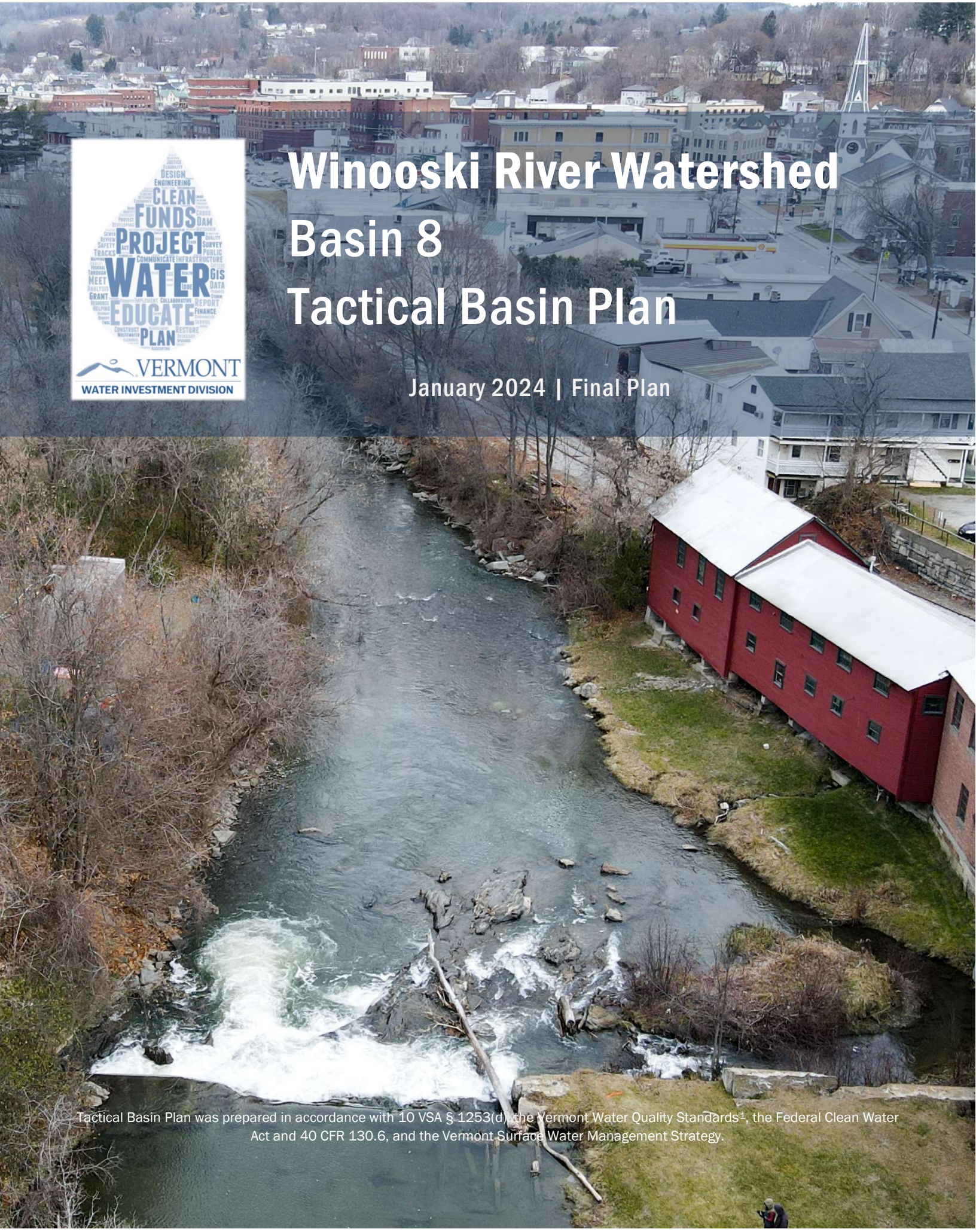


# Winooski River Watershed Basin 8 Tactical Basin Plan

January 2024 | Final Plan

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:

1/5/2024

Jason Batchelder, Commissioner — Date

Department of Environmental Conservation

1/5/2024

Julie Moore, Secretary — Date

Agency of Natural Resources

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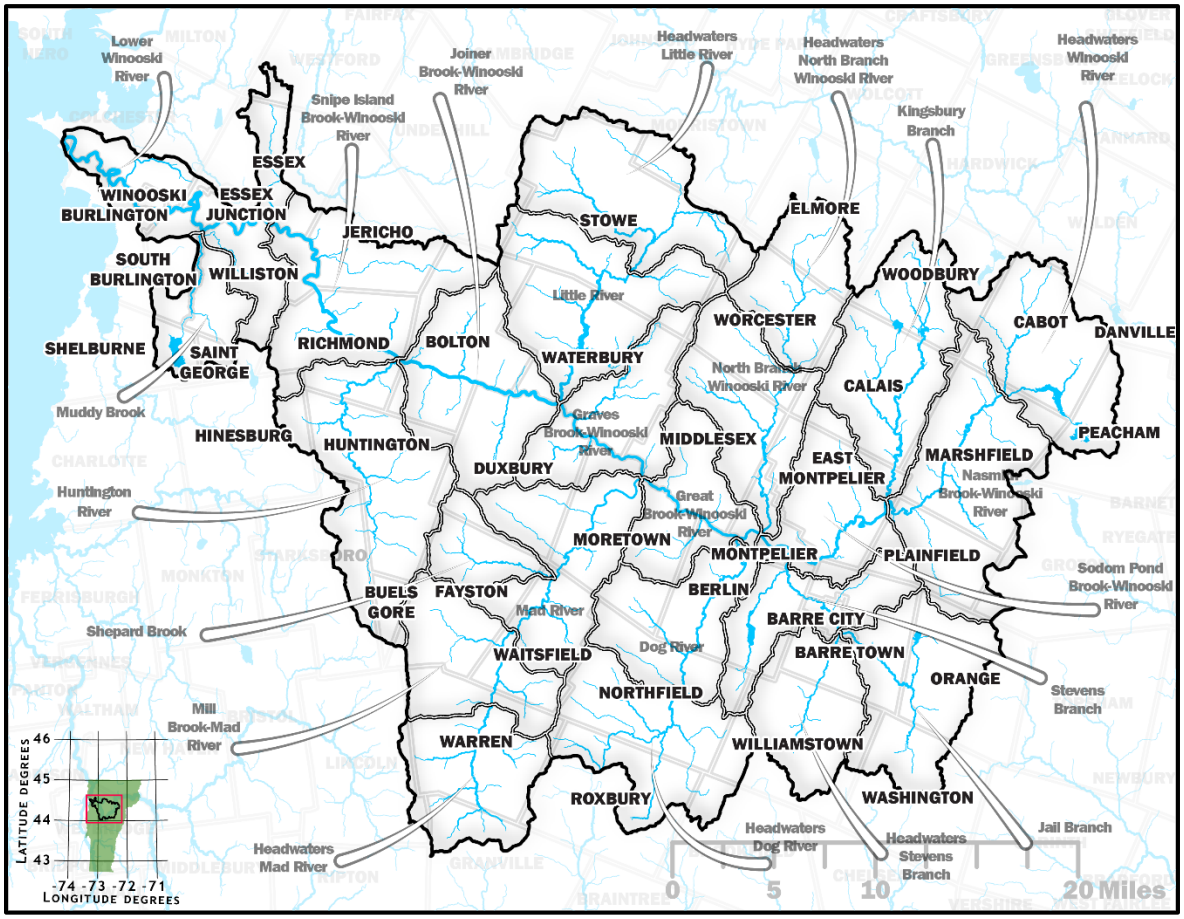
**GIS & Mapping support: Sean Regalado & Phillip Jones, VT Agency of Natural Resources**

**Cover Photo: Stevens Branch running through Barre City, Jim Deshler Photography**

## Winooski River Basin Towns

| | | | |
|---|---|---|---|
| Barre City | Elmore | Morristown* | Waitsfield |
| Barre Town | Essex | Northfield | Walden* |
| Berlin | Fayston | Orange | Warren |
| Bolton | Granville* | Peacham | Washington |
| Brookfield* | Groton* | Plainfield | Waterbury |
| Buels Gore | Hinesburg* | Richmond | Westford* |
| Burlington | Huntington | Roxbury | Williamstown |
| Cabot | Jericho | Saint George | Williston |
| Calais | Lincoln* | Shelburne | Winooski |
| Cambridge* | Marshfield | South Burlington | Woodbury |
| Colchester | Middlesex | Starksboro* | Worcester |
| Duxbury | Montpelier | Stowe | |
| East Montpelier | Moretown | Underhill* | |

**Only a very small area of the town is in the watershed and is covered in more detail in corresponding basin plans.*



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# Executive Summary

The Winooski River basin (Basin 8) covers approximately 1080 square miles, and accounts for 11.5 percent of Vermont's land area. The main stem of the Winooski River flows 94 miles from Cabot to Colchester and enters Lake Champlain at an elevation 1,200 feet lower than where it originates. The Basin occupies major parts of Washington and Chittenden Counties and lesser parts of Lamoille, Orange, Caledonia, and Addison Counties. The entire watershed includes fifty towns and is roughly 73% forest, 9% agriculture, 9% surface waters and wetland, 6% field and shrubland, and 3% developed area including roads. 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 water quality standards, there are waters in need of restoration and continued monitoring. 39 lakes, ponds, or river segments are identified for restoration. 24 river segments and three lakes are considered impaired, seven lakes are impacted by aquatic exotic species, eight river segments are considered to have altered flow regimes, and three lakes have increasing nutrient trends. 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 Winooski River watershed contribution to the Main Lake segment of 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. 50 detailed strategies and 71 monitoring priorities are recommended for the next five years and summarized in Table 1. 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.**

| | Focus Areas | Priority Strategies |
|---|---|---|
| Agriculture | Muddy Brook, Winooski River, Headwaters Little River, Headwaters Winooski River, Headwaters Stevens Branch, Nasmith Brook, Huntington River, Jail Branch, Stevens Branch, Sodom Pond Brook, Snipe Island Brook, Great Brook, Mad River | • Target field Best Management Practice implementation in high priority watersheds.<br>• Improve nutrient management planning (NMP) through technical support, NMP workshops, and financial support for improved nutrient utilization.<br>• Implement NMPs and associated agricultural water quality practices in high priority catchments.<br>• Support farm teams, conservation equipment programs, soil health assessments, and farmer participation in the Vermont Pay for Phosphorus Program. |

| | Focus Areas | Priority Strategies |
|---|---|---|
| Developed Lands - Stormwater | Basin-wide, with focus on Lower Winooski, Muddy Brook, middle Winooski near Montpelier, Stevens Branch, Jail Branch, and towns of Waterbury, Bolton, Brookfield, Orange, Duxbury for assessment | • Develop, design, and implement stormwater treatment projects identified in Flow Restoration Plans and Phosphorus Control Plans of MS4 and TS4 permittees, Stormwater Master Plans, stormwater mapping reports, or other assessments.<br>• Support the design and implementation of non-regulatory small-scale stormwater practices through Clean Water Initiative or other funding sources.<br>• Provide outreach and technical support to landowners with 3-acre impervious parcels.<br>• Promote and, where appropriate, coordinate existing campaigns to raise awareness and adoption of simple residential stormwater management approaches and chloride application best practices. |
| Developed Lands - Roads | Basin-wide, with focus on Barre City, Stowe, Northfield, Montpelier, Barre Town, Calais, Plainfield, Moretown, Berlin, Cabot, Duxbury, and Middlesex, stormwater-impaired stream segments, lake watersheds with significant road networks | • Provide technical support and funding to towns to implement priority Municipal Roads General Permit projects and to update road erosion inventories.<br>• Develop private road phosphorus reduction estimates and complete private road segmentation and assessments. |
| Wastewater | Barre City, Burlington, Cabot, Calais, Essex Junction, Huntington, Marshfield, Montpelier, Northfield, Middlesex, Moretown, Plainfield, Richmond, South Burlington, Stowe, Waitsfield, Warren, Waterbury, Williamstown, Winooski, Woodbury | • Support municipalities pursuing wastewater treatment facility phosphorus optimization, expansion projects, and upgrades to meet total maximum daily load allotments, phosphorus optimization and combined sewer overflow requirements.<br>• Support and ensure monitoring and permit compliance for waste management systems.<br>• Provide technical assistance and funding to towns interested in exploring and implementing village wastewater systems and septic replacement through ANR Village Wastewater Solutions.<br>• Promote septic system maintenance in communities adjacent to nutrient- or bacteria-degraded waters via Wastewater Workshops. |

| | Focus Areas | Priority Strategies |
|---|---|---|
| Rivers | Winooski Headwaters, Dog River, Stevens and Jail Branches, Little River, Huntington River, Mad River | • Evaluate water quality benefits of protection and restoration projects identified in state-supported plans and develop and implement priority projects.<br>• Pilot the identification, development, and implementation of low-tech, process-based restoration projects to improve stream equilibrium.<br>• Support municipalities in updating flood hazard bylaws and considering adoption of river corridor protections with new Federal Emergency Management Agency maps.<br>• Scope, develop, and implement priority culvert upgrade and dam removal projects.<br>• Encourage landowner and recreationist stewardship of riparian areas through established social marketing and signage campaigns for water quality and biodiversity benefit, e.g., Stream Wise.<br>• Support outreach to towns on opportunities to reclassify waters based on recreation-fishing, aquatic biota and wildlife, and aquatic habitat uses. |
| Lakes | Sabin Pond, Forest Lake, Shelburne Pond, Peacham Pond, Lake Mirror, Lake Greenwood, Curtis Pond | • Implement Next Generation Lake Assessments to rapidly assess lake stressors and evaluate the need for more detailed lake assessments.<br>• Evaluate community support for and implement Lake Wise assessments and Lake Watershed Action Plans in populated lake communities with fair to poor shoreland or watershed conditions.<br>• Develop and implement priority projects identified during Lake Wise or Lake Watershed Action Plan assessment.<br>• Maintain and build the capacity for existing aquatic invasive species management and prevention programs.<br>• Where applicable, increase protections for high-quality lakes through reclassification or evaluate reclassification potential through additional monitoring. |
| Wetlands | Potential Class I wetlands, VRAM-assessed wetlands, RCPP-identified wetland restoration priorities | • Develop a process for crediting the phosphorus reduction of wetland protection and restoration projects.<br>• Scope and develop small-scale (10 – 50-acre) wetland protection and restoration opportunities.<br>• Provide support to the Wetlands Program for publicizing updated wetland mapping and local efforts for reclassification. |
| Forests | State lands, town forests, and large private lands with significant tributary networks | • Pilot forest road inventories and implement priority projects on state, municipal, and potentially private lands.<br>• Identify and implement feasible forest erosion projects identified with emerging forest erosion mapping tools.<br>• Support the use of skidder bridges through rental and incentive programs.<br>• Encourage land conservation and Use Value Appraisal enrollment where landowners are interested, especially in drinking water source protection areas. |

The 2018 Winooski basin plan identified 52 strategies to address protection and restoration of surface waters. Of the 52 strategies identified, 32 are complete, 17 are in progress, one is discontinued, and two have not been pursued but will be carried over to this basin plan (continued) (Figure 1). The Winooski basin report card, to be included in the upcoming 2023 Vermont Clean Water Initiative Performance Report, will include a list of detailed updates for each strategy identified in the 2018 Plan. Several strategies will be carried over to this plan.

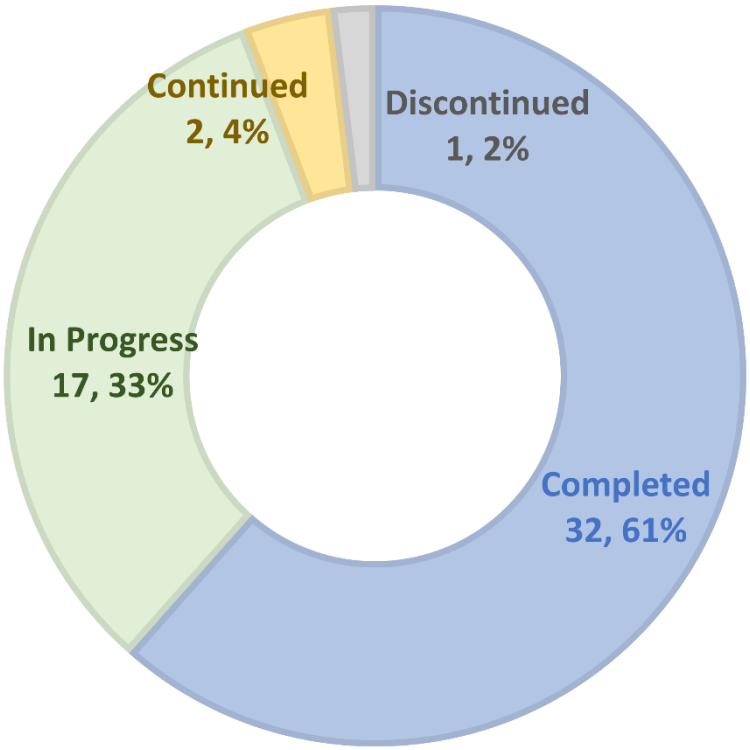



**Figure 1. Status of strategies from the 2018 TBP.**

The 50 priority strategies identified in this plan reflect input from the public, state and federal water quality staff, sector-based workgroups, watershed groups, and regional planning commissions. During the basin planning process, stakeholders expressed that unified clean water messaging, technical support and training on how to protect and maintain surface waters, and continued financial and technical support, are all critical to meet water quality goals. There was also a strong sentiment that all waters in the Winooski River Basin should be protected regardless of their current status. The importance of ensuring access to waters for all members of the community was identified including ensuring clean surface water for consumptive and recreational uses and the safe consumption of fish, access to waters for recreation for all abilities and economic levels, open space availability and access in more densely populated areas and equitable implementation of clean water projects.

# 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 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.

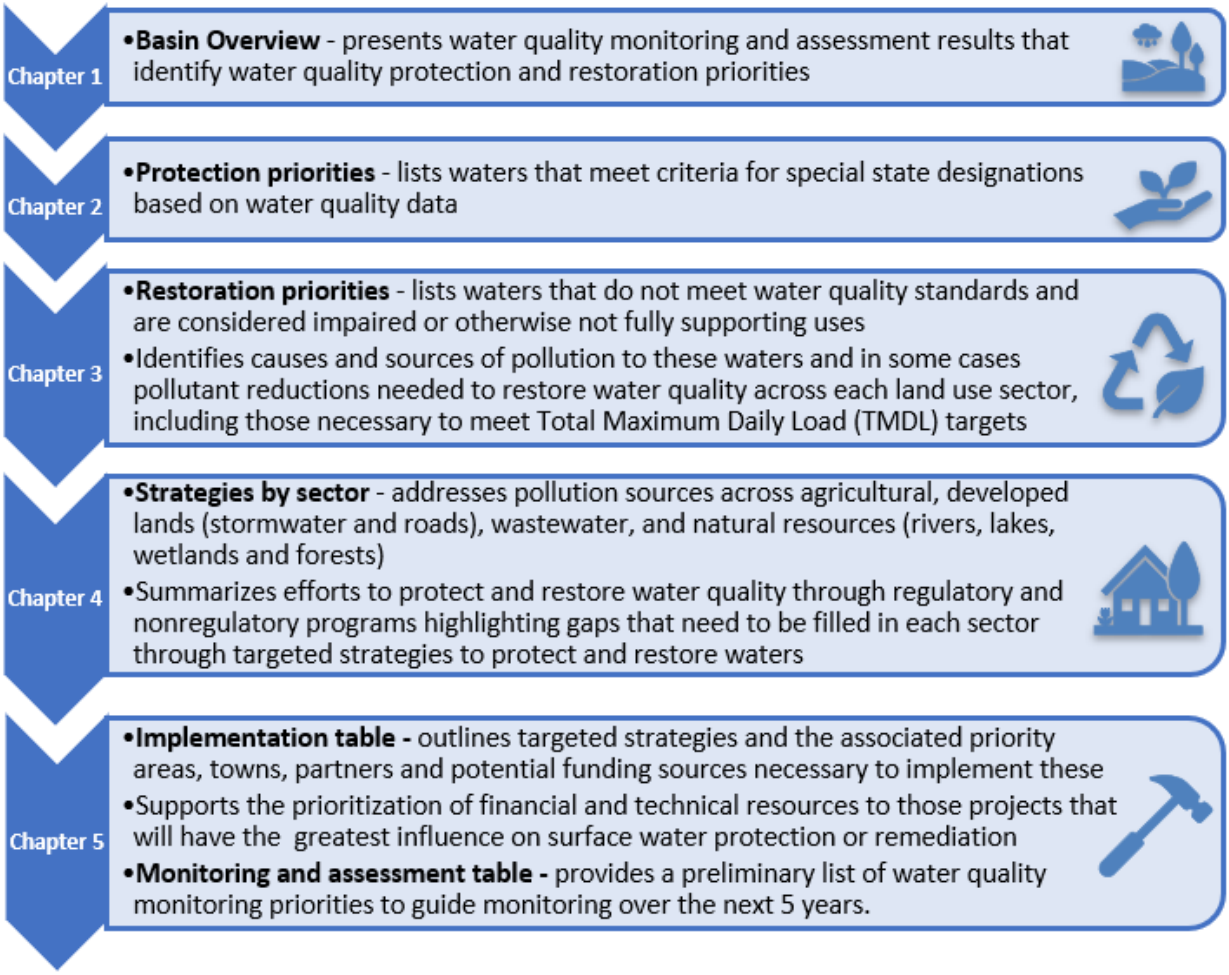



**Figure 4. Chapters of Tactical Basin Plans.**

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 (Figure 4).

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 Winooski River basin (Basin 8) encompasses 1,080 square miles in Vermont. The entire watershed spans fifty towns covering six counties: major parts of Washington and Chittenden County and lesser parts of Lamoille, Orange, Caledonia, and Addison counties. The Winooski River begins its 94-mile journey in Cabot and terminates at its confluence with Lake Champlain in Colchester. The river basin comprises 24 sub-basins (Figure 5) which include the Huntington, Mad, Dog, and Little Rivers, the Kingsbury, Stevens, Jail, and North Branches, and many other smaller Winooski River tributaries. Detailed information about each of these rivers and other smaller watersheds within the Basin can be found in previous individual basin assessment reports and the 2018 Winooski River Tactical Basin Plan.

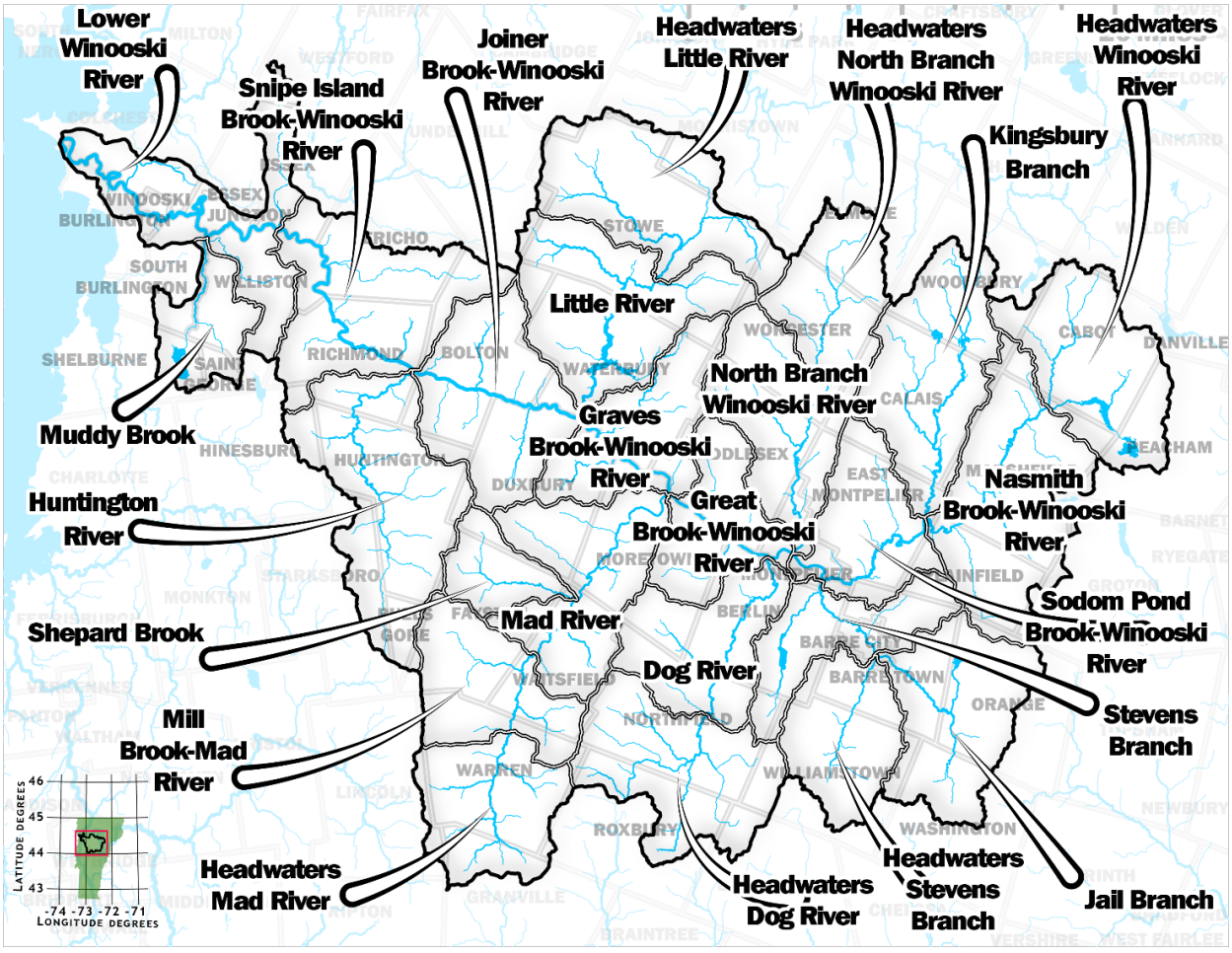



**Figure 5. The Winooski basin is composed of 24 sub-watersheds that drain to Lake Champlain.**

## Land Use and Land Cover

The Winooski Basin is a predominantly forested landscape. Forested land covers about 73% of the Basin while about 9% is wetlands and open water. Developed and agricultural land cover about 3% and 9% of the Basin, respectively (Figure 6). A basin-wide analysis of land use change from 2001 to 2019 showed some changes in land cover over this time including increases in developed lands (7715 acres) and shrub scrub (5779 acres) and decreases in forest (-9914 acres) and pasture and hay (-3635 acres). Developed land increases were greatest in the lower portion of the Winooski basin (Winooski River, Muddy Brook, and Snipe Island Brook sub-basins), in the headwaters of the Little River and Graves Brook-Winooski sub-basins, and in the Jail and Stevens Branch sub-watersheds. Likewise, forestland losses were greatest in the Little River and headwaters Little River, Graves Brook-Winooski, Snipe Island Brook-Winooski, and Nasmith Brook-Winooski sub-watersheds.

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 can too.

## Climate Change Implications for Water Resource Management

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).

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.

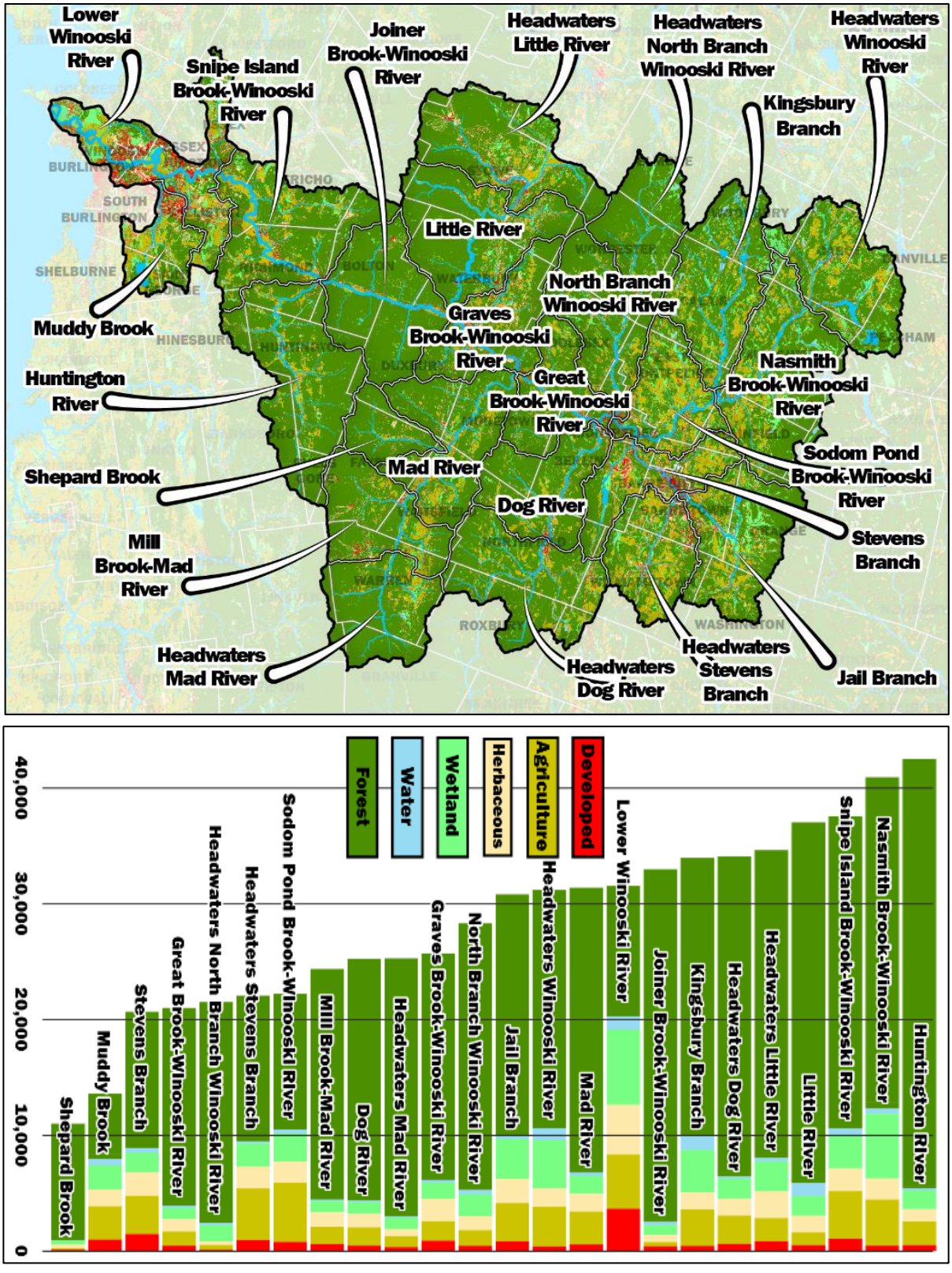



Figure 6. Land cover by acreage across Winooski basin sub-watersheds.

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 fluvial erosion (stream-related erosion) all of 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 streamflows 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 streamflows 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'Neil-Dunne, 2016) (Weiskel, 2007). However, the plan also identifies restoration strategies— such as floodplain, stream, and wetland restoration and agricultural, forestry, and stormwater best management practice implementation— to complement protective measures where appropriate. 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 a Climate Action Plan (2021 Initial Vermont Climate Action Plan), and requires the Agency of Natural Resources to adopt rules consistent with the plan.

## Summer 2023 Flooding

In July 2023 catastrophic flooding occurred across Vermont, in some places surpassing water levels experienced during Tropical Storm Irene. The Winooski basin town of Calais received the greatest 48-hour rainfall amount in the state during this storm event (9.20"), and 4-8" of rain were commonplace through central Vermont. Many Winooski basin towns sustained severe damage, and statewide impacts warranted a federal disaster declaration in eight Vermont counties. Moreover, a preliminary estimate (as of September 2023) suggests that the 7-day, flood event phosphorus export to Lake Champlain from the Winooski River exceeded the typical total annual phosphorus load from the Winooski by 130%.

Due to this "superstorm", the following content was developed at the end of the DRAFT Winooski Tactical Basin Plan development process. The following strategies were subsequently drafted as the top recommendations to support flood resiliency in Vermont for municipalities, property owners, and agencies:

- Further consider the benefits of establishing a statewide minimum flood hazard standard for communities to enhance flood recovery and mitigation funding opportunities across the state.
- Pursuant to the Climate Action Plan, identify approaches to expand protection of ANR-mapped river corridors to ensure that future development does not occur in areas vulnerable to flood damage.
- Seek to make permanent the Flood Resilient Communities Fund (FRCF) that was created through an ARPA funding allocation in 2021 and has been a successful flood mitigation program. Additionally, evaluate expanding eligibilities for the FRCF program to maximize the impact of federal hazard mitigation funding and coordinate flood resilience work at the statewide level across state agencies.
- Consider additional conservation practices and incentives for agricultural lands that are located in river corridors and low-lying floodplains that often provide ecosystem services in major flood events.

Of particular note in the Winooski River Basin was the substantial damage to municipal infrastructure that was caused by both inundation (e.g., Barre and Montpelier) and fluvial erosion (e.g., Cabot, Calais, Marshfield, Plainfield, and Washington). The impacts to drinking water and wastewater infrastructure were significant to communities along the Winooski River in central Vermont, with initial estimated repair costs that are projected to be in the millions of dollars. In addition, there were dam breaches and multiple landslides that occurred during and immediately

following the summer flooding that threaten public health and safety and require continued monitoring and/or repair. The importance of private property buyouts and slope stability mitigation will be near term priorities for investment in order to build longer term flood resilience.

## 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 Water Quality Monitoring Program Strategy.

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 Winooski 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 Winooski River
- the Rethink Runoff Stream Team (on behalf of Chittenden County MS4/TS4 permittees)
- Friends of the Mad River (Mad River Watch)
- Barre City River Access Taskforce
- Winooski Headwaters Community Partnership

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.

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 Rivers Program supports stream geomorphic assessments that evaluate geomorphic and physical habitat conditions of rivers.
- The Wetlands Program conducts assessments on wetlands to determine the biological condition and ecological integrity of wetlands.
- The Vermont Fish and Wildlife Department conducts fisheries assessments and targeted temperature monitoring to assess the health of recreational fish populations and opportunities for habitat restoration.
- The Rivers Program and Lakes and Ponds Management and Protection Program maintain a network of twelve stream and five 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 Rivers Program's 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 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 VWQS. Most of the DEC monitoring data can be accessed through the Vermont Integrated Watershed Information System online data portal.

The following is an overview of water resource health in the Winooski basin. More detail is provided in Chapters 2 and 3. Chapter 2 includes waters where values and uses exceed current classifications,

while Chapter 3 includes waters on the Vermont Priority Waters List, the list of rivers and lakes that do not meet VWQS or other Agency criteria.

## 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. These 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.

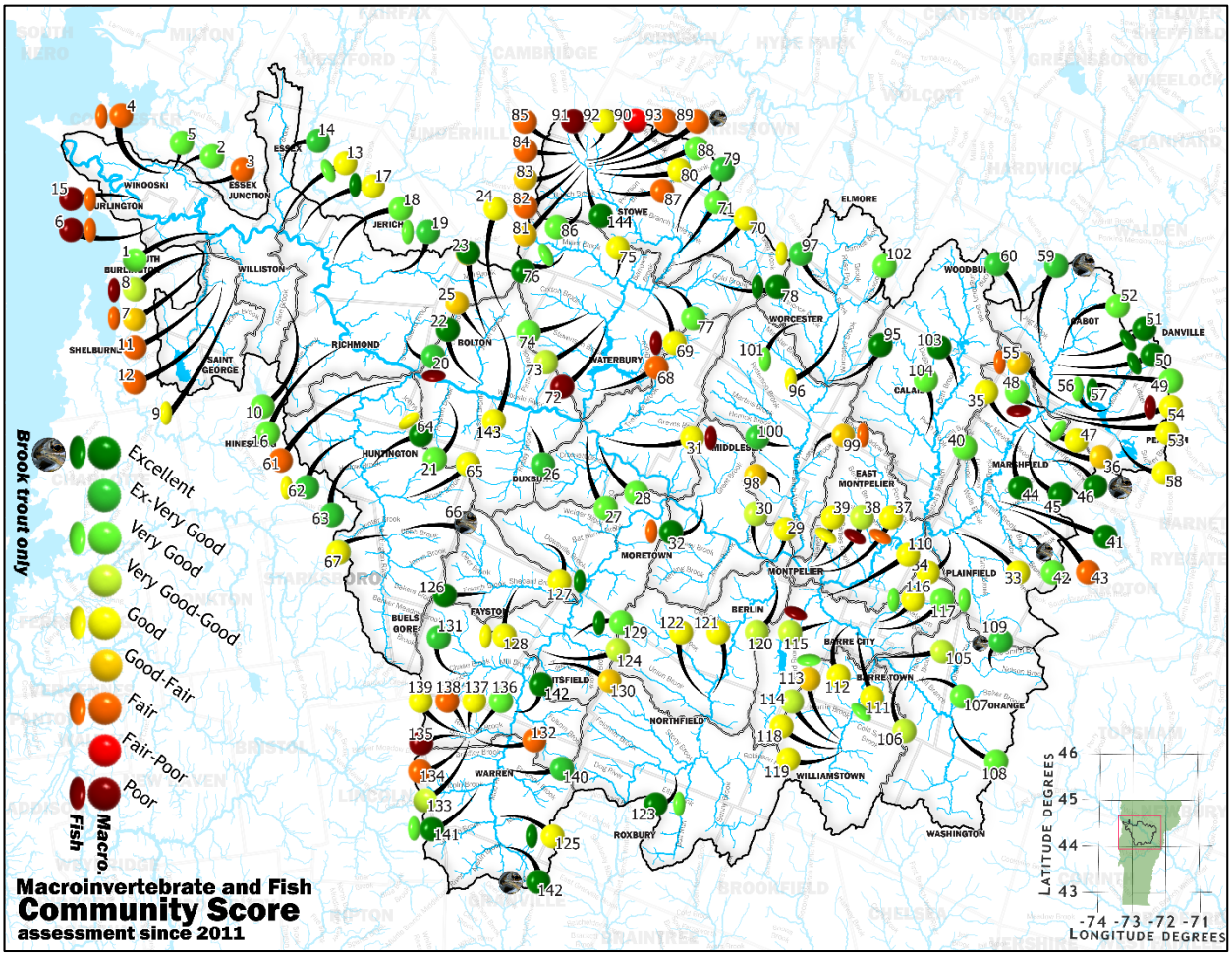



**Figure 7. Biological condition of fish and macroinvertebrate communities of the Winooski basin sampled since 2011. Map IDs correspond with data in Table 2.**

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 the VWQS (2022).

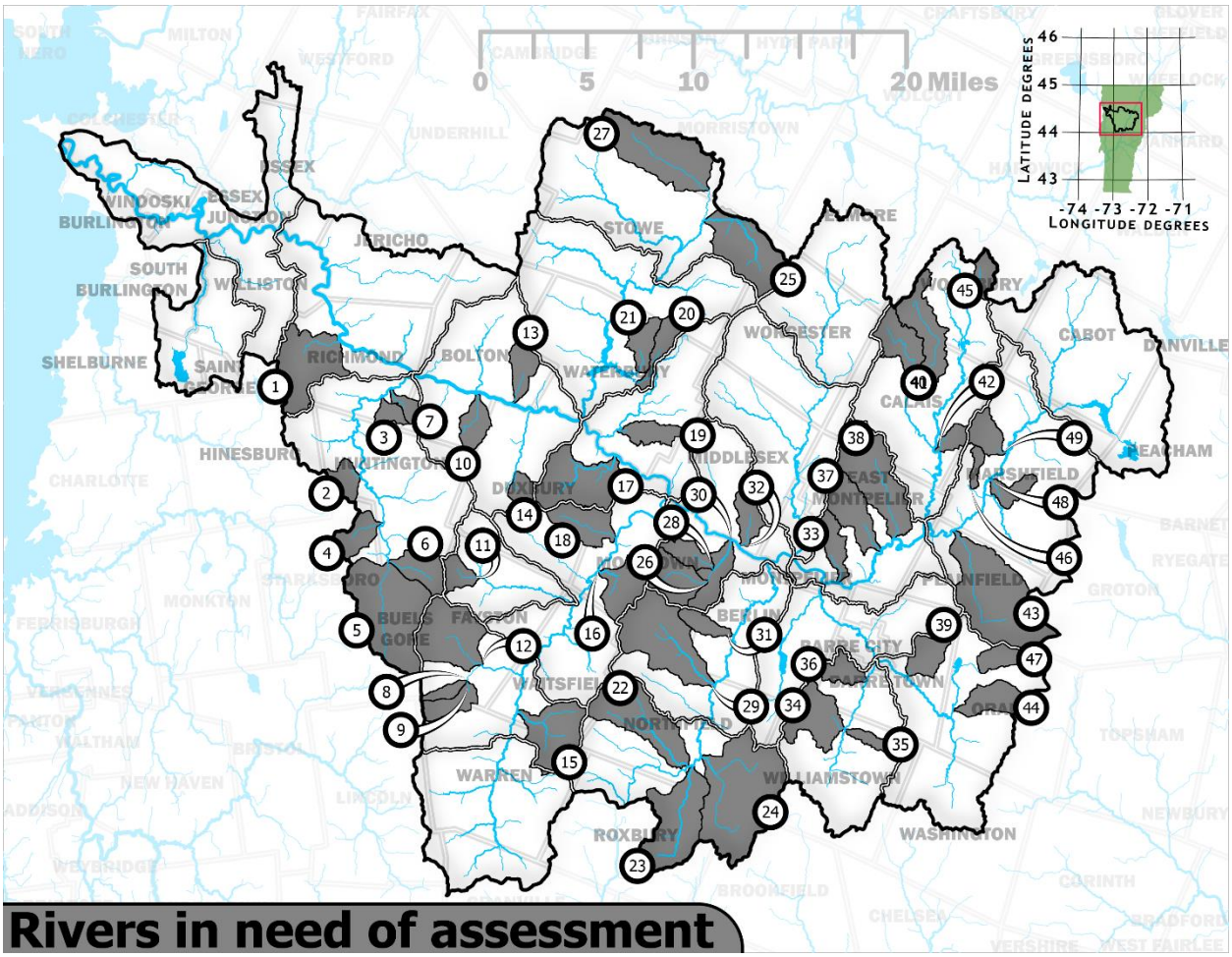



**Figure 8. Stream catchments without current biosurvey data in the Winooski basin. Sites are listed in the Chapter 5 Monitoring Table (Table 20).**

## *Macroinvertebrate Monitoring Results*

Macroinvertebrate assessments were completed at 138 sites in the Winooski basin between 2011 and 2022 (Figure 7, Table 2). 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 8). Some of these will be prioritized based on land use or other factors for the 2025 monitoring season and can be found in the Chapter 5 Monitoring and Assessment Table.

Of the 138 completed macroinvertebrate sites assessed, 60 monitoring sites (43%) exhibited *Very Good* or better condition in their most recent assessment. Of these, 19 were found to be *Excellent*, meaning their macroinvertebrate community is comparable to reference or natural condition. Most of these waters are either headwater streams or located higher up in the watershed. Another 41 were found to be in *Very Good* to *Very Good - Excellent* condition. Streams in *Very Good* or better condition exceed the VWQS criteria for B(2) classification and are priorities for additional assessment and protection. 48 (35%) macroinvertebrate assessments scored *Good* or *Good - Very Good*. These streams meet the VWQS B(2) criteria and are priorities for maintenance and protection. Ten sites (7%) had macroinvertebrate assessments that scored *Fair to Good*. Condition is indeterminate at these sites, and they require more monitoring to determine full aquatic biota support status. 20 sites (15%) scored *Fair* or lower, failing to meet VWQS B(2) criteria.

## *Fish Monitoring Results*

Fish community assessments were completed at 52 sites between 2011 and 2021 in the Winooski basin (Figure 7, Table 2). Six of the sample sites had only Brook Trout, which means that a community assessment could not be made; however, a density criterion can be applied for upward reclassification of Brook Trout only streams. Of the 46 sites where fish communities could be assessed, 21 (46%) had fish communities in *Excellent* or *Very Good* condition, indicating the fish communities at these sites exceed the VWQS for class B(2) streams. Ten (22%) 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.

15 sites (33%) with fish assessments exhibited communities in *Fair* or *Poor* condition. Fish-based conditions at five of these sites scored similarly to the macroinvertebrate-based conditions (i.e., segments of Sunnyside, Centennial, Muddy, Molly's, and Long Meadow Brooks). However, at the remaining ten sites the *Fair* or *Poor* fish-based conditions were in contrast with *Good* to *Excellent* macroinvertebrate-based conditions. Often, a fish community can suggest different stressors from a 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 20).

**Table 2. Bioassessment results in the Winooski basin assessed between 2011 and 2022. Map ID corresponds to assessed sites in biological condition map above. For each site, only the most recent assessment result is given. 'BKT' indicates a brook trout only fish community.**

| Map ID | Site Name, River Mile | Year | Macroinvertebrate Assessment | Year | Fish Assessment |
|---|---|---|---|---|---|
| 1 | Winooski River, 16.3 | 2022 | Very Good | | |
| 2 | Sunderland Brook, 3.6 | 2015 | Very Good | | |
| 3 | Sunderland Brook, 4.6 | 2021 | Fair | | |
| 4 | Sunnyside Brook, 0.2 | 2020 | Fair | 2014 | Fair |
| 5 | Sunnyside Brook Trib 1, 0.1 | 2014 | Very Good | | |
| 6 | Centennial Brook, 0.2 | 2020 | Poor | 2020 | Fair |
| 7 | Muddy Brook, 1.1 | 2021 | Fair - Good | 2020 | Fair |
| 8 | Allen Brook, 2.4 | 2020 | Good - Very Good | 2020 | Poor |
| 9 | Allen Brook, 4.3 | | | 2016 | Good |
| 10 | Allen Brook, 8.2 | 2015 | Very Good | | |
| 11 | Muddy Brook Trib 4, 0.5 | 2015 | Fair | | |
| 12 | Muddy Brook Trib 4, 0.7 | 2015 | Fair | | |
| 13 | Alder Brook, 0.3 | 2020 | Good | 2020 | Very Good |
| 14 | Alder Brook, 4.1 | 2015 | Very Good - Excellent | | |
| 15 | Morehouse Brook, 0.3 | 2021 | Poor | | |
| 16 | Winooski River, 29.9 | 2015 | Very Good | | |
| 17 | Sand Hill Brook, 0.4 | 2020 | Good | 2020 | Excellent |
| 18 | Mill Brook, 0.3 | 2015 | Very Good | | |
| 19 | Mill Brook, 3.6 | 2015 | Very Good - Excellent | 2015 | Very Good |
| 20 | Snipe Island Brook, 1.4 | 2015 | Very Good - Excellent | 2015 | Poor |
| 21 | Preston Brook, 0.9 | 2018 | Very Good | | |
| 22 | Joiner Brook, 0.5 | 2020 | Excellent | | |
| 23 | Joiner Brook, 3.8 | 2022 | Excellent | | |
| 24 | Joiner Brook, 5.5 | 2022 | Good | | |
| 25 | Goose Pond Brook, 0.1 | 2021 | Fair - Good | | |
| 26 | Ridley Brook, 0.8 | 2018 | Very Good - Excellent | | |
| 27 | Winooski River, 42.6 | 2015 | Very Good | | |
| 28 | Winooski River, 42.9 | 2015 | Very Good | | |
| 29 | Winooski River, 54.3 | 2022 | Good - Very Good | | |
| 30 | Winooski River, 54.7 | 2015 | Good | | |
| 31 | Thatcher Brook, 0.1 | 2020 | Good | 2020 | Poor |
| 32 | Great Brook, 0.8 | 2015 | Excellent | 2015 | Fair |
| 33 | Winooski River, 70.7 | 2015 | Good | | |
| 34 | Winooski River, 70.9 | 2015 | Good | | |

| Map ID | Site Name, River Mile | Year | Macroinvertebrate Assessment | Year | Fish Assessment |
|---|---|---|---|---|---|
| 35 | Winooski River, 81.6 | 2020 | Good | | |
| 36 | Winooski River, 81.8 | 2020 | Fair - Good | | |
| 37 | Blanchard Brook, 0.1 | 2015 | Good | 2015 | Fair |
| 38 | Blanchard Brook, 0.2 | 2020 | Good - Very Good | 2020 | Poor |
| 39 | Blanchard Brook, 0.4 | 2016 | Good | 2016 | Good |
| 40 | Guernsey Brook, 0.9 | 2022 | Excellent | 2016 | Very Good |
| 41 | Nasmith Brook, 0.8 | 2022 | Excellent | | |
| 42 | Nasmith Brook, 2.7 | 2022 | Very Good - Excellent | 2016 | BKT |
| 43 | Lye Brook, 0.2 | 2022 | Very Good - Excellent | | |
| 44 | Marshfield Brook, 0.1 | 2022 | Excellent | | |
| 45 | Marshfield Brook, 1.3 | 2021 | Excellent | | |
| 46 | Turtlehead Pond Trib #1, 0.2 | 2022 | Excellent | 2021 | BKT |
| 47 | Winooski River, 82.7 | 2015 | Good | 2015 | Very Good |
| 48 | Winooski River, 82.8 | 2015 | Very Good | 2015 | Poor |
| 49 | Winooski River, 83.8 | 2020 | Good | | |
| 50 | Winooski River, 84.7 | 2016 | Excellent | | |
| 51 | Winooski River, 85.3 | 2018 | Excellent | 2018 | Excellent |
| 52 | Winooski River, 85.7 | 2016 | Very Good | | |
| 53 | Mollys Brook, 0.1 | 2015 | Good | | |
| 54 | Mollys Brook, 0.5 | 2015 | Good | 2015 | Poor |
| 55 | Mollys Brook, 1.5 | 2015 | Fair - Good | 2015 | Fair |
| 56 | Mollys Brook, 4.5 | | | 2015 | Very Good |
| 57 | Mollys Brook, 5.5 | | | 2015 | Excellent |
| 58 | Sucker Brook, 0.3 | 2015 | Good | | |
| 59 | Jug Brook, 1.4 | 2015 | Very Good - Excellent | 2015 | BKT |
| 60 | Jug Brook, 3.0 | 2013 | Very Good - Excellent | | |
| 61 | Huntington River, 0.7 | 2022 | Fair | | |
| 62 | Huntington River, 7.9 | 2015 | Very Good - Excellent | 2015 | Good |
| 63 | Huntington River, 8.6 | 2022 | Very Good - Excellent | | |
| 64 | Fargo Brook, 0.3 | 2015 | Excellent | 2015 | Good |
| 65 | Brush Brook, 2.8 | 2018 | Very Good - Excellent | 2018 | Good |
| 66 | Cobb Brook, 0.4 | 2020 | Very Good | 2020 | Good |
| 67 | Cobb Brook, 0.6 | | | 2021 | BKT |
| 68 | Little River, 2.2 | 2019 | Fair | | |
| 69 | Little River, 7.1 | 2013 | Good | 2013 | Poor |
| 70 | Little River, 11.8 | 2015 | Good | | |
| 71 | Little River, 12.2 | 2015 | Very Good | | |
| 72 | Cotton Brook, 0.1 | 2019 | Poor | | |
| 73 | Cotton Brook, 0.2 | 2022 | Good - Very Good | | |

| Map ID | Site Name, River Mile | Year | Macroinvertebrate Assessment | Year | Fish Assessment |
|---|---|---|---|---|---|
| 74 | Cotton Brook, 1.2 | 2022 | Very Good - Excellent | | |
| 75 | Great Brook, 0.1 | 2017 | Good | | |
| 76 | Michigan Brook, 0.1 | 2021 | Very Good | 2021 | Very Good |
| 77 | Gold Brook, 0.4 | 2020 | Very Good | | |
| 78 | Gold Brook, 3.0 | 2016 | Excellent | 2016 | Excellent |
| 79 | West Branch Little River, 1.0 | 2015 | Very Good - Excellent | | |
| 80 | West Branch Little River, 6.5 | 2022 | Good | | |
| 81 | West Branch Little River, 7.4 | 2022 | Fair - Good | | |
| 82 | West Branch Little River, 7.5 | 2016 | Fair | | |
| 83 | West Branch Little River, 8.0 | 2022 | Fair - Good | | |
| 84 | West Branch Little River, 8.3 | 2018 | Fair | | |
| 85 | West Branch Little River, 8.8 | 2022 | Fair | | |
| 86 | Ranch Brook, 1.5 | 2022 | Very Good - Excellent | | |
| 87 | Inn brook, 0.6 | 2013 | Fair | | |
| 88 | Pinnacle Brook, 0.1 | 2022 | Very Good | | |
| 89 | Big Spruce Brook, 0.2 | 2022 | Fair | 2020 | BKT |
| 90 | Big Spruce Brook, 0.3 | 2022 | Poor - Fair | | |
| 91 | Big Spruce Brook, 0.8 | 2022 | Poor | | |
| 92 | Big Spruce Brook, 0.9 | 2015 | Good | | |
| 93 | Little Spruce Brook, 0.1 | 2021 | Fair | | |
| 94 | North Branch Winooski River, 3.4 | 2020 | Good | 2020 | Good |
| 95 | North Branch Winooski River, 11.0 | 2015 | Excellent | | |
| 96 | North Branch Winooski River, 15.2 | | | 2018 | Good |
| 97 | North Branch Winooski River, 16.1 | 2022 | Very Good - Excellent | 2017 | Good |
| 98 | North Branch Winooski Trib 3, 0.7 | 2017 | Fair - Good | | |
| 99 | Long Meadow Brook, 0.9 | 2020 | Fair - Good | 2020 | Fair |
| 100 | Martins Brook, 0.7 | 2020 | Very Good - Excellent | | |
| 101 | Hancock Brook, 1.9 | | | 2021 | Very Good |
| 102 | Hardwood Brook, 1.6 | 2013 | Very Good | | |
| 103 | Kingsbury Branch, 13.5 | 2020 | Excellent | | |
| 104 | Pekin Brook, 0.9 | 2014 | Very Good | 2014 | Very Good |
| 105 | Jail Branch, 0.1 | 2015 | Good - Very Good | | |
| 106 | Jail Branch, 2.2 | 2020 | Good - Very Good | | |
| 107 | Jail Branch, 2.8 | 2015 | Very Good | | |
| 108 | Orange Brook, 0.2 | 2013 | Very Good | | |
| 109 | Nelson Brook, 2.3 | 2016 | Very Good - Excellent | 2016 | BKT |
| 110 | Stevens Branch, 0.6 | 2020 | Good | | |
| 111 | Stevens Branch, 2.8 | 2015 | Good | 2015 | Very Good |
| 112 | Stevens Branch, 3.3 | 2015 | Good | | |

| Map ID | Site Name, River Mile | Year | Macroinvertebrate Assessment | Year | Fish Assessment |
|---|---|---|---|---|---|
| 113 | Stevens Branch, 11.9 | 2020 | Fair - Good | 2020 | Very Good |
| 114 | Stevens Branch, 12.1 | 2020 | Good - Very Good | | |
| 115 | Stevens Branch Trib 6, 0.2 | 2021 | Good - Very Good | 2021 | Poor |
| 116 | Gunners Brook, 0.8 | 2020 | Very Good | 2021 | Very Good |
| 117 | Gunners Brook, 1.1 | 2020 | Good | 2021 | Very Good |
| 118 | Stevens Branch Trib 23, 0.3 | 2018 | Good | | |
| 119 | Stevens Branch Trib 23, 0.5 | 2015 | Good | | |
| 120 | Dog River, 0.9 | 2015 | Good - Very Good | | |
| 121 | Dog River, 8.8 | 2020 | Good | | |
| 122 | Dog River, 9.0 | 2020 | Good | | |
| 123 | Dog River, 14.8 | 2016 | Excellent | 2016 | Very Good |
| 124 | Mad River, 12.1 | 2015 | Good - Very Good | | |
| 125 | Mad River, 21.9 | 2015 | Good | 2015 | Excellent |
| 126 | French Brook, 0.5 | 2020 | Excellent | | |
| 127 | Dowsville Brook, 2.9 | 2013 | Good | 2013 | Excellent |
| 128 | Shepard Brook, 4.3 | 2013 | Good - Very Good | 2013 | Good |
| 129 | Pine Brook, 0.5 | 2019 | Very Good | 2019 | Excellent |
| 130 | High Bridge Brook, 0.4 | 2020 | Fair - Good | | |
| 131 | Chase Brook, 1.2 | 2020 | Very Good - Excellent | | |
| 132 | Clay Brook, 1.8 | 2016 | Fair | | |
| 133 | Clay Brook, 2.0 | 2022 | Good | | |
| 134 | Clay Brook, 2.1 | 2022 | Good – Very Good | | |
| 135 | Clay Brook, 2.3 | 2015 | Poor | | |
| 136 | Rice Brook, 0.1 | 2015 | Good - Very Good | | |
| 137 | Rice Brook, 0.4 | 2021 | Good | | |
| 138 | Rice Brook, 0.6 | 2021 | Fair | | |
| 139 | Rice Brook, 0.7 | 2016 | Good | | |
| 140 | Freeman Brook, 0.4 | 2015 | Very Good - Excellent | | |
| 141 | Lincoln Brook, 0.9 | 2020 | Excellent | 2020 | Very Good |
| 142 | Folsom Brook, 0.2 | 2022 | Excellent | | |
| 143 | Joiner Brook, 5.0 | 2022 | Good | | |
| 144 | Pinnacle Brook, 0.6 | 2022 | Excellent | | |

## *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 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.

Phase 1 Stream Geomorphic Assessments have been completed on about 1160 miles of streams in the watershed (38% of stream miles), and 394 miles have had Phase 2 Stream Geomorphic Assessments completed (about 13% of perennial stream miles). 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 9). Most larger tributaries in the Winooski have been subject to Phase 2 Assessments; therefore, the fair to pair geomorphic conditions noted by Phase 2-assessed reaches are likely representative of basin conditions. No assessments have been completed in the basin since the 2018 TBP.

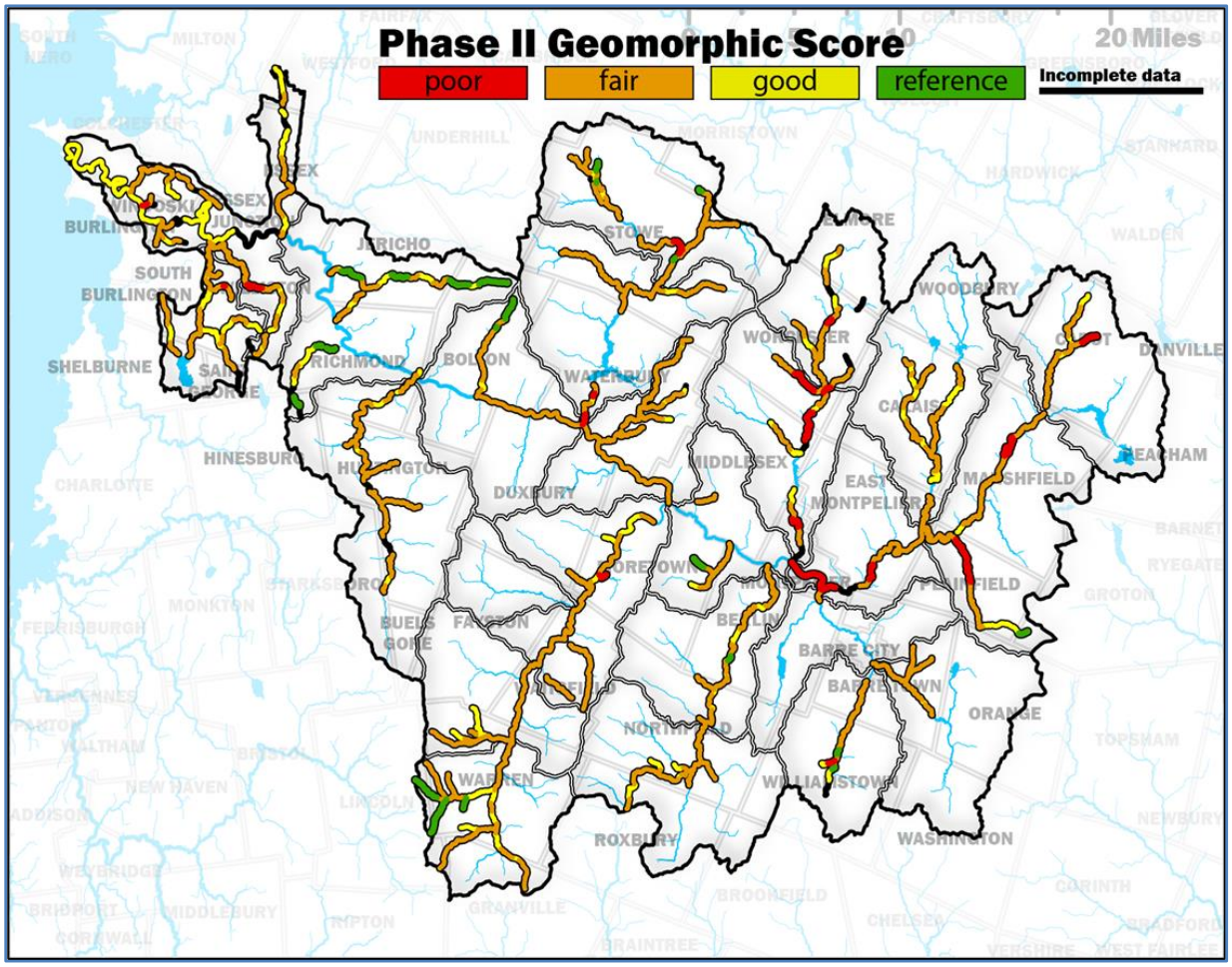



**Figure 9. Geomorphic condition of assessed Winooski basin rivers and streams.**

## *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 nine total sites in the Winooski basin: two wastewater treatment facility (WWTF) effluent sites (Montpelier [receives landfill leachate] and Barre [permitted to receive landfill leachate but does not currently]) and seven surface water sites (the mouth of Muddy Brook, the Stevens Branch above and below the Barre WWTF, and the Winooski River at its mouth, below Allen Brook, and above and below the Montpelier WWTF). Samples were analyzed for 36 PFAS chemicals, including the five Vermont-regulated PFAS.

An April 2022 PFAS monitoring report of the results indicates that PFAS concentrations were low and below reporting limits at all but two of the sample Winooski surface water sites. Five PFAS chemicals were above detection limits in the Winooski River below Allen Brook and eight were above detection limits at the mouth of Muddy Brook. However, both sites' total PFAS concentrations were still below the Vermont Drinking Water Advisory of 20 parts per trillion (ppt) for the sum of the five Vermont-regulated PFAS (Muddy Brook = 14.8 ppt; Winooski below Allen Brook = 10.7 ppt) and low compared to national studies.

At WWTFs, five PFAS chemicals were above detection limits in Barre effluent and 12 were above detection limits in Montpelier effluent. Total PFAS concentrations in Barre effluent were 2.5 ppt for the five VT-regulated PFAS chemicals and 36.8 ppt for all analyzed PFAS chemicals, respectively.

Likewise, total PFAS concentrations in Montpelier effluent were 79.7 ppt and 377.8 ppt, respectively.

In addition to surface water sampling, yellow perch, northern pike, brown bullhead, rainbow trout, and brown trout were sampled for PFAS in the Stevens Branch below the WWTF (trout species) and at the mouth of the Winooski River (non-trout species). While fish tissue concentrations were highest at the Winooski mouth among the sites sampled in northern Vermont (maximum total PFAS = 18.6 μg/kg), these values are considered low relative to national fish tissue studies (ANR, 2022). Winooski basin surface waters (5 sites) and fish tissue (2 sites) were sampled again in 2022 and a report of the results is in preparation.

## *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 also evidence that negative impacts occur below the VWQS criteria concentrations. Macroinvertebrate community health in Vermont streams appears to 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. In 2022, 8 lakes and 33 streams were sampled for chloride concentration in the Winooski basin. Ten river (no lake) sites showed elevated concentrations (>50 mg/l). Where elevated levels exist, there is a greater chance of impairment existing; however, sufficient data needs to be collected to make impairment determinations according to assessment methodologies supportive of the VWQS.

Beginning in 2022, electrical conductivity has been monitored in Little and Big Spruce Brooks (Stowe) as a method to estimate continuous chloride concentrations. Such targeted monitoring creates a more robust and extensive dataset to properly document chloride impaired waters. Likewise, although not close to impaired levels, chloride concentrations in the mainstem Winooski River and the Main Lake segment of Lake Champlain have been increasing significantly since 1993. More information on the WSMD approach to chloride monitoring and reduction is available in the 2022-2023 Water Quality Monitoring and Assessment Report.

## Lakes and Ponds

There are 46 lakes and ponds in the Basin that are ten acres or greater. Of the nine lakes in the Basin over 100 acres, five have dams that are managed by hydroelectric facilities: Waterbury Reservoir (869 acres), Molly's Falls Reservoir (402 acres), Peacham Pond (347 acres), Wrightsville Reservoir (181 acres), and Thurman W. Dix Reservoir (125 acres). Berlin Pond (290 acres) and Thurman W. Dix Reservoir serve as drinking water supplies for the cities of Montpelier and Barre, respectively. The three remaining large ponds are Shelburne Pond (479 acres), Sabin Pond (148 acres), and Forest Lake (135 acres). Most lakes and ponds in the Basin (including these largest lakes) are impounded by dams. More information on dam location, status, purpose, and ownership can be found in Appendix A.

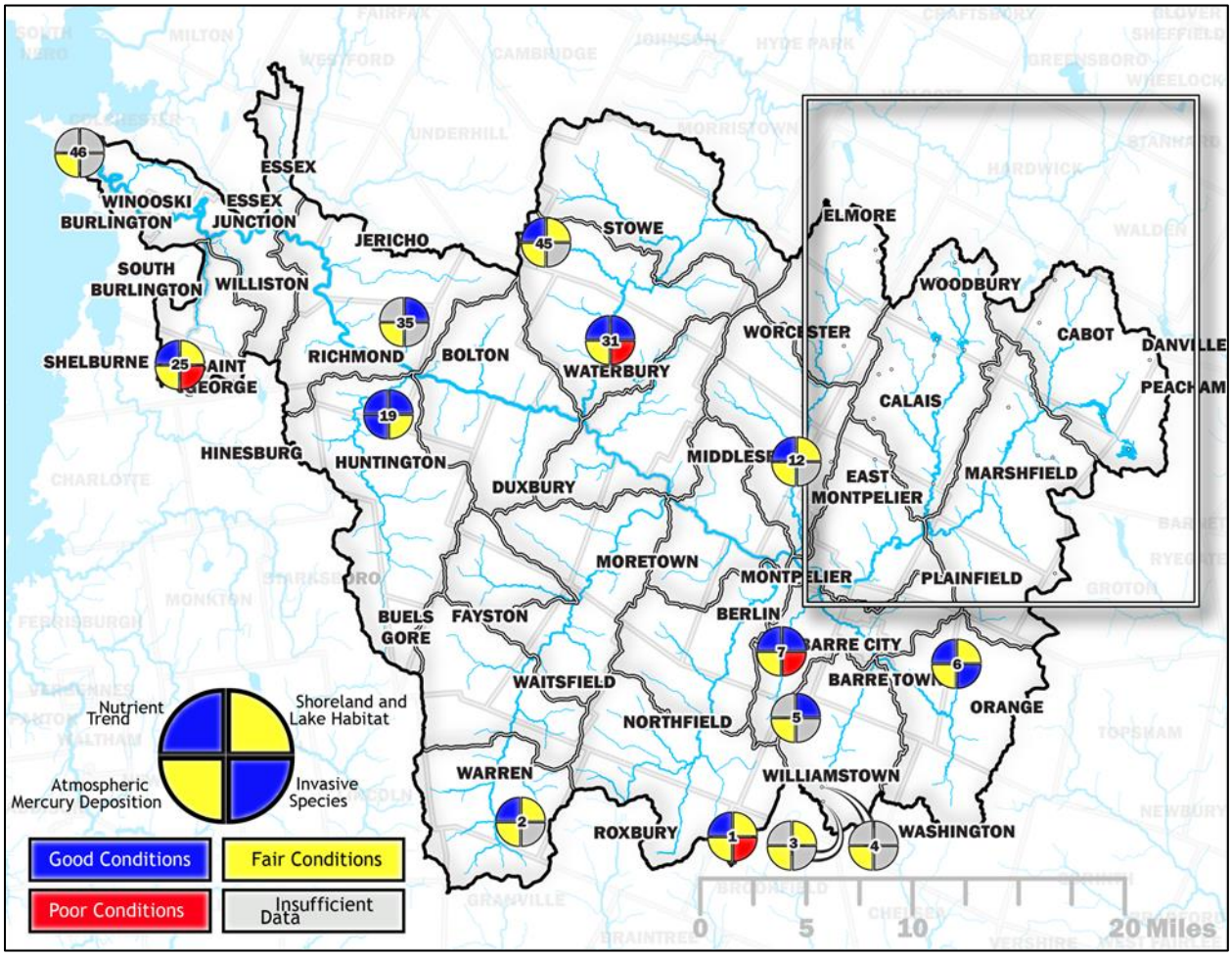



**Figure 10. Condition of Winooski basin lakes and ponds. 32 more lakes in the Kinsgbury Branch and Winooski Headwaters are displayed in Figure 11. Map ID corresponds with data in Table 3.**

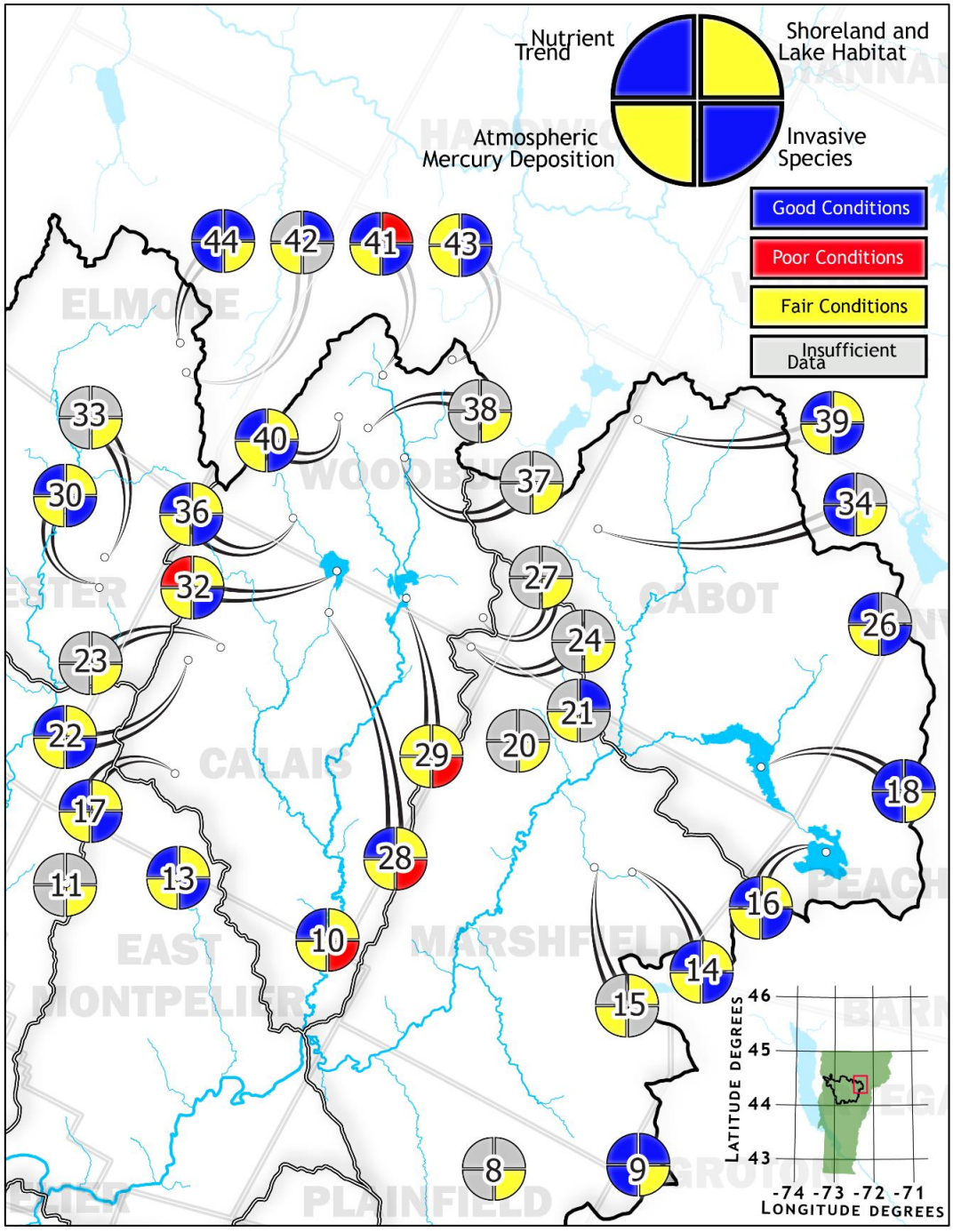



**Figure 11. Condition of Winooski basin lakes and ponds, inset from Figure 10. Map ID corresponds with data in Table 3.**

## *Lake Scorecard Assessment*

The Vermont Lakes and Ponds Management and Protection Program shares lake assessments using the Vermont Inland Lakes Scorecard (Figures 10 and 11, Table 3). 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. Winooski basin Lake Scorecard results are summarized below for lakes larger than 10 acres.

### Shoreland Condition and Nutrient Trends

Of the 33 lakes evaluated for shoreland condition in the basin, 11 have *Good* ratings, one has a *Poor* rating (Lake Greenwood), and 21 have a *Fair* rating. Of the 29 lakes monitored for nutrient water quality trends, one lake (Forest Lake) has a *Poor* rating, while Sabin Pond and Buck Lake scored as *Fair*. Spring phosphorus levels are significantly increasing in Sabin Pond and Buck Lake, while both spring and summer phosphorus are significantly increasing in Forest Lake. Notably, not enough data has been collected in Sabin Pond or Buck Lake to determine whether summer phosphorus levels are increasing as well. One waterbody, Shelburne Pond, is officially impaired by elevated phosphorus.

### Acid Impairment

Beyond nutrient impairment, Vermont has acid-impaired waterbodies, including one in the Winooski basin (Beaver Pond). Three main airborne pollution types affect lakes and ponds in Vermont: sulfur oxides, nitrogen oxides, and mercury. These pollutants are attributable to the prevailing weather pattern that carries mid-west air pollution through the region, the proximity to those pollution sources and to the lack of buffering capacity of the bedrock geology.

Sulfur and nitrogen oxides transported to Vermont from out of state air emissions results in acid forming pollutants raising in-lake acid concentrations. Lakes and ponds are regularly monitored for low pH (high acidity), which impacts biological communities. Thirty-nine lakes and ponds are included in the Vermont Acid Impaired Lake Total Maximum Daily Load. Since the USEPA began enforcing the Clean Air Act and its amendments, nationwide emissions and deposition of acid forming pollutants have declined. As a result, Vermont's in-lake acid concentrations have improved. Beaver Pond in Roxbury is the only acid-impaired waterbody in the Basin. More information about long term monitoring of Vermont's acid lakes can be found at:
https://dec.vermont.gov/watershed/map/monitor/acid-rain

### Mercury Contamination

Mercury contamination has resulted in fish consumption advisories in nearly every lake in Vermont. Dramatic shifts in water level, due to the way reservoirs are managed for hydroelectrical production, cause the release of bio-available mercury that is otherwise sequestered in the sediments. This mercury is more easily transferred up the food chain to fish and loons and other larger birds and mammals. All lakes in the Basin received a fair condition score for mercury.

## Aquatic Invasive Species

Seven of the 26 lakes greater than 10 acres that have been surveyed for aquatic invasive species have *Poor* ratings – Berlin Pond, Shelburne Pond, Waterbury Reservoir, North Montpelier Pond, Baker Pond, Sabin Pond, and Lake Mirror. A poor score indicates that there is at least one invasive species present, regardless of its abundance or 'nuisance' level.

**Table 3. Winooski basin Lake Scorecard ratings for lakes greater than ten acres. 'ID' = Insufficient data.**

| Map ID | Lake ID | Area (ac) | Max Depth (ft) | Nutrient Trend | Shoreland Condition | Aquatic Invasive Species | Atmospheric Mercury Deposition |
|---|---|---|---|---|---|---|---|
| 1 | BAKER (BRKFLD) | 37.7 | 10 | Good | Fair | Poor | Fair |
| 2 | BLUEBERRY | 46.3 | 16 | Good | Fair | ID | Fair |
| 3 | CUTTER | 15.9 | 11 | ID | Fair | ID | Fair |
| 4 | LIMEHURST | 10.9 | | ID | ID | ID | Fair |
| 5 | MARTIN; | 20.7 | 4 | ID | Good | ID | Fair |
| 6 | THURMAN W. DIX | 125.3 | 24 | Good | Fair | Good | Fair |
| 7 | BERLIN | 289.6 | 59 | Good | Good | Poor | Fair |
| 8 | BANCROFT | 25.3 | 12 | ID | ID | ID | Fair |
| 9 | PIGEON | 69.9 | 21 | Good | Good | Good | Fair |
| 10 | NORTH MONTPELIER | 41.6 | 12 | Good | Fair | Poor | Fair |
| 11 | HORN OF THE MOON | 10.4 | | ID | ID | ID | Fair |
| 12 | WRIGHTSVILLE | 180.5 | 19 | Good | Fair | ID | Fair |
| 13 | SODOM | 27.1 | 5 | Good | Fair | Good | Fair |
| 14 | TURTLEHEAD | 69.7 | 18 | Good | Fair | Good | Fair |
| 15 | BAILEY | 17.1 | 2 | ID | Fair | ID | Fair |
| 16 | PEACHAM | 347.4 | 61 | Good | Fair | Good | Fair |
| 17 | BLISS | 31.6 | 15 | Good | Fair | Good | Fair |
| 18 | MOLLYS FALLS | 402.4 | 35 | Good | Good | Good | Fair |
| 19 | GILLETT | 31.0 | 8 | Good | Good | Good | Fair |
| 20 | KNOB HILL | 17.3 | | ID | ID | ID | Fair |
| 21 | RICHARDS; | 14.7 | 6 | ID | Good | ID | Fair |
| 22 | CURTIS | 76.2 | 31 | Good | Fair | Good | Fair |
| 23 | WATSON | 11.5 | | ID | ID | ID | Fair |
| 24 | LITTLE MUD (WOODBY) | 10.0 | | ID | ID | ID | Fair |
| 25 | SHELBURNE | 479.3 | 25 | Good | Fair | Poor | Fair |
| 26 | MOLLYS | 46.0 | 28 | Good | ID | Good | Fair |
| 27 | MUD (WOODBY)-W | 21.1 | | ID | ID | ID | Fair |
| 28 | MIRROR | 87.8 | 106 | Good | Fair | Poor | Fair |
| 29 | SABIN | 147.5 | 58 | Fair | Fair | Poor | Fair |

| Map ID | Lake ID | Area (ac) | Max Depth (ft) | Nutrient Trend | Shoreland Condition | Aquatic Invasive Species | Atmospheric Mercury Deposition |
|---|---|---|---|---|---|---|---|
| 30 | LOWER WORCESTER | 30.9 | 8 | Good | Fair | Good | Fair |
| 31 | WATERBURY | 869.2 | 100 | Good | Good | Poor | Fair |
| 32 | FOREST (CALAIS) | 135.4 | 97 | Poor | Fair | Good | Fair |
| 33 | UPPER WORCESTER | 10.3 | | ID | ID | ID | Fair |
| 34 | WEST HILL | 47.9 | 13 | Good | ID | Good | Fair |
| 35 | RICHMOND | 17.8 | 12 | ID | Good | ID | Fair |
| 36 | CRANBERRY MEADOW | 23.4 | 23 | Good | Fair | Good | Fair |
| 37 | WOODBURY; | 10.6 | | ID | ID | ID | Fair |
| 38 | WALTON | 12.0 | | ID | ID | ID | Fair |
| 39 | COITS | 39.7 | 7 | Good | Fair | Good | Fair |
| 40 | VALLEY | 92.3 | 70 | Good | Fair | Good | Fair |
| 41 | GREENWOOD | 91.5 | 41 | Good | Poor | Good | Fair |
| 42 | LITTLE (ELMORE) | 12.3 | 14 | ID | Good | ID | Fair |
| 43 | BUCK | 47.3 | 33 | Fair | Good | Good | Fair |
| 44 | HARDWOOD | 49.7 | 15 | Good | Good | Good | Fair |
| 45 | MANSFIELD | 39.5 | 18 | Good | Fair | ID | Fair |
| 46 | HALFMOON COVE | 22.1 | 7 | ID | ID | ID | Fair |

## *Lake Champlain*

Unlike other lakes in the Basin, Lake Champlain is not located within the boundaries of the Basin but instead receives water from the Winooski River and several other large watersheds. In 2021, 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 segment.

- Despite several invasive species interceptions and prevention measures, the fishhook waterflea was discovered in the Lake in 2018 and the entire lake faces a deteriorating trend of new aquatic invasive species.

The Main Lake segment into which the Winooski River flows contains about 85% of the Lake's total volume. It offers plentiful recreational opportunities, a diverse fishery, and high-quality drinking water for many Lake Champlain Basin residents. The water quality in this segment is generally excellent, though the 2021 Report assigned a *Poor* status to Main Lake in-lake phosphorus conditions and phosphorus inputs from rivers. While reductions to lake phosphorus loading via the Lake Champlain Total Maximum Daily Load is an ongoing need, phosphorus reduction from wastewater treatment facilities is a notable Champlain basin-wide improvement according to the 2021 Report.

## 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 138 wetlands in the Basin have been assessed using the Vermont Rapid Assessment Method (VRAM; Figure 12). 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 scoring wetland, Little Elmore Wetland, scored a 97. 17 other wetlands scored above 80, indicating excellent condition and/or very high levels of function and value. 39 wetlands scored below 50, and the average score was 60. The lowest scoring wetland, with a score of just 18, was a swale in an industrial park setting. 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.

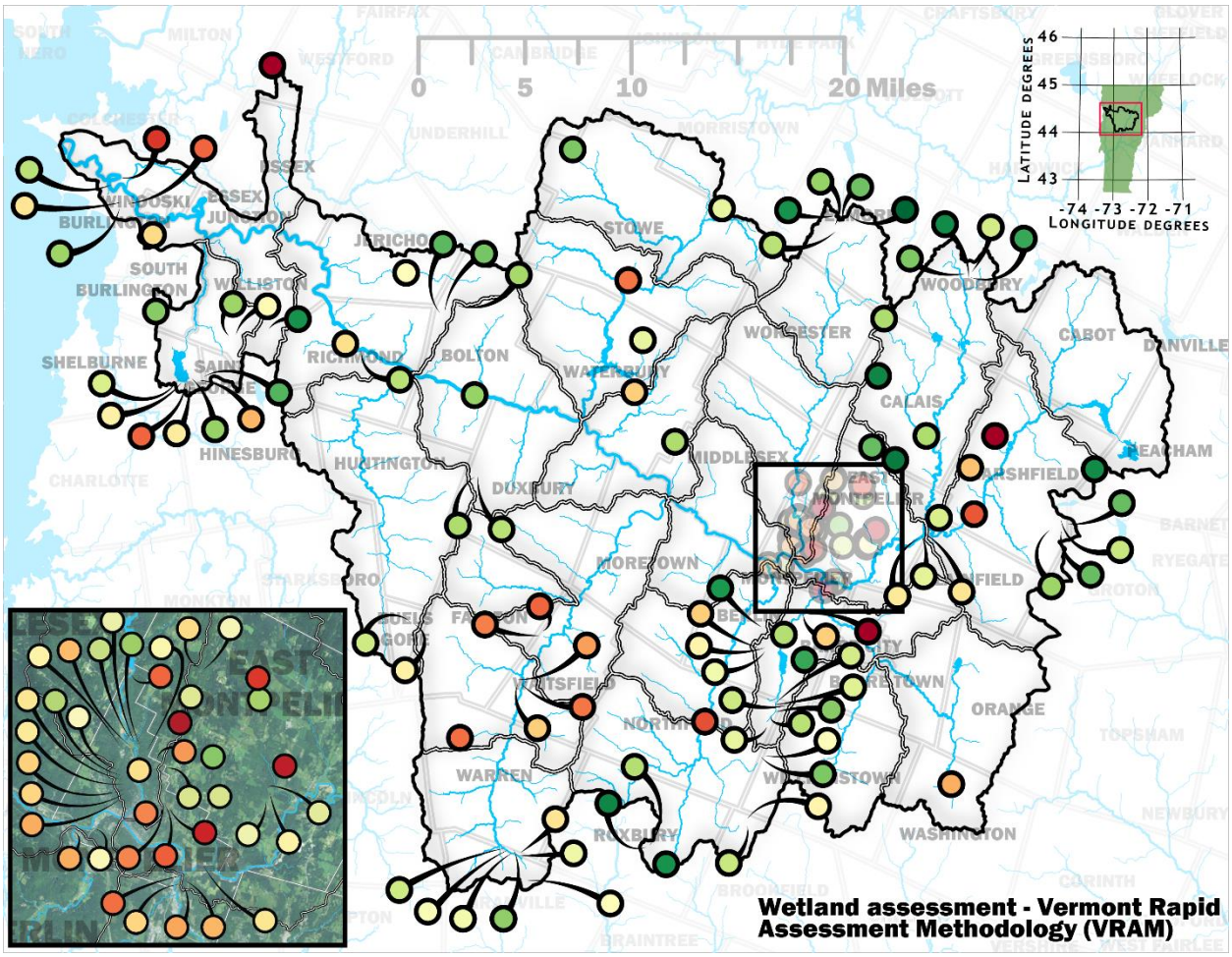



**Figure 12. Completed Wetland VRAM assessments. Green indicates better wetland condition and red indicates poorer condition.**

## Recreational Fisheries

The Winooski basin contains a diversity of fish species, many of which support popular recreational fisheries. Three trout species, contributing to one such recreational fishery, are naturally reproducing through the upper mainstem of the Winooski (above Bolton Dam) and as far downstream as Duxbury. Naturalized (wild) populations of rainbow and brown trout are found in much of the Winooski River's main stem and some tributaries. In the colder, higher elevation streams, wild populations of native brook trout flourish. Increasing temperatures in the main stem and some tributaries limit wild trout distribution while increasing temperatures, road culverts, and dams can all disconnect habitat.

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. FWD completed 165 monitoring events between 2018-2022 in 65 rivers in the Winooski basin. Brook trout were the only salmonids in 47 of the sampled stream segments. Salmonid biomass was variable across sites; biomass criteria for increased stream protection and the streams that qualify for such protections are described in Chapter 2, Table 6. Though not updated with the most recent sampling data, FWD's 2017 Upper Winooski Fisheries Assessment provides an excellent overview of trout population and habitat conditions across the basin. The Fisheries Management Documents Library also provides a searchable database of FWD's past fisheries and habitat assessments, including many specific to sub-watersheds within the Winooski basin.

Landlocked Atlantic salmon is also present in the Winooski basin, with as many as 128 returning from Lake Champlain in recent years. Salmon migrating up the Winooski River encounter the Winooski One dam and fish lift which is operated annually through a joint effort of the FWD, US Fish & Wildlife Service, Burlington Electric Department and Green Mountain Power (condition of Federal Energy Regulatory Commission license for the Winooski One Dam). Lifted salmon are transported upstream of the Winooski One, Gorge 18, and Essex 19 hydroelectric dams and released back into the Winooski River in Richmond. This stretch of the mainstem above the lower dams maintains cooler water temperatures and has more suitable substrate for spawning, with some spawning activity observed. However, recruitment success has been minimal.

# 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. One lake and 50 streams in this Basin meet or exceed standards for very high-quality condition and are 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 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 4 lists the possible classes for each designated use.

**Table 4. 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 ANR 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

Ten waters in the Winooski basin are designated as A(2) public water sources (Table 5). Four are actively being used by Barre City, Barre Town, Montpelier, and Waterbury, while six located in Essex, Williamstown, and Barre Town are no longer being used as a public water supply. 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 5. Current and abandoned Class A(2) public water sources.**

| Waters | Location | Water User | Status |
|---|---|---|---|
| Thatcher Brook and tributaries | Waterbury | Village of Waterbury | Active |

| Waters | Location | Water User | Status |
|---|---|---|---|
| Thurman Dix, Lower Reservoir and tributaries | Barre Town, Orange | City of Barre | Active |
| Consolidated quarries: Barclay #1 and capital quarries | Barre Town | Websterville | Active |
| Berlin Pond | Berlin, Northfield, Williamstown | City of Montpelier | Active |
| Unnamed tributary to Alder Brook | Essex | Winooski, Essex Center, Essex Jct., Pinewood Manor | Abandoned |
| Martin Brook, Reservoir, and tributaries | Williamstown | City of Barre | Abandoned |
| Bolster Reservoir and tributaries, excluding Pecks Pond | Barre Town (South Barre) | City of Barre | Abandoned |
| Unnamed brook and tributary | Barre Town | Barre Town | Abandoned |
| Little John and Milne quarries | Barre Town (southwest of East Barre Village) | Barre Town | Abandoned |
| Old Granite Quarry (Standard Quarry) | Barre Town (south of Websterville) | Barre Town and Williamstown (Foxville) | Abandoned |

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

Biomonitoring assessments by the WSMD identified 13 surface waters as consistently and demonstrably attaining a higher level of quality than Class B(2) based on draft criteria for aquatic biota reclassification: 11 meeting Class B(1) and two meeting Class A(1) (Figure 13).

## Waters In Need of Further Assessment

12 rivers and streams need supplemental monitoring to determine their potential for enhanced protection (Figure 14). These waters are included in Chapter 5 in the Monitoring and Assessment Table.

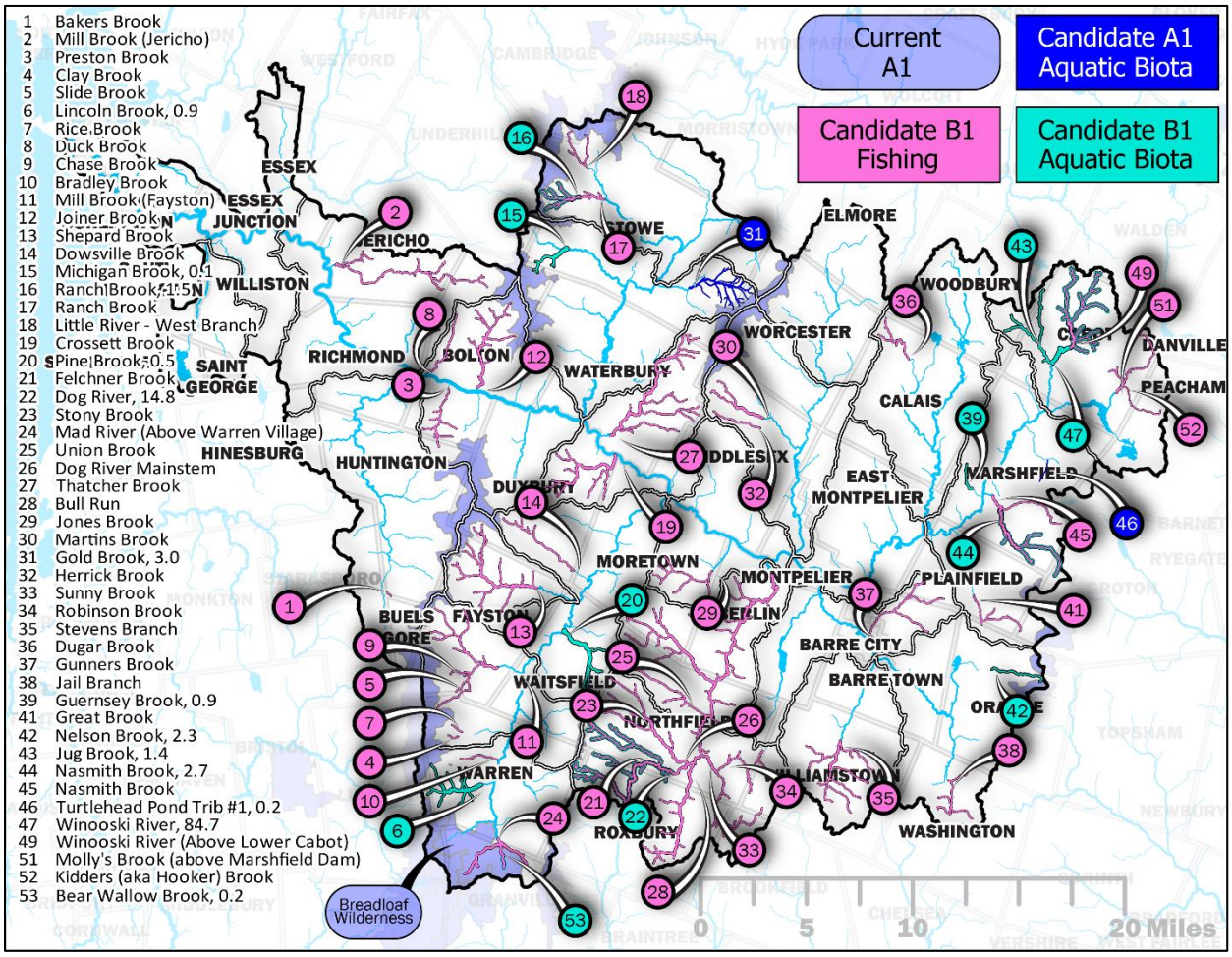



**Figure 13. Candidate stream reaches for reclassification based on draft criteria for aquatic biota and fishing uses.**

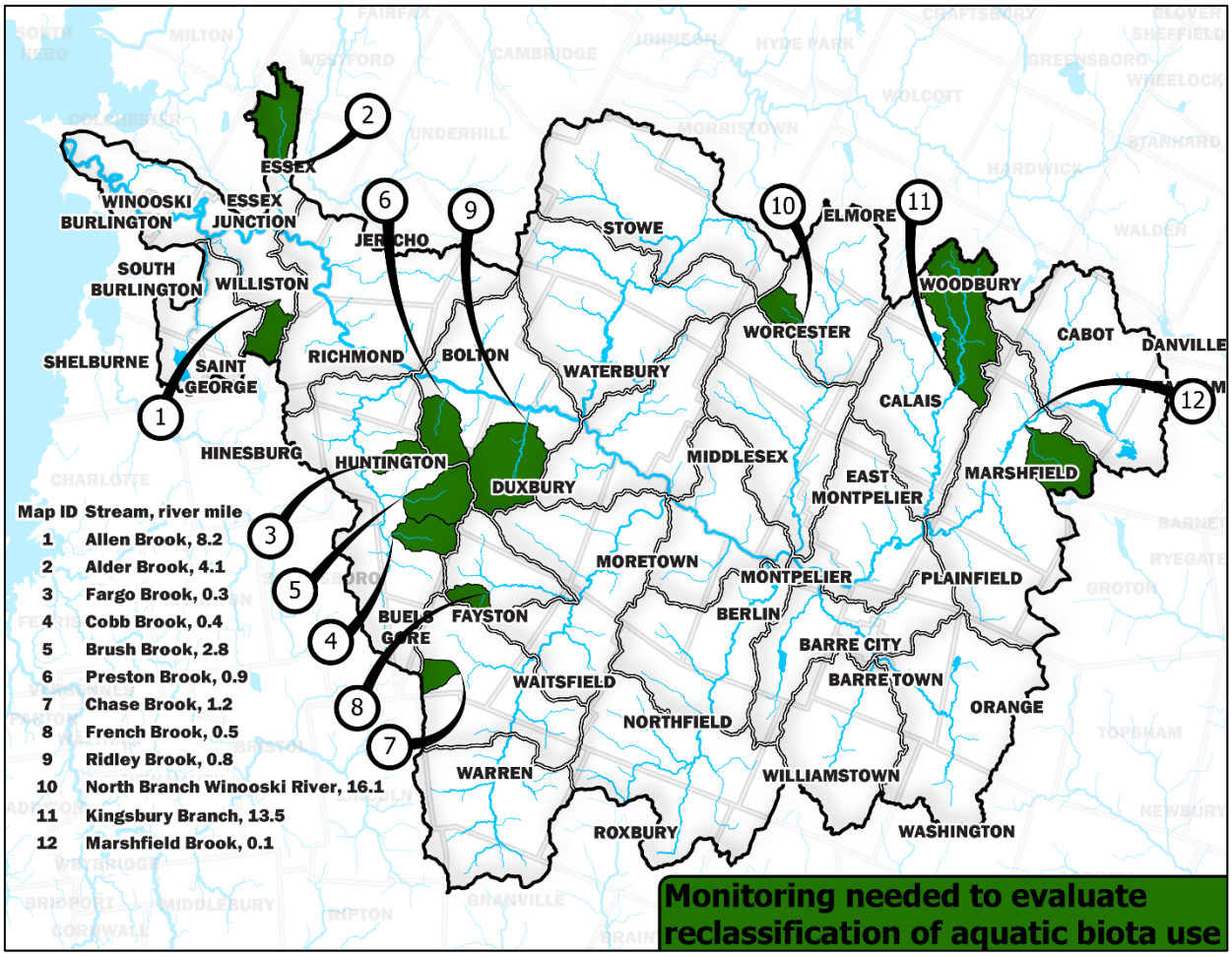



**Figure 14. Priority streams for additional assessment to determine eligibility for A(1) or B(1) reclassification for aquatic biota.**

## 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). 37 streams meet B(1) criteria for recreational fishing (§29A-306 of the VWQS) (Figure 13; Table 6). 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. Four streams in the Mid-Winooski sub-basin (Duck, Joiner, Mill, and Preston Brooks) remain B(1) candidates, though there has been a substantial decline in salmonid abundance observed in recent sampling events primarily due to a reduction in

the abundance of young-of-year rainbow trout. One previous B(1) candidate (Ridley Brook in Duxbury) no longer qualifies due to recent substantial declines in abundance to below criteria thresholds.

**Table 6. Streams that meet B(1) criteria for recreational fishing. Coordinates represent the biological sampling point; stream reaches including and above this point are generally considered to meet B(1) crtieria.**

| Stream | Latitude | Longitude | Sub-basin | Town |
|---|---|---|---|---|
| Gunners Brook | 44.20545 | -72.5062 | Stevens Branch | Barre City |
| Stevens Branch | 44.13294 | -72.53333 | Stevens Branch | Barre City |
| Kelly Brook | 44.25086 | -72.6542 | Great Brook – Winooski | Berlin |
| Duck Brook | 44.38365 | -72.9253 | Joiner Bk - Winooski | Bolton |
| Joiner Brook | 44.37373 | -72.8783 | Joiner Bk - Winooski | Bolton |
| Preston Brook | 44.37259 | -72.9063 | Joiner Bk - Winooski | Bolton |
| Winooski River (Above Lower Cabot) | 44.40153 | -72.3137 | Headwaters Winooski | Cabot |
| Kidders (aka Hooker) Brook | 44.37392 | -72.261 | Headwaters Winooski | Cabot |
| Jug Brook | 44.40032 | -72.3417 | Headwaters Winooski | Cabot |
| Dugar Brook | 44.39334 | -72.4678 | Kingsbury Branch | Calais |
| Crossett Brook | 44.32805 | -72.747 | Graves Bk - Winooski | Duxbury |
| Dowsville Brook | 44.273039 | -72.82419 | Mad River | Duxbury |
| Mill Brook | 44.194164 | -72.889842 | Mill Bk - Mad River | Fayston |
| Chase Brook | 44.178856 | -72.88431 | Mill Bk - Mad River | Fayston |
| Shepard Brook | 44.236758 | -72.82111 | Shepard Brook | Fayston |
| Bakers Brook | 44.2333 | -72.9633 | Huntington | Huntington |
| Mill Brook | 44.45666 | -73.0141 | Snipe Island Bk - Winooski | Jericho |
| Nasmith Brook | 44.29974 | -72.3876 | Nasmith Brook -Winooski | Marshfield |
| Martins Brook | 44.35313 | -72.6067 | North Branch | Middlesex |
| Herrick Brook | 44.34628 | -72.6092 | North Branch | Middlesex |
| Jones Brook | 44.24897 | -72.6548 | Great Bk - Winooski | Moretown |
| Welder Brook | 44.27792 | -72.7698 | Mad River | Moretown |
| Dog River Mainstem | 44.24616 | -72.5991 | Dog River | Multiple |
| Union Brook | 44.15772 | -72.677 | Dog River | Northfield |
| Felchner Brook | 44.12513 | -72.7158 | Headwaters Dog River | Northfield |
| Stony Brook | 44.11922 | -72.6817 | Headwaters Dog River | Northfield |
| Robinson Brook | 44.11606 | -72.643 | Headwaters Dog River | Northfield |
| Bull Run | 44.11714 | -72.673 | Headwaters Dog River | Northfield/Roxbury |
| Sunny Brook | 44.12088 | -72.6583 | Headwaters Dog River | Northfield/Roxbury/ Brookfield |

| Stream | Latitude | Longitude | Sub-basin | Town |
|---|---|---|---|---|
| Molly's Brook (above Marshfield Dam) | 44.3705 | -72.27 | Headwaters Winooski | Peacham |
| Great Brook | 44.23199 | -72.4063 | Nasmith Brook - Winooski | Plainfield |
| Little River - West Branch | 44.52389 | -72.7747 | Headwaters Little River | Stowe |
| Ranch Brook | 44.5021 | -72.7587 | Headwaters Little River | Stowe |
| North Road Tributary | 44.23099 | -72.7739 | Mad River | Waitsfield |
| Lincoln Brook | 44.09731 | -72.908 | Headwaters Mad | Warren |
| Bradley Brook | 44.11949 | -72.85795 | Headwaters Mad River | Warren |
| Mad River (Above Warren Village) | 44.063642 | -72.855567 | Mad River | Warren |
| Clay Brook | 44.13515 | -72.89537 | Mill Bk - Mad River | Warren |
| Rice Brook | 44.138231 | -72.89165 | Mill Bk - Mad River | Warren |
| Slide Brook | 44.167197 | -72.88753 | Mill Bk - Mad River | Warren |
| Jail Branch | 44.10577 | -72.4303 | Jail Branch | Washington |
| Thatcher Brook | 44.3409 | -72.7514 | Graves Bk - Winooski | Waterbury |

## 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. Peacham Pond currently meets the nutrient criteria for B(1) aesthetics, and Lakes Mirror and Greenwood are recommended for additional monitoring to determine their B(1) eligibility. No lakes currently meet the criteria for A(1) aesthetics given the available data, but five have been prioritized for additional monitoring to determine their A(1) eligibility: Lake Mansfield, Berlin Pond, Forest Lake (Calais), Turtlehead Pond, and Sabin Pond (Table 20: Monitoring and Assessment Table).

# 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 a Class II nor a 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 highlights the designated Class I wetlands statewide and lists those recommended for Class I designation. In 2017 Chickering Fen (Calais) and Peacham Bog (Peacham) were designated as Class I wetlands. The Vermont Wetlands Program also assessed Lanesboro Bog since the 2018 TBP and deemed it a candidate Class I wetland. Six other wetlands have been identified for further study for Class I wetland designation (Figure 15).

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.

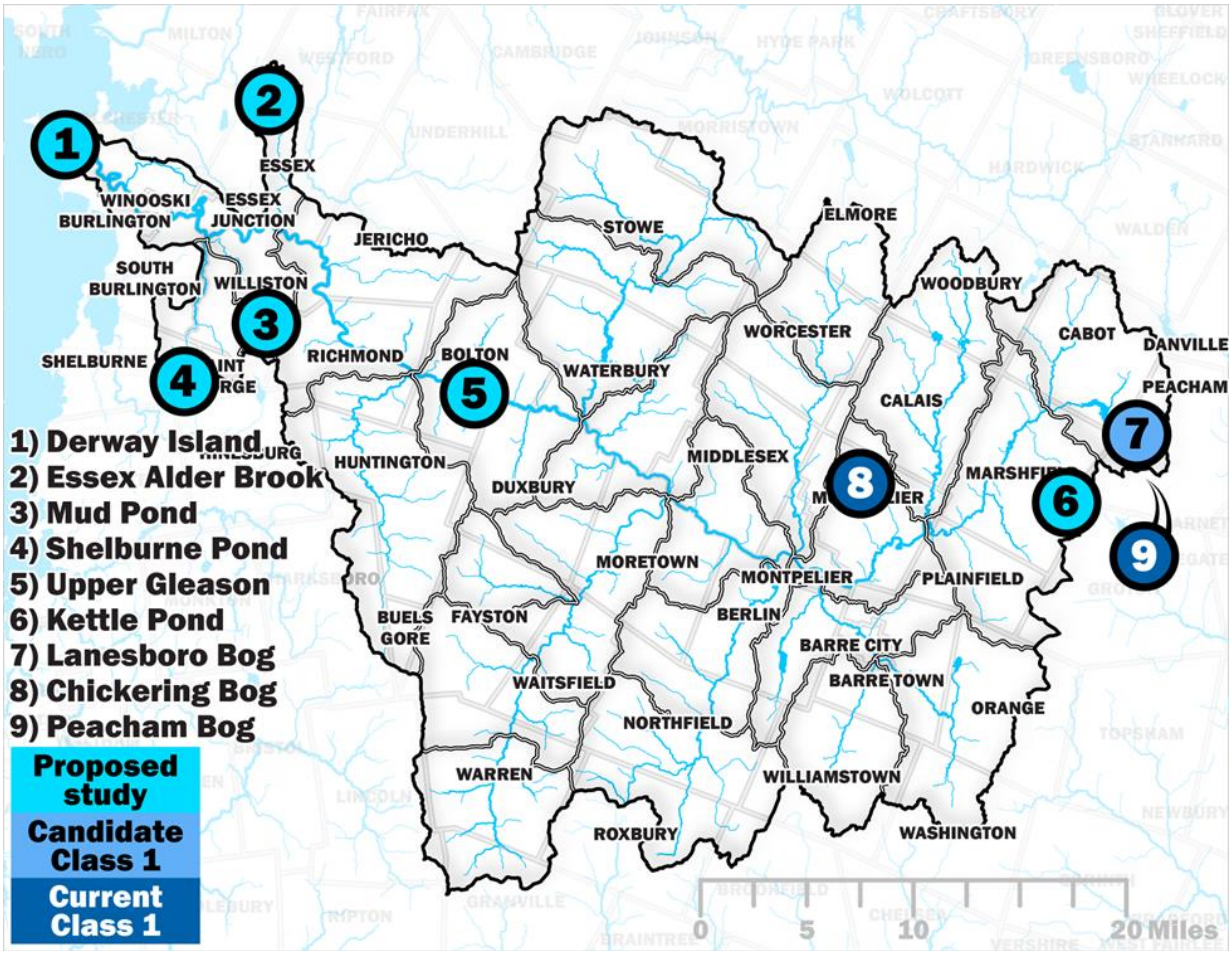



**Figure 15. Candidate Class I wetlands and those proposed for study to determine Class I eligibility.**

## 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[1] projects, and other activities. ORWs can be designated by the ANR through a public petition process.

There are currently no ORW designated waters in the Winooski Basin. Based on data collected by the Watershed Management Division, the ANR would support a community-led effort to petition the following waters as ORW, or other waters where petitioners can demonstrate the presence of ORW values:

- The Huntington River from the Gorge to the confluence with the Winooski (Richmond: 2.3 miles) due to outstanding recreational, aesthetic, and cultural reasons. The Huntington Gorge and the river above and below serve as a major swimming destination for Chittenden County (though significant caution is advised as swimming in the gorge is dangerous and it has been the site of many accidents). The steep gorge, the waterfalls, and the forested riverbanks create a gorgeous setting. Culturally the gorge is a former mill site, with foundations remaining nearby.
- The North Branch of the Winooski River from Worcester Middlesex town line upstream to headwaters (about 14 miles) based on the river's exceptional natural, scenic, and recreational values. Numerous swimming holes, many surrounded by waterfalls, dot the river.

## 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 of waters 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.

[1] 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.

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 listed in the basin plan should be viewed as a partial 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. Existing uses are listed on the Winooski Tactical Basin Planning webpage and include swimming, boating, fishing, and public water sources.

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 7 and 8; Figures 16 and 17), waters altered by invasive species or flow regulation (Table 9; Figure 18), 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 and therefore 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.

Nine rivers and streams including Muddy Brook (South Burlington/Williston), Little River and West Branch Little River, Graves and Thatcher Brooks (Waterbury), Jail Branch through Barre City, High Bridge Brook (Waitsfield), and Long Meadow Brook (East Montpelier/Calais) have biomonitoring data that indicate fair or poor condition. However, there are not enough data for these streams to fully evaluate their attainment of Aquatic Biota use, or monitoring results show volatile conditions from year to year (Figure 19). These streams are a priority for further assessment and are listed in Table 10 and Chapter 5's Monitoring and Assessment Table (Table 20).

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

## *Impaired Lakes*

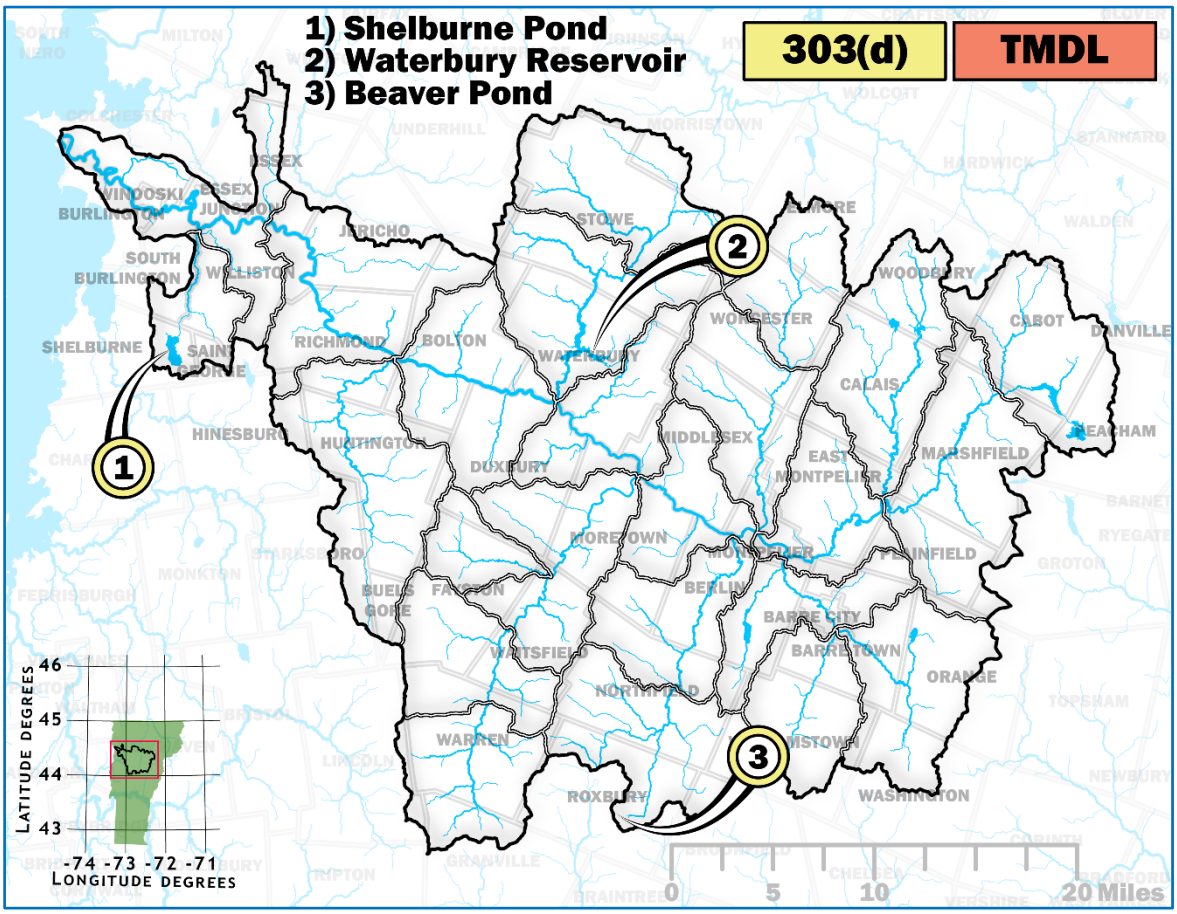



Figure 16. Impaired lakes in the Winooski basin. Map number corresponds with Table 7.

Table 7. Impaired lakes in the Winooski basin and their pollutants. '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.

| Map # | Name | Problem | Pollutant | List |
|---|---|---|---|---|
| 1 | Shelburne Pond (Shelburne) | Excessive algae and native plant growth causes periodic low dissolved Oxygen and fish kills. | Phosphorus | A |
| 2 | Waterbury Reservoir (Waterbury) | Sedimentation, turbidity | Sedimentation/siltation | A |
| 3 | Beaver Pond (Roxbury) | Atmospheric deposition; extremely sensitive to acidification; episodic acidification | Acid | A |

## *Impaired Rivers*

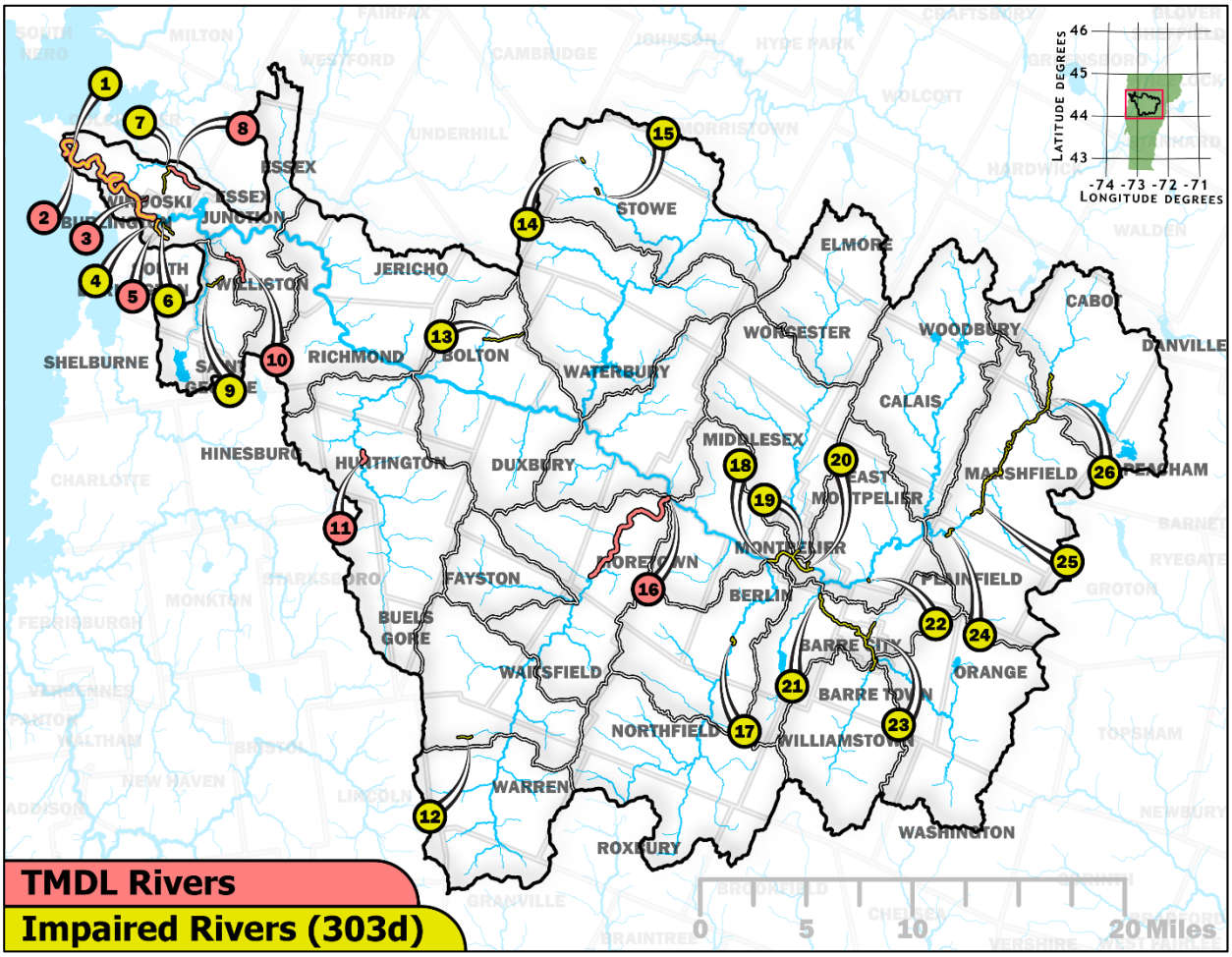



Figure 17. Impaired streams in the Winooski basin. Map number corresponds with Table 8.

Table 8. Impaired streams in the Winooski basin and their pollutants. '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. 'rm' = river mile.

| Map # | Name | Pollutant | Problem | Impaired Use | List |
|---|---|---|---|---|---|
| 1 | Winooski River, Mouth to Winooski Dam | E. coli | Burlington CSOs | Contact recreation | A |
| 2 | Winooski River, Mouth to Winooski Dam | Mercury in fish tissue | Elevated levels of mercury in walleye | Fish consumption | D |
| 3 | Morehouse Brook, Mouth to rm 0.6 | Pollutants in urban stormwater | Stormwater runoff, erosion | Aquatic Biota and Wildlife | D |
| 4 | Centennial Brook, Mouth to rm 1.2 | Chloride | Elevated chloride levels due to road salt | Aquatic Biota and Wildlife | A |
| 5 | Centennial Brook, Mouth to rm 1.2 | Pollutants in urban stormwater | Stormwater runoff, land development; erosion | Aquatic Biota and Wildlife | D |
| 6 | Unnamed Trib to Winooski River | Iron, arsenic | South Burlington landfill leachate entering surface water. | Aquatic Biota and Wildlife | A |
| 7 | Sunnyside Brook (Trib #8 to Sunderland Brook) (1.2 Mi.) | Chloride | Elevated chloride levels due to road salt | Aquatic Biota and Wildlife | A |
| 8 | Sunderland Brook, rm 3.5 (Rt. 7) to rm 5.3 | Pollutants in urban stormwater | Stormwater runoff, land development; erosion | Aesthetics, Aquatic Biota and Wildlife | D |
| 9 | Muddy Brook Tributary #4 and Trib to Trib #4 | Toxicity, chloride | Chloride criteria exceeded; impacts to macroinvertebrates | Aquatic Biota and Wildlife | A |
| 10 | Allen Brook, rm 2.4 to rm 5.0 (Talcott Rd) | Pollutants in urban stormwater, E. coli | Stormwater runoff, land development; erosion | Aquatic Biota and Wildlife, Contact recreation | D |
| 11 | Huntington River, Vicinity of Bridge Street in Huntington | E. coli | Elevated E. coli levels detected at several sampling stations | Contact Recreation | D |
| 12 | Clay Brook, rm 1.8 to rm 2.3 | Iron, pollutants in urban stormwater | Stormwater runoff, erosion from construction activities & gravel parking lot; increased peak stormwater flows | Aesthetics, Aquatic Biota and Wildlife | A |

| Map # | Name | Pollutant | Problem | Impaired Use | List |
|---|---|---|---|---|---|
| 13 | Goose Pond Brook | Low pH | Chronic acidification | Aquatic Biota and Wildlife | A |
| 14 | Little Spruce Brook | Pollutants in urban stormwater | The stressors to aquatic biota include chloride, sedimentation, and erosion. | Aquatic Biota and Wildlife | A |
| 15 | Inn Brook, rm 0.3 to 0.6 | Iron | Iron seeps originating from disturbed soils | Aesthetics, Aquatic Biota and Wildlife | A |
| 16 | Mad River, Mouth to Moretown (6.2 Miles) | E. coli | Possible failing septic systems and other unknown sources; elevated E. coli levels | Contact Recreation | D |
| 17 | Dog River, Riverton Canoe Access Downstream 0.5 Miles | E. coli | Consistently elevated E. coli | Contact Recreation | A |
| 18 | Winooski River Above Montpelier WWTF Discharge | E. coli | Montpelier WWTF collection system passes CSOs | Contact Recreation | A |
| 19 | Lower North Branch, Winooski River Mouth to Montpelier Rec Fields | E. coli | Montpelier WWTF collection system passes CSOs | Contact Recreation | A |
| 20 | Blanchard Brook, Mouth to rm 0.4 | Cause unknown, temperature | Failed biocriteria; stressors include temperature, chloride, sediment, nutrients, and developed land runoff | Aquatic Biota and Wildlife | A |
| 21 | Stevens Branch, from Barre City Limits to Mouth, 5.8 Miles | E. coli | Consistently elevated e. coli, urban runoff | Contact Recreation | A |
| 22 | Muddy Brook (0.1 Mile) | Cadmium | CV landfill: leachate entering surface water | Aquatic Biota and Wildlife | A |
| 23 | Gunners Brook, Below Farwell St. Dump (Approx 0.5 Mile) | Toxicity, sediment/siltation | Farwell St. landfill leachate, surface runoff from developed area | Aesthetics, Aquatic Biota and Wildlife, Contact Recreation | A |

| Map # | Name | Pollutant | Problem | Impaired Use | List |
|---|---|---|---|---|---|
| 24 | Winooski River, Plainfield rm 70.7 to rm 71.4 | E. coli | Consistently elevated E. coli | Contact Recreation | A |
| 25 | Winooski River, Marshfield, rm 72.8 Up to Confluence with Mollys Brook | E. coli | Consistently elevated E. coli, impairment continues upstream into VT08-09 | Contact Recreation | A |
| 26 | Winooski River, Cabot, Mollys Falls Brook Up to rm 83.8 | E. coli | Consistently elevated E. coli; continuation of downstream impairment from VT08-07 | Contact Recreation | A |

## *Altered Lakes and Rivers*

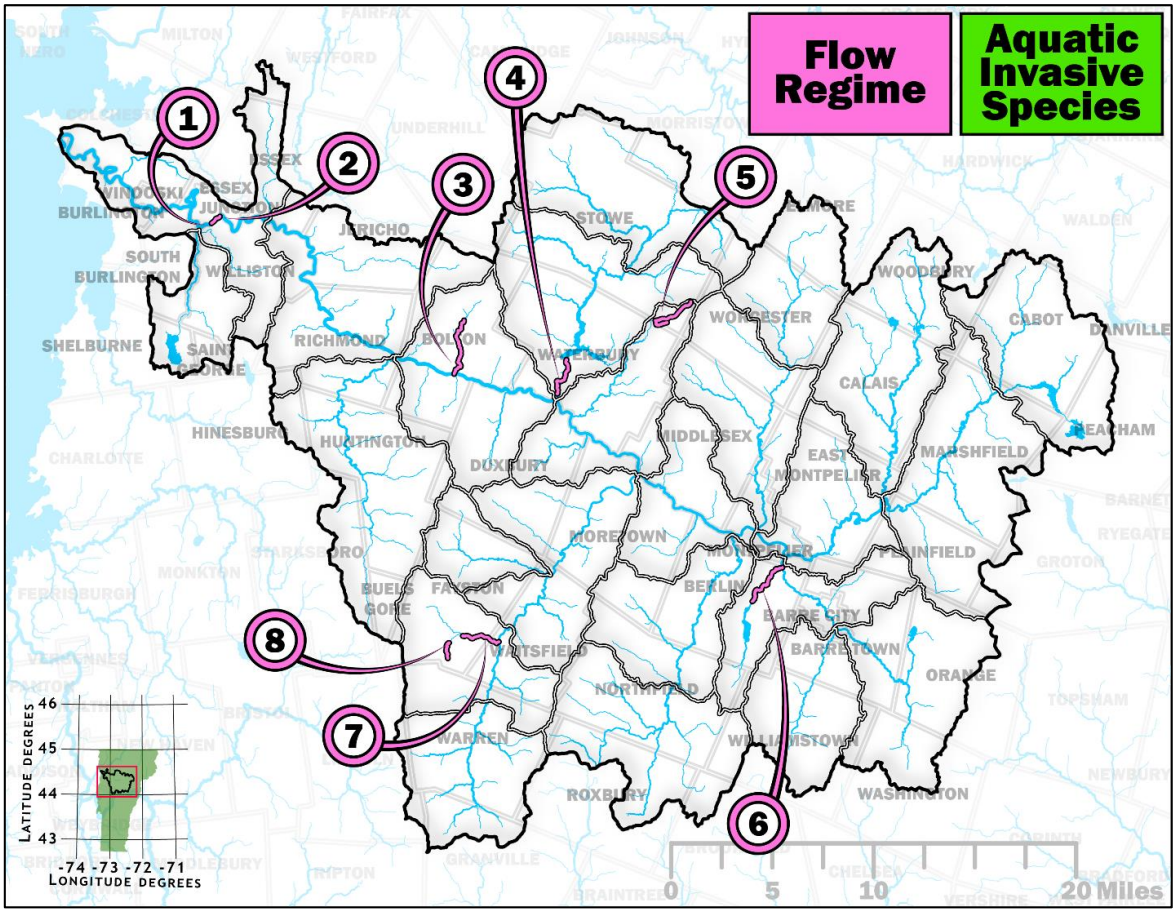



**Figure 18. Altered streams in the Winooski basin. Map number corresponds with Table 9. Two lakes are unmapped here but included in Table 9.**

**Table 9. Altered lakes and streams in the Winooski basin, from Figure 18. '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. 'rm' = river mile.**

| Map # | Name | Problem | Status | List |
|---|---|---|---|---|
| NA | Shelburne Pond (Shelburne) | Locally abundant Eurasian water milfoil growth. | No active management | E |
| NA | Waterbury Reservoir (Waterbury) | Winter drawdown alters all uses. | New turbine runner and bypass flow valve are operational; winter drawdown will continue until tainter gates are replaced; | F |

| Map # | Name | Problem | Status | List |
|---|---|---|---|---|
| | | | DEC Dam Safety and USACE are in the project's pre-design phase and anticipate implementation no earlier than 2027. | |
| 1 | Winooski River, from No 19 Dam down 0.1 miles | Artificial & inadequate flow in bypass reach | FERC licenses expires in 2025 | F |
| 2 | Winooski River at Essex No. 19 | Artificial & inadequate flow in bypass reach | FERC licenses expires in 2025 | F |
| 3 | Joiner Brook (2.9 Miles) | Artificial & insufficient flow below Bolton Valley snowmaking water withdrawal | Non-support 2.9 mi | F |
| 4 | Lower Little River Below Hydro Dam (2.6 Miles) | Artificial flow regime in the winter | New turbine runner and bypass flow valve are operational; winter drawdown will continue until tainter gates are replaced; DEC Dam Safety and USACE are in the project's pre-design phase and anticipate implementation no earlier than 2027. | F |
| 5 | Tyler Brk (0.1 Mi) & Merriam Brk (0.1 Mi), Thatcher Brook Tribs | Artificial & inadequate flow condition below Waterbury Village public water supply withdrawal point | Water System ID #5284 - Waterbury Village Water | F |
| 6 | Benjamin Falls Brook (Pond Brook) from Berlin Pond to Mouth | Artificial dewatering of brook by Montpelier & Berlin water supply withdrawals | Water System ID #5272 | F |
| 7 | Mill Brook (2.1 Miles) | Artificial & insufficient flow below Mad River Glen snowmaking water withdrawal | Partial support 2.1 mi | F |
| 8 | Slide Brook (0.8 Miles) | Artificial & insufficient flow below Mt. Ellen snowmaking water withdrawal | Non-support 0.8 mi | F |

## *Monitoring Priorities for Further Impairment Evaluation*

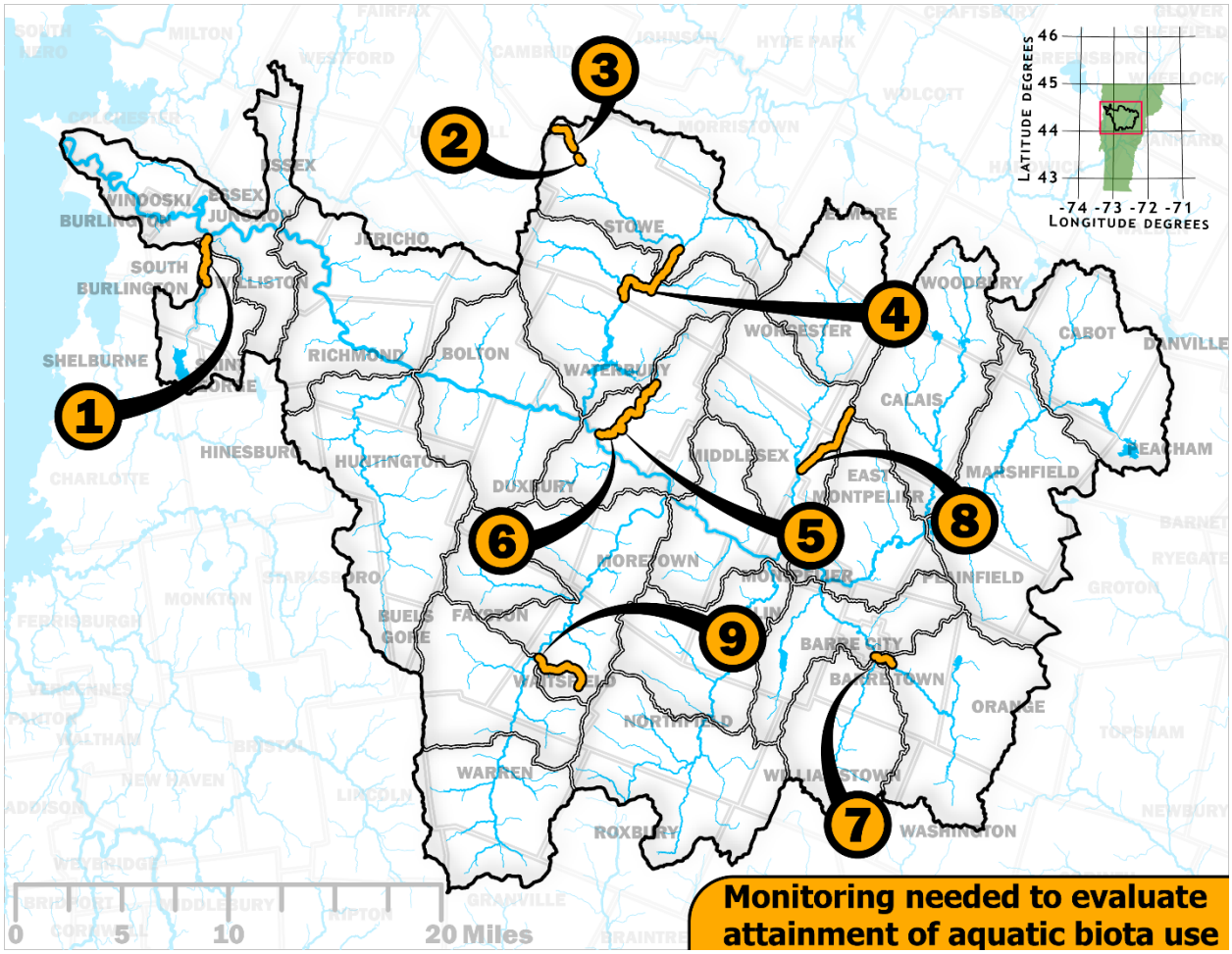



**Figure 19. Monitoring needs to determine potential river segment impairment. Map IDs correspond with information in Table 10. Biomonitoring data indicate fair or poor conditions at these sites, but additional data must be collected to fully evaluate attainment.**

**Table 10. Monitoring needs to determine river segment impairment, from Figure 19.**

| Map ID | Name | Problem | Pollutant |
|---|---|---|---|
| 1 | Muddy Brook | Runoff from developed lands | Sediment, Stormwater, Chloride |
| 2 | West Branch Little River at Mansfield Base Road | Runoff from developed lands | Sediment, Stormwater |
| 3 | West Branch Little River (rm 8.5 up to headwaters) | Sediment source(s) need further assessment; pH shock in springtime | Sediment, acid |

| Map ID | Name | Problem | Pollutant |
|---|---|---|---|
| 4 | Little River, from West Branch down to reservoir | Channel instability, channel manipulation, urban/suburban development | Urban runoff, sediment |
| 5 | Graves Brook (Mouth upstream to rm 0.3) | Residential watershed, some agriculture, riparian encroachments | Sediment |
| 6 | Thatcher Brook (Waterbury to Waterbury Center) | Morphological instability | Sediment |
| 7 | Jail Branch, Barre City and below (1.5 miles) | Land development; erosion/sedimentation; urban runoff | Sediment, nutrients, E. coli |
| 8 | Long Meadow Brook | Unknown | Sediment |
| 9 | High Bridge Brook | Unknown | Temperature |

## 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.

Under certain circumstances, there are alternative restoration approaches that may be more immediately beneficial or practicable in achieving VWQS than pursuing the TMDL approach in the near-term. An alternative restoration approach is a description of actions, with a schedule and milestones, that is more immediately beneficial or practicable to achieving VWQS.

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 and alternative plans in the Winooski basin include:

- Clay and Rice Brook Watersheds – Warren – 2008 Water Quality Remediation Plan
- West Branch Little River – Stowe – 2012 Mansfield Base Area Water Quality Remediation Plan
- Big Spruce Brook – Stowe – 2010 Iron Seep Remediation Plan
- Winooski River – Cabot – 2001 Pathogens TMDL

- Morehouse Brook – Winooski and Colchester – 2007 Stormwater TMDL
- Centennial Brook – South Burlington – 2007 Stormwater TMDL
- Allen Brook – Williston – 2008 Stormwater TMDL
- Sunderland Brook – Colchester – 2008 Stormwater TMDL
- Vermont Statewide 2011 Bacteria-impaired TMDL (Appendices for the Mad River, Huntington River, Allen Brook)
- Lake Champlain Phosphorus TMDL
- Northeast Regional Mercury 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 reissuance in 2018 of the MS4 permit is the requirement for municipalities to develop Phosphorus Control Plans to comply with the Lake Champlain Phosphorus TMDLs. 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 (56%), as well as portions of northeastern New York (37%) and southern Quebec (7%). 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 20) to ensure that phosphorus reductions are achieved. To meet requirements of the 2016 Lake Champlain Phosphorus TMDL (LC TMDL), Vermont's implementation plan 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, serves to inform the Accountability Framework for the LC TMDL's Phase 3 Implementation Plan.

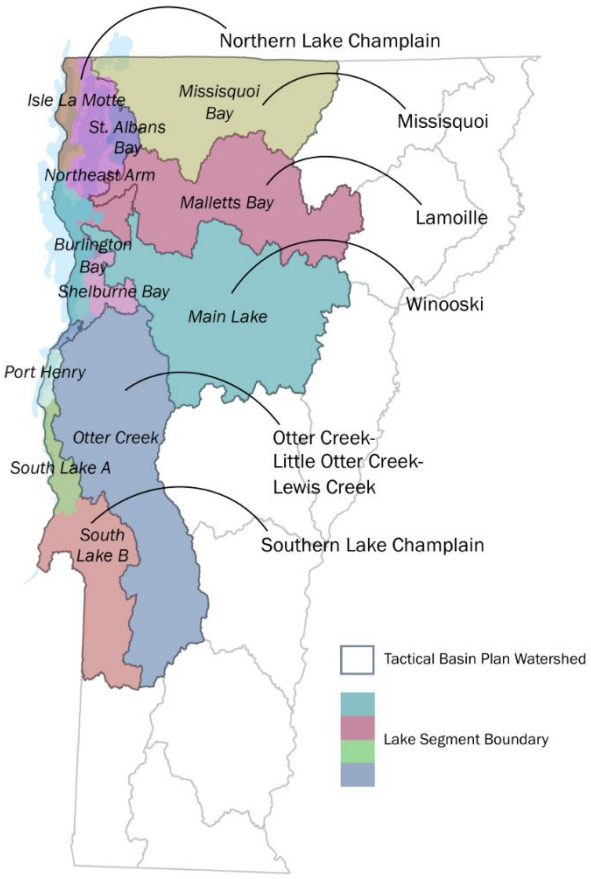



**Figure 20. The 12 TMDL lake segments and their watersheds.**

## *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 land-use sectors. Vermont's successful completion of the 28 milestones in Phase 1's Accountability Framework[2] 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 plan, to date, are embedded in the TBPs associated with the Lake Champlain Basin (the specific Winooski TBP is noted in parentheses below). Along with providing

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

updates on Vermont's progress towards addressing policy commitments, each phase provides the following information:

- Phase 2 (2018 Winooski TBP) downscales phosphorus allocations to the tactical basin level and prioritizes basin catchments for remediation (critical source areas) based on highest modeled phosphorus load reductions.
- Phase 3 (2023 Winooski 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 2018 and the current 2023 plan direct technical and financial resources to critical source areas to facilitate regulatory compliance and voluntary adoption of BMPs across all land-use sectors. Specific projects to address strategies are included in the Watershed Projects Database.

The following Phase 3 content for the 2023 Winooski TBP describes Vermont's progress towards achieving maximum phosphorus reduction and, along with information in Chapters 4 and 5, updates the sector-by-sector approach to reducing phosphorus loading to the Winooski basin. As the Wastewater targets are achieved through wastewater treatment facility permitting process, five-year targets are not set, and progress towards these targets and supporting programs are only 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 Act 76 (2019) that will accelerate implementation of natural resource restoration projects to meet non-regulatory target reductions.

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 and accounting methods 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 TMDLs, 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 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 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 located in the Clean Water Reporting Framework 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 below with a goal of meeting load 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 the Phase 3 includes an overview of progress between TBPs, more specificity relating to completion of strategies in each TBP implementation table as 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 (Chapter 5).

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 Vermont Clean Water Initiative's 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 were identified in Phase 2. The state's progress towards program promulgation is described in Table 11. Chapters 4 and 5 describe how the Agency supports delivery of outreach and technical assistance to facilitate compliance.

**Table 11. Regulatory programs for phosphorus reduction.**

| 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 has list of when each parcel is due for permitting; once issued. Site will have five-year period to implement, with incentive for early adopters. |
| | Municipal Separate Sewer System (MS4) General Permit | MS4 jurisdiction | SOP | Determined by MS4 | DEC is updating MS4 permit in summer 2023. Updated phosphorus control plans, and flow restoration plans will be due by January 2024 to comply with updated permit. |
| Developed Lands: Roads | Municipal Roads General Permit (MRGP) | Town, but have access to 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 life of the TMDL | DEC reissued MRGP in January 2023. Towns must update road erosion inventories (REI) by Fall 2027. upgrade 7.5% of their non-compliant road segments annually, including 20% of Very High Priority segments annually once the REI is |

| Source Sector* | Permit Program | Reporting Scale | Efficiency | Spatial Scale of TP Loading | Implementation Timeline |
|---|---|---|---|---|---|
| | | | | | updated, 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 increased AMP compliance. |

*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 conservation easements, 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 Central Vermont Regional Planning Commission is the Winooski basin CWSP and in SFY 2023 contracted with DEC to achieve an annual phosphorus reduction target of 69.6 kg for 1,040,947 dollars; and in FY 2024 a reduction of 69.6 kg for 1,097,230 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 Central Vermont Regional Planning Commission will be developing an operation and maintenance program to ensure 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; and
- Strategic communication efforts to ensure understanding of and support for the plan among key stakeholders as well as throughout the watershed.
- 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.
- Creating resources that support the work of partners and the Basin Water Quality Council, the Watershed Planning Program Communications plan, and the Engagement and Training resources on the Watershed Planning Program website.
- Completing a partners' needs assessment and addressing 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.

## *Winooski 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. Phosphorus reductions will be realized by reducing phosphorus loading from the associated Vermont basins draining into each of these lake segments. The Winooski River basin (Basin 8) drains into the Main Lake segment of Lake Champlain (Fig. 20). 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 Winooski basin, an estimated 30.0% or 58,420 kg reduction in annual TP loading is required across all sectors to meet TMDL targets (Table 12).

**Table 12. Summary table of total phosphorus watershed annual loading, total annual reduction targets, and required reductions for the Winooski basin.**

| Source | Category | Allocation Category | Total Load (kg/yr) | Estimated Target Reduction (kg/yr) | Reduction Required for Basin (%) |
|---|---|---|---|---|---|
| Agriculture | Fields[1]/pastures | Load | 29,716 | 13,937 | 46.9 |
| | Barnyard Production Areas | Wasteload | 2,332 | 1,865 | 80.0 |
| Developed Lands | Stormwater | Wasteload | 23,345 | 4,716 | 20.2 |
| Developed Lands | Roads | Wasteload | 19,388 | 3,916 | 20.2 |
| Wastewater[2] | WWTF discharges | Wasteload | 24,358 | 15,444 | 63.4 |
| Rivers | All streams | Load | 57,572 | 16,638 | 28.9 |
| Forests | All lands | Load | 38,084 | 1,904 | 5 |
| | | ***Total*** | ***194,795*** | ***58,420*** | ***30*** |

[1]Fields include cultivated crops and hay
[2]WWTF numbers are based on permitted loads

In SFY 2022 about 11% of the overall TMDL reduction goal for the basin was met (Figure 21).

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

- Estimated TMDL TP Loading and Reduction online report

- Winooski Basin Agricultural Phosphorus Loading & Reduction online report
- Winooski Basin Agricultural Tracking & Target Setting online report

Sub-tactical basin scale phosphorus loading and reduction estimates for HUC12 watersheds within the Winooski 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.

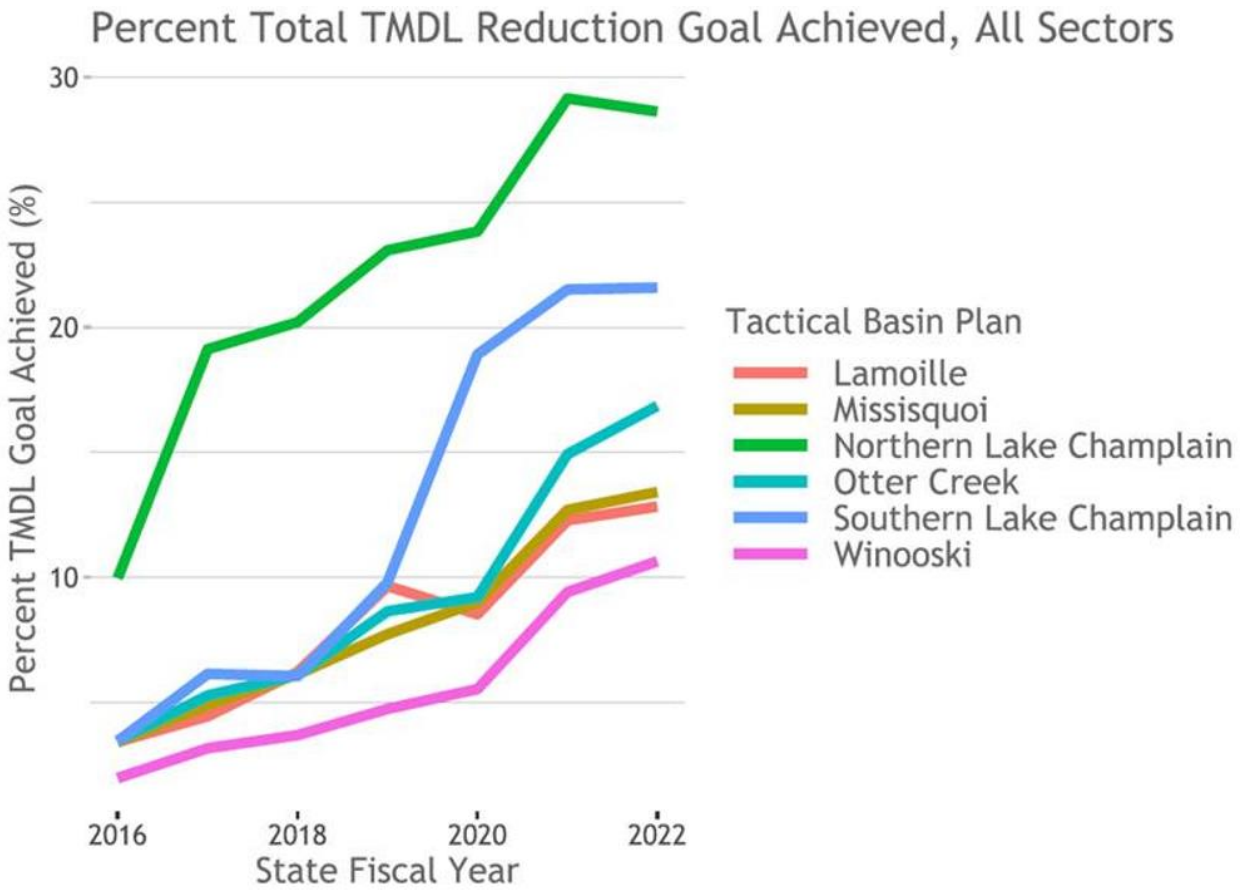



**Figure 21. Percent TMDL reduction goal achieved by tactical basin and state fiscal year.**

### *Summary of P reductions 2016-2022 by sector*

To date the Winooski basin's progress towards meeting overall reduction goals has risen steadily but does not match the rate achieved by other basins (Figure 21). Across sectors within the basin, agriculture has shown the most progress (Figure 22).

The TMDL mandates TP reductions from specific land use sectors by 2036 (Table 12). Between 2016 and 2020, the annual calculated phosphorus reductions in the Winooski basin have generally increased every year (Figure 22). Annual totals are not cumulative, and the same volume of reductions must be achieved every year to meet the 2036 target. As of 2022, the agriculture lands sectors show the greatest progress with field and pasture area and barnyard production area meeting 23.4% of the target (25% and 11% of their targets respectively). The stormwater sector had the next highest reduction, meeting 7.2% of its target (Figure 22).

The Winooski basin's limited progress compared to other basins (Figure 21) can be attributed to the higher percentage of the TP allotment directed towards stormwater and rivers and a lower

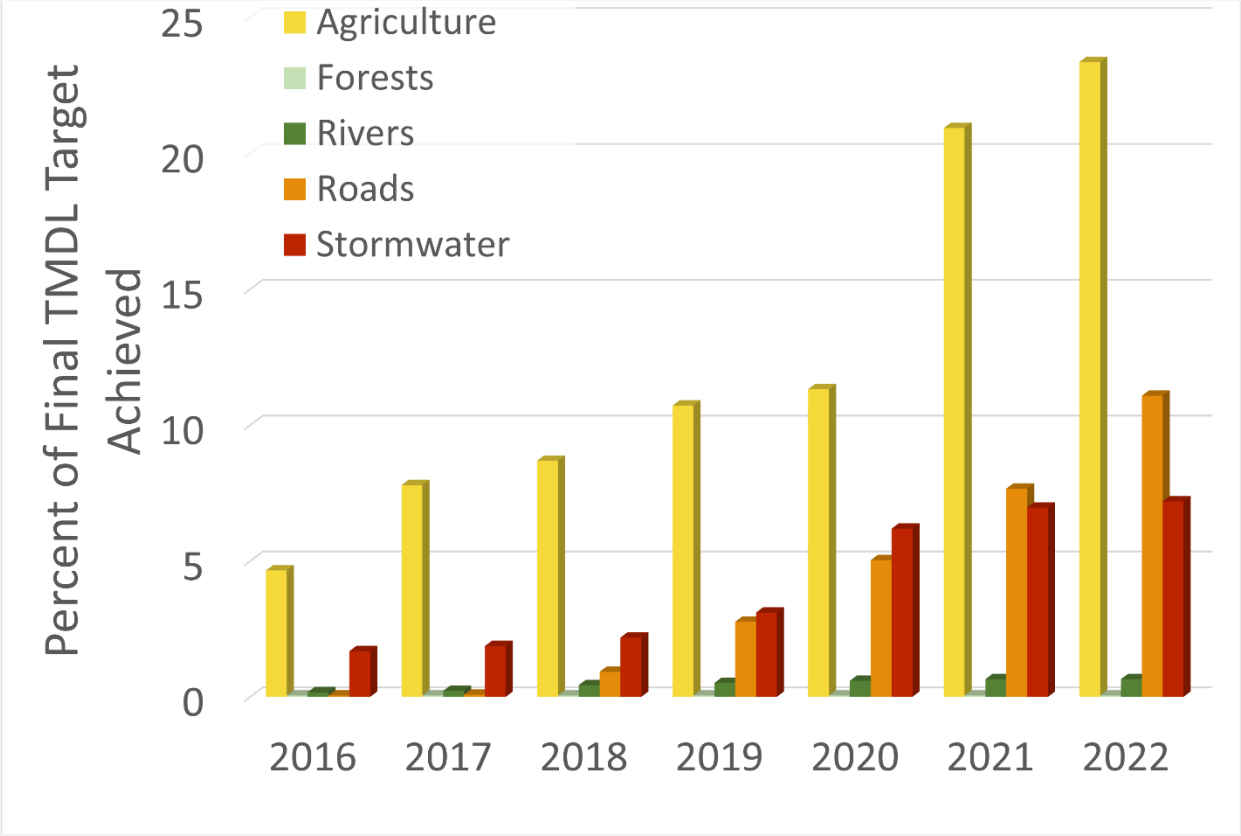



**Figure 22. Percent TMDL TP reduction goal achieved in the Winooski basin by land-use sector by state fiscal year. Note that SFY estimates are not cumulative. No non-regulatory forestland reductions have been credited in any fiscal year to date.**

percentage towards agriculture. Stormwater and River sectors have shown limited TP reductions state-wide in the Annual Clean Water Performance Reports for the reasons described earlier.

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 expected infusion of ARPA funds and assistance from the CWSP for many clean water project types.

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

## *TMDL Sector Targets: Winooski 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 will establish the five-year targets (Table 13). 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 13. The Winooski basin five-year TP targets and final targets for each land-use sector. The final TMDL target for forest lands is expected to be 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 | 3,733 | 13,937 |
| Agriculture: Barnyard Production Areas | 592 | 1,865 |
| Developed Lands: Stormwater | 1,548 | 4,716 |
| Developed Lands: Roads | 89 | 3,916 |
| Rivers | 0 | 16,638 |
| Forests | 0 | 1,904 |

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 2022. The estimate does not include SFY 2023 data but assumes a 14-year period stretching between 2023 and 2036.

The river, forest and wastewater sectors do not have five-year targets. The forest targets are expected to be met through Acceptable Management Practice compliance where forest management is occurring. The rivers are expected to meet targets through a longer time frame than the other sectors, also below for additional explanation. The wastewater sector allotment was incorporated into wastewater treatment facility permits.

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, developed land and rivers sectors. As noted above, as the data includes SFY 2022 data, actual achievements as of the printing of this plan may be higher.

## *Agricultural Sector*

The TMDL agricultural reduction goal for the Winooski basin is 13,937 kg TP, for non-point agricultural field sources and 1,865 kg TP for barnyard production area sources (see Table 12 and The Lake Champlain TMDL[3]) The reductions to meet the 2036 goals will be achieved through Required Agricultural Practices (RAP) compliance (see Table 11) and non-regulatory Best Management Practice (BMP) adoption.

The agricultural community has made substantial progress towards meeting agricultural TMDL targets. Basin-wide in SFY 2022, 11% of the total barnyard management goal and 25% of the field practice reduction goal were met, though some field practices like 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 last plan, two significant contributions to efforts include standing up the Pay for Phosphorus program and the additional involvement by partners through the CWSP framework to address 10% of the agricultural phosphorus not met by existing regulatory programs.

[3] The report breaks the agricultural sector into three classes – field crops (hay and cultivated crops), pasture, and barnyard production practices.

To keep track of the work by multiple partners, the Vermont Agency of Agricultural, Food and Markets manages a multi-partner planning database to support phosphorus reduction tracking and accounting efforts by state and federal agencies.

## Winooski Agricultural Tracking and Accounting Results

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

- In SFY 2022, over 4,800 acres of agricultural BMPs were *newly* implemented in the basin (several BMPs have multi-year lifespans and are only counted in the year they are first implemented); this represents a decrease from 7,100 newly implemented acres in SFY 2021. Cover cropping, manure injection, and conservation tillage were the most common practices in SFY 2022.
- Approximately 3,700 kg of agricultural phosphorus were estimated to have been reduced by BMP management actions in the basin in SFY 2022 (Fig. 23). This number represents an increase of about 400 kg TP over reductions achieved in SFY 2021. Cover cropping was responsible for the most reductions, followed by conservation tillage and manure injection. Overall, about 23.4% of the TMDL agricultural reduction goal was met in SFY 2022 (Figure 22).

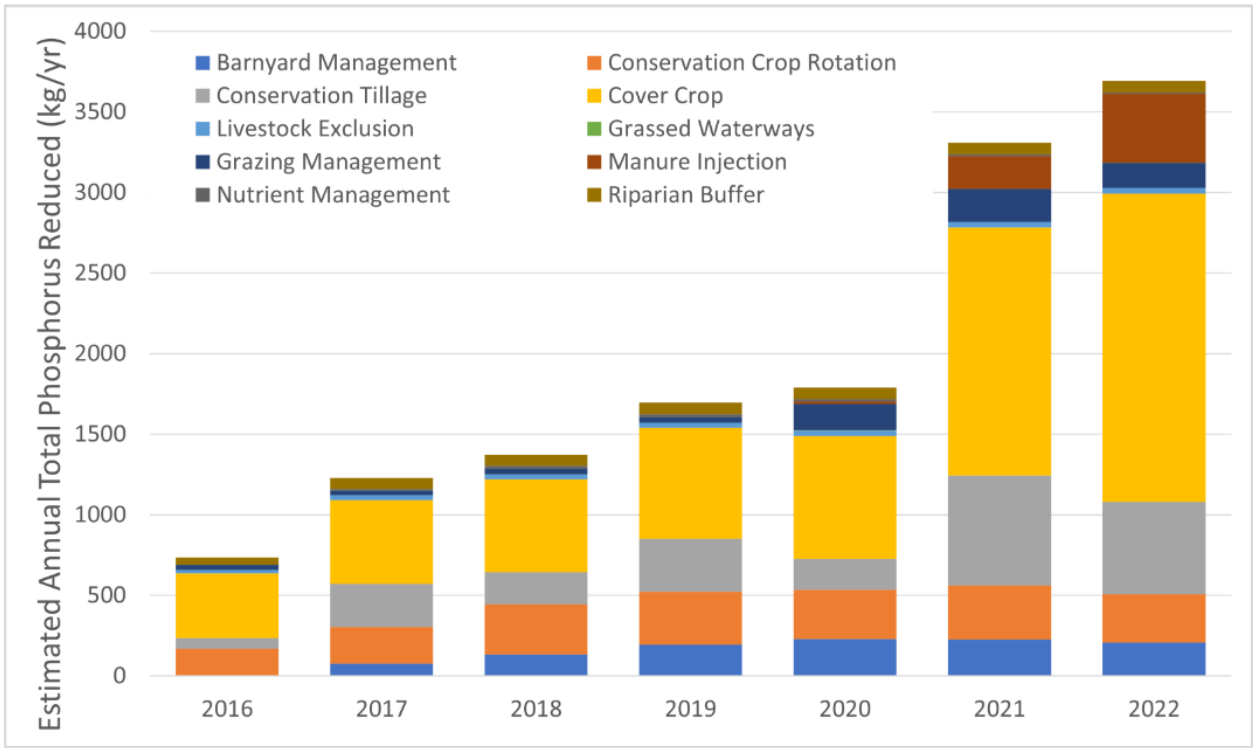



**Figure 23. Estimated total phosphorus reductions (kg/yr) by agricultural practice and state fiscal year. Agricultural practices include crops, pasture, and barynard management.**

## Agricultural Target Setting

Progress on agricultural reductions in the Winooski 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 % 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 to inform strategy development:

- Basin-wide in SFY 2022, 11% of the total barnyard management reduction goal was met, and 25% of the field practice reduction goal was met. The TMDL mandates that 100% of these goals are met by the year 2036.
- Muddy Brook and Headwaters of the Little and Winooski Rivers 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 2022 data, the remaining agricultural field practices TMDL goal is 10,451 kg TP. Annual cumulative reductions of approximately 746 additional kg of phosphorus from agricultural field practices are required each year from SFY 2023-2036 to meet the TMDL. The five-year reduction target for SFY 2027 is therefore 3,733 kg of phosphorus.
- Based on SFY 2022 data, the remaining production area TMDL goal is 1,659 kg TP. An annual cumulative reduction of approximately 118 kg of phosphorus from production areas is required each year from SFY 2023-2036 to meet the TMDL. The five-year reduction target for SFY 2027 is therefore 592 kg of phosphorus.

### Assessment of Progress

The annual progress achieved over the last several years aligns closely with the next five-year target. Vermont will continue to support and improve on programs described in Chapter 4 to facilitate similar 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.

## *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.

The TMDL target for developed lands in the Winooski basin is 3,916 kg for roads and 4,716 kg for the remainder (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 2022, TP mitigation from both roads and developed lands achieved roughly 7% of the TMDL reduction goal for these sectors. 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 24).

## 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 11 for regulatory descriptions). The Transportation Separate Storm Sewer System Permit (TS4) and the Municipal Roads General Permit; Municipal Separate Storm Sewer Permit multisector (MS4) in addition to other regulatory and nonregulatory phosphorus mitigation efforts not currently suitable

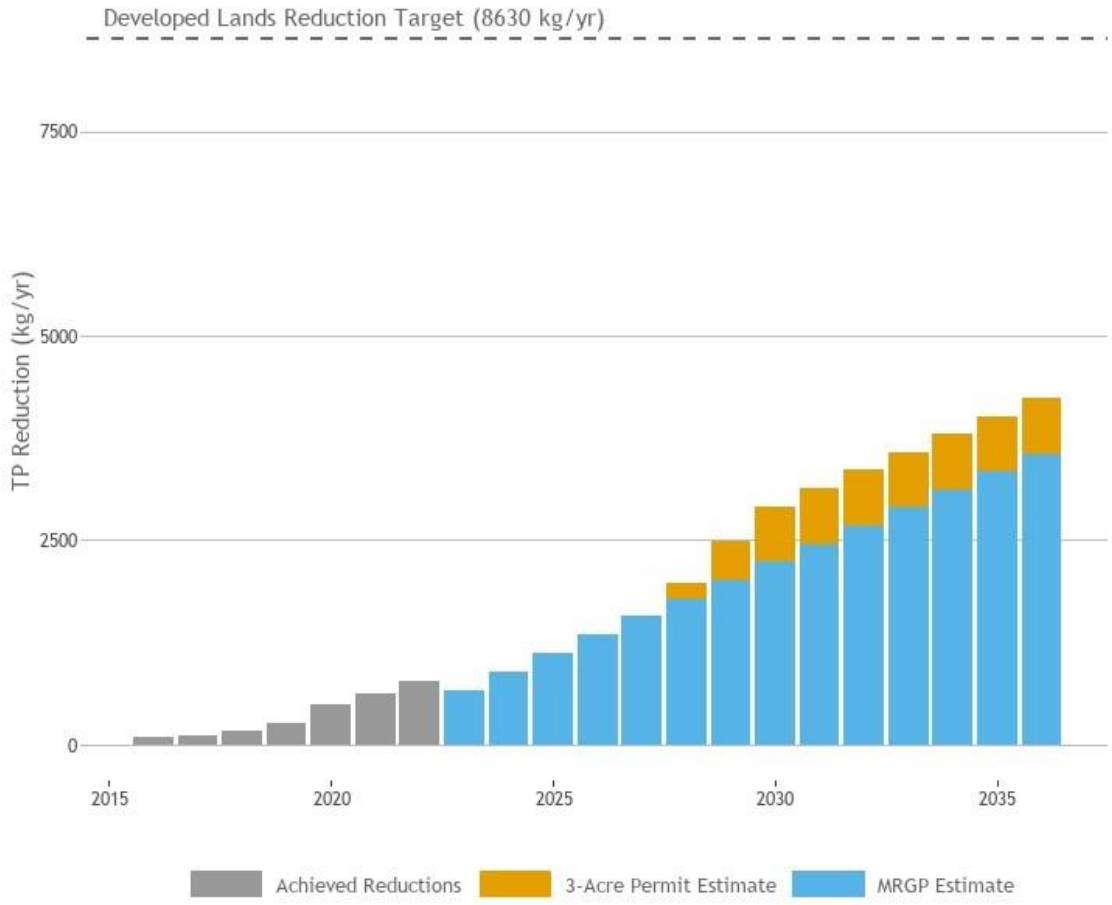



**Figure 24. Achieved developed lands TP reductions and anticipated reductions from regulatory stormwater programs. The developed lands target reduction target for the Winooski basin is approximately 8630 kg/yr.**

for modeling P reduction expectations will also contribute to the target (see Chapter 4).

Total phosphorus from developed lands that is not addressed by regulatory programs is given to Clean Water Service Providers for mitigation.

## Winooski Basin Stormwater Tracking and Accounting Results and Target Setting

ANR expects that through the MRGP and Three-acre permits, TP mitigation from both roads and developed lands will achieve roughly 50% of the TMDL reduction goal for these sectors by 2036,

see Figure 23), leaving the remainder to be address through other regulatory programs and non-regulatory efforts. Currently modeled MS4 and TS4 P reductions towards the target are minimal. See below for information about the Clean Water Service Provider who will support non-regulatory stormwater management projects. In the subsequent tactical basin plan (2028), progress against the first five-year target will be assessed.

By 2036, over 4,200 kg of developed lands TP is expected to be mitigated by the MRGP and 3-acre permit regulatory programs in the Winooski 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 2022 reductions and anticipated regulatory reductions over the five-year target period of 2023-2027 (Table 14).

**Table 14. Five-year developed lands TMDL TP target for the Winooski basin.**

| Sector | Anticipated regulatory reductions (kg TP/yr) | Remaining five-year target (kg TP/yr) |
|---|---|---|
| Developed Lands: Stormwater | 15 | 1,548 |
| Developed Lands: Roads | 1,154 | 89 |

Key accounting highlights to inform strategy development:

- The TMDL developed lands reduction goal in the Winooski basin is approximately 8,630 kg TP. Reductions from MRGP and 3-acre permit programs are estimated to mitigate about 50% of this amount. SFY 2022 reductions in developed lands in the Winooski basin were 773 kg TP.
- The five-year target for total developed lands (stormwater + roads) in the Winooski basin is 1,637 kg TP, which is an increase of 864 kg over what was achieved in SFY 2022.

## 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 50% is expected to be addressed through nonregulatory 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. Beginning in 2023, the CWSPs will support 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 CWSP will also support operations and maintenance practices to ensure functionality of projects of expected lifespan. The calculation for the funding received by Winooski CWSP does

consider the higher phosphorus reduction expected for developed land, but it is not commensurate with the total load for the basin.

Additional opportunities to support nonregulatory 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 5-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 are expected to be achieved through regulatory compliance, additional nonregulatory work by the CWSP or other partners could provide 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 Winooski 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 33.8% of phosphorus loading to the Winooski basin. The TMDL target is 16,638 kg TP, requiring a 38.7% load reduction, (see Table 12 and The Lake Champlain TMDL interactive online report).

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 as a result 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 speed up 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 has only recently obtained a methodology for attributing phosphorus reduction credits to stream-sector projects. An outcome of the Functioning Floodplain Initiative (FFI) is the 2023 released methodology that attributes phosphorus removal to projects that move a stream towards equilibrium and therefore less erosive activity.

The FFI team, including DEC staff and hired consultants, has developed 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 on the Functioning Floodplain Initiative website.

### Winooski 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.

### 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.

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 SFY2016-2022, partners in the Winooski basin restored 10 acres of floodplain, reforested 91 acres of riparian buffer, conserved 133 acres of riparian corridor and 103 acres of wetlands through easements, improved 27 undersized stream crossings, and remediated 105 square feet of gully erosion (see Vermont's Clean Water Dashboard Project Output Measures report). However, only a

portion of these projects were credited with P reductions (see Fig. 22) to the extent that they would be using 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 learning and 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 target for the forest sector in the Winooski basin is 1,904 kg TP, requiring a 5% load reduction, (see The Lake Champlain TMDL interactive online report). The ANR expects that reductions will be achieved primarily through compliance with Acceptable Management Practices (AMPs). Although the Agency will continue to support additional forest BMP (nonregulatory) implementation that are supplemental to Acceptable Management Practices compliance, this iteration of the Phase 3 will not include any projected forestland BMP reduction estimates or forestland BMP five-year targets.

### Lake Champlain Basin Forestland Mitigation, Tracking, and Accounting Efforts

The Winooski basin's forest target will be met through regulatory compliance as Vermont understands that, according to the Lake Champlain TMDL, lake segments with 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 are described in Chapter 4.

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 of the project will calibrate models and expand on forestry BMP accounting methodologies. With the Phase II Quality Assurance Project Plan just recently approved by Environmental Protection Agency, the field verification and ground-truthing is underway for the 2023 field season.

### Winooski Basin Forestland Tracking and Accounting Results

The Natural Resources Tracking & Accounting Standard Operating Procedures (based on above methodology) is now available to support tracking of Acceptable Management Practices compliance and accounting for forest sector reductions. Although no additional BMP work is presently required in the Winooski basin to meet the forest sector target, the Standard Operating Procedures will also allow DEC to start tracking and crediting associated phosphorus reductions towards the forestland target or support any future redistribution of phosphorus reductions among the 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, Vermont) 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 and forestry BMP implementation within the Winooski basin.

Additional resources to support nonregulatory activity are described in Chapter 4.

# Chapter 4 – Strategies to Address Pollution by Sector

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 25). 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.


**Figure 25. Land use sector framework with practices used to enhance, maintain, protect, and restore water quality.**

# A. Agriculture

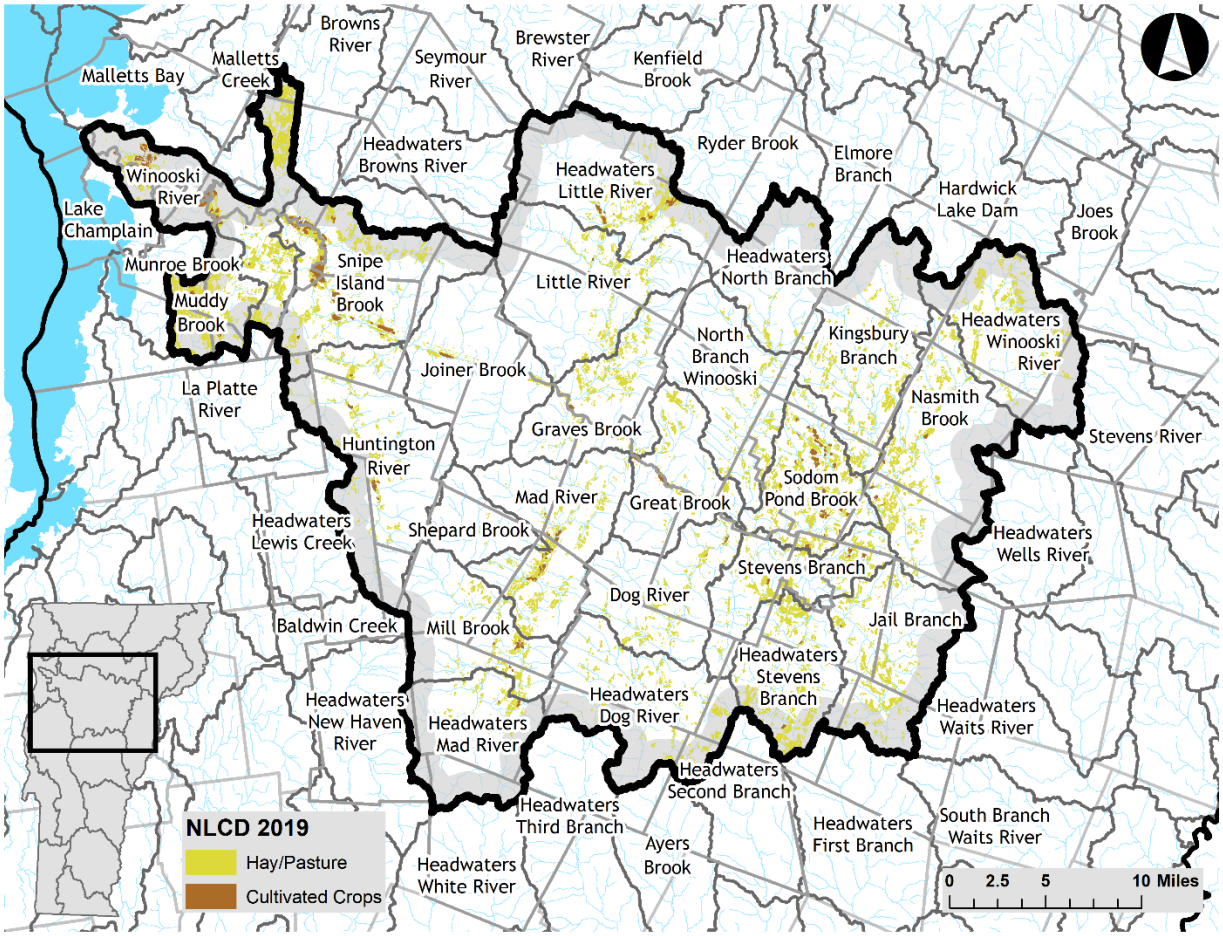



**Figure 26. Agricultural land cover in the Winooski basin.**

Agricultural land cover makes up approximately 9.5 percent of the Winooski basin with 0.7 percent in cultivated crop and 8.8 percent in hay or pasture. The highest concentrations of agricultural land are found along the lower Winooski River (Muddy Brook, Winooski River, and Snipe Island sub-watersheds), the Huntington River, the headwaters of the Little River, the Mad River, the Stevens Branch watershed, Sodom Pond Brook, and the Winooski headwaters (Figures 26, 27). Pasture and hay production is most widespread, while cultivated crops are concentrated in the Lower Winooski basin, Sodom Pond Brook watershed, and a few other sub-watersheds.

Agricultural runoff constitutes 18.8% of the Winooski basin's estimated TMDL baseline total phosphorus (TP) loading (kg/yr) to Lake Champlain. The Phase 3 portion of Chapter 3 above provides additional detail on the quantitative TMDL TP reduction targets, tracking and accounting methods, and progress towards these P targets since 2016. Agricultural runoff may also be one

contributing factor to E. coli stream impairments in the upper portion of the river in Plainfield, Marshfield, and Cabot, the Huntington River in Huntington, and the Mad River in Moretown (Chapter 3 Figure 17), as well as phosphorus impairment in Shelburne Pond (Chapter 3 Figure 16). The following sections describe regulatory programs and non-regulatory tools to address agricultural runoff to surface waters during this plan cycle. When appropriate, agricultural partner efforts will target several sub-basins in which remaining TMDL TP reduction goals are large (Figure 28).

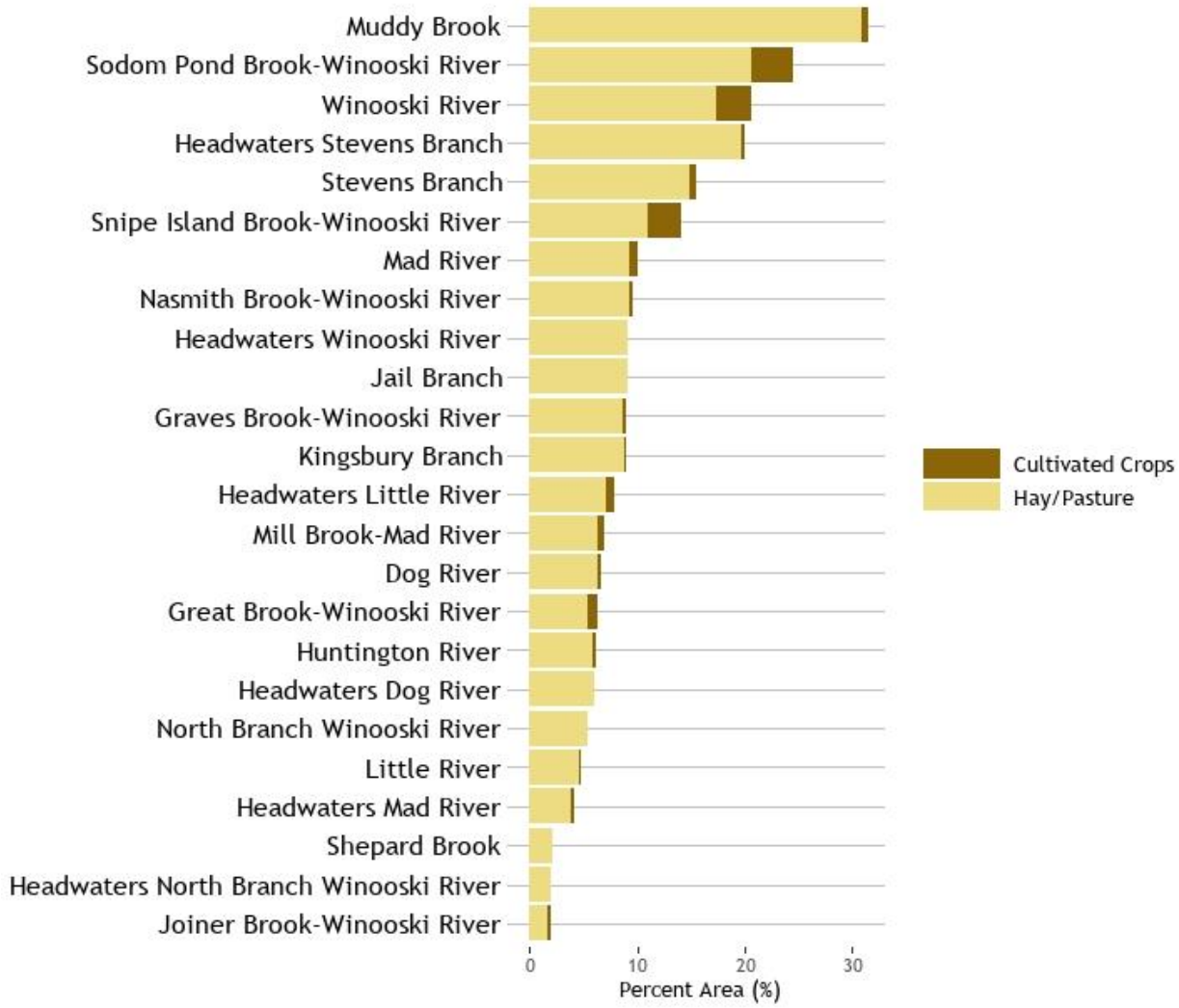



**Figure 27. Agricultural land cover in the Winooski watershed by HUC 12 watershed.**

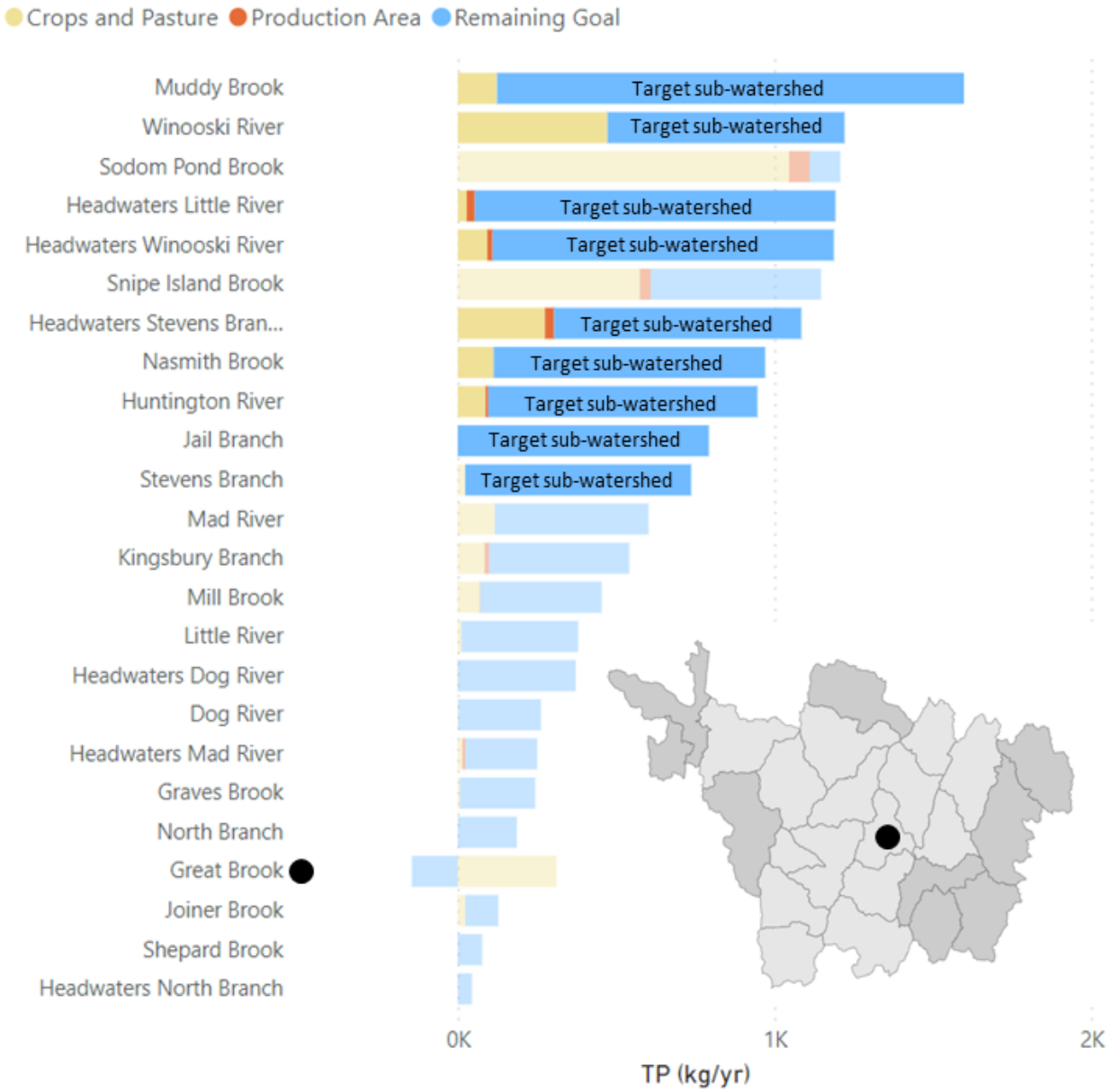



**Figure 28. Agricultural total phosphorus (TP) reductions as compared to TMDL targets by sub-watershed. The full length of each bar is the total TP reduction target for that HUC12. Yellow and orange bar sections indicate the TP reduction achieved in SFY2022. The blue bar section indicates the remaining TP goal to reach the total reduction goal. Nine "target watersheds" (dark gray sub-watersheds in inset) are a focus of implementation in this Basin Plan cycle because of large remaining TP goals. Note that, for Great Brook (black point), reductions achieved (yellow bar) have surpassed the 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 farms are regulated by additional sets of rules promulgated by the AAFM based on farm animal numbers into large, medium, certified small and small farms.

There are currently one permitted Large Farm Operation and six Medium Farm Operations in the basin. 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 32 Certified Small Farm Operations, that are required to certify annually with the Agency, will be inspected at least once every seven years, and need to comply with the RAPs. The AAFM estimates there are 117 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 will continue to help landowners understand where they fall within the RAP farm categories and the RAP requirements.

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. As a result of regulatory farm inspections and technical assistance provided to farms in counties overlapping the basin, in SFY 2022 approximately 57% of farm facilities inspected in Washington County, 75% in Chittenden County, and 81% in Lamoille County were compliant with the RAPs. The compliance rate of Washington County, which constitutes the largest portion of the Winooski basin, is lower than the overall Lake Champlain Basin compliance rate in SFY 2022, in which approximately 72% of farm facilities inspected were compliant. Information regarding farm inspections, compliance, and enforcement actions can be reviewed on AAFM's Water Quality Interactive Data Report.

## *Technical and Financial Assistance*

Availability of technical and financial assistance throughout the basin is provided by the Lamoille County and Winooski Natural Resources Conservation Districts, UVM Extension, AAFM, and the Natural Resources Conservation Service (NRCS), who help facilitate compliance with water quality

regulations and the voluntary adoption of conservation practices. AAFM and NRCS funded programs provide most of the financial support directly to farmers as well as to the agricultural partner organizations. Outreach, education, technical assistance, and financial assistance is available for farmers to implement field Best Management Practices (BMPs), such as cover cropping, crop rotation, and reduced tillage practices, and available for farmers to implement farmstead BMPs, such as waste storage facilities or clean water diversion practices. These agricultural assistance and outreach programs are essential tools in promoting field and farmstead BMPs that protect water quality, improve soil health, and increase farm viability. Cover cropping is the most popular BMP implemented in the Winooski basin, while grazing management, conservation tillage, and manure injection cover fewer acres and are more annually variable (Figure 29). Cover cropping has been implemented on most corn acreage in the basin (3618 acres in SFY2022 out of around 4770 total crop acres); therefore, significant additional TP reductions will have to be realized through pasture, hay, and trapping/control practices. Agricultural partners suggested that a lack of access to capital equipment (e.g., drag lines for manure injection, no till drills for cover cropping and crop to pasture/hay conversion) and a lack of understanding of what is fundable (e.g., whole-pasture fencing vs. riparian-only fencing) are current barriers to BMP implementation, especially for smaller farms. Outreach and technical assistance may help increase awareness of the resources available to implement these water quality-benefitting practices.

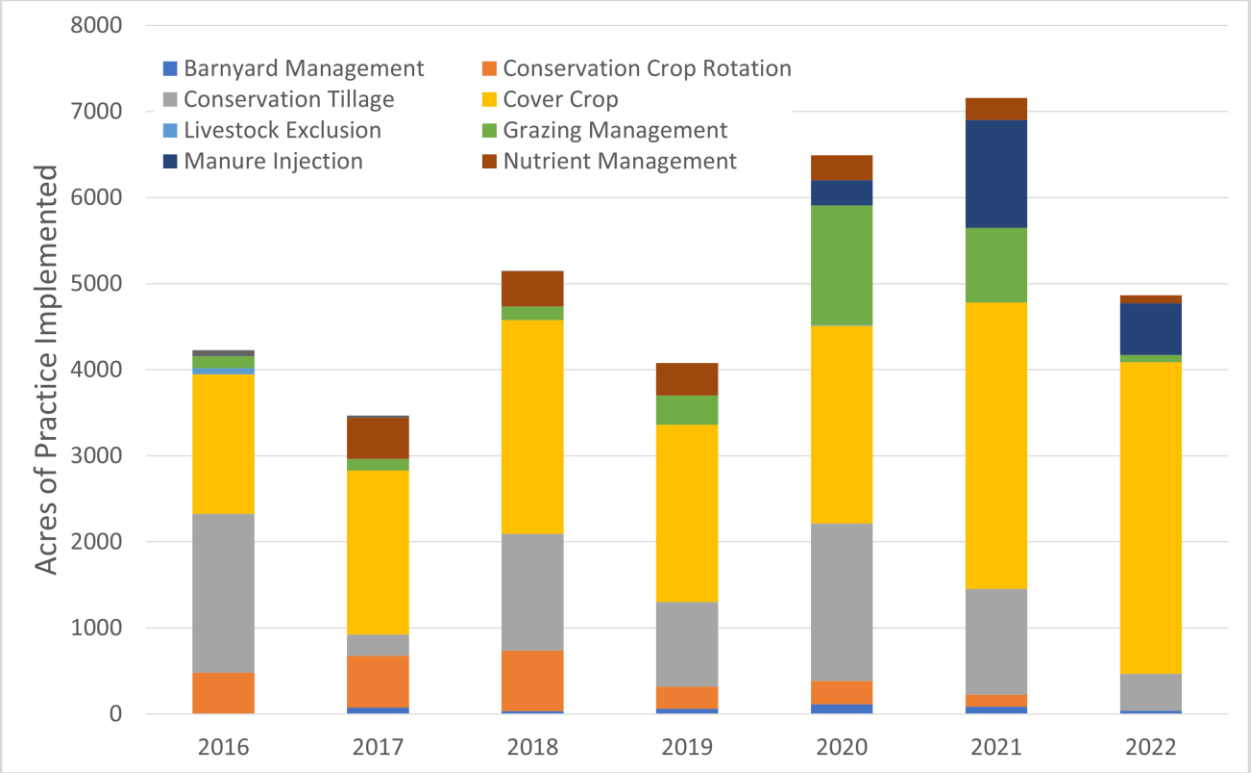



**Figure 29. Implemented agricultural practices in the Winooski basin by state fiscal year.**

AAFM and partners provide educational opportunities and technical assistance to farmers to promote and assist with conservation practice adoption. Between 2018-2022, AAFM and the Agricultural Clean Water Initative Program supported 34 education events with 684 attendees in the Winooski basin. Over the same period, UVM Extension, Conservation Districts, and AAFM conducted approximately 63, 243, and 94 on-farm technical assistance visits in Washington, Chittenden, and Lamoille Counties, respectively.

In a series of early 2023 VT Agricultural Water Quality Partnership meetings hosted by the Winooski Natural Resources Conservation District, technical service providers indicated a variety of places where outreach and assistance to farmers are improving or could be improved in the Winooski basin. Technical service providers suggested that farmers may be overwhelmed with both the number of service providers that visit their operation as well as turnover in provider staff. The Farm Team model, in which technical service providers from multiple organizations coordinate their assistance to individual farms, is one potential solution to these concerns and is being explored further in the Winooski basin during the next TBP planning cycle. Likewise, providers indicated that they also were not familiar with all resources available to farmers, especially for non-traditional or emerging programs. Resource guides like Franklin County Natural Resource Conservation District's Assistance for Agricultural Producers and the development of simpler brochures may be a helpful complement to a potential farm team model in the basin. Providers further highlighted that emerging resources for new farmers, small-scale farmers, and under-served and marginalized farmers are improving equity in agricultural funding opportunities in the basin, but that providers need a way to identify these farmers and target 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.

In addition to traditional agricultural funding, Act 76 formula grants can fund agricultural practices on non-RAP farms in the watershed. 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. A way to identify the smaller farms that need BMPs to address water quality issues is needed, as is the capacity to complete outreach to them and a way to support project operations and maintenance as required by formula grant funding.

## B. Developed Lands

ANR 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 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 increase the velocity and volume of runoff into rivers and lakes. This leads to an increased frequency and intensity of flooding as well as a greater likelihood that runoff will become contaminated with pollutants. The result is increased erosion and property damage, degraded aquatic and terrestrial habitats, and threats to public health via contaminated drinking water and recreational pursuits.

Developed lands make up about 2.7% of the land cover in the Winooski basin, with locally higher concentrations in the Headwaters Stevens (4.5%), Muddy Brook (7.4%), Stevens Branch (7.1%), and Lower Winooski (11.6%) sub-watersheds. These lands include the general land use classes of urban, residential, and industrial areas, as well as paved and unpaved roads. Phosphorus loading from developed lands account for approximately 25.1% 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. Stormwater runoff is also a partial cause of 50% of the 24 stream impairments identified in the basin, contributing excess sediment, chloride, nutrients, bacteria, temperature, and other pollutants to surface waters (Figure 17, Table 10). 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) General permit. 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 loads from MS4 communities to Lake Champlain segments as reported in Chapter 3 Phase 3 content.

The Towns of Essex, Colchester, Shelburne, and Williston, the Cities of Winooski and Burlington, the Village of Essex Junction, the Burlington International Airport, and the University of Vermont are MS4 permittees and have developed Flow Restoration Plans to achieve the Stormwater TMDLs, and/or Phosphorus Control Plans to achieve the Lake Champlain TMDL phosphorus reduction targets. 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. Together, Phosphorus Control Plans and Flow Restoration Plans are integrated into each MS4 community's Stormwater Management Program Plan and progress made on each are reported annually. The MS4 General Permit is being re-issued in 2023 with MS4 communities required to demonstrate compliance by 2024.

## *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 Winooski 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. The towns of Williston, Essex, South Burlington, and Colchester have the highest estimated acreage of three-acre sites, and about 340 sites covering about 2800 acres exist basin-wide (Table 15). The Agency is presently making available grant funding in the form of rebates for individual landowners, while municipalities can access Clean Water funding and/or subsidized loans, to obtain permit coverage. Program development for SFY 2022-2025 will be supported by an infusion of American Rescue Plan Act funds. The Green Schools Initiative was developed specifically to address public three-acre sites.

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 15. Estimated three-acre parcels and associated impervious cover for Winooski basin towns.**

| Town | Estimated # of Parcels | Estimated Acreage | Town | Estimated # of Parcels | Estimated Acreage |
|---|---|---|---|---|---|
| Williston | 48 | 515.4 | Bolton | 4 | 123.6 |
| South Burlington | 43 | 395.0 | Moretown | 3 | 18.0 |
| Colchester | 42 | 335.3 | Fayston | 3 | 25.8 |
| Essex | 35 | 217.3 | Waitsfield | 3 | 23.3 |
| Burlington | 28 | 227.8 | Middlesex | 3 | 10.6 |
| Stowe | 18 | 109.9 | Williamstown | 3 | 17.9 |
| Berlin | 18 | 119.3 | Northfield | 2 | 26.7 |
| Barre Town | 16 | 127.7 | Plainfield | 2 | 10.1 |
| Barre City | 14 | 81.1 | St. George | 1 | 7.5 |
| Montpelier | 13 | 70.8 | Duxbury | 1 | 4.2 |
| Hinesburg | 10 | 56.9 | East Montpelier | 1 | 11.0 |
| Waterbury | 9 | 156.8 | Cabot | 1 | 12.4 |
| Richmond | 5 | 38.4 | Marshfield | 1 | 5.3 |
| Warren | 4 | 42.3 | Roxbury | 1 | 4.2 |
| Winooski | 4 | 34.1 | Worcester | 1 | 4.2 |

## *Green Schools Block Grant*

DEC is funding a Green Schools Block Grant administered through GreenPrint Partners to have stormwater design and permitting work completed on behalf of schools in the Lake Champlain

basin. Public schools and colleges in the Lake Champlain basin that are required to obtain three-acre general permit coverage (3-9050) will be able to sign up to receive technical and financial assistance for stormwater design and permit obtainment. The 21 three-acre school sites in the Winooski basin include Barre City Elementary and Middle School, Barre Town Elementary and Middle School, Spaulding High School, Lyman Hunt Middle School, Allen Brook School, Williston Central School, Albert D. Lawton Intermediate School, Essex Elementary School, Essex Middle School, Founders Memorial School, Crosset Brook Middle School, Harwood Union Middle and High School, Warren Elementary School, Stowe Middle and High School, Chamberlin School, Marcotte Central School, Montpelier High School, Berlin Elementary School, U32 High School, Richmond Elementary School and Camels Hump Middle School, Winooski High School.

The Green School Initiative will also partner with Lake Champlain Sea Grant to provide stormwater education and outreach to school communities. Lake Champlain Sea Grant will 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. Most schools in the basin except Stowe, Chamberlin, Berlin Elementary, U32, and Richmond are enrolled in Phase 1 of the Green Schools initiative for 3-acre permit obtainment.

### *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. As of spring 2023, all municipalities in the basin have been mapped except for Buels Gore, Saint George, Elmore, and Brookfield.

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. Stormwater Master Plans are developed with municipal and public involvement and further prioritize projects identified in initial mapping efforts, offering a strategic approach to address stormwater runoff in the plan focus area. Stormwater master planning has been completed for 31 of 50 municipalities in the basin (Table 16). Plans are available at DEC's Stormwater Infrastructure Mapping Directory and, for the Mad River watershed, also via an online interactive format.

Projects identified as high priority in the stormwater mapping reports and master plans may be implemented by towns with the aid of watershed partners. Currently, in SFY23-24 the Central Vermont RPC is collating information on Stormwater Master Plan-identified projects in the

Winooski basin to find remaining, potentially phosphorus-efficient stormwater projects for formula grant funding.

**Table 16. Towns with completed stormwater assessments. 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 Winooski basin.**

| Town | Year(s) Stormwater Mapped | Stormwater Master Plan(s) Completed |
|---|---|---|
| Barre City | 2013 | 2016 Park Street SWMP, 2017 Quarry Hill SWMP, 2018 Townwide SWMP |
| Barre Town | 2016 | 2016 Park Street SWMP, 2017 Quarry Hill SWMP, 2018 Townwide SWMP |
| Berlin | 2013 | 2018 Townwide SWMP |
| Bolton | 2019 | |
| Brookfield | | |
| Buels Gore | | |
| Burlington | 2013 | MS4, Integrated Plan in development, 2014 Centennial Brook FRP, |
| Cabot | 2013 | 2014 Upper Winooski Integrated Road Erosion Assessment |
| Calais | 2017 | 2019 Kingsbury Branch SWMP |
| Cambridge | 2012, 2018 | 2021 Townwide SWMP |
| Colchester | 2010 | MS4, 2015 Sunderland Brook FRP, 2016 Morehouse Brook FRP |
| Duxbury | NA | 2019 Mad River SWMP |
| East Montpelier | 2014, 2018 | 2019 Kingsbury Branch SWMP |
| Elmore | | |
| Essex | 2002, 2008 | MS4, 2015 Sunderland Brook FRP, 2021 Phosphorus Control Plan |
| Fayston | 2017 | 2019 Chase Brook SWMP, 2019 Mad River SWMP |
| Granville | 2015 | |
| Groton | 2014 | |
| Hinesburg | 2015 | |
| Huntington | 2017, 2021 | |
| Jericho | 2012, 2017 | 2017 Townwide SWMP |
| Lincoln | 2018 | |
| Marshfield | 2013 | 2014 Upper Winooski Integrated Road Erosion Assessment |
| Middlesex | 2015 | |
| Montpelier | 2015 | 2016 Townwide SWMP |
| Moretown | 2015 | 2019 Mad River SWMP |
| Morristown | 2012, 2019 | 2019 Townwide SWMP |
| Northfield | 2019 | 2021 Northfield Ridge and River Routes |

| Town | Year(s) Stormwater Mapped | Stormwater Master Plan(s) Completed |
|---|---|---|
| Orange | 2021 | |
| Peacham | 2021 | |
| Plainfield | 2013, 2018 | 2018 Townwide SWMP, 2014 Upper Winooski Integrated Road Erosion Assessment |
| Richmond | 2009 | 2018 Townwide SWMP |
| Roxbury | 2018 | |
| Saint George | | |
| Shelburne | 2009 | MS4 |
| South Burlington | 2013 | MS4 |
| Starksboro | 2019 | |
| Stowe | 2020 | 2023 Stowe SWMP |
| Underhill | 2012, 2021 | 2018 Townwide SWMP |
| Waitsfield | 2009 | 2019 Mad River SWMP |
| Walden | | |
| Warren | 2017 | 2019 Mad River SWMP, 2002 WQRP for Clay and Rice Brooks |
| Washington | 2015 | |
| Waterbury | 2009, 2017 | |
| Westford | | |
| Williamstown | 2013 | 2023 Townwide SWMP |
| Williston | 2012 | MS4, 2013 Townwide Watershed Improvement Plan, 2016 Allen Brook FRP, 2021 Phosphorus Control Plan |
| Winooski | 2004 | MS4, 2015 Morehouse Brook FRP |
| Woodbury | 2018 | 2019 Kingsbury Branch SWMP |
| Worcester | 2015 | |

FRP = Flow Restoration Plan
MS4 = Municipal Separate Storm Sewer System
SWMP = Stormwater Master Plan
WQRP = Water Quality Remediation Plan

## *Illicit Discharge Detection & Elimination Studies*

Illicit discharges are discharges of wastewater or industrial process water into a stormwater-only drainage system. All towns in the basin with mapped stormwater infrastructure (except Orange, Peacham, and Duxbury) have completed, in-progress (Roxbury), or planned (Bolton, Starksboro) IDDE studies. Study outcomes are provided in thirteen reports:

- Characterization of Outfalls on the Winooski River in Montpelier (2001)
- Characterization of Outfalls to the Winooski River and Tributaries in Barre City (2003)
- Detection and Elimination of Non-Stormwater Discharges to the Streams of the City of Barre (2007)

- Detection and Elimination of Non-Stormwater Discharges to the North Branch, Dog River and the Stevens Branch of the Winooski River in Montpelier, Berlin, and Northfield (2009)
- Illicit Discharge Detection and Elimination in Richmond, Waterbury, Moretown, and Waitsfield (2011)
- Assessment of Stormwater System Outfalls in Marshfield, VT (2013)
- Detection of Illicit Discharge from Stormwater System Outfalls in Plainfield, VT (2013)
- Monitoring of Stormwater System Outfalls in Cabot, VT (2013)
- Detecting and Eliminating Illicit Discharges in the Stevens Branch Watershed and Stowe (2016)
- Upper Winooski River Basin Illicit Discharge Detection and Elimination Project: Final Report (2018)
- Statewide Contract No 2 Illicit Discharge Detection and Elimination Study: Final Report (2019)
- Detecting and Eliminating Illicit Discharges in Montpelier: Final Report (2020)
- Statewide Contract No 3 Illicit Discharge Detection and Elimination Study: Final Report (2021)

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 the completion of Illicit Discharge Detection and Elimination studies and mapping in Roxbury, Bolton, Duxbury, and Orange, follow-up on recommended actions from previous studies, and the elimination of discharges identified by new studies.

### *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.

### *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 regionally and in the Winooski 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 in the Lake Champlain Basin. The program, managed by the Chittenden County Regional Planning Commission and the Winooski Natural Resources Conservation District, assists several municipalities and entities in complying with federally required stormwater permits. Rethink Runoff 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 Friends of the Winooski River and the Winooski Natural Resources Conservation District have since expanded Storm Smart assessments throughout the Winooski 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. Additionally, residents who implement practices recommended by BLUE BTV are eligible for rebates commensurate with the area of impervious service treated by the practice.

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 Winooski basin residents.

## Roads

It is estimated that more than 75% of Vermont roads were constructed prior to any requirements for managing stormwater runoff (ANR, 2012). 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 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. Road runoff also results in sediment that may contribute to elevated chloride and phosphorus levels or increasing phosphorus concentrations in streams and lakes; therefore, Lake Wise efforts and Lake Watershed Action Plans (described in the Lakes section below) consider the outcomes of road erosion assessments alongside other sources of water quality degradation.

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, the Municipal 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.

As of 2023, road segments are surveyed and scored according to either open drainage REI or closed drainage REI supplemental documents. The latest REI survey and scoring documents (2023) are available for roads with either open or closed drainages. REI's 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.

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 roads are those municipal roads 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. 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 have either completed or are in the process of completing REIs (Barre City, Morristown) as of summer 2023. Some towns do have a significant portion of roads with incomplete data, including Barre City, Montpelier, Stowe, Northfield, Morristown, and Waterbury. 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. *Very High Priority* connected segments will have to meet standards by December 31, 2025, for all road types, except for Class 4 roads, which will have to meet standards by December 31, 2028. Towns will report and manage their progress annually via the MRGP Implementation Table Portal database. For additional information see the DEC Municipal Roads Program.

DEC 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.

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*" and are in sub-basins with phosphorus impairments or with lakes that have increasing nutrient trends related to road stormwater runoff (Figure 30). Resources available from the Clean Water Fund (e.g., VTrans Municipal Grants-in-Aid, VTrans Better Roads grants) assist with development of designs, capital budgets,cost estimates and implementation of road projects. Completion of these projects may be counted towards meeting the requirements of the MRGP.

Stowe, Northfield, Montpelier, Barre Town, Calais, Plainfield, Moretown, Berlin, Cabot, Duxbury, and Middlesex are priority towns for funding because they have the highest number of non-compliant roads to be improved (Figure 29). Additionally, Barre City, Montpelier, Stowe, Northfield, Morristown, and Waterbury are priorities for technical assistance to decrease the number of unassessed road segments. Priorities for funding road assessments or improvements may also include lakes with impaired or increasing nutrient trends (Forest Lake), priority road-related projects identified in Stormwater Master Plans (Table 16) or Lake Watershed Action Plans (not yet completed in the basin but see the Lakes section below), or lake watersheds with potentially impactful municipal or private road erosion adjacent to waterways. These lakes may include Mirror Lake, Curtis Pond, Greenwood Lake, Cranberry Meadow Pond, Gillett Pond, West Hill Pond, Berlin Pond, Thurman W. Dix Reservoir, Sodom Pond, Worcester Pond, and Mollys Falls Reservoir, or others with currently unmapped private road erosion concerns. 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.

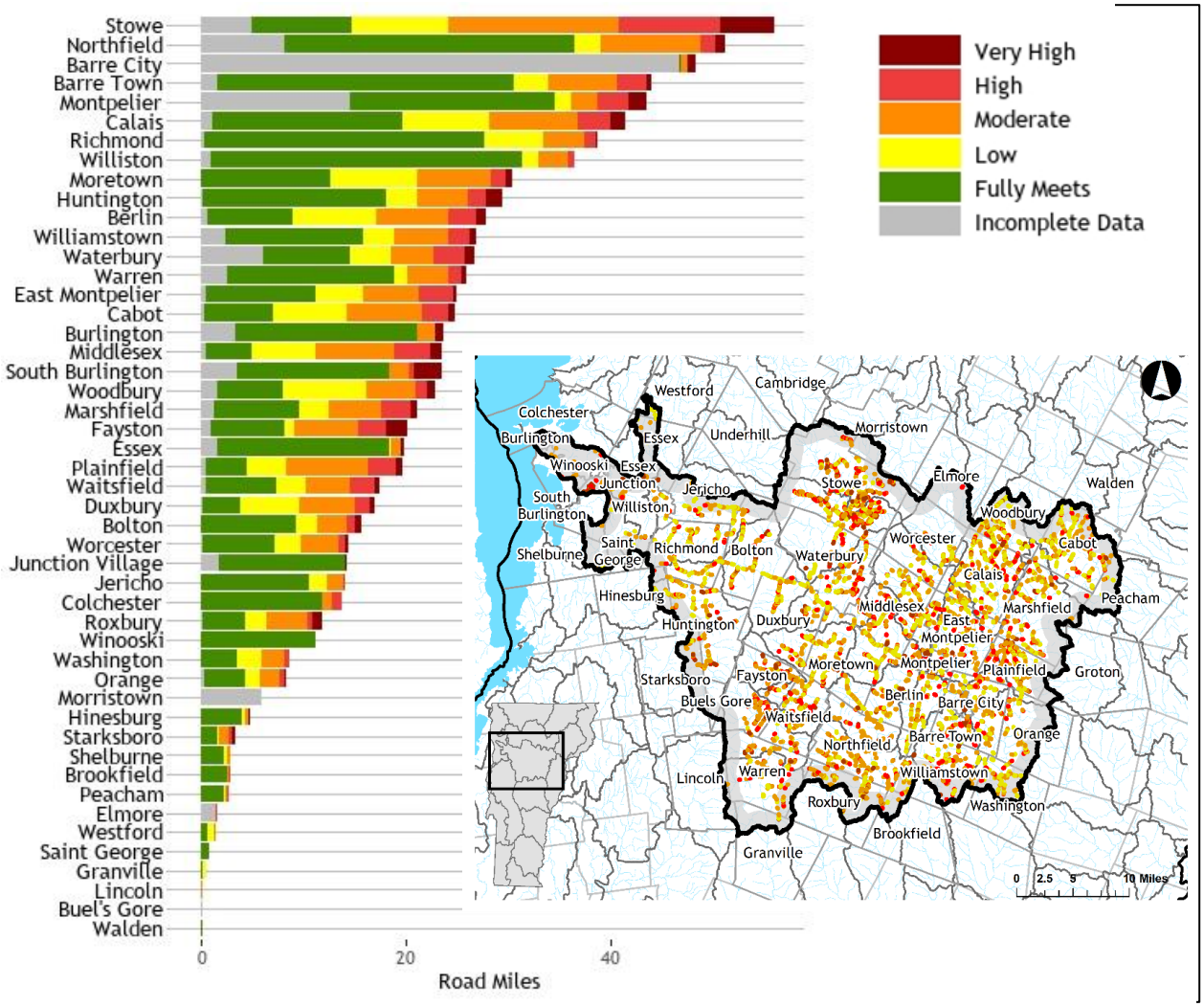



**Figure 30. Road miles by MRGP improvement priority in Winooski basin towns and the distribution of non-compliant segments across the basin. Visit the ANR Atlas for segement data. Fully compliant segments or those with incomplete data are not mapped here.**

## *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 that achieves on average 25% of the total reduction to Lake Champlain in each 4-year period. Projects on VTrans roads, rights-of-way, and facilities will be prioritized to include highly hydrologically connected road segments, existing road drainage deficiency, or localized erosion.

The Phosphorus Control Plan meets the requirements of the Lake Champlain Phosphorus TMDL and will result in the reduction of phosphorus loading from roads, rights-of-way, and facilities under the Agency's control by over 20% in the Main Lake segment within the next 20 years (by June 17, 2036). The highest loading totals for paved roads in the Main Lake drainage are those with high hydro-connectivity with a low slope (681 kg/yr) and moderate hydro-connectivity with a low slope (406.8 kg/yr).

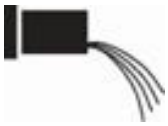
A VTrans Lake Champlain Basin Phosphorus Control Plan Story Map outlines the agency's process towards developing the Phosphorus Control Plans and this VTrans factsheet provides additional information. VTrans has also developed the Vermont Transportation Resilience Planning Tool as a web-based application 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.

## *Vermont Road and Bridge Standards*

In addition to the MRGP, towns can voluntarily adopt the most current version of the Vermont 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.

Managing for road runoff in the upper watershed catchments will lessen the pressure on the downstream areas receiving 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 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 Winooski basin, 15 municipal and one industrial wastewater treatment facility treat wastewater to established standards identified in NPDES permits before discharging it into a receiving water (Table 17). Municipal wastewater treatment facilities (WWTFs) receive wastewater originating from a combination of domestic, commercial, and industrial activities.

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 discharge to the Main Lake segment (see Table 17). As a result, the permitted loading for all Winooski basin WWTFs was collectively reduced by 15.4 MT/yr or 63.4% from the baseline 2016 estimates.

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 by 2019 and have reissuance dates on or before 6/30/2026. 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.

**Table 17. Summary of permit requirements for the wastewater treatment facilities in the Winooski River basin. To view the permits, see the Vermont's Wastewater National Pollutant Discharge Elimination System Permit webpage.**

| Facility (Permit ID) | Permit Expiration | Permitted Flow (MGD[1]) | Current Percent of Flow[2] | TMDL Allocated Wasteload (MT P/yr)[3] | Treatment Type | Receiving Water |
|---|---|---|---|---|---|---|
| Barre 3-1272 | 9/30/2025 | 4.000 | 53% | 1.105 | Extended aeration | Steven's Branch |
| Burlington – North 3-1245 | 9/30/2009[4] | 2.000 | 40% | 0.552 | Activated sludge | Winooski River |
| Burlington – Riverside 3-1247 | 9/30/2009[4] | 1.200 | 42% | 0.331 | Activated sludge | Winooski River |
| Cabot 3-1440 | 9/30/2025 | 0.050 | 35% | 0.041 | Activated sludge | Winooski River |
| Essex Junction 3-1254 | 6/30/2026 | 3.300 | 59% | 0.911 | Activated sludge | Winooski River |
| Global Foundries 3-1295 | 3/31/2026 | 8.000 | 39% | 2.210 | Sequencing batch reactor, industrial treatment | Winooski River |
| Marshfield 3-1195 | 12/31/2025 | 0.045 | 33% | 0.311 | Aerated lagoon | Winooski River |
| Montpelier 3-1207 | 9/30/2022 | 3.970 | 42% | 1.097 | Activated sludge | Winooski River |
| Northfield 3-1158 | 9/30/2025 | 1.000 | 45% | 0.276 | Sequencing batch reactor | Dog River |
| Plainfield 3-0381 | 9/30/2025 | 0.125 | 40% | 0.138 | Sequencing batch reactor | Winooski River |
| Richmond 3-1173 | 12/31/2025 | 0.222 | 39% | 0.061 | Extended aeration | Winooski River |
| So. Burlington – APPW 3-1278 | 6/30/2026 | 3.300 | 53% | 0.911 | Activated sludge | Winooski River |
| Stowe 3-1232 | 9/30/2025 | 1.000 | 34% | 0.276 | Sequential batch reactor | Little River |
| Waterbury 3-1160 | 12/31/2025 | 0.510 | 65% | 0.141 | Aerated lagoon | Winooski River |
| Williamstown 3-1176 | 12/31/2022 | 0.150 | 61% | 0.166 | Aerated lagoon | Steven's Branch |

| Facility (Permit ID) | Permit Expiration | Permitted Flow (MGD[1]) | Current Percent of Flow[2] | TMDL Allocated Wasteload (MT P/yr)[3] | Treatment Type | Receiving Water |
|---|---|---|---|---|---|---|
| Winooski 3-1248 | 6/30/2026 | 1.400 | 47% | 0.387 | Activated sludge | Winooski River |

[1]MGD = Million gallons per day

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

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

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

To ensure that facilities have time to implement any needed construction of upgraded phosphorus treatment facilities to continue to meet the TMDL allocations, discharge permits require that municipalities develop plans to maximize phosphorus reductions and meet limits. 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 Winooski WWTFs have completed a Phosphorus Optimization Plan, and none has been required to develop a Phosphorus Elimination/Reduction Plan at this time. The current permit required upgrades at the majority of the WWTFs are to maximize phosphorus and biological oxygen demand removal.

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 Monitoring and Assessment 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 Northfield, Montpelier, 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. 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.

The Wastewater Management Program website includes additional information regarding specific 1272 orders, Long-Term Control Plans, and CSO annual reports. 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 can be viewed on the Wastewater Program's discharge permit database.

In addition to the improved 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 eleven operations with pretreatment permits that discharge to Winooski 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 through the Clean Water State Revolving Fund, Vermont Pollution Control State Revolving Fund, and the Vermont Engineering Planning Advance Program; and grants via the Vermont Pollution Control Grants and the Clean Water Fund (created via Act 64: the Vermont Clean Water Act). The US Department of Agriculture also provides loans via USDA Rural Development Water and Environmental Loans and Grants.

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

Most recently, to assist municipalities with Phosphorus Optimization Plans, DEC collaborated with the Lake Champlain Basin Program in 2018 to initiate a wastewater optimization and technical assistance program. To date, the following permittees in the basin have or will receive assistance: Marshfield, Northfield, Burlington North, Richmond, and Winooski. One additional year of funding is currently available.

The DEC and partners are also available to assist municipalities with asset management planning, which includes needed upgrades and timeline as well as funding sources and deadlines. 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 Winooski basin, which has the highest number of WWTF. With an asset management plan in place, municipalities could plan over a longer time period as well as 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 (existing uses list is found on the Winooski 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 wastewater treatment facilities and associated infrastructure upgrades listed below that have municipal support for future drafts of the

Project Priority List articulated in the DEC's Intended Use Plan. Please see the Intended Use Plan for the list of Winooski basin municipalities with projects currently on the Project Priority List.

### Barre City

There have been no recent upgrades to the WWTF. Much of the infrastructure has exceeded 20 years in operation and the WWTF's current permit requires that the facility conduct a 20-Year Engineering Evaluation. The facility did not conduct this evaluation as required in 2018 and is not currently in compliance with the permit conditions to perform this work. The City has retained a consultant who has started the required evaluation.

The EPA identified Barre City as a community that could benefit from technical assistance. Region 1 has referred a technical assistance group consisting of Moonshot Mission and the US Water Alliance and this group has been consulting with the City on water and wastewater issues. They hope to increase public engagement and identify funding opportunities for the City.

The DEC Wastewater Pretreatment Program is starting the process of determining which industrial users that discharge to the Barre City WWTF should be subject to a pretreatment permit. This work will help address some of the operational issues occurring because of high strength waste and excess FOG (fats, oils, grease) in the collection system.

### Burlington North

The City of Burlington operates this activated sludge facility and disinfects with chlorine. The operators have been doing trials to improve phosphorous removal and were planning to start two-point injection in January 2018.

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 requirements of the 2016 Lake Champlain Total Daily Maximum Load (LC TMDL). This will allow the facilities to share their Total Phosphorus wasteload allocations, required in the LC TMDL and allow unused TP at one facility to be allocated or traded to another. This is the first integrated permit in Vermont and because of this, drafting the permit has taken more time. The permit is on schedule to be issued sometime in the 2024 calendar year.

### Burlington – Riverside

The City of Burlington operates this activated sludge facility and disinfects with chlorine. No major upgrades have occurred at the WWTF in the past five years. This facility is also included in the integrated permit process, see Burlington North.

### Cabot

The WWTF was constructed in 2000 and consists of six septic tanks, a filter system, an aerated equalization basin, an activated sludge basin, a Membrane Bioreactor system, and Ultraviolet light disinfection. Sodium Aluminate is added for enhanced phosphorus removal prior to entering the aerated EQ tanks. A new electrical board and supervisory control and data acquisition system was installed in December 2018.

### Essex Junction

No major upgrades have occurred at the Essex Junction WWTF in the past five years. The WWTF had a major refurbishment in 2012-2013. Anaerobic and anoxic tanks were added to the aeration tank for improved phosphorous removal. The sand filter was also replaced with cloth disc filters for improved particulate and phosphorous removal.

### GlobalFoundries

The WWTF is complex and includes three main processes: Chemical metal polishing pretreatment, biological wastewater treatment, and industrial wastewater treatment. The biological wastewater treatment process includes three Sequencing Batch Reactors that achieve complete nitrification and biological phosphorus removal. No major upgrades have occurred in the past five years of the wastewater treatment system. Minor refurbishment projects have been completed for the stormwater collection system managed by the Permittee.

### Marshfield

No major upgrades have occurred at the WWTF in the past five years. The WWTF consists of an influent pump station with grinder pumps, two equally sized aerated lagoons, and a chlorine contact tank. There is no specific treatment technology used for phosphorus removal at the facility, but it does remove approximately 20% to 30% of influent phosphorus and nitrogen via the normal lagoon treatment process.

### Montpelier

The WWTF is currently in the planning phase of an upgrade/refurbishment to existing infrastructure, including the odor control system, leachate holding tank and secondary clarifiers. Treatment for Total Ammonia Nitrogen is also being considered.

Montpelier was issued a new 1272 order on February 15, 2023, that includes deadlines for CSO abatement project implementation. Project in the order include installing rain gauges and CSO level monitoring equipment, cleaning and slip lining the siphon under the Winooski River and under the North Branch of the Winooski River, reconstructing the main pipe on State Street, completing hydraulic analysis and modelling of the CSO system, and submitting a revised Long-term Control

Plan by January 31, 2027. Montpelier is very close to the status of no CSO, with just a hydrologic problem causing overflows.

Weston Mobile Home Cooperative, new Town Center designated area, and Berlin Four Corners designated village in Berlin are interested in sewer extensions that would discharge to the Montpelier WWTF, where Berlin would be a co-permittee. Riverton is exploring a community wastewater disposal system.

### Northfield

No major upgrades have occurred at the WWTF in the past five years. The WWTF was last upgraded in 2003 and consists of an aerated grit removal system, two Sequencing Batch Reactors, a post-Sequencing Batch Reactor equalization tank, and chlorine contact tanks. The two Sequencing Batch Reactors operate in parallel, providing secondary treatment to remove organics, nitrogen, and phosphorus. Alum and polymer are added to improve solids settling and phosphorus removal.

Northfield was issued a new 1272 order on April 19, 2022, that includes deadlines for CSO abatement project implementation. Projects in the order include the South Main Street Area Stormwater Separation and CSO Abatement Project and the Sherman Avenue and Houston Street Stormwater Improvements Project. Storm drains will be constructed and tested to verify that no sanitary sewer connections are present.

### Plainfield

A 20-Year Engineering Evaluation was completed in 2021 that identified several areas where refurbishment was necessary in the short and medium term. Short term projects to improve the ultraviolet light disinfection system, sludge storage, pump stations and collection pipes are being addressed by the Town. The facility has started to use a cerium-based chemical for phosphorus removal.

### Richmond

The treatment system consists of a headworks equipped with an equalization tank, mechanical fine screen, anoxic tanks, and an aerated grit removal system. Wastewater is then treated by a clarifier where Sodium Aluminate is added, followed by filtration from 10-micron disk filters. Ultraviolet light is used for disinfection. Sludge is dewatered via a filter press. This facility receives septage from haulers. No major upgrades have occurred at the WWTF in the past five years. Richmond is currently starting on a 20-year evaluation process.

### So. Burlington – Airport Parkway (APPW)

The facility consists of a headworks, three primary clarifiers, aeration tanks with anaerobic and anoxic selectors for Biological Nutrient Removal, three secondary clarifiers, three-disc cloth 10-

micron filters, and ultraviolet disinfection. The facility also uses two parallel treatment trains of two-phased anaerobic digestion system to digest sludge, which produces electricity used at the facility. No major upgrades have occurred at the WWTF in the past five years. A biosolids upgrade is required to continue to process biosolids from the South Burlington Bartlett Bay WWTF.

### Stowe

Stowe is a Sequencing Batch Reactor facility that uses both biological removal and chemical precipitation for phosphorus removal. No major upgrades have occurred at the WWTF in the past five years.

### Waterbury

No major upgrades have occurred at the WWTF in the past five years. In 2014, Waterbury installed the Evoqua CoMag tertiary treatment system to consistently achieve sufficient TP removal. In 2021, the running total annual pounds of TP has averaged 10% of the annual TP effluent permit limit. The WWTF has continued to meet permit compliance in the 2022 operating year, and it is expected that the facility will remain in compliance for years to come without further optimization.

### Williamstown

Williamstown cleaned their lagoons in 2020 to address effluent toxicity. Subsequent Whole Effluent Toxicity testing indicates that this effort was successful.

### Winooski

No major upgrades have occurred at the WWTF in the past five years. The latest upgrade included work on the headworks facility.

## *PFAS Monitoring*

As part of a statewide investigation of potential conveyors of PFAS, DEC will support 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. If not installed appropriately, wastewater may reach groundwater that enters surface waters or be discharged to surface waters.

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. All new wastewater systems and potable water supplies under 6,499 gallons per day must obtain a Wastewater System and Potable Water Supply Permit

Larger systems of 6,500 gallons per day and over are permitted through Vermont's Indirect Discharge Program, a NPDES permit. Indirect discharge systems are soil-based disposal systems, which also include primary treatment, and may include secondary or tertiary treatment levels depending on discharge requirements. Water quality related indirect discharges are monitored. Systems can be municipality or privately owned.

There are 45 permitted indirect discharge systems in the Winooski basin with a total treatment capacity of 855,331 gallons per day. Most discharge systems are in either the Mad River watershed (513,685 gallons per day), the mainstem Winooski or its direct tributaries (219,446 gallons per day), or the Little River watershed (122,200 gallons per day).

### *Financial and Technical Assistance*

For residential systems under 6,440 gallons, state financial assistance is available to qualifying homeowners for system upgrades and until 2024 includes 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. Lakes in the basin that would benefit from wastewater workshops are larger populated lakes like Peacham Pond, Sabin Pond, Forest Lake, Lake Greenwood, and Curtis Pond. Communities adjacent to *E. coli* impaired stream segments with possible septic sources (e.g., middle Huntington River, lower Mad River) or where residential development is dense and adjacent to waterways (Little River watershed) may also benefit from these workshops, and other interested river and lake communities are encouraged to participate. More information can be found at the Wastewater Workshop website.

## *Village Wastewater Solutions*

Many historic villages do not have municipal treatment facilities. Closely spaced on-site septic systems adjacent to waterways can be the source of elevated levels of contamination. 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. Momentum has been growing in rural villages to explore options to deal with 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, as well as Village Water and Wastewater Initiative American Rescue Plan Act grant funding. Nine basin towns are included in the draft Clean Water State Revolving Fund Project Priority List articulated in the draft FFY23/FFY24 "Intended Use Plan" as developed by the DEC 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

Northern Border Regional Commission grants are also available to Winooski basin municipalities for addressing wastewater. A current collaboration between DEC and partners and the villages of Wolcott, East Burke, and West Burke to identify cost-effective wastewater solutions is being

supported through the grant. This wastewater solutions project is expected to provide a model for other villages throughout Vermont.

In the Winooski basin, the historic village centers with their dense, septic-based development located along rivers with elevated *E. coli* levels (see Table 8) would benefit from alternative wastewater solutions. In the Mad River subbasin the town of Warren's decentralized wastewater disposal system is a good example of managing wastewater in rural villages. Ongoing work includes the designated villages in the towns of Berlin (Riverton Village), Waitsfield (just upstream of an *E. coli* impaired segment of the Mad River) and Huntington (within an *E. coli* impaired segment of the Huntington River) who have both initiated a village wastewater study in 2022. Along the upper Winooski River, East Montpelier and Middlesex have both completed preliminary planning and have recently been considering pursuing additional action.

## 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 intensive 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 state-wide. A key consequence of these activities is the loss of resilience and the ecosystem services provided by rivers that fully achieve dynamic equilibrium. In the Winooski basin, loss of river equilibrium is the major contributor of TP loading to Lake Champlain (33.8% of the total load, see Chapter 3). Therefore, the plurality of the TMDL reduction goal for this basin (38.7%) is expected to be met through river regulatory reductions and voluntary projects.

Improving all forms of connectivity, upstream-to-downstream and river-to-floodplain, encourages river equilibrium. Dynamic equilibrium is essential for good water quality, healthy aquatic habitat, and flood resilience in the basin and will help to mitigate impacts of increased runoff and streamflow described in the Climate Change section. Tactical basin planning engages local, regional, and federal partners in the development of strategies needed to accelerate practices to move toward equilibrium and increase river connectivity to meet the state's clean water goals. River corridor plans, planting projects, strategic wood additions, Aquatic Organism Passage restoration, and community efforts to regulate floodplain and river corridor development, are examples of some of the tools used to increase river connectivity.

### *Stream Stability Restoration through the Functioning Floodplains Initiative*

Assessing stream and floodplain function supports the valuation of ecosystem services and the potential for natural resource restoration opportunities. Societal benefits such as safe swimming, fish and wildlife, public safety and property protection may be categorized under the general ecosystem services of water quality, ecological integrity, and flood resilience.

The Functioning Floodplains Initiative (FFI) is a planning tool 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 project team has developed a methodology for a project credit scoring system that rewards phosphorus load reducing practices, as derived from the TMDL baseload allocations. The stream network itself is estimated to be the largest source of phosphorus baseload in the Winooski basin (33.8%), with required reductions of 38% over the TMDL lifetime. The FFI tool will result in 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.

Stream stability and storage may be restored through 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. A given restoration project may include one or more of these components. This connectivity-based framework for TP base load allocation and crediting 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 river instability baseload is distributed to the reach scale by using TMDL sub-watersheds as the components of each HUC12 to develop the total HUC12 allocation. The HUC12 load allocation then gets downscaled to the reach level using an "area-weighted" reach assignment.

The FFI project team established 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, 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. This crediting system will consider "stacked" practices (e.g., protection + riparian buffers). DEC will devise how this will be quantified and reported on in the tracking and accounting systems.

Going forward, the river instability phosphorus scoring and crediting system will be based on the increments of restored and protected connectivity, with the highest project credits awarded in areas with higher baseload allocations. Therefore, the size of the connectivity credit awarded to a project is commensurate with the degree to which geomorphic equilibrium is restored.

### *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 River Management 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 Winooski basin plans are linked in Table 18.

While overall water quality in the basin is satisfactory, degraded geomorphic condition of the basin's streams (Figure 9) may impact:

- wildlife and fish habitat (e.g., riparian buffer removal increases water temperature, reduces shading and habitat for insects that feed fish, and channel alteration destroys aquatic habitat);
- public safety (e.g., loss of floodplains that store floodwaters, accelerated streambank erosion which results in infrastructure damage, and channel straightening that increases flow velocity during rain events);
- water quality (e.g., higher phosphorus loading from bank soil erosion stormwater runoff from encroachment of impervious surfaces and agricultural land).

Rivers are in a constant balancing act between the energy they produce from the slope of the channel, and the volume and weight of the moving water and the energy they expend to carry water, sediment, and debris downstream. A change in any one of these factors will trigger adjustments of the other variables until the river system comes back into equilibrium. These changes can be caused by natural events such as storms and by human activity such as channel manipulation. The impact of these changes may be seen immediately and for decades after the activity occurred.

The legacy from Tropical Storm Irene in 2011 and other large flood events like those in July 2023 will be felt for years to come. While such flooding impacts are unlikely to be fully mitigated, the goal of managing toward, protecting, and restoring the equilibrium condition of Vermont rivers is to lessen or avoid conflicts between human investments and river dynamics in a manner that is technically sound, and both economically and ecologically sustainable. In addition, it will help to mitigate impacts of increased runoff and streamflow from climate change.

Where funding, local support, and interest exists, priority projects and objectives identified in RCPs and SGAs 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. This plan recommends partners work with the Planner, the Vermont Rivers Program, the Winooski Clean Water Service Provider, and possibly outside consultants to seek cost-efficient, P-reducing stream restoration projects within existing RCPs and SGAs and develop projects where landowners are supportive. Priority sub-watersheds include those identified by a working group of local stream restoration partners organized by The Nature Conservancy: the Stevens and Jail Branches, Winooski headwaters, the Dog River, and possibly the Mad and Huntington Rivers.

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. This plan

recommends partners work with the Vermont Rivers Program beginning in 2024 to pilot an SGA/RCP update process in either the Dog River or Stevens/Jail Branches where partners have previously expressed concern that RCPs are out-of-date while communities have expressed interest in new project development.

**Table 18. Stream Geomorphic Assessments and River Corridor Plans are available for many of the Winooski basin's major river segments and sub-watersheds.**

| River | SGA Phase 1 Completed | SGA Phase 2 Completed | RCP Completed | Other |
|---|---|---|---|---|
| Alder Brook | 2006* | 2006* | | |
| Allen Brook | | | | 2008: Departure Analysis and Project ID |
| Centennial Brook | | 2006 | | |
| Dog River | | | 2009 | |
| Huntington River | 2005 | 2006 | 2009 | |
| Kingsbury Branch | | | 2008 | |
| Pekin Brook | | | 2010 | |
| Little River | | | 2010 | |
| Lower Mad River | 2008 | | 2018 | |
| Upper Mad River | 2008 | 2008 | 2008 | |
| Mill Brook | 2007* | 2007* | | |
| Muddy Brook | 2008* | 2008* | | |
| North Branch Winooski | 2007 | | 2009 | |
| Lower Winooski | 2006* | 2006* | | |
| Lower Winooski - Richmond Tributaries | 2007 | | | |
| Middle Winooski | 2007 | | 2015 | |
| Joiner Brook and Winooski River | | | 2009 | |
| Upper Winooski - North Branch and Lower Stevens Branch | 2007 | | | |
| Upper Winooski - Cabot | 2004 | 2006 | 2006 | 2006: Upper Winooski Tributary Phase 2 |
| Upper Winooski - Montpelier to Cabot | | 2007 | 2008 | 2010: Plainfield to Montpelier RCP |
| Stevens and Jail Branches | | 2004 | 2009 | |
| Sucker Brook | 2007* | 2007* | | |
| Sunderland Brook | | 2007 | | |

| River | SGA Phase 1 Completed | SGA Phase 2 Completed | RCP Completed | Other |
|---|---|---|---|---|
| West Branch Little River | | 2005 | 2007 | 2010: Upper West Branch RCP |
| Great Brook | | | 2014 | |

* indicates both SGA phases were completed in the same report.

## *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. Since the 2018 plan, Winooski partners have used state funds to plant 36 acres of forested buffer, restore eight acres of floodplain and remediated 105 square feet of perennial stream gully erosion. Friends of the Winooski River currently holds a block grant to develop berm removal projects in the Little River watershed; this lateral stream-to-floodplain reconnection practice has the potential to greatly enhance flood resilience, increase sediment retention, and improve surface water quality.

Scientific research also 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 Winooski 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. 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 Resource Conservation District's Northwestern Vermont Riparian Planting Guide further details many of the Vermont-specific challenges and opportunities in riparian restoration, and DEC would support working groups on Winooski-relevant topics.

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. River Corridor Easements have been purchased on 171 acres in the Winooski basin, mainly in the upper

Little River, North Branch, Kingsbury Branch, Dog River, and upper Mad River. This practice is now creditable for phosphorus reductions via the FFI tool which may accelerate its implementation, although near term limitations in capacity to implement them may require prioritization of Easement projects. If capacity limitations on River Corridor Easement implementation is constraining these efforts, this may be an area to invest in increasing capacity.

Since the last TBP, the Lake Champlain Basin Program and NEIWPCC have developed Stream Wise, a program that engages streamside property owners in the trans-boundary Lake Champlain basin to enhance and protected vegetated stream buffers. In addition to hosting online education materials, the Stream Wise programs 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 than education alone. The Friends of the Winooski River was an original community partner promoting the Stream Wise program and will be joined by the Lamoille County Conservation District in late 2023.

### *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 not yet been widely implemented in the Winooski basin, but the Vermont Land Trust and The Nature Conservancy implemented a trial beaver dam analog project

on ~200ft of stream in Jericho in 2021. Moreover, there is a growing interest in this work among partners as funding opportunities expand (e.g., Natural Resource Conservation Service, formula grants), regional partners share their expertise (e.g., Vermont Land Trust, The Nature Conservancy, and Trout Unlimited), and successful project examples 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). The Nature Conservancy currently leads a Winooski-specific floodplain restoration working group that seeks to identify project area needs and opportunities and to develop local capacity for project development and implementation. Likewise, Friends of the Winooski River currently holds a project development block grant to identify viable in-stream and floodplain restoration projects and will work with The Nature Conservancy to determine where process-based restoration techniques may be appropriate.

This plan does not prioritize process-based restoration at the sub-watershed scale, but when projects are proposed that improve both water quality and habitat and are supported by both FWD and the Rivers Program, funding should be prioritized. In the Winooski, 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 or FWD strategic wood policy. A further layer of prioritization focusing on B(1) fishing candidate streams would add wildlife co-benefits and 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. Additionally, training and workshops on assessment and implementation of this work are needed to grow the knowledge base required to increase implementation.

### *Aquatic Organism Passage Workgroup*

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 to move among complementary foraging, spawning, thermal refuge, and overwintering habitats. Without access to essential habitat, fish diversity and abundance decline.

The US Fish and Wildlife Service has organized several partners in the Winooski basin (Friends of the Winooski River, Winooski River Natural Resource Conservation District, FWD) to identify

priority culverts for retrofit or replacement to restore aquatic organism passage and improve crossing compatibility with its geomorphic setting. Finding these mutually beneficial projects can be an important strategy given the relatively large expense of crossing projects and cost share opportunities with fish and wildlife-focused or transportation-focused funding programs. The group has focused on the Stevens Branch and its tributaries (Williamstown, Barre) and the Winooski headwaters (Cabot, Marshfield, Plainfield) to identify projects and will continue to develop and implement priority upgrades in these basins over the next five years, with some effort in other watersheds including the Little River. Since the previous basin plan, state funding has supported the improvement of 26 crossings in the basin, reconnecting six stream miles for fish habitat use and flow and sediment transport.

## *Dams and Dam Safety*

There are records of 186 dams of different types, sizes, and condition in the Winooski basin. While some dams are used to generate energy and 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 186 inventoried dams, 104 are in-service, 44 are fully breached, 20 are partially breached, 11 have been removed, and the status of seven is unknown. The 124 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. 26 of 186 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). 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.

Likewise, The Nature Conservancy has organized both statewide and Winooski-focused working groups to scale up dam removal activity where appropriate. At the statewide scale, The Nature Conservancy's working group has helped clarify partner-identified capacity needs for scaling up dam removal efforts, including increasing dam-specific project management staff capacity, administrative support staff- capacity, and access to private unrestricted funds. Within the Winooski, working group partners (Friends of the Winooski River, Winooski Natural Resource Conservation District, Central Vermont Regional Planning Commission, The Nature Conservancy, FWD, Vermont Natural Resources Council, Vermont Rivers Conservancy) have developed priority lists for nine dam removals actively being pursued by partners and for 21 dams that require further project scoping. Significant progress is expected to be made on developing these projects over the five-year life of this plan.

Two hydroelectric (Essex No. 19, Little River Hydro Dam) and one water supply (Berlin Pond) dam alter the downstream flow regimes of their outlet or bypass streams and are included in DEC's Priority Waters list (Table 9). Essex No. 19 is in the process of Federal Energy Regulatory Commission re-licensing, with its current license expiring in 2025. Bypass flow studies were expected to be completed in 2022, and re-licensing documents suggest Essex No. 19 will move to a fully run-of-river operation in its next license.

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. Dam owners are encouraged to contact the Vermont Dam Safety Program and their Watershed Planner if they are interested in discussing dam removal. 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 Winooski basin and additional details on each dam's ecological impact.

### *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. Winooski basin towns in Chittenden, Washington, Lamoille, and Orange counties had initial discovery meetings with FEMA between 2019 and 2021. 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 2023, the Central Vermont Regional Planning Commission, Chittenden County Regional Planning Commission, and Lamoille County Planning Commission reviewed by-laws of most of their member municipalities. Depending on the county, results suggest no to minor revisions will be required for many municipalities to meet National Flood Insurances Program requirements. 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 and within the Winooski basin. 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 the Winooski River and its tributaries are partly responsible for 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.

Instream fish habitat was severely impacted in some areas following the removal of woody habitat and alteration of stream channels after Tropical Storm Irene. Within the Winooski River basin, it was estimated that major impact to instream habitat occurred along roughly 15,425 feet of stream following Tropical Storm Irene (Kirn 2012). It is too early to estimate the impacts of July 2023 flooding. 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 Winooski River. State endangered lake sturgeon annually spawn in the Winooski River downstream of the Winooski One Dam and state threatened Eastern sand darters have been found from the lower river upstream through the Essex 19 dam. 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. Moreover, under guidance from FWD, the Vermont Chapter of the Native Fishes Coalition is pursuing a signage campaign in the Winooski basin to bring awareness to local waterways that support game and non-game native species and to highlight the importance of protecting riparian habitat and water quality to maintain these populations.

## Lakes

A lake's physical characteristics are driven by its watershed size, topography, geology, soil fertility and erodibility, and vegetation. A lake's water quality is impacted by human activities and the land uses on the immediate shoreland and farther up into the watershed. The loss of native vegetation at the shoreline, the locations of roads, the development pressures around the shoreline and along tributaries, and into the watershed, and activities such as agriculture and forestry all contribute to overall lake and pond health. All these activities impact how water moves across the landscape and ultimately into the lake and ponds.

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. Recommendations included are guided by data from the VT Inland Lakes Scorecard depicting the condition of lakes and ponds, along with input from the Lakes and Ponds Management Program 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.

The Lake Wise Program encourages lakeshore owners to implement practices that improve and protect lake water quality conditions and habitat. A Lake Wise Award certifies a property is well managed, using shoreland Best Management Practices, and is maintained to protect the lake. Lake Wise assessments review shoreland practices for their benefit to water quality and wildlife habitat and suggest actions if improvements are needed. Lakes with a Fair or Poor shoreland score will benefit from implementing Lake Wise Program best management practices.

One lake in the basin greater than ten acres has a Poor shoreland habitat condition rating from the VT Lake Scorecard (Lake Greenwood), and 21 are rated fair. Of these lakes, five were identified as potential priorities for Lake Wise assessments because of their shoreland condition and number of lakeshore residents: Peacham Pond, Sabin Pond, Forest Lake, Lake Greenwood, and Curtis Pond. If other communities in fair-rated shorelands are interested in pursuing Lake Wise, they can contact the Lake Wise Program. Watershed partners (Friends of the Winooski River, Caledonia County Conservation District) have already performed Lake Wise assessments in some of these lake communities (Curtis Pond, Sodom Pond, West Hill Pond, Peacham Pond) and have targeted initial communications in others (Greenwood, Sabin). Continued outreach is dependent on both community interest and stable funding from the Lake Champlain Basin Program or DEC. Lake users interested in becoming involved in the health of their favorite lake or pond should use the Lake Score Card Checklist of Lake Protection Actions, on the DEC Lakes and Ponds website, as a first step to moving toward a healthier lake or pond.

Several lakes in the Winooski basin are either current candidates for reclassification to B(1) aesthetics (Peacham Pond) or may be candidates depending on additional data collection and community support (Lake Mirror, Lake Mansfield, Berlin Pond, Forest Lake, Sabin Pond, and Turtlehead Pond). While Forest Lake and Sabin Pond may be eligible given their current and historical total phosphorus levels, these lakes' spring and/or summer nutrient conditions are also

trending upwards (see Chapter 1). To reverse or stop the trend, and maintain their likely high quality, these lakes are listed as priorities for monitoring, outreach, protection, and restoration in this plan.

## *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. 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. To date no lakes in the basin have completed LWAPs or have received funding to develop an LWAP.

Sabin Pond and Forest Lake are possible LWAP candidates because of their increasing nutrient trends, fair condition shorelines, and moderately disturbed watersheds. However, these lakes do not have active lake associations, despite a significant number of shoreline residents. Additional partner outreach should target these lakes to determine local community support for assessment and lake and watershed restoration to slow increasing nutrient trends. Friends of the Winooski River initiated this work in SFY2022 and, depending on capacity and funding, may be able to facilitate additional community interactions.

Shelburne Pond is a eutrophic to hypereutrophic, phosphorus-impaired lake that is lightly used for recreation by Burlington-area residents but also experiences cyanobacterial blooms each year. Shelburne Pond's shoreline hosts no residences and there is no lake association, but its watershed is highly disturbed with a significant proportion in agricultural and developed lands. DEC is interested in discussing pond water quality improvement efforts with surrounding landowners and believes there should be a collective effort to improve water quality in the lake and increase access and use. Therefore, this plan recommends Shelburne Pond for additional tributary monitoring (LaRosa Program), nutrient source tracking, and in-lake investigations, rather than an LWAP, to address nutrient and cyanobacterial concerns. A small working group consisting of DEC (Watershed Planning and Lakes and Ponds Management and Protection Program [LPMPP]) and Winooski Natural Resource Conservation District will continue to meet in SFY2024 to established specific sampling and outreach needs.

LPMPP's Next Generation Lake Assessments (NGLAs) may be appropriate for Winooski basin lakes that have disturbed watersheds and/or shorelines and possible upward nutrient trends but currently lack community support for a full LWAP. NGLAs are a comprehensive, quantitative multiday survey of a lake's condition during the summer index period. Data collected from NGLAs can help prioritize lakes for future LWAPs or identify priority catchments within a lake watershed for project identification, outreach, and development without needing a full LWAP process. NGLAs have been performed on nine Winooski lakes to date (Buck Lake, Cranberry Meadow Pond, Forest

Lake, Gillett Pond, Little Pond (Elmore), Mollys Falls Reservoir, Peacham Pond, Richmond Pond, Wrightsville Reservoir). Shelburne Pond was just sampled in 2022 and a report is pending. Current lakes recommended for NGLAs in this basin include Sabin Pond and any others with emerging water quality concerns. Basin-specific monitoring needs and timeline are planned in annual summits among DEC and ANR programs, with the Winooski basin next slated for sampling in 2025.

## *Cyanobacteria*

LPMPP, the VT Department of Health, and the Lake Champlain Committee also work with trained volunteers to monitor the frequency and magnitude of cyanobacteria blooms and assess spatial and temporal trends in bloom occurrence. Cyanobacteria, also known as blue-green algae, are naturally found in fresh water in the U.S., and in Lake Champlain and other Vermont waters. Cyanobacteria grow well in water that has high amounts of nutrients like phosphorous and nitrogen. Cyanobacteria can multiply quickly to form surface scums and dense populations known as blooms, especially during the warm days of late summer and early fall. Some types of cyanobacteria can release natural toxins or poisons (called cyanotoxins) into the water, especially when they die and break down.

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. Between 2017 and 2021, volunteer monitors or DEC staff evaluated five Winooski basin lakes at least once for cyanobacteria blooms (Shelburne Pond, Baker Pond, Gillett Pond, Waterbury Reservoir, and Molly's Falls Reservoir). Annual reports on long-term chemical and biological monitoring programs including cyanobacteria blooms are available on the DEC LPMPP website.

## *Preventing Aquatic Invasive Species*

Aquatic invasive species (AIS) have been confirmed in six Winooski basin lakes. Eurasian Watermilfoil is present in Shelburne Pond, Berlin Pond, Baker Pond (Brookfield), and North Montpelier Pond. Curly-leaf Pondweed is present in Shelburne Pond and Forest Lake (Calais). Brittle naiad is present in Waterbury Reservoir, while Shelburne Pond also hosts European Frogbit. None of the Winooski basin's AIS infestations are actively managed. Additional AIS populations may exist but have not been confirmed with recent lake surveys. Depending on the species, AIS can both impact and respond favorably to water quality degradation. 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).

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. Vermont Fish and Wildlife Department (FWD) manages seventeen lake access areas in the basin. The VT Public Access Greeter Program, the Vermont Invasive Patrollers, and the Vermont Invasive Patrollers for Animals are spread prevention programs that incorporate AIS identification training, surveying and monitoring, watercraft inspection, and decontamination programs. VT Public Access Greeter Programs are supported by DEC's Aquatic Nuisance Control Grant-in-aid funding. 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.

The Aquatic Nuisance Control Grant-in-aid Program provides financial assistance to municipalities and agencies of the state for aquatic invasive and nuisance species management programs. Waterbury Reservoir and Peacham Pond are the only lakes in the Winooski basin with an active Greeter program. A map of active greeter and control efforts is available online.

## 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. Protecting the remaining wetland resources is an important strategy in the basin. Additionally, restoring degraded wetlands is essential to improving water quality. 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 is being developed by the Program, is expected to be complete in the Winooski basin in mid-SFY2024, and will eventually cover the entire state. Current maps can be found at Wetland Inventory Map.

Enhanced protection, in the form of a Class I wetland determination, 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. Five wetlands have been identified as candidates for Class I assessment and support for reclassification. These wetlands include Alder Brook in Essex, Shelburne Pond shoreland wetlands in Shelburne, Upper Gleason in Bolton, Mud Pond in Williston, and Derway Island and other wetlands along the Winooski mouth in Burlington and Colchester. Lanesboro Bog in Marshfield was assessed in the last planning cycle and does meet Class I conditions.

This plan recommends conducting these wetland assessments and evaluating community interest in reclassification for qualifying wetlands, including Lanesboro Bog. Stakeholders are encouraged to reach out to their basin planner and Wetlands Program staff for technical support to research and submit Class I wetland designation petitions for review, including for additional wetlands not mentioned here which may qualify.

### *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 18) and the Vermont Regional Conservation Project Partnership (RCPP) Wetlands Project Outreach and Development map created by Arrowwood Environmental. The RCPP prioritization model highlights many wetlands in the lower Winooski (Muddy Brook, Winooski River, and Snipe Island Brook sub-watersheds) as high priorities for wetland restoration, as well as some others in the lower Stevens Branch, Sodom Pond Brook, and Headwaters Little River sub-watersheds. 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 Resource 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, VT Wetlands and Rivers 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 not simple ways to estimate the magnitude of phosphorus reductions. One need for the greater Vermont 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 Winooski 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. 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.

## Forests

Forest lands cover approximately 73% of the basin. As the dominant land cover, forests are important for safeguarding many high-quality surface waters. Yet, 22.3% 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.[4] The Department of Forests, Parks and Recreation (FPR) and watershed partners 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 poled fords. These reusable bridges are also economical, easy to install, and can be transported from job to job.

[4] Acceptable Management Practices for Logging Jobs

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 Winooski Natural Resource Conservation District. The District received two new skidder bridges which 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*

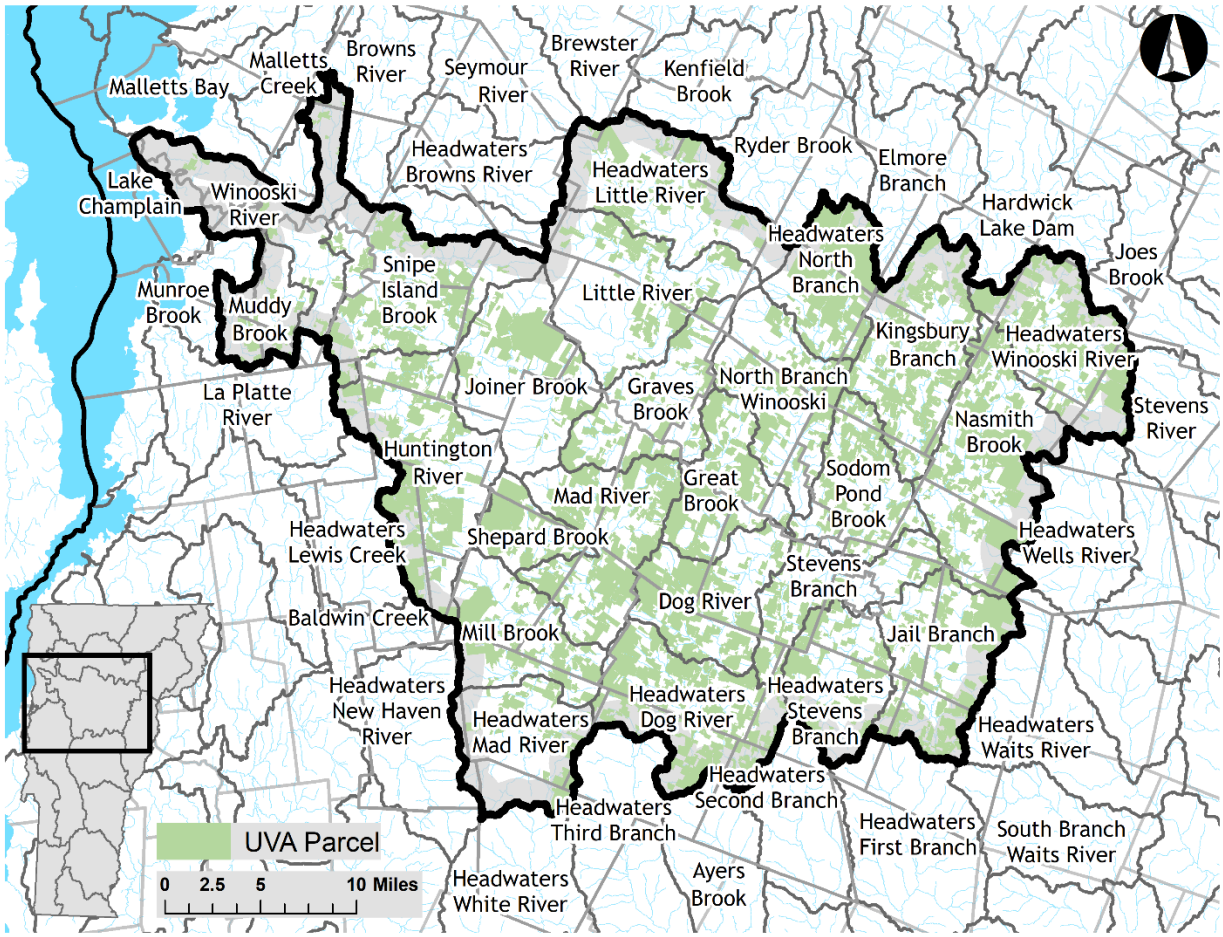



**Figure 31. Winooski basin parcels enrolled in the Use Value Appraisal program.**

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.

About 36% of the basin (243,660 acres) is enrolled in the UVA program (Figure 31). Another 10% of the basin (70,860 acres) is protected via federal, state, municipal, or non-profit ownership and management. Federal and state lands include portions of the Green Mountain National Forest (Mad River headwaters), Camels Hump State Park and Forest (Mad River and Huntington headwaters and middle Winooski tributaries including Joiner Brook), Mount Mansfield State Forest (Little River and its headwaters), CC Putnam State Forest (Little River and its headwaters and the North Branch of the Winooski and its headwaters), Groton State Forest (Winooski headwaters), and many other state parks, forests, and wilderness management areas.

Increased enrollment in the UVA program is encouraged wherever landowners express interest, and this plan particularly encourages increased enrollment in Source Protection Areas with substantial remaining UVA-eligible parcels. Major surface water source protection areas with unprotected lands are located within the Jail Branch (Barre City water system) and Stevens Branch (Montpelier Water System) sub-watersheds, whereas 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 roads in the basin are primarily found in Mount Mansfield State Forest, CC Putnam State Forest, and Camels Hump State Park. ANR inventoried a significant portion of forest roads in all three major state lands in 2022 and will continue surveys in Mount Mansfield State Forest and Groton State Forest in 2023 and 2024. 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 Central Vermont Regional Planning Commission 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 forests could include Northfield, Berlin, Montpelier, Barre City, Marshfield, and Worcester. Central Vermont Regional Planning ANR is also considering ways to identify potential phosphorus and sediment reduction projects on forest trails and to estimate phosphorus reduction potential for these project types.

## 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 in Barre City where the River Access Task Force is active; 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 Winooski Basin Implementation Table

## A. Progress in the Basin

The previous Winooski basin plan was completed in 2018. A total of 52 strategies were identified in the plan. 49 (or 94%) have been implemented or are in progress by ANR and its watershed partners, 3 are awaiting action and have been carried over to this plan, and 0 have been 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 19) and the Monitoring and Assessment Table (Table 20) 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 reports on 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 52 strategies from the 2018 plan will be in the Appendix of the next Clean Water Initiative Performance Report. Progress made in addressing the strategies in the 2023 Winooski Basin Implementation Table will be reported in the 2028 TBP and the Clean Water Initiative Program 2025 and 2027 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

Winooski basin kicked off in the fall of 2022 with presentations to each of the three county regional planning commissions' Clean Water Advisory Committees. With help from the Clean Water Advisory Committees, who represent towns, 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. 68 respondents from 16 in-basin towns (mainly Chittenden County) offered their input. 49% of respondents provided contact information to remain engaged in the planning process and 25% asked to be contacted about developing clean water projects on their property.

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. Survey respondents' top-recommended solutions based on their perceived threats to surface water quality in the basin included agricultural BMP implementation, natural resource restoration (e.g., floodplain restoration and buffer establishment), land protection, wastewater facility and private system improvements, and the study of per- and polyfluoroalkyl substances. These and many other water quality concerns mentioned (e.g., riparian invasive species, cyanobacterial blooms, fisheries and aquatic biodiversity loss, safe recreational access) are discussed throughout this plan. Where specific waterbodies and pollutants were identified or interest in clean water project development was expressed, the planner will coordinate with state and watershed partners to further evaluate the concern or project opportunity.

## 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 Lamoille County Conservation District (LCCD), Winooski Natural Resources Conservation District (WNRCD), Central Vermont Regional Planning Commission (CVRPC), Chittenden County Regional Planning Commission (CCRPC), Lamoille County Planning Commission (LCPC), Friends of the Mad River (FMR), Friends of the Winooski River (FWR), 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 (IT) (Table 19) provides a list of 50 priority strategies created as the go-to implementation guide for watershed action. The IT 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 projects in the Watershed Projects Database 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 annual Clean Water Performance Reports.

In relation to the Lake Champlain Phosphorus TMDL, IT strategy progress will be measured against the five-year total TP reduction targets for each sector, outlined in Chapter 3. These reduction targets are addressed through both the regulatory programs described in Chapter 3 and the prospective reductions assigned to Clean Water Service Providers and guided by the IT 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 IT 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 (i.e., flood resiliency, 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 19. Implementation Strategies. Acronyms are listed on Page 153.

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| **Strategies to address runoff from Agricultural Lands** | | | | | |
| 1 | Support farmers in developing, updating, and implementing nutrient management plans. | Basin wide | All towns | AAFM, LCCD, NRCS, UVM Ext., WNRCD | NRCS, AAFM, RCPP, Pay for P |
| 2 | Maintain cover cropping and other annual practices by supporting farmers' consecutive adoption of practices through education and outreach, and/or enrollment in applicable conservation programs. | All sub-watersheds, especially Sodom Pond Brook, Snipe Island Brook, Winooski River, Great Brook, Huntington River, Mad River, Mill Brook – Mad River | East Montpelier, Richmond, Jericho, Essex, Colchester, Middlesex, Moretown, Huntington, Waitsfield, Warren, Fayston | AAFM, NRCS, UVM Ext., WNRCD | EQIP, CSP, AAFM, AGCWIP |
| 3 | Target outreach and increased funding to HUC 12 watersheds where field practice implementation has been lagging TMDL reduction targets to increase crop rotation, cover crop, no till practice, hayland BMP, and grazing management implementation. | Muddy Brook, Winooski River, Headwaters Little River, Headwaters Winooski River, Headwaters Stevens Branch, Nasmith Brook, Huntington River, Jail Branch, Stevens Branch | Shelburne, South Burlington, Williston, Colchester, Stowe, Cabot, Williamstown, Marshfield, Barre Town, Orange, Washington | AAFM, LCCD, NRCS, UVM Ext., WNRCD | NRCS, AAFM, RCPP, Pay for P, AGCWIP |
| 4 | 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, LCCD, NRCS, UVM Ext., WNRCD | VHCB, AGCWIP |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 5 | Provide technical assistance to support soil health and water quality improvements through Soil Health Assessments, the development and implementation of grazing plans, and pasture and hayland BMPs. | Strategy 3 watersheds | Strategy 3 towns | AAFM, LCCD, NRCS, UVM Ext., WNRCD | AGCWIP, RCPP, TBPSG |
| 6 | Support collaborative efforts among partners to enhance service to the agricultural community, such as a farm team model that streamlines technical service provider interactions with individual farms. | Strategy 3 watersheds | Strategy 3 towns | AAFM, LCCD, NRCS, UVM Ext., WNRCD | AGCWIP, TBPSG |
| 7 | 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-specific practice guidance). | Basin wide | All towns | AAFM, LCCD, NRCS, UVM Ext., WNRCD | AGCWIP, TBPSG |
| 8 | Convene meetings of the VT Agricultural Water Quality Partnership to track progress on TBP agricultural strategies and identify emerging areas of concern. | Basin wide | All towns | AAFM, LCCD, NRCS, UVM Ext., WNRCD | TBPSG, VAWQP |
| 9 | Identify and address barriers to farmer enrollment and maintenance in the Pay for Phosphorus Program | Strategy 3 watersheds | Strategy 3 towns | AAFM, LCCD, NRCS, UVM Ext., WNRCD | NRCS, AAFM, RCPP, Pay for P |
| 10 | Investigate and pursue opportunities for river corridor easements on agricultural parcels | Strategy 3 watersheds | Strategy 3 towns | AAFM, LCCD, Stowe Land Trust, Vermont Land Trust, WNRCD | VRP, CREP |
| **Strategies to address runoff from Developed Lands - Stormwater** | | | | | |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 11 | Develop stormwater mapping reports, stormwater master plans (SWMPs), and illicit discharge and detection studies to identify priority stormwater projects. | Basin wide | Waterbury, Bolton, Brookfield, Orange, Duxbury, or other DEC-identified regions | DEC, CCRPC, CVRPC, FWR, Municipalities, LCCD, LCPC, WNRCD | CWI, Formula |
| 12 | Support the prioritization, design, and implementation of stormwater projects. | Basin wide | Towns with existing stormwater master plans, phosphorus control plans, or other stormwater-related planning. See Table 16. | DEC, CCRPC, CVRPC, FWR, FMR, Municipalities, LCPC, WNRCD | CWI, TBPSG, Formula |
| 13 | Provide outreach and technical assistance to landowners with 3-acre parcels. | Basin wide with emphasis on watersheds with high proportion of developed lands, including Stevens Branch, Jail Branch, Lower Winooski, Muddy Brook | Basin wide, especially Barre, Barre City, Berlin, Burlington, Montpelier, Williamstown, Northfield, Stowe, Shelburne, Williston, Essex Junction, Winooski, Burlington | DEC, CVRPC, LCCD, LCPC, WNRCD | LCBP, Green Schools Initiative, ARPA 3-acre funds |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 14 | Promote and, where appropriate, coordinate existing campaigns to raise awareness of residential stormwater management approaches (e.g., Rethink Runoff, Storm Smart, Lawn to Lake, Blue BTV). | Basin wide | All towns | DEC, FMR, FWR, LCBP, LCCD, LCPC, WNRCD | LCBP, TBSPG |
| 15 | Educate towns, businesses and contractors on winter maintenance strategies that reduce use of chlorides. | Catchments of chloride-impaired waters (Centennial Brook, Sunnyside Brook) and watersheds with high proportion of developed lands, including: Stevens Branch, Jail Branch, Lower Winooski, Muddy Brook | Barre, Barre City, Berlin, Burlington, Montpelier, Williamstown, Northfield, Stowe, Shelburne, Williston, Essex Junction, Winooski, Burlington | CCPRC, CVRPC, FMR, FWR, LCPC, WNRCD, UVM Sea Grant | LCBP |
| 16 | Support evaluating and improving town salt and sand storage facilities to improve stormwater management on these sites. | Basin wide | All towns | CCRPC, CVRPC, FWR, LCCD, LCPC, WNRCD, Municipalities | SWMG, GIA |
| **Strategies to address runoff from Developed Lands - Roads** | | | | | |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 17 | Assist municipalities in updating REI and prioritizing and implementing roads projects to meet the Municipal Roads General Permit (MRGP). | Basin wide | All towns with focus on Barre City, Stowe, Northfield, Montpelier, Barre Town, Calais, Plainfield, Moretown, Berlin, Cabot, Duxbury, and Middlesex | CCRPC, CVRPC, LCPC, Municipalities | AOT Municipal Assistance Grants |
| 18 | Pilot a GIS road segmentation and private REI to identify, prioritize, develop, and implement private road restoration projects. | Prioritized private road networks: lakes with nutrient impairments, degrading nutrient trends, or otherwise steep private road networks where road associations exist | All towns | CCRPC, CVRPC, FMR, FWR, LCCD, LCPC, WNRCD, Municipalities | Formula, LCBP, TBPSG |
| **Strategies to address Wastewater** | | | | | |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 19 | Support municipalities pursuing WWTF phosphorus optimization, expansion projects, and upgrades to meet TMDL allotments, phosphorus optimization and CSO requirements. | Basin wide | Barre City, Burlington, Cabot, Essex Junction, Marshfield, Montpelier, Northfield, Plainfield, Richmond, South Burlington, Stowe, Waterbury, Williamstown, Winooski | DEC, CVRPC, LCPC, Municipalities | CWSRF, USDA-Rural Development |
| 20 | 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 | Basin wide | All towns, including Huntington, Waitsfield, Warren, Middlesex, Moretown | DEC, LCPC | ARPA, CWSRF, EPA Engineering Planning Advance, MPG, TBPSG, USDA Community Facilities Program, USDA-RD SEARCH Grant |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 21 | Educate onsite septic owners about septic system maintenance and alternative systems through local outreach and education programs such as Wastewater Workshops. | Lake watersheds with increasing nutrient trends (Sabin, Forest) or highly developed shorelines; River communities where septic is a likely source of E. coli impairment (middle Huntington, Lower Mad) or where residential development is otherwise dense (Little River) | Calais, Woodbury, Moretown, Huntington, Stowe | VLPMPP, CVRPC, FWR, LCPC, Municipalities, Lake Associations, Conservation Commissions | TBPSG |
| **Strategies to support Natural Resource Protection and Restoration - Rivers** | | | | | |
| 22 | Develop and implement priority protection and restoration projects identified in Stream Geomorphic Assessments (SGAs), River Corridor Plans (RCPs), or culvert inventories. | TNC working group priority watersheds: Winooski Headwaters, Dog River, Stevens Branch | Cabot, Marshfield, Plainfield, Berlin, Northfield, Roxbury, Berlin, Barre, Barre City, Williamstown | VRP, CVRPC, FMR, FWR, LCCD, LCPC, TNC, WNRCD | Building Resilient Infrastructure and Communities Fund, DIBG, Flood Resilient Communities Fund, Formula, RCEBG, WBBG |
| 23 | Enhance (beyond RAPs) riparian buffers through woody buffer establishment and invasive species control. | SGA/RCP-identified sites | All towns | AAFM, CVRPC, FMR, FWR, LCCD, LCPC, NRCS, USFWS, WNRCD | CREP, Formula, LCBP, RCEBG, WBBG |
| 24 | Support outreach, training, or technical assistance to increase adoption of innovative agency-supported approaches that address tree stock shortage or invasive species concerns when establishing buffers or accelerate landowner interest in buffer adoption (e.g., agroforestry). | SGA/RCP-identified sites | All towns | LCCD | LCBP, FWD Watershed Grant, TBPSG |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 25 | Pilot a process to update existing River Corridor Plans and prioritize additional Stream Geomorphic Assessment fieldwork. | Partner-identified priority watersheds: Dog River, Stevens and Jail Branches | Cabot, Marshfield, Berlin, Northfield, Moretown, Roxbury, Berlin, Barre, Barre City, Williamstown | VRP, DEC, CVRPC | LCBP, TBPSG |
| 26 | 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 (Little River, Headwaters North River, Joiner Brook - Winooski, Huntington, Headwaters - Mad, Millbrook – Mad), or other private and/or protected lands within working group-identified priority watersheds (headwaters Winooski, Dog River, Stevens and Jail Branches) | Stowe, Waterbury, Warren, Huntington, Duxbury, Richmond, Jericho, Worcester, Elmore | VRP, FWD, DEC, AAFM, FWR, LCCD, WNRCD, TNC, USFWS | CREP, DIBG, EQIP, Formula grants, NFWF, USFWS |
| 27 | Develop and implement projects from a list of priority culverts with aquatic organism passage (AOP) and geomorphic compatibility benefits. | Winooski AOP working group priorities on candidate B(1)-Fisheries streams (Upper Winooski, Stevens and Jail Branches) | Cabot, Marshfield, Plainfield, Berlin, Williamstown | FWD, Rivers, CVRPC, FWR, LCPC, USFWS, WNRCD | LCBP, NFWF, TBPSG, USFWS, FWD |
| 28 | Identify, develop, and implement high priority dam removal projects. | TNC working group active (9 dams) and scoping (21 dams) lists | All towns | Rivers, FWD, DEC, AAFM, CVRPC, FWR, LCPC, VNRC, WNRCD, TNC, USFWS | DRBG, Formula, RCPP, NFWF, USFWS |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 29 | Identify and remove streamside berms to increase floodplain access. | Basin wide | All towns | Rivers, FWD, NRCDs, FWR, TNC | CWI, SWG, USFWS Partners for Fish and Wildlife |
| 30 | Support recreational river access through the establishment and maintenance of stable access areas. | Stevens Branch, Jail Branch, lower Winooski River, other river segments with few or unsafe access opportunities | Barre City; All towns | Barre City, Barre City River Access Task Force, LCPC | LCBP, Watershed Grant, DIBG (if a water quality component exists) |
| 31 | Educate towns about and assist them in adopting new FEMA flood maps using model river corridor bylaw or similarly protective language. | Basin wide | All towns, esp. those without adequate river corridor protections in place. See Municipal Protectiveness Table (Appendix B) | CCRPC, CVRPC, LCPC, Rivers | FEMA, TBPSG |
| 32 | Implement social marketing campaign that incentivizes riparian stewardship (i.e., Stream Wise). | Basin wide | All towns | FMR, FWR, LCCD, WNRCD | LCBP |
| 33 | Coordinate with FWD to develop and implement a native fish signage campaign that highlights the biodiversity co-benefits of water quality improvement and fosters river stewardship interest from new stakeholders. | Upland B(1) Fisheries candidates (allopatric brook trout) and lowland streams with other SGCN species, as identified by FWD | Multiple | FWD, NFC | Watershed Grant, Other |
| 34 | Support outreach to towns on opportunities to petition reclassifying waters to B(1) or A(1). | Multiple: See Figure 13, Table 6 | Multiple | DEC, CVRPC, NFC | 604(b) |
| **Strategies to support Natural Resource Protection and Restoration - Lakes** | | | | | |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 35 | Use Next Generation Lake Assessments (NGLAs) to evaluate need for Lake Watershed Action Plans (LWAPs) or to rapidly identify restoration and protection needs in less complex lake watersheds | Basin wide, including Sabin Pond | All towns | VLPMPP | 104 or 319 funding |
| 36 | Support Lake Watershed Action Plans for priority lakes where there is sufficient opportunity for community engagement. | Possibly Forest Lake (Calais), Sabin Pond | Calais, Woodbury | VLPMPP, CVRPC, FWR, Lake Associations | CWI, Formula grant |
| 37 | Support Lake Wise assessments on priority lakes where there is sufficient opportunity for community engagement. | Sabin Pond, Forest Lake (Calais), Curtis Pond, Lake Greenwood, Peacham Pond | Calais, Woodbury, Peacham | VLPMPP, WNRCD | 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. | Buck Lake, Mirror Pond, Gillett Pond, Curtis Pond, Peacham Pond, Sabin Pond, Forest Lake, Waterbury Reservoir | Calais, Huntington, Woodbury, Peacham, Waterbury | Caledonia County NRCD, 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 a 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, Municipalities | Aquatic Nuisance Control Grant, LCBP, TBPSG |
| 40 | Support B(1) designation for qualifying lakes or additional monitoring to evaluate B(1) or A(1) eligibility elsewhere | Current B(1) candidate: Peacham Pond; See Table 20 for 16 lakes with reclassification-related monitoring needs | Peacham, Calais, Woodbury | VLPMPP, CVRPC, Lake Associations, Municipalities | |
| **Strategies to support Natural Resource Protection and Restoration - Wetlands** | | | | | |
| 41 | Increase the identification, landowner outreach, development, and implementation of wetland protection and restoration projects, especially at smaller scales (10-50 acres). | SGA-, RCP-, or RCPP-identified sites | All towns | VWP, VCWIP, AAFM, FWR, LCCD | CWI, Formula grants, RCPP, ACEP-WRE |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 42 | Support local efforts to reclassify Class I wetland candidates. | Any qualifying wetland, including those proposed for study in Figure 15 and Table 20 | Multiple towns, including Essex/Westford Burlington/Colchester, Shelburne, Williston, Bolton, Marshfield, Peacham | VWP, Municipalities, CVRPC | TBPSG |
| 43 | Support outreach to towns and the public – especially zoning administrators, prospective land purchasers, wastewater designers, and realtors – regarding updated wetlands mapping available in the Winooski basin in Fall 2023. | Basin wide | All towns | Wetlands, Municipalities, CVRPC | DEC, TBPSG |
| 44 | Evaluate and pursue opportunities to incorporate adjacent wetlands into the footprints of existing and new river corridor easements. | Basin wide | All towns | Wetlands, Rivers, LCCD, Stowe Land Trust, Vermont Land Trust, Vermont Rivers Conservancy | TBPSG |
| **Strategies to support Natural Resource Protection and Restoration - Forests** | | | | | |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 45 | Pilot the identification and prioritization of forest road segments with water quality impacts via the pending 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: possibly headwaters of Little River, North Branch, Mad, Huntington, Winooski, Stevens and Jail Branches. | Mount Mansfield State Forest, CC Putnam State Forest, Camels Hump State Park; Potential town forests of Northfield, Berlin, Montpelier, Barre City, Marshfield, and Worcester | DEC, FPR, CVRPC | CWI, LCBP, TBPSG |
| 46 | Pilot the identification and prioritization of other erosional features like gullies using the Forestland Erosion Assessment tool. | State and municipal lands with significant stream networks, especially in areas of high runoff potential; as above. | As above. | DEC, FPR, CVRPC | CWI, LCBP, TBPSG |
| 47 | Develop and 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, CVRPC, NRCS | CWI, EQIP, Formula, RCPP |
| 48 | Coordinate outreach and training on properly implementing the AMPs for practitioners, landowners, and technical service providers, including via local workshops and VAWQP presentations. | Basin wide | All towns | NRCS, UVM ext., VAWQP, FPR LEAP and Master Loggers Program | TBPSG |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 49 | Encourage forest conservation and potential UVA enrollment wherever landowners express interest, and especially in Source Protection Areas | Surface- and groundwater Source Protection Areas with remaining unprotected lands (SW: Barre City – Jail Branch, Montpelier – Stevens Branch; GW: multiple unprotected SPAs) | Multiple towns | CWIP, FPR, Vermont Land Trust, Stowe Land Trust | RCPP |
| 50 | Reinvigorate skidder bridge programs and increase the use of skidder bridges through direct grants to foresters to purchase skidder bridges. | Basin wide | All towns | FPR, LCCD, WNRCD | CWI |

## D. Monitoring and Assessment Table

The Monitoring and Assessment Table (Table 20) 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. 'ID' number links listed catchments to their location in Figure 8: Rivers in Need of Assessments.

**Table 20. Priorities For Monitoring and Assessment. Acronyms are listed on Page 153.**

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| **Lakes and Ponds** | | | | |
| Sabin Pond | Chemical monitoring, chlorophyll-a, Secchi, Next Generation Lake Assessment | Calais, Woodbury | LPMPP; Lay Monitoring | Assessment for A1 eligibility. Continue tracking increasing nutrient trends. Rapidly assess lakeshore and catchment conditions. |
| Forest Lake (Calais) | Chemical monitoring, chlorophyll-a, Secchi | Calais, Woodbury | LPMPP; Lay Monitoring | Assessment for A1 eligibility. Continue tracking increasing nutrient trends. |
| Berlin Pond | Chemical monitoring, chlorophyll-a, Secchi | Berlin | LPMPP; Lay Monitoring | Assessment for A1 eligibility. |
| Lake Mansfield | Chemical monitoring, chlorophyll-a, Secchi | Stowe | LPMPP; Lay Monitoring | Assessment for A1 eligibility. |
| Turtlehead Pond | Chemical monitoring, chlorophyll-a, Secchi | Marshfield | LPMPP; Lay Monitoring | Assessment for A1 eligibility. |
| Lake Mirror | Chemical monitoring, chlorophyll-a, Secchi | Calais | LPMPP; Lay Monitoring | Assessment for B1 eligibility. |
| Lake Greenwood | Chemical monitoring, chlorophyll-a, Secchi | Woodbury | LPMPP; Lay Monitoring | Assessment for B1 eligibility. |
| Blueberry Lake | Chemical monitoring, chlorophyll-a, Secchi | Warren | LPMPP | Assessment for general reclassification eligibility; Most recent spring TP = 11.2 µg/l |
| Buck Lake | Chemical monitoring, chlorophyll-a, Secchi | Woodbury | LPMPP | Assessment for general reclassification eligibility; Most recent spring TP = 10.1 µg/l |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| Coits Pond | Chemical monitoring, chlorophyll-a, Secchi | Cabot | LPMPP | Assessment for general reclassification eligibility; Most recent spring TP = 10.0 µg/l |
| Cranberry Meadow Pond | Chemical monitoring, chlorophyll-a, Secchi | Woodbury | LPMPP | Assessment for general reclassification eligibility; Most recent spring TP = 13.6 µg/l |
| Curtis Pond | Chemical monitoring, chlorophyll-a, Secchi | Calais | LPMPP; Lay Monitoring | Assessment for general reclassification eligibility; Most recent spring TP = 13.6 µg/l |
| Gillett Pond | Chemical monitoring, chlorophyll-a, Secchi | Richmond | LPMPP; Lay Monitoring | Assessment for general reclassification eligibility; Most recent spring TP = 9.4 µg/l |
| Hardwood Pond | Chemical monitoring, chlorophyll-a, Secchi | Elmore | LPMPP | Assessment for general reclassification eligibility; Most recent spring TP = 12.0 µg/l |
| Pigeon Pond | Chemical monitoring, chlorophyll-a, Secchi | Groton | LPMPP | Assessment for general reclassification eligibility; Most recent spring TP = 8.1 µg/l |
| Valley Lake | Chemical monitoring, chlorophyll-a, Secchi | Woodbury | LPMPP; Lay Monitoring | Assessment for general reclassification eligibility; Most recent spring TP = 14.2 µg/l |
| Wrightsville Reservoir | Secchi | East Montpelier | LPMPP; FPR | Trend detection in high-use recreational lake |
| Mollys Falls Reservoir | Secchi | Cabot | LPMPP; FPR | Trend detection in high-use recreational lake |
| Waterbury | Secchi | Waterbury | LPMPP; FPR | Trend detection in high-use recreational lake |
| Shelburne Pond | Chemical and cyanobacterial monitoring, Secchi | Shelburne | LPMPP, UVM, WNRCD | Trend detection in high-use recreational lake; Evaluate cyanobacterial blooms; Internal vs. external loading, seasonal P fluctuations, and other needs laid out by DEC - Lakes program |
| Cutter Pond | Chemical monitoring | Williamstown | LPMPP | Insufficient data to determine water quality status. Medium sized pond (20.5 acres) with more than 40% agricultural and development lands. |
| Unnamed Pond (referred to as Richards) | Chemical monitoring | Marshfield | LPMPP | Insufficient data to determine water quality status. Medium sized pond (14.7 acres) with more than 20% agricultural and development lands. |
| Identified Lakes and Ponds | Complete AIS survey and plankton net survey | Multiple | LPMPP | Generate AIS status of lakes and ponds with no data. |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| **Rivers and Streams** | | | | |
| Tributaries to Shelburne Pond | Chemical monitoring | Shelburne | LaRosa, Local partner TBD | Identify tributaries that may disproportionally contribute phosphorus. |
| Tributaries to Forest Lake | Chemical monitoring | Calais, South Woodbury | LaRosa, Local partner TBD | Identify tributaries that may disproportionally contribute phosphorus. |
| Tributaries to Sabin Pond | Chemical monitoring | Calais, South Woodbury | LaRosa, Local partner TBD | Identify tributaries that may disproportionally contribute phosphorus. |
| Stevens Branch | Biological monitoring | Barre City, Barre Town, Berlin, Williamstown | BASS, Barre City River Access Task Force | Re-assess status and boundaries of E. coli impairment because of increasing primary contact recreation interest. |
| Stevens Branch watershed | Chemical monitoring | Barre City, Barre Town, Berlin, Williamstown | LaRosa, Local partner TBD | Systematically sample data gaps listed below to source track elevated nutrient levels |
| Thatcher and Graves Brook watershed | Chemical monitoring | Waterbury | LaRosa, Local partner TBD | Systematically sample data gaps below to source track elevated nutrient levels |
| Ridley Brook | Biological monitoring; habitat monitoring | Duxbury | BASS; FWD | Declining salmonid biomass and possible habitat degradation (sedimentation) |
| Muddy Brook, 1.1 | Biological monitoring | South Burlington/Williston | DEC - BASS | Current indeterminant condition (*Fair to Good*) |
| Goose Pond Brook, 0.1 | Biological monitoring | Bolton | BASS | Current indeterminant condition (*Fair to Good*) |
| Winooski River, 81.8 | Biological monitoring | Marshfield | BASS | Current indeterminant condition (*Fair to Good*) |
| Mollys Brook, 1.5 | Biological monitoring | Cabot | BASS | Current indeterminant condition (*Fair to Good*) |
| West Branch Little River, 7.4 | Biological monitoring | Stowe | BASS | Current indeterminant condition (*Fair to Good*) |
| West Branch Little River, 8.0 | Biological monitoring | Stowe | BASS | Current indeterminant condition (*Fair to Good*) |
| North Branch Winooski Trib 3, 0.7 | Biological monitoring | Middlesex | BASS | Current indeterminant condition (*Fair to Good*) |
| Long Meadow Brook, 0.9 | Biological monitoring | East Montpelier | BASS | Current indeterminant condition (*Fair to Good*) |
| Stevens Branch, 11.9 | Biological monitoring | Williamstown | BASS | Current indeterminant condition (*Fair to Good*) |
| High Bridge Brook, 0.4 | Biological monitoring | Waitsfield | BASS | Current indeterminant condition (*Fair to Good*) |
| Allen Brook, 2.4 | Biological monitoring | Williston | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Snipe Island Brook, 1.4 | Biological monitoring | Richmond | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| Thatcher Brook, 0.1 | Biological monitoring | Waterbury | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Great Brook, 0.8 | Biological monitoring | Middlesex | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Blanchard Brook, 0.1 | Biological monitoring | Montpelier | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Winooski River, 82.8 | Biological monitoring | Marshfield | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Mollys Brook, 0.5 | Biological monitoring | Marshfield | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Mollys Brook, 1.5 | Biological monitoring | Cabot | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Little River, 7.1 | Biological monitoring | Stowe | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Long Meadow Brook, 0.9 | Biological monitoring | East Montpelier | BASS | Poor to Fair fish community scores contrast Good to Excellent macroinvertebrate scores |
| Allen Brook, 8.2 | Biological monitoring | Williston | BASS | Determine potential for enhanced protection. |
| Alder Brook, 4.1 | Biological monitoring | Essex | BASS | Determine potential for enhanced protection. |
| Fargo Brook, 0.3 | Biological monitoring | Huntington | BASS | Determine potential for enhanced protection. |
| Cobb Brook, 0.4 | Biological monitoring | Huntington | BASS | Determine potential for enhanced protection. |
| Brush Brook, 2.8 | Biological monitoring | Huntington | BASS | Determine potential for enhanced protection. |
| Preston Brook, 0.9 | Biological monitoring | Bolton | BASS | Determine potential for enhanced protection. |
| Chase Brook, 1.2 | Biological monitoring | Fayston | BASS | Determine potential for enhanced protection. |
| French Brook, 0.5 | Biological monitoring | Fayston | BASS | Determine potential for enhanced protection. |
| Ridley Brook, 0.8 | Biological monitoring | Duxbury | BASS | Determine potential for enhanced protection. |
| Hancock Brook, 1.9 | Biological monitoring | Worcester | BASS | Determine potential for enhanced protection. |
| Kingsbury Branch, 13.5 | Biological monitoring | Calais | BASS | Determine potential for enhanced protection. |
| Marshfield Brook, 0.1 | Biological monitoring | Marshfield | BASS | Determine potential for enhanced protection. |
| Muddy Brook | Biological monitoring | Williston, South Burlington | BASS | Determine attainment of aquatic biota use. |
| West Branch Little River at Mansfield Base Road | Biological monitoring | Stowe | BASS | Determine attainment of aquatic biota use. |
| West Branch Little River (rm 8.5 up to headwaters) | Biological monitoring | Stowe, Cambridge | BASS | Determine attainment of aquatic biota use. |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| Little River, from West Branch down to reservoir | Biological monitoring | Stowe, Waterbury | BASS | Determine attainment of aquatic biota use. |
| Graves Brook (Mouth upstream to rm 0.3) | Biological monitoring | Waterbury | BASS | Determine attainment of aquatic biota use. |
| Thatcher Brook (Waterbury to Waterbury Center) | Biological monitoring | Waterbury | BASS | Determine attainment of aquatic biota use. |
| Jail Branch, Barre City and below (1.5 miles) | Biological monitoring | Barre City | BASS | Determine attainment of aquatic biota use. |
| Long Meadow Brook | Biological monitoring | East Montpelier, Calais | BASS | Determine attainment of aquatic biota use. |
| High Bridge Brook | Biological monitoring | Waitsfield | BASS | Determine attainment of aquatic biota use. |
| ID 38: Sodom Pond Brook; 44.272, -72.483 | Biological monitoring, chemical monitoring | East Montpelier | BASS, LaRosa | Data gap in medium watershed with more than 20% agricultural and developed lands. |
| ID 27: Mallory Brook; 44.264, -72.495 | Biological monitoring, chemical monitoring | East Montpelier | BASS, LaRosa | Data gap in medium watershed with more than 20% agricultural and developed lands. |
| ID 42: Still Brook; 44.331, -72.441 | Biological monitoring, chemical monitoring | Calais | BASS, LaRosa | Data gap in small watershed with more than 20% agricultural and developed lands. |
| ID 36: Miller Creek; 44.176, -72.508 | Biological monitoring, chemical monitoring | Barre Town | BASS, LaRosa | Data gap in small watershed with more than 20% agricultural and developed lands. |
| ID 39: Honey Brook; 44.179, -72.470 | Biological monitoring, chemical monitoring | Barre Town | BASS, LaRosa | Data gap in small watershed with more than 20% agricultural and developed lands. |
| ID 35: Cold Spring Brook; 44.142, -72.528 | Biological monitoring, chemical monitoring | Williamstown | BASS, LaRosa | Data gap in small watershed with more than 20% agricultural and developed lands. |
| ID 33: Barnes Brook; 44.242, -72.537 | Biological monitoring, chemical monitoring | Montpelier | BASS, LaRosa | Data gap in small watershed with more than 20% agricultural and developed lands. |
| ID 41: Pekin Brook; 44.378, -7272.459 | Biological monitoring, chemical monitoring | Calais | BASS, LaRosa | Data gap in larger tributary with mixed land use. |
| ID 18: Welder Brook; 44.272, -72.747 | Biological monitoring | Moretown | BASS | Data gap in medium watershed with less than 5% agricultural and developed lands. |
| ID 5: Upper Huntington River; 44.255, -72.961 | Biological monitoring | Huntington | BASS | Data gap in medium watershed with less than 5% agricultural and developed lands. |
| ID 27: Sterling Brook; 44.508, -72.659 | Biological monitoring | Morristown | BASS | Data gap in medium watershed with less than 5% agricultural and developed lands. |
| ID 12: Mill Brook; | Biological monitoring | Fayston | BASS | Data gap in medium watershed with less than 5% |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| 44.185, -72.872 | | | | agricultural and developed lands. |
| ID 6: Jones Brook; 44.255, -72.961 | Biological monitoring | Huntington | BASS | Data gap in medium watershed with less than 5% agricultural and developed lands. |
| ID 26: Herring Brook; 44.243, -72.659 | Biological monitoring | Moretown | BASS | Data gap in medium watershed with less than 5% agricultural and developed lands. |
| ID 40: Dugar Brook; 44.378, -72.460 | Biological monitoring | Calais | BASS | Data gap in medium watershed with less than 5% agricultural and developed lands. |
| ID 23: Bull Run; 44.117, -72.672 | Biological monitoring | Northfield | BASS | Data gap in medium watershed with less than 5% agricultural and developed lands. |
| ID 45: Buck Lake Brook; 44.440, -72.415 | Biological monitoring | Woodbury | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. Likely lake-influenced. |
| ID 7: Wes White Creek; 44.373, -72.958 | Biological monitoring | Richmond | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 14: Upper Ridley Brook; 44.317, -72.841 | Biological monitoring | Duxbury | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 32: Sunny Brook; 44.268, -72.629 | Biological monitoring | Middlesex | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 9: Slide Brook; 44.174, -72.886 | Biological monitoring | Fayston | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 13: Pinneo Brook; 44.363, -72.845 | Biological monitoring | Bolton | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 47: Nate Smith Brook; 44.181, -72.402 | Biological monitoring | Orange | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 8: Lockwood Brook; 44.175, -72.886 | Biological monitoring | Fayston | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 28: Kelley Brook; 44.251, -72.653 | Biological monitoring | Moretown | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 30: Jones Brook; 44.271, -72.638 | Biological monitoring | Berlin | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 3: Johns Brook; 44.367, -72.967 | Biological monitoring | Richmond | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 10: Gleason Brook; 44.370, -72.878 | Biological monitoring | Bolton | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| ID 11: Deer Brook; 44.245, -72.875 | Biological monitoring | Fayston | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 48: Cold Brook; 44.311, -72.392 | Biological monitoring | Marshfield | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 31: Chase Brook; 44.206, -72.635 | Biological monitoring | Berlin | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 44: Baker Brook; 44.155, -72.427 | Biological monitoring | Orange | BASS | Data gap in small watershed with less than 5% agricultural and developed lands. |
| ID 25: Sunny Brook; 44.123, -72.665 | Biological monitoring | Northfield | BASS | Data gap |
| ID 22: Stony Brook; 44.117, -72.678 | Biological monitoring | Northfield | BASS | Data gap |
| ID 25: Moss Glen Brook; 44.488, -72.662 | Biological monitoring | Stowe | BASS | Data gap |
| ID 34: Martin Brook; 44.143, -72.530 | Biological monitoring | Williamstown | BASS | Data gap; Abandoned A2 water |
| ID 46: King Brook; 44.305, -72.408 | Biological monitoring | Marshfield | BASS | Data gap |
| ID 1: Johnnie Brook; 44.406, -73.009 | Biological monitoring | Richmond | BASS | Data gap |
| ID 2: Hollow Brook; 44.314, -72.988 | Biological monitoring | Huntington | BASS | Data gap |
| ID 43: Great Brook; 44.277, -72.427 | Biological monitoring | Plainfield | BASS | Data gap |
| ID 19: Graves Brook; 44.345, -72.744 | Biological monitoring | Waterbury | BASS | Data gap |
| ID 15: Folsom Brook; 44.154, -72.838 | Biological monitoring | Waitsfield | BASS | Data gap |
| ID 16: Doctors Brook; 44.250, -72.762 | Biological monitoring | Moretown | BASS | Data gap |
| ID 17: Crossett Brook; 44.328, -72.747 | Biological monitoring | Duxbury | BASS | Data gap |
| ID 29: Cox Brook; 44.172, -72.653 | Biological monitoring | Northfield | BASS | Data gap |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| ID 4: Carpenter Brook; 44.282, -72.966 | Biological monitoring | Huntington | BASS | Data gap |
| ID 20: Bryant Brook; 44.378, -72.727 | Biological monitoring | Waterbury | BASS | Data gap |
| ID 49: Beaver Meadow Brook; 44.331, -72.392 | Biological monitoring | Marshfield | BASS | Data gap |
| ID 21: Alder Brook; 44.385, -72.725 | Biological monitoring | Waterbury | BASS | Data gap |
| **Wetlands** | | | | |
| Derway Island and other wetlands at mouth of Winooski | Wetland assessment | Burlington, Colchester | Wetlands | Assessment for Class I wetland eligibility. |
| Alder Brook | Wetland assessment | Essex | Wetlands | Assessment for Class I wetland eligibility. |
| Shelburne Pond | Wetland assessment | Shelburne | Wetlands | Assessment for Class I wetland eligibility. |
| Upper Gleason | Wetland assessment | Bolton | Wetlands | Assessment for Class I wetland eligibility. |
| Mud Pond | Wetland assessment | Williston | Wetlands | Assessment for Class I wetland eligibility. |
| Other high-quality wetlands proposed by local communities | Wetland assessment | Multiple | Wetlands | 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 |
| CVRPC | Central Vermont Planning Commission |
| 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 |
| FFI | Functioning Floodplain Initiative |
| FMR | Friends of the Mad River |
| FPR | Vermont Forests, Parks and Recreation |
| FWD | Vermont Fish & Wildlife Department |
| FWR | Friends of the Winooski River |
| GIA | Grants-in-Aid |
| LCBP | Lake Champlain Basin Program |
| LCCD | Lamoille County Conservation District |
| LCPC | Lamoille County 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 |
| 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 |
| 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 |
| WBBG | Woody Buffer Block Grant |
| WSMD | Vermont Watershed Management Division |
| WWTF | Wastewater Treatment Facility |

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# Appendix A. Dams in the Winooski Basin

**Table A1. List of dams in the Winooski 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 (accessed: 02/24/2023).**

| Dams ID | Dam Name | Stream | Dam Status | Purposes | Hazard Potential |
|---|---|---|---|---|---|
| **61** | Brooklyn Street | Stevens Branch | Breached (Partial) | | Minimal |
| **62** | Habbep | Stevens Branch | In Service | | Low |
| **63** | Jones Brothers | Stevens Branch | Breached | | |
| **66** | Bolster Reservoir | Stevens Branch-TR | In Service | Water Supply | Low |
| **67** | East Barre | Jail Branch | In Service | Flood Control | High |
| **68** | Barre-3 | Jail Branch | Breached (Partial) | | Minimal |
| **69** | Jockey Hollow | Stevens Branch | In Service | | Minimal |
| **70** | Sargents Mill | Jail Branch | Breached | | |
| **72** | Barre-8 | Stevens Branch-TR | In Service | | Minimal |
| **73** | Giacherio | Gunners Brook | In Service | | Minimal |
| **112** | Berlin-1 | Winooski River-TR | In Service | | Minimal |
| **113** | Berlin-2 | Stevens Branch-TR | In Service | | Minimal |
| **114** | Berlin Pond | Stevens Branch-TR | In Service | Water Supply | Low |
| **115** | Montpelier Reservoir (Lower) | Benjamin Falls Brook | In Service | Water Supply | Low |
| **116** | Montpelier No. 4 | Winooski River | In Service | Hydroelectric | Low |
| **117** | Newbrough Upper | Dog River-TR | In Service | Recreation | Significant |
| **118** | Newbrough Lower | Dog River-TR | Removed | | |
| **119** | Riverton | Dog River | Breached | | |
| **120** | Montpelier Reservoir (Upper) | Benjamin Falls Brook | Breached (Partial) | Water Supply | Minimal |
| **165** | Baker Pond | Sunny Brook | In Service | Recreation | Low |
| **170** | Wardner Pond | Sunny Brook | Breached | | |
| **187** | Winooski One | Winooski River | In Service | Hydroelectric | Significant |
| **188** | Chace Mills No. 21 | Winooski River | Removed | | |
| **189** | Howe Farm WMA | Winooski River-OS | Removed | Fish & Wildlife | Low |
| **190** | Burlington Electric WMA | Winooski River-OS | In Service | Fish & Wildlife | Low |
| **191** | West Hill Pond | Jug Brook-TR | In Service | Recreation | Significant |
| **192** | Marshfield No. 6 | Mollys Brook | In Service | Hydroelectric | High |
| **193** | Milne | Mollys Falls Reservoir-TR | In Service | | Low |
| **194** | Clarks Saw Mill | Winooski River | In Service | Other | Low |
| **196** | Cabot-6 | Winooski River | Breached | | |
| **199** | Cabot Creamery Lagoons | Winooski River - TR - OS | In Service | | Minimal |
| **200** | Nelson Pond | Mirror Lake-TR | Breached | | |
| **201** | Sabin Pond | Kingsbury Branch | Breached | | |
| **202** | Mirror Lake | Dugar Brook-TR | Breached (Partial) | Recreation | Significant |

| Dams ID | Dam Name | Stream | Dam Status | Purposes | Hazard Potential |
|---|---|---|---|---|---|
| **203** | North Calais Mill | Mirror Lake Brook | In Service | | Minimal |
| **204** | Calais-7 | Mirror Lake Brook | Breached (Partial) | | Minimal |
| **205** | East Calais Mill | Kingsbury Branch | In Service | Recreation | Low |
| **206** | Curtis Pond | Curtis Pond Brook | In Service | Recreation | Significant |
| **207** | Robinsons Sawmill | Curtis Pond Brook | In Service | | Minimal |
| **208** | Adamant Pond | Beaver Meadow Brook | In Service | Recreation | Significant |
| **209** | Hatch's Mill | Beaver Meadow Brook | In Service | | Minimal |
| **210** | Rogers | Sodom Pond Brook-TR | In Service | Recreation | Low |
| **211** | Scribner | Mirror Lake Brook | Breached (Partial) | | Minimal |
| **212** | Maple Corners | Curtis Pond Brook | Breached | | |
| **213** | Elmslie | Pekin Brook | In Service | Recreation | Significant |
| **332** | Bolton Falls No. 1 | Winooski River | In Service | Hydroelectric | Low |
| **333** | Duxbury Mill | Crossett Brook | In Service | | Minimal |
| **334** | Ice Pond | Winooski River-TR | Breached (Partial) | | Minimal |
| **336** | Montpelier No. 5 | Winooski River | Breached (Partial) | | Minimal |
| **337** | North Montpelier Pond | Kingsbury Branch | In Service | Recreation | Low |
| **338** | North Montpelier | Kingsbury Branch | Breached | | |
| **339** | Sodom Pond | Sodom Pond Brook | Breached | | |
| **340** | East Montpelier | Winooski River | Breached | | |
| **341** | Crystal Pool | Sodom Pond Brook | In Service | | Minimal |
| **342** | Chapels Pond | Sodom Pond Brook-TR | In Service | | Minimal |
| **343** | Bennett Brook | Bennett Brook | In Service | | Minimal |
| **344** | Pazini | Kingsbury Branch-TR | In Service | | Minimal |
| **345** | Nelson Pond | Sodom Pond Brook-TR | In Service | Other; Recreation | Low |
| **354** | Saxon Hill Reservoir (North) | Winooski River-TR | In Service | Water Supply | Minimal |
| **355** | Saxon Hill Reservoir (South) | Winooski River-TR | In Service | Water Supply | Minimal |
| **356** | Essex No. 19 | Winooski River | In Service | Hydroelectric | High |
| **358** | Essex School Reservoir | | In Service | | Minimal |
| **359** | Essex Town Reservoir | Winooski River-TR | | | |
| **579** | Richards | Winooski River-TR | In Service | Recreation | Significant |
| **580** | Bailey Pond | Marshfield Brook | In Service | Recreation | Low |
| **581** | Marshfield Pond | Marshfield Brook | In Service | Other | Low |
| **582** | Laird Pond | Nasmith Brook | Breached | Recreation | |
| **583** | Farrington | Winooski River | Breached | | |
| **584** | Marshfield-6 | Winooski River | Breached | | |
| **585** | Marshfield-7 | Winooski River | Breached | | |
| **586** | Marshfield-8 | Winooski River | Removed | | |
| **587** | Marshfield-9 | Winooski River | Breached | | |

| Dams ID | Dam Name | Stream | Dam Status | Purposes | Hazard Potential |
|---|---|---|---|---|---|
| **602** | Wrightsville | North Branch Winooski River | In Service | Flood Control | High |
| **603** | Middlesex No. 2 | Winooski River | In Service | Hydroelectric | High |
| **604** | Middlesex-3 | Great Brook-TR | In Service | | Minimal |
| **617** | Lane | North Branch Winooski River | In Service | Other | Low |
| **618** | Bailey | | In Service | | Minimal |
| **619** | Montpelier No. 3 | Winooski River | Breached (Partial) | | Minimal |
| **620** | Dodge-Roya | North Branch Winooski River | Breached | | |
| **621** | Trestle | North Branch Winooski River | Breached (Partial) | | Minimal |
| **622** | Langdon Pond | Winooski River-TR | Breached (Partial) | | Minimal |
| **623** | North Branch | North Branch Winooski River | In Service | | Minimal |
| **624** | Moretown No. 8 | Mad River | In Service | Hydroelectric | Low |
| **625** | USGS Gage No. 2880 | Mad River | In Service | | Minimal |
| **626** | Eight Trout Club | Welder Brook | Breached | Recreation | |
| **627** | Ward Lower | Mad River | Breached | | |
| **628** | Ward (Upper) | Mad River | Breached | | |
| **629** | Moretown-6 | Mad River | Breached | | |
| **630** | Cox Brook | Cox Brook | In Service | | Significant |
| **636** | Kimibakw | Sterling Brook-TR | In Service | Recreation | Low |
| **639** | Schwartz | Sterling Brook-TR | In Service | Recreation | Significant |
| **680** | Dry Pond | Berlin Pond-TR | Breached | | |
| **681** | Vatters Pond | Robinson Brook | In Service | Recreation | Low |
| **682** | Boutwell | Robinson Brook | Breached | | |
| **683** | Northfield Mills | Dog River | In Service | | Low |
| **684** | Cross Bros. | Dog River | Breached (Partial) | | Minimal |
| **685** | Pierson | Cox Brook | Removed | | |
| **686** | Towne | Robinson Brook-TR | In Service | Recreation | Low |
| **687** | Camp Wihakowi | Bull Run | Removed | | Minimal |
| **688** | Cooks Mill | Sunny Brook | Breached | | |
| **689** | Randall Wood Products | Dog River | Breached | | |
| **690** | Northfield-12 | Felchner Brook | In Service | | Minimal |
| **691** | Union Brook | Union Brook | Breached | Other | |
| **703** | Thurman W. Dix Reservoir | Orange Brook | In Service | Water Supply | High |
| **704** | Upper Orange Reservoir | Orange Brook | In Service | Water Supply | Low |
| **705** | Lower Orange Reservoir | Orange Brook | In Service | Water Supply | Low |
| **708** | Bennetts Mill | Nelson Brook | Breached | | |
| **713** | Orange-11 | Orange Brook | Breached | | |
| **714** | Orange-12 | Orange Brook | In Service | | Low |
| **725** | Peacham Pond | Sucker Brook | In Service | Hydroelectric | Significant |

| Dams ID | Dam Name | Stream | Dam Status | Purposes | Hazard Potential |
|---|---|---|---|---|---|
| **731** | Bruces Mill | | Breached | | |
| **749** | Old Batchelder Mill | Winooski River | In Service | | Low |
| **751** | Collins | Great Brook-TR | Removed | | |
| **804** | Gillett Pond | Johns Brook | In Service | Recreation | Low |
| **820** | Roxbury-2 | Dog River-TR | In Service | | Minimal |
| **822** | Beaver Pond | Dog River-TR | In Service | | Low |
| **904** | Myer-Madison | | | | |
| **905** | Lee | | In Service | | Minimal |
| **934** | Gorge No. 18 | Winooski River | In Service | Hydroelectric | Low |
| **937** | Auclaire | Muddy Branch-OS | In Service | | Minimal |
| **970** | Lake Mansfield | Miller Brook | In Service | Recreation | High |
| **971** | Culver Mill | Miller Brook | In Service | Recreation | Low |
| **972** | Adams | Little River | Removed | Other | |
| **973** | Moscow Mills | Little River | In Service | Hydroelectric | Minimal |
| **974** | Pike | Little River | In Service | | Minimal |
| **975** | Sylvan Park | Little River-TR | In Service | Recreation | Low |
| **976** | Bloch | Barrows Brook-TR | In Service | Recreation | Significant |
| **977** | Barrows Brook | Barrows Brook | In Service | Recreation | Minimal |
| **978** | Heath | West Branch Little River-TR | In Service | Recreation | Minimal |
| **979** | Mount Mansfield Corp. | West Branch Waterbury River-OS | In Service | Recreation | Minimal |
| **980** | Stowe-11 | Little River-TR-OS | In Service | Recreation | Minimal |
| **981** | Beaver Pond | Miller Brook | In Service | | Minimal |
| **982** | Trapp Family Lodge Lagoon | West Branch Little River-OS | In Service | | Minimal |
| **983** | Goldberg | Little River-TR | Breached | | |
| **984** | Michigan Brook Diversion Dam | Michigan Brook | In Service | | Minimal |
| **985** | Stowe Upper Golf Course | West Branch Little River-OS | In Service | Recreation | High |
| **986** | McAllister Pond | Barrows Brook-TR | In Service | Recreation | Significant |
| **987** | Mount Mansfield Corp. Diversion Structure | West Branch Waterbury River | In Service | | Minimal |
| **1073** | Moriarty Mill | Mad River | Breached | | |
| **1074** | Sugarbush Snowmaking Pond | Mad River-OS | In Service | Recreation | Low |
| **1083** | Warren Lake | Mills Brook | In Service | Recreation | High |
| **1084** | Warren Village | Mad River | Breached (Partial) | | Minimal |
| **1085** | Shashoua | Mad River - TR | Removed | | Significant |
| **1087** | Sugarbush Snowmaking Pond Diversion Structure | Mad River | In Service | Recreation | Minimal |
| **1088** | Hands Mill | Jail Branch | Breached (Partial) | Other | Significant |
| **1091** | Creamery | Jail Branch | Removed | | |

| Dams ID | Dam Name | Stream | Dam Status | Purposes | Hazard Potential |
|---|---|---|---|---|---|
| **1093** | Waterbury | Little River | In Service | Flood Control | High |
| **1094** | Feed Company (Upper) | Thatcher Brook | Breached | | |
| **1095** | Ice Pond | Thatcher Brook | Breached (Partial) | | Minimal |
| **1096** | Colbyville Upper | Thatcher Brook | In Service | Hydroelectric | Low |
| **1097** | Colbyville Lower | Thatcher Brook | Breached (Partial) | | Minimal |
| **1098** | Brisco | Bryant Brook-OS | In Service | Recreation | Low |
| **1099** | Waterbury-7 | Alder Brook-TR | | | |
| **1171** | Whitcomb | Stevens Branch-TR | Breached (Partial) | | Minimal |
| **1172** | Rouleau | Stevens Branch-TR | In Service | | Minimal |
| **1173** | Limehurst Pond | Stevens Branch-TR | In Service | Recreation | Low |
| **1177** | Sorimaini | Stevens Branch-TR | Breached | | |
| **1178** | Martin Reservoir | Martin Brook | | | |
| **1179** | Williamstown-9 | Stevens Branch-OS | In Service | | Minimal |
| **1180** | Williamstown-10 | Martin Brook | In Service | | Minimal |
| **1181** | McCarthy | | | | |
| **1183** | Martin Brook | Martin Brook | In Service | Other | Minimal |
| **1184** | Horwitz Pond | | Breached | Recreation | |
| **1212** | Winooski Water Supply Upper | Winooski River-TR | In Service | Recreation | |
| **1213** | Winooski Water Supply Lower | Winooski River-TR | In Service | | |
| **1214** | Kelly Pond | Winooski River-TR | | | |
| **1222** | Valley Lake | Dog Pond Brook | Breached | Recreation | |
| **1224** | Woodbury Upper | Dog Pond Brook | Breached (Partial) | Recreation | Significant |
| **1225** | Woodbury Lower | Dog Pond Brook | Breached (Partial) | | Minimal |
| **1226** | Woodbury | Dog Pond Brook | Breached | | |
| **1227** | South Woodbury Pond | Sabin Pond-TR | In Service | Recreation | Significant |
| **1228** | Daniels Mill | Woodbury Lake-TR | Breached | | |
| **1229** | Woodbury-11 | Nelson Pond-TR | Breached | | |
| **1230** | Woodbury-12 | Nelson Pond-TR | Breached | | |
| **1231** | Benjamin | Woodbury Lake-TR | In Service | | Low |
| **1232** | Woodbury-14 | Woodbury Lake-TR | Breached | | |
| **1233** | Woodbury-15 | Nelson Pond-TR | | | |
| **1234** | King Pond (Lower) | Forest Lake-TR | In Service | | Minimal |
| **1235** | Mamet | Jug Brook-TR | In Service | Recreation | Low |
| **1257** | Worcester Pond | Worcester Brook | Breached | Recreation | |
| **1258** | Ladds Mill | North Branch Winooski River | In Service | Hydroelectric | Low |
| **1259** | Janawics | North Branch Winooski River | Removed | | |
| **1260** | Chandler Sawmill | Minister Brook | Breached (Partial) | | Minimal |
| **1261** | Worcester Brook | Worcester Brook | Breached | | |

| Dams ID | Dam Name | Stream | Dam Status | Purposes | Hazard Potential |
|---|---|---|---|---|---|
| **1262** | Worcester-6 | North Branch Winooski River | Breached | | |
| **1272** | Nissenbaum Dam | West Branch Little River-TR | Breached | | |

# Appendix B. Winooski Basin Municipal Protectiveness Table

Table B1. Surface-water related protections adopted by municipalities predominantly in the Winooski basin.

| | 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? | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 |
| **Barre City** | Yes | No | Yes | No | None | 7.5% | 342 | 23% | 8 | 11% | | No | No | No |
| **Barre Town** | Yes | Yes | Yes | No | None | 7.5% | 7 | 29% | 1 | <1% | | Yes | Yes | Yes |
| **Berlin** | Yes | Yes | Yes | Yes | CRS | 17.5% | 161 | 19% | 3 | 12% | | Yes | Yes | Yes |
| **Bolton** | Yes | Yes | Yes | Yes | Interim | 17.5% | 36 | 22% | 1 | 7% | Yes | Yes | Yes | Yes |
| **Buels Gore** | No | Yes | No | Yes | None | 7.5% | 0 | - | 0 | 0% | Yes | Yes | Yes | Yes |
| **Burlington** | Yes | Yes | Yes | Yes | None | 12.5% | 42 | 17% | 0 | <1% | Yes | Yes | Yes | Yes |
| **Cabot** | Yes | Yes | Yes | No | Interim | 7.5% | 30 | 10% | 1 | 4% | | No | No | Yes |
| **Calais** | Yes | Yes | Yes | Yes | None | 12.5% | 39 | 3% | 0 | 4% | | Yes | Yes | Yes |
| **Colchester** | Yes | Yes | Yes | No | CRS | 7.5% | 81 | 19% | 0 | 1% | Yes | Yes | Yes | Yes |
| **Duxbury** | Yes | Yes | No | Yes | None | 7.5% | 37 | 8% | 0 | 5% | | No | No | No |
| **East Montpelier** | Yes | Yes | Yes | Yes | By-law | 17.5% | 33 | 9% | 1 | 3% | | Yes | Yes | Yes |
| **Elmore** | Yes | Yes | Yes | Yes | By-law | 17.5% | 8 | 13% | 0 | 1% | Yes | Yes | Yes | Yes |
| **Essex** | Yes | Yes | Yes | Yes | Interim | 17.5% | 8 | ? | 1 | 0% | Yes | Yes | Yes | Yes |
| **Essex Junction** | Yes | Yes | Yes | Yes | Interim | 17.5% | 9 | ? | 2 | <1% | Yes | Yes | No | No |
| **Fayston** | Yes | Yes | Yes | No | Interim | 7.5% | 15 | 7% | 0 | 2% | | Yes | Yes | No |
| **Huntington** | Yes | Yes | Yes | Yes | By-law | 17.5% | 20 | 10% | 0 | 2% | Yes | Yes | Yes | No |
| **Jericho** | Yes | Yes | Yes | Yes | Interim | 17.5% | 13 | 8% | 2 | 1% | Yes | Yes | Yes | No |
| **Marshfield** | Yes | Yes | Yes | Yes | None | 12.5% | 35 | 3% | 1 | 5% | | Yes | Yes | Yes |

| | 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? | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 |
| **Marshfield Village** | Yes | Yes | Yes | Yes | None | 12.5% | 6 | 33% | 1 | 15% | | - | - | - |
| **Middlesex** | Yes | Yes | Yes | No | Interim | 7.5% | 38 | 16% | 0 | 4% | | Yes | No | Yes |
| **Montpelier** | Yes | Yes | Yes | Yes | CRS | 17.5% | 255 | 38% | 18 | 9% | Yes | No | No | No |
| **Moretown** | Yes | Yes | Yes | Yes | None | 12.5% | 55 | 31% | 2 | 7% | | Yes | Yes | No |
| **Northfield** | Yes | Yes | No | Yes | Interim | 7.5% | 108 | 12% | 0 | 5% | | Yes | No | No |
| **Orange** | Yes | Yes | No | No | Interim | 7.5% | 21 | 10% | 0 | 4% | | No | No | No |
| **Peacham** | Yes | Yes | Yes | Yes | Interim | 17.5% | 11 | ? | 0 | 2% | | | | |
| **Plainfield** | Yes | Yes | Yes | Yes | Interim | 17.5% | 21 | 33% | 0 | 4% | | Yes | No | Yes |
| **Richmond** | Yes | Yes | Yes | Yes | Interim | 17.5% | 100 | 18% | 4 | 6% | Yes | Yes | Yes | Yes |
| **Roxbury** | Yes | Yes | No | No | Interim | 7.5% | 6 | ? | 1 | 1% | | No | No | No |
| **Saint George** | Yes | Yes | No | Yes | By-law | 7.5% | 0 | - | 0 | 0% | Yes | Yes | Yes | Yes |
| **Shelburne** | Yes | Yes | No | Yes | Interim | 7.5% | 9 | 33% | 0 | <1% | Yes | Yes | Yes | Yes |
| **South Burlington** | Yes | Yes | Yes | Yes | By-law | 17.5% | 4 | ? | 1 | <1% | Yes | Yes | Yes | Yes |
| **Stowe** | Yes | Yes | Yes | Yes | Interim | 17.5% | 91 | 9% | 1 | 3% | Yes | Yes | Yes | Yes |
| **Waitsfield** | Yes | Yes | No | No | Interim | 7.5% | 19 | 74% | 1 | 2% | | | | |
| **Warren** | Yes | Yes | No | Yes | Interim | 7.5% | 18 | 17% | 0 | 1% | | Yes | Yes | Yes |
| **Washington** | Yes | Yes | Yes | Yes | None | 12.5% | 25 | ? | 2 | 4% | | Yes | Yes | Yes |
| **Waterbury** | Yes | No | No | No | None | 7.5% | 25 | 84% | 0 | 2% | | No | No | No |
| **Waterbury Village** | Yes | Yes | No | No | None | 7.5% | 150 | 21% | 11 | 22% | | - | - | - |
| **Williamstown** | Yes | Yes | Yes | Yes | None | 12.5% | 81 | 5% | 1 | 6% | | No | No | No |
| **Williston** | Yes | Yes | Yes | Yes | Interim | 17.5% | 17 | 6% | 0 | <1% | Yes | Yes | Yes | Yes |
| **Winooski** | Yes | Yes | Yes | Yes | Interim | 17.5% | 3 | 100% | 0 | <1% | Yes | Yes | Yes | No |

| | 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? | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 |
| **Woodbury** | Yes | Yes | No | Yes | None | 7.5% | 5 | 40% | 0 | 1% | | No | No | Yes |
| **Worcester** | Yes | Yes | Yes | Yes | Interim | 17.5% | 6 | ? | 0 | 1% | | No | No | No |

[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).

# Appendix C. Responsiveness Summary

## Vermont Department of Environmental Conservation

## Agency of Natural Resources

## Responsiveness Summary to Public Comments Regarding:

## Basin 8 Tactical Basin Plan

On October 10, 2023, the Vermont Department of Environmental Conservation (DEC) of the Agency of Natural Resources (ANR) released a final draft of the Basin 8 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 November 10, 2023, included three public meetings on October 10, 17, and 24, 2023. Three additional public meetings were noticed by Planning Commissions during their monthly Clean Water Advisory Committee 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.

2023 meetings for public comment include:

• October 10 – 6:30 PM – Berlin, VT – Hybrid Meeting & Presentation (25 Attendees)

• November 17 – 6:30 PM – Winooski, VT – Hybrid Meeting & Presentation (12 Attendees)

• November 24 – 6:30 PM – Morrisville, VT – Hybrid Meeting & Presentation (28 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. Biological condition of fish…. The map indicates poor condition of macroinvertebrates and only fair condition of fish in lower Winooski River as sampled after 2011. The map indicates sampling upstream of Winooski. PFAS-laden leachate from Coventry was discharged to the North Burlington Wastewater Treatment Facility (WWTF) from 2001 to 2015. In 2019 significant amounts of PFAS were detected in the Winooski River downstream of this facility.

Question: What is the current status of fish, macroinvertebrates and PFAS in lower Winooski River?

**Response:** The fish and macroinvertebrate assessments referenced in this comment are not from the lower mainstem Winooski River but from Centennial Brook and Morehouse Brook (Sites 15 and 6; Table 2) – two stormwater-impaired tributaries to the Lower Winooski that are on the Impaired Waters list (TBP Table 8). No general macroinvertebrate assessments have been performed in the lower Winooski river segment in question, as this is a non-wadeable reach that is not systematically assessed according to the 2022 Vermont Surface Water Assessment and Listing Methodology.

In 2021 ANR did sample surface waters for 36 PFAS chemicals at the mouth of the Winooski River (Colchester boat launch; 44.53650, -73.27427). The results are presented in an April 2022 PFAS Monitoring report and summarized on Page 28 of the TBP. PFAS levels at this site were below detection limits for all but one PFAS species (PFBA = 1.98 parts per trillion). Levels of the five Vermont-regulated PFAS were all below quantification limits, but their estimated total concentration was 4.3 parts per trillion. This estimated total concentration is below the current Vermont Drinking Water Advisory of 20 parts per trillion.

In 2021 PFAS concentrations were also sampled in the body tissue of seven individual fish at the mouth of the Winooski River (see the April 2022 PFAS Report's *Fish Tissue Comparability* section). The Vermont Department of Health is reviewing fish tissue concentrations from the April 2022 Vermont report to determine if these levels pose any health risk to consumers.

Surface water and fish tissue samples were also monitored in the lower Winooski and other sites after 2021. A report on the findings is expected to be available in early 2024.

DEC continues to monitor surface waters and fish tissue for PFAS and has launched a 2023-2024 sampling campaign specifically targeting wastewater treatment facilities and other industry, land application, and landfill sites. All wastewater treatment facilities, including North Burlington, are included in this sampling campaign. The purpose of this effort (summarized on Page 108 of the TBP) is to quantify PFAS in municipal wastewater discharges across the state and subsequently to focus resources on identifying and reducing or eliminating PFAS sources in select communities.

**Comment 2:** Page 23: Table 2 does not include lower Winooski River near Derway Island and the WWTF. There is no mention of contaminants in water.

**Response:** Table 2 presents information on bioassessment sampling results only; possible contaminants are not systematically sampled during bioassessment. For information on potential contaminants, sites identified as impaired for a given use are listed in Table 8 (TBP Page 51) along with the putative pollutant and problem/source generating the impairment.

As of 2022, no biocriteria have been established in the 2022 Vermont Surface Water Assessment and Listing Methodology to evaluate macroinvertebrate or fish community condition in nonwadeable river reaches like the Lower Winooski.

**Comment 3:** Page 51, Table 8: Map #1 and 2. For Winooski River mouth to Dam: pollutants should include PFAS. Testing in 2019 found them there.

**Response**: Surface waters are listed as impaired in Table 8 when observed water quality data exceed criteria set to protect designated uses in the Vermont Water Quality Standards. Act 21 (2019) requires the State to establish PFAS standards specific to surface waters for protecting both human health and aquatic life. Vermont's Plan for Deriving Ambient Water Standards for PFAS recommends following EPA development of PFAS surface water quality standards as they become available. In 2022 EPA proposed draft Aquatic Life Ambient Water Quality Criteria for PFOA and PFOS, but these standards have not yet been adopted by EPA.

**Comment 4:** While I appreciate the extensive planning around phosphorus in the Tactical Basin Plan, it is not the only pollutant that we should be concerned about. Per- and polyfluoroalkyl substances (PFAS), developed during the Manhattan Project, have been around since 1945. We've known about the dangers of these "forever chemicals" for over 60 years. However, they have only been garnering public attention for the last 10 years or so. The EPAs new Health Advisory Levels (HALS) on PFAS, as well as the proposed regulated drinking water standards must be considered in this 5-year Tactical Basin Plan. Vermont can always do more than EPA, but it can't do less than the EPA. And the EPA is posed to do far more on PFAS regulated drinking water standards in the next 5 years; already the EPA has set an extremely low Health Advisory Level for PFAS. I fear that the proposed plan does not demonstrate the urgent need to start tackling PFAS in Vermont, as well as the interconnectedness between issues that need to be addressed to guarantee healthy and safe lakes, ponds, streams, and wetlands for all Vermonters. Some of the proposed 1074 watershed projects should include PFAS.

**Response:**

The 2023 PFAS Road Map is DEC's current guidance document on PFAS action within the department and in coordination with other agencies. The PFAS Road Map documents several ways in which Vermont has taken action to address emerging PFAS concerns while also relying on emerging EPA guidance when appropriate. We highlight these strategies more explicitly earlier in the PFAS Monitoring section (Page 28) than in the draft plan.

**Grouped Comments 5:**

(A) PFAS is in landfill leachate, wastewater treatment plants, industrial discharges, pesticides, and more. Everything is connected. Too much of the state's work is siloed. Education is the key when it comes to PFAS. The topic is complex because there are 14,000 forms of PFAS in this class of toxic chemicals. Furthermore, Vermont's testing of PFAS in our various bodies of water and in fish and other wildlife at this point in time is paltry. Multiple PFAS tests should be done each year at far more sites and of far more fish, including water and fish in Lake Champlain. Sadly, non-detection does not mean that there aren't any PFAS in the water...it simply means that current testing methods don't detect PFAS below 4 parts per trillion (ppt).

(B) Concerning PFAS testing of water and fish, the last report I read from ANR was for April 2021--Vermont Per- and Polyfluoroalkyl Substances (PFAS) Surface Water, Fish Tissue, and

Wastewater Treatment Facility Effluent Monitoring Report—the limited testing found PFAS in both fish and rivers. As far as I know, little PFAS testing of fish or water has been done in Lake Champlain. The 2021 report found fish tissue samples of PFAS at 18.6 ppb…which the report deemed low. This sample was taken at the mouth of the Winooski River. However, if you translate to ppt – which Vermont uses for drinking water quality – we are looking at 18,600 ppt in fish tissue. The European Union regulates PFAS in fish at 65 ppt and above.

I know from tests on water that PFAS levels can vary dramatically from one test to the next, depending on a variety of factors. The 2021 ANR report tested in so few places that it hardly represents a good examination of PFAS in Vermont. Testing only once every year or two years is inadequate. The Vermont PFAS/Military Poisons own PFAS testing demonstrated levels in the Winooski Salmon Hole at 148.5 parts per trillion of 17 different PFAS; we found 40.5 ppt of the 5 regulated forms of PFAS in Vermont. In the Gilbrook Pond near Camp Johnson, we found 84.3 ppt of total PFAS and 37.8 ppt of the 5 regulated PFAS in Vermont. Without more in-depth testing and more often, we really have no sense of contamination levels in the Winooski Basin or anywhere else in Vermont.

(C) Furthermore, all potential sources of generation of these toxins should be registered and tracked by ANR/DEC, with the data provided in a state database. This is a very serious issue that has thus far gone largely unattended and needs to be dealt with without delay.

**Response:** In 2019 Vermont established a Statewide Sampling Plan to identify the extent of and to inform the appropriate response to PFAS contamination and its associated risks. The Sampling Plan identifies several purposes of sampling, and each purpose may require a different sampling design to best achieve its goals. These designs may differ from the spatial and temporal frequency indicated in the comment above.

In addition to identifying landscape sources of PFAS, Vermont is also pursuing legal action against large manufacturers of PFAS that included PFAS in wide variety of consumer, household, and other commercial products and industrial uses that are the ultimate sources of PFAS. The State of Vermont has filed two lawsuits against 3M Company and E.I. du Pont de Nemours and Company (DuPont) and related DuPont companies, seeking to make Vermont whole by making those responsible for PFAS contamination pay to remove their toxic chemicals from Vermont's groundwater and public water systems, among other things. The lawsuits are expected to take several years.

**Comment 6:** PFAS in drinking water is also concerning. What will happen when the EPA lowers the PFAS drinking water standards even further? What will happen to private well owners who must pay for PFAS testing themselves…and that testing is quite expensive and doesn't give them numbers below 4 ppt for PFAS. During the summer flooding, some free well testing was offered by the Vermont Health Department, but not for PFAS. Considering that PFAS travels through water, soil (see the ANR study on PFAS ambient concentrations in soils at various locations around the state) and air; we cannot leave private well owners out to dry if we care about their health and well-being as Vermonters.

**Response**: In May 2023 Vermont's Agency of Natural Resources and Department of Public Health submitted comments on the EPA's draft PFAS National Primary Drinking Water Regulation Rulemaking that reflect the State's current perspective on PFAS and federal drinking water standards. These comments include discussion on MCL compliance and feasibility, laboratory testing capacity, monitoring schedules, federal funding needs to support remediation, and increased state staffing needs to support the proposed regulations, among other topics.

Private water sources for household use are not regulated by the EPA or the State of Vermont. However, DEC investigates sources of PFAS contamination that may be impacting private wells and evaluates which homes need to be sampled in areas where residents are using private drinking water wells that could be impacted from a nearby PFAS source. For users of private water sources outside specified areas of concern, DEC provides an info sheet for drinking water testing.

Given that 40% of Vermont residents drink water from private wells, according to the 2023 PFAS Road Map (pages 12-13) DEC has also initiated a Private Well PFAS Testing Program. Among other goals, the program will estimate the impacts of PFAS on water supplies where there is no known PFAS source.

**Comment 7:** Finally, wastewater and industrial discharges must be seriously examined. Dilution is no longer the solution to pollution when you are dealing with chemicals that last thousands of years. In 2020, Weston conducted a study of 19 Wastewater Treatment Facilities, landfills, as well as industrial discharges from businesses. All industrial discharges and sludges sampled contained PFAS.

Wastewater Treatment Plants must treat effluent for PFAS, as well as leachate that they receive from landfills. It cannot be released into our rivers and waterways anymore. We believe that PFAS will soon be classified as a toxic substance by the EPA; we must be proactive and protect our water from these forever chemicals that bioaccumulate in all living organisms.

**Response:** Neither wastewater or landfills are generating PFAS; rather, levels of chemicals in effluent and leachate reflect what is available in Vermont's stream of commerce. To this end, the updated 2023 PFAS Road Map expands efforts around PFAS source control and use reduction.

Moreover, as described on page 108 of the TBP, Vermont is currently implementing a sampling campaign at all wastewater facilities and other likely sources of PFAS 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.

**Grouped Comments 8:**

(A) Regarding PFAS/PFOS discharges from WWTFs/CSOs and contamination of the Winooski watershed with these chemicals from the land application of WWTF sewage sludges, PFAS/ PFOS are HIGHLY TOXIC and do not degrade in the environment, but accumulate and move through the food chain. Both plants and animals uptake and concentrate these "forever chemicals" in their and their offspring's bodies. These chemicals in fact can even be found in the larvae of dragonflies which are now being utilized in bio-monitoring assays documenting the concentration and extent of these chemicals in the natural environment. Wildlife such as deer

and turkeys feeding on farmlands that have received WWTF sludges over the years are found to have very high concentrations of PFAS/PFOS in their body tissues, above safe levels for human consumption. These contaminants spread further and wider when the animals containing them are then fed on by predators and eaters of carrion.

Sewage sludges tend to contain high concentrations of PFAS/PFOS and the land-spreading of these sludges on farmland only serves to further contaminate the food/feed/pasture/pasturing animals grown on them, but also results in the further release to, and contamination of, the watershed during flood events and where sediment and nutrient runoff to the drainage occur. Since these contaminants only further accumulate and spread throughout the environment, the plan should advise the elimination of or a moratorium on the land-spreading of WWTF sludges not only in the Winooski Basin, but throughout Vermont's river basins.

(B) Use of bio-solids should be discouraged as they are a source of per-and polyfluoroalkyl substances (PFAS) and toxic heavy metals; if used, 50-100ft buffers are advisable to keep toxins out of waters.

(C) Please work with your colleagues in your sister programs to see that the PFAS/PFOS issue gets more seriously addressed and that sludges are disposed of (at least until a better option is arrived at) in certified landfills and not disposed of on our precious food and feed-growing farmland.

(D) Lastly, please stop referring to these WWTF sludges as "biosolids", a very misleading term (by intent actually) which only further confuses the public as to where these sludges come from and the environmental and public health risks they present.

**Response:** DEC's investigation of and response to PFAS in biosolids used in land applications in Vermont is detailed in the 2023 PFAS Road Map (*Investigating PFAS in Biosolids and Wastewater Sludges:* pages 27-29) and the 2021 PFAS Road Map: *Characterizing and Monitoring Biosolids and Septage Land Application* (pages 6-9). In summary, DEC has investigated PFAS at WWTFs where biosolids are produced in Vermont, in soil and groundwater at a subset of agricultural sites where biosolids application is permitted, and at water supplies within a quarter mile of these sites. Based on initial sampling results, DEC directed all land application permittees to conduct soil and groundwater testing at all permitted sites statewide. Permittees with sites associated with PFAS above the groundwater enforcement standard were directed to halt land application, retest groundwater to confirm results, and identify and test any water supplies within a quarter mile of the site.

In response to PFAS detection in biosolids, the State has 1) worked with permittees to develop site-specific action plans, 2) updated the Solid Waste Rules to include PFAS monitoring requirements for biosolids importers and for all permittees generating biosolids in Vermont for distribution for land application, 3) begun addressing PFAS before it enters the waste stream via pretreatment and pollution prevention efforts, and 4) coordinated with the Agency of Agriculture, Food & Markets to identify potential adverse PFAS impacts to agriculture and the food supply resulting from land application of biosolids, including interacting with farmers to investigate the soil-to-crop-to animal pathway of PFAS movement into potential animal forage and agricultural commodities. DEC also

aims to collaborate regionally and nationally to assess the viability of current sludge management options (landfill, land application, and incineration) and to find alternative management options.

The term 'biosolids' is explicitly defined and used at least 200 times in the Vermont Solid Waste Management Rules. Moreover, this term is used at the federal level in EPA's 1993 40 CFR Part 503 rule to determine risk from the use or disposal of biosolids. Given the precedence of this term in state and federal rules, it is not within the scope of the TBP to revise the use of this term. It may be worth noting that both EPA 40 CFR Part 503 and Vermont Solid Waste Management Rules do identify biosolids as "sewage sludge" upon initial introduction of the term.

**Comment 9:** Pages 27-28: This appears to be the only discussion of PFAS in this draft plan. I have not yet found PFAS in Vermont's Water Quality Standards 2022, despite legislation setting a preliminary standard of 20 ppt for the sum of 5 PFAS. The challenge of PFAS to human and ecological health cannot be overstated due to their persistence, mobility, bio-accumulation. They attack the immune system and cause serious health effects at tiny amounts. EPA's lifetime advisory limits are far below Vermont's current standard.

**Response:** A discussion on PFAS and wastewater treatment facilities is also available on page 108 of the TBP. As required by Act 21, Vermont's Water Supply Rule was revised through rulemaking to reflect the Maximum Contaminant Level of 20 parts per trillion for five PFAS in drinking water. Regarding Vermont's Water Quality Standards, Vermont plans to adopt EPA-recommended PFAS criteria in its water quality standards after these recommendations have been finalized. Currently, both EPA's National Primary Drinking Water Regulation and National Recommended Water Quality Criteria for Aquatic Life and Human Health for PFAS are not yet finalized. EPA's draft aquatic life criteria are significantly higher than the interim drinking water health advisory issued by the EPA in June 2022, Vermont's Drinking Water Advisory level, and the observed PFAS concentrations in Vermont surface waters to date.

**Grouped Comments 10:**

(A) Question: How can the State protect human and ecological health when you allow discharge of leachate containing heavy metals and PFAS "forever chemicals" to international waters, to waters we all depend on for life, to waters needed for generations to come?

(B) Keep leachate out of Winooski watershed!

(C) The plan should also disallow the acceptance of industrial wastewater sources, such as transfer station and landfill leachate, where there has been no pre-treatment to remove 99.9% of the PFAS/PFOS contamination prior to acceptance. As we know, WWTFs were never designed to treat and cannot treat wastewater containing PFAS/PFOS, and adding concentrated industrial sources to our already contaminated largely residential wastewater flows must not be allowed to continue.

**Response**: The purpose of TBPs is to identify strategies that support existing regulatory programs and that promote the development and implementation of non-regulatory clean water projects. It is

beyond the scope of a TBP to propose new regulation. Vermont's determination and issuance of pretreatment permits is summarized on DEC's Discharge Permits webpage.

As of February 2023, $7 million in American Rescue Plan Act funds were made available for wastewater pretreatment projects for municipalities to create and disseminate an Industrial User Survey in order to gather information about industrial users, to develop local pollution limits to protect the wastewater treatment facility, or to update a Sewer Use Ordinance. Funding could also be distributed by the municipality to industrial users to implement, improve or expand pretreatment systems, including PFAS.

Vermont's 2023 PFAS Road Map summarizes DEC's commitment to working with landfills to determine appropriate next steps towards limiting the discharge of PFAS into the environment due to landfill leachate. Each landfill will be individually considered, and management options may include ongoing monitoring of leachate, wastewater treatment facility effluent, and receiving waters, restrictions on the management of sludges produced by wastewater treatment facilities accepting leachate, and the evaluation of treatment options at the landfill facilities that may allow for reductions in concentrations prior to leaving the facilities.

**Comment 11:** Response to potential statewide PFAS (include PFOA) contamination does not appear to be included in the Vermont Surface Water Management Strategy (VSWMS)

Recommendation: Incorporate PFOAs in the (VSWMS). DEC conduct statewide monitoring for PFOAs in groundwater and surface water to protect water quality and public health.

**Response**: Vermont's 2017 revision of the Statewide Surface Water Management Strategy discusses polyfluorinated compounds ('PFCs') in Chapter 2: Toxic Substances. ANR and partner agencies are planning and implementing statewide PFAS monitoring and regulation as described in the responses above and in the 2023 PFAS Road Map.

**Comment 12:** Page 9: The headwaters of the Winooski River in the Lowell Mountains must be left free from any use of herbicides for control of invasive species due to human disturbances. The herbicides are toxic to wildlife and to fish in the headwaters. Non-toxic methods of plant control are necessary in such sensitive areas.

**Response:** The Lowell Mountains form the headwaters of the Missisquoi and Lamoille Rivers; this comment is better suited for these basins' plans and may be submitted in response to those draft plans as appropriate.

**Comment 13:** Pesticides, including neonicotinoids, remain and are re-cycled in surface water and groundwater, and are potential threats to beneficial insects.

Recommendations: DEC include reduction of neonicotinoids use in the Vermont Surface Water Management Strategy. VAAFM and DEC coordinate to conduct more extensive monitoring of

pesticides and herbicides (including neonicotinoids) in groundwater and surface water in and nearby agricultural fields in the Winooski basin.

**Response:** The state's general approach to pesticides is discussed in Chapter 2: Toxic Substances of the 2017 Vermont Surface Water Management Strategy, and subsequent revisions may provide some information on particular pesticides of concern or those with timely updates. For example, it may be important to note that recently passed Vermont law classifies neonicotinoids as a restricted use pesticide, meaning that their purchase and use is now limited to only state-licensed applicators. However, it is beyond the scope of the Winooski Tactical Basin planning process to revise the Surface Water Management Strategy or recommend additional regulation.

The Public Health and Agricultural Resource Management Division (PHARM) of the Vermont Agency of Agriculture, Food & Markets has been monitoring select surface water sites throughout high agricultural use areas of the state for pesticides since 2017, including one site in the Winooski. No neonicotinoids were detected at the Winooski site.

It is also noteworthy that the Lake Champlain Basin Program is presently funding a comprehensive assessment of pesticides in the Lake Champlain Basin.

**Comment 14:** Phosphorus load allocations and reduction targets in the TMDL for phosphorus in Lake Champlain do not include the role of contributing chemical fertilizers.

Recommendations: In future TMDL modeling, include the role of contributing chemical fertilizer applications which are known to affect the estimated phosphorus loading.

**Response:** Vermont recognizes that management of lawns is a source of nutrients to our waterways and currently includes regulation (10 V.S.A. § 1266b) as a mechanism for managing this source as part of our plan to reduce nutrient levels in Lake Champlain (LC P TMDL Phase I). Vermont adopted 10 V.S.A § 1266b in 2012 to prohibit the application of phosphorus fertilizer to turf unless the grass is being established during the first growing season, or a soil test indicates the need for phosphorus. Fertilizer applications to impervious surfaces or within 25 feet of surface waters are prohibited. Reductions in fertilizer use via this regulation were included when setting phosphorus wasteload allocations and reduction targets from developed lands in the 2015 Phosphorus TMDL as described in Appendix A of the 2015 Lake Champlain BMP Scenario Tool.

In agricultural settings, Vermont also recognizes nutrient management on farms, including chemical fertilizers, as a potential source of phosphorus entering waterways. Phosphorus loads and potential phosphorus reductions from nutrient management on agricultural fields was also included in TMDL modeling as described in the 2015 Lake Champlain BMP Scenario Tool. Phase 1 of the Lake Champlain Phosphorus TMDL Implementation Plan called for the state to revise the Required Agricultural Practices regulating agricultural activity related to water quality, including nutrient management planning. Under the Required Agricultural Practices Section 6.03, all Large Farm, Medium Farm, and Certified Small Farm Operations must develop a field-by-field Nutrient Management Plan that meets the USDA Natural Resources Conservation Service Nutrient Management Practice Code 590 Standard. Chemical fertilizers are included in Nutrient Management

Planning. Implementation of Nutrient Management Plans under the Required Agricultural Practices are anticipated to reduce phosphorus loading to waterways, in part by reducing excessive fertilization of fields beyond necessary amendment levels.

**Grouped Comments 15:**

(A) Page 62, Table 11, Regulatory programs for phosphorus reduction. Across all three categories, the use of glyphosate-based herbicides must be reduced or eliminated. Scientists in Montreal found that glyphosate is 18% phosphorus and must be considered in the TMDL for P in affected lakes. A quick figuring of 2021 reported use of glyphosate in Chittenden and Washington Counties added up to over 6 thousand pounds of the herbicide, for a possible total of over 1 thousand pounds of P . Glyphosate's P loading also contributes to cyanobacteria contamination and degradation of our waters.

(B) Recommended agricultural practices to reduce sediment or phosphorus may exacerbate other water quality problems. No-till methods to decrease sediment runoff may increase the use of Glyphosate, i.e., Roundup, and other pesticides that reduce water quality and may lead to ecosystem damage and possibly contribute to phosphorus loading. Research in the Maumee River watershed is showing how no-till and Glyphosate use may actually be increasing dissolve phosphorus loading to Lake Erie.

Recommendation: Vermont Agency of Agriculture, Food and Markets (VAAFM) include reduction of use of Glyphosate in recommended agricultural practices. VAAFM and DEC coordinate to conduct more extensive monitoring of Glyphosate in groundwater and surface water in and nearby agricultural fields in the Winooski basin. VAAFM conduct research on links of no-till and Glyphosate use to phosphorus loading and explore other ways to prevent farm field erosion aside from no-till.

**Response:** AAFM and DEC acknowledge that glyphosate is one of the most commonly used herbicides in Vermont and its usage could go up as water quality practices like cover cropping and no-till increase. AAFM has been testing for glyphosate in Vermont's waters to better understand its impact on the environment. As of August 2022, AAFM tested over 1250 surface and groundwater samples and found glyphosate or its primary metabolite, aminomethylphosphonic acid, in just two samples (none within the Winooski basin).

Glyphosate may be a small though non-trivial component of the phosphorus load in the basin. The amount of phosphorus as glyphosate estimated to be applied to corn, field, and forage lands in 2021 (792 pounds; derived from AAFM's 2021 data) is smaller than the phosphorus reductions achieved by two conservation practices that might encourage glyphosate use: conservation tillage and cover cropping (4896 pounds of phosphorus reduced in 2021: Winooski Basin Agricultural Phosphorus Loading & Reduction). Thus, traditional conservation practices still appear net-beneficial, especially when considering that it is highly unlikely that glyphosate was only used on agricultural lands in 2021 response to the implementation of these conservation practices. However, during the 2024-2029 planning cycle DEC will further discuss with AAFM and partners whether non-regulatory education and outreach on glyphosate use and conservation practices is warranted in the basin. Moreover,

AAFM regulates pesticide use considering risks to human health and the environment. If scientific data indicate an increased risk to either, AAFM will work with state and federal partners to lessen the risk.

**Comment 16:** Residual, legacy phosphorus incorporated in lake sediment does not appear to be identified as a factor limiting phosphorus reduction in the TMDL for phosphorus in Lake Champlain and its river basins.

Recommendation: In future TMDL modeling, include the reintroduction of phosphorus through lake sediments to estimate phosphorus loading.

**Response:** The state is aware of the role of internal phosphorus loading in driving lake phosphorus concentrations in parts of Lake Champlain. The importance of internal phosphorus loading is very different among basins of the lake. Internal loading has been clearly identified as an important factor in shallow eutrophic bays such as Missisquoi Bay. There is evidence to suggest that it may have a role in the Inland Sea and St Albans Bay as well, a question that DEC scientists are actively investigating. In the central Main Lake Basin, where the Winooski River empties, there does not seem to be evidence to support internal loading as a major factor, because oxygen concentrations in bottom waters remain high throughout the year, and phosphorus concentrations in deep waters tend to be similar to or lower than concentrations in shallow waters. In future TMDL modeling, the state will consider alternate models in areas where evidence suggests that internal loading may be underestimated by current models. This is already the case for Missisquoi Bay, where targets were based on a more sophisticated model which simulated internal phosphorus loading.

Even in cases where internal loading is an important factor, management actions may focus on control of external sources. Internal P sources ultimately derive from watershed inputs, so over time, control of external loading will help to reduce internal loads, although this response may be slower than many of us would like to see. In a lake as large and complex as Lake Champlain, control of internal sources is often impractical and/or prohibitively expensive, so watershed action remain our best tool in many cases.

**Comment 17:** Page 7: Supports to agriculture must widen buffers to protect waters of the state from farm nutrients.

**Response:** Strategy 23 of the TBP (page 144) specifically identifies the goal of expanding riparian buffers beyond the minimum Required Agricultural Practices: "Enhance (beyond RAPs) riparian buffers through woody buffer establishment and invasive species control." Moreover, DEC's financial support of buffer restoration through its Clean Water funding programs require a minimum average 35ft buffer be established through the project reach, as described in the 2023 Clean Water Funding Policy.

**Comment 18:** Question: How does use of underground drain tile comply with Required Agricultural Practices Sec 6?

**Response:** In 2018 the Agency of Agriculture, Food & Markets filed an amendment to the Required Agricultural Practices rule specifically to address subsurface tile drainage. Required Agricultural Practices for producers with subsurface tile drainage now includes additional

requirements for field stacking of manure, nutrient management planning, barnyard management, vegetated treatment areas, rodent guards, and surface inlets.

**Comment 19:** Agriculture policies do not appear to encourage small-farm agriculture, which can lead to phosphorus loading on a larger scale from large farms.

Recommendation: VAAFM should create policy incentives to enable small scale farms to be economically viable

**Response:** The Winooski basin agricultural community comprises one Large Farm Operation, six Medium Farm Operations, 32 Certified Small Farm Operations, and approximately 117 Small Farm Operations (farm size classification infographic available here). Therefore, the current distribution of farm operations in the Winooski is skewed toward smaller farms. Moreover, it is beyond the scope of the tactical basin plan to recommend policy changes to the Agency of Agriculture, Food & Markets.

However, technical and financial assistance for small farms was identified as a need during discussions with agricultural technical service providers in the basin. Pages 85-86 of the TBP discuss agricultural strategies and opportunities in the Winooski basin, and many of these strategies target smaller farms. Strategies include increasing the efficiency of technical assistance (and reducing the time burden of technical assistance for producers) using a farm team model, leveraging existing resource guides for quickly identifying assistance opportunities, identifying and communicating cost share or equipment rental opportunities for small farms to implement BMPs without major capital investment, and supporting BMP implementation using DEC's Act 76 formula grants, which are only eligible where the producer is not required to meet the Required Agricultural Practices (generally small farms).

**Comment 20:** This is not my area of advocacy, but I cannot help but notice that your plan is weak-toothless- and leaves the lawn care industry untouched by this proposal for removing phosphorus from our water ways. I live in ***redacted***. Every single summer for the past 19 yrs, I've seen evidence in the form of green algal blooms (spring/summer), which turn into muddy brown looking (fall/winter) dead zones in my neighborhood pond. We can deduct it's being polluted by my own neighbors' lawn fertilizer (we live on sandy soil) whether it's homeowner-applied or by these lawn care companies. We observe this evidence of phosphorus build up where there is zero agriculture/ farming uphill and surrounding area- only residential properties.

Firstly, I am betting you all and state officials do not monitor how much landscaping/ lawn care fertilizer is being used in our watershed area. I see these companies spraying commercial properties and allowing their runoff to spill over and run into the drains which will eventually lead to the Winooski R. I see them applying their fertilizer right before or even during rainfall.

My comment/ question is: why are you letting residential properties and landscaping companies that offer commercial fertilization of lawns off so lightly? It is my strong opinion that both these two, the consumer and the service provider, should be taxed to discourage this behavior. We need to move away from behavior that is destructive to our environment and towards behavior that is sustainable and encourages regrowth during this time of mass species extinctions.

My last words are to grow a spine. If you are not making folks uncomfortable, you are not doing your job.

**Response:** Vermont adopted legislation effective in 2012 (10 V.S.A § 1266b) that prohibits the application of phosphorus fertilizer to turf unless the grass is being established during the first growing season, or a soil test indicates the need for phosphorus. Fertilizer applications to impervious surfaces or within 25 feet of surface waters are also prohibited. The law applies to anyone that fertilizes lawns, including lawn care companies. Vermont recognizes that management of lawns is a source of nutrients to our waterways and included 10 V.S.A. § 1266b as a mechanism for managing this source as part of our plan to reduce nutrient levels in Lake Champlain (LC P TMDL Phase I).

As is the case with all regulations, compliance is supported through education and outreach as well as enforcement actions. The Agency of Agriculture, Food & Markets (AAFM) promulgates 10 V.S.A § 1266b. DEC and AAFM do regularly monitor surface water and groundwater sites for a variety of potential contaminants including nutrients and pesticides. In addition, AAFM does manage the Environmental Complaint Form for the public to anonymously report suspected fertilizer, pesticide, or other violations that may affect human health or the environment. Reporting suspected violations significantly aids AAFM in performing local site investigations and enforcing a variety of regulations. However, to date AAFM has received no reports of suspected fertilizer application violations. We encourage anyone suspecting a violation to report it via the form above.

Vermont education and outreach on residential fertilizer use includes both regulatory and non-regulatory components. 10 V.S.A. § 1266b requires that stores selling lawn fertilizers provide this education to ensure that fertilizer users understand phosphorus restrictions at the point of sale. In addition, Vermont supports collaborative educational campaigns on lawn management for water quality. DEC's northwestern VT watershed planner is an active member of the Lake Champlain Basin Program's Lawn to Lake coalition that has created and supported the "Don't P on the Lawn" and "Raise the Blade" campaigns. In addition, the Agency recognizes the importance of the Chittenden County MS4 communities' outreach program, Rethink Runoff, for communicating best practices for residential stormwater management, including lawn care, through a variety of public outlets. These efforts support Vermont's commitment to reduce phosphorus contributions from lawn care.

DEC and its partners need to continue to assess whether these messages regarding phosphorus use are being delivered and heard. Surveys from both the Lake Champlain Sea Grant and Rethink Runoff team suggest that, while Vermonters have been improving some fertilizer-related practices (e.g., shifting the timing of application), the proportion of the surveyed population that use fertilizers may not have changed in the past decade. One strategy of the Winooski TBP explicitly calls for residential stormwater outreach campaigns in the basin (e.g., Lawn to Lake, Rethink Runoff, Blue BTV, Storm Smart) to coordinate on effective messaging that may accelerate behavioral change in residential stormwater management, including lawn care. Additionally, the Lawn to Lake Coalition are supporting an effort led by the Lake Champlain Committee to support educational signage compliance at the point of sale for residential lawn fertilizer.

**Comment 21:** Regulatory efforts to address phosphorus, such as the Required Agricultural Practices, do not focus sufficient attention on chemical fertilizers.

Recommendation: VAAFM update the Required Agricultural Practices for farms to include the reduction of the use of contributing chemical fertilizers.

**Response:** Under the Required Agricultural Practices Section 6.03, all Large Farm, Medium Farm, and Certified Small Farm Operations must develop a field-by-field Nutrient Management Plan that meets the USDA Natural Resources Conservation Service Nutrient Management Practice Code 590 Standard. Chemical fertilizers are included in Nutrient Management Planning. For all farms, records of soil analysis and nutrient application need to be kept for five years. Moreover, nutrients need to be applied at agronomic rates, meaning that application rates are determined by soil nutrient content, fertilizer nutrient content, and nutrient requirements of the target crop. Requiring application at agronomic rates should prevent excess fertilizer application and subsequent runoff to surface waters. Moreover, it is beyond the scope of the tactical basin plan to recommend policy changes or require revisions to rules administered by the Agency of Agriculture, Food & Markets.

**Grouped Comments 22:**

(A) First and foremost, the recent floods have brought many issues to the forefront related to our water. A July 2023 Reuters News article describes how the floods have tainted US Northeast public and private water supplies with pesticides, raw sewage, fuel, and many other chemical toxins, including PFAS. Planning for future climate disasters is imperative and much more money needs to be set aside to ensure we have the infrastructure to handle flooding. Ironically, discharges and overflows are a common occurrence in Vermont even when we don't have a climate disaster. Well before the flooding, multiple swimming areas were closed due to cyanobacteria and sewage discharges.

(B) Page 8: Provide incentives for municipalities to engage in Long Term Control Strategy planning and upgrades for wastewater treatment facilities. Repeated combined sewage overflow events are degrading Lake Champlain and other Waters of the State.

Question: Which municipalities have engaged in or completed this planning process?

(C) Municipalities need to engage in long-term planning to reduce combined sewer overflows (CSOs).

(D) Regarding chronic wastewater treatment facility (WWTF) and combined sewage overflows (CSOs), a significant issue is that the current WWTF/CSO infrastructure is truly only compliant with its NPDES permits as these permits actually allow these overflows of raw sewage to our rivers and lakes, just so long as they are reported. Additionally, DEC has been allowing municipalities to certify new connections to the WWTF infrastructure DESPITE chronic overflows and underdesigned WWTF infrastructure capacity to fully manage and treat flows. I request that the plan first acknowledge these realities and then require that our antiquated or undersized WWTF/CSO infrastructure be (A) upgraded to prevent overflows in all but the

rarest cases based upon our current weather patterns, and (B) that until such time as these improvements are made and become fully operational, that NO NEW connections be allowed to the municipal waste water systems and that NO industrial sources of wastewater be allowed for disposal at these plants or into the conveyances to the plants.

**Response:** DEC's general approach to CSOs is described on Page 104 of the TBP, and updates on individual WWTFs (including CSO projects) are on Pages 105-109.

The three municipalities in the basin with combined sewer overflows (CSOs) are Burlington, Montpelier, and Northfield. CSO-generating facilities are subject to the 2016 CSO Rule (superseding the 1990 CSO Control Policy) which requires a 2-Phased approach to bring all remaining CSOs into compliance with the requirements of state and federal law, including the Vermont Water Quality Standards. The two phases include 1) the implementation of Nine Minimum Controls and the development of a Long-Term Control Plan to achieve compliance with water quality standards (including identifying, prioritizing, and scheduling the implementation of CSO abatement projects), and 2) the implementation of both the Minimum Controls and the Long-Term Control Plan. The Rule requires, among many other things, the assurance that new sources of stormwater and wastewater to the combined sewer system do not increase the volume, frequency or duration of CSO events.

Financial assistance from the state for both planning and implementing CSO abatement projects outlined in Long-Term Control Plans includes $10 million in funding allocated specifically for these project types in SFY2022 and an additional $20 million in funding in SFY2023 as outlined on Page 8 of Vermont's FFY2023 Intended Use Plan for the Clean Water State Revolving Fund.

The TBP identifies strategies to support existing regulatory programs and to encourage the development and implementation of non-regulatory clean water efforts. It is outside the scope of a TBP to recommend additional regulation.

**Grouped Comments 23:**

(A) In the Phosphorus TMDL and the Winooski Tactical Basin Plan, groundwater quality and the interaction between groundwater and surface water does not appear to be factored into the understanding of phosphorus loading to Lake Champlain.

Recommendation: The DEC and VGS expand monitoring and research on the interaction of phosphorus exchange in groundwater and surface water and incorporate these results in the VSWMS and basin planning efforts.

(B) page 11&12 - I suggest some narrative be added about why the plan has no mention of basin 8 groundwater. It seems many actions in the plan benefit groundwater quality and quantity.

**Response:** Most surface waters interact with groundwater to some extent and therefore each has the potential to influence the quality and quantity of the other. The Vermont Geological Survey

within DEC works to monitor and better understand groundwater and surface water interactions as they relate to water quality.

The Winooski TBP and basin planning efforts in general are intended to focus on and address surface water protection and restoration. DEC's 2021-2025 Non-Point Source Management Plan (Page 79) and especially the 2018 Vermont Groundwater Management Plan focus instead on the protection of groundwater quality and quantity. Where groundwater is identified as a likely vector for pollutants to surface waters (e.g., via poorly maintained soil-based wastewater disposal systems: TBP Page 110) or as an important source of surface water resilience (e.g., base flow maintenance and temperature regulation: TBP Page 14), the TBP does discuss groundwater resources. The Watershed Planning Program will also consider the need to include a general description of groundwater and surface water interactions as we update our template for future tactical basin plans (e.g., five slated for publication in late 2024).

Phosphorus can be transported by groundwater to surface waters, but the importance of this phosphorus source relative to others is highly dependent on the physical and biogeochemical setting. The Vermont Geological Survey will continue to work towards understanding if and under what conditions groundwater may be an important contributor to surface water phosphorus loading.

**Comment 24:** *What we have to offer is a couple suggested projects; the plan itself is awesomely comprehensive, congratulations on that.*

**Response:** We appreciate these two recommendations (redacted here to protect personal information) and have reached out to basin partners to discuss these opportunities further.

**Grouped Comments 25:**

(A) Climate Change and Resilience. I would like to see more reference to the importance of wetlands and forests for climate change and flood mitigation.
(B) Wetlands must be protected as flood control, habitat for wildlife, filters for water resources. Example: Derway Island and its extensive wetlands and ponds in Burlington absorbed much of the Winooski's overflow in July and protected a community of homes in the Delta of Winooski's confluence with Lake Champlain.

**Response:** We agree that forests and wetlands are critical natural systems to support climate and flood resiliency in the Winooski basin in addition to their well-known water quality benefits. Nature-based solutions, including land conservation and wetland protection, are identified in the TBP (page 16) as effective to climate change adaptation, flood mitigation, and water quality improvement. Wetland and forestlands protection and restoration strategies are also discussed on pages 127-133 of the plan. However, the TBP refers readers to Vermont's Climate Action Plan for a more thorough evaluation of the role that wetland and forest protection and restoration strategies will play in climate change and flood resilience than can be covered in the TBP.

Derway Island is specifically identified in the TBP as a wetland that warrants further exploration for reclassification as a Class I wetland, which would increase protections for its environmental value. Community groups can petition for Class I wetland reclassification. Potential petitioners are

encouraged to discuss their petition proposals with the Wetlands Program to learn about the Program's designation efforts.

**Comment 26:** In regards to Municipal Roads General Permit (MRGP), municipalities are required to spend funding and resources on road best management practices which may result in small phosphorus load reductions.

Recommendation: Allow municipalities more leeway with deciding which road segments need to be address and when.

**Response:** The MRGP is estimated to eventually achieve nearly half the total developed lands phosphorus reduction target in the Winooski basin (TBP Figure 24 Page 73) and has accounted for 10% of phosphorus reductions achieved in 2023. Therefore, supporting municipalities in implementing permit requirements to achieve phosphorus goals in a timely manner is an important priority for DEC. The State provides technical and financial assistance for MRGP planning and implementation through the Clean Water-funded VTrans Municipal Grants-in-Aid and Better Roads programs, which combined had an average annual allocation of around $4 million dollars in State fiscal years 2023 and 2024. The MRGP requires the use of the Road Erosion Inventory to determine which road segments do not meet or only partially meet MRGP standards. While DEC does require that municipalities remediate a certain proportion of road segments in each Road Erosion Inventory-based priority category each year, DEC does not dictate which specific 100ft segments within a coarse priority ranking should be targeted for remediation.

**Comment 27:** Recreation effects on River and Stream Water Quality. I'd like to see more assessment of this. Here in the Mad River Valley we are seeing more and more recreation activity by residents and tourists. There are a number of swimming areas, rafting, etc. We've had a chronic issue with e coli at one area down river, overuse at Warren Falls. There is a tension point between needed recreation for tourism and protection of our natural resources. I think help for towns to navigate this issue is an imperative

**Response:** We acknowledge that recreational activities like hiking, biking, and ski trail use and river access can increase erosion to waterways if recreational features are not managed properly. To this end, Strategy 30 of the TBP calls for DEC to "Support recreational river access through the establishment and maintenance of stable access areas", and Strategies 45 and 46 call for the use of new mapping tools to better identify and remediate sources of forestland erosion, eventually including recreational trails.

To our knowledge E. coli issues in the Mad River have not been sourced to recreational activities to date, and the Friends of the Mad River's 2016 report on Water Quality Conditions in the Mad River Watershed, Vermont 1985-2015 do not link recreational activity to elevated E. coli levels, either.

To the extent that this issue is a concern to multiple towns in the region, we encourage Mad River towns to reach out to the Central Vermont Regional Planning Commission's Clean Water Advisory Committee (CWAC). The CWAC oversees CVRPC's water quality planning program in accordance with CVRPC plans, policies, and procedures; acts as a liaison between local communities and the Vermont Agency of Natural Resources; and provides local and regional input regarding water quality issues important to the region. DEC provides financial support to CVRPC to host CWAC meetings

on water quality issues that are of concern both to the state as well as to the towns that CVRPC supports. These meetings may be used to gauge other municipalities' concerns about a topic and, where warranted, to discuss possible next steps with the RPC and the watershed planner.

**Comment 28:** Also the role of the River Corridor program to protect water quality and reduce erosion. In the Mad River Valley we have a number of programs working on knotweed eradication, runoff from properties etc.

**Response:** The TBP describes the importance of river corridor protection and restoration for water quality improvement in a variety of locations including Chapter 1: Climate Change, Summer Flooding, and Stream Geomorphic Assessment (Page 14, 17, and 27); Chapter 3: Phase 3 Lake Champlain TMDL Content – Rivers Sector (Page 76); Chapter 4: Natural Resources - Rivers (Page 112); and 13 explicit implementation strategies in Chapter 5 Table 19 (Page 145). 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.

Mad River Valley efforts like Ridge to River, Storm Smart, and town-led knotweed control efforts are important components of Winooski basin conservation and restoration efforts. This plan supports such efforts through relevant strategies including:

- 23: Enhance (beyond RAPs) riparian buffers through woody buffer establishment and invasive species control.
- 24: Support outreach, training, or technical assistance to increase adoption of innovative agency-supported approaches that address tree stock shortage or invasive species concerns when establishing buffers or accelerate landowner interest in buffer adoption (e.g., agroforestry).
- 14: Promote and, where appropriate, coordinate existing campaigns to raise awareness of residential stormwater management approaches (e.g., Rethink Runoff, Storm Smart, Lawn to Lake, Blue BTV).

**Comment 29:** The draft's Table 3 Determination of existing uses of flowing waters for swimming in Basin 8 (referenced via link on page 104), omits the most popular swim hole in the Town of Waitsfield: Mad River - Great Eddy Bridge Swim Hole. Sometimes also referred to as the Bridge Street Swim Hole, it's located in the center of Waitsfield Village and accessed by the municipally owned Lovett Park (50 Bridge St, Waitsfield). This swimming hole was identified in The Best River Ever: A Conservation Plan to Protect and Restore Vermont's Beautiful Mad River Watershed, funded by the Lake Champlain Basin Program (LCBP) and prepared by the Mad River Valley Planning District and Friends of the Mad River (Appendix B - Topic Paper G, Swimming).

Please find attached the following supporting documentation:

- 2023 Waitsfield Town Plan (adopted 10/9/23), Section 7.I. Recreation, pg 7-17 & 7-18
  - Lists the following in the Public Facilities section

        - "Lovett Park next to the Big Eddy Covered Bridge which serves as a public river/swimming access point."
- Mad River Valley Chamber of Commerce website, Swimming in the Mad River Valley section
    - Lists the following
        - "Great Eddy Bridge Swim Hole - Located in historic Waitsfield Village next to our covered Bridge. This swimming hole has something for everyone. There is a rocky beach stretching out from the edge and a deep pool located right below the bridge."

Here's my input on the four items included in Table 3:

- Waterbody
    - Mad River - Big Eddy Covered Bridge
- Town
    - Waitsfield
- Aesthetic values and use by public confirmed
    - Waitsfield Town Plan, LCBP Study
- Public Access
    - Municipally-owned park, Lovett Park, serves as a public river/swimming access point, and public parking spots along adjacent municipally-owned Bridge Street.

I hope this info proves useful and is considered in subsequent versions of the 2023 Winooski River Basin Plan. Feel free to follow up with any questions or thoughts.

**Response:** Given the available documentation of aesthetic values, public use, and public access provided in the two reports above, the site will be included in the list of existing uses of flowing waters for swimming in the Winooski basin.

**Comment 30:** Page 14: Thanks for the consideration of climate change and the effects on water and aquatic biota.

**Response:** You're welcome. DEC appreciates efforts to expand public awareness of this issue.

**Comment 31:** table 1 appears to only show 32 priority strategies (not 50) - table 19 shows implementation strategies. What is the difference?

**Response:** Table 1 displays a snapshot summary of the full strategy table. We believe this subset of strategies demonstrate the full diversity of strategies for those reading the Executive Summary only, while reducing the table length by more than 30%. Some strategies from Table 19 were combined and simplified into a single line in Table 1 (though with detail lost), and some strategies not presented in Table 1 are simply earlier or later phases of strategies that are included in Table 1 (e.g., identification, development, and implementation strategies for the same project type might be differentiated in Table 19 but combined in Table 1).

**Comment 32:** page 10 figure 1 suggests all strategies in 2018 plan are equal in value/extent - suggest completely remove the figure and replace with a table identifying completed strategies and those

awaiting action also create a new appendix that reveals all strategies from 2018 plan that are completed, awaiting action and in progress.

**Response:** The table you suggest is being developed as the Basin 8 2018 Tactical Basin Plan Report Card, which includes an explanation of Vermont's progress on each of the 2018 strategies. This Report Card will be an Appendix to the Clean Water Initiative 2023 Performance Report, available on DEC's Clean Water Initiative Reports webpage in early 2024. This Report Card and link is referenced in the narrative adjacent to Figure 1. We updated Figure 1 of the TBP to better reflect the current status of strategies as available in the draft Report Card.

**Comment 33:** page 11 - I would hope this plan and other plans affecting other basins are also consistent with expectations for WQ management plans under federal Clean Water Act Section 303e. If so say so.

**Response:** Yes, the Vermont Surface Water Management Strategy and associated Tactical Basin Plans satisfies the basic requirements for state water quality planning set forth by Section 303(e) of the Clean Water Act. This has been noted in the TBP on page 11.

**Comment 34:** page 37 - last sentence "...recruitment success has been minimal" due to what? Overfishing, habitat, low DO, poor AOP.

**Response:** The potential factors limiting landlocked salmon recruitment success are complex and not easily summarized within the TBP – a surface water quality management plan. The Strategic Plan for Lake Champlain Fisheries, the 2022 Lake Champlain Landlocked Atlantic Salmon River-Run Restoration Plan (not yet available online), and VT Fish and Wildlife District Fisheries Biologists are better sources of more detailed information on this topic.

**Grouped Comments 35:**

(A) page 38 last sentence in 2nd paragraph - add table that identifies the one lake and 50 streams prioritized for reclassification; if not explained elsewhere then add narrative (or appendix) explaining how to reclassify and or who responsible; I have to ask how serious is DEC/ANR in wanting to see reclassification move forward?

- 

(B) page 39 - A2 - can't DEC by rule reclassify abandoned A2 waters to something different? If so then say so (and commit to do it under implementation table!).

**Response**: This information is available in Figure 13 and Table 6. Within the narrative of Page 39 readers are directed toward ANR webpages for further information on the reclassification process for streams, lakes, and wetlands: "*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.*"

**Comment 36:** identify who designated Chickering Fen and Peacham Bog as class 1 wetlands in 2017. If DEC did that then can DEC commit to designating other wetlands as class 1 in the plan?

**Response:** Pursuant to 10 V.S.A. § 315, the ANR Secretary may determine whether any wetland is a Class I Wetland. This wetland determination is based on an evaluation of the extent to which the wetland serves the functions and values of the Vermont Wetland Rules, is exceptional or

irreplaceable in its contribution to Vermont's natural heritage and, therefore, merits the highest level of protection.

Class I designations may either be initiated by a petition or the Secretary of the Agency of Natural Resources. The majority of existing Class I wetlands were initiated by the Secretary, including Chickering Fen and Peacham Bog.

The Wetlands Program will continue to work to initiate Class I designations where appropriate and where capacity allows. Given that there are over 50 potential Class I wetlands, it is unlikely that the Program will initiate re-classification of all those that qualify. Potential petitioners are encouraged to discuss their petition proposals with the Wetlands Program to learn about the Program's designation efforts.

**Comment 37:** page 57 & 58 - include mention all the waters having TMDL or alternative plans remain impaired.

**Response**: This is not completely true, as West Branch Little River and Big Spruce Brook were actually delisted in 2022 as described in the 303(d) List Responsiveness Summary. While conditions have consistently improved in the West Branch Little River, in Big Spruce Brook DEC needs to collect additional data to further refine assessment since existing patterns make it difficult to attribute poor biological condition to stressor in either Little Spruce Brook or Big Spruce Brook.

**Comment 38:** page 133 - a nice touch on watershed planning and social equity; it makes me wonder if the plan mentions anything anywhere about protecting / improving aquatic biodiversity (ie provide some linkage to 30 by 30 and 50 by 50).

**Response:** Many of the TBP's strategies— for example, chloride reduction, dam removal, culvert upgrades, riparian buffer enhancement, invasive species spread prevention and management, reclassification, river corridor and forestland protection, lake shoreline and wetlands restoration— support the protection and improvement of aquatic habitat and biodiversity. Act 59 (2023), which establishes landscape-level conservation goals for Vermont, was formally enacted after the full drafting of this TBP. DEC staff are currently participating in stakeholder-led initiatives to best determine how statewide conservation goals can be met, including through the implementation of TBP strategies.

**Comment 39:** page 136 - implementation table provides an indication of 50 priority strategies by pollution or resource type - are those in any sort of ranked fashion or is entire table unranked?; is DEC willing or able to identify or somehow draw the reader's attention to highest or most critical priorities?; are there other strategies that are something other than priority? if not say so.

**Response**: Strategies within the table are not ranked or ordered. Partners and funding opportunities often differ substantially enough across sectors that prioritizing across all strategies is not meaningful. Some prioritization may be necessary in future plans if, for example, phosphorus reduction severely lags reduction goals in some but not other water quality sectors.

**Comment 40:** can you identify somehow which listed waters for monitoring DEC has priority interest with and or would be responsible for?

**Response**: DEC and associated departments (e.g., Fish and Wildlife) sample Vermont's 15 basins on a 5-year rotational schedule, with the Winooski basin planned for sampling in 2025. Prior to this sampling season, involved Agency programs (i.e., those listed as 'Partners" in Table 20) will prioritize sites within the TBP implementation table for sampling.

**Comment 41:** page 35 since you identified highest scoring wetland (add town location) suggest you also identify lowest scoring wetland (name of wetland & town location).

**Response:** We added the lowest scoring wetland to provide the full range of VRAM scores from sampled wetlands. However, VRAM assessments are not randomized across the basin and don't provide a representative sample of wetland conditions. Therefore, we refrain from identifying towns associated with the highest and lowest scoring wetlands to avoid possible misinterpretation of these wetland's conditions as representative of the wetlands in the rest of those towns.

**Comment 42:** page 46 - add distance lengths to Huntington River segment and North Branch segment; recommend adding footnote for Huntington River segment about hazardous conditions at the gorge and number of fatalities there since X year.

**Response:** Approximate mileages and a note of caution regarding Huntington Gorge were added to the narrative.

**Comment 43:** page 113 3rd paragraph - can you identify (table and or map?) where relationship applies?

**Response:** The Functioning Floodplains Initiative team established relationships between stream connectivity and phosphorus allocation across nearly all streams in the Champlain basin, from the largest mainstems to intermittent headwaters with drainage areas < 0.25mi$^2$. The Functioning Floodplains Initiative User Guide is now publicly available and is now linked from the TBP for readers interested in learning more about FFI methods.

**Comment 44:** page 17 - 2nd bullet - how many mapped river corridors in Winooski basin; 4th bullet - including buy outs? including river corridor easements?

**Response:** River Corridors are delineated by DEC as described in the 2017 Flood Hazard Area & River Corridor Protection Procedure. River Corridors include the width of the meander belt of a river and an additional 50' buffer to allow for a stable wooded bank when the river is at its equilibrium / least erosive slope. River Corridors are not mapped for small streams but do include, by definition, the area within 50 feet of the top of bank of streams with a watershed less than 2 square miles. All streams with a drainage area >0.25 square miles currently have a mapped river corridor ≥ 50ft in the ANR Natural Resources Atlas.

Buyouts and river corridor easements are one of many conservation tools being considered to support flood resiliency in Vermont.

**Minor Narrative Comments/Requests:**

(A) page 17: bottom of page add Washington to Cabot, Calais, Plainfield.
**Response:** Agreed and added.

(B) page 18 - top - add mention of old dams that failed and or came close to failing.
**Response:** Agreed and added.

(C) page 150 add page break so section D starts at top of new page;
**Response:** Agreed and added.

(D) table A1 - recommend you fill in those blocks that are empty under "purposes" and "hazard potential" if you can't add info then revise table explanation explaining empty blocks.
**Response:** The following explanation was added to the Table A1 caption:
*"The table is completed to the extent possible with information currently available in the Agency of Natural Resources Vermont Dams Inventory."*

Following the passage of Act 161 - An Act Relating to the Regulation of Dams in 2018, the portion of 10 V.S.A. Chapter 43: Dams that applies to dams regulated by the Dam Safety Program was amended. The amendments included, among other information, the addition of a purpose statement and requirements for hazard classifications. The Administrative Dam Safety Rule is in effect as of August 1, 2020 and the Dam Safety Program is working to implement the associated requirements. The Phase II development of Technical Standards is underway with adoption targeted for mid-2025. Status updates are available on the Act 161 § 1110 Rulemaking Process website. Information in the Tactical Basin Plan Table A1 will be updated in subsequent basin planning rounds as it becomes available through the implementation of the new Dam Safety rules.

(E) table B1 - is it "predominantly" or "wholly" in the basin?
**Response:** 'Predominantly.' Including only those towns 'wholly' in the basin would exclude a significant portion of the land area of the basin from this table.

(F) Priority Strategies Table, page 8, Developed Lands – Stormwater:
- Develop, design, and implement stormwater treatment projects identified in **Flow Restoration Plans and** Phosphorus Control Plans **of MS4 and TS4 permittees**, Stormwater Master Plans, stormwater mapping reports, or other assessments.
- Support the design and implementation of **non-regulatory** small-scale stormwater practices **through applicable funding sources from the Clean Water Initiative Program and other appropriate sources** ~~formula grant funding~~.

**Response:** Bolded and struck-through suggestions were implemented.

(G) Bottom of page 18:
The Rethink Runoff Stream team ~~(coordinated by Winooski Natural Resources Conservation District)~~ **(on behalf of Chittenden County MS4/TS4 permittees)**
**Response:** Bolded and struck-through suggestions were implemented.

**Addressed Figure/Table/Statistics Comments:**

(A) Page ii - cover photo credit - add narrative about overlooking view of where?
**Response:** Added "Stevens Branch running through Barre City."

(B) page 21 figure 8 explain what numbers in circles are related to; maybe add a table that identifies catchments.
**Response:** We added an "ID" tag and coordinates in Table 20 to match the catchment IDs from the Figure 8 map.

(C) page 27: explain the statement "most of the stream reaches with P2 assessments have been rated as fair to poor."
**Response:** On page 27 we included an additional description and reference to the Stream Geomorphic Assessment Phase 2 protocol.

(D) figure 28 - title - "focus of agricultural implementation" ; think about somehow identifying in gray map Great Brook - the single catchment with a negative remaining goal!
**Response:** We include symbology and edited caption to identify Great Brook in the map (Figure 28, Page 83).

(E) page 29 under lakes and ponds
- how many lakes/ponds impounded with high or significant hazard rating?
- how many dams recommended for removal?
**Response:** Dams and dam removal are further discussed in the "Dams and Dam Safety" section of Chapter 4 (Pages 119-120). 26 of 186 inventoried dams are classified as high or significant hazard, and we add this note to the narrative of the TBP. This section already identifies that partners are pursuing 9 dams for removal and are considering scoping another 21 dams to assess dam removal need, benefits, and feasibility. DEC has not comprehensively ranked and recommended dams for removal because removal is a priority basin-wide wherever the removal results in ecological, hydrological, and safety benefits and landowners are supportive of the effort.

(F) page 116 bottom of page - can you show (table or map) where those 171 acres exist?
**Response:** We added the main locations of existing corridor easements in the narrative: ***"…****mainly in the upper Little River, North Branch, Kingsbury Branch, Dog River, and upper Mad River."*

**Unaddressed Figure/Table/Statistics Comments:**

**General Response:** We appreciate feedback on ways to better quantify and visualize important watershed information in basin plans. The Watershed Planning Program has adopted a template approach to drafting basin plans to maintain statewide consistency and to increase the efficiency of plan creation. While the following comments will not be integrated in the 2023 Winooski TBP, they will be considered at the Program level to revise the template for future basin plans (including five slated for publication at the end of 2024). Additionally, much of the data displayed in the tactical basin plans are available for more interactive visualization and exploration on the Agency's Vermont Natural Resources Atlas.

**Figure Comments:**

(A) Page iii - the figure deserves to be larger along with some explanation or key of the interior lines (subwatershed boundaries I take it). If you can make that happen then I would recommend a new line showing boundary between Chittenden County and Washington County. Maybe keep the figure as is but add a larger one as an appendix.

(B) page 15 - make map larger or keep as is but add larger map as appendix; figure 6 - explain herbaceous category amend title of figure noting basin's 24 sub-watersheds.

(C) page 20 figure 7 make larger use entire page.

(D) page 27 this map deserves larger representation; provide figures for each category; add table or somehow identify streams with poor or fair;

(E) page 41 - figure 13 - enlarge to full page add abandoned A2 waters

(F) page 98 figure 30 - make larger re-orient as landscape image.

**Table Comments:**

(A) Executive Summary: add table for waters in 2nd paragraph.

(B) page 33 - table 3 add column showing lake's contributing watershed area; remove atmospheric mercury deposition column since info does not vary.

(C) page 120 first paragraph - add table or map showing the 9 dams and 21 other dams

(D) page 115 table 18 make entire table fit on one page.

**New Statistics/Metrics Comments:**

(G) Executive Summary: add population figures by town, pro-rate population for partial towns based on area within w/shed (or don't include population for partial towns)

(H) page 13 - add town population figures, add town population density, note % population in basin compared to Vermont total.