Act seeks to improve flood resilience by requiring the development of a State River Corridor Base Map to identify areas suitable for development within existing settlements in river corridors that will not contribute to fluvial erosion hazards. It also establishes minimum flood hazard area standards. The Act protects, regulates, and restores wetlands so that the State achieves a net gain of wetlands acreage, and ensures updated wetland maps for all tactical basins by 2030. It also enables the Dam Safety Revolving Loan Fund to provide financial assistance for emergency and nonemergency dam projects.

B. Water Quality Conditions

The Vermont Water Quality Standards (VWQS) provide the basis used by the Vermont Department of Environmental Conservation (DEC) in determining the condition of surface waters including whether the water meets or does not meet certain criteria. The assessment of a water's condition within the context of the VWQS requires consideration of the water's classification, designated and existing uses, and the corresponding narrative and numeric water quality criteria (see Chapter 2 for definitions). This assessment categorizes Vermont's surface waters as either "full support, altered, or impaired.".

DEC uses a five-year rotational monitoring approach, where basin sites are typically monitored once every five years. This state-collected data is augmented by community-science monitoring programs throughout the state, including the LaRosa Partnership Program and the Lay Monitoring Program. Water quality monitoring and assessment work is described in detail in the Watershed Management Division's Water Quality Monitoring Program Strategy and The 2022/2023 Water Quality Monitoring and Assessment Report

Most surface water monitoring is led by programs in DEC's Watershed Management Division (WSMD), including the Rivers Program, the Lakes and Ponds Management and Protection Program, and the Wetlands Program. The result of this work offers site specific assessments of the Basin's waters.

Within the Rivers Program, the Biomonitoring and Aquatic Studies Section focuses on biological monitoring of aquatic macroinvertebrate and fish communities, plus targeted water chemistry and temperature monitoring. Biomonitoring staff also support the LaRosa Partnership Program, a community-based nutrient and chloride monitoring program. See the LaRosa Partnership Program's Power BI interface and database reports to interact with data collected through this program. The following North Lake basin organizations have all participated in the program at least once since the 2018 TBP (links provides access to an organization's data, where available):

- the Friends of the Northern Lake Champlain
- the Rethink Runoff Stream Team (on behalf of Chittenden County MS4/TS4 permittees)/ Sampling assisted in prioritizing streams for further DEC assessment work to identify chloride impairment
- The Lewis Creek Association, sampling assisted in moving the Mud Hollow Brook and Holmes Creek to the impaired stream status list.
- Lake Iroquois Association

The Rivers Program also supports stream geomorphic assessments that evaluate geomorphic and physical habitat conditions of rivers and the Streamflow Protection section administers a cooperative

agreement with the U.S. Geological Survey to maintain and operate a number of stream gages in Vermont.

The Lakes and Ponds Management and Protection Program supports the Inland Lake Assessment and Lay Monitoring Programs, which evaluate nutrient conditions and trends on lakes, as well as shoreland condition and more in-depth lake assessments through the Spring Phosphorus Program and Next Generation Lake Assessments. The Lakes and Ponds Program also performs surveys to monitor the spread of aquatic invasive species in Vermont's public waters through the Vermont Aquatic Invasive Species Program.

Jointly, the Rivers Program and Lakes and Ponds Management and Protection Program maintain a network of 12 stream and 13 lake sentinel sites statewide respectively, which are monitored every year for biology, temperature, water chemistry and hydrology (at a subset of sites). These sentinel sites have negligible prospects for development or land use change and are closely monitored to isolate long term impacts related to climate change.

The Wetlands Program conducts biological assessments on the functions and values of wetlands.

In addition to the WSMD's surface water monitoring programs in this basin, the following programs also contribute monitoring data to determine the health of Vermont's surface waters:

- The Vermont Fish and Wildlife Department (VFWD) conducts fishery assessments and targeted temperature monitoring to assess the health of recreational fish populations and opportunities for habitat restoration.
- A network of streamflow gages is funded and operated in partnership among DEC, Vermont Agency of Transportation (VAOT) and Vermont Department of Public Safety (VDPS).
- The Vermont Agency of Agriculture, Food, and Markets conducts monitoring at sampling sites throughout Vermont. The Agency also runs the Ambient Surface Water Study to establish baseline levels of pollutants and to monitor for the presence of neonicotinoids, glyphosate, corn herbicides, and nitrate in Lake Champlain and its contributing tributaries.
- The Drinking and Groundwater Protection Division and the Watershed Management Division monitor Per- and Polyfluoroalkyl Substances.

Tactical Basin Plans include monitoring information reported by Vermont State agencies as results relate to the designated uses defined by the Vermont Water Quality Standards. Most of the DEC monitoring data can be accessed through the Vermont Integrated Watershed Information System (IWIS) online data portal.

Compilation of this data following the 5-year monitoring cycle highlights the changes that have taken place over time. These changes are described by water resource – rivers and streams, lakes and ponds, wetlands – with a separate section for recreational fisheries. More detail is provided in the Northern Lake Champlain Drainages Assessment Report.

Rivers and Streams

Biological Assessment

Biological communities reflect overall ecological integrity (i.e., chemical, physical, and biological condition). Therefore, biomonitoring results can directly assess the status of a waterbody relative to the primary goal of the federal Clean Water Act. Biological communities integrate the effects of different stressors and thus provide a broad measure of the stressors' aggregate impact. Because they integrate stressors over time, they can provide an ecological measure of fluctuating environmental conditions. The WSMD uses biological monitoring (i.e., biomonitoring) to detect aquatic biota impairments in wadeable streams, as well as the type and severity of potential stressors causing the impairment. Biomonitoring is also important for identifying streams at or near a reference level condition. Each community of macroinvertebrates and fish is rated from *Poor* (severely degraded and not meeting VWQS) to *Excellent* (similar to the natural condition and exceeding the VWQS). If a stream repeatedly fails to meet minimum aquatic biota expectations, it is a candidate for the Vermont Priority Waters List. If a stream has macroinvertebrate and fish communities consistently at or near a reference level condition, it is a candidate for increased protection through upward reclassification.

Macroinvertebrate and fish monitoring is conducted following procedures outlined in the WSMD Field Methods Manual (DEC 2022). Applying biocriteria and determining assessments for both communities is outlined in Appendix G of the VWQS (2022).

Macroinvertebrate Monitoring Results

Macroinvertebrate assessments were completed at 66 sites in the North Lake basin between 2011 and 2022 (See pages 35-45 in the Northern Lake Champlain Direct Drainages Assessment Report). The results of the assessments are described below. In addition, to ensure a comprehensive understanding of water quality basin wide, a gap analysis was conducted by DEC to identify sites without current monitoring data (Figure 7). Sites with a larger watershed are a higher priority. In addition, some of these will be prioritized based on land use, potential for biological sampling or other factors for the 2026 monitoring season and can be found in the Chapter 5 Monitoring and Assessment Table.

Of the most recent sample dates for each site, 18 (27%) monitoring sites exhibited *Good* or better condition in their most recent assessment. Of these, three were found to be Excellent, meaning their macroinvertebrate community is comparable to reference or natural condition (two in a 2.5 mile

stretch on the LaPlatte River and one on Trout Brook). Another five were found to be in *Very Good* to *Very Good - Excellent* condition, including one site each on the LaPlatte River, Trib #7 to the LaPlatte River, Crooked Creek, and two sites on Trout Brook. Streams in *Very Good* or better condition exceed the VWQS criteria for B(2) classification and are priorities for additional assessment and protection. Ten sites (15%) had the most recent macroinvertebrate assessments that scored *Good* or *Good - Very Good*. These streams meet the VWQS B(2) criteria and are priorities for maintenance and protection. The most recent assessment at 47 sites (41%) scored *Fair* or lower, failing to meet VWQS B(2) criteria. Many of these sites represent multiple sampling reaches on a relatively small number of impaired streams. One site (Malletts Creek) had a macroinvertebrate assessment that scored *Fair to Good*, a condition is indeterminate and requires more monitoring to determine full aquatic biota support status.

Fish Monitoring Results

Fish community assessments were completed at 28 unique sites between 2011 and 2022 in the North Lake basin. Of the most recent sampling for each site, there were no *Excellent* assessments, and only four (14%) had fish communities in *Very Good* condition, indicating the fish communities at these sites exceed the VWQS for class B(2) streams. Another eight sites with fish assessments exhibited communities in *Good* condition, which meet the VWQS for class B(2) streams and are priorities for maintenance and protection.

Sixteen sites (57%) with fish assessments exhibited communities in *Fair* or *Poor* condition. Many of these sites represent multiple sampling reaches on a relatively small number of impaired streams. When sites were monitored for both macroinvertebrates and fish, 17 sites had both communities supporting similar conditions

For example, LaPlatte River 5.8- and 14-mile segments supported bug and fish scores within the *good* to *very good* range and Munroe Brook and McCabes at 1.2 river segments supported fish and bugs scores that failed VWQS at *fair* or below. The other sites with similar bug and fish scores follow:

- Stone Bridge Brook 0.3
- Indian Brook 5.8
- Englesby Brook 0.6
- Trout Brook 0.3 & 0.8
- Stevens Brook 4.2, 6.5, 6.8, 7.5
- Stevens Brook Trib #7 0.2
- Mill River 0.7
- Rugg Brook 0.5, 4.3, 4.8

There were nine other sites where bugs or fish passed and the other failed when sample during same year. For example, bugs did not meet VWQS while fish did at two McCabe Brook sites, and at Potash, Mud Hollow and Patrick Brook). Other sites include:

- Mill River 5.2
- Jewett Brook 4.1
- Indian Brook 7.0
- Stone Bridge 5.5

Often, a fish community can suggest different stressors from a corresponding macroinvertebrate community; therefore, assessing both the macroinvertebrate and fish community at a site is useful when resources allow it. Sites that fail to pass VWQS for a single community but score well for the other may be prioritized for further sampling to determine if anthropogenic impacts are responsible for the degradation. These sites are included in the Chapter 5 Monitoring Table (Table 18).

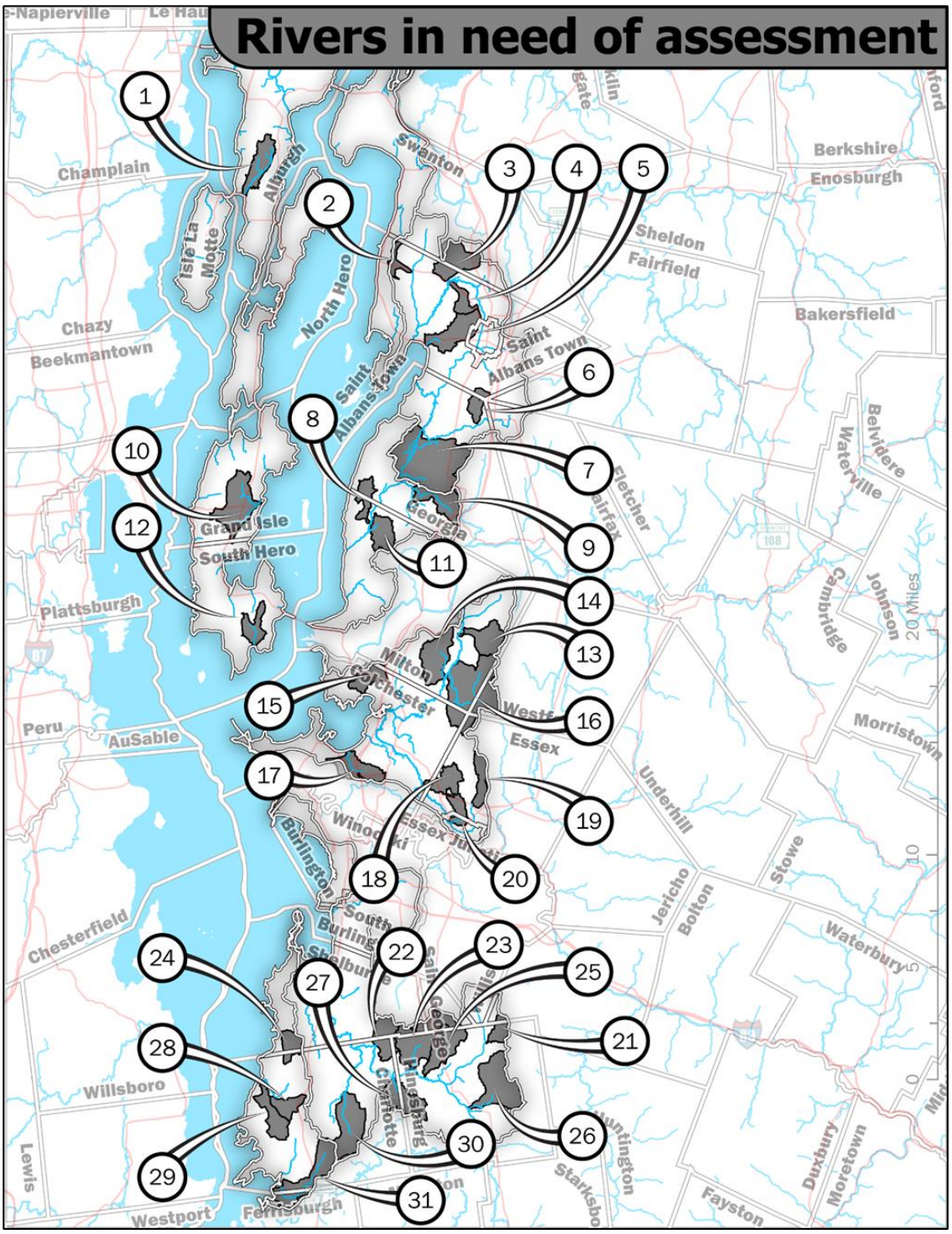


Figure 7. Stream catchments without current biological data in the North Lake basin. Sites are listed in Table 2.

Table 2. Rivers with unassessed aquatic biota use, values are in percent land cover. The Map IDs correspond to the map above, where watersheds are included. Asterisks are officially unnamed streams.

Name, Map ID	Developed	Agriculture	Forest	Wetland
Beaver Brook* (14)	8.8	9.8	39.7	22.1
Beecher Hill Brook* (26)	2.5	8.0	76.3	5.7
Beene Hill Brook* (8)	1.6	37.7	48.5	8.7
Bingham Brook (30)	1.8	60.4	15.8	11.4
Bostwick Brook* (24)	5.7	57.8	22.1	6.2
Church Creek* (5)	8.4	27.5	22.3	22.9
Comstock Creek* (3)	2.7	51.5	14.8	22.8
Conger Creek* (6)	0.6	20.1	55.0	13.6
Corral Brook* (11)	2.1	15.1	62.6	11.8
Dorset Creek* (22)	2.4	48.2	27.5	9.8
East Shore Creek* (10)	2.9	34.9	11.0	45.2
Everbreeze Brook* (17)	8.9	11.0	35.3	28.0
Hardscrabble Creek* (13)	1.6	11.8	77.4	3.6
Hinesburg Brook* (27)	1.6	40.0	41.7	9.0
Kellogg Creek* (4)	3.7	49.7	15.0	18.2
Kimball Brook (31)	3.3	55.3	25.4	8.9
Land Fill Creek (18)	4.5	2.5	70.8	12.1
Lower Newton Brook* (2)	1.7	80.9	2.4	8.1
Marrs Hollow Brook* (16)	0.8	8.5	74.6	10.7
Oneil's Creek* (23)	2.3	35.7	39.7	10.8
Pattee Hill Creek* (7)	2.3	45.6	28.6	14.8
Pringle Brook (28)	3.9	34.3	25.7	24.4
Raymond's Creek* (15)	4.9	5.2	53.3	27.4
Richmond Creek* (21)	3.4	16.1	63.5	6.9
Shelburne Falls Creek* (25)	1.9	21.9	61.6	7.4
Sodom Creek* (9)	2.7	34.7	37.2	17.5
Sucker Brook (1)	0.6	38.1	14.4	34.7
Thasha Creek* (20)	5.0	2.6	60.0	11.4
Walden's Creek* (19)	1.3	10.7	55.1	25.9
Whipple Creek* (12)	8.8	9.8	39.7	22.1
Windswept Creek* (29)	2.5	8.0	76.3	5.7

Stream Geomorphic Assessment

Fluvial geomorphology is a subdiscipline of geomorphology that investigates how flowing water shapes and modifies Earth's surface through erosional and depositional processes. The WSMD Rivers Program conducts a three-phase approach to assess the physical condition of rivers in the State of Vermont. Phase 1 is a watershed assessment. Phase 2 is a rapid field stream assessment, and Phase 3 is a survey assessment.

The Noth Basin has 983 stream miles covering first order to 6th order streams. Phase 1 and Phase 2 Stream Geomorphic Assessments have been completed where needed, see Chapter 4, Table 16. Most of the stream reaches with Phase 2 Assessments have been rated as fair to poor condition as a function of their departure from their reference stream type (Phase 2 SGA Protocol Page 76; Figure 8-10). Most larger tributaries in the North Lake basin have had Phase 2 Assessments; therefore, the fair to pair geomorphic conditions noted by Phase 2 assessed reaches are likely representative of basin conditions. No Phase 1 or Phase 2 geomorphic assessments have been completed in the basin since the 2020 TBP. For more information on these type of assessments see the River Program's Geomorphic Assessment webpage. To learn more about the rivers and streams with Phase 1 and Phase 2 assessments in Basin 5, see Chapter 4.

Rivers

Conditions and trends

Physical condition

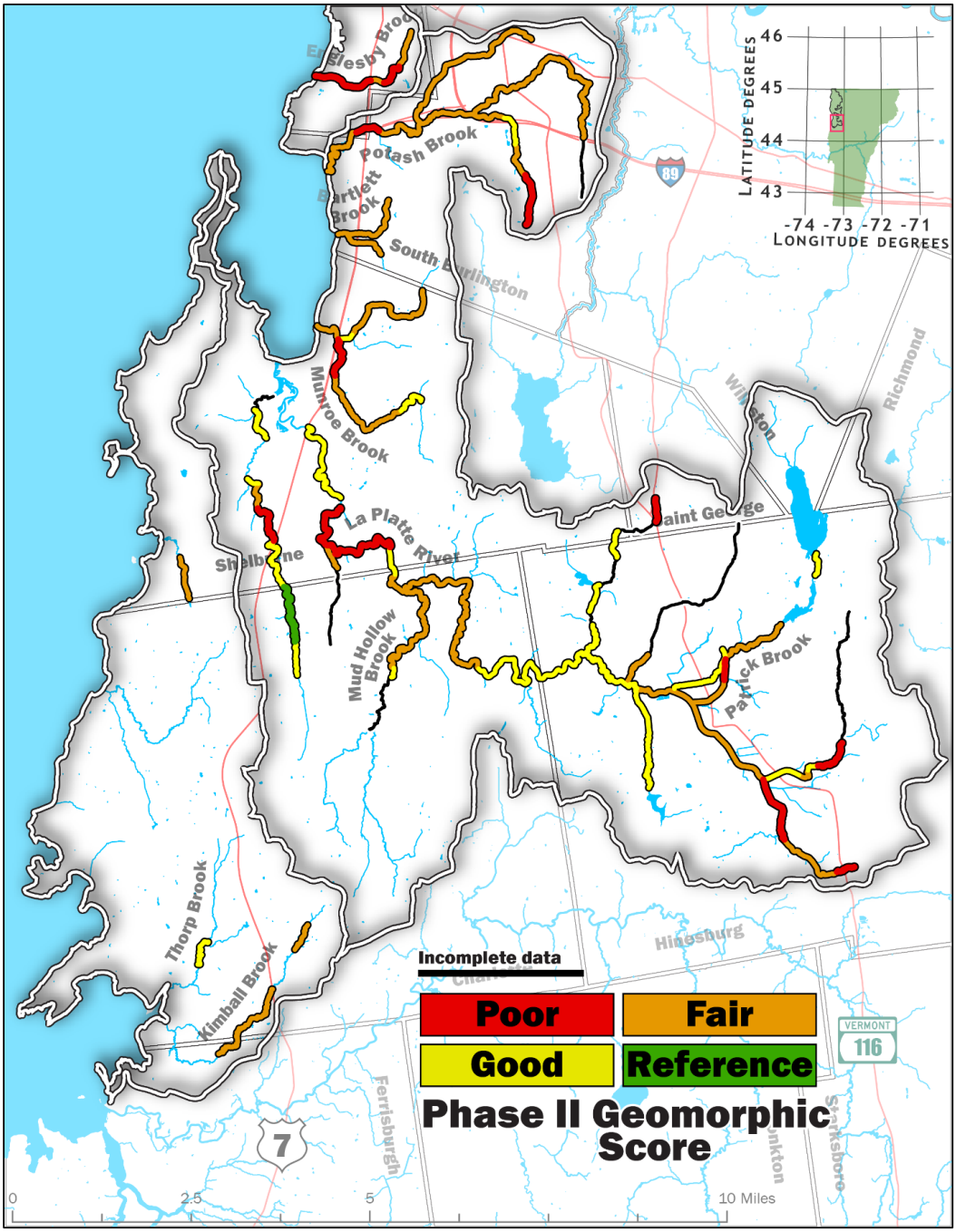


Figure 8. Map of North Lake Basin rivers, southern section, with Phase II geomorphic condition scores through 2023. Poor rivers have extreme departure from reference condition, fair rivers have major departure, and good rivers have minor departure. Reference rivers have no departure.

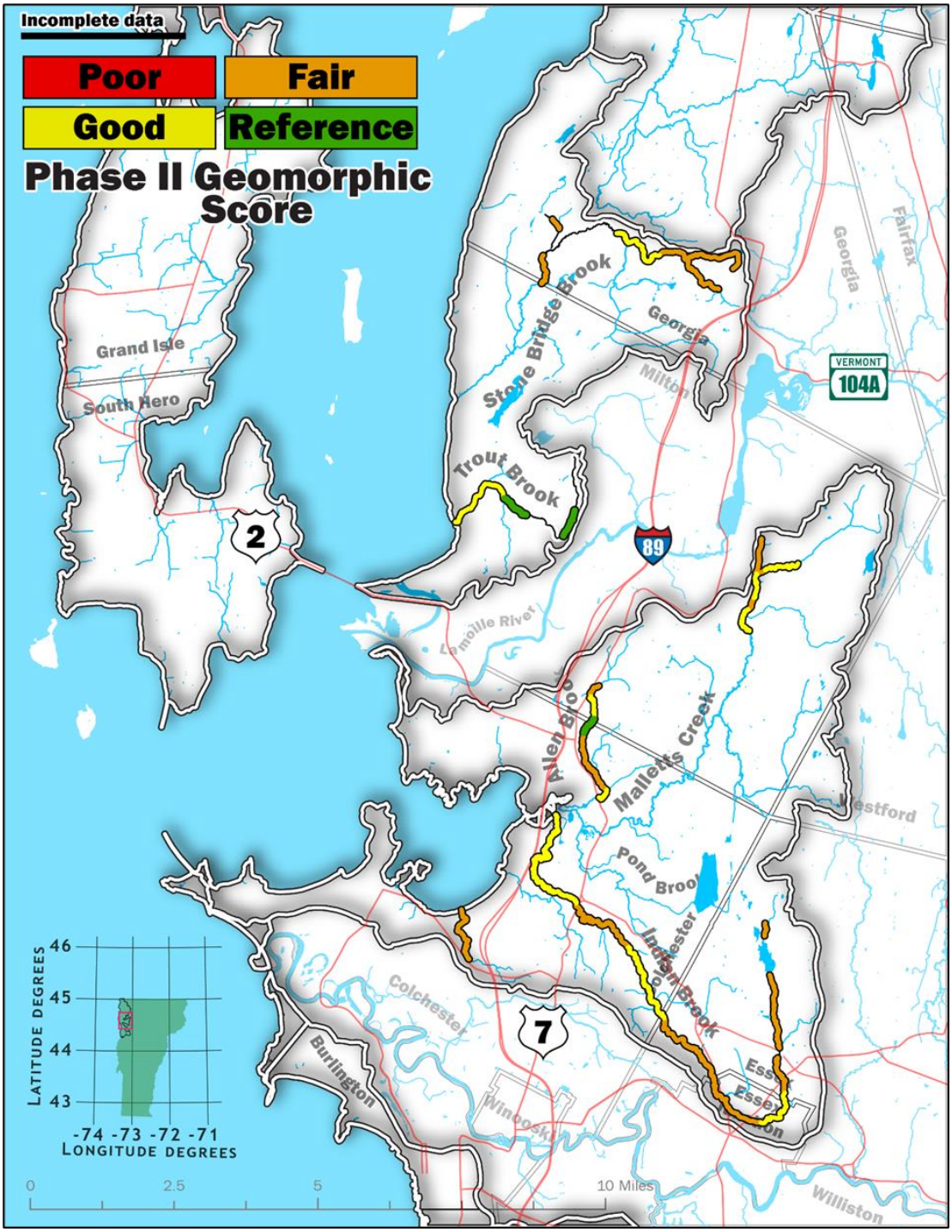


Figure 9. Map of North Lake Basin rivers, middle section, with Phase II geomorphic condition scores through 2023. Poor rivers have extreme departure from reference condition, fair rivers have major departure, and good rivers have minor departure. Reference rivers have no departure.

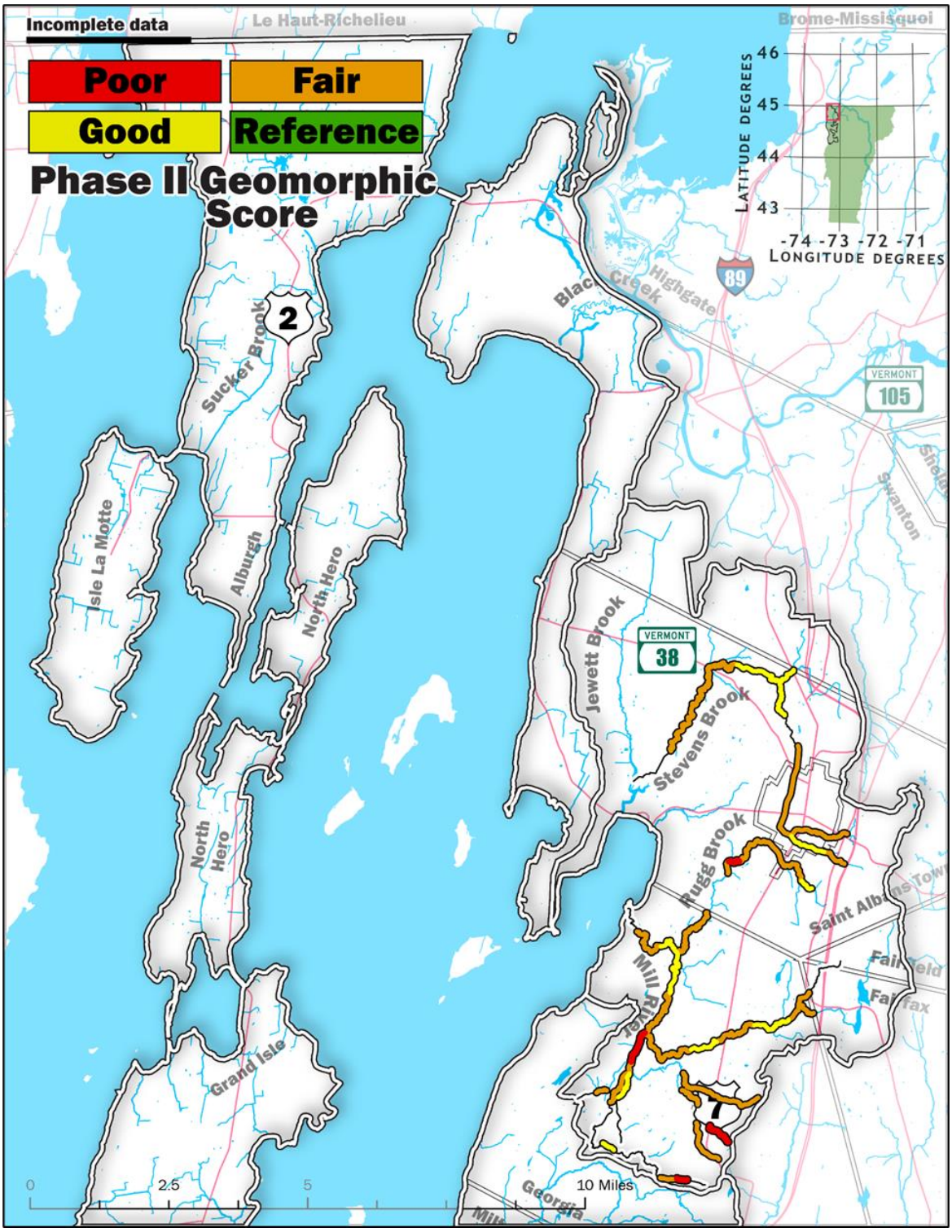


Figure 10. Map of North Lake Basin rivers, norther section, with Phase II geomorphic condition scores through 2023. Poor rivers have extreme departure from reference condition, fair rivers have major departure, and good rivers have minor departure. Reference rivers have no departure.

PFAS Monitoring

Per- and polyfluoroalkyl substances (PFAS) are a large group of human-made chemicals that have been used in industry and consumer products worldwide since the 1950s. PFAS chemicals from household and commercial products may find their way into water, soil, and biosolids. As a result, PFAS have been found in people, fish, and wildlife all over the world. Some PFAS do not break down easily and therefore stay in the environment for a very long time, especially in water.

The DEC is working with the Vermont Department of Health to identify sources and reduce the use and release of and public exposure to PFAS. The 2023 PFAS Road Map outlines strategic priorities relating to PFAS and summarizes the actions taken by DEC to address PFAS in Vermont. Major actions include adopting drinking water and groundwater PFAS standards; developing a plan to derive ambient surface water quality standards; adopting Solid Waste Rules that require PFAS testing for biosolids and sites where biosolids are applied; responding to PFAS contamination in multiple sites; and developing a statewide investigation of the potential major sources of PFAS including wastewater treatment facilities, publicly owned treatment works, industrial sources, land application sites, and landfills. To this end, additional wastewater-specific PFAS sampling and source prioritization information is available in Chapter 4 – Wastewater.

In 2021 DEC and the Vermont Fish & Wildlife Department completed a water quality monitoring study to evaluate levels of PFAS in northern Vermont surface waters. Surface water sampling is just one component of a much more comprehensive 2019 PFAS Sampling Plan. This study included testing 23 WWTF including the Burlington Main and South Burlington Airport Park in the North Lake basin. Samples were analyzed for 36 PFAS chemicals, including the five Vermont-regulated PFAS. The wastewater effluent concentrations (before dilution and mixing with the receiving waters) at all 23 WWTFs for the (5) regulated PFAS were all under 100 parts per trillion (ppt). The available dilution for these WWTF facilities results in instream concentrations of less than 20 ppt for the (5) regulated PFAS; which is also the VDOH drinking water guidance. Additional sampling was reported in a 2021 PFAS Sampling plan, but did not include any North Lake basin surface waters or WWTF.

Chloride Monitoring

Chloride is a naturally occurring element in the environment but usually occurs in relatively small amounts in Vermont surface waters. Most sources of chloride result from human activities including deicing agents (road salt), agriculture (animal waste), dust suppression, human waste (septic and wastewater treatment), and water softeners. In most areas, road salt is believed to be the most significant contributor of chloride to the environment in Vermont.

For the protection of aquatic biota, the VWQS have chloride specific criteria for both acute and chronic exposures that were recommended to states by the US Environmental Protection Agency in 1988. There is evidence that negative impacts to aquatic biota occur below the VWQS criteria concentrations. Sensitive macroinvertebrate populations and overall community health in Vermont streams can be negatively impacted at chloride levels as low as 50 mg/l. The Environmental Protection Agency is currently in the process of reviewing more recent toxicity studies regarding chloride impacts to aquatic biota, but any future recommendations to revise the VWQS are still several years away.

Chloride is routinely sampled in lakes and streams as part of several monitoring programs conducted by the WSMD. The North Lake basin has four (Potash, Bartlett, Englesby, Munroe) of the seven streams statewide that are impaired due to high chloride concentrations. Indian Brook is one of four statewide streams where chloride is currently suspected as a contributing factor of aquatic biota impairment, but sufficient data has not yet been collected. The WSMD has identified two lakes and ponds in the state with an average chloride concentration greater than the chronic criterion of 230 mg/L; however, none of these are in the North Lake basin. More information on the WSMD approach to chloride monitoring and reduction is available in the 2022-2023 Water Quality Monitoring and Assessment Report.

The north-south crossing of a major transportation corridor across the basin, (e.g., Route 7 and I-89) as well as the concentration of large parking lots in this urbanized basin are significant contributors of chloride to surface waters.

Lakes and Ponds

There are nine lakes and ponds in the Basin that are ten acres or greater (Figure 11). Although they are all impounded by dams, none of them are managed by hydroelectric facilities. More information on dam location, status, purpose, and ownership can be found in Appendix A.

Lake Scorecard Assessment

The Vermont Lakes and Ponds Management and Protection Program shares lake assessments using the Vermont Inland Lakes Scorecard (Figures 10). The scorecard provides available data on overall lake health by providing a rating of a waterbody's nutrient trend, shoreland and lake habitat, atmospheric pollution, and aquatic invasive species. The Lake Scorecard's rating system is detailed here. Lake-specific water quality and chemistry data can be accessed online through the Lay Monitoring Program webpage. The North Lake basin Lake Scorecard results are summarized below for lakes larger than 10 acres.

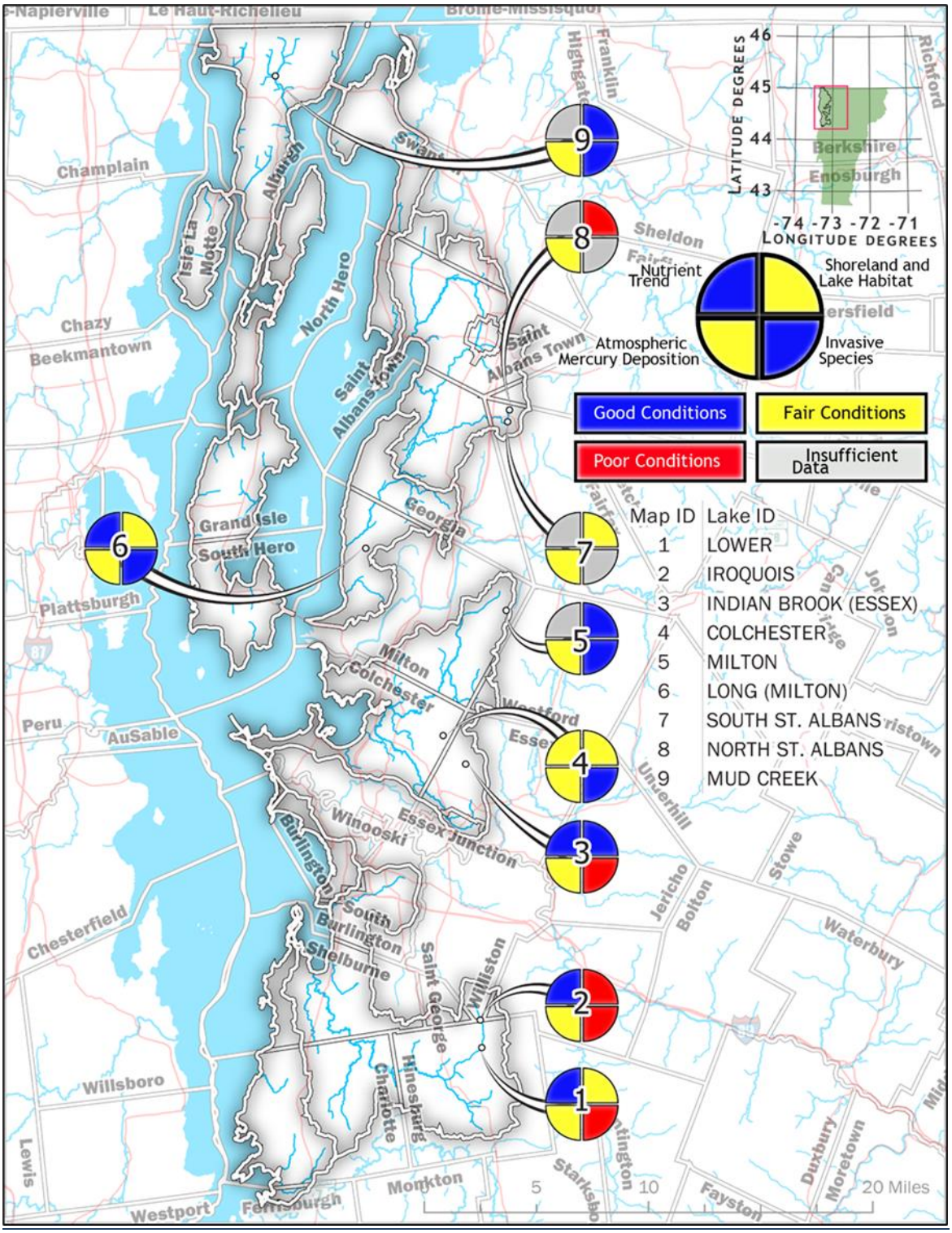


Figure 11. Lake scorecards for Basin 5. Only lakes greater than 10 acres are included. Lake IDs and additional information are provided in the table below.

Shoreland Condition and Nutrient Trends

Of the nine lakes evaluated for shoreland condition in the basin, 3 have *Good* ratings, 4 have a *fair* rating, and 2 have a *Poor* rating. Of the 5 lakes monitored for nutrient water quality trends, four lakes have a *Good* rating. Colchester Pond has elevated phosphorus levels and scored as *Fair* based on an increasing Spring phosphorus trend. Although Lake Iroquois has slightly elevated phosphorus, phosphorus trends for both spring and summer have decreased since the 1980s. Spring phosphorus levels in Indian Brook Reservoir have also decreased since the 1980s.

Mercury Contamination

Mercury contamination has resulted in fish consumption advisories in nearly every lake in Vermont. Mercury is an atmospherically deposited contaminant, which arrives in Vermont primarily as a result of coal burning emissions, or solid waste incineration. Much has been accomplished in recent years to control emissions nationally, yet this remains a long-term issue. Atmospherically deposited mercury is transferred up the food chain from plankton to fish, loons, and larger birds and mammals.

Aquatic Invasive Species

Three of the seven lakes greater than 10 acres that have been surveyed for aquatic invasive species have *Poor* ratings – Indian Brook Reservoir, Lake Iroquois and Lower Sunset Lake. A *poor* score indicates that there is at least one invasive species present, regardless of its abundance or 'nuisance' level (see Chapter 4 Lakes).

Lake Champlain

Part of Lake Champlain is located within the boundaries of the Basin. In 2024, the Lake Champlain Basin Program released the 3-year Lake Champlain State of the Lake and Ecosystem Indicators Report. The report describes several ongoing needs and challenges:

- The annual amount of phosphorus delivered to the Lake must be reduced to implement the Lake Champlain P Total Maximum Daily Load (see Chapter 3).
- High flows transport most of the nutrients and sediment to the Lake and as a result, phosphorus loading is driven by annual differences in precipitation, snowpack, and drought. Annual variability in loading is likely to continue and may increase as climate changes alters precipitation patterns.
- Warm weather cyanobacteria blooms continue to impact recreation in many parts of the Lake leading to beach closures though only occasionally in the Main Lake, Malletts Bay segments. St. Albans Bay experiences more cyanobacteria blooms and resulting beach closures.

- The Lake Champlain Water Chestnut Management Program incorporates several locations within the Basin that are monitored, surveyed, and in some sites harvested annually. These include Black Creek Marsh in St. Albans, Missisquoi National Wildlife Management Area, and Sand Bar Wildlife Management Area. In the past few years, several new locations have been found in the Basin, and these are added to the overall list to be monitored and managed if necessary.

Wetlands

The Vermont Wetlands Program houses the Wetland Bioassessment Program, which assesses the biological condition and ecological integrity of Vermont wetlands. Plant species are used as the primary biological indicator to assess wetland health. Based on a 2017 analysis of bioassessment data, the principal factors that correlate with poor wetland condition are:

- presence of invasive plant species,
- disturbance to the wetland buffer or immediate surrounding area,
- disturbance to wetland soils, and
- disturbance to wetland hydrology (how water moves through a wetland) through ditching (e.g., agricultural), filling (e.g., roads) and draining (e.g., culverts).

Wetlands in remote areas and at high elevations tend to be in good condition, with the most threatened wetlands occurring in areas of heavy agricultural use and high development pressure often exhibiting habitat loss.

Wetland Bioassessment and Vermont Rapid Assessment Method

A total of 137 wetlands in the basin have been assessed using the Vermont Rapid Assessment Method (VRAM; Figures 12 and 13). The VRAM assigns each wetland a score ranging from 15 to 100 with higher numbers representing more intact ecological condition and higher levels of wetland functions and values. The highest VRAM score, in Appletree Marsh, was 87. Eleven other wetlands also scored above 80, indicating excellent condition and/or very high levels of function and value. 29 wetlands scored below 50, and the average score was 62. The lowest scoring wetland in this basin (and the entire state) with a score of just 11, was a ditch between a parking lot and a road in St. Albans. Note that the VRAM assessments in this watershed may not necessarily be representative of the basin's wetlands, as random sampling was not conducted and a full inventory of all the wetlands in the basin is not possible at this time.

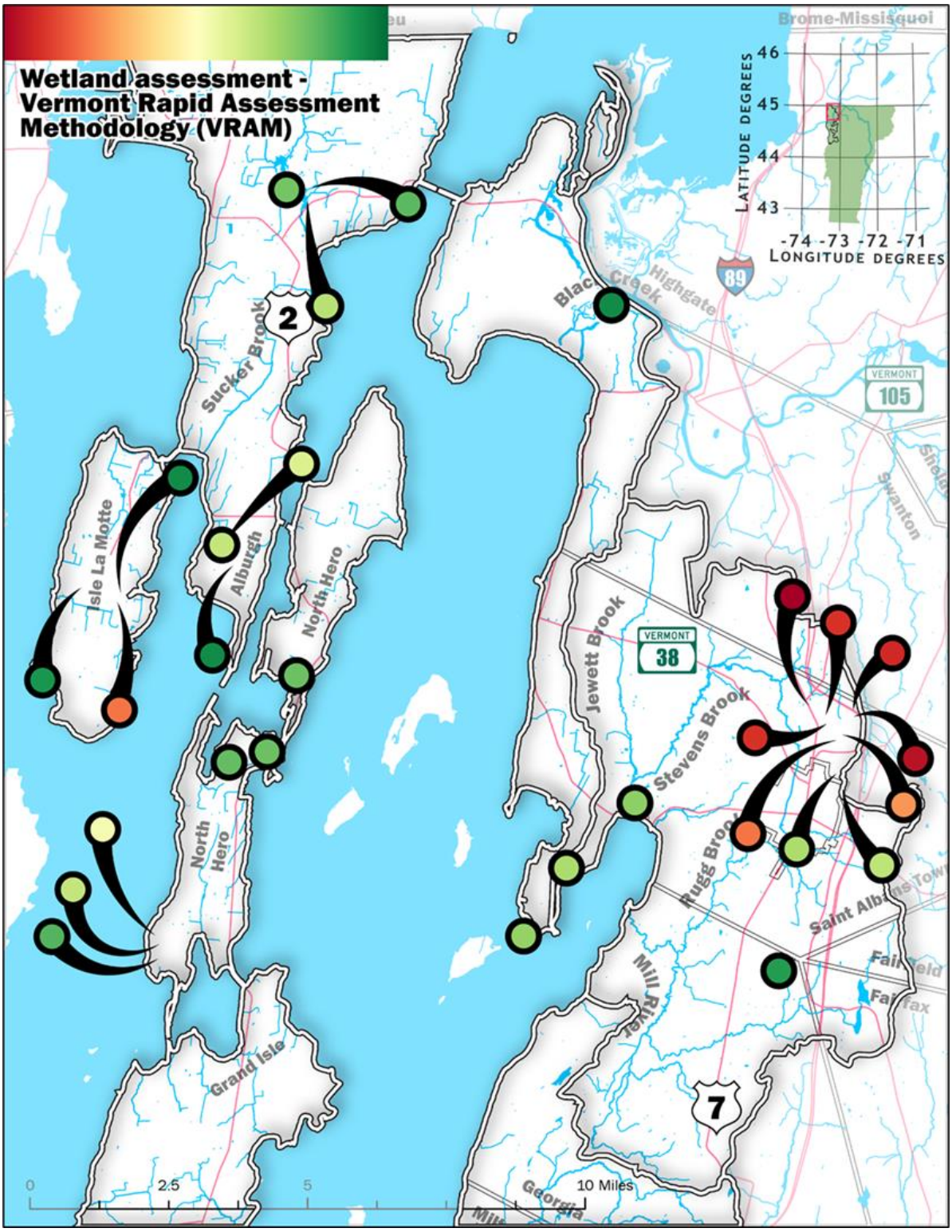


Figure 12. VRAM scores Basin 5 (North). The red to green symbology illustrates the relative wetland condition amongst VRAMs ranging from worst to best conditions.

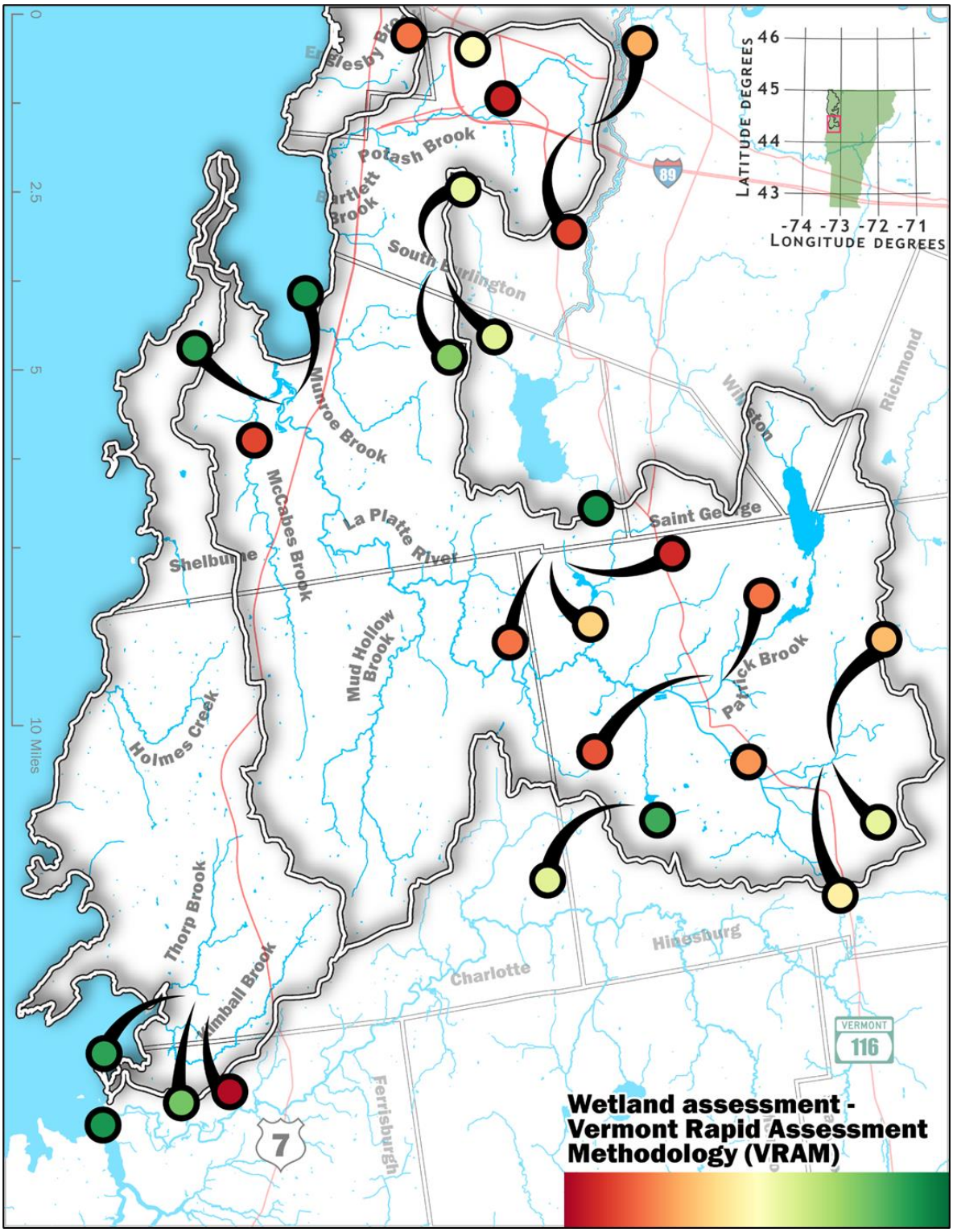


Figure 13. VRAM scores Basin 5 (South). The red to green symbology illustrates the relative wetland condition amongst VRAMs.

Recreational Fisheries

The North Lake basin contains a diversity of fish species, many of which support popular recreational fisheries. Fishery habitats in the basin's streams range from high velocity riffles with cobble substrate such as in the upper LaPlatte River, to slow moving pools with sand substrate, such as in Indian Brook. In addition, seasonally flooded wetlands are spawning habitat for northern pike, yellow perch, brown bullhead, pumpkinseed, bowfin, largemouth bass, black crappie, carp, mudminnow and longnose gar.

Lake Champlain's spring high-water levels inundate upland meadows as well as wetlands, providing additional spawning habitat for fish. Prime spawning habitat for northern pike lies above 98.5 feet (the average annual high is 99.7 feet); however, it is the additional spawning habitat created during the infrequent years with spring lake levels rising above 100 feet that support the abundant population of northern pike (ANR 1978). The high lake levels allow northern pike to swim through flooded fields to spawn on grasses, where eggs and small fry will benefit from the warm temperatures of the shallow water. Carmans Marsh in Swanton and Malletts Creek in Colchester are excellent examples of this environment.

Threatened and endangered species of fish in the basin include the Stonecat and Channel Darter. Present in the lower LaPlatte River, Stonecat prefer moderate current of medium-sized cobbles. Channel Darter prefer streams with sandy to small gravel bottoms. Both are intolerant of siltation and general habitat degradation, and Stonecat disappear when flow is reduced by a dam.

The Vermont Fish & Wildlife Department (FWD) assesses fishery populations and important nursery areas to document biological and habitat conditions to manage for high-quality recreational fisheries. The Fisheries Management Documents Library provides a searchable database of FWD's past fisheries and habitat assessments, including a few specific to sub-watersheds within the North Lake basin.

Chapter 2 – Priority Areas for Surface Water Protection

The state protects lakes, wetlands, and rivers by establishing and supporting surface water management goals. Tactical Basin Plans (TBPs) identify surface waters that consistently attain a higher level of quality and value based on physical, chemical, and biological criteria. These waters are prioritized for reclassification or designation. This allows for the establishment of enhanced management objectives and supports implementation of strategies to protect these surface waters.

Additional pathways such as land stewardship programs, local protection efforts, conservation easements, and land acquisition are also used to increase protection of priority waters. These are described in Chapter 4 - Strategies for Protection and Restoration. Trout Brook is the only stream that attains a very high-quality condition and is prioritized for reclassification.

A. Surface Water Reclassification and Designation

Vermont's surface water classification system establishes management goals and supporting criteria for designated uses in four classes of water. Designated uses include aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, swimming, public water supply, and irrigation. The Vermont Water Quality Standards (VWQS) begin classification with two broad groups based on elevation:

- All waters above 2,500 feet in elevation are designated Class A(1) for all uses, unless specifically designated Class A(2) for use as a public water source.
- All waters at or below 2,500 feet in elevation are designated Class B(2) for all uses, unless specifically designated as Class A(1), A(2), or B(1) for any one or more uses.

Current classifications of surface waters and their uses are published in the VWQS and are identified through the tactical basin planning process or on a case-by-case basis. Table 3 lists the possible classes for each designated use.

Table 3. Uses of Vermont waters by classification.

Classification	Applicable Uses
Class A(1)	One or more of: Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating or swimming
Class A(2)	Public water source
Class B(1)	One or more of: Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, or boating
Class B(2)	Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, swimming, public water source or irrigation

Surface waters may be protected by the anti-degradation policy of the VWQS (DEC, 2022) or through one of the following pathways:

- Reclassification of surface waters
- Class I Wetland designation
- Outstanding Resource Waters designation

The tactical basin planning process includes the review of monitoring and assessment data to identify and document surface waters that meet the criteria for a higher classification or designation. (10 V.S.A. § 1253).

Public involvement is an essential component of protecting river, wetland, and lake ecosystems. The VWQS indicate that in the basin planning process, "Public participation shall be sought to identify and inventory problems, solutions, high quality waters, existing uses and significant resources of high public interest." The public, watershed partners, and stakeholders are encouraged to make recommendations for additional monitoring and research where very high-quality waters may exist. In addition, the public may petition the DEC to reclassify streams and lakes, and to designate Outstanding Resource Waters. DEC has developed procedures and documents for Class I wetland designations and draft documents for stream reclassification. When the public is involved in developing proposals regarding management objectives, the increased community awareness can lead to protection of uses and values by the community and individuals.

Further information on reclassification and the petition process can be found on the following WSMD webpages: Stream Reclassification, Lakes and Ponds Reclassification, and Class I Wetlands. Strategies for enhanced protection of waters are described in further detail in the following sections. Surface waters in need of supplemental monitoring to determine their potential for enhanced management are included in Chapter 5 in the Monitoring and Assessment Table.

A(2) Public Water Sources

Four waters in the North Lake basin are designated as A(2) public water sources (Table 5). The North and South St. Albans Reservoirs (Fairfax) are active drinking water supply reservoirs for the City of St. Albans. This reservoir receives water from Silver Lake in Georgia (Lamoille River Watershed) via a piping system. The other two are not in use: Colchester Pond and Milton Pond water supplies. Any A(2) waters that are no longer used as water supply are candidates for reclassification to A(1) or B(1) for better long-term management.

Table 4. Current and abandoned Class A(2) public water sources.

Waters	Location	Water User	Status
North and South St. Albans Reservoir	St. Albans	City of St. Albans	In use
Colchester Pond	Colchester	Colchester	No longer used
Milton Pond	Milton	Milton	No longer used

A(1) & B(1) Waters for Aquatic Biota

Biomonitoring assessments by the WSMD have not identified any surface waters in the basin that are consistently and demonstrably attaining a higher level of quality than Class B(2) based on draft criteria for aquatic biota reclassification for Class B(1) or Class A(1). Trout Brook, see Figure 14, may be a future candidate for reclassification as it has shown biological conditions expected of a B(1) water in the past. The WSMD will collect additional data to confirm if conditions continue to support reclassification. The majority of these waters tend to be found in predominantly forested areas with limited development, see map of Class A1 waters and candidates[2]).

The WSMD will target additional surface waters for monitoring to confirm suspected condition supporting a higher classification than B2, based on preliminary data as well as forested condition of their watershed, see Chapter 5's Monitoring and Assessment Table. For more information, visit the stream reclassification webpage.

B(1) Waters for Recreational Fishing

Rivers and streams classified as B(1) recreational fishing waters support wild, self-sustaining salmonid populations characterized by the presence of multiple age classes and a minimum abundance of 1,000 individuals per mile (all species/ages/sizes); and/or 200 large (> 6 inches total length) individuals per mile; and/or 20 pounds/acre (all species/ages/sizes). No streams in the basin meet B(1) criteria for recreational fishing (§29A-306 of the VWQS). Unless otherwise noted, B(1) classification would apply to the stream from the given point of sampling to its headwaters. These waters shall be managed to achieve and maintain the documented quality of fishing. It is important to note that all waterbodies that would naturally support fish populations are protected and maintained for this use in perpetuity.

A(1) & B(1) Waters for Aesthetics

The VWQS include a designated use for aesthetic conditions. DEC has developed numeric nutrient criteria for lakes and ponds in relation to this use, which are reflected in Table 3 of the VWQS. No lakes in the basin currently meet the nutrient criteria for B(1) or A(1) aesthetics.

[2] https://dec.vermont.gov/sites/dec/files/wsm/docs/2023-11-09-ClassA1-Candidates.pdf

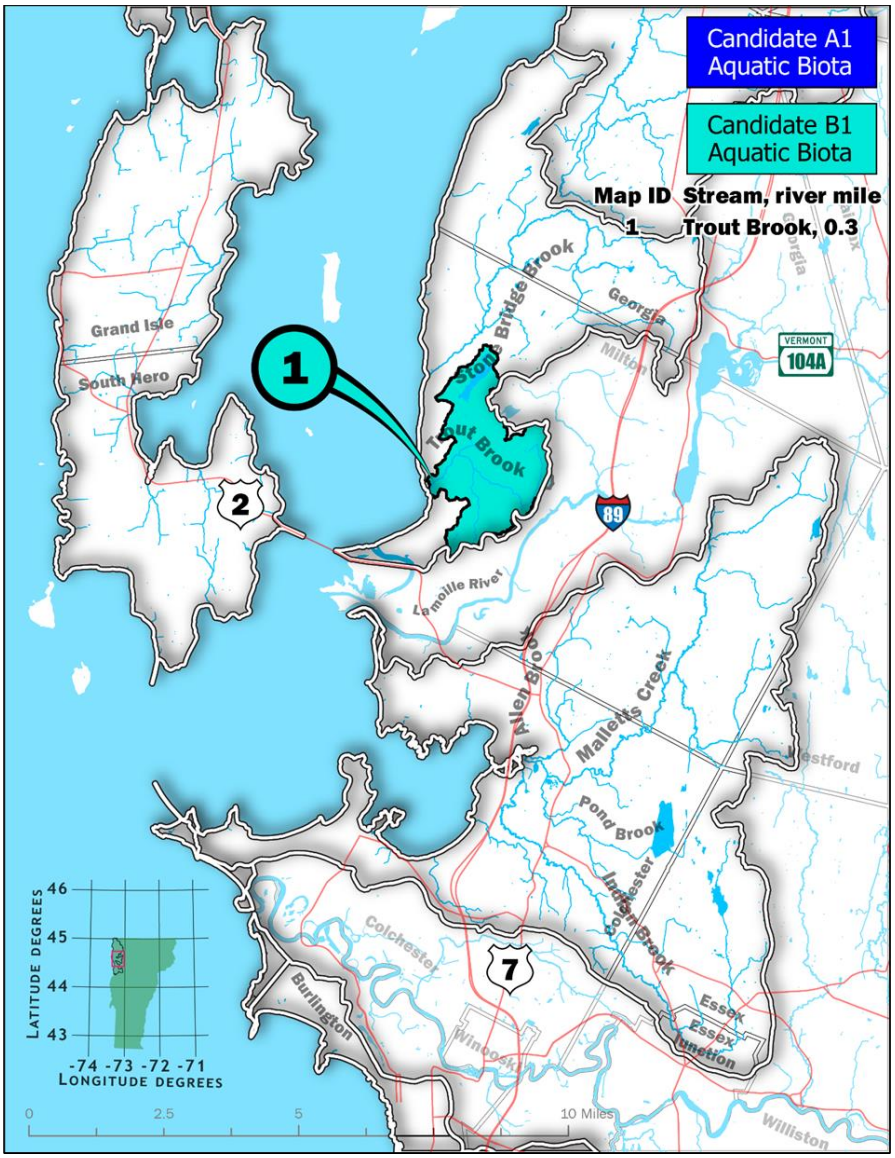


Figure 14. Trout Brook is the only B(1) reclassification candidates. Currently, the North Lake basin has no A(1) candidates.

B. Class I Wetland Designation

The State of Vermont identifies and protects the functions and values of significant wetlands to achieve no net loss of wetlands. Based on an evaluation of the extent to which a wetland provides functions and values, it is classified as:

- **Class I**: Exceptional or irreplaceable in its contribution to Vermont's natural heritage and therefore, merits the highest level of protection.
- **Class II**: Merits protection, either taken alone or in conjunction with other wetlands.
- **Class III**: Neither Class II nor Class I wetland.

Impacts to Class I wetlands may only be permitted when the activity is necessary to meet a compelling public need for health or safety. The Wetlands Program Class I Wetlands website highlight the designated Class I wetlands statewide and] lists those recommended for Class I designation (see Class I Wetland Candidate Story Map). Recommendations in the basin are included in Figure 15.

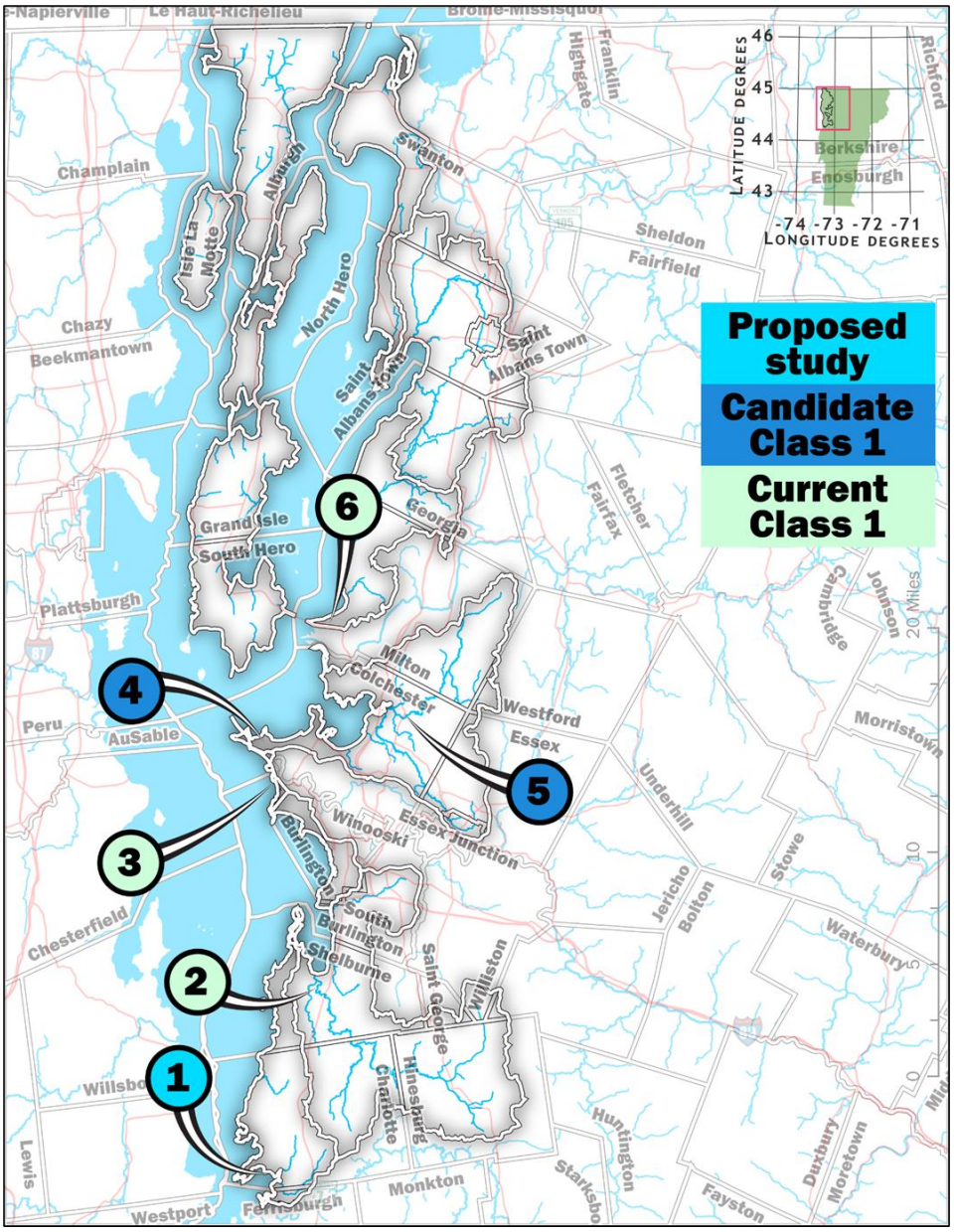


Figure 15. Class I wetlands in the basin: #2 - LaPlatte River Wetlands, #3 - North Shore wetland, and #6 - Sand Bar wetland complex. Candidates for Class I wetlands identified include #4 - the Colchester Bog, a UVM natural area, and #5 - Munson Flat. #1-Thorp Brook wetland is proposed for study to determine Class I eligibility.

DEC supports the further study and reclassification of wetlands, and the Wetlands Program welcomes recommendations for Class I candidates. Wetlands that are found to meet criteria for designation may be proposed for reclassification through petition or departmental rulemaking authority, consistent with the Vermont Wetland Rules.

C. Outstanding Resource Waters Designation

Rivers, streams, lakes, and ponds that have "exceptional natural, cultural, recreational, or scenic values" can be protected through designation as Outstanding Resource Waters (ORW). ORW designation protects exceptional waters through permit conditions for in-stream alterations, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250[3] projects, and other activities. ORWs can be designated by the ANR through a public petition process.

No ORW designated waters currently exist in the North Lake basin. Based on data collected by the Watershed Management Division, the ANR would support a community-led effort to petition a water as an ORW where petitioners can demonstrate the presence of ORW values.

D. Identification of Existing Uses

Existing uses of waters and the level of water quality necessary to protect those existing uses shall be maintained and protected regardless of the water's classification (DEC, 2022). The ANR may identify existing uses during the tactical basin planning process or on a case-by-case basis during application reviews for State or Federal permits. Consistent with the federal Clean Water Act, the VWQS stipulate that existing uses may be documented in any surface water location where that use has occurred since November 28, 1975. Pursuant to the definition of Class B(1) in Act 79, the ANR may identify an existing use as Class B(1) when that use is demonstrably and consistently attained.

The ANR stipulates that all lakes and ponds in the state have existing uses of swimming, boating, and fishing. The ANR recognizes that fishing activities in streams and rivers are widespread and too numerous to thoroughly document for the basin. In the case of streams too small to support significant fishing activity, the ANR recognizes these as potential spawning and nursery areas, which contribute fish stocks downstream where fishing may occur. These small streams support the use of fishing and therefore, are protected at a level commensurate with downstream areas.

Existing uses are listed on the Northern Lake Champlain Direct Drainages webpage and include swimming, boating, fishing, and public water sources. Existing uses should be viewed as a partial

[3] Vermont's land use and development law, established in 1970. The law provides a public, quasi-judicial process for reviewing and managing the environmental, social, and fiscal consequences of major subdivisions and development in Vermont through the issuance of land use permits.

accounting of known existing uses based upon limited information. The list does not change protection under the Clean Water Act or VWQS for unlisted waters.

The public is encouraged to recommend waters for the existing uses of swimming, boating, fishing, public water source, and ecological significance given that they provide evidence of such use.

Chapter 3 – Priority Areas for Surface Water Restoration

A. Impaired and Altered Surface Waters

The DEC monitors and assesses the chemical, physical, and biological status of individual surface waters to determine if they meet the VWQS per the 2022 Vermont Surface Water Assessment and Listing Methodology (DEC, 2022). As summarized in Figure 1 of the Listing Methodology, surface waters are assessed as: full support, altered, or impaired depending on their support of existing uses and their attainment of water quality standards.

The assessment results are the basis for the biennial statewide 303(d) List of Impaired Waters and List of Priority Surface Waters Outside the Scope of 303(d) (Table 5 and 6; Figures 17 and 19), waters altered by invasive species or flow regulation (Table 7; Figure 20), as well as the priority waters for protection for aquatic biota and wildlife (Chapter 2). The lists identify impaired or altered waters and includes preliminary information on responsible pollutant(s) and/or physical alterations to aquatic and riparian habitat and identifies the problem, if known. Altered and impaired waters become a priority for restoration. Additionally, the Vermont Lake Score Card identified lakes and ponds that have increasing nutrient trends are a priority for nutrient reduction strategies. To address documented water quality concerns, the strategies proposed in the Chapter 5 Implementation Table are prescribed based on the land use sector-specific practices outlined in the Vermont Surface Water Management Strategy.

North Lake basin has eight rivers and streams with biomonitoring data indicating *fair* or *poor* condition but have insufficient data to fully evaluate the attainment of Aquatic Biota use, or their monitoring results show volatile conditions from year to year (Table 8 and Figure 2). These streams are a priority for further assessment.

The following figures and tables are grouped to show the impaired or altered waterbodies in the North Lake basin, their known or suspected pollutant sources, and monitoring needs for further evaluation.

Impaired Lakes

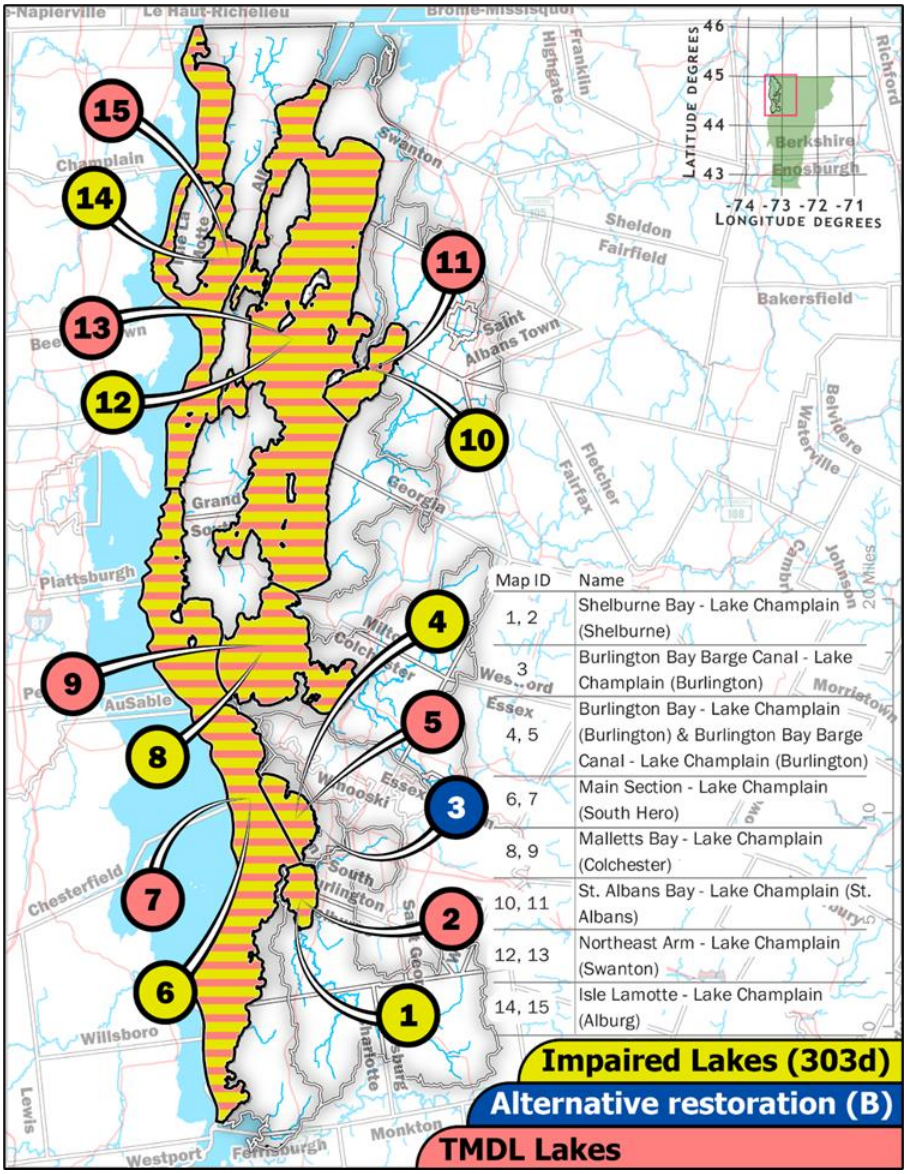


Figure 16. Map of impaired lakes across the North Lake basin. Lake Champlain lake segments are impaired and also need a TMDLfor specific, non-nutrient pollutants. Yellow represents lake segments that are on the 2022 and draft 2024[4] 303(d) list (Part A-Priority Waters List). Salmon color represent lake segments that are on Part D of the 2022 Priority Waters List and have an approved Total Maximum Daily Load (TMDL) Blue signifies an impaired section of the lake with an alternative restoration plan, in this case, the Barge Canal is a Superfund site, see Priority Waters List Part B for more detail.

[4] As of 9/24/2024, the date of the release of the draft plan, Vermont's 2024 list has not yet been approved by EPA.

Table 5. Impaired lakes in the North Lake basin and their pollutants. 'List' indicates the part of the 2022 and draft 2024 Water lists to which the waterbody belongs based on attributes described in Chapter 4 of the 2022 Vermont Surface Water Assessment and Listing Methodology.

Map ID	Name	Problem	Pollutant	List
1	Shelburne Bay - Lake Champlain (Shelburne)	PCBs in fish tissue	Elevated levels of PCBs in lake trout	A
2	Shelburne Bay - Lake Champlain (Shelburne)	Mercury in fish tissue, phosphorus	Elevated levels of mercury in walleye, Phosphorus enrichment	D
3	Burlington Bay Barge Canal - Lake Champlain (Burlington)	Xylene, toluene	Contamination from coal tar in sediments of Pine Street Barge Canal (SITE #770042)[5]	B
4	Burlington Bay & Burlington Bay Barge Canal - Lake Champlain (Burlington)	PCBs in fish tissue	Elevated levels of PCBs in lake trout	A
5	Burlington Bay & Burlington Bay Barge Canal - Lake Champlain (Burlington)	Mercury in fish tissue, phosphorus	Elevated levels of mercury in walleye, Phosphorus enrichment	D
6	Main Section - Lake Champlain (South Hero)	PCBs in fish tissue	Elevated levels of PCBs in lake trout	A
7	Main Section - Lake Champlain (South Hero)	Mercury in fish tissue, phosphorus	Elevated levels of mercury in walleye, Phosphorus enrichment	D
8	Malletts Bay - Lake Champlain (Colchester)	PCBs in fish tissue	Elevated levels of PCBs in lake trout	A
9	Malletts Bay - Lake Champlain (Colchester)	Mercury in fish tissue, phosphorus	Elevated levels of mercury in walleye, Phosphorus enrichment	D
10	St. Albans Bay - Lake Champlain (St. Albans)	PCBs in fish tissue	Elevated levels of PCBs in lake trout	A
11	St. Albans Bay - Lake Champlain (St. Albans)	Mercury in fish tissue, phosphorus	Elevated levels of mercury in walleye, Phosphorus enrichment	D
12	Northeast Arm - Lake Champlain (Swanton)	PCBs in fish tissue	Elevated levels of PCBs in lake trout	A
13	Northeast Arm - Lake Champlain (Swanton)	Mercury in fish tissue, phosphorus	Elevated levels of mercury in walleye, Phosphorus enrichment	D
14	Isle La Motte - Lake Champlain (Alburg)	PCBs in fish tissue	Elevated levels of PCBs in lake trout	A
15	Isle La Motte - Lake Champlain (Alburg)	Mercury in fish tissue, phosphorus	Elevated levels of mercury in walleye, Phosphorus enrichment	D

[5] see Priority Waters List Part B for more detail

Impaired Rivers

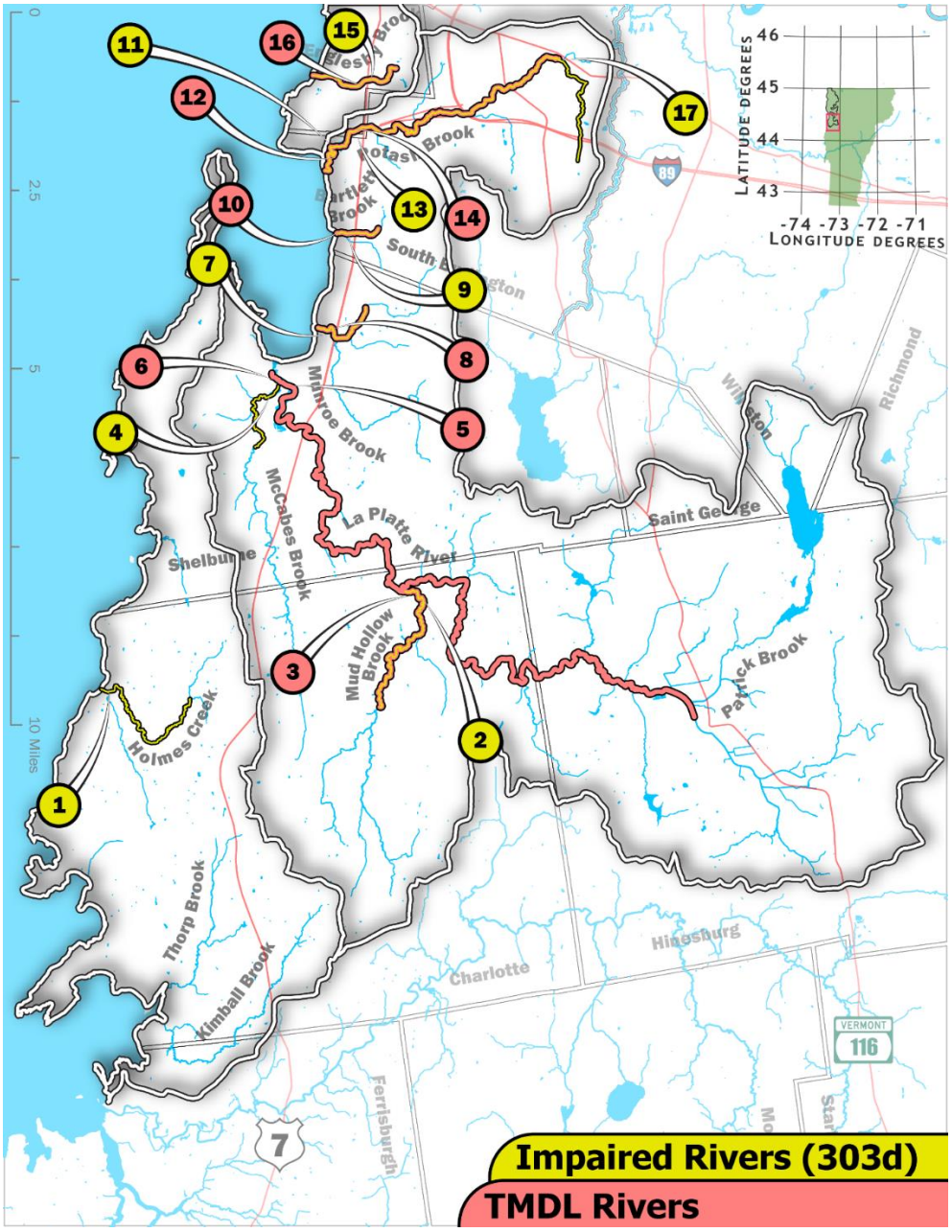


Figure 17. Map of impaired rivers in North Lake basin (southern section). Yellow represents rivers that are on the draft 2024[6] 303(d) list (Part A-Priority Waters List). Salmon represents rivers that have an approved TMDL but remain impaired (Part D-Priority Waters List). Use the stream name to find monitoring data for the stream from this report viewer.

[6] As of 9/24/2024, the date of the release of the draft plan, Vermont's 2024 list has not yet been approved by EPA. See Table 6 for additional explanation.

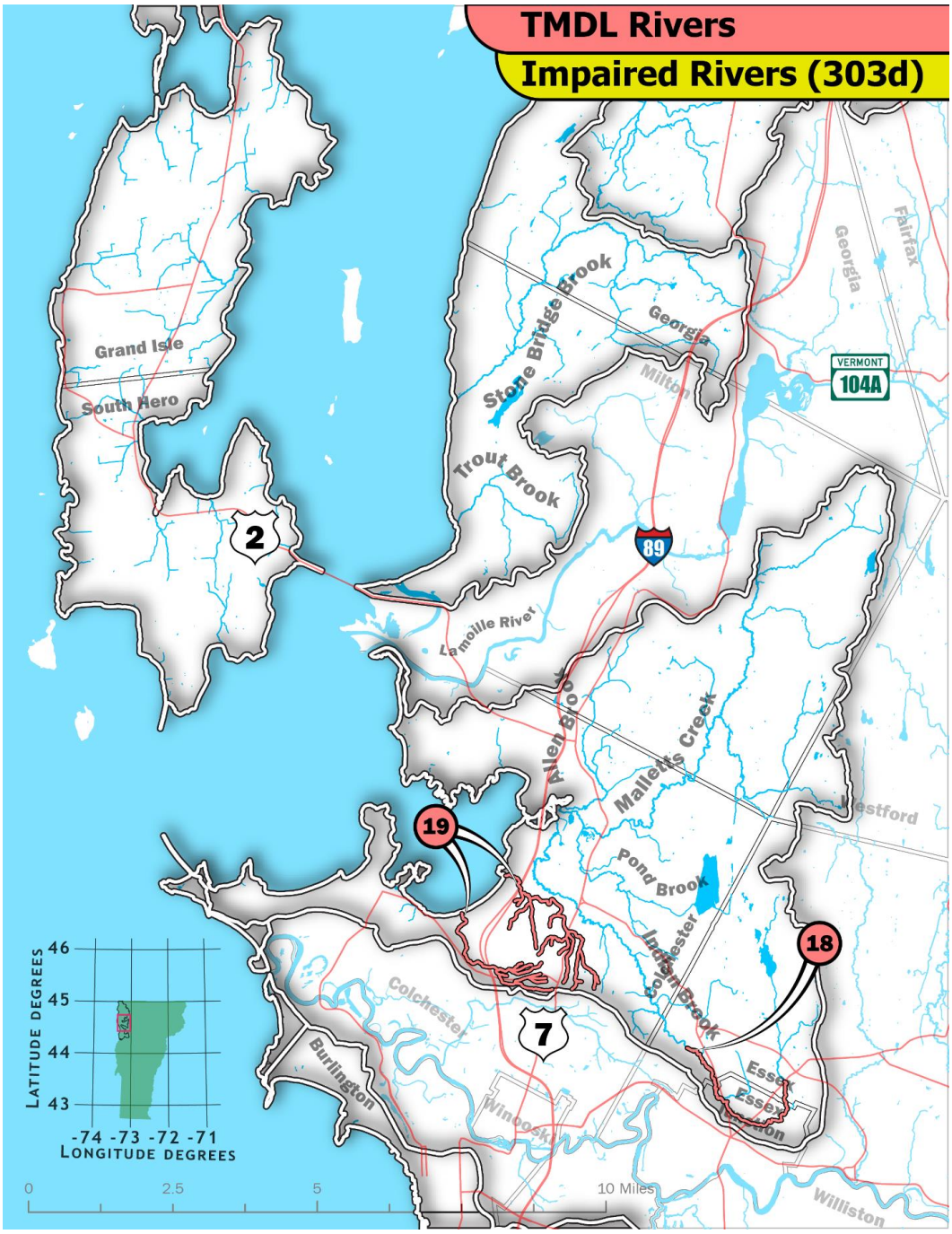


Figure 18. Map of impaired rivers in North Lake basin (middle section).

Salmon represents rivers that have an approved TMDL (2022 and draft 2024 Part D-Priority Waters List) but remain impaired. Find monitoring data for the streams in this report viewer.

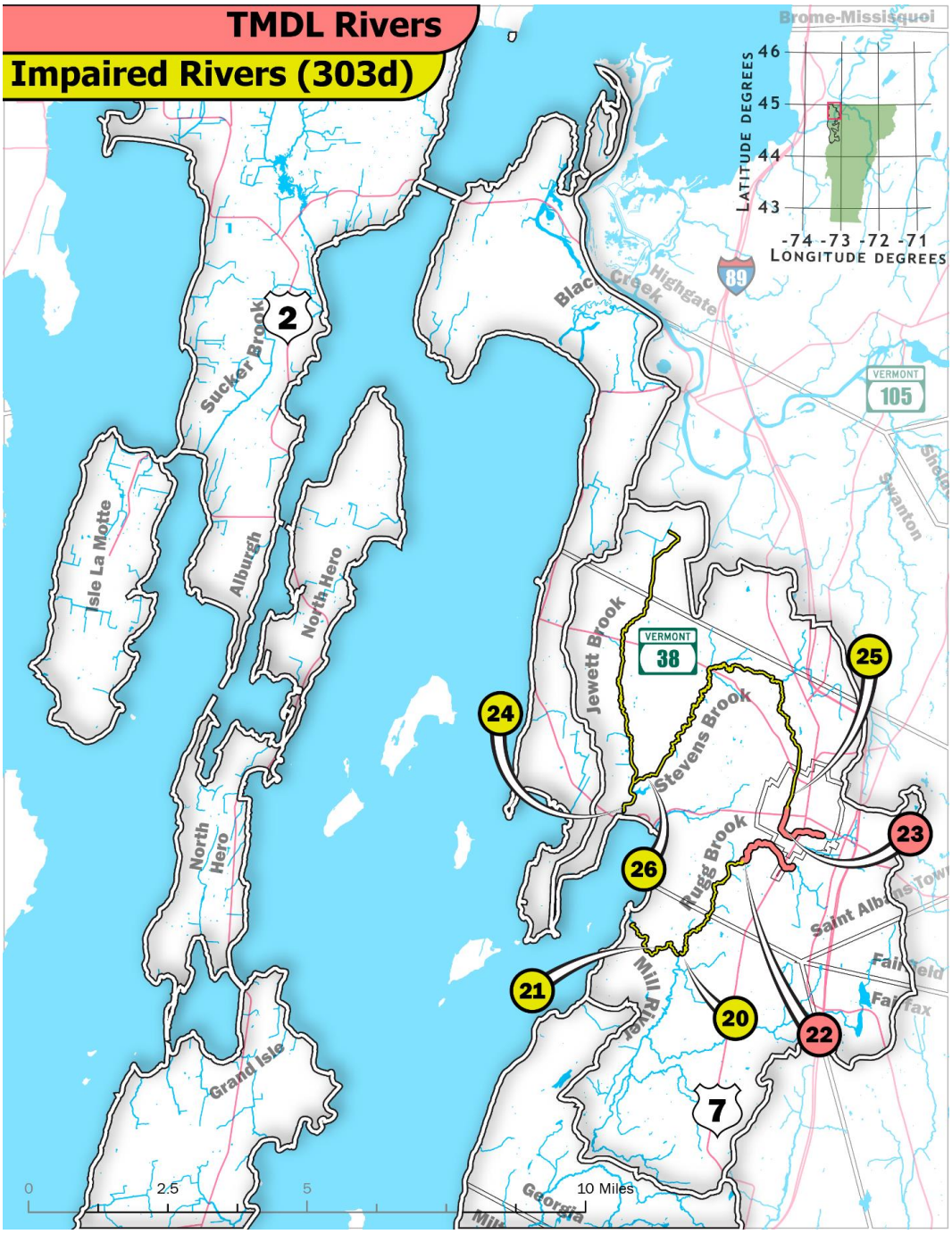


Figure 19. Map of impaired rivers in the North Lake basin (northern section).

Yellow represents rivers that are on the 2022 and draft 2024 303(d) list (Part A-Priority Waters List). Salmon represents rivers that have an approved TMDL (Part D-Priority Waters List) but remain impaired. Find monitoring data for the streams in this report viewer.

Table 6. Impaired streams in the North Lake basin and their pollutants. 'List' indicates the part of the draft 2024[7] Priority Water list to which the waterbody belongs based on attributes described in Chapter 4 of the 2022 Vermont Surface Water Assessment and Listing Methodology. River mile(rm).

Map ID	Name	Pollutant	Problem	Impaired Use	List
7	Munroe Brook, Mouth to rm 2.8 (Including North Trib.)*	Chloride	Chloride concentration above chronic criteria based on continuous monitoring	Aquatic Biota	A
9	Bartlett Brook, Mouth to rm 0.7*	Chloride	Chloride concentration above chronic criteria based on continuous monitoring	Aquatic Biota	A
11	Potash Brook, Mouth Upstream 1 Mile	Chloride	Elevated chloride levels due to road salt	Aquatic Biota	A
13	Potash Brook, I189 River Upstream 4.2 Miles	Chloride	Elevated chloride levels due to road salt	Aquatic Biota	A
15	Englesby Brook, Mouth to rm 1.3*	Chloride	Elevated chloride levels due to road salt	Aquatic Biota	A
17	Upper Potash Brook, Kennedy Drive to Above Route 89	Chloride	Elevated chloride levels due to road salt	Aquatic Biota	A
3	Mud Hollow Brook, mouth upstream 3 miles	Escherichia coli (E. coli)	Agricultural runoff, streambank erosion	Contact Recreation	D
5	LaPlatte River from Hinesburg to rm 0.2	E. coli	Agricultural runoff	Contact Recreation	D
19	Direct Smaller Drainages to Inner Malletts Bay	E. coli	Urban runoff, potential failed/failing septic systems; includes Smith Hollow Brook & Crooked Creek	Contact Recreation	D
6	LaPlatte River, at Mouth	Mercury in fish tissue, E. coli	Agricultural runoff	Contact Recreation, Fish Consumption	D
25	Stevens Brook, Lasalle St Downstream 0.5 Miles	Metals	Sediment contamination from St Albans Gas and Light hazardous waste site	Contact Recreation Aquatic Biota,	A

[7] As of 9/24/2024, the date of the release of the draft plan, Vermont's 2024 list has not yet been approved by EPA. Table 6. River segments with asterisks are on the 2024 list, but not on the 2022 list.

Map ID	Name	Pollutant	Problem	Impaired Use	List
2	Mud Hollow Brook, mouth upstream 3 miles*	Nutrients	Elevated phosphorus and nitrogen concentrations due to runoff form agricultural lands.	Aquatic Biota	A
4	McCabe's Brook, Mouth to rm 1.4	Nutrients	Includes above and below WWTF; possible toxic impact below WWTF; unstable channel above	Aquatic Biota	A
1	Holmes Creek, mouth upstream 2.7 miles	Nutrients, sedimentation/siltation	Elevated phosphorus and nitrogen concentrations and sedimentation due to riparian encroachment and runoff form agricultural lands.	Aquatic Biota	A
8	Munroe Brook, Mouth to rm 2.8, including North Trib	Pollutants in urban stormwater	Stormwater runoff, erosion, land development	Aquatic Biota	D
10	Bartlett Brook, Mouth to rm 0.7	Pollutants in urban stormwater	Stormwater runoff, land development, erosion	Aquatic Biota	D
14	Potash Brook, I189 River Upstream 4.2 Miles	Pollutants in urban stormwater	Stormwater runoff, land development, erosion	Aquatic Biota	D
18	Indian Brook, rm 5.8 (Suzie Wilson Rd) to rm 9.8	Pollutants in urban stormwater	Stormwater runoff, land development, erosion	Aquatic Biota, Aesthetics	D
22	Rugg Brook, rm 3.1 to rm 5.3	Pollutants in urban stormwater	Stormwater runoff	Aquatic Biota Aesthetics	D
23	Stevens Brook, rm 6.5 (Pearl St) to rm 9.3	Pollutants in urban stormwater	Stormwater runoff, erosion/sedimentation, morphological instability	Aquatic Biota	D
12	Potash Brook, Mouth Upstream 1 Mile	Pollutants in urban stormwater, E. coli	Stormwater runoff, land development, erosion	Aquatic Biota, Contact Recreation	D
16	Englesby Brook, Mouth to rm 1.3	Pollutants in urban stormwater, E. coli	Stormwater runoff, Blanchard Beach closure	Aquatic biota RB, Contact Recreation, Aesthetics	D
21	Mill River, from St. Albans Bay to 1.8 Miles Upstream	Sedimentation/siltation, nutrients	Agricultural runoff, streambank erosion	Aquatic Biota	A
24	Jewett Brook (3.5 Miles)	Sedimentation/siltation, nutrients	Agricultural runoff	Aquatic Biota	A

Map ID	Name	Pollutant	Problem	Impaired Use	List
20	Rugg Brook, from Mouth to Approx 3.1 Miles Upstream	Sedimentation/siltation, nutrients, E. coli	Agricultural runoff	Aquatic Biota, Contact Recreation, Aesthetics	A
26	Stevens Brook, Mouth Upstream 6.5 Miles	Sedimentation/siltation, nutrients, E. coli	Agricultural runoff; morphological instability; St Albans CSO	Aquatic biota, Contact Recreation	A

Altered Lakes and Rivers

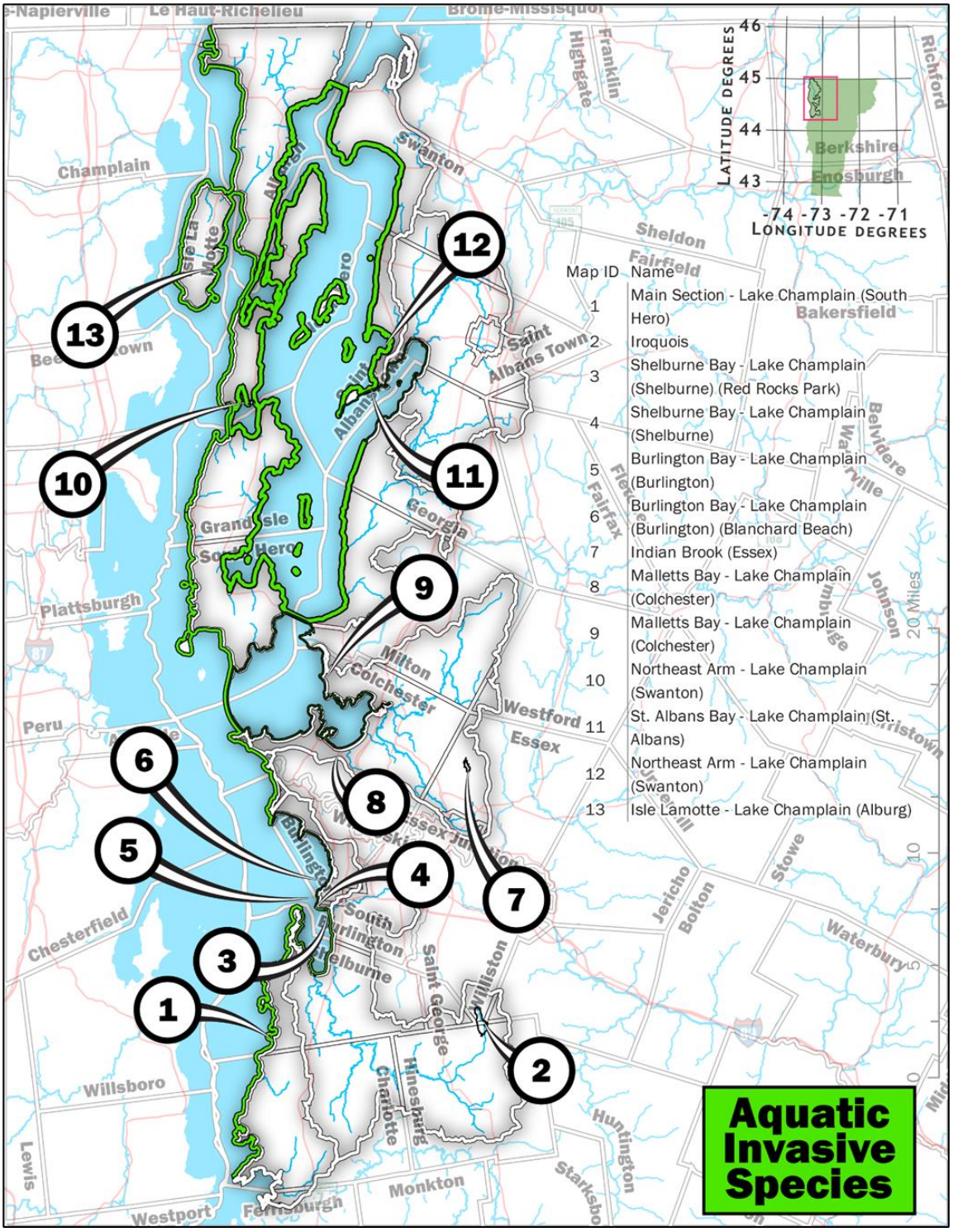


Figure 20. Surface waters altered by aquatic invasive species in the North Lake basin, see Table 7 for the associated aquatic invasive species and status.

Table 7. Altered lakes in the North Lake basin, from Figure 20. 'List' indicates the part of the Priority Water list to which the waterbody belongs based on attributes described in Chapter 4 of the 2022 Vermont Surface Water Assessment and Listing Methodology. River mile (RM); Eurasian water milfoil (EWM), zebra mussels (ZM).

Map ID	Name	Problem	List
1	Main Section - Lake Champlain (South Hero)	EWM and ZM infestation.	E
2	Iroquois	Abundant EWM growth.	E
3	Shelburne Bay - Lake Champlain (Shelburne) (Red Rocks Park)	EWM and ZM infestation	E
4	Shelburne Bay - Lake Champlain (Shelburne)	ZM, EWM	E
5	Burlington Bay - Lake Champlain (Burlington)	EWM and ZM infestation.	E
6	Burlington Bay - Lake Champlain (Burlington) (Blanchard Beach)	EWM and ZM infestation.	E
7	Indian Brook (Essex)	Locally abundant EWM growth.	E
8	Malletts Bay - Lake Champlain (Colchester)	EWM and ZM infestation.	E
9	Malletts Bay - Lake Champlain (Colchester)	EWM and ZM infestation.	E
10	Northeast Arm - Lake Champlain (Swanton)	EWM and ZM infestation.	E
11	St. Albans Bay - Lake Champlain (St. Al bans)	EWM and ZM infestation.	E
12	Northeast Arm - Lake Champlain (Swanton)	EWM and ZM infestation.	E
13	Isle La Motte - Lake Champlain (Alburg)	EWM and ZM infestation.	E

Monitoring Priorities for Further Impairment Evaluation

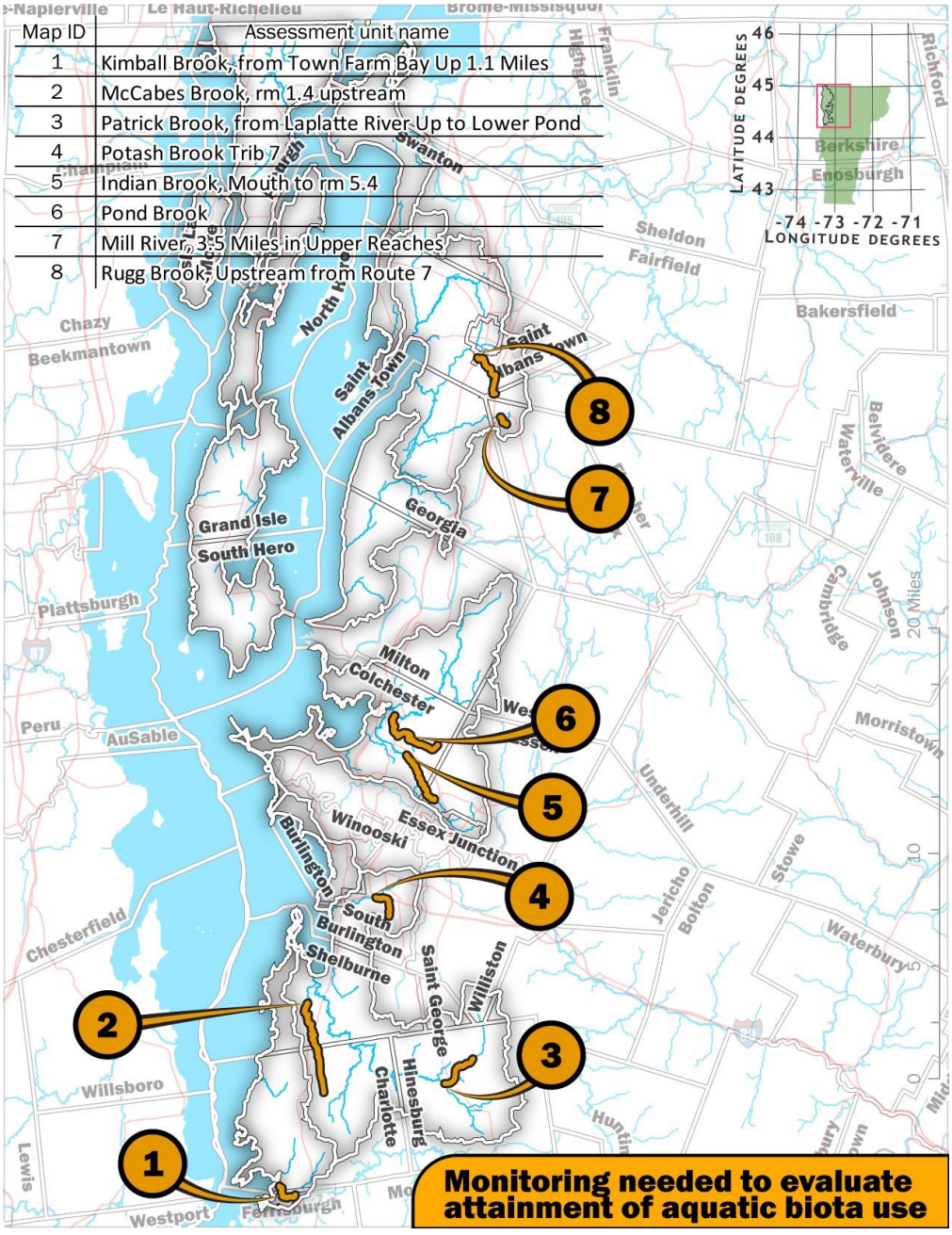


Figure 21. Map of rivers that require more monitoring to evaluate attainment of Aquatic Biota use.

Map IDs correspond with information in Table 8. Biomonitoring data indicates *Fair* or *Poor* conditions at these sites, but additional data must be collected to fully evaluate attainment.

Table 8. North Basin rivers that require more monitoring to evaluate attainment of aquatic biota use. See Figure 21 for location of stream segments (Map ID).

Map ID	Name	Pollutant	Problem
1	Kimball Brook, from Town Farm Bay Up 1.1 Miles	Nutrients, turbidity	Pasture, barnyard, lack of riparian vegetation
2	McCabes Brook, rm 1.4 upstream	Nutrients, chloride, potential low flow	Agricultural runoff, road salt
3	Patrick Brook, from LaPlatte River Up to Lower Pond	Sediment, habitat alterations	Land development, channelization
4	Potash Brook Trib 7	Chloride	Elevated chloride levels due to road salt
5	Indian Brook, Mouth to rm 5.4	Sediment, metals, toxicity	potential impacts from landfill leachate, developed areas, hazardous waste site
6	Pond Brook	Nutrients, chloride, turbidity	Agricultural runoff, road salt
7	Mill River, 3.5 Miles in Upper Reaches	Nutrients, organic enrichment, sediment, Escherichia coli (e. Coli)	Agricultural & urban runoff, streambank erosion
8	Rugg Brook, Upstream from Route 7	Habitat alterations, flow regime modification	Land development, suburban runoff

B. Total Maximum Daily Loads (TMDLs)

For waters that are listed as impaired, the federal Clean Water Act requires a plan that identifies the pollutant reductions a waterbody needs to undergo to meet VWQS and it must identify ways to implement those reductions. A Total Maximum Daily Load (TMDL) is the calculated maximum amount of a pollutant that a waterbody can receive and still meet VWQS. TMDLs can be calculated for reducing water pollution from specific point source discharges or for an entire watershed to determine the location and amount of pollution reductions needed.

TBPs are implementation plans guiding the execution of actions necessary to meet TMDL reduction targets specific to each planning basin, see Chapter 4 and the implementation table for associated strategies.

TMDLs in the North Lake basin include:

- Northeast Regional Mercury TMDL
- Stormwater TMDLs for Bartlett, Potash, Englesby, Munroe, Indian, Rugg and Stevens Brooks
- Vermont Statewide 2011 Bacteria-impaired TMDL (Appendices for the Lower LaPlatte, Englesby, Mud Hollow and direct small drainages to Inner Malletts Bay)
- Lake Champlain Phosphorus TMDL

The Mercury TMDL is primarily focused on regional efforts to reduce atmospheric deposition and so is not described in greater detail beyond the link provided above. The Stormwater TMDLs are primarily addressed through a combination of permits issued pursuant to Vermont's federally delegated National Pollutant Discharge Elimination System permitting program. These permits include an enhanced Municipal Separate Stormwater System (MS4) General Permit and the Transportation Separate Storm Sewer System (TS4) General Permit. Included in the 2018 reissuance of the MS4 permit is the requirement for municipalities to develop Phosphorus Control Plans to comply with the Lake Champlain Phosphorus TMDL. The bacterial TMDLs will be met in part by regulations and actions that will be implemented to meet the Lake Champlain Phosphorus TMDL targets, see next section.

Lake Champlain Phosphorus TMDL Phase 3 Content

Lake Champlain covers 373 square miles with a watershed that extends across 8,234 square miles, draining nearly half the land area of Vermont, as well as portions of northeastern New York and southern Quebec. The large land to water ratio (20:1) has resulted in significant phosphorus loading from land-use activity in the watershed, a predominant source of the lake's phosphorus impairment (LCBP 2021). The excessive phosphorus in the lake has impaired aquatic life and reduced recreational use due to cyanobacteria blooms, unpleasant odors, and low dissolved oxygen concentrations.

The United States Environmental Protection Agency (EPA) established TMDLs for the 12 Vermont segments of Lake Champlain (Figure 22) to ensure that phosphorus reductions are achieved. To meet requirements of the 2016 Lake Champlain Phosphorus TMDL (LC TMDL), Vermont's implementation plan (Phase 1) takes a lake-wide approach in recognition of the interconnectedness of the segments. As required, the plan is a phased approach over a 20-year period and includes an accountability framework to ensure pollution reduction targets are achieved across contributing land-use sectors. This section, along with Chapters 4 and 5, gauges progress as part of the LC TMDL's Phase 3's accountability framework (See the North Lake basin 2020 plan for the Phase 2). This North Lake basin TBP and associated Phase 3 content was published a year ahead of the expected schedule to better distribute staff workload (2024 instead of 2025). As such, the reporting period for the basin during this period will be curtailed from a 5-year period to a 4-year period. As a

result, the final TBP Report Card will be issued concurrent to the 2024 Clean Water Performance Report. It should be noted that the subsequent North Lake TBP development will then progress on a 5-year cycle going forward, and the next iteration of the North Lake TBP will be completed by the end of 2029 instead of 2030, along with the corresponding TMDL "phase 4" content and final report card for that next 5-year reporting period.

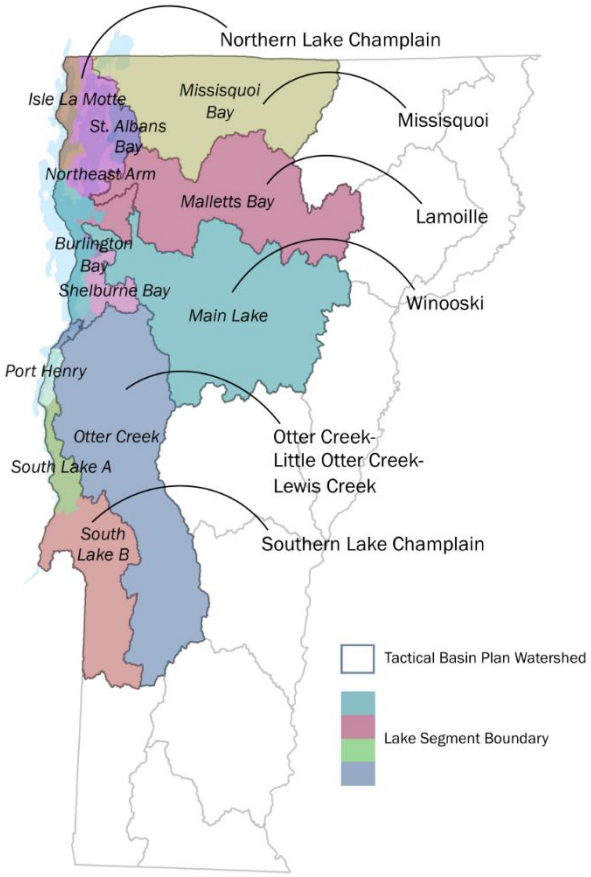


Figure 22. The 12 TMDL lake segments and their watersheds.

Phases 1, 2, & 3 of the Lake Champlain TMDL

The 2016 VT Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan addresses the major Vermont sources of phosphorus to Lake Champlain across all sectors. Vermont's successful

completion of the 28 milestones in Phase 1's Accountability Framework[8] in 2020 has resulted in enhanced state regulatory oversight for municipal road and stormwater management, silvicultural and agricultural practices, as well as incentives for landowners to implement water quality best management practices. In addition, the state established a long-term funding source, the Clean Water Fund, to support clean water projects and a tracking and accounting system to evaluate total phosphorus (TP) reduction progress.

The subsequent two phases of the LC TMDL are embedded in the TBPs associated with the Lake Champlain Basin. Along with providing updates on Vermont's progress towards addressing policy commitments, each phase provides the following information:

- Phase 2 in the 2020 North Lake TBP downscales phosphorus allocations to the tactical basin level from land-use sectors and prioritizes basin catchments for remediation (critical source areas) based on highest modeled phosphorus load reductions.
- Phase 3 in the 2024 North Lake TBP documents phosphorus reductions by sector achieved since the last basin plan and sets projected target reductions for the next five years.

Using outcomes of Phase 2 and 3, the TBP strategies in the 2020 and the current 2024 plan direct technical and financial resources to critical source areas to facilitate regulatory compliance and voluntary adoption of Best Management Practices (BMPs) across all land-use sectors. Specific projects to address strategies are included in the ANR's Watershed Projects Database.

The following Phase 3 content for the 2024 North Lake TBP describes Vermont's progress towards achieving maximum phosphorus reduction and, along with information in Chapters 4 and 5, updates the approach for reducing phosphorus loading from each land-use sector including, agriculture, forestry, developed lands and streams. In addition, five-year targets are assigned. As the wastewater targets identified in Phase 1 are achieved through each wastewater treatment facility permitting process, five-year targets are not set, and progress towards these targets are discussed in Chapter 4.

Commitment and Strategy to Meet Targets

To meet the TMDL targets, the state of Vermont has enhanced regulatory program commitments as well as established a clean water delivery framework with the passage of Act 76 (2019) that will accelerate implementation of natural resource restoration projects to meet non-regulatory target reductions.

[8]see Progress Report on Lake Champlain TMDL Implementation Plan (January 2021)

Key initiatives include:

- the creation of the state's clean water engagement strategy to develop, maintain, and enhance the Agency's organizational partnerships,
- the passage of Act 76 to support those partnerships and ensure project prioritization and funding,
- tracking, accounting, and reporting the progress that is being made in each sector, and
- project reporting systems to obtain an accurate reflection of phosphorus reduction by project type.

These initiatives are described below and in detail in Chapter 4.

Measuring Progress Toward TMDL Targets

Vermont has made a long-term commitment to provide the mechanisms, staffing, and financing necessary to achieve and maintain compliance with the LC TMDL, along with the Vermont Water Quality Standards. To achieve this, the Vermont Department of Environmental Conservation's Clean Water Initiative Program and the Watershed Planning Program coordinate with committed state and federal agencies and local partners to fund, develop, implement, and track clean water projects that protect and restore water quality. The Clean Water Initiative Program's work includes the development and application of tracking and accounting methods as well as standard operating procedures (SOPs) for phosphorus reduction estimation and reporting (see Tracking and Accounting methodology here.)

The Clean Water Initiative Program tracks practices implemented by state-fiscal year (SFY) in the Clean Water Reporting Framework (CWRF) database and annually documents progress towards statewide pollution reduction goals annually in the Vermont Clean Water Initiative Performance Report. The ANR Clean Water Portal's Clean Water Interactive Dashboard, an online tool, provides a link to the year's report and allows users to interact with data on investments, project outputs, estimated pollutant load reductions and project cost effectiveness.

For the Phase 3 content, the Watershed Planning Program uses project reporting outputs that are generated from the CWRF database in development of the State-fiscal year TP reduction estimates by general land-use sector for each basin, along with the overall TMDL sector reduction targets. At the beginning of the subsequent five-year planning cycle, the Watershed Planning Program will evaluate and document progress against the five-year target reduction target (described in this section) with a goal of meeting pollution reduction targets and in-lake water quality standards over the projected TMDL lifespan.

In addition, the Watershed Planning Program reports on the state's progress in each basin towards implementing and supporting regulatory and non-regulatory programs that address the TMDL commitments. While this Phase 3 content includes an overview of progress within each basin, more

specificity relating to completion of strategies in each TBP implementation table is assessed in the basin interim and final report cards completed at two and a half year intervals with the final report coinciding with the completion of the TBP 5-year cycle (Chapter 5). The report cards are published concurrently with Vermont Clean Water Initiative's Annual Performance Reports (annual performance reports).

The ANR uses an adaptive management approach towards meeting targets and any revisions to accounting and target setting will be documented in subsequent TBPs and the annual performance reports.

DEC also works with the Lake Champlain Basin Program and the New York State Department of Environmental Conservation to implement the Lake Champlain Long-Term Water Quality and Biological Monitoring Project. Field data from the project, collected annually since 1992, are used to assess the attainment of annual mean TP criteria for Lake Champlain and annual TP loading as well as trends for major tributaries, in addition to other monitoring goals.

State Programs to Meet Regulatory Targets

The regulatory programs that support the attainment of annual TMDL reduction targets in each sector are described in Phase 1 and Phase 2. The state's progress towards program promulgation is described in Table 9. Chapters 4 and 5 describe how the Agency supports delivery of outreach and technical assistance to facilitate compliance.

Table 9. Regulatory programs supporting attainment of annual TMDL reduction targets

Source Sector*	Permit Program	Reporting Scale	Efficiency	Spatial Scale of TP Loading	Implementation Timeline
Agriculture	Required Agricultural Practices/Large Farm Operation & Medium Farm Operation Rules and Permits	HUC12	Reduction efficiencies vary. Calculated using Standard Operating Procedures (SOP)	Implemented and tracked at HUC12 scale	Estimates completed at HUC12 scale per farm size inspection cycle. Certified Small Farm Operations at least once every 7 years, Medium Farm Operations at least once every 3 years, and Large Farm Operations annually.
Developed Lands: Stormwater	Operational 3-acre Permit	HUC12	35% reduction	Can estimate once 3-acre GIS layer is finalized	Stormwater Program created parcel list and permitting due date as well as incentives for early adopters. Once issued, site will have five-year period to implement.
	Municipal Separate Sewer System (MS4) General Permit	MS4 jurisdiction	SOP	Determined by MS4	DEC updated the MS4 permit in Summer 2023. All MS4 communities have updated phosphorus control plans, and flow restoration plans and are in compliance.
Developed Lands: Roads	Municipal Roads General Permit (MRGP)	Town, although GIS road segments should be possible to aggregate at HUC12 scale	SOP	Stormwater Program provided estimates of what regulatory MRGP P reduction estimates expected over the lifespan of the TMDL	DEC reissued MRGP in January 2023. Towns must update road erosion inventories (REI) by Fall 2027. In addition, towns must upgrade 7.5% of their non-compliant road segments annually, including 20% of Very High Priority segments annually beginning in 2026, and complete all work by 12/31/2036.
	Transportation Separate Storm Sewer System (TS4) Permit	Lake Segment	TBD	TBD	Stormwater Program issued the TS4 permit to VTrans April 2023
Forests	Acceptable Management Practices (AMPs)	HUC12	See Forestry SOPs	Completed at HUC12 scale	Assumed that lake segments with 5% forest reduction will be achieved via compliance with revised AMPs

*While no river state regulatory programs have been promulgated to achieve TMDL targets, municipal River Corridor Bylaw adoption is encouraged for towns without existing bylaws identified in the Municipal Protectiveness Table (Appendix B).

Act 76 Framework to Meet Non-Regulatory Targets

The state recognizes the valuable role of community partners in facilitating the community's adoption of nonregulatory practices. The 2019 Vermont Clean Water Service Delivery Act (Act 76)

provides a funding and project delivery framework to facilitate partner implementation of non-regulatory projects to achieve Vermont's clean water and TMDL goals by:

- providing long-term funding through general fund revenue;
- supporting non-regulatory projects such as, wetland and floodplain restoration, and riparian tree and shrub plantings;
- establishing Basin Water Quality Councils led by regional Clean Water Service Providers (CWSPs) to identify, implement, operate, and maintain non-regulatory projects to meet TMDL reduction targets; and
- distributing funds for non-regulatory projects based on interim phosphorus reduction targets and a standard cost per unit phosphorus reduced, consistent with "pay for performance" models.

The Chittenden County Regional Planning Commission is the North Lake basin CWSP and in SFY 2023 received a grant from DEC to achieve an annual phosphorus reduction target of 42 kg for $645,340.00; and in FY 2024 a reduction of 45 kg for $741,808.00 dollars through the identification, development, design and implementation of clean water projects. Additional funding and phosphorus reduction targets will be provided each year of this initial CWSP assignment term through June 30, 2028. With DEC guidance, the Chittenden County Regional Planning Commission will be developing an operation and maintenance program to ensure the functioning of installed phosphorus reduction projects.

Engagement Strategy

In addition to Act 76 funding framework, the Watershed Planning Program engages partners using strategies that strengthen the partners' sense of ownership and therefore participation in the planning process and implementation. The desired outcomes of the state's engagement strategy follow:

- Multi-partner collaboration across sectors and localities to assist with developing, writing, and implementing TBPs;
- Strategic inclusion and engagement with different sectors and localities throughout the TMDL Phase 3 planning process to ensure that all concerns, needs, and goals are addressed;
- Strategic communication efforts to ensure understanding of and support for the plan among key stakeholders and the general public throughout the watershed; and
- Needs assessment to support financial and technical assistance to partners and develop programs to expand capacity in our stakeholder networks.

The DEC's accomplishments to date include:

- Standing up the CWSPs as a function of Act 76 program delivery (see above). The DEC's statutory partners are now serving as CWSPs as well as members of recently established Basin Water Quality Councils. These groups will enhance community outreach and engagement for clean water project delivery efforts.
- Development of a Watershed Planning Program Communication Plan.
- Creating web-based resources that support the work of partners and the Basin Water Quality Council, including engagement and training resources and Clean Water Fund applicant and recipient resources,
- Completing a partners' needs assessment and addressing an identified need for financial support to build partner capacity through the Clean Water Workforce Capacity Development Initiative

These efforts will continue to promote widespread and improved understanding of the requirements for TMDL implementation efforts, support diverse and sustained collaboration, and help in building new partnerships. As a result, the TMDL implementation efforts will continue to enhance shared ownership and be well informed by those working on the ground, which will enhance reasonable assurance that Vermont will achieve improvements in local water quality and the Lake Champlain TMDL reduction targets.

North Lake River Basin TMDL Targets

Each of the 12 Lake Champlain segments has individual TP load estimates and reduction goals under the Lake Champlain TMDL. Information on how phosphorus loading was projected in the Lake Champlain Basin can be found in Chapter 5 of the Phosphorus TMDLs for Vermont Segments of Lake Champlain (LC TMDL). Phosphorus reductions will be realized by reducing phosphorus loading from the associated Vermont basins draining into each of these lake segments. The lake segments wholly contained in the North Lake basin include Isle La Motte, Northeast Arm, Burlington Bay and Shelburne Bay. Moreover, Malletts Bay, Main Lake and Otter Creek are partially contained in the North Lake basin (Figure 21). The US Environmental Protection Agency, DEC, and Tetra Tech used the best available modeling to also develop TP reduction goals at the smaller basin scale. In the North Lake basin, an estimated 26% or 16776 kg reduction in annual TP loading is required across all the land-use sectors to meet TMDL targets (see Estimated TMDL TP Loading and Reduction online report).

Table 10. Summary table of allocations for TMDL source sectors in the North Lake basin (Estimated TMDL TP Loading and Reduction online report).

Source	Category	Allocation Category	Total Load (kg/yr)	Estimated Target Reduction (kg/yr)	Reduction of Total Load required (%)
Agriculture	Fields/pastures	Load	39,969	10,992	28%
	Barnyard Production Areas	Wasteload	1,279	1,023	80%
Developed Lands	Stormwater	Wasteload	12,276	2,135	17%
Developed Lands	Roads	Wasteload	5,813	973	17%
Wastewater[9]	WWTF discharges	Wasteload	10,200	5,800	57%
	CSO Discharges[10]	Wasteload	870	100	11%
Rivers	All streams[11]	Load	2,893	1,516	52%
Forests	All lands	Load	2,775	137	5%

In SFY 2023 about 30.5% of the overall TMDL reduction goal was met in the North Lake basin across all land use sectors. The basin exceeds the progress of all other Vermont basins (Figure 23).

Three interactive online reports are included in this Phase 3 section to further illustrate loading and reduction estimates for the TMDL within the North Lake basin and the agricultural sector where ample tracking information allows for more detailed estimations. Each of these reports is provided below and within this section's text.

- Estimated TMDL TP Loading and Reduction online report
- North Lake Basin Agricultural Phosphorus Loading & Reduction online report
- North Lake Basin Agricultural Tracking & Target Setting online report

[9] WWTF numbers are based on permitted loads
[10] Burlington Bay only
[11] Individual stream loads not established for Burlington Bay, Northeast Arm or Isle La Motte lake sections.

Sub-tactical basin scale phosphorus loading and reduction estimates for HUC12 watersheds within the North Lake basin and the other Vermont basins is summarized in the first report, Estimated TMDL TP Loading and Reduction, which displays estimates for all land-use sectors and HUC12 watersheds in the Lake Champlain Basin. The first page of the report summarizes estimated phosphorus loading by HUC12 watershed; the second page of the report summarizes estimated TMDL reductions by HUC12 watershed. Although reductions are reported at the basin scale, for tracking and target setting purposes these reduction targets have been downscaled to a HUC12 watershed scale. These HUC12-scale targets can be compared to reported reductions to assess progress, identify new strategies, and prioritize future funding and management actions.

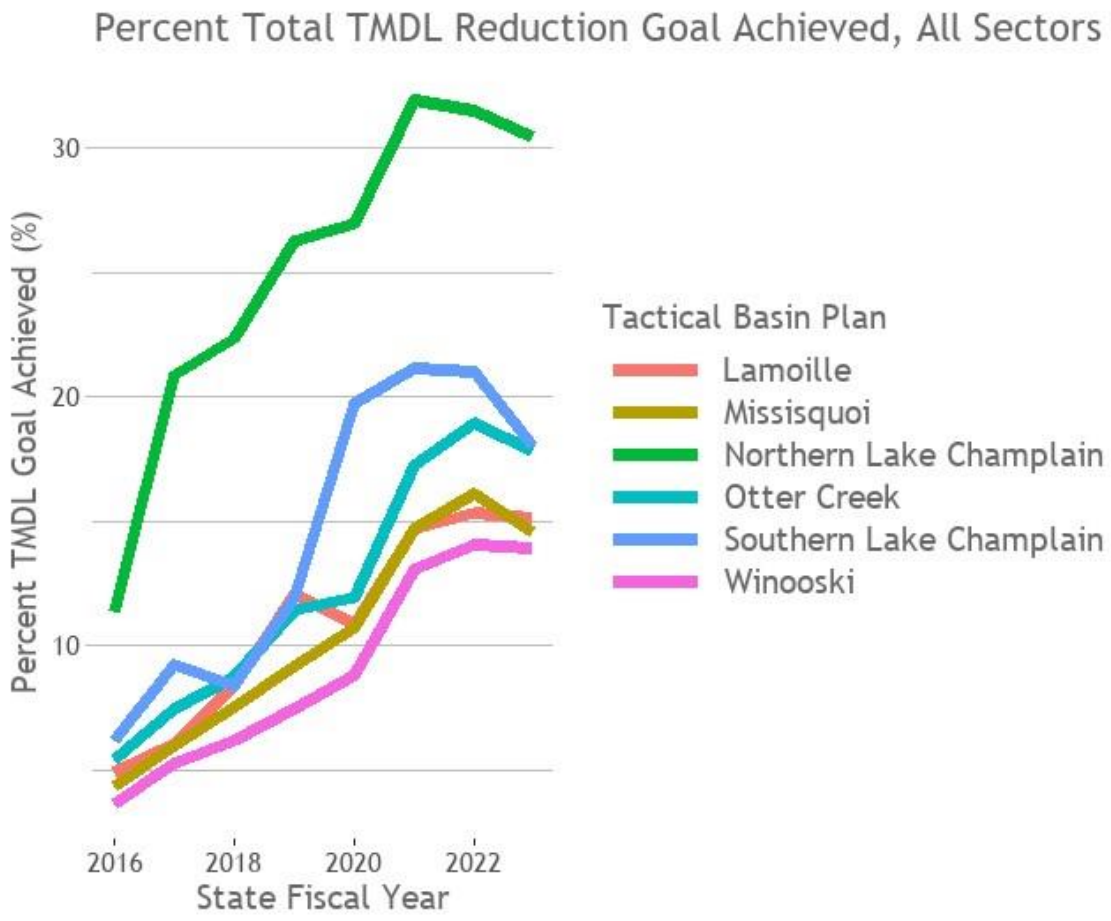


Figure 23. Percent TMDL reduction goal achieved for land-use sectors by tactical basin and state fiscal year.

Summary of P Reductions SFY 2016-2023 by Sector

The TMDL mandates specific TP reduction targets from agriculture, forestry, stream and developed land sectors by 2036 (Table 11). Annual totals are not cumulative, and the same volume of reductions must be achieved every year to meet the 2036 target. Between 2016 and 2023, the annual calculated phosphorus reductions in the North Lake basin have generally increased every year; however, trends have plateaued since then (Figure 24). One exception is the forest land sector, where continual increasing trends, based on AMP compliance, have achieved 314% of its target. Regarding other sectors, agriculture lands met 34.9% and stormwater met 18% of their targets. The sectors showing the least progress included roads at 8.91% and streams at less than 1% of their target (Figure 23).

The North Lake basin's progress compared to other basins (Figure 23) can be attributed to the higher percentage of the TP allotment directed towards agriculture, where reductions have been higher across the state. The lower percentage allotted towards Rivers and Streams also contributes to the basin's progress as these sectors have shown limited TP reductions statewide. The Vermont Clean Water Initiative Annual Reports provide a more detailed explanation regarding sector trends.

6

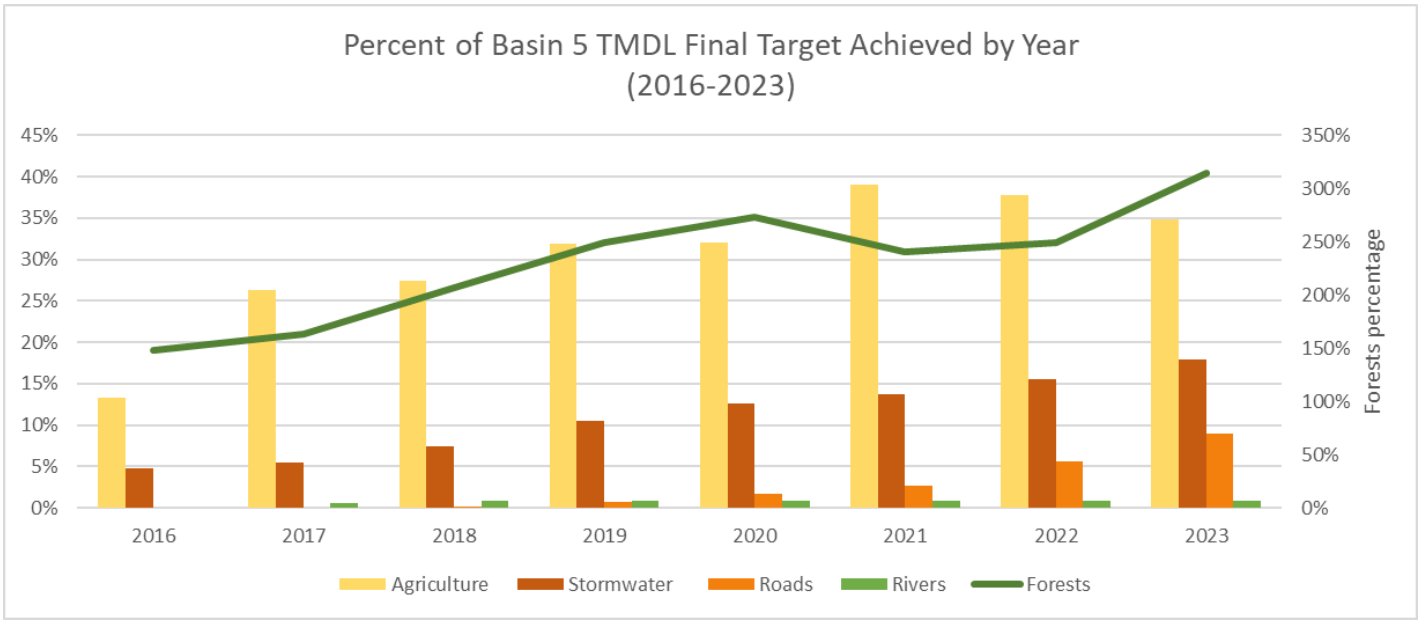


Figure 24. Percent of North Lake basin TMDL final target achieved annually from SFY 2016-2023. The green line depicts forest sector regulatory reductions.

Explanation of Figure 24: The State acknowledges some of the phosphorus reduction gains reported for SFY 2022 have not continued in SFY 2023. Implementation of the TMDL is not a linear path.

Changing rates of progress over the 20-year implementation timeframe are to be expected and are associated with swings in financial assistance levels, and the capacity of agencies and partners to administer funds, implement projects, and report outcomes. In addition, now that many of the low-hanging projects have largely been implemented, identification and implementation of projects that are in some cases more complex and involved, will need to be completed to reach Vermont's water quality goals in the basin. The variability of implementation rates across years also underscores the importance of investing in program and partner capacity to broaden the reach and impact of clean water project implementation. The narrative provides some context to explain TMDL implementation progress by sector.

The Agency expects increases in reductions across all sectors in the next five years and beyond as regulatory compliance continues, additional phosphorus accounting tools are developed, as well as the infusion of ARPA funds and assistance from the CWSP contribute P reductions through increased project implementation.

The following section addresses progress in all land-use sectors, five-year targets, and planned improvements to facilitate meeting those targets.

TMDL Sector Targets: North Lake Basin

A goal of the Phase 3 and subsequent Phases is to refine pollution reductions targets to achieve the load allocations of the TMDL through non-regulatory actions identified in the TBP. This Phase 3 establishes the five-year targets (Table 11). Subsequent phases will report on TP reduction progress towards nonregulatory sources in five-year increments.

In addition to meeting 2036 targets, the Lake Champlain TMDL also requires reporting on TP reduction progress towards nonregulatory sources in five-year increments.

Table 11. The North Lake basin five-year TP targets and final targets for each land-use sector.

The final TMDL target for forest lands has been fully met by regulatory compliance; therefore, no five-year non-regulatory target is provided.

Sector and Category	2028 Target (kg TP/year)	2036 Target (kg TP/year)
Agriculture: Fields/Pastures	2,726	10,992
Agriculture: Barnyard Production Areas	282	1,023
Developed Lands: Stormwater [12]	671	2135
Developed Lands: Roads	275	973

[12] For both Developed lands category: Includes target for non-regulatory projects, or those outside of the MS4, 3 acre and MRGP.

Rivers	0	1516
Forests	0	137

The five-year target setting is obtained by subtracting current-year reduction estimates and any anticipated reductions from regulatory programs from the overall TMDL sector goal and dividing into five-year segments:

$$[5\ year\ target = \frac{TMDL\ target - (current\ SFY\ reduction + regulatory\ reduction\ estimates)}{remaining\ TMDL\ years} * 5] \qquad Eqn\ 1$$

The five-year targets represent a linear estimate that describes how much additional TP should be reduced over the next five years to reach the 2036 TMDL target, given the amount of TP reduction achieved in SFY 2023. The estimate does not include SFY 2024 data but assumes a 14-year period stretching between 2024 and 2036.

The river and forest sectors do not have five-year targets assigned in this Phase 3. The forest targets have already been met through Acceptable Management Practice compliance where forest management is occurring. The rivers are expected to meet targets over a longer time frame than the other sectors, see also below for additional explanation.

The following provides the results from the tracking and accounting efforts as a measure of progress towards meeting phosphorus reduction goals as well as supporting information for developing the five-year targets for agricultural and developed land sectors. Data shown includes up to SFY 2023, so actual achievements as of the printing of this plan may be higher.

Agricultural Sector

The TMDL agricultural reduction target for the North Lake basin is 10,992 kg/year TP, for non-point agricultural field sources and 1,023 kg TP for barnyard production area sources (see Table 11 and the LC TMDL[13]). The reductions to meet the 2036 target will be achieved through Required Agricultural Practices (RAP) compliance (see Table 9) and non-regulatory Best Management Practice (BMP) adoption.

The agricultural community has made substantial progress towards meeting targets. Overall, about 34.9% of the agricultural target was met in SFY 2023 (Figure 25): 80% of the total barnyard

[13] The Lake Champlain TMDL interactive online report breaks the agricultural sector into three classes – field crops (hay and cultivated crops), pasture, and barnyard production practices – for each HUC12 watershed in the Northern Lake Champlain Basin

management target and 26% of the field practice reduction target were met. Field practices (e.g., cover cropping) must be maintained annually to sustain these reductions.

Lake Champlain Agricultural Mitigation, Tracking, and Accounting Efforts

State and federal agencies and partner groups are supporting programs and funding sources to assist the agricultural community's compliance with RAPs or adoption of non-regulatory BMPs (see Chapter 4). Since the 2020 tactical basin plan, two significant contributions to efforts include standing up the AAFM's Pay for Performance program and the additional involvement by partners through the CWSP framework to address 10% of the agricultural phosphorus not met by existing regulatory programs.

To keep track of the work by multiple partners, the Vermont Agency of Agricultural, Food and Markets manages the Multi-Partner Agricultural Conservation Practice Tracking and Planning Geospatial Database (Partner Database)to support phosphorus reduction tracking and accounting efforts by state and federal agencies.

North Lake Agricultural Tracking and Accounting Results

A summary of agricultural tracking and accounting work in the North Lake basin is available in this multi-page interactive online report, which details agricultural land use, BMP implementation, and estimated phosphorus reductions. The data reporting starts in 2016, which represents the start of the 20-year TMDL implementation period[14]. Key data include:

- In SFY 2023, approximately 6,800 acres were *newly* enrolled in at least one agricultural BMP. This acreage represents a decrease from 8,200 enrolled acres in SFY 2022. Cover cropping, manure injection, and conservation tillage were the most common practices in SFY 2023.

- Approximately 4,200 kg of agricultural phosphorus were estimated to have been reduced by BMP management actions in the basin in SFY 2023. This number represents a slight decrease of about 300 kg TP over reductions achieved in SFY 2022. Cover cropping was responsible for the most reductions, followed by conservation crop rotation and manure injection (Figure 25).

[14] Agricultural BMP implementation data represented in the online interactive report is primarily from State and Federal Cost-share programs. Many farms implement agricultural conservation practices without the support of cost-share programs. The state is limited in its ability to capture the water quality benefits of practices implemented outside cost - share programs, and only some of these data are presented in this report.

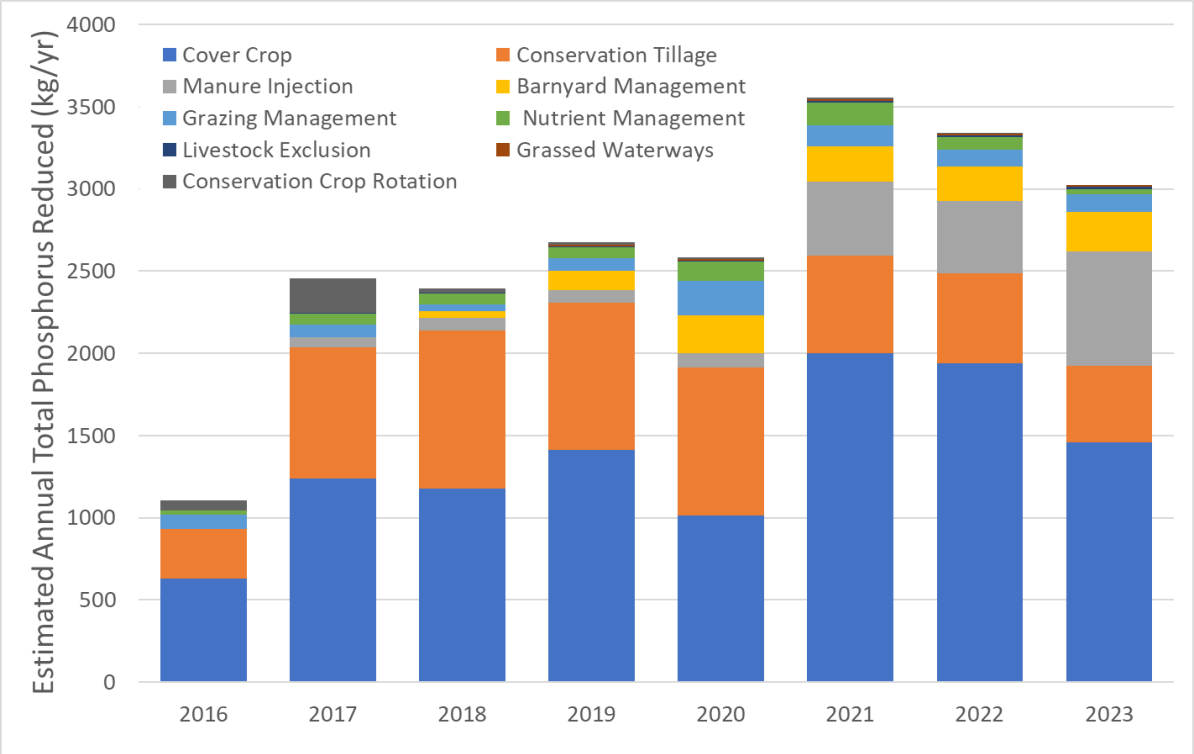


Figure 25. Estimated total phosphorus reductions (kg/yr) from SFY 2016-2023 by agricultural practice. Agricultural practices include crops, pasture and barnyard management.

Agricultural Target Setting

Progress on agricultural reductions in the North Lake basin is summarized in the Agricultural Practice Accounting online report. This report displays estimated reductions and remaining target reductions by HUC12 watershed, as well as the percentage of the TMDL target achieved at the tactical basin scale. This information supports the development of strategies to enhance compliance and BMP adoption (Chapter 5).

Key accounting highlights:

- Basin-wide in SFY 2023, 27.9% of the total barnyard practice reduction goal was met, and 36.1% of the field practice reduction goal was met. The TMDL mandates that 100% of these goals are met by the year 2036. Saint Albans Bay and Lake Champlain HUC12 watersheds have the largest remaining agricultural reductions.

In the subsequent tactical basin plan (2028), progress against the first five-year target will be assessed. The incremental five-year agricultural targets and the information supporting the calculation of the targets (see eqn. 1) follows:

- Based on SFY 2023 data, the remaining agricultural fields and pasture TMDL goal is 7,088 kg TP. An annual cumulative reduction of approximately 545 kg of phosphorus from agricultural field practices is required each year from SFY 2024-2036 to meet the TMDL.

The 5-year reduction target for SFY 2028 is therefore an additional 2,726 kg of phosphorus over what was achieved in SFY 2023.

- Based on SFY 2023 data, the remaining production area TMDL goal is 734 kg TP. An annual cumulative reduction of approximately 56 kg of phosphorus from production areas is required each year from SFY 2024-2036 to meet the TMDL. The 5-year reduction target for SFY 2028 is therefore 282 kg of phosphorus over what was achieved in SFY 2023.

Assessment of Progress

From 2016-2023, the basin achieved roughly 35-40% of the agricultural goal. In the 13 years left in the TMDL, the goal should be achievable if this trend resumes; however, the line has plateaued.

- The slight dip over the last year is not necessarily due to lack of interest from the agricultural community and may be attributable to the following:
- Some practices can only be implemented for a limited number of years to be eligible for cost share. Many programs are also subject to funding caps, which may limit the reported acres of practice implementation.
- Many farms implement agricultural conservation practices without the support of cost share programs. The State is limited in its ability to capture the water quality benefits of practices implemented outside cost share programs, and only some of these data are presented in this report.
- The multi-year federal Farm Bill governs much of the funding available to support agricultural practice implementation. Funds are often limited near the end of a Farm Bill cycle. The most recent Farm Bill was passed in 2018 and is set to expire at the end of the calendar year 2023.
- Agricultural water quality programs have recently expanded in focus and emphasis to include holistic planning and implementation on farms, the results of which may not be fully reflected in available data

Vermont will continue to support and improve on programs described in Chapter 4 to facilitate an increase in rates of BMP adoption and RAP compliance activity by the agricultural community. The state expects to meet the target by working with partners to direct resources and funding delivery based on agricultural activity and P loading potential as well P loading achieved identified in the interactive online report of estimated P loading and reductions. Future efforts expected to work towards decreased P loading from the agricultural sector include:

- Discussions with partners have and will continue to identify how to improve delivery of services to overcome farmer resistance to adoption or to support their continued implementation of a BMP.

- New research into whole farm nutrient management as well as BMPs to reduce tile drain P provide additional tools, see Chapter 4 for additional information.

Another opportunity currently under investigation is the reduction of the agricultural P loading through the diversion of St. Albans Bay's Jewett Brook to a treatment train. The recently completed Phase 2 of the study found the treatment train and a potential location both feasible. Published results 2023 LCBP technical report 85B follow: Assuming seasonal operation (spring and fall) for the proposed Dunsmore 2 Treatment Train, a median total phosphorus removal rate of 286 kg per year (631 lb./yr) at a ballpark cost estimates of $800 per kilogram is proposed.

Developed Lands/Stormwater

Developed lands encompass multiple general land use classes, including urban, residential, and industrial areas, as well as paved and unpaved roads. TMDL phosphorus reduction goals for developed lands are broken down by these general land use classes.

In the North Lake basin, the TMDL reduction goal for developed lands follows: 2,135 kg for non-road developed lands, 588 kg for paved and 385 kg for unpaved roads (see The Lake Champlain TMDL interactive online report).

Vermont expects that regulatory compliance will achieve significant TP reduction with community adoption of nonregulatory practices meeting the remainder. As of 2023, TP mitigation from roads and developed lands achieved roughly 9% and 18% of the TMDL reduction goal for these sectors, respectively. Achieved reductions have been accelerating in recent years and additional reductions are expected over the life of the TMDL as regulatory programs in these sectors get underway (Figure 26).

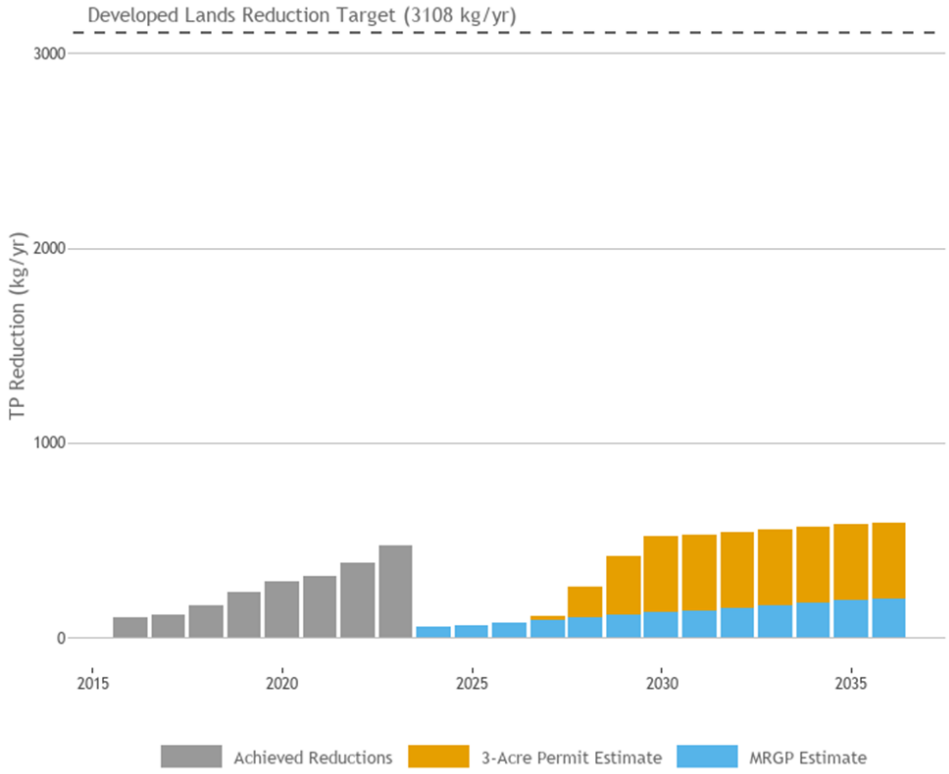


Figure 26. Achieved developed lands TP reductions and anticipated reductions from regulatory stormwater programs. The developed lands reduction target for North Lake basin is approximately 3,108 kg/yr.

Explanation of Figure 26: Estimated phosphorus reductions in the stormwater and transportation related stormwater land-use sectors have been incrementally growing. This progress is associated with increased implementation of several regulatory programs designed to reduce and mitigate stormwater pollution from developed lands and roads. See narrative for description of programs. Regulatory programs are at varying stages of implementation, and continued expansion of compliance will increase estimated phosphorus reductions in future years. Additional methodologies for calculating phosphorus reductions in development will allow P reduction to be attributed to other project types not currently included in the accounting.

Lake Champlain Basin Stormwater Mitigation, Tracking, and Accounting Efforts

Vermont has developed expectations for TP reduction from developed land based on the Municipal Road General Permit (MRGP) and Operational three-acre permit compliance (Table 9 for regulatory descriptions). The Transportation Separate Storm Sewer System Permit (TS4), and the Municipal Separate Storm Sewer Permit multisector (MS4) in addition to other regulatory and nonregulatory

phosphorus mitigation efforts not currently suitable for modeling P reduction expectations will also contribute towards the target (see also Chapter 4).

Total Phosphorus from developed lands that is not addressed by regulatory programs is assigned as a non-regulatory P reduction target to Clean Water Service Provider.

North Lake Basin Stormwater Tracking and Accounting Results and Target Setting

The ANR expects that through the MRGP and Three-acre permits, TP mitigation from both roads and developed lands will achieve roughly 20% of the TMDL reduction goal for these sectors by 2036, see Figure 25 and key highlights), leaving the remainder to be address through other regulatory programs and non-regulatory efforts. The currently modeled reductions of two other regulatory programs, the MS4 and the TS4 towards the target are minimal. In the subsequent tactical basin plan (2028), progress against the first five-year target will be assessed.

By 2036, approximately 600 kg of developed lands TP are expected to be mitigated annually by the MRGP, and 3-acre permit regulatory programs in the North Lake basin. Using *Equation 1*, the five-year target for nonregulatory stormwater and road reductions in the basin was calculated using the above information as well as the SFY 2023 reductions and anticipated regulatory reductions over the five-year target period of 2024-2028 (Table 12).

Table 12. The North Lake basin's five-year developed lands TMDL TP target (SFY2028) for non-regulatory sources. The calculation is based on the remainder of the TP target after anticipated regulatory reductions.

Sector	Anticipated regulatory reductions by 2036 (kg TP/yr)	Remaining nonregulatory reduction's five-year target (kg TP/yr)
Developed Lands: Stormwater	390	671
Developed Lands: Roads	206	275

Key accounting highlights to inform strategy development:

- The TMDL developed lands reduction goal in the North Lake basin is approximately 3,108 kg TP. Reductions from MRGP and Three-acre permit programs are estimated to mitigate about 20% of this amount. Developed lands reductions in SFY 2023 were 471 kg TP.

Assessment of Progress

A significant decrease in developed lands phosphorus loading from nonregulatory projects will be needed from current annual reduction to meet the five-year target. While the reductions associated with regulatory compliance will continue to increase as permit holders meet requirements, the remaining 80% is expected to be addressed through non-regulatory BMP adoption.

The Act 76 framework will provide a boost to nonregulatory project implementation by providing community partners with the resources to leverage their community connection and knowledge towards finding and implementing projects. In 2023, the CWSPs began supporting the implementation of non-regulatory practices needed to meet the interim five-year targets for roads and developed lands and phosphorus reduction achieved through other sector-based regulatory programs. The CWSPs also support operations and maintenance practices to ensure functionality of projects to achieve their expected lifespan.

Additional opportunities to support non-regulatory activity are described in Chapter 4, including stormwater management on private roads.

If the developed lands' P target continues to look challenging during the upcoming five-year performance period, Vermont would consider redirecting P reduction to sectors with less expensive solutions and opportunities for additional project implementation. As the forest sector reductions have been exceeded through regulatory compliance, additional non-regulatory work by the CWSP or other partners could achieve additional P credits.

It is worth noting that the area attributed to roads in the Lake Champlain TMDL Soil Water Assessment model was based on an older land use/land cover dataset and modeling and exceeds more recent and precise estimates of impervious road area based on newer land use/land cover data published by the Lake Champlain Basin Program in 2011 (LCBP 2011). The original larger TMDL road surface area results in larger estimates of phosphorus loading, and associated load reduction potential than current tracking and stormwater permit reduction estimates, which are based on the smaller areas from the Lake Champlain Basin Program 2011 impervious surface analysis. Further analysis based on the Lake Champlain Basin Program 2016 1-meter resolution land use/land cover dataset is expected to further refine the current road surface areas, associated loading, and load reduction potential through MRGP implementation and may provide more clarity on the magnitude of refinement needed. DEC plans to fully evaluate options for how to refine loading estimates and targets in the near term. Reduced road TP loading estimates, and thus reduced TP reduction potential from roads, may require increased reduction from other sectors to meet the overall TMDL goal. Overall, there's uncertainty in the final target for stormwater, although the overall TP reduction for North Lake basin stays the same.

Rivers Sector

The TMDL target for rivers is associated with the river system's progress towards equilibrium and therefore a more stable condition because highly eroding, unstable stream reaches account for most of the phosphorus inputs from river channels.

Excessive channel erosion as an outcome of river instability and lack of floodplain connectivity accounts for 4.45% of phosphorus loading to the North Lake basin. The TMDL reduction target is

1516 kg TP, requiring a 28.9% load reduction, (see Table 10 and The Lake Champlain TMDL interactive online report). As of SFY 2023 8.91% of the goal had been achieved.

Vermont expects to achieve TMDL river sector TP reductions in part through active floodplain restoration activities; however, the primary focus continues to be the protection of river corridors to allow for ongoing channel evolution processes, stream equilibrium, and natural floodplain function through the natural channel forming processes that occur during floods. Much of this will happen because of regulatory compliance, although further research is needed to determine the level of phosphorus reductions that will be achieved. For this reason and the assumption that the progress towards stream equilibrium will take decades, this Phase 3 will not include a five-year reduction target for non-regulatory river restoration.

Lake Champlain Basin River Mitigation, Tracking, and Accounting Efforts

In contrast to the other sectors, ANR expects streambank source loads to decrease over time due to natural stream evolution processes. Therefore, the ANR is focused on actions designed to support and enhance these natural processes rather than on actions essential to achieving the reductions.

Passive restoration achieved through regulation is the primary mechanism to address phosphorous loading due to stream instability. The Rivers Program has estimated that two-thirds of future stream reductions will be achieved through implementation of regulatory programs aimed at restoring stream equilibrium conditions over time. Specifically, regulatory programs that limit new encroachments and channelization practices facilitate larger scale passive restoration as rivers reconnect to floodplains and achieve a stable slope through the channel evolution process. These programs include the stream alteration permit program and flood hazard area/river corridor regulations implemented at the state and local levels.

The potential for regulatory and non-regulatory phosphorus reduction allocation and tracking will be refined with Functioning Floodplains Initiative tools, described below, additional geospatial analysis, and considerations for strengthened regulations that further support the restoration of equilibrium conditions. The remaining 33% of the stream reduction targets were attributed to the CWSP for the implementation of stream restoration and protection projects annually, until such time that the estimates can be refined.

The DEC recently obtained the methodology for attributing phosphorus reduction credits to stream-sector projects as a result of the 2023 Functioning Floodplain Initiative (FFI). In addition, the WID's 2022 Natural Resource Standard Operation Practices and associated Interim Phosphorus Reduction Calculator provide the opportunity to calculate P credits for river and floodplain restoration and protection projects.

The FFI team, including DEC staff and hired consultants, has developed and continues to improve a web-based system for planning and tracking implementation, effectiveness, and value of river and floodplain/wetland restoration and conservation projects. This system allows users to readily access

information and visualize maps developed in prior efforts and is designed to track implementation of projects to understand how progress is being made at different scales towards restoring stream equilibrium, floodplain functionality and flood resilience. The tracking interface will be used to update, and display implemented projects at the site, reach, HUC12 sub-watershed, and basin scales, and provide updated calculations of benefits.

The FFI project establishes a relationship between connectivity score and phosphorus allocation, whereby the higher the connectivity score, the more the phosphorus reduction target is achieved. This relationship demonstrates that repairing the most disconnected reaches may achieve larger phosphorus reduction. In other words, the size of the connectivity credit awarded to a project is commensurate with the degree to which geomorphic equilibrium is restored (see Chapter 4 for additional information).

As a result, DEC is now able to attribute phosphorus credit to river projects associated with stream's progress towards geomorphic equilibrium. This ability to track and prioritize projects will also allow DEC and partners to target resources towards projects where there is the greatest opportunity to achieve improved stream equilibrium conditions and expected phosphorus reductions. More information is available on the Functioning Floodplain Initiative website.

North Lake Basin River Tracking and Accounting Results and Target Setting

The ANR views river equilibrium as a long-term (multiple decades) process that will be achieved primarily through regulatory compliance and therefore has not projected incremental targets for non-regulatory actions. Although the FFI can now be used to attribute phosphorus reduction as well as progress towards equilibrium to river restoration projects, only River Corridor Bylaw regulations are counted in the FFI toward regulatory reductions. No method exists to assign a load reduction to other stream regulations.

With regard to non-regulatory actions, WID has tracked river sector projects and accounted for P reduction as shown below.

Assessment of Progress

In addition to state regulations that support natural processes, the TBP river corridor protection strategies that enhance natural processes include supporting municipalities in adopting and implementing floodplain protection regulations. In addition, TBP strategies support river corridor easement and riparian buffer enhancement and protection opportunities, as well as restoration activities identified in River Corridor Plans and through the Functioning Floodplain Initiative tool.

Flooding that occurred in 2023 galvanized community interest and partner collaboration and will continue to increase implementation of River sector projects to enhance floodplain access. Through continued education by ANR and partners about the benefits of floodplain access towards flood resilience, the community has embraced conservation and other nature-based solutions towards

flood resilience. In addition, FEMA has increased available funding (e.g., CWF contribute the cost-share for buy outs that result in floodplain enhancements).

Progress in other sectors will also contribute to natural stream evolution processes, such as the agricultural sector's riparian buffer protection and animal exclusion activities through RAP compliance.

Funding to support active as well as passive restoration for phosphorus reduction, will now benefit from the FFI's ability to assign TP reductions for existing standard project types, expand phosphorus crediting capabilities for certain rivers projects that don't currently receive phosphorus credit (e.g., river corridor easements and large wood additions), and may retroactively attribute TP reductions to projects already implemented but not fully credited.

From SFY2017-2023, partners in the North Lake basin restored 8 acres of floodplain, reforested 17 acres of riparian buffer, conserved 44 acres of riparian corridor and 56 acres of wetlands through easements, and improved 4 undersized stream crossings, (see Vermont's Clean Water Dashboard Project Output Measures report). However, only a portion of these projects were credited with P reductions to the extent that partners had access and were able to use the new FFI tool. The FFI tool will therefore provide both a re-accounting of past work and an incentivizing of TP efficient rivers projects for formula grant consideration. As part of the engagement strategy, the FFI project team and Agency trained partners on using the tool in spring 2023.

Forestland Sector

Forestlands phosphorus loading is attributed to forest management activities, where loading can be minimized through forest management practices that maintain water quality and minimize erosion.

The TMDL reduction target for the North Lake basin forest sector is 137 kg/yr, requiring a 5% load reduction. The loading reduction estimated to date is 430 kg TP, meeting 314% of the load reduction target (see The Lake Champlain TMDL interactive online report). Although the final target has been met through compliance with Acceptable Management Practices, the Agency will continue to support additional forest BMPs (nonregulatory) implementation.

Lake Champlain Basin Forestland Mitigation, Tracking, and Accounting Efforts

According to the Lake Champlain TMDL, lake segments with at least 5% forest reduction will be achieved via compliance with the 2017 updated Acceptable Management Practices. The regulatory programs and support towards Acceptable Management Practice compliance (see Chapter 4)

In calculating the forest sector reduction, regulatory compliance was associated with enrollment of a forest parcel in the Vermont's Use Value Appraisal (UVA) Program. The program enables eligible private landowners who practice long-term forestry to have their land appraised based on the property's value of production of wood rather than its residential or commercial development value.

To qualify, parcels must contain at least 25 acres that will be enrolled and be managed according to a forest management plan approved by the Vermont Department of Forests, Parks and Recreation (FPR). Parcels enrolled in the UVA Program require application of the Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont to the maximum practical extent possible. Forestland parcels enrolled in the UVA Program are eligible for phosphorus credit if the 10-year forest management plan and compliance work began after the TMDL modeling periods. For the Lake Champlain Basin, this refers to UVA enrollment only after 2010. Previous Phase 3's did not include UVA acreage as part of the P reduction calculation, resulting in minimal forest sector reduction estimates. The ANR is still evaluating the estimated phosphorus reductions assigned to UVA program compliance. This review may result in changes to the estimated forest sector phosphorus reductions related to future UVA program compliance.

The ANR is currently developing the calibration of the phosphorus and sediment accounting methods to estimate load reductions associated with forestland BMP implementation. The completed Phase I of the project included identifying and mapping critical source areas of forestland and establishing a method to estimate the potential for phosphorus and sediment reductions associated with forestland BMPs and Acceptable Management Practices. Phase II is in progress, including the completion of the field verification and ground truthing during the 2023 field season.

North Lake Basin Forestland Tracking and Accounting Results

The Natural Resources Tracking and Accounting Standard Operation Procedures (based on above methodology) was used to support tracking of Acceptable Management Practices compliance and accounting for forest sector reductions. Although no additional BMP work is presently required in the North Lake basin to meet the forest sector target, the Standard Operating Procedures will also allow DEC to start tracking and crediting associated phosphorus reductions to support any future redistribution of phosphorus reductions among the other sectors.

Assessment of Progress

The Agency has undertaken the development of forestlands assessment and planning tools to address phosphorus reductions stemming from forest management activities. Currently, the Agency is coordinating with natural resource consultants, professional foresters, and researchers with the University of Vermont's Spatial Analysis Lab to deploy a basin-wide forest landscape assessment tool to identify critical source areas and erosional features to inform the prioritization framework that will be used to design and implement forestry BMPs. Phase II of this assessment and prioritization project will be used to:

- Develop a framework to field verify and calibrate the Spatial Analysis Lab model's identification of erosion features in critical source areas on forested lands;

- Refine the framework for project prioritization in high priority Lake Champlain basins (Missisquoi and South Lake) to achieve target load allocations for lake segments that won't meet reduction targets through VT Acceptable Management Practices compliance alone; and
- Pilot the project prioritization framework in a representative geographic area.

While the Forestlands Critical Source Area mapping project is currently underway, the Agency has been actively conducting Road Erosion Inventories on state forest roads and will soon be piloting a Trail Erosion Inventory later this year. These assessment tools will then be applicable to private forest road assessments akin to the development of private roads Road Erosion Inventories discussed above and in Chapter 4. With these new tools, the Agency will be better able to support Acceptable Management Practices compliance as well as additional voluntary forestry BMP implementation within the North Lake basin. Additional resources to support nonregulatory activity are described in Chapter 4.

Chapter 4 – Strategies to Address Pollution by Sector

The ANR's approach to remediation of degraded surface waters and protection of high-quality waters includes the use of both regulatory and non-regulatory tools with associated technical and financial assistance to incentivize implementation. Tactical basin plans address water quality by land use sector (Figure 23). Ongoing protection and restoration efforts and recommendations to meet water quality objectives are developed for each sector. These recommendations support the development of the strategies in the Chapter 5 Implementation Table. The Phase 3 content for the

Figure 27. Land-use sector framework with practices used to enhance, maintain, protect, and restore water quality

LC TMDL (see Chapter 3) provides a summary of accomplishments in each of the sectors in terms of progress towards meeting phosphorus-reduction targets. Outcomes of outreach, education and technical assistance are described in the 2023 report card, which will be updated in 2024. The ANR updates funding, projects, and phosphorus reductions by sector for the basin annually in the Clean Water Interactive Dashboard.

A. Agriculture

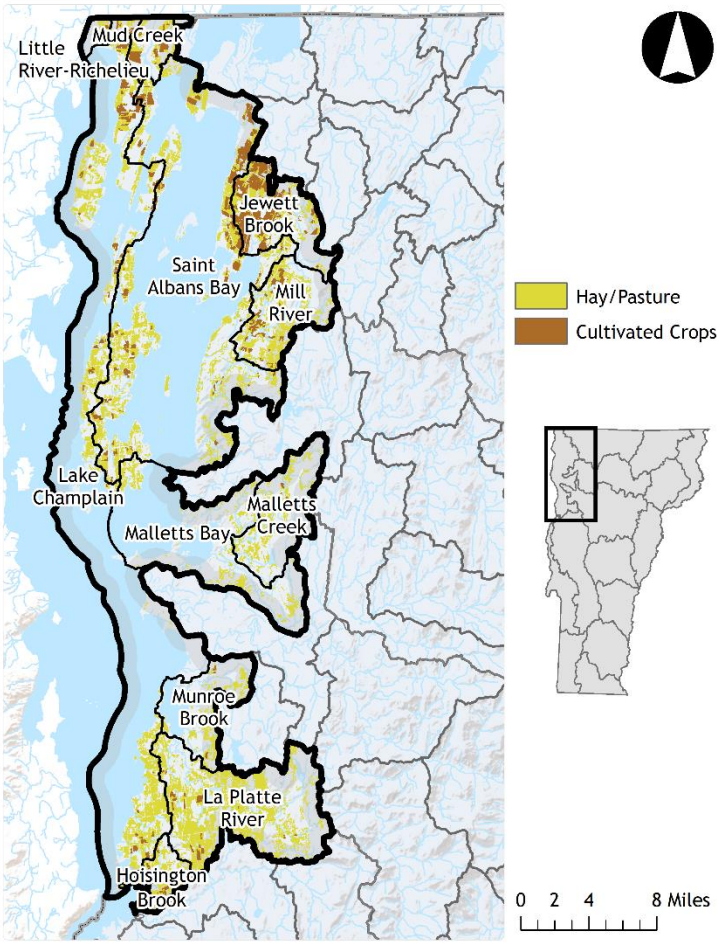


Figure 28. Agricultural land cover in the North Lake basin, see also Figure 29 for more detail.

The agricultural landscape makes up approximately 35% of the North Lake basin and is managed predominantly by livestock and dairy operations to raise animals and grow corn and hay (Figure 6, 31). The subbasins with the highest percentage of acreage in either hay or corn include St. Albans Bay; the Alburg drainage, and Shelburne Bay (Figures 28, 29). Other agricultural operations in the basin grow fruit and vegetables, and more recently, hemp. They also manage forests for sap production. This section will focus primarily on livestock and dairy operations, although strategies will be relevant to other field crops and agricultural operations.

Without proper management of fields and farmsteads, agricultural land use can be a source of nutrients, sediment, pathogens, and toxins to surface waters. Agricultural runoff constitutes 61% of the North Lake basin's estimated TMDL baseline phosphorus loading (kg/yr) to Lake

Champlain, excluding wastewater discharges[15]. Agricultural runoff is also the source of impairment to Holmes Brook, Mud Hollow, and LaPlatte River, either as a source of *E. coli* or cause of aquatic biota degradation (see Chapter 2). The following sections describe regulatory programs and non-regulatory tools that will reduce agricultural runoff and thereby address water resource impairment during this plan cycle.

The Chapter 5 strategies, as outcomes of this section, identify geographic targets including sub-basins with significant remaining TMDL phosphorus reduction goals (Figure 30 and Chapter 3) or agricultural-impaired streams (Table 6). This prioritization directs the work of partners towards waterbodies for the purpose of expediting their recovery and subsequent removal from the 303(d) List of Impaired Waters.

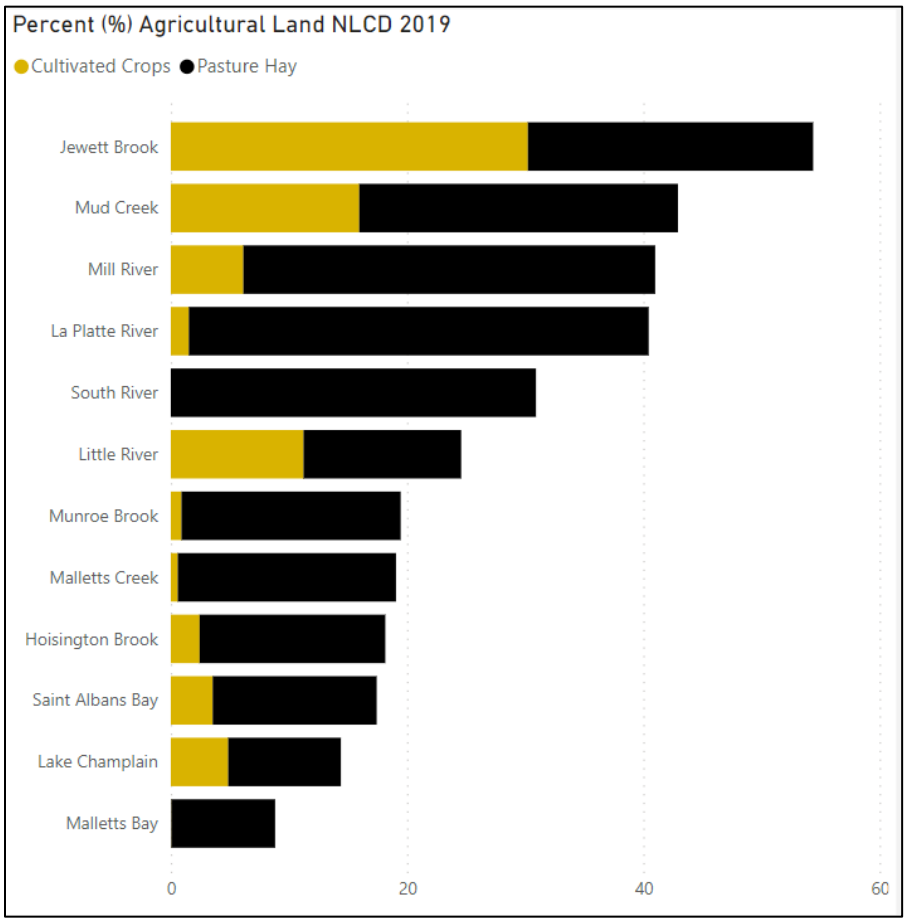


Figure 29. Agricultural land cover in the North Lake basin by HUC 12 watershed**.** Based on the 2019 National Land Cover Database (NLCD).

[15] see Chapter 3, LC TMDL Phase 3 content for LC TMDL phosphorus reduction targets, tracking and accounting methods, and progress towards these P targets since 2016 as well WPP's interactive online report.

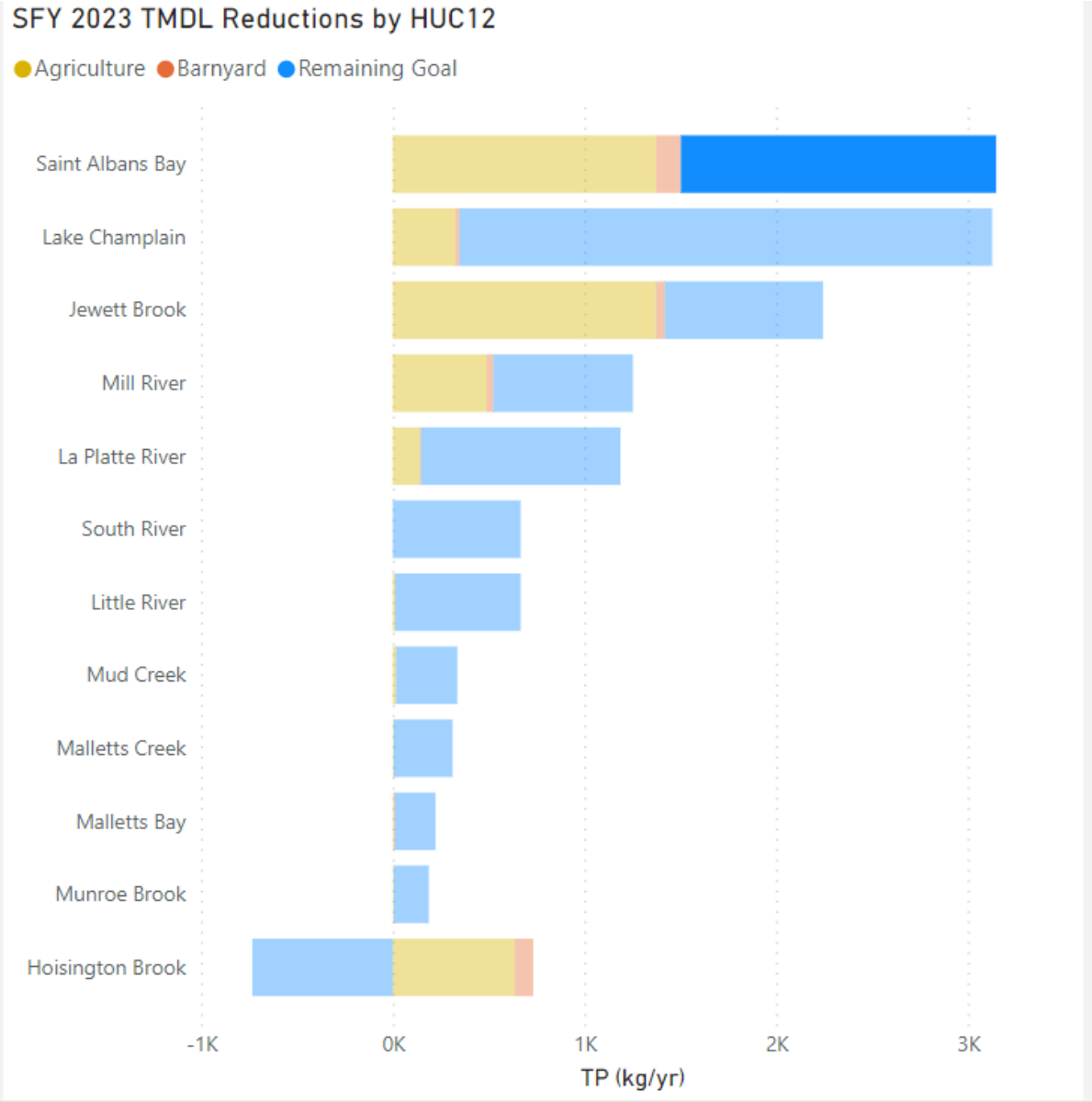


Figure 30. Agricultural total phosphorus (TP) reductions as compared to TMDL targets by sub-watershed (HUC12).

The full length of each bar is the total TP reduction target for that HUC12. Yellow and orange bar sections indicate the TP reduction achieved in SFY2023. The blue bar section indicates the remaining TP goal to reach the total reduction goal. Eight "target watersheds" are a focus of implementation in this basin plan cycle because of large remaining TP goals, see Agriculture section in Chapter 4. The Hoisington Brook watershed is also a target because of bacterial TMDL targets. Note that, for Hoisington Brook watershed, TP eductions achieved (yellow bar) have surpassed the LC P TMDL target resulting in a negative remaining goal (blue bar).

Regulatory Programs

Vermont Agency of Agriculture, Food, and Markets (AAFM) regulatory programs work towards protecting surface waters by requiring baseline farm management practices to ensure environmental stewardship. The revisions of the Required Agricultural Practices (RAPs) in 2016 and 2018 aim to reduce nutrients such as TP and nitrogen entering state waterways. The RAPs apply to different types of farms, farm sizes and farming activities. In addition to the RAPs, Vermont Large Farm and Medium Farm Operations are regulated by additional sets of rules promulgated by the AAFM.

There are currently three permitted Large Farm Operations and 11 Medium Farm Operations in the basin. The farms may include multiple facilities in different locations, and all are in dairy production. Large farms are inspected annually, and medium farms are inspected once every three years by AAFM. These farms must comply with the Required Agricultural Practices (RAPs), Large Farm Operation Rule and Medium Farm Operation permitting program requirements as applicable, and the VWQS.

An estimated 21 Certified Small Farm Operations are required to certify compliance with the RAPs annually and will be inspected at least once every seven years by the Agency. The AAFM estimates there are 114 Small Farm Operations in the basin that do not meet the thresholds of a certified small farm and are not required to receive a routine inspection by AAFM, but still need to comply with the RAPs. Outreach provided by AAFM, and partners will continue to help landowners understand where they fall within the RAP farm categories and the RAP requirements.

Generally, CSFOs, MFOs, and LFOs are concentrated in the northern half of the North Lake basin in the St. Albans Bay, Jewett Brook, and Mill River HUC12 watersheds, with additional CSFOs and SFOs concentrated in the Lake Champlain, La Platte River, and Mallets Bay HUC12 watersheds.

AAFM regulatory programs support farmers to ensure their clear understanding of the RAPs and program rules, while helping assess, plan, and implement any conservation and management practices necessary to meet water quality goals. Inspections by AAFM include assessments of farm nutrient management plans, production area assessments of all facilities associated with the permitted or certified operation, and cropland management assessments in accordance with RAPs and permit rules as applicable. The regulatory farm inspections, technical assistance and outreach provided to farms has supported their SFY2023 73% production areas compliance rate in the basin(see AAFM's Water Quality Interactive Data Report for additional data on farm inspections, compliance and enforcement action.)

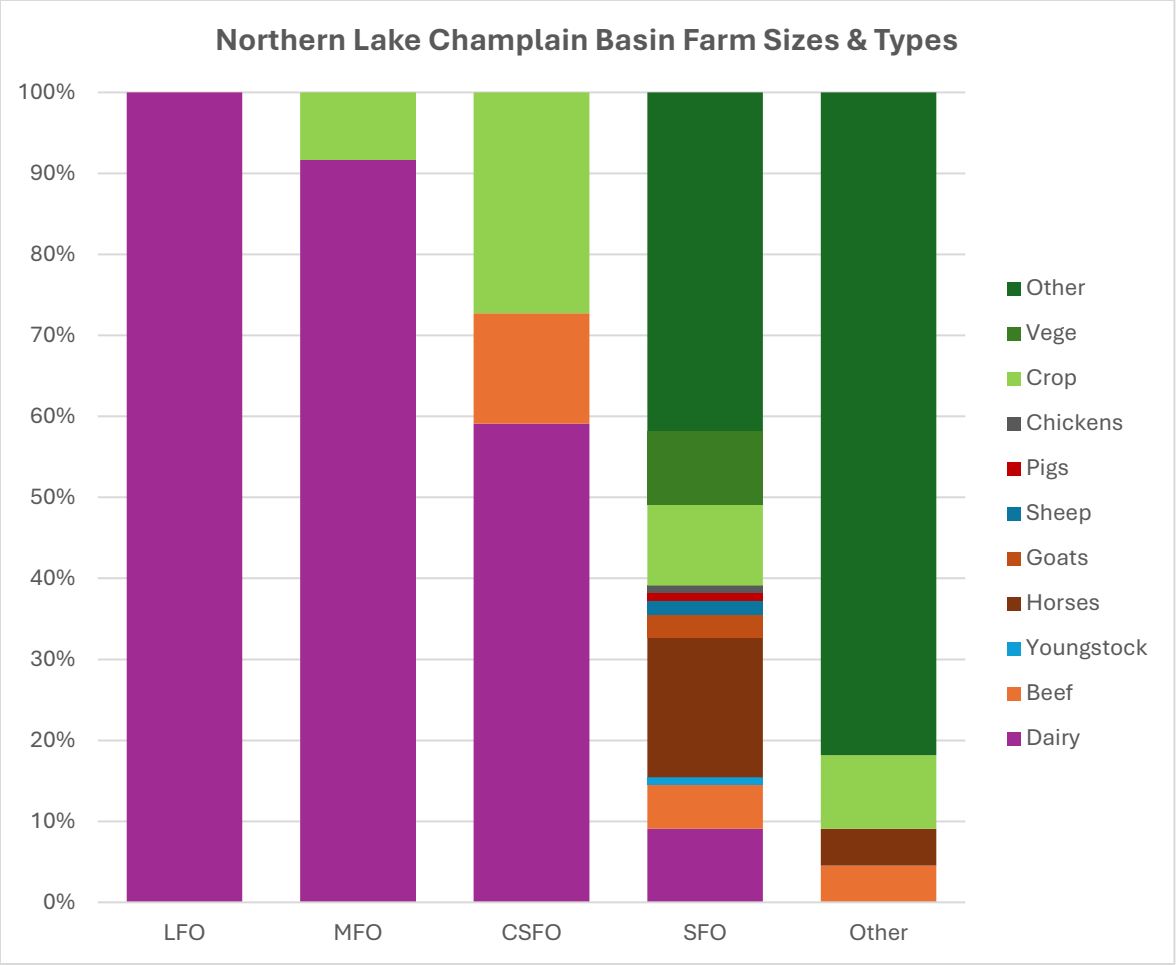


Figure 31. AAFM data January 2024.

Technical and Financial Assistance

The AAFM and agricultural partners provide agricultural producers with technical and financial assistance to facilitate compliance with water quality regulations as well as the voluntary adoption of conservation practices. In the North Lake basin, the partners include Franklin County, Grand Isle County and Winooski Natural Resources Conservation Districts, UVM Extension, and the Natural Resources Conservation Service (NRCS). In addition, the Franklin and Grand Isle Farmers Watershed Alliance , Champlain Valley Farmer Coalition, and Friends of Northen Lake Champlain support farmer-led discussions and collaboration to address gaps in funding and technical assistance.

The AAFM and NRCS -funded programs financially support farmers to implement Best Management Practices (BMP) and partners to provide outreach, education and technical assistance to facilitate the farmers' adoption of practices or regulatory compliance. The BMPs include field practices such as cover cropping, crop rotation, and reduced tillage practices, and farmstead practices, such as waste storage facilities or clean water diversion practices. These agricultural

assistance and outreach programs have successfully promoted BMPs in the basin that protect water quality, improve soil health, and increase farm viability. See AAFM's Water Quality Interactive Data Report and the Clean Water Initiative Annual Reports for data related to BMP implementation and assistance and outreach programs in the Basin

Programs since the last planning process that have enhanced opportunities for farmers to reduce agricultural loading include:

- Stewardship programs that assess entire farm, including Pay for Performance Program (VAAFM), and Conservation Stewardship Program (NRCS)
- Nutrient Management Planning and Whole Farm Nutrient Management – Efforts to provide education, outreach and technical assistance for farms developing and implementing Nutrient Management Plans over the past 8 years is progressing to voluntary enhancements in planning and implementation such as incorporating precision agriculture methods and technology, and whole farm nutrient management.
- End of tile drain treatment practices – studies supported by the LCBP, and outreach helps to support implementation, but additional strategies to encourage implementation is needed

In addition to traditional agricultural funding, Act 76 formula grants can fund agricultural practices on non-RAP farms in the watershed via the Clean Water Service Providers. Non-RAP farms are generally farms that are less than 4-acres, or do not file a 1040(F), or make less than $2,000 annually from the sale of agricultural products. These farms are very small in scale but there may be significant TP loading if best management practices are not in place. Moreover, costs for practices to reduce TP loading from these farms may be lower than stormwater treatment type practices. To date, although potential projects have been identified, the Basin 5 CWSP has not yet received any formula grant applications for the agricultural sector. The lack of applications may be due to the following factors: a) the prioritization of other existing funding programs by agricultural partners for water quality and conservation work on RAP-regulated farms, b) the small scale of non-RAP farms resulting in projects with limited P reduction, and c) most project implementers have limited capacity and knowledge to identify and develop these projects.

Enhancing Partnerships

AAFM and partners provide educational opportunities and technical assistance to farmers to promote and assist with conservation practice adoption. The Northern Lake Champlain Direct Drainages (Basin 5) TMDL Implementation 2023 Progress Report included as Appendix B in the Vermont Clean Water Initiative 2024 Performance Report describes the educational events and technical assistance provided by partners between SFY 2021 and 2023.

The AAFM assists with funding and coordinating agricultural partners throughout the watershed to streamline outreach to farmers where multiple resources may be available. One tool includes the

Multi-Partner Agricultural Conservation Practice Tracking and Planning Geospatial Database (Partner Database).

Partner coordination is also supported by the Vermont Agricultural Water Quality Partnership (VAWQP). The coalition of state and federal organizations is dedicated to improving agricultural water quality in Vermont by coordinating partner efforts to provide education, technical and financial assistance to the farming community. The Partnership collaborates to strategically leverage unique resources, funding mechanisms, technical expertise, outreach techniques, and more.

In the North Lake basin, the VAWQP supports the Franklin County and Winooski Natural Resources Conservation Districts to facilitate regional coordination and partner workshops. VAWQP discussions support enhanced partners understanding of resources available to farmers, especially for non-traditional or emerging programs. Partner and resource coordination, like Franklin County Natural Resource Conservation District's Guide to Assistance for Agricultural Producers and Farm Teams model, play an important part in farm's accessing programs promoting BMP implementation.

Partners are also developing resources for new farmers, small-scale farmers, and under-served and marginalized farmers to improve equity in agricultural funding opportunities in the basin. The challenge is identifying and targeting them for outreach on available programs. A capacity building project to support diverse and new farming audiences, spearheaded by UVM Extension's New Farmer Project and the Women's Agricultural Network, is an example effort addressing this need via the participation of 24 agricultural service providers.

The North Lake TBP recommendations and resulting strategies are based on modeling that supports the identification of where BMPS would be best located to achieve optimal phosphorus reductions. In addition, through multiple meetings held during the tactical basin planning process, partners have contributed information regarding barriers as well as incentives that affect the community's rate of BMP adoption. These partner discussions identified the following opportunities to improve delivery of technical and financial assistance towards the advancement of agricultural water quality work. The opportunities are organized under 4 themes that are also associated with a Chapter 5 Implementation Table (Table 17) strategy:

- Support RAP Compliance: focus on NMP Development and Implementation (Strategies 1, 8)
    - Focus education, outreach and technical assistance with CSFOs and SFOs, including NMP implementation technical assistance.
    - Encourage small farm NMP implementation through discussion of co-benefits that would be of interest to the farm.
    - Improve the accuracy of NMP implementation on Large and Medium Farm Operations by providing training to NMP Technical Service Providers, Agricultural

Consultants, and custom manure applicators in addition to implementation of the State's Technical Service Provider Rule (anticipated 2024).

- Support Field BMP Implementation: improve water quality, soil health, crop yields and crop resiliency (Strategies #2-6)
    - Provide education, outreach, on-farm technical assistance and financial assistance to support field BMP adoption and implementation
    - Reduce cost through collaborative equipment sharing among farms and equipment cost share by AAFM and others
    - Utilize the whole farm approach to assess, identify, and prioritize BMPs as well as identify and access appropriate cost-share programs.
- Support Soil Health Improvements: improve water quality and reduce erosion (Strategies #1-5, 10)
    - Plan and implement practices that promote soil health, minimize soil erosion, and meet the NRCS 590 NMP Standard and RAP Requirements[16]
    - Reduce erosion by encouraging appropriate best management practices based on the context of the farm and field. In Basin 5, this may include
        - Protection of grassed areas in erosion prone areas when farm coverts back to corn from hay
        - Reduction of soil compaction in heavy soils by encouraging cover crop and low tillage practices on cropland and rotational grazing and fencing on pastures
- Support Collaboration: enhance outcomes of outreach and technical assistance activities among partners and farmer organizations (Strategies #5-9)
    - Identify gaps in agricultural community information needs
    - Coordinate efforts to distribute information in both directions between farmers and state, federal, local and other organizations and agencies and identify effective approaches like "kitchen table" sessions.
    - Address partners and farmer collaborative training needs

[16] Language included in the AAFM NMP standard and RAP language: "Cropland shall be cultivated in a manner that retains soil in the field and promotes soil health while minimizing visible erosion into buffer strips, across property boundaries, or that creates gully erosion."

B. Developed Lands

The Agency of Natural Resources considers developed lands to include hard or impervious surfaces like parking lots, sidewalks, rooftops, and roads. Stormwater runoff from developed lands is a significant threat to water quality in Vermont. Stormwater runoff is any form of precipitation that flows over the land during or after a storm event or snowmelt. Along this route, stormwater picks up and carries pollutants with it to the waterbodies it enters. On undeveloped lands, such as forests and meadows, a portion of this runoff is absorbed into the ground through infiltration while the rest takes a relatively slow path to nearby rivers, lakes, and ponds. On developed lands, however, infiltration is reduced by impervious surfaces, which increases the velocity and volume of runoff into rivers and lakes. This leads to an increased frequency and intensity of flooding, scouring and erosion of stream channels, as well as a greater likelihood that runoff will carry pollutants to surface waters. The result is property damage, degraded aquatic and terrestrial habitats, and threats to public health via contaminated drinking water and polluted waterbodies used for recreation.

Developed land occupies approximately 13% of the basin, the highest percent of any other Vermont basins, with the highest concentrations in Chittenden counties' Shelburne Bay and Burlington Bay drainages, followed by Malletts Bay and St. Albans Bay drainages (Figure 3.) These drainages include eight streams that are impaired by stormwater, where excessive flow is a significant source of the degradation. In addition, Malletts Bay direct drainages are impaired due to bacteria, a stormwater contaminant. Another contaminant, Chloride, contributes to the impairment of Shelburne and Burlington Bay drainages (Figure 17 and 18). Phosphorus loading from developed lands account for approximately 38% of all phosphorus loading from the basin to Lake Champlain. The Phase 3 TMDL portion of Chapter 3 above provides additional detail on the quantitative TMDL TP reduction targets, tracking and accounting methods, and progress towards these TP targets since 2016. Managing stormwater to reduce both flows and contaminants as well as reducing the use of contaminants are the primary goals of developed land strategies. The following sections describe regulatory programs and non-regulatory tools to address stormwater runoff to surface waters during this plan cycle.

Stormwater

The tactical basin planning approach engages local, regional, and federal partners in the development of strategies needed to accelerate adoption and monitoring of stormwater-related Best Management

Practices (BMPs) to meet the state's clean water goals and TMDL targets. Basin stakeholders have been actively participating in voluntary actions and implementing priority projects and municipalities are working on meeting regulatory requirements and are working to remediate identified discharges.

Stormwater mapping, Indirect Discharge Detection and Elimination studies and Stormwater Master Plans are the tools used to identify stormwater actions needed to address stormwater-related water resource impairments.

Regulatory requirements 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 permits for developed lands include:

- Operational Stormwater Permits
- Construction Stormwater Discharge Permits
- Municipal Separate Storm Sewer System (MS4) General Permits
- Multi-Sector General Permit (Industrial)

Municipal Separate Storm Sewer System (MS4) General Permit

Designated municipalities that discharge to stormwater impaired waters must manage stormwater runoff from municipally owned or controlled impervious surfaces through the Municipal Separate Storm Sewer System (MS4) Generalpermit. MS4 permittees develop Stormwater Management Programs to comply with the six Minimum Control Measures. They develop 1) public education and outreach plans, 2) public involvement and participation activities, 3) illicit discharge and elimination programs, 4) regulations for construction site stormwater runoff, 5) regulations for post-construction stormwater management, and 6) good housekeeping programs. In addition to the six Minimum Control Measures, the MS4 General Permit also requires compliance with the Stormwater Impaired Waters TMDLs and the Lake Champlain Phosphorus TMDL. DEC has developed initial estimated TP load reductions to the North Lake basin expected through MS4 General Permit compliance as reported in Chapter 3 Phase 3 content (see Figure 26).

The municipalities and organizations in the Northern Lake Champlain Basin subject to an MS4 permit are listed from north to south as follows: City of Saint Albans, and towns of Milton, Colchester, Essex, Cities of Essex Junction, Burlington and South Burlington and towns of Williston and Shelburne. In addition, both the University of Vermont and Burlington International Airport are MS4s.

The North Basin MS4-designated municipalities have developed Flow Restoration Plans to achieve the Stormwater TMDLs, and/or Phosphorus Control Plans to achieve the Lake Champlain TMDL phosphorus reduction targets (see Table 13). The Phosphorus Control Plans include both town-wide

retrofits to stormwater systems to enhance phosphorus removal and the implementation of municipal road upgrades and stabilization to meet the requirements of the Municipal Road General Permit standards contained within their MS4 permits

In MS4 communities where a Chloride-impaired waterbody has been documented (South Burlington, Burlington, and Shelburne) the municipalities, 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.

Together, Phosphorus Control Plans, Flow Restoration Plans and Chloride Response plans are integrated into each MS4 community's Stormwater Management Program Plan and progress made on each are reported to ANR annually. As of the writing of this plan, all MS4 communities are in compliance.

Stormwater General Permit 3-9050 (Three-Acre General Permit)

General Permit 3-9050 addresses runoff from impervious surfaces. This permit covers all operational stormwater permitting, including new development, redevelopment, and permit renewal. It serves as the statutorily required "Three-Acre General Permit" under the Vermont Clean Water Act. Parcels in the Lake Champlain watershed, including the North Lake basin, will need to apply for permit coverage by 2023. Vermont's Stormwater Program maintains a list of three-acre properties identified as of September 2020. Basin wide, approximately 190 sites cover about 1353 acres (Table 13).The top 3 municipalities containing the highest estimated acreage of three-acre sites are Burlington, South Burlington, and Shelburne.

To accelerate permit compliance, the Agency is presently making available grant funding in the form of rebates for individual landowners. In addition, the MS4 Community Formula Grant program is designed to assist MS4 communities with 3-acre and other permit compliance. The funding will help reduce negative water quality impacts through the design and implementation of stormwater and roads projects and make progress toward phosphorus reduction targets outlined within the grantees' phosphorus control plans. The appropriation has been fully allocated and there will be no call for future awards. Most of the MS4 grants are made of a combination of American Rescue Plan Act, ARPA dollars and state clean water fund dollars, with the grantee contributing leverage equal to 20% of their total award amount. The projects must be completed by August 2026, when ARPA funding will run out. Additional assistance to communities is provide by the Green Schools Initiative, which was developed specifically to address public schools three-acre sites, see additional information below.

As of July 1, 2022, projects that expand or redevelop one half-acre (0.5 acres) or more of impervious surface are required to apply for stormwater operational permit coverage. Additional information on the ½ acre threshold can be found on the stormwater program website.

Table 13. Estimated three-acre parcels and associated impervious cover for North Lake basin towns. (2024 data for Chittenden County and 2020 data for Grand Island and Franklin Counties). Towns with an asterisk have a school with a three-acre parcel, see Green Schools below and the list here:

Town	Estimated # of Parcels	Estimated Acreage	Town	Estimated # of Parcels	Estimated Acreage
Alburgh	1	9	**Hinesburg***	10	56
Burlington*	25	168	**Milton**	5	59
Charlotte*	6	21	**Shelburne***	23	147
Colchester*	14	72	**South Burlington***	31	247
Essex Town*	8	45	**South Hero**	1	20
Georgia*	2	12	**St. Albans city***	20	121
Grand Isle	2	12	**St. Albans Town**	22	193

Green Schools Block Grant

DEC has funded a Green Schools Funding Initiative to assist schools in the Lake Champlain and Memphremagog meet compliance with the state's Three-acre permit. During Phase 1, the funding program administrator, GreenPrint Partners, worked to help participating schools obtain permit coverage and complete stormwater designs. Of the roughly 61 schools seeking three-acre permit obtainment, all are successfully moving towards obtaining permits, with 37 issued and 15 under review and nine expected to be permitted by March 2025.

Phase 2 is currently underway and is focused on supporting construction with DEC's $18.29 million dollars. GreenPrint Partners is helping the majority of schools, who have requested funding, implement permitted designs. Although the permit's notice of intent provides a five-year timeframe for schools to construct the permitted stormwater management practices, it's the goal of the Green Schools Initiative to construct the stormwater management practices before the end of 2026. In the summer of 2024, seven schools have scheduled construction, including the following North Lake basin schools: Charlotte Central, Burlington's Lyman Hunt schools and St. Albans BFA Fairfax.

In the North Basin, the 14 school sites requiring a permit in the North Lake basin cover 114 acres across the towns included in Table 13 and can be found at the GreenPrint Partners website[1].

The Green Schools Initiative partners with Lake Champlain Sea Grant to provide schools with watershed and stormwater lesson plans as well as training for students and teachers. Additionally, Lake Champlain Sea Grant will help schools identify ways to maximize the benefits of green stormwater projects, such as creating pollinator habitat and outdoor classrooms.

Stormwater Mapping and Master Planning

Stormwater infrastructure mapping projects are completed for municipalities by the Clean Water Initiative Program to supplement any existing drainage data collected by towns with the intention of 'providing a tool for planning, maintenance, and inspection of stormwater infrastructure. Town reports can be found by clicking on the town on the left side of the municipal stormwater website. The ANR has completed all needed stormwater mapping in the basin.

The reports and maps for each town provide an overall understanding of the connectivity of the storm drainage systems on both public and private properties, raise the awareness of the need for regular maintenance, and identify potential stormwater retrofit opportunities. These reports identify potential priority projects and provide information necessary to develop a stormwater master plan (SWMP).

While the MS4 communities develop plans to identify stormwater management projects to meet a phosphorus and flow targets, municipalities without the regulatory obligations are offered the opportunity to develop Stormwater Master Plans. They are developed collaboratively with municipal and public involvement and further prioritize projects identified in initial mapping efforts, offering a strategic approach to voluntarily address stormwater runoff in the plan focus area. Stormwater master planning has been completed for 3 municipalities in the basin (Table 14). Plans are available at DEC's Stormwater Infrastructure Mapping Directory.. The ANR will make recommendations or support proposals as appropriate for additional SWMPs. Stormwater Master Planning in the Lake Champlain Basin is currently funded through CWSP Formula Grants.

Priority areas for financial and technical assistance to manage stormwater discharging in near proximity to public beaches serving disadvantaged communities.

Table 14. North Lake basin municipalities with Stormwater Master Plans (SWMP) or Flow Restoration Plans (FRP).
Town-wide SWMP projects could include more than one watershed. Visit the Stormwater Infrastructure Mapping Directory to access town-specific stormwater mapping reports and master plans. Some reports are not included if completed outside the North Lake basin.

Town	SWMP / FRP	Date (SWMP)	Projects Identified
Burlington	Englesby Brook FRP		29
Burlington	Potash Brook FRP		1
Essex Junction	Indian Brook FRP		9
Essex	Indian Brook FRP		4
Vt. Agency of Transportation (VTrans)	Indian Brook FRP		2
Essex/EJ/VTrans	Indian Brook FRP		2
Milton	Town-wide SWMP	2019	65
Shelburne	Munroe Brook FRP		25
VTrans	Munroe Brook FRP		2
South Burlington	Munroe Brook FRP		2
South Burlington	Bartlett Brook FRP		7
University of Vermont	Bartlett Brook FRP		2
VTrans/private	Bartlett Brook FRP		1
South Burlington	Englesby Brook FRP		3
South Burlington	Potash Brook FRP		96
UVM	Potash Brook FRP		3
BTV Airport	Potash Brook FRP		1
VTrans	Potash Brook FRP		6
St. Albans Town	Stevens Brook FRP		5
St. Albans City	Stevens Brook FRP		11
St. Albans Town	Rugg Brook FRP		15
St. Albans City	Rugg Brook FRP		5
St. Albans Town*	Town-wide SWMP	2015	39
Alburgh	Town-wide SWMP	2015	14
Georgia*	Town-wide SWMP	2013	21
Swanton*	Town-wide SWMP	2013	28

Illicit Discharge Detection & Elimination Studies

Illicit discharges are discharges of wastewater or industrial process water into a stormwater-only drainage system. In addition to the MS4ts's, the following towns have completed IDDE studies: Alburgh, Hinesburg, St. Albans Town and South Hero. The study outcomes are included in each of the linked reports[17]

Most of these illicit discharges have been identified and eliminated. Where sources were difficult to locate, compliance was difficult, or the infrastructure was no longer in use, follow-up actions are identified in the reports. This plan recommends following up on any outstanding issues identified in IDDE studies or retesting outfalls that had inconclusive results.

Municipal Stormwater Outreach and Education

Many of the stormwater issues associated with developed lands can be prevented or mitigated using Low Impact Development and Green Stormwater Infrastructure systems and practices. These concepts strive to manage stormwater and pollutants by restoring and maintaining the natural hydrology of a watershed. Rather than funneling stormwater off site through pipes and infrastructure, these systems (gardens or permeable materials) focus on infiltration, evapotranspiration, and storage as close to the source as possible to capture runoff before it gets to surface waters.

The Vermont Green Infrastructure Toolkit is a project of the ten Regional Planning Commissions of the Vermont Association for Planning and Development Agencies and the Agency of Natural Resources' Water Investment Division. The toolkit is a clearinghouse of information useful to municipalities to promote the adoption of Green Infrastructure policies and practices to combat the problems caused by urban, suburban, and rural stormwater runoff.

To further enhance green infrastructure knowledge and capabilities of municipalities and contractors, DEC partners with Lake Champlain Sea Grant in the Green Infrastructure Collaborative. This partnership aims to bridge the gap between research, extension, and application of green stormwater infrastructure in Vermont. The Green Infrastructure Collaborative currently focuses on promoting best practices for operation and maintenance of GSI and hosting trainings. A listserv is used for information sharing between hundreds of professionals.

Residential Stormwater Outreach and Education

Voluntary actions by individual landowners and residents can also reduce local stormwater runoff issues if adopted at scale. Several outreach campaigns have been developed and implemented

[17] The most up to date Illicit Discharge Detection and Elimination Studies are linked to the following webpage: https://dec.vermont.gov/watershed/cwi/manage/idde

regionally and in the North Lake basin specifically to encourage practices like reducing lawn mowing and fertilizing, using permeable pavers, redirecting downspouts, picking up pet waste, lessening salt application, and installing rain barrels. Nationwide, the Environmental Protection Agency provides general Stormwater Smart Outreach Tools to promote sound stormwater management.

Regionally, Lawn to Lake is a collaborative program promoting healthy lawn and landscape practices to protect water resources in the Lake Champlain Basin. To date, their campaigns have included efforts to reduce phosphorus runoff from lawns ("Don't 'P' on Your Lawn) and improve soil health and stormwater infiltration by increasing grass height on lawns ("Raise the Blade").

Likewise, Rethink Runoff is an ongoing awareness and public outreach effort to reduce sediment and pollutants in stormwater runoff certain areas of Chittenden County in the Lake Champlain Basin. The program, managed by the Chittenden County Regional Planning Commission and the Winooski Natural Resources Conservation District, assists the nine several municipalities and three entities in Chittenden County in complying with Minimum Control Measures #1 and #2 of their MS4 permits with federally required stormwater permits. Rethink Runoff produces and places media advertisements promoting good residential and business stormwater treatment techniques and offers online stormwater education materials, hosts workshops on residential stormwater topics, and manages volunteer programs for storm drain cleaning, stream clean ups, rain garden maintenance, and water quality monitoring (the Stream Team). A 2023 public Rethink Runoff survey indicates where residential stormwater management behaviors have improved, lapsed, or stayed constant over the past 20 years and hints at stormwater practices where messaging could be improved.

The Friends of the Mad River developed the Storm Smart program to work with property owners in the Mad River Valley to reduce stormwater flow to local roads and rivers. Storm Smart offers online educational materials and free on-site assessments to determine simple steps residents can take to reduce runoff from a property. The Winooski Natural Resources Conservation District and Friends of the Winooski have expanded the assessments into the North Lake basin.

The City of Burlington's BLUE BTV program similarly assesses properties and recommends stormwater practices for residents interested in reducing pollution from stormwater runoff. Lake Champlain Sea Grant also partners with the Town of Williston to offer this program. Residents who implement practices recommended by BLUE are eligible for rebates commensurate with the area of impervious surface managed by the practice.

Lewis Creek Association's Ahead of the Storm program showcases examples of optimal conservation practices for stormwater management. It provides resources to landowners to help them assess and understand where problems might be occurring on the land, and what opportunities there are to improve these areas.

This plan encourages the continued promotion of these outreach campaigns using lessons learned from the 2023 survey or others. Where appropriate, campaigns may look to coordinate efforts to

streamline outreach to residents, integrate materials from related campaigns to attract broader audiences (e.g., campaigns with a fish, wildlife, or pollinator habitat focus), employ social marketing techniques to promote adoption of stewardship techniques, or collaborate to develop messaging unique to North Lake basin residents.

Roads

Where road networks intersect stream networks, roads and their ditches effectively serve as an extension of the stream system. Roads can increase stormwater runoff, and, in this basin, unpaved roads are an important source of sediment and phosphorus to receiving waterbodies. In the Lake Champlain TMDL, unpaved roads are estimated to contribute 29.6% of the phosphorus loading from the developed lands sector. Roads can impinge on stream floodplains and be a barrier to aquatic organism passage due to undersized or perched culverts. In addition, winter management of roads contributes chlorides to surface waters.

Tactical basin planning engages local, regional, and federal partners to accelerate the implementation of transportation-related practices to meet the state's clean water goals. Two regulatory programs, theMunicipal Roads General Permit (MRGP) and the Transportation Separate Storm Sewer System Permit (TS4) are driving road water quality implementation efforts in the basin.

Municipal Roads General Permit

Road Erosion Inventories (REI) are used by Vermont municipalities to:

- identify sections of local roads in need of sediment and erosion control,
- determine individual road segment compliance with MRGP required practices,
- prioritize road segments that pose the highest risks to surface waters, and
- estimate costs to remediate those sites using Best Management Practices.

REIs are required by the Municipal Roads General Permit. The MRGP is intended to achieve significant reductions in stormwater-related erosion from municipal roads, both paved and unpaved. The permit is required by the Vermont Clean Water Act (Act 64) and the Lake Champlain Phase 1 TMDL. As of 2023, road segments are surveyed and scored according to either open drainage REI or closed drainage REI supplemental documents

The implementation of the priorities identified in REI's will reduce sediment, nutrients, and other pollutants associated with stormwater-related erosion generated from unpaved municipal roads and

outfalls. A secondary benefit of upgrading roads to MRGP standards is improving the flood resilience of the municipal transportation system from the increased frequency of localized high intensity rain events associated with climate change. The inventories are conducted for "hydrologically connected roads." Hydrologically connected open drainage roads are within 100' of or that bisect a wetland, lake, pond, perennial or intermittent stream or a municipal road that drains to one of these water resources. Closed-drainage roads collect stormwater in catch basins connected to outlet pipes and are hydrologically connected when the outlet is within 500 feet of a surface water. These road segments can be viewed using the Stormwater - Road Segment Priority layer on the ANR Natural Resource Atlas and REI results by town can be viewed in the MRGP Implementation Table.

Based on protocols developed by DEC with the assistance of the Regional Planning Commissions, all the towns in the basin completed their initial REIs mandated by the first MRGP issued in January 2018. Towns were required to bring 15% of connected segments scoring *Partially Meeting* or *Not Meeting* to the MRGP standards or *Fully Meeting* status by December 31, 2022. Towns report and manage their progress annually via the MRGP Implementation Table Portal database. For additional information see the DEC Municipal Roads Program.

The Department reissued the MRGP in January 2023. The new permit continues the implementation requirements of the previously issued permit, requiring towns to upgrade at least 7.5% of their non-compliant segments to meet MRGP standards annually. The re-issued permit requires a second, town-wide reassessment of all hydrologically connected segments by the Fall of 2027. After the updated REI is completed, 20% of total *Very High Priority* segments will be required to be upgraded to meet MRGP standards each year, as part of the 7.5% annual requirement mentioned above. One change in the reissued MRGP is that the Active Channel Width is now required for new intermittent stream crossings, as well as replacements to existing non-compliant intermittent structures. CCRPC began to conduct new REIs in 2023 with full completion planned for the entire county by the end of 2025. Metropolitan Planning Organization funding was used, which is not available to the NRPC. NRPC expects to start conducting REIs for Franklin County towns using Clean Water funding administered by VTrans, available in August 2024.

This plan recommends that technical and financial assistance be provided to towns to complete the new, required REIs and for towns interested in implementing road projects with water quality benefits. Priority projects for water quality are those projects that are "*very high priority*" (Figure 32) and are in sub-basins with phosphorus impairments or with lakes that have increasing nutrient trends related to road stormwater runoff (Tables 5 and 6).

Based on the results of the next REI, towns with the highest number of non-compliant roads to be improved are a priority for funding and technical assistance. Additional priorities for funding road assessments or improvements may also include lakes with increasing nutrient trends (Colchester Pond)), priority road-related projects identified in Stormwater Master Plans (Table 14) or Lake

Watershed Action Plans (Lake Iroquois), or lake watersheds with potentially impactful municipal or private road erosion adjacent to waterways. Private and forest roads can be significant sources of runoff but are not yet fully mapped at the basin scale. Strategies to address these non-regulatory roads are discussed in the Forestlands section below. Clean Water Fund formula and enhancement grants support private road stormwater remediation.

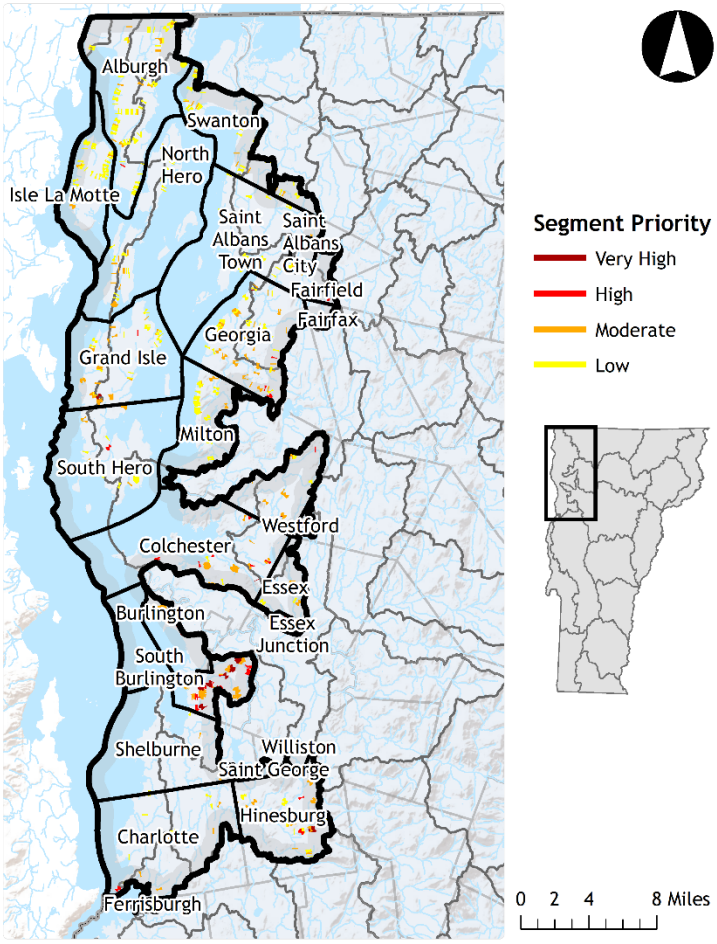


Figure 32. Distribution of MRGP non-compliant road segments across the basin

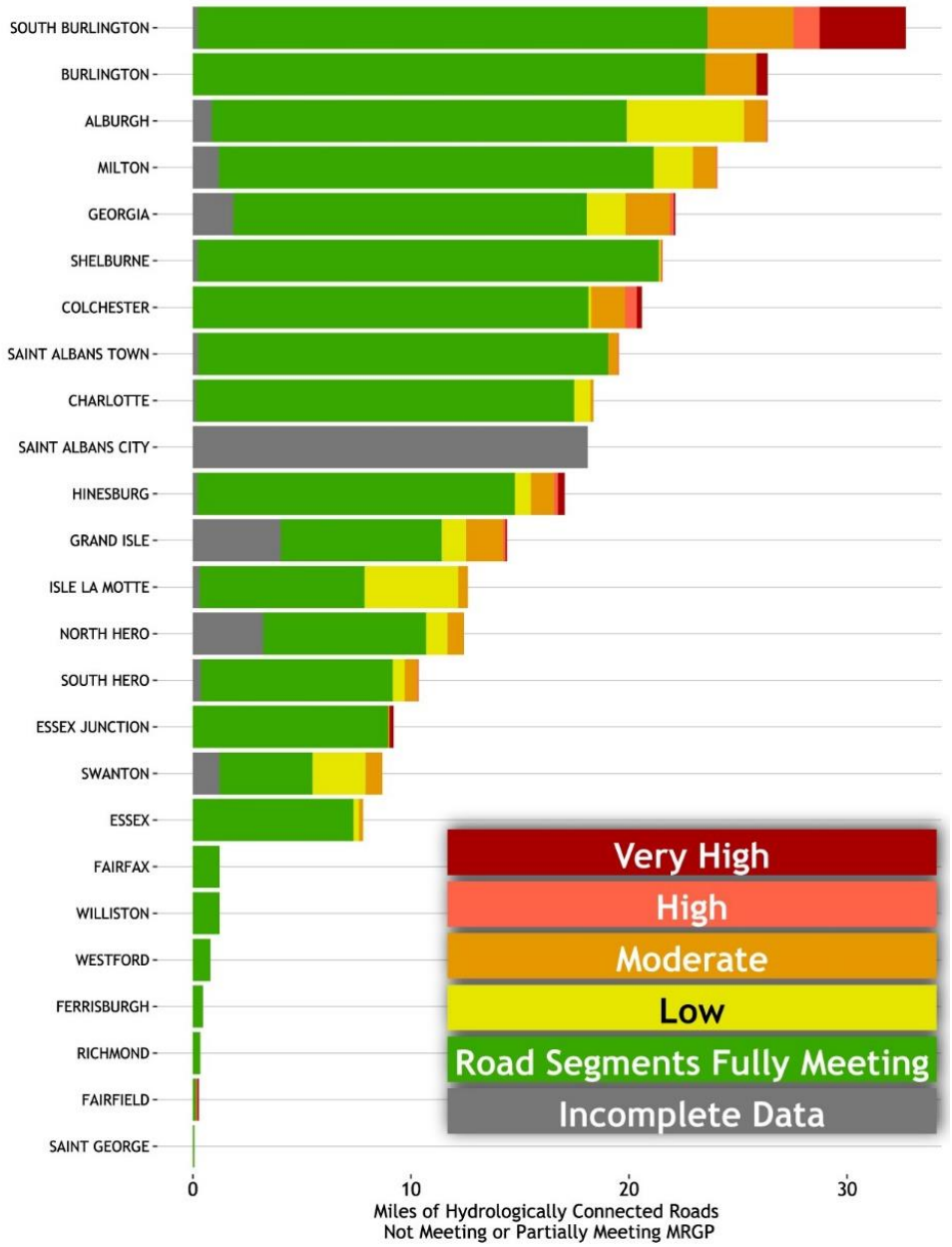


Figure 33. Road miles by MRGP improvement priority in North Lake basin towns and the distribution of non-compliant segments across the basin. See the ANR Atlas for segement data. Fully compliant segments or those with incomplete data are not mapped here.

VTrans Municipal Grants in Aid & Vermont Local Roads

The VTrans Municipal Grants In Aid Program provides technical support and grant funding to municipalities to promote the use of erosion control and maintenance techniques that save money,

while ensuring best management practices are implemented in accordance with the MRGP. The Vermont Local Roads team provides training, technical assistance, communication tools and opportunities for information exchange to assist municipalities in improving their road networks. These programs help implement the strategies described here and listed in Chapter 5.

Transportation Separate Storm Sewer System General Permit – TS4

The Transportation Separate Storm Sewer System General Permit (TS4) covers stormwater discharges from all Vermont Agency of Transportation (VTrans) owned or controlled impervious surfaces. The TS4 general permit combines the stormwater requirements for VTrans associated with its designated regulated small MS4s; industrial activities, commonly regulated under the Multi-Sector General Permit; and previously permitted, new, redeveloped, and expanded impervious surface, commonly regulated under State Operational Stormwater permits.

As required by the permit, VTrans has an approved Phosphorus Control Plan (PCP) for each Lake segment within the Vermont portion of the Lake Champlain Basin. The PCPs, developed in phases, identify and document a suite of best management practices that should collectively achieve the required LC TMDL reductions in phosphorus loading from VTrans stormwater discharges (see Chapter 3 for additional information on the LC TMDL). The practices on VTrans roads, rights-of-way, and facilities are prioritized to include highly hydrologically connected road segments, existing road drainage deficiency, or localized erosion.

VTrans reported in its 2023 annual report to DEC implementing BMPs to reduce P by more than 22% of the PCPs' 1605 kg/yr target for Lake Champlain. The lake segments that receive some or all their loading from the North Lake basin as well as the expected TMDL reduction goals follow: Burlington Bay (24%); St. Albans Bay (22%), Shelburne and Burlington Bays (20%), and Malletts Bay (21%); the Northeast Arm (7%) and Isle La Motte (9%).

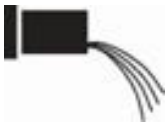
A VTrans Lake Champlain Basin Phosphorus Control Plan Story Map outlines the agency's process towards developing and implementing the Phosphorus Control Plans. VTrans submits annual progress reports to ANR .

VTrans has also developed the Vermont Transportation Resilience Planning Tool as a web-based application that assesses the risk to bridges, culverts, and road segments based on their vulnerability to damage from floods and the criticality of their location in the roadway network, and then identifies potential mitigation measures based on the factors driving the vulnerability. The use of this tool to prioritize projects is part of VTrans Resilience Improvement Plan.

Vermont Road and Bridge Standards

In addition to the MRGP, towns can voluntarily adopt the most current version of the Vermont Town Road and Bridge Standards. These standards are administered by VTrans and go above and beyond MRGP standards. For example, municipalities may adopt MRGP standards for non-hydrologically connected roads. Towns adopting the Vermont Road and Bridge Standards may be entitled to higher cost share rates in federally declared flood event reimbursements. DEC will coordinate with VTrans District Offices to gather up to date information on annually adopted Road and Bridge Standards, coordinate outreach to municipalities, and update the Vermont Flood Ready website. All municipalities in the basin have adopted the most recent version (2019) of these standards.

Managing for road runoff in the upper watershed catchments will lessen the pressure on the downstream areas that receive larger contributions of runoff. Waters being impacted or impaired lower in the watershed do not negate the need for action higher up in the watershed. Lack of good management in the upper parts of the sub-basins can often be the cause of water quality issues further downstream due to cumulative impacts. For this reason, road BMPs for water quality are recommended basin wide on public and private roads and particularly on steep slopes.



C. Wastewater

Wastewater discharges to surface waters or ground waters represent a regulated and readily measurable and controlled source of pollutants, including pathogens and phosphorus. Vermont addresses these discharges primarily through implementation of the National Pollutant Discharge Elimination System and Indirect Discharge (NPDES) permit program as well as state permit programs. DEC provides financial assistance and technical assistance to municipalities and other permittees to upgrade wastewater treatment infrastructure and along with partners supports the community's development of community onsite systems and maintenance of residential onsite systems.

Direct Discharges from Wastewater Treatment Facilities

In the North Lake basin, seven municipal[18], one state of Vermont and two industrial wastewater treatment facility treat wastewater to established standards identified in NPDES permits before discharging it into a surface water (Table 15). An overarching consideration for the Agency's issuance of NPDES permits (discharge permits) is the 2016 Lake Champlain Phosphorus TMDL (LC TMDL). The LC TMDL altered the allowable phosphorus discharge loads from wastewater treatment facilities that contributed a significant portion of the total phosphorus load to Lake Champlain.

Since August 1, 2018, DEC has issued wastewater discharge permits incorporating the LC TMDL phosphorus allocations according to the five-year tactical basin planning schedule. All but the Burlington facilities were issued permits. The DEC is working on an integrated permit for all three Burlington facilities to provide the flexibility needed for the City of Burlington to meet the requirements of the LC TMDL. This will allow the facilities to share their total phosphorus wasteload allocations and allow unused phosphorus at one facility to be allocated or traded to another. The flexibility includes the allocation for the treated combined sewer overflow at the main WWTF. The permit is on schedule to be issued sometime in the 2024 calendar year.

[18] Municipal wastewater treatment facilities (WWTFs) receive wastewater originating from a combination of domestic, commercial, and industrial activities.

Table 15. Summary of permit requirements for the wastewater treatment facilities in the North Lake basin[19], see the Vermont's Wastewater National Pollutant Discharge Elimination System Permit webpage.

Facility (Permit ID)	Permit Expiration[1]	Permitted Flow (MGD[2])	2023 Percent of Flow[3]	TMDL Allocated Wasteload (MT P/yr)[4]	Treatment Type	*# of CSOs*	Receiving Water
St Albans City 3-1279	9/30/2022	4.000	3.03 MGD 62.5%	1.105	Trickling Filter, Rotating biological contactor, cloth disk filters	1	Stevens Brook
St Albans Northwest Correctional 3-1260	9/30/2022	0.040	0.017 MGD 42%	0.028	Tertiary treatment	0	Lake Champlain
VT Fish & Wildlife –Ed Weed Fish Culture Station 3-1312	6/30/2022	11.500	2.69 MGD 23%	0.914	Clarifier w/ alum	0	Lake Champlain
Burlington Main 3-1331	6/30/2010[5]	5.300	4.11 MGD 78%	1.464	Activated sludge	3	Shelburne Bay
South Burlington – Bartlett Bay 3-1284	9/30/2022	1.250	0.82 MGD 65%	0.345	Extended aeration	0	Shelburne Bay
Shelburne 1 (Crown Rd) 3-1289	9/30/2022	0.440	0.32 MGD 72%	0.122	Sequencing batch reactor with cloth disk filtration	0	McCabes Brook
Shelburne 2 (Harbor Rd) 3-1304	12/31/2022	0.660	0.41 MGD 61%	0.182	Sequencing batch reactor with cloth disk filtration	0	LaPlatte River
Hinesburg 3-1172	9/30/2028	0.250	0.21 MGD 83%	0.069	Aerated lagoon, to be replaced with sequenced batch reactor followed by cloth disk filtration	1	LaPlatte River

[1]The expired permits remain in effect under Title 3 Section 814 administrative continuance as timely application for renewals was received.

[2]MGD = Million gallons per day

[3]Percentage was calculated using the average monthly flows (Effluent Gross Value) for the period 5/1/2022 to 5/1/2023.

[4]The TMDL Waste Load Allocation (metric tons P/yr) is the same as the current permitted load.

[5]Facility in the process of integrated permit drafting. See facility-specific notes below.

[19] Since the 2020 TBP, the Wastewater Program determined that the Alburgh Village WWTF would be a better fit under the Indirect Discharge Permit and requested they apply for an indirect permit in a letter dated March 31, 2021. Since that time, the Village has applied for and received coverage under Indirect Permit ID-9-0337 which became effective May 23, 2023. The direct discharge permit was terminated effective May 31, 2023.

To ensure that facilities are operating as efficiently as possible for purposes of phosphorus removal all permittees must develop a Phosphorus Optimization Plan to identify opportunities to implement optimization techniques that achieve phosphorus reductions primarily using existing infrastructure and equipment.

After completion and implementation of the Phosphorus Optimization Plan, all permits require the facilities' phosphorus discharge to be evaluated by the Agency Secretary relative to 80% of the facilities' allowable load threshold of the permit. If a facility is at, or reaches, 80% of its effluent phosphorus concentration or annual mass limit, the permittee must develop a Phosphorus Elimination/Reduction Plan to ensure compliance with the permit's annual mass limit. See Wastewater Management Program fact sheet for additional information. All North Lake WWTFs besides Burlington Main and Hinesburg have completed a Phosphorus Optimization Plan, and none has been required to develop a Phosphorus Elimination/Reduction Plan at this time. Hinesburg has not developed a POP yet because the facility needs to complete an upgrade in order to meet their phosphorus limits. Burlington has not developed a POP yet because the integrated permit is still being drafted.

Before issuing the permit, the DEC WSMD also conducts a reasonable potential analysis to ensure all water quality criteria in receiving streams are met. The Wastewater Management Program is working with the Rivers Program to increase the frequency of instream sample collection upstream of WWTFs prior to permit renewal. The upstream data is used during the reasonable potential analysis, described below, to calculate the resulting downstream concentration once mixed with the WWTF effluent under critical conditions to determine if there is reasonable potential to violate VWQS. The increased instream sampling as well as increased effluent sampling requirements being incorporated into WWTF permits contribute to more statistically accurate, data-based determinations for WWTF permit effluent limits.

Permit limitations must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which are or may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard, including state narrative criteria for water quality. At each renewal, permit writers use this "reasonable potential analysis" to determine whether a discharge, alone or in combination with other sources of pollutants to a waterbody and under a set of conditions arrived at by making a series of reasonable assumptions, could lead to an excursion above an applicable water quality standard. If the expected receiving water concentration determined exceeds the applicable VWQS at critical conditions, limits are included in the permit. A permit writer conducts a reasonable potential analysis using effluent and receiving water data, and the findings are included in the permit issuance documentation, which can be viewed on the Wastewater Program's discharge permit database.

The Agency is also actively working with St. Albans and Burlington on minimizing overflows from combined sewer systems, an additional source of nutrients and pathogens to surface waters. A

combined sewer system collects sewage and stormwater in the same pipe and directs it to the wastewater treatment facility. Although the systems work well in dry weather, the runoff from strong storms or snowmelt overwhelms the combined system. To prevent sewage backups into basements or onto roadways, some of the untreated wastewater is diverted into lakes and rivers via outfall pipes[20]. After issuing a 1272 order, DEC works cooperatively with the communities to ensure that comprehensive plans with a high probability of success will be created. After these Long-Term Control Plans are finalized, DEC issues a new 1272 order with the schedule of activities planned to eliminate or abate combined sewer system overflows (CSOs) and annual reports to summarize Long-Term Control Plan activities completed each year.

A summary of work completed by facilities and expected upgrades to meet WWTF permits is located at the end of this section. Permit issuance documentation, which includes CSO 1272 orders, Long Term Control Plans and CSO annual reports, can be viewed on the Wastewater Program's discharge permit database.

In addition to the enhanced WWTF functioning achieved through Phosphorus Optimization Plans, Phosphorus Elimination/Reduction Plans and CSO Long-Term Control Plans, large contributions of commercial discharges to facilities now receive pretreatment. The Wastewater Management Program issues permits under the Federal Pretreatment Permit program for certain industrial and commercial discharges to municipal WWTFs. The conditions of the DEC pretreatment permit help minimize the potential that industrial or commercial discharges will interfere with the operation of the treatment facility, resulting in the release of untreated wastewater to the environment. The list of 12 operations with pretreatment permits that discharge to North Lake basin WWTFs can be viewed on DEC's Wastewater Pretreatment Permit webpage.

Technical and Financial Assistance

The DEC and partners assist municipalities in discharge permit compliance by providing access to funding and technical assistance.

Vermont provides loans and grants to supports municipal WWTF and associated infrastructure upgrades primarily through the Clean Water State Revolving Fund, Vermont Pollution Control State Revolving Fund, and the Vermont Engineering Planning Advance Program. The USDA Rural Development Water and Environmental Loans and Grants are also available.

Six basin towns are included in the Clean Water State Revolving Fund Project Priority List articulated in the FFY23/FFY24 Intended Use Plan as developed by the DEC Water Investment

[20] Facilities report all partially or untreated discharges, including CSO that the Agency uploads to the following webpage: https://anrweb.vt.gov/DEC/WWInventory/SewageOverflows.aspx

Division. The Water Investment Division prioritization for facility upgrades includes water quality benefits as described in the tactical basin plan, see next section. Vermont has already facilitated St. Albans' and Burlington's CSO elimination efforts through 2024 ARPA awards of over $3 million each.

The DEC Wastewater Management Program works cooperatively with local organizations to facilitate technical assistance related to optimization of nutrient removal and energy efficiency at WWTF, including Vermont Rural Water Association and Vermont Energy Investment Corporation,

The DEC and partners are also available to assist municipalities with asset management planning, which includes identifying needed upgrades and funding sources as well as a timeline. Without a plan, facilities tend to delay upgrades and therefore Clean Water State Revolving Fund funding requests until required by permits. As permit reauthorization occurs at the same time for all facilities within the same basin, they may end up competing for a set amount of annual funding. This planning is especially important in the North Lake basin, which has a high number of WWTF. With an asset management plan in place, municipalities could plan over a longer time-period, taking advantage of multiple Clean Water State Revolving Fund cycles.

Facility–specific information

The WWTF upgrades and associated projects described below, as well as those in the Priority List of Vermont Waters, will provide water quality benefits by addressing the Lake Champlain and/or Bacterial TMDLs and associated implementation plans. In addition, any WWTF and infrastructure upgrades or other wastewater management projects within a DEC-specified distance upstream of a swimming hole identified as an existing use (surface waters with Existing uses are found on the North Lake Planning webpage) would also benefit water quality. The projects are also required to uphold Vermont's Anti-Degradation Policy.

The Water Investment Division will consider each of the WWTF and associated infrastructure upgrades listed below that have municipal support for future drafts of the Priority List of Vermont Waters articulated in the DEC's Intended Use Plan. Please see the Intended Use Plan for the list of North Lake basin municipalities with projects currently on the Project Priority List.

St Albans City - Following primary clarifiers, rotating biological contactors, trickling filter, and secondary clarifiers, the effluent is treated in flocculation tanks with alum and polymer for phosphorus removal by means of cloth disk filtration. Effluent then undergoes a by chlorination/dichlorination process for disinfection. An $18M upgrade project was completed that improves the ability of the facility to remove Phosphorus and repaired or replaced other equipment. Associated with the collection system for the WWTF is the presence of one active combined sewer overflow (CSO). This overflow occurs near Lower Weldon Street and flows to Stevens Brook. The City has prepared a Long-Term Control Plan in accordance with the CSO Rule and ANR has issued

a §1272 Order to compel the City to construct the projects developed in the Long-Term Control Plan.

St Albans Northwest Correctional – The facility consists of four aerated lagoons and tertiary filtration followed by ultraviolet disinfection. Alum and polymer are added at tertiary treatment for phosphorus removal. The last major upgrade to the facility was in 2009, which included building a headworks building and replacing the tertiary treatment and UV system. The facility is adequately meeting effluent requirements and is fully optimized.

VT Fish and Wildlife – Ed Weed Fish Culture - Wastewater flowing through the raceways is sent directly to the 1.3-acre polishing pond while wastewater from the cleaning of the raceways is directed to a clarifier and then to the finishing pond for treatment. While in the clarifier, the wastewater is treated with alum to facilitate solids settling. Effluent discharged from the pond flows down a stabilized channel to Lake Champlain. With operational processes currently in place and practices and operational procedures applied since 1998, the facility has historically been well below their phosphorus waste load allocation.

Burlington Main - Designed for an average daily flow of 5.3 MGD during dry weather conditions; however, the secondary treatment process has the hydraulic capacity to treat peak flow rates of 13 MGD of combined dry and wet weather wastewaters during storm events. Wet weather flows exceeding 11 MGD are treated through mechanical screening, vortex separation and disinfection to avoid discharge of waterborne human pathogens. This process also provides a high level of treatment for the "first flush" that typically contains the highest level of pollutant concentration. The Burlington Main WWTF has a conventional activated sludge treatment process. Burlington Main completed separate projects to upgrade the disinfection systems in 2021 and SCADA and PLCs in 2022. The City is evaluating this WWTF for additional age and nutrient related projects. The City has prepared a Long-Term Control Plan in accordance with the CSO Rule and ANR has issued a §1272 Order to compel the City to construct the projects developed in the Long-Term Control Plan. Burlington completed an integrated plan for the stormwater and the three Burlington wastewater facilities.

South Burlington – Bartlett Bay - Provides advanced treatment of wastewater including rotary screening, extended aeration for secondary treatment and nitrification, chemical precipitation for phosphorus removal, a cloth disk filter for effluent polishing, and ultraviolet disinfection. Bartlett Bay WWTF is undergoing their twenty-year evaluation in preparation of their next age-related refurbishment project and was on the CWSRF Project Priority List for a $19M project in 2022. The Water Investment Division completed their review of the Preliminary Engineering Report (PER) and sent the PER acceptance letter in December 2023 approving the PER and alternatives selected. The project is now in the process of finalizing the Basis of Final Design.

Shelburne 1 – Crown Rd. - Provides advanced treatment of wastewater using sequential batch reactors for secondary treatment and nitrification, chemical precipitation for phosphorus removal, a cloth disk filter for effluent polishing and chlorination/dechlorination for disinfection. Shelburne is currently undertaking final design to convert this WWTF to a pump station and to pump wastewater to the Shelburne 2 WWTF.

Shelburne 2 – Harbor Rd. - Provides advanced treatment of wastewater using rotary screening, sequential batch reactors for secondary treatment, nitrification, biological phosphorus removal, chemical precipitation for added phosphorus removal, filter for effluent polishing and ultraviolet light disinfection. Shelburne is in the final design phase for consolidating these two facilities into Shelburne 2, eliminating Shelburne 1. Additionally, there will be a bond vote November 2024 to decide if they will go forward with the consolidation.

Hinesburg - Consists of three aerated lagoons, chemical addition for phosphorus removal and chlorination/dichlorination for disinfection. Hinesburg achieves good phosphorus removal for the technology. Their current phosphorus load was established in the 2002 LC TMDL and exceeds the allowed phosphorus discharge in the 2016 LC TMDL. Their wasteload allocation would require a 75% reduction to meet their target permitted load going forward.

When renewed in 2017, the permit included reduced limits on both total phosphorus and ammonia and a compliance schedule that required an upgrade of the treatment system to address total phosphorus removal and ammonia removal by December 31, 2022. The facility upgrade has begun. It was delayed due to COVID-19 and cascading impacts to the global supply chain as well as geotechnical issues at the site. On submission of the permit renewal application in April 2022, the facility requested an increase in permitted flow from 250,000 gallons per day to 325,000 gallons per day and proposed to change the facility to a sequencing batch reactor (SBR) system followed by chemical addition and cloth disk filtration. The renewed permit issued September 27, 2023, again includes a compliance schedule that further reduced phosphorus, and ammonia limits due to the increase in the facility design flow. The limit will go into effect following completion of the facility upgrade or by October 31, 2027. With the upgrade, the facility's limits will drop from 608 to 152 pounds per year.

PFAS Monitoring

As part of a statewide investigation of potential conveyors of PFAS, DEC is supporting a sampling program for wastewater treatment facilities. Other sources included in the investigation are industry, land application sites, and landfills. As part of implementing the DEC 2023 PFAS Road Map, $1.25 million dollars of American Rescue Plan Act funding has been dedicated for a two-phased project to (1) quantify PFAS in municipal wastewater discharges across the State and (2) focus resources on

identifying and reducing or eliminating PFAS sources in select communities. DEC will partner with a contractor to conduct quarterly influent and effluent sample collection at each of Vermont's 94 municipal WWTFs and analysis for PFAS utilizing current analytical methods. This first phase of the project is expected to take place over one year. Upon completion of phase 1, the information obtained will be used to select municipalities for additional PFAS investigation. The second phase will involve collaboration with DEC and municipal officials to plan and conduct targeted collection system sampling for PFAS analysis to identify sources and mass loading to municipal WWTFs.

Soil-Based Wastewater Disposal Systems (Septic Systems)

In Vermont's mostly rural landscape, the majority of wastewater is treated through soil-based wastewater disposal systems. Failed or poorly functioning systems can contribute *E. coli*, phosphorus, or nitrogen to surface waters. Additionally, failed systems can cause cross-contamination of nearby drinking water wells. Since 2007, the State of Vermont has had regulatory jurisdiction over the design, permitting, and installation of all new wastewater systems and potable water supplies including septic systems.

Financial and technical assistance for soil-based systems

For residential systems under 6,440 gallons, state financial assistance is available to qualifying homeowners for system upgrades and until 2024 included American Rescue Plan Act funding. Technical assistance and education are provided by Town Health Officers, including investigating citizen concerns about failed septic systems.

The WSMD Lakes and Ponds Management and Protection Program and the Drinking Water and Groundwater Protection Division support outreach to homeowners during neighborhood gatherings organized by partners. At these wastewater workshops, homeowners learn about the options for a well-functioning onsite wastewater system and good maintenance practices for wastewater systems on lakeshores. Shorelines in the basin that benefited from these wastewater workshops included Lake Iroquois and the Lake Champlain shoreline communities of the Champlain Islands and Maquam Bay. These lake shorelines s in the basin would continue to benefit from wastewater workshops to address communities' needs... More information can be found at the Wastewater Workshop website.

Village wastewater solutions

When the town of Colchester began to look for alternative treatment to address inadequate on-site systems around Malletts Bay, it had the benefit of proximity to an existing WWTF to enable a sewer extension; however, for many towns that is not an option. Closely spaced on-site septic systems adjacent to waterways can be the source of elevated levels of contamination. Momentum has been

growing in rural villages to explore options to address concerns about pollution from septic systems and the need for economic growth in village centers that is limited by the lack of centralized shared wastewater systems.

DEC provides direct funding and technical assistance to small communities without municipal treatment to help evaluate and plan for wastewater needs. It is anticipated there will be a steady demand by small communities for wastewater evaluations and planning in the coming years. Small lots and older on-site sewage systems, without municipal treatment infrastructure, re-development or the re-sale of property may require expensive upgrades. Another factor is the economic viability of small communities, which cannot support commercial or residential growth due to the lack of wastewater treatment options. Alternative treatment systems are available to communities not wishing to build large waste treatment facilities, including several advanced technologies for small community scale systems that have been approved for use in Vermont.

Resources available for assisting municipalities include the Clean Water State Revolving Fund. Up until 2024, Village Water and Wastewater Initiative American Rescue Plan Act grant funding has contributed to reducing pollutants from on-site systems, including planning support to South Hero. Colchester's sewer extension to the South Burlington's Airport Park WWTF to address failing on-site systems is included in the Clean Water State Revolving Fund Project Priority List articulated in the FFY22/FFY23 DEC's "Intended Use Plan" as developed by the Water Investment Division.

Assistance in planning for on-site systems as well as connections to existing sewer is also available through the Vermont Engineering Planning Advance Program. The loan program is available to municipalities without existing municipal water or sewer systems for conducting a feasibility study for community-based drinking water and/or wastewater solutions. Consulting engineers assess the town's needs and goals offering treatment options.

To support towns with limited staff for supporting wastewater studies, Vermont has formed an interagency Village Wastewater Solutions Initiative. The program offers the following resources:

- Organizing Village Wastewater Solutions
- Wastewater Solutions for Vermont Communities

In the North Lake basin, the historic village centers or lake communities with their dense, septic-based development may benefit from alternative wastewater solutions. A current example is the decentralized wastewater disposal system managed by the town of Charlotte at Thompson's Point (Town Farm Bay). In this basin, NRPC has helped support discussions in South Hero. Other villages that may benefit from a decentralized system include Villages in Ferrisburgh, Georgia, and St Albans Town.

D. Natural Resources

Forests, lakes, ponds, rivers, floodplains, and wetlands are all examples of natural systems that provide continuing benefits both socially and ecologically. Natural resource restoration and protection projects help to prevent and reduce nutrient and sediment pollution, improve flood resiliency by mitigating flood hazards, enhance habitat function, and support Vermont's outdoor recreational opportunities. These projects are also the most economical and have a long-term benefit with little to no maintenance requirements. Restoration and protection of natural systems offer a cost-effective, long-term means to mitigate water quality and the effects of climate change and enhance the ecosystem services - flood control, wildlife habitat, filtration of pollutants - these natural resources provide.

While Agency regulatory programs protect natural resources, the Agency's also works to support landowner interest in natural resource protection and restoration and depends on partners to provide some of this assistance.

Rivers

In response to historic channel management, floodplain and riparian corridor encroachments, and watershed-wide land use and land cover changes, most Vermont rivers are actively adjusting their shape, size, and course as they seek to re-establish equilibrium (i.e., balance). Human activities can prevent or disrupt this balance by changing flow inputs to the channel (e.g., deforestation, increasing impervious surfaces and runoff, or water withdrawals) or by changing the sediment regime (e.g., dams, dredging). Legacy and present-day impacts, such as development within riparian corridors, channel straightening, berm and dam construction, removal of riparian vegetation, and construction of undersized crossing structures, have contributed to stream instability statewide. The key consequence of these activities is the degraded water quality, loss of resilience and the ecosystem services provided by rivers that fully achieve dynamic equilibrium.

Fluvial geomorphic equilibrium is the condition in which a persistent stream and floodplain morphology is created by the dynamic fluvial processes associated with the inputs of water, sediment, and woody debris from the watershed. The stream and floodplain morphology are derived within a consistent climate; and influenced by topographic and geologic boundary conditions. When

achieved at a watershed scale, equilibrium conditions are associated with minimal erosion, watershed storage of organic material and nutrients, and aquatic and riparian habitat diversity.

Improving all forms of connectivity, upstream-to-downstream and river-to-floodplain, encourages river equilibrium. Enhanced equilibrium will also help to achieve climate resilience through mitigating impacts of increased runoff and streamflow (see Climate Change section) as well as work towards meeting the Lake Champlain P TMDL targets through reducing sedimentation, a source of phosphorus; in the North Lake basin, enhanced equilibrium is expected to address 22 % of the land-use sector's P target.

The ANR's strategies to enhance stream stability and storage include implementing projects, such as, but not limited to, active in-stream restoration, the removal of constraints, the protection of natural processes through easements, floodplain restoration to reduce channel incision, dam removals and other efforts that move the river and floodplain toward equilibrium conditions. The Rivers Program supports partners in project identification and prioritization through use of the stream geomorphic assessments as well as the Functioning Floodplain Initiative tool. The Rivers Program and ANR provide technical support and financial assistance for project implementation as well.

The Functioning Floodplain Initiative Tool

Assessing stream and floodplain function supports the valuation of ecosystem services and the potential for natural resource restoration opportunities. In 2023, the ANR released the Functioning Floodplain Initiative tool, a connectivity-based framework for TP base-load allocation and crediting. It is predicated on the understanding that restoring stream and floodplain connectivity will increase stream equilibrium and therefore reduce net TP loading to Lake Champlain.

The Functioning Floodplains Initiative tool (FFI) is a web-based planning tool to augment the Rivers Program's River Corridor Planning process described below. It was developed to provide practitioners, program managers, and policymakers with the maps and data to identify potential, wetlands, riparian areas, and floodplains restoration opportunities in the Lake Champlain Basin. The FFI tool also provided a phosphorus crediting tracking system that quantifies the gains made towards river system equilibrium and resultant water quality improvement.

There are two types of river and floodplain load reduction credit types for river instability. They are:

- Stream stability reconnection credits for projects at reach and watershed scales.
- Storage attenuation credits for projects that reconnect floodplains and wetlands.

Generally, repairing the most disconnected reaches will achieve the most phosphorus reduction. From a target-setting perspective, project implementers should target those reaches that will address the highest pollution reductions, are necessary in the area they are located, and are feasible with the resources available.

The FFI tool is a planning tool and only one step in determining if a project is a priority project to pursue for implementation and crediting considerations. Other resources, such as River Corridor Plans, stream geomorphic assessment data, field evaluations, project location, and other information about the site and project alternatives will be needed to determine the full needs, priorities, and options for pursuing a given project.

River Corridor Plans

A River Corridor Plan (RCP) is a synthesis of the physical data collected during Phase I and II Stream Geomorphic Assessments (SGAs) based on protocols and guidelines developed by the Rivers Program. These plans identify causes of channel instability and make recommendations for restoration and protection projects. All SGAs and RCPs can be found at: Stream Geomorphic Assessment - Final Reports, and North Lake basin plans are linked in Table 16.

Where funding, local support, and interest exists, priority projects and objectives identified in RCPs and SGAs (Table 16) should be pursued. The FFI tool provides a method for calculating whether proposed projects stand to restore one or more dimensions of river connectivity and what the phosphorus-reduction credit of such projects will be. Within the Act 76 framework, cost-efficient priority projects that have effective phosphorus reduction credits and selected by Basin Water Quality Councils could be implemented using Water Quality Restoration Formula Grant funding or other funding sources.

The SGAs or RCPs on some stream segments may be outdated and require updated field assessments because of substantial probability of geomorphic change (e.g., for plans developed before Tropical Storm Irene or the July 2023 flooding). However, limited resources requires that SGA/RCPs are evaluated and prioritized with respect to their need for collecting current data. During the North Lake tactical basin planning process, the following streams were prioritized for updated field assessments: Mill River, Stonebridge Brook, Malletts Creek and Allen Brook. In 2023, the CWSP funded an alternative assessment using existing SG Additional streams with DEC support for additional assessment updates include Holmes Brook and the LaPlatte River. Stormwater impairments should be addressed before geomorphic assessments are conducted and therefore may not be a priority. The DEC staff will help partners further prioritize watershed(s) and reaches for assessments, type of assessment needed (i.e., new vs update), and use of the FFI tool as it relates to project scoping and planning in conjunction with SGA work for phosphorus reductions and restored and protected connectivity.

This plan recommends that DEC and partners continue to update processes for stream stability assessments and project identification through review of the alternative assessment outcomes to determine potential steps for improvement. The DEC staff will help partners develop an understanding of the advantages provided by the use of the FFI tool to prioritize projects for phosphorus reductions and restored and protected connectivity

Table 16. Stream Geomorphic Assessments and River Corridor Plans are available for many of the North Lake basin's major river segments and sub-watersheds.

River	SGA Phase 1 Completed	SGA Phase 2 Completed	RCP Completed	Other
Allen Brook				2008 - Departure analysis; 2023 Alternative Assessment
Bartlett Brook		2006		
Direct Drain to Lake Champlain	2008			
Indian Brook				2008 - Departure analysis
LaPlatte River		2006		
LaPlatte River			2007	
LaPlatte River			2008	
LaPlatte River		2004		
LaPlatte River and McCabes Brook		2007		
Mallets Creek & Allen (Petty) Brook		2011		2023 alternative assessment
Mallets Creek & Allen (Petty) Brook		2011		
Stonebridge Brook, Mill River, Rugg Brook, Deer Brook		2008		2023 alternative assessment
Munroe Brook		2006		
Pond Brook and Smith Creek	2006			
Potash Brook		2006		
Stevens Brook / Rugg Brook / Jewett Brook	2006			

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River Restoration and Conservation

Active river restoration can include, but is not limited to, the reconnection of floodplains through berm removal, dam removals, woody buffer plantings (trees and shrubs), in-stream wood additions, head-cut stabilization, encroachment removal, and upgrading structure size.

Scientific research strongly supports the value of planting trees and shrubs along stream and lake shorelines for both water quality and wildlife habitat. Shoreline vegetation filters and cleans polluted runoff from uphill land uses, provides shoreland and shallow water habitat, stabilizes banks, and increases lake and river aesthetics. A significant proportion of North Lake basin riparian area is not forested (2019 National Land Cover Database-based riparian condition map), and partners are actively developing and implementing projects to restore buffers. The FCNRCD is funded to identify and prioritize riparian buffer planting in the Missisquoi Bay watershed. Throughout the Lake Champlain Basin, the UVM Extension's Watershed Forestry Partnership (WFP) is facilitating collaboration among partners towards riparian forest restoration, including a 2024 meeting attended by North Lake basin partners. However, regional tree stock shortages as well as difficulties in funding and implementing invasive species management in the riparian zone can hamper buffer implementation. Organizations like the Lake Champlain Basin Program are supporting efforts to increase available tree inventory. As efforts to increase inventory ramp up, this plan recommends partners continue to evaluate and implement innovative buffer solutions in coordination with AAFM, DEC, FWD, US Fish and Wildlife Service, and other agencies active in this area. Appropriate methods are context-dependent but might include riparian agroforestry, hydroseeding, passive restoration, and invasive species mapping and novel management techniques. The Franklin County Natural Resources Conservation District's Northwestern Vermont Riparian Planting Guide further details many of the Vermont-specific challenges and opportunities in riparian restoration. A significant challenge is the management of invasive specifies, especially Japanese Knotweed, before and after planting to ensure the long-term success of the planting.

In addition, ANR prioritizes river reaches that are identified as high priority sediment and nutrient storage areas for conservation. One option for protection, outside of land acquisition, is purchasing river corridor easements to avoid future encroachment and flood damage as well as to restrict channel management activities. River Corridor Easements protect rivers from channel management like armoring and straightening that can degrade the river and functions of a river corridor. This practice is now creditable for phosphorus reductions via the FFI tool, which may accelerate its implementation. Limitations to implementing River Corridor Easements in the basin may include capacity limitations among partners, state staff capacity, as well as landowner's hesitation towards committing to the easement "in perpetuity." The DEC supports continuing discussion to identify and address barriers.

Since the last TBP, the Lake Champlain Basin Program and NEIWPCC have developed Stream Wise, a program that engages streamside property owners in the Lake Champlain basin to enhance

and protect vegetated stream buffers. In addition to hosting online education materials, the Stream Wise program offers free property assessments to provide recommendations on improving streamside management and to award private landowners that maintain wide riparian buffers of native plants. Such a social marketing campaign that helps and rewards individual landowners is thought to be a more effective strategy to shifting streamside management behavioral change within a community than education alone. An outcome of the program may also include an increase in riparian buffer plantings. The basin partners funded by the LCBP to support the Stream Wise Program beginning in 2024 include: the Franklin County, Winooski, and GI NRCDs and the Friends of the Northern Lake Champlain.

Process-based Restoration

Process-based restoration is defined by Beechie et al. (2010) as work that "aims to reestablish normative rates and magnitudes of physical, chemical, and biological processes that create and sustain river and floodplain ecosystems (e.g., rates of erosion and deposition, channel migration, growth and succession of riparian vegetation)." One area that process based restoration has been focused on restoring is the incorporation of wood back into river systems through different formats to help generate those processes that help move a stream toward equilibrium. Large woody material is a critical component of rivers. It improves fish habitat, stream stability, floodplain connection, nutrient processing, and sediment storage, but it is generally lacking in most Vermont streams due to past and present river management practices to accommodate land uses such as logging, agriculture, and urban and residential development.

Likewise, the long-term absence of beaver populations from many stream basins due to past overharvest has likely contributed to more streams becoming single-threaded, flashy, and incised than would have historically existed on the landscape. Strategic wood addition, beaver dam analog construction, and post-assisted log structures are examples of low tech process-based restoration techniques meant to initiate stream channel evolution toward a more complex, connected, resilient configuration where sited, designed, and implemented appropriately. Process-based restoration should move the stream toward becoming self-sustaining, such that over time additional work to maintain these or other created structures is not needed to achieve the goals of the project.

Process-based restoration has seen some implementation in the North Lake basin, The Vermont Land Trust implemented a trial beaver dam analog project along Crooked Creek in Colchester 2023. Moreover, there is a growing interest in this work among partners as funding opportunities expand (e.g., Natural Resources Conservation Service, CWSP formula grants), regional partners share their expertise (e.g., Vermont Land Trust, The Nature Conservancy, and Trout Unlimited), and successful project examples, such as at Crooked Creek become more common in Vermont (e.g., strategic wood addition in brook trout streams of the Memphremagog basin, beaver dam on The Nature Conservancy's Hubbardton River Clayplain Preserve). Going forward in the basin, the Lewis Creek

Association completed a preliminary design in the Spring of 2024 and plans to pursue a McCabe Brook floodplain restoration project in the next year.

In the North Lake, viable projects can be identified by targeting initial field assessments on streams within conserved public and private lands that adhere to the general stream slope and width recommendations of the Vermont Rivers Program and FWD strategic wood policy. A further layer of prioritization focusing on adding wildlife co-benefits would potentially help leverage other funding sources for this work. For clean water funding consideration, partners should consult early with the Rivers Program and other trained partners to collect appropriate field data to assess whether a project has a high probability of providing water quality benefits. The DEC and partners will be supporting additional training and workshops on assessment and implementation of this work to grow the knowledge base required to increase implementation.

Stream Crossings

Bridges and culverts convey the flow of water under transportation corridors. Transportation corridors include federal, state, and local roads, logging and forest roads, private roads and driveways, and railroads. Most of this infrastructure was built before engineers and scientists fully understood the balance required for managing sediment and flow to protect stream channels (and adjacent developed lands). The correct sizing and placement of bridges and culverts plays a significant role in protecting water quality in the basin. Correctly sized and installed structures prevent erosion and scouring upstream and downstream, allow for the passage of fish and wildlife, and reduce impacts from flooding. Replacing structures with ones that meet the current geomorphic and connectivity standards allows fish and other aquatic organisms to move among complementary foraging, spawning, thermal refuge, and overwintering habitats. Without access to essential habitat, fish diversity and abundance decline.

The relatively large expense of crossing projects often requires multiple sources of funding to allow for competitive grant applications. While the North Lake basin's limited trout fisheries reduce opportunities to use US Fish and Wildlife Service funding, municipalities and private-land owners have been willing to contribute to enhance flood resilience provided by a geomorphologically compatible structures. As an example, a Formula Grant and municipal funds are supporting the upgrade of a Fairfax town culvert.

Dams and Dam Safety

There are records of 21 dams of different types, sizes, and condition in the North Lake basin. While some dams are used to generate energy and support recreational opportunities such as boating, fishing, and swimming, dams also impede a river's ability to transport flow and sediment; cause streambank erosion and flooding problems; degrade and alter fisheries habitat; create barriers to fish and other aquatic organisms' movement and migration; alter downstream water temperature; degrade water quality; and impede river-based recreational activity.

Of the 21 inventoried dams, 17 are in-service, one is fully breached, two are partially breached, and one is in the process of being removed. The 20 active in-service and partially breached dams may constrict the stream channel enough to reduce sediment transport, prevent lateral movement, and inhibit aquatic organism passage if mitigating actions have not been taken (e.g., fish ladder). Additional dam information can be found in Appendix A.

The Vermont Dam Safety Rules are in place to protect public safety and provide for the public good through the inventory, inspection, and evaluation of dams in the State. The Dam Safety Program administers the rules which apply to all non-power dams (dams that do not relate to the generation of electricity energy for public use) and all non-federal dams (dams that are not owned by the US or are subject to Federal Energy Regulatory Commission license or exemption). The rules set requirements and standards on dam registration, classification, inspection, application, and approval to construct, re-construct, alter, repair, breach, or remove a dam, as well as related standards including design standards, operation and maintenance standards, inspection standards, and Emergency Action Plans.

All dams, even small dams for backyard ponds, are significant structures that can have major public safety and environmental implications. Three of 21 inventoried dams are considered high or significant hazards (Appendix A), indicating that either direct loss of life is probable from an incident, uncontrolled release, or dam failure (high hazard) or that major property losses, disruption of critical services, and environmental losses are probable (significant hazard). The WSMD Dam Safety Program has reached out to dam owners of the two high hazard dams with results. Dam removals are pursued by private and public dam owners, often with the help from watershed groups and partners. The Vermont Dam Task Force is an interdisciplinary team of natural resource professionals that collaborate to share and investigate current dam removal protocols, watershed science, funding, and dam removal opportunities. The group meets bi-monthly to collaborate on projects. In addition, The Nature Conservancy provides support, most recently through the 2023 publication of the "Scaling Up Dam Removal Guide."

Opportunities for dam removal are limited in the North Lake basin. Those that have been completed include the Vermont Land Trust's removal of a a farm pond dam on Crooked Creek with assistance from Enhancement grants. A current project includes the removal of a dam on Potash Brook with funding through both UVM as landowner and a Formula grant.

Opportunities for restoration may exist at other sites upon further discussion with dam owners as the risk to public safety and ownership liability associated with aging and deteriorating dams becomes more evident. Identifying additional dams to those listed by ANR may provide opportunities and in the North Basin, dammed farm ponds have been identified, including a breached dam on Holmes Brook. The ANR supports partner's work to prioritize dam removals as well as to provide outreach to dam owners to encourage them to consider removal and contact information for further information. Dam removal is a priority basin-wide where the removal will

result in restoration of stream equilibrium and habitat, fish passage, and sediment reduction. The Nature Conservancy hosts the Vermont Dam Screening Tool for the Lake Champlain basin that provides information for dams in the North Lake basin and additional details on each dam's ecological impact. This information is included in Appendix A under TNC Rank.

This plan recommends that the remaining dams of Appendix A are prioritized for scoping to determine the need for, feasibility of, and owner interest in removal. Dam removal is a priority basin-wide where the removal will result in restoration of stream equilibrium, habitat, and fish passage and mitigation of public safety risks. Information on a dam's current ownership, purpose, hazard potential classification, and condition are available through Appendix B and the Vermont Dam Inventory. To begin evaluating the relative ecological benefit of dam removals, The Nature Conservancy and the University of Massachusetts have developed the Critical Linkages project and the Northeast Aquatic Barrier Prioritization Tool that model the effects of individual northeastern dams on habitat connectivity for both anadromous and resident fish species.

FEMA Maps

The Federal Emergency Management Agency (FEMA) is currently updating the Flood Insurance Rate Maps in Vermont for the National Flood Insurance Program. This will be the first map update for many towns since the 1970s or 1980s. This new update will cover the entire state in stages and may become effective in some counties as soon as 2025 as part of FEMA's Risk Mapping, Assessment, and Planning program. North Lake basin towns in Franklin and Chittenden counties had initial discovery meetings with FEMA between 2017 and 2019. During the meetings, stakeholders, including FEMA, state, and community officials, discussed areas of flooding concern and project goals, milestones, and products. Draft updated maps for most counties in the basin may be ready for town review by winter 2024.

Most high-risk flood hazard areas in the basin will be mapped as Zone A, using a new Baseline Engineering strategy that combines computer modeling and high-resolution ground elevation data (lidar). Other areas with existing detailed flood studies will be labeled as Zone AE, with the older studies aligned with current topography. The new Flood Insurance Rate Maps will include aerial photographs that show houses and roads.

Flood Insurance Rate Maps are the basis of floodplain regulations and the National Flood Insurance Program. When the new maps go into effect, FEMA requires that town bylaws meet current standards for participation in the National Flood Insurance Program. To support towns in the timely adoption of updated bylaws, DEC provides a model bylaw that meets or exceeds the National Flood Insurance Program requirements, addresses river corridors consistent with Act 250 review, and ensures municipal eligibility for the maximum amount from the Emergency Relief and Assistance Fund. For ease of adoption in the limited time that will be available to the towns, it was designed for use as either a stand-alone bylaw or an appendix to a zoning bylaw.

The regional planning commissions, with financial and technical support coordinated by the DEC regional floodplain managers, are facilitating the planning commissions' and selectboards' bylaw adoption. This process also benefits from the participation of other partners in the support of meaningful community engagement in consideration of public safety, equity, and the multiple benefits of functioning river corridors and floodplains. The DEC Rivers Program details the FEMA mapping process in Vermont online. Although DEC supports a town's adoption of enhanced river floodplain protection, the current update to a town's bylaw is a time-sensitive priority. As such, this TBP recommends regional planning commissions perform targeted outreach to communities to adopt model flood hazard bylaws as part of the map update process. Flood hazard bylaw updates reduce river and infrastructure conflicts, ultimately mitigating downstream erosion and pollutant transport by increasing stream lateral and longitudinal connectivity.

In 2024, the Northwest Regional Planning Commission and Chittenden County Regional Planning Commission completed review of the floodplain bylaws of their member municipalities (Appendix B). No towns or cities in the Chittenden County needed updates; however, Hinesburg is investigating possible improvements to their bylaws. With funding support from ANR, planning Commissions will target municipalities needing updates for outreach and technical assistance.

Fish Communities and their Habitat

Barriers, thermal modification, lack of naturally vegetated riparian areas and woody instream habitat threaten fish populations statewide. FWD's state-level population and habitat management objectives strategies are available in the 2018 VT Management Plan for Brook, Brown, and Rainbow Trout. Dams along streams can contribute to result in thermal modification, and most are complete barriers to upstream fish movement. Some improvements in operational impacts from hydroelectric facilities are obtained through involvement in the federal relicensing process or for dams not federally licensed through Vermont's Public Utility Commission. Other dams that no longer function as intended in addition to road crossings that block fish movement are being slowly removed through various local partnerships.

Projects to restore fish habitat and protect water quality are currently ongoing and have occurred though various local, State, and federal partnerships. Many of these efforts, including culvert upgrades, dam removal, in-stream habitat improvement, and riparian protection and restoration, are described in previous sub-sections and offer both aquatic and water quality co-benefits.

In addition to recreationally important species, several listed Threatened and Endangered fish species are found in the North Lake River: the Stone Cat and the Channel Darter have been found in the lower LaPlatte River. Increasing management focus is being paid to these species as well as other Species of Greatest Conservation Need (SGCN) that are found in the watershed.

Lakes

A lake's water quality is impacted by human activities and the land uses within its watershed. The loss of native vegetation at the shoreline, the locations of roads, the development pressures along the shoreline and into the watershed, and activities such as agriculture and forestry contribute to overall lake and pond health.

Preventing and mitigating water quality degradation, preserving and enhancing lake habitat and shoreline stability, and ensuring recreational uses of lakes and ponds are priorities for the basin. The recommendations below are based on the VT Inland Lakes Scorecard status of lakes and ponds, and feedback from the Lakes and Ponds Management and Protection Program (LPMPP) and basin stakeholders.

Protecting and Improving Lakeshore Condition

The Shoreland Protection Act (Chapter 49A of Title 10, §1441 et seq.), regulates shoreland development within 250 feet of a lake's mean water level for all lakes greater than 10 acres in size. The intent of the Act is to prevent degradation of water quality in lakes, preserve habitat and natural stability of shorelines, and maintain the economic benefits of lakes and their shorelands. The Act seeks to balance good shoreland management and shoreland development. In the North Lake basin, Vermont Lakes and Ponds Shoreland Permitting have delegated shoreland permit authority to Burlington and Colchester. These municipalities oversee bylaws that are functionally equivalent to Shoreland Protection regulations.

The Lakes and Ponds Program's guidance documents and Lake Wise Program also helps to encourage good shoreline management. The Shoreland Best Management Practices guidance, released in 2022, is comprised of multiple Best Management Practice documents. Each document highlights different shoreland management activities to improve water quality and the health of lakeshore habitat. Examples of activities include planting native trees and shrubs, installing rain gardens to absorb runoff, improving driveways and pathways, and creating no-mow zones. Small practices can be implemented by landowners directly, but larger projects may require support from local partners and additional clean water funding.

The Lake Wise Program encourages lakeshore owners to implement best management practices that improve and protect lake water quality conditions and habitat. The program awards lake-friendly shoreland properties including state parks, town beaches, private homes, and businesses. Lake Wise assessments review shoreland practices for their benefit to water quality and wildlife habitat and suggest actions if improvements are needed.

In addition to individuals, a lake association can also earn the Gold Lake Wise Award when 15% or more of all the properties on the lake have earned the Lake Wise award. To date, five lake associations in Vermont have earned this award, including the North Lake basin's Lake Iroquois Association. As happened on Lake Iroquois, the program is most successful where the Lakes and Ponds Program and partners can focus outreach efforts on shoreline owners within a community over multiple summer. Lakes with a *Fair* or *Poor* shoreland score will benefit from implementing Lake Wise Program best management practices.

Five lakes in the basin greater than ten acres have a *Fair* and *Poor* shoreland habitat condition rating from the Vermont Lake Scorecard: South St Albans Reservoir, Long Pond, Colchester Pond and Sunset Lake (aka Lower Pond) and Lake Iroquois. While Lake Iroquois shoreline has seen improvement through the Lake Wise program, the other lakes have not yet become involved. The potential for community involvement that is necessary for a successful program may be greatest at Long Pond and Lower Sunset Pond. The significant agricultural land use adjacent to the shorelines of South St. Albans Reservoir and Colchester Pond make agricultural focused strategies a better choice.

In addition to in-land lakes, the Lake Champlain shoreline has also benefited from Lake Wise. Community interest has resulted in assessments in the Lake Champlain Islands and Swanton shoreline. The Lake Champlain State parks have also received Lake Wise assessments. As a result, the Alburgh Dunes State Park and the Niquette Bay State Park have received Lake Wise awards. Partners and the Lakes and Ponds Program expect to continue to support the Lake Champlain shoreline community's interest in the Lake Wise Program. Based on community interest and shoreline conditions, Town Farm Bay and Malletts Bay have potential for successful Lake Wise efforts. Lake Wise Program staff or watershed partners collaborate to reach out to priority lake communities based on the above information but will also consider requests made directly by a lake community. Continued outreach is dependent on both community interest and stable funding from the Lake Champlain Basin Program (LCBP), or DEC. Projects and practices identified in the Lake Wise Program assessment are simple enough to be completed by shoreline owners supported by guidance documents and technical assistance from partners. Funding may be available where a partner is willing to coordinate implementation of larger projects across multiple parcels. Bioengineering for stabilizing shorelines is an example. The Vermont Youth Conservation Corps and other similar groups have been beneficial in providing the labor for shoreline practices. Project on public land, like state and city parks, provide additional benefits by providing educational value. Project designs for multiple projects are available for installation at state and municipal parks across Lake Champlain as a result of a LCBP-funded Lake Wise assessment. Designs are available for Kill Kare State Park (St. Albans) and in development for Red Rock Park and Oakledge Park (South Burlington).

Lake Watershed Action Plans

Lake Watershed Action Plans (LWAPs) are assessments to identify pollution sources in the lake watershed that result in water quality and habitat degradation. The LPMPP uses the following metrics to determine priority lakes for Lake Watershed Action Plans: Increasing Phosphorus Trends, Disturbed Shoreline/Watershed, engaged Lake Association or other watershed group. Sources of data for these metrics include data from the VT Lake Scorecard, Next Generation Lake Assessment Reports, as well as Lake Wise and AIS program engagement. The LWAPs result in a prioritized list of projects and strategies to address the sources of pollution and habitat degradation identified in the assessment. The plan may also contain recommendations to preserve natural features and functions, encourage use of low impact green stormwater infrastructure, and maintain the aesthetic and recreational uses of lakes.

Two LWAPs have been completed in the basin to date. In 2024 the WNRCD conducted a planning and concept design process that resulted in a Lake Iroquois and Patrick Brook LWAP with assistance from the Lake Iroquois Association, and the Lewis Creek Association through LCBP-funding. In 2023, a variation on an LWAP was completed for Keeler Bay by the Grand Isle County Natural Resources Conservation District in partnership with the South Hero Land Trust.

Where the community is not engaged in lake health issues, but a group exists to support an organized effort, the initial step is to conduct Lake Wise outreach and assessments to energize the community and increase interest in an LWAP

The Northern Lake Champlain shorelines and bays where outreach and Lake Wise assessment were completed are a priority for LWAPs and include the Northeast Arm (Maquam Bay) and Carry and Pelot's Bays. Although partners see the benefit of LWAPs for Inner Malletts Bay and Town Farm Bay, the Lake Wise assessments was identified as a first step.

Cyanobacteria

Since 2003, the Lake Champlain Committee has trained citizen volunteers to monitor for cyanobacteria at lakeshore locations. Volunteer monitors, along with staff from the Vermont Department of Health and LPMPP, file weekly online reports that are then displayed on the Cyanobacteria Tracker Map. The program helps citizens, along with health, environmental and recreational officials, assess the safety of our beaches. It also provides important data to help us further understand when and why blooms occur. The 2023 monitoring sites covered Lake Iroquois and Indian Brook Reservoir along with Lake Champlain. While the inland lakes monitoring only identified one incident of cyanobacteria, no blooms were reported. For Lake Champlain, the Main Lake, Northeast Arm and Alburg Drainage experienced numerous blooms, many at public beaches. The 2023 Annual Cyanobacteria reports is available on the DEC LPMPP long-term chemical and biological monitoring programs website.

Preventing Aquatic Invasive Species

Aquatic invasive species (AIS) can affect water quality by degrading shoreline habitat, generating imbalance in lake food webs, and altering chemical and physical factors important to aquatic systems (e.g., hydrology, nutrient transport, and oxygen concentration). Lake Champlain as well as three North Lake basin in-lakes have confirmed populations: Lake Iroquois, Sunset Lake and Indian Brook Reservoir (see this online map). The most prevalent AIS at the nuisance level, include Eurasian Watermilfoil, which is present in all of these waterbodies, while Eurasian Frogbit and Curly Leaf Pondweed are present in many. Water chestnut is present in Black Creek, St. Albans Bay and in the Missisquoi National Wildlife Management Area (MNWR). New populations have been found throughout Lake Champlain and were quickly identified and harvested. A few of these new locations will be continuously surveyed and managed and includes Sand Bar State Park and Wildlife Management Area adjacent to the Northeast Arm and a new location in Gander Bay within the MNWR. The DEC with partners and support from federal programs, aggressively manage water chestnut in Lake Champlain

New AIS introductions occur mainly in waterbodies that have launch sites for motorboat watercraft, are near infested waters, and lack spread prevention programs. Incoming motorboats from AIS infested waters are a high risk for introducing AIS in and on motors, propellers, trailers, and boating equipment. The majority of the public access sites in Vermont are managed by Vermont Fish and Wildlife Department (FWD). In the basin, they are located on Lake Iroquois and along the Lake Champlain shoreline. The Winooski Valley Park District manages a public boat access on Colchester Pond. The WVPD and the FWD, often assisted by watershed or lake organizations, support education of boaters at theses access sites about spread prevention through partnerships with the Vermont Public Access Greeter Program, the Vermont Invasive Patrollers, and the Vermont Invasive Patrollers for Animals. The Lake Champlain Basin Program supports greeter programs at Lake Champlain boat launches. These prevention programs incorporate AIS identification training, surveying and monitoring, watercraft inspection, and decontamination facilities. Greeters interact with boaters at boat access areas, inspect watercraft, identify and remove any suspicious matter, and collect and report AIS data. Greeters also distribute educational material on aquatic invasive species. Vermont Invasive Patrollers Program trainings are offered on an annual basis.

In 2023, Lake Champlain boat launch stewards were stationed at the Converse Bay launch in Charlotte, the Shelburne Bay launch in Shelburne, Perkins Pier and USCG station launches in Burlington, the Colchester Point launch and Malletts Bay launch in Colchester, the John Guilmette in South Hero, and the Larry Greene launch in Swanton. The Converse Bay, Shelburne Bay, Malletts Bay, and John Guilmette launches also host a high-pressure hot water decontamination station that stewards can use to decontaminate watercraft on launch and/or retrieve. Colchester Pond and Lake Iroquois are the only inland lakes in the North Lake basin with an active greeter program. A map locating active greeter programs and presence of AIS is available online. These efforts provide local

information about AIS in these ponds and their boat launch stewards help minimize the spread of AIS to and from these ecologically important areas.

The Vermont Aquatic Nuisance Control Grant-in-aid Program and the Lake Champlain Basin Program (LCBP) provide financial assistance to community-led groups, municipalities and agencies of the state for aquatic invasive and nuisance species management programs. While the primary goal is spread prevention and control of new infestations in a waterbody, the remaining assistance is directed to associations and towns for reoccurring management of infestations, primarily through mechanical harvesting operations to protect recreational opportunities. In the North Lake basin, the Lake Iroquois's long-term management program that incorporates mechanical and herbicide programs has received funding and DEC issued a permit for a 2024 herbicide application to address Eurasian watermilfoil. In addition, both Pelot's Bay and St. Albans Bay's mechanical harvesting programs receive financial assistance. The municipalities of Shelburne and Charlotte have supported Lewis Creek Association and volunteers, including LCBP boat-launch stewards in harvesting European Frogbit and other AIS from Town Farm Bay and lower LaPlatte River and McCabes Brook to protect the bays' ecology.

Wetlands

Wetlands cover about 7.7% of the basin and are important for safeguarding many of its high-quality surface waters. As recently as the 1950s, wetlands were seen as obstacles to development, agriculture, and transportation, and consequently, were systematically drained and altered. These losses and alterations diminished the important ecosystem services provided by wetlands such as sediment and nutrient attenuation, wildlife habitat, and flood water storage. Lake Champlain fringe wetlands are especially important for fish spawning and nursery habitat. Wetland conservation and restoration and identifying sites with the greatest potential for improving water quality are priority recommendations.

Wetland Assessment and Protection

The Wetlands Program regulates wetlands in accordance with the Wetlands Rules which are focused on protecting wetland functions and values. The Program also monitors and assesses wetland conditions. The Program relies on wetland mapping to help preliminarily identify the locations of regulated wetlands (Class II and Class I). Enhanced wetland mapping by the Program is expected to be completed for the entire state by 2025. Current updates, including for the North Lake basin, can be found at Wetland Inventory Map.

Enhanced protection, in the form of a Class I wetland designations, can be afforded to wetlands determined to be exceptional or irreplaceable in their contribution to Vermont's natural heritage, based on their functions and values. The Colchester Bog and Munson Flats in Colchester are candidates for reclassification to Class I based on current assessment data. The Thorp Brook Wetland in Charlotte is a candidate for further wetland assessments to determine eligibility. The program supports evaluating community interest in reclassification of these wetlands. These three wetland complexes are hydrologically connected to Lake Champlain, providing a significant function of providing fish spawning and nursery habitat. Wetlands Program staff are available to support community-led Class I wetland designation petitions, evaluation of community interest or additional wetland assessments for the above-mentioned wetlands or others that may quality.

Wetland Restoration

Wetland restoration is the process of returning a degraded wetland to an approximation of its pre-disturbance condition. The United States lost over half of its wetlands through ditching and filling between 1780 and 1980, and Vermont has lost as much as 35 percent. While conservation and protection of wetlands are critical for preventing continued loss of remaining intact wetlands, wetland restoration is essential for rehabilitating those that have historically been degraded or lost. Clean water goals for wetland restoration include assessing areas of degraded and prior converted wetlands and areas of hydric soils for restoration potential and implementing restoration as sites and opportunities are identified. This plan recommends that wetland restoration and conservation be explored where water pollution reduction and flood protection is evident.

Recommendations for wetland restoration can be found in Stream Geomorphic Assessments and River Corridor Plans (Table 16) and the Vermont Regional Conservation Project Partnership (RCPP) Wetlands Project Outreach and Development map created by Arrowwood Environmental. The lake watershed action plans may also include opportunities. In Grand Isle, the Keeler Bay Stormwater Plan identifies opportunities. The RCPP prioritization model highlights many wetlands in the North Lake basin including the Champlain Islands along with Charlotte and the subwatersheds of Jewitt and Mill Brooks in St. Albans Bay. Opportunities to enhance AOP to lake fringe wetlands also protects wetland hydrology. Field surveys are critical for ensuring accuracy as some wetlands may have been missed or misidentified.

Wetlands can also be protected through easements or other conservation programs that restrict certain uses within the eased area. Such conservation programs include the Farm Service Agency's Conservation Reserve Program, Natural Resources Conservation Service's Wetland Reserve Easement program, a 2020-2025 RCPP opportunity administered by the Clean Water Initiative Program that targets smaller privately owned wetlands (10-50 acres), and Vermont's River Corridor Easement program. For the latter, DEC Wetlands and River Programs are developing template language so that river corridor easement footprints can be readily expanded to protect wetlands adjacent to the river corridor.

Wetland restoration and protection has the potential to reduce downstream phosphorus loading but there are no simple ways to estimate the magnitude of phosphorus reductions. One need for the greater Vermont Lake Champlain Basin is to develop phosphorus reduction estimates for wetland restoration projects. Currently, process-based restoration projects lump in-stream improvements with floodplain wetland enhancement to estimate TP reduction credits using the Interim P Calculator Tool. This approach is being refined by Eric Roy and a team of researchers at the University of Vermont to devise more accurate estimates of stream versus wetland-based P reduction capacities using the Functioning Floodplain Initiative Tool and empirical data.

Watershed partners have worked on wetlands restoration projects opportunistically in the North Lake basin. Better accounting for phosphorus crediting as described above might be one way to accelerate wetlands restoration if the practice's P reduction efficiency appears competitive for formula grant funding through Act 76.

In the meantime, using CWSP funding to support wetland restoration as part of other CWF projects, like RCE and riparian planting would be cost effective. In addition, using programs like Stream Wise could help to interest landowners in taking the step towards streamside wetland restoration. Any project that would restore floodplain as part of wetland restoration may also be eligible for phosphorus credits.

The Clean Water Initiative Program's current RCPP wetland easement program allows for limited restoration (e.g., tree planting) on smaller 10-50-acre wetlands, while Wetland Reserve Easements allow more intensive active restoration efforts. In small headwater and lowland streams, growing interest among multiple partners in process-based restoration techniques like beaver dam analogues and stage zero floodplain restoration is also likely to enhance wetland restoration in the basin. The Wetlands Program's level 3 wetland assessment conducted before and after these projects would enhance the Agency's understanding of these benefits.

Forests

Forest lands cover approximately 37% of the basin. Forests are important for safeguarding many high-quality surface waters. Yet, 4.2% of phosphorus runoff is shown to originate from forestlands. Reducing runoff and erosion from forests is important to meeting the state's clean water goals. Forest management activities offer many benefits, maintaining healthy forest communities, improving wildlife habitat, addressing non- native invasive species, contributing to the working landscape economy, and remediating poor legacy road infrastructure. Improving management and oversight of harvesting activities by following the Acceptable Management Practices (AMPs) and providing educational outreach and technical assistance to forest landowners and land managers are

basin priorities. Providing funding to implement improvement practices will grow the practice of good stewardship and water quality protection.

Mapping Critical Source Areas & Identifying Legacy Erosion

As an outcome of the Clean Water Service Delivery Act (Act 76), ANR has contracted a consultant team to identify and map critical source areas of forestland erosion and establish a method to estimate the potential for phosphorus and sediment reductions associated with forestland BMPs and AMPs. This consultant will assist in identifying forestland phosphorus and sediment reduction potential using remote sensing, a GIS-based (LiDAR) landscape analysis of erosion risk potential, and critical source area (CSA) mapping of forest roads, trails, and log landings. These features will be prioritized based on their erosion risk potential. An additional element of this work is to establish forestland BMP phosphorus and sediment accounting methods to estimate load reductions associated with forestland BMP and AMP implementation on lands in the Use Value Appraisal Program.

A second phase of this work will assess forestlands to identify and prioritize legacy erosion associated with the critical source areas and to ground truth and calibrate the analytical and prioritization tools. The ground truthing of the landscape analysis is intended to calibrate the prioritization framework of critical source areas, as well as to develop a prioritization framework to address legacy erosion in high priority basins (i.e., South Lake Champlain and Missisquoi Bay) to achieve target load allocations that will not meet reduction targets through Vermont AMP compliance alone. Vermont ANR anticipates this work will be completed by fall 2025 with training available on the use of the tool by spring 2025.

Forestry AMPs and Skidder Bridge Programs

Acceptable Management Practices for Logging Jobs are scientifically proven methods designed for loggers, foresters, and landowners to prevent soil, petroleum products, and excessive logging slash from entering the waters of the State and to minimize the risks to water quality.

Stream crossings can have a significant negative impact on water quality. These impacts can be minimized by making sure that stream crossing structures are properly sized and installed correctly before crossing streams with logging equipment.[21] The Department of Forests, Parks and Recreation (FPR) and local Natural Resources Conservation Districts provide portable temporary bridge rental opportunities for use during timber harvests. These "skidder" bridges reduce the occurrence of sedimentation, channeling, and degradation of aquatic habitat, allowing loggers to harvest timber in compliance with AMPs. When properly installed, used, and removed, Skidder bridges provide better protection from stream bank and stream bed disturbance than do culverts or

[21] Acceptable Management Practices for Logging Jobs

poled fords. These reusable bridges are also economical, easy to install, and can be transported from job to job.

Specifications for building skidder bridges can be found at: Temporary Wooden Skidder Bridges. Information on the bridge rental program is found at: Temporary Bridge Rentals. These bridges should be utilized on logging projects basin-wide especially on steep slopes and areas with erodible soils adjacent to surface waters.

Additional guidance is available from FPR in the Vermont Voluntary Harvesting Guidelines to Protect Forest Health and Sustainability, and through support for local skidder bridge programs, and forest land conservation efforts. FPR is using Clean Water funding to re-launch skidder bridge construction and rental programs in 2023 with the assistance of conservation districts including the Franklin and Winooski Natural Resource Conservation Districts. The Districts each received two new skidder bridges that will be rented at a rate of $100 per month.

Enhanced coordination between ANR and the US Department of Agriculture – Natural Resources Conservation Service such as the Regional Conservation Partnership Program (RCPP) has also brought additional technical and financial assistance statewide to forest landowners developing and implementing water quality improvement projects in Vermont, including buffer establishment, stream habitat and stream crossing improvement, forest trail and landings improvement, and forestry easements. After an initial grant of $16 million in 2015, this RCPP grant was extended for five years in 2020 with an additional $10 million in assistance to farmers and forest landowners. Importantly, RCPP is a standalone program from the US Department of Agriculture – Environmental Quality Incentives Farm Bill program, allowing separate caps of $450,000 for each program per landowner.

Use Value Appraisal Program & AMPs

Vermont's Use Value Appraisal Program (UVA) enables eligible private landowners who practice long-term forestry or agriculture to have their land appraised for tax purposes based on the property's value for the production of forest or agricultural products rather than on its residential or commercial development value. Compliance with UVA requires that the AMPs be employed to the maximum practicable extent. If AMPs are not employed on the UVA parcel resulting in a discharge, it may affect parcel eligibility in UVA and be a water quality violation. While there is overlap between requirements of the AMPs and UVA, they should be viewed as distinct from each other. In addition, Act 146 creates a new enrollment subcategory in the Managed Forestland category called 'Reserve Forestland,' with enrollments in the subcategory beginning July 1, 2023. This change to UVA accelerates the development of old forest conditions, and it does so in a way that preserves working lands as the primary focus of the Managed Forestland category of the UVA program.

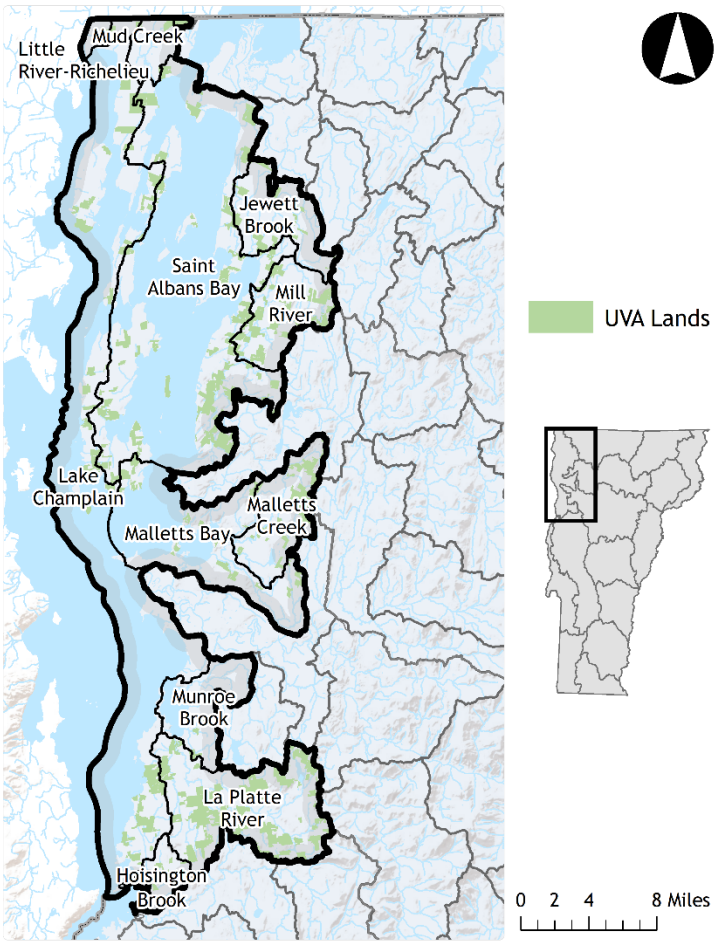

Figure 34. North Lake basin parcels enrolled in the Use Value Appraisal Program.

About 36% of the basin (243,660 acres) is enrolled in the UVA program (Figure 34). Another 10% of the basin (70,860 acres) is protected via federal, state, municipal, or non-profit ownership and management. Examples of public land primarily in forest includes the federal Missisquoi Wildlife Refuge, the Fred Johnson and Maquam Bay State Wildlife Management Areas, Mt Philo, Niquette Bay, Grand Isle, North Hero State Parks, lands managed by the Winooski Valley Park District and many town forests.

Increased enrollment in the UVA program is encouraged wherever landowners express interest. This plan particularly encourages increased enrollment in Source Protection Areas for public drinking water supplies with development pressures and otherwise limited forestland where substantial remaining UVA-eligible parcels exist. The Champlain Water District source water protection area includes the Shelburne Bay watershed, an area with development pressures. The Champlain Islands, St. Albans Town and Swanton also have Source Protection Areas that have limited forest area and would therefore benefit from increased protection of existing forested areas. Unprotected groundwater source protection areas are distributed across the basin. Additional voluntary forestland

protections beyond UVA enrollment such as forest easements, deed restrictions, or long-term leases are especially encouraged in these surface water and groundwater source protection areas in accordance with their Source Protection Plans and via a variety of funding programs. More information is available on the UVA Reserve Forestland website. County Foresters are available for consultation when questions arise about UVA, AMPs, and other practices to protect water quality.

Forest Road Assessments and Management

The ANR is in the process of assessing and prioritizing erosion issues along hydrologically connected forest roads on ANR-owned lands. State Forest is limited in the North Lake basin and therefore, so are forest roads. Where ANR inventories forest roads on state land, these inventories will identify potential road projects, which can reduce sediment and phosphorus loading to surface waters in the basin.

The ANR Road Erosion Inventory App should become a resource for contractors and volunteers on other public and private lands by spring 2024. The downloadable app can be used to assess and prioritize road segments in the field. Landowners may use this app to prioritize forest land projects and for supporting funding requests. This plan recommends first piloting these tools, in coordination with Northwest and Chittenden County Regional Planning Commissions and conservation commissions, on municipal forest lands to encourage increased forest land project implementation and to evaluate the tools' use before engaging private landowners. Priority town forest could include Hinesburg.

E. Watershed Planning and Social Equity

Vermont's natural resources are held in trust for everyone and should be a source of inspiration and enjoyment for all. The Agency of Natural Resources is committed to ensuring that everyone living in and visiting Vermont has meaningful access and equal opportunity to participate in Agency programs, services, and activities and that everyone feels safe and welcome on Vermont's public lands. The Agency's Office of Civil Rights and Environmental Justice, led by Director Karla Raimundí, advances this mission.

ANR is committed to the work needed to engage our state's diverse population in shaping our shared work. As an Agency, we strive to be inclusive, both leading and supporting important work needed around diversity, equity, and inclusion – in our land management practices, in our environmental policies and permitting, and in ensuring our public processes are accessible, equitable and transparent.

Ensuring clean surface water for consumptive and recreational uses, ensuring fish caught in Vermont are safe for consumption, ensuring access to waters for all abilities and in all communities, providing open space availability in more densely populated areas, and ensuring clean water projects are equitably implemented in all communities are areas where tactical basin planning can work toward equity and environmental justice.

Focus areas for the basin include:

- Clean surface water for consumptive and recreational uses;
- Safe consumption of fish caught in Vermont for subsistence anglers;
- Access to waters for recreation for all abilities and economic levels in all communities, for example North Beach in Burlington and Oak Ledge in South Burlington; and
- Equitable implementation of clean water projects in all communities, for example through explicit consideration of environmental justice in formula grant funding decisions.

Chapter 5 – The North Lake Basin Implementation Table

A. Progress in the Basin

The previous North Lake basin plan was completed in 2020. All but one of the plan's 55 strategies are implemented or are in progress by ANR and its watershed partners. One strategy is discontinued.

The TBP addresses all impaired and altered waters in the basin as well as protection needs for high quality waters. The list of strategies in the Implementation Table (Table 17) and the Monitoring and Assessment Table (Table 18) cover future assessment and monitoring needs, as well as projects that protect or restore waters and related education and outreach.

The process for identifying priority strategies is the result of a comprehensive review and compilation of internal ANR and external watershed partner monitoring and assessment data and reports. The monitoring and assessment reports include Stormwater Master Plans and stormwater mapping reports, Stream Geomorphic Assessments, River Corridor Plans, bridge and culvert assessments, Hazard Mitigation Plans, flood modeling, agricultural modeling and assessments, Road Erosion Inventories, biological and chemical monitoring, lake assessments, wetland assessments, fisheries assessments, and natural communities and biological diversity mapping.

The Water Investment Division's Clean Water Initiative Program funds, tracks, and reportson priority projects to restore Vermont's waters, and communicates progress toward meeting the water quality restoration targets outlined in the TMDLs. The Clean Water Initiative Program also coordinates funding, tracking, and reporting of clean water efforts for state partners, including the Agencies of Agriculture, Food and Markets; Commerce and Community Development; Transportation, and other ANR Departments (FWD and FPR), and federal partners including the Natural Resources Conservation Service and the US Fish and Wildlife Service's Partners for Fish and Wildlife Program.

The Division's reporting on financial investments made and phosphorus loads addressed occurs annually. Progress toward the 55 strategies from the 2020 plan will be in the Appendix of the next Clean Water Initiative Performance Report. Progress made in addressing the strategies in the 2024 North Lake TBP's Implementation Table will be reported in the 2029 TBP and the Clean Water Initiative Program 2027 and 2029 Performance Reports.

B. Public Participation

Public input is key to the development of this Plan and the strategies included in the Implementation Table. Public participation is sought throughout the planning process with guidance from the Watershed Planning Program Communication Plan. The planning process for the North

Lake basin kicked off in the fall of 2023 and finished with public meetings on the final draft in the fall of 2024. With help from the Regional Planning Commissions who represent the municipalities, as well as partners, the Watershed Planning Program distributed information and requested input through presentations, email distribution lists, Front Porch Forms, and Instagram posts. Provided links to an on-line survey and story map helped to further engage the community, providing alternative educational formats about the basin and the planning process online story map.

The primary goals of the on-line survey and web map are to provide an opportunity for stakeholders to contribute information to the planning process and to educate the community. The survey was distributed through state and partner networks. 35 respondents from 16 in-basin towns (mainly Chittenden County) offered their input. Contact information was collected to allow respondents to remain engaged in the planning process.

Although not a representative sample of all stakeholders in the basin, public meeting input and survey results can help inform the topics, strategies, and projects addressed in this plan.

C. Coordination of Watershed Partners

There are several active organizations undertaking watershed monitoring, assessment, protection, restoration, and education and outreach projects in the basin in coordination with the ANR. These partners are non-profit, private, state, federal, or other organizations working on both private and public lands. Partnerships are crucial in carrying out non-regulatory projects to improve water quality. The Franklin County Natural Resources Conservation District (FCNRCD), Grand Isle Natural Resources Conservation District (GICNRCD), Winooski Natural Resources Conservation District (WNRCD), Chittenden County Regional Planning Commission (CCRPC), Northwest Regional Planning Commission (NRPC), Friends of Northern Lake Champlain (FNLC), Lewis Creek Association (LCA), US Department of Agriculture Natural Resources Conservation Service (NRCS), UVM Extension Service, US Fish and Wildlife Service (USFWS), AAFM, Vermont Agency of Transportation (VTrans), Vermont Land Trust (VLT), Vermont River Conservancy (VRC), Trout Unlimited (TU), Vermont Natural Resources Council (VNRC), The Nature Conservancy (TNC), lake associations, and municipal groups are active in:

- providing outreach and education to local stakeholders, private landowners, and municipalities;
- developing stream and floodplain protection and restoration projects (e.g., river corridor easements, tree plantings, culvert and bridge upgrades, dam removals, stream channel habitat restoration);
- developing stormwater projects (e.g., Stormwater Master Plans, road erosion inventories, implementation of town road Best Management Practices);
- working with farms in the basin developing and implementing Best Management Practices for water quality; and

- monitoring water quality (e.g., lay monitoring program on lakes and rivers).

The work necessary to meet water quality goals in this basin requires collaboration among all these groups to maximize the effectiveness of the watershed partners and the funding investments. Without funding or partners, little of this work would be possible. The Agency is grateful for the active engagement and long-term commitment of so many partner organizations and interested citizens.

D. Implementation Table

The Implementation Table (Table 17) provides a list of 50 priority strategies, created as the go-to implementation guide for watershed action. The table provides specificity for where each strategy should focus by identifying priority sub-basins and towns. A list of related individual project entries is found in the online Watershed Projects Database. Projects in the Database vary in level of priority based on the strategies outlined in the table. All Database projects are not expected to be completed over the next five years, but each strategy listed is expected to be implemented and reported upon in future TBPs and subsequent phases of TMDL implementation plans and interim and final TBP report cards included in the WID's annual Clean Water Performance Reports.

In relation to the Lake Champlain Phosphorus TMDL, strategy progress is measured against the five-year total TP reduction targets for each sector in Chapter 3. These reduction targets are addressed through both the regulatory programs and the reductions assigned to Clean Water Service Providers described in Chapter 3 and guided by the TBP's strategies. The effectiveness of those strategies and related implementation efforts will be measured according to Total Phosphorus reductions estimated for each sector. Clean Water Initiative Program clean water project tracking and accounting will estimate the mass of pollutants reduced by implemented projects supporting the strategies and track progress towards achieving the five-year target milestones. Progress achieved through outreach, technical assistance, and project funding will inform DEC's gap analysis related to each subsequent phase of TMDL implementation, each annual Clean Water Performance Report, and attendant interim and final TBP report cards.

As projects are developed, priority for Clean Water Initiative Program funding is given to those projects that achieve the highest water quality benefits. Projects that provide cumulative benefits (e.g., flood resilience, water quality improvement, water resource protection, aquatic organism passage) receive additional consideration for prioritization. The Vermont ANR relies on collaboration with partners and stakeholders to help carry out the strategies identified in the basin plan and achieve implementation priorities.

Table 17. Implementation Strategies. Acronyms are listed on Page 153.'

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
Strategies to address runoff from Agricultural Lands					
1	Support farmers and contractors in developing, updating, and implementing nutrient management plans.	Basin wide	All towns	AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD	NRCS, AAFM, RCPP, Pay for P, AgCWIP
2	Support farmers in maintaining cover cropping and other annual practices implementation through consecutive adoption of practices.	HUC12 watershed with high annual enrollment, see Estimated TMDL TP Loading and Reduction online report		AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD	EQIP, CSP, AAFM, AGCWIP
3	Support farmers in increasing acreage of cropland BMP including crop rotation, cover crop, and no till practice,	HUC12 watershed with lagging TMDL reduction targets (Figure 30):		AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD	NRCS, AAFM, RCPP, Pay for P, AGCWIP
4	Support the development and implementation of grazing plans, and pasture and hayland BMPs.	LaPlatte River, Hoisington Brook,	Grand Isle County towns	AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD	NRCS, AAFM, RCPP, Pay for P, AGCWIP
5	Develop a list of locally available equipment necessary for BMP implementation (cover crop, crop to hay conversion, conservation tillage, manure injection) and assist farmers in accessing this equipment through local rental programs, cost-shares, or cooperative applications to funding programs.	Basin wide	All towns	AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD	VHCB, AGCWIP

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
6	Provide technical assistance to farms to enhance field agronomic practices that support soil health and water quality improvements through strategies such as whole farm nutrient management planning, soil health assessments, precision agriculture, and feed management.	HUC 12 watershed with lagging TMDL reduction targets (Figure 30)		AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD	AGCWIP, RCPP, TBPSG
7	Support collaborative efforts among partners to enhance service to the agricultural community, including Farm Team* or Case Manager models that streamlines technical service provider interactions with individual farms.	Basin wide	All towns	AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD	AGCWIP, TBPSG
8	Determine information needs of Small Farm Operations to encourage BMP implementation (e.g., economic benefits of conservation BMPs; examples of implemented BMP water quality benefits; equine, grazing, or vegetable practice guidance).	Basin wide	All towns	AAFM, NRCS, UVM Ext., FCNRCD, GICNRCD WNRCD	AGCWIP, TBPSG
9	Coordinate with partners to track progress on TBP agricultural strategies and identify emerging areas of concern	Basin wide	All towns	AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD	TBPSG, VAWQP
10	Support farm participation in environmental stewardship programs, such as the VAAFM Pay For Performance (Pay for P) and NRCS Conservation Stewardship Program	HUC12 watershed with lagging TMDL reduction targets (Figure 30)		AAFM, NRCS, UVM Ext., GICNRCD, FCNRCD, WNRCD,	NRCS, AAFM, RCPP, Pay for Performance
11	Identify and implement cost-effective P reduction projects on non-RAP farms.		Franklin County	AAFM, NRCDs. CWSP, RPC	Formula grants

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
12	Support collaboration between landowners and municipalities to identify, find funding and manage agricultural stormwater that erodes municipal road ditches		Grand Isle, County, Hinesburg, Charlotte, Milton, Georgia, St. Albans town and Swanton	FCNRCD, GINRCD, NRPC, watershed groups	TBPSG
Strategies to address runoff from Developed Lands - Stormwater					
13	Identity priority stormwater management projects through development or update of Stormwater Master Plans or similar assessments	Watersheds and stormsheds of public swimming access and public water system inlet points.	DEC-identified regions	DEC, CCRPC, NRPC, FNLC, LCA, Municipalities, FCNRCD, GICNRCD, WNRCD	LCBP, CWI, Formula
14	Support the prioritization, design, and implementation of stormwater projects identified in Stormwater Master Plans, Flow Restoration Plans and Phosphorus Control Plans of MS4 and TS4 permittees or similar assessments.	See above	Towns with existing stormwater master plans, phosphorus control plans, or other stormwater-related planning. See Table 13.	DEC, CCRPC, NRPC FNLC, FCNRCD, LCA, Municipalities, LCA, WNRCD, GICNRCD	CWI, Formula, LCBP
15	Support landowners in meeting three-acre permit requirements		Schools and homeowner association	DEC, NRPC, WNRCD, GICNRCD	LCBP, Green Schools Initiative, ARPA 3-acre funds

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
16	Promote social-marketing based programs to facilitate adoption of residential stormwater management approaches (e.g., Ahead of the Storm, Rethink Runoff, Storm Smart, Lawn to Lake, Blue BTV,).	Basin wide	All towns	DEC, LCA, FNLC, LCBP, FCNRCD, WNRCD, NRPC	LCBP, TBSPG
17	Educate towns, businesses and contractors on winter maintenance strategies that reduce use of chlorides.	Catchments of chloride-impaired waters and stormwater-impaired waters	MS4 Towns	CCPRC, NRPC, LCA, WNRCD, GICNRCD, UVM Sea Grant	LCBP
18	Evaluate and improve town salt and sand storage facilities to improve stormwater management on these sites.	Basin wide	South Hero	CCRPC, NRPC, FNLC, WNRCD, GICNRCD Municipalities	SWMG, GIA
Proposed Strategies to address runoff from Developed Lands - Roads					
19	Assist municipalities in updating REI and prioritizing and implementing roads projects to meet the Municipal Roads General Permit (MRGP).	Basin wide	All towns	CCRPC, NRPC, Municipalities	VTrans Municipal Assistance Grants
20	Pilot a GIS road segmentation and private REI methodology to identify, prioritize, develop, and implement private road restoration projects.	Lakes with nutrient impairments or degrading nutrient trends, or otherwise hydrologically connected steep road networks where road associations exist.	All towns	CCRPC, NRPC, LCA, FCNRCD, WNRCD, GICNRCD, Municipalities	Formula, LCBP, TBPSG
Proposed Strategies to address Wastewater					

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
21	Support municipalities pursuing WWTF phosphorus optimization, expansion projects, and upgrades to meet TMDL allotments, phosphorus optimization and CSO requirements.	Basin wide	Alburgh, St. Albans, Colchester, Burlington, South Burlington, Shelburne, Hinesburg	DEC, NRPC, Municipalities	CWSRF, USDA-Rural Development
22	Assist communities in addressing inadequate individual on-site wastewater treatment on small, challenging sites through the planning and development of solutions, including community wastewater systems (e.g., ANR Village Wastewater Solutions) or innovative/alternative on-site systems		Villages in Ferrisburgh, Georgia, St Albans Town, South Hero	DEC WID	ARPA, CWSRF, EPA Engineering Planning Advance, MPG, TBPSG, USDA Community Facilities Program, USDA-RD SEARCH Grant
23	Educate onsite-septic owners about septic system maintenance and alternative systems through local outreach and education programs (e.g., Wastewater Workshops, Shoreline Socials).	Lake watersheds with increasing nutrient trends or highly developed shorelines (Lake Iroquois, Northeast Arm, southern Town Farm Bay, Champlain Islands)		LPMPP, NRPC, GICNRCD, Municipalities, Lake Associations, Conservation Commissions	TBPSG
Strategies to support Natural Resource Protection and Restoration - Rivers					

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
24	Develop and implement priority protection and restoration projects identified in Stream Geomorphic Assessments (SGAs), River Corridor Plans (RCPs), culvert inventories.	Streams with updated SGAs including Mill River, Stonebridge Brook, Malletts Creek and Allen Brook	Georgia, Milton, Colchester	VRP, NRPC, LCA, FNLC, FCNRCD, TNC, WNRCD, GICNRCD	Building Resilient Infrastructure and Communities Fund, DIBG, Flood Resilient Communities Fund, Formula, RCEBG, WBBG
25	Enhance riparian buffers through establishment of woody vegetation.	SGA/RCP-identified sites or other assessment process	All towns	AAFM, NRPC, LCA, FNLC, FCNRCD, NRCS, USFWS, WNRCD, GICNRCD	CREP, Formula, LCBP, RCEBG, WBBG
26	Support adoption of innovative agency-supported approaches to buffer enhancement that address tree stock shortage, invasive species concerns or enhance landowner interest (e.g., agroforestry).	SGA/RCP-identified sites or other assessment process	All towns	LCA, FCNRCD, WNRCD, GICNRCD	LCBP, FWD Watershed Grant, TBPSG
27	Conduct additional Stream Geomorphic Assessment fieldwork to update existing reports. Work with DEC to prioritize watershed(s) and reaches for assessments, type of assessment needed (i.e.: new vs update), and use of the FFI tool as it relates to project scoping and planning in conjunction with SGA work.	Holmes Brook, LaPlatte Watershed and other streams in non-MS4 towns		VRP, DEC, NRPC, CCRPC,	CWI, Formula grants, TBPSG
28	Pilot the identification, design, and implementation of low tech, process-based restoration projects (e.g., strategic wood addition, beaver dam analogs, post-assisted log structures) to restore fluvial processes in small drainages.	Protected federal or state lands, or other private and/or protected lands with greatest potential to enhance floodplain connectivity (FFI tool results)		VRP, FWD, DEC, AAFM, FNLC, FCNRCD, WNRCD, TNC, USFWS	CREP, DIBG, EQIP, Formula grants, NFWF, USFWS

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
28	Scope, develop and implement priority dam removal projects	Holmes Brook, Thorp Brook		Rivers, FWD, DEC, AAFM, NRPC, FNLC, VNRC, FCNRCD, WNRCD, TNC, USFWS	DRBG, Formula, RCPP, NFWF, USFWS
31	Support municipalities in updating flood hazard bylaws and considering adoption of river corridor protections with new Federal Emergency Management Agency maps.	Basin wide	All towns, See Municipal Protectiveness Table (Appendix B)	CCRPC, NRPC, Rivers	FEMA, TBPSG
32	Encourage riparian stewardship through established social marketing campaigns, e.g., Stream Wise	Basin wide	All towns	LCA, FNLC, FCNRCD, WNRCD, GICNRCD	LCBP
Strategies to support Natural Resource Protection and Restoration – Lakes					
35	Evaluate need for Lake Watershed Action Plans (LWAP) based on results from Lake Wise assessments, Lake Score Cards, Next Generation Lake Assessments, and AIS Spread Prevention Programs to evaluate need or to rapidly identify restoration and protection needs in less complex lake watersheds.	Inner Malletts Bay, Town Farm Bay, Northeast Arm	Colchester, Charlotte, Grand Isle, St. Albans, Swanton	VLPMPP	104 or 319 funding; Aquatic Nuisance Control Grant
36	Support Lake Watershed Action Plans for in-land lakes and bays of Lake Champlain with increasing nutrient trends, fair to poor shoreline or watershed conditions and opportunity for community engagement.	Carry and Pelots Bay	North Hero	VLPMPP, NRPC, FNLC, Lake Associations	CWI, Formula grant

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
37	Support Lake Wise assessments where opportunity for community engagement exists.	Keeler Bay, Lake Iroquois, Town Farm Bay Northeast Arm, Malletts Bay	Georgia, Swanton, Champlain Islands, Colchester, Charlotte, Hinesburg, Williston	VLPMPP, WNRCD, FCNRCD, FNLC	Formula grants, PDBG, TBPSG
38	Develop, design, and implement priority projects identified through Lake Wise assessments, LWAPs, NGLAs, other assessment processes, or Lakes Program recommendations.	Keeler Bay, Lake Iroquois, Malletts Bay, Vermont Parks with Lake Wise Assessments: Grand Isle, Kill Kare State Park, Burlington's Leddy Park.		WNRCD, GICNRCD, FNLC, LIA, LCA VFWD, VLPMPP	CWI, Watershed Grant, DIBG
39	Coordinate aquatic invasive species spread prevention efforts throughout the basin among lake associations through collaboration on local Public Access Greeter Programs, hosting VIP/A trainings in the watershed at priority lakes, installing signage on public accesses, and conducting aquatic plants surveys.	Basin wide; coordinate with VT AIS Program	All towns	VLPMPP, WNRCD, Lake Associations, Federation of Lakes and Ponds, Municipalities	Aquatic Nuisance Control Grant, LCBP, TBPSG
	Support trainings to enhance partner contributions to Lake Wise, bioengineering and other DEC identified training needs.	Basin wide		FCNRCD, GINRCD, LCA, FNLC	TBPSG

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
Strategies to support Natural Resource Protection and Restoration - Wetlands					
41	Support the identification and implementation of wetland protection and restoration projects, especially for 10-50-acre projects.	SGA-, RCP-, or RCPP-identified sites, River Corridor Easement or Floodplain and riparian restoration projects. Keeler Bay Stormwater Plan	All towns including Champlain Islands, Charlotte, Hinesburg	VWP, VCWIP, AAFM, FNLC, FCNRCD, LCA, South Hero Land Trust, Vermont Land Trust, CWSP? VRC,	CWI, Formula grants, RCPP, ACEP-WRE
42	Support reclassification to Class I, including development of petitions or collection of additional data where needed to document significant functions in wetlands that exceed Class II wetland criteria	Thorp Brook, Colchester Bog, Malletts Creek	Charlotte, Colchester	UVM , VWP, Municipalities,	TBPSG
43	Support outreach to towns and the public – especially zoning administrators, prospective land purchasers, wastewater designers, and realtors regarding updated wetlands mapping	Basin wide	All towns	Wetlands, Municipalities, NRPC	DEC, TBPSG
Strategies to support Natural Resource Protection and Restoration - Forests					
45	Identify and prioritize of forest road segments with water quality impacts using the Forestland Erosion Assessment tool and subsequent forest REIs.	State and municipal lands with significant road and stream networks, especially in areas of high runoff potential, including Mill River, Malletts Creek, LaPlatte River watersheds	All towns	DEC, FPR, NRPC, FCNRCD	CWI, LCBP, TBPSG
47	Implement AMPs and high priority forest road projects on state, municipal, and private lands.	Basin wide; High priority forest REI segments	All towns	DEC, FPR, NRPC, NRCS, FCNRCD	CWI, EQIP, Formula, RCPP

	Strategy	Priority Area or Watershed	Town(s)/entities	Partner(s)	Funding
48	Support outreach and training on properly implementing the AMPs for practitioners, landowners, and technical service provider	Basin wide	All towns	NRCS, UVM ext., VAWQP, FPR LEAP and Master Loggers Program, FNCRD	TBPSG
49	Assist interested landowners with forest conservation and UVA enrollment	Basin wide. Source Protection Areas in Champlain Islands, St. Albans Town, Georgia, Swanton	Multiple towns	CWIP, FPR, Vermont Land Trust, South Hero Land Trust	RCPP
50	Increase the use of skidder bridges through direct grants to foresters to purchase skidder bridges as well as rentals.	Basin wide	All towns	FPR, FCNRCD, WNRCD	CWI

D. Monitoring and Assessment Table

The Monitoring and Assessment Table (Table 18) provides a preliminary list of water quality monitoring priorities to guide monitoring over the next five years. The ANR's Water Quality Monitoring Strategy describes the monitoring programs supported by ANR and its partners, who are listed in Chapter 2. Common goals for monitoring efforts across programs include identifying water quality conditions, tracking water quality trends, identifying pollution sources, and evaluating improvements over time. The table includes more sites than there is capacity to monitor and as such, will be further prioritized before monitoring occurs.

Table 18. Priorities For Monitoring and Assessment based on input from partners and DEC staff. Other priority surface waters for monitoring may include surface waters located in the following tables and associated figures. They were identified based on an analysis of IWIS data: Table 8, Figure 21 identify rivers requiring additional monitoring to evaluate attainment of aquatic biota use. Table 2, Figure 6 include additional opportunities for monitoring where data does not currently exist. Acronyms are listed on Page 153. For location of streams with asterisk (named by DEC staff), see Table 2 and Figure 6.

Waterbody	Project Description	Town	Partners	Purpose
Rivers				
Mars Hollow Brook*	Biological monitoring (1 year)	Milton	BASS	Assessment for B1 eligibility based on 85% forested watershed
Beecher Falls Brook*	Biological monitoring	Hinesburg	BASS	Assessment for B1 eligibility based on almost 85% forested watershed and floodplain enhancement
Trout Brook (see Figure 9)	Biological monitoring (especially fish)	Georgia	BASS	Update assessment for B1 eligibility
Sucker Brook	Chemical monitoring, Stream geomorphic Assessment lite	LPP	GICNRCD	Nutrient trends, sources

Waterbody	Project Description	Town	Partners	Purpose
Mud Brook	Chemical and biological monitoring, fisheries/habitat?	Alburgh	BASS, GICNRCD, DFW	Determine attainment of aquatic biota use,
Mill River (above Rugg Brook confluence and in addition to Patty Creek*)	Chemistry and Biological monitoring identify P and sediment source	Georgia, St. Albans Town?	BASS, FNLC	Data gap
Patty Creek* (Northeast trib to Mill Brook)	Biological and chemical monitoring,	Georgia	BASS, FNLC	Data gap in large watershed
Jewett Brook	Biological monitoring	St. Albans Town	BASS	Understand relative contribution of stressors.
Stevens Brook, Trib 7	Biological monitoring	St. Albans Town	BASS	Determine attainment of aquatic biota use, poor fish and bug assessment in 2021
Malletts Creek (44.57559, -73.10464)	Fish monitoring	Colchester		Data gap, fisheries habitat?
Allen Brook (downstream VTrans garage)	Chemical and biological monitoring	Milton	BASS, DEC	Determine attainment of aquatic biota use., Chloride Trends
Niquette Park trib*	Stream geomorphic Assessment lite	Colchester	?	Assessment of geomorphic condition
Smith Hollow Brook	Biological monitoring above Williams Road, and Stream Geomorphic Assessment lite along entire length	Colchester	BASS, ?	Data gap, assessment of geomorphic condition
Indian Brook	Chemistry for Chloride,	Colchester	BASS, DEC	Determine attainment of aquatic biota due to high Chloride (don't have flow data to assess based on numeric criterion?)
Bingham Brook	Chemistry and Biological monitoring	Charlotte	BASS	Data Gap; flows into agricultural impaired stream (Mud Hollow) (LPP ID: BB1)

Waterbody	Project Description	Town	Partners	Purpose
O'Neil trib* to the LaPlatte River	Biological monitoring	Hinesburg	BASS	Biological Data gap, LPP data indicates high nutrient trends (LPP ID: LP13)
Lakes				
Duck (Shelburne)	Chemical monitoring, chlorophyll-a, Secchi	Shelburne	LPMPP	Insufficient data to determine water quality status. Poor watershed score
Indian Brook;	Chemical monitoring, chlorophyll-a, Secchi	Essex	LPMPP	Insufficient data to determine water quality status. Poor watershed score
Eagle	Chemical monitoring, chlorophyll-a, Secchi	Milton	LPMPP	Insufficient data to determine water quality status.
Georgia Plains	Chemical monitoring, chlorophyll-a, Secchi	Georgia	LPMPP	Insufficient data to determine water quality status.
Mallett	Chemical monitoring, chlorophyll-a, Secchi	Colchester	LPMPP	Insufficient data to determine water quality status. Poor watershed score
Colchester Pond	Continue tracking increasing nutrient trends.	Colchester	LPMPP, Lay Monitoring	
Wetlands				
Colchester Bog	Wetland assessment update	Colchester		Update VRAM
Thorp Brook	Wetland assessment	Charlotte		Study Assessment for Class I wetland eligibility.

List of Acronyms

104	Federal Clean Water Act, Section 104
319	Federal Clean Water Act, Section 319
604(b)	Federal Clean Water Act, Section 604b
A(1)	Class A(1) Water Management
A(2)	Class A(2) Water Management
AAFM	Agency of Agriculture, Food and Markets
ACEP-WRE	Agricultural Conservation Easement Program – Wetland Reserve Easements
AGCWIP	Agricultural Clean Water Initiative Grant Program
AIS	Aquatic Invasive Species
AMP	Acceptable Management Practice
ANR	Agency of Natural Resources
ARPA	American Rescue Plan Act
B(1)	Class B(1) Water Management
B(2)	Class B(2) Water Management
BASS	Biomonitoring and Aquatic Studies Section, DEC Watershed Management Division
BMP	Best Management Practice
CCNRCD	Caledonia County Natural Resource Conservation District
CCRCP	Chittenden County Regional Planning Commission
CREP	Conservation Reserve Enhancement Program
CWI	Clean Water Initiative
CWIP	Clean Water Initiative Program
CWSP	Clean Water Service Provider
CWSRF	Clean Water State Revolving Fund
DEC	Department of Environmental Conservation
DIBG	Design-Implementation Block Grant
EPA	US Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
ERAF	Emergency Relief and Assistance Fund
FEMA	Federal Emergency Management Agency
FCNRCD	Franklin County Natural Resources Conservation District
FFI	Functioning Floodplain Initiative
FPR	Vermont Forests, Parks and Recreation
FWD	Vermont Fish & Wildlife Department
FNLC	Friends of the Northern Lake Champlain
GICNRCD	Grand Isle Natural Resource Conservation District
GIA	Grants-in-Aid
LCBP	Lake Champlain Basin Program
LCA	Lewis Creek Association
LIA	Lake Iroquois Association
NRPC	Northwest Regional Planning Commission
LPMPP	Lake and Ponds Management and Protection Program
LWAP	Lake Watershed Action Plan
MRGP	Municipal Roads General Permit
MS4	Municipal Separate Storm Sewer System
NFWF	National Fish and Wildlife Foundation

NGLA	Next Generation Lake Assessment
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
ORW	Outstanding Resource Water
P	Phosphorus
PDBG	Project Development Block Grant
PFW	Partners for Fish and Wildlife
RAP	Required Agricultural Practice
RCEBG	River Corridor Easement Block Grant
RCP	River Corridor Plan
RCPP	Regional Conservation Partnership Program
REI	Road Erosion Inventory
SFY	State Fiscal Year
SGA	Stream Geomorphic Assessment
SWG	State Wildlife Grant
SWMG	Stormwater Management Grant
SWMP	Stormwater Master Plan
SOP	Standard Operating Procedure
TP	Total Phosphorus
TBP	Tactical Basin Plan
TBPSG	Tactical Basin Planning Support Grant
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TP	Total Phosphorus
TS4	Transportation Separate Storm Sewer System Permit
TU	Trout Unlimited
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UVA	Use Value Appraisal program, or Current Use Program
UVM Ext.	University of Vermont Extension
VAWQP	Vermont Agricultural Water Quality Partnership
VLT	Vermont Land Trust
VNRC	Vermont Natural Resources Council
VRAM	Vermont Rapid (Wetland) Assessment Method
VRC	Vermont River Conservancy
VSA	Vermont Statutes Annotated
VTrans	Vermont Agency of Transportation
VWQS	Vermont Water Quality Standards
WFP	Watershed Forestry Partnership
WBBG	Woody Buffer Block Grant
WSMD	Vermont Watershed Management Division
WWTF	Wastewater Treatment Facility

References

ANR. (2021) *Vermont Climate Action Plan*. Vermont Climate Action Office, Agency of Natural Resources. Retrieved from https://climatechange.vermont.gov/readtheplan

ANR. (2022). *Vermont Per- and Polyfluoroalkyl Substances (PFAS) Surface Water, Fish Tissue, and Wastewater Treatment Facility Effluent Monitoring Report.* Montpelier: ANR. Retrieved from https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/2021-PFAS-Surface-Water-Fish-Tissue-and-WWTF-Effluent-Monitoring-Report.pdf

ANR. (1978). *Position of the State of Vermont regarding regulation of Lake Champlain and the Richelieu River.*

Betts, A. K. (2011). *Climate Change in Vermont.* Climate Change Adaptation White Paper Series, Vermont Agency of Natural Resources. Retrieved from https://climatechange.vermont.gov/sites/climate/files/documents/Data/VTCCAdaptClimateChangeVTBetts.pdf

DEC. (2015). *Vermont Lake Champlain Phosphorus TMDL Phase 1 - Implementation Plan.* Montpelier: Vermont. Retrieved from https://www.epa.gov/sites/default/files/2015-09/documents/vt-lake-champlain-tmdl-phase1-ip.pdf

DEC. (2017, January). *Vermont Surface Water Management Strategy.* Retrieved from VT Department of Environmental Conservation Website: http://dec.vermont.gov/watershed/map/strategy

DEC. (2022). *Vermont Surface Water Assessment and Listing Methodology*. Montpelier, Vermont: Agency of Natural Resources. Retrieved from https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/WSMD_AssessmentAndListingMethodology.pdf

DEC. (2022, November 15). *Vermont Water Quality Standards Environmental Protection Rule Chapter 29A*. VT: State of Vermont. Retrieved from https://dec.vermont.gov/sites/dec/files/documents/2022-Vermont-Water-Quality-Standards.pdf

Environmental Protection Agency. (2008, March). *Handbook for Developing Watershed Plans to Restore and Protect Our Waters.* Retrieved from US Environmental Protection Website: https://www.epa.gov/sites/production/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf

Galford, G. F.-G.-A. (2021). *The Vermont Climate Assessment 2020.* Burlington, VT: Gund Institute for Ecological Economics, University of Vermont. Retrieved from vtclimate.org

Kratzer, J. F. (2013). *Factors Limiting Brook Trout Biomass in Northeastern Vermont Streams.* (Vol. 33). North American Journal of Fisheries Management.

Kratzer, J. F. (2018). *Response of Brook Trout biomass to strategic wood additions in the East Branch Nulhegan River watershed, Vermont. North American* (Vol. 38). Journal of Fisheries Management.

Lake Champlain Basin Program. (2024). *2024 Lake Champlain State of the Lake and Ecosystem Indicators Report.* Grand Isle, VT. Retrieved from https://www.lcbp.org/

National Oceanic and Atmospheric Administration. (2013, May 28). *Climate Information*. Retrieved from National Centers for Environmental Information: https://www.ncdc.noaa.gov/climate-information

Neidhardt, H., & Shao, W. (2023). Impact of climate change-induced warming on groundwater temperatures and quality. *Applied Water Science, 13*(235).

Pealer, S., & Dunnington, G. (2011, April). *Climate Change and Vermont's Waters.* Montpelier. Retrieved April 14, 2020, from Climate Change in Vermont: https://climatechange.vermont.gov/sites/climate/files/documents/Data/VTCCAdaptWaterResources.pdf

Stamp J, M. A. (2020). Effects of extreme high flow events on macroinvertebrate communities in Vermont Streams. *River Res Applic., 36*, 1891–1902.

United States Environmental Protection Agency. (2016, June 17). Phosphorus TMDLs for Vermont Segments of Lake Champlain. Boston, MA. Retrieved from https://ofmpub.epa.gov/waters10/attains_impaired_waters.show_tmdl_document?p_tmdl_doc_blobs_id=79000

Vermont Clean Water Act, VT No. 64 (H.35) (June 16, 2015).

Watson, K. B., Ricketts, T., Galford, G., Polasky, S., & O'Neil-Dunne, J. (2016). Quantifying flood mitigation services: The economic value of Otter Creek wetlands and floodplains to Middlebury, VT. *Ecological Economics, 130*, 16-24. doi:https://doi.org/10.1016/j.ecolecon.2016.05.015.

Weiskel, P. K. (2007). *The Charles River, Easter Massachusetts: Scientific Information in Support of Environmental Restoration.* US Geological Survey. Retrieved from https://pubs.usgs.gov/gip/2007/47/pdf/gip-47.pdf

Appendix A. Dams in the North Lake Basin

List of dams in the North Lake basin. These dams are either in service, partially breached, breached, or removed. The table is completed to the extent possible with information available in the Agency of Natural Resources Vermont Dam Inventory).

State ID	Dam Name	Stream	Town	TNC Rank	Dam Haz Class	Dam Status	Comments
3.01	**Mud Creek**	**Mud Creek**	**Alburgh**	**Medium**	**3**	**In Service**	**VDFW WMA**
51.01	**Colchester Pond**	**Pond Brook**	**Colchester**	**High**	**2**	**In Service**	**WVPD natural area/park**
69.01	**Indian Brook Reservoir**	**Indian Brook**	**Essex**	**Medium**	**1**	**In Service**	**Town park: DEC risk prioritization identified as high hazard dam**
70.01	**St. Albans North Reservoir**	**Mill River**	**Fairfax**	**Medium**	**1**	**In Service**	**Provides drinking water: DEC risk prioritization identified as high hazard dam**
70.02	**St. Albans South Reservoir**	**Mill River**	**Fairfax**	**Low**	**1**	**In Service**	**Provides drinking water**
79.01	**Stone Bridge Pond**	**Stone Bridge Brook**	**Georgia**	**High**		**Breached**	
97.01	**Lake Iroquois**	**Patrick Brook**	**Hinesburg**	**Medium**	**3**	**In Service**	**Lake with homes**
97.02	**Lower Pond**	**Patrick Brook**	**Hinesburg**	**Very Low**	**2**	**In Service**	**Pond with homes**
97.03	**Iroquois Mfg. Co. Mill Pond (Upper)**	**Patrick Brook**	**Hinesburg**	**Very Low**	**3**	**In Service**	
97.04	**Cemetery Pond**	**Patrick Brook**	**Hinesburg**	**Low**		**Breached (Partial)**	
97.05	**Twitchell**	**La Platte River-TR**	**Hinesburg**	**Medium**	**3**	**In Service**	**Pond with home**
97.07	**Champlain Valley Union High School**	**Patrick Brook-OS**	**Hinesburg**	**Low**	**3**	**In Service**	
97.08	**Iroquois Mfg. Co. Mill Pond (Lower)**	**Patrick Brook**	**Hinesburg**	**Very Low**	**3**	**Breached (Partial)**	

State ID	Dam Name	Stream	Town	TNC Rank	Dam Haz Class	Dam Status	Comments
128.04	**Milton Pond**	**Malletts Creek-TR**	**Milton**	**High**	**3**	**In Service**	
128.07	**Long Pond**	**Lake Champlain-TR**	**Milton**	**Medium**	**3**	**In Service**	**Pond with homes**
192.02	**UVM (Upper)**	**Lake Champlain-TR**	**South Burlington**	**Very Low**	**3**	**In Service**	**At UVM horticulture research center**
192.03	**UVM (Lower)**	**Lake Champlain-TR**	**South Burlington**	**Very Low**	**3**	**In Service**	**Design to remove, DEC dam removal order obtained. At UVM horticulture research center**
192.05	**UVM (East)**	**Muddy Branch-OS**	**South Burlington**	**Very Low**	**3**	**In Service**	**At UVM horticulture research center**
192.06	**Village at Dorset Park Pond #1**	**Potash Brook-TR – OS**	**South Burlington**		**3**	**In Service**	**Stormwater management**
192.07	**Village at Dorset Park Pond #2**	**Potash Brook-TR – OS**	**South Burlington**		**3**	**In Service**	**Stormwater management**
192.08	**Village at Dorset Park Pond #3**	**Potash Brook-TR – OS**	**South Burlington**		**2**	**In Service**	**Stormwater management**

Appendix B. North Lake Basin Municipal Protectiveness Table

Surface-water related protections adopted by municipalities predominantly in the North Lake basin.

[1]The River corridor protection eligibility criteria for a 17.5% Emergency Relief and Assistance Fund (ERAF) rate can be met through Community Rating System participation (CRS), River Corridor by-law adoption (By-law), or temporarily through early adopter status for communities that adopted some river corridor protections before October 2014 (interim).

Chittenden County	Status	Burlington	Charlotte	Colchester
National Flood Insurance Program (NFIP)	Enrolled?	Yes	Yes	Yes
Road and Bridge Standards	Adopted?	Yes	Yes	Yes
Hazard Mitigation Plan (LHMP)	Adopted?	Yes	Yes	Yes
River Corridor Protection	Adopted?	No	Early Adopter	Early Adopter
Comments on River Corridor Protection				NFIP CRS community
ERAF % from State	Percent	12.5	17.5	17.5
Structures in SFHA	Number	42	36	81
SFHA structures insured	Percent	14%	3%	17%
Critical or Public Facilities in SFHA	Number	0	0	0
Flood Hazard By-law	Adopted?	Yes	Yes	Yes
	Comment	Yes	Yes	Yes
Flood Resilience in Town Plan	Completed?	Yes	Yes	Yes
	Comment			
Municipal Bylaw or Zoning District for Water Resource Setback	River/Stream	Yes	Yes	Yes
	Comment	Named Streams has a 100 ft. setback. minor streams have a 50 ft. setback. Winooski River has a 250 ft. setback.	100 ft. setback from named streams, 50 ft. setback from unnamed streams, 150 ft. setback from LaPlatte tributary and stream parallel to Bean Road (Section 3.15)	River = 250 ft. setback. Streams = 85 ft. setback. NOTE: 250 ft. back from mean water mark on Winooski & Lamoille River creates no-build buffer 100 ft. from mean water mark.
	Wetland	Yes	Yes	Yes
	Comment	Wetland has a 100 ft. setback.	Proposed development within 50 feet of a "potentially significant wetland" triggers a review process.	50 ft. setback.
	Lake/Pond	Yes	Yes	Yes
	Comment	Lake Champlain = 250 ft. setback. minor lake/pond = 50 ft. setback.	100 ft. vegetated buffer for Lake Champlain	Lake, Pond = has 250 ft. setback.
Potential actions to address gaps in Water Quality Protection		Could expand protections in Special Flood Hazard Area. Current regs allow some Conditional Use. Actively implementing Flow Restoration Plan(s) and Phosphorus Control Plan as required.	Continue to pursue funds for final design and implementation of water quality projects identified by Town and/or Lewis Creek Association (LaPlatte River Partnership)	Actively implementing Flow Restoration Plan(s) and Phosphorus Control Plan as required.

	Status	Essex	Essex Junction	Hinesburg
National Flood Insurance Program (NFIP)	Enrolled?	Yes	Yes	Yes
Road and Bridge Standards	Adopted?	Yes	Yes	Yes
Hazard Mitigation Plan (LHMP)	Adopted?	Yes	Yes	Yes
River Corridor Protection	Adopted?	Early Adopter	Early Adopter	Early Adopter
Comments on River Corridor Protection				Have some streams within muni Fluvial Erosion Hazard Overlay District
ERAF % from State	Percent	17.5	17.5	17.5
Structures in SFHA	Number	8	9	38
SFHA structures insured	Percent	?	?	?
Critical or Public Facilities in SFHA	Number	1	2	2

Flood Hazard Bylaw	**Adopted?**	Yes	Yes	Yes
	Comment	Yes		
Flood Resilience in Town Plan	**Completed?**	Yes	Yes	Yes
	Comment			
Municipal Bylaw or Zoning District for Water Resource Setback	**River/Stream**	Yes	Yes	Yes
	Comment	Streams has a 50 ft. setback.	Streams have a 50 ft. setback	Outside of Village District, streams have a 75 ft. setback for new structures, but vegetation mgt. is not addressed. Village District: has stream buffer provisions combined with stream setbacks in village growth area. In these areas stream buffers have greater protection regarding how vegetation is managed. - LaPlatte River and Patrick Brook – 100' on either side. Village District - Streams in developed areas – 25' on either side (see map for clarification), unless waived by the DRB based as described below.
	Wetland	Yes	No	Yes
	Comment	Class II wetlands have a 50 ft. setback.		Wetlands and their associated buffer areas (per State of VT) are protected in Hinesburg's two large rural districts (AG and RR2 – 80% of Hinesburg) from certain types of development – i.e., subdivisions and projects requiring site plan review. See section 5.26 of the Zoning Regulations and section 6.12 of the Subdivision Regulations
	Lake/Pond	Yes	No	Yes
	Comment	Lakes/Ponds/Reservoirs over .5 ac = 150 ft. setback.		Lake/Pond has a 75 ft. setback. Outside of Village District
Potential actions to address gaps in Water Quality Protection		Actively implementing Flow Restoration Plan(s) and Phosphorus Control Plan as required.	Actively implementing Flow Restoration Plan(s) and Phosphorus Control Plan as required.	Continue to pursue funds for final design and implementation of water quality projects identified by Town and/or Lewis Creek Association (LaPlatte River Partnership)
	Status	Milton	Richmond	Saint George
National Flood Insurance Program (NFIP)	**Enrolled?**	Yes	Yes	Yes
Road and Bridge Standards	**Adopted?**	Yes	Yes	Yes
Hazard Mitigation Plan (LHMP)	**Adopted?**	Yes	Yes	Yes
River Corridor Protection	**Adopted?**	Early Adopter	Early Adopter	Y es
Comments on River Corridor Protection				
ERAF % from State	**Percent**	17.5	17.5	17.5
Structures in SFHA	**Number**	71	100	0
SFHA structures insured	**Percent**	13%	16%	?
Critical or Public Facilities in SFHA	**Number**	0	4	0

Flood Hazard Bylaw	**Adopted?**	Yes	Yes	Yes
	Comment			
Flood Resilience in Town Plan	**Completed?**	Yes	Yes	Yes
	Comment			
Municipal Bylaw or Zoning District for Water Resource Setback	**River/Stream**	Yes	Yes	Yes
	Comment	25 ft. buffer from surface waters throughout town, 50 ft. minimum buffer from surface waters in forestry/conservation district	Winooski, Huntington Rivers has a 50 ft. setback. For other rivers, brooks & ponds a 50 ft. setback is "highly encouraged."	Streams have a 50 ft. setback.
	Wetland	Yes	Yes	Yes
	Comment	50 ft. minimum buffer from wetlands in forestry/conservation district	Class II wetlands have a 50 ft. setback.	Class II wetlands have a 50 ft. setback.
	Lake/Pond	Yes	Yes	No
	Comment	25 ft. buffer from surface waters throughout town, 50 ft. minimum buffer from surface waters in forestry/conservation district	Gillette Pond & Lake Iroquois has a 50 ft. setback. other rivers, brooks & ponds has a 50 ft. setback.	Note: No significant ponds in town.
Potential actions to address gaps in Water Quality Protection		Continue to pursue funding for design and implementation of projects identified in Stormwater Master Plan and in Town Phosphorus Control Plan	Continue to pursue funding for design and implementation of projects identified in Stormwater Master Plan	None

Franklin County

Municipality	National Flood Insurance Program	Road and Bridge Standards	Local Emergency Management Plan	Local Hazard Mitigation Plan	River Corridor Protection[1]	ERAF Rate	E911 Structures in Special Flood Hazard Area (SHFA)	SFHA Structures Insured	Critical or Public Structures in SFHA	Percent of All Town Structures in SFHA	Steep Slope Protection	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?
	Enrolled?	Adopted?	Completed?	Adopted?	None, CRS, By-Law, or Interim	Percent	Count	Percent	Count	Percent	In by-laws, ordinances, town plan, or zoning?	Rivers	Wetlands	Lakes
Alburgh	Yes	No	No	No	No	7.5%	203	3%	0	11%	No	Yes	No	Yes- Cites SPA
Bakersfield	Yes	Yes	No	Yes	Yes	7.5%	14	0	0	2%	Yes	Yes	Yes	No
Berkshire	Yes	Yes	Yes	No	No	7.5%	19	11%	0	3%	Yes	Yes	Mentioned in Town Plan but no regulations in place	Yes
Enosburg Falls Village	Yes	Yes	Yes	No	Yes	7.5%	2	0	0	0%	Yes	Yes	No	No
Enosburgh	Yes	Yes	Yes	No	No	7.5%	24	13%	0	2%	Yes	Yes	Yes	No
Fairfax	Yes	Yes	Yes	Yes	No	12.5%	35	0	0	2%	Yes	Yes	No	Yes- Cites SPA

Municipality	National Flood Insurance Program	Road and Bridge Standards	Local Emergency Management Plan	Local Hazard Mitigation Plan	River Corridor Protection[1]	ERAF Rate	E911 Structures in Special Flood Hazard Area (SHFA)	SFHA Structures Insured	Critical or Public Structures in SFHA	Percent of All Town Structures in SFHA	Steep Slope Protection	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?
Fairfield	Yes	Yes	No	Yes	No	7.5%	61	0	1	6%	Yes	Yes	Mentions the need for protections in Town Plans but has no regulations in place.	Yes- Cites SPA
Fletcher	Yes	Yes	Yes	No	No	7.5%	45	0	0	7%	Yes	No	Yes	Yes
Franklin	Yes	Yes	Yes	No	No	7.5%	57	2%	3	6%	Yes	Yes	Yes	Yes
Georgia	Yes	Yes	Yes	Yes	Yes	17.5%	28	7%	0	1%	Mentioned in Town Plan but has no regulations in place.	Yes	Yes	Yes
Grand Isle	Yes	No	Yes	No	No	7.5%	84	6%	0	7%	No	Yes	Yes	Yes
Highgate	Yes	No	Yes	Yes	No	7.5%	48	2%	0	3%	Mentioned in Town Plan but has no regulations in place.	Yes	Yes	Yes

Municipality	National Flood Insurance Program	Road and Bridge Standards	Local Emergency Management Plan	Local Hazard Mitigation Plan	River Corridor Protection[1]	ERAF Rate	E911 Structures in Special Flood Hazard Area (SHFA)	SFHA Structures Insured	Critical or Public Structures in SFHA	Percent of All Town Structures in SFHA	Steep Slope Protection	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?
Isle La Motte	Yes	Yes	Yes	Yes	Yes	17.5%	59	3%	0	11%	No	The Town Plan mentions setbacks suggested by ANR but has no regulations in place	No	No
Montgomery	Yes	Yes	Yes	No	Yes	7.5%	48	13%	1	6%	Mentioned in Town Plan	Yes	No	No
North Hero	Yes	Yes	Yes	Yes	No	12.5%	162	10%	0	16%	No	50-foot setbacks on streams- Town Plan states plan to adopt River Corridor regulations in the future	Yes	Yes
Richford	Yes	Yes	Yes	No	Yes	7.5%	16	0	0	5%	Yes	No	Encouraged in Town Plan but no regulations in place	No

Municipality	National Flood Insurance Program	Road and Bridge Standards	Local Emergency Management Plan	Local Hazard Mitigation Plan	River Corridor Protection[1]	ERAF Rate	E911 Structures in Special Flood Hazard Area (SHFA)	SFHA Structures Insured	Critical or Public Structures in SFHA	Percent of All Town Structures in SFHA	Steep Slope Protection	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?
Richford Village	Yes	Yes	Yes	No	Yes	7.5%	27	4%	0	4%	Yes	No	Encouraged in Town Plan but no regulations in place	No
Sheldon	Yes	Yes	Yes	No	No	7.5%	30	7%	0	3%	Yes	No	Yes	No
South Hero	Yes	No	Yes	No	No	7.5%	58	14%	0	4%	Mentioned in Town Plan but has no regulations in place	Town Plan mentions the need for development to minimize impacts to rivers, but no regulations are in place	No	Yes
St. Albans City	Yes	Yes	Yes	Yes	No	12.5%	53	2%	3	2%	Yes	No	Yes	No
St. Albans Town	Yes	No	Yes	Yes	No	7.5%	283	8%	1	9%	Yes	Yes	No	Yes
Swanton	Yes	Yes	Yes	Yes	No	12.5%	162	9%	1	4%	Yes	Yes	Yes	Yes
Swanton Village	Yes	Yes	Yes	Yes	No	12.5%	16	19%	0	1%	Yes	Yes	Yes	Yes

Appendix C. Responsiveness Summary

Vermont Department of Environmental Conservation

Agency of Natural Resources

Responsiveness Summary to Public Comments Regarding:

Basin 5 Tactical Basin Plan

On September 25, the Vermont Department of Environmental Conservation (DEC) of the Agency of Natural Resources (ANR) released a final draft of the Basin 5 Tactical Basin Plan for a public comment period. Press releases were sent out to regional publications by DEC and the Chittenden County Regional Planning Commission, Central Vermont Regional Planning Commission, and Lamoille County Planning Commission informing the public of the public comment opportunity. The public-comment period, which ended on October 24, included two public meetings, see below. X additional public meetings were noticed by X during their monthly X for further public outreach on the draft plan. Comments were received either during the formal public comment meetings or written comments were submitted via email or mail.

2024 meetings for public comment include:

• October 1 – 11:00 AM – Winooski, Vt. – Hybrid Meeting & Presentation (x Attendees)

• October 17 – 6:00 PM – Essex Junction, Vt. – Hybrid Meeting & Presentation (x Attendees)

The DEC prepared this responsiveness summary to address specific comments and questions and to indicate how the plans have been modified in response to public comment. Comments may have been paraphrased or quoted in part, and similarly comments are grouped and answered collectively when appropriate. The full text of the comments provided for each plan is available for review by contacting the Water Investment Division.

Comments

Comment 1: Page 20: Figure 7.