# Stevens, Wells, Waits, Ompompanoosuc & Connecticut River Direct Tributaries

# Basin 14 Tactical Basin Plan

South Branch Waits River, Bradford

**May 2020 | Draft**

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.

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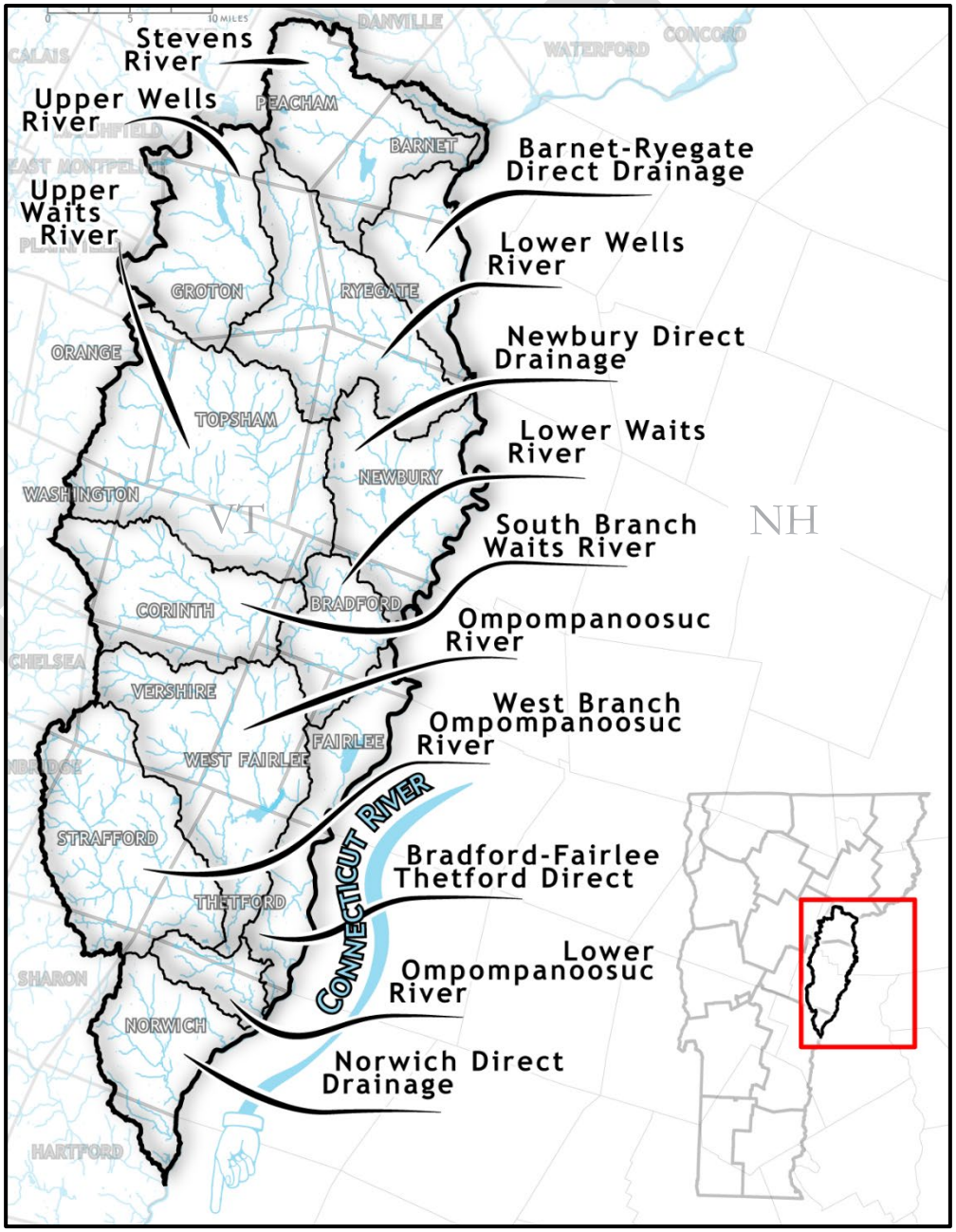
**Cover Photo: Danielle Owczarski**

## List of Basin 14 Towns

| | | | |
|---|---|---|---|
| Barnet | Groton | Peacham | Topsham |
| Bradford | Hartford | Ryegate | Tunbridge* |
| Chelsea* | Newbury | Sharon* | Vershire |
| Corinth | Norwich | Strafford | Washington |
| Fairlee | Orange | Thetford | West Fairlee |

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

## Basin 14 Watershed Boundary and Towns



# Basin 14 Tactical Plan Overview

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# Executive Summary

Basin 14 comprises multiple sub-basins including the Stevens, Wells, Waits, and Ompompanoosuc Rivers, and five Connecticut River tributaries. The basin stretches south, from Peacham to Hartford, draining portions of Caledonia, Orange, and Windsor counties and covers significant areas of 17 individual towns. The Basin 14 Tactical Basin Plan (TBP) provides a detailed description of current watershed condition and identifies water quality focused strategies to protect and restore the basin's surface waters.

*The goal of the Tactical Basin Plan is to "Protect the Best and Restore the Rest" when it comes to surface waters of the State of Vermont.*

Adapting how we manage and use our surface waters in the face of climate change is one of the chief overarching challenges for Basin 14 – and beyond (Galford G. L., 2014) (State of Vermont, 2015). 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 to Vermonters (Pealer & Dunnington, 2011). Protective measures, such as strategic land acquisition and limitations on development in riparian areas, may be the most economical solution to achieve healthy surface waters (Watson, Ricketts, Galford, Polasky, & O'Niel-Dunne, 2016) (Weiskel, 2007). But where pollution from historic and current land use occurs, strategies are identified in this plan that will complement protective measures, such as river corridor easements, riparian area plantings, floodplain and wetland restoration, dam removals, and agriculture, logging and stormwater best management practices. To implement these strategies, a significant investment in time by federal, state, and local stakeholders is required. These coordination efforts are ongoing.

Between 2015 and 2019 over 790 water quality monitoring events took place at thirty-four lakes, two reservoirs, fifty-six rivers, and ten wetlands in Basin 14. The information from these monitoring events has been incorporated in Chapters 1, 2, and 3 which cover the condition of surface waters, and protection and restoration priorities, respectively. Overwhelmingly, the waters in Basin 14 meet or exceed water quality standards. Target areas for protection and restoration are outlined in Figure 1 and Table 1.

In Chapter 2, a total of sixty-nine river segments, lakes, ponds, and wetlands are identified for protection or additional monitoring. Of the sixty-nine waters, twenty-four river segments and four lakes and ponds meet criteria for enhanced protection for fishing, aesthetics, or aquatic life. Thirteen river segments and nineteen lakes and ponds are identified for additional monitoring to determine if they meet reclassification criteria. Nine wetlands are identified as potential Class I candidates and are recommended for additional assessment to determine if they meet Class I wetland criteria.

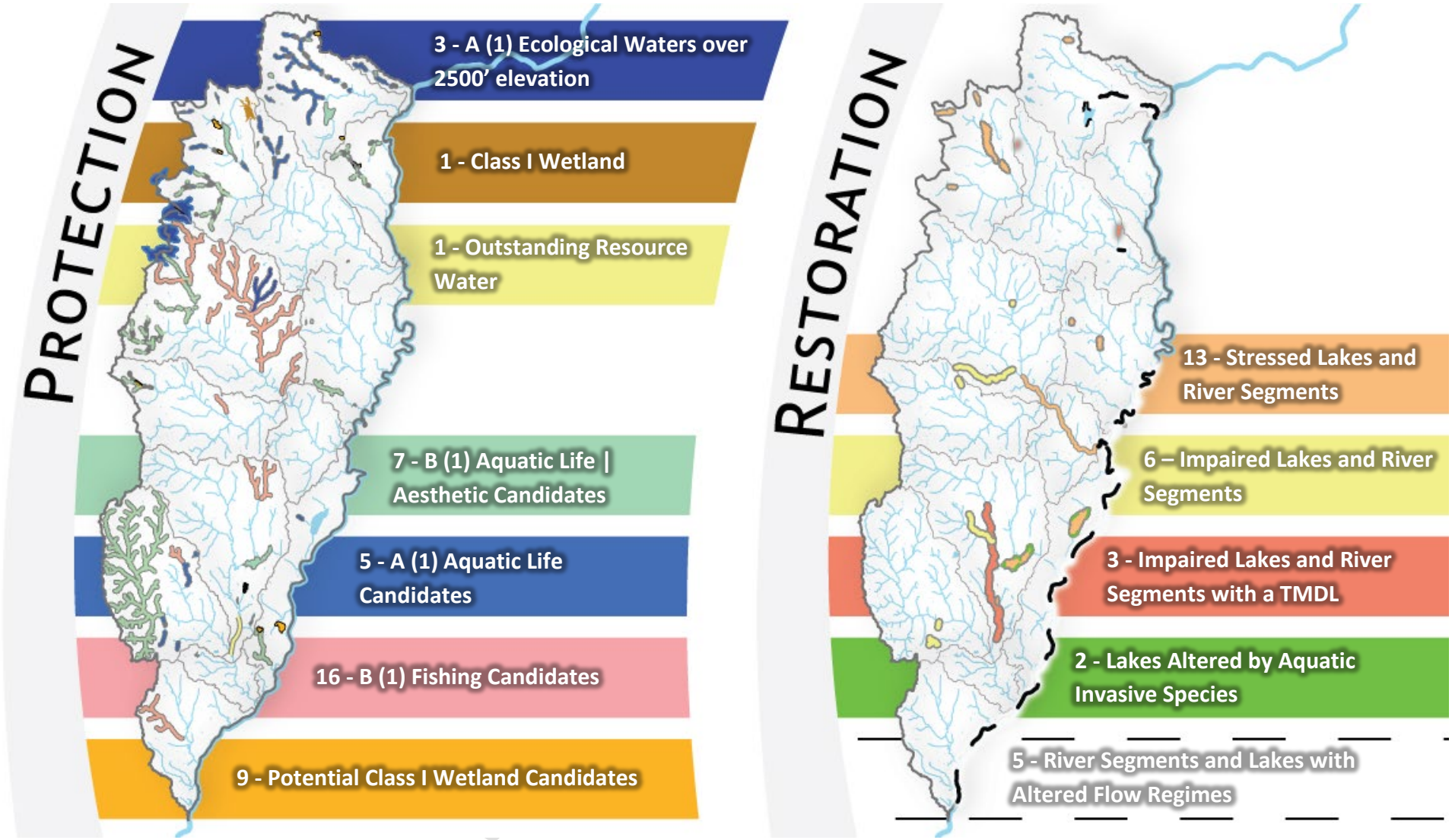



**Figure 1. Surface waters prioritized for protection and restoration strategies in Basin 14.**

**Table 1. Focus areas and priority strategies for restoration and protection in Basin 14.**

| Focus Areas | Priority Strategies |
|---|---|
| **Agriculture** | |
| **Ticklenaked Pond & Scotch Burn, Middle Brook & Blood Brook, Waits River, Ompompanoosuc River, Connecticut River Mainstem** | • Support outreach and project identification for agricultural best management practices (BMPs), riparian area plantings, river corridor and wetlands easements, and riparian area restoration.<br>• Implement water quality monitoring on farms to measure effectiveness of restoration efforts.<br>• Continue nutrient management planning and funding for cover crop and no-till practices.<br>• Continue coordination with agriculture workgroups for Ticklenaked Pond.<br>• Coordinate with agricultural service providers to determine if there is a gap in outreach and implementation of water quality BMPs along the Connecticut River. |
| **Developed Lands - Stormwater** | |
| **Ompompanoosuc River, CT Direct Tributaries, Wells River, Waits River** | • Develop stormwater master plans in Hartford, Newbury, and Bradford.<br>• Support watershed partners and municipalities to prioritize stormwater projects in Basin 14.<br>• Identify and remediate stormwater sources of impairment to the Tabor Branch Tributary. |
| **Developed Lands - Roads** | |
| **Waits River, South Peacham Brook** | • Complete Road Erosion Inventories (REIs) and implement BMPs on high priority road segments.<br>• Identify and address sources of runoff from municipal sand and salt storage areas.<br>• Provide and support training for road crews on culvert replacements through the VT River and Roads workshops, and installation and maintenance of road BMPs through the VDEC Stormwater Program. |
| **Wastewater** | |
| **Ompompanoosuc River** | • Support workgroup around source identification for the *E. coli* impaired watershed of the Ompompanoosuc River.<br>• Promote proper septic system maintenance and explore opportunities for community wastewater. |
| **Natural Resources - Rivers** | |
| **Ompompanoosuc River, Waits River, Stevens River, Wells River, Bloody Brook, Prospective A(1) & B(1) Rivers & Streams** | • Develop and implement projects from River Corridor Plans.<br>• Implement strategic wood addition to increase habitat and channel stability.<br>• Restore stream connectivity through floodplain restoration.<br>• Replace or retrofit high priority stream crossings that have been identified in bridge and culvert assessments by municipalities and the Vermont Agency of Transportation.<br>• Support strategic dam removal project development, design, and implementation.<br>• Provide outreach to communities on floodplain and river corridor protections.<br>• Provide technical support for river and stream reclassification protection efforts. |
| **Natural Resources - Lakes** | |
| **Ticklenaked Pond, Lake Morey, Lake Fairlee, Harveys Lake, Prospective B(1) Lakes** | • Support Lake Wise planning, assessment, and implementation.<br>• Support volunteer in-lake and tributary monitoring.<br>• Support aquatic invasive species spread prevention efforts.<br>• Support lake watershed partners with education and outreach efforts.<br>• Explore options for flow improvements in Harveys Lake, South Peacham Brook, and Stevens River.<br>• Provide technical support for river and stream reclassification protection efforts. |
| **Natural Resources - Wetlands** | |
| **Class I Wetland Candidates** | • Conduct studies on potential Class I candidates and support local outreach to municipalities and landowners to gauge interest in supporting Class I designations.<br>• Provide technical support for parties interested in submitting petitions. |
| **Natural Resources - Forests** | |
| **Existing & Prospective A(1) & B(1) watersheds** | • Implement forest infrastructure restoration projects on state-owned forest lands.<br>• Provide outreach, technical assistance, and workshops to private forestland owners, foresters, and loggers on Acceptable Management Practices and Current Use Program, use of skidder bridges, and voluntary harvesting guidelines.<br>• Support forestland conservation and skidder bridge program. |

Although many surface waters monitored in Basin 14 meet or exceed water quality standards, there are waters in need of restoration. In Chapter 3, a total of twenty-six lakes, ponds, or river segments are identified for restoration. Two river segments and eleven lakes are stressed, seven river segments and two lakes are impaired, two lakes are altered by invasive aquatic species, and four river segments and one lake have altered flow regimes (Figure 1).

Chapters 4 and 5 outline sector-based strategies to meet protection and restoration goals, by providing a list of fifty-five detailed strategies and fifty-eight monitoring priorities for the next five years.

The 2015 Basin 14 plan identified eighty-five strategies to address protection and restoration of surface waters. Of the eighty-five strategies identified, twenty-one are complete, twenty-five are ongoing, twenty-one are in progress, fifteen are awaiting action, and three are discontinued (Figure 2). Seventy-nine percent of the strategies identified in the 2015 TBP are active or complete[1]. The Basin 14 report card in Appendix A includes the 2015 list of strategies with detailed updates on progress.

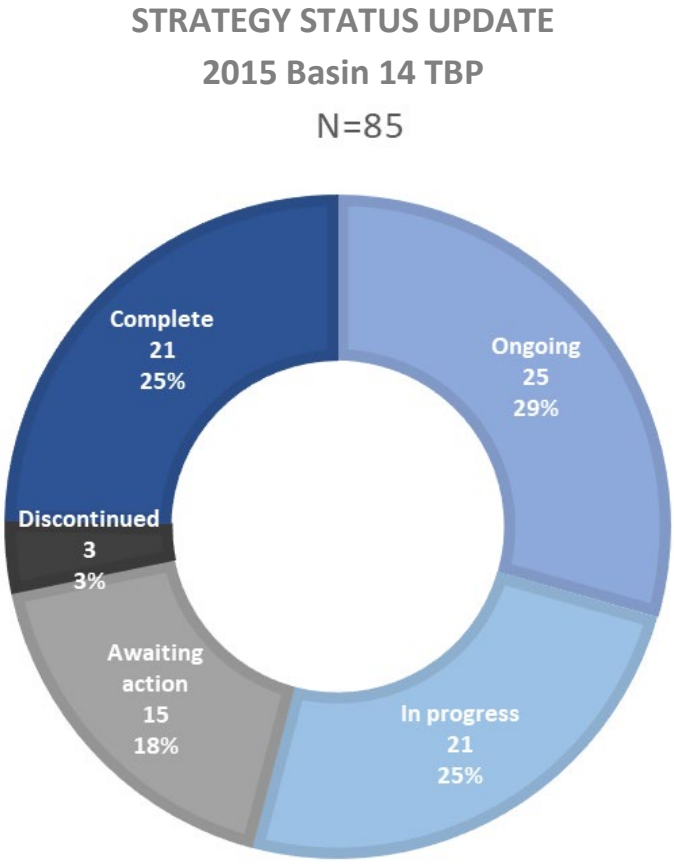



**Figure 2. Status of 85 strategies from the 2015 Basin 14 TBP.**

While water quality improvements are being made in Basin 14, a lack of funding, resources, and interest are primary challenges to implementation. Public input was solicited during the development of this plan, and the fifty-five strategies identified for priority in this plan reflect input from the public, state and federal water quality staff, watershed groups, and regional planning commissions. The Basin 14 community feels strongly that education, outreach, and training on how to best protect and maintain our natural resources is a worthwhile investment, in addition to continued financial and technical support for implementation of watershed projects.

[1] Complete = strategies with an explicit start and end point. In progress = strategies actively being pursued and have the potential for completion. Ongoing = In progress programmatic strategies or initiatives that have no defined end date. Awaiting action = strategies that have not been initiated for various reasons such as a lack of resources or local support, or low priority (i.e. other projects need to be completed first).

# What is a Tactical Basin Plan?

Simply put, a Tactical Basin Plan (TBP) is strategic guidebook produced by the Vermont Agency of Natural Resources (VANR) to "protect the best and restore the rest" of Vermont's surface waters.

Tactical basin planning is carried out by the Water Investment Division (WID) in collaboration with the Watershed Management Division (WSMD) and in coordination with watershed partners. Tactical basin plans (TBPs) are developed in accordance with the Vermont Surface Water Management Strategy (VSWMS) and the Vermont Water Quality Standards (VWQS) to protect, maintain, enhance, and restore the biological, chemical, and physical integrity of Vermont's water resources. The basin-specific water quality goals, objectives, strategies, and projects described in the TBPs aim to protect public health and safety and ensure public use and enjoyment of VT waters and their ecological health.

The TBP process (Figure 3) allows for the issuance of plans for Vermont's fifteen basins every five years, as required by statute 10 V.S.A. § 1253. The plans incorporate the U.S Environmental Protection Agency's (EPA) 9-element framework for watershed plans (Environmental Protection Agency, 2008) and meet obligations of the Vermont Clean Water Act.

The basin planning process includes:

1. Monitoring water quality
2. Assessing and analyzing water quality data
3. Identifying strategies and projects to protect and restore waters
4. Seeking public comment and developing the plan
5. Implementing and tracking plan priorities (which is ongoing throughout the planning cycle).


**Figure 3. Steps to the basin planning process on a 5-year schedule.**

The plans communicate opportunities for protection by providing a list of recommended waters for special state designations, conservation, and local ordinance protection based on water quality data. They justify opportunities for restoration by providing a list of waters with an explanation of their causes and sources of pollution, and in some cases, identify

reductions needed to restore water quality including those necessary to meet Total Maximum Daily Load (TMDL) targets.

Chapters 1-4 in the Basin 14 TBP provide an overview of the basin, identification of protection and restoration priorities, and surface water strategies to achieve sector-based protection and restoration priorities. Chapter 5 provides a list of sector specific strategies to achieve water quality goals and a progress report for the strategies identified in the 2015 TBP (Figure 4).

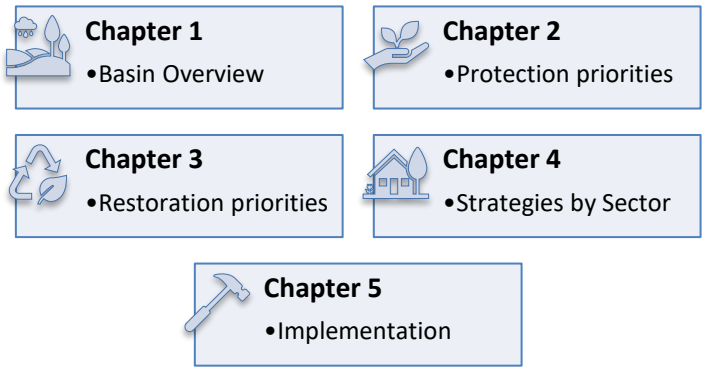



**Figure 4. The five chapters in the Vermont Tactical Basin Plans.**

One of the most utilized parts of the plan is the implementation table in Chapter 5. The 2015 Basin 14 Report Card located in Appendix A provides a status update for each of the objectives identified in the previous basin plan. These strategies target individual projects that are tracked via its online counterpart, the Watershed Projects Database (WPD). The WPD is found on VANR's Clean Water Portal and is continuously updated to capture project information from the TBP process, on the ground assessments, and emerging projects due to natural and anthropogenic events.

VANR's Clean Water Portal is an online platform that houses a variety of clean water tools to assist with project planning, searching existing projects, funding opportunities, and more. Tools on the portal used for watershed planning include:

- Clean Water Project Explorer
- Watershed Projects Database (WPD) Search
- Water Quality Project Screening Tool
- Funding Opportunities Tool
- Stormwater Treatment Practice (STP) Calculator
- Clean Water Cashboard

TBPs target strategies and prioritization of resources to those projects that will have the greatest influence on surface water protection or remediation.

# Chapter 1 – Basin Description and Conditions

## A. Basin 14 Watershed Overview

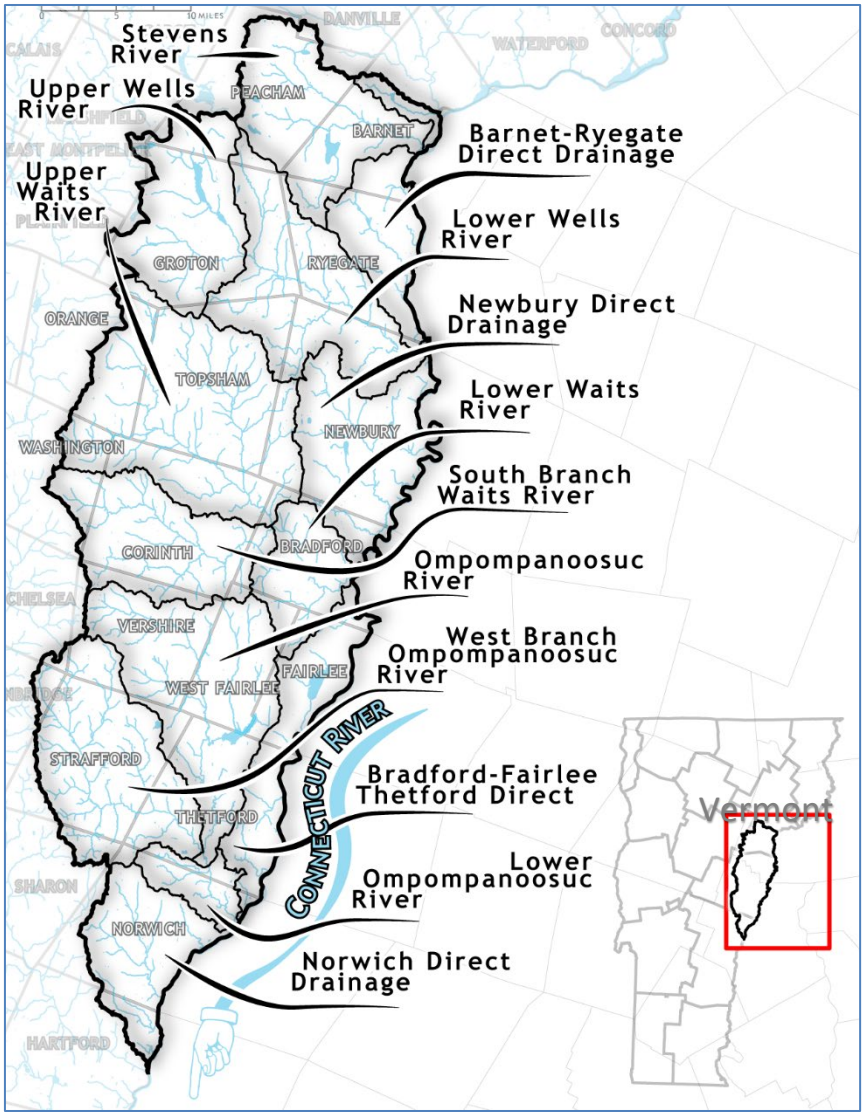



**Figure 5. Basin 14 is located in east central VT and is a 580 square mile watershed; the same size of the island of Oahu in Hawaii where the historic attack on Pearl Harbor took place.**

Basin 14 encompasses 580 square miles in Vermont, draining portions of Caledonia, Orange, and Windsor Counties. The watershed[2] comprises thirteen sub-watersheds (Figure 5) which include the Stevens, Wells, Waits, and Ompompanoosuc Rivers, and five Connecticut River tributaries emphatically referred to as the "little rivers". These rivers are - from north to south - Sutton Brook, Manchester Brook, Peach Brook, Zebedee Brook, and Bloody Brook.

The northern most point of the basin originates in Peacham around the headwaters of the Stevens River and terminates at the furthest south point in Norwich as Bloody Brook flows into the Connecticut River. Looking at Basin 14 from a smaller sub-watershed level helps us to parse out patterns that are not observable on a larger basinwide scale when looking at specific issues within a section of river, a lake, or a wetland. All waters in each of the sub-watersheds flow southeast towards the Connecticut River. Detailed information about each of these rivers can be found in the individual basin

[2] A river basin is an area of land drained by a river and its tributaries. The terms 'basin' and 'watershed' are used interchangeably in this report. The Stevens, Wells, Waits, Ompompanoosuc and Connecticut River Direct Tributary watersheds are also referred to as Basin 14.

assessment reports for the Stevens, Wells, Waits, Ompompanoosuc Rivers plus Connecticut River tributary watersheds.

Lakes and ponds are not abundant in the Basin, but a few large and popular lakes are found here, including Harvey's Lake in Barnet where Jacques Cousteau got his start scuba diving, Lake Groton surrounded by Groton State Forest, home to numerous kettle ponds and wetlands, Ticklenaked Pond in Ryegate, known for its unique name, Lake Morey in Fairlee, where one can find the longest ice skating trail (4.5 miles) in the United States, and Lake Fairlee, whose shoreline is shared and managed by the three towns of West Fairlee, Fairlee, and Thetford.

Peacham Bog, the only documented raised bog in Vermont, is located in Basin 14 in the Groton State Forest, and is one of only nine Class 1 wetlands in the state. Raised bogs are among the world's oldest living ecosystems that rise in height over time as a result of peat formation. Raised bogs are fed by precipitation only (ombrotrophy) and started forming around 10,000 years ago during the retreat of the last glaciation. This wetland complex is a biodiversity hotspot and provides temporary storage for floodwaters, while also protecting fish habitat, and surface water and groundwater, by retaining and slowly releasing water to Coldwater Brook in the Wells River sub-basin. The Brook's year-round cold clean water supports a wild self-sustaining population of Brook Trout (*Salvelinus fontinalis*). Nine additional wetlands have been identified as potential Class I wetlands in this plan in Chapter 3.

## Geology

The surface and ground waters of Basin 14 run through the copper belt within a calcareous sandy marble bedrock. This bedrock is more susceptible to karst – a special type of landscape eroded by the dissolution of soluble rocks – which can result in sinkholes and caves. While Basin 14 is not known for its sinkholes or underground caves, micro-karst features allow water to readily move underground and form springs. Closer to the Connecticut River, quartz schist and quartzite dominate along with black graphitic phyllite and Ammonoosuc volcanics which are less calcareous (Gale, 2020).

The geology of a basin relates to water quality through physical processes such as groundwater seepage and surficial infiltration of precipitation that control baseflows and low-flow conditions. Chemical processes cause water and minerals in bedrock to interact (e.g. weathering of minerals by precipitation, leaching of chemicals into water after mining activities) and water and sediments in surficial geology to interact (e.g. erosion of soils during rain events, erosion of streambanks after gravel extraction). Sometimes this interaction is natural and sometimes it is human caused (e.g. Elizabeth Mine copper pollution). In order to determine background levels of elements in sediment and bedrock, the Vermont Geology Department has been testing bedrock geochemistry for the last 30 years and till geochemistry since 2015, looking at over 40 elements.

The rich sediments deposited by glacial Lake Hitchcock after glaciation and alluvial sedimentation from historic flooding have created river valleys with rich soil utilized by agriculture in the

Connecticut River Valley. Because most of the headwaters throughout the basin are heavily forested or narrow, much development and agriculture are located along the rivers where soil is rich and deep, and the topography is flat. This land use pattern can lead to surface water pollution from stormwater runoff close to surface waters and inherently higher flood damage risks from encroachment into the river corridors and floodplains. However, Basin 14 is less susceptible to landslides, the movement downslope of a mass of rock, debris, earth, or soil, and gullies, trenches cut into land by the erosion of an accelerated stream of water, in comparison to the White River or Champlain Valley waterways (Springston, 2019).

The lower density of gullies may be due mostly to a lower population density which resulted in less impervious area from developed lands. However, these unstable gullies are also largely within the portions of the lowlands that were formerly occupied by glacial lakes. As these lowland areas are often the sites of the larger towns, it is somewhat uncertain whether the unstable gullies are more due to the increased density of population, roads, and buildings or to the highly erodible sand and silt/clay deposits that underlie these areas, both of which have a combined influence to exacerbate formation and growth. (Springston, 2019).

## Demographics

The human population in Basin 14 did not change significantly from 2000 to 2018. Caledonia County's population increased by 2% (+600), Orange County's population increased by 2.7% (+773), while Windsor County's population decreased 3.7% (-2,132). The fastest growing county in Vermont over that time period is Chittenden County with a 12.2% increase of 18,001 people. A large increase in population can equate with increased development resulting in impacts to water quality (Coles, 2012), but based on the numbers in Basin 14, a significant population increase is not evident.

## Land Use

Overall land cover in Basin 14 is 1% open water, 3.2% wetlands, 6.1% developed (including the interstate and roads), 9.1% agriculture, and 77.9% forests (Figure 6). An analysis of land use change in the basin comparing land use in 2001 to 2016 did not show significant differences. Basinwide there was a very small decrease in forest cover (<2%) and negligible increases in herbaceous cover (0.5%) and wetland cover (0.2%). When looking at land cover change by sub-watershed, one of the largest shifts was in the Upper Wells River Basin where forest cover changed from 87.6% to 81.9%. This almost 6% change appeared to be due to silvicultural activities based on imagery review where the herbaceous cover increased as a result of what appeared to be selective cutting practices, which may have a low impact on water quality, especially when Vermont's Acceptable Management Practices are applied (Fulton & West, 2002). The Upper Wells River basin hosts the largest area of State Forest Land in Basin 14, covering over 50% of the land area, making it unlikely for development.

The forested landscape is largely responsible for the good water quality in upstream areas in the

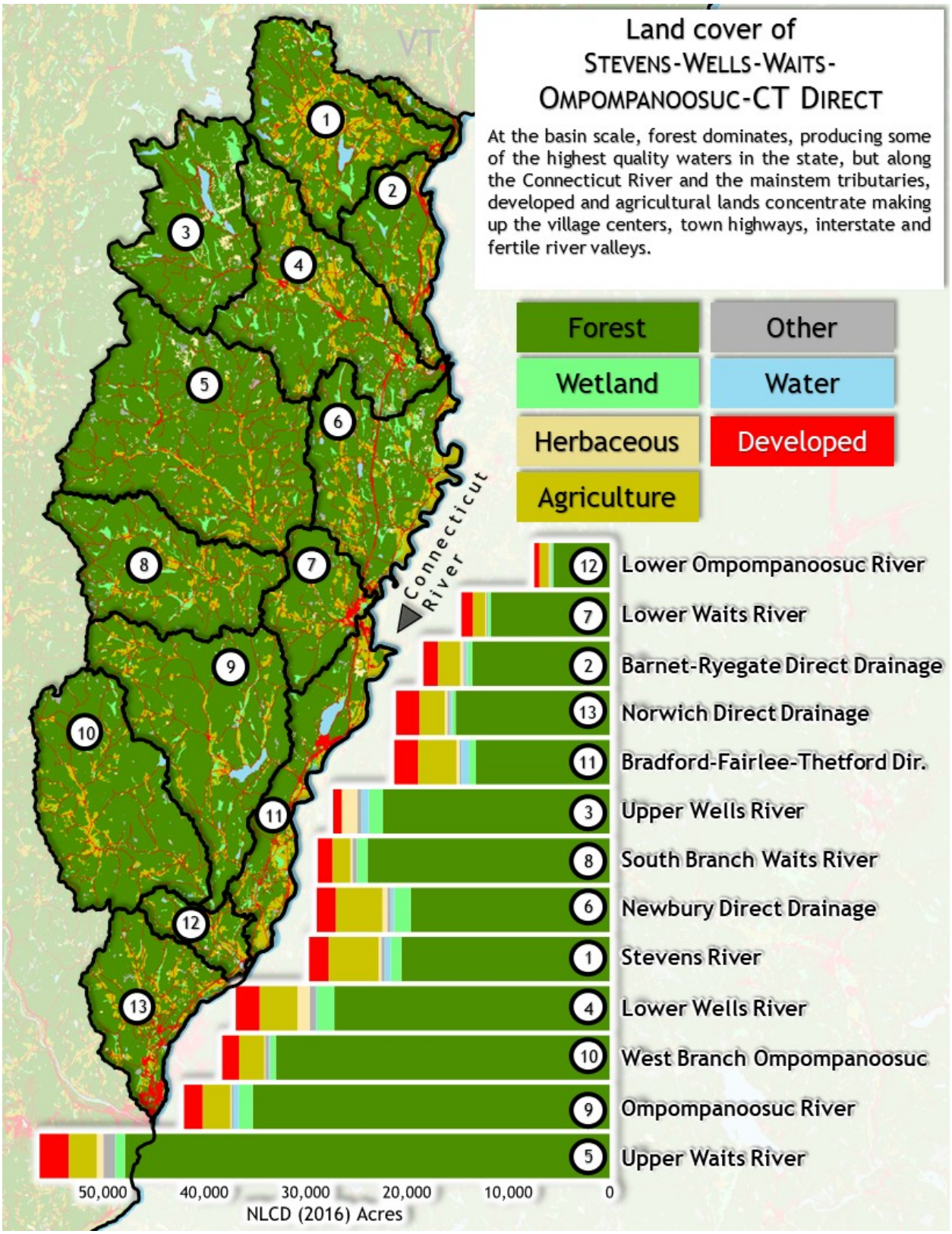



**Figure 6. Land cover estimates by acreage for the thirteen sub-basins of Basin 14. The Upper Waits River and Ompompanoosuc River are the largest sub-watershed in Basin 14. (Source: 2016 LULC data)**

basin. The areas in Basin 14 that are experiencing degraded water quality trends are near concentrated residential and road development (lower Waits River, Ompompanoosuc River, Lake Morey), concentrated agriculture closer to the Connecticut River (Tabor Branch, Ticklenaked Pond, Lake Fairlee), historical mining activities (Lords Brook, Copperas Brook, Pike Hill Brook, Schoolhouse Brook, Cookville Brook), higher elevation areas with less calcareous bedrock (Ricker Pond, Osmore Pond, Groton Pond, Kettle Pond, Levi Pond), and large dams (South Peacham Brook, Harveys Lake, Wells River, Waits River, and the Connecticut River). Managing land use to reduce discharge of polluted runoff and allowing adequate space for treatment can both improve and protect water quality. Good existing management practices and quality local stewardship may also be responsible for the overall superior water quality of this basin.

## Climate Change and Implications for Basin 14

Climate is defined by long-term weather patterns, which in turn, influence human and natural systems. The 2014 Vermont Climate Assessment established state-level, climate change information with implications for local surface waters. Since 1941, Vermont average temperatures have increased 2.7° F with warming occurring twice as fast in winter. The latter results in earlier thaw dates for rivers, lakes and ponds, and mountain snowpack. 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.

The impact of increased runoff and streamflow in a watershed depends on local land use and land cover. In developed areas, more precipitation can increase stormwater volume and velocity thereby mobilizing larger pollutant loads (Galford, et al., 2014). In addition, increased streamflow will increase bed and bank erosion and deliver more sediments downstream. In areas where non-point source pollution is a concern more runoff can increase sediment, nutrient, and pathogen loading to surface waters (Galford, et al., 2014). Changes in climate increasingly require watershed restoration projects to preserve natural sediment attenuation locations and incorporate stormwater and non-point source runoff controls to counteract pollutant transport as well as consider the potential for higher peak flows. Restoring floodplain connectivity along streams is essential to provide space for sediment, debris, and nutrients to settle and store naturally and to maintain ecosystem resilience as the climate changes.

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 seasonal activities and alter their abundance. Maintaining habitat connectivity, river and lake riparian buffers, and stream equilibrium conditions will help reduce the impacts of climate change on Vermont's rivers, lakes and ponds, and wetlands.

Two long-term streamflow datasets in Basin 14 were analyzed by VDEC staff to look at local trends in streamflow characteristics: The East Orange Branch in East Orange, VT and the Wells River in

Wells River, VT. The U.S. Geological Survey operates streamflow gages on these minimally regulated rivers and provides both daily average and annual peak streamflow. East Orange Branch has been monitored since 1959 and the Wells River since 1941. Several streamflow statistics show increasing trends. At both gages annual peak flow and annual average flow are increasing at a statistically significant rate over their respective periods of record. Annual volume is an important climate indicator and useful for agricultural and water-supply applications, but the peak flood flows of these rivers are what is most likely to cause stream channel erosion resulting in damage to infrastructure. Changes in flood flows are apparent when splitting the period of common record for both gages and comparing the first thirty years to the most recent thirty years, which were more frequent and higher in magnitude from 1989-2018 than 1959-1988. The difference is more minor at Wells River but pronounced at the East Orange Branch. In fact, moderate floods were twice as likely during the second thirty-year period for this stream.

Streamflow is influenced by several environmental factors with precipitation being the most important. Daily precipitation data for the Ompompanoosuc, Waits, Wells and Stevens River watersheds are available from the PRISM climate dataset (http://prism.oregonstate.edu/) for the period 1981-2018. VDEC analysis showed that, during this time, trends in annual average precipitation, annual maximum 1-day precipitation, and number of days per year with one or more inches of precipitation increased for all watersheds. When comparing the beginning and end of this period, trends show almost two more days per year of 1+ inches of precipitation (from around six days to eight) and more than five additional inches of total annual precipitation in this region (approximately 39 inches to 44.5).

Monitoring data also indicate trends in low-flow and drought conditions for the basin. Average late summer streamflows are increasing for both gaged streams. This is also the case for annual minimum 7-day average streamflow, especially at the East Orange Branch. A decrease in drought severity is reflected in trends for the Standardized Precipitation Index (SPI), the most used drought index worldwide. Long-term rainfall records (125 years) from nearby St. Johnsbury show significant positive (wetter) trends in the SPI for each of the four seasons, suggesting that droughts have become less severe on a seasonal basis. It is important to note these trends reflect what has been observed in the past, and in some cases these trends may or may not persist into the future. For example, many models and the information in the 2014 Vermont Climate Assessment suggest an increased frequency and severity of low-flow, drier conditions for Vermont due to predictions of longer periods between heavy rainfall events in future decades. Additional information on climate change in Vermont can be found at: https://climatechange.vermont.gov.

## B. Water Quality Conditions in Basin 14

There is a wide variety of water quality monitoring and assessment work that is supported by the Department and its partners which are described in detail in the Water Quality Monitoring Program Strategy. The results of this work provide us with a snapshot into the condition of a Basin's waters.

Monitoring programs in this basin include the Biological and Aquatic Studies Section (BASS) – that focuses on biological monitoring of macroinvertebrate and fish communities as well as targeted chemistry sampling around Wastewater Treatment Facilities (WWTF) or other pollution concerns. BASS also supports the LaRosa volunteer water quality monitoring program. The Vermont Fish and Wildlife Department (VFWD) conducts fishery assessments and temperature monitoring to understand recreational fish populations and evaluates streams for strategic wood addition to restore habitat. The Rivers Program supports stream geomorphic assessments that evaluate geomorphic and habitat conditions of rivers. The Lakes and Ponds Program supports the Spring Phosphorus and Lay Monitoring Programs, which evaluate nutrient conditions and trends on lakes, as well as shoreland condition, and more in-depth lake assessments in addition to surveys for aquatic invasive species. Additionally, the Wetlands Program conducts chemical and biological assessments of wetlands. And finally, a network of streamflow gages is funded and operated in partnership among VDEC, Vermont Agency of Transportation (VAOT) and Vermont Department of Public Service (VDPS).

## Condition of Rivers and Streams

### *Bioassessment on Streams*

The Watershed Management Division (WSMD) in VDEC assesses the health of a waterbody using biological, chemical and physical criteria as described in the Vermont Water Quality Monitoring Program Strategy 2011-2020 which was updated in 2015. Most of this data can be accessed through the Vermont Integrated Watershed Information System (IWIS) online data portal. The biological sampling of streams in VT is carried out by the WSMD using biological indices that measure the health of streams by looking at multiple structural and functional aspects of the macroinvertebrate and fish communities. Biomonitoring is best used for detecting aquatic life impairments and assessing their relative severity, and for recognizing streams at or near a reference level condition that may be suitable to higher levels of protection through reclassification. The ratings for the community assessments range from *Poor* - not meeting Vermont's water quality standards (VWQS) - to *Excellent* - exceeding water quality standards. The monitoring information below was collected in Basin 14 from 2016 to 2019 (Appendix B).

#### Macroinvertebrate Monitoring Results

A total of thirty-nine macroinvertebrate assessments were completed between 2016 and 2019 in Basin 14. Results of these assessments are described below. In addition, to ensure a comprehensive understanding of water quality basinwide, a gap analysis was conducted by VDEC to identify sites without current monitoring data (Figure 7). These areas will be prioritized for the 2021 monitoring season and can be found in Chapter 5 in the Basin 14 Monitoring and Assessment Table.

Twenty-four sampling events exhibited macroinvertebrate communities in *Very Good* or better condition. Fifteen of those streams exhibited communities in *Excellent* condition. Two streams of note are Mud Pond Brook, in Peacham, at river mile 0.6 and Middle Brook, in West Fairlee, at river

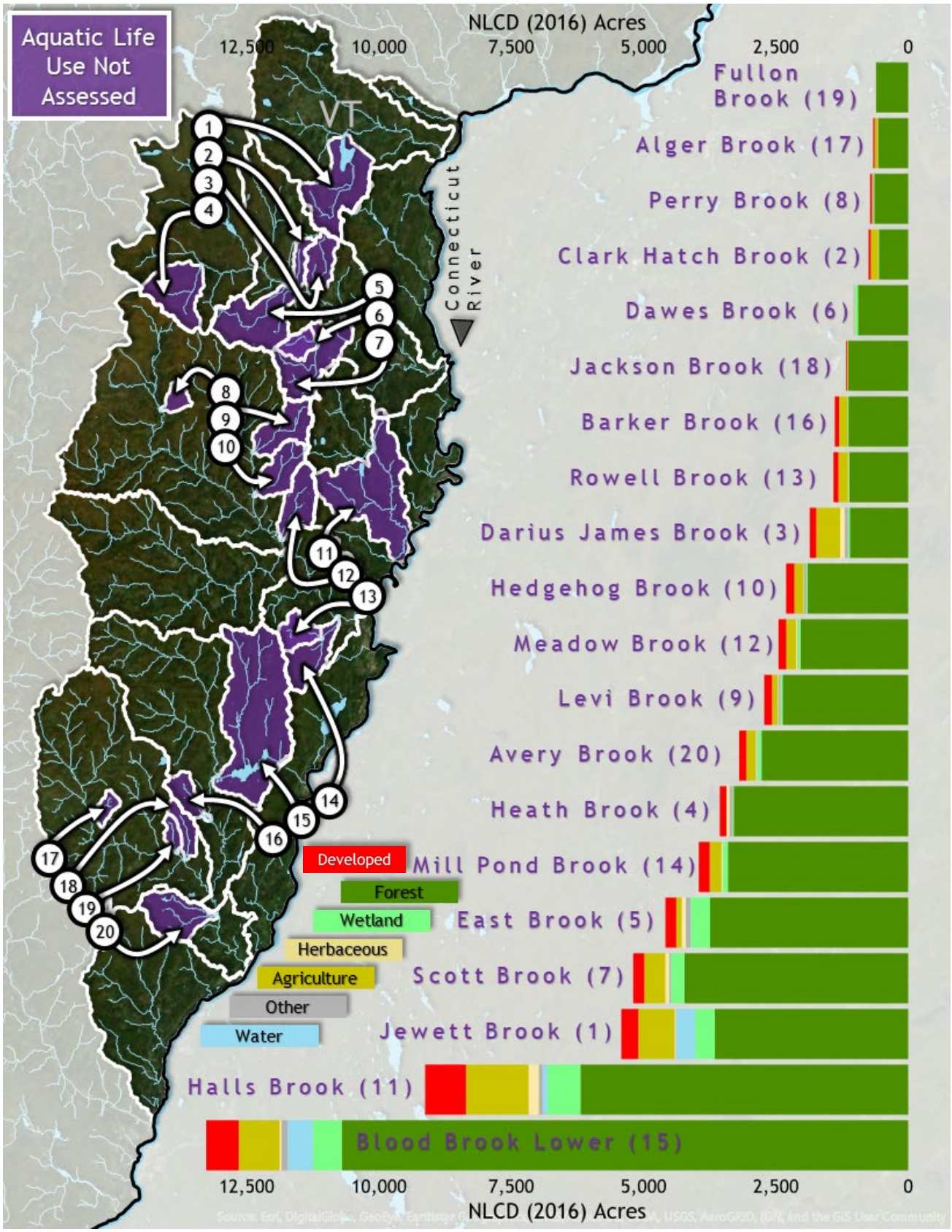



**Figure 7. Priority watersheds for biological monitoring in 2022 for Basin 14. Priority areas for monitoring are numbered and highlighted in purple. NLCD = National Land Cover Database.**

mile 6.3. The macroinvertebrate and fish communities were both in *Excellent* condition. Streams in *Very Good* or better condition exceed VWQS.

Six sampling events exhibited macroinvertebrate communities in *Good* or better condition. The following streams meet this condition: South Peacham Brook (sampled twice), Cloud Brook, Tannery Brook, Cookville Brook, and Charles Brown Brook. Three sites of note are South Peacham Brook, Cloud Brook and Charles Brown Brook. South Peacham Brook shows a *Very Good* condition upstream of the Harvey Lake Dam. The stream is in *Good* condition below the dam. The decrease in condition may be attributed to nutrient enrichment and increased temperature below the dam. Cloud Brook was sampled after a flooding event and landslide. This site will be sampled again in 2022 to track signs of recovery. Charles Brown Brook was sampled just above the Norwich Fire District Dam. The dam was removed in 2019. This site will be sampled again in 2022 to track condition. Sites in *Good* to *Good-Very Good* condition meet VWQS.

Nine sampling events exhibited macroinvertebrate communities in *Poor* to *Fair* condition. Most of these waters (8) receive mine runoff. Sites that range from *Fair to Poor* condition do not meet Vermont's water quality standards and require steps for mitigation. Three streams sampled from 2016-2019 were rated *Poor*, Pike Hill Brook, Cookville Brook Tributary #4, and Lords Brook Tributary #2. Each of these surface waters will be monitored before and after restoration efforts to track recovery as restoration efforts are planned. More information on the mine restoration efforts is found in the 2015 Basin 14 Status Update Table in Appendix A.

## Fish Monitoring Results

A total fifteen individual sites were sampled for fish in Basin 14. Three fish sampling events were unable to be assessed. Two of the unassessed sites were small streams that had no fish, and one site was a Brook Trout only stream.

Eight sampling events exhibited fish communities in *Excellent* condition: Mud Pond Brook, Tabor Branch Tributary #5, Middle Brook, South Peacham Brook, Roaring Brook, Abbott Brook Tributary #3, East Orange Branch Waits River, and South Branch Wells River. Two sampling events exhibited fish communities in *Very Good* condition: Charles Brown Brook and North Branch Wells River. Streams in *Very Good* or better condition exceed VWQS.

Four sampling events exhibited fish communities in *Good* condition and one sampling event exhibited a fish community in *Poor* condition. The following streams were assessed as *Good*: Peacham Hollow Brook, in Barnet, below the dam near Ferguson Road, Waits River, Schoolhouse Brook, and Zebedee Brook. Bloody Brook, in Norwich, had a *Poor* fish community. Two streams of note are Bloody Brook, in Norwich, and Peacham Hollow Brook, in Barnet below Harveys Lake dam near Ferguson Road. In contrast to the *Good* fish community, the macroinvertebrate community in Peacham Hollow Brook exhibited *Excellent* condition. And in contrast to the *Poor* fish community, the macroinvertebrate community in Bloody Brook exhibited *Excellent* condition. Before the sampling effort in Bloody Brook, a severe flooding event took place that may have impacted Brook

Trout habitat. This site will be resampled in 2022 to assess recovery. Those sites exhibiting *Poor* or *Fair* conditions may not meet VWQS. More information about the results of these sampling sites can be found in the Vermont Integrated Watershed Information System (IWIS).

## *Stream Geomorphic Assessments*

Seventy-three percent of assessed streams are in fair geomorphic condition, thirteen percent are in good condition, five percent are in poor condition, and two percent are in reference condition (Figure 8). Major stream alterations following flooding events like Tropical Storm Irene and more recent flooding events are a major driver of degraded geomorphic conditions in the Basin 14.

Between 2009 and 2016 six Phase 2 Stream Geomorphic Assessments (SGAs) were completed in Basin 14. Figure 8 also shows the geomorphic condition for those streams with completed Phase 2 SGAs. Most of the major sub-basin and their major tributaries have been assessed

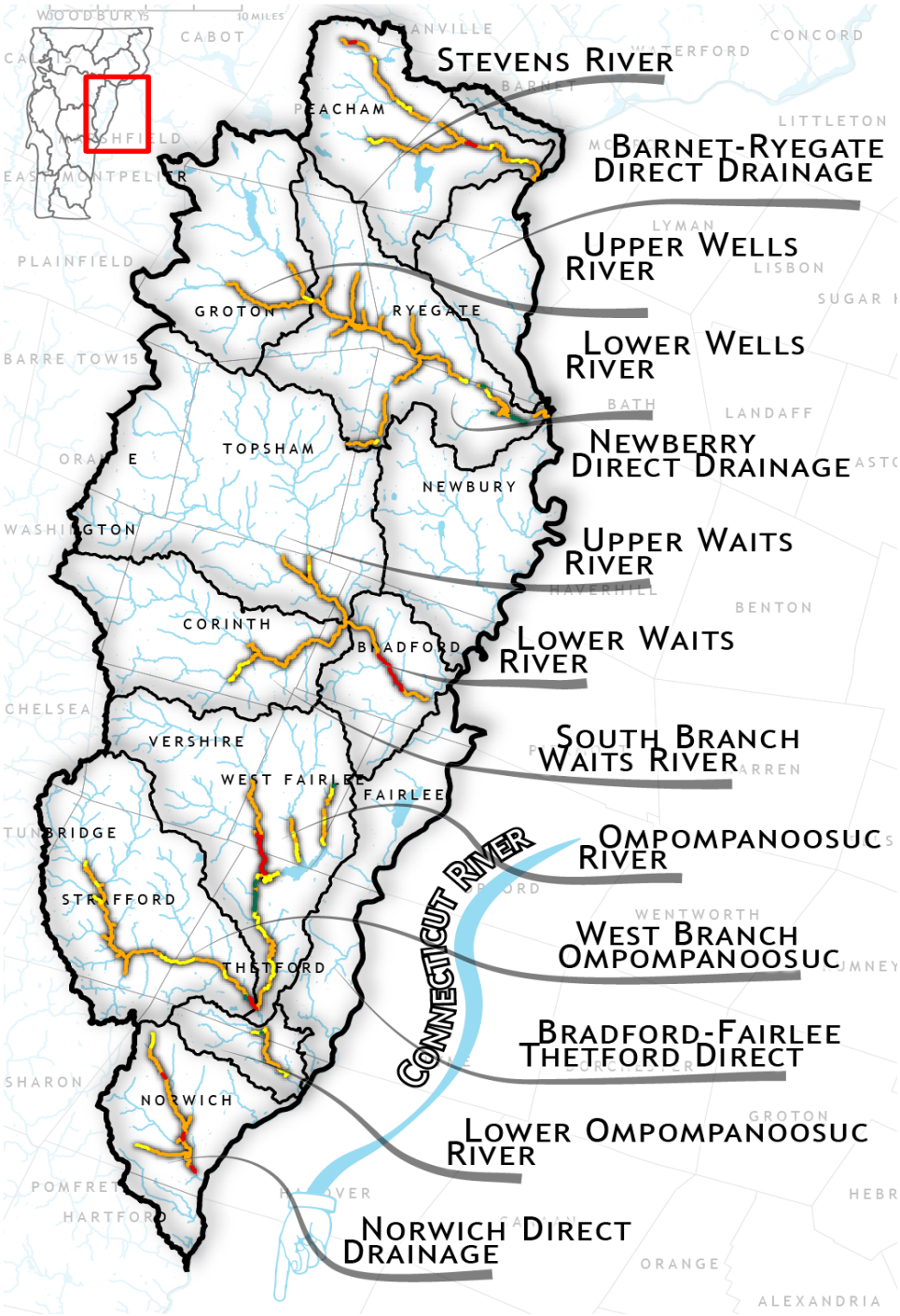



**Figure 8. Geomorphic condition of assessed streams in Basin 14 from reference to poor condition. Reference=green, good=orange, fair=yellow, poor=red.**

including the Stevens River, Waits River, Wells River, and Ompompanoosuc River. Final SGA reports and River Corridor Plans (RCPs) can be accessed at: https://anrweb.vt.gov/DEC/SGA/finalReports.aspx.

## Condition of Lakes and Ponds

There are a total of fifty-six lakes and ponds in Basin 14 (Vermont Lakes and Ponds Program, 2019). Thirty-one (55%) are ten acres or greater. Twenty-four of the thirty-one lakes are twenty acres or greater. The four largest lakes in order from largest to smallest are Lake Morey (549 acres), Lake Fairlee (461 acres), Groton Lake (435 acres) and Harveys Lake (357 acres). Lakes that are ten acres or greater should be in accordance with the Vermont Hydrology Policy and meet the Hydrology Criteria (§29A-304) in the 2017 VT Water Quality Standards.

Thirty-one lakes in Basin 14 have at least two ratings on the VT Inland Lakes Scorecard (Figure 9). These ratings are driven by data availability. The VT Inland Lake Score Card is a user-friendly interface developed by the Vermont Lakes and Ponds Management and Protection Program (VLPP) to share available data on overall lake health by providing a rating of a waterbody's nutrient trend, shoreland and lake habitat, atmospheric pollution, and aquatic invasive species. Lake-specific water quality and chemistry data can be accessed online through the VT Lay Monitoring Program webpage.

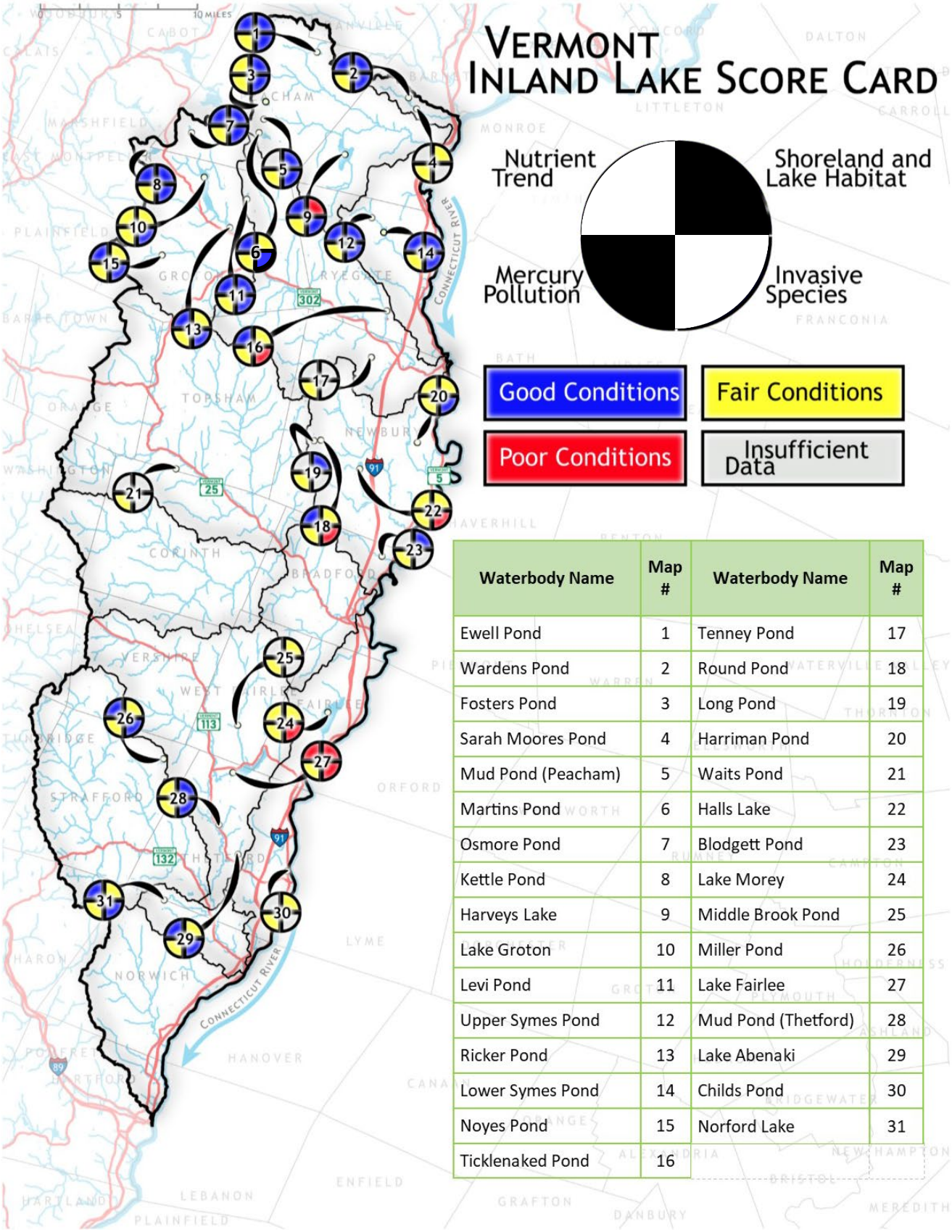
Of the thirty-one lakes monitored in Basin 14, poor conditions are reported on only seven lakes. Six poor condition ratings are for invasive species (Martins Pond, Ticklenaked Pond, Round Pond, Halls Lake, Lake Morey, and Lake Fairlee). Two poor conditions ratings are for shoreland and lake habitat (Harveys Lake and Lake Fairlee). One poor condition rating is for nutrient trend (Lake Fairlee). Seven lakes show good conditions for all parameters except for mercury pollution which is reported in fair condition statewide.

Five lakes are in poor condition for aquatic invasives: Lake Morey (Eurasian Water Milfoil – EWM), Lake Fairlee (EWM), Ticklenaked Pond (EWM), Halls Lake (Variable Leaved Milfoil, EWM), and Round Pond (EWM) (Figure 9). A "poor" score indicates that there is at least one invasive species present, regardless of its abundance or 'nuisance' level. More information about how these lakes are being managed is found in the Natural Resources – Lakes section of Chapter 4.

Those wishing to better understand the scoring process are encouraged to read the 'How Lakes Are Scored' sections and watch the recorded webinar on the YouTube channel for the VDEC Watershed Management Division.

### *Long-Term Monitoring of Acid Sensitive Lakes*

There are three main airborne pollution types that affect lakes and ponds in Vermont: sulfur oxides, nitrogen oxides, and mercury. Mercury contamination has resulted in fish consumption advisories in nearly every lake in Vermont and those of nearby states as well – so all lakes in Basin 14 get a fair




| Waterbody Name | Map # | Waterbody Name | Map # |
|---|---|---|---|
| Ewell Pond | 1 | Tenney Pond | 17 |
| Wardens Pond | 2 | Round Pond | 18 |
| Fosters Pond | 3 | Long Pond | 19 |
| Sarah Moores Pond | 4 | Harriman Pond | 20 |
| Mud Pond (Peacham) | 5 | Waits Pond | 21 |
| Martins Pond | 6 | Halls Lake | 22 |
| Osmore Pond | 7 | Blodgett Pond | 23 |
| Kettle Pond | 8 | Lake Morey | 24 |
| Harveys Lake | 9 | Middle Brook Pond | 25 |
| Lake Groton | 10 | Miller Pond | 26 |
| Levi Pond | 11 | Lake Fairlee | 27 |
| Upper Symes Pond | 12 | Mud Pond (Thetford) | 28 |
| Ricker Pond | 13 | Lake Abenaki | 29 |
| Lower Symes Pond | 14 | Childs Pond | 30 |
| Noyes Pond | 15 | Norford Lake | 31 |
| Ticklenaked Pond | 16 | | |

**Figure 9. Scorecard information for lakes and ponds in Basin 14. Table shows lakes or ponds over 10 acres (except for Waits Pond which is 6 acres and Sarah Moores Pond which is 9 acres).**

condition score (Figure 9). Sulfur and nitrogen oxides are largely transported to Vermont from out of state air emissions and are beyond this plan to address.

Lakes and ponds in Basin 14 are regularly monitored for low pH (high acidity), which impacts biological communities. One small waterbody – Levi Pond in Groton – in Basin 14 is regularly sampled to ascertain impacts of acid precipitation. Levi Pond is considered impaired for acidity because of its low pH. An additional five lakes in Basin 14 – Groton, Kettle, Noyes, Mud (Thetford), Osmore and Ricker – also show low pH and are considered acid stressed by the VT Lakes and Ponds Program. These ponds are monitored periodically. Groton, Kettle, and Ricker were monitored in 2018 and Mud, Noyes, and Osmore were last monitored in 2011. More information about long-term monitoring of VT's acid lakes can be found at: https://dec.vermont.gov/watershed/map/monitor/acid-rain

## Condition of Wetlands

### *Wetland Monitoring*

The Vermont Wetlands Program uses its Bioassessment Project to gather data about the health of Vermont wetlands. Based on a 2017 analysis of bioassessment data, the principal factors that correlate with poor wetland condition are:

- presence of invasive species,
- disturbance to the wetland buffer or 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 high development pressure and exhibiting habitat loss.

The VT Wetlands Bioassessment Project calculates the Coefficient of Conservation (CoC) at each assessed wetland. The CoC is a metric that uses the presence and abundance of plant species to evaluate wetland status. Plant species are identified either within a defined plot or within a single natural community type. Each plant has a designated score to indicate its tolerance of disturbance. These scores are averaged to determine the overall balance of disturbance-tolerant species in the wetland which can offer information on the level of disturbance in the wetland. CoC scores have been calculated from 40 species lists in this basin, with an average score of 4.4 which is on par for the state average. However, the wetlands surveyed may not be representative of the basin.

VRAM, the Vermont Rapid Assessment Method, is a method of rapidly assessing both condition and function of a wetland. Scores can range from 4 to 100. There are 34 VRAM plots in this basin. While these are not evenly distributed through the basin, they do include assessments at several wetland types at varying elevations. Scores range from a minimum of 46 to a maximum of 94 with a mean of 75. Wetlands with high scores tend to be higher in the watershed and often include

softwood swamp and/or peatland. Wetlands which scored lower include wetlands in the immediate Connecticut River valley, shrub swamps, and wetlands where the surrounding landscape has been significantly altered by human activity.

Interested organizations and citizens can help build the dataset of wetlands in the Basin 14 by conducting VRAM analysis. Individuals or groups interested in learning the VRAM protocol should contact Wetlands Scientist Charlie Hohn at Charlie.Hohn@vermont.gov for further information.

## Condition of Fisheries

### *Lakes & Ponds*

Information for the Lake and Pond Fisheries section of this plan was provided by the Vermont Department of Fish and Wildlife (VFWD). Offering a unique angling opportunity in Basin 14, Martins Pond and Noyes Pond are two of only nine ponds in Vermont to support fishable populations of naturally reproducing wild Brook Trout. Other notable fishing lakes are Lake Groton, Ricker Pond, and Ticklenaked Pond for warm water species including Smallmouth Bass, Largemouth Bass, Chain Pickerel, Yellow Perch, Brown Bullhead, and sunfish. Lake Fairlee supports a wide diversity of species which provide fishing opportunities for Largemouth Bass, Smallmouth Bass, Yellow Perch, Chain Pickerel, Rainbow Smelt, Pumpkinseed, Rock Bass, Brown Bullhead, Rainbow Trout (stocked) and Brown Trout (stocked). Miller Pond is managed with annual stockings of hatchery-reared Brook Trout and Rainbow Trout and supports Largemouth Bass, Pumpkinseed and Bluegill populations. Lake Morey and Halls Lake represent good Largemouth Bass and Smallmouth Bass populations. Some fish over 20 inches have been observed by VFWD.

Largemouth Bass were illegally introduced to Levi Pond and a population has become established. Before bass were introduced, Levi Pond provided fishing opportunities for wild and stocked Brook Trout. Harveys Lake used to support wild and stocked Lake Trout, but hypolimnetic dissolved oxygen levels are currently too low for Lake Trout. VFWD now stocks Harveys Lake with Brown and Rainbow Trout. Harveys Lake provides fishing for these stocked trout and for Rainbow Smelt, Yellow Perch, and Chain Pickerel.

### *Flowing Water Fisheries*

Water temperature data is collected by VFWD along several mainstem locations to assess potential impacts of elevated summer water temperatures on salmonid populations. VFWD collected hourly water temperature data from June to October in the Ompompanoosuc in 2018 and the Waits River in 2019. Streams are also electrofished by VFWD.

The Stevens River and tributaries support mostly Cold-Water Fish Habitat. The Wells River and tributaries support Cold-Water Fish Habitat throughout the watershed, but Wells River wild trout populations are supplemented with cultured trout from South Ryegate Village downstream to the mouth. Apart from the mainstem of the Waits River, which is stocked annually with yearling rainbow trout between Corinth and Bradford, the vast majority of streams within the watershed

provide suitable habitat for naturally reproducing wild Brook Trout and are managed as wild trout waters. Naturalized populations of wild Rainbow and Brown Trout are not found in the Ompompanoosuc River or the Waits River despite decades of past stocking. Tributary streams of the Ompompanoosuc River are managed as wild Brook Trout waters and the annual stocking of yearling Rainbow Trout occurs in the East Branch between the Tucker Hill Covered Bridge and the Union Village Dam and in the West Branch between Strafford and South Strafford

### Summary

Most surface waters in Basin 14 meet or exceed water quality standards and waters that exceed standards outnumber the waters that do not meet standards. However, both restoration and protection efforts are required to maintain and improve water quality in Basin 14. The following chapters will provide an overview of priority waters for protection and restoration and sector specific strategies to meet our water quality goals.

# Chapter 2 – Priority Areas for Surface Water Protection

In order to protect VT surface waters and their designated uses, the VWQS establish water quality classes and associated management objectives. In addition to the pathways provided by the VWQS, tactical basin plans identify opportunities to increase protection of high-quality waters through land stewardship programs, local protection efforts, conservation easements, and land acquisition.

As specified in the VWQS, all surface waters are managed to support designated uses valued by the public at a level of Class B(2) (i.e., good condition) or better. Designated uses include: swimming, boating, fishing, aquatic biota, aquatic habitat, aesthetics, drinking water source, and irrigation. This section of the plan identifies surface waters where monitoring data indicate conditions may meet or exceed the VWQS objectives for A(1) and B(1) designated uses. These high-quality waters may be protected by the anti-degradation policy of the VWQS or by upward reclassification through one of the following protection pathways:

- Reclassification of surface waters
- Class 1 Wetland designation
- Outstanding Resource Waters designation
- Designation of waters as cold-water fisheries
- Identification of existing uses

In Basin 14, five waters meet criteria for A(1) aquatic life, three waters meet criteria for B(1) aquatic life, four waters meet criteria for B(1) aesthetics, sixteen waters meet criteria for B(1) fishing, and nine wetlands are identified for further study as Class 1 wetland candidates. Four abandoned A(2) public water sources are identified for evaluation for reclassification, and thirty-two rivers and lakes have been identified as potential reclassification candidates in need of additional monitoring: seven for A(1) and twenty-five for B(1) (Figure 10).

The Vermont Water Quality Standards establish water quality classes and associated management objectives. The protection of water quality and water-related uses can be promoted by establishing specific management objectives for bodies and stretches of water. The management objectives describe the values and uses of the surface water that are to be protected or achieved.


**Figure 10. Surface water protection highlights in Basin 14.**

The Agency of Natural Resources is responsible for determining the presence of existing uses on a case-by-case basis or through basin planning and is also responsible for classification or other designations. Once the Agency establishes a management goal, the Agency manages state lands and issues permits to achieve all management objectives established for the associated surface water.

Before the Agency recommends management objectives through a classification or designation action, input from the public on any proposal is required and considered. The public may present a proposal for establishing management objectives for Agency consideration at any time, while the Agency typically relies on the publication of basin plans to identify candidates for reclassification (10 V.S.A. § 1424a). When the public develops proposals regarding management objectives, the increased community awareness can lead to protection of uses and values by the community and individuals.

Public involvement is an essential component to restoring and protecting river and lake ecology. The Vermont Water Quality Standards 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.*" Emphasis on the identification of values and expectations for future water quality conditions can only be achieved through public contributions to the planning process. The public,

watershed partners, and stakeholders are encouraged to make recommendations for additional monitoring and research where very high-quality waters appear to exist.

## A. Surface Water Classification

Vermont's surface water classification system establishes management goals and supporting criteria for uses in each class of water. The VWQS begin classification with two broad groups based on elevation:

- All waters above 2,500 feet altitude, National Geodetic Vertical Datum, 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 altitude, National Geodetic Vertical Datum, are designated Class B(2) for all uses, unless specifically designated as Class A(1), A(2), or B(1) for any use.

Pursuant to Act 79 of 2016, the Vermont General Assembly, recognizing the wide range of quality for Class B waters, created a new intermediary water quality class between B(2) and A(1), now called Class B(1). Act 79 also sets forth the expectation that individual uses of waters (e.g., aquatic biota and wildlife, aquatic habitat, recreation, aesthetics, fishing, boating, or swimming) may be individually classified, so a specific lake or stream may have individual uses classified at different levels. Act 79 indicates that uses may be reclassified independently to Class A(1) or B(1) for individual uses if the quality of those uses are demonstrably and consistently of higher quality than Class B(2). The extent of the water being reclassified is subject to review based on documented conditions.

Current classifications of surface waters and their uses are identified through the tactical basin planning process or on a case-by-case basis. The current classification, however, does not signify that the A(1) or B(1) criterion is not met. Additional waters suitable for reclassification may be identified in the future as some waters have not been monitored. Table 2 lists the possible classes into which each use may be placed.

**Table 2. A list of uses that can be placed into each water class in the Vermont Water Quality Standards.**

| Classification (2016) | 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 |

## A(2) Public Water Sources

Five waters are designated as A(2) public water sources in Basin 14. Four of the five waters have been abandoned as public water sources and could be reclassified to reflect their current condition for each designated use (Table 3).

**Table 3. Class A(2) designated public water sources in the Basin 14.**

| Waters | Water Source | Description |
|---|---|---|
| South Peacham Brook | Town of Peacham | **Abandoned**. An artificial impoundment on South Peacham Brook, and all waters within its watershed above the intake. |
| Charles Brown Brook | Village of Norwich | **Abandoned**. Charles Brown Brook and all waters within its watershed above the water intake in the Town of Norwich. |
| Mill Pond Brook | Village of Bradford | **Abandoned**. Mill Pond Brook and all waters within its watershed above the intake dam in the Towns of Fairlee, Bradford, and West Fairlee. Locally known as the Brushwood Impoundment. |
| Unnamed tributary to Lake Morey | Village of Fairlee | **Abandoned**. An unnamed tributary to Lake Morey and all waters in its watershed in the Town of Fairlee to the water intake dam, including a man-made impoundment. |
| Unnamed Tributary to Connecticut River | Village of Newbury | **Emergency**. An unnamed tributary to the Connecticut River and all waters within its watershed above the water intake in the Town of Newbury. The tributary is approximately one mile south of Pulaski Mountain. The intake is located approximately 0.7 mile upstream of its confluence with the Connecticut River. |

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

Based upon biomonitoring assessments conducted by the VDEC WSMD, eight surface waters in the Basin consistently and demonstrably attain a higher level of quality than Class B(2), meeting Class A(1) or Class B(1) criteria for aquatic life (Table 4 and Figure 11). Waters meeting A(1) aquatic biota criteria are South Peacham Brook, Mud Pond Brook, Upper Middle Brook, Abbot Brook Tributary #3, and Lords Brook (not including Tributary #2). Waters meeting B(1) aquatic life criteria are Roaring Brook, Upper West Branch Ompompanoosuc River, and Zebedee Brook.

Thirteen sites require additional sampling to determine if they meet A(1) or B(1) criteria for aquatic biota. Potential A(1) waters are Sutton Brook, North Branch Wells River, Beaver Brook, Meadow Brook, Glens Falls Brook, and Sargent Brook. Potential B(1) waters are Peacham Hollow Brook, McIndoe Falls Tributary, Manchester Brook, South Branch Wells River, East Orange Branch Waits River, Waits River mainstem, and Cookville Brook.

**Table 4. List of rivers and streams that either meet criteria for A(1) or B(1) for aquatic life use or require more monitoring to make a determination. Map #'s correspond with Figure 11. *Potential A(1) or B(1).**

| Map # | Name | Use | Protection Class | Status |
|---|---|---|---|---|
| **4** | South Peacham Brook & Mud Pond Brook | Aquatic Life | A(1) | Meets Criteria |

| | | | | |
|---|---|---|---|---|
| **17** | Tabor Branch Tributary #5 | Aquatic Life | A(1) | Meets Criteria |
| **26** | Roaring Brook | Aquatic Life | B(1) | Meets Criteria |
| **31** | Middle Brook | Aquatic Life | A(1) | Meets Criteria |
| **33** | West Branch Ompompanoosuc | Aquatic Life | B(1) | Meets Criteria |
| **34** | Abbot Brook Tributary #3 | Aquatic Life | A(1) | Meets Criteria |
| **40** | Lords Brook (not including tributary #2) | Aquatic Life | A(1) | Meets Criteria |
| **41** | Zebedee Brook | Aquatic Life | B(1) | Meets Criteria |
| **1** | Peacham Hollow Brook | Aquatic Life | A(1)* | Needs Additional Monitoring |
| **2** | Sutton Brook | Aquatic Life | A(1)* | Needs Additional Monitoring |
| **7** | Beaver Brook | Aquatic Life | A(1)* | Needs Additional Monitoring |
| **8** | North Branch Wells River & Red Brook | Aquatic Life | A(1)* | Needs Additional Monitoring |
| **10** | McIndoe Falls Tributary | Aquatic Life | B(1)* | Needs Additional Monitoring |
| **12** | South Branch Wells River | Aquatic Life | B(1)* | Needs Additional Monitoring |
| **13** | Manchester Brook | Aquatic Life | B(1)* | Needs Additional Monitoring |
| **16** | Waits River | Aquatic Life | B(1)* | Needs Additional Monitoring |
| **21** | East Orange Branch Waits River | Aquatic Life | B(1)* | Needs Additional Monitoring |
| **27** | Cookville Brook | Aquatic Life | B(1)* | Needs Additional Monitoring |
| **28** | Meadow Brook | Aquatic Life | A(1)* | Needs Additional Monitoring |
| **32** | Glen Falls Brook | Aquatic Life | A(1)* | Needs Additional Monitoring |
| **39** | Sargent Brook | Aquatic Life | A(1)* | Needs Additional Monitoring |

## B(1) Waters for Recreational Fishing

Certain waters in Basin 14 support productive populations of cold-water salmonids. 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 1000 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)[3]. The sixteen streams that meet B(1) criteria for recreational fishing (§29A-306) are: Depot Brook, East Brook, and Tannery Brook all from the mouth to the headwaters, South Branch of the Wells River from West Groton Village upstream, Waits River (headwaters), Middle Brook (headwaters), Abbot Brook Tributary #3, Riddle Pond Brook, Knox Mountain Branch, Pierson Hill Brook, Center Brook, Bear Notch Brook, Charles Brown Brook, Tabor Branch, and Meadow Brook (Table 5 and Figure 11).

[3] It should be recognized that wild trout populations vary widely from year to year and therefore an individual population may sometimes go below or greatly exceed these values in any given year. The upstream and downstream extent of the stream classification should be based upon consistent or improving water quality, physical habitat quality and land use conditions. The reach should include all upstream habitats which are deemed essential to sustain water quality and physical habitat requirements necessary to support wild salmonid populations at a Very Good level.

Table 5. List of rivers and streams that meet criteria for B(1) for fishing. Map #'s correspond with Figure 11.

| Map # | Name | Use | Protection Class | Status |
|---|---|---|---|---|
| 14, 15 | Upper Waits River (Topsham & Orange) | Fishing | (B)1 | Meets Criteria |
| 18 | Levi Brook | Fishing | (B)1 | Meets Criteria |
| 19 | Hedgehog Brook | Fishing | (B)1 | Meets Criteria |
| 20 | Riddle Pond Outlet | Fishing | (B)1 | Meets Criteria |
| 22 | Pierson Hill Brook | Fishing | (B)1 | Meets Criteria |
| 23 | Tabor Branch | Fishing | (B)1 | Meets Criteria |
| 24 | Center Brook | Fishing | (B)1 | Meets Criteria |
| 25 | Meadow Brook | Fishing | (B)1 | Meets Criteria |
| 29 | Bear Notch Brook | Fishing | (B)1 | Meets Criteria |
| 30 | Middle Brook | Fishing | (B)1 | Meets Criteria |
| 35 | Abbot Brook Tributary #3 | Fishing | (B)1 | Meets Criteria |
| 42 | Charles Brown Brook | Fishing | (B)1 | Meets Criteria |
| NA | Depot Brook | Fishing | (B)1 | Meets Criteria |
| NA | East Brook | Fishing | (B)1 | Meets Criteria |
| NA | Tannery Brook | Fishing | (B)1 | Meets Criteria |
| NA | South Branch of the Wells River | Fishing | (B)1 | Meets Criteria |

These waters shall be managed to achieve and maintain very good quality fishing. The eleven waters identified may be adjusted in the future based on new and updated surveys and as protocols are refined. Waters that meet the revised criteria in the water quality standards for both B(1) and A(1) fishing use will be continually identified and updated. It is important to note that all waterbodies that would naturally support fish populations are protected and maintained in perpetuity.

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

The 2016 VWQS contains a designated use regarding the use of waters for aesthetic conditions, and VDEC developed numeric nutrient criteria for lakes and ponds in relation to this use (see table 3 on page 30 in the VWQS). Four lakes in Basin 14 meet the nutrient criteria for B(1) aesthetics: Fosters Pond, Harveys Lake, Lake Groton, and Lake Fairlee (Table 6 and Figure 12). Although these waterbodies exceed the VWQS for B(2) waters, all but one of the lakes are experiencing significant trends that indicate stress. Lake Groton has a significantly decreasing Secchi depth, Lake Fairlee has increasing spring and summer total phosphorus and decreasing summer Secchi depths and Fosters lake has significantly increasing spring total phosphorus. Strategies to address these trends are described in Chapter 4 and 5.

Nineteen lakes were identified as potential A(1) or B(1) candidates for aesthetics (Table 6 and Figure 12). These lakes require additional monitoring. Recommendations for monitoring are covered in Chapter 5 in the Basin 14 Monitoring and Assessment Table. Because monitoring all the recommended lakes listed in table 6 is unlikely, due to resource constraints, a subset has been recommended in Chapter 5.

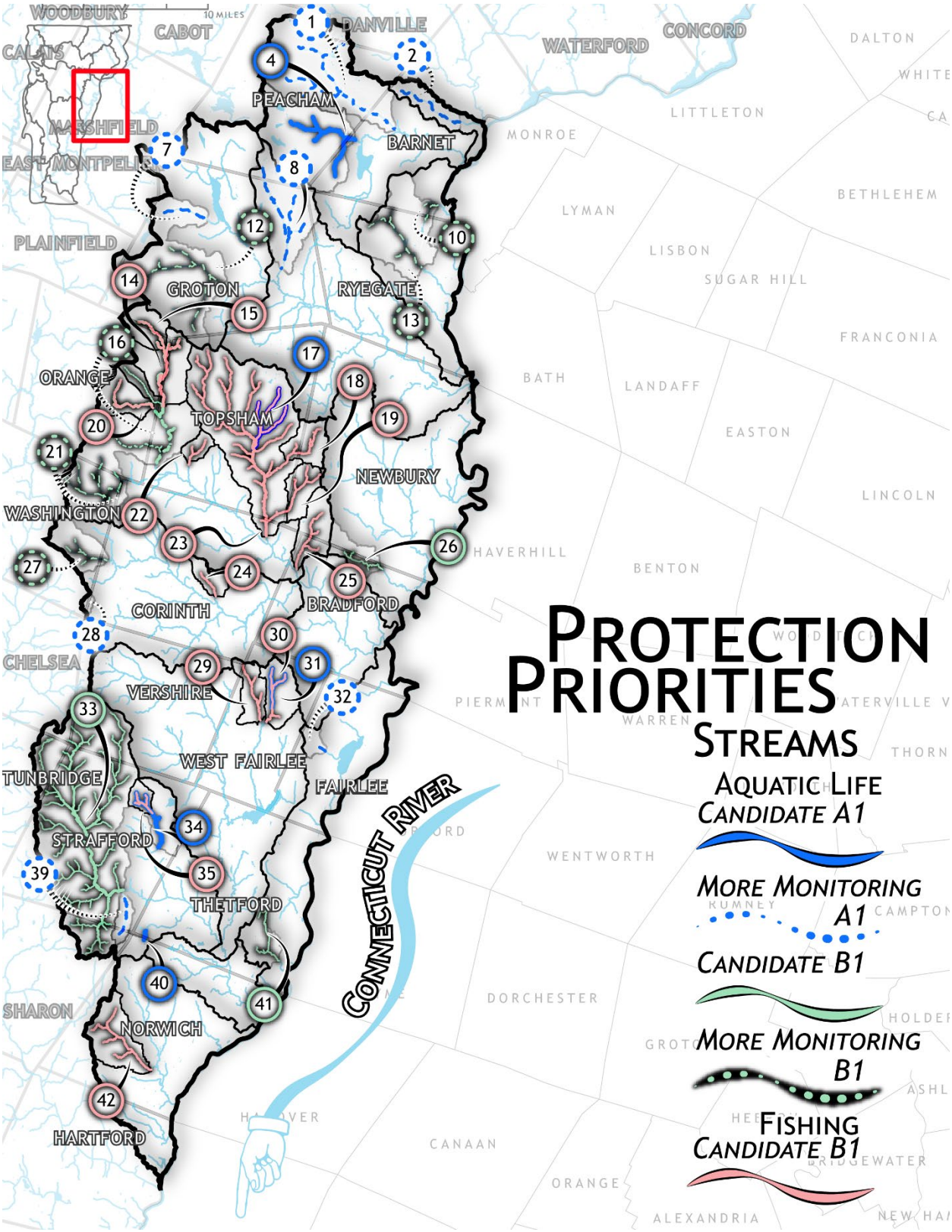



**Figure 11. Map of A(1) and B(1) candidates in Basin 14 for aquatic life and fishing uses that either exceed the 2016 VWQS or need additional sampling to determine their status.**

**Table 6. Lakes that meet criteria for B(1) aesthetics or require additional monitoring to determine their status and their corresponding map identification number. *Potential A(1) or B(1) water.**

| Map # | Name | Use | Protection Class | Status |
|---|---|---|---|---|
| **4** | Fosters Lake | Aesthetics | B(1) | Meets Criteria |
| **7** | Harveys Lake | Aesthetics | B(1) | Meets Criteria |
| **11** | Lake Groton | Aesthetics | B(1) | Meets Criteria |
| **26** | Lake Fairlee | Aesthetics | B(1) | Meets Criteria |
| **2** | Ewell Pond | Aesthetics | B(1)* | Needs Additional Monitoring |
| **3** | Warden Pond | Aesthetics | B(1)* | Needs Additional Monitoring |
| **5** | Mud Pond (Peacham) | Aesthetics | A(1)* | Needs Additional Monitoring |
| **6** | Osmore Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **8** | Kettle Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **10** | Martins Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **13** | Levi Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **15** | Ricker Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **17** | Upper Symes Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **18** | Lower Symes Pond | Aesthetics | B(1)* | Needs Additional Monitoring |
| **19** | Noyes Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **20** | Tenney Pond | Aesthetics | B(1)* | Needs Additional Monitoring |
| **21** | Round Pond | Aesthetics | B(1)* | Needs Additional Monitoring |
| **22** | Long Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **23** | Blodget Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **25** | Miller Pond | Aesthetics | A(1)* | Needs Additional Monitoring |
| **27** | Mud Pond (Thetford) | Aesthetics | B(1)* | Needs Additional Monitoring |
| **31** | Lake Abenaki | Aesthetics | A(1)* | Needs Additional Monitoring |
| **32** | Norford Lake | Aesthetics | A(1)* | Needs Additional Monitoring |

## Class 1 Wetland Designation

It is policy of the State of Vermont to identify and protect significant wetlands and the values and functions they serve in such a manner that the goal of no net loss of such wetlands and their functions is achieved. Based on an evaluation of the extent to which a wetland provides functions and values, it is classified at one of three levels:

- **Class 1**: Exceptional or irreplaceable in its contribution to Vermont's natural heritage and therefore, merits the highest level of protection
- **Class 2**: Merits protection, either taken alone or in conjunction with other wetlands
- **Class 3**: Neither a Class 2 or Class 1 wetland

Impacts to Class 1 wetlands may only be permitted when the activity is necessary to meet a compelling public need for health or safety. The VT Wetlands Program has created a Class 1 website with an interactive map. This website includes the determinations for nine Class 1 wetlands: Dorset

Marsh, Northshore Wetland, Tinmouth Channel, Chickering Fen, Dennis Pond Wetlands, Sandbar Wetlands, Peacham Bog, LaPlatte River Wetlands, and Beaver Meadows Wetland. The last six wetlands were added since 2016.

In 2017 Peacham Bog was designated as a Class 1 wetland. Nine wetlands have been identified for further study for Class 1 wetland designation (Figure 12). VDEC supports the further study and petitioning of these nine wetlands. The VT Wetlands Program welcomes recommendations for Class 1 candidates.

## Wetlands for Further Study for Class 1 Designation

- Stoddard Swamp – Peacham
- Roy Mountain Swamp – Barnet
- Stillwater Brook Wetlands – Groton
- Beaver Brook Wetlands – Groton
- Lower Symes Pond – Ryegate
- Cookville Swamp – Corinth
- Gillette Swamp – Thetford
- Conant Swamp – Thetford
- Zebedee Brook Wetlands – Thetford

As part of the implementation of this tactical basin plan, the Department will develop and implement procedures and documents to enable submission, evaluation, and implementation of petitions to classify wetlands as Class 1. Those wetlands that satisfy criteria for designation may be proposed for such designation through departmental rulemaking authority, and as consistent with the Vermont Wetland Rules.

**Table 7. Class 1 wetlands candidates that require additional monitoring to determine their status, and their corresponding map identification number in Figure 12.**

| Map # | Name | Protection Level | Use | Status |
|---|---|---|---|---|
| **1** | Stoddard Swamp | Class 1 | Wetland | Needs further study |
| **9** | Stillwater Brook Wetlands | Class 1 | Wetland | Needs further study |
| **12** | Roy Mountain Swamp | Class 1 | Wetland | Needs further study |
| **14** | Beaver Brook Wetlands | Class 1 | Wetland | Needs further study |
| **16** | Lower Symes Pond | Class 1 | Wetland | Needs further study |
| **24** | Cookeville Swamp | Class 1 | Wetland | Needs further study |
| **28** | Conant Swamp | Class 1 | Wetland | Needs further study |
| **29** | Zebedee Brook Wetlands | Class 1 | Wetland | Needs further study |
| **30** | Gillette Swamp | Class 1 | Wetland | Needs further study |

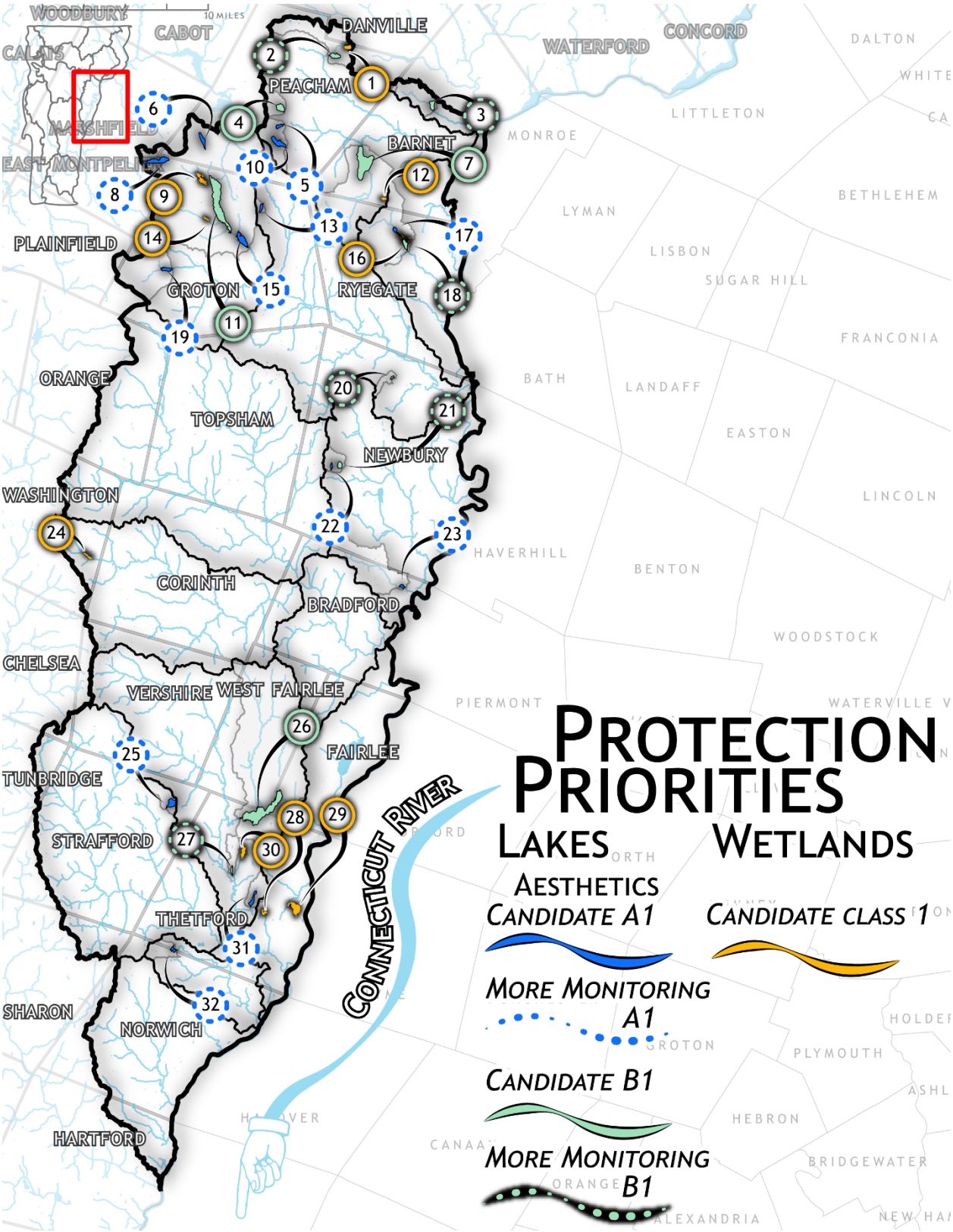



**Figure 12. Map of Class 1 wetlands candidates, B(1) lake candidates for aesthetics, and potential A(1) and B(1) lake candidates for aesthetics in Basin 14.**

# Warm and Cold-Water Fish Habitat Designations

## Warm Water Fish Habitat

All surface water wetlands and the following waters are designated as warm water fish habitat for purposes of the Vermont Water Quality Standards:

- Halls Lake, Newbury
- Harriman Pond, Newbury
- Lake Abenaki, Thetford
- Lake Morey, Fairlee
- Lower Symes Pond, Ryegate
- Ticklenaked Pond, Ryegate
- Waits River from the CVPS Dam in Bradford to its confluence with the Connecticut River – June 1 to September 30

The VWQS specify a lower minimum dissolved oxygen concentration for Warm-Water Fish habitat than waters in the remainder of the basin, which are Cold-Water Fish Habitat. There are no proposed changes to warm water fish habitat designations currently.

## Cold-Water Fish Habitat

All waters not designated as warm water fish habitat above are designated as Cold-Water Fish Habitat for Basin 14, as noted in the Vermont Water Quality Standards (Vermont Department of Environmental Conservation, 2017).

# Outstanding Resource Waters Designation

Vermont Act 67 ("An Act Relating to Establishing a Comprehensive State Rivers Policy," 1987) provides protection to rivers and streams that have "exceptional natural, cultural, recreational, or scenic values" through the designation of Outstanding Resource Waters (ORW). ORW designation may protect exceptional waters through permit conditions in stream alterations, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects, and other activities. ORWs are waters which can be designated by the VANR through a petition process. A portion of the Ompompanoosuc River, called the Great Falls, in the Town of Thetford, was designated in 1996 on the basis of its exceptional recreational, cultural, scenic and natural values. This portion of river starts just downstream of the confluence of the drainages from Gillette Swamp and Mud Pond and ends at the confluence of the Ompompanoosuc with the West Branch, 3.8 miles downstream. This site was designated after a stay on a license to construct and operate a hydroelectric facility was lifted and terminated as a result of the support of this designation. This area continues to provide the values it was designated for in 1996.

There are currently no waters recommended for ORW designation in Basin 14. Although no other waters have been identified as ORW in this plan, there may be waters in the basin which merit this designation and for which ORW status should be pursued. The Agency will support collaborative efforts to develop the materials, and to conduct outreach necessary to support rulemaking for ORW designation of these waters, should there be public interest.

## B. Identification of Existing Uses

The VANR 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 VANR may identify an existing use as Class B(1) when that use is demonstrably and consistently attained.

The VANR stipulates that all lakes and ponds in the basin have existing uses of swimming, boating, and fishing. The VANR recognizes that fishing activities in streams and rivers are widespread and too numerous to thoroughly document for Basin 14. In the case of streams too small to support significant fishing activity, the VANR 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 in Basin 14 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. The existing uses in Basin 14 of swimming, boating, fishing, and drinking water supply are found at: https://dec.vermont.gov/water-investment/watershed-planning/tactical-basin-planning/basin14. The public is encouraged to recommend waters for existing uses of swimming, boating, fishing, drinking water, and ecological significance given that they provide evidence of such use. For existing uses of waters, the level of water quality necessary to protect those existing uses shall be maintained and protected regardless of the water's classification (VDEC, 2017).

# Chapter 3 – Priority Areas for Surface Water Restoration

## A. Stressed or Impaired Surface Waters

The VDEC monitors and assesses the chemical, physical, and biological status of individual surface waters to determine if they meet the VWQS per the 2019 Vermont Surface Water Assessment and Listing Methodology (Vermont Department of Environmental Conservation, 2019). Surface waters are assessed as: full support, stressed, altered, or impaired. To address Section 303(d) of the Federal Clean Water Act, the VDEC develops the 303(d) List of Impaired Waters, which includes impaired lakes, ponds, rivers, and streams that do not meet VWQS.

The State also produces the Priority Waters List, which identifies other waters that do not meet water quality standards, but do not require a TMDL. Sections of that list include: Part B- impaired waters that have other required remediation measures in place; Part D-impaired waters with TMDLs in place; Part E-waters altered by AIS; and Part F-waters altered by flow modifications. These lists can be viewed on the VDEC Assessment and Listing webpage. For a more detailed description of monitoring results use the Vermont Integrated Watershed Information System (IWIS) online data portal. Figure 13 and Table 8 show the known stressed, impaired, or altered waterbodies in Basin 14.

A primary goal of the plan is to identify and address pollutants degrading the listed waters with strategies listed in the Chapter 5 Implementation Table. The types of strategies prescribed are based on the sector-specific practices outlined in the Vermont Surface Water Management Strategy.

## Updates to Listing

The Wells River in Newbury was recommended to be removed from the stressed waters listing in 2020. The seeps that contribute to the river continue to exhibit significant iron precipitate but monitoring along the mainstem of the Wells shows no signs of impairment in water quality or biology related to the seeps. VDEC will continue to monitor the status of the seeps from the closed Newbury Landfill and the closed CPM Landfill (old paper sludge site).

Ticklenaked Pond in Ryegate was recommended to be removed from Vermont's 303(d) Part D impaired waters list. A number of water quality best management practices were implemented in the watershed to decrease external phosphorus loading from agricultural lands, public and private roads, and shorelines. The implementation of the practices were followed by an alum treatment to bind phosphorus in lake bottom sediments in 2015. The watershed practices in conjunction with the alum treatment have improved water quality over the past five years. Monitoring and implementation will continue in this watershed to ensure trends continue in a positive direction. See more details on this work in the TMDL section in this Chapter (3).

For updates on Pike Hill Brook, Copperas Brook, and Schoolhouse Brook see actions 40, 50, and 51 in Table A1 in Appendix A.

**Table 8. Basin 14 priority waters and pollutants. This table corresponds with Figure 13 map numbers.**

| Map # | Name | Pollutant/Problem | List |
|---|---|---|---|
| 1 | Ewell Pond | Organic enrichment, anoxic hypolimnion | Stressed |
| 2 | Harveys Lake | Dam alters aquatic habitat | Flow |
| 3 | South Peacham Brook, Stevens River | Dam alters aquatic habitat | Flow |
| 4 | Ricker Pond | Low pH, acid deposition | Stressed |
| 5 | Osmore Pond | Low pH, acid deposition | Stressed |
| 6 | Groton Pond | Low pH, acid deposition | Stressed |
| 7 | Levi Pond | Low pH, atmospheric deposition | TMDL |

| Map # | Name | Pollutant/Problem | List |
|---|---|---|---|
| **8** | Kettle Pond | Low pH, acid deposition | Stressed |
| **9** | Noyes Pond | Low pH, acid deposition | Stressed |
| **10** | Ticklenaked Pond | Phosphorus, agricultural runoff | TMDL |
| **11** | Wells River, below dam at Boltonville | Poor flow in dam bypass segment | Flow |
| **12** | Tabor Branch Tributary # 6 | Agricultural runoff | 303(d) |
| **13** | Round Pond (Newbury) | Eurasian Watermilfoil (EWM) | Stressed |
| **14** | Cookville Tributary #4 | Acid mine drainage, Pike Hill Mine | 303(d) |
| **15** | Pike Hill Brook | Metals, Pike Hill Mine drainage | 303(d) |
| **16** | Halls Pond | EWM, sedimentation, variable-leaved milfoil | Stressed |
| **17** | Waits River, below Bradford Dam | Poor flow in dam bypass segment | Flow |
| **18** | Waits River, South Branch to Tabor Branch | Temperature, physical alteration | Stressed |
| **19** | Waits River, Below South Branch | Temperature, sedimentation | Stressed |
| **19** | Ompompanoosuc River, USACOE Beach to Brimstone Corner | *E. coli*, unknown sources | TMDL |
| **20** | Schoolhouse Brook and Tributary | Metals, acid mine drainage, Ely Mine | 303(d) |
| **21** | Lake Morey | Organic enrichment | Stressed |
| **21** | Lake Morey | Eurasian Watermilfoil | Exotics |
| **22** | Copperas Brook | Metals, Elizabeth Mine | 303(d) |
| **23** | Lords Brook, Tributary #2, and Tributary #1 of Tributary # 2 | Metals, “South Cut” and “South Mine” | 303(d) |
| **24** | Lake Fairlee | Organic enrichment, phosphorus, sedimentation | Stressed |
| **24** | Lake Fairlee | Eurasian Watermilfoil | Exotics |
| **25** | Mud Pond (Thetford) | Low pH, acid deposition | Stressed |
| **26** | CT River, Above Wilder Dam to Bradford | Water level fluctuation erodes streambanks | Flow |

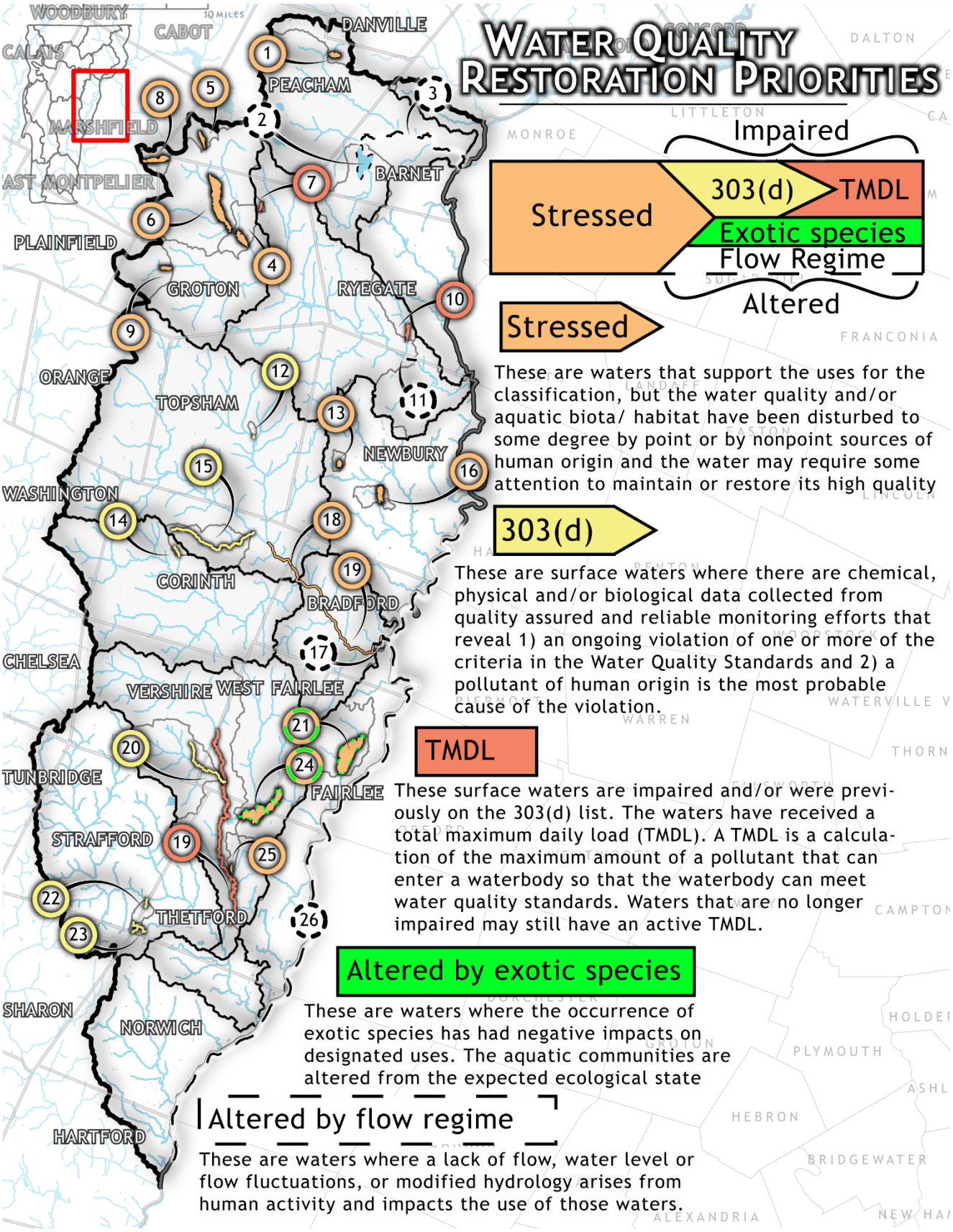



Figure 13. Priority areas for restoration in Basin 14.

## B. Basin Specific Total Maximum Daily Loads (TMDLs)

A Total Maximum Daily Load or TMDL is the calculated maximum amount of a pollutant that a waterbody can receive and still meet Vermont Water Quality Standards. In a broader sense, a TMDL is a plan that identifies the pollutant reductions a waterbody needs to meet Vermont's Water Quality Standards and develops a means to implement those reductions. 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 needed pollution reductions.

TMDLs for Basin 14 include:

- 2004 TMDL for 7 Acid Impaired Lakes in Vermont
- Vermont Statewide Total Maximum Daily Load (TMDL) for Bacteria-Impaired Waters
    - Bacteria TMDL Ompompanoosuc River
- Long Island Sound (LIS) Dissolved Oxygen TMDL
- Northeast Regional Mercury Total Maximum Daily Load
- Ticklenaked Pond TMDL

### Long Island Sound TMDL

The Long Island Sound Dissolved Oxygen TMDL released in 2000 is designed to address low dissolved oxygen or hypoxia in Long Island Sound bottom waters. It is often referred to as the Connecticut River Nitrogen TMDL because it is linked to an overabundance of nitrogen discharging into the Sound from the Connecticut River and other tributaries. While nitrogen is essential to a productive ecosystem, too much nitrogen fuels the excessive growth of algae. When the algae die, they sink to the bottom, where they are consumed by bacteria. The microbial decay of algae and the respiration of these organisms use up the available oxygen in the lower water column and in the bottom sediments, gradually reducing the dissolved oxygen concentration to unhealthy levels (New York State Department of Environmental Conservation; Connecticut Department of Environmental Protection, 2000).

In 2013 a Vermont-specific section, the Vermont Enhanced Implementation Plan for the Long Island Sound TMDL, was added to the LIS-TMDL to address four goals:

1. To identify the Vermont sources of nitrogen as they are currently understood, across broad land use sectors, such as developed, agricultural and forested;
2. To identify the status and trends of important drivers of nitrogen export such as the intensity of agricultural and development activities and investigate how these might have changed since the TMDL baseline period of 1990;
3. To identify the management programs, operating at that time, that address these drivers of nitrogen loading that have a significant effect on reducing or preventing nitrogen export. A part of this is to identify a timeline as to when programs were initiated or enhanced; and

4. Using a weight-of-evidence approach, to assess the combined management programs/projects to develop a qualitative evaluation as to whether management efforts are sufficient to meet the original 2000 TMDL of a 10% non-point source nitrogen reduction and if these strategies are sufficient to maintain that control into the future (Vermont Department of Environmental Conservation, 2013).

Vermont nitrogen watershed export to LIS is estimated to be about 4% of the total load to the Sound (Vermont Department of Environmental Conservation, 2013). Approximately 14% of Vermont's estimated 4% nitrogen export to the LIS comes from Basin 14. Basin 14 delivers less than 1% from municipal wastewater treatment, 12% from developed land runoff, 10% septic system effluent, and 18% from agriculture through nitrogen fixing crops (0.1%), farm fertilizer (3.8%), and manure (14.1%) (Figure 14) (Astor, 2019). Approximately 60% of nitrogen from Basin 14 comes from atmospheric deposition (Astor, 2019). Efforts to reduce atmospheric deposition have been occurring at the national level through the 1990 Clean Air Act and its amendments. Total nitrogen deposition has declined since 1985 (NADP, 2018).

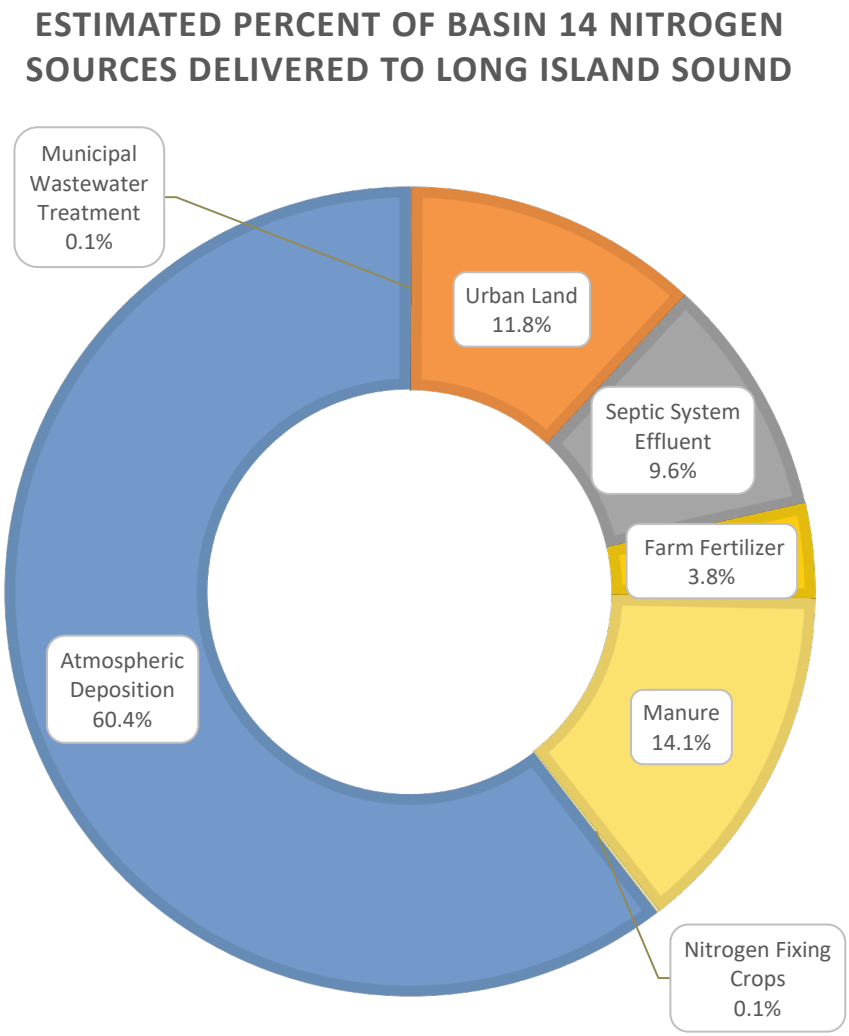



**Figure 14. Estimated percent of nitrogen sources delivered to the Long Island Sound from Basin 14 (Astor, 2019).**

In 2017, EPA embarked on its Nitrogen Reduction Strategy to investigate and better define control strategies to reduce nitrogen in the Long Island Sound. Information on the most current developments and strategies can be found in EPA's Long Island Sound Study.

The sources of nitrogen to be addressed in Vermont include wastewater discharges, agricultural lands, developed lands, and forest practices. The adoption of Vermont's Act 64 – the Vermont

Clean Water Act – helps implement overarching strategies and steps required to meet loading reductions for the Long Island Sound's TMDL.

In addition, the Long Island Sound Watershed Regional Conservation Partnership Program (LISW-RCPP) was created in 2015 across six states to coordinate the development and implementation of a comprehensive working lands program with foci on: 1) nutrient management and soil health, 2) protection of non-industrial forest habitat, biodiversity, and drinking water sources, and 3) stream erosion and flood resiliency improvements on working lands through riparian restoration. In partnership with the Vermont Association of Conservation Districts (VACD), UVM Extension, the Connecticut River Conservancy, The Nature Conservancy and federal, state and local organizations in VT, NH, MA, CT, NY and RI, ten million dollars is being invested in the adoption of best management practices on private working lands, providing both technical and financial assistance (Connecticut Council on Soil and Water Conservation, 2015).

## Ticklenaked Pond TMDL

The 2009 Ticklenaked Pond TMDL continues to be carried out. Water quality practices have been applied in the watershed to treat runoff from developed and agricultural lands. The alum treatment was applied in 2015 and has so far been successful in reducing algae blooms, increasing water transparency, and reducing total phosphorus (TP) in the water column. Continued efforts to reduce phosphorus loading from the watershed are necessary to ensure the longevity of this treatment. One toxic algae bloom was reported in August of 2017 after a particularly rainy summer and storm event in July 2017 that resulted in the discharge of sediment into the pond. Overall TP levels in spring and summer have been decreasing since the treatment. As a result, the pond is up for consideration for removal from Vermont's 303d Part D impaired waters list. VDEC continues to monitor the pond and to support a lay monitor for the summer months. VDEC has also partnered with CCNRCD to monitor the Scotch Burn tributary streams to track agricultural runoff. The Ticklenaked Pond Association has continued to stay engaged on the water quality condition of the lake. In 2018, VDEC and the VDOH presented to the Ryegate Select Board and coordinated with the town to publish cyanobacteria warnings on their website and recruit cyanobacteria volunteer monitors. The Ticklenaked Pond Association hosted a presentation delivered by VDEC and CCNRCD describing the results of the watershed implementation and alum treatment in 2019. The Lake Wise Program will assess sites on the lake in the summer of 2020 to identify best management practices to protect aquatic habitat and water quality.

## Ompompanoosuc River Bacterial TMDL

The Ompompanoosuc River in Fairlee and Thetford, is listed as impaired by pathogenic bacteria, indicated by the presence of *E. coli*, which is an indicator of difficult to detect disease causing microbes. Bacterial impairments result in negative impacts to public health and water-based recreation. *E. coli* lives in the intestines of warm-blooded animals and originate from humans and animals – pets, livestock, and wildlife. Human produced communities of *E. coli* are introduced into

surface waters from substandard septic systems, runoff from incorrectly applied manure, and runoff from neglected pet waste.

The bacteria listed segment of the Ompompanoosuc extends 9.8 miles from Brimstone Corner in Vershire to the USACOE Sandy Beach area at the Union Village Dam in Thetford. Initial monitoring of this section of river for *E. coli* and other pollutants was conducted in 2006 and 2007. The Ompompanoosuc River Bacterial TMDL was developed in 2011. A small number of practices recommended in the 2011 TMDL were implemented between 2011 and 2015. Follow up monitoring was conducted in 2015 to measure any changes as a result of best management practices implemented in the impaired stretch of the watershed. Monitoring was conducted during the summer months and a significant reduction in *E. coli* communities between the two monitoring efforts was not observed. However, the levels of *E. coli* communities increased significantly from Vershire in the Village of West Fairlee. Land use also intensifies along the river within that corridor. More information about the monitoring results can be found in 2019 Basin 14 Assessment Report.

VDEC, watershed partners, and local stakeholders continue to implement the Ompompanoosuc bacteria TMDL by identifying and remediating potential agricultural and septic sources through nutrient management planning and septic surveys, and intercepting runoff before it enters the river by expanding and conserving riparian buffers and floodplains. Specific actions focused on the Ompompanoosuc are found in the Implementation Table section of Chapter 5. A team of collaborators met in April of 2020 to reassess ongoing efforts and develop a list of actions items. The primary focus of the group is to identify funding or other opportunities for source identification using PhyloChip technology to identify where the *E. coli* communities are originating from and then targeting actions to address the sources. Because source tracking is complicated and expensive, the group will continue to pursue additional avenues that result in overall water quality improvement to the Ompompanoosuc River with co-benefits like enhanced riparian habitat, stormwater runoff interception, and reductions in land and stream channel erosion.

# Chapter 4 – Strategies to Address Pollution by Source Sector

Tactical basin plans address water quality by sector as summarized in the following sections which are consistent with the Clean Water Initiative Program's 2019 Performance Report (Vermont Agency of Natural Resources, 2019). The following sections provide specifics about protection and restoration efforts underway or recommended for each source sector. A summary table of the strategies for each sector is found in the Executive Summary in Table 1. A more detailed list of priority strategies by source sector is included in Chapter 5 in the Implementation Table Summary.


### *Agriculture*

- Conservation practices that reduce sources of pollution from farm production areas and farm fields.


### *Developed Lands--Stormwater*

- Practices that reduce or treat polluted stormwater runoff from developed lands, such as parking lots, sidewalks, and rooftops.


### *Developed Lands--Roads*

- Stormwater and roadside erosion control practices that prevent erosion and treat road-related sources of pollution.


### *Wastewater*

- Improvements to municipal wastewater infrastructure that decrease pollution from municipal wastewater systems through treatment upgrades, combined sewer overflow (CSO) abatement, and refurbishment of aging infrastructure.


### *Natural Resource Restoration*

- Restoration of "natural infrastructure" functions that prevent and abate pollution. Natural infrastructure includes: floodplains, river channels, lakeshores, wetlands, and forest lands.

## A. Agriculture

Agricultural land use makes up approximately nine percent of the land cover in Basin 14 (Figure 15). One percent is cultivated crop and eight percent is hay or pasture. The highest concentrations of agricultural land are found in the Connecticut direct tributary watersheds except for the Stevens River watershed. The concentrations range from 11% of total land area used for agriculture to 25%. An analysis comparing implemented field practice acres (FY2016-2019) to agricultural concentrations (LULC 2016) in the sub-basins showed that field practice acreage was highest in the areas with the highest concentrations of agriculture. Two areas with higher agricultural land cover concentrations, but low field practices were the Norwich Direct Drainage and the Barnet and Upper Ryegate Direct Drainage. The higher level of cumulative agricultural intensity in these sub-basins make them a priority for outreach and implementation of agronomic and farmstead practices for water quality. The Stevens River Drainage exhibits the highest density of farms and is an also a priority for outreach and implementation for the Long Island Sound TMDL. Additional assessments through inspections and voluntary farm visits will help to locate areas for targeted action.

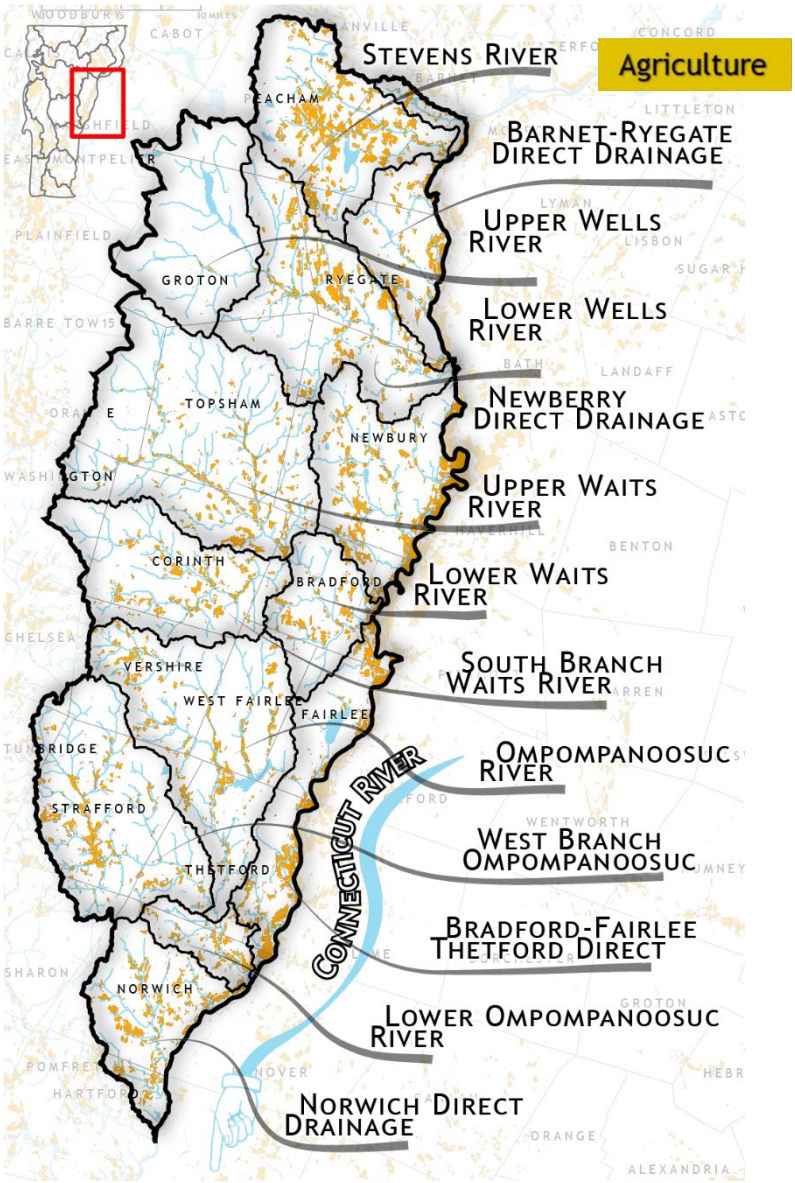



Figure 15. Agricultural land cover in Basin 14. For a comparative view of agricultural land cover to other major land cover types, follow this link to the landcover map in Chapter 1.

There are two Large Farm Operations (LFOs) and four Medium Farm Operations (MFOs) permitted in Basin 14. LFOs are inspected annually and

MFOs are inspected once every three years by the Agency of Agriculture Food and Markets (VAAFM). These farms must comply with the Required Agricultural Practices (RAPs), LFO and MFO permitting program requirements, and Vermont's Water Quality Standards.

An estimated twelve Certified Small Farm Operations (CSFOs), 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. By the writing of this plan, twelve CSFOs have submitted certifications in accordance with the RAPs.

The VAAFM estimates there are thirty-five Small Farm Operations (SFOs) in the Basin that do not meet the thresholds of a CSFO or are required to receive a routine inspection by VAAFM, but still need to comply with the RAPs. Additionally, there are an estimated 113 water quality points in Basin 14 that indicate areas where farming historically occurred, prior farms that sold, current vegetable farms, and other characteristics that imply agricultural use current or historic. These locations, if active, may fall below the RAP thresholds.

From state fiscal year 2016 to 2019, VAAFM dedicated over $432,000 in Basin 14 to agricultural equipment and pollution prevention implementation through the Capital Equipment Assistance Program (CEAP), Best Management Practice Program (BMP), Farm Agronomic Practice program (FAP), and Conservation Reserve Enhancement Program (CREP) (Table 9). CSFO inspections (once every seven years) that verify compliance with the RAPs started in Basin 14 in 2016. The goal for each VAAFM inspector, who cover multiple basins, is to inspect at least twenty-five CSFOs per field season. As of the writing of this plan, thirty-three percent of CSFOs in Basin 14 have received routine inspections by VAAFM. Meet and greets to CSFO and SFO farmers will occur on an on-going basis throughout the year. Outreach will need to continue throughout the watershed to the remaining farms or locations to help landowners understand where they fall within the RAP farm categories and to help them understand the requirements under the RAPs.

**Table 9. Completed agricultural practices in Basin 14 funded by VAAFM between SFY2016-2019.**

| Practices | Practice Count | VAAFM Funding |
|---|---|---|
| Access Road | 1 | $ 7,300 |
| Cover Crop | 9 | $ 23,080 |
| Cover Crop and Field Improvement Equipment - No-Till Grain Drill | 1 | $ 27,000 |
| Diversion | 2 | $ 9,227 |
| Heavy Use Area Protection | 4 | $ 115,969 |
| Livestock Exclusion | 3 | $ 2,394 |
| Riparian Forest Buffer | 4 | $ 19,596 |
| Roof Runoff Management | 1 | $ 2,076 |
| Solid/Liquid Waste Separation Facility | 1 | $ 68,199 |
| Waste Storage Facility | 1 | $ 49,000 |
| Waste Storage Structure | 2 | $ 83,992 |
| Waste Treatment - Milk House Waste | 3 | $ 24,455 |
| **Grand Total** | **32** | **$ 432,288** |

VAAFM is also coordinating with agricultural partners throughout the watershed to streamline outreach to farmers where multiple resources may be available through the Multi-Partner Agricultural Conservation Practice Tracking and Planning Geospatial Database (Partner Database) launched in 2019. This coordination ensures no duplicative strategies and reduces confusion for farmers when dealing with multiple organization. VAAFM provides a spectrum of assistance programs and resources (both technical and financial) that are available to farmers to improve agricultural practices that increase farm viability and protect water quality. These resources can be found at: https://agriculture.vermont.gov/water-quality/assistance-programs.

The USDA Natural Resources Conservation Service (NRCS) also provides a spectrum of assistance programs and resources for farmers to improve agricultural practices that increase farm viability, protect water quality, and improve soil health. These resources can be found at: https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/

The White River (WR) and Caledonia County (CC) Natural Resource Conservation Districts (NRCDs) are strong non-regulatory agricultural partners in Basin 14. Since the last plan was published in 2015 both districts have been actively pursuing strategies to improve water quality in the basin in relation to agricultural activities. CCNRCD has been actively involved with nutrient management planning for farms in Caledonia County. WRNRCD works with the Connecticut River Watershed Farmers Alliance, a farmer-based watershed group for the Connecticut River Basin. WRNRCD helps CRWFA manage their No-Till Drill rental program, which has been very successful. CRWFA is a member-based organization that holds workshops on cover cropping, farms tours to observe good stewardship practices, provides resources to help farmers learn more about agricultural topics, and collaborates with related organizations throughout the watershed.

UVM Extension and the Center for Sustainable Agriculture provide farm focused technical assistance related to soil health and water quality in Basin 14. UVM Extension staff also work closely with CRWFA. They perform one on one assistance and offer outreach and workshops. They work on nutrient management planning, crop and soil fertility issues, no till, pest management, and hay ground revitalization. Some water quality monitoring was completed in 2019 in Bradford focusing on tile drainage.

Watershed and agriculture partners in Basin 14 convened to collaborate on agriculture and water quality issues during the development of this plan. Their feedback and recommendations for agricultural strategies for watershed health are found in the implementation table in Chapter 5.

# B. Developed Lands

## Stormwater

This section integrates basin-specific information on stormwater-related water resource impairments, regulatory programs, stormwater master plans, Illicit Discharge Detection and Elimination (IDDE) studies, existing implementation efforts and partnerships to inform strategies to address stormwater-related water resource impairments. 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 BMPs to meet the state's clean water goals including reductions to support the Long Island Nitrogen TMDL. The section is organized around the 3-acre operational permit, stormwater master planning and IDDE studies which are the primary drivers for voluntary implementation efforts in the basin.

### *Draft General Permit 3-9050 (Three-Acre General Permit)*

Draft General Permit 3-9050 is a permit for stormwater runoff from impervious surfaces. It is an important component of the Vermont Clean Water Act of 2015 (Act 64) and is designed to assist in the implementation of clean-up efforts in Lake Champlain, Lake Memphremagog, and stormwater-impaired waters, while also protecting high quality surface waters statewide.

This general permit covers all operational stormwater permitting, including new development, redevelopment, and permit renewal. Additionally, this general permit serves as the "Three-Acre General Permit" as required under the Vermont Clean Water Act.

Parcels in the Connecticut River watershed, including Basin 14, will need to apply for permit coverage by 2033. Since this date is well beyond the timeframe for this plan, voluntary stormwater efforts through stormwater master planning are likely to be the primary drivers for stormwater implementation efforts for this planning cycle.

### *Stormwater Mapping and Master Planning*

Stormwater infrastructure mapping projects are completed for municipalities by the Vermont Clean Water Initiative Program to supplement the existing drainage data collected by towns and with the intention of providing a tool for planning, maintenance, and inspection of the stormwater infrastructure. Stormwater mapping reports were completed for significant areas of fourteen towns in Basin 14 (Table 10). The reports can be found at: https://dec.vermont.gov/water-investment/cwi/solutions/developed-lands/idde.

The reports and maps from each project are meant to provide an overall picture and understanding of the connectivity of the storm system on both public and private properties to raise the awareness of the need for regular maintenance. These reports identify potential priority projects in the study areas and provide information necessary to develop a stormwater master plan. The highlighted projects can be completed separately or in conjunction with the development of a stormwater master plan.

Projects identified as high priority in the stormwater mapping reports may be implemented by towns with the aid of Regional Planning Commissions or other partners where necessary. Those towns with significant development should consider developing a stormwater master plan, while a multi-town stormwater masterplan can be developed for smaller towns. No Stormwater Master Plans (SWMPs) have been completed in Basin 14. Three towns in Basin 14 – Hartford, Newbury, and Bradford – are recommended to complete SWMPs using the stormwater mapping reports for reference. The remaining eight towns that had projects identified in stormwater mapping reports are recommended for single project implementation (Table 10). These towns should determine which projects they can pursue and move towards completing single or batch preliminary designs for those projects identified in Basin 14.

**Table 10. Towns with completed stormwater mapping reports ranked by number of high priority projects identified in the mapping report. Click on the town to link to report.**

| Town Name* | Year Completed | Recommendations for Implementation | Number of High Priority Projects Identified | |
|---|---|---|---|---|
| | | | Highest | High |
| **Hartford** | 2015 | SWMP | 9 | 5 |
| **Newbury** | 2014 | SWMP | 6 | 5 |
| **Bradford** | 2014 | SWMP | 3 | 2 |
| Topsham | 2018 | Single projects | 2 | 0 |
| Strafford | 2018 | Single projects | 2 | 1 |
| Norwich | 2014 | Single projects | 2 | 1 |
| Barnet | 2017 | Single projects | 1 | 0 |
| Ryegate | 2014 | Single projects | 1 | 0 |
| Corinth | 2018 | Single projects | 1 | 0 |
| Fairlee | 2014 | Village SWMP to be completed in 2022 | 1 | 0 |
| Thetford | 2018 | Single Projects | 1 | 0 |
| Groton | 2014 | No projects identified | 0 | 0 |
| West Fairlee | 2015 | No projects identified | 0 | 0 |
| Vershire | 2018 | No projects identified | 0 | 0 |

*Towns with mapping that do not have stormwater infrastructure in Basin 14 were not included. **SWMP** = Stormwater Master Plan.

## *Illicit Discharge Detection & Elimination Studies*

In 2000, the Vermont Legislature required VDEC to implement a statewide program to promote detection and elimination of improper or illegal connections and discharges. Illicit discharges are discharges of wastewater or industrial process water into a stormwater-only drainage system. All towns in Basin 14 except Orange and Peacham have completed IDDE reports. The outcomes of these studies are listed in four reports:

- Detecting and Eliminating Illicit Discharges in the Upper and Middle Connecticut River Basin: Final Report (2017)
- White River Basin - Illicit Discharge Detection and Elimination Study - Final Report (2018)
- Statewide Contract No 2 Illicit Discharge Detection and Elimination Study: Final Report (2019)
- Statewide Contract No 3 Illicit Discharge Detection and Elimination Study: Final Report (2020)

In the Basin 14 watershed, problems were found only in Groton, Thetford, and West Fairlee. In Groton, a commercial sewer lateral to stormwater was corrected by the town and a suspect septic was check by and engineer and found to be okay. In West Fairlee, a suspect pipe was found with high methylene blue active substances assay which indicates a soap discharge. This discharge was investigated, and the investigation was inconclusive.

## Vermont Green Infrastructure Toolkit

Stormwater runoff from developed lands, including the road network, is one of the greatest threats to water quality in Vermont. Stormwater runoff is any form of precipitation that flows over the land during or after a storm event or because of snowmelt. On undeveloped lands, a portion of this runoff is absorbed into the ground through infiltration and the rest takes a relatively slow path to nearby rivers, lakes, and ponds. On developed lands, however, infiltration is reduced by impervious surfaces such as roads, rooftops, and driveways, which also increases the velocity and volume of polluted 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 recreation sports and contaminated drinking water.

Many of the stormwater issues associated with developed lands can be mitigated and prevented using Low Impact Development (LID) and Green Stormwater Infrastructure (GSI) systems and practices. These emerging 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 (VAPDA) and the Vermont Agency of Natural Resources' Water Investment Division. The toolkit is a clearinghouse of information useful to Vermont municipalities to explore how to promote the adoption of Green Infrastructure policies and practices to combat the problems caused by urban, suburban and rural stormwater runoff.

## Roads

### *Road Erosion Inventories*

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

- identify sections of local roads in need of sediment and erosion control,
- rank road segments that pose the highest risks to surface waters, and
- estimate costs to remediate those sites using Best Management Practices.

REI's are required by the Municipal Roads General Permit (MRGP) as part of the Road Stormwater Management Plan. The MRGP is intended to achieve significant reductions in stormwater-related erosion from municipal roads, both paved and unpaved. Municipalities will implement a customized, multi-year plan to stabilize their road drainage system. The plan will include bringing road drainage systems up to basic maintenance standards, and additional corrective measure to reduce erosion as necessary to meet a TMDL or other water quality restoration effort. The permit is required by the Vermont Clean Water Act (Act 64) and the Lake Champlain Phase I TMDL.

The implementation of the priorities identified in REI's will reduce sediment, phosphorus and other pollutants associated with stormwater-related erosion generated from unpaved municipal roads that contribute to water quality degradation. 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 "Municipal Road Theme" on the ANR Natural Resource Atlas and REI results by town can be view in the MRGP Implementation Table.

Based on protocols developed by VDEC with the assistance of the regional planning commissions, all of the towns in Basin 14 have completed or plan to complete REIs by 2020 (Table 11). Road segments that do not meet standards and are on a steep slope are priorities for water quality protection.

**Table 11. Status of towns with Road Erosion Inventories, now required by the Municipal Road General Permit.**

| REI Status | Complete | Completed 2016 (not in online database) | Planned (2020) |
|---|---|---|---|
| **Towns** | Hartford (6), Norwich (1), Thetford (3), West Fairlee (1), Topsham (9), Newbury (0), Groton (14), Ryegate (2), Peacham (9), Barnet (27), Orange (9) | Corinth, Strafford | Washington, Bradford |

**Number of very high priority segments in parentheses.**

This plan recommends that technical and financial assistance be prioritized for interested towns based on the water quality benefit of a project. Projects that "do not meet standards" and are in sub-basins with sediment impairments related to road stormwater runoff are water quality priorities such

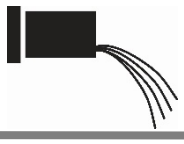
as the Harveys Lake Watershed in Barnet, the town of Groton, and the Waits River from the confluence of the South Branch in Bradford. Resources available from the Clean Water Fund (e.g. VDEC Grant-in-Aid and VAOT Better Roads grants) assist with development of designs, capital budgets, cost estimates and implementation of road projects. Completion of these projects may be counted towards meeting the requirements of the MRGP. The MRGP requires towns to bring 15% of non-compliant roads up to MRGP standards by December 31, 2022 and report their progress to VDEC annually. For additional information see the VDEC Municipal Roads Program.

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 VAOT 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.

Managing for road runoff in the upper catchments will lessen the pressure on the areas receiving larger contributions of runoff. Waters being stressed or impaired lower in the watershed does not negate the need for action high 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 because of cumulative impacts. For this reason, road BMPs for water quality are recommended basin wide.

### Stormwater Projects Outcomes in Basin 14

Water quality projects implemented in Basin 14 between 2016 and 2019 were focused on road projects. No non-road stormwater projects were completed using state funds. A total of 60 projects were funded and implemented by the State of Vermont in SFY2016-2019. Fifty-six of those projects were implementation projects and four were for assessment and planning for road erosion and culvert inventories. Corinth was the most active town with twelve projects funded for roads. All towns in Basin 14 have received funding to complete road related water quality projects from the State of Vermont.



## C. Wastewater

### Wastewater Treatment Facilities (WWTF)

There are two municipal wastewater treatment facilities that are subject to NPDES discharge permits in the basin (Table 12). These facilities are subject to State of Vermont issued NPDES permits.

An overarching consideration for the issuance of permits in the Basin 14 planning basin is the Long Island Sound TMDL for nitrogen. This multi-state TMDL has been promulgated with interim waste load and nonpoint source nitrogen load allocations. As of the issuance of this Plan, all facilities are operating under permits developed under a nitrogen permitting strategy whereby all Vermont WWTFs ultimately discharging to the Connecticut River must, collectively, discharge no more than 1,727 lbs. TN/day. Each individual facility has a unique total nitrogen (TN) loading limit. In addition to the nitrogen loading limit, WWTFs are required to develop optimization plans for maximizing nitrogen removal and regularly monitor for nitrogen compounds.

As part of an effort to be better informed about potential nutrient impacts, the WSMD, with assistance from certain municipalities, is conducting an extensive sampling effort to document the current loading conditions to determine the "reasonable potential" that WWTFs have, to cause or contribute to downstream water quality impairment. Results of these investigations are recorded as part of permit issuance documentation. Shown in Table 11 is the one municipal wastewater discharge permit in Basin 14 for a facility in Bradford, that discharges to the Waits River.

**Table 12. Basin 14 wastewater treatment facilities and other facilities subject to NPDES Direct Discharge Permits.**

| Facility (permit ID) | Permit effective date | Permit expiration date | Permitted flow (MGD) | IWC* 7Q10 /LMM | Current Percent of Design Flow (2014-2019) | Treatment type | # of CSOs | Receiving water |
|---|---|---|---|---|---|---|---|---|
| **Bradford 3-1157** | March 2016 | December 2020 | 0.137 | 0.010 /0.004 | 59% | Extended aeration | 0 | Waits River |

** Instream Waste Concentration – or the proportion of river flow at lowest base (7Q10) and low median monthly (LMM) flow attributable to discharge, for the facility design flow. Note that the IWC is specific to the flow of receiving water.*

### *Facility Specific Information*

#### Bradford

The Town of Bradford operates an extended aeration, secondary wastewater treatment facility that discharges to the Waits River immediately upstream of its confluence with the CT River. Disinfection is accomplished by means of liquid chlorine followed by dechlorination.

## Wastewater Project Outcomes in Basin 14

The town of Ryegate was funded in 2016 and 2018 to complete designs and construction for a wastewater treatment facility refurbishment and wastewater collection system refurbishment.

## Septic Systems

The State of Vermont adopted, on July 1, 2007, universal 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 need to obtain a Wastewater System and Potable Water Supply Permit for activities such as: subdivision of land; construction of a new

building that needs a wastewater system (often referred to as sewage disposal or a septic system) or water supply; and repair and/or replacement of a failed wastewater system or water supply. Wastewater systems that have wastewater surfacing, backing up into the building or discharging to the waters of the State are considered failed systems. A permit is also required when there is an existing wastewater system and/or potable water supply but there will be an increase in water or wastewater design flows due to either a modification to, or a change in use of, a connected building.

Systems installed before July 1, 2007 and systems installed or receiving increased flows after 2007 that did not receive a permit could potentially discharge into surface waters if the system was not installed correctly and is located in close proximity to a river, lake, or wetland. Failed systems that discharge pollutants into surface waters are difficult to identify without landowner permission and there is no current regulatory tool that requires inspections of pre- or post-2007 wastewater systems on a regular basis unless specified in their permit. If a citizen observes signs of a failed septic system, they should contact their Town Health Officer. There are programs that provide financial assistance to qualifying homeowners that need to upgrade their systems, but costly upgrades prevents many homeowners from upgrading their systems.

Momentum has been gaining in rural villages to explore options to deal with concerns about pollution from septic systems and growth in village centers that result in a need for centralized shared wastewater systems. A demonstration project in the town of Warren, Vermont was reported to the US Environmental Protection Agency as a different approach for managing wastewater in rural villages (Stone Environmental, Inc., 2005). Areas with elevated *E. coli* levels like the Ompompanoosuc River in the town of Fairlee could benefit from this type of approach. An *E. coli* workgroup will be formed in 2020 to look at options for source identification, outreach and education, and implementation. Funding is the most common barrier to identifying and remediating *E. coli* sources. People are also concerned about reporting or putting financial strain on their neighbors with potentially failing systems.

## Septic Socials

Concerns around failing septic systems is especially important in lakeshore communities. Many camps along lakeshores were built before July 1, 2007 and many of the camps were built for seasonal occupancy. If a lake is experiencing an increase in nutrients or *E. coli*, it is often difficult to pinpoint the exact sources. Septic systems are often a source. One way to get people informed about the health of their systems is to host a septic social. Septic socials are neighborhood gatherings where homeowners learn about the options for a well-functioning septic system and good maintenance practices, including household products that are kind to septic systems. The event provides an informal opportunity for people who may never have seen a septic system to learn about them. The host opens the gathering by talking about the importance of water quality protection. A septic system specialist discusses operation and maintenance of septic systems using the host homeowner's system as the demonstration model. Attendees are provided with brochures and other resource materials to take home. Septic socials are best for areas with old septic systems that may be having an impact on water quality. These places are often around lakes with old camps or buildings built for

seasonal use that are now seeing more activity year-round. Septic socials can also be held in riverbank communities. Areas in Basin 14 that would benefit from septic socials are all the larger populated lakes including Harveys Lake, Lake Morey (a septic social was held there in 2019), Lake Fairlee and Groton Lake, but other interested lake communities are encouraged to participate. The Ompompanoosuc River in the Village of West Fairlee and the town of Thetford would also benefit from holding septic socials. More information about septic socials can be found at: http://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise/lake-wise-septic-system-socials.

# D. Natural Resources

## Rivers

### *River Corridor Plans*

A River Corridor Plan (RCP) is a synthesis of the physical data collected during Phase I and II SGAs based on protocols and guidelines developed by the Vermont River Management Program. These plans identify causes of channel instability and make recommendations for restoration. All SGAs and RCPs can be found at: anrweb.vt.gov/DEC/SGA/finalReports.aspx. Where funding, local support, and interest exists, priority projects and objectives identified in these plans in the Bloody Brook, Wells, Waits, Stevens, and Ompompanoosuc River watersheds should be pursued.

While water quality in Basin 14 is satisfactory, the degraded geomorphic condition (Figure 8, page 21) of the basin's streams may impact:

1. wildlife and fish habitat (ex. riparian buffer removal that reduces shading and habitat for insects that feed fish, and channel alteration that destroys aquatic habitat).
2. public safety (ex. loss of floodplains that store floodwaters, accelerated streambank erosion which results in infrastructure damage, and channel straightening that increases flow velocity during rain events).
3. water quality (ex. higher *E. coli* populations caused by increased fine sediment resuspension and bank soil erosion, and nutrient and chemical runoff from encroachment of impervious surfaces and agricultural land).

Rivers are in a constant balancing act between the energy they produce and the work that must be done to carry the water, sediment, and debris produced in their watersheds. A change in any one of these factors will cause adjustments of the other variables until the river system comes back into equilibrium (balance). These changes can be caused by natural events and by human activity. The impact of which may be seen immediately or for decades after the activity occurred.

The legacy from Irene and more recent flood events will be felt for years to come. The goal of managing toward, protecting, and restoring the equilibrium condition of Vermont rivers is to resolve 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.

Dam removals are an example of a project identified in RCPs. Three dams were removed in Basin 14 by the Connecticut River Conservancy between 2015 and 2019:

- Norwich Fire District Dam on Charles Brown Brook in Norwich
- Geer Dam on the Ompompanoosuc River in West Fairlee
- Groton-9 dam on the Wells River in Groton

CRC has also been working on preliminary design for the Harveys Lake Dam removal. More information about dams in Basin 14 can be found in Appendix C.

## *Riparian Area Planting Projects*

Scientific research strongly supports the value of planting trees and shrubs along stream and lake shorelines for both water quality and wildlife habitat (Figure 16). Shoreline vegetation filters and cleans dirty runoff from uphill land uses, provides shoreland and shallow water habitat, stabilizes banks, and increases lake and river aesthetics. New research has also shown that streams in the lower flatter reaches of the watershed are more likely to release carbon dioxide as a biproduct of ecosystem respiration when temperatures in streams rise compared to streams in steep watersheds (Jankowski & Schindler, 2019). Reducing soil erosion to streams by capturing stormwater and stabilizing soils and increasing riparian buffers (vegetation along shorelines) on low elevation streams may help to mitigate temperature increases

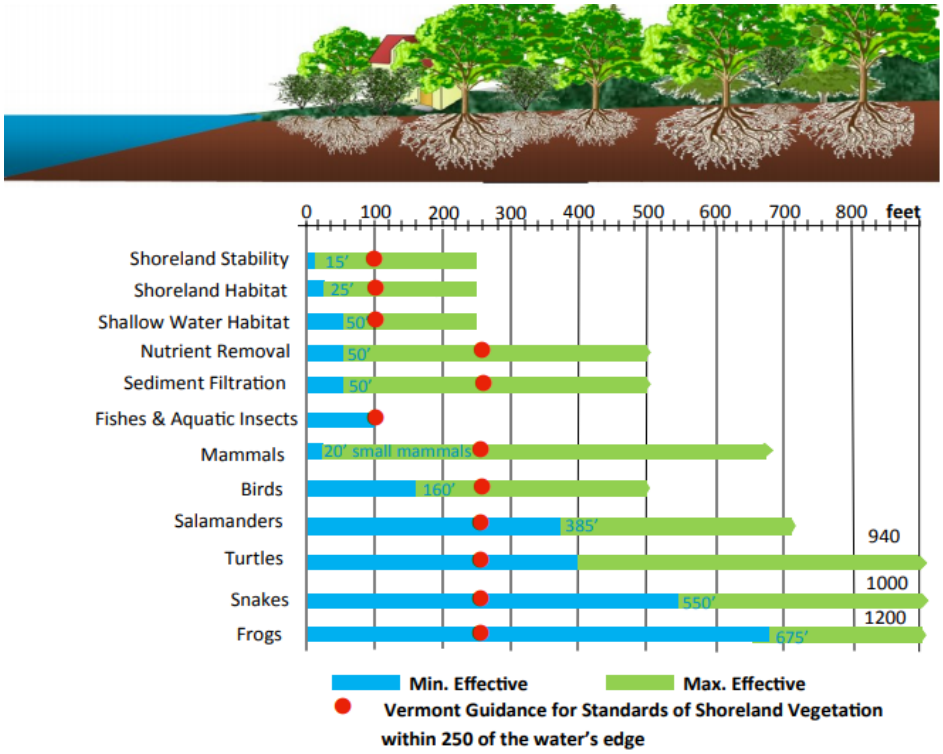



**Figure 16. Recommended widths of shoreline vegetation for protection.**

Source: https://dec.vermont.gov/sites/dec/files/wsm/lakes/Lakewise/docs/lp_shorewidth.pdf

and their impact on the carbon cycle.

Most riparian area planting projects are coordinated and carried out by the Connecticut River Conservancy (CRC) in Basin 14. In the last year, CRC has planted buffers along the Stevens River in Barnet, Bloody Brook in Norwich, Connecticut River in Bradford, and the Ompompanoosuc River in Strafford and Fairlee. The White River NRCD manages the Trees for Streams Program in Basin 14 and works with watershed partners and private landowners to plant riparian buffers to enhance riverbank stability and water quality.

### *Strategic Wood Addition to Rivers and Streams*

VFWD is focusing on the implementation of strategic wood additions for fishery stream health. Large woody material provides several fish habitat and fluvial benefits in streams, but it is generally lacking in many Vermont streams due to past and present river management practices to accommodate land use for logging, agriculture, and urban and residential development. Large wood has been strategically added to trout streams on public lands in the Northeast Kingdom and on streams in the Green Mountain National Forest, where it has improved Brook Trout habitat and fluvial functions. Several streams in the Groton State Forest are being scouted to identify opportunities for future strategic wood addition projects. NRCS has been researching strategic wood addition in Meadow Brook and in the South Branch Waits watershed starting with baseline temperature monitoring and trout surveys collected by VFWD in collaboration with Trout Unlimited.

### *Stream Alteration Permits & Activities*

Also related to the health of rivers and streams is the infrastructure – bridges and culverts – built to relay the flow of water under transportation corridors. Transportation corridors include state, local, and private roads, large interstates, logging roads, private 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 structures plays a significant role in protecting water quality in Basin 14. Correctly sized structures prevent erosion and scouring upstream and downstream, allow for the passage of fish and wildlife, and reduce impacts from flooding. Correct placement of structures allows fish to move seasonally and to spawning territories. Without access to essential habitat, fish diversity and abundance decline.

The Rivers Program's Stream Alteration Permit Program helps to protect and restore water quality in Basin 14. If an activity will change, alter, or modify the course, current, or cross section of any watercourse within or along the boundaries of VT, that activity may be require a permit. The VDEC Rivers Program issues permits covering three general areas of activities. These three areas are:

- Activities that involve construction or excavation in rivers and streams
- Activities exempt from municipal regulation in flood hazard areas and river corridors

- Activities that involve water withdrawals, dam removal, or hydroelectric power

A total of 135 stream alteration permits or activities were issued in towns in Basin 14 (Tunbridge, Sharon and Chelsea were not included) between 4/2016 and 1/2020. Of the 135 permits issued, 109 were Next Flood activities, 20 were General Permits, and 6 were Title 19 activities. Next Flood activities include those practices that involve protection and stabilization activities like culvert replacement, channel stabilization, structure stabilization, and removal of debris behind stream crossing such as culverts and bridges. These generally happen after flooding events and are in response to emergency conditions. For example, 40 (30%) Next Flood activities took place in the months of July and August in 2017 after the July 1, 2017 flooding event in the Upper Valley. Norwich, Strafford, and Thetford convened 20 or more permits or activities during this time period. Of the 135 permits or activities, seven projects involved bridge replacements and 29 projects involved culvert replacement.

Oversight on these replacements includes recommendations for the correct sizing of crossing structures to handle passing high waters and debris. Two projects were dam removals and one project was a bridge removal. Eighty-four (62%) projects were to repair or protect manmade infrastructure, which provides support for why local zoning and bylaws for floodplain and river corridor protection are important. This plan does not provide estimates for the cost of this work, but assumes these fixes are costly and when culverts and bridges are sized correctly and structures are built in outside of floodplains and river corridors, they are more likely to weather the next storm or flood event.

### *Local Zoning and Bylaws*

Local zoning, bylaws, and town plan policies can provide community specific protections and guidance to maintain and enhance local water resources. Local protections also afford benefits to downstream communities and water resource users. Although a town may have bylaws or town plan policies, it does not mean their resources are afforded the strongest protection. Communities should work with their regional planning commissions to identify opportunities that provide their constituents with the highest level of natural resource protection within their means. Towns with high development pressure, significant impervious surface cover including roads, and significant development within proximity to water resources are a high priority for protection, as well as those areas with deficiencies related to their protective policies, zoning, or bylaws. A list of towns and existing natural resource protection regulations is available in Appendix D.

- Local stormwater regulations prevent runoff of pollutants from hard surfaces into wetlands, rivers and lakes. Stormwater management also slows flow into waterbodies during some flood events.
- Smart planning and design for development through Local Hazard Mitigation Plans (LHMP) and ERAF attainment in towns and villages saves money and lowers the risk of significant loss during flood events, while protecting water quality as an added benefit.

- Limiting development on steep slopes, ridgelines, and landslide hazard areas can protect high quality water resources and prevent excessive erosion and sedimentation to streams and lakes that impacts water quality and aquatic habitat.
- Protecting river corridors helps protect roads and structures from erosive damage, improves water quality, moderates flooding, and enhances wildlife habitat. River corridor protection, limits development close to stream and river channels to allow the channel to establish and maintain a least-erosive path through the valley lessening the need to armor channel edges.

  In recognition of historic settlement patterns, the VDEC model river corridor protection bylaw (http://bit.ly/model-regulations) provides for infill and redevelopment in designated centers and densely developed areas provided that new development does not further encroach on the river relative to pre-existing development. **The towns of Corinth and Peacham are the only towns in Basin 14 that have adopted river corridors into their flood hazard bylaws.**
- In April 2020 the US Geological Survey scheduled Discovery Meetings to inform updated Flood Insurance Rate Maps throughout Basin 14. Unfortunately, these meetings have been postponed due to circumstances around the COVID-19 pandemic and will be rescheduled.

  Floodplains function in part to allow excessive water to spread out and slow down. This reduces water depth and power and allows sediment, including phosphorus, to deposit. Updated FIRMs will identify the high-risk flood hazard areas in the Basin that are the focus of municipal flood regulations. Most of the area will have much improved computer-model based Zone A hazard information using updated flood discharge data and one-foot contours. Some reaches will have older studies aligned with current topography. A few areas may be prioritized for updated field-based studies incorporating data from bridges and other obstructions. The effective date for the new maps is not likely until 2025 or later. The VDEC model bylaws use no adverse impact standards that are consistent with statewide flood resilience goals.

  Current Flood Insurance Rate Maps for communities in the Basin are posted at www.msc.fema.gov. **All towns are recommended to participate in this process.**

## *VDEC Hazard Area Bylaws and ERAF*

VDEC River Corridor and Floodplain Protection Program has prepared model flood hazard bylaws (bit.ly/model-regulations) to assist municipalities in the development of their flood hazard regulations. These bylaws have been pre-reviewed by the Federal Emergency Management Agency (FEMA) and meet or exceed the requirements of the National Flood Insurance Program (NFIP). In addition, adoption and enforcement of Section D, River Corridors, qualifies communities for enhanced cost share under the Emergency Relief and Assistance Fund (ERAF).

ERAF provides State funding to match Federal Public Assistance after federally declared disasters. Eligible public costs are reimbursed by federal taxpayers at 75%. As of October 23, 2014, the State of Vermont contributes an additional 7.5% toward the costs. For communities that take specific

steps to reduce flood damage the State will contribute 12.5% or 17.5% of the total cost. As of May 4, 2020, only one town, Orange, in Basin 14 qualified for the 17.5% contribution. All the remaining towns in the basin, except for Hartford, have expired Local Emergency Management Plans (LEMPs) that are required to be updated on an annual basis. All towns are participating in the National Flood Insurance Program and have adopted the Town Road and Bridge Standards. Six towns do not have a Local Hazard Mitigation Plan, but all of the six are working on a new plan. Towns that meet ERAF criteria protect water quality while protecting themselves financially.

Questions regarding the model flood hazard bylaws and ERAF should be directed to the appropriate VDEC Regional Floodplain Manager: bit.ly/flood-manager.

### *Landslide, Rockfall and Erosion Mapping*

The Vermont Geological Survey responds to and monitors landslide and rockfall events, maps areas prone to erosion and landslides, and is working with our partners to implement landslide hazard mapping protocols (Clift & Springston, 2012) from the State Hazard Mitigation Plan. In 2015 the Division began a program to provide planning-level landslide hazard maps for all Vermont counties, contingent upon funding and availability of Lidar. Landslide hazard susceptibility maps were prepared for Addison County, the Town of Highgate, and Washington County in 2016 - 2017; Chittenden County is in progress in 2018. The maps help Vermont prepare for safer growth and development, develop mitigation and hazard avoidance strategies (FEMA), avoid economic loss, and be prepared (USGS preparedness list) to respond to events.

Anyone can report a landslide to the Vermont Geological by visiting: https://vtanr.maps.arcgis.com/apps/GeoForm/index.html?appid=505af0d19dd44faaa912ef3d5c80a3b6.

## Lakes

The recommendations below were developed based on the VT Inland Lakes Scorecard status of lakes and ponds in Basin 14. More information about the VT Inland Lakes Scorecard and Basin 14 lakes and ponds is found in Condition of Lakes and Ponds section of Chapter 1.

### *Recommendations for Continued or Enhanced Monitoring*

Six lakes - Fosters Pond in Peacham, Lake Groton in Groton, Harriman Pond and Halls Lake in Newbury, Lake Morey in Fairlee, and Mud Pond in Thetford - report fair conditions for nutrient trends.

Fosters Pond and Halls Lake are showing a significant increase in spring total phosphorus (TP) concentrations, but summer TP trends have remained stable. Fosters Pond is considered an oligotrophic waterbody and has a small undeveloped watershed. There is logging activity within the watershed, but the reason for the increasing TP trend is not clear. Continued monitoring is

recommended for both Fosters Pond and Halls Lake and a windshield survey of the watershed is recommended for Fosters Pond.

Harriman Pond and Mud Pond in Thetford are showing a significant increase in spring TP but neither is monitored in the summer months. The addition of a Lay Monitor for these two lakes would help to understand summer TP concentrations.

Lake Morey is showing a significant increase in summer TP, but not spring TP. Tributaries for Lake Morey were monitored in 2019. A second round of monitoring is planned for 2020 to understand the TP contributions from the tributary watersheds. Lake Morey has an established Lay Monitor and Lake Wise shoreland assessments are recommended for large ownership and heavy use areas around the lake. Analysis of the 2019 and 2020 tributary data and any follow-up recommendations will be presented in the following tactical basin plan. While Lake Morey is showing a significant increase in summer TP, its current and historic levels of TP make it a candidate for B(1) aesthetics. In order to reverse or stop the trend, and maintain Lake Morey's status as a B(1) water, Lake Morey is listed as a high priority for protection and monitoring in this plan.

Lake Groton shows good overall water quality for TP, but the Secchi depth is significantly decreasing which indicates a decrease in water clarity. This decrease in water clarity could be due to increased browning from acid-related conditions or increased turbidity. Further study into the decreased clarity is recommended.

### *Recommendations for Restoration*

One lake in Basin 14 – Lake Fairlee – is exhibiting a poor condition nutrient trend. Spring and summer TP are highly significantly increasing and the summer Secchi trend is significantly decreasing. A three-town committee consisting of representatives from Thetford, Fairlee, and West Fairlee have convened to address water quality concerns in Lake Fairlee. The group coordinated a lake tour with members of the committee, the Lake Fairlee Lay Monitor, WRNRCD, and VDEC WID and WSMD staff to discuss the history of lake water quality, land use around the lake, and the possibility of developing outreach and education materials for the communities and/or developing a tributary water quality sampling program. VDEC Lakes and Ponds Program Staff plans to reach out to the committee to discuss the possibility of developing a Lake Watershed Action Plan for Lake Fairlee as a step towards implementing management strategies in the watershed to promote improved water quality. Similar to Lake Morey, although Lake Fairlee is showing a poor condition nutrient trend, its current and historical levels of TP make it a candidate for B(1) aesthetics. In order to reverse or stop the trend, and maintain Lake Fairlee's status as a B(1) water, Lake Fairlee is listed as a high priority for protection and restoration in this plan.

### *Preventing Aquatic Invasive Species*

Aquatic invasive species have been confirmed in five lakes in Basin 14. Lakes with the highest risk potential for invasive species introduction should take preemptive measures to prevent spread. Those lakes and ponds with public access areas (Fish and Wildlife Accesses) are good sites to host

spread prevention signage and materials, public greeters, and Vermont Invasive Patrollers (VIP). The priority lakes and ponds for AIS outreach are Martins Pond (VFWD Access Area), Ticklenaked Pond (Town Public Beach and VFWD Access Area), Round Pond (Private Access Areas), Lake Fairlee (VFWD Access Area), Halls Lake (Town Access Area), and Lake Morey in Fairlee (VFWD Access Area). Lake Morey, Lake Fairlee, and Harveys Lake have VT Public Access Greeter Programs supported by VDEC's Grant-in-aid. Greeters interact with boaters, inspect watercraft, identify any suspicious matter, collect and report data, and distribute educational material on aquatic invasive species. The Grant-in-aid Program is offered by VDEC, and provides financial assistance to municipalities and agencies of the state for aquatic invasive and nuisance species management programs. Funding for Grant-in-aid grants comes from a portion of annual revenues from motorboat registration fees and federal funds. This grant program has supported over 70 municipalities since 1994.

### *Protecting and Improving Shoreland Condition*

Effective July 1, 2014, the Vermont Legislature passed the Shoreland Protection Act (Chapter 49A of Title 10, §1441 et seq.), which 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.

Shoreland developed prior to July 1, 2014 is not required to retroactively meet standards. The Lake Wise Program, an Agency of Natural Resources initiative that awards lake-friendly shoreland property, including that of state parks, town beaches, private homes and businesses, is available to lakeshore owners and Lake Associations to assess shoreland property for improvements that benefit water quality and wildlife habitat. Lakes with a fair shoreland score will benefit from implementing Lake Wise Program best management practices. More information on the program can be found at: http://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise/what.

Three lakes in Basin 14 are a high priority for Lake Wise: Harveys Lake, Lake Fairlee, and Ticklenaked Pond. Two lakes in the Basin 14 have a poor shoreland habitat condition rating from the VT Lake Scorecard: Harveys Lake and Lake Fairlee. Both lakes meet VWQS criteria for (B)1 aesthetics and are considered a high priority for Lake Wise assessments and implementation of Lake Wise BMPs to maintain their high aesthetic rating.

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 VDEC Lakes and Ponds website, as a first step to moving toward a healthier lake or pond.

# Wetlands

## *Wetland Permitting*

The VT Wetlands Program plays in integral role in protecting the State's surface water through wetland regulatory, protection, and monitoring activities. Between 2015 and 2019 approximately 160 projects were reviewed by VT Wetland Ecologists in Basin 14. Of those projects, only twenty-one resulted in permits where a wetland or buffer was altered. Eight were transportation related, two were solar, one was utility, and the remaining fell in no specific category. The projects that did not result in permits are an example of the VT Wetland Rules protecting wetland functions and values. The VT Wetlands Program worked with the prospective permittees to identify the wetland boundaries and locate their projects outside of the Class II wetland and its 50-foot buffer. The project review also provides the opportunity to identify the presence and partial boundaries of Class II wetlands for future reference. Additional protection, in the form of a Class I wetland determination, can be afforded to wetlands that have been determined to be exceptional or irreplaceable in their contribution to Vermont's natural heritage, based on their functions and values. Nine wetlands have been identified in Chapter 2 for further exploration into whether these wetlands meet Class I criteria.

Because the VT Wetlands Program does not have the resources to pursue all potential Class I recommendations, this plan recommends that interested stakeholders reach out to their basin planner and VDEC staff for technical support to research and submit Class I wetland petitions for review.

## *Wetland Conservation and Mapping*

A new initiative is in progress for the protection of wetlands in Vermont. The state is currently working on a Wetlands Easement calculator to evaluate the value of wetlands for protection through the easement process. River Corridor Easements are used by the state and partner organizations to purchase channel management and development rights in the most sensitive and important areas along stream channels to encourage stream equilibrium, sediment and nutrient attenuation, and flood protection. The wetland conservation easements will be used in a similar way to protect and restore wetlands with significant function and values related to water quality, flood protection, climate change mitigation and wildlife habitat. This plan recommends that opportunities for wetland conservation be explored where water pollution reduction and flood protection is evident. Recommendations for wetland protection and restoration can be found in Stream Geomorphic Assessments and River Corridor Plans.

## Forests

### *Forestry AMPs and Skidder Bridge Programs*

The Vermont Department of Forest Parks and Recreation (VDFPR) provides temporary steel truck bridge rental opportunities for loggers during timber harvests. When properly installed, used, and removed, portable temporary bridges minimize stream bank and stream bed disturbance as compared with alternative devices, such as culverts or poled fords. Portable skidder bridges are also economical because they are reusable, easy to install, and can be transported from job to job. In addition, these bridges reduce the occurrence of sedimentation, channeling, and any degradation of aquatic habitat, while allowing loggers to harvest timber in compliance with The Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont. For more information on the truck bridge rental program visit: https://fpr.vermont.gov/forest/managing-your-woodlands/acceptable-management-practices/temporary-bridge-rentals.

In March 2018, the VDFPR held a temporary skidder bridge lottery and twelve loggers and logging companies were chosen to receive bridges that were constructed by Fontaine Millworks in East Montpelier. The VDFPR will also be offering workshops for building bridges throughout the state. Specifications for building your own skidder bridge can be found here: https://fpr.vermont.gov/skidder-bridges.

The VDFPR updated the AMPs for Maintaining Water Quality on Logging Jobs in Vermont effective as of October 22, 2016. Vermont first adopted these rules 1987. The AMPs are intended and designed to prevent any mud, petroleum products and woody debris (logging slash) from entering the waters of the State and to otherwise minimize the risks to water quality. The AMPs are scientifically proven methods for loggers and landowners to follow for maintaining water quality and minimizing erosion. The new manual was published in 2019 and can be downloaded from VDFPR' website.

Compliance with Vermont's Use Value Appraisal program (UVA) requires that the AMPs be employed to the maximum practicable extent. If the AMPs are not employed on UVA enrolled forestland but no discharge occurs, it may affect UVA eligibility without presenting a water quality violation. However, if the AMPs are not employed to the maximum practicable extent 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. Almost fifty percent of the State's forestland employs the AMPs as a requirement of the UVA program or because of state ownership (Figure 17). This does not mean that the other forestland areas are not employing the AMPs but may be less likely to require AMPs on their property. Topsham, Newbury, and West Fairlee have the largest areas of forest lands that are not under the UV program in Basin 14. These areas are priority for outreach and education for AMPs and the UVA program.

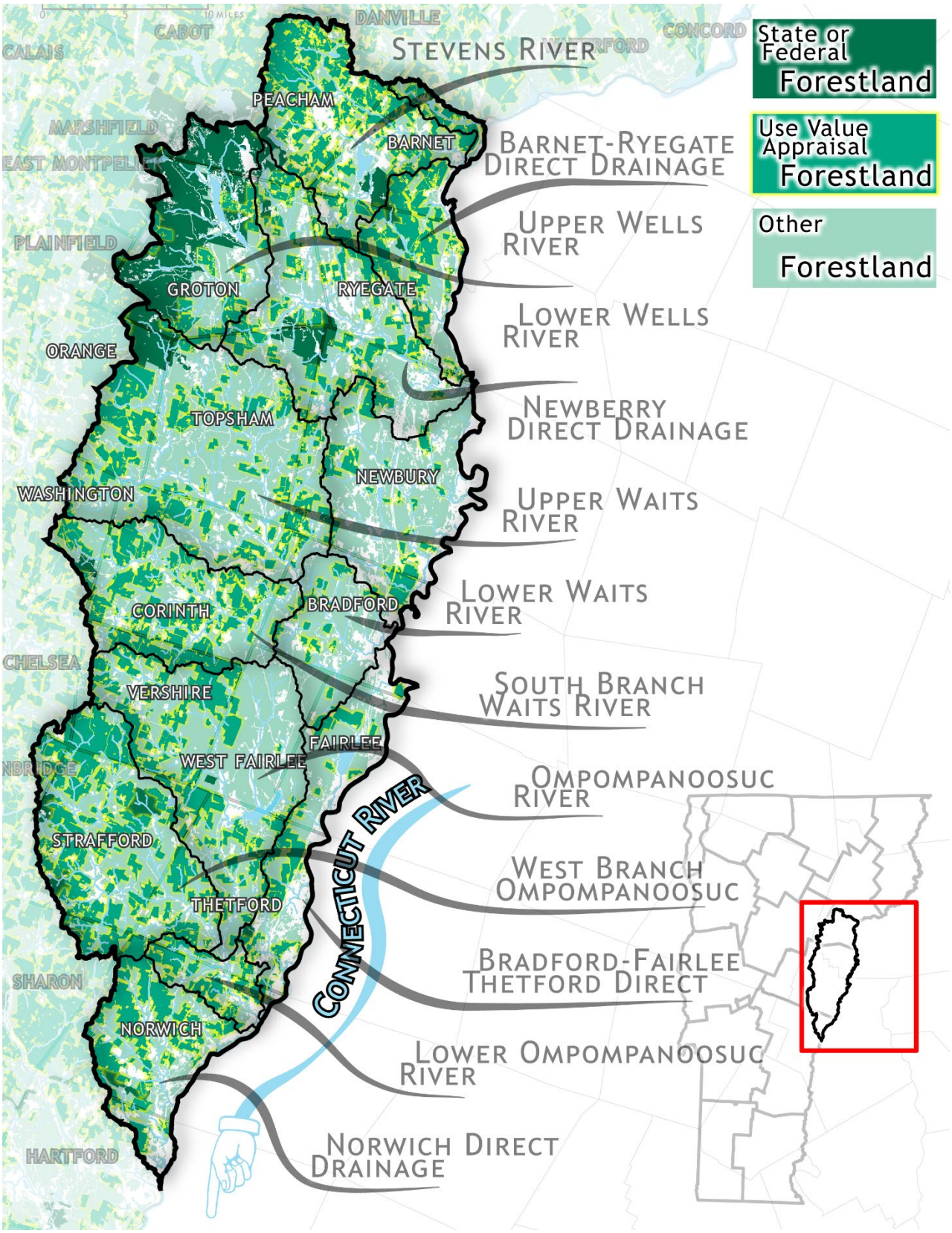



**Figure 17. Forestland in Basin 14 represented by forestland management and ownership types.**

In addition to programs like the AMPs and skidder bridge rentals, AMP county foresters are available for consultation when questions arise about practices to protect water quality. A large portion of the headwaters of the northern part of Basin 14 is public land management by the VDFPR and VFWD. VDFPR has replaced and removed a majority of their stream crossing structures under forest roads to restore geomorphic condition of streams.

VDFPR is also collaborating with VDEC on the development of a forest road stormwater inventory process to assess the condition of forest roads and recommend BMPs to prevent erosion of logging road infrastructure and sedimentation into streams.

### *Natural Resource Project Outcomes in Basin 14*

Only a small number of natural resource projects were funded by the State of Vermont during SFY 2016 through 2019. The projects included evaluation of thermal refugia in the Wells River basin, three dam removal projects, a culvert project for fish passage, *E. coli* education and outreach in the Ompompanoosuc River basin, tree planting along the Wells River, and two river corridor easements. Since 2015, twelve site visits have been conducted by the Lake Wise program to shoreland properties on Lake Fairlee (1), Lake Groton (2), Kettle Pond (1), Lake Morey (6), Noyes Pond (1), and Osmore Pond (1). Five Lake Wise signs have been awarded to landowners on Lake Groton (2), Lake Morey (1), and Ricker Pond (2) compared to Seymour Lake (38) and Echo Lake (24) in the Memphremagog Basin. Additional projects have been funded through other mechanisms and are not required to be tracked in the Vermont Watershed Projects Database.

# Chapter 5 – The Basin 14 Implementation Table

## A. Progress in Basin 14

The Tactical Basin Plan addresses all impaired, stressed, and altered waters in the basin as well as protection needs for high quality waters. The list of strategies in the Implementation Table (Table 13) and the Monitoring and Assessment Table (Table 14) cover future assessment and monitoring needs, as well as projects that protect or remediate waters and related education and outreach.

The Implementation Table provides a list of fifty-five priority strategies created with the intention to be used as the go-to guide in the first step toward watershed action. A list of related individual project entries is found in the online Watershed Projects Database (WPD). The projects vary in level of priority based on the strategies outlined in the summary. All projects in WPD are not expected to be completed over the next five years, but each action in the summary is expected to be pursued and reported upon in the following plan and updated in the WPD.

As projects are developed, priority for Clean Water Initiative Program funding will be given to those projects that achieve the highest water quality benefits. Additionally, projects that provide cumulative benefits (i.e. flood resiliency, water quality improvement, water resource protection, aquatic organism passage) will receive additional consideration for prioritization.

The previous Basin 14 was completed in 2015. A total of 85 action items were identified in the plan. Sixty-seven (79%) have been implemented or are in progress by VANR and its watershed partners, fifteen are awaiting action and have been carried over to this plan, and three have been discontinued (Figure 18). A report card for each of the 85 strategies can be viewed in Appendix A.

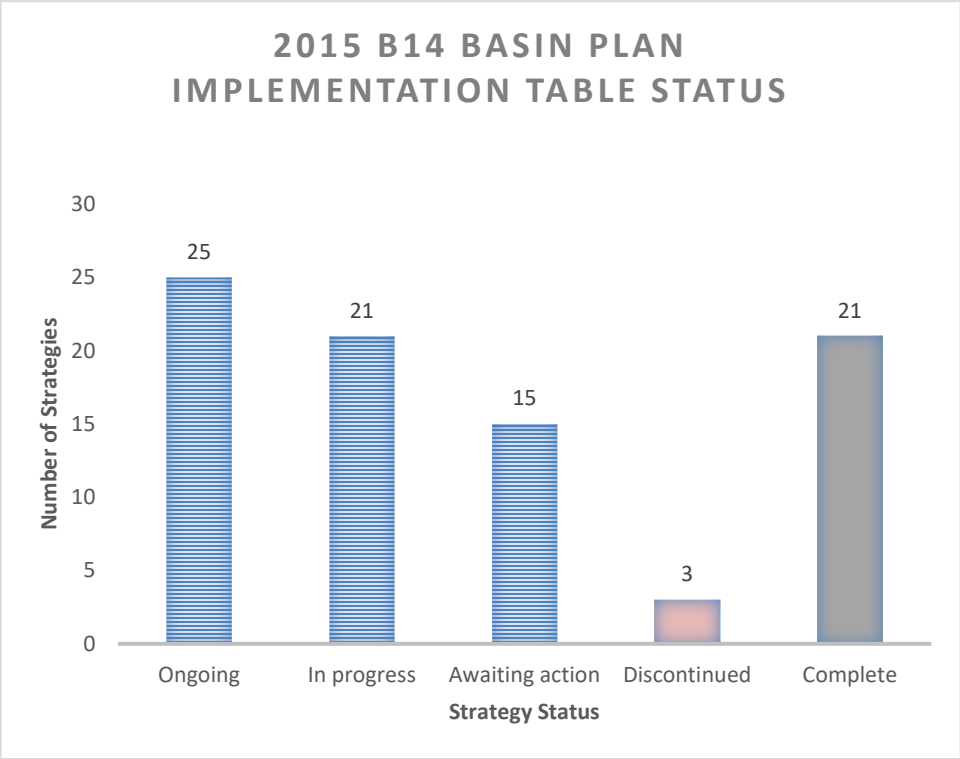



**Figure 18. Status of the 85 priority strategies identified in the 2015 Basin 14 plan. Sixty-seven (79%) are complete, ongoing, or in progress. Fourteen projects (16%) have been re-evaluated and will be carried over to the 2020 B14 plan.**

The 2020 B14 Tactical Basin Plan builds upon those original plan recommendations by promoting specific, geographically explicit projects in areas of the basin that have been identified for intervention, using environmental modeling and on-the-ground monitoring and assessment data where available.

## B. Coordination of Watershed Partners

There are several active organizations undertaking watershed monitoring, assessment, protection, restoration, and education and outreach projects in Basin 14. These partners are non-profit, private, state, and federal organizations working on both private and public lands. Partnerships are crucial in carrying out non-regulatory projects to improve water quality. Caledonia Natural Resources Conservation District (CNRCD), Central Vermont Regional Planning Commission, Connecticut River Conservancy, Northeastern Vermont Development Association, Two Rivers Ottauquechee Regional Commission, US Fish and Wildlife Service, Vermont River Conservancy, White River Natural Resource Conservation District (WRNRCD), lake associations, and municipal groups including local conservation commissions 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 BMPs).
- monitoring water quality (e.g. lay monitoring program on lakes, *E. coli* and nutrient monitoring in rivers).

Partners active in working with farms in the basin developing and implementing BMPs for water quality include Natural Resource Conservation Service (NRCS), Agency Agriculture Food and Markets (VAAFM), CNRCD, WRNRCD, VDEC, Connecticut River Farmers Watershed Alliance (CRFWA), and the University of Vermont Extension Service.

The large amount of work that is necessary to meet water quality targets in this basin require collaborations among all these groups to maximize the effectiveness of watershed partners. Without funding or partners, little of this work would be possible.

## C. Basin 14 Implementation Table

The process for identifying priority strategies is the result of a comprehensive compilation and review of both internal ANR monitoring and assessment data and reports, and those of our watershed partner organizations. The monitoring and assessment reports include, but are not limited to, stormwater mapping reports, geomorphic assessments, river corridor plans, bridge and culvert assessments, Hazard Mitigation Plans, agricultural modeling and assessments, road erosion inventories, biological and

chemical monitoring, lake assessments, fisheries assessments, and natural communities and biological diversity mapping.

A summary of priority strategies to address water quality in Basin 14 are identified in Table 13. The summary is the guiding list to go to as a first step for watershed action. The strategies can be linked to the on-going detailed list of projects in the online Watershed Projects Database.

The following tables serve to identify high priority implementation strategies and tasks that provide opportunities for all stakeholders in surface water management across each major river basin to pursue and secure technical and financial support for implementation. For these priorities to be achieved, partners and stakeholders must help to carry out the strategies identified in the basin plan.

Table 13, the Implementation Table Summary, provides a summary of strategies and actions to address water quality priorities by sector.

**Table 13. Summary implementation strategies for the Basin 14 tactical basin plan. *See list of acronyms on page 82.**

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| **Strategies to address runoff from Agricultural Lands** | | | | |
| 1. Support agricultural Best Management Practice (BMP) outreach, and farmstead and field practice implementation by agricultural service providers. | Middle Brook, Blood Brook, Stevens River, Connecticut River mainstem and direct tributaries | Thetford, Fairlee, West Fairlee, Barnet, Peacham, and towns along the CT River | WRNRCD, VAAFM, NRCS, UVM Extension, CCNRCD | TBPSG, ACWIP, CREP, EQIP, GWFS |
| 2. Identify and remediate possible sources of impairment to the Tabor Branch Tributary, including agricultural sources. | Tabor Branch Tributary #6 | Topsham | WRNRCD, VAAFM | ACWIP, VAAFM BMP |
| 3. Continue coordination with agriculture specific workgroup for this watershed. Implement water quality monitoring on farms to measure effectiveness of BMPs and compare with 2012 monitoring data. Install water quality BMPs on farms to decrease runoff. Continue nutrient management planning. | Ticklenaked Pond, Waits River | Ryegate, Bradford | CCNRCD, VFWD, VDEC Lakes, NRCS, VAAFM, VDEC WPP | TBPSG, ACWIP, CREP, EQIP, VAAFM BMP |
| 4. Implement the Ompompanoosuc bacteria TMDL by focusing technical assistance and BMP implementation on the *E. coli* impaired watershed of the Ompompanoosuc River. Reach out to farmers to identify WQ issues and work with farmers to fix. | Ompompanoosuc River | West Fairlee, Thetford | VAAFM, WRNRCD, VDEC WPP, Municipalities, Conservation Commissions, TRORC | TBPSG, ACWIP, CREP, EQIP, CWI |

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| 5. Coordinate with agricultural service providers to determine if there is a gap in outreach and implementation of water quality BMPs along the CT River. | Connecticut River Mainstem | Connecticut River Towns | VAAFM, NRCS, CRFWA, CCNRCD, WRNRCD, UVM Extension | TBPSG |
| 6. Extract agriculture focused projects from River Corridor Plans and share with B14 agriculture service providers. | Surface Waters that have River Corridor Plans (RCPs) | To be determined by review of RCPs | VDEC WPP | TBPSG, CWI, MEF |
| 7. Increase technical assistance to farms to develop BMP projects for farmers to submit to VAAFM for funding. | Basinwide | All towns | VAAFM, WRNRCD, CCNRCD, UVM Extension | ACWIP, VAAFM BMPs |
| 8. Support funding to provide assistance for managing shared equipment. | Basinwide | All towns | WRNRCD | ACWIP, CEAP |
| 9. Build capacity of the Connecticut River Watershed Farmers Alliance. | Basinwide | All towns | CRWFA, WRNRCD | MEF, ACWIP |
| 10. Form farm management teams to provide an organized contact for farmers around technical assistance for water quality protection. | Basinwide | All towns | VAAFM, WRNRCD, NRCS, VLT, VHCB, CRC | ACWIP |
| 11. Continue funding and programs for cover crop and no-till. | Basinwide | All towns | VAAFM, UVM Extension | VAAFM FAP |
| 12. Look into the possibility of the development and creation of an inter-seeding machine for cover cropping. | Basinwide | All towns | VAAFM, CRFWA | MEF, VAAFM CEAP |
| **Strategies to address runoff from Developed Lands - Stormwater** | | | | |
| 13. Identify and remediate possible stormwater sources of impairment to the Tabor Branch Tributary. | Tabor Branch Tributary #6 | Topsham | WRNRCD, VDEC, Town of Topsham Highway Department, landowners | VAOT MAB Grants, TBPSG, Grant-in-Aid |
| 14. Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping Reports have been completed. | Basinwide | Barnet, Chelsea, Corinth, Fairlee, Norwich, Orange, Peacham, Ryegate, Sharon, Strafford, Thetford, Topsham, Tunbridge, Washington | TRORC, NVDA, VDEC, CCNRCD, CVRPC, Municipalities | CWI, TBPSG, Grant-in-Aid |

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| 15. Develop stormwater master plans. | Dothan Brook, Harriman Brook, Connecticut River, Waits River | Hartford, Newbury, Bradford | TRORC, VDEC, Hartford, Newbury, Bradford | CWI, TBPSG |
| **Strategies to address runoff from Developed Lands - Roads** | | | | |
| 16. Provide and support training for road crews on culvert replacements and installation and maintenance of road BMPs. | Basinwide | All towns | TRORC, VDEC, NVDA, VAOT | VDEC Stormwater Program, River & Roads Training Program |
| 17. Complete Road Erosion Inventories (REIs) to meet Municipal Road General Permit (MRGP) requirements. | Waits River | Corinth, Strafford | Corinth, Strafford, Better Roads, TRORC, VDEC | VAOT MAB Grants, Grant-in-Aid |
| 18. Implement best management practices for high priority road segments identified in REIs to meet MRGP requirements. | Basinwide with a focus on South Peacham Brook in Barnet and Groton. | All towns | Municipalities, TRORC, NVDA, CVRPC VDEC | VAOT MAB Grants, Grant-in-Aid, CWI |
| 19. Address potential erosion sources from municipal winter sand storage area. Combine outreach efforts with MRGP outreach. | Stevens River | Peacham | Peacham, VDEC, NVDA, CCNRCD | VAOT MAB Grants |
| 20. Address runoff from the Town of Vershire's road sand storage area. | Vershire | Vershire | Vershire, VDEC, TRORC | VAOT MAB Grants |

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| **Strategies to address Wastewater** | | | | |
| 21. Initiate workgroup around source identification and community septic for the *E. coli* impaired watershed of the Ompompanoosuc River. | Ompompanoosuc River | West Fairlee | Thetford, West Fairlee, VDEC, WRNRCD, CRC, TRORC, AAFM, USEPA | LISFF, VFWD Watershed Grant, AVCC Tiny Grant |
| 22. Promote septic system maintenance through local outreach and education programs, such as a septic social. | Harveys Lake, Lake Groton, Lake Fairlee, Ompompanoosuc River | Barnet, Groton, Fairlee, West Fairlee, Thetford | VDEC, Thetford, West Fairlee | VFWD Watershed Grant, AVCC Tiny Grant |
| **Natural Resource Protection and Restoration - Wetlands** | | | | |
| 23. Conduct studies on potential Class I candidates and local outreach to municipalities and landowners to gauge interest in supporting Class I designations. Provide technical support for parties interested in submitting petitions. | Stoddard Swamp, Roy Mountain Swamp, Stillwater Brook Wetlands, Beaver Brook Wetlands, Lower Symes Pond, Cookville Swamp, Gillette Swamp, Conant Swamp, Zebedee Brook Wetlands | Peacham, Barnet, Groton, Ryegate, Corinth, Thetford | Municipalities, local stakeholders, VDEC, TRORC, NVDA, VFPR, VFWD, CCNRCD | TBPSG, 604(b) funds, VFWD Watershed Grants, Local Conservation Funds |
| 24. Update wetland mapping. | Basinwide | All towns | VDEC, Municipalities | Municipal Planning Grants |
| 25. Provide outreach and training to interested communities on conducting Vermont Rapid Assessment Method inventories. | Basinwide | All towns | VDEC, Municipalities | VDEC Wetlands Program, Municipal Planning Grant, VT |

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| | | | | Watershed Grant |
| **Natural Resource Protection and Restoration - Rivers** | | | | |
| 26. Increase Emergency Relief Assistance Fund (ERAF) rating by increasing municipal protections of water resources through local ordinances and the adoption of recommended standards and plans with focus on the development and implementation of local hazard mitigation plans. | Basinwide | All towns | VDEC, NVDA, TRORC, CVRPC, Municipalities | Hazard Mitigation Grant, Municipal Planning Grant |
| 27. Assess current process for renewing Local Emergency Management Plans (LEMPs) and identify ways to improve the process to increase timely adoption. | Basinwide | All towns | VDEC, NVDA, TRORC, CVRPC, Municipalities | |
| 28. Implement the Ompompanoosuc bacteria TMDL by expanding and conserving riparian buffers and floodplains on the *E. coli* impaired watershed of the Ompompanoosuc River. | Ompompanoosuc River | Vershire, West Fairlee, Thetford | Vershire, West Fairlee, Thetford, VDEC, WRNRCD, CRC, TRORC | TBPSG, MEF, RCE Block Grant, Riparian Buffer Block Grant, WQEP Grant (Act 76) |
| 29. Form workgroup to assess water quality monitoring needs along the CT River. Coordinate with watershed partners to develop a plan on how to address lack of sampling. | Connecticut River Mainstem | Connecticut River Towns | CRC, CRJC, CRWFA, WRNRCD, CCNRCD, TRORC | TBPSG, CWI, MEF |
| 30. Implement strategic wood addition to increase habitat and channel stability. Pursue other restoration opportunities along Waits using the River Corridor plan for reference. Targeted outreach for riparian restoration (plantings), CREP and RCE in this area. Provide technical outreach staff with messaging about benefits of wildlife, habitat, pollinators to help explain value of riparian buffers. | Waits River | Corinth, Bradford, Topsham | WRNRCD, VAAFM, NRCS, Municipalities, Landowners, CRC | CREP, RCE Block Grant, Woody Riparian Buffer Block Grant, WQEP Grant (Act 76) |

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| 31. Develop high priority actions identified in river corridor plans as the opportunity presents itself and resources are available. | Stevens River, Wells River, Waits River, Ompompanoosuc River, Bloody Brook | Peacham, Barnet, Ryegate, Groton, Newbury, Corinth, Bradford, West Fairlee, Thetford, Strafford, Norwich | VDEC, CRC, VRC, Municipalities, Landowners, NVDA, TRORC, WRNRCD, CCNRCD | TBPSG, CWI, MEF, WISPr, WQEP Grant (Act 76) |
| 32. Address flow alteration issues and high flow backwash into Harveys Lake associated with the Harveys Lake dam. | South Peacham Brook and Harvey's Lake | Barnet | Town of Barnet, VDEC, Harveys Lake Association, VFWD, CRC | CWI, MEF, WQEP Grant (Act 76) |
| 33. Inventory Groton State Forest lands within the sub-basin and identify streams that would benefit from in-stream habitat restoration practices. Implement these projects as appropriate. | Wells & Waits River Headwaters | Peacham, Groton | VFPR, VFWD, TU, VDEC | EQIP, SWG |
| 34. Assess waters for reclassification on municipal and VFPR lands that have been identified in the 2020 Basin 14 TBP. These headwaters include North Branch of the Wells River, Red Brook, Beaver Brook, the South Branch of the Wells River, and the Waits River headwaters. Additional monitoring is recommended to determine if these waters meet criteria for reclassification for aquatic biota. The Waits River headwaters currently meeting the criteria for B(1) for fishing. | Wells River headwaters, Waits River headwaters | Peacham, Groton, Orange, Topsham, Washington, NVDA, CVRPC, TRORC | VDEC, VFPR, Municipalities | |
| 35. Initiate riparian buffer planting and protection projects along stressed and altered waters in the sub-basins: South Branch Waits, Waits River, Tabor Branch, and Cookville Brook. | South Branch Waits, Waits River, Tabor Branch, Cookville Brook | Corinth, Topsham | WRNRCD, VDEC, VAAFM, NRCS | CWI, MEF, SWG |
| 36. Assess opportunity to meet with dam owner to assess water quality implications | Waits River | Bradford | VDEC, VFWD, Dam Operator | |
| 37. Determine the feasibility of removal of the Montague Rod and Reel Dams and develop these projects if there is interest and support. | Ompompanoosuc River West Fairlee and Thetford | Thetford | CRC, American Rivers, VDEC, VFWD, WRNRCD | TBPSG, MEF, CWI |
| 38. Complete a riparian buffer inventory for the CT River corridor in Basin 14 to identify high priority planting sites to intercept runoff. | Mid-CT River and direct tributaries | Barnet, Ryegate, Newbury, Bradford, Fairlee, Thetford, Norwich, Hartford | VDEC | |

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| 39. Replace or retrofit high priority stream crossings that have been identified in bridge and culvert assessments by municipalities and VAOT. Conduct additional assessments, as necessary. | Basinwide | All towns | VFWD, VFPR, VDEC, Municipalities, Landowners, CRC, CCNRCD, NVDA, TRORC, CVRPC, USFWS, NRCS | ERP, MEF, VAOT MAB Grants, SWG |
| 40. Assure the implementation of the Environmental Stewardship BMPs to reduce lead shot residue from entering waterways from the Thetford Fish and Game Club shooting range and complete follow-up monitoring. | Unnamed tributaries to Gillette Swamp and Ompompanoosuc River | Thetford | VDEC | |
| 41. Support development for remediation plan for Pike Hill Mine Superfund Site. WMPD currently coordinating with EPA on the remedial investigation to define the nature and extent of contamination and assessing the potential threats to human health and the environment. Timeline for actual site remediation and restoration of impacted streams and wetlands is 7-10 years. | Pike Hill Brook and Cookville tributary #4 | Corinth | EPA, VDEC, VFWD, Landowner, Corinth | EPA Superfund |
| 42. Complete and begin implementing the Ely Mine Implementation Plan. WMPD currently coordinating with EPA on finalizing the remedial design for site cleanup, which will include restoring Ely Brook, its tributaries and the onsite ponds to meet VT Water Quality Standards. Timeline for cleanup is 2-5 years. | Schoolhouse Brook and Tributary | Vershire | EPA, VDEC, VFWD, Landowner, Vershire | EPA Superfund |
| 43. Expand and protect riparian buffers within the FERC jurisdictional impoundment associated with Wilder Dam. | CT River main stem riparian buffer (river right, Wilder Dam impoundment area) | Hartford, Norwich | VDEC, Great River Hydro | |
| 44. Increase conservation flows below the Wilder Dam and reduce the magnitude of peaking operations and water level fluctuations in the impoundment which would improve aquatic habitat in the Connecticut River, as appropriate related to the Wilder Dam on the Connecticut River through the FERC re-licensing and 401 Water Quality Certification process. | CT River main stem above and below Wilder Dam | None | VDEC, VFWD, Great River Hydro, USFWS, CRC, TNC | |

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| **Natural Resource Protection and Restoration - Lakes** | | | | |
| 45. Provide technical support to the three-town water quality committee to develop a lake action plan to address phosphorus concerns on Lake Fairlee. Provide education to shoreland owners on Lake Wise BMPs. Implement road improvements around the lake to minimize runoff. Develop water quality monitoring plan for tributaries to Lake Fairlee where resources allow and continue in-lake lay monitoring. | Lake Fairlee & Tributaries | Thetford, Fairlee, West Fairlee | VDEC, VLMP, LPP, WRNRCD, Volunteer Monitors | LPP, VLMP, CWI, WQEP Grant (Act 76), VFWD Watershed Grant |
| 46. Continue WQ monitoring and cyanobacteria monitoring. | Ewell Pond | Peacham | VDEC Lakes, VLMP, VDEC WPP, Volunteer Monitor | VDEC, VLMP |
| 47. Continue WQ monitoring, cyanobacteria monitoring and assessment and implementation of Lake Wise water quality BMPs on roads and shoreline properties. | Lake Morey | Fairlee | VDEC, VWID WPP, VLMP, Lake Morey Committee, LPP | LPP, VLMP |
| 48. Continue to support volunteer water quality monitoring on lakes in the basin. | Fosters Pond, Lake Groton, Halls Pond, Harveys Lake, Lake Morey, Ticklenaked Pond | Peacham, Groton, Barnet, Newbury, Ryegate, Fairlee | VDEC Lakes, Lay Monitors | VLMP |
| 49. Conduct Lake Wise assessments and implement identified shoreland BMPs on priority waterbodies. Build local knowledge of shoreland best management practices among contractors, landscapers, and other shoreland site workers by offering a Shoreland Erosion Control Certification Courses in the basin. | Harveys Lake, Lake Morey, Lake Fairlee, Fosters Lake, Ewell Pond | Peacham, Barnet, Fairlee, West Fairlee, Thetford | VDEC Lakes | CWI |
| 50. Continue to implement and support local Access Greeter programs. | Lake Fairlee, Harveys Lake, Lake Morey | Fairlee, West Fairlee, Thetford, Barnet | VDEC, lake Volunteers | ANS Grant |
| 51. Recruit residents to join the Vermont Invasive Patrollers. Offer VIP training to Natural Resource Conservation Districts. There are currently no VIPs in this basin. | Kettle Pond, Lower Symes Pond, Mud Pond, Lake Abenaki, Harveys Lake, Halls Lake, Miller Pond, Lake Groton, Norford Lake, and Lake Morey. | Barnet, Bradford, Chelsea, Corinth, Fairlee, Groton, Hartford, Newbury, Norwich, Orange, Peacham, Ryegate, Sharon, Strafford, Thetford, Topsham, Tunbridge, | VDEC, Lake Volunteers, CCNRCD, WRNRCD | ANS Grant |

| Strategy | Priority Area or Watershed | Town(s) | Partner(s)* | Funding* |
|---|---|---|---|---|
| | | Vershire, Washington, West Fairlee | | |
| 52. Continue variable-leaved milfoil surveys to confirm eradication. Plant survey completed in 2018. Survey will be conducted again in 2020 by VDEC staff. | Halls Lake | Newbury | VDEC | |
| **Natural Resource Protection and Restoration - Forests** | | | | |
| 53. Provide outreach, technical assistance and workshops to private forestland owners, foresters, and loggers on AMPs, use of skidder bridges, and voluntary harvesting guidelines. | Basinwide | Barnet, Bradford, Chelsea, Corinth, Fairlee, Groton, Hartford, Newbury, Norwich, Orange, Peacham, Ryegate, Sharon, Strafford, Thetford, Topsham, Tunbridge, Vershire, Washington, West Fairlee | VFPR, VDEC, CCNRCD, WRNRCD | TBPSG, CWI |
| 54. Implement forest infrastructure restoration projects on state lands such as culvert replacements or retrofits, road decommissioning where water quality benefits are identified through assessments and long-range management plans. | State lands in basin | Washington, Sharon, Orange, Groton, Peacham | VFPR, VFWD, TU | CWI, ERP |
| 55. Initiate workgroup around source identification and community septic for the *E. coli* impaired watershed of the Ompompanoosuc River. And promote septic system maintenance through local outreach and education. | Ompompanoosuc River | West Fairlee | Vershire, West Fairlee, VDEC, WRNRCD, CRC, TRORC, AAFM, USEPA | LISFF, VFWD Watershed Grant |

## D. Basin 14 Monitoring and Assessment Table

Table 14, the Monitoring and Assessment Table, provides a preliminary list of water quality monitoring priorities to guide monitoring over the next 5 years. This list has more sites than there is capacity to sample and as a result, will need further prioritization. This will occur during a monitoring summit before the 2022 field season.

**Table 14. Basin 14 priorities for monitoring and assessment. Monitoring on private lands requires landowner permission.**

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| **Lakes and Ponds** | | | | |
| 1. Lake Morey | Lay monitor to collect in-lake chemistry | Fairlee | VDEC Lakes & Ponds, Lay Monitoring Volunteer | To identify sources of phosphorus leading to in-lake increased total phosphorus during spring and summer. |
| 2. Lake Fairlee | Lay monitor to collect in-lake chemistry | Fairlee, West Fairlee, Thetford | VDEC Lakes & Ponds, Lay Monitoring Volunteer | Identify source(s) of increasing phosphorus trends and low dissolved oxygen. |
| 3. Ticklenaked Pond | Lay monitor to collect in-lake chemistry | Ryegate | VDEC Lakes & Ponds, Lay Monitoring Volunteer | Continue summer and supplemental monitoring to track trends. |
| 4. Harveys Lake | Lay monitor to collect in-lake chemistry | Barnet | VDEC Lakes & Ponds, Lay Monitoring Volunteer | Continue summer monitoring to track trends. |
| 5. Ewell Pond | Continue WQ monitoring and cyanobacteria monitoring | Peacham | VDEC Lakes & Ponds, Lay Monitoring Volunteer | Monitor increasing phosphorus and decreasing DO levels. Determine the reason for the trend. |
| 6. Miller Pond | Establish Lay Monitor | Strafford | VDEC Lakes & Ponds, Lay Monitoring Volunteer | One of only two oligotrophic lakes in Basin 14. This lake shows no signs of increasing spring TP and would benefit from summer monitoring to determine TP trends. |
| 7. Fosters Pond | Lay monitor to collect in-lake chemistry | Peacham | VDEC Lakes & Ponds, Lay Monitoring Volunteer | Continue summer monitoring to track trends. |
| 8. Lake Groton | Lay monitor to collect in-lake chemistry | Groton | VDEC Lakes & Ponds, Lay Monitoring Volunteer | Continue summer monitoring to track trends. |
| 9. Abenaki Pond | Lay monitor or VDEC to collect in-lake chemistry | Thetford | VDEC Lakes & Ponds, Lay Monitoring Volunteer | Start collecting summer TP to determine if levels are normal. |
| 10. Halls Lake | Complete AIS survey | Newbury | VDEC Lakes & Ponds | Confirm presence or absence of variable-leaved milfoil. |
| 11. Kettle Pond | Monitor presence/absence of | Marshfield, | VDEC Lakes & Ponds, | To identify, track and prevent aquatic invasive |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| | aquatic invasive species. | Groton | Vermont Invasive Patroller | species. |
| 12. Lower Symes Pond | Monitor presence/absence of aquatic invasive species. | Ryegate | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| 13. Mud Pond | Monitor presence/absence of aquatic invasive species. | Peacham | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| 14. Lake Abenaki | Monitor presence/absence of aquatic invasive species. | Thetford | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| 15. Harveys Lake | Monitor presence/absence of aquatic invasive species. | Barnet | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| 16. Halls Lake | Monitor presence/absence of aquatic invasive species. | Newbury | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| 17. Miller Pond | Monitor presence/absence of aquatic invasive species. | Strafford | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| 18. Lake Groton | Monitor presence/absence of aquatic invasive species. | Groton | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| 19. Norford Lake | Monitor presence/absence of aquatic invasive species. | Norwich, Thetford | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| 20. Lake Morey | Monitor presence/absence of aquatic invasive species. | Fairlee | VDEC Lakes & Ponds, Vermont Invasive Patroller | To identify, track and prevent aquatic invasive species. |
| **Rivers and Streams** | | | | |
| 21. Scotch Burn – Ticklenaked Pond tributary | Collect total Phosphorus and dissolved phosphorus at pre-determined sites on the Scotch Burn Brook tributary to Ticklenaked Pond | Ryegate | VDEC WID, CCNRCD | To identify current concentrations of phosphorus in Scotch Burn and its tributaries to Ticklenaked Pond. This information will be compared to 2012 sampling events to determine if levels of TP and DP in the streams are lower. |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| 22. Lake Fairlee Tributaries | Collect total Phosphorus and dissolved phosphorus at pre-determined sites to understand phosphorus contributions of major tributaries to the lake. | Fairlee, Thetford, West Fairlee | VDEC, Lake Fairlee Water Quality Committee, VDEC Basin Planner | Identify source(s) of increasing phosphorus trends and low dissolved oxygen. |
| 23. Lake Morey tributaries | Collect tributary samples for one more year to understand phosphorus concentrations during based and freshet flows. | Fairlee | VDEC Lakes & Ponds, Monitoring Volunteer, VDEC Basin Planner | To identify sources of phosphorus leading to in-lake increased total phosphorus during spring runoff. |
| 24. Dothan Brook | Biological and chemical monitoring | Hartford | VDEC MAP | To determine if reports about stormwater runoff are impacting water quality. |
| 25. Charles Brown Brook | Biological and chemical monitoring | Norwich | VDEC MAP | To assess condition after dam removal. |
| 26. Cloud Brook | Biological and chemical monitoring | Barnet | VDEC MAP | To assess condition 5 years after flood event and landslide. |
| 27. Lower Blood Brook | Biological and chemical monitoring | Norwich | VDEC MAP | Data gap. Large watershed with no data. |
| 28. Halls Brook | Biological and chemical monitoring | Newbury | VDEC MAP | Data gap. Large watershed with no data. |
| 29. Jewett Brook | Biological and chemical monitoring | Ryegate, Barnet | VDEC MAP | Data gap. Large watershed with no data. |
| 30. Scott Brook | Biological and chemical monitoring | Newbury | VDEC MAP | Data gap. Large watershed with no data. |
| 31. East Brook | Biological and chemical monitoring | Groton | VDEC MAP | Data gap. |
| 32. Mill Pond Brook | Biological and chemical monitoring | Bradford, Fairlee | VDEC MAP | Data gap. |
| 33. Heath Brook | Biological and chemical monitoring | Groton | VDEC MAP | Data gap. |
| 34. Levi Brook | Biological and chemical monitoring | Topsham | VDEC MAP | Data gap. |
| 35. Meadow Brook | Biological and chemical monitoring | Bradford | VDEC MAP | Data gap. This is a site where NRCS is scoping for strategic wood additions. |
| 36. Darius James Brook | Biological and chemical monitoring | Ryegate | VDEC MAP | Data gap. Small stream with dense agricultural land use. |
| 37. Peacham Hollow Brook | Biological and chemical monitoring | Barnet | VDEC MAP | Determine reclassification status for aquatic biota |
| 38. Beaver Brook | Biological and chemical monitoring | Groton | VDEC MAP | Determine reclassification status for aquatic biota |
| 39. North Branch Wells River | Biological and chemical monitoring | Groton | VDEC MAP | Determine reclassification status for aquatic biota |
| 40. Red Brook | Biological and chemical monitoring | Groton | VDEC MAP | Determine reclassification status for aquatic biota |
| 41. Glenn Falls Brook | Biological and chemical monitoring | Fairlee | VDEC MAP | Determine reclassification status for aquatic biota |
| 42. Abbott Brook Trib #3 | Biological and chemical monitoring | Strafford | VDEC MAP | Determine reclassification status for aquatic biota |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| 43. Sargent Brook | Biological and chemical monitoring | Strafford | VDEC MAP | Determine reclassification status for aquatic biota |
| 44. Sutton Brook | Biological and chemical monitoring | Barnet | VDEC MAP | Determine reclassification status for aquatic biota |
| 45. McIndoe Falls Trib | Biological and chemical monitoring | Barnet | VDEC MAP | Determine reclassification status for aquatic biota |
| 46. South Branch Wells River | Biological and chemical monitoring | Groton | VDEC MAP | Determine reclassification status for aquatic biota |
| 47. Manchester Brook | Biological and chemical monitoring | Ryegate | VDEC MAP | Determine reclassification status for aquatic biota |
| 48. Waits River | Biological and chemical monitoring | Thetford | VDEC MAP | Determine reclassification status for aquatic biota |
| 49. East Orange Branch Waits River | Biological and chemical monitoring | Washington | VDEC MAP | Determine reclassification status for aquatic biota |
| **Wetlands** | | | | |
| 50. Upper and Lower Symes Wetland Complex | Lake-wetland complex bioassessment and biological monitoring. | Ryegate | DEC Lakes & Ponds, VDEC Wetlands | Determine biological condition and if site meets Class I wetland criteria |
| 51. Stoddard Swamp | Bioassessment, WQ monitoring, wetland functions and values assessment | Peacham | VDEC Wetlands, VDEC MAP | Determine biological condition and if site meets Class I wetland criteria |
| 52. Roy Mountain Swamp | Bioassessment, WQ monitoring, wetland functions and values assessment | Barnet | VDEC Wetlands, VDEC MAP | Determine biological condition and if site meets Class I wetland criteria |
| 53. Stillwater Brook Wetlands | Bioassessment, WQ monitoring, wetland functions and values assessment | Groton | VDEC Wetlands, VDEC MAP | Determine biological condition and if site meets Class I wetland criteria |
| 54. Beaver Brook Wetlands | Bioassessment, WQ monitoring, wetland functions and values assessment | Groton | VDEC Wetlands, VDEC MAP | Determine biological condition and if site meets Class I wetland criteria |
| 55. Cookville Swamp | Bioassessment, WQ monitoring, wetland functions and values assessment | Corinth | VDEC Wetlands, VDEC MAP | Determine biological condition and if site meets Class I wetland criteria |
| 56. Conant Swamp | Bioassessment, WQ monitoring, wetland functions and values assessment | Thetford | VDEC Wetlands | Determine biological condition and if site meets Class I wetland criteria |
| 57. Zebedee Brook Wetlands | Bioassessment, WQ monitoring, wetland functions and values assessment | Thetford | VDEC Wetlands, VDEC MAP | Determine biological condition and if site meets Class I wetland criteria |
| 58. Gillette Swamp | Wetland functions and values assessment | Thetford | VDEC Wetlands | Determine biological condition and if site meets Class I wetland criteria |

# List of Acronyms

| | |
|---|---|
| 604(b) | Federal Clean Water Act, Section 604b |
| ACWIP | Agricultural Clean Water Initiative Grant Program |
| AIS | Aquatic Invasive Species |
| AMPs | Acceptable Management Practices (for logging) |
| ANS | Aquatic Nuisance Species |
| AOP | Aquatic Organism Passage |
| BASS | Biomonitoring and Aquatic Studies Section |
| BMP | Best Management Practices |
| BBR | Better Back Roads (VAOT) |
| CCNRCD | Caledonia County Natural Resources Conservation District |
| CEAP | Capital Equipment Assistance Program |
| CRC | Connecticut River Conservancy |
| CRWFA | Connecticut River Watershed Farmers Alliance |
| CREP | Conservation Reserve Enhancement Program |
| CVRPC | Central Vermont Regional Planning Commission |
| CWI | Clean Water Initiative Grant Funding |
| CWIP | Clean Water Initiative Program |
| CWSRF | Clean Water State Revolving Fund |
| DWSRF | Drinking Water State Revolving Fund |
| EBTJV | Eastern Brook Trout Joint Venture |
| EQIP | Environmental Quality Incentive Program |
| ERP | Ecosystem Restoration Program |
| FAP | Farm Agronomic Practices |
| GIS | Geographic Information System |
| GSI | Green Stormwater Infrastructure |
| IDDE | Illicit Discharge Detection (and) Elimination |
| LFO | Large farm Operation |
| Lidar | Light Detection and Ranging |
| LIS | Long Island Sound |
| NRCS | Natural Resources Conservation Service |
| NVDA | Northeast Vermont Development Association |
| NWSC | North Woods Stewardship Center |
| ORW | Outstanding Resource Water |
| PUC | Public Utility Commission |
| RAP | Required Agricultural Practices |
| RCPP | Regional Conservation Partnership Program |
| RMP | River Management Program |
| RPC | Regional Planning Commission |
| SFO | Small Farm Operation |
| SGA | Stream Geomorphic Assessment |
| SWMP | Stormwater Master Plan |
| TBP | Tactical Basin Plan |
| TBPSG | Tactical Basin Planning Support Grants |
| TMDL | Total Maximum Daily Load |
| TNC | The Nature Conservancy |
| TRORC | Two Rivers Ottauquechee Regional Commission |
| TS4 | Transportation Separate Storm Sewer System General Permit |
| TPL | Trust for Public Lands |
| TU | Trout Unlimited |
| USDA | United States Department of Agriculture |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| UVA | Use Value Appraisal program, or Current Use Program |
| UVM Ext. | University of Vermont Extension Service |
| VAAFM | Vermont Agency of Agriculture, Food, and Markets |
| VACD | Vermont Association of Conservation Districts |
| VANR | Vermont Agency of Natural Resources |

| | |
|---|---|
| LTP | Land Treatment Plan |
| LULC | Land Use Land Cover |
| MAB | Municipal Assistance Bureau |
| MAPP | Monitoring, Assessment and Planning Program |
| MEF | Upper Connecticut River Mitigation and Enhancement Fund |
| MFO | Medium Farm Operation |
| MPG | Municipal Planning Grant |
| MRGP | Municipal Roads General Permit |
| NFIP | National Flood Insurance Program |
| NFWF | National Fish and Wildlife Foundation |
| NMP | Nutrient Management Plan |
| NPS | Non-point source pollution |
| NRCD | Natural Resources Conservation District |
| VAOT | Vermont Agency of Transportation |
| VDEC | Vermont Department of Environmental Conservation |
| VDFPR | Vermont Department of Forests, Parks and Recreation |
| VFWD | Vermont Fish and Wildlife Department |
| VHCB | Vermont Housing and Conservation Board |
| VIP | Vermont Invasive Patrollers |
| VLCT | Vermont League of Cities and Towns |
| VLRP | Vermont Local Roads Program |
| VLT | Vermont Land Trust |
| VRC | Vermont Rivers Conservancy |
| VWQS | Vermont Water Quality Standards |
| VYCC | Vermont Youth Conservation Corp |
| WISPr | Water Infrastructure Sponsorship Program |
| WRNRCD | White River Natural Resources Conservation District |
| WQEP | Water Quality Enhancement and Protection |

# References


Astor, S. (2019). *Spatially referenced models of streamflow and nitrogen, phosphorus, and suspended-sediment loads in streams of the Northeastern United States: U.S. Geological Survey Scientific Investigations Report 2019–5118*. doi:https://doi.org/10.3133/sir20195118

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

Clift, A. E., & Springston, G. (2012, December 31). Protocol for Identification of Areas Sensitive to Landslide Hazards in Vermont. Vermont: Vermont Geological Survey. Retrieved from http://dec.vermont.gov/sites/dec/files/geo/TechReports/VGTR2012-1LandslideProtocol.pdf

Coles, J. M. (2012). *Effects of urban development on stream ecosystems in nine metropolitan study areas across the United States*. Reston: U.S. Geological Survey. Retrieved from https://pubs.usgs.gov/circ/1373/pdf/Circular1373.pdf

Connecticut Council on Soil and Water Conservation. (2015). Long Island Sound Watershed RCPP. Retrieved May 7, 2018, from http://www.lisw-rcpp.com/about.html

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

Fulton, S., & West, B. (2002). Forestry Impacts on Water Quality. In D. N. Wear, & J. G. Greis, *Southern Forest Resource Assessment* (p. 635). Ashville, North Carolina: U.S. Department of Agriculture, Forest Service, Southern Research Station. Retrieved from srs.fs.usda.gov/sustain/report/pdf/chapter_21e.pdf

Gale, M. (2020, January 14). Basin 14 Geology. (D. B. Owczarski, Interviewer)

Galford, G. L. (2014). *Considering Vermont's Future in a Changing Climate: The First Vermont Climate Assessment*. Gund Institute for Ecological Economics, Burlington. Retrieved from http://dev.vtclimate.org/wp-content/uploads/2014/04/VCA2014_FullReport.pdf

Galford, G. L., Carlson, S., Ford, S., Nash, J., Palchak, E., Pears, S., . . . Baker, D. V. (Eds.). (2014). Considering Vermont's Future in a Changing Climate: The First Vermont Climate Assessment. 219.

Jankowski, K., & Schindler, D. (2019, November 26). Watershed geomorphology modifies the sensitivity of aquatic ecosystem metabolism to temperature. *Scientific Reports*, 9. doi:https://doi.org/10.1038/s41598-019-53703-3

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

New York State Department of Environmental Conservation; Connecticut Department of Environmental Protection. (2000, December). A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound. Albany; Hartford, New York; Connecticut, United States of America. Retrieved May 7, 2018, from http://longislandsoundstudy.net/wp-content/uploads/2010/03/Tmdl.pdf

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

Redstart Consulting. (2014, July 17). First Branch White River Watershed: Stream Geomorphic Assessment and River Corridor Plan 2012-2013. (D. Ruddell, H. Wahlstrom, A. Spencer, E. McLane, C. Haynes, & B. Machin, Eds.) Vermont.

Springston, G. (2019). *Landslide Inventory of Orange County, Vermont*. Montpelier: Vermont Geological Survey. Retrieved from https://dec.vermont.gov/sites/dec/files/geo/HazDocs/OrangeCountyLandslideStudy.pdf

State of Vermont. (2015, August 15). *Climate Change in Vermont*. Retrieved from Water Quality: https://climatechange.vermont.gov/our-changing-climate/what-it-means/water-quality

State of Vermont. (2016, April 21). *More Total Precipitation* . Retrieved from Climate Change in Vermont: https://climatechange.vermont.gov/our-changing-climate/dashboard/more-annual-precipitation

Stone Environmental, Inc. (2005). *Warren, Vermont: A Different Approach for Managing Wastewater in Rural Villages*. US EPA Case Study, Warren. Retrieved February 31, 2020, from https://www.epa.gov/sites/production/files/2015-06/documents/warren_report_1.pdf

VDEC. (2015). *Water Quality Monitoring Program Strategy Interim Update – May 2015*. Montpelier: VDEC. Retrieved from https://dec.vermont.gov/sites/dec/files/documents/WSMD_MonitoringStrategy2015.pdf

VDEC. (2016, March). *Vermont Surface Water Assessment and Listing Methodology*. Montpelier, Vermont: Agency of Natural Resources.

Vermont Agency of Natural Resources. (2019). *Vermont Clean Water Initiative 2019 Performance Report*. Montpelier: VT Agency of Administration. Retrieved from https://dec.vermont.gov/sites/dec/files/2020-01-14_CleanWaterPerformanceReport_SFY2019-FINAL.pdf

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

Vermont Department of Environmental Conservation. (2013). *Vermont Enhanced Implementation Plan for the Long Island Sound TMDL*. Montpelier: LIS TMDL Workgroup. Retrieved May 7, 2018, from http://click.neiwpcc.org/neiwpcc_docs/LIS%20TMDL_VT%20State%20Section.pdf

Vermont Department of Environmental Conservation. (2017, January 15). *Vermont Water Quality Standards Environmental Protection Rule Chapter 29A*. VT: State of Vermont.

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

Vermont Department of Environmental Conservation. (2019). *Vermont Surface Water Assessment and Listing Methodology*. Montpelier, Vermont: Agency of Natural Resources.

Vermont Lakes and Ponds Program. (2019). Vermont Lakes Database.

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

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

# Appendix A. 2015 Basin 14 TBP Status Update

Overall, work completed in the watershed since the publication of the previous Tactical Basin Plan has allowed several assessments and efforts to support the implementation of specific strategies. This includes mapping and assessing road and stormwater infrastructure, rivers and streams, agricultural land, and wetlands. Extensive work has been done in partnership with the Connecticut River Conservancy, Two Rivers-Ottauquechee Regional Commission, Northern Vermont Development Association, Central Vermont Regional Planning Commission, Caledonia County NRCD, White River NRCD, town based organizations, non-profits, and divisions of state and federal government as well as landowners to work towards restoring impaired waters and managing the watershed for healthier rivers, wetlands, and lakes. Conservation projects and especially buffer projects have increased the total land under conservation, and towns and villages throughout the watershed are working to increase flood preparedness, reduce erosion and green their infrastructure for better water quality.

**Table A1. 2015 Basin 14 report card with 2019 updates from local, state, and federal watershed partners.**

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Action 01 - Continue to regularly monitor waters in this basin through the Sample Palooza interstate monitoring program to better determine nutrient load sources as part of the Long Island Sound Nitrogen TMDL implementation.** | Basinwide | Gather additional nutrient water quality data to better direct ANR and partners' watershed protection and restoration work in the watershed. | VDEC, NH DES, and CRC | Monitoring | Ongoing | Samples were collected and results were published from 2015-2018. |
| **Action 02 - Continue to support volunteer water quality monitoring on lakes in the basin - Fosters, Groton, Halls, Harveys, Morey, Ticklenaked.** | Basinwide | Gather additional nutrient water quality data to better direct ANR and partners' watershed protection and restoration work in the watershed. | VDEC and local lakes volunteers | Monitoring | Ongoing | All currently monitored. Ticklenaked has a new monitor for next year. Lake Fairlee and Martins Pond is also being monitored. Tributary monitoring on Morey and potentially on Lake Fairlee. Lake monitor on Ricker Pond. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Action 03 - Hold workshop(s) in the watershed showcasing and demonstrating practices to protect water quality: Findings from the Vermont Timber Harvesting Assessment, AMP Revision, Voluntary Harvesting Guidelines for Vermont Landowners** | Basinwide | Promote sustainable timber harvesting practices to control soil erosion and reduce sedimentation to waterways. | VFPR, VDEC, and Center for Northern Woodlands | Forestry | Ongoing | Along with the work on State Land, VFPR continues to do training with Vermont Loggers on properly implementing the AMPs and to actively incentivize loggers to utilize temporary skidder bridges through the availability of cost share programs and low-cost rentals for loggers and landowners. In 2017 there was a LEAP (Logger Education to Advance Professionalism) workshop in Groton where a training was held on AMP implementation, job closeout, the Vermont Wetland Rules, and the proper use of skidder bridges. This workshop was attended by loggers and foresters. The AMPs were updated in 2018. One of the significant changes is improved guidance for installing or repairing permanent culverts on intermittent streams. The new AMP manual will be completed in the summer of 2019. |
| **Action 04 - Assist municipalities in developing Stormwater Master Plans that identify and remediate sources of stormwater-related NPS pollution in Village Centers through educational work sessions.** | Basinwide | Remediate impacts of impervious surface-related stressors to waters. | TRORC, VDEC, Watershed towns | Stormwater | In progress | Need to work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. |
| **Action 05 - Build local knowledge of shoreland best management practices among contractors, landscapers, and other shoreland site workers by offering a Shoreland Erosion Control Certification Course annually** | Basinwide | Promote littoral habitat protection on lakes by control of shoreland soil erosion, nutrient loss and sedimentation. | VDEC | Lakes & Ponds | Ongoing | Some coordination with WRNRCD, but turnover in staff (loss of local partner). Will try in the next five years to focus shoreland training in Basin 14 and plan to coordinate with NRCD. Focus outreach on camps, businesses, and private landowners. Lake Morey did a septic local 2018 with large turnout. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Action 06 - Recruit homeowners, recreation area managers, and state parks to demonstration sites showcasing shoreland BMPs.** | Basinwide | Promote littoral habitat protection on lakes by control of shoreland soil erosion, nutrient loss and sedimentation. | VDEC and VFPR | Lakes & Ponds | In progress | Some activity. Check in with Lake Morey - Greg. Informal trainings and discussions on Lake Fairlee. Lake Wise assessment completed on Groton - parking and access sites need work. Kettle Pond - 2017 |
| **Action 07 - Continue to support local Access Greeter programs on Lakes Fairlee, Harveys, and Morey** | Basinwide | Reduce the spread of invasive species and protect existing biodiversity in basin lakes. | VDEC and lake volunteers | Lakes & Ponds | Ongoing | All three lakes communities maintained Greeter Programs in 2019. |
| **Action 08 - Recruit residents to join the Vermont Invasive Patrollers. There are currently no VIPs in this basin** | Basinwide | Reduce the spread of invasive species and protect existing biodiversity in basin lakes. | VDEC and lake volunteers | Lakes & Ponds | Awaiting action | No VIPs currently exist in this basin on priority lakes and ponds. Priority areas for VIPs are: Kettle Pond, Lower Symes Pond, Mud Pond, Lake Abenaki, Harveys Lake, Halls Lake, Miller Pond, Lake Groton, Norford Lake, and Lake Morey. |
| **Action 09- Complete agricultural AEM assessments Tier 1 and 2 in the watershed identified by agricultural partners and implement priority BMPs contained within. Focus areas include Peacham Hollow Brook, Stevens River, South Peacham Brook, Cloud Brook, Willow Brook, Unnamed tributary to Harveys Lake (Appendix G.1).** | Peacham Hollow Brook, Stevens River, South Peacham Brook, Cloud Brook, Willow Brook, Unnamed tributary to Harveys Lake | Address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | CCNRCD, small farmers, VACD, VAAFM, and VDEC | Agriculture | Ongoing | In 2017, VAAFM water quality staff began conducting outreach and educational visits (equivalent to Tier 1s) in the Basin 14 watershed to small farm and Certified Small Farm Operations (CSFOs) to inform them of the newly revised Required Agricultural Practices (RAPs) regulations, share technical and financial assistance resources, and introduce VAAFM water quality staff. During these visits, some CSFOs opted to have an inspection (equivalent to Tier 2s). For other CSFOs, VAAFM water quality staff followed up in 2017 and 2018 to conduct water quality inspections. Outreach visits and inspections of all sized farm operations is ongoing in the watershed. VAAFM technical and financial assistance (equivalent to Tier 3), such as the Best Management Practices (BMP) program and Farm Agronomic Practices (FAP) program, continues to be available in the Basin 14 |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| | | | | | | watershed. Three CREP projects have been completed in Basin 14 since 2015, two in the Ompompanoosuc and one in the Wells River. |
| **Action 10 - Prepare road erosion inventories and capital budgets targeting medium and high priority road segments using the ANR Atlas Road Erosion Risk Ranking and implement BMPs accordingly.** | Towns of Peacham and Barnet | Address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | Towns of Peacham and Barnet, BBR program, NVDA, and VDEC | Stormwater | Ongoing | Peacham and Barnet REI were completed using the 2017 format. These inventories will be converted and available online by Sept 30, 2019. Capital budgets are not part of the current REI deliverables to towns. NVDA is in the process with these towns. Implementation tables and follow up meetings with towns are forthcoming during the Fall of 2019. |
| **Action 11 - Address potential erosion sources from municipal winter sand storage area** | Town of Peacham | Address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | Town of Peacham, VDEC, and NVDA | Stormwater | Awaiting action | No information on outreach to the town. Recommend that NVDA and Basin Planner reach out to town for discussion. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| **Action 12- Replace or retrofit high priority stream crossings that have been identified through previously completed or new the bridge and culvert assessment process. Conduct additional assessments, as necessary.** | Stevens River watershed- 3 high priority structures have been identified (See Appendix J.) for specific crossings) | Identify and remediate dams and undersized stream crossings that contribute to stream disequilibrium and/or hinder aquatic organism passage. | Towns of Peacham and Barnet, landowners, VAOT, CRC, CCNRCD, VDEC, VFWD, and NVDA | Rivers | Ongoing | Many culverts have been identified as geomorphically incompatible (n=39) and a barrier to fish passage (n=445) throughout the basin. In 2019 VFWD completed a survey of culverts statewide to update the database. Because staff resources and funds are limited for culvert and bridge replacement projects, only a small number of these projects can be expected to be completed. However, when funding is available, these projects will be prioritized based on their water quality and habitat benefit on a case-by-case basis. In addition, any structure replacements or retrofits that go through the VT Stream Alteration permit process will automatically be required to be resized to meet geomorphic standards. |
| **Action 13- Develop projects identified in river corridor plan as high priority actions** | Stevens River Watershed- 9 high priority reaches have been identified (See Appendix J.) | Restore, maintain, and protect stream equilibrium and floodplain attenuation assets and flood resiliency. | VDEC, CRC, CCNRCD, Towns of Barnet and Peacham, landowners, NVDA, and VAOT | Rivers | Ongoing | Coordinated meeting with watershed partners to develop plan for prioritization of projects for development and implementation. Caledonia NRCD and CRC are partners for the Stevens River Watershed. CRC completed a buffer planting in Barnet in 2018 and completed a bioengineering and planting project on the Stevens in Barnet in 2019. Additional plantings are scheduled along both sides of the Stevens River from the crossing of I-91 to the Barnet Village Dam. |
| **Action 14- Address flow alteration issues associated with the Harvey's Lake dam** | South Peacham Brook and Harvey's Lake | Address flow alteration issues in the watershed. | Town of Barnet, VDEC, Harvey's Lake Association, VFWD | Rivers | In progress | Study on dam removal and lake level maintenance completed. Funding currently unavailable to implement new dam at lake outlet with the removal of the existing dam on South Peacham Brook. Funding received for 60% design that will be reviewed and a determination made to bring to 100% design. Town has been advised to cease lake level manipulations of current dam. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| **Action 15- Collect additional assessment data for Stoddard Swamp and, if appropriate, support the re-classification of this wetland ecosystem as a Class 1 wetland** | Stoddard Swamp | Gather additional water quality data to better direct ANR and partners' watershed protection and restoration work in the watershed. | VDEC and VFWD NGNH | Protection | Complete | Site visit completed by VT Wetlands Program. Stoddard Swamp is a relatively small wetland but one with several state significant natural community types as well as a good-condition beaver wetland. Plant diversity is high and significant animal habitat is also present. The wetland is owned by the Department of Fish and Wildlife. The wetland does likely meet the criteria for Class I if petitioned by a watershed/conservation group, but the Wetlands program is not planning to petition it at this time. |
| **Action 16- Add additional biological monitoring sites within this sub-watershed to better prioritize watershed protection and restoration measures** | South Peacham Brook and tributaries, East Peacham Brook and tributaries | Gather additional water quality data to better direct ANR and partners' watershed protection and restoration work in the watershed. | VDEC | Monitoring | Complete | 14 data gaps were filled with biomonitoring by VDEC MAP including South Peacham Brook and Peacham Hollow Brook. |
| **Action 17- VDEC recommends that South Peacham Hollow Brook be re-classified from A2 to B since it is no longer used as a public water supply** | South Peacham Hollow Brook | Reclassify waters to better reflect current and future waters management and protection goals. | VDEC and the Town of Peacham | Protection | Awaiting action | No information on outreach to the town. Recommend that TRORC and Basin Planner reach out to town for discussion. |
| **Action 18- Complete shoreland and lake habitat surveys to better direct lakeshore protection and restoration efforts** | Ewell Pond, Mud Pond (Peacham) | Protect VHQW lakes and ponds and undeveloped lakeshores and important wetland ecosystem complexes. | VDEC | Lakes & Ponds | Complete | Lake Assessment and lake shoreland score complete. |
| **Action 19- Protect the ecologically significant Jewett Brook and associated wetland complexes by expanding the Roy Mountain Wildlife Management Area (to include all these areas Figure 2).** | Jewett Brook and adjacent lands | Protect VHQW lakes and ponds and undeveloped lakeshores and important wetland ecosystem complexes. | VDEC, VFWD, LARC | Protection | Awaiting action | The Jewett Brook complex is identified as an important aquatic habitat and species assembly as a priority target for ecologically functional landscape in the Vermont Conservation Design March 2018 report. Protection and improvement or removal of artificial barriers is recommended to maintain its current |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| | | | | | | function. |
| **Action 20(a)- Continue to implement the Ticklenaked Pond TMDL post-restoration monitoring and remove from the D-List of Waters when and if appropriate.** | Ticklenaked Pond | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | VDEC | Monitoring | Ongoing | 2018 meeting with Ryegate Selectboard on cyanobacteria blooms and risks to public health. Volunteer trained to track cyanobacteria blooms, bloom reports are hosted on town website, monitoring is ongoing with plan to repeat targeted monitoring in 2020, and outreach to Lake Association, private landowners and town completed in 2019 on implementing BMPs on farms, roads and lakeshores. Annual check-in with Lake Association established. |
| **Action 20(b)- Implement high priority agricultural BMPs and protection measures in the Ticklenaked Pond watershed. Two farms have been specifically targeted for additional BMP installation. Practices include barn roof gutters, barnyard management, manure storage, gully stabilization, milk house waste management, and livestock exclusion.** | Ticklenaked Pond watershed (See Appendices G.1 and K.) | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | VDEC, VAAFM, NRCS, White River NRCD and ARS | Agriculture | In progress | Ag Workgroup established to report on actions to meet the TMDL. VAAFM BMP program provided technical and financial assistance to implement clean water diversion and management practices on one farm in the Ticklenaked Pond watershed. The farm is currently working with NRCS planners to apply for EQIP assistance to implement additional BMP practices. Livestock exclusion fencing and laneway installed at one farm. Partial barnyard improvements at one farm, but more work needed. Both farms completed Nutrient Management Plans. Corn fields near key tributary seeded down. Manure storage application with NRCS filed for one farm. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| **Action 21- Develop a monitoring plan for the Town of Newbury old landfill site.** | Wells River, Newbury | Identify and remediate stressors responsible for causing water quality impairments and stressed waters. | Town of Newbury, VDEC | Monitoring | In progress | In 2016 additional site work was completed at existing groundwater monitoring wells to better understand groundwater flow and potential discharge from the Newbury landfill. A revised post-closure plan developed from this work is currently under consideration as part of the post-closure certification application for this site. VDEC MAP attempted to monitor the receiving waters (Wells River) in 2018, but there was not an adequate site for access. Staff will follow up during next monitoring rotation. |
| **Action 22- Develop a revised new monitoring plan for the Newbury Paper Sludge site. Develop and implement a remediation plan to address metal discharges from the site.** | Wells River, Newbury | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | VDEC Sites Management Program and property owner | Monitoring | Discontinued | 2014 water quality sampling of water chemistry and macroinvertebrate communities indicates the receiving water of the leachate seeps meets the VT Water Quality Standards. The macroinvertebrate community is in *Excellent* condition and water chemistry did not show elevated levels of metals associated with the seeps. VDEC will continue to monitor this site over time to ensure it continues to meet the VT Water Quality Standards. |
| **Action 23- Complete agricultural AEM assessments Tier 1 and 2 in the watershed identified by agricultural partners and implement priority BMPs contained within** | Wells River and tributaries (See Appendices G.1 and K.) | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | CC and White River NRCDs, VAAFM, VACD, small farmers, and VDEC | Agriculture | Ongoing | VAAFM outreach, inspections, and technical and financial assistance ongoing. See notes in Action #9. In Fall of 2019 WRNRCD is applying for funding to conduct BMP surveys. |
| **Action 24- Prepare road erosion inventories and capital budgets targeting medium and high priority road segments using the ANR Atlas Road Erosion Risk Analysis and implement BMPs accordingly.** | Towns of Ryegate, Groton, and Newbury (Capital budget completed for Groton) | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | Towns of Ryegate, Groton, and Newbury, BBR, NVDA, TRORC, and VDEC | Stormwater | Complete | All REIs are complete. Implementation plans are complete. NVDA has not reviewed the data with Ryegate and Groton. This is a part of the process that NVDA will carry out in Fall 2019. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| **Action 25- Replace or retrofit high priority stream crossings that have been identified through previously completed or new the bridge and culvert assessment process. Conduct additional assessments, as necessary.** | Wells River watershed- 3 high priority crossings (See Appendix J.) | Identify and remediate dams and undersized stream crossings that contribute to stream disequilibrium and/or hinder aquatic organism passage. | Towns of Ryegate, Groton, Newbury, VAOT, VFPR, landowners, VFWD, VDEC, USFWS, NRCS, CRC, CC and White River NRCDs, NVDA, TRORC, and VDEC | Rivers | Ongoing | 5 upsized culverts on Swamp Road within Lower Wells River watershed. Part of a 2018 Grants-In-Aid project. Many culverts have been identified as geomorphically incompatible (n=39) and a barrier to fish passage (n=445) throughout the basin. In 2019 VFWD completed a survey of culverts statewide to update the database. Because staff resources and funds are limited for culvert and bridge replacement projects, only a small number of these projects can be expected to be completed. However, when funding is available, these projects will be prioritized based on their water quality and habitat benefit on a case-by-case basis. In addition, any structure replacements or retrofits that go through the VT Stream Alteration permit process will automatically be required to be resized to meet geomorphic standards. |
| **Action 26- Develop projects identified in river corridor plan as high priority actions.** | Wells River watershed- 6 high priority reaches have been identified (see Appendix J.) | Restore, maintain, and protect stream equilibrium and floodplain attenuation assets and flood resiliency. | Towns of Ryegate, Groton, and Newbury, VDEC, NVDA, TRORC, CC and White River NRCD and CRC. | Rivers | Ongoing | CRC and Caledonia NRCD finalized Phase 2 SGA in 2016 for Ryegate and Groton. Clough River Corridor Easement on ~84 acres of Wells River Corridor in Ryegate, executed in 2016. Buffer Planting was completed in Newbury by CCNRCD. Coordinated meeting with watershed partners to develop plan for prioritization of projects for development and implementation. Caledonia NRCD and CRC are partners for the Stevens River Watershed. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| **Action 27- Prepare an infrastructure-river conflict management plan and restoration designs for Wells River Village. Implement plan and design recommendations if appropriate.** | Wells River within Wells River Village | Restore, maintain, and protect stream equilibrium and floodplain attenuation assets and flood resiliency. | Town of Newbury, Wells River Village, VDEC, and TRORC | Protection | Complete | In 2017 the Town of Newbury and the Village of Wells River adopted their 2016 Multi-Jurisdictional Local Hazard mitigation plan. This plan includes hazards analysis, projects and activities, and a map depicting critical facilities, town infrastructure, the NFIP designated floodway, and 100-year and 500-year floodplain additions. The Town will monitor, evaluate, and update the Local Hazard Mitigation Plan at Selectboard meetings and after every federally declared disaster directly impacting the Town. |
| **Action 28- Implement the removal of Groton Village Number 9 dam.** | Wells River, Groton | Improve in-stream aquatic habitat and passage. | CRC, American Rivers, USFWS, VFWD, VDEC, Town of Groton, TU, and landowner | Rivers | Complete | Dam was removed in 2015. |
| **Action 29- Inventory Groton State Forest lands within the sub-basin and identify streams that would benefit from in-stream habitat restoration practices. Implement these projects as appropriate** | Waters within Groton State Forest | Improve in-stream aquatic habitat and passage. | VFPR, VFWD, TU, and VDEC | Rivers | In progress | VFWD is currently working to identify areas for instream aquatic habitat restoration. |
| **Action 30- Further protect the important functions and values of Peacham Bog by re-classifying the wetland ecosystem from Class 2 to Class 1.** | Peacham Bog | Reclassify waters to better reflect current and future waters management and protection goals. | VDEC and VFPR | Protection | Complete | Peacham Bog Wetland was re-classified as a Class I wetland in 2017. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| **Action 31- Pending. *Referred to Chapter 3, page 56, paragraph 3 in 2015 plan. Correct reference is Chapter 3, page 48 paragraph 3).** | Wells River headwaters | Reclassify waters to better reflect current and future waters management and protection goals. | VDEC and VFPR | Protection | In progress | Waterbodies that are candidates for reclassification on VFPR lands have been identified in the 2020 Basin 14 TBP. These headwaters include North Branch of the Wells River, Red Brook, Beaver Brook, and the South Branch of the Wells River. Additional monitoring is recommended to determine if these waters meet criteria for reclassification for aquatic biota. |
| **Action 32- Add new biomonitoring sites in this sub-watershed to better prioritize watershed protection and restoration measures. Includes Beaver Brook, Osmore Brook, Stillwater Brook, Red Brook, North Branch, Coldwater Brook, Tannery Brook, and Wells River (update RM 4.4 and 10.5).** | Beaver Brook, Osmore Brook, Stillwater Brook, Red Brook, North Branch, Coldwater Brook, Wells River (update RM 4.4 and 10.5). | Gather additional water quality data to better direct ANR and partners' watershed protection and restoration work in the watershed. | VDEC | Monitoring | In progress | 14 data gaps were filled with biomonitoring by VDEC MAP including Red Brook. |
| **Action 33- Identify flow improvement opportunities associated with the Boltonville Dam, and implement as appropriate.** | Wells River, Ryegate | Address flow alteration issues in the watershed. | VDEC, dam operator, VFWD | Rivers | Discontinued until further notice | Flow demonstration was going to be conducted as part of Low Impact Hydro certification process which would require the project to meet VWQS. The dam owner recently informed the VT Rivers Program that their board voted to discontinue this effort for now due to economics of the Renewable Energy Credit (REC) markets. |
| **Action 34(a) - Implement high priority recommendations included within the Wells River Stormwater Infrastructure Mapping Reports.** | Wells River (Watersheds 9 and 12- top priority 11- second priority) | Remediate impacts of impervious surface-related stressors to waters. | TRORC, Wells River (Newbury), and VDEC | Stormwater | Awaiting action | Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| **Action 34(b) - Implement high priority recommendations included within the Boltonville Stormwater Infrastructure Mapping Report.** | Boltonville (Watersheds 2 and 3) | Remediate impacts of impervious surface-related stressors to waters. | TRORC, Boltonville (Newbury), and VDEC | Stormwater | Awaiting action | Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. |
| **Action 34(c) - Implement high priority recommendations included within the Ryegate Stormwater Infrastructure Mapping Report.** | East Ryegate (Watershed 8) | Remediate impacts of impervious surface-related stressors to waters. | NVDA, Ryegate, and VDEC | Stormwater | Awaiting action | Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. |
| **Action 34(d) - Implement high priority recommendations included within the Groton Stormwater Infrastructure Mapping Report.** | Groton Village (Watershed 6) | Remediate impacts of impervious surface-related stressors to waters. | NVDA, Groton, and VDEC | Stormwater | In progress | Groton will be developing HMGP starting in October. NVDA will look at the SW mapping in the process. |
| **Action 35- Complete shoreland and lake habitat surveys to better direct lakeshore protection and restoration efforts on Ricker Pond, Levi Pond, Noyes Pond, Kettle Pond, and Osmore Pond.** | Ricker Pond, Levi Pond, Noyes Pond, Kettle Pond, and Osmore Pond | Protect VHQW lakes and ponds and undeveloped lakeshores and important wetland ecosystem complexes. | VDEC, VFPR, VFWD | Monitoring | Complete | Lake Assessment and lake shoreland score complete. No VFWD access, only VFPR. |
| **Action 36- Identify and remediate possible sources of impairment to the Tabor Branch Tributary, including agricultural and road-related sources.** | Tabor Branch watershed | Identify and remediate stressors responsible for causing water quality impairments and stressed waters. | WRNRCD, VAAFM, VDEC, Town of Topsham Highway Department, landowners | Monitoring | In progress | Monitoring will be carried out in spring and summer of 2020. Recommend focused outreach by ag technical service provider. Water quality inspections are ongoing with VAAFM. |
| **Action 37- Initiate riparian buffer planting and protection projects along stressed and altered waters in the sub-basins: South Branch Waits, Waits River, Tabor Branch, and Cookville.** | South Branch Waits, Waits River, Tabor Branch, Cookville (see appendix G.1 and K) | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | WRNRCD, VDEC, VAAFM, VAOT | Rivers | Ongoing | Riparian projects through VAAFM are ongoing. TRORC reports two culverts upsized and one culvert added on Ben Dexter Road which crosses Tabor Branch. Updates were a part of 2017 Grants-In-Aid project. No direct stream crossings but culverts are within floodplain. |

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| **Action 38- Determine the feasibility of improving in-stream aquatic habitat and implement if appropriate on the Waits River mainstem downstream of South Branch Confluence.** | Waits River main stem-downstream of South Branch confluence | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | VFWD, VDEC, CRC, WRNRCD | Rivers | In progress | Focus will be prioritized on headwaters for both in-stream aquatic habitat restoration and riparian protection and restoration. Restoration on lower sections of the Waits will be based on interest and feasibility. Temp logger data from 2007 and 2019 will be synthesized in a report by VFWD. |
| **Action 40- Develop a remediation plan for Pike Hill Mine Super Fund Site.** | Pike Hill Brook and Cookville tributary number 4 watersheds | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | EPA, VDEC, VFWD, and landowner | Other | In progress | WMPD currently coordinating with EPA on the remedial investigation to define the nature and extent of contamination and assessing the potential threats to human health and the environment. Timeline for actual site remediation and restoration of impacted streams and wetlands is unknown but for planning purposes 7-10 years. Sampled in 2014 and 2019 for fishing by VFWD. |
| **Action 41- Complete agricultural AEM assessments Tier 1 and 2 in the watershed identified by agricultural partners and implement priority BMPs contained within: Waits River, South Branch, and Tabor Branch.** | Waits River, South Branch, Tabor Branch (see appendices G.1 and K) | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | WRNRCD, VACD, VAAFM, and VDEC | Agriculture | Ongoing | VAAFM outreach, inspections, and technical and financial assistance ongoing. See notes in Action #9. |
| **Action 42- Prepare road erosion inventories and capital budgets targeting medium and high priority road segments using the ANR Atlas Road Erosion Risk Ranking and implement BMPs accordingly in Bradford, Corinth, Topsham, and Washington.** | Waits | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | TRORC, CVRPC, VDEC, BBR, Bradford, Corinth, Topsham, and Washington | Stormwater | Ongoing | BMPs funded by Better Roads in Orange. Corinth REI completed in 2017. Topsham REI planned for 2019 (funding secured). REI for Washington and Orange scheduled for summer 2019. Bradford REI & culvert inventory planned for 2020 (funding secured). |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| **Action 43- Develop projects identified in river corridor plan as high priority actions in Waits River watershed high priority reaches.** | Waits River watershed- 30 high priority reaches have been identified (See Appendix J) | Restore, maintain, and protect stream equilibrium and floodplain attenuation assets and flood resiliency. | CRC, VDEC, WRNRCD, TRORC, watershed towns | Rivers | Ongoing | Bank stabilization buffer in Bradford. CRC completed root wad and buffer planting project in 2015. |
| **Action 44- Replace or retrofit high priority stream crossings that have been identified through previously completed or new the bridge and culvert assessment process. Conduct additional assessments, as necessary.** | Waits River watershed- 20 high priority structures have been identified (Appendix J) | Identify and remediate dams and undersized stream crossings that contribute to stream disequilibrium and/or hinder aquatic organism passage. | Watershed towns, VAOT, VFPR, landowners, VFWD, VDEC, USFWS, NRCS, CRC, CC and White River NRCD, TRORC, and VDEC | Rivers | Ongoing | Culvert Replacements completed through VAOT Grant-in-Aid projects: multiple culvert replacements and upsizing in South Branch Waits River watershed, multiple replacements in Lower Waits River watershed, and replacements and added culverts in the Tabor Branch watershed. CRC replaced a high priority culvert on Abbott Brook in Strafford with the help of VFWD in 2016. Many culverts have been identified as geomorphically incompatible (n=39) and a barrier to fish passage (n=445) throughout the basin. In 2019 VFWD completed a survey of culverts statewide to update the database. Because staff resources and funds are limited for culvert and bridge replacement projects, only a small number of these projects can be expected to be completed. However, when funding is available, these projects will be prioritized based on their water quality and habitat benefit on a case-by-case basis. In addition, any structure replacements or retrofits that go through the VT Stream Alteration permit process will automatically be required to be resized to meet geomorphic standards. |
| **Action 45- Pending. *Referred to Chapter 3, page 56, paragraph 3 in 2015 plan. Correct reference is Chapter 3, page 48 paragraph 3).** | Waits River headwaters | Reclassify waters to better reflect current and future waters management and protection goals. | VDEC and VFPR | Protection | In progress | Waterbodies that are candidates for reclassification on VFPR lands have been identified in the 2020 Basin 14 TBP. These include the Waits River headwaters and tributaries. Additional monitoring is recommended to determine if these |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
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| | | | | | | waters meet criteria for reclassification for aquatic biota. These waters currently meet the criteria for B(1) fisheries. |
| **Action 47- Implement high priority recommendations included within the Bradford Stormwater Infrastructure Mapping Reports.** | Bradford Village - Watershed's first priority - 26, 18, 22 second priority - 20 and 21 third priority 16 and 32 | Remediate impacts of impervious surface-related stressors to waters. | Town and Village of Bradford, TRORC, VDEC | Stormwater | Awaiting action | Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. |
| **Action 48- Implement the Ompompanoosuc bacteria TMDL by identifying and remediating potential agricultural and septic sources, expanding and conserving riparian buffers and floodplains, and promoting septic system maintenance.** | East Branch Ompompanoosuc | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | Towns of Vershire, West Fairlee, and Thetford, VDEC, WRNRCD, CRC, and UVLT | Other | Ongoing | Monitoring, outreach and education completed by town of Fairlee. Outreach and education are ongoing and opportunities are being explored as they arise to improve private wastewater systems and agricultural practices. More Ag outreach should be focused in the high *E. coli* areas. |
| **Action 49- Develop a better understanding of current water quality conditions of the bacteria impaired reach of the Ompompanoosuc with additional water quality monitoring** | Impaired section of the East Branch Ompompanoosuc and tributaries | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | Towns of Vershire, West Fairlee, and Thetford, VDEC, WRNRCD, CRC, and UVLT | Monitoring | Ongoing | WRNRCD partnered with West Fairlee CC to conduct a septic social and received a VDEC grant to do septic education. WRNRCD funded the printing of septic awareness brochures. Most of the households that could potentially be contributing to the water quality impairment cannot afford to remediate the problem and there is no available cost share. WRNRCD is hoping to develop an educational program by the elementary school in West Fairlee. |
| **Action 50- Continue the implementation of the Elizabeth Mine Remediation Plan and monitoring – evaluate feasibility of** | West Branch Ompompanoosuc, Lords Brook, Copperas Brook | Identify and remediate stressors responsible causing water quality impairments and | EPA, VDEC, Towns of Strafford and Thetford | Monitoring | Complete | Elizabeth Mine remediation mostly completed. Treatment switched from active to passive. Monitoring will follow. |

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| **developing Use Attainability Analysis for aquatic habitat in Copperas Brook.** | | stressed waters. | | | | |
| **Action 51- Complete and begin implementing the Ely Mine Implementation Plan** | Schoolhouse Brook and tributary | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | EPA, VDEC, VFWD, Town of Thetford | Other | In progress | WMPD currently coordinating with EPA on finalizing the remedial design for site cleanup, which will include restoring Ely Brook, its tributaries and the onsite ponds to meet VT Water Quality Standards. Timeline for cleanup is 2-5 years. |
| **Action 52(a)- Assure the implementation of the Environmental Stewardship BMPs to reduce lead shot residue from entering waterways from the Thetford Fish and Game Club shooting range.** | Unnamed tributary to Gillette Swamp, Thetford | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | Town of Thetford, Fish and Game Club, VDEC WMPD, and VFWD | Other | Ongoing | The Environmental Management Plan was developed in 2016 in coordination with the VDEC Waste Management and Prevention Division and included a calendar of actions for completion. |
| **Action 52(b)- Conduct monitoring at the Thetford Fish and Game Club to determine efficacy of BMP implementation at this shooting range.** | Unnamed tributary to Gillette Swamp, Thetford | Identify and remediate stressors responsible causing water quality impairments and stressed waters. | VDEC WMD and WMPD | Monitoring | Complete | Previous monitoring showed that surface waters in the watershed met Vermont Water Quality Standards, but levels were elevated. Post sampling should be completed in 2022 to confirm efficacy of Environmental Management Plan. |
| **Action 53- Complete agricultural AEM assessments Tier 1 and 2 in the watershed identified by agricultural partners and implement priority BMPs contained within** | Ompompanoosuc watershed, with a focus on the East Branch watershed (See Appendices G.1 and K.) | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | WRNRCD, VACD, VAAFM, and VDEC | Agriculture | Complete | Assessments completed. VAAFM outreach, inspections, and technical and financial assistance ongoing. See notes in Action #9. |
| **Action 54(a)- Prepare road erosion inventories and capital budgets targeting medium and high priority road segments using the ANR Atlas Road Erosion Risk Ranking and implement** | Vershire, West Fairlee, Thetford and Strafford | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | TORC, VDEC, BBR, Vershire, West Fairlee, and Strafford | Stormwater | Complete | Vershire REI & culvert inventory completed; West Fairlee REI completed with culvert inventory and high priority segment determination currently in progress; Thetford REI on track to be finished this year (TRORC not doing this REI); Strafford REI completed. Vershire, |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **BMPs accordingly.** | | | | | | West Fairlee, Thetford and Strafford are all currently implementing BMPs through Grants-in-Aid projects. |
| **Action 54(b)- Address runoff from the Town of Vershire's road sand storage area.** | Vershire | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | Vershire, VDEC, TRORC | Stormwater | Awaiting action | No information on outreach to the town. Recommend that TRORC and Basin Planner reach out to town for discussion. |
| **Action 55- Develop projects identified in river corridor plan as high priority actions, both active and passive, and determine feasibility of implementation** | Ompompanoosuc River (See Appendix J.) | Restore, maintain, and protect stream equilibrium and floodplain attenuation assets and flood resiliency. | VDEC, TRORC, WRNRCD | Rivers | Ongoing | Two river corridor easements completed in 2017. CRC and White River NRCD completed a buffer planting in 2017. |
| **Action 56- Design and implement high priority recommendations included in the Town of West Fairlee Stormwater Infrastructure Mapping Report and complete IDDE survey of the Village.** | Town of West Fairlee - Watershed 1 and 2 (ANR, 2015) | Remediate impacts of impervious surface-related stressors to waters. | Town of West Fairlee, TRORC, and VDEC | Stormwater | Complete | Stormwater Infrastructure Mapping and IDDE study complete. Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. Fairlee is currently working on a SWMP for their village center along Route 5. The plan should be completed in 2022. |
| **Action 57- Determine the feasibility of removal of the Geer and Montague Rod and Reel Dams and develop these projects if appropriate** | Ompompanoosuc River West Fairlee and Thetford | Improve in-stream aquatic habitat and passage. | CRC, AM, VDEC, VFWD | Rivers | In progress | Geer Dam removed in 2017. Montague Rod and Reel Lower Dam removed, and upper dam breached. Watershed partners currently involved in outreach to town and landowners to determine interest in removal. |
| **Action 58- Complete shoreland and lake habitat surveys to better direct lakeshore protection and restoration efforts on** | Abenaki Pond, Miller Pond | Protect VHQW lakes and ponds and undeveloped lakeshores and important wetland | VDEC | Lakes & Ponds | Complete | Lake Abenaki was assessed in 2012. Miller Pond was assessed in 2018. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Abenaki Pond and Miller Pond.** | | ecosystem complexes. | | | | |
| **Action 59- Use the Critical Source Area (CSA) "lite" agricultural runoff model maps to better identify potential sources of nitrogen from agricultural sources as part of the LI Sound N TMDL. Target high erosion potential polygons for BMP outreach and implementation.** | Mid-CT River and direct tributaries watershed (Appendix K.) | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | VDEC, NRCS, and VAAFM | Agriculture | Discontinued | This action is being replaced through the implementation of the Required Agricultural Practices by the Agency of Agriculture, Farm & Markets (VAAFM). |
| **Action 60- Develop a comprehensive wetland inventory and restoration prioritization and restore and protect high priority wetland ecosystems** | Mid- CT River and direct tributaries watershed | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | VDEC, CRC, and TRORC | Protection | Complete | VT Wetlands Program has hired a full-time monitoring and assessment position to work on wetland assessment statewide. Restoration prioritization has taken place in the Connecticut River basin through NRCS. Monitoring by the Wetlands program occurred in this watershed in 2017. 28 rapid assessments and 15 vegetation releves were conducted, with 10 sets of water samples collected. Inventory and mapping of the area continue. |
| **Action 61- Complete a riparian buffer inventory for the CT River corridor, river right, and downstream most reaches of direct tributaries and implement high priority projects.** | Mid-CT River and direct tributaries | Identify and address significant sources of sediment, nutrients, and bacteria entering waters in the watershed. | VDEC, CRC, and TRORC | Rivers | In progress | A riparian buffer analysis will be completed for the entire basin. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Action 62- Replace or retrofit high priority stream crossings that have been identified through previously completed or new the bridge and culvert assessment process.** | Middle Connecticut River watershed (See Appendix J.) | Identify and remediate dams and undersized stream crossings that contribute to stream disequilibrium and/or hinder aquatic organism passage. | VFWD, VDEC, towns | Rivers | Ongoing | One culvert on Upper Turnpike Rd upsized in 2018 Grants-In-Aid project. Many culverts have been identified as geomorphically incompatible (n=39) and a barrier to fish passage (n=445) throughout the basin. In 2019 VFWD completed a survey of culverts statewide to update the database. Because staff resources and funds are limited for culvert and bridge replacement projects, only a small number of these projects can be expected to be completed. However, when funding is available, these projects will be prioritized based on their water quality and habitat benefit on a case-by-case basis. In addition, any structure replacements or retrofits that go through the VT Stream Alteration permit process will automatically be required to be resized to meet geomorphic standards. |
| **Action 63- Initiate a new portable skidder bridge rental program in this sub-watershed.** | Fairlee or other suitable location | Identify and remediate dams and undersized stream crossings that contribute to stream disequilibrium and/or hinder aquatic organism passage. | VFPR, WRNRCD, and VDEC | Forestry | Discontinued | Through discussions with other Districts the rental program has come to an end. Instead, the focus is on finding a way to cost share with loggers in owning them. The Senate of Ag committee first brought up this idea and is discussing it with the Districts. Rentals are infrequent, and many loggers simply want to buy them. See Action 3. |
| **Action 64- Implement high priority actions within the Bloody Brook River Corridor Management Plan and stream crossing assessment.** | Bloody Brook watershed – (See Appendix J.) | Restore, maintain, and protect stream equilibrium and floodplain attenuation assets and flood resiliency. | Town of Norwich, VDEC. TRORC, | Rivers | In progress | Were the two high priority culverts replaced on Marsh Hill and Godfrey Road. Projects will be implemented where there is interest and funding available. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Action 65(a) - Implement high priority recommendations included within the Norwich Stormwater Infrastructure Mapping Report.** | Towns of Norwich - Watersheds 1 and 4 are top priority and 18 is second priority (ANR, 2014) | Remediate impacts of impervious surface-related stressors to waters. | Town of Norwich, TRORC, CRC, and VDEC | Stormwater | Awaiting action | Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. |
| **Action 65(b) - Implement high priority recommendations included within the Fairlee Stormwater Infrastructure Mapping Report.** | Fairlee - Watershed 3 (ANR, 2014) | Remediate impacts of impervious surface-related stressors to waters. | Town of Fairlee, TRORC, CRC, and VDEC | Stormwater | Awaiting action | Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. |
| **Action 65(c) - Implement high priority recommendations included within the Newbury Village Stormwater Infrastructure Mapping Report.** | Newbury Village - Watershed 1 (ANR, 2014) | Remediate impacts of impervious surface-related stressors to waters. | Newbury Village, TRORC, CRC, and VDEC | Stormwater | Awaiting action | Work with watershed partners and municipalities to prioritize stormwater projects in Basin 14 where Stormwater Mapping has been completed. |
| **Action 65(d) - Implement high priority recommendations included within the Hartford Stormwater Infrastructure Mapping Report.** | Hartford (ANR, 2014) | Remediate impacts of impervious surface-related stressors to waters. | Town of Hartford, TRORC, CRC, and VDEC | Stormwater | In progress | Coordination meeting with town of Hartford in 2017 to discuss applying for funding to complete a SWMP. Town is interested, but staffing is a concern. Will continue to work with the town to accomplish this. |
| **Action 66- Determine sources of erosion to Dothan Brook and implement protection and restoration measures accordingly.** | Dothan Brook | Remediate impacts of impervious surface-related stressors to waters. | Town of Hartford, TRORC, and VDEC | Monitoring | Awaiting action | No information on outreach to the town. Recommend that TRORC and Basin Planner reach out to town for discussion. |
| **Action 67(a) - Complete IDDE surveys for Norwich.** | Norwich Village | Remediate impacts of impervious surface-related stressors to waters. | VDEC | Other | Complete | Completed in January 2017. Detecting and Eliminating Illicit Discharges in the Upper and Middle Connecticut River Basin: Final Report. |
| **Action 67(b) - Complete IDDE surveys for Fairlee.** | Fairlee Village | Remediate impacts of impervious surface-related stressors to waters. | VDEC | Other | Complete | Completed in January 2017. Detecting and Eliminating Illicit Discharges in the Upper and Middle Connecticut River Basin: Final Report. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Action 67(c) - Complete IDDE surveys for Hartford.** | Hartford (including Wilder and WRJ) | Remediate impacts of impervious surface-related stressors to waters. | VDEC | Other | Complete | IDDE study completed in 2018. |
| **Action 68- Add additional biological monitoring sites in this sub-watershed to better prioritize watershed protection and restoration measures on Sutton Brook, Manchester Brook and unnamed tributaries north of Manchester Brook.** | Sutton Brook, Manchester Brook and unnamed tributaries north of Manchester Brook | Gather additional water quality data to better direct ANR and partners' watershed protection and restoration work in the watershed. | VDEC | Monitoring | Complete | Sutton Brook sampled in 2017. Macroinvertebrate assessment *Excellent* and all water quality parameters collected meet water quality standards. Manchester Brook sampled in 2017. Macroinvertebrate assessment *Very Good* and all water quality parameters collected meet water quality standards. |
| **Action 69- Expand and protect streambank associated with Wilder Dam impoundment with regulatory activities.** | CT River mainstem | Address flow alteration issues in the watershed. | VDEC and Great River Hydro | Rivers | Ongoing | Great River Hydro's updated FERC license is due to July 2020. ANR and other parties are in discussion on future operations of the Wilder Dam Project. |
| **Action 70- Increase conservation flows below the Wilder Dam and reduce the magnitude of peaking operations and water level fluctuations in the impoundment which would improve aquatic habitat in the Connecticut River, as appropriate related to the Wilder Dam on the Connecticut River through the FERC re-licensing and 401 Water Quality Certification process.** | CT River main stem above and below Wilder Dam | Address flow alteration issues in the watershed. | VDEC, VFWD, Great River Hydro | Rivers | In progress | Wilder Project is still in the FERC relicensing process. ANR continues to discuss and finalize the habitat-flow study with Great River Hydro before they file revise their FERC license application. |
| **Action 71- Complete shoreland and lake habitat survey to better direct lakeshore protection and restoration efforts on Harriman Pond and Lake** | Harriman Pond, Lake Morey | Protect VHQW lakes and ponds and undeveloped lakeshores and important wetland ecosystem | VDEC | Lakes & Ponds | Complete | Lake Assessment and lake shoreland score complete. Volunteer monitoring is being conducted on Lake Morey to identify need for restoration efforts. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Morey.** | | complexes. | | | | |
| **Action 72- Protect the ecologically significant Symes Pond lakeshore and associated wetland complexes by expanding the Roy Mountain Wildlife Management Area to include all these areas (Figure 10).** | Symes Pond and adjacent lands | Protect VHQW lakes and ponds and undeveloped lakeshores and important wetland ecosystem complexes. | VDEC, VFWD, and LARC | Protection | Awaiting action | The Symes Pond complex is identified along with Manchester Brook as an important aquatic habitat and species assembly as a priority target for ecologically functional landscape in the Vermont Conservation Design March 2018 report. Protection and improvement or removal of artificial barriers is recommended to maintain its current function. |
| **Action 73- Continue variable-leaved milfoil surveys to confirm eradication.** | Halls Lake | Raise awareness of aquatic invasive plants, animals, and pathogens spread prevention. | VDEC and Halls Lake Association | Lakes & Ponds | Ongoing | Plant survey completed in 2018. Variable-leaved milfoil not present. Survey will be conducted again in 2020 by VDEC staff. As a rule, 5-years absence is considered an eradication success. A more thorough survey can formalize the eradication when staff resources are available. |
| **Action 74(a)- Improve canoe access areas between McIndoe Falls to Dodge Falls and in Norwich.** | McIndoe Falls impoundment, downstream of Dodge Falls, Connecticut River near Norwich | Improve recreational boating opportunities in the Middle Connecticut River. | VRC, VYCC, CRC | Recreation | Complete | In 2017 TransCanada (now Great River Hydro) completed improvements at McIndoe Falls, rehabilitating the portage and access. The town of Norwich has also improved the access ramp off Route 5. |
| **Action 74(b)- Expand canoe-accessible river camping sites.** | Between North Thetford and Norwich on the Connecticut River | Improve recreational boating opportunities in the Middle Connecticut River. | VRC, VYCC, CRC | Recreation | Ongoing | New campsites were established at McIndoe Falls (Stephan's Island). The Horse Meadow Campsite (in North Haverhill, NH) has also been reestablished in partnership with the Thetford Academy, and Patchen Point in Norwich was formally designated as a campsite. Work along the river continues as part of a larger paddlers trail effort focused on the entire Connecticut River. |

| Project Description | Target Area(s) | Objective | Potential Project Partners | Sector | Status | Update or Recommendation for 2020 TBP |
|---|---|---|---|---|---|---|
| **Actions 39 & 46- Identify flow improvement opportunities associated with the Bradford Dam, and implement as appropriate.** | Waits River, Bradford | Address flow alteration issues in the watershed. | VDEC, VFWD, Dam Operator | Rivers | In progress | The hydro-electric facility is exempt from FERC licensing process. Added to the 2020 Strategy Table. |

# Appendix B. Biological Water Quality Monitoring Results

Table B1. Biological monitoring assessment results from 2015 to 2019.

| Map # | Stream Name | Year | Macroinvertebrate Assessment Rating | Fish Assessment Rating |
|---|---|---|---|---|
| 1 | Peacham Hollow Brook | 2017 | Excellent | |
| 2 | Sutton Brook | 2017 | Excellent | |
| 3 | Peacham Hollow Brook | 2017 | Excellent | Good |
| 4 | South Peacham Brook | 2017 | Good | Very Good |
| 4 | South Peacham Brook | 2017 | Good | |
| 5 | South Peacham Brook | 2017 | Ex-Very good | Excellent |
| 6 | Mud Pond Brook | 2017 | Excellent | Excellent |
| 7 | Cloud Brook | 2017 | Good | |
| 8 | Stevens River | 2017 | Excellent | |
| 9 | McIndoe Falls Trib | 2017 | Ex-Very good | |
| 10 | Beaver Brook | 2017 | Excellent | |
| 11 | Red Brook | 2017 | Excellent | |
| 12 | Manchester Brook | 2017 | Very good | |
| 13 | North Branch Wells River | 2017 | | Very Good |
| 14 | Tannery Brook | 2017 | Good | |
| 15 | South Branch Wells River | 2017 | | Excellent |
| 16 | East Brook | 2017 | Fair | |
| 17 | Wells River | 2017 | Excellent | |
| 18 | Tabor Branch Trib 5 | 2017 | Excellent | Excellent |
| 19 | Waits River | 2017 | Excellent | Good |
| 20 | East Orange Branch Waits River | 2017 | Very good | Excellent |
| 21 | Tabor Branch | 2017 | Very good | |
| 22 | Pike Hill Brook | 2017 | Fair | |
| 23 | Pike Hill Brook | 2017 | Poor | |
| 24 | Pike Hill Brook | 2017 | Fair | |
| 25 | Cookville Brook Trib # 4 | 2017 | Poor | |
| 26 | Roaring Brook | 2017 | Ex-Very good | Excellent |
| 27 | Cookville Brook | 2017 | Good | |
| 28 | Cookville Brook | 2017 | Ex-Very good | |
| 29 | South Branch Waits River | 2017 | Ex-Very good | |
| 30 | Meadow Brook | 2017 | Excellent | |
| 31 | Middle Brook | 2017 | Excellent | Excellent |
| 32 | Glen Falls Brook | 2017 | Excellent | |
| 33 | Schoolhouse Brook | 2017 | Fair | Good |
| 34 | Abbott Brook Trib #3 | 2016 | Ex-Very good | Excellent |
| 35 | Sargent Brook | 2017 | Excellent | |
| 36 | Copperas Brook | 2019 | Fair | |
| 36 | Copperas Brook | 2017 | F-Poor | |
| 37 | Lords Brook Trib 2 | 2019 | Poor | |

| Map # | Stream Name | Year | Macroinvertebrate Assessment Rating | Fish Assessment Rating |
|---|---|---|---|---|
| 38 | Zebedee Brook | 2016 | | Good |
| 39 | Bloody Brook | 2017 | Excellent | Poor |
| 40 | Charles Brown Brook | 2017 | Good | Very Good |

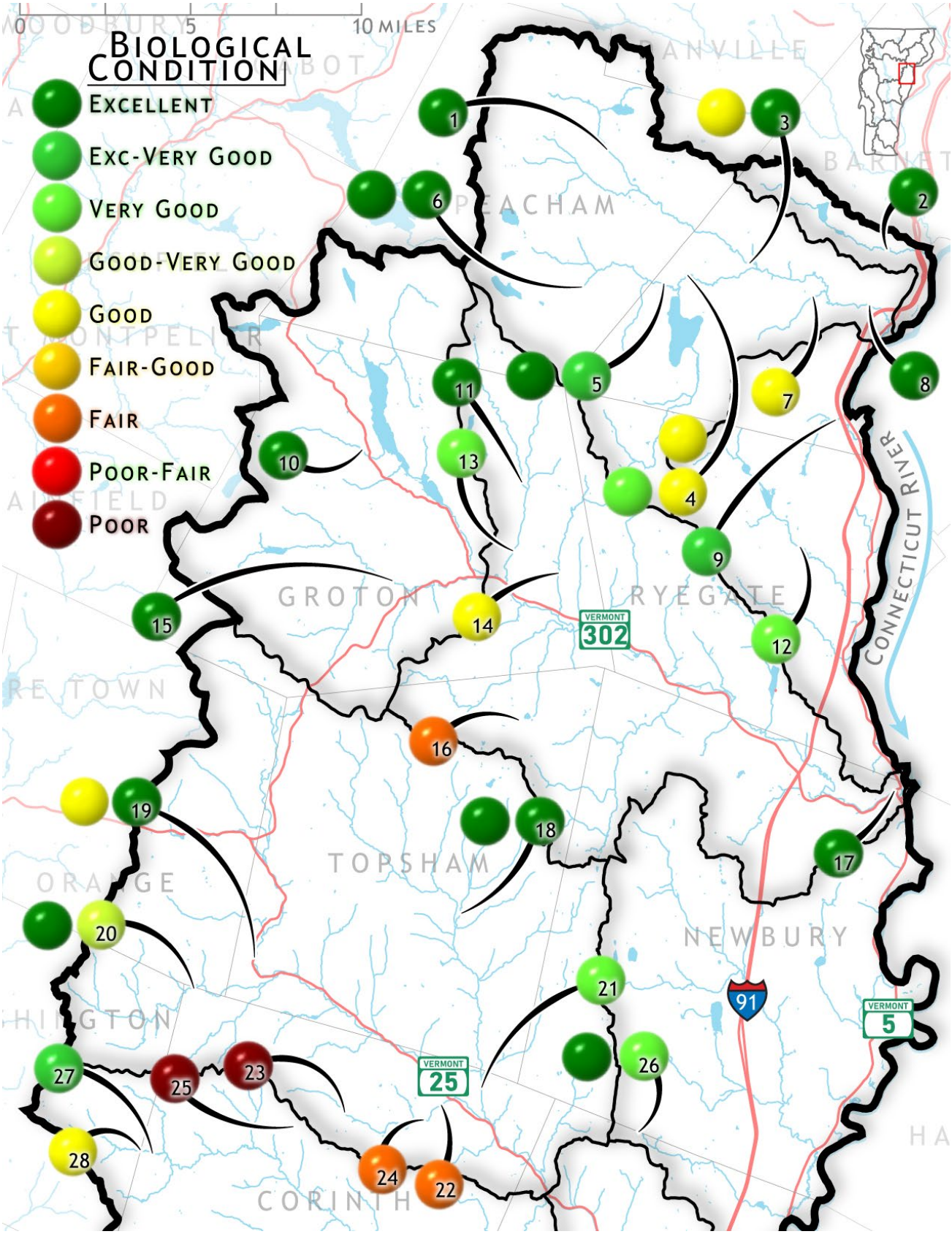


**Figure B1. Biological monitoring results for fish and macroinvertebrate assessments in the upper half of Basin 14 from 2015-2019. Where two assessment ratings are shown, the fish assessment result is on the left and macroinvertebrate is on the right.**

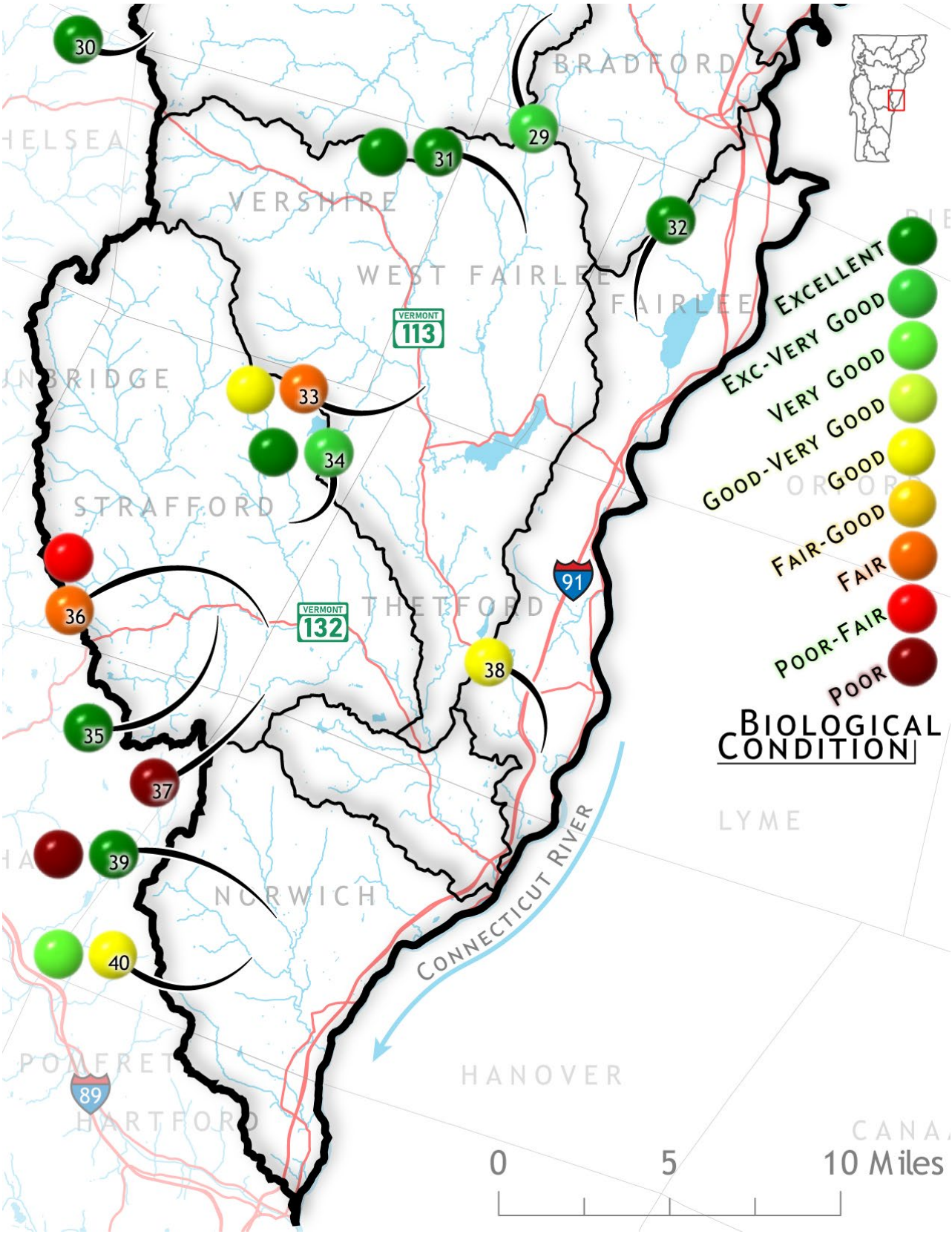


**Figure B2. Biological monitoring results for fish and macroinvertebrate assessments in the lower half of Basin 14 from 2015-2019. Where two assessment ratings are shown, the fish assessment result is on the left and macroinvertebrate is on the right.**

# Appendix C. Dams in Basin 14

There are approximately 60 dams of different types, sizes, and condition in Basin 14. While dams are used to generate energy and recreational opportunities such as boating, fishing, and swimming, they can also:

- impede a stream's ability to transport flow and sediment;
- cause streambank erosion and flooding problems;
- degrade and alter fisheries habitat;
- create barriers to fish movement and migration;
- alter downstream temperature
- degrade water quality; and
- impede river-based recreational activity.

Of the 60 inventoried dams, 53 are in-service, 1 is fully breached, 4 are partially breached, and 2 are not active. The 57 active in-service and partially breached dams constrict the stream channel enough to reduce sediment transport, prevent lateral movement, and inhibit aquatic organism passage (AOP). The remaining 3 dams have been breached to a point that they are not causing considerable constriction of the stream channel or impediments to AOP. A detailed list of known non-historic dams in the watershed can be found in Table C1.

On January 18, 2018, H.554 or Act 161, the Dam Safety bill, passed the Vermont House of Representatives and received final approve on May 10$^{th}$ of the same year. The bill was developed collaboratively with the VDEC, Vermont Natural Resources Council, Vermont Trout Unlimited, the Vermont Section of the American Society of Civil Engineers, and other partners. The bill addresses gaps in inspection requirements for hundreds of small dams. Under the bill, VDEC will be required to maintain an inventory of all dams in the state and develop rules that will require all dams to be regularly inspected.

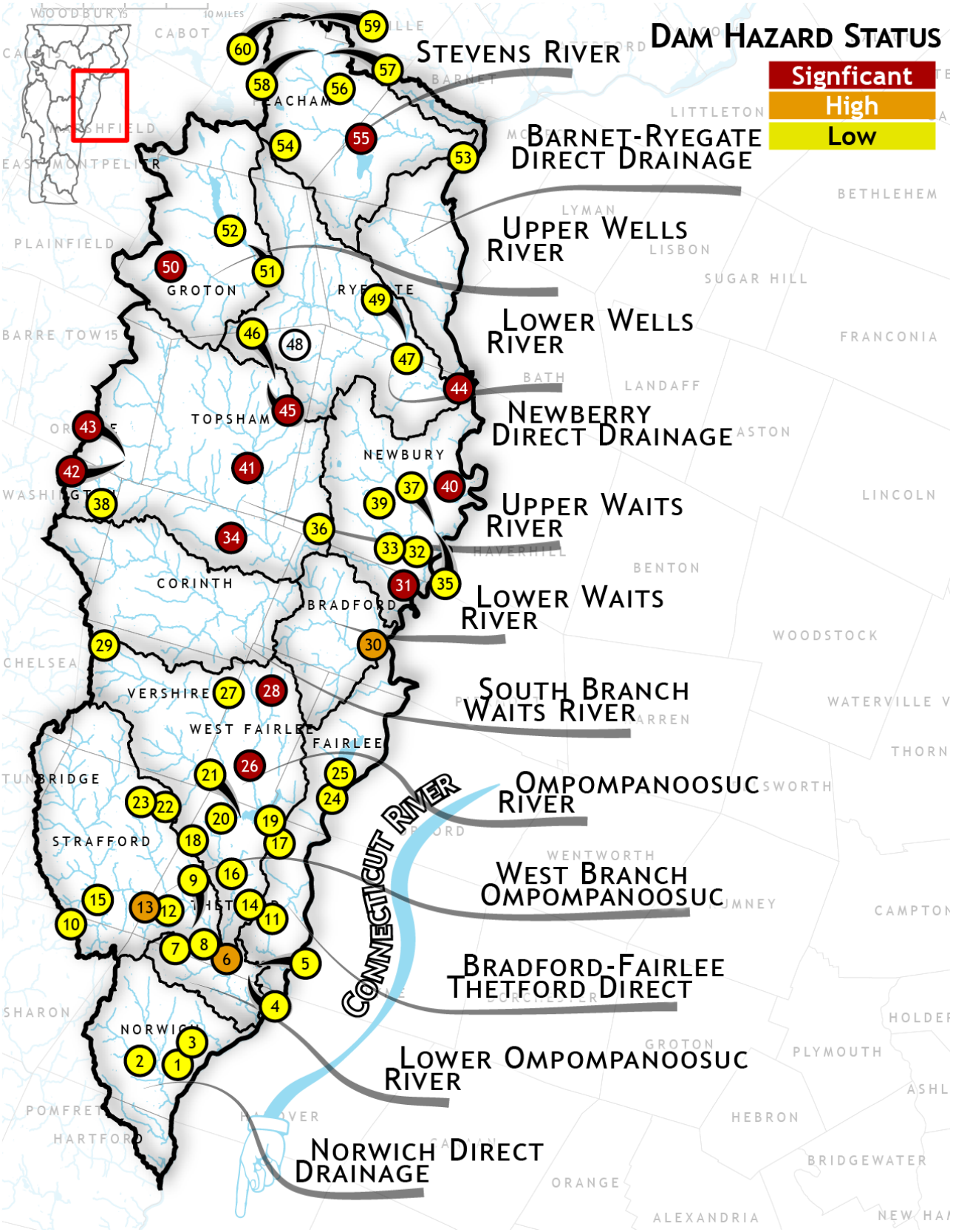


Figure C1. Non-historic dams located in Basin 14. Map #'s in table C1 correlate with the numbers in this map. Source: Source: Vermont Dam Inventory (accessed: 10/01/2019)

Table C1. Active dams in Basin 14 organized by town name. These dams are either in service, partially breached, or deleted. Dams that are not "in-service" are in italics. Source: Vermont Dam Inventory (accessed: 10/01/2019)

| Map # | Dam Name | Town | Stream | Owner Type | Surface Acres | Drainage ($m^2$) | Dam Status | Purposes | Year Built | Original Purpose | State Reg | Fed Reg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Noonan | Norwich | | Private | 0.1 | | In Service | | | | None | None |
| *2* | *Norwich Reservoir* | *Norwich* | *Charles Brown Brook* | *Local Government* | *0* | *5.2* | *Breached* | *Other* | *1920* | *Water Supply* | *None* | *None* |
| 3 | Hunt Griswold | Norwich | Connecticut River-TR | Private | 1.92 | | In Service | Recreation | 1959 | Recreation | None | None |
| 4 | Thetford-23 | Thetford | Ompompanoosuc River-TR | Private | 0 | | In Service | | | | None | None |
| 5 | Thetford-22 | Thetford | Ompompanoosuc River-TR | | 2.14 | | In Service | | | | None | None |
| 6 | Union Village | Thetford | Ompompanoosuc River | Federal | 805 | 126 | In Service | Flood Control | 1950 | Flood Control | None | USACOE |
| 7 | Norford Lake | Thetford | Avery Brook-TR | Private | 18 | 1.03 | In Service | Recreation | 1925 | Recreation | VDEC | None |
| 8 | Payson | Thetford | Ompompanoosuc River-TR | Private | 20 | 0.27 | In Service | Recreation | 1975 | Recreation | VDEC | None |
| *9* | *Manchester* | *Thetford* | *Ompompanoosuc River-TR* | *Private* | *3* | *0.39* | *Breached (Partial)* | | | | *VDEC* | *None* |
| 10 | CCC Pond | Sharon | Ompompanoosuc River-TR | State | 9 | 0.28 | In Service | Recreation | 1935 | Recreation | VDEC | None |
| 11 | Thetford-21 | Thetford | Connecticut River-TR | | 1.23 | | In Service | | | | None | None |
| 12 | Gove Hill Christian Association | Thetford | Lords Brook-TR | Private | 3 | 0.07 | In Service | Recreation | 1968 | | VDEC | None |
| 13 | Elizabeth Mine TP-1 | Strafford | West Branch Ompompanoosuc Riv. | Private | 42 | 0.43 | In Service | Tailings | 1958 | Tailings Pond | VDEC | None |
| 14 | Lake Abenaki | Thetford | Ompompanoosuc River-TR | | 44 | 1.01 | In Service | Recreation | 1900 | | VDEC | None |
| 15 | Strafford Recreation | Strafford | W Branch Ompompanoosuc Riv.-TR | | 0.7 | | In Service | | | | None | None |
| 16 | Mud Pond | Thetford | Ompompanoosuc River-TR | Private | 13 | 1 | In Service | Recreation | 1940 | | VDEC | None |
| 17 | Thetford-24 | Thetford | Roaring Brook | Private | 1.7 | | In Service | | | | None | None |
| 18 | Thetford-20 | Thetford | Barker Brook-TR | | 2.66 | | In Service | | | | None | None |
| 19 | Fin n' Feather | Thetford | Lake Fairlee-TR | Private | 5 | 0.79 | In Service | Recreation | 1956 | | VDEC | None |
| *20* | *Montague Rod and Reel Co. (Upper)* | *Thetford* | *Ompompanoosuc River* | *Private* | *0.5* | | *Breached (Partial)* | | | | *None* | *None* |
| 21 | Lake Fairlee | Thetford | Ompompanoosuc River-TR | Local Government | 463 | 20.28 | In Service | Recreation | 1939 | Water Level Reg. | VDEC | None |
| 22 | Miller Pond | Strafford | Abbot Brook-TR | State | 63 | 1.04 | In Service | Recreation | 1960 | Recreation | VDEC | None |
| *23* | *Malmquist* | *Strafford* | *Abbot Brook-TR* | *State* | *2* | *0.59* | *Breached (Partial)* | | | | *VDEC* | *None* |
| 24 | Bancroft Mill | Fairlee | Connecticut River-TR | Private | 4 | 9.6 | In Service | Recreation | | Mill Power | VDEC | None |
| 25 | Lake Morey | Fairlee | Connecticut River-TR | State | 506 | 7.26 | In Service | Recreation | 1897 | | VDEC | None |
| 26 | Middle Brook | West Fairlee | Middle Brook | Private | 17 | 9.5 | In Service | Recreation | 1948 | Recreation | VDEC | None |
| *27* | *Powell* | *Vershire* | *Ompompanoosuc River-TR* | | *10* | *0.98* | *Deleted* | | *1970* | | *VDEC* | *None* |
| 28 | Keefe Site 2 | West Fairlee | Middle Brook | Private | 4 | 1.53 | In Service | Recreation | 1965 | Recreation | VDEC | None |
| 29 | Vershire-6 | Vershire | Meadow Brook-TR | Private | 1.9 | | In Service | | | | None | None |
| 30 | Bradford | Bradford | Waits River | Public Utility | 91 | 153 | In Service | Hydroelectric | 1908 | Hydro Power | PUC | FERC |
| 31 | Blodgett | Bradford | Roaring Brook | Private | 14 | 4.84 | In Service | Recreation | 1965 | Recreation | VDEC | None |
| 32 | Old Stone | Newbury | Halls Brook | Private | 0 | 20 | In Service | Hydroelectric | 1838 | Mill Power | PUC | FERC |
| 33 | Cole | Newbury | Halls Brook-TR | | 2 | 0.15 | In Service | Recreation | | | VDEC | None |
| 34 | Holland | Corinth | Pike Hill Brook-TR | Private | 3 | 0.22 | In Service | Recreation | 1966 | Recreation | VDEC | None |
| 35 | Newbury Water Supply (Lower) | Newbury | Connecticut River-TR | Local Government | 2.15 | 0.94 | In Service | Water Supply | 1890 | Water Supply | VDEC | None |
| 36 | Victory in Jesus | Newbury | Meadow Brook-OS | Private | 0.37 | | In Service | | 2006 | | None | None |

| Map # | Dam Name | Town | Stream | Owner Type | Surface Acres | Drainage ($m^2$) | Dam Status | Purposes | Year Built | Original Purpose | State Reg | Fed Reg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37 | Newbury Water Supply (Upper) | Newbury | Connecticut River-TR | Local Government | 0.6 | 0.85 | In Service | Water Supply | | Water Supply | None | None |
| 38 | Green | Washington | East Orange Branch-TR | Private | 2.4 | 2.01 | In Service | Recreation | 1971 | Recreation | VDEC | None |
| 39 | Halls Lake | Newbury | Halls Brook | Private | 84 | 0.88 | In Service | Recreation | | | VDEC | None |
| 40 | The Fish Pond | Newbury | Connecticut River-TR | Private | 5 | 0.47 | In Service | Recreation | 1973 | Recreation | VDEC | None |
| 41 | Blake | Topsham | Tabor Branch-TR | Private | 3 | 0.62 | In Service | Recreation | 1972 | Wildlife/Recreation | VDEC | None |
| 42 | East Orange (Lower) | Orange | East Orange Branch-TR | Private | 0.9 | 0.18 | In Service | Recreation | | | None | None |
| 43 | East Orange (Upper) | Orange | East Orange Branch-TR | Private | 0.81 | 0.18 | In Service | Recreation | | | None | None |
| 44 | Adams Paper Co. | Newbury | Wells River | Private | 11 | 98 | In Service | Hydroelectric | 1912 | | PUC | FERC |
| 45 | Clark Site No. 2 | Topsham | Tabor Branch-TR | Private | 8 | 0.2 | In Service | Recreation | 1974 | Recreation | VDEC | None |
| 46 | Clark Site No. 1 | Topsham | Tabor Branch-TR | Private | 0.9 | | In Service | | | | None | None |
| 47 | Boltonville No. 11 | Newbury | Wells River | Private | 2 | 94 | In Service | | 1928 | Hydro Power | PUC | FERC |
| *48* | *Morse* | *Topsham* | *East Brook* | | *0* | | | | | | *None* | *None* |
| 49 | Ticklenaked Pond | Ryegate | Wells River-TR | Private | 48 | 2.26 | In Service | Recreation | | | VDEC | None |
| 50 | Noyes Pond | Groton | South Branch Wells River | State | 39 | 3.76 | In Service | Recreation | 1934 | Recreation | VDEC | None |
| 51 | Ricker Pond | Groton | Wells River | State | 92 | 21.09 | In Service | Recreation | 1900 | Mill Storage | VDEC | None |
| 52 | Lake Groton | Groton | Ricker Pond-TR | State | 414 | 18.75 | In Service | Recreation | 1968 | Recreation | VDEC | None |
| 53 | Barnet No. 14 | Barnet | Stevens River | Private | 0 | 48 | In Service | Hydroelectric | | | PUC | FERC |
| 54 | Martins Pond | Peacham | Stevens River-TR | State | 77 | 1.25 | In Service | Recreation | 1958 | Recreation | VDEC | None |
| 55 | Harveys Lake | Barnet | Stevens River | Local Government | 409 | 20 | In Service | Recreation | 1970 | Recreation | VDEC | None |
| 56 | East Peacham Pond | Peacham | Peacham Hollow Brook-OS | Private | 5 | 0.37 | In Service | Recreation | 1948 | | VDEC | None |
| *57* | *Ewell Pond* | *Peacham* | *East Peacham Brook-TR* | *Private* | *50* | *3.1* | *Breached (Partial)* | *Recreation* | *1930* | *Mill Storage* | *VDEC* | *None* |
| 58 | Dawson | Peacham | Peacham Hollow Brook | Private | 3 | 0.59 | In Service | Recreation | | | VDEC | None |
| 59 | Aiken | Peacham | Peacham Hollow Brook-TR | Private | 2 | 0.73 | In Service | Recreation | 1969 | Recreation | VDEC | None |
| 60 | Tinkers Pond | Peacham | Rake Factory Brook-TR | Private | 7 | 0.08 | In Service | Recreation | 1908 | | VDEC | None |

# Appendix D. Municipal Water Quality Protectiveness Table

Table D1. Municipal Water Quality Protectiveness Table for the Basin 14.

| Town | ERAF Rate (%) | NFIP Community | Road and Bridge Standards (2019) | Local Emergency Management Plan | Local Hazard Mitigation Plan | River Corridor Protection | Flood Hazard Area Management | Flood Regulations Last Updated | Flood Resilience Element in Municipal Plans | Corridor Protection, Setbacks and Buffers | Steep Slope/Ridgeline Development | Stormwater/LID Requirements |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Barnet** | 7.5 | Yes | Yes | No | No | No | Prohibited activities in the flood hazard area include new structures, storage, and fill. Permitted uses include improvements to existing structures, small accessory structures, at grade parking, and recreational vehicles. Exempted activities include road maintenance, open space recreation, forestry, and agriculture. All other uses require a conditional use determination. | 2018 | Yes | No | No | No |
| **Bradford** | 7.5 | Yes | Yes | No | Yes | Interim | New structures, both residential and non-residential, and storage are prohibited in the Special Flood Hazard Area, as is fill (except as needed to elevate existing structures). Improvements to existing structures and utilities are either permitted or subject to conditional use review. Accessory structures and at grade parking are permitted. | 2014 | Yes | Streambank Conservation Provision in Zoning Bylaws: All buildings and structures erected from the effective date of these Bylaws shall be setback 35 feet from the upper edge of the streambank. Dumping and filling within the setback area is also prohibited. | Wetlands and Excessively Steep Slopes District within Zoning Bylaws: Building development prohibited on sites in excess of 25% grade. Access roads across a slope exceeding 25% permitted if road doesn't have above 15% slope and adequate erosion control plans in place. | Not discussed in Town Plan, Flood Hazard Area Bylaw or Zoning Bylaw. |
| **Chelsea** | 7.5 | Yes | Yes | No | Yes | No | All development shall be reasonably safe from flooding and shall not decrease the distance between any existing primary buildings' footprint and streams. New residential principal structures and net fill are prohibited unless it has been demonstrated through hydrologic and hydraulic analyses that it would not increase flood levels during base flood discharge. See document for further conditions on residential and non-residential development as well as subdivisions. | 2017 | Yes | Streambank Conservation Provision in Zoning Bylaws: All buildings and structures erected from the effective date of these Bylaws shall be setback 35 feet from the upper edge of the streambank. | Not discussed in Town Plan, Zoning Bylaws, or Flood Hazard Area Bylaws. | Not discussed in Town Plan, Zoning Bylaws, or Flood Hazard Area Bylaws. |
| **Corinth** | 7.5 | Yes | Yes | No | Yes | Yes | New structures, both residential and non-residential, and storage are prohibited in the Special Flood Hazard Area, as is fill (except as needed to elevate existing structures). Improvements to existing structures, including storage tanks, are either permitted or subject to conditional use review. Accessory structures and at grade parking are permitted. | 2015 | Yes | Not discussed in Town Plan or in Flood Hazard Area Bylaw. | Town Plan policy: "To minimize conflicts with scenic values, telecommunication tower designs and construction shall follow these guidelines whenever possible:… Towers shall avoid breaking the silhouette of peaks and ridges by locating downslope whenever feasible. | Not discussed in Town Plan or in Flood Hazard Area Bylaw. |
| **Fairlee** | 7.5 | Yes | Yes | No | Yes | Yes | New structures, including residential and non-residential, and storage are prohibited in the Special Flood Hazard Area, as is fill (except as needed to elevate existing structures). Improvements to existing structures are either permitted or subject to conditional use approval. Small accessory structures and at grade parking are permitted. | 2018 | Yes, but TP expired | Unified Development Bylaw: Development regulations also apply to River Corridors as published by VT ANR, including Statewide River Corridors. Where river corridors are not mapped, the standards shall apply to the area measured as 50 feet from the top of bank or slope of perennial streams. In River Corridors, new structures, storage and fill (unless needed to elevate existing structures) are prohibited. | Not addressed in Unified Development Bylaw or discussed in Town Plan. | Unified Development Bylaw: Stormwater run-off and treatment shall be dealt with on-site. |

| Town | ERAF Rate (%) | NFIP Community | Road and Bridge Standards (2019) | Local Emergency Management Plan | Local Hazard Mitigation Plan | River Corridor Protection | Flood Hazard Area Management | Flood Regulations Last Updated | Flood Resilience Element in Municipal Plans | Corridor Protection, Setbacks and Buffers | Steep Slope/Ridgeline Development | Stormwater/LID Requirements |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Groton** | 7.5 | Yes | Yes | No | No | No | Zoning permit is required for all development in Special Flood Hazard Areas. A zoning permit may be issued for residential accessory structures and minor residential building improvements. | 2005 | YES | No | No | No |
| **Groton Village** | 7.5 | Yes | Yes | No | No | No | see Groton | see Groton | see Groton | see Groton | see Groton | see Groton |
| **Hartford** | 7.5 | Yes | Yes | Yes | No | No | New development and substantial improvements must elevate lowest floor 1 ft above BFE. All development shall be reasonably safe from flooding: designed and anchored to prevent flotation, collapse, and movement of the structure; constructed with materials resistant to flood damage; construction methods that minimize flood damage; and service facilities located in areas to prevent water from entering. | 2007 | Yes | Protection of Surface Waters in Zoning Bylaws: Riparian buffer shall be maintained for 100ft from TOB of the CT, Ottauquechee, & White Rivers or for 30ft from edge of stream or any other surface water ID'd in Hartford GIS Natural Resources Map. No development, excavation, filling, clearing or grading without Conditional Use approval from Zoning Board of Adjustment. | Hartford's Zoning Ordinance contains the Rural Lands, Agricultural Lands, and Wildlife Connector Overlay District which state that development should be located down-slope of ridgelines and prominent hills in areas where ridgelines and hillsides are easily visible from existing roadways, and development shall be considered relative to the availability of less visible locations on-site. | Applications for Conditional Use approval under the Surface Water Zoning Bylaw must include a description of practices used to protect water quality of project generated stormwater runoff per the "Low Risk Site Handbook for Erosion Prevention and Sediment Control" as well as an erosion control plan. |
| **Newbury** | 7.5 | Yes | Yes | No | Yes | No | Flood Hazard Overlay (which includes SFHA): Principal residential and non-residential structures, storage, net fill (except as necessary to elevate existing structures), and critical facilities are all prohibited. Non-substantial improvements (that do not increase footprint), development related to existing permitted on-site septic or water supply, building utilities, and at grade parking are all permitted. Non-substantial improvements (that do increase footprint) and substantial improvements are all subject to conditional use review. | 2017 | Yes | Streambanks in Unified Zoning & Subdivision Regulations: Outside of village districts, no land disturbance is allowed within a riparian buffer extending 35ft from TOB of all second order streams except for agricultural and forestry practices, road and driveway crossings, permitted septic repairs, utility crossings, crossings by recreational trails, removal of invasive species, stream restoration projects, and maintenance of existing structures. In village districts, all structures must be setback 25ft from TOB of streams. In all other districts, residential structures must be 50ft from TOB of streams, and commercial structures must be 100ft from TOB. | No new slopes may be created with a grade above 1:3. Disturbance of steep slopes (over 25%) shall be minimized. Subdivision on slopes greater than 25% may require licensed professional engineer to certify that they do not pose a landslide or erosion risk. | To receive Conditional Use approval from the DRB: No increase is allowed in off-site stormwater runoff in terms of volume or peak discharge. Sites creating more than half an acre of impervious surface will be required to submit an engineered stormwater plan. Sites disturbing more than an acre and/or creating an acre of impervious surface require a state stormwater permit in addition to local permits. |
| **Norwich** | **7.5** | Yes | Yes | No | Yes | No | Flood Hazard Overlay District (Includes Special Flood Hazard Areas): New principal structures residential or non residential, fuel and hazardous materials storage, and major development in floodway (above 500 sq ft) are not allowed. | 2009 | Yes | Shoreline Protection Overlay (SPO) District in Zoning Regulations: The Primary Shoreline Protection Area is measured from TOB as defined below - 100ft for CT & Ompomp. Rivers; 100ft for Blood Brook from CT River to New Boston Rd; 50ft for Streams & Lakes on the SPO Map; 25ft for Streams not shown on the SPO Map. See document for specific prohibited, permitted and conditional uses. | Norwich 2009 Zoning Regulations state that an erosion control plan must be developed for excavation and filling in areas to be disturbed with slopes greater than 15%. Excavation, filling and development in areas in excess of 25% slope is not allowed except for the installation of utility lines. | Applications for Site Plan & Conditional Use Review must include a grading and drainage plan that includes a provision for stormwater management. Additionally, DRB is allowed to impose safeguards/conditions regarding stormwater management including LID stormwater management practices, upon Site Plan review as well. |
| **Orange** | 17.5 | Yes | Yes | Yes | Yes | Interim | Goes above NFIP minimum, no new structures in floodplain, no storage structures and no fill. Does allow small accessory structures with permit. | 2014 | Yes | No | No | No |
| **Peacham** | **7.5** | Yes | Yes | No | Yes | Interim | Prohibited activities in the Special Flood Hazard Area, Floodway, and FEH Zone are new structures, storage, and fill. Prohibited activity in the floodway is small accessory structures. Other uses may be permitted, exempted or require a conditional use review | 2013 | YES | No | No | No |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ryegate** | 7.5 | Yes | Yes | No | No | No | Prohibited activity in the Special Flood Hazard area is fill. Permitted activities are small accessory structures, at grade parking, and recreational vehicles. Exempted activities are road maintenance, outdoor recreation, forestry and agriculture. All other uses require a conditional use determination. | 2017 | YES | No | No | No |
| **Sharon** | 7.5 | Yes | Yes | No | Yes | Interim | New residential or non-residential structures are prohibited from the Special Flood Hazard Area, Fluvial Erosion Hazard Zone, and stream buffer. | 2010 | Yes | Subdivision Regulations (Applies to all subdivisions): No building envelopes shall be placed within 100ft of the TOB of any perennial stream or edge of any wetland. No ground disturbance or removal of healthy vegetation will be allowed within 50ft of such boundaries except for permitted crossings. This may not be waived. | Subdivision Regulations (Applying to all subdivision): No new slopes may be created with a grade greater than 1:3. Disturbance of steep slopes (over 25%) shall be avoided. Subdivisions on slopes greater than 25% may require a licensed professional engineer to certify that it does not pose a landslide or erosion risk. What is listed above may not be waived. The Sharon Town Plan states that locating buildings at the top of ridgelines or at the brows of hills where land is open and sites would be highly visible from nearby public roads is prohibited. It is the policy of Sharon to restrict land development on ridgelines and that any structures or buildings shall be located away from ridgelines, and shall be built lower on the hillsides, hidden within wooded areas. | Subdivision Regulations (Applies to all subdivisions): Stormwater shall be handled by an erosion control plan prepared by a licensed professional engineer for control of erosion, sediment, and stormwater runoff during and following development. The above may be waived by the Sharon Planning Commission. Sharon Town Plan: It is the policy of the town to limit encroachments on the riparian corridor by limiting and by careful siting and setback of roads, paved paths, parking lots, buildings and structures where streamside vegetation exists or has reasonable potential for restoration and maintenance. |
| **Strafford** | 7.5 | Yes | Yes | No | Yes | No | In "Fringe Areas," new residential construction and existing buildings to be substantially improved, shall have the lowest floor elevated to at least 1ft above base flood elevation, as shall new non-residential development. Existing, non-residential buildings to be substantially improved shall have the lowest floor elevated to at least 1ft above base flood elevation or be designated to be watertight below the base flood elevation. Permits are required for all of the above types of development. | 1993 | Yes | Town Plan Policy: Preservation of the natural state of streams should be encouraged by maintenance of existing stream bank and buffer vegetation including trees, together with wildlife habitat. Town Plan Recommendation: The Town should update the Strafford Flood Zoning Ordinance to ensure that it meets the standards required by the Federal Emergency Management Agency so that Strafford may continue to participate in the National Flood Insurance Program (NFIP). The reviewed ordinance should consider prohibiting new development in the Special Flood Hazard Area (excluding small ancillary structures). | Town Plan policy: To encourage preservation of open land, farms, forests, wetlands, scenic ridgelines, wildlife habitat, and outdoor recreation. Town Plan recommendation: Planning Commission should consider adding language to the Strafford Bylaw which addresses lighting, viewsheds, and residential construction on ridgelines. | Not addressed in the Town Plan or in Flood Hazard Area Zoning Ordinance. |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Thetford** | 7.5 | Yes | Yes | No | Yes | Interim | All development shall be reasonably safe from flooding and: designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure during the occurrence of the base flood; constructed with materials resistant to flood damage; constructed by methods and practices that minimize flood damage; and constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding. Existing residential buildings in Zones A, A1-A30, and AE shall have the lowest floor, including basement, elevated to at least one foot above base flood elevation. Existing non-residential buildings in the above zones shall have the lowest floor, including basement, elevated to at least one foot above base elevation, or together with attendant utility and sanitary facilities, be designed so that below the base flood elevation, the structure is watertight. | 2008 | No & TP expired | Zoning Bylaw: No structures shall be allowed within the setback distance as follows: For first order streams the setback shall be 50ft. For second order streams, the setback shall be 75ft. For third order streams or higher, the setback shall be three channel widths from the center of channel. Setbacks shall be measured from top of bank. For steep-sided streams where little or no floodplain is evident, setback shall be measured from top of slope. | Town Plan policy: "Slopes greater than 25 percent should be left undeveloped because of high erosion potential and difficulty for development. Slope considerations should be added to the Zoning Ordinance. (PRIORITY)." "Consider adding subdivision regulations to exclude very steep slopes and wetlands from the calculation of lot size when determining minimum lot sizes or when calculating allowable density for cluster and multi-unit development." "To the extent possible, the Town Planning Commission and Development Review Board should discourage ridgeline development and should take an active role in site determinations where such development is to proceed. Consider ridgeline zoning." | Not addressed in Town Plan or in Flood Hazard Area Zoning Bylaw. |
| **Topsham** | 7.5 | Yes | Yes | No | Yes | No | Until a regulatory floodway has been designated, no new construction, substantial improvements, or other development shall be permitted in the area of the special flood hazard unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing development and anticipated development will not increase the water surface elevation of the base flood more than 1ft at any point within the community. In areas where a regulatory floodway has been designated, both residential and non-residential development, existing and new, in Zones A, A1-A30, AE and AH shall have the lowest floor, including basement, elevated to at least 1ft above base flood elevation. | 2008 | TP expired but did have a Floodplain element. Adopted before Flood Resiliency requirement was in place. | Town Plan Principle: "Preservation of the natural state of streams should be encouraged by maintenance of existing stream bank and buffer vegetation including trees, together with wildlife habitat." | Not addressed in Town Plan or in Flood Hazard Ordinance. | Not addressed in Town Plan or in Flood Hazard Ordinance. |
| **Tunbridge** | 7.5 | Yes | Yes | No | Yes | No | All structures shall be designed to minimize flood damage to development; to provide adequate drainage; shall be designed/anchored to resist flotation, collapse, or lateral movement; constructed with materials and methods that minimize flood damage; and the flood carrying capacity within any altered or relocated portion of a watercourse shall be maintained. The lowest floor of new buildings shall be elevated 1 foot or more above BFE. Fully closed areas below BFE and subject to flooding shall be used solely for parking of vehicles, storage, building access. | 2014 | Yes | Town Plan Policy: Preservation of the natural state of streams should be encouraged by maintenance of existing stream bank and buffer vegetation including trees, together with wildlife habitat.<br>Town Plan Recommendation: Planning Commission should consider creating a policy regarding development and riparian buffer zones in future versions of [the Town] plan.<br>Act 250 Requirement regarding commercial development along Route 110: Maintain trees and existing vegetation adjacent to Route 110. A generously landscaped buffer (using native plants and trees) shall be part of any new construction adjacent to Route 110. | Act 250 Lot Layout: Locating buildings at the top of ridgelines or at the brows of hills where land is open, and sites would be highly visible from nearby public roads is prohibited. | Town Plan Policy: Developments, and their associated stormwater discharges, that are adjacent to wetlands should be planned so they do not cause undue disturbance to wetland areas. Maintenance of a naturally vegetated buffer strip between a wetland and the project site is encouraged to prevent groundwater pollution and direct discharges into a wetland. |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Vershire** | 7.5 | Yes | Yes | No | Yes | No | Until a regulatory floodway has been designated, no new construction, substantial improvements, or other development shall be permitted in the area of the special flood hazard unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing development and anticipated development, will not increase water surface elevation of the base flood at any point within the community. Additionally, new residential construction and existing buildings to be substantially improved in Zones A, A1-A30, and AE, shall have the lowest floor elevated to at least 1ft above base flood elevation, as shall new non-residential development. Existing, non-residential buildings to be substantially improved in Zones A, A1-A30, and AE shall have the lowest floor elevated to at least 1ft above base flood elevation or together with attendant utility and sanitary facilities be designed so that below base flood elevation, the structure is watertight. | 2010 | Yes | Streambank Conservation in Zoning Ordinance: All buildings and structures erected from the effective date of this ordinance shall be setback 35 feet from the upper edge of streambank on a perennial stream and 50ft from the edge of a state designated wetland. | Natural Resource Limitations within Zoning Ordinance: Building development on slopes in excess of 25% grade is prohibited. Access roads across a slope exceeding 25% may be permitted provided the road itself does not have a slope in excess of 15% and that adequate erosion control measures are followed. | Not specifically addressed in Zoning Ordinance or Town Plan. |
| **Washington** | 7.5 | Yes | Yes | No | No | No | Flood fringe: Development required to be designed to minimize flood damage to proposed development and to public utilities and facilities and to provide adequate drainage. Development shall be floodproofed to withstand hydrostatic pressure certified by a professional engineer or architect. See flood hazard bylaws for more details. http://centralvtplanning.org/wp-content/uploads/2012/03/Washington-Flood-1998.pdf. | 1998 | No, 2021 Update | Wetland, stream and lakeshore setback of 50 feet | Development on slopes >15% needs a conditional use permit from the Town. | No |
| **Wells River Village** | 7.5 | Yes | No | No | Yes | No | see Newbury | see Newbury | see Newbury | see Newbury | see Newbury | see Newbury |
| **West Fairlee** | 7.5 | Yes | Yes | No | No | No | Unless a regulatory floodway is designated, no new construction, substantial improvement, or other development (including fill) shall be permitted within zones A1-A30 and AE on the town's FIRM unless the proposed development will not increase the water surface elevation of the base flood more than 1ft at any point within the town. Additionally, in "Fringe Areas" the lowest floor of all new buildings shall be at or above base flood elevation, as shall existing buildings to be substantially improved for residential purposes. | 1990 | Yes | Town Plan policies: "Preservation of the natural state of streams and, to the extent possible, Lake Fairlee, shall be encouraged by:…Maintenance of existing stream bank and buffer vegetation including trees, together with wildlife habitat." "New development within the limits of the 100-year floodplain is strongly discouraged. Improvements to existing structures in the floodplain are acceptable, provided that careful planning is done to ensure against unnecessary loss of property or public endangerment." "Consistent with the guidance of the VT ANR, a buffer zone of 50ft must be maintained contiguous to all rivers and streams." | Town Plan Policies & Recommendations: "Construction and careless or destructive use of vehicles and machinery in areas of shallow soils, steep slopes or high water table is strongly discouraged." "All commercial or housing development projects or proposals in areas of shallow soils, steep slopes, or high-water table must include detailed plans for avoiding or preventing soil erosion. It shall be the responsibility of owners who develop in these areas to restore all soils lost to erosion, all water bodies or waterways contaminated, and wildlife habitats negatively impacted as a consequence of development." "The Selectboard, the Planning Commission and the Conservation Commission should work together to do all they can to safeguard the integrity of West Fairlee's soils by monitoring land use and ensuring sound building practices and careful use of machinery on the land, especially in areas of shallow soils, steep slopes or high water table." | Town Plan Recommendation: "Promote future land use planning that facilitates sustained hazard mitigation efforts, including:… defining critical areas for upland storm water runoff limitation and management." |