Vermont Agency of Natural Resources

Watershed Management Division

Lamoille

DRAFT - 2016 TACTICAL BASIN PLAN

The Lamoille River Basin (in Vermont) - 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.

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION

Vermont Surface Water Management Strategy

To preserve, enhance, restore, and conserve Vermont's natural resources, and protect human health, for the benefit of this and future generations.

Approved:

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Alyssa B. Schuren, Commissioner Date

Department of Environmental Conservation

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Deb Markowitz, Secretary Date

Agency of Natural Resources

Cover Photo: Mud Pond, Hyde Park, photographed by Chris Nelson

Lamoille River Basin Tactical Plan Overview

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Partners and Towns

All of the following organizations and agencies contributed to the development of the Lamoille Tactical Basin Plan and/or will assist in the plan's implementation:

Caledonia County Natural Resource Conservation District

Central Vermont Regional Planning Commission

Chittenden County Regional Planning Commission

Friends of Green River Reservoir

Friends of Northern Lake Champlain

Greensboro Land Trust

Lake Eden Lake Association

Lamoille County Natural Resource Conservation District

Lamoille County Planning Commission

Lamoille River Paddlers Trail

Northeastern Vermont Development Association

Northwest Regional Planning Commission

Smugglers Notch Resort

USDA Natural Resources Conservation Service

US Fish and Wildlife Service

Vermont Agency of Agriculture, Food and Markets

Vermont Agency of Transportation

Vermont Department of Environmental Conservation

Vermont Department Fish and Wildlife

Vermont Department Forests, Parks and Recreation

Vermont Youth Conservation Corps

Winooski Natural Resources Conservation District

Twenty-four Towns in the Basin (with land cover percent): Hyde Park, Johnson, Hardwick, Waterville, Wolcott, Underhill, Eden, Fairfax, Westford, Belvidere, Morristown, Cambridge and Greensboro, Stannard, Elmore, Fletcher, and Jericho (≥50%). Walden, Woodbury, Milton, Craftsbury, Essex, Georgia, and Wheelock (25% to <50%).

Eleven Towns in the Basin with Minimal Coverage: Sheffield, Glover, Lowell, Montgomery, Cabot, Worcester, Bolton, Stowe, Bakersfield, Colchester and Fairfield (<25%).

Executive Summary

The Lamoille River Tactical Basin Plan (TBP) provides an overall assessment of the health of the Lamoille River basin and defines on-going and future actions and strategies to address high-priority stressors (see Surface Water Management Strategy.).

This plan organizes assessment and strategies by the Upper, Middle, and Lower sub-basins of the Lamoille River. The purpose of the plan is to address high priority stressors to achieve sustained ecological health and human use by identifying actions to meet or exceed state water quality standards. An additional goal of this plan is to set priorities for meeting targets for phosphorus loading for the Lamoille River and all of the waters in its drainage basin that contribute to Mallets Bay in Lake Champlain.

The Lamoille River drainage basin headwaters flow through dense forest blocks, lakes, ponds and wetlands, along backroads and into rural valleys where development mainly consists of rural villages and town centers settled along the mainstem and major tributaries. As the river flows further downstream, floodplains and agricultural lands are more common. Here historical dams built for flood protection and power generation dot the landscape from Hardwick to Milton. High priority stressors in the Lamoille River Basin include: flow alteration from dams and water-withdrawal; encroachment, channel erosion, land erosion, and nutrient loading from rural and urban development and agriculture along riparian areas; toxics from discrete locations of contaminant leaks or spills; and invasive species in both riverine and lacustrine environments. The Lamoille River basin is also home to numerous popular swimming holes, whitewater and still water boating opportunities, high quality fisheries, and ecologically intact headwater streams, wetlands, and lake and pond communities.

Chapter 1 of the Tactical Basin Plan (TBP) provides a brief description of the basin, the purpose of tactical basin planning, the planning and implementation process, and the new regulations for water quality protection. Chapter 2 provides a summary of water quality in the basin based on assessment reports, inventories and monitoring data from internal and external partners, and identifies target areas for implementation, protection, monitoring, and assessment. Chapter 3 provides information on regulatory programs for addressing stressors and pollutants, including the Lake Champlain Phosphorus TMDL. Chapter 4 establishes management and protection goals identified in the Vermont Water Quality Standards for surface waters, including existing uses, designations and reclassifications. Chapter 5, the heart of this plan, is the implementation table which describes geographically explicit strategies to protect or restore surface waters in the basin.

These strategies address both overall regional water quality issues as well as specific actions on targeted waters. The goal is to carry out as many of these actions as possible over the next five years, to bring improvements and protections to the regions surface waters. **Priority is given to those waters that are identified as facing the greatest challenges due to either degraded conditions already present or the exceptional quality and characteristics that should be protected.**

Top Objectives and Strategies

Protect very high quality surface waters throughout the Lamoille River watershed for re-classification and designation of significant natural resource assets such as biological integrity, recreation, water quality protection, and fisheries, with a focus on Sandbar Wetland Complex, Belvidere Bog and North Branch Wetlands Complex, Molly Bog and Morristown Bog Complex, and Flagg Pond and Flagg Pond Cedar Swamp Complex.

Promote (or provide) education and outreach opportunities to communities, landowners, farmers, road crews, conservation commissions, and all other stakeholders within the watershed on the Vermont Clean Water Act and associated regulatory and non-regulatory water quality protection programs.

Promote implementation of agricultural water quality practices, specifically cover cropping, in areas of corn-hay rotation, continuous hay, and continuous corn that are a significant source of phosphorus and where field practices are best suited to conditions. This should be concentrated on the lower Browns River, Seymour River, and Mill Brook watersheds and the mainstem of the Lamoille in Cambridge, Fletcher, Georgia and Fairfax.

Protect riparian areas from encroachment and increase flood resilience through conservation easements, floodplain and wetland restoration, as well as encouraging towns to adopt appropriate ordinances with a focus on flood prone communities, such as Hardwick, Wolcott, Johnson, Cambridge, Jeffersonville, and Westford.

Protect river corridors and support stream equilibrium through active and passive stream channel restoration and conservation easements with a focus on Haynesville Brook, Tucker Brook, Stannard Brook, Bunker Brook, Kate Brook, Wild Branch, Elmore Branch, Ryder Brook, Brewster River, Browns River and the mainstem of the Lamoille.

Inventory and prioritize municipal road erosion features that discharge into surface water and implement high priority actions in existing road erosion inventoried sites with a focus on priority catchments in Hyde Park, Milton, Cambridge, Fletcher, Georgia, Fairfax, and Craftsbury.

Reduce stormwater inputs into water resources in villages and town centers through stormwater master planning and the implementation of existing stormwater mapping inventories, with focus on Hyde Park, Johnson, Cambridge, Georgia, Hardwick, Fairfax, Milton, Craftsbury, Walden, and Morristown in priority catchments.

Improve lakeshore zone habitat along Lake Caspian, Lake Elmore, and Lake Eden through direct outreach with landowners and lake watershed plans and encourage participation in the VT Lake Wise Program and implementation of lakeshore best management practices.

Prioritize potential wetland restoration projects and floodplain restoration on agricultural lands for phosphorus retention and sediment attenuation, with a focus in the Browns River watershed and other high priority catchment areas.

Increase understanding of water quality conditions in the basin through the establishment and/or continuation of short-term intensive and long term monitoring programs, and carry out priority monitoring recommendations on stressed waters for possible impairments and reclassification.

Summary of Classification Opportunities

Waters recommended for additional monitoring for reclassification to Class A(1) for one or more uses:

- Sawmill Brook (river mile 1.8) - Greensboro
- Foote Brook (river mile 2.6) - Johnson

Waters recommended for additional monitoring for reclassification to Class B(1) for one or more uses:

- Rivers and Streams
    - Waterman Brook (river mile 1.2) - Johnson
    - Smith Brook (river mile 0.9) - Johnson
    - Brewster River (river mile 4.2-5.0) - Cambridge
    - Lamoille River (river mile 20.9-80.8) - Fairfax to Greensboro
    - Lee River (river mile 2.8) - Jericho
    - Stones Brook headwaters (river mile 5.2) - Fletcher

Waters recommended for evaluation for reclassification to Class B(1) for one or more uses:

- Lakes and Ponds
    - Schofield Pond - Hyde Park
    - Long Pond - Greensboro
    - Little Elmore - Elmore
    - Zack Woods Pond - Hyde Park & Wolcott
    - Wolcott Pond - Wolcott
    - Flagg Pond - Wheelock

Wetlands proposed for Class I:

Sandbar Wetland Complex

Wetlands proposed for study to determine Class I potential:

Belvidere Bog and North Branch Wetlands Complex
Molly Bog and Morristown Bog Complex
Flagg Pond Cedar Swamp in Wheelock

Other Priority Actions based on scientific assessments and monitoring:

- Incorporate River Corridors and flood resiliency strategies into regional plans and municipal planning and zoning updates.
- Conduct stream assessment on Streeter Brook and its tributaries that address sediment and stormwater impacts.
- Continue project implementation and work with Vermont Agency of Transportation (VTrans), the Town of Georgia and the Georgia Conservation Commission in the Deer Brook watershed to address sediment impairment from stormwater discharges along the Route 7 corridor and highway road culvert degradation.
- Identify, prioritize and stabilize eroding gullies within the watershed that provide quantifiable phosphorus reduction and are cost effective.
- Implement restoration projects of high priority in River Corridor Plans for the Lamoille mainstem, Browns River, Brewster River, Centerville Brook, Elmore Branch, Gihon River, Rodman Brook, Wild Branch and their tributaries in priority catchments.
- Protect the intact-forested landscape and significant wetland communities to reduce resource fragmentation where it is not already conserved using Vermont Agency of Natural Resources (VANR) Natural Resource Atlas to identify intact forest blocks and sensitive riparian areas.
- Use GIS mapping resources to identify sensitive riparian areas to inform recommendations for ecologically sensitive treatment areas in current use parcels in partnership with Vermont Department of Forests, Parks and Recreation (VFPR).
- Provide support by providing project recommendations for mitigation funds from the Vermont Asbestos Group (VAG) mine site settlement.
- Provide towns information on landfills, hazardous waste sites, and salvage yards that have potential to impact surface waters during flooding events.

In addition to these top priority actions and classification opportunities, the basin plan also includes actions to address all impaired or stressed waters in the basin.

The Vermont Agency of Natural Resources has prepared an online mapping tool, the VANR *Natural Resources Atlas*, that allows the reader to identify the locations of many Basin features http://anrmaps.vermont.gov/websites/anra5/.

Chapter 1 – Planning Process and Watershed Description

A. Tactical Basin Planning Process

Tactical basin plans (TBPs) are developed according to the goals and objectives of the Vermont Surface Water Management Strategy to protect, maintain, enhance, and restore the biological, chemical, and physical integrity, and public use and enjoyment of Vermont's water resources, and to protect public health and safety. The tactical basin planning process allows for the completion of tactical basin plans for all of Vermont's fifteen basins every five years, as required by statute. The streamlined process for issuing tactical basin plans facilitates targeting strategies and prioritization of resources to those projects that will have the greatest impact on surface water protection or remediation. The Tactical Planning Process is outlined in Chapter 4 of the VT Surface Water Management Strategy.

The previous Lamoille River Basin Plan was approved in 2009. Seventy action items were identified in the 2009 plan. Many of these recommendations have been implemented or are in progress by VANR and its watershed partners. A report card of this progress can be viewed in Appendix C. The 2016 tactical plan builds upon those original plan recommendations by promoting specific, geographically explicit actions in areas of the basin that have been identified for intervention, using environmental modeling and on-the-ground monitoring and assessment data.

Action items summarized by the Implementation Table summary in Chapter 5 of this document will be addressed over the life of this and subsequent Lamoille TBPs. The articulation of all possible projects derived from the assessments that are integrated by this Tactical Basin Plan number in excess of 1,300, as of publication. Successes and challenges in implementing actions will be reviewed and addressed as part of required annual reporting pursuant to Act 64 of 2015; Vermont's new Clean Water Act. As envisioned by Act 64, the TBP will not be a static document.

B. Vermont Water Quality Standards

The Vermont Water Quality Standards (VWQS) define biological integrity as "the ability of a body of water to support and maintain a community of organisms that has the expected species composition, diversity, and functional organization comparable to that of the water in its natural condition." The health of a biological community is a reflection of the level of combined human-induced stresses acting upon it. Aquatic communities that are most impaired suffer from an accumulation of multiple stressors.

As a follow-up to the 1972 Federal Clean Water Act, which requires states "to restore and maintain the chemical, physical and biological integrity of the nation's waters.", the VWQS are rules **specific to Vermont** that protect the waters of the state.

The implementation actions identified in the TBPs are meant to fulfill all of the geographically-specific planning requirements in the VWQS, while the statewide planning requirements, including state-scale strategies, are addressed in the statewide Surface Water Management Strategy.

C. The Vermont Clean Water Act

In 2015 the Vermont Legislature passed Act 64, the Vermont Clean Water Act. This Act strengthens multiple statutes related to water quality in the State. The Act addresses agricultural water quality on small, medium, and large farms through the Agency of Agriculture, Food and Markets. It establishes water quality requirements for stormwater discharges from new and existing development, industrial and municipal stormwater discharges, and runoff from municipal roads through the Department of Environmental Conservation (VDEC). Through the Department of Forests, Parks and Recreation and VDEC, the Act addresses water quality runoff from forest silvicultural activities and supports wetland restoration efforts within the Lake Champlain Basin. Regulations specific to these new requirements are covered in detail in the final VT Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) Phase I Implementation Plan and summarized in Chapter 3.

The Act also establishes the requirement that all water quality improvement actions undertaken by the State be integrated by means of TBPs, and establishes partnerships with Regional Planning Commissions, Conservation Districts, and other organizations to support this work. Regarding work with the Regional Planning Commissions, the Agency of Natural Resources (Agency) will work with the applicable regional planning commissions to develop an analysis and formal recommendation on conformance with the goals and objectives of applicable regional plans, see 10 V.S.A 1253(d)(2)(G). The overall role of the TBPs is not to determine where development should happen. This TBP encourages communities to take protective measures that will restore, maintain and enhance water quality in all areas, and does not preclude any development that is consistent with municipal zoning, regional and municipal plans, and with applicable state and federal regulations.

In order to assist Vermonters in meeting these requirements, the Clean Water Fund has been established, and paired with other funds available for water quality improvements, allocations will be dedicated towards the highest priority water quality remediation actions.

In order to implement the high priority actions required to protect, enhance, maintain and restore water quality, the TBP spell out clear attainable goals and targeted strategies to achieve goals laid out in the Vermont Clean Water Act and the Lake Champlain Phosphorus TMDL. The Implementation Table is a tool by which progress can be tracked with regard to measurable indicators of each major goal. In addition, the implementation of actions and Implementation Table itself will be revisited periodically, and be modified accordingly to best address newly emerging information, unanticipated events, and new requirements such as are anticipated by legislative acts such as Act 110, Act 16, and Act 64, now generally referred to as the Vermont Clean Water Act.

For more information about the Vermont Clean Water Act, readers should review the content of the Vermont Clean Water Initiative website at: http://dec.vermont.gov/watershed/cwi.

D. Lamoille River Basin

A river basin is an area of land drained by a river and its tributaries. The terms 'basin' and 'watershed' are used synonymously throughout this document. The Lamoille River Basin, also referred to as Basin 7, can be separated into fifteen sub-watersheds at the Hydrologic Unit Code 12 (HUC12) level (Figure 1). The fifteen sub-watersheds are grouped into three major sub-basins for the purpose of this report and for ease of presenting the following assessments and recommendations (Figure 2).

There are a total of 24 lakes and ponds that are 20 acres or larger in the Lamoille River Basin. Caspian Lake, Arrowhead Mountain Lake, and Green River Reservoir are by far the largest with surface areas of 789, 760, and 554 acres respectively. In addition to the Lamoille River mainstem and its direct tributaries, the Lamoille River Basin includes 11 major tributaries including the: Browns River, Stones Brook, Wild Branch, Seymour River, North Branch, Ryder Brook, Gihon River, Elmore Branch, Brewster River, Green River, and Kenfield Brook.

The main stem of the Lamoille flows 84.9 miles from Wheelock to Milton, and drops approximately 1200 feet draining 706 square miles, which accounts for 7.5 percent of Vermont's land area. The basin occupies a major part of Lamoille and lesser parts of Franklin, Chittenden, Orleans, Washington, and Caledonia Counties.

The watershed spans thirty-five towns covering five counties, of which is approximately:

- 76% forested,
- 13% agricultural,
- 6% surface waters & wetlands, and
- 5% developed areas including roads.

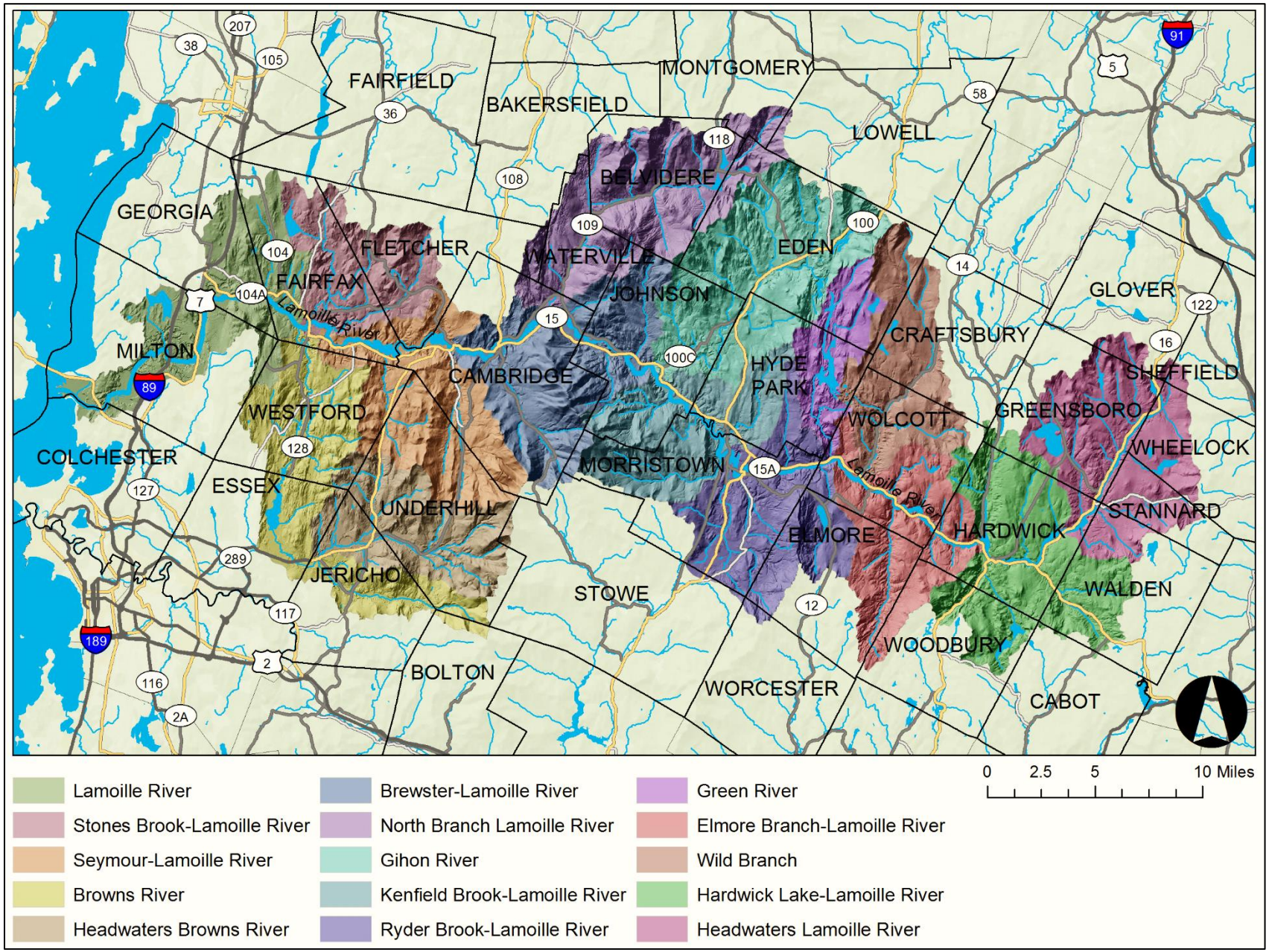


Figure 1. The 15 major sub-basins - HUC12s - of the Lamoille River watershed.

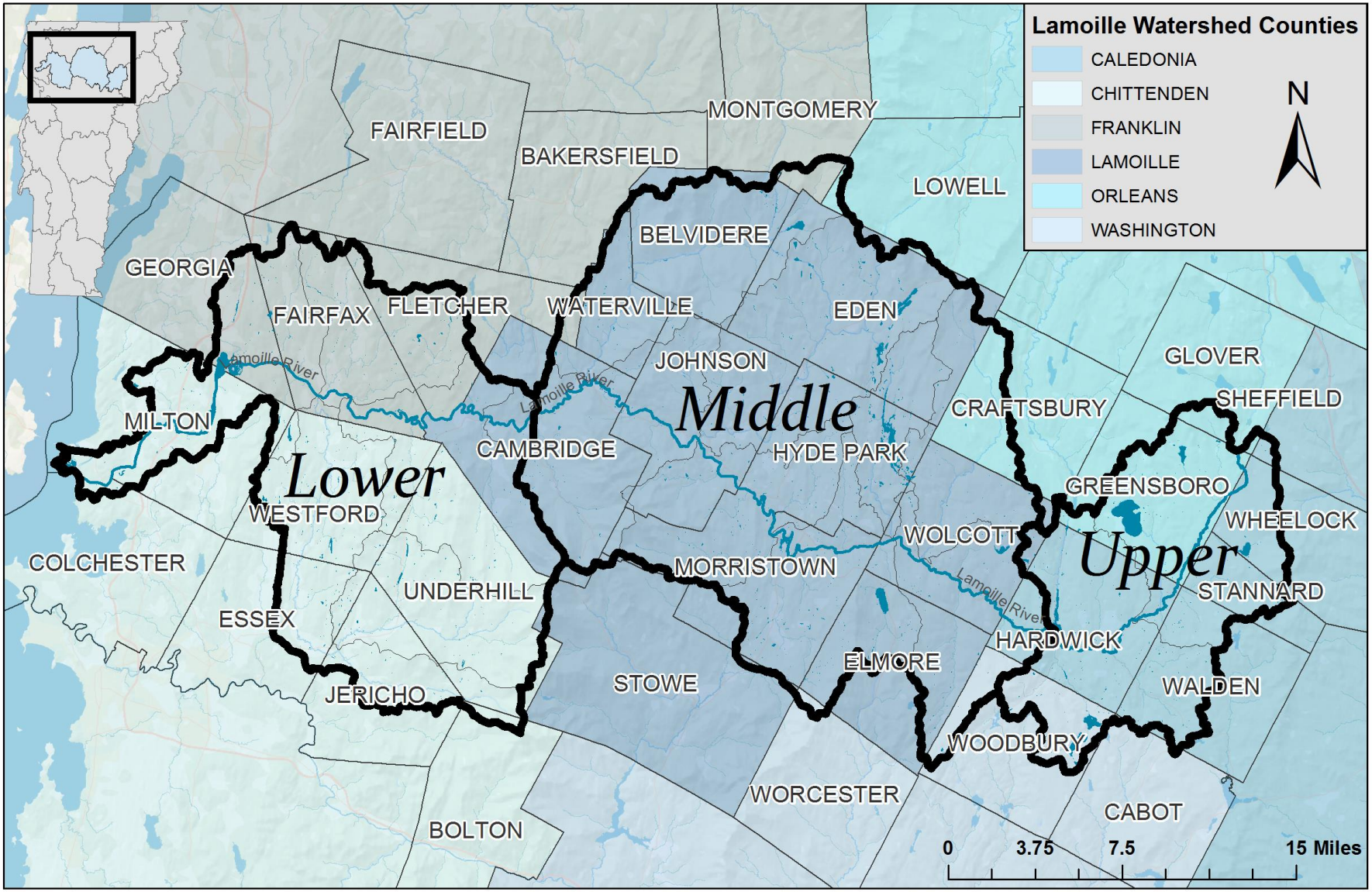


Figure 2. Upper, Middle, and Lower Lamoille major sub-basins.

Chapter 2 – Water Resource Assessments & Recommendations

A. Overview of Water Resources and Stressors

In this plan, three major sub-watersheds are highlighted for specific intervention based on VDEC's evaluation of monitoring and assessment data. The three major sub-watersheds are the Lower, Upper, and Middle Lamoille waters (Figure 2 above).

The Upper Lamoille

The upper Lamoille sub-basin covers significant parts of the towns of Greensboro, Wheelock, Stannard, Walden, Woodbury and Hardwick, with very small areas in Glover, Cabot and Sheffield. It includes the headwaters of the Lamoille mainstem, which originates in the northwest corner of Wheelock, along the east side of Vermont Route 16 at the outlet of Horse Pond and flows in a southwesterly direction to Hardwick, ending at the outlet of Hardwick Lake.

This area is primarily forested and valued for its timber harvest, active pastoral landscape and small productive town centers. It includes Long Pond, Horse Pond and Caspian Lake of Greensboro, Flagg Pond of Wheelock, and East Long Pond and Nichols Pond of Woodbury, all of which are considered in the overall top 25% of Vermont's Best Lakes (Vermont Lakes and Ponds Program, 2012). Sawmill Brook, a high quality water, drains Long Pond in Greensboro. Streams in the forested headwaters such as Haynesville, Stannard, and Tucker Brooks have seen major flooding events that have resulted in manmade channel alterations and extensive sedimentation from eroding streambanks and river-road conflicts. Cooper Brook, which flows south to the mainstem of Lamoille, supports a high quality native trout fishery. Many small mountain tributary streams make their way into the mainstem through forested slopes, along roads and through culverts and bridges, filtered by wetlands and floodplains.

Alder Brook supports a large riparian wetland complex from Greensboro to Hardwick where it flows into Hardwick Lake, a waterbody historically dammed for hydroelectric, but never utilized for that purpose. East of Hardwick, the Lamoille river flows in a westerly direction where Route 15 now follows the course of the river. In Hardwick Village, the river flows westerly and then northerly. The river has been armored and channelized through Hardwick Village in an effort to protect Route 15 and existing infrastructure in the floodplain.

Important Upper Lamoille Wetlands

The Northern Vermont Piedmont region at the headwaters of the watershed contains a number of northern white cedar swamps that were surveyed by the Vermont Nongame and Natural Heritage Program in 1996. One of the largest of these areas is at the southern end of Long Pond in Greensboro. This wetland is about 115 acres. The vegetation is second-growth dominated by white cedar and interspersed with emergent white spruce. This site supports a population of the fairy slipper (*Calypso*

bulbosa), a state-threatened orchid; a rare moss in Vermont (*Calliergon richardsonni*); and an adult black-backed woodpecker (*Picoides articus*) was observed in the swamp in 1996. This is a typical northern white cedar swamp with a mossy groundcover growing on over a meter of woody muck. A portion of this wetland is owned and managed by The Nature Conservancy.

Page Brook Swamp, located in Wheelock and Sheffield, is a more diverse wetland complex than Long Pond. The wetland complex is approximately 100 acres, 45 acres of which is northern white cedar swamp. This complex also includes spruce-fir-tamarack swamp, beaver meadows, ponds, and a fen-like area at the eastern side of the swamp. This wetland complex is relatively isolated, with forested buffers and only scattered residences. The wetlands contain diverse vegetation including a rare state endangered sedge, a rare fly-honeysuckle, a rare moss currently known in only eight sites in the state, and a population of uncommon swamp thistle.

Other significant northern white cedar swamps in the headwaters of the Lamoille River watershed include Flagg Pond in Wheelock (70 acres), Bear Mountain Pond Swamp in Walden (50 acres), Mount Sarah Southeast Swamp in Greensboro (20 acres), and Hardbury Swamp in Hardwick (22 acres). The 1996 Significant Northern White Cedar and Red Maple-Cedar Swamps of Vermont Report by the Vermont Nongame and Natural Heritage Program contains more information on these and other wetlands.

The Middle Lamoille

The middle Lamoille sub-basin covers significant parts of the towns of Craftsbury, Belvidere, Eden, Johnson, Hyde Park, Morristown, Wolcott, Waterville, Elmore and Cambridge with very small areas in Stowe, Worcester, Woodbury, Hardwick, Lowell, Montgomery, Fletcher and Bakersfield. This area includes eight main tributaries that flow into the Lamoille mainstem along route 15. The Middle Lamoille includes all waters downstream of Hardwick Lake to the confluence of the Brewster River from Hardwick to Cambridge.

Sub-Watersheds

The eight main tributaries in the Middle Lamoille are: Elmore Branch, Wild Branch, Green River, Ryder Brook, Kenfield Brook, Brewster River, North Branch of the Lamoille, and the Gihon River. Each river is unique and characterized by the geology, soils, and landscape that they flow through.

Elmore Branch

Elmore Branch originates in Woodbury and flows downstream with the majority of its drainage in Elmore eventually flowing into the Lamoille River at School Street in Wolcott. The drainage basin covers 17.6 square miles. The headwaters are mainly forested and the land use within the watershed is 84% forest, 3% residential, 3% agricultural crop, 1% field and pasture and 9% water (Bear Creek Environmental and Lamoille County Planning Commission, 2009). The stream mainly runs along East Elmore Branch Road, where river to road conflicts are evident. In many areas Eagle Ledge Road, a

Class IV town road, is in direct conflict with the river and there has been significant damage to the road and sedimentation to the river as a result.

Wild Branch

Wild Branch headwaters originates in the Lowell Mountains in the town of Eden, flows south along Wild Branch Road and North Wolcott Road in Craftsbury and Wolcott, and empties into the Lamoille River just south of Fort Hill Road in Wolcott. The watershed of the Wild Branch is approximately 40 square miles. The Wild Branch is true to its name; the stream winds sinuously through unconfined valleys with moderate to gentle valley slopes at the mid to lower reaches of its flowpath. The river is considered unstable and prone to fluvial erosion (Bear Creek Environmental and Lamoille County Planning Commission, 2010). River corridor easements along floodplains on this river have been secured in order to allow this river to adjust and flow freely in important areas

Green River

Located within the Northern Green Mountains of Vermont, the Green River flows through the Towns of Wolcott, Hyde Park, and Eden into the Lamoille River. Most of the river flows through forested land, with portions running through residential areas. The approximately 12-mile river drains a 19.3 square mile watershed. The river is dammed upstream at the Green River Reservoir. The dam was constructed in 1946 and is an operating hydro-electric facility owned and operated by Morrisville Water & Light (MWL). The dominant surficial material within the Green River watershed is glacial till, with significant amounts of dense till and outwash, and scattered small amounts of alluvium material near and within the river corridor. The majority of this watershed is forested with lesser amounts of agricultural and developed use lower in the watershed (Lamoille County Planning Commission, 2012).

Ryder Brook

The headwaters of the Ryder Brook drainage basin originate high in the hills of Worcester at just under 2500 feet in elevation. Ryder Brook drains over 18 square miles of land. Bedell Brook, a tributary to Ryder Brook, enters Elmore draining the Worcester Mountains perpendicular to Elmore Mountain Road. The brook then flows into a series of beaver meadow wetlands and into managed forest lands in Morristown before leveling out at 800 feet in elevation into an agricultural river valley where the stream becomes sinuous and joins Ryder Brook north of Stancliffe Road in Morristown. Both Joe's Pond and Molly Bog and Morristown Bog Complex feed into Ryder Brook via an unnamed tributary and Lawrence Brook respectively. Ryder Brook receives runoff from the Morrisville-Stowe Airport and golf course as well as rural residential development before it flows into Lake Lamoille parallel to Cady's Falls Road.

Kenfield Brook

Kenfield Brook drainage basin, which is located entirely within Morristown, is primarily forested and drains a 12.4 square mile land area. The headwaters of Mud Brook and Beaver Meadow Brook drains to Kenfield Brook from the steep slopes of the Sterling Mountain Range in Mount Mansfield State Forest.

Beaver Meadow Brook empties into the depressional Beaver Meadow wetland complex and continues through a thickly forested area before it reaches Kenfield Brook. The Mud Brook headwaters are connected to a series of high elevation beaver wetlands. There are dams on both Mud Brook and a northern tributary to Mud Brook. One dam is owned by the state of Vermont and the second dam is privately owned and soon to be removed. The brook runs into Beaver Meadow Brook, which then flows into Kenfield Brook at Mud City. Kenfield continues from the confluence along a mixed forested and field landscape and merges with the Lamoille mainstem after flowing north under Duhamel Road.

Brewster River

The Brewster River watershed is primarily located within the Town of Cambridge and the Village of Jeffersonville, with small areas of the headwaters in the Towns of Johnson, Morristown, and Stowe. The watershed has a drainage area of 19.8 square miles and outlets to the Lamoille River immediately east of the VT Route 108 river crossing. The mainstem of Brewster River drains the northwestern face of Sterling Mountain and joins with a major tributary draining the north face of Mt Mansfield and the Smugglers' Notch ski area. In 2011 severe flooding in the Village of Jeffersonville caused extensive damage to homes and businesses. In addition, slope failures occurred in 1999 and 2006 by the mouth of the river causing extensive sedimentation and property damage. (Fitzgerald Environmental Associates, LLC., 2015). Areas of the river higher up in the watershed are being impacted by river road conflicts, water withdrawals and stormwater runoff. A flood modeling effort was completed in Village of Jeffersonville at the confluence with the Lamoille River. The Lamoille County Planning Commission (LCPC) and the town are working to implement high priority projects that, in addition to reducing flood levels, will remove constrictions on the Brewster River channel and restore it to a more natural flow.

North Branch

The 60 square mile drainage basin of the North Branch is located primarily in Belvidere and Waterville with its headwaters stretching from Lowell, Montgomery, and Bakersfield to Cambridge where it joins the Lamoille River just north of Route 15 and 0.7 miles south of Route 109. The headwaters drain a steep and mountainous landscape of the Cold Hollow mountain range settling into a broad valley where a large high quality wetland complex has formed along the river by Belvidere Corners in Belvidere and Belvidere Pond in Eden. The North Branch flows through the town centers of Belvidere Junction and Waterville and through large open agricultural floodplains in Cambridge where the river is impacted by sedimentation from river bank erosion and channel instability by encroachment from agriculture, roads, and rural development.

Gihon River

The Gihon River drains the forested headwaters of Eden Notch and the southern flanks of Belvidere and Hadley Mountains. The watershed is 64.75 square miles and the main stem of the Gihon River flows through Eden, Hyde Park, and Johnson. The upper section of the Gihon River in Eden has undergone minor channel straightening, floodplain encroachment, and removal of riparian vegetation

and is located downstream from the Vermont Asbestos Group (VAG) mine. Many wetlands, ponds and lakes occur in this watershed including Lake Eden and South Pond. There are numerous floodplain encroachments in North Hyde Park Village and Johnson Village, which has resulted in riverbank encroachment, stormwater runoff, and unnatural channel management practices such as stone armoring. (Bear Creek Environmental and Lamoille County Planning Commission, 2009).

Important Middle Lamoille Wetlands

Many of the important wetlands in the Northern Green Mountain Region lie along tributaries of the Lamoille River such as Lawrence Brook, North Branch, and the Gihon River. The Molly Bog wetland complex in Morristown lies along Lawrence Brook and covers more than 300 acres. The complex is on the west side of Route 100, extends south into Stowe, north along the Lawrence Brook, and contains forested, scrub- shrub and emergent wetlands. The wetland complex also contains a peatland complex consisting of four bogs: Molly Bog, Beugrands Bog, Percy's Bog and Andromeda Bog.

Molly Bog is an example of a northeastern kettlehole bog, and is owned by the University of Vermont, along with 35 acres of spruce-fir swamp and upland hardwood forest. This area is designated a State Fragile Area and is registered as a National Natural Landmark by the National Park Service. The wetland complex provides habitat for one endangered, one rare and two uncommon plant species. The peatland complex also contains one of the greatest diversities of mosses in the state. The peat layers in the bogs provide evidence of past glacial activities, making this a natural area of considerable scientific and educational interest.

The Belvidere Bog wetland complex is located at the headwaters of the Lamoille River North Branch, and is approximately 375 acres. A number of wetland types are present in this complex including shrub swamp, cedar swamp, shallow marsh, mixed shrub swamps, deep marsh, a rare dwarf-shrub bog community, and numerous beaver ponds. The wetland complex is highly significant for its size, diversity and function in the watershed. The Belvidere Bog wetland complex has been rated highly significant for coldwater fishery habitat, water quality protection, erosion control, education, recreation, and wildlife habitat. The wetland complex is considered habitat for the common loon, once considered endangered, and also was rated as a high quality northern level bog. The size of the wetland complex and the undisturbed area surrounding the complex makes this area suitable for wildlife species that need large ranges such as black bear, bobcat and moose.

Other important wetlands in this region of the Lamoille River watershed include the scrub-shrub wetlands along the White Branch in Eden (217 acres) and Gihon River in Eden (151 acres). There are also large wetlands associated with Bear Swamp in Wolcott (246 acres), Green River Reservoir in Hyde Park (209 acres), Lake Elmore in Elmore (144 acres), Beaver Meadow in North Hyde Park (171 acres), and various oxbows in the Lamoille River in Cambridge.

The Lower Lamoille

The Lower Lamoille includes all waters from the confluence of the Brewster River to the confluence of the Lamoille River with Lake Champlain. The watershed extends from Cambridge to Colchester and Milton emptying into Mallets Bay.

Sub-Watersheds

Seymour River - Lamoille River

The Lamoille mainstem, Seymour River and Settlement Brook in Underhill and Cambridge, and Beaver Brook in Underhill, Westford and Fairfax are the main rivers in this 132 square mile sub-watershed. One large hydro-electric dam, Fairfax Falls, on the Lamoille mainstem is owned and operated by Central Vermont Public Service Corporation (CVPSC). The headwaters of the Seymour River flow down from Mount Mainsfield State Forest and then adjacent to Pleasant Valley Road through forest, rural residential and agricultural land. Settlement Brook flows parallel to Seymour River adjacent to Irish Settlement Road through a mostly forested landscape until it joins Seymour River at the junction of County Farm Road and Lower Pleasant Valley Road in Cambridge. Both waterways have been altered because of road, residential, and agricultural conflicts and both receive runoff from the aforementioned activities, but Seymour River has shown more signs of impacts. In addition, flooding at the confluence of the Seymour River and the Lamoille mainstem is a near annual event. Cultivated crops, hay and pasture are concentrated along the Lamoille mainstem in this sub-watershed.

Stones Brook - Lamoille River

The Stones Brook-Lamoille River sub-watershed covers just over 88 square miles and includes a small portion of the Lamoille mainstem in Fairfax, Stones Brook and Wilkins Brook in Fletcher and Fairfax, Mill Brook in Fairfax and Halfmoon Pond in Fletcher. All three brooks originate in a forested landscape, that quickly becomes dominated by agricultural lands with rural residential development patterns. The lower reaches of these brooks are often lacking vegetated riparian buffers and have been altered in some landscapes to prevent flooding and erosion of fields. Much has been done in the Mill Brook watershed to address stressors since the 2009 Lamoille Basin Plan.

Browns River Headwaters and Browns River Mainstem

The Browns River watershed is divided into headwaters and lower drainages covering over 238 square miles. The majority of the headwater sub-watershed is in Underhill with smaller areas in Jericho, Essex and Westford. Tributaries are Stevensville Brook and Clay Brook in Underhill and Roaring Brook in Underhill and Jericho. The headwaters originate in Mountain Mansfield State Forest and flow along Mountain Road in Underhill, River Road in Underhill and Jericho and then along Route 15 in Jericho. Historic gravel mining in this section of the river has resulted in unstable conditions and impacts to aquatic biota. There are two dams along the mainstem of Browns River and a large wetland complex along The Creek in Underhill parallel to Route 15. This wetland complex provides flood storage and

water quality protection to downstream communities, but has seen hydrologic alterations and habitat fragmentation due to development.

The lower drainage of the Browns River begins in Underhill and ends at the Lamoille River in Fairfax. The headwaters, Lee River, start in the Fort Ethan Allen Military Reservation and are primarily forested until reaching the developed area of the reservation. There is active management along this area on the river which may lead to stormwater runoff. Tributaries to the Browns River in the lower drainage are Lee River in Jericho, Abbey Brook in Essex, and Rogers Brook and Morgan Brook in Westford. Route 128 runs parallel to the mainstem of Browns River from Essex to the mouth in Fairfax. Many wetlands along the mainstem have been altered and drained for agricultural activities. Stormwater runoff from roads, lack of vegetated riparian buffers, and residential development are water quality stressors in this sub-watershed.

Lower Lamoille

The Lower Lamoille sub-watershed covers just over 133 square miles and includes Beaver Meadow Brook in Fairfax, Deer Brook in Georgia, Streeter Brook in Milton, Arrowhead Mountain Lake in Georgia and Milton, Round Pond in Milton, and Silver Lake in Fairfax and Georgia. There are many smaller tributaries to the Lamoille River mainstem, which flows from Fairfax along Route 104 to its mouth in Mallets Bay in Milton and Colchester. There are three dams on the mainstem of the Lamoille in Milton including Clarks Falls at the outlet of Arrowhead Mountain Lake, the Milton Dam just north of Ritchie Avenue, and Peterson Dam off of Peterson Road north of West Milton Road. These hydro-electric dams are owned and operated by CVPSC. Inputs from commercial and residential development, the Route 7 and Interstate 89 corridors, and agricultural runoff have stressed certain sections of this watershed. Stormwater and agricultural best management practices have been installed to mitigate impacts on the impaired Deer Brook watershed.

Special Values and Features of the Lower Lamoille Waters

The lower Lamoille River, like all tributaries to Lake Champlain, supports a wide variety of fish species, including a few rare and state-listed. Lake Sturgeon, nearly fished to extinction, should slowly recover in the Lamoille River due to closing of the fishery in the 1960s, continuation of the Lake Champlain sea lamprey control program, which has reduced sturgeon mortality due to sea lamprey attacks, and a soon to be implemented Sturgeon Recovery Plan (MacKenzie, 2016). Recovery will be limited, however, due to the reduction in spawning created by the Peterson Dam, which was built on the Sturgeon Hole. Sturgeon historically used this the location as a pre-spawn staging area on their way upstream to spawning grounds above where the dam was constructed. Recovery will also be limited due to Lake Sturgeon's late maturity (first spawn at age 19-25 years) and the fact that females do not spawn every year.

Other rare fish include the threatened Eastern Sand Darter, the uncommon Mottled Sculpin, and two species of Redhorse Sucker, which are limited to lower reaches of the Lamoille River and other large

tributaries to Lake Champlain. The diverse fish community number over 25 species, rare and otherwise, downstream from the Peterson Dam.

Additionally, there are a total of 13 native mussel species in the Lamoille River within river reaches above and below the dams from Fairfax Falls to the delta in Lake Champlain. Six of these species are currently listed as either threatened or endangered in Vermont. The Lamoille River offers ideal habitat for freshwater mussels and supports the only known population of the very rare elktoe mussel (*Alasmidonta marginata*) in Vermont. Many of these populations have been documented with surveys by VFWD Wildlife Diversity Program, and VDEC.

Important Lower Lamoille Wetlands

The Champlain Valley region contains a rich diversity and abundance of wetlands. The warmer climate of the Champlain Valley and the rich delta soil make this region distinct from other areas in Vermont.

One important wetland is the Sandbar State Park and Wildlife Refuge wetland at the mouth of the Lamoille River. This extensive wetland complex is over 1,600 acres, much of which is owned and managed by the Vermont Fish and Wildlife Department. In addition to containing 20 acres of one of the best examples of floodplain forest in Vermont, the wetland complex also contains extensive shallow water and deep water marshes; shrub swamps dominated by buttonbush; and large stands of the uncommon wild rice. This wetland complex provides nesting habitat for rare and uncommon waterfowl and wading bird species including: Pied-Billed Grebe, American Bittern, Least Bittern, Great Blue Heron, Blue-Winged Teal, Common Goldeneye, Hooded Merganser, Sora, and Common Moorhen. The wetland complex is also the only known nesting site in Vermont for the Cerulean Warbler. A large population of the uncommon meadow horsetail (*Equisetum pratense*) is also present in this wetland complex. The size, location, functions, and diversity of this wetland complex make it one of the most important wetlands in the Lamoille River watershed

A large unnamed wetland complex in Milton that is privately owned and is the only red maple-northern white cedar swamp located in a deltaic sandplain landscape. This community type comprises only the eastern half of the 600-acre wetland, and contains balsam fir, red maple, black ash and white cedar. The western half of the wetland contains largely undisturbed red maple-black ash swamp with green ash, hemlock and poison sumac. These two halves are divided by a powerline corridor, which is considerably less diverse than the eastern and western sections of the wetland. The wetland complex contains one state-threatened plant, one rare sedge, and the uncommon Tuckerman's sedge. The wetland complex is located within the sands of the historic, periglacial delta of the Lamoille, which in addition to its largely undisturbed nature makes it an important wetland.

There are a number of other large, diverse wetlands in the Champlain Valley region of the Lamoille River watershed including: Mill Brook Black Spruce Bog in Fairfax (300 acres); Lower Lamoille Oxbow Swamp just upstream from Sandbar in Milton (275 acres); Essex Center Swamp in Essex (100 acres); Browns River Swamp in Essex (500 acres); Browns River Wetland in Jericho (120 acres) and many

others. These wetlands provide water quality protection and wildlife habitat in an environment that is becoming increasingly urbanized.

B. Assessment and Management Methodology

The Agency's Watershed Management Division (WSMD) in the Department of Environmental Conservation (DEC) assesses the health of a waterbody using biological, chemical and physical criteria. Most of this data can be pulled from the Vermont Integrated Watershed Information System online data portal.

The results of assessments are the basis for the biennial statewide Vermont Priority Water List. In addition, the information is also utilized in the development of the Lake Score Card (Tables 5-7) and stream geomorphic assessment (SGA) reports (Table 8).

The Vermont Surface Water Management Strategy (Vermont Department of Environmental Conservation, 2016) lays out the goals and objectives of the Watershed Management Division to address pollutants and stressors that affect the designated uses of Vermont surface waters. The strategy discusses the 10 major stressors that are managed to protect and improve surface waters (Figure 3). Figure 3 links to the stressor chapter of the Surface Water Management Strategy that describes in detail the stressors, their causes and sources. The chapter also describes the Division's approach to addressing the stressor through monitoring, technical assistance, regulations and funding. The 2016 Assessment and Listing Methodology articulates three categories of surface waters where degradations are noted.

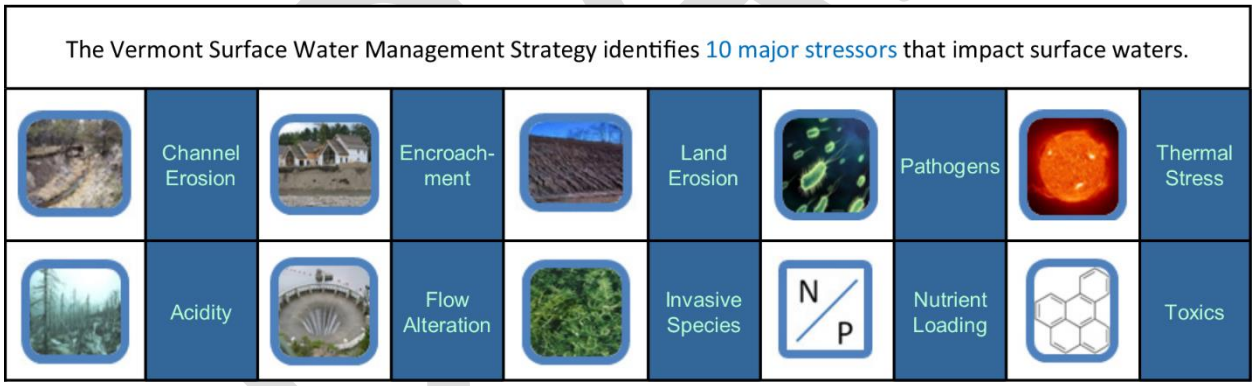


Figure 3. The ten major stressors that are managed to protect and improve surface waters.

Stressed waters support designated uses, but the water quality and/or aquatic biota/ habitat have been disturbed to some degree by point or by nonpoint sources of human origin and the water may require some attention to maintain or restore its high quality. In some instances, stressed waters may have documented disturbances or impacts and the water needs further assessment to confirm impairment.

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

Impaired waters are those surface waters where there are chemical, physical and/or biological data collected from quality assured and reliable monitoring efforts that reveal 1) an ongoing violation of one or more of the criteria in the Water Quality Standards and 2) that a pollutant of human origin is the most probable cause of the violation. Impaired waters are those that require pollution control efforts under one or more provisions of the Clean Water Act. The most common mechanism to address an impaired water is the development and promulgation of a Total Maximum Daily Load (TMDL).

Specific surface waters that are in need of further assessment, and impaired waters in need of a TMDL or other Clean Water Act pollution control effort are shown in tables 1, 2, and 3 below and are organized by subwatershed-specific sections.

C. Condition of Specific Water Resources

Impaired Waters and Priority Surface Waters

Following are the stream segments or lake sections that are impaired, altered, or stressed and appear on the 2016 List of Priority Waters that the Watershed Management Division maintains to track impacted waters (Tables 1-3 and Figures 4-6). Zoom in to maps for more detail. Actions to address the impairments, alteration or stresses are identified in the Lamoille Basin Implementation Table summaries. A detailed list of actions can be viewed via the Watershed Projects database.

Upper Lamoille

Table 1. Status of rivers, streams, lakes, and ponds in Upper Lamoille.

Stream or lake segment	Town	Mileage & status	Pollutant(s)	Primary Stressor	Use Impairment	Problem/Source
UPPER LAMOILLE						
Altered						
VT07-21L05 Hardwick Lake	Hardwick	145 acres ***Altered*** Part F list	Flow alteration		AES, ALS	Water level fluctuation
Stressed						
VT07-22L04 Caspian Lake	Greensboro	789 acres ***Stressed***	Flow alteration		ALS	Water level fluctuation
Haynesville Brook	Walden, Hardwick	***Stressed***	Physical alteration, sediment		ALS, AES, 2CR	Post-flood work, streambank erosion
Tucker Brook	Hardwick	***Stressed***	Physical alteration, turbidity, siltation		ALS, AES, 2CR	Post-flood work, streambank erosion

Stream or lake segment	Town	Mileage & status	Pollutant(s)	Primary Stressor	Use Impairment	Problem/Source
UPPER LAMOILLE						
Stannard Brook	Wheelock, Stannard, Walden, Hardwick	***Stressed***	Sediment		ALS	Floods and post-flood work (1973, 95, 97); bank erosion; macroinvertebrates in fair condition 2002

RM = River Mile, AES = Aesthetics, ALS = Aquatic Life Support, 2CR = secondary contact recreation

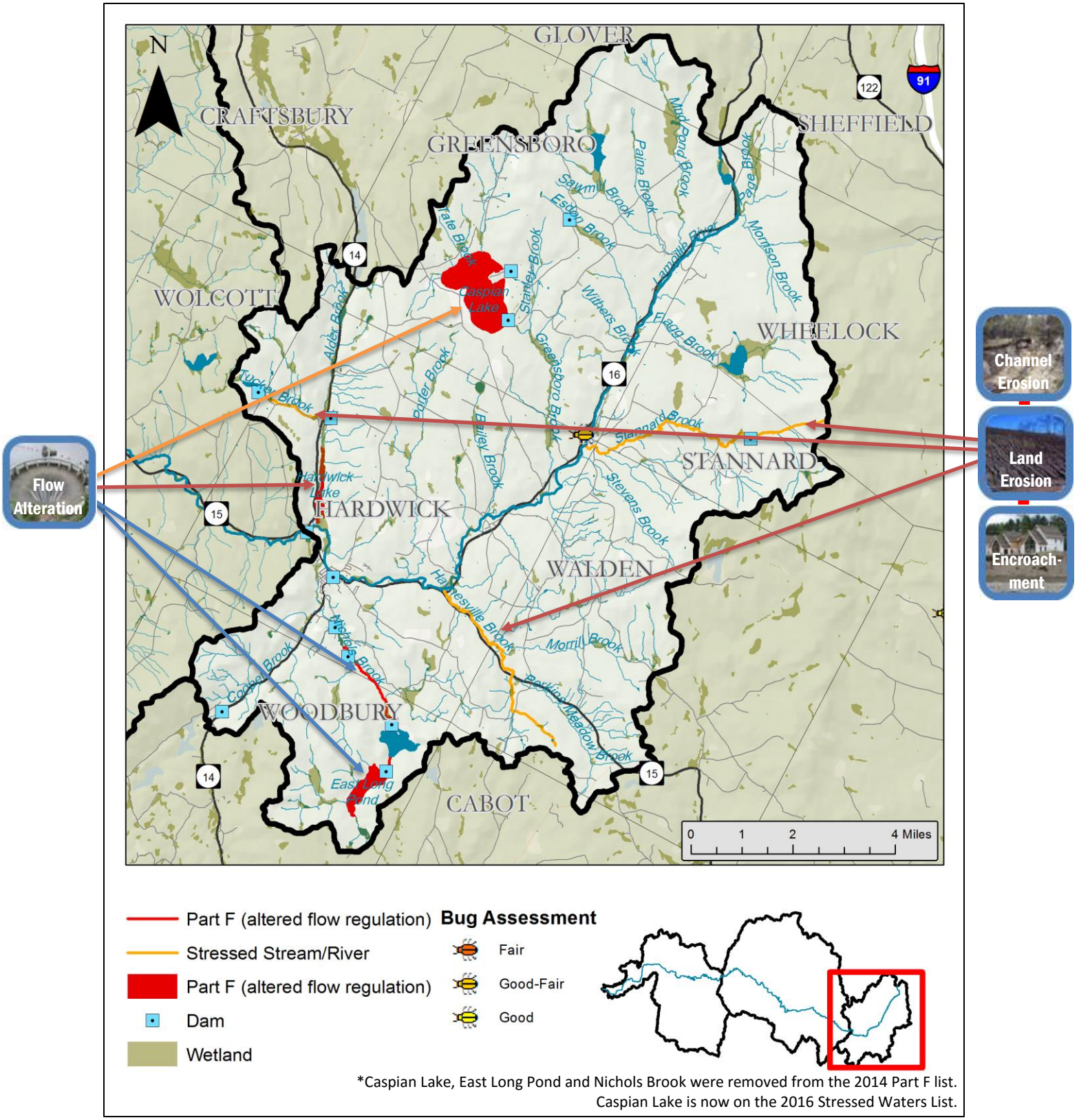


Figure 4. Upper Lamoille basin priority surface waters and related water quality stressors.

Middle Lamoille

Table 2. Status of rivers, streams, lakes, and ponds in Middle Lamoille.

Stream or lake segment	Town	Mileage & status	Pollutant(s)	Primary Stressor	Use Impairment	Problem/Source
MIDDLE LAMOILLE						
Impaired						
Rodman Brook, from mouth to RM 0.6	Morristown	0.6 miles ***Impaired*** 303(d) List Part A	Iron		AES, ALS	Lamoille landfill leachate
Hutchins Brook, from RM 2.0 to RM 3.0	Eden	1.0 miles ***Impaired*** 303(d) List Part A	Sediment, asbestos		ALS, AES, CR	Asbestos mine tailings erosion
Hutchins Brook, Tributary 4, mouth to RM 0.3	Eden	0.3 miles ***Impaired*** 303(d) List Part A	Sediment, asbestos		ALS	Asbestos mine tailings erosion
Tributary #10 to Brewster River	Cambridge	1.0 miles ***Impaired*** 303(d) List Part A	Iron		AES, ALS	Ski area development
Lake of the Clouds	Cambridge	1 acres ***Impaired*** Part D list	pH		ALS	Acid deposition from remote sources; 2003 EPA-approved TMDL
Altered						
Lamoille River, Hardwick Lake to Lake Lamoille in Morrisville	Hardwick, Wolcott, Morristown	15.7 miles ***Altered*** Part F list	Flow alteration		AES, ALS, 2CR	Wolcott Dam: Artificial and poor flow regime downstream
			Flow alteration		AES, ALS	Wolcott Dam: Impoundment water level fluctuation by hydro impairs aquatic habitat; erosion
			Flow alteration		ALS	Wolcott Dam: Possible fish passage problem at dam (threat)

Stream or lake segment	Town	Mileage & status	Pollutant(s)	Primary Stressor	Use Impairment	Problem/Source
MIDDLE LAMOILLE						
			Flow alteration		AES, ALS, 2CR	Hardwick Lake Dam: Artificial flow regime downriver
			Flow alteration		ALS	Possible fish passage problem at dams (threat)
			Flow alteration		AES, ALS, 2CR	Below Morrisville Dam: No flow in bypass impairs aesthetics, recreation, and habitat
Green River, downstream from reservoir	Hyde Park	4.7 miles ***Altered*** Part F list	Artificial flow regime		ALS	Artificial flow regime and condition by hydro operations alters aquatic habitat
Green River Reservoir	Hyde Park, Eden	***Altered*** Part F list	Water level fluctuation		ALS	Water level fluctuation and winter drawdown alters aquatic habitat
Lake Elmore	Elmore	***Altered*** Part F list	Flow alteration		ALS	Water level fluctuation by hydro alters aquatic habitat
Elmore Pond brook, from dam to 2.2 miles downstream	Elmore, Wolcott	2.2 miles ***Altered*** Part F list	Artificial flow regulation		All uses	Below Lake Elmore dam artificial flow regulation and condition
Lake Lamoille	Morristown	148 acres ***Altered*** Part F list	Water level fluctuation		ALS	Above Cady's Falls dam water level fluctuation by hydro alters aquatic habitat
Mid-Lamoille River immediately below Cady's Falls dam	Morristown	0.3 miles ***Altered*** Part F list	Lack of flow, de-watering of falls		AES, ALS	Cady's Falls dam & hydro facility possible fish passage problem at dam and lack of flows to support habitat

Stream or lake segment	Town	Mileage & status	Pollutant(s)	Primary Stressor	Use Impairment	Problem/Source
MIDDLE LAMOILLE						
Unnamed brook, trib to Brewster River	Cambridge	1.0 miles ***Altered*** Part F list	Insufficient flow		ALS	Artificial flow condition, insufficient flow below Morse Reservoir, used for domestic water
Lake Elmore	Elmore	***Altered*** Part E list	Eurasian watermilfoil		AES, ALS, CR, 2CR	Locally abundant Eurasian watermilfoil growth; ongoing local non-chemical control program
Stressed						
Bunker Brook	Hardwick	1.5 miles ***Stressed***	Physical alterations		AH, AES	Rip-rap, channelization
Kate Brook	Woodbury, Hardwick	2.0 miles ***Stressed***	Physical alterations		AH, AES	Rip-rap, channelization
Wild Branch	Eden, Craftsbury, Wolcott	15.0 miles ***Stressed***	Sediment, turbidity		ALS, AES, 2CR	Channel alterations, encroachments, bank erosion, sediment and scour are major stressors
North Branch Lamoille River, Route 109 to mouth	Cambridge	1.0 miles ***Stressed***	Sediment		AH	Bank erosion, channel instability
Brewster River, from ski area to mouth	Cambridge	5.9 miles ***Stressed***	Sediment, stormwater		ALS, AES	Construction erosion, road & parking lot runoff, other stressors identified in River Corridor Plan
Ryder Brook	Morristown	3.5 miles ***Stressed***	Sediment, physical alterations		ALS, AES, 2CR	Loss of riparian vegetation, development

Stream or lake segment	Town	Mileage & status	Pollutant(s)	Primary Stressor	Use Impairment	Problem/Source
MIDDLE LAMOILLE						
Elmore Branch	Elmore, Wolcott	4.0 miles ***Stressed***	Sediment, turbidity,		ALS, AES, 2CR?	Channelization, road encroachments on floodplain, road runoff
Dark Branch	Eden	3.3 miles ***Stressed***	Asbestos, sediment		ALS	Asbestos mine erosion
Gihon River	Eden, Johnson	0.4 miles ***Stressed***	Organics		ALS, CR, DWS	Underground storage tank leak & spills; currently being updated
Mud Brook	Morristown	0.5 miles ***Stressed***	Iron		ALS, AES	State-owned dam & culvert, iron precipitate, low density of macroinvertebrates

RM = River Mile, AES = aesthetics, ALS = aquatic life support, AH = aquatic habitat, CR = contact recreation, 2CR = secondary contact recreation, DWS = drinking water supply

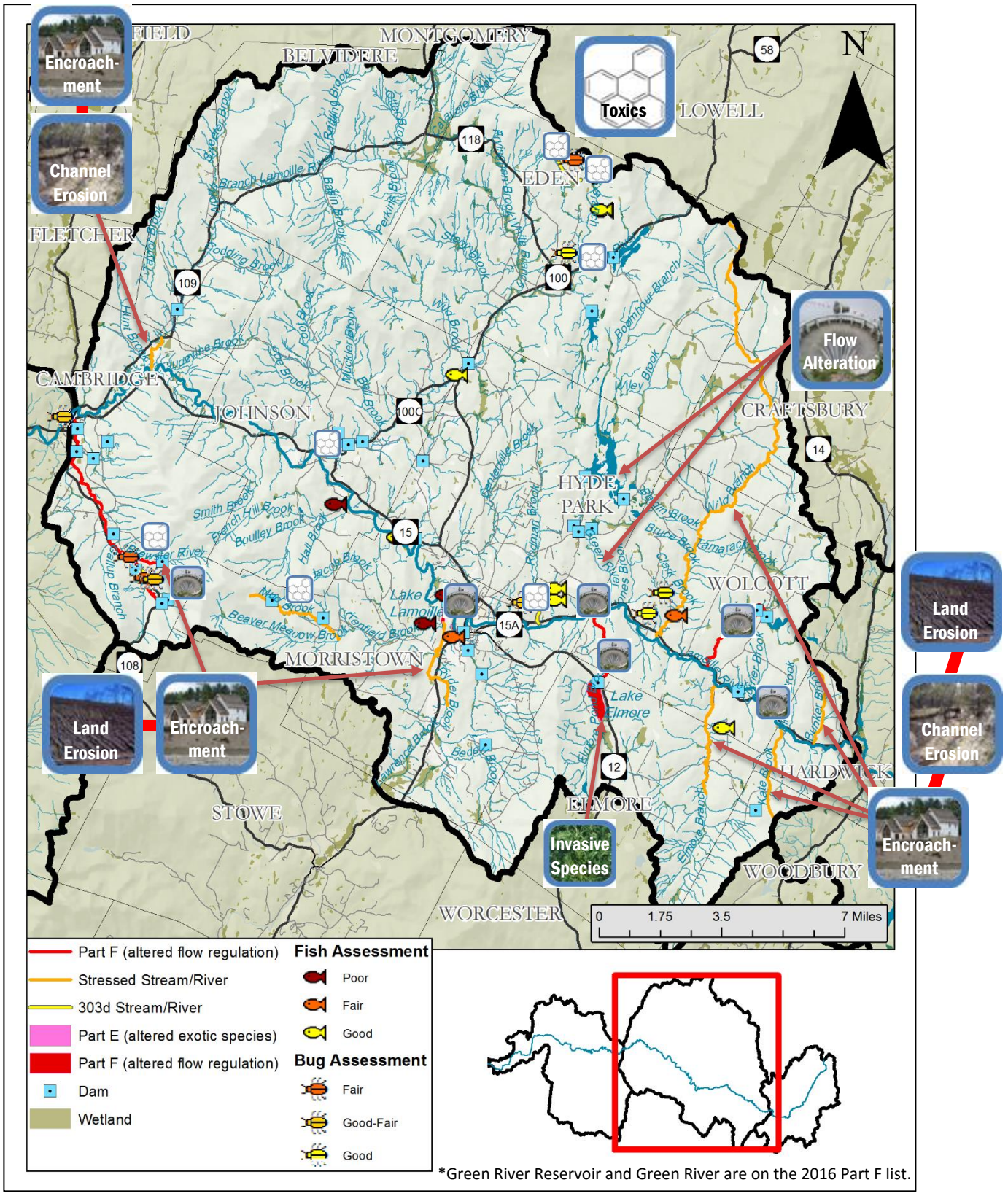


Figure 5. Middle Lamoille basin priority surface waters and related water quality stressors.

Lower Lamoille

Table 3. Status of rivers, streams, lakes, and ponds in the Lower Lamoille Watershed.

Stream or lake segment	Town	Mileage & status	Pollutant	Primary Stressor	Use Impairment	Problem/Source
LOWER LAMOILLE						
Impaired						
Deer Brook, mouth to 2.5 miles upstream	Georgia	2.5 miles ***Impaired*** 303(d) list Part A	Sediment		ALS	Erosion from stormwater discharges; corroding road culverts; some BMPs implemented
Lower Lamoille River below Arrowhead Mtn Lake dam to Route 2 bridge	Milton, Colchester	6 miles ***Impaired*** Part B list	Flow alteration		ALS	3 dams (Clarks, Milton, Peterson) create dissolved oxygen problems downstream
Lower Lamoille mouth to Clarks Falls Dam	Milton, Colchester	8.5 miles ***Impaired*** Part D list	Mercury		FC	Elevated levels of mercury in walleye; 2007 EPA-approved TMDL
Arrowhead Mountain Lake	Georgia, Milton	***Impaired*** Part D list	Mercury		FC	Elevated levels of mercury in walleye; 2007 EPA-approved TMDL
Lamoille River Tributary #4	Milton	0.3 miles ***Impaired*** 303(d) List Part A	Metals		ALS	Macroinvertebrate impacts from old Milton landfill (Pb, Zn, Cu, Fe)

Stream or lake segment	Town	Mileage & status	Pollutant	Primary Stressor	Use Impairment	Problem/Source
LOWER LAMOILLE						
Altered						
Arrowhead Mountain Lake	Georgia, Milton	114 acres ***Altered*** Part E list	Eurasian watermilfoil		AES, ALS, CR, 2CR	Population confirmed in 1988; weevil present; noted natural milfoil decline in 1995; weevil augmentation (98-99)
Stressed						
Browns River, from west of Jericho/Essex line up 7.5 miles	Underhill, Jericho	7.5 miles ***Stressed***	Sediment, physical alterations, temperature		AH, AES	Former large scale gravel mining, streambank de-stabilization, sediments, physical alteration, and temp
Streeter Brook	Milton	0.6 miles ***Stressed***	Stormwater possible		ALS	Sample site is below some roads and subdivisions; macroinvertebrate community results have ranged over the last 10 years
Seymour River, mouth upstream	Cambridge	3.5 miles ***Stressed***	Sediments, nutrients		AH, AES	Bank erosion, instability, ag encroachment
Stevensville Brook, from RM 2.0 up to headwaters	Underhill, Stowe	3.0 miles ***Stressed***	Low ph, flood scour		AH	Acid deposition, flashy stream
Lower Mid Lamoille, from Arrowhead Mtn Lake to Fairfax Falls dam	Fairfax, Georgia	5.0 miles ***Stressed***	Mercury		FC	Elevated levels of mercury in walleye

RM = River Mile, AES = aesthetics, ALS = aquatic life support, AH = aquatic habitat, CR = contact recreation, 2CR = secondary contact recreation, FC = fish consumption

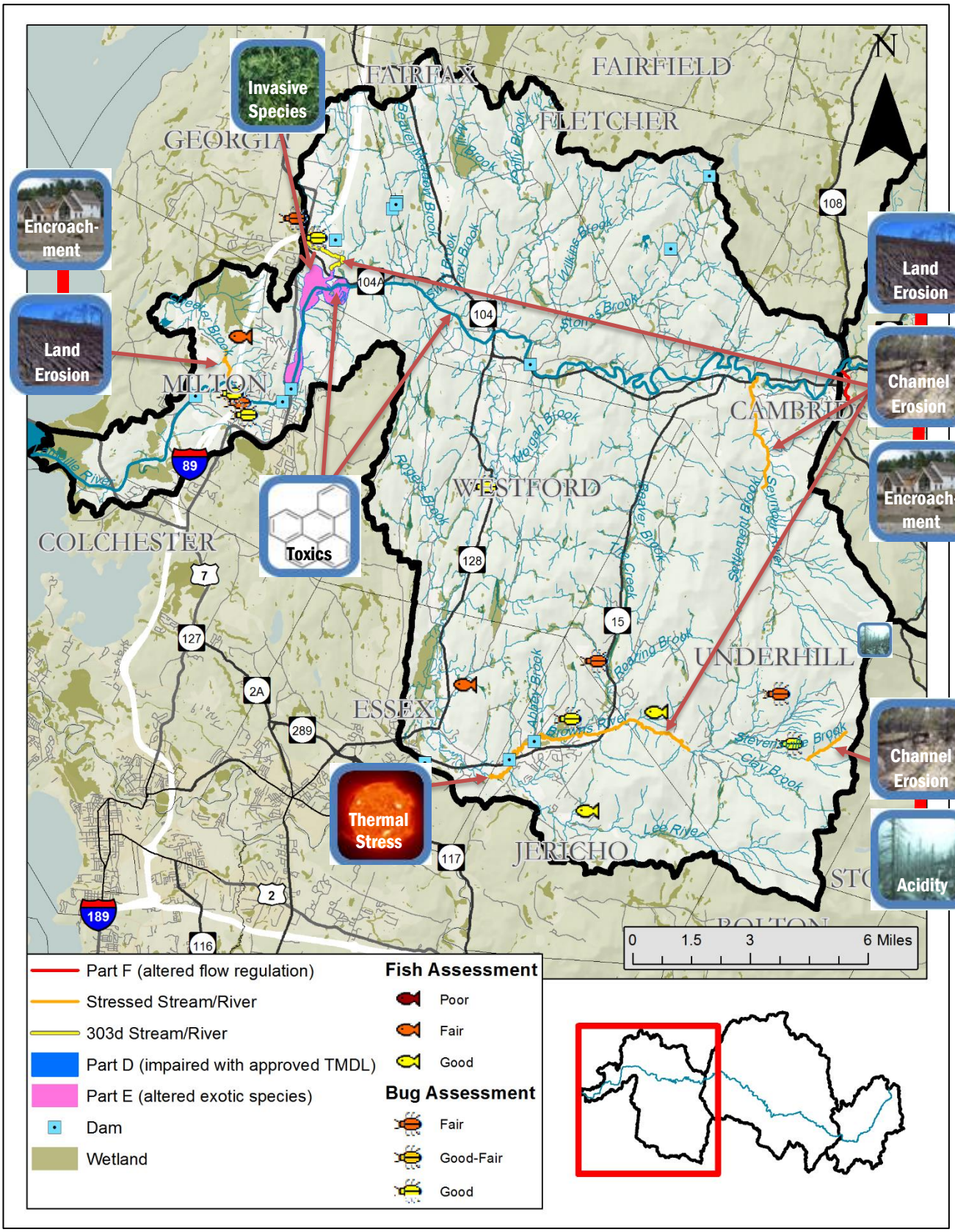


Figure 6. Lower Lamoille basin priority surface waters and related water quality stressors.

D. Water Quality Monitoring and Assessment

Several types of assessments are conducted to support tactical basin planning in order to address impaired, stressed, and altered waters along with high quality waters and those waters that may be threatened by natural or human activities (Table 4).

Types of monitoring and assessments that have been completed, or are ongoing or planned in the Lamoille watershed are:

- Stream geomorphic assessments
- Water quality monitoring
- Biological monitoring
- Agricultural Assessment and Planning
- Better Back Roads/Road erosion inventories
- Stormwater master planning and Illicit Discharge Detection and Elimination (IDDE) infrastructure mapping

Table 4. Status of assessments for the Lamoille River Basin

Sub-Basin	Geomorphic Assessment	Water Quality Monitoring	Biomonitoring	Agricultural Assessment and Planning	Better Backroads/ Road Erosion Inventory	Stormwater master plan or Illicit Discharge Detection
Upper Lamoille	PC, X	O, X	O, X	X	X	PC
Middle Lamoille	PC, X	O, X	O, X	X	PC	X, PC
Lower Lamoille	PC, N	O, X	O, X	X	X	X, PC

X= proposed in plan C= Completed PC= Partial Completed O= On-going U= Underway N= not proposed at this time

River and Stream Biological monitoring

Over 58 biological monitoring river and stream sites were sampled in the Lamoille Basin between 2010 and 2015. Three sites were sampled in the Upper Lamoille, twenty-seven sites were sampled in the Middle Lamoille and twenty-eight sites were sampled in the Lower Lamoille. Tables with 2010-2015 information on monitoring results, site locations, and monitoring recommendations are located in Appendix D. The 2016 Lamoille River Watershed Assessment Report is an update of the monitoring information in Basin 7 and summarizes assessment data for specific sites of interest.

Recommended Monitoring and Assessment Focus

Sections of streams and river recommended for further monitoring and assessment are chosen to monitor water quality trends over time, and identify high quality waters and impacted waters. The

VDEC Monitoring, Assessment and Planning Program (MAPP) is given the list of recommended sampling sites to add to their 5-year basin rotation. Although the next sampling rotation for the Lamoille Basin is 2020, priority sites will be sampled when there is capacity.

Upper Lamoille Waters

Five sites are recommended for sampling in the Upper Lamoille watershed (Table D3). These sites include Greensboro Brook to identify very high quality waters; Stannard, Tucker, and Haynesville Brooks to track water quality from human and natural impacts; and Porter Brook, which is the main tributary and outlet of Lake Caspian, but lacks sampling data.

Middle Lamoille

Thirteen sites are recommended for sampling in the Middle Lamoille watershed (Table D3). Rattling and Calavale Brook headwaters in Belvidere have never been sampled and need to be assessed to determine if sampling is possible in the lower reaches. Tributaries to the Gihon River need additional sampling to assess condition to further support the very high quality water status in the middle and lower reaches of the Gihon. One site on the Gihon showed a decline at river mile 14.5 dues to a loss of taxa. This site should be monitored to track additional changes.

Centerville Brook, Wild Brook and White Branch have not historically been sampled and are recommended for sampling to determine current status. Wild and White Branches are located primarily in a forested basin, while Centerville Brook is located within a more developed area with roads, rural development and agriculture impacts. Basin Brook was last sampled in 1992 with density and richness not meeting full support, while other metrics showed full support. Additional sampling is needed to assess the current status.

Rodman Brook, which was proposed for de-listing will remain on the list due to a slope failure incident at the adjacent landfill, which was the initial source of iron. The site will be re-evaluated after the failure is mitigated and an additional biological sample below the landfill can be obtained. Brewster River Tributary 10, located to the east of Route 108 adjacent to the entrance of Smugglers Notch Resort Village, was rated as 'fair' in 2013 and field observations described that the water was turbid from recent rainfall with a lot of iron precipitate; this site should continue to be monitored as restoration opportunities are implemented.

Lower Lamoille

Three sites are recommended for sampling in the Lower Lamoille watershed (Table D3). Streeter Brook needs additional data and investigation to follow-up on past sampling that showed ranges from *very good-good* to *good-fair* macroinvertebrate communities. Stones Brook needs to be assessed to determine if it should be considered a high quality water, and Beaver Brook, which has no sampling data, but covers a significant area in the Lower Lamoille, needs monitoring data to assess its current condition.

Sampling of Tributary #4 to Lamoille River in Milton in 2015 showed poor condition of the macroinvertebrate community adjacent to and below the Milton Landfill. Additional monitoring of metals is being conducted by the VT Hazardous Waste Program. The site will continue to be monitored for biological integrity. Deer Brook showed a fair rating in 2011 at river mile 2.1 and a good rating at river mile 1.4, these sites should continue to be monitored as projects are implemented to address water quality issues.

Lakes and Ponds Biological and Water Quality Monitoring

The Vermont Lakes and Ponds Program has identified 77 lakes in the Lamoille River watershed. There are 38 lakes and ponds over 10 acres in size and 23 of those lakes are greater than 20 acres. Lake and pond water quality and habitat conditions are monitored through numerous study programs including the Spring Phosphorus and Lake Assessment Programs and by the Lay Monitoring Program among others. While many fully support the requirements of the VWQS, most lakes and ponds are affected by atmospheric deposition of pollutants from sources outside of Vermont and several lakes and ponds exhibit high levels of fish mercury.

Tables 5, 6, and 7 show lake-specific information compiled to create the Vermont Lake Score Card, which has been developed to convey a large amount of data gathered and analyzed through these monitoring efforts. The Score Card rates Vermont lakes in terms of water quality, invasive species, atmospheric deposition, and shoreland condition. Tables 6 and 7 also take into consideration the Best Lakes Rating and if the site is used for sentinel sampling, which is long-term sampling for reference sites to track impacts of climate change.

Lamoille Basin Lakes and Ponds Status and Recommendations

Lake Score Card

Water Quality

The water quality score is derived from a statistical trend analysis of phosphorus, chlorophyll-a, and Secchi depth (water clarity measurement) data over time. Stable or improving trends are scored with a blue or good rating, declining trends are scored with a yellow or fair rating, and highly significantly declining trends receive a red or reduced score. Phosphorus is a key plant nutrient and increased phosphorus concentrations typically result in increased algae growth (measured by chlorophyll-a) and decreased water clarity (measured by Secchi depth).

Status & Recommendations

Two lakes in the Lamoille Basin are exhibiting a decline in water quality trends: Halfmoon Pond in Fletcher and Lake Eden in Eden. Lake Eden secchi depth and TP levels are increasing, which indicates a negative water quality trend. This could be due to increased sedimentation, shoreland runoff, and leaky septic systems. The lake association is currently working with partners to determine the source of the pollution and implement actions to mitigate impacts. Halfmoon Pond in Fletcher is a privately owned pond with extremely high levels of total phosphorus. This lake has the highest levels of

phosphorus recorded by the Lakes and Ponds Program in the state. Agricultural practices around the pond should be evaluated as a source and stream monitoring should be employed downstream of the waterbody to determine if the lake is acting as a contributing source to the river system.

Caspian Lake in Greensboro is considered to be in the top overall 20% of Vermont lakes. However, there is public concern that sedimentation and road and developed land runoff are impacting recreational use and water quality. Based on results from the Lay Monitoring Program, there is no indication that water quality is showing a negative trend. Sedimentation from road conflicts are recommended to be addressed by the town. In addition, actions identified in the Caspian Lake Feeder Stream Study conducted by VDEC and the Greensboro Land Trust should be considered by the town for Better Road grant projects. Caspian Lake would also benefit from shoreland owners creating a lake association and becoming involved in the VT LakeWise Program to address the negative trend in shoreland and lake habitat.

Nichols Pond in Woodbury is a 171-acre pond with public access. In 2010, Nichols Pond was delisted as a flow altered water (Vermont Department of Environmental Conservation, 2014). In 2008, Hardwick Electric Department (HED) was issued a Dam Order from the VDEC in 2008 to rebuild the dam. Under the dam order, HED was no longer permitted to drawdown the lake to augment hydroelectric production downstream. As a result, the pond was taken off the flow altered waters list. In addition, the lake scorecard for water quality increased in quality from yellow in 2010 to blue in 2014.

Shoreland and Lake Habitat

The shoreland and lake habitat score reflects the conditions of a lake's shoreland and shallow water habitat. The more lawn and development near the water's edge, the lower the shoreland condition. Blue scores represent lakes with >75% vegetated shores; yellow shows lakes with 50-75% vegetated shores; and red shows lakes with less than 50% lakeshore vegetation. Loss of shoreland habitat is now considered by the US Environmental Protection Agency to be the primary threat to lake biota.

Status & Recommendations

Thirteen lakes in the Lamoille Basin have a yellow shoreland habitat score of 50-75% and one lake, Lake Elmore, has a shoreland habitat score of red with less than 50% shoreland vegetation cover. Despite Lake Elmore's degrading shoreland habitat condition, the TP annual mean is significantly decreasing. Based on the habitat score, the lake would benefit greatly from shoreland owners becoming involved in the VT LakeWise Program (VLWP). Outreach should be targeted in this lake community and the Lake Elmore Lake Association (LELA) is encouraged to work with VDEC to develop a plan of action.

The additional ten lakes should be evaluated for the level of shoreland vegetation and aquatic habitat loss. The towns and landowners for those ten lakes should focus on protection and education, and actively come up with a plan to address further degradation and pursue actions to restore lakeshore

habitat. Areas with development owned or managed by the State of Vermont should be identified and the land managers should coordinate with the VLWP.

Aquatic Invasive Species

The Aquatic Invasive Species score measures the presence or absence of invasive species (blue no known invasive; red confirmed invasive). It does not reflect the abundance or degree of nuisance posed by the species present. Left unchecked, invasive species can cause significant harm to a lake's recreational experience and its ecosystem. The score card also tells which, if any, invasive is in a lake. Known populations should be reported to the VT Lakes and Ponds Program.

Status & Recommendations

There are three lakes in the Lamoille Basin with a confirmed aquatic invasive. There may be more lakes in the basin that have not been confirmed with a significant population. The three lakes are Arrowhead Mountain Lake in Georgia and Milton, Lake Elmore, and Long Pond in Eden. LELA is actively involved with invasive species removal in Lake Elmore. Both Arrowhead Mountain Reservoir and Long Pond in Eden would benefit from invasive species removal activities and management plans since both are used extensively for recreation.

Two lakes in the Lamoille River basin are involved with VDEC's Public Access Greeter Program. With support and guidance from state experts, public access greeters at Caspian Lake and Lake Eden educate lake visitors about invasive species. These greeters also provide courtesy watercraft inspections to boaters to ensure invasive plants and animals are not transported from one waterbody to another. The program at Caspian, which began in 2002, inspected 561 watercrafts in 2015. Greeters at Lake Eden, which began its program in 2009, inspected 1,361 watercrafts in 2015. Both programs plan to continue operations in 2016 and beyond, and Lake Eden is hoping to develop a boat washing station at the Lake Eden access.

Atmospheric Pollution

There are two main airborne pollution types reflected in the atmospheric pollution score: sulfur and nitrogen oxides and mercury. Sulfur and nitrogen oxides are largely transported to Vermont from out of state air emissions and is beyond this plan to address. A TMDL addressing all acid impaired lakes in Vermont has been approved by EPA. Mercury contamination has resulted in fish consumption advisories in nearly every lake in Vermont and those of nearby states as well – so all Vermont lakes, but two, get a yellow score. Acid precipitation has resulted in the acidification of some of the high elevation lakes, but this trend is improving for the majority of acid-sensitive lakes.

Status & Recommendations

Big Muddy Pond was initially sampled as part of the Long-Term Monitoring Program, a joint state and federal effort to assess lake acidification. This lake has shown some improvement. However, this is not the case for Lake of the Clouds which remains critically acidic showing no indications that it has begun to improve. The Long-Term Monitoring Program should continue to track the status of acid-impaired water bodies.

Best Lakes Rating

The best lakes rating is based on a ranking system developed by the VDEC Lakes and Ponds Program. Lakes or ponds that ranked in the top 25 percent in the state in any of three categories are shown in the following tables. The three categories include: water quality, biological diversity, and unusual or scenic natural features.

Both Schofield Pond and Zack Woods Pond are located in Vermont Department of Forest, Parks, and Recreation property. Both ponds are part of the Green River Reservoir State Park. Schofield Pond is part of an important wetland complex that includes a rare intermediate fen. In January 2013, several non-profit and state partners conserved 393-acres including Zack Woods Pond, Perch Pond and the surrounding landscape. Both Zack Woods and Schofield Ponds are used as sentinel research sites and should be managed to prevent any impacts or degradation to water quality and investigated for reclassification to B(1) waters.

Little Elmore Pond is the only lake in the Lamoille Basin in the top 5% of Vermont's best lakes overall. Flagg Pond, East Long Pond, Schofield Pond, and Zack Woods Pond score in the top 10% of Vermont's best lakes overall. Protective measures from impacts should be considered for all lakes in the top 25% best lakes.

Lakes and Ponds Monitoring Results by Sub-basin

The Lakes Scorecard color descriptions for each category are described above in detail. The generalized condition of BLUE is good, YELLOW is fair, and RED is reduced, and WHITE = no current data. WQ = water quality, AIS = aquatic invasive species, Shore = shoreland and lake habitat, and Atmos = atmospheric pollution.

Table 5. Vermont lake and pond assessment information in the Upper Lamoille Basin.

Lake or Pond	Town	Lakes Scorecard				Best Lakes Rating
		WQ	AIS	Shore	Atmos	Top Percent in VT
Tuttle	Hardwick					20%
Hardwick*						
Long	Greensboro					25%
Caspian						20%
Horse						20%
Flagg Pond	Wheelock					10%
Nichols	Woodbury					25%
East Long						10%

***** High flushing rate reflects more of a river type ecosystem than lake.

Table 6. Vermont lake and pond assessment information in the Middle Lamoille Basin.

Lake or Pond	Town	Lakes Scorecard				Best Lakes Rating	
		WQ	AIS	Shore	Atmos	Top Percent in VT	Sentinel Research Site
Little Elmore	Elmore					5%	
Elmore							
Big Muddy	Eden						
Ritterbush							
Long							
South							
Eden							
Green River	Hyde Park						
Schofield						10%	x
Zack Woods						10%	x
Mud							
Lake-of-the-Clouds	Cambridge						
Wolcott	Wolcott					25%	
Wapanacki							
Lamoille*	Morristown						

***** High flushing rate reflects more of a river type ecosystem than lake.

Table 7. Vermont lake and pond assessment information in the Lower Lamoille Basin.

Lake or Pond	Town	Lakes Scorecard			
		WQ	AIS	Shore	Atmos
Silver	Georgia				
Arrowhead Mountain	Georgia				
Round	Milton				
Halfmoon	Fletcher				

Lakes and Ponds Recommended Monitoring and Assessment Focus

There are six lakes and ponds in this drainage system identified in the above tables as needing further assessment at this time. These waterbodies include: Big Muddy Pond (ATMOS, AIS), Mud Pond (AIS), Long Pond (SHORE), Lake-of-the-Clouds (ATMOS, AIS), and Silver Lake (AIS).

There are several very small ponds (mostly less than 10 acres in size) in the basin for which VDEC has little or no information. The accessibility of all of these smaller lakes to the public is unknown. Of the 31 lakes three are 10 or more acres and have not been assessed. These include: Mud Pond North in Woodbury, Mud Pond West in Woodbury, and Round Pond in Eden. A complete list of the 31 unassessed lakes and ponds can be found in Appendix E.

E. Additional Assessments

Stream Geomorphic Assessments

Stream geomorphic assessments (SGA) provide the basis for stream alteration regulatory decisions, technical assistance for fluvial conflict resolution, stream corridor protection and restoration, flood hazard mitigation and water quality protection. The assessment data is critical to prioritization of riparian and fluvial process-related water quality restoration and protection projects, project design alternatives analyses, and project design criteria. SGA provides insight into the social, economic and ecological interrelationships between people and fluvial systems; as such, it is a valuable educational tool. All of the SGA datasets collected and final reports in Vermont are compiled in the Stream Geomorphic Assessment Data Management System (and can be viewed on the ANR Natural Resource Atlas).

These databases are used to ensure that projects are implemented in a manner consistent with and complementary to equilibrium conditions. Much of the Lamoille River Basin has been subject to SGA at the Phase I (desktop research) or Phase II (field data collection) level, and River Corridor Plans (RCP) have been established for several watersheds, including the Upper Lamoille, Brewster, Browns, and Gihon Rivers, and Foote and Rodman Brooks (Table 8).

Since 2009, partners in the planning process (regional planning commissions and conservation districts in Lamoille and Chittenden Counties) have conducted geomorphic assessments on basin rivers and many of their tributaries to identify priority stream reaches for protection (with assistance from VDEC – River Management Program). All SGA final reports in Basin 7 can be found at https://anrweb.vt.gov/DEC/SGA/finalReports.aspx.

Table 8. Stream Geomorphic Assessments in the Lamoille Basin from 2009-2015.

Date Completed	River	Report	PRIORITIES IDENTIFIED	
			Projects	Bridge and Culvert[1]
UPPER LAMOILLE				
2/01/2009	Upper Lamoille	Upper Lamoille River Phase 2 SGA	Preliminary management strategies identified	
MIDDLE LAMOILLE				
3/18/2010	Wild Branch	Wild Branch River Corridor Plan	14	5

Date Completed	River	Report	PRIORITIES IDENTIFIED	
			Projects	Bridge and Culvert[1]
3/15/2013	Brewster River	Brewster River Phase 1 Report and River Corridor Plan	8	--
7/31/2015	Brewster River	Brewster River Corridor Plan	24	5
2/10/2010	Centerville Brook	Centerville Brook River Corridor Plan	15	5
10/30/2009	Elmore Branch	Elmore Branch Corridor Plan	13	1
10/10/2010	Foote Brook	Foote Brook Phase 1 and Corridor Plan	4	--
10/30/2009	Gihon River	Gihon River Corridor Plan	32	7
9/01/2010	Green River	Green River Phase 1 Report	Phase II assessment not recommended due to generally stable condition	
12/20/2010	Lamoille HUC 2	Lamoille HUC 2 River Corridor Plan	15	1
8/02/2010	Rodman Brook	Rodman Brook Phase 1 Report	Phase I study indicated the river was in fair condition	
3/22/2011	Rodman Brook	Rodman Brook River Corridor Plan	6	--
LOWER LAMOILLE				
3/30/2010	Browns River	Browns River Phase 2 Stream Geomorphic Assessment Summary	33 (9[2])	3
3/01/2009	Browns River	Browns River Phase Corridor Plan	57	23[3]

[1] Replacements or retrofits with high and high to moderate priorities only
[2] Number of the 33 projects that need further feasibility study or engineering design
[3] No prioritization given

Recommendations

High priority projects identified in all River Corridor Plans (RCP) should be scoped and implemented where supported and feasible, followed by moderate priorities, and then low. The major commonalities across all reports was the importance of riparian buffers with woody vegetation, river corridor protection, and adequate sizing and placement of structures (bridges and culverts). The application of these three strategies would largely negate the need for high cost projects to protect and restore infrastructure. A combination of proactive measures (i.e. local zoning, building outside the river corridor protection zone, and sizing structures adequately) and implementation of priority projects will result in local economic benefits, public safety, clean water, and wildlife habitat protection. Protecting floodplains and wetlands upstream and downstream of developed town centers and villages is an important tool for protecting water quality as well.

Upper Lamoille

Preliminary management strategies were identified for each reach assessed for the Upper Lamoille. These management strategies should be reviewed and those strategies that are still priorities should be scoped and implemented. The main concerns were sediment inputs from Hardwick Village and flood storage capacities upstream. Ensuring floodplain access, reducing stormwater inputs, and restoring Alder Brook at the Hardwick Dam are high priorities.

Surface waters recommended for SGA and river corridor planning are Kate Brook, Tucker Brook, Bunker Brook, Stannard Brook, and Haynesville Brook.

Middle Lamoille

Many of the river corridor plan projects in the Middle Lamoille have been followed up by VDEC, LCPC and Lamoille County Conservation District (LCCD). A list of tracked projects was generated by LCPC, but has not been updated since 2013. The list will be revisited through funding provided by the Clean Water Act to LCPC in coordination with VDEC.

For the Brewster River, flood resiliency strategies and projects were identified as high priorities and include undersized structure replacements and retrofits, river corridor zone protection for Cambridge to ensure public safety, and detailed flood hazard mapping for the Brewster River above Jeffersonville. Three project bundles were also identified for further development and should be viewed as high priority projects for the Brewster River watershed.

Surface waters recommended for SGA and river corridor planning are Ryder Brook, Seymour River, Settlement Brook, and the North Branch of the Lamoille.

Lower Lamoille

Surface waters recommended for SGA and river corridor planning are Streeter Brook, Deer Brook (needs update), and Mill Brook.

Geomorphic Compatibility and Aquatic Organism Passage (AOP)

In 2012, under funding provided by The Nature Conservancy through grants with VANR, using the Vermont Geomorphic Bridge and Culvert Assessment protocols, 1160 culverts and 14 arches were assessed in the Lamoille River basin.

After data was collected, The Vermont Culvert AOP Screening Tool was used to provide a rapid screening of structures regarding:

1) their susceptibility to failure due to sizing or design ("geomorphic compatibility"); and
2) their ability to permit unrestricted movement for fish (The Nature Conservancy, 2012).

The results were shared with 24 towns in the Lamoille River basin and identified priority structure replacements and retrofits. These results were further prioritized by geomorphic compatibility, downstream barriers and likelihood of aquatic organism passage success by VDEC. Those structures with full incompatibility were listed as the highest priorities. This list should be used by towns when developing capital budgets for road projects and applying for Better Roads grants where they also complement the town's needs. The full list is available for viewing on the online watershed projects database or companion spreadsheets.

In assessing AOP projects, partners should reference the Implementing AOP Enhancement Projects in Vermont guidance developed by VFWD. The guidance provides a brief overview of steps likely to be encountered in the identification and development of AOP enhancement projects based upon experience from past projects (Kirn, 2016). Because the guidance does not include funding opportunities, interested parties should contact their local Trout Unlimited chapter, United States Fish and Wildlife Service (USFWS), or VFWD for information on funding opportunities.

In addition, the Lamoille County Planning Commission, with support from the High Meadows Fund, developed a Hydraulic Model of the Lamoille Main Stem to be used as a tool for identifying potential opportunities for flood plain restoration and identifying undersized bridges and culverts.

Stormwater Mapping, Master Planning and IDDE

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 slow path to nearby rivers, lakes and ponds. On developed lands, however, infiltration is reduced by impervious surfaces such as roads, rooftops, and driveways. Runoff almost doubles when impervious surface area is 10 to 20 percent of the watershed area and triples at 35 to 50 percent impervious surface area (Arnold & Gibbons, 1996). 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 Green Infrastructure Collaborative (GIC) is a partnership between the Lake Champlain Sea Grant Program (LCSG) at UVM and the Vermont Department of Environmental Conservation to promote LID and GSI practices in Vermont watersheds to manage stormwater runoff from developed lands.

Basin-wide Illicit Discharge Detection and Elimination (IDDE) Study

In 2014, Stone Environmental, Inc., conducted a basin-wide IDDE study. The study, Detecting and Eliminating Illicit Discharges to Improve Water Quality in the Lamoille River Basin, was completed in 2014. The study reviewed eleven municipalities and Johnson State College in the Lamoille watershed. The project sought to find and then eliminate contaminated, non-stormwater discharges leaking into stormwater systems. A total of 305 stormwater drainage systems were investigated and of these, 80 were dripping or flowing when inspected. Of these 80, there were 26 that were suspected illicit discharges; however, 11 were confirmed as illicit discharges (Stone Environmental, Inc., 2014). Plans are in place to correct the majority of these illicit discharges.

Further investigation or follow-up is recommended for:

- Copley Hospital heating and ventilation equipment drains that are connected to a stormwater system discharging to a tributary of the river.in Morrisville,
- a sewer lateral serving Jersey Heights Road in Morrisville with potential leaking wastewater,
- a water leak(s) on Old Academy Street in the Town of Fairfax water distribution system, and
- a commercial garage with a floor drain connected to the stormwater system in Hyde Park Village.

Over the next three years VDEC will also test North Hyde Park Village, Greensboro Village, Greensboro Bend, and East Hardwick Village.

Stormwater Mapping in Basin 7

Stormwater infrastructure mapping projects are completed for municipalities by the Agency of Natural Resources Ecosystems Restoration program to supplement the existing drainage data collected by the towns and with the intention of providing a tool for planning, maintenance, and inspection of the stormwater infrastructure. Stormwater mapping projects were completed for 10 towns in the Lamoille Basin (Figure 7). The reports can be found at: http://dec.vermont.gov/watershed/cwi/manage/idde.

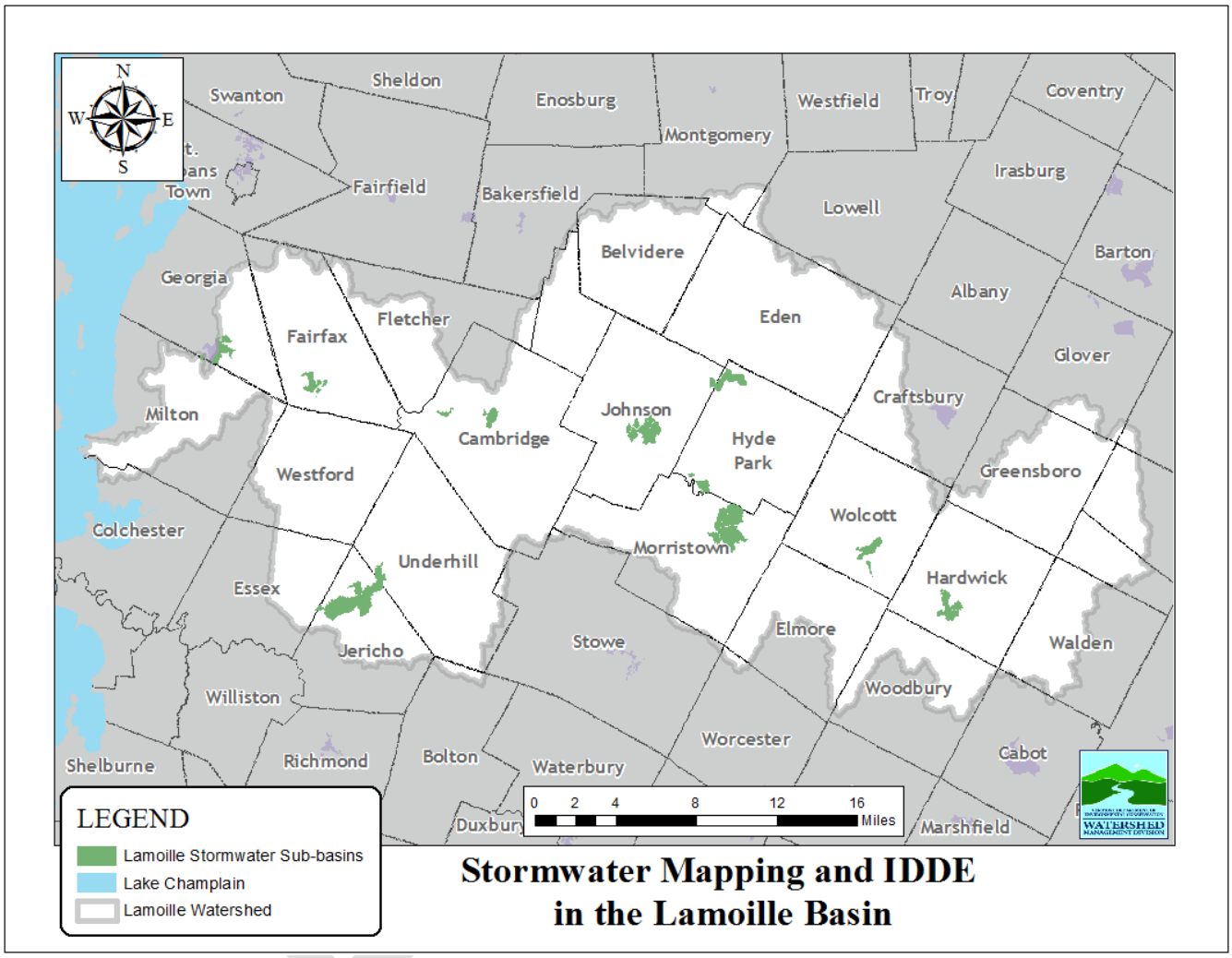


Figure 7. Current status of stormwater mapping and IDDE completed by the State of VT. Milton has completed their own mapping not shown here. Purple polygons are mapped areas outside of the Lamoille Basin.

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 in order to raise the awareness of the need for regular maintenance. The generation and transport of nonpoint source pollution increases with increasing connectivity of a drainage system. Having an understanding of the connectedness of the system is also a valuable tool for hazardous material spill planning and prevention. These reports identify priority projects in the study areas and provide information necessary

to develop a stormwater master plan. The completed 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 should be implemented by towns with the aid of Regional Planning Commissions or other partners where necessary.

Stormwater Master Planning

Upper Lamoille Recommendations

Stormwater master plans are recommended for four towns in the Upper Lamoille Basin. These towns, in order of population size are: Hardwick (including Hardwick Village), Woodbury, Greensboro, and Stannard (Table 9). The latter three towns do not have significant areas of developed land and would benefit from a regional or multi town approach with rural road focus. Hardwick exhibits the highest urban density and number of stormwater permits in the Upper Lamoille basin. Greensboro and Walden have three and four stormwater permits respectively (Figure 8).

Table 9. Upper Lamoille municipalities with existing stormwater plans and suggested templates for towns without plans. Priority areas are highlighted in yellow.

Municipality with Urbanized Area/Rural Municipality	2008 Pop.	Listed for Water Quality Problems Due to Developed Land	DEC GIS SW Map	Existing Stormwater Ordinance	Suggested SW Master Planning Template	Status of SW Master Planning	Growth Center Category
Hardwick/ Hardwick Village	3,207		2011	No	1b	Mapping and IDDE completed for Hardwick Village	Hardwick Village Center
Greensboro	773		2016	Yes	3b		
Stannard	194			NA	3b		
Woodbury[1]	808			No	3b		

[1]Woodbury and South Woodbury Village Centers drain to the Winooski, although some town road drain to the Lamoille.

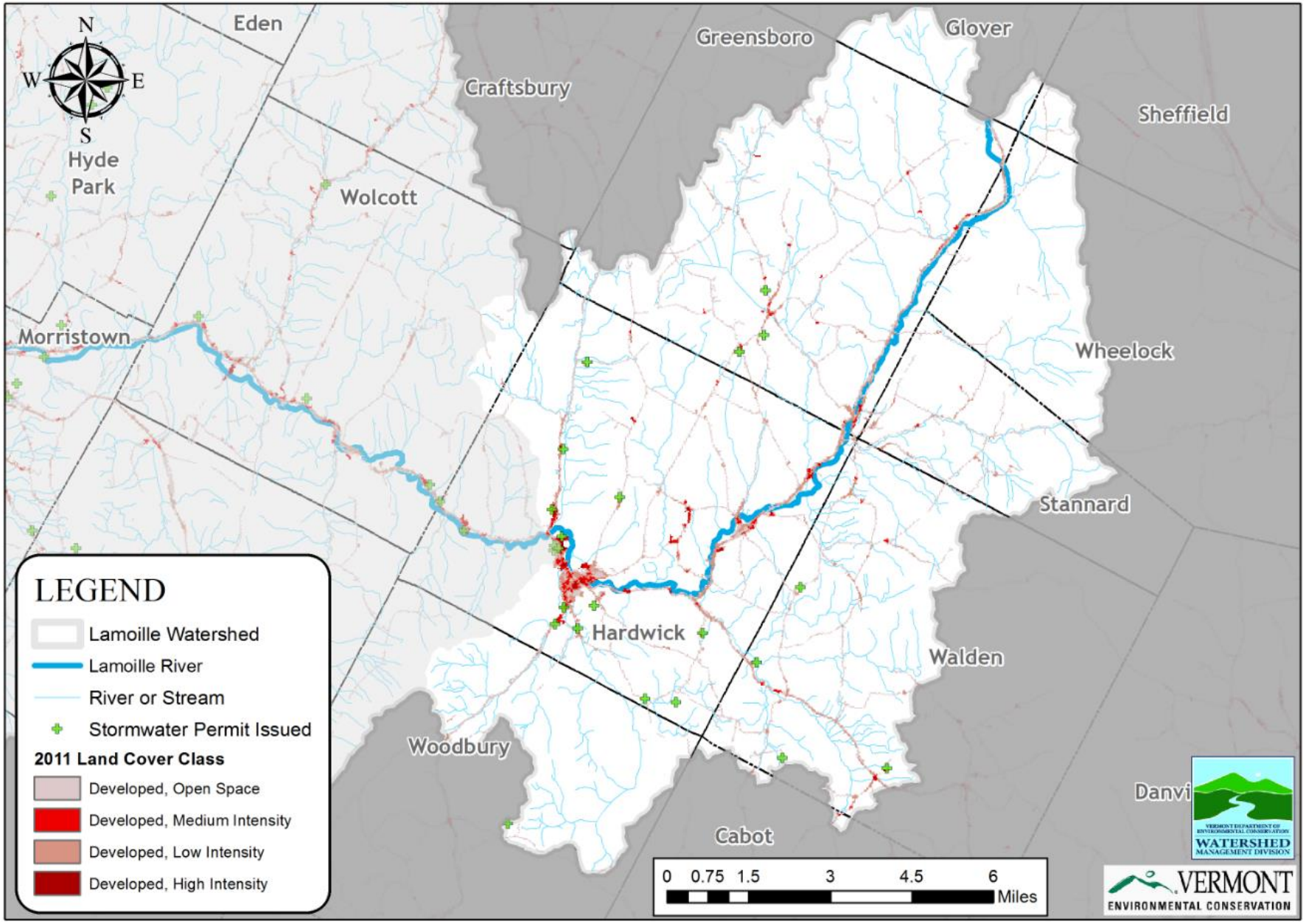


Figure 8. Developed lands and stormwater permits issued in the Upper Lamoille Watershed.

Middle Lamoille Recommendations

Stormwater master plans are recommended for eight towns in the Middle Lamoille Basin. Towns with the highest urban density and number of stormwater permits in the Middle Lamoille are Morristown (including Morrisville), Cambridge, Johnson, and Hyde Park (Figure 9). Four towns that have been identified as high priority are Hyde Park (including Hyde Park Village), Morristown (including Morrisville), Johnson (including the Village of Johnson) and Cambridge (including Cambridge Village, Jeffersonville, and Smugglers Notch Resort area) (Table 10). GSI is recommended in these areas for retrofits to stormwater treatment. In those communities with existing infrastructure along river corridors, vegetation along river banks should be re-established by working with willing property owners to convert lawns to vegetation that will help to capture surface water runoff and provide protection from soil erosion. Existing surface parking areas, recreation fields, and other locations may be regraded or lowered to provide for additional flood storage.

Morrisville is recommended to develop a comprehensive stormwater master plan for their downtown area. An additional area of stormwater concern and anticipated growth in Morristown is the zone around the Morrisville-Stowe Airport. A master plan for this area of development should be considered because of its location adjacent to Ryder Brook to ensure development that would not result further stress to Ryder Brook. Hyde Park is encouraged to continue with scoping and implementation of projects identified by stormwater mapping. As an accompaniment to the mapping, development of a stormwater master plan for Hyde Park is recommended to scope and develop budgets for each project previously identified. The remaining four towns in order of population size are Wolcott, Eden, Waterville, and Belvidere. The latter four towns would benefit from a regional or multi town approach with rural road focus.

Table 10. Middle Lamoille municipalities with existing stormwater plans and suggested templates for towns without plans. Priority areas are shown in highlighted in yellow.

Municipality with Urbanized Area/Rural Municipality	2008 Pop.	Listed for Water Quality Problems Due to Developed Land	DEC GIS SW Map	Existing Stormwater Ordinance	Suggested SW Master Planning Template	Status of SW Master Planning	Growth Center Category
Hyde Park/ Hyde Park Village/ North Hyde Park Village	3,299		2011	Yes; Requires local stormwater review for developments with 0.5-1.0 acres of new impervious surface	1a	Implementation Phase for Hyde Park Village	Hyde Park Village Center
Morristown/ Morrisville	5,561	Ryder Brook ***Stressed***	2011	Yes	1b	Completed for Wilkins Ravine watershed, need to cover	Morrisville Downtown

Municipality with Urbanized Area/Rural Municipality	2008 Pop.	Listed for Water Quality Problems Due to Developed Land	DEC GIS SW Map	Existing Stormwater Ordinance	Suggested SW Master Planning Template	Status of SW Master Planning	Growth Center Category
						impervious area not addressed	
Cambridge/ Cambridge Village/ Jeffersonville Village/ Smugglers Notch Ski Area	3,090	Tributary to Brewster River ***Impaired*** 303(d) List Part A	2011	Yes; encourages GSI and LID through its Subdivision regulations	2a		Jeffersonville Village Center/ Cambridge Village Center
Johnson/ Johnson Village	3,194		2011	No	2a		Johnson Village Center
Belvidere	286			No	3b		
Eden	1,120			NZ	3b		
Wolcott	1,714		2014	NA	3b		
Waterville	680			NZ	3b		Waterville Village Center

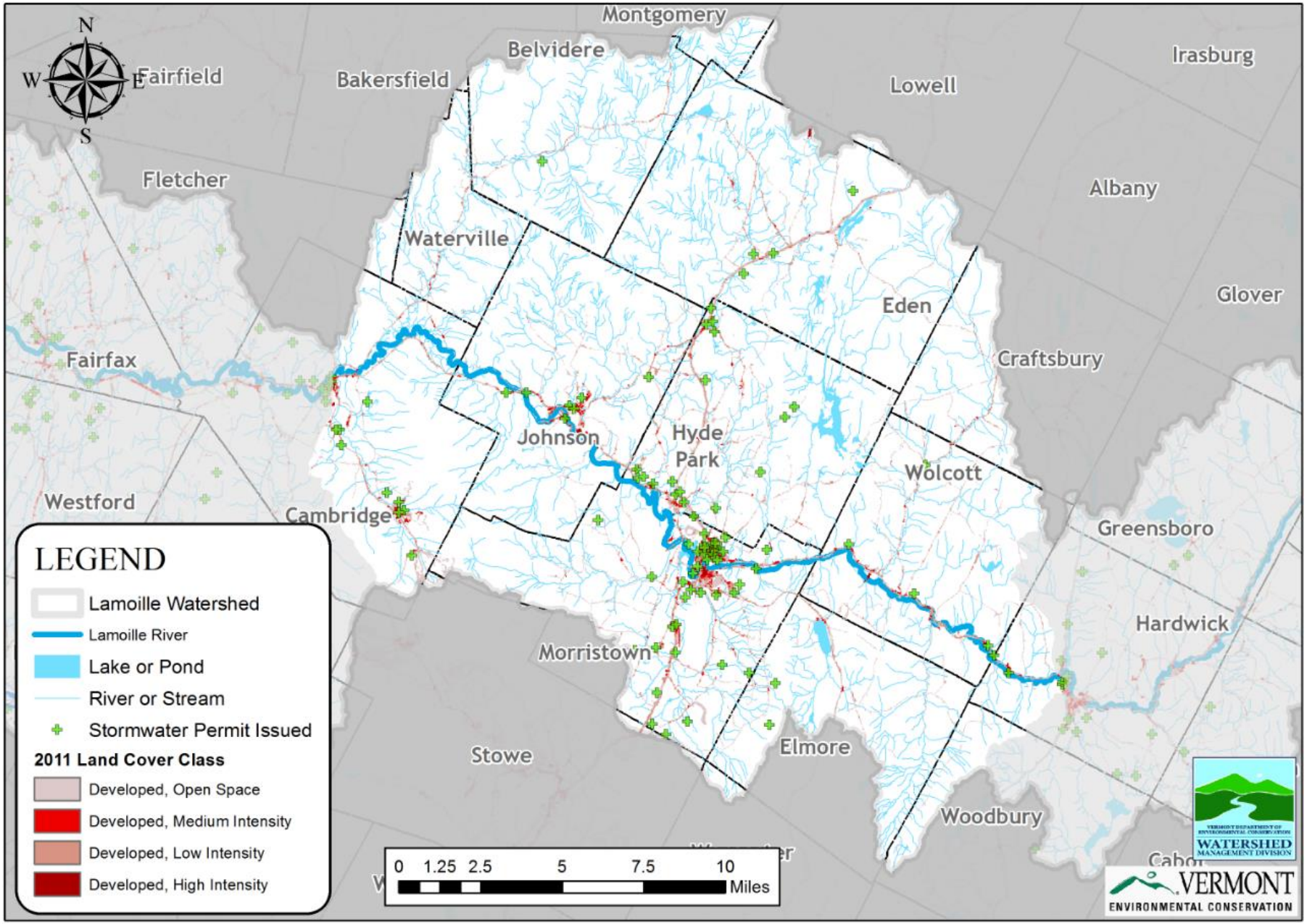


Figure 9. Developed lands and stormwater permits issued in the Middle Lamoille Watershed.

Lower Lamoille Recommendations

Towns with the highest number of stormwater permits and urban density, including paved roads and highways, in the Lower Lamoille are Milton, Georgia, Fairfax, and Jericho (Figure 10). Two areas in the Lower Lamoille watershed have the highest concentrations of stormwater permits. One area is concentrated around the impaired section of Deer Brook in Georgia and the other is in an area south of the Lamoille mainstem just downstream from Arrowhead Reservoir in Milton.

Stormwater master plans are recommended for six towns in the Lower Lamoille Basin. Three towns identified as high priority are Fairfax (including Fairfax Village), Jericho (including Jericho Village), and Underhill (including Underhill Flats Village) (Table 11). The remaining three towns in order of population size are Milton, Georgia (including Georgia South Village), and Fletcher. Georgia is encouraged to develop a comprehensive stormwater master plan follow-up with project scoping and design for the area discharging into Deer Brook, including disconnections to stormwater discharging into "Deer Brook Gully". Milton, which is considered a Municipal Separate Storm Sewer System (MS4) community, will continue to carry out the minimum control measures outlined in its Stormwater Management Plan and will, pursuant to new provisions of Act 64, develop a phosphorus control plan for lands within its MS4 area. The VTrans small MS4 includes state highways in the towns of Jericho and Underhill.

Table 11. Lower Lamoille municipalities with existing stormwater plans and suggested templates for towns without plans. Priority areas are highlighted in yellow.

Municipality with Urbanized Area/Rural Municipality	2008 Pop.	Listed for Water Quality Problems Due to Developed Land	DEC GIS SW Map	Existing Stormwater Ordinance	Suggested SW Master Planning Template	Status of SW Master Planning	Growth Center Category
Fairfax/ Fairfax Village	4,195		2011	NA	1b & 3b		Fairfax Village Center
Fletcher	1,301			NA	3b		
Georgia/ Georgia South Village	4,507	Deer Brook ***Impaired*** 303(d) list-Part A	2011	NA	3b	Complete for Georgia South Village	
Jericho/ Jericho Village	5,190	Browns River ***Stressed***	2011	Yes	2a	In progress	Jericho Corners Village Center/ Jericho Village Center
Underhill & Underhill Flats Village	3,082	Browns River ***Stressed***	2011	Yes	2a		
Milton	10,714		2004	NA	3c	Completed management plan for MS4 designated area	

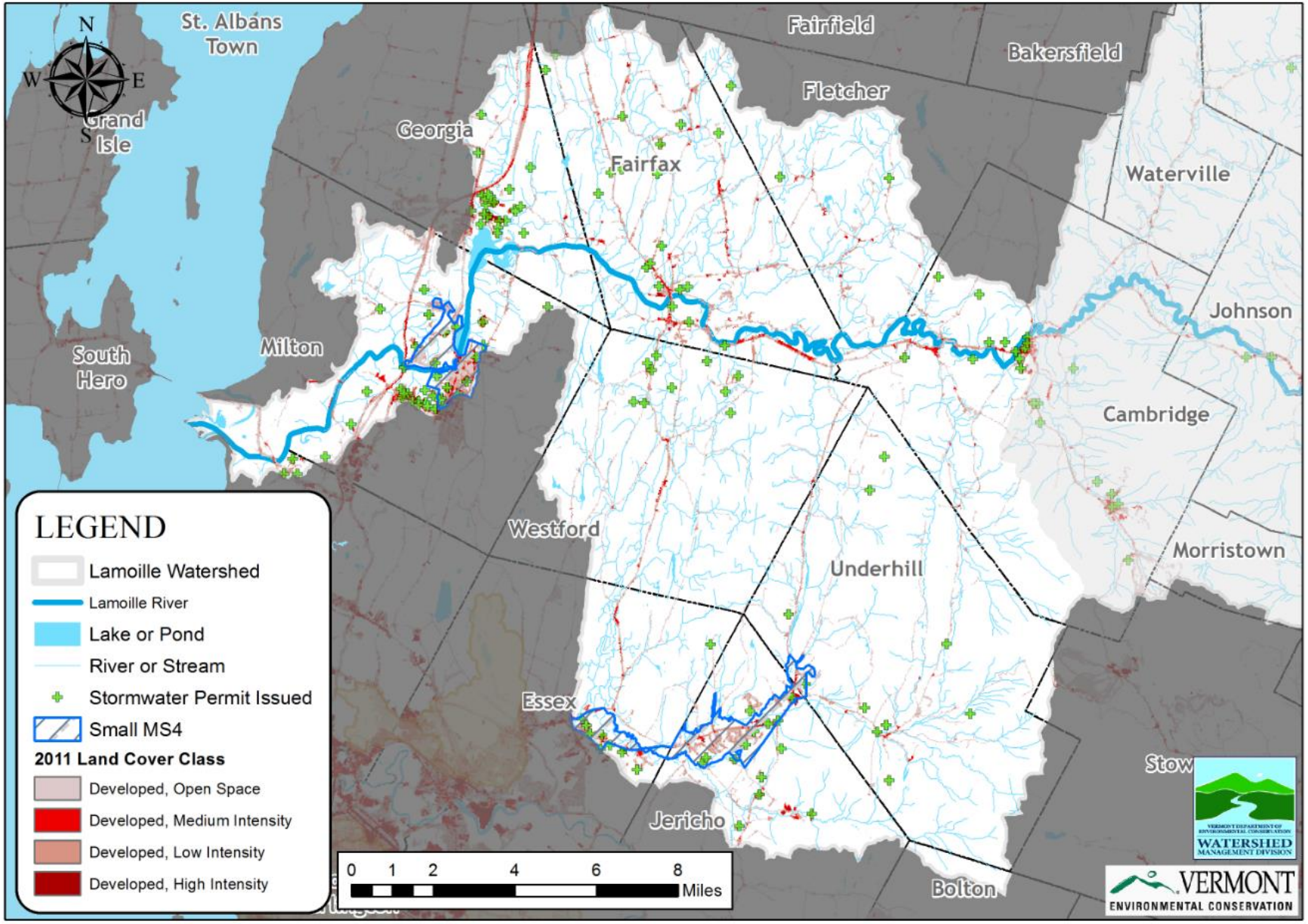


Figure 10. Developed lands, small municipal separate storm sewer systems (MS4) and stormwater permits issued in the Lower Lamoille Watershed.

Road Erosion Inventories

Act 64, the Vermont Clean Water Act, requires VDEC to develop a new Municipal Roads General Permit (MRGP). The MRGP will require all Vermont municipalities to conduct Road Erosion Inventories (REIs) for hydrologically-connected municipal road segments. An initial GIS determination of hydrologically-connected municipal road segments is available for all Vermont municipalities on the ANR Natural Resources Atlas.

Towns will also be required to develop Road Stormwater Management Plans for all hydrologically-connected road segments not meeting MRGP standards. Towns would then be required to implement the Road Stormwater Management Plans over a period of time defined by the MRGP. As of the writing of this document, VDEC is preparing the MRGP and related standards and requirements. The final MRGP will be developed by December 2017. See the Lake Champlain Phosphorus TMDL section for more information on the MRGP and priority catchments.

The implementation of the priorities identified in the REI's and Road Stormwater Management Plans will support the reduction of sediment, phosphorus pollutants and other contaminants generated from unpaved municipal roads that contribute to water quality degradation. VDEC is working collaboratively with VTrans, regional planning commissions, natural resources conservation districts, and other partners to provide municipalities with outreach, technical and financial assistance, and additional training to assist towns with the upcoming MRGP requirements.

Middle Lamoille Waters

The Lamoille County Planning Commission worked with eight municipalities to create road erosion inventories from 2011 to 2014. A total of 127 high priority projects were identified near surface waters (Table 12). The Commission is currently checking in with towns to determine those projects that are complete and those that need follow up. Some of the projects included designs and capital budgets with cost estimates, while others did not. This plan recommends that designs, capital budgets, and cost estimates be completed for high priority projects where towns are willing and able to implement.

Table 12. Road Erosion Inventories completed for the Middle Lamoille watershed.

Town	REI Completed	Year	# of High Priority Projects Identified
Eden	Y	2014	16
Elmore	Y	2013	14
Wolcott	Y	2013	9
Johnson	Y	2014	33
Hyde Park	Y	2011	12*
Morristown	N	n/a	n/a

Town	REI Completed	Year	# of High Priority Projects Identified
Belvidere	Y	2014	11
Cambridge	Y	2013	15
Waterville	Y	2014	17

* 7 projects completed and 3 planned for 2016 and new inventory planned.

VTrans Project Identification in the Lamoille Watershed

In 2016 the Environmental Program for the Maintenance and Operations Bureau of the Highway Division of VTrans set up site visits with each VTrans maintenance district within the Lamoille basin. VTrans Environmental Program staff identified all state routes within the watershed and asked each of the four districts in the Lamoille basin what erosion problems or washout problems they had on those routes. Data collected and documented included: problem description, duration of problem, potential solution, and cost of solution. This information was used to rank the projects. Because funds were limited, projects were selected based on the cost of the fix, benefits, and feasibility of completing the project. VTrans has documented the remaining projects and plans to have them incorporated into a larger project when funds become available or the timing is practical. Five of the sites that were identified and fixed this summer included bank erosion stabilization at river crossing structure inlets and outlets in Underhill, Wolcott, and Hyde Park.

F. Status and Management of Water Resources by Land Use

Landfills and Hazardous Waste Sites

The Waste Management and Prevention Division (WMPD) oversees the use, treatment and handling of hazardous and solid wastes. The Division performs emergency response for hazardous materials spills, issues permits for federal and state programs regulating hazardous wastes, solid wastes, and underground storage tanks, and manages cleanup at hazardous sites under state and federal authorities, including the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA, also known as Superfund).

Active sites in contact with surface waters that have been identified in the Lamoille River Basin are described in summary below with recommendations for follow-up. All landfills and hazardous waste sites can be viewed on the ANR Natural Resources Atlas. See appendix H for a list of sites in proximity of surface waters in the Lamoille Basin. More information on each site can be found in the 2016 Lamoille River Watershed Assessment Report and by using the Environmental Research Tool.

Middle Lamoille

Waterville VOC Site

A Supplemental Site Investigation Report and Corrective Action Feasibility Investigation (CAFI) was completed in January 2016 for the Waterville VOC site (#2014-4485) that encompasses three former gasoline locations in Waterville village near the North Branch Lamoille River. The report thoroughly details the various investigations to date of the site and all of the monitoring results so far.

Initial identification of a problem and investigation into it began in 2013. In July 2014, Environmental Compliance Service (ECS) inspected the banks of the North Branch of the Lamoille and found seven seeps along 100 feet of riverbank. Groundwater, soil, and surface water samples were all taken. Benzene was in the groundwater of all three seep locations well above the Vermont Groundwater Enforcement Standards (VGES). Trimethylbenzene and naphthalene were above the VGES at the upstream seep. The surface water sample near the upstream seep had benzene at 34.0 ug/liter (L) exceeding the Vermont Water Quality Standard for consumption of water and organisms of 1.2 ug/L.

The seeps were again inspected and sampled in December 2015. Surface water samples were also collected in December 2015 at three sites–the Church Street Bridge near a popular swimming hole, near the upstream seep, and further upstream on the North Branch. Benzene was found the in Near Upstream Seep surface water sample at 2.0 ug/L. No sheens were seen on the flowing surface water at the time of sampling (Environmental Compliance Services, Inc., 2016).

The CAFI recommends several remediation technologies to clean up the petroleum contaminants in the vicinity of the water supply distribution lines and the plume that is migrating towards the North Branch. The actions for remediation and monitoring identified in the CAFI should be followed. The WMPD will work with VDEC water quality scientists to ensure the surface waters of the North Branch are remediated.

Lamoille Landfill and Salvage Depot

The Lamoille Landfill and Salvage Center is located north of Route 15 and west of Garfield Road and Rodman Brook in Morristown. The landfill was closed in 1992. Groundwater and surface water monitoring for both organics and inorganics occurred in May and October each year from 1992 until 2010 and were reported to the landfill owner as well as VDEC.

Rodman Brook biological monitoring in recent years has shown a healthy macroinvertebrate community and declining levels of metals. The brook has been considered for de-listing from the impaired waters list in 2016.

However, a gully erosion and slope failure incident at the landfill in summer of 2015 led to exposed underlying waste, allowing waste constituents to be in contact with surface runoff, and increasing leachate generation through the waste mass into groundwater. On December 28, 2015, WMPD staff checked to confirm if the site was adequately stabilized because of the late fall repairs, but the site was not in compliance.

A Notice of Alleged Violation (NOAV) was issued and a site visit took place in January 2016 with VDEC staff, the engineer, the contractor, and the land owner. Temporary erosion control is being put into place with more permanent repairs being designed for spring. Permanent repairs have been required, but lack of funds has delayed implementation

It is not known what, if any, impact there has been to the biological community of Rodman Brook downstream of the landfill culvert. As a recommendation, biomonitoring in this location should continue and the damage to the site should be mitigated.

Vermont Asbestos Group (VAG) Mine

An excellent background and history of the VAG mine site is given in the Weston Solutions Sampling and Analysis Plan (Weston Solutions, Inc., 2015).

The 1500-acre VAG site with asbestos quarries and the associated tailings piles are found in both Lowell and Eden with part of the mine draining to the Missisquoi River watershed and part draining to the Lamoille River watershed (Hutchins Brook, Dark Branch, and Gihon River). The Eden Quarry and associated tailings pile, the oldest part of the mine, is estimated at more than 5 million tons and it is this area that is impairing streams and wetlands in the Lamoille watershed.

Following a complaint from a private individual to the VDEC Wetlands Program, Vermont Department of Health, VAG, and United States Geological Survey (USGS) began collecting data to look into environmental impacts and potential human health impacts in 2005. In 2007, VDEC and USGS collected water, tailing, sediment, and macroinvertebrate data. Also in 2007, the Environmental Protection Agency (EPA) began to control the tailings runoff in several areas by constructing berms and creating waterbars and diversion channels to keep runoff from reaching off-site streams and wetlands. That specific work was completed in 2008.

Funding for operations and maintenance, which includes cleaning sediment basins, checking erosion on the site, and insuring that warning signs and gates and other security is in place, comes from the G-1 Holdings Trust, the successor to the past owner/operator of the mine.

After a lengthy public discussion, voters in both Eden and Lowell voted against Superfund listing by a substantial majority at Town Meeting in March 2012. As a result, the Governor did not support the listing and the Superfund is not available to study, design, and implement remediation at this site. There are some experimental vegetation plots on the site but the focus of the efforts at the site are

primarily maintenance of erosion control practices put in by EPA. In spring of 2015 a Memorandum of Agreement (MOA) was signed by VANR and USFWS to coordinate natural resource damage restoration associated with the mine.

Wetland and stream monitoring off site will need to be done on a regular basis to document what is likely to be ongoing impact until the proper resources are brought to bear to stabilize and remediate the site. VANR and USFWS are starting the process to develop restoration projects based on the MOA.

Lower Lamoille

Milton Landfill

The Milton Landfill is a closed and capped unlined landfill located off Route 7 in Milton. A tributary to the Lamoille river (Trib #4) runs along the south and east side of the landfill and this tributary has been sampled over twenty years for landfill contaminants.

When landfills were first closed, a monitoring period of 20 years was used for budgeting and planning purposes, however, not intended as the cessation point of post-closure management of the landfills. In September 2013, the VDEC Waste Management & Prevention Division issued a letter requiring continued monitoring due to the continued presence of contaminants at levels of concern in groundwater monitoring samples. At the time of this plan, there was an October 2015 ground and surface water monitoring round done at the Milton Landfill by Waite-Heindel Environmental Management. Solar developers are working on a phase 1 for the capped area of the landfill and the landowner is continuing to monitor. The site has been added to Part A of the 2016 Priority Waters list as impaired for aquatic life use. Chemical and biological monitoring is looking better after addressing some stormwater work along an up-stream tributary to the stream which runs adjacent to the landfill. The monitoring site up from landfill is also showing elevated levels of metals indicating there may be multiple sources impacting the stream.

Water quality monitoring should continue at this site and a TMDL plan should be developed. Further investigation above the landfill should be done as well.

Basin-wide

A list of sites within 100 and 500-ft of surface water with land use restrictions are included in Appendix H at the end of this tactical basin plan.

Recommended Landfill and Hazardous Waste Site Focus

VDEC will continue to monitor, assess and remediate landfills, salvage yards and hazardous waste sites in the Lamoille Basin with ongoing stressors and impairments identified in tables 1-3. Towns are encouraged to work with the VT Hazardous Waste Program using the list in Appendix H to

assess the risk of surface water contamination to flood prone sites and develop plans for site remediation or flood protection. Additionally, each RPC in the watershed manages a brownfields programs, and may have funding available to assess and develop clean-up plans for these sites.

Dams and Flow-Altered Waters

There are approximately 47 active dams and 16 historical dams of different types, sizes, and condition in the Lamoille River Watershed (Figure 11). Of the 16 historical dams, nine have been breached and seven have been removed. Certain dams in the watershed provide renewable energy and recreational opportunities such as boating, fishing, and swimming, which can sometimes be at the expense of river-based recreation. In addition, impoundments can create unique wetland aquatic communities, although somewhat artificial since they are maintained by the presence of the dams. Dams can also impede streams' ability to transport flow and sediment; cause streambank erosion and flooding problems; degrade and alter fisheries habitat; create barriers to migratory fish passage; degrade water quality; and impede river-based recreational activity. A complete list of in-service dams, including active hydro-electric dams, in the watershed can be found in Appendix G.

The majority of the major dams in the watershed are along waters that are listed as Surface Waters Altered by Flow Regulation Part F on the List of Priority Waters (DEC 2016) or are considered stressed. The Part F sites and stressed waters are considered by the state to be priority waters for management action (Table 14). The goals for flow-altered waters are to:

- Eliminate or reduce artificial lake and pond water level fluctuations where unnecessary or not cost effective.
- Identify small dams for stream restoration projects through selective removal or retrofitting that restore fish passage, aquatic habitat, and natural stream functions.

From a regulatory standpoint, hydroelectric dams fall into two broad categories. The first consists of those that are regulated under the Federal Power Act which is administered by the Federal Energy Regulatory Commission (FERC). These facilities operate under a federal license or exemption that specifies flow and reservoir management, fish passage, recreational facilities, and other requirements. FERC is required to ensure a license or exemption will be incompliance with federal law and regulations, including the federal Clean Water Act. Under Section 401 of the Clean Water Act, the Department issues a water quality certification with conditions that need to meet Vermont Water Quality Standards. The surface waters impounded by and downstream of regulated hydroelectric facilities are designated as Class B2 for all uses pursuant to 10 V.S.A.1253 and the Water Quality Standards, and section 401 certifications are conditioned to ensure attainment of relevant management objectives. FERC cannot issue a license or exemption until the State has issued a water quality certification and FERC is required to include the conditions of the certification in the license or exemption.

The second category includes unlicensed facilities that are regulated by the State Public Service Board, rather than the federal government. The facilities are not under federal jurisdiction because they have not made significant changes in operations or generation capacity since the adoption of the Federal Power Act. Most of these facilities do not have conservation flow or reservoir management requirements. Hydroelectric facilities that are regulated by state statute are under 10 V.S.A. Chapter 43. In addition, 10 V.S.A. § 1003 authorizes VDEC to seek the cooperation of the owner of a dam if the regulation of stream flow appears contrary to the public interest. The surface waters impounded by and downstream of regulated hydroelectric facilities are designated as Class B2 for all uses pursuant to 10 V.S.A.1253, and the Water Quality Standards establish the relevant management objectives for these waters that are in the public interest. After conferring with the owner and other interested parties, the department may require the owner to change the way the dam is operated so that the public interest is protected.

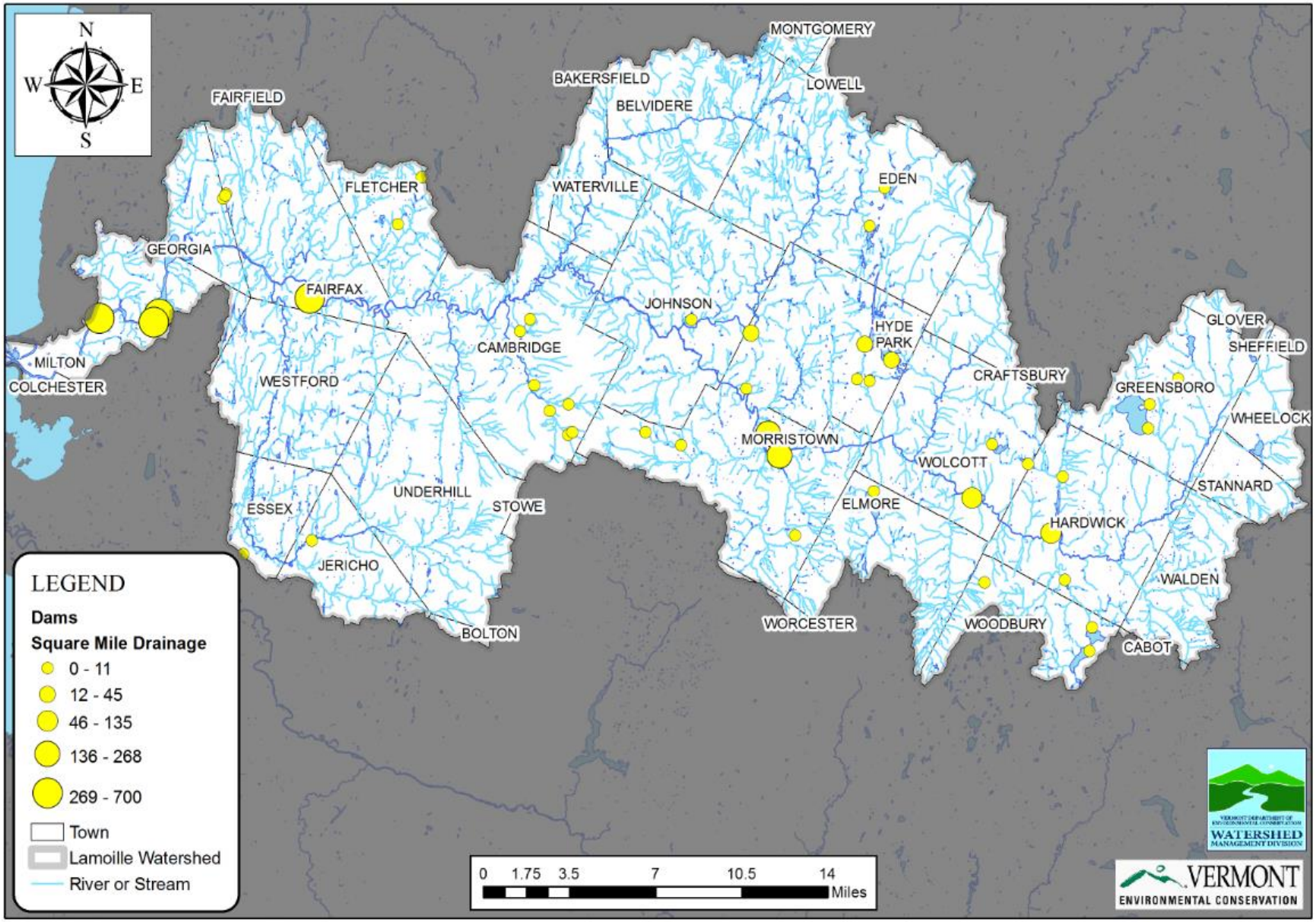


Figure 11. In-service dams of the Lamoille River Basin by drainage size (square miles).

2016 Update of Flow-altered Waters

The 2009 Lamoille basin plan provided a list of flow-altered waters in the basin including their current status and recommendations for increased water quality. Since 2009, five surface water segments - Nichols Brook, East Long Pond, Nichols Pond, Brewster River, and Sterling Brook - have been de-listed from the Priority List of Waters, and two - Caspian Lake and Tributary to Brewster River - have been improved but are still altered or stressed (Table 13). It is anticipated that four others will be de-listed as a result of the 401 certification for the 2015 Morrisville Water & Light FERC re-licensing. Sites that are de-listed may still be affected by stressors related to flow alteration.

Table 13. Updated list of waters that have been removed or down-graded from the 2014 flow-altered waters list or were previously listed as flow altered waters in the 2009 Lamoille Plan.

Water Segment and Location	Previous impacts	Current Status
UPPER LAMOILLE		
Nichols Brook- below dam on East Long Pond & Nichols Pond, Woodbury	Artificial flow regulation and condition at 2 dams	No longer fluctuating. De-listed.
East Long Pond, Woodbury	Water level fluctuation by hydro impairs aquatic habitat and endangered species	No longer fluctuating De-listed.
Nichols Pond, Woodbury	Water level fluctuation impairs aquatic habitat	No longer fluctuating De-listed.
Caspian Lake, Greensboro	Water level fluctuation has potential to impair fishery	This waterbody has been down-graded to "stressed" and is no longer on the flow-altered waters list.
MIDDLE LAMOILLE		
Brewster River, Cambridge	Artificial flow condition, insufficient flow below Smugglers Notch snowmaking water withdrawal	De-listed. Smugglers Notch Resort is still using two intakes on the River for snowmaking, but are incompliance with the Snowmaking Rule.
Sterling Brook, Cambridge	Artificial flow condition, insufficient flow below Smugglers Notch snowmaking water withdrawal	De-listed based on the condition that it meets the February Median Flow (FMF) standard.
Tributary to Brewster River, Cambridge	Artificial flow condition, insufficient flow below Smugglers Notch snow-making withdrawal.	Snow-making withdrawal in compliance with Snowmaking Rule. Drinking water withdrawal present.

Flow-Altered Waters in the Lamoille Basin

Fourteen segments of surface waters have been identified as flow-altered waters or waters stressed by flow alteration. The 2016 list of flow-altered waters can be found at: http://dec.vermont.gov/sites/dec/files/documents/WSMD_mapp_Part_F_2016_final_complete.pdf. The table below lists the flow-altered waters and waters stressed by flow alteration by major sub-basin and includes remediation recommendations (Table 14).

Table 14. Flow-altered waters in the Upper Lamoille River Basin.

Water Segment	Location	Flow Alteration	Remediation & comments
UPPER LAMOILLE			
Hardwick Lake *Flow-altered*	Hardwick	Water level fluctuation by hydro impairs aquatic habitat and wetlands	No longer managed for hydro, lake drained for fall/winter ice control. Town vote did not support removal of Jackson Dam in 2002. Complete alternatives analysis. Re-assess town support based on current conditions. See *Recommendations* section.
Caspian Lake *Stressed*	Greensboro	Water level fluctuation has potential to impair fishery	Down-graded to "stressed" waters since Hardwick electric stopped water level fluctuation. Issues with ice damage due to lack of draw-downs. Should evaluate best water level to maintain to have the least amount of impacts.
MIDDLE LAMOILLE			
Lamoille River above and below Hardwick Lake *Flow-altered*	Hardwick	Artificial flow regime down river. Possible fish passage problem (threat). Water level fluctuation impairs aquatic habitat and wetlands. This is an unlicensed facility not subject to FERC.	Town vote did not support removal of Jackson Dam in 2002. Town should consider an alternatives analysis. Re-assess town support based on current conditions. See *Recommendations* section.
Lamoille River below Pottersville Dam *Flow-altered*	Hardwick, Wolcott, Morristown	Artificial and poor flow regime downstream impairs aquatic habitat and increases erosion. Possible fish passage threat. This is an unlicensed facility not subject to FERC.	Pursue conservation flows through appropriate state regulatory processes and Hardwick Electric.
Lamoille River immediately below Cady Falls Dam *Flow-altered*	Morristown	Threat of fish passage problem at dam due to artificial dewatering of falls	Agency issued Section 401 water quality certification; FERC draft new license.

Water Segment	Location	Flow Alteration	Remediation & comments
Lamoille River below Morrisville Dam *Flow-altered*	Morristown	No flow in bypass impairs aesthetics, recreation, and habitat	Agency issued Section 401 water quality certification; FERC draft new license.
Lake Lamoille *Flow-altered*	Morristown	Water level fluctuation may impair aquatic habitat	Agency issued Section 401 water quality certification; FERC draft new license.
Mud Brook *Stressed*	Morristown	Stressed for iron impacting aesthetics and aquatic life support.	State owned dam and culvert. Assess opportunity for removal.
Lake Elmore *Flow-altered*	Elmore	Water level fluctuations impacting aquatic life support	Currently under review for FERC re-licensing
Elmore Pond Brook, from dam to 2.2 miles downstream *Flow-altered*	Elmore, Wolcott	Artificial flow regulation impacting all existing uses	Currently under review for FERC re-licensing
French Hill Brook	Johnson	Lack of flow to support habitat and aesthetics; a possible fish passage problem at water withdrawal point	Town of Johnson has developed a groundwater well for drinking water; assess dam removal
Unnamed tributary to Brewster River *Flow-altered*	Cambridge	Artificial flow condition, insufficient flow below Smugglers Notch drinking water withdrawal.	In compliance with the Snowmaking Rules. Pursue options for other sources for drinking water supply.
Green River, Downstream from Reservoir (1 mile) *Flow-altered*	Hyde Park	Artificial flow regime and condition by hydro operations alters aquatic habitat	Agency issued Section 401 water quality certification; FERC draft new license.
Green River Reservoir *Flow-altered*	Hyde Park	Water level fluctuation and winter drawdown alters aquatic habitat	Agency issued Section 401 water quality certification; FERC draft new license.

Recommendations

Hardwick Dam

The report, *Hardwick Lake Today and Tomorrow*, supported by the Northern Rivers Land Trust in partnership with Sterling College was published in 2013. The study was a result of the NRLT trustees conducting their first research study on the current status of the Hardwick dam and lake and

its possible future. The report can be found at: http://www.northernriverslandtrust.org/Final_Hardwick_Lake_Report_2013.pdf.

The July 2015 dam inspection by VANR states that the overall condition of the dam is poor due to deterioration of concrete. The report recommended that a professional engineer experienced in dam safety should be retained to assess the condition of the concrete and make a recommendation for repairs. The report also suggested, as an alternative to repairing the dam, that consideration should be given to the removal of the dam. Additionally, the owner of the dam is encouraged to consider an alternatives analysis in combination with the engineer review to look at a cost-benefit comparison for repair, removal, and changing the flow management of the dam. This analysis should take the 2013 report into consideration and look at recreational use impacts, fish and wildlife impacts, wetland impacts, and economic impacts of the three alternatives.

Wetlands in the Basin

Wetland Monitoring

The Wetlands Program of the Vermont Department of Environmental Conservation conducts detailed surveys on wetlands throughout the state, collecting data on plant species composition and cover, water chemistry, soils, and other factors. Wetlands in the Lamoille basin where this type of data was collected include a wetland in the Lamoille River WMA (2011), a wetland on Rogers Brook in Westford (2010), and Bear Swamp in Wolcott (2010). Further surveys are planned as part of the rotational basin monitoring schedule, with likely targets for more detailed survey including the Belvidere Bog wetland complex in Belvidere and Towne Swamp in Milton.

Wetland Restoration Efforts

The 2007 VT Agency of Natural Resources' Lake Champlain Basin Wetland Restoration Plan identified wetland restoration potential with phosphorus attenuation benefits throughout the basin, and found that the Lamoille sub-basin has a moderate number of opportunities. The plan identified over 350 potential restoration sites for a total of over 3,000 acres for restoration within the Lamoille basin. Within the basin the model identified a concentration of opportunity along the Brown's River in Essex. The 2007 Plan is being updated to include changes in land use and improvements in data layers (2016). To date restoration efforts have been focused outside of the Lamoille basin due to the lower density of opportunities, due to the higher property values, and due to the projected effectiveness of other phosphorus reduction activities available.

Recommendations

Due to their functions that protect water quality, in addition to the co-benefits for wildlife habitat, education, recreation, and flood protection, wetlands are a valuable asset to the people and wildlife of VT. All Class I and II wetlands are protected by the Vermont Wetlands Program. Towns can

further protect wetlands by adopting setbacks and zoning that would allow review of development plans for wetland impacts. In addition, towns or interested stakeholders can work to update wetland mapping to help the Wetlands Program to identify wetlands and protect water quality functions. All towns should consider mapping updates, but those towns with higher development pressures are considered priority. Some towns in other watersheds have carried out additional mapping to make their maps more accurate and protect sites that were not initially identified.

Those wetlands that provide water quality protection at the highest level are a priority for protection in the Lamoille River Basin. These wetland types include those that attenuate sediment, filter overland runoff from flooding and stormwater, support fisheries, and provide refuge for wetland dependent species. Identifying wetlands that provide the valuable service of water quality protection for local communities is an important step to ensuring the function of that wetland is not degraded over time. Wetlands that are exceptional or irreplaceable in their contribution to Vermont's natural heritage merit the highest level of protection. Towns can petition the state to reclassify Class II wetlands as Class I with support from their community if the wetland warrants further protection based on its functions and values. Five of these wetlands are identified in the Class I Wetland Designation section of this plan. This list is not exhaustive and towns and interested stakeholders are encouraged to bring forward additional sites that meet a high level of function for water storage, surface and groundwater protection, and aquatic habitat.

Forested Lands in the Basin

Logging and Forested Land

Forests limit erosion and the ability of water to transport sediment, nutrients and pollutants that can cause water quality problems when forest vegetation and organic debris on the forest floor slow and infiltrate surface water runoff and spread it out. Forested lands contribute the lowest amounts of nutrients, sediment and other pollutants into Vermont streams per acre compared to other land uses (Table 15). However, the land use unit area total phosphorus load per year does not take into account runoff from unstable wood roads connected to surface water or logging practices that do not follow the VT Acceptable Management Practices for water quality. Despite the ecosystem services forests provide, irresponsible

Table 15. Land use unit area load per year (Tetra Tech, Inc and US EPA, 2015).

Source	Total Phosphorus (kilograms/hectare/year)
	Mean
Back road	5.03
Farmstead	3.58
Pastureland	2.11
Cropland	1.40
Developed	1.17
Wetland	0.07
Forest	0.06 [1]

[1] The land use unit area total phosphorus load per year does not take into account runoff from unstable wood roads connected to surface waters or logging practices that do not follow the VT Acceptable Management Practices for water quality.

forestry practices can cause water quality problems. Because forestland makes up over 76% of land cover in the Basin, it is important that best management practices are followed when practicing forestry.

The major sources of non-point source pollution from forested lands are erosion from logging operations and associated roads and staging areas. Riparian areas are generally managed according to Acceptable Management Practices (AMPs) to protect surface waters from harmful discharges, but some riparian zones may deserve special treatment to protect riparian functions. The AMPs list buffers along streams and road construction guidelines among other practices that protect water quality, and provide protections under presumption of compliance for the landowner and logger. Landowners can play a large part in encouraging good silvicultural practices by working with a forester to develop a management plan and oversee forestry operations.

Importance of Forest Blocks

Forest blocks are areas of contiguous forest and other natural habitats, often spanning multiple ownerships and frequently unfragmented by roads, development, or agriculture (Figure 12). Vermont's forest blocks are primarily forests, but can also include wetlands, rivers and streams, lakes and ponds, cliffs, and rock outcrops. Forest blocks play an important role in protecting water quality, providing flood storage and flow management, and protecting habitat for fish and wildlife all the way to the bottom of the food chain. Forests provide shading to keep waters cool, and the soils and woody vegetation act as a carbon sink. Conservation of large forest blocks is particularly important in the Lamoille Basin, which is approximately 76 percent forested.

There are three main areas of large forest blocks in the Lamoille Basin: the Green Mountains from the Underhill side of Mount Mansfield north to Belvidere and Montgomery, the Worcester Mountain Range from Elmore north to Eden, and the headwaters east of the low elevation mountains in Walden, Stannard, Wheelock, and Sheffield including Stannard, Wheelock, and Ide Mountains. The largest blocks trend north to south in these three distinct areas providing protection to headwaters, intact riparian buffers, and significant aquatic and upland habitats (Figure 12). In order to protect large forest blocks, the State must support and work with private landowners to ensure AMPs are followed and pledge that state managed lands provide model examples of water quality protection.

Managing and Protecting Headwaters for Water Quality

Headwater streams make up a large proportion of the total length and watershed area of fluvial networks, and are partially characterized by the large volume of organic matter and invertebrate inputs from the riparian forest, relative to stream size. Much of those inputs are exported to downstream reaches through time where they potentially subsidize river communities (Wipfli, Richardson, & Naiman, 2007). Organic matter entering headwater systems consists of leaves, woody debris, detritus, and waste products of plants and animals. Microorganisms living in the stream use

this material for food, transforming the organic matter from an unusable form (inorganic carbon) into food for other organisms (organic carbon). This process is the basis of the food web in freshwater ecosystems (Freeman, Pringle, & Jackson, 2007). While each headwater stream is short and narrow, they collectively represent a majority of the drainage network of any watershed management unit. Consequently, it makes sense to focus on headwater streams in any watershed plan.

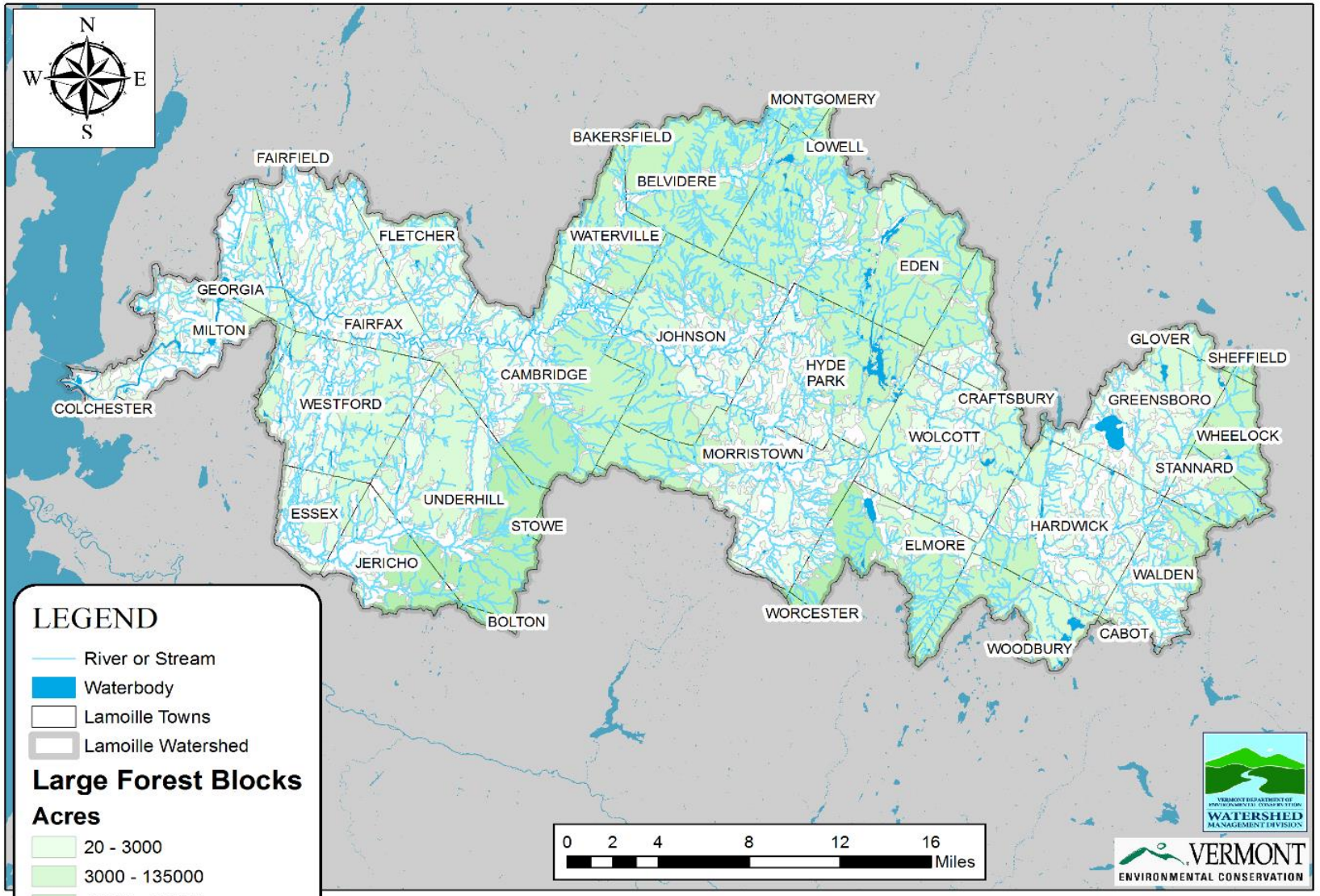


Figure 12. Large forest blocks in the Lamoille Basin.

Identifying and implementing priority conservation practices for forest landowners at the headwater stream level is important in watershed management for several reasons:

- Controlling soil erosion on logging trails
- Improving stream crossings
- Restoring forest riparian buffers along streams
- Stabilizing erosion-prone soils.

Addressing the Impacts of Forestry on Water Quality

There are four main ownership types in Vermont: private ownerships (including individuals and families, business and non-profits), state ownerships, federal ownership and municipal ownerships (Figure 13). VFPR recently released the 2015 Vermont Forest Fragmentation Report to the legislature. The report documented the importance of forests for clean water supply and flood protection, as well as climate change mitigation. Forest owners and managers in the public and private sectors should work to promote land conversion and manage their forests to protect water quality. There are currently many programs and objectives that have been identified by state and non-governmental organizations that provide support for better management for water quality. Some of those programs and objectives are described below.

Private and Public Lands Enrolled in Current Use

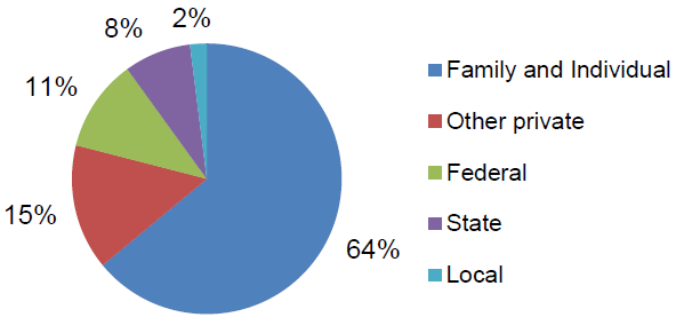


Figure 13. Ownership of forests in Vermont (Department of Forests, Parks and Recreation, 2015).

On parcels over 25-acres, landowners may be eligible to enroll forestland in Vermont's Use Value Appraisal Program (also known as Current Use). For forestland to be eligible it must be managed according to a 10-year forest management plan that provides for continued management for forest products which meets minimum plan and management standards and is approved by the Department of Forests Parks and Recreation (VFPR). Landowners with riparian areas and forested wetlands are encouraged to manage for protection of these sites during any forest management. The lands adjacent to streams, rivers, lakes, and ponds are specialized ecological areas that provide numerous functions, including protecting water quality and aquatic habitat, providing terrestrial wildlife travel corridors, supporting significant natural communities and adjacent wetlands, and protecting channel-forming processes and channel stability (VT Department of Forest, Parks and Recreation, 2010). Forested wetlands and riparian areas that are ecologically inappropriate for active timber management may qualify as Ecologically Significant Treatment Areas (ESTAs). ESTA acres are limited and must be part of a parcel containing actively managed forest areas.

Factors to consider in evaluating the need for and width of riparian ESTAs include existing condition of the riparian area, stream channel size and character, steepness of slope, characteristics of soil, nature of special aquatic habitats, presence of concentrated terrestrial wildlife use, presence of seeps or other wetlands, presence of floodplains or other rare to uncommon shoreline natural communities, and presence of streams requiring special protection for maintaining channel stability. A reasonable justification of the ecological need and recommended width of riparian ESTAs shall be provided to the County Forester. Appropriate riparian ESTAs are eligible for enrollment in Use Value Appraisal (UVA) Program based on County Forester approval. Landowners can also make a contract when hiring a logger stipulating certain protective practices to limit erosion.

VDEC is currently working with VFPR on a GIS mapping process for identifying potentially eligible riparian areas by evaluating sensitive riparian areas based on slope steepness, soil erodibility and location in relation to high quality waters and stressed or impaired streams. More information on the Use Value Appraisal Program can be found at: http://fpr.vermont.gov/forest/your_woods/use_value_appraisal.

Publicly Managed Forests

Lands managed by VFPR recently received a lift for riparian protection and flood resilience. In 2015 the Riparian Management Guidelines for Agency of Natural Resources Lands was released to recognize riparian areas for their important contribution to protect water quality, stream channel equilibrium, and aquatic and terrestrial habitats. The guidelines provide VANR land managers with strategies and considerations for the identification and management of riparian areas to protect, restore or enhance riparian area functions and values (Agency of Natural Resources, 2015).

In 2016, as a response to the flooding damage on VANR Lands from Hurricane Irene in 2011, the State Lands and Flood Resiliency blueprint was released. The report identifies that a legacy of old road networks with inadequate stream crossings and drainage, and other land use modifications exacerbates the inherent vulnerability of steep sloped forested headwaters and outlines strategies to address the legacy impacts.

Some of the strategies identified that benefit water quality are:

- Replacing failing or undersized structures,
- Minimizing development of new skid roads,
- Restoring old logging roads,
- Decommissioning problem roads,
- Utilizing green stormwater infrastructure on developed VANR lands,
- Restoring impacted stream corridors on state lands.

VFPR also maintains a database – LandManager – that will be used to document and report on watershed restoration and flood resilience accomplishments on state lands.

In addition to state owned forests, the Lamoille Basin also has locally owned forests in the form of woodlots, town forests, and natural areas. There are 22 locally owned forests in total: three are school forests, five are town conservation areas, twelve are town forests, and two are town watersheds. These forestlands cover over 2400 acres of land. In 2013, the Vermont Natural Resources Council (VNRC) produced Community Strategies for Vermont's Forests and Wildlife: A Guide for Local Action. This guide gives local communities both regulatory and non-regulatory tools to take local action to protect forests for current and future generations. Towns should utilize this guide to help them determine where important forests for water quality benefits should be protected and how to do it.

As an example, LCPC produced forest resource maps for the entire Lamoille County that identify forest blocks, forest resource constraints, forest stewardship potential, and water resources among others. This information can be used for town planning and by conservation commissions to target protection of forest water resources. For instance, the town of Jericho, with help from VFWD, has categorized priority conservation areas in their town. As part of their town planning process and land conservation efforts, all towns in the Lamoille basin should develop maps to identify priority forest areas in relation to water quality with help from regional planning commissions and VNRC's manual.

Privately Managed Forests

Privately managed forests make up the majority of forest ownership in the Lamoille basin. Some privately owned forests are under the Current Use program, while others are not. It is the responsibility of those enrolled in Current Use to ensure they are meeting the standards for forestry AMPs. Those not enrolled in Current Use are not required to apply the AMPs, however, they are not allowed to discharge into surface waters. Application of AMPs is encouraged on all actively managed forests. Private landowners can work with their county foresters, AMP foresters, or consulting foresters if they have questions about AMP requirements. In addition, outreach to the landowners, foresters, and loggers who utilize the land is vital. VFPR has a Watershed Forester who trains technical staff in the field to provide this information. All of these stakeholders play important and distinct roles in demonstrating and spreading awareness of practices supportive of forestry which results in water quality protection.

This year Cold Hollow to Canada teamed up with UVM and Bear Creek Environmental with funds from the Ecosystem Restoration Program grants to use light detection and ranging data, otherwise known as LiDAR data, to look at potential sources of sediment coming off of forest roads and into surface waters in Franklin County (Butler, 2016). Results from this project will help inform how this information and technique can be used across other watersheds, such as the Lamoille.

The State of Vermont received funding from the USDA Natural Resources Conservation Service (NRCS) through the new Regional Conservation Partnership Program (RCPP). The $16 million grant will help agricultural producers and private forest landowners in the Lake Champlain Basin invest in conservation practices to protect and improve water quality. Forest conservation practices for forest landowners funded through RCPP include: controlling soil erosion on logging trails; improving stream crossings; restoring forest riparian buffers along streams; and stabilizing erosion-prone soils. Contact information for financial assistance can be found at: http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Forest_Management/Library/RCPP%20Handout.pdf.

Portable Skidder Bridges Program

Portable skidder bridges are now widely accepted as a best management practice for controlling non-point source pollution associated with timber harvesting operations. When properly installed, used, and removed, skidder bridges minimize stream bank and stream bed disturbance as compared with alternative devices, such as culverts or poled fords. 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 AMPs for Maintaining Water Quality on Logging Jobs in Vermont (VT Department of Forests, Parks and Recreation, 2016).

The Department of Forests, Parks and Recreation is promoting and demonstrating the use of portable bridge designs on timber harvesting operations throughout Vermont. Loggers have the opportunity to use portable skidder bridges by participating in the Portable Skidder Bridge Rental Program.

Tables 16 and 17 show the 2015 summary of portable skidder bridge rental activities in the Lamoille and a summary from the inception of the rental program starting in 2008 to present. Thanks to an Ecosystem Restoration Program grant from Vermont Association of Conservation Districts (VACD), VFPR has been able to increase capacity statewide for this program. Through this grant coordinated by the Lamoille County Conservation District manager Kim Jensen, the conservation districts were able to get programs started for Essex and Poultney/Mettowee with two new bridge staging areas. The Winooski District also added a third staging area at Cyr Lumber in Milton.

Table 16. 2015 portable skidder bridge program accomplishments for Lamoille Watershed Conservation Districts and VT.

District	Number of Bridges	Number of Rentals
Winooski	3	4
Orleans	2	3
***Caledonia**	2	4
Lamoille	3	1
Watershed Districts Totals	**10**	**12**

Vermont Totals	**20**	**21**

*Caledonia currently has no bridges in their rental pool. One bridge was sold in early 2016 and two other bridges were taken out of service due to excessive wear and tear/old age.

Table 17. Portable skidder bridge rental program data from 2008 to 2015. Use of skidder bridges rented has tripled since 2008.

Indicator of Success	2008	2009	2010	2011	2012	2013	2014	2015
Number of Conservation Districts offering a rental option	2	5	5	9	9	10	10	12
Number of portable skidder bridges in the rental pool	6	14	15	23	24	19	16	20
Number of bridges rented	7	11	14	18	25	26	26	21

Recommendations

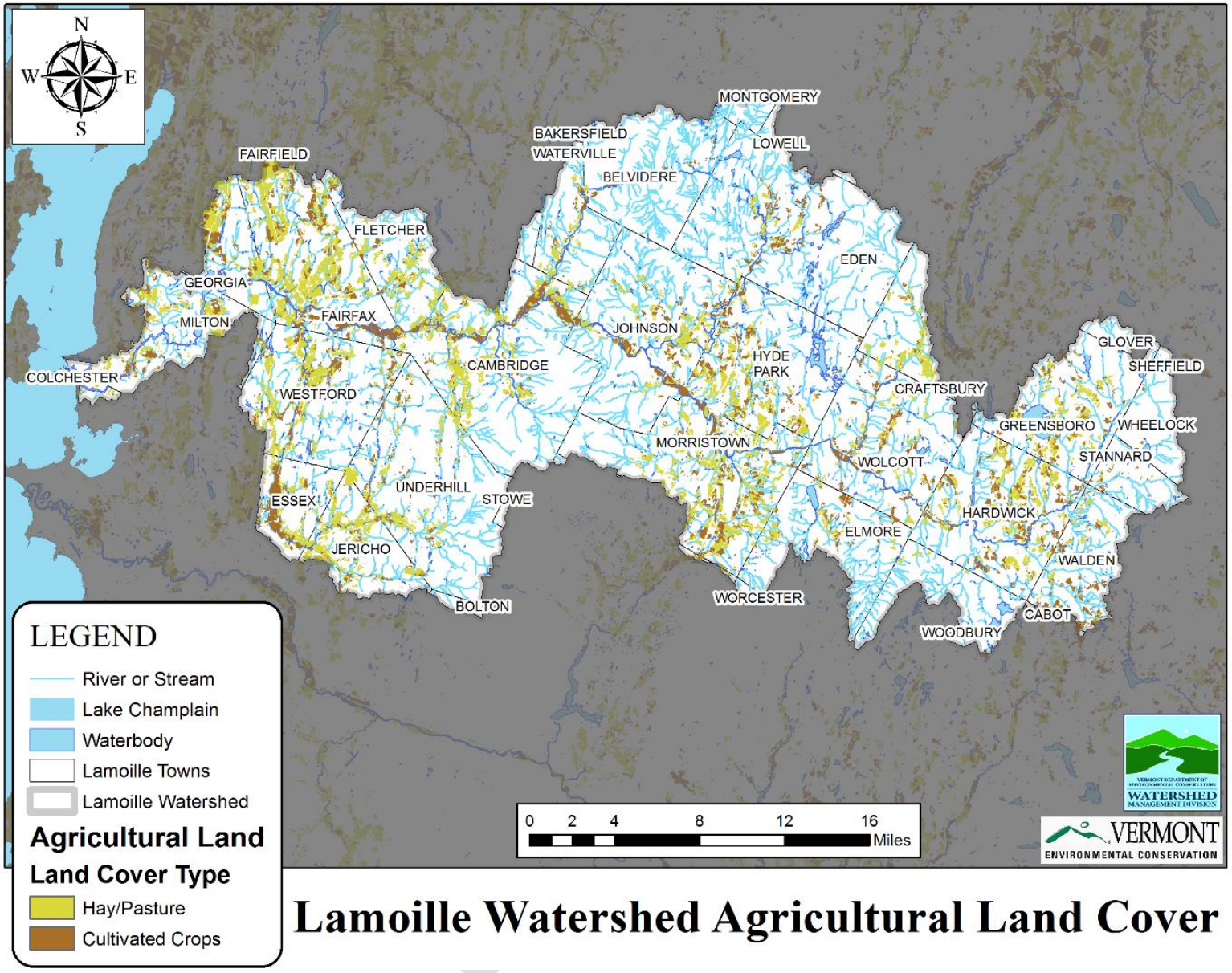
Protect large forest blocks, especially in headwaters, and core habitat within the Lamoille basin and identify riparian areas in close proximity to surface waters sensitive to logging practice to share with land managers, county foresters, and stewardship foresters. Inventory logging roads based on the Class 4 road template and identify high priority logging road sites for restoration and repair. Encourage and support responsible stewardship by private land owners by extending outreach to private landowners about RCPP funding for water quality improvements and identify high priority projects on private lands in the Lamoille Basin using the technique from the Cold Hollow Study, if successful at identifying priority sites for mitigation. Keeping forestry viable in the Lamoille Basin will help to prevent conversion to other land uses that may contribute more runoff and phosphorous to the environment.

Agriculture

Although only 13 percent of the Lamoille basin consists of agricultural land (Figure 14), more than 30 percent of phosphorus loading (kilograms/year) to Lake Champlain from the Lamoille watershed is attributed to this land surface (Figure 15). In addition, the second highest phosphorus loading per hectare is associated with this land-use, making agricultural lands a high priority for action for the Lake Champlain phosphorus TMDL (see section Lake Champlain Phosphorus TMDL for more detail). For example, cropland, pastureland, and farmstead have a mean contribution of 7.09 kg/ha/yr, while forests, which make up over 70 percent of the land cover in the Lamoille basin have a mean contribution of 0.06 kg/ha/yr. It's important to note that the 0.06 kg/ha/yr from forests is based on natural loads and does not take into consideration inadequate logging infrastructure such as undersized culverts, eroding roads, and discharge from logging practices.

In the Lamoille Basin, river valley bottoms are associated with agriculture because of the rich soils and fine sediments the rivers have deposited over thousands of years since the retreat of the last

glacier. In some areas of the Lamoille, the rich farming soils are a result of the deposition of Lake Vermont and the Champlain Sea long before the first European settlers laid down their roots. It is no coincidence that farming is so closely tied with water quality. Patterns of farming from the last century have led to the challenges the people of Vermont face with phosphorus pollution today. Farmers were once encouraged to ship in and spread large amounts of phosphorus and nitrogen fertilizers on their fields, install miles of ditches and tile drains to dry up wetlands, and control and straighten stream channels.



Lamoille Watershed Agricultural Land Cover

Figure 14. Agricultural land use in the Lamoille watershed.

As the years passed and the science of agriculture and the environment evolved, humankind came to the realization that some of the practices promoted by educational, governmental, and familial institutions have had a deleterious effect on surface waters worldwide. In addition to phosphorus, bacteria that lives in animal feces (such as E. coli) can pollute streams and rivers, making them unsafe for swimming and recreation. Economic pressures on farmers to clear riparian buffers and extend cropland lead to river channel erosion, soil loss, habitat alteration, and surface water temperature increases that impact habitat for aquatic organisms, mammals, amphibians and reptiles. As a result of these impacts, a well-planned and well-rounded solution is needed for long-term viability for farms and water quality health.

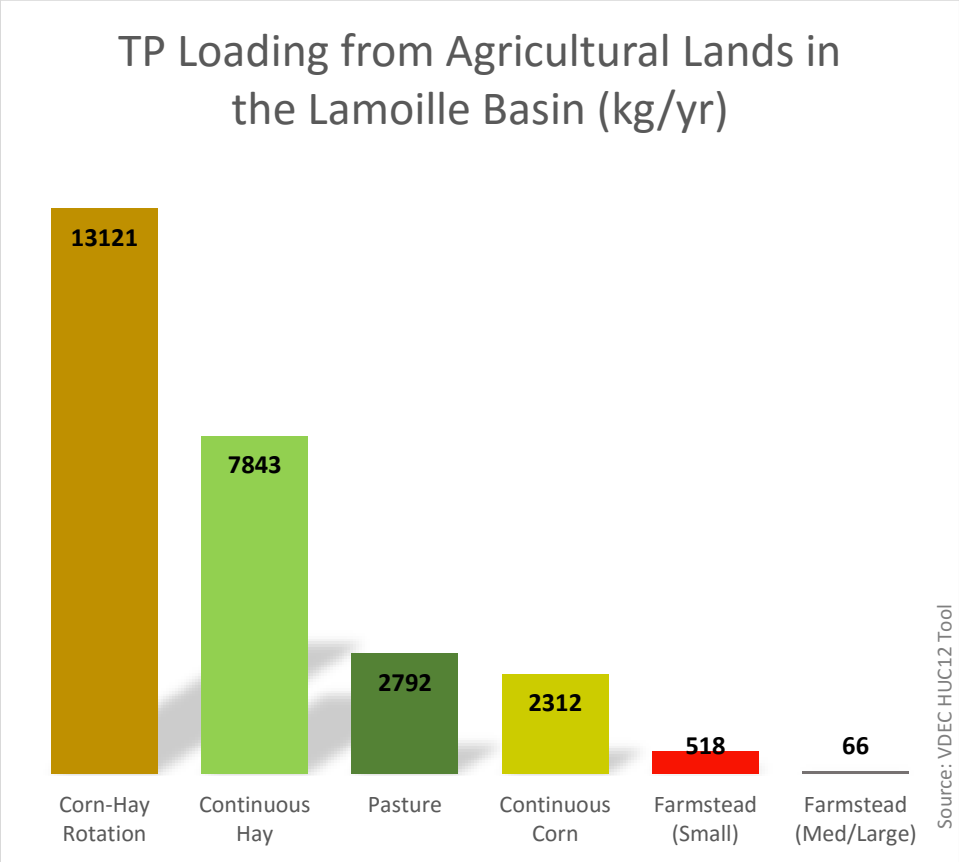


Figure 15. Total annual total phosphorus loading from agricultural lands in the Lamoille River watershed.

Required Agricultural Practices (RAPs)

By the end of 2016 the VAAFM Required Agricultural Practices (RAPs) should be finalized. As a result of Act 64—the Vermont Clean Water Act—signed into law in June 2015, the Agency of Agriculture was tasked with updating the Accepted Agricultural Practices (AAPs) to further reduce the impact of agriculture on water quality across the state. The RAPs are an updated version of the AAPs, the rules in place since 1995 which regulate farms in order to protect water quality, re-written to a higher level of performance (Agency of Agriculture Food & Markets, 2016). These practices, if applied on all eligible farms, is expected to improve water quality throughout the state.

Regional Conservation Partnership Program (RCPP)

Through RCPP, the Vermont Natural Resource Conservation Service (NRCS) and state, local and regional partners coordinate resources to help producers install and maintain conservation activities in selected project areas. Partners leverage RCPP funding in project areas and report on the benefits achieved. The Vermont Association of Conservation Districts (VACD) recently received funding from the Regional Conservation Partnership Program (RCPP) to - in cooperation with 14 Natural Resource Districts, UVM Extension and NRCS - assist small farm operators in the development of nutrient management plans (NMPs). The purpose of the program is to improve water quality by reducing phosphorus and other nutrient loading from small livestock farm operations in the Lake Champlain Basin and beyond (VT Association of Conservation Districts, 2015).

Lamoille Basin Agricultural Priority Areas

Below is a list of watersheds (by HUC12 and catchments ID) in the Lamoille basin that have exhibited stressors or impairments associated with agriculture. The watershed priorities are based information from the 2016 List of Priority Waters, Stream Geomorphic Assessments, environmental modeling, and field reconnaissance. They are listed in order of importance for evaluation:

1. Seymour River - Lamoille River (041504050304)
2. Lower Lamoille (041504050306)
3. Stones Brook - Lamoille River (041504050305)
4. Browns River (041504050202)
5. Centerville Brook - Hyde Park (4586404)
6. Lower section of the Gihon - Johnson and Hyde Park (4586314)
7. Porter and Bailey Brook - Hardwick (4586560 & 4586568)
8. Headwaters of the Browns – Underhill (4586602)
9. Middle Wild Branch – Craftsbury (4586342)
10. Perkins Meadow Brook and Haynesville Brook - Walden (4587514)
11. Mainstem of Lamoille – Hyde Park, Morristown, & Johnson (4586372 & 4586410)

Maps for these priority HUC12s and catchments are found in the Lake Champlain Phosphorus TMDL section of the plan.

Future Assessment Goals

The USDA's NRCS has developed plans in the Rock and Pike river watershed in the Missisquoi Basin that take a strategic approach to prioritizing water quality work over the next five years. The planning process included VDEC as well as other partners to assist in developing strategies to ensure effective and measurable conservation. The goal of the plan is to allocate resources to the most critical areas. As a result, increased Environmental Quality Incentives Program (EQIP) funding

will be strategically directed to critical areas with the help of case managers who will work one-on-one with farmers in these watersheds. Five Erosion and Runoff Potential Areas (ERPs) have been identified in the Lamoille River Basin by the Natural Resource Conservation Service for future assessment, .

Chapter 3 – Regulatory Programs for Addressing Stressors and Pollutants

Regulatory programs play a significant role in ensuring that pollutants and stressors responsible for degraded water quality are addressed. The VANR's and the Agency of Agricultural, Food and Markets' regulatory programs that are associated with water resource protection are described Vermont Surface Water Management Strategy - Appendix A .

The passing of Act 64 in 2015, resulted in the creation of the State's Clean Water Initiative Program (CWIP). The CWIP has provided additional resources and direction to the Tactical Basin planning process for Basin 7 with regard to sediment and phosphorus reduction. The goal of this Initiative is to satisfy the State's legal obligations under both the Vermont Clean Water Act and the federal Clean Water Act. The priorities to achieve this goal include:

1. Implementing agricultural best management practices
2. Reducing and treating stormwater runoff and erosion from developed lands
3. Installing pollution controls on state and municipal roads
4. Restoring and protecting natural infrastructure for flood resiliency and water quality improvements
5. Increasing investments in municipal wastewater treatment infrastructure

The CWIP also strengthens the relationship between VANR and the Regional Planning Commissions, Vermont League of Cities and Towns, and municipalities to strategically identify projects for the Tactical Basin Plans to address the above priorities.

The regulatory processes that will support the priorities include the development of the following permits or regulations:

Regulatory Program or Permit	Application	Issuance Date	Regulated Community
Required Agricultural Practices (RAPs)	Adopt and implement a set of minimum conservation practices to protect water quality	2016	Agricultural operations
Municipal Roads General Permit (MRGP)	Inventory and control stormwater discharges from municipal roads	2017	Municipalities

Regulatory Program or Permit	Application	Issuance Date	Regulated Community
Municipal Separate Sewer System (MS4) General Permit	Restore stormwater-impaired streams	2017 (Re-issuance)	12 MS4 communities
Operational Three-Acre Permit	Inventory and control stormwater discharges on sites where impervious surfaces exceed 3 acres	2017	Municipalities and Private Land Owners
Transportation Separate Storm Sewer System (TS4) Permit	Inventory and control stormwater discharges from the transportation network and associated transportation facilities	2016	State transportation

See VDEC's Clean Water Initiative webpage for additional information, including timing for permit enactment. The new as well as existing regulations will be an important tool for ensuring that Vermont water quality standards are met. While the implementation table of this plan includes numerous actions that will be implemented on a voluntary basis, actions will also help to facilitate adoption of permit requirements and provide municipalities and landowners with incentives to develop and implement required management plans under the new permits.

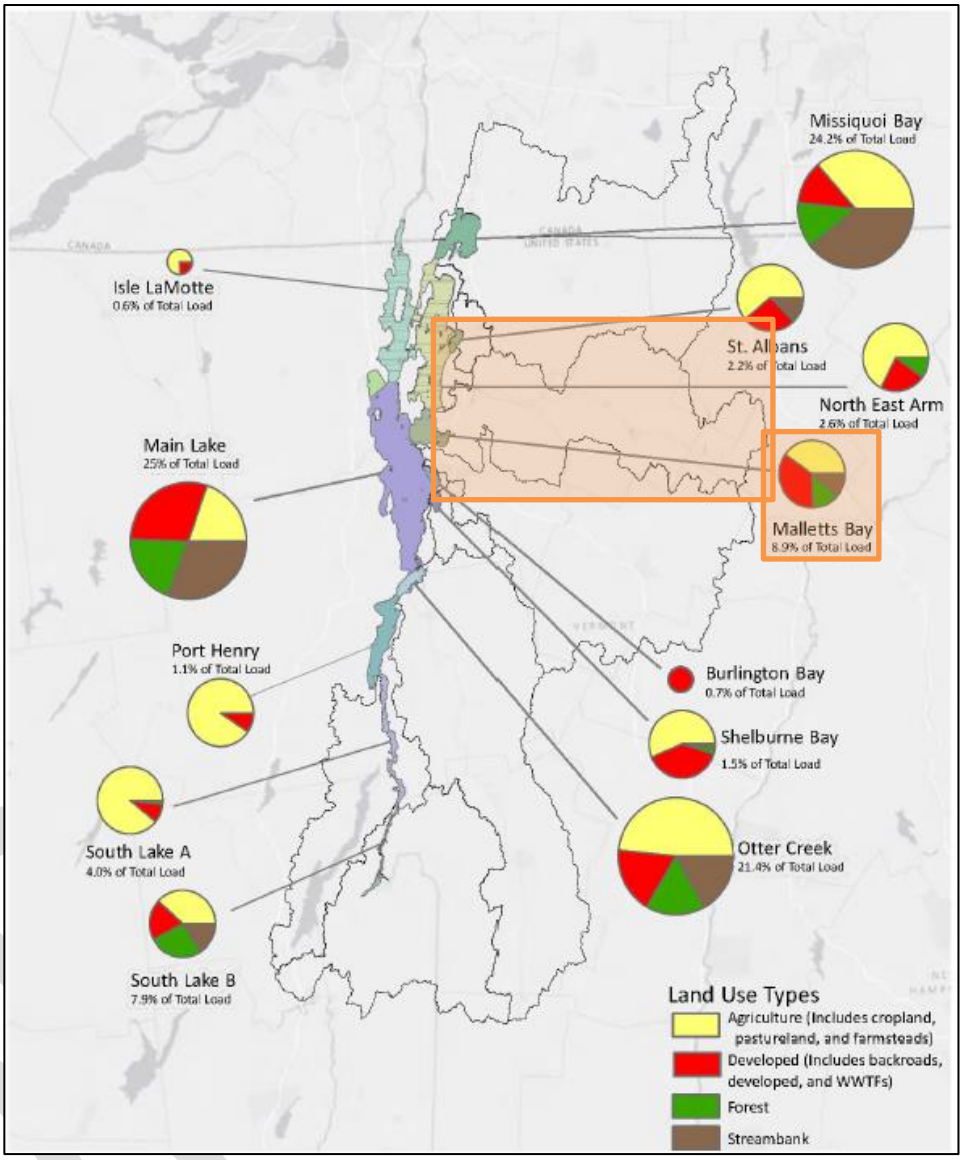
Lake Champlain Phosphorus TMDL

The Basics

A total maximum daily load or TMDL is the amount of a pollutant a waterbody can safely absorb and still meet water quality standards. The maximum pollutant load is divided among the various pollutant sources and locations. In the case of Lake Champlain, there are proposed TMDLs outlining the phosphorus reductions for each of the twelve lake segments required to restore the Lake and meet Vermont's Water Quality Standards. The Lamoille watershed inputs into the Mallets Bay lake segment.

In 2002, the U.S. Environmental Protection Agency (EPA) approved a Lake Champlain Phosphorus TMDL that was prepared by the States of Vermont and New York. In 2011, the EPA concluded that two elements of the TMDL did not comply with EPA regulations and guidance, and thus their approval of the 2002 TMDL was withdrawn. The EPA approved the Vermont Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan in September 2016 and the State of Vermont is finalizing a new aggressive restoration plan for Lake Champlain and its tributaries. The approved proposal addresses all major sources of phosphorus to Lake Champlain and involve new and increased efforts from nearly every sector of society, including state government, municipalities, farmers, developers, and homeowners.

Phosphorus in the Lake comes primarily from nonpoint sources (Figure 16). Nonpoint sources deliver phosphorus from the land to our waterways by rain or snowmelt. Nonpoint sources of phosphorus come from roads, parking lots, lawns, agricultural and logging operations, and eroding stream channels. Point source discharges of phosphorus include regulated stormwater discharges and sewage treatment plants.



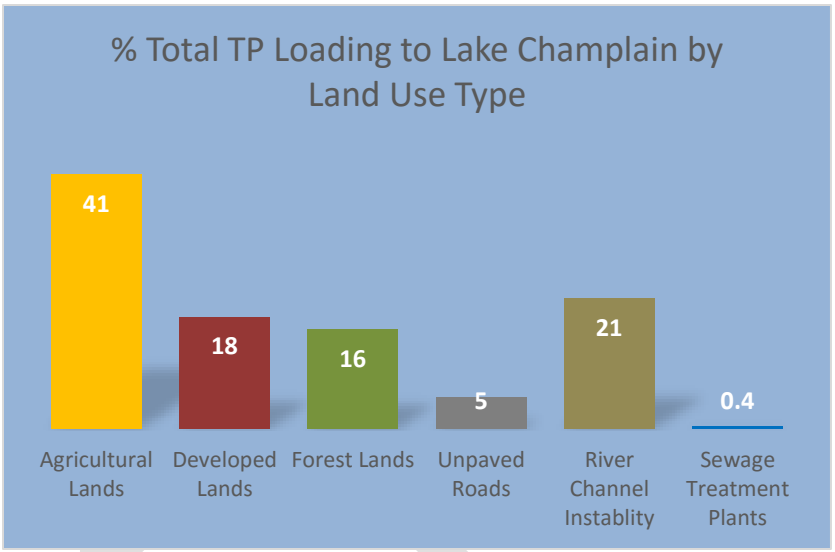
Source: US Environmental Protection Agency, 2016.

Figure 16. Vermont sources of phosphorus loading to Lake Champlain segments, by land use; annual average of 2001-2010 .
The Lamoille Basin and Mallets Bay are highlighted.

Measuring the phosphorus content of water that comes out of a pipe (point source) is less complicated than measuring phosphorus content of water flowing over land surfaces (non-point source). As a result, determining phosphorus loading of non-point sources requires environmental modeling based on long-term field measurements and land use information from satellite imagery and LiDAR data. More information on how phosphorus loading was projected in the Lake Champlain Basin can be found in Chapter 5 of the Phosphorus TMDLs for Vermont Segments of Lake Champlain.

Phosphorus pollution in the Lamoille River ultimately ends up in Lake Champlain, but the sources of pollution by land use type are slightly different within the Lamoille Basin compared to the entire Lake Champlain watershed (Figures 17 & 18).

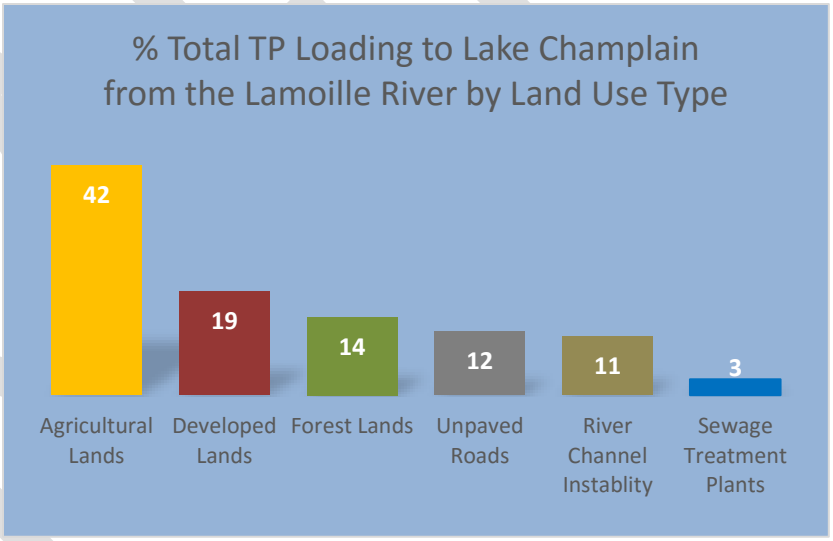
Agricultural lands are the largest source of phosphorus to the Lamoille River followed by developed lands, forest lands, unpaved roads, and river channel instability (which includes eroding and non-eroding banks). Forest lands, river channel instability and sewage treatment plants are similar in that they contribute approximately one-third or less the phosphorus input of agricultural lands.



Source: U.S. Environmental Protection Agency, 2016

Figure 17. Sources of phosphorus in Lake Champlain by land use type.

Understanding the relationship between phosphorus and land use is important because phosphorus pollution is a significant threat to clean water in the Lamoille Basin and Lake Champlain, which are both important for recreational and drinking water uses, as well as aquatic life and habitat function. Addressing phosphorus pollution through actions on the landscape will also lead to reductions in other pollutants in the watershed.



Source: Tetra Tech, Inc. and US EPA, 2015

Figure 18. Sources of phosphorus in the Lamoille Basin by land use type.

Investments in a clean Lake Champlain will support local and regional economies, enhance tourism and recreation-based businesses, support property values, help local communities reduce future flood damage risk, support the viability of public infrastructure, and improve the ecological functions within the watershed.

The Lamoille Tactical Basin Plan will report actions to reduce phosphorus loading per land use type in sub-watersheds and catchments within the basin. However, the reduction of phosphorus to Lake Champlain could take decades in some areas. Accomplishing all the necessary phosphorus reduction actions on the land that drains to the Lake will require many phases of action. Progress will be tracked incrementally through internal tracking systems and a portion of the progress will be tracked in the tactical basin plan implementation table database, which is an electronic extension of the implementation tables included in past tactical basin plans.

The Lamoille Watershed and the Lake Champlain Phosphorus TMDL

As discussed in the previous chapter, the Lamoille basin drains into the Mallets Bay lake segment of Lake Champlain (Figure 19). The Mallets Bay lake segment (number 9 in Figure 19) is fed by the Lamoille River and four direct drainages. These drainages include: Indian Brook, Pond Brook, Mallets Creek, and Allen Brook. The latter drainages are part of Basin 5 or the Northern Lake Champlain basin.

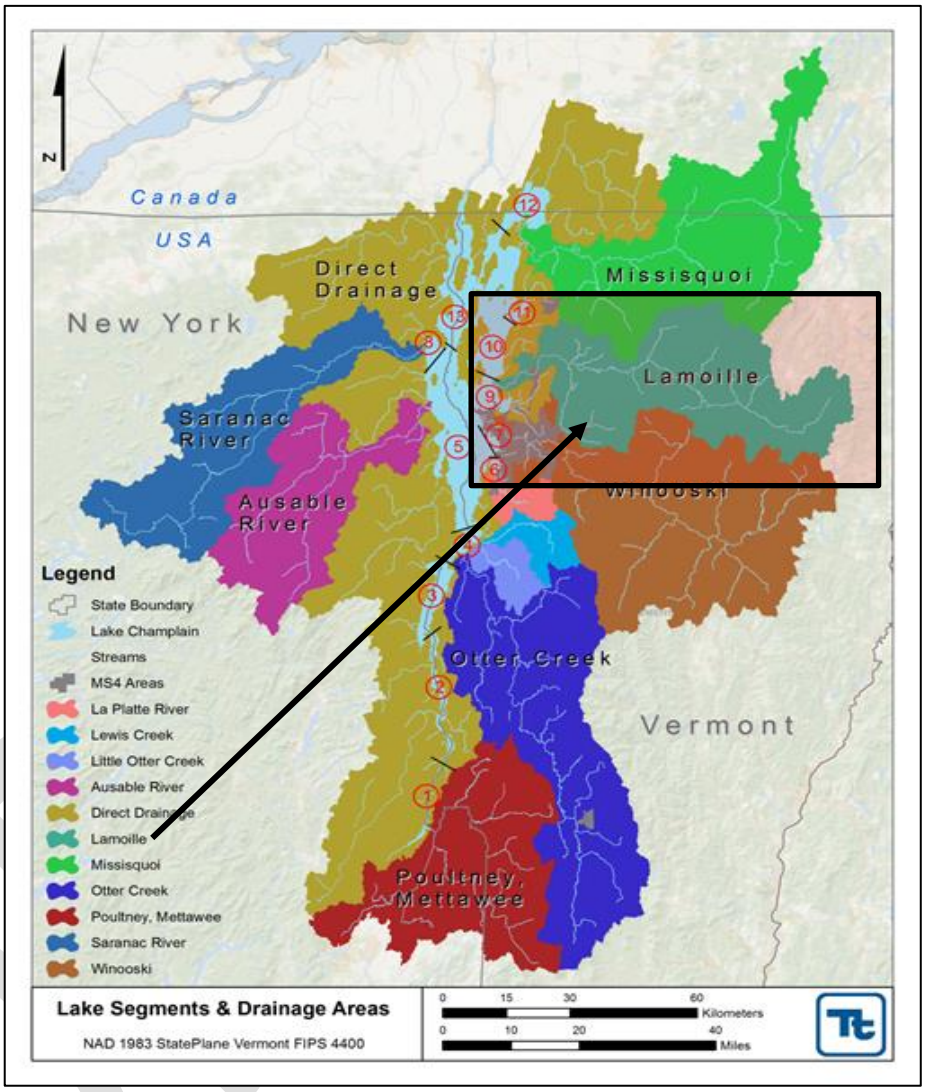


Figure 19. Lake segments and drainage areas of the Lake Champlain basin.

Vermont contributes about 69 percent (630.6 MT/yr) of the total phosphorus load per year to Lake Champlain in comparison to Quebec at 9 percent (77 MT/yr) and New York at 23 percent (213.8 MT/yr). On average, Mallets Bay receives approximately 8.9 percent (56.4 MT/yr) of the total load to Lake Champlain compared to Missisquoi Bay, which receives about 24 percent (136.3 MT/yr) of the total load and Shelburne Bay, which receives about 1.5 percent (10.2 MT/yr) of the total load[2].

[2] This information is based on tables in the June 17, 2016 Phosphorus TMDLs for Vermont Segments of Lake Champlain by the U.S. Environmental Protection Agency.

Total annual total phosphorus (TP) loading varies from year to year based on flow and on-going land use. Compared to the ten major watershed contributors shown in Figure 20, the Lamoille watershed is Vermont's fourth highest contributor of phosphorus into Lake Champlain after the Winooski, Missisquoi, and Otter Creek basins (Figure 20).

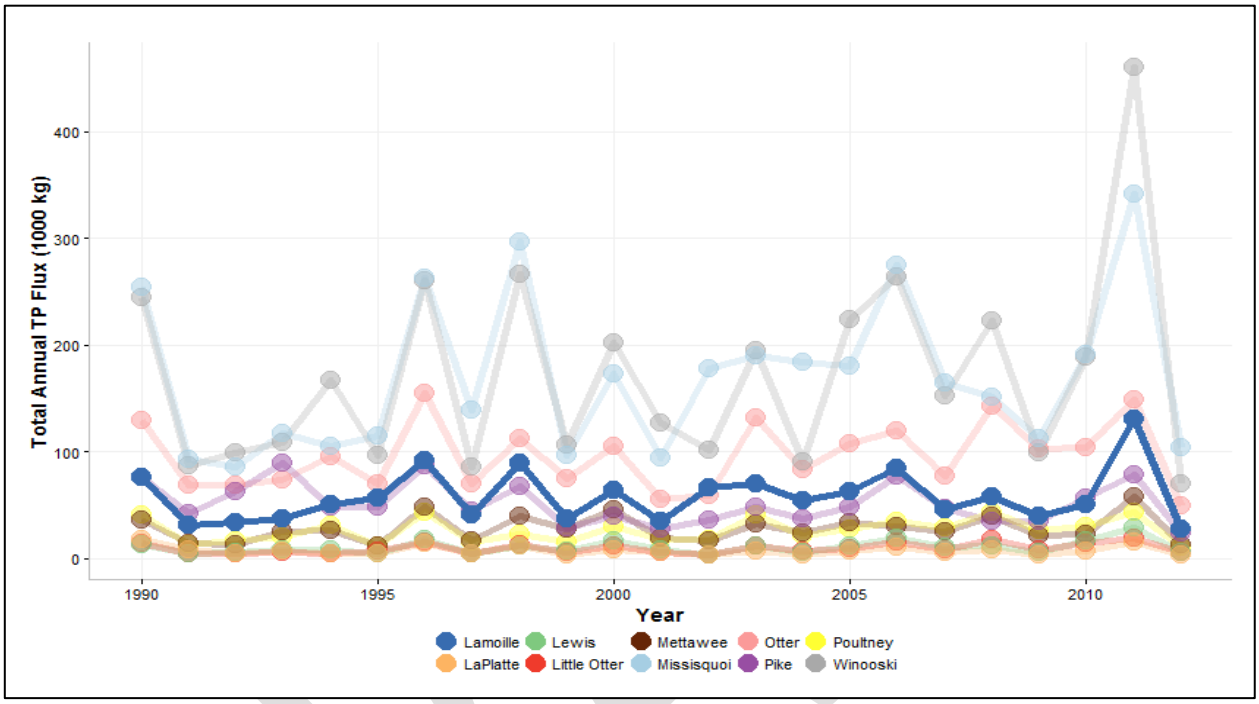


Figure 20. Total annual total phosphorus contributions to Lake Champlain from 1990 to 2012 by the ten major watershed's in the Lake Champlain basin. Lamoille is dark blue.

In order to meet the Lake Champlain Phosphorus TMDL expectations, total annual TP loading into Mallets Bay is required to be decreased by 17.6 percent or by approximately 10 MT/yr. The following sections will address how these requirements will be met across all sectors within the Lamoille basin including regulatory and non-regulatory actions.

Lake Champlain Phosphorus TMDL Phase II Plan

The Lake Champlain Phosphorus Total Maximum Daily Load (LC TMDL) establishes the allowable phosphorus loadings, or allocations, from the watershed for the lake water quality to meet established standards. These allocations represent phosphorus loading reductions that are apportioned both by land use sector (developed land, agriculture, etc.) and by lake watershed basin (Lamoille, Missisquoi, etc.). Due to the large size of the Lake Champlain watershed in Vermont, the modeling techniques used to estimate loading were implemented at a coarse scale. For example, the modeled loading at the mouth of the major river basins is based on monitoring data and represents the collective inputs from the various land uses and physical features of the watershed. On the whole, this is useful to estimate the necessary level of phosphorus reducing Best Management

Practices (BMPs). However, when looking at smaller scale areas such as a municipality, a particular farm or a local road network, it's necessary to complete a detailed on-the-ground analysis to determine appropriate actions for the particular area.

As part of the LC TMDL development, EPA developed a "Reasonable Assurance" analysis at the major-basin scale to determine if it was theoretically possible to obtain to necessary phosphorus reductions. By using modeling results for the entire Champlain Basin, the TMDL was able to show that through a concerted effort across all phosphorus sources, it appeared possible to reach the lake loading targets with appropriate application of BMPs. However, since this exercise was conducted at the major-basin scale, there is no specific prescription as to where BMPs should be applied. It is through the development of the Tactical Basin Plans that more precise opportunities for BMPs can be identified and prioritized for implementation.

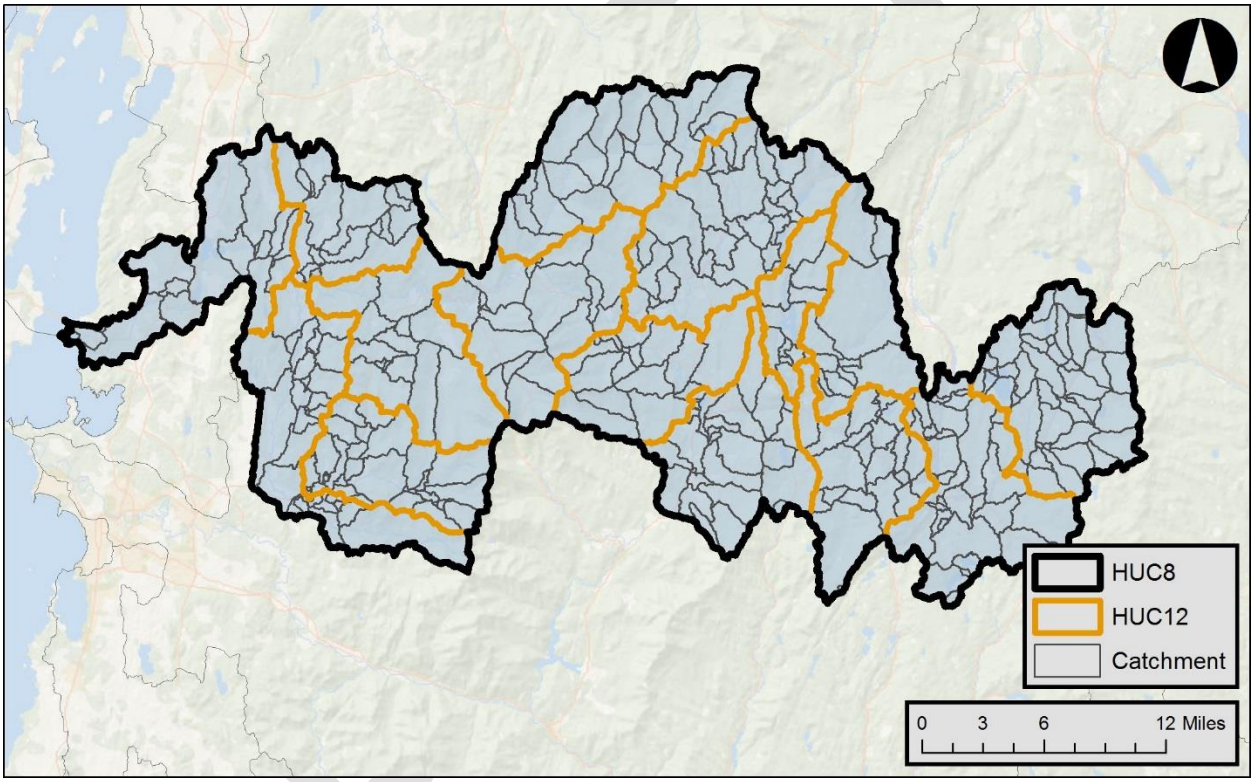
The LC TMDL will be implemented through a series of permit programs as well as identification of site specific BMPs outside the scope of specific programs, many guided by the content of the Tactical Basin Plans. While many programs will be "self-implementing", in many instances, application will proceed in a two-step process of first knowing "where to look" for opportunities followed secondly by "what to do". Many of the phosphorus reduction programs require an initial "assessment" phase to identify what BMPs may already exist on the landscape and where others need to be placed. In some instances, the Tactical Basin Plans can aid prioritization areas of "where to look" first such as expected high phosphorus producing areas. After the assessment phase, BMP implementation can be prioritized and carried forward. Additionally, the Tactical Basin Plans can identify known beneficial projects, the "what to do", prioritize them for funding so that implementation can be expedited, and also tracked transparently.

The LC TMDL also incorporates an "Accountability Framework" that aims to ensure that phosphorus reduction actions are being implemented at a sufficient pace to see results in the lake. While the specific timeline for lake improvement isn't specified by the TMDL, an estimate of the predicted phosphorus reduction needs to be identified within each Tactical Basin Plan on a 5-year rotating basis. Estimating the potential phosphorus reductions expected from site specific actions is one way of determining if the level of effort is sufficient compared to the overall TMDL goals. This portion of the Tactical Basin Plan attempts to provide that estimate of phosphorus reduction reasonably expected from actions taken in specific areas across the basin, specific to source types and regulatory program.

In conjunction with Tactical Basin Planning is a project implementation tracking system that VDEC is also developing. This system intends to track implementation of projects across all sectors and apply an expected phosphorus reduction estimate to each. Over time, as projects are continually implemented, a more precise estimate of cumulative **actual** phosphorus reductions can be reported rather than relying on estimates of **potential** actions.

Several useful modeling products were used to spatially represent where LC TMDL reductions will be most effectively targeted to implement the TMDL. The underlying data from which many of the following analyses originate is the EPA SWAT model (Soil and Water Assessment Tool). This model was developed to estimate phosphorus loading from the Lake Champlain watershed from various land use sectors for development of the TMDL. Discrete SWAT models were calibrated and validated for each of the Hydrologic Unit Code – level 8 (HUC8) watersheds as well as for direct drainages to the lake. Three additional tools were developed from the SWAT modeling results: the HUC – level 12 (HUC12) Tool, the BMP Scenario Tool, and the Clean Water Roadmap (in development). In the analyses that follow, varying geographic scales are used, depending on the source sector; figure TMDL1 displays these geographic scales. In order of decreasing size, they are the HUC8, HUC12, and catchment scales.

Figure TMDL1. Comparison of HUC8, HUC12, and catchment watershed scales in the Lamoille Basin.



HUC12 Tool

The HUC12 Tool (Figure TMDL2) is a Microsoft Excel spreadsheet that displays SWAT estimates of total phosphorus (TP) loading at a HUC12 scale for each lake segment. TP loading estimates (kg/yr) in the HUC12 Tool are summarized by general land use category for each HUC12 in a lake segment basin (Table TMDL1). In addition, detailed annual load (kg/yr) and areal loading rate (kg/ha/yr) estimates can be displayed by land use for each HUC12 watershed. This more detailed information includes the minimum, maximum, mean, median, 25th percentile, and 75th percentile

loading rates per hectare for each land use category. In this way, TP loading magnitudes can be compared across all HUC12 watersheds in a lake segment basin as well as different land use categories within a HUC12.

Figure TMDL2. Screenshot of HUC12 Tool display for Malletts Bay lake segment. The Deer Brook HUC12 is highlighted.

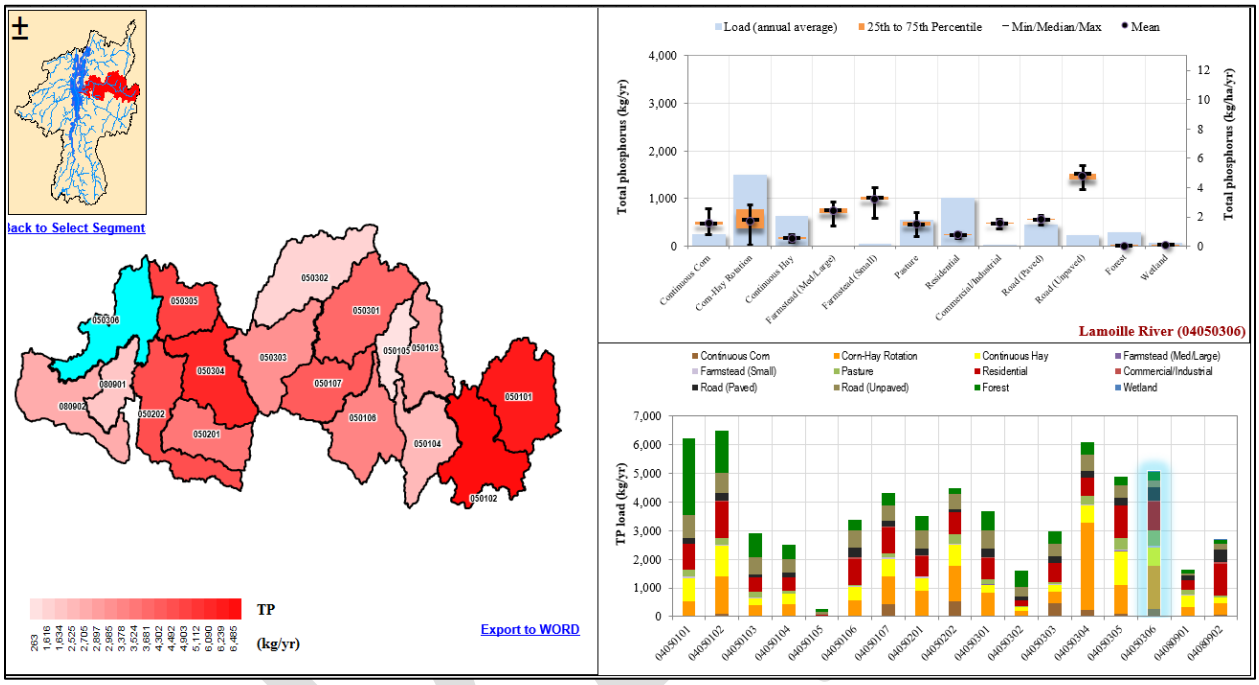


Table TMDL1. General land use categories in the HUC12 Tool.

HUC12 Tool Land Use Categories	
Continuous Corn	Residential
Corn-Hay Rotation	Commercial/Industrial
Continuous Hay	Road (Paved)
Farmstead (Med/Large)	Road (Unpaved)
Farmstead (Small)	Forest
Pasture	Wetland

BMP Scenario Tool

This Microsoft Excel based tool allows users to apply BMP scenarios at the lake segment basin scale to evaluate the phosphorus load reduction potential of various management actions. The Scenario Tool uses SWAT model results and estimates of BMP efficiencies to answer questions such as: what is the expected phosphorus reduction if this BMP is applied to 60% of the applicable area in a lake segment basin? BMP suitability in a basin is based on SWAT model inputs such as land use, soil type, and slope. Multiple BMPs can be 'applied' in a basin, and BMP scenarios can be evaluated for

a range of loading sources: developed lands, forests, agricultural lands, unpaved roads, and streambank erosion. This functionality allows users to evaluate whether a specific management plan has the potential to meet the TMDL loading targets for Lake Champlain. Stored scenarios can be compared and contrasted with tabular and visual summaries. The tool also contains extensive summary tables and figures of TMDL targets and existing source loads.

Clean Water Roadmap Tool (in development)

The Clean Water Roadmap Tool (CWR) is a partnership between VDEC, Keurig-Green Mountain Coffee Roasters, the Nature Conservancy (TNC), and other stakeholders. The overall goal of the CWR is to 'map' the results of the Lake Champlain SWAT model and associated follow-on products, especially EPA's BMP Scenario Tool, along with management actions contained in VDEC's Tactical Basin Plan implementation tables and tracking systems. The CWR will provide a description of *one way* the LC TMDL phosphorus reductions can be achieved, largely based on EPA's reasonable assurance scenario.

The CWR will be a map-based application that allows users to click on a specified watershed and receive a summary report of relevant best management practices (BMPs) and ultimately, associated implementation table activities in the selected area. BMP suitability will be assessed using the landscape criteria in SWAT and EPA's Scenario Tool, while implementation table activity locations will be based on data in VDEC's BMP tracking database. The summary data will also include estimated phosphorus loadings based on SWAT modeling. Additional relevant spatial information, such as township boundaries, partner data (TNC's Conservation Blueprint for Water Quality), hydrologically connected backroads, etc., may also be included. The CWR can be used by regional planners, the public, and VDEC staff to identify priority areas and actions for Lake Champlain phosphorus reductions.

What follows below - through a series of discussion, tables, and graphics - is an expression of the TMDL reductions required in as site-specific manner as currently possible. Many of these expressions rely on modeled information that are limited by certain spatial extents even though some sector analyses may be more developed based on the currently available data. Because of this, the summing of loading results across different sectors may not "add up" to overall basin loading estimates but are sufficient for planning-level analyses. In some instances, this information will aid the "where to look" aspect of planning while other instances provide the "what to do". Over time, additional assessment information will more accurately inform the identification of BMP opportunities and it is the goal of the Tactical Basin Plans to present the most up-to-date information available to facilitate implementing the LC TMDL.

TMDL allocations for the Malletts Bay segment of Lake Champlain

Table TMDL2 below provides the final phosphorus allocations and the resulting reductions required for the Mallets Bay segment of Lake Champlain. These values are taken directly from the final LC TMDL.

Table TMDL2. Summary table of allocations for the Mallets Bay segment of Lake Champlain. The "Analysis" column identifies more detailed sector-specific analyses found later in this section.

Source	Category	Allocation category	Total allocation (MT/yr.)	% reduction required for basin	Analysis
Forest	All lands	Load	7.19	5.0%	Figure LA-1 Tables LA-1, 2
Stream Channels	All streams	Load	3.58	44.9%	---
Agriculture	Fields/pastures	Load	15.48	28.6%	Figures LA-2, 3 Tables LA-3, 4, 5
	Production Areas	Wasteload	0.31	80.0%	Tables WLA-1, 2
Developed Land	Summary		13.66	20.5%	Tables WLA-3, 4, 5, 6 Figures WLA-1, 2
	VTrans owned roads and developed lands	Wasteload			Figure WLA-3 Table WLA-7
	Roads MRGP	Wasteload			Figure WLA-4 Tables WLA-8, 9
	MS4	Wasteload			Table WLA-10
	Larger unregulated parcels	Wasteload			Table WLA-11
Wastewater	WWTF discharges	Wasteload	3.24	0.2%	Table WLA-12
	CSO discharges	Wasteload	NA	NA	NA

Figure TMDL3 below illustrates the required level of TP reductions identified in the above table at the HUC12 and further to the catchment-scale. The transition from blue to red indicates a greater level of TP reduction across all catchments, as prescribed for all land use sectors across the basin. For example, for any given catchment, the TMDL reduction percentage is applied to each appropriate land use sector, based on the TMDL reductions required for that sector (Table TMDL2, above). Then, all reductions are summed for the catchment and displayed on a relative loading scale. It should be noted that this representation treats all lands in each land use sector equally in its required reduction, which therefore gives a relative sense of the magnitude of potential opportunities for phosphorus reduction.

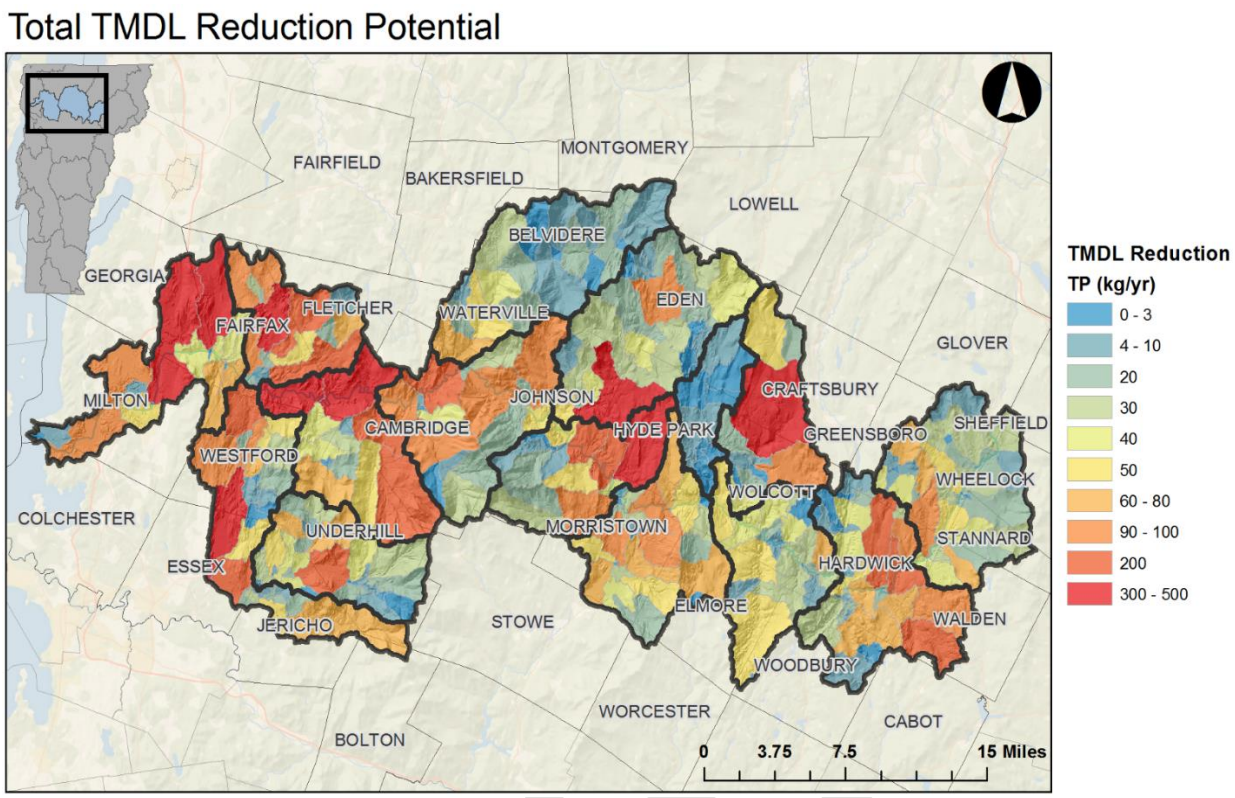


Figure TMDL3. The necessary TP reductions specified by the TMDL if applied uniformly across the entire Lamoille Basin, at the catchment scale.

Within the basin, the top 20 catchments with the greatest overall identified TP reductions are identified in Table TMDL3. The catchments are located by what town they occur and the total TMDL reduction is broken down by each land use sector. The bold numbers represent catchments that are in the top 20 of TP modeled export for each land use sector. If the total required LC TMDL reductions were applied to these top 20 catchments, which make up 15% of the total number of catchments, then 36% of the overall needed basin reduction would be realized. For context, there are 307 total individual catchments in the Lamoille Basin.

Table TMDL3. Catchments with the highest TP export by land use. Values in bold represent the highest total TP export identified in the top 20 catchments per land use.

Catchment ID	Town Name	Ag Reduction (kg/yr)	Developed Land Reduction (kg/yr)	Farmstead Reduction (kg/yr)	Forest Reduction (kg/yr)	Potential TP Reduction (kg/yr)
4586672	Fletcher	**375**	**67**	**8**	3	453
4587106	Fairfax	**272**	**38**	**10**	3	323
4587258	Georgia	**186**	**118**	**9**	3	317
4586404	Hyde Park	**203**	**94**	**13**	4	314
4586314	Hyde Park	**182**	**64**	**10**	3	259
4587212	Essex	**196**	30	5	2	234

4586342	Craftsbury	**136**	**67**	**13**	12	229
4586304	Fairfax	**181**	**44**	1	1	228
4586258	Fairfax	**189**	27	3	2	221
4586560	Hardwick	**160**	**32**	3	5	201
4586602	Underhill	**148**	32	5	3	188
4587514	Walden	**119**	**44**	4	6	172
4586508	Cambridge	**100**	**35**	**8**	8	150
4586346	Cambridge	**112**	24	**8**	2	146
4586286	Fletcher	**100**	32	**7**	2	142
4586410	Hyde Park	**95**	**33**	**9**	1	138
4586568	Hardwick	**99**	31	3	2	136
4586372	Johnson	**110**	22	-	1	133
4587130	Westford	**96**	26	5	1	128
4586260	Fletcher	82	**37**	**6**	3	128
Percent of total TP reduction if all sector allocations are applied to these catchments						36%

Limiting Phosphorus Losses from Managed Forest

Vermont adopted rules in 1987 for Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont. 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.

Vermont Department of Forests, Parks, and Recreation (FPR) has begun the process of updating the AMPs. Key modifications include:

- Require compliance with standards set forth in the VDEC Stream Alteration General Permit for actions including the installation and sizing of permanent stream crossing structures on perennial streams.
- Strengthen standards pertaining to temporary stream crossing practices on logging operations. The proposed standards include:
    - Better management of ditch water on approaches to stream crossings. The proposal is to prohibit drainage ditches along truck roads from terminating directly into streams and to specify a minimum distance for installing turn-outs. Drainage ditches approaching stream crossings must be turned out into the buffer strip a minimum of 25 feet away from the stream channel, as measured from the top of the bank.
    - Better management of surface water runoff from skid trails, truck roads and temporary stream crossings on logging operations. The proposal is to prevent surface runoff from entering the stream at stream crossings from skid trails and truck roads and to specify a minimum distance for installing surface water diversion

practices, such as drainage dips. Surface runoff is to be diverted into the buffer strip at a minimum distance of 25 feet from the stream channel, as measured from the top of the bank.

  - Better management of stream crossings after logging. The proposal is to prevent erosion and to specify a minimum distance from the stream for diverting runoff. Upon removal of the temporary stream crossing structures, the site is to contain water bars 25 feet from the stream channel on downhill approaches to the stream crossing to divert runoff into the buffer to capture sediment before entering the stream. Additionally, all exposed soil, at a minimum of 50 feet on each side of the crossing, must be stabilized with seed and mulch according to application rates specified in the AMPs.

- Include a new AMP to address the management of petroleum products and other hazardous materials on logging operations. Such materials must be stored in leak-proof containers, place outside of buffer strips, and must be removed when logging is completed.
- Enhanced stream buffer guidance in the AMPs and established metrics for minimum residual stand density, stand structure and crown cover.
- Enhanced options and guidance with metrics provided for soil stabilization to establish temporary and permanent ground cover.
- Better clarification provided for selection and spacing of water diversions on skid trails and truck roads both during and immediately after logging.
- Increased seeding/mulching of exposed soil adjacent to streams and other bodies of water from 25 feet to 50 feet.

For the Mallets Bay segment of Lake Champlain, an overall TP reduction target of 5% has been allocated to all forest lands. Based on documentation that the primary sources of phosphorus from forested areas are forest roads and harvest areas, and that AMPs are being revised to address better management of road erosion and harvest areas to avoid water quality impacts, EPA suggests the 5% reduction called for in the Reasonable Assurance scenario is easily supported.

Based on watershed modeling in support of the TMDL, the catchments are displayed in Figure LA-1 in order of increasing TP export – from blue to red. While TP loading rates are generally low in forested areas, there are situations which could exacerbate loading. Gleaned from the modeling input data, areas of steep slopes and thin soils could be most problematic for forest road building and harvest activity. It is these areas that could receive the most activity oversight to control erosion.

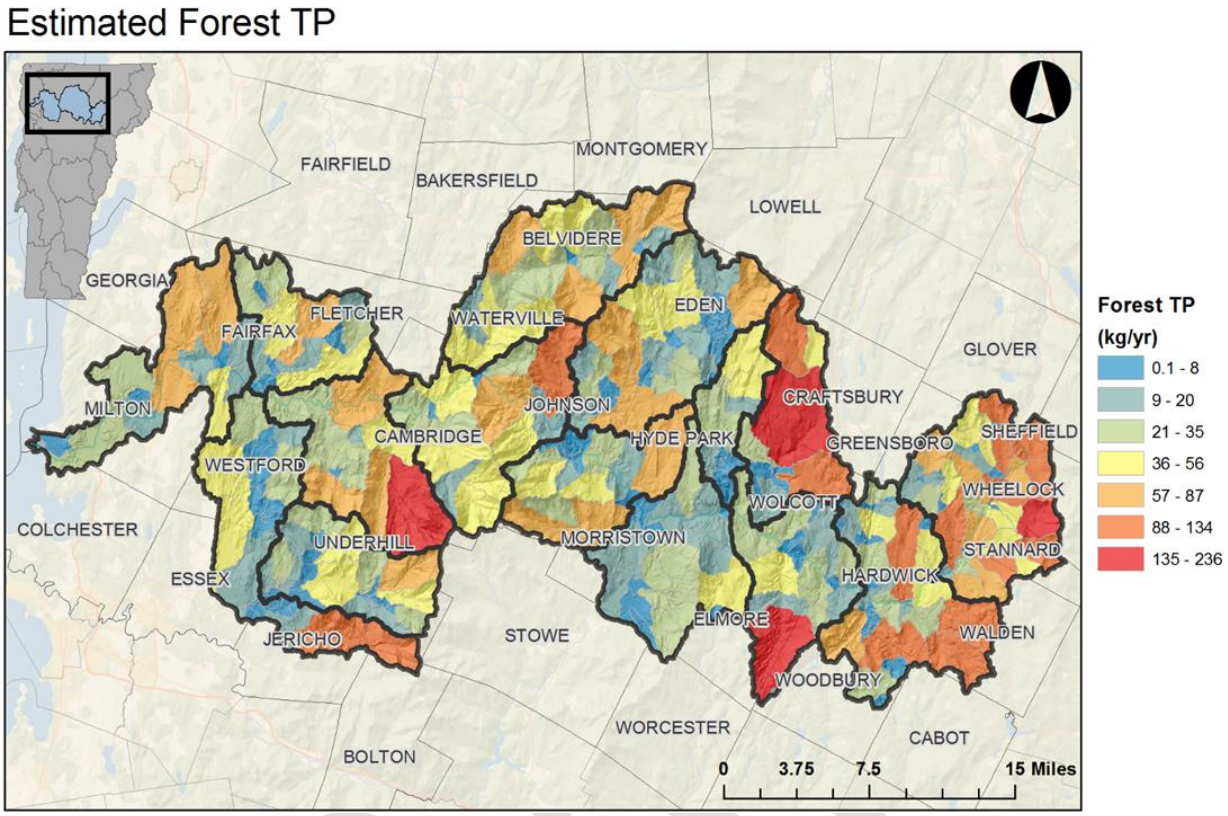


Figure LA-1. Estimated forest TP loading for the Lamoille basin at the catchment scale.

The mapped catchment and HUC12 scale TP export is also shown in Tables LA-1 and LA-2. Table LA-1 identifies the highest-loading catchments in Figure LA-1 by town and also lists the forest load as well as the potential phosphorus load reduction if the overall basin reduction target were applied (5%). However, actual reductions based on adherence to the Accepted Management Practices could perhaps be greater in these areas if export rates are actually higher. Table LA-2 provides similar data for the top 5 exporting HUC12s. If allocated reductions were completely applied to these top five HUC12s, approximately 62% of the required reductions from forest land could be realized.

Table LA-1. The top 4 modeled catchments for forest TP load export (red catchments in Figure LA-1).

Catchment ID	Town Name	Forest TP (kg/yr)	Potential TP Reduction (kg/yr)
4586342	Craftsbury	236	12
4587518	Elmore	185	9
4586508	Cambridge	157	8
4586756	Wheelock	150	7
Percent of total TP reduction if sector allocations are applied to these catchments			8%

Table LA-2. Summary table of top TP forest export HUC12s.

HUC12 Waterbody	Forest (kg/yr)	Potential TP Reduction (kg/yr)
Headwaters Lamoille River	2682	134
Hardwick Lake-Lamoille River	1478	74
Wild Branch	815	41
Gihon River	664	33
North Branch Lamoille River	587	29
Percent of total TP reduction if sector allocations are applied to these HUC12		62%

Reducing Phosphorus Attributable to Unstable Stream Channels

The Lake Champlain Phase I Implementation Plan recognizes that we will never achieve the load reduction targets for unstable streams if we focus entirely on restoration (manipulation-type) activities. If the river corridors along our incised and straightened stream channels are not protected from encroachment, they will be developed, and the potential for restoration would be lost forever. River corridor and floodplain protection ensure that the desired channel evolution, stream equilibrium, and natural floodplain function can take place whether it be from restoration activities or through the natural channel forming processes that occur during floods. Further, the estimation of precise subwatershed phosphorus loadings from stream channels would be a scientifically tenuous proposition at any scale smaller than that established by the TMDL. As such, this Tactical Basin Plan relies on the identification of high-priority subwatersheds where Stream Geomorphic Assessments indicate the highest likelihood for phosphorus reductions thru the pursuit of dynamic stream equilibrium. These are shown in Chapter 2 of this Plan, in the Implementation Table summary in Chapter 5, and also in the online Watershed Projects database.

VDEC has developed a methodology to document long-term achievement of the TMDL allocation for stream channels. This methodology serves as a surrogate for long-term physico-chemical monitoring that would be required for each restorative practice type were it possible to isolate cause and effect at this functional level of assessment—which it is not. This tracking approach follows the methodology used by Tetra-Tech to develop the load and load-reduction calculations for unstable streams by evaluating how different practices affect the evolution of Vermont's incised streams to an idealized condition where stream equilibrium is achieved and the stream has access to its floodplain at the (~2-yr) channel forming flow. Is has been documented that under these ideal geomorphic and hydraulic conditions we see significant capture and storage of fine sediment and phosphorus.

The Stream Equilibrium (SE) Tracking Method starts by establishing a total watershed deficit where the existing condition is subtracted from the ideal condition and a total watershed sum is derived by adding the deficit that is calculated for each reach in the watershed. The deficit for each reach is comprised of two components, one to track restoration activities and another to track corridor and floodplain protection activities. This is a novel approach because most tracking tools focus entirely

on activities that manipulate the environment to achieve restoration. The total watershed deficit is envisioned to be calculated as follows:

$$\sum_{\text{All Reaches}} \frac{\text{Channel Width} \times \text{Reach Length} \times \text{Confinement Deficit (ideal – existing)} \times \text{Channel Evolution Deficit (ideal – existing)}}{\text{Reach Sensitivity Value}}$$

Plus

$$\sum_{\text{All Reaches}} \frac{\text{Channel Width} \times \text{Reach Length} \times \text{Reach Protection Deficit (ideal – existing)}}{\text{Reach Sensitivity Value}}$$

The SE tracking method includes spatial and temporal factors that recognize the value of larger floodplains along lower gradient reaches and the influence that erodibility (as a function of channel boundary and bed load characteristics) has on the time frame at which floodplain accessibility might be achieved. For deficit reduction associated with active restoration there is the opportunity to evaluate projects that remove encroachments, thereby changing the stream confinement ratio (so essential to the achievement of an equilibrium channel slope) and the evaluation of projects that directly affect channel dimensions, roughness, channel evolution stage and slope. The deficit reduction associated with reach protection projects is evaluated for the strength (standards and longevity) of the land use and channel management restrictions that are put into place.

Data to support the scoring is largely available in the Vermont Stream Geomorphic Assessment database. The land protection scoring will be developed from different existing GIS data layers, and finally, a restoration practice scoring matrix will be developed to be able to score each type of project pursued on the ground by the VANR and its partners.

Controlling Phosphorus from Agriculture

Load Allocation

In this section, a description of the applicable agricultural phosphorus runoff control regulations will be provided, along with a tabular description of BMP's that have been suggested by the Reasonable Assurance Scenario presented by EPA's HUC 12 Scenario Tool. The following regulatory programs or provisions that are part of the load allocation for agricultural lands will be described: Required

Agricultural Practices for regulated Small Farms; Large and Medium Farm Permits; BMP Programs, and the Agency of Agriculture – Conservation Law Foundation Settlement Agreement.

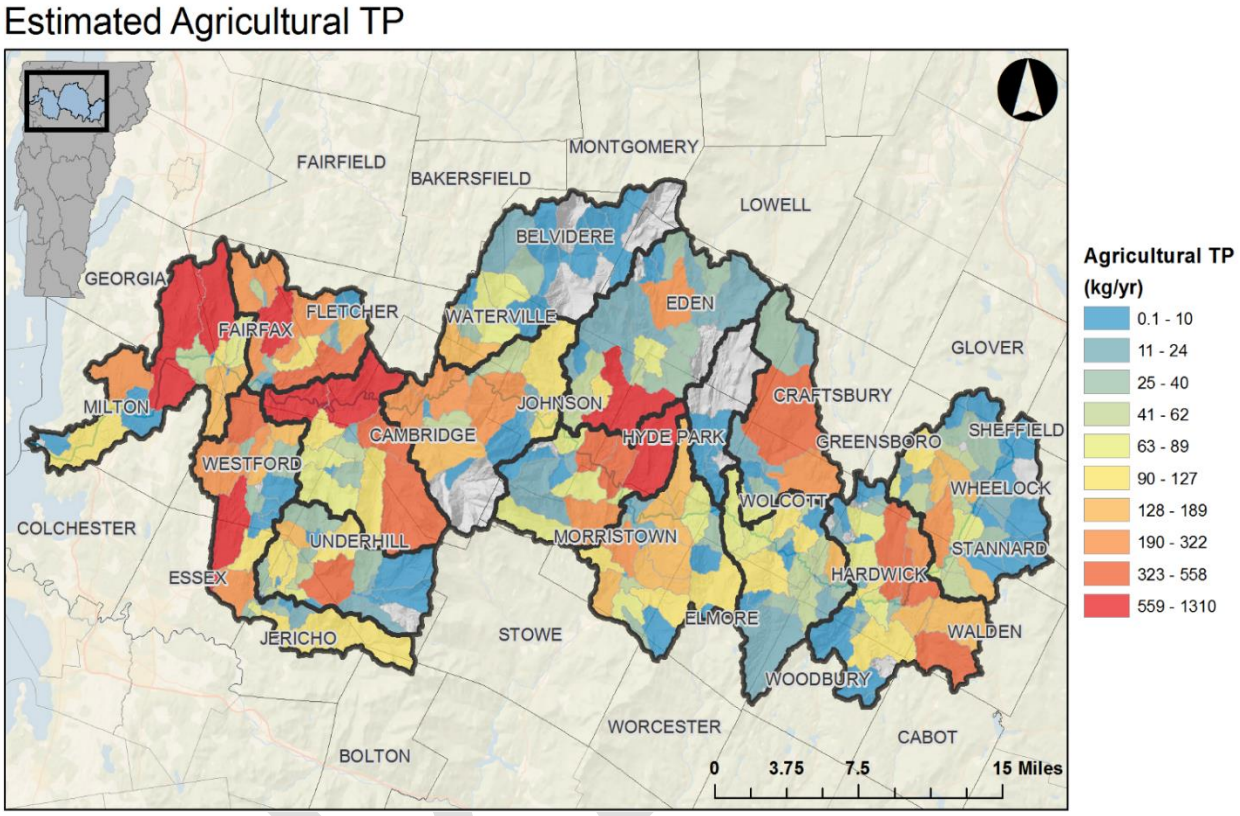


Figure LA-2. Estimated agricultural TP export by catchment. Bolded watershed outline represents HUC12 watersheds.

Another representation of the modeled TP export map is given in Table LA-3 below. The top twenty TP export catchments are listed and are associated with the town in which they occur. The TP reduction amount is simply calculated by applying the 28.6% reduction allocation as expressed in the TMDL for the entire basin. This ranking provides the general reduction opportunities as they exist across the landscape but actual practice implementation will vary across catchments as practical assessment information is obtained. Figure LA-3 presents the total phosphorus load and projected reduction, by agricultural land-use type, for the 13 HUC12-scale watersheds that comprise the Lamoille Basin. The content following Figure LA-3 provides information regarding agricultural practice efficiencies based on information contained in the Required Agricultural Practices.

Table LA-3. Catchments with the highest estimated TP agricultural export (non-farmstead).

Catchment ID	Town Name	Ag TP (kg/yr)	TP Reduction based on overall basin agricultural load allocation (kg/yr)
4586672	Fletcher	1310	375
4587106	Fairfax	951	272
4586404	Hyde Park	711	203
4587212	Essex	686	196
4586258	Fairfax	662	189
4587258	Georgia	650	186
4586314	Hyde Park	636	182
4586304	Fairfax	635	181
4586560	Hardwick	558	160
4586602	Underhill	517	148
4586342	Craftsbury	477	136
4587514	Walden	414	119
4586346	Cambridge	391	112
4586372	Johnson	385	110
4586286	Fletcher	349	100
4586508	Cambridge	349	100
4586568	Hardwick	348	99
4587130	Westford	337	96
4586410	Hyde Park	334	95
4587214	Essex	322	92
Percent of total TP reduction if sector allocations are applied to these catchments			43%

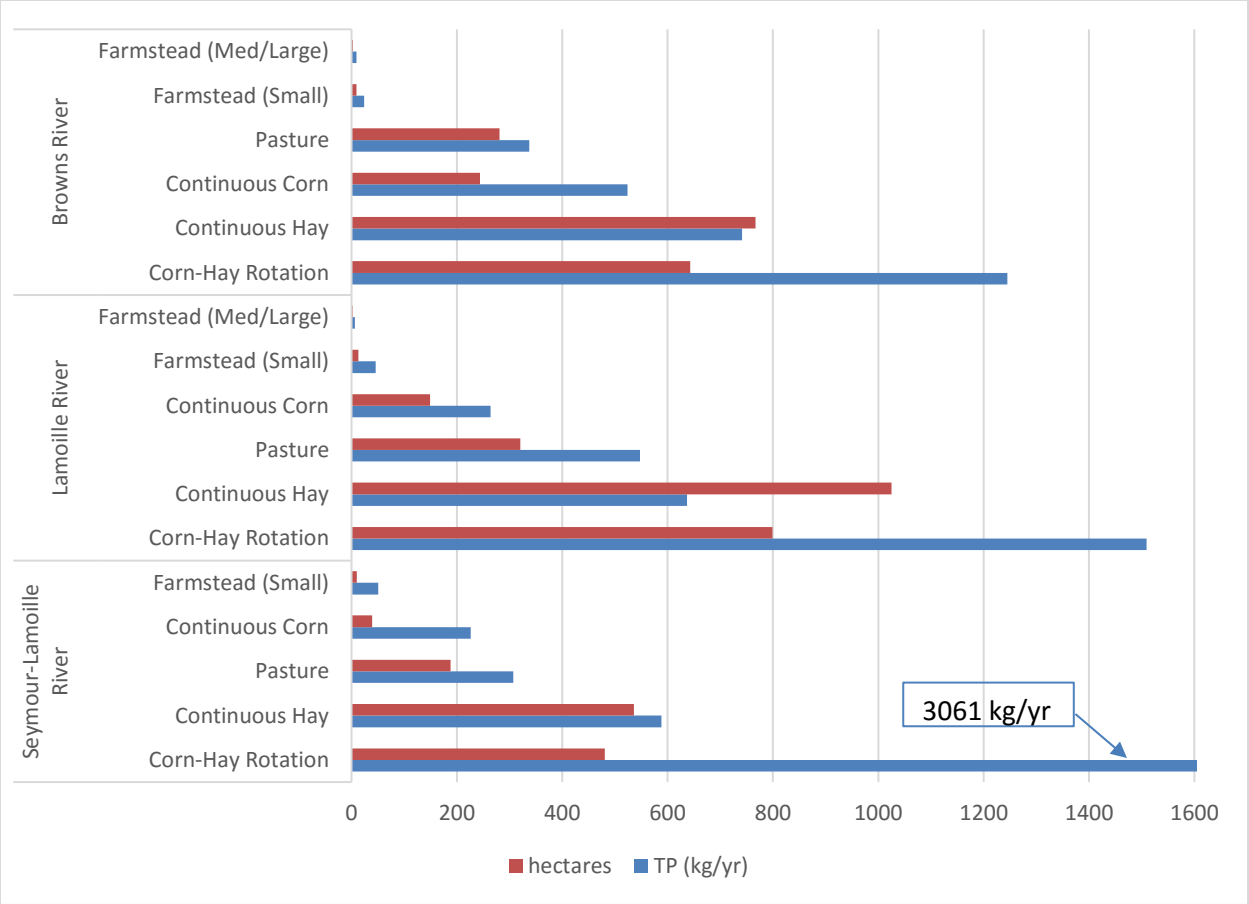


Figure LA-3. SWAT loading estimates and areas for agricultural sources in the Lamoille River basin HUC12 watersheds (4 separate graphics).

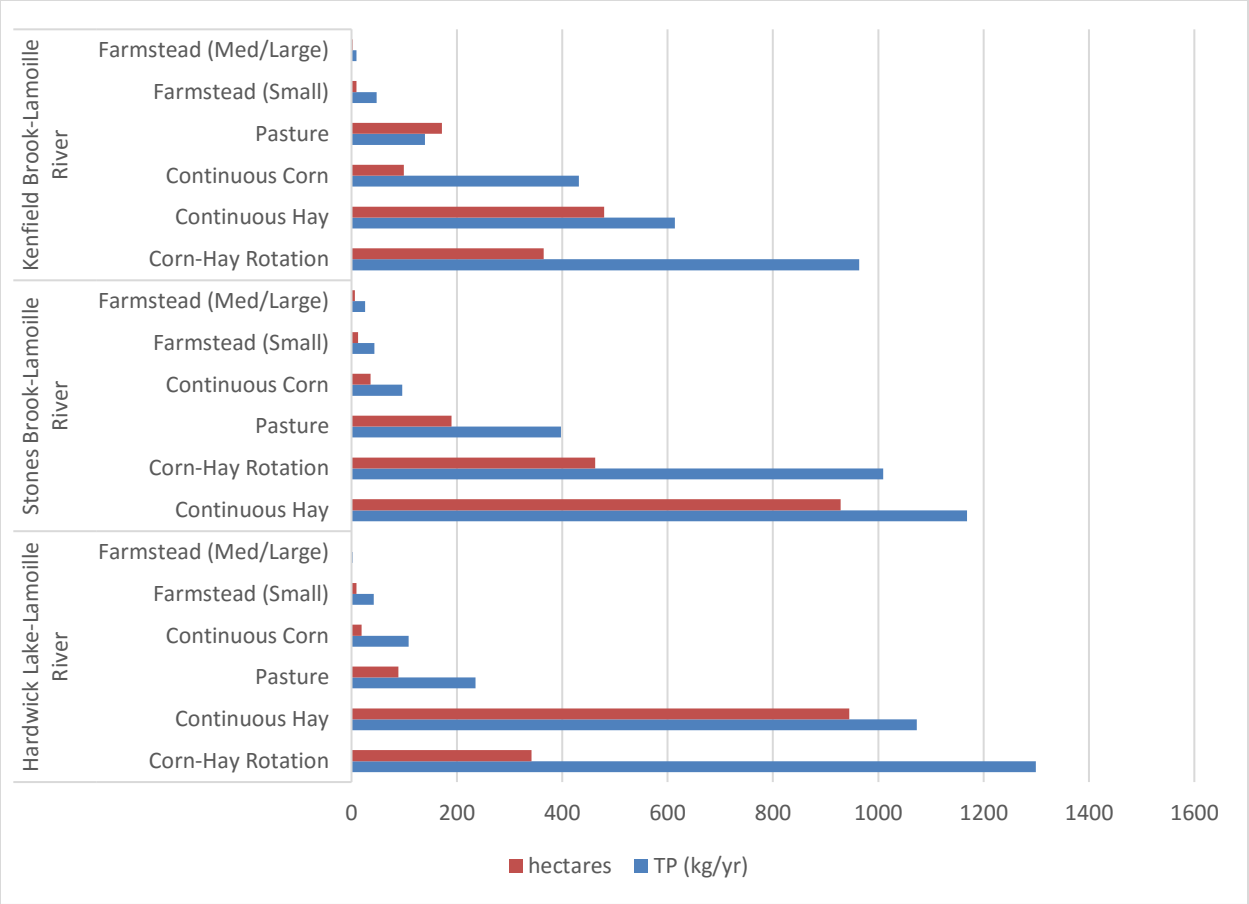


Figure LA-3 continued

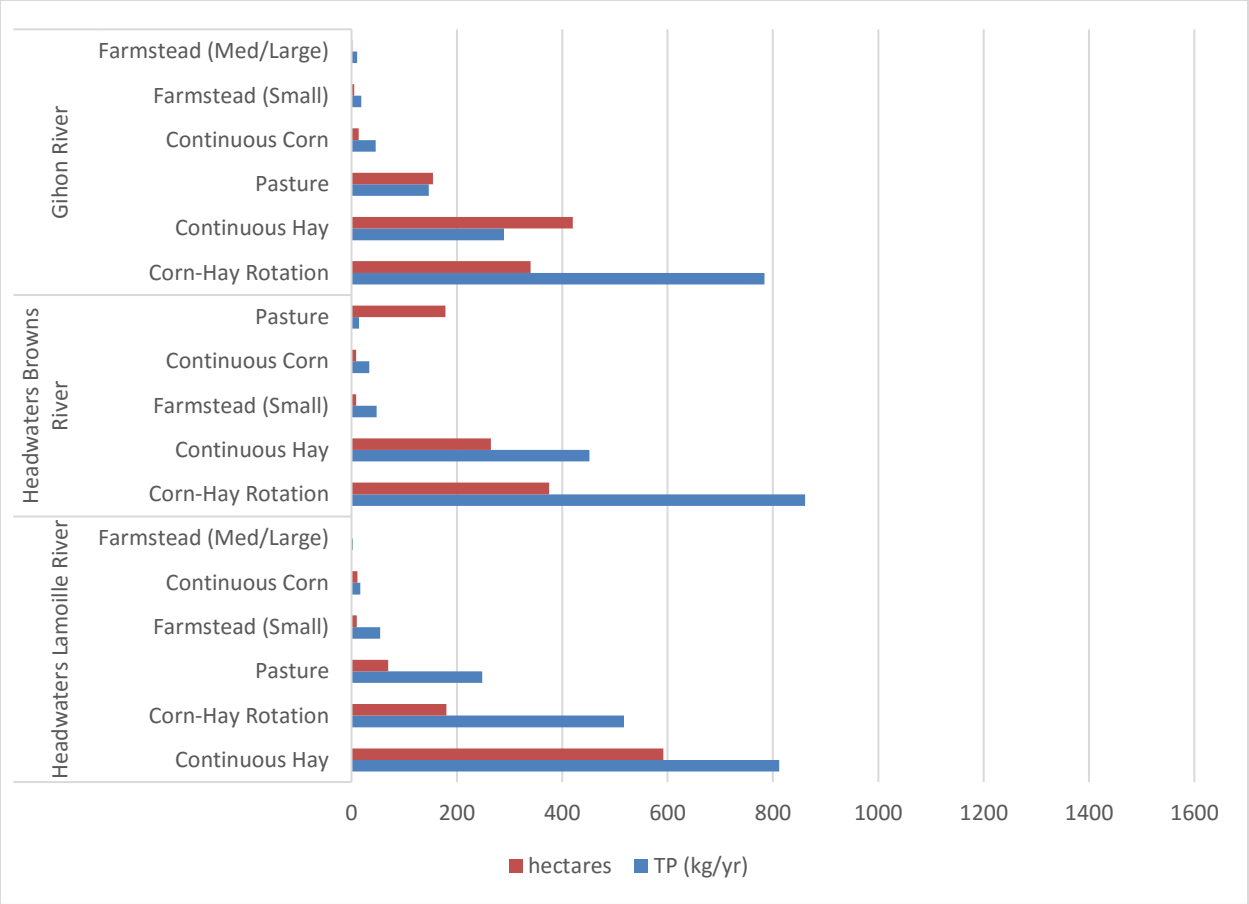


Figure LA-3 continued

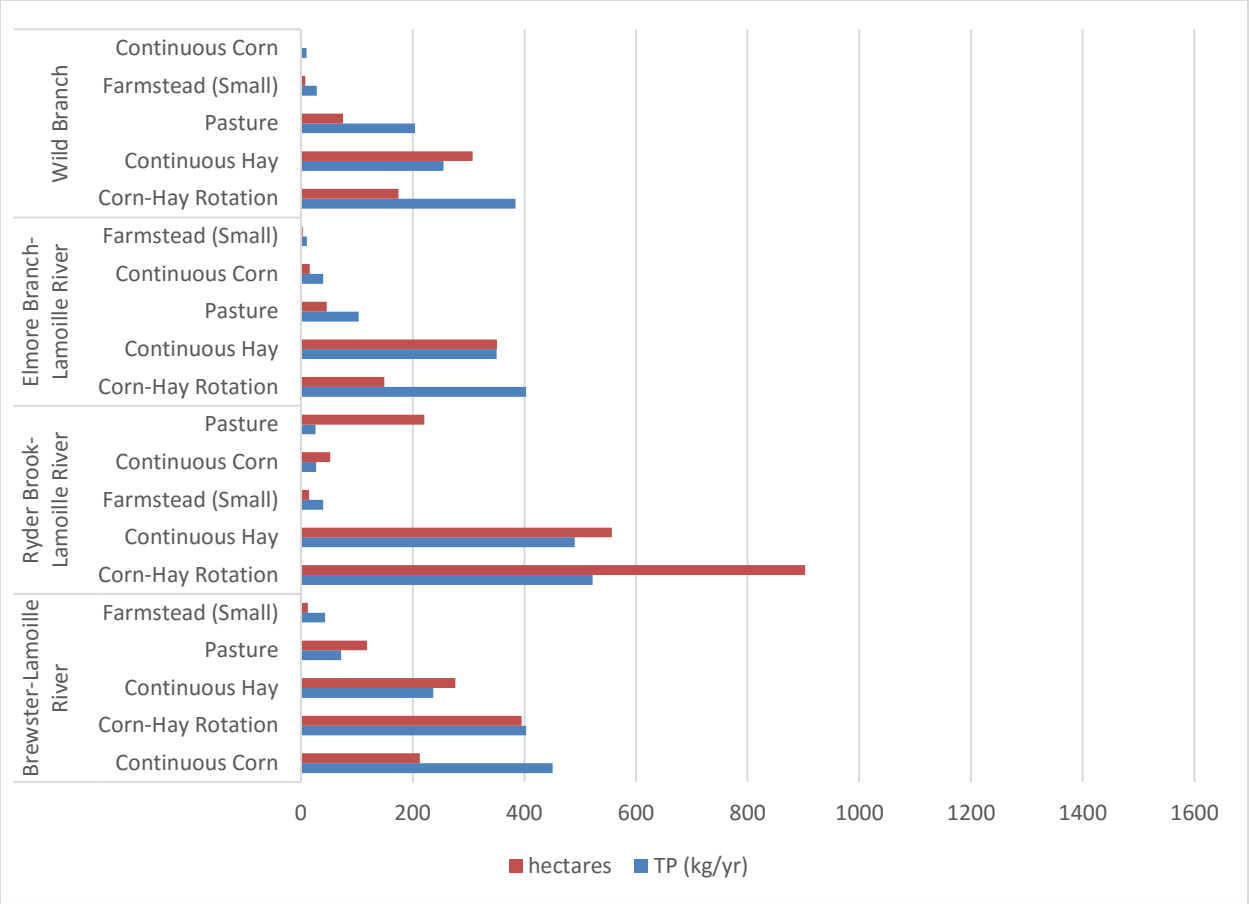


Figure LA-3 continued

Table LA-4. TP reduction efficiencies associated with BMPs as represented in the SWAT-based Scenario Tool

BMP Type	Minimum % Efficiency	Maximum % Efficiency	Average % Efficiency	Efficiency Source
Barnyard Management	80.00	80.00	80.00	Literature
Change in crop rotation	19.49	28.11	25.26	SWAT
Conservation tillage	10.00	50.00	27.50	SWAT
Cover crop	25.00	30.00	28.33	SWAT
Crop to Hay	0.00	80.00	64.17	SWAT
Ditch buffer	51.00	51.00	51.00	Literature
Fencing/livestock exclusion without riparian buffer	55.00	55.00	55.00	SWAT
Fencing/livestock exclusion with riparian buffer	73.45	73.45	73.45	SWAT
Grassed Waterways	20.00	68.20	38.95	SWAT
Reduced P manure	0.30	17.79	4.95	SWAT
Riparian buffer	41.00	41.00	41.00	SWAT

Table LA-5 will show all RAPs and discuss RAP equivalent to the above BMPs as well as discussing other nutrient control requirements not represented here.

Table LA-5. BMPs associated with Required Agricultural Practice and best corresponding BMP presented in Scenario Tool.

Required Agricultural Practice	Corresponding BMPs
Nutrient Management Plan Development and Implementation (Reduced P Manure?) – for Certified Small Farm Operations	
Increase in Riparian Buffer (non-forested) on streams from 10-25ft for Small Farms.	
Ditch buffers on all farms (0-10ft)	
Cover crops on frequently flooded soils	
Reduced manure application timing on frequently flooded fields	
Increase in riparian buffer from 25ft-100ft on all annual cropland that has an average slope greater than or equal to 10% (not sure how this fits into the TMDL tracking). For small farms they will be going from 10'-100'.	
Gully stabilization on all farm fields (most commonly addressed through grassed waterways)	
Increased setbacks for construction of waste storage facilities from surface water (50' to 200')	
Increase setbacks for unimproved stacking of ag wastes from surface water (100' to 200')	
Cut erosion rates in ½ on small farms	
Livestock exclusion from production areas	
Partial livestock exclusion in pastures	

Wasteload Allocation

In this section, a description of the applicable agricultural phosphorus runoff control regulations will be provided Table WLA-1. In this instance, the only separable-applicable regulatory program is the NPDES Confined Animal Feeding Operation permit. As this program at present does not provide coverage for any Vermont facilities, the tabular representation will provide information regarding the numbers of farms, CAFO, LFO/MFO, or Certified Small.

Table WLA-1. Summary of Agricultural phosphorus loads and target reductions from production areas.

HUC12	Total load allocation	Total load, existing.	Number of facilities enrolled by Regulatory Program		
			CAFO	Farmstead – Medium Large	Farmstead - Small
00004050101	X kg/yr	X%			
4050102	Y kg/yr	Y%			
4050103	Z kg/yr	Z%			

Table WLA-2. SWAT estimated farmstead loading for the Lamoille basin HUC12s (all estimates are kg/yr)

HUC 12 NAME	Farmstead (Med/Large)	Farmstead (Small)	Total	Overall 80% TMDL Reduction
Headwaters Lamoille River	3	54	57	46
Hardwick Lake-Lamoille River	2	42	44	35
Wild Branch	0	28	28	23
Elmore Branch-Lamoille River	0	11	11	8
Green River	0	0	0	0
Ryder Brook-Lamoille River	0	40	40	32
Kenfield Brook-Lamoille River	10	48	57	46
Headwaters Browns River	0	48	48	38
Browns River	9	24	33	27
Gihon River	10	18	29	23
North Branch Lamoille River	0	22	22	18
Brewster River-Lamoille River	0	43	43	35
Seymour River-Lamoille River	0	51	51	41
Stones Brook-Lamoille River	26	43	69	55
Lamoille River	6	46	52	42
Unnamed	0	31	31	25
Unnamed	0	10	10	8
Total			**626**	**501**

Controlling Phosphorus from Developed Lands

In the LC TMDLs, all permissible developed land phosphorus loads are considered part of the wasteload allocation. As such, this section describes the four regulatory programs identified to address phosphorus and other impairment pollutant discharges from developed lands. They are the: Transportation Separate Storm Sewer System Permit (TS4); Municipal Roads General Permit;

Municipal Separate Storm Sewer Permit; and, the so-called Operational Three-acre Impervious Surface Permit.

As a generalized summary, Table WLA-3 indicates which regulatory program applies to which jurisdiction and the estimated modeled load for that jurisdiction where it is able to be determined.

Table WLA-3. Total Load and the Regulatory Programs applicable in each jurisdiction

Jurisdiction	Load reduction target (%)	Applicable Regulatory Program to address Phosphorus			
		TS4	MRGP	MS4	Three-acre designation
VTrans/State highways	20.5%	✓			
Essex				✓	
Milton				✓	
All other non-MS4 municipalities			✓		✓

Prior to discussing the permitting regulatory authorities and their specific areas of application, modeled loading across the entire basin can be visualized in Figure WLA-1. This map represents estimated annual phosphorus loading at the catchment scale with municipal boundaries overlain. This estimate includes loading from all areas of developed lands including roads and low and high density development. These areas are further described in the following Table WLA-4, whereby the top 20 TP loading catchments are presented. The last column shows the amount of TP reduced if the basin-wide developed lands TMDL allocation of 20.5% were applied to each of these catchments. Summarized at the bottom is the percentage, 28%, of total TP reduction identified in the TMDL that could be realized if the developed lands TMDL reduction of 20.5% were applied. In other words, if the basin-wide TMDL allocation of 20.5% reduction were applied to just these high exporting catchments, 28% of the total necessary reduction would be realized.

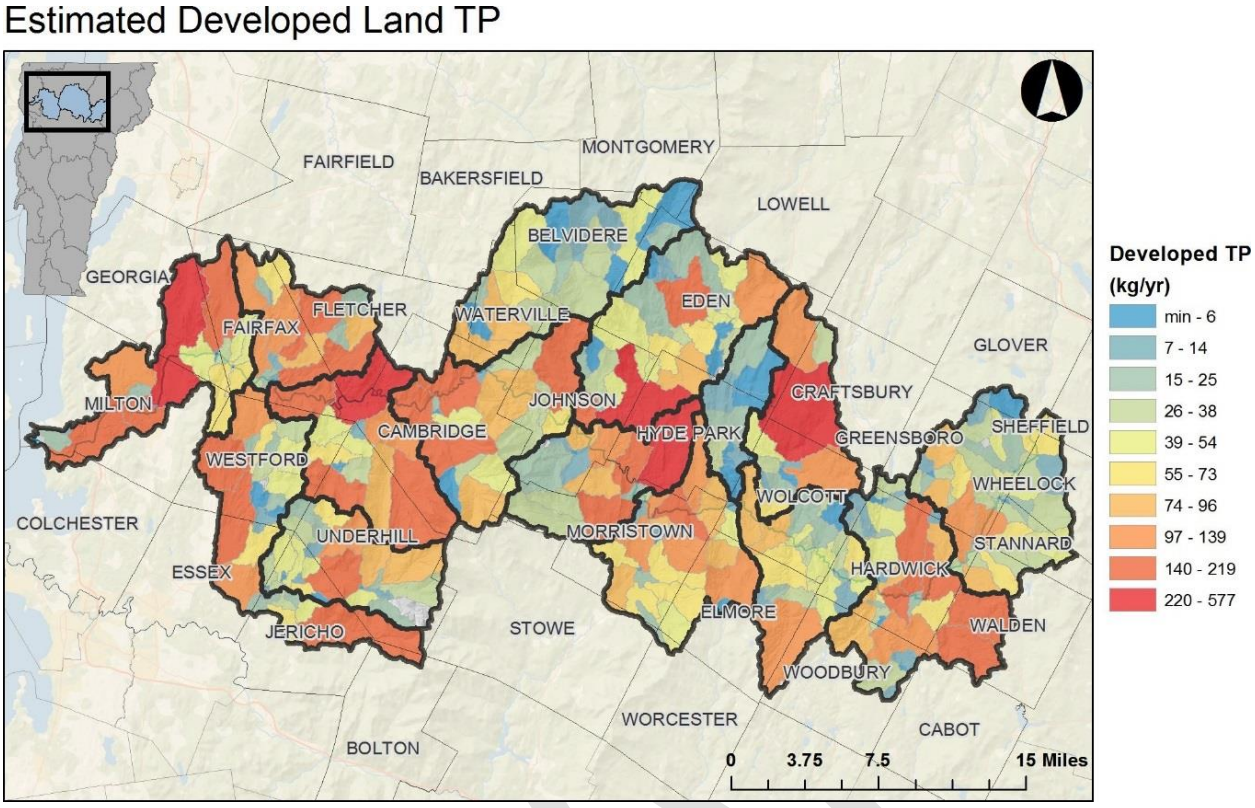


Figure WLA-1. Total developed land load from all sources in the Lamoille basin, at the catchment scale. HUC 12 basins are shown by bolded lines

Table WLA-4. Catchments with the highest estimated TP developed lands export. Catchments are associated with individual towns if the majority of the area of that catchment occurs within a given town boundary.

Catchment ID	Town Name	Developed Lands TP Load (kg/yr)	Developed lands TP reduction (20.5%) based on overall TMDL basin allocation (kg/yr)
4587258	Georgia	577	118
4586404	Hyde Park	457	94
4586342	Craftsbury	328	67
4586672	Fletcher	328	67
4586314	Hyde Park	311	64
4587264	Milton	219	45
4586304	Fairfax	217	44
4587514	Walden	214	44
4586458	Morristown	211	43
4587106	Fairfax	186	38
4587266	Milton	184	38
4586260	Fletcher	180	37
4586234	Eden	172	35
4586508	Cambridge	169	35

Catchment ID	Town Name	Developed Lands TP Load (kg/yr)	Developed lands TP reduction (20.5%) based on overall TMDL basin allocation (kg/yr)
4587552	Walden	169	35
4586386	Cambridge	167	34
4586410	Hyde Park	163	33
4587136	Westford	161	33
4586300	Johnson	159	33
4586560	Hardwick	158	32
Percent of total TP reduction if sector allocations are applied to these catchments			**28%**

Phosphorus Loading from Roads

Currently, TP loading estimates for roads only exist from the SWAT model which distinguishes only between paved and unpaved roads. Unfortunately, two of the primary phosphorus reduction regulatory programs related to roads, the MRGP and the TS4, are defined by more narrow parameters than just paved and unpaved. For example, the MRGP will apply to municipally managed roads, and require applicable practices to be applied to all roads that are "hydrologically-connected" to waterbodies, while the TS4 permit will only apply to state-managed roads.

Derived directly from the SWAT loading estimates, Figure WLA-2 identifies the range of catchment TP loading from roads, both paved and unpaved, across the Lamoille basin. A further breakdown of loading estimates is presented in Tables WLA-5 and WLA-6 whereby the top twenty highest roads loading catchments, paved and unpaved, are shown respectively along with the overall basin TP reduction necessary to comply with the developed lands allocation of 20.5%. If this overall 20.5% reduction were achieved for all these catchments, approximately 28% and 29% of the roads allocation for paved and unpaved roads respectively could be realized. However, for each catchment or municipality these are not actual allocations but rather opportunities. Actual reductions will be accounted for as the essential roads permits are implemented.

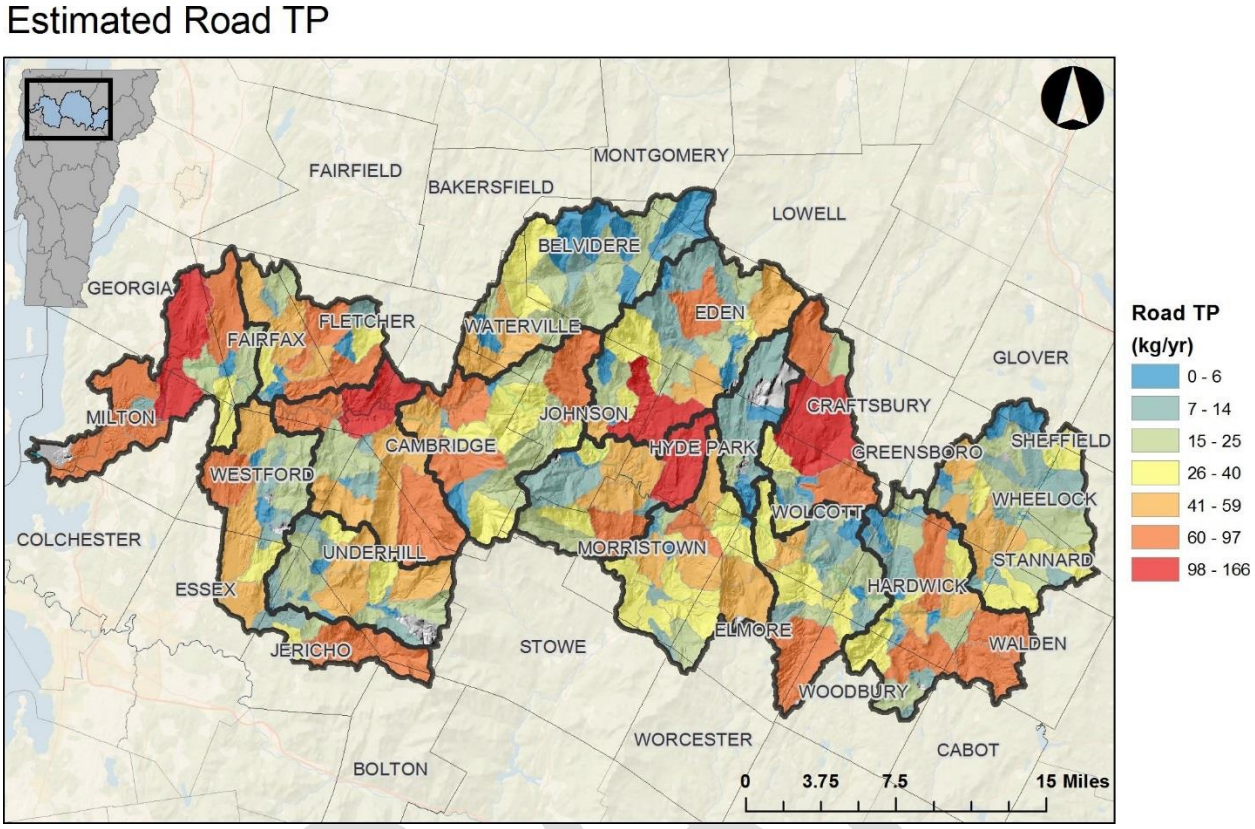


Figure WLA-2. Estimated SWAT loading from all paved and unpaved roads in the Lamoille basin at the catchment scale. Bolded lines represent the HUC12 watersheds.

Table WLA-5. Catchments with the highest estimated TP export from paved roads.

Catchment ID	Town Name	Paved TP Load (kg/yr)	Paved TP Reduction (kg/yr)
4586672	Georgia	144	29
4586342	Hyde Park	135	28
4586300	Craftsbury	122	25
4586314	Fletcher	118	24
4587552	Hyde Park	113	23
4587136	Milton	79	16
4587556	Milton	75	15
4586404	Elmore	70	14
4586254	Cambridge	69	14
4586508	Fairfax	67	14
4587512	Milton	63	13
4586260	Cambridge	60	12
4586386	Cambridge	60	12
4586560	Jericho	59	12
4586394	Walden	59	12
4587518	Fletcher	58	12

Catchment ID	Town Name	Paved TP Load (kg/yr)	Paved TP Reduction (kg/yr)
4586448	Johnson	58	12
4586468	Morristown	58	12
4586470	Fairfax	57	12
4586414	Wolcott	55	11
Percent of total TP reduction if sector allocations are applied to these catchments			**28%**

Table WLA-6. Catchments with the highest estimated TP export from unpaved roads.

Catchment ID	Town Name	Unpaved TP Load (kg/yr)	Unpaved TP Reduction (kg/yr)
4586672	Fletcher	40	8
4586342	Craftsbury	40	8
4586300	Johnson	39	8
4586314	Hyde Park	35	7
4587552	Walden	34	7
4587136	Westford	33	7
4587556	Jericho	32	7
4586404	Hyde Park	32	7
4586254	Eden	27	6
4586508	Cambridge	26	5
4587512	Hardwick	26	5
4586260	Fletcher	26	5
4586386	Cambridge	25	5
4586560	Hardwick	24	5
4586394	Wolcott	21	4
4587518	Elmore	21	4
4586448	Underhill	21	4
4586468	Underhill	20	4
4586470	Morristown	20	4
4586414	Morristown	20	4
Percent of total TP reduction if sector allocations are applied to these catchments			**29%**

In order to derive more detailed loading source estimates than those given above, it was necessary to apply a secondary analysis to the initial SWAT loading estimates. To further break down the SWAT loading data for paved and unpaved roads, the extent of VTrans-managed and municipal-managed paved roads was derived from a more detailed GIS analysis than that used in the model. Through this analysis, the estimated load was apportioned at a somewhat finer level. Although, when combining the separate data sources to estimate loads, there are unavoidable inconsistencies that become apparent. For example, there is not an exact fit between the input roads data for the two

methods and therefore results don't necessarily align. At this time and with the tools available, these issues are inherent in the analysis. However, it's believed that they provide good planning level information when considered across the entire basin.

State Managed Roads (Transportation Separate Storm Sewer System General Permit – TS4)

The TS4 is a new stormwater permit for all of VTrans owned and controlled infrastructure. As part of the permit, VTrans will develop comprehensive Phosphorus Control Plans (PCPs) for their developed land in each lake segment. This includes state roads, garages, park and rides, welcome centers, airports and sand and gravel operations. The plans will require inventories of all regulated surfaces, establishment of baseline phosphorus loading per lake segment, and a prioritized schedule for implementation of BMPs to achieve the lake segment percent phosphorus reductions.

To begin this assessment, VDEC estimated the miles of state roads per HUC12 in the Lamoille basin, given in Figure WLA-3 and which is also reflected in Table WLA-7. In order to provide some estimate of the overall basin loading at the bottom of the table, the hybrid analysis mentioned above was utilized with all the inherent inconsistencies. The noted load and estimated reduction provide a reasonable planning level loading estimate. As the TS4 permit evolves, VTrans will further delineate the number, location, and condition of drainage from state roads along with other non-road infrastructure.

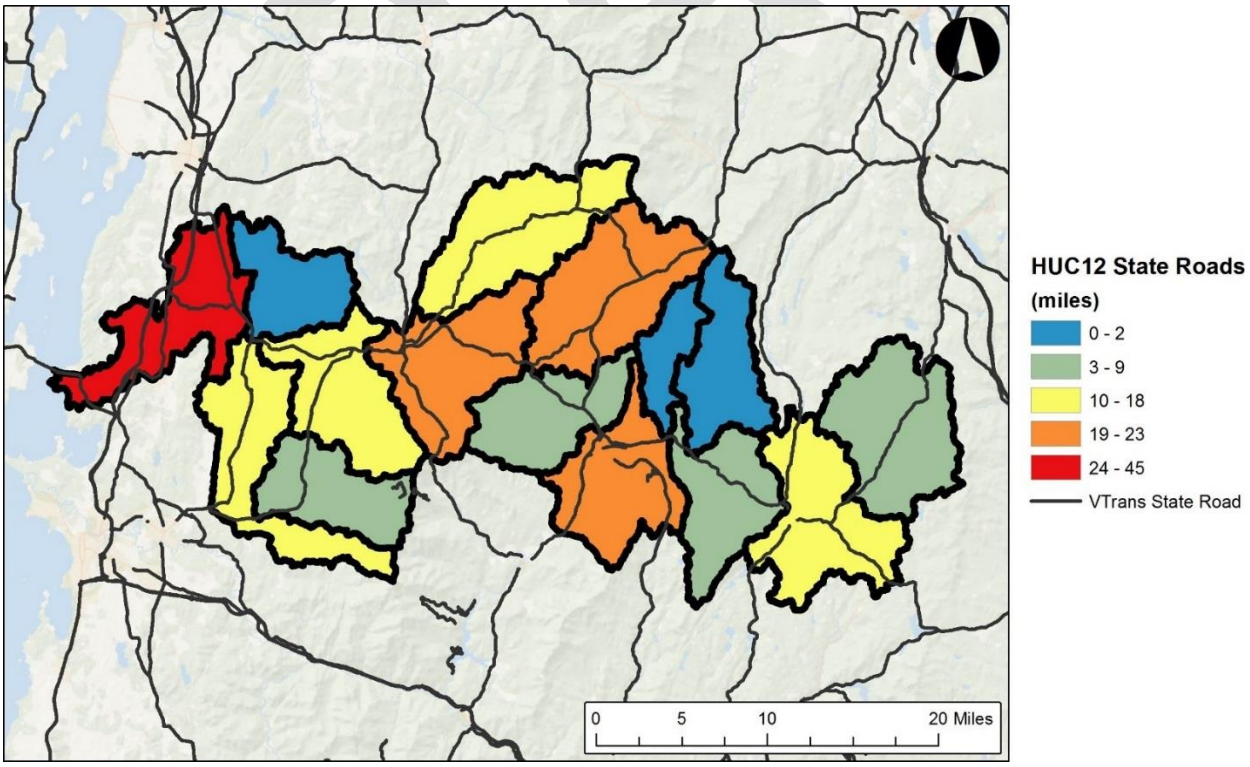


Figure WLA-3. Estimated mileage of state-managed roads summarized by HUC12 in the Lamoille basin.

Table WLA-7. Estimated miles for State-managed highways (this does not include other VTrans owned and controlled infrastructure)

HUC 12	River Name	State managed road miles
04050101	Headwaters Lamoille River	9.4
04050102	Hardwick Lake Dam-Lamoille River	18.0
04050103	Wild Branch	0.3
04050104	Elmore Branch-Lamoille River	8.6
04050105	Green River	0.1
04050106	Ryder Brook-Lamoille River	22.0
04050107	Kenfield Brook-Lamoille River	8.8
04050201	Headwaters Browns River	9.2
04050202	Browns River	13.9
04050301	Gihon River	21.0
04050302	North Branch LaMoille River	16.1
04050303	Brewster River-Lamoille River	23.1
04050304	Seymour River-Lamoille River	13.0
04050305	Stones Brook-Lamoille River	1.6
04050306	Lamoille River	44.9
Total miles VTrans managed roads		**210**
Total estimated P load from VTrans managed roads		**1925**
Total estimated reduction		**395**

Municipally Managed Roads (Municipal Roads General Permit)

The Municipal Roads General Permit is a new stormwater permit for all Vermont cities and towns that is intended to achieve significant reductions in stormwater-related erosion from municipal roads, both paved and unpaved. The permit will require each municipality to develop a road stormwater management plan to bring road drainage systems up to basic maintenance standards to stabilize conveyances and reduce erosion. The road management plan will require an inventory of municipal roads and current conditions, an identification of potential road best management practices (BMPs), and a prioritized implementation schedule to achieve the road standards. Implementation of the Municipal Roads General Permit by each municipality is estimated to achieve the 20.5% reduction of TP from the developed lands within the municipality.

The following maps and tables were developed to assist municipalities in setting priorities through the road management planning process. In order to break some of the basin roads loading data down to a town scale, the sum of loading from the catchments within that town needs to be calculated. Figure WLA-4 shows the primary watershed catchments within each town. For these calculations, a given catchment is associated to any given town if the majority of that catchment falls within that town. While not a perfect fit, it does provide a reasonable estimate of the modeled TP load for any given municipality. Based on this association of catchments related to towns, VDEC

was able to estimate the TP load coming from both paved and unpaved roads in each of the towns, shown in Table WLA-8. As towns implement road management plans and stabilize road networks, VDEC will be able to use this data to estimate the reductions in TP loading and confirm progress in meeting the LC TMDL.

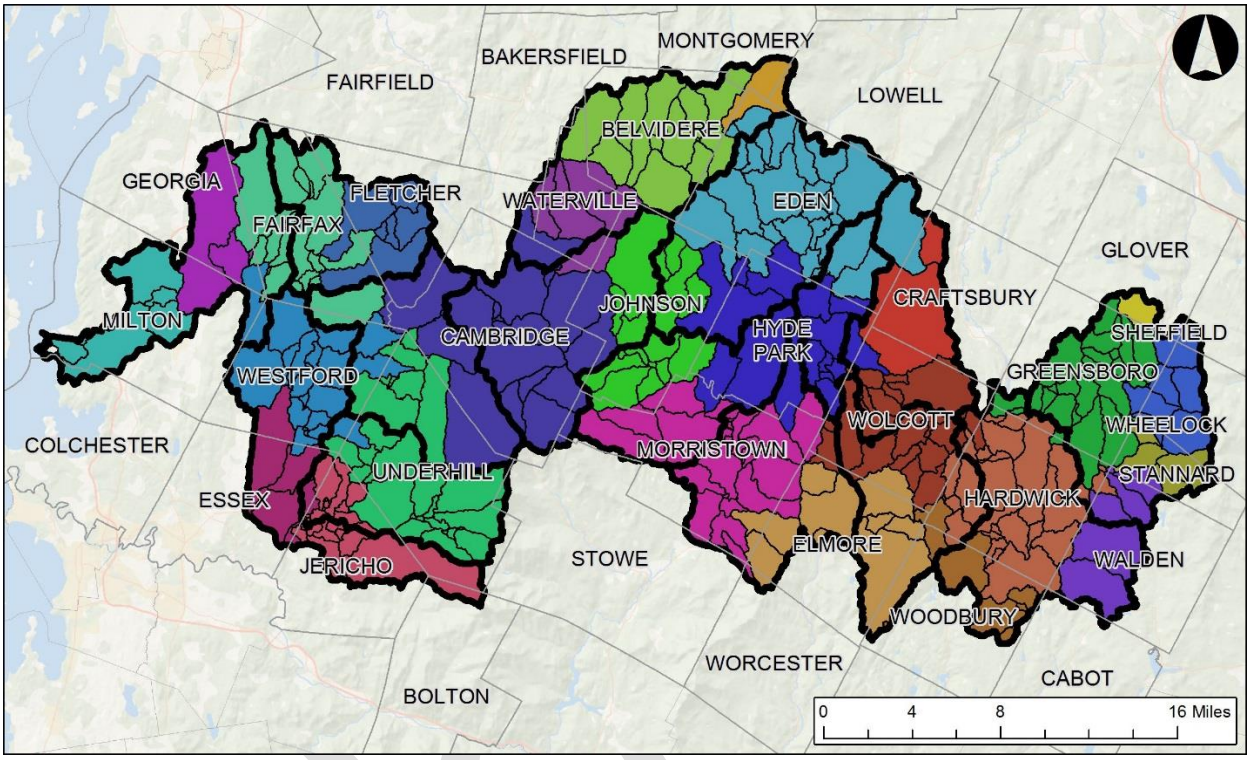


Figure WLA-4. Association of catchments to towns in the Lamoille Basin

Table WLA-8. SWAT loading for all non-VTrans managed roads occurring in each municipality (non-MS4)

Town	Municipal Paved Roads (kg/yr)*	Unpaved Roads (kg/yr)	Town	Municipal Paved Roads (kg/yr)*	Unpaved Roads (kg/yr)
Belvidere	4	43	Jericho	175	75
Cambridge	194	116	Johnson	118	100
Craftsbury	122	43	Montgomery	<1	<1
Eden	86	101	Morristown	310	136
Elmore	30	93	Stannard	1	31
Fairfax	232	87	Underhill	208	152
Fletcher	199	116	Walden	48	254
Georgia	64	17	Waterville	24	43
Glover	0	<1	Westford	26	112
Greensboro	168	136	Wheelock	0	28
Hardwick	179	145	Wolcott	94	99

Hyde Park	278	130		Woodbury	0	16
Total loading from all roads (kg/yr)			**4463**			
Total reduction based on overall basin allocation of 20.5% reduction (kg/yr)			**915**			

**these include a small proportion of paved private roads*

DEC developed remote sensing information for municipalities to initially identify hydrologically-connected road segments that have the potential to be at risk of erosion and may be a source of sediment and phosphorus pollution to surface waters. This estimated mileage, along with more detailed town maps, will help municipalities establish initial town road inventories and prioritize improvements. Results of this analysis are given in Table WLA-9. It should be noted that mileages are given for the entirety of each town, whether or not the whole town or just a part of it is in the basin.

Table WLA-9. Estimated mileage of hydrologically connected municipal road miles by town. These do not include state managed or private roads.

Town	Hydrologically-connected municipal road miles		Town	Hydrologically-connected municipal roads mile
Belvidere	7.3		Jericho	19.3
Cambridge	30.4		Johnson	24.0
Craftsbury	22.9		Milton	31.4
Eden	13.6		Montgomery	21.6
Elmore	12.9		Morristown	34.5
Essex	23.1		Stannard	7.1
Fairfax	22.0		Underhill	25.6
Fletcher	21.7		Walden	17.6
Georgia	27.3		Waterville	9.4
Glover	17.1		Westford	17.0
Greensboro	19.8		Wheelock	12.2
Hardwick	22.2		Wolcott	19.1
Hyde Park	24.3		Woodbury	27.8

Municipally-Separate Storm Sewer Systems (MS4)

The Municipal Separate Storm Sewer System permit is a permit for municipalities with census designated urbanized areas and stormwater impaired watersheds. Under the MS4 permit, those designated municipalities will be required to develop a comprehensive phosphorus control plans (PCP) to achieve the percent phosphorus reduction for their respective lake segment, on all developed land within the municipality. These municipalities will not need separate permit coverage under the Municipal Road Permit or the "3-acre designation," as these requirements will be

incorporated into the phosphorus control planning within the municipality. The PCPs will include requirements to inventory all developed land within the municipality, estimate phosphorus loading from developed land, and identify BMPs and an implementation schedule to achieve the required reductions. VDEC has developed initial estimated TP loads from developed land within each MS4 municipality, as shown below in Table WLA-10.

Table WLA-10. Estimated loading from developed land categories for MS4 communities. Loading only represents portions of the municipality that drains to the Lamoille basin.

MS4 Municipality	Paved road (excluding Vtrans managed roads) (kg/yr)	Unpaved roads (kg/yr)	Other developed lands (kg/yr)
Essex	30	37	260
Milton	181	18	373

Operational three-acre impervious surface permit program

The Stormwater Program will issue a general permit by January 2018 that will include a schedule by which owners of three or more acres of impervious surface will need to obtain permit coverage. Following issuance of the general permit, the Program will identify and notify affected owners. An impervious surface will require coverage under the three-acre permit if the impervious is not covered under a permit that incorporates the requirements of the 2002 Vermont Stormwater Management Manual (VSMM).

It is anticipated that the "three-acre impervious surface" program will address the developed lands phosphorus reductions necessary to achieve the TMDL that are not addressed by other developed lands programs. Ongoing tracking of implementation will be used to verify this projection. If additional reductions in phosphorus are required to implement the TMDL, developed lands permitting requirements may be adjusted accordingly, including requiring projects with less than three acres of impervious surface to obtain permit coverage

An initial estimate of parcels containing three or more acres of impervious was completed by TetraTech, Inc. with funding from EPA (Table WLA-11).

Table WLA-11. Estimated three-acre parcels and associated impervious cover for Lamoille basin towns within the Lamoille Basin.

Town	Parcels (#)	Impervious (acres)
Belvidere	2	16.3
Cambridge	6	70.7
Eden	7	67.9
Elmore	1	3.9
Essex	6	21.6
Fairfax	5	22.6
Georgia	4	24.3

Hardwick	6	34.2
Hyde Park	3	17.1
Jericho	3	91.3
Johnson	4	32.4
Milton	9	58.9
Morristown	15	80.4
Stowe	1	0.1
Westford	1	3.2
Wolcott	2	9.5
Total	**75**	**554.6**

The initial estimate of the three-acre parcel coverage will require additional screening by VDEC prior to notification of the affected parties. The analysis does not yet identify which impervious surfaces have permit coverage that incorporates the requirements of the 2002 VSMM. VDEC will also identify eligible impervious surfaces from existing permits that were not identified in the TetraTech analysis because the impervious surface is located on more than one parcel.

Controlling Phosphorus from Wastewater Treatment Facilities and Other Industrial Discharges

This section of the Phase II statement in each tactical basin plan is intended to provide additional information to readers regarding wastewater treatment facilities in the Lake Champlain Basin.

As of the issuance of this Plan, all facilities are presently operating under administrative continuance of existing permits, which were issued in conformance with the allocations in place under the remanded 2002 LC TMDL. The 2016 LC TMDL did not alter the allowable phosphorus discharge loads from WWTFs that discharge to Mallets Bay. The municipal wastewater discharge permits in place in the Lamoille Basin are shown in Table WLA-12.

As part of a necessary refinement of the facility-specific phosphorus wasteload allocations, WSMD, with assistance from certain municipalities, is conducting an extensive sampling effort to document the current loading conditions for phosphorus, and determine the "reasonable potential" that WWTP's have to cause or contribute to downstream water quality impairment. In addition, the forthcoming LC TMDL will present a wasteload allocation for phosphorus loads, to which each facility in the basin will adhere.

Table WLA-12. Summary of permit requirements for the wastewater treatment facilities in the Mallets Bay lake segment watershed.

Facility (permit ID)	Permit expiration date	Planned permit re-issuance year	Design flow MGD	IWC[1] 7Q10 /LMM	Current permitted load (mt P/yr)	TMDL WLA (mt P/yr)	2015 Flow (MGD)[2] / Percent of Design Flow	Treatment type	# of CSOs	Receiving water
Fairfax (3-1194)	9/30/10	2017-18	0.078	0.001/< 0.001	0.539	0.539	0.033 / 42%	Aerated lagoon	0	Lamoille River
Jeffersonville (3-1323)	3/31/10	2017-18	0.077	0.001/< 0.001	0.532	0.532	0.036 / 47%	Aerated lagoon	0	Lamoille River
Johnson (3-1149)	3/31/09	2017-18	0.270	0.029/0 .012	0.224	0.224	0.120 / 44%	Sequential batch reactor	0	Gihon River
Morrisville (3-1155)	12/31/13	2017-18	0.550	0.018/0 .007	0.352	0.352	0.221 / 40%	Sequential batch reactor	0	Lamoille River
Milton (3-1203)	12/31/10	2017-18	1.000	0.010/0 .004	0.829	0.829	0.245 / 25%	Sequential batch reactor	0	Lamoille River
Hardwick (3-1143)	12/31/09	2017-18	0.371	0.023/0 .009	0.410	0.410	0.220 / 59%	Aerated lagoon	0	Lamoille River
PBM Nutritionals (3-1209)	6/30/12	2017-18	0.425	NA	0.352	0.352	0.125 / 29%	Activated Sludge upgrade to Movable Bed Bio Reactor	0	Lamoille River

[1] 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.
[2] Million Gallons per Day

Facility-specific information

Upper Lamoille Waters

Hardwick WWTF

The Hardwick WWTF treatment system consists of two aerated lagoons and chlorine is used for disinfection followed by dechlorination. In summer 2015, the facility undertook two major maintenance projects with its lagoons. The first was to replace approximately 4,500 square feet of liner in lagoon #2 that incurred a major failure in 2014. The second project included significant removal of accumulated sludge in lagoon #2. The solids buildup had the potential to reduce the treatment facility's hydraulic detention time and removal efficiencies and was compounded by cold weather and ice.

Middle Lamoille Waters

Morrisville WWTF

The Morrisville WWTF underwent a major upgrade in 2008 whereby treatment technology changed from activated sludge with chlorination to sequential batch reactor with ultraviolet disinfection. A slight flow limit increase was permitted, from 0.425 to 0.550 million gallons per day (MGD). There are no combined sewer overflows (CSOs) associated with this facility.

Johnson WWTF

The Johnson WWTF operates with sequential batch reactor technology accompanied by ultraviolet disinfection. There are no CSOs associated with this facility.

Lower Lamoille Waters

Jeffersonville WWTF

The Jefferson WWTF provides secondary treatment by two aerated lagoons and disinfection through the addition of chlorine. The facility was constructed in 1989/1990 and there are three pump stations included in the collection system. A sludge removal project was conducted in 2004. There are no CSOs associated with this facility.

Fairfax WWTF

The Fairfax WWTF provides secondary treatment of municipal wastewater consisting of three aerated lagoons with liquid chlorine disinfection. Operation was initiated in 1980 and currently has three pump stations within the collection system. A sludge cleanout project was completed for all three lagoons in 2007. There are no CSOs associated with this facility.

Milton WWTF

The Milton WWTF was upgraded in 2006 when sequential batch reactor (SBR) technology replaced the aeration lagoon. Disinfection technology also changed from chlorine to ultraviolet disinfection. The facility has a septage receiving facility and does receive septage. There are no CSOs associated with this facility.

Summary

The information provided in the foregoing provides the best-available information regarding the locations of the Lamoille Basin where phosphorus loading is modeled to be greatest. This information is provided by source sector, and tied to the regulatory programs that are highlighted by Act 64 to compel phosphorus pollution reductions for each sector. An important consideration in the development of this modeling analysis is the pace at which the expected reductions may be achieved from any given sector. Generally, the Lake Champlain MDL is envisioned to be implemented over a 20-year timeframe. Figure A-4 provides a hypothetical representation of the

pace at which nutrient reductions may be achieved, informed by the timelines during which each regulatory program is being put into place.

The capability for the State to compel reductions in the first five-year iteration of this tactical plan cycle is limited by the timelines set forth by Act 64 for the establishment and re-promulgation of the permit programs. In other words, the State cannot compel, for example, the reduction of phosphorus from specific municipal road segments, until: 1) that permit program has been established; 2) the municipality has applied for coverage under that program; and, 3) the municipality has completed their road assessment, and staged a plan for implementation based on the most effective phosphorus reduction efforts. Figure TMDL 4 provides the timelines for permit promulgation, permit application and assessment/inspection, and implementation. These timelines do not, however, preclude any particular landowner or municipality from taking action sooner on specific projects, and many owners or municipalities have done so.

As has been described in this Chapter, a robust phosphorus reduction tracking approach is also being put into place to document implementation of on-the-ground practices and projects. It is through this tracking system that the real phosphorus reduction accomplishments will be documented over time, and reported publicly, as required by Act 64. As of this writing, the modeling and projected phosphorus reductions shown by this Chapter are the best information available to Vermonters, but remain a starting point. Future iterations of the Lamoille Tactical Basin Plan will provide augmented specificity in regards to phosphorus reductions achieved, reductions planned, and as appropriate, success stories documenting incremental water quality improvement.

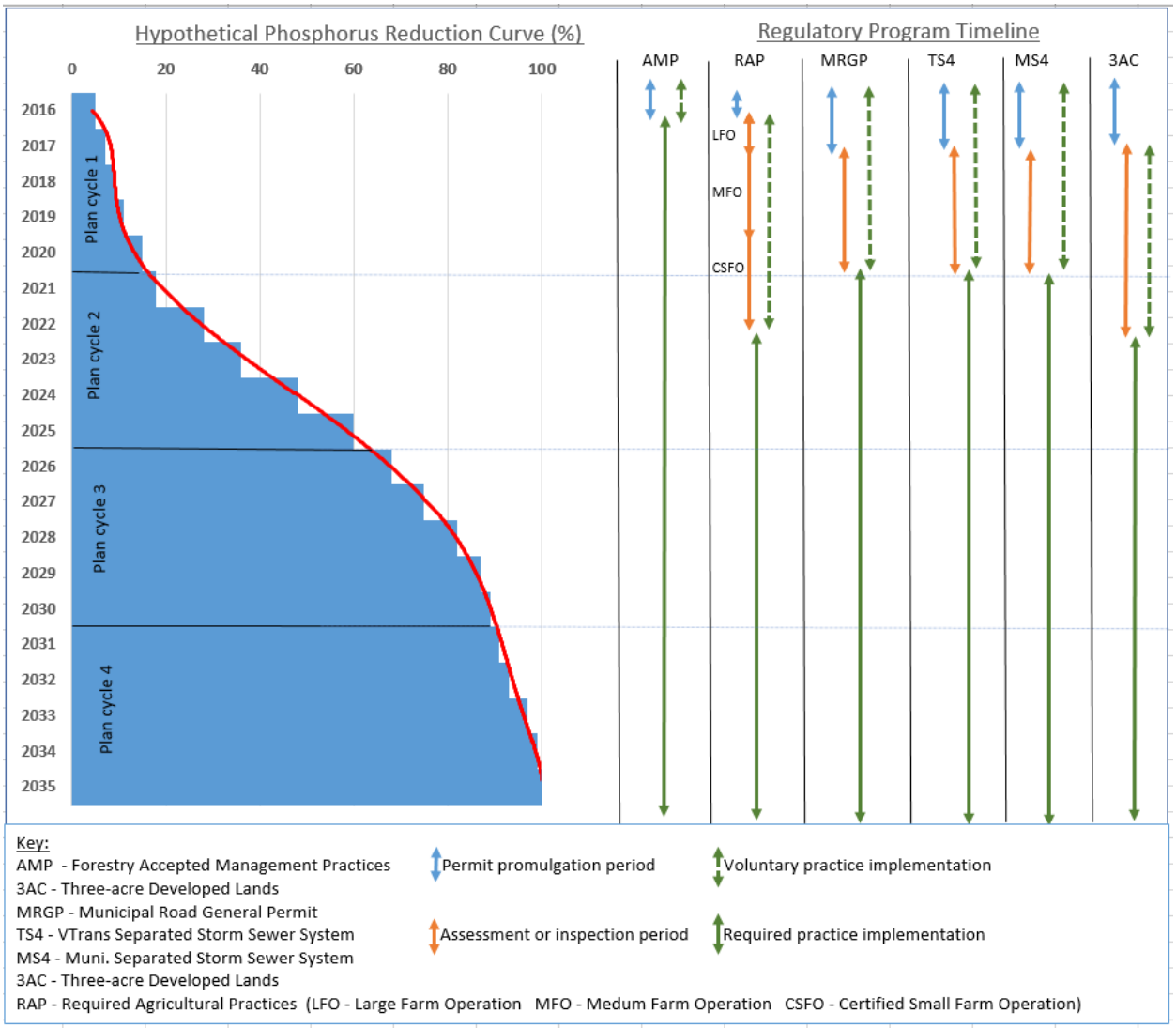


Figure TMDL4. Theoretical phosphorus reduction, relative to the load and wasteload reductions required by the LC TMDL. The timelines for regulatory programs are also shown.

Chapter 4 - Management Objectives for Surface Waters in the Lamoille River Basin

The Vermont Water Quality Standards establish water quality classes and associated management objectives. The protection or improvement of water quality and water-related uses can be promoted by establishing specific management objectives for particular bodies or stretches of water. The management objectives describe the values and uses of the surface water that are to be protected or achieved through appropriate management. In the Very High Quality Waters section of this plan, a number of waters are identified as being of notable high quality, and these, as well as other unique

areas, may be candidates for establishing alternate management objectives or augmented protections through one of the processes that are further described below.

- Opportunities for reclassification of waters
- Identification of existing uses
- Opportunities for designation of Outstanding Resource Waters
- Classification of wetlands
- Designation of waters as cold water fisheries

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 promote reclassification. 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.

A number of rivers and streams, lakes and ponds, and wetlands in the Lamoille River watershed currently achieve a very high quality of water and aquatic habitat and may also provide exceptional opportunities for swimming, fishing, and boating. In addition to protecting and improving water resources by managing stressors, there is the opportunity to protect surface waters by identifying and documenting this high quality and preserving those excellent conditions or features through various classifications or designations. Several statewide references and reports available with descriptions of the exceptional ecological quality or recreational uses of Vermont surface waters. The Agency's Natural Resource Atlas provides a statewide application identifying surface water and riparian areas with a high contribution to biodiversity.

A. Classification and Recent Proposed Revisions to the Vermont Water Quality Standards

Since the 1960s, Vermont has had a classification system for surface waters that establishes management goals objectives and supporting criteria for each use in each class of water 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 and A, 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, etc.) may be individually classified, such that a specific lake or stream may have individual uses classified at different levels. Act 79 indicates that uses may be reclassified independently to Class B(1) may be designated for individual uses if the quality of those uses are demonstrably and consistently of higher quality than Class B(2).

These waters and their elevated uses are identified through the tactical planning process. Waters where one or more uses exhibit a level of quality consistent with Class B(1) or Class A(1) criteria for designated uses are considered to support an equivalent existing use as that level of designated use. Waters whose existing uses have been identified as higher than B(2) may be reclassified to the corresponding level of designated use.

Table 19 lists the possible classes into which each use may be placed. These goals describe the class-specific uses of surface waters that are to be protected or restored through appropriate management practices. The Agency works to implement activities that restore, maintain or protect the management objectives The current classification system includes only three water quality classes: Class A(1), Class A(2), and Class B.

Table 19. 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

As of the writing of this draft Plan, the Vermont Water Quality Standards have been proposed to be amended to account for this change. The proposed new Standards feature four classes: A(1), A(2), B(1) and B(2), and have been restructured to clarify the quality criteria pertaining to each designated use, by class.

With the exception of the waters listed below, all waters in Basin 7 are Class B(2) pursuant to the proposed new Standards.

1) Waters above 2,500 feet in elevation classified A(1) by Vermont statute.

2) Surface waters classified as A(2) that are managed to be suitable for use as a public water source with disinfection, and filtration when necessary (Table 20).

Table 20. Class A(2) designated public water sources in the Lamoille Basin.

Waters	Water Source	Description	Approx. Miles/Acres
Upper Lamoille			
Unnamed Tributary to the Lamoille River	Village of Hardwick	(No longer used). Unnamed tributary to the Lamoille River and all waters in its watershed in Hardwick upstream of the water intake.	1.0 mile
Middle Lamoille			
Smith Brook	Village of Johnson	Smith Brook in Johnson and all waters in its watershed upstream of the water intake.	1.6 miles
French Hill Brook	Village of Johnson	French Hill Brook in Johnson and all waters in its watershed upstream of the water intake.	2.4 miles
Lower Lamoille			
Unnamed tributary to the Lamoille River	Village of Fairfax	(No longer used). Unnamed tributary to the Lamoille River and all waters in its watershed in Fairfax upstream of the water intake.	0.1 mile
Silver Lake	City of St. Albans (located in Georgia)	Silver Lake and all waters in its watershed in the Towns of Georgia and Fairfax.	30 acres (lake only)

Tactical basin plans identify surface waters where monitoring data indicates conditions are significantly better than the water quality objectives and criteria of the VT Water Quality Standards. This high-level of quality may be protected by site-specific application of the anti-degradation policy of the Standards, or by reclassification to a higher level designated use. Data analysis of water quality and biological integrity indicates that several waters in the Basin support very high quality conditions (Table 21). A similar analysis of lakes and ponds ranks lakes using long-term datasets for water quality, biological diversity and unusual or scenic natural features (Table 22). Scores from these separate categories are combined to identify lakes with exemplary qualities in all three, of which there are four in the Basin. Lastly, very high quality waters for supporting recreational fishing (Table 23) are included based on surveys from the VT Department of Fish and Wildlife.

Rivers - Biological integrity

There are several sub-watersheds in the Lamoille River watershed that support very high quality aquatic biota. VDEC assesses the biological health of running waters using assessments of macroinvertebrate and fish communities. Based on VDEC's long-term sampling of stream locations in the Lamoille River Basin, there are several streams that exhibit ecological integrity nearly consistent with very good or excellent conditions, based on these assessments (Table 21). Certain of these surface waters could qualify as candidates for reclassification to Class B(1) or A(1) with additional sampling.

Table 21. Basin streams that support exceptional ecological integrity. *

WB-ID	Name	Town	River mile (RM[1])	Score	Notes
UPPER LAMOILLE					
VT07-22	Sawmill Brook	Greensboro	1.8	Excellent-very good macroinvertebrates (2011) Excellent macroinvertebrates (2013)	Assess twice for fish
VT07-22	Lamoille River	Greensboro	80.8	Excellent macroinvertebrates (2013)	Assess once for macroinvertebrates and twice for fish
MIDDLE LAMOILLE					
VT07-04	Lamoille River	Johnson, Hyde Park Morristown	45.0 to 53.6	2 sites with excellent to very good macroinvertebrates (2011-2013)	Assess twice for fish if possible
VT07-06	Foote Brook	Johnson	2.6	Excellent-very good macroinvertebrates (2013)	Assess once for macroinvertebrates and twice for fish
VT07-06	Smith Brook	Johnson	0.9	Very good macroinvertebrates and fish (2013)	Assess fish and macroinvertebrates once more
VT07-06	Waterman Brook	Johnson	1.2	Excellent-very good macroinvertebrates (2013) Fish showed low density	Assess fish again at different site
VT07-13	Brewster River	Cambridge	4.2 to 5.0	Very good macroinvertebrates (2014)	Assess fish at at least two sites for two years, assess macroinvertebrates once more at two sites

WB-ID	Name	Town	River mile (RM[1])	Score	Notes
LOWER LAMOILLE					
VT07-02/04	Lamoille River	Georgia, Fairfax, Fletcher, Cambridge, Johnson	20.9 to 33.5	2 sites with excellent to very good macroinvertebrates (2011-2013);	Assess macroinvertebrates once more, Assess fish at all sites if possible
VT07-03	Stones Brook	Fletcher	5.2	Very good macroinvertebrates (2007)	Assess macroinvertebrates one more time and fish two more times

[1] RM = river mile as measured from the mouth upstream (or from the NY state line).

*Note - Biological data indicates a consensus very good or excellent condition by both fish and macroinvertebrates.

Lakes & Ponds

The Lakes and Ponds Program of VDEC completed a process in 2013 to identify high quality lakes in the state to prioritize conservation and protection efforts. Lakes were independently ranked in three separate categories using long-term datasets for water quality, biological diversity and unusual or scenic natural features (Table 22). Scores from the separate categories were combined to identify lakes with exemplary qualities in all three.

Table 22. Lakes and ponds in the Basin that exhibit Very High Quality based on Best Lakes analysis and current trends in water quality and shoreline conditions.

Lake/pond	Location	Supporting Data
UPPER LAMOILLE		
Long Pond	Greensboro	Top 25% for best lakes in VT: WQ=1, BD=5, USNF=1
Flagg Pond	Wheelock	Top 10% for best lakes in VT: WQ=3, BD=4, USNF=2
MIDDLE LAMOILLE		
Little Elmore	Elmore	Top 5% for best lakes in VT: WQ=2, BD=5, USNF=5
Schofield Pond	Hyde Park	Top 10% for best lakes in VT: WQ=1, BD=4, USNF=5
Zack Woods Pond	Hyde Park	Top 10% for best lakes in VT: WQ=3, BD=4, USNF=2

Lake/pond	Location	Supporting Data
Wolcott Pond	Wolcott	Top 25% for best lakes in VT: WQ=1, BD=5, USNF=1

Best Lakes Scores are presented under "Supporting Data" if lakes were ranked in any of three categories, along with the rank score from 1 (lowest) to 5 (best) in each: WQ - Water Quality, BD – Biological Diversity, USNF – Unusual or Scenic Natural Features. Lakes and ponds with a negative trend in water quality, aquatic invasive species, or shoreline conditions were not included in this list.

Very High Quality Waters Supporting Recreational Fishing

VT Department of Fish and Wildlife assesses wild trout populations and important nursery areas to document very high quality recreational fisheries, which are typically found in surface waters that exhibit clean and cool conditions. Abundant wild trout populations are defined as supporting multiple age classes of one or more species of wild trout (Brook, Brown, Rainbow Trout) at levels generally equal to or greater than 1,000 fish/mile and/or 20 pounds/acre. 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 a given year. Other waters that have not been surveyed may also support similar wild trout densities and may be identified in the future.

Certain noteworthy streams are also important to support spawning and nursery habitat for the Lamoille River watershed. Although, very high quality waters are being called out in this plan, it is important to note that all waterbodies that would naturally support fish populations are protected and maintained for this and future generations of people. Table 23 lists streams supporting both mixed resident trout, allopatric brook trout (populations with no other salmonids) and spawning/nursery stream populations. An updated survey of recreational fishery should be conducted regularly.

Table 23. Basin streams supporting very high quality mixed resident trout, allopatric brook trout and spawning/nursery stream populations.

Stream Surveyed	Sub-watershed (see figure 1)	Segment description
UPPER LAMOILLE		
Tate Brook	Headwaters Lamoille River	headwaters downstream to the mouth at Caspian Lake
Porter Brook	Hardwick Lake - Lamoille River	headwaters downstream to the mouth at Caspian Lake
Cooper Brook	Hardwick Lake - Lamoille River	headwaters downstream to the mouth
Haynesville Brook	Hardwick Lake - Lamoille River	headwaters downstream to the mouth
MIDDLE LAMOILLE		
Elmore Branch	Elmore Branch - Lamoille River	headwaters downstream to ~1.5 miles above the mouth
Gihon River	Gihon River	Eden Mills downstream to 2nd Route 100

Stream Surveyed	Sub-watershed (see figure 1)	Segment description
		crossing in Eden
Unnamed tributary at Mount Norris Boy Scout camp	Gihon River	headwaters downstream to the mouth at Lake Eden
Wild Brook	Gihon River	headwaters downstream to the mouth at the Gihon River
Brewster River	Brewster - Lamoille River	falls in Jeffersonville downstream ~1.1 miles to the mouth at the Lamoille River
Foote Brook	Brewster - Lamoille River	headwaters downstream to the mouth at the Lamoille River
Hunt Brook	Brewster - Lamoille River	headwaters downstream to the mouth at the Lamoille River
Judevine Brook	Brewster - Lamoille River	headwaters downstream to ~0.5 miles above the mouth
Kenfield Brook	Kenfield Brook - Lamoille River	headwaters downstream to the mouth at the Lamoille River
Perkins Brook	North Branch Lamoille River	headwaters downstream to the mouth at the North Branch
Taylor Brook	North Branch Lamoille River	headwaters downstream to the mouth at the North Branch
Seymour River	Seymour - Lamoille River	headwaters downstream to the confluence with Settlement Brook
Settlement Brook	Seymour - Lamoille River	headwaters downstream to the mouth at the Seymour River
LOWER LAMOILLE		
Stevensville Brook	Headwaters Browns River	headwaters downstream to the mouth at the Browns River
Browns River	Headwaters Browns River	headwaters downstream to Maple Leaf Road bridge, Underhill
Lee River	Browns River	headwaters downstream to the mouth at the Browns River

Critical Spawning Habitat and High Biological Diversity Waters

Middle and Lower Lamoille

The Lamoille River from Peterson Dam in Milton to the mouth should qualify for Critical Spawning and Nursery Waters as well as High Biological Diversity Waters. It is critical spawning habitat for

walleye. This reach also provides spawning and residence habitat for species with limited state distribution, including the endangered Lake Sturgeon, the threatened Eastern Sanddarter, Mottled Sculpin, and Shorthead Redhorse.

B. Existing Uses

All surface waters in Vermont are managed to support designated uses valued by the public at a level of Class B(2). These uses include swimming, boating, and fishing, aquatic biota, aquatic habitat, aesthetics, drinking water source and irrigation.

The degree of protection afforded to these uses is based on the water's class as described in Table 19. In addition, under the anti-degradation policy of the Vermont Water Quality Standards, if the Agency of Natural Resources identifies a waterbody with one or more uses that exceed the classification criteria for the designated use class, then those uses shall be protected to maintain that higher level of quality.

The Agency may identify existing conditions, known as existing uses, of particular 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 Vermont Water Quality Standards have always stipulated 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 the new Class B(1) in Act 79, the Agency will identify an existing use at Class B(1) levels when that use is demonstrably and consistently attained.

It is the Agency's long-standing stipulation that all lakes and ponds in the basin have existing uses of swimming, boating and fishing. Likewise, the Agency recognizes that fishing activities in streams and rivers are widespread throughout the state and can be too numerous to document. Also recognized is that streams too small to support significant angling activity provide spawning and nursery areas, which contribute to fish stocks downstream where larger streams and rivers support a higher level of fishing activity. As such, these small tributaries are considered supporting the use of fishing and are protected at a level commensurate with downstream areas.

Based on the above paragraph, the existing uses identified by VDEC for the Lamoille River Basin to date should therefore be viewed as only a partial accounting of known existing uses based upon limited information. The list does not change protection under the Clean Water Act or Vermont Water Quality Standards for waters not listed. Appendix F presents the current list of Existing Uses determined for the Lamoille Basin, while Tables 21-23 identify those surface waters where additional data will be obtained to demonstrate the consistent attainment of Class B(1) or A(1) criteria for aquatic life and wildlife. Table 24 lists identified surface waters that are classified as Class A(2) for public water supply, and where Class B(1) or B(2) management objectives may be more suitable.

Table 24. Candidate Surface Waters for Reclassification from Class A(2) to Class B.

Water	Location	Supporting Data
Unnamed Tributary to the Lamoille River	Fairfax	(No longer used). Unnamed tributary to the Lamoille River and all waters in its watershed in Fairfax upstream of the water intake.
Unnamed Tributary to the Lamoille River	Hardwick	(No longer used). Unnamed tributary to the Lamoille River and all waters in its watershed in Hardwick upstream of the water intake.

C. Outstanding Resource Waters

In 1987, the Vermont Legislature passed Act 67, "An Act Relating to Establishing a Comprehensive State Rivers Policy." A part of Act 67 provides protection to rivers and streams that have "exceptional natural, cultural, recreational or scenic values" through the designation of Outstanding Resource Waters (ORW). Depending on the values for which designation is sought, ORW designation may protect exceptional waters through the permits for stream alteration, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects and other activities. ORWs are waters which can be designated by the Agency of Natural Resources through a petition process. ORWs display outstanding qualities that are determined to deserve a higher level of protection. ORW designation may be based on any one or more of the following features:

1. existing water quality and current water quality classification;
2. the presence of aquifer protection areas;
3. the waters' value in providing temporary water storage for flood water and storm runoff;
4. the waters' value as fish habitat;
5. the waters' value in providing or maintaining habitat for threatened or endangered plants or animals;
6. the waters' value in providing habitat for wildlife, including stopover habitat for migratory birds;
7. the presence of gorges, rapids, waterfalls, or other significant geologic features;
8. the presence of scenic areas and sites;
9. the presence of rare and irreplaceable natural areas;
10. the presence of known archeological sites;
11. the presence of historic resources, including those designated as historic districts or structures;
12. existing usage and accessibility of the waters for recreational, educational, and research purposes and for other public uses;
13. studies, inventories and plans prepared by local, regional, statewide, national, or international groups or agencies, that indicate the waters in question merit protection as outstanding resource waters; and

14. existing alterations, diversions or impoundments by permit holders under state or federal law.

There are currently no ORW designated waters in the Lamoille River watershed. Two surface waters have been identified as prospective candidates for ORW, which are presented in Table 25. As part of the implementation of this tactical basin plan, the Department will evaluate the consistency of these surface waters with the features and values identified in prior ORW determinations. Surface waters that satisfy criteria for designation as ORW will be proposed for such designation through rulemaking. The waters in table 25 are not proposed for ORW, but are recommended for further study if there is adequate public support.

Table 25. Surface waters identified as prospective Outstanding Resource Waters needing further study

Water	Location	Supporting Data	ORW Feature
Lamoille River, river mile 15.7 through 80.8	Georgia, Fairfax, Fletcher, Cambridge, Johnson, Hyde Park, Morristown, Hardwick, Wolcott	Lamoille River Paddlers' Trail: Cambridge to Colchester Inventory and Assessment; Lamoille Uses and Values by McArdle	1, 7, 12
Zack Woods Pond	Hyde Park, Wolcott	Sentinel research site, top 10% state best lakes, unique natural features, Eden and Hyde Park town plans; VDEC Biomonitoring Data	1, 6, 7, 12

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

Class II: Merits protection, either taken alone or in conjunction with other wetlands

Class III: Neither a Class II or Class I wetland

Impacts to Class I wetlands may only be permitted when the activity is necessary to meet a compelling public need for health or safety. There are currently no Class I wetlands in the Lamoille River Basin, however, the Sandbar wetland complex has been recently proposed for reclassification by VDEC and may be integrated in the Vermont Wetland Rules this winter. As part of the

development of this tactical basin plan, there are a handful of wetlands that warrant study for Class I potential. These wetlands are listed below. More information can be found on each wetland in Appendix K.

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 I. 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.

The VT Wetlands Program has created a Class I website with an interactive map. This website has the determinations for the 3 existing Class I wetlands, and materials about the four candidates which are currently on public notice, including Sandbar Wetland Complex. Over time new materials will be added, such as, a Class I petition form and a list of other wetlands which likely qualify. The web address is: http://dec.vermont.gov/watershed/wetlands/class1wetlands.

Active Wetland Re-classification Efforts

- Sandbar Wetland Complex - currently in process for Class I

Wetlands for Further Study for Re-Classification to Class I

- Belvidere Bog and North Branch Wetlands Complex
- Molly Bog and Morristown Bog Complex
- Flagg Pond Cedar Swamp Complex in Wheelock

E. 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 (WQS):

Lamoille River Watershed

UPPER

- Flagg Pond in Wheelock
- Hardwick Lake and Tuttle Pond in Hardwick
- Horse Pond and Long Pond in Greensboro

MIDDLE

- Lake Elmore in Elmore
- Long Pond (Belvidere Pond) in Eden
- Wapanaki Lake in Wolcott

LOWER

- Lamoille River from the Peterson Dam in Milton to its confluence with Lake Champlain - June 1, through September 30, only.
- Arrowhead Mountain Lake in Milton and Georgia
- Halfmoon Pond in Fletcher

The WQS specifies a lower minimum dissolved oxygen concentration than waters in the remainder of the basin, which are Cold-Water Habitat. There are no proposed changes to warm water fish habitat designations at this time.

Cold-Water Fish Habitat

All waters not designated as warm water fish habitat above are designated as cold-water fish habitat for the Lamoille River Basin, as noted in the Vermont Water Quality Standards, 2014.

Chapter 5 – The Implementation Table: Protection and Remediation Actions

The tactical plan implementation table summaries (Tables 26-28) identify objectives for the Lamoille River Basin, and outline specific actions to achieve the stated objectives. Action items include both necessary data collection and assessment efforts, and specific implementation projects. These summary tables are intended to present a broad view of the ~1,300 individual project entries contained in the Watershed Projects database. VDEC and its partners will proceed to make progress in all areas of the summary table, and in so doing, endeavor to accomplish the incremental phosphorus reduction shown in Chapter 3 for this tactical basin plan cycle. Action items reflect many of the primary goals and objectives identified in the Statewide Surface Water Management Strategy. This following tables serve to identify high priority implementation actions 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. In order for these priorities to be achieved partners and stakeholders must help to carry out the actions identified in the basin plan.

A. Watershed Partners

There are several active organizations undertaking watershed monitoring, assessment, protection, restoration, and education and outreach projects in the Lamoille River Basin. These partners are non-profit, state, and federal organizations working on both private and public lands. A list of Lamoille Basin watershed Partners can be found in Appendix J.

B. Lamoille Basin Implementation Table Summary

A summary of priority actions to address water quality in the Lamoille Basin, organized by basinwide actions and major sub-basin actions, are identified in tables 26 and 27. The on-going detailed list of actions can be viewed via the Watershed Projects database.

The table is split into two major categories: **Project Identification, Development, and Implementation** and **Monitoring and Assessment**. There are eleven action types in the project table that correspond with the top priorities in the Lamoille Basin. These actions types can be accessed directly by clicking on the following bookmarks: address agricultural stressors; address stormwater issues; encourage stream equilibrium and wetland and river corridor protection; address invasive species; address lake and pond shoreland and lake habitat condition; address impaired waters, landfills, or hazardous waste sites; address flow altered waters; waters for public water source reclassification; protection and evaluation for ORW and reclassification; address forests and water quality; and support recreational uses. Clicking on the links provided in the "Source" columns supply the reader with supporting documentation or rationale for the action.

Project Identification, Development, and Implementation

Table 26. Project identification, development, and implementation priorities for the Lamoille River basin.

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
A. Actions to address agricultural stressors							
BASINWIDE							
A1	Lamoille Watershed with a focus on priority catchments	Establish Conservation Tillage/Cover Cropping Program for high priority sites along the Lamoille River	All towns with priority catchments	Watershed wide	Land erosion, nutrients	LC TMDL Modeling Tools	AAFM, NRCS, VDEC, LDDC, WNRCD
UPPER LAMOILLE							
A2	Porter Brook, Bailey Brook, Perkins Meadow Brook, Haynesville Brook	Map areas of corn-hay rotation, continuous corn, and continuous hay based on soil type located in floodable soils to identify cover crop and conservation tillage priorities in high priority catchments	Hardwick, Walden	Agricultural segments of watershed	Nutrients, encroachment, channel erosion, land erosion	LC TMDL Modeling Tools	AAFM, NRCS, CCNRCD, FSA
A3	Porter Brook, Bailey Brook, Perkins Meadow Brook, Haynesville Brook	Provide education and assistance to agricultural communities in priority watersheds on agricultural BMPs to meet TMDL requirements in high priority catchments	Hardwick, Walden	Agricultural segments of watershed	Technical assistance and education	LC TMDL Modeling Tools	AAFM, NRCS, VDEC, CCNRCD, UVM Extension
A4	Porter Brook, Bailey Brook,	Identify areas of nutrient input, identify high priority projects,	Hardwick, Walden	Agricultural segments of	Nutrients, encroachment,	LC TMDL Modeling Tools	AAFM, NRCS, VDEC, CCNRCD

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Perkins Meadow Brook, Haynesville Brook	and implement agricultural water quality practices in high priority catchments		watershed	channel erosion, land erosion		
MIDDLE LAMOILLE							
A5	Lamoille mainstem, Browns River, Centerville Brook, Lower Gihon, Middle Wild Branch	Map areas of corn-hay rotation, continuous corn, and continuous hay based on soil type located in floodable soils to identify cover crop and conservation tillage priorities in high priority catchments	Cambridge, Johnson, Morristown, Hyde Park, Wolcott, Craftsbury	Agricultural segments of watershed	Nutrients, encroachment, channel erosion, land erosion	LC TMDL Modeling Tools	AAFM, NRCS, LCCD, FSA
A6	Lamoille mainstem, Centerville Brook, Lower Gihon, Middle Wild Branch	Provide education and assistance to agricultural communities in priority watersheds on agricultural BMPs to meet TMDL requirements in high priority catchments	Cambridge, Johnson, Morristown, Hyde Park, Wolcott, Craftsbury	Agricultural segments of watershed	Technical assistance and education	LC TMDL Modeling Tools	AAFM, NRCS, VDEC, NRCDs, UVM Extension
A7	Lamoille mainstem, Centerville Brook, Lower Gihon, Middle Wild	Identify areas of nutrient input, identify high priority projects, and implement agricultural water quality practices in high priority catchments	Cambridge, Johnson, Morristown, Hyde Park, Wolcott, Craftsbury	Agricultural segments of watershed	Nutrients, encroachment, channel erosion, land erosion	LC TMDL Modeling Tools	AAFM, NRCS, VDEC, LCCD

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Branch						
LOWER LAMOILLE							
A8	Seymour River, Lamoille Mainstem, Beaver Meadow Brook, Deer Brook, Stones Brook, Mill Brook, Browns River	Map areas of corn-hay rotation, continuous corn, and continuous hay based on soil type located in floodable soils to identify cover crop and conservation tillage priorities in high priority catchments	Cambridge, Underhill, Jericho, Essex, Westford, Fletcher, Georgia, Fairfax, Milton	Agricultural segments of watershed	Nutrients, land erosion	LC TMDL Modeling Tools	AAFM, NRCS, VDEC, UVM Extension, FSA
A9	Seymour River, Lamoille Mainstem, Beaver Meadow Brook, Deer Brook, Stones Brook, Mill Brook, Browns River	Provide education and assistance to agricultural communities in priority watersheds on agricultural BMPs to meet TMDL requirements in high priority catchments	Cambridge, Underhill, Jericho, Essex, Westford, Fletcher, Fairfax, Milton	Agricultural segments of watershed	Technical assistance and education	LC TMDL Modeling Tools	AAFM, NRCS, VDEC, NRCDs
A10	Seymour River,	Identify areas of nutrient input, identify high priority projects,	Cambridge, Underhill,	Agricultural segments of	Nutrients, encroachment,	LC TMDL Modeling Tools	AAFM, NRCS, VDEC, WNRCD

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Lamoille Mainstem, Beaver Meadow Brook, Deer Brook, Stones Brook, Mill Brook, Browns River	and implement agricultural water quality practices in high priority catchments	Jericho, Essex, Westford, Fletcher, Fairfax, Milton	watershed	channel erosion, land erosion		
A11	Halfmoon Pond	Work with landowner to identify current sources of nutrients and employ practices to address the sources	Milton		Encroachment, nutrients	VDEC – Lakes and Ponds	AAFM, NRCS
B. Actions to address stormwater issues							
BASINWIDE							
B1	Middle Lamoille	Regional Hydroseeder Program	Regional		Land erosion, nutrients	LCCD, Municipalities	LCCD, VDEC
B2	Entire Watershed	Design and implement high priority projects identified in stormwater master plans and stormwater mapping reports	All towns with stormwater mapping and master plans		Land erosion, nutrients	LC TMDL Modeling Tools, Stormwater mapping and master plan reports	Municipalities, RPCs, VDEC, NRCDs
UPPER LAMOILLE							
B3	Greensboro Brook	Design and implement green stormwater infrastructure projects to mitigate stormwater runoff along	Greensboro	Waters downstream of town center	Land erosion, toxics, nutrients	Town of Greensboro select board	Town of Greensboro, ORNRCD, AOT Better Roads, VDEC

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
		Laurendon Avenue					
B4	Upper Lamoille River	Develop stormwater master plan for the Village of Hardwick and identify priority projects for mitigating runoff	Hardwick	The Lamoille River adjacent to the village of Hardwick	Land erosion, toxics, nutrients	Stormwater Master Planning, VDEC - Stormwater Mapping Reports	Town of Hardwick, CCNRCD, VDEC
B5	Caspian Lake	Install road erosion BMPs/SW GSI/gully erosion stabilization. *Can also be addressed through townwide road erosion inventory as well	Greensboro		Land Erosion	Caspian Lake Feeder Stream Study	Town of Greensboro, VDEC – Stormwater, Greensboro Land Trust
B6	Lamoille River and tributaries	Inventory and prioritize municipal road erosion features using VDEC's MRGP interim road erosion inventory guidance	Walden, Hardwick, Greensboro	All connected surface waters	Nutrients, land erosion, flood resiliency	LC TMDL Modeling Tools	NVDA, Municipalities, VDEC, CCNRCD, AOT Better Roads
B7	Stannard Brook	Develop a stormwater management project for implementation for the town sand storage area	Stannard	All connected surface waters	Nutrients, land erosion	VDEC Field identification	VDEC, CCNRCD, Town of Stannard
MIDDLE LAMOILLE							
B8	Middle Lamoille	Inventory and prioritize municipal road erosion features using VDEC's MRGP interim road erosion inventory guidance	Craftsbury, Hyde Park, Morristown	All connected surface waters	Nutrients, land erosion, flood resiliency	Road Erosion Inventories, LC TMDL Modeling Tools	Municipalities, VDEC, LCPC, LCCD, AOT Better Roads
B9	Middle	Implement high priority road	All Lamoille	All connected	Nutrients, land	Road Erosion	VDEC, LCPC,

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Lamoille	projects identified by road erosion inventories	County towns with a focus on Johnson, Hyde Park, and Cambridge	surface waters	erosion, channel erosion, encroachment	Inventories, Lamoille County Road Erosion Inventories, LC TMDL Modeling Tools	Municipalities
B10	Middle Lamoille	Develop stormwater master plans and identify priority projects for mitigating runoff using stormwater mapping information	Hyde Park, Morrisville, Johnson, Cambridge	Segments receiving road stormwater runoff waters in priority catchments	Nutrients, land erosion, encroachment	Stormwater Master Planning, VDEC - Stormwater Mapping Reports, LC TMDL Modeling Tools	Municipalities, VDEC, LCCD, LCPC
B11	Lamoille River	Wolcott Town Garage and Fire Station Stormwater management project	Wolcott	Lamoille Mainstem	Land erosion, nutrients	VDEC, AOT	Town of Wolcott, VDEC, LCPC
B12	Middle Lamoille	Implement priority projects identified in Stormwater Mapping reports	Hyde Park, Wolcott	Segments receiving road stormwater runoff in priority catchments	Nutrients, land erosion, encroachment	Stormwater Mapping in Basin 7, VDEC - Stormwater Mapping Reports	VDEC, LCPC, LCCD, Towns of Hyde Park and Wolcott
B13	North Branch Lamoille	Re-locate or build a salt shed for salt and sand storage for the Town of Belvidere	Belvidere		Nutrients, land erosion	VDEC Field identification	VDEC, LCPC, Town of Belvidere
B14	Elmore Lake	Develop a stormwater management project for the Elmore town garage sand storage area	Elmore	Segments receiving road stormwater runoff	Nutrients, land erosion	VDEC Field identification	VDEC, LCPC, LCCD, Town of Elmore
B15	Direct tributary to	Final design and implementation of stormwater	Johnson		Land erosion, channel erosion	Lamoille Stormwater Alternatives Project -	VDEC, LCCD, Johnson State

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Lamoille	projects identified for Johnson State College				Johnson State College Project Final Report	College
LOWER LAMOILLE							
B16	Deer Brook	Re-visit gully restoration design and review for implementation; implement stormwater priorities identified in the Georgia Stormwater Master Plan; work with AOT to replace eroding culverts on I-89	Georgia	Mouth to 2.5 miles upstream ***Impaired***	Nutrients, land erosion	Deer Brook Gully Remediation and Stormwater Treatment Report, Deer Brook Fluvial Erosion Hazard Mapping & Phase 2 Assessment Report, Georgia Stormwater Mapping Project, Georgia Stormwater Management Plan	VDEC, NRPC, Town of Georgia, Georgia Conservation Commission
B17	Direct tributary to the Lower Lamoille	Repair eroding access road in VTrans right-of-way along I-89 southbound	Milton	Tributary discharges into the Lamoille on the west side of the I-89 crossing on the south bank	Nutrients, land erosion	VDEC Field identification	VDEC, VTrans
B18	Streeter Brook	Identify potential sources of stormwater runoff and nutrient input and prioritize a list of actions to address sources	Milton	0.6 miles by falls north and south of Sanderson Rd. Stressed	Nutrients	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC, WNRCD, CCRPC, Town of Milton
B19	Lower Lamoille River	Continue to carry out the minimum control measures outlined the Milton	Milton		Nutrients, land erosion, encroachment	Stormwater Master Planning, Milton Stormwater	VDEC, Town of Milton, CCRPC

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
		Stormwater Management Plan and develop a phosphorus control plan for lands within the MS4 area.				Management Plan, VDEC Stormwater Program	
B20	Lower Lamoille River	Develop stormwater master plan using completed VDEC stormwater mapping and focus on priority catchments	Fairfax, Underhill, Jericho		Nutrients, land erosion	Stormwater Master Planning, VDEC - Stormwater Mapping Reports, LC TMDL Modeling Tools	VDEC – CWIP, Municipalities, CCRPC, NRPC
B21	Lower Lamoille and tributaries	Inventory and prioritize municipal road erosion features using VDEC's MRGP interim road erosion inventory guidance	Fletcher, Fairfax, Milton, Georgia, Westford	Segments receiving road stormwater runoff	Nutrients, land erosion, flood resiliency	LC TMDL Modeling Tools	Municipalities, VDEC, CCRPC, NRPC, AOT Better Roads
B22	Lower Lamoille and tributaries	Implement high priority road projects identified by road erosion inventories	Milton, Colchester, Westford, Jericho, Underhill, Essex	Segments receiving road stormwater runoff in high priority catchments	Nutrients, land erosion, channel erosion, encroachment	Road Erosion Inventories, LC TMDL Modeling Tools	VDEC, CCRPC, Municipalities
B23	Lower Lamoille and tributaries	Implement projects addressing vulnerabilities from water pollution from county and municipal All-Hazards Mitigation Plans	Milton, Colchester, Westford, Jericho, Underhill, Essex	Segments receiving road stormwater runoff	Nutrients, land erosion, flood resiliency	Chittenden County and Municipal Hazard Mitigation Plans	Municipalities, CCRPC, VDEC, AOT Better Roads
C. Actions to encourage stream equilibrium and wetland and river corridor protection							

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
BASINWIDE							
C1	Basinwide with a focus on target towns	Protect river corridors to support flood resiliency and river equilibrium in target areas	Hardwick, Wolcott, Johnson, Cambridge, Jeffersonville, Westford		Land erosion, encroachment, channel erosion	VDEC SGA and River Corridor Mapping, RPC Flood Resiliency Program	VDEC - Rivers, LCPC, CNRCD,
C2	Lamoille River	Assess and catalogue VFWD riparian/streambank parcels for streambank protection and potential easement opportunities	Multiple	Lamoille mainstem	Recreation, protection	VFWD, VDEC, Existing Uses, Appendix F	VDEC, VFWD
UPPER LAMOILLE							
C3	Hardwick Lake and Lamoille River	Propose and complete alternatives analysis for Jackson Dam	Hardwick	Hardwick Lake	Flood resiliency, channel erosion, flow alteration	Dam safety report	Town of Hardwick, Hardwick Electric, VDEC, CCNRCD, USFW, Army Corps of Engineers
C4	Caspian Lake	Work with landowners to determine flow levels that support aquatic habitat and lakeshore habitat protection	Greensboro	Caspian Lake outlet	Flow alteration	VDEC Rivers Program and Greensboro Land Trust site visit	VDEC, Greensboro Land Trust, Hardwick Electric
C5	Haynesville Brook	SGA and river corridor plan to identify stressors and priority projects to address stressors	Walden, Hardwick	Entire stressed segment ***Stressed***	Encroachment, flood resiliency, channel erosion, land erosion	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC – Rivers, CCNRCD, NVDA
C6	Tucker Brook	SGA and river corridor plan to identify stressors and priority	Hardwick	Entire stressed segment	Encroachment, flood resiliency,	VDEC Water Quality Assessment Report,	VDEC – Rivers, CCNRCD, NVDA

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
		projects to address stressors		***Stressed***	channel erosion, land erosion	2016 Stressed Waters List	
C7	Stannard Brook	SGA and river corridor plan to identify stressors and priority projects to address stressors	Wheelock, Stannard, Walden, Hardwick	Entire stressed segment ***Stressed***	Encroachment, flood resiliency, channel erosion, land erosion	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC – Rivers, CCNRCD, NVDA
C8	Upper Lamoille Mainstem	Follow up on preliminary management strategies identified in the Upper Lamoille River Phase 2 SGA	Greensboro, Hardwick		Reach 25A to 30B	Upper Lamoille River Phase 2 SGA	
C9	Upper Lamoille waters	Work with towns to consider joining the NFIP as part of an effort to increase ERAF rating	Wheelock, Walden		Flood resiliency	Municipal Protection Matrix, ERAF database	NVDA, Municipalities, VDEC - Rivers
C10	Upper Lamoille waters	Work with towns to adopt river corridor protection	Hardwick, Stannard, Wheelock, Walden, Greensboro, Craftsbury, Woodbury		Channel erosion, encroachment, flood resiliency, nutrients	Municipal Protection Matrix, ERAF database	NVDA, CVRPC, municipalities, VDEC – Rivers
C11	Upper Lamoille waters	Work with towns to add approved RPC flood resiliency section to town plan	Stannard, Walden, Craftsbury		Flood resiliency	Municipal Protection Matrix	NVDA, municipalities, VDEC – Rivers
C12	Upper Lamoille Waters	Adopt flood hazard by-law	Wheelock, Walden		Flood resiliency	Municipal Protection Matrix	NVDA, municipalities, VDEC – Rivers
MIDDLE LAMOILLE							
C13	Middle	Work with towns to consider	Eden,		Flood resiliency	Municipal Protection	LCPC,

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Lamoille waters	joining the NFIP as part of an effort to increase ERAF rating	Waterville			Matrix, ERAF database	Municipalities, VDEC - Rivers
C14	Middle Lamoille waters	Work with towns to adopt river corridor protection or strengthen existing river protection by-laws, setbacks, and zoning	Eden, Elmore, Wolcott, Johnson, Cambridge, Hyde Park, Morristown, Belvidere, Waterville		Channel erosion, encroachment, flood resiliency, nutrients	Municipal Protection Matrix, ERAF database	LCPC, municipalities, VDEC – Rivers
C15	Middle Lamoille waters	Work with towns to add approved RPC flood resiliency section to town plan	Elmore, Wolcott, Hyde Park, Cambridge, Waterville		Flood resiliency	Municipal Protection Matrix	LCPC, municipalities, VDEC – Rivers
C16	Middle Lamoille Waters	Adopt flood hazard by-law	Eden, Waterville		Flood resiliency, Encroachment	Municipal Protection Matrix	NVDA, municipalities, VDEC – Rivers
C17	Lamoille River, Wild Branch	Undertake flood modeling and alternatives analysis and implement best choices for flood resiliency, floodplain restoration, buyouts, protection (RCEs)	Wolcott, Johnson, Cambridge		Flood resiliency, land erosion, channel erosion, encroachment	RPC, Towns flooding history, High Meadows Project, Wild Branch River Corridor Plan	LCPC, Towns of Wolcott, Johnson, Cambridge
C18	Middle Lamoille waters	Implement high priority flood mitigation projects intenfied in the Jeffersonville Flood Mitigation Master Plan	Jeffersonville		Flood resiliency, land erosion	LCPC, Jeffersonville Flood Mitigation Master Plan	LCPC, VDEC, FEMA, Village of Jeffersonville

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
C19	Bunker Brook	SGA and river corridor plan to identify stressors and priority projects to address stressors	Hardwick	Stressed segment – 1.5 miles ***Stressed***	Encroachment, flood resiliency, nutrients, channel erosion, land erosion	2016 Stressed Waters List	VDEC – Rivers, CCNRCD, Town of Hardwick
C20	Kate Brook	SGA and river corridor plan to identify stressors and priority projects to address stressors	Woodbury, Hardwick	Stressed segment – 2.0 miles ***Stressed***	Encroachment, flood resiliency, nutrients, channel erosion, land erosion	2016 Stressed Waters List	VDEC – Rivers, CCNRCD, CCRPC Towns of Hardwick and Woodbury
C21	Seymour River	SGA and river corridor plan to identify stressors and priority projects to address stressors	Cambridge, Underhill		Channel erosion, encroachment, flood resiliency, nutrients	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC – Rivers, LCPC
C22	Ryder Brook	SGA and river corridor plan to identify stressors and priority projects to address stressors	Morristown	Focus area where stressors are located	Channel erosion, encroachment, flood resiliency, nutrients	VDEC	VDEC – Rivers, LCPC
C23	Brewster River	Scope and implement priority incomplete projects and actions identified in the River Corridor Plan	Cambridge	See report	Encroachment, flood resiliency, nutrients, channel erosion, land erosion	2015 Brewster River River Corridor Plan	VDEC – Rivers, LCPC, LCCD, Town of Cambridge, Smugglers Notch Resort
C24	Centerville Brook	Scope and implement priority incomplete projects and actions identified in the River Corridor Plan	Hyde Park	See report	Encroachment, flood resiliency, nutrients, channel erosion, land erosion	2010 Centerville Brook River Corridor Plan	VDEC – Rivers, LCPC, LCCD, Town of Hyde Park

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
C25	Elmore Branch	Scope and implement priority incomplete projects and actions identified in the River Corridor Plan	Elmore	See report	Encroachment, flood resiliency, nutrients, channel erosion, land erosion	2009 Elmore Branch River Corridor Plan	VDEC – Rivers, LCPC, LCCD, Town of Elmore
C26	Gihon River	Scope and implement priority incomplete projects and actions identified in the River Corridor Plan	Eden, Hyde Park, Johnson	See report	Encroachment, flood resiliency, nutrients, channel erosion, land erosion	2009 Gihon River River Corridor Plan	VDEC – Rivers, LCPC, LCCD, Towns of Eden, Hyde Park, and Johnson
C27	Rodman Brook	Scope and implement priority incomplete projects and actions identified in the River Corridor Plan	Morristown, Hyde Park		Toxics, encroachment, channel erosion	Rodman Brook River Corridor Plan	VDEC Rivers, VFWD, LCCD, LCPC, Towns of Morristown and Hyde Park
C28	Wild Branch	Scope and implement priority incomplete projects and actions identified in the River Corridor Plan	Wolcott, Craftsbury, Eden		Land erosion, encroachment, channel erosion	Wild Branch River Corridor Plan	VDEC Rivers, VFWD, LCCD, LCPC, Towns of Morristown and Hyde Park
C29	Lamoille River	Complete Lamoille River HUC 1 Corridor Plan and prioritize projects	Johnson, Cambridge, Fletcher, Fairfax, Georgia, Milton, Colchester		Encroachment, flood resiliency, nutrients, channel erosion, land erosion	VDEC, LCCD, LCPC	VDEC – Rivers, LCPC, LCCD, Municipalities
C30	North Branch	Identify target areas for	Cambridge	Stressed segment	Encroachment,	VDEC - Rivers	VDEC – Rivers,

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Lamoille	easements and river corridor protection and restoration and work with landowners to secure easements; SGA and river corridor plan to identify stressors and priority projects to address stressors		– 1.0 miles ***Stressed***	flood resiliency, nutrients, channel erosion, land erosion		LCPC, LCCD, VRC, Landowners
C31	Lamoille River	Scope and implement priority incomplete projects and actions identified in the HUC 2 Corridor Plan and prioritize projects	Hardwick, Wolcott, Hyde Park, Johnson		Encroachment, flood resiliency, nutrients, channel erosion, land erosion	VDEC, LCCD, Lamoille HUC 2 River Corridor Plan	VDEC – Rivers, LCPC, LCCD, Municipalities
LOWER LAMOILLE							
C32	Lower Lamoille waters	Work with towns to adopt river corridor protection	Georgia, Fletcher, Fairfax,		Channel erosion, encroachment, flood resiliency, nutrients	Municipal Protection Matrix, ERAF database	NRPC, municipalities, VDEC – Rivers
C33	Lower Lamoille waters	Work with towns to add approved RPC flood resiliency section to town plan	Fletcher, Fairfax		Flood resiliency	Municipal Protection Matrix	LCPC, municipalities, VDEC – Rivers
C34	Browns River	Scope, prioritize and implement projects identified in the Browns River Corridor Plan	Underhill, Jericho, Essex, Westford	from west of Jericho/Essex line up 7.5 miles and fluvial erosion hazard areas	Land erosion, channel erosion, thermal stress	Browns River Corridor Plans, 2016 Stressed Waters List, Chittenden County and Municipal Hazard Mitigation Plans	CCRPC, WNRCD, VDEC - Rivers
C35	Browns River	Identify and implement wetland restoration on high	Westford, Underhill,	Lower part of the watershed	Encroachment, nutrients	NRCS Wetland Restoration	VDEC, TNC, USFW, NRCS, AAFM

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
		priority sites identified by VDEC	Jericho, Essex			Identification, VDEC	
C36	Class II Wetlands in Lower Lamoille	Work with towns to update wetland mapping. Priority goes to towns with the highest coverage of wetlands, and highest development pressure	Milton, Westford, Essex, Underhill, Fairfax, Fletcher		Encroachment, flood resiliency	VDEC, VSWI	VDEC, CCRPC, WNRCD, Municipalities, Conservation Commissions
C37	Lower Lamoille waters	Work with towns to adopt river corridor protection or strengthen existing river protection by-laws, setbacks, and zoning	Westford, Underhill		Channel erosion, encroachment, flood resiliency, nutrients	Municipal Protection Matrix, ERAF database	CCRPC, municipalities, VDEC – Rivers
C38	Lower Lamoille waters	Work with towns to add approved RPC flood resiliency section to town plan	Milton		Flood resiliency	Municipal Protection Matrix	CCRPC, municipalities, VDEC – Rivers
C39	Lower Lamoille and tributaries	Implement projects addressing vulnerabilities from flooding and fluvial erosion from county and municipal All-Hazards Mitigation Plans	Milton, Colchester, Westford, Jericho, Underhill, Essex		Channel erosion, flood resiliency	Chittenden County and Municipal Hazard Mitigation Plans	Municipalities, CCRPC, VDEC, AOT Better Roads
D. Actions to address invasive species							
BASINWIDE							
D1	Entire Basin	Identify and treat purple loosestrife populations in wetlands and riparian areas	Multiple		Invasive species	VDEC, LCCD, USFW	LCCD, USFW
D2	Identified	Assess AIS on lakes and ponds	Multiple		Invasive species	VDEC – Lakes and	VCED – Lakes and

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Lakes and Ponds	with no data				Ponds	Ponds, Eco-Americorp
UPPER LAMOILLE							
D3	Lake Caspian	Continue to support greeter program and maintain AIS signage	Greensboro		Invasive species	VDEC – Lakes and Ponds	VDEC Public Access Greeter Program
D4	Hardwick Lake, Horse Pond, Long Pond, Nichols Pond	Maintain AIS signage	Hardwick, Greensboro, Woodbury		Invasive species	VDEC – Lakes and Ponds	VDEC-Lakes and Ponds
MIDDLE LAMOILLE							
D5	Long Pond	Manage and prevent AIS introduction	Eden		Invasive species	VDEC – Lakes and Ponds	VDEC Lakes and Ponds, Town of Eden, Pond User Group
D6	Lake Elmore	Continue to monitor and manage AIS	Elmore		Invasive species	VDEC – Lakes and Ponds	VDEC Public Access Greeter Program
D7	Lake Eden	Continue Public Access Greeter Program to prevent AIS introduction; install boat washing station	Eden		Invasive species	LCPC, VDEC – Lakes and Ponds;	VDEC Public Access Greeter Program
D8	Lake Eden, Green River Reservoir, Long Pond, Wolcott Pond	Maintain AIS signage	Eden, Hyde Park, Belvidere, Wolcott		Invasive species	VDEC – Lakes and Ponds	VDEC Lakes and Ponds

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
LOWER LAMOILLE							
D9	Arrowhead Mountain Lake 114 acres ***Altered***	Develop a lake association to work with VDEC to develop and invasive species management plan for the waterbody	Georgia, Milton		Invasive species	VDEC – Lakes and Ponds	VDEC Lakes and Ponds, Georgia and Milton Conservation Commissions
E. Actions to address lake and pond water quality and lake shoreland habitat condition							
UPPER LAMOILLE							
E1	Hardwick Lake	Determine what is causing the declining shoreland and lake habitat and make improvements	Hardwick		Encroachment	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds Monitoring and LakeWise Program, Town of Hardwick
E2	Lake Caspian	Initiate LakeWise Program to determine projects that will improve shoreland and lake habitat	Greensboro		Encroachment, land erosion	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds Monitoring and LakeWise Program, Town of Greensboro, Greensboro Land Trust
E3	Horse Pond	Determine what is causing the declining shoreland and lake habitat and make improvements if necessary	Greensboro		Encroachment	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds Monitoring, VFWD
E4	Nichols Pond	Determine what is causing the declining shoreland and lake habitat and make	Woodbury		Encroachment	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds Monitoring

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
		improvements if necessary					
E5	East Long Pond	Determine what is causing the declining shoreland and lake habitat and make improvements if necessary	Woodbury		Encroachment	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds Monitoring
MIDDLE LAMOILLE							
E6	Lake Elmore	Initiate LakeWise Program to determine projects that will improve shoreland and lake habitat and reduce sedimentation; Full lake assessment is recommended	Elmore		Encroachment	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds Monitoring and LakeWise Program, Elmore Lake Association, VDFPR, LCPC
E7	Lake Eden	Determine what is causing declining water quality, sedimentation, and shoreland and lake habitat trend and initiate the LakeWise Program; Full lake assessment is recommended	Eden		Encroachment, land erosion, nutrients	VDEC – Lakes and Ponds, VDEC Field identification	VDEC – Lakes and Ponds Monitoring and LakeWise Program; Lake Eden Lake Association, Town of Eden, LCPC
E8	South Pond	Determine what is causing the declining shoreland and lake habitat and make improvements	Eden		Encroachment, land erosion, nutrients	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds Monitoring and LakeWise Program
E9	Ritterbush Pond	Determine what is causing the declining shoreland and lake habitat trend and make improvements	Eden		Encroachment, land erosion	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds Monitoring and LakeWise Program, Johnson State

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
							College
E10	Lake Wapanacki	Determine what is causing the declining shoreland and lake habitat and make improvements	Wolcott		Encroachment	VDEC – Lakes and Ponds	VDEC- Lakes and Ponds LakeWise Program, Private landowners
LOWER LAMOILLE							
E11	Round Pond	Determine what is causing the declining shoreland and lake habitat and make improvements if necessary	Milton		Encroachment	VDEC – Lakes and Ponds	VDEC- Lakes and Ponds LakeWise Program
F. Actions to Address Impaired Waters, Landfills, or Hazardous Waste Sites							
MIDDLE LAMOILLE							
F1	Lowell asbestos mine-Hutchins Brook, Hutchins Brook Trib 4, Dark Branch	Continue to implement remediation measures to reduce erosion and tailing discharges	Eden	Hutchins Brook - river mile 2.0 to 3.0, Trib 4 - river mouth to river mile 0.3, Dark Branch - entire segment 3.3 miles	Restoration, Toxics	VDEC Water Quality Assessment Report, 2016 List of Priority Waters, Landfills & Hazardous Waste Sites	EPA, VDEC
F2	Gihon River	Assess condition of water quality at hazardous waste sites and remediate	Eden, Johnson	0.4 miles ***Stressed***	Restoration, Toxics	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC, Landowners
F3	North Branch	Continue monitoring surface waters and employ restoration	Waterville		Toxics (Volatile Organic	Landfills & Hazardous Waste Sites	VDEC, Landowners

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
		methods if needed			Compounds)		
F4	Mud Brook	Assess current condition of waters below Mud Brook Dam and evaluate dam removal	Morristown	0.5 miles ***Stressed***	Restoration, Iron	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC, VDFPR, LCCD
F5	Rodman Brook	Remediate landfill washout and ensure no further violations	Morristown	Mouth to river mile 0.6 ***Impaired***	Toxics	VDEC Water Quality Assessment Report, 2016 Stressed Waters List, Landfills & Hazardous Waste Sites	VDEC – Hazardous Waste, Landowners
F6	Tributary to Brewster River	Remediate iron impairment by developing and implementing a stormwater master plan	Cambridge	miles ***Impaired***	Restoration, Iron	VDEC Water Quality Assessment Report, 2016 List of Priority Waters	VDEC, Smugglers Notch Resort
LOWER LAMOILLE							
F7	Lamoille River Trib #4	Develop TMDL plan; Investigate area above the landfill	Milton	River mile 0.4 to 0.7 ***Impaired***	Restoration, Toxics	VDEC Water Quality Assessment Report, 2016 List of Priority Waters, Landfills & Hazardous Waste Sites	VDEC, Town of Milton
F8	Deer Brook	Re-visit gully restoration design and review for implementation; implement stormwater priorities identified in the Georgia Stormwater Master Plan; work with AOT to	Georgia	Mouth to 2.5 miles upstream ***Impaired***	Nutrients, land erosion	Deer Brook Gully Remediation and Stormwater Treatment Report, Deer Brook Fluvial Erosion Hazard	VDEC, NRPC, Town of Georgia, Georgia Conservation Commission

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
		replace eroding culverts on I-89				Mapping & Phase 2 Assessment Report, Georgia Stormwater Mapping Project, Georgia Stormwater Management Plan	
F9	Lower Lamoille	Re-sample the mercury impaired waters within the basin to update data.	Milton, Colchester	Mouth to Clarks Falls Dam 8.5 miles ***Impaired***	Toxics	2016 List of Priority Waters	VDEC, VFWD
G. Actions to Address Flow Altered Waters							
UPPER LAMOILLE							
G1	Caspian Lake	Evaluate best water level to maintain to have the least amount of impacts	Greensboro		Assess, restore, flow-alteration	VDEC - Rivers Program, Lakeshore landowners, Dams and Flow-Altered Waters	VDEC- Rivers and Lakes & Ponds Program, Hardwick Electric, Concerned lakeshore landowners
G2	Hardwick Lake	Town should consider an alternatives analysis; Re-assess town support based on current conditions	Hardwick		Assess, restore, flow-alteration	VDEC - Rivers and Dam Safety Programs, Dams and Flow-Altered Waters	VDEC - Rivers and Dam Safety Programs, Hardwick Electric, CCNRCD, Town of Hardwick
MIDDLE LAMOILLE							
G3	Lamoille	Pursue conservation flows	Hardwick,	Below Pottersville	Assess, restore,	2016 List of Priority	VDEC - Rivers,

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	River	through appropriate state regulatory processes and Hardwick Electric	Wolcott, Morristown	dam to Lake Lamoille 15.7 miles ***Altered***	flow-alteration	Waters, Dams and Flow-Altered Waters	Hardwick Electric
G4	Mud Brook	Assess current status of water quality and removal of dam	Morristown	0.5 miles	Assess, dam removal, flow-alteration	2016 Stressed Waters List, Dams and Flow-Altered Waters	VDEC - Rivers, Wetlands, & MAPP; VFPR
LOWER LAMOILLE							
G5	Lower Lamoille River	Resume monitoring to determine if dissolved oxygen levels meet WQS	Milton, Colchester	From Clarks Falls to Route 2 bridge 6 miles ***Impaired***	Assess, flow-alteration	2016 List of Priority Waters	VDEC – Rivers, CVPS
Waters for public water source reclassification							
UPPER LAMOILLE							
G6	Unnamed tributary to the Lamoille River	Town petition for reclassification of waters to B1 since it is no longer used as a water supply	Hardwick	Unnamed tributary to the Lamoille River and all waters in its watershed in Hardwick upstream of the water intake	Reclassification	VT Water Quality Standards, Existing Uses	Town of Hardwick, NVDA, VDEC
LOWER LAMOILLE							
G7	Unnamed tributary to the Lamoille River	Town petition for reclassification of waters to B1 since it is no longer used as a water supply	Fairfax	Unnamed tributary to the Lamoille River and all waters in its	Reclassification	VT Water Quality Standards, Existing Uses	Town of Fairfax, NRPC, VDEC

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
				watershed in Fairfax upstream of the water intake			
H. Actions for protection and evaluation for ORW and reclassification							
BASINWIDE							
H1	Basinwide	Complete monitoring to assess streams with exceptional ecological integrity for reclassification	Multiple	All surface waters identified in Table 21	Assess, protection	VDEC, Rivers - Biological Integrity	VDEC - MAPP
H2	Lamoille River	Evaluate for ORW	Multiple	River mile 15.7 to 80.8	Assess, protection	DEC Biomonitoring Data, Lamoille River Paddlers' Trail (LRPT): Cambridge to Colchester Inventory and Assessment, LRPT Website, Lamoille Uses and Values by McArdle	VDEC, LPTA, VRC
UPPER LAMOILLE							
H3	Flagg Pond Wetland Complex	Evaluate for Class I potential	Wheelock		Protection, assess	Class I Wetland Matrix, VDEC – Lakes and Ponds	VDEC, VFWD, VFPR
H4	Long Pond	Collect additional lakes data and report to support reclassification	Greensboro		Protection, monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds, Greensboro Land Trust, Town of Greensboro

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
MIDDLE LAMOILLE							
H6	Zack Woods Pond	Gather data and evidence for reclassification or ORW	Hyde Park, Wolcott		Protection, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds, Friends of Green River Reservoir, VFPR
H7	Schofield Pond	Gather data and evidence for reclassification and protect shoreline from new encroachments	Hyde Park		Protection, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds, Town of Hyde Park
H8	Little Elmore Pond	Gather data and evidence for reclassification to B1	Elmore		Protection, assess	VDEC – Lakes and Ponds	VDEC - Lakes and Ponds, Town of Elmore
H9	Molly Bog & Morristown Bog Complex	Evaluate for Class I potential	Morristown		Protection, assess	Class I Wetland Matrix, VDEC Water Quality Assessment Report	VDEC - Wetlands, Morristown Conservation Commission, UVM
H10	Wolcott Pond	Conserve and protect to prevent degradation to water quality and shoreland and lake habitat	Wolcott		Protect	VDEC – Lakes and Ponds	VDEC, Town of Wolcott, LCPC, LCCD, Friends of Wolcott Pond
H11	North Branch Wetland Complex	Evaluate for Class I potential	Belvidere		Protection, assess	Class I Wetland Matrix, VDEC, Town of Belvidere	Town of Belvidere, VDEC - Wetlands
LOWER LAMOILLE							
H12	Sandbar Wetland Complex	Petition for Class I wetland classification	Milton, Colchester		Protection	VDEC - Wetlands, Lower Lamoille Watershed, Basin 7 Watershed	VDEC – Wetlands, Friends of Lake Champlain, Lake Champlain Basin

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
						Assessment Report, Class I Wetland Matrix	Program, Town of Milton, Town of Colchester, WNRCD
H14	Hidden Swamp	Compile natural resource reports on the swamp and evaluate if wetland meets criteria for potential Class I determination	Milton, Westford		Protection, assess	Town of Westford	Towns of Milton and Westford, VDEC - Wetlands
I. Actions to Address Forests and Water Quality							
BASINWIDE							
I1	Basinwide	Protect headwaters and sensitive surface waters in large forest blocks through conservation easement and land acquisition	Belvidere, Waterville, Lowell, Eden, Johnson, Hyde Park, Underhill, Jericho, Elmore, Wheelock, Stannard, Walden	Headwaters and sensitive surface waters in target areas	Land erosion, encroachment	VFWD	VDEC, VDFPR, VDFW, Towns, Private Landowners, VLT, TNC
I2	Basinwide	Continue and expand the Portable Skidder Bridge Program where needed	All areas with forest manage-ment and timber harvest		Land erosion, channel erosion, encroachment	VDFPR	VDFPR, LCCD, VACD
I3	Basinwide	Identify sensitive surface water sites on UVA parcels and	All towns	All surface water sensitive to	Land erosion, channel erosion,	VDEC	VDEC, VDFPR

Table #	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
		develop outreach to protect identified areas		erosion	encroachment		
J. Actions to Support Recreational Uses							
BASINWIDE							
J1	Lamoille River	Increase recreational access to the Lamoille River – upgrade and establish access areas, portage trails and river campsites; develop and implement MWL area recreational plan which includes portages, access improvements and camp sites	Multiple	Lamoille mainstem from headwaters to mouth	Recreation	Lamoille River Paddlers' Trail Inventory and Assessment, LRPT website	LRPT, VDEC, VFWD, RPCs, NRCDs, MWL
J2	Lamoille River	Assess and catalogue VFWD riparian/streambank parcels for recreational opportunities	Multiple	Lamoille mainstem	Recreation, protection	VFWD, VDEC, Existing Uses, Appendix F	VDEC, VFWD

Monitoring and Assessment Needs

Table 28. Monitoring and assessment priorities for the Lamoille River basin.

#	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
UPPER LAMOILLE							
M1	Greensboro Brook	New monitoring site	Greensboro, Hardwick	At least one site on segment	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring

#	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
M2	Stannard Brook	Monitoring update	Stannard	River mile 3.0, ***Stressed***	Encroachment, channel erosion, land erosion	VDEC Water Quality Assessment Report	VDEC - Monitoring
M3	Lamoille River	Additional fish monitoring	Greensboro	River mile 80.8	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M4	Tucker Brook	New monitoring site	Hardwick	One site on segment closer to route 14 ***Stressed***	Channel erosion, land erosion, encroachment	VDEC Water Quality Assessment Report	VDEC - Monitoring
M5	Haynesville Brook	New monitoring site	Walden, Hardwick	Two sites; one in forested area upstream in Walden and second along Route 15 in Hardwick ***Stressed***	Encroachment, channel erosion, land erosion	VDEC Water Quality Assessment Report	VDEC - Monitoring
M6	Porter Brook	New monitoring site	Hardwick	At least one site	Encroachment	VDEC Water Quality Assessment Report	VDEC - Monitoring
M7	Flagg Pond Cedar Swamp	Wetland assessment, Class I evaluation	Wheelock		Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC – Wetlands Biomonitoring
M8	Long Pond	Collect additional lakes data and report to support reclassification	Greensboro		Protection, monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds, Greensboro Land Trust, Town of Greensboro
M9	Page Brook Cedar Swamp	Wetland assessment, Class I evaluation	Wheelock, Sheffield		Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC – Wetlands Biomonitoring
MIDDLE LAMOILLE							

#	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
M10	Centerville Brook	New monitoring site	Hyde Park, Morrisville	Site near Depot Street	Encroachment, nutrients, erosion	VDEC Water Quality Assessment Report	VDEC - Monitoring
M11	Waterman Brook	Additional fish monitoring at alternate site	Johnson	Close to river mile 1.2	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M12	Foote Brook	Additional bug and fish monitoring	Johnson	River mile 2.6	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M13	Rattling Brook	New monitoring site – potential high quality water	Belvidere	Above confluence with the North Branch	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M14	Calavale Brook	New monitoring site – potential high quality water	Belvidere	Above confluence with the North Branch	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M15	Basin Brook	Site sampled once in 1992. Density and richness metrics were not meeting goals.	Belvidere	River mile 0.5	Re-evaluate	VDEC Water Quality Assessment Report	VDEC - Monitoring
M16	North Branch Lamoille River	Site sampled for macroinvertebrates in 2013, need more data for reclassification	Waterville	River mile 2.0	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M17	Wild Brook (to Gihon R)	New monitoring site – potential high quality water	Johnson	Upstream of confluence with Gihon River above 100C	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M18	White Branch (to Gihon R)	New monitoring site – potential high quality water	Eden	Above confluence with the Gihon River	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M19	Gihon River	New monitoring site for lower part of the river	Johnson		Monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M20	Kenfield	Additional fish and bug data for	Morristown	River miles 0.2 and	Monitor, assess	VDEC Water Quality	VDEC - Monitoring

#	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	Brook	each site		1.5		Assessment Report	
M21	Mud Brook	Re-sample 2002 site, need current data to determine status for dam removal	Morristown	0.5 miles ***Stressed***	Monitor, assess	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC - Monitoring
M22	Rodman Brook	Continue monitoring after restoration	Morristown	0.6 miles ***Impaired***	Monitor, assess	VDEC Water Quality Assessment Report, 2016 Stressed Rivers List	VDEC - Monitoring
M23	Wild Branch	Sample river mile 0.1 and one site upstream	Wolcott	River mile 0.1	Monitor, assess	VDEC Water Quality Assessment Report, 2016 Stressed Waters List, Wild Branch River Corridor Plan	VDEC - Monitoring
M24	Green River	Sample a second time for fish and macroinvertebrates	Hyde Park	River mile 2.9	Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M25	Little Elmore Pond	Assess water quality	Elmore		Protection, monitor, assess	VDEC – Lakes and Ponds	VDEC - Lakes and Ponds, Town of Elmore
M26	Big Muddy Pond	Assess water quality and AIS	Eden		Monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds, Johnson State College
M27	Ritterbush Pond	Assess water quality	Eden		Monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds, Johnson State College
M28	Long Pond	Assess shoreland and lake habitat	Eden		Monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds
M29	Mud Pond	Assess water quality and AIS	Hyde Park		Monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds

#	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
M30	Lake-of-the-Clouds	Continue to monitor for acidity	Cambridge		Monitor	VDEC Water Quality Assessment Report	VDEC - Monitoring
M31	Lake Lamoille	Assess water quality and shoreland and lake habitat	Morristown		Monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds, Monitoring and LakeWise Program
M32	North Branch Wetland Complex	Wetland Assessment, Class I evaluation	Belvidere		Protection, monitor, assess	VDEC, Town of Belvidere	Town of Belvidere, VDEC - Wetlands Biomonitoring
M33	Molly Bog & Morristown Bog Complex	Wetland Assessment, Class I evaluation	Morristown		Protection, monitor, assess	VDEC Water Quality Assessment Report	VDEC - Wetlands Biomonitoring, Morristown Conservation Commission
LOWER LAMOILLE							
M34	Stones Brook	New monitoring site – need data to assess nutrient enrichment	Fletcher	Headwaters	Monitor, assess	VDEC – Lakes and Ponds	VDEC - Monitoring
M35	Stevensville Brook	Site last sampled for macroinvertebrates in 2007, need more data for current status	Underhill, Stowe	3.0 miles from headwaters downstream ***Stressed***	Acidity, channel erosion	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC - Monitoring
M36	Streeter Brook	New monitoring site – need data to assess stressed site upstream	Milton	RM 0.6 and another site upstream of sub-division	Monitor, assess	VDEC Monitoring Data	VDEC - Monitoring
M37	Beaver Meadow Brook	New monitoring site(s)	Underhill, Westford, Fairfax	One or two new sites in Westford and Fairfax	Monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring

#	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
M38	Silver Lake	Assess water quality and aquatic invasive species	Georgia		Monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds
M39	Arrowhead Mountain Lake	Assess shoreline condition	Georgia, Milton		Monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds
M40	Round Pond	Review shoreline data for recommendations on decreasing trend	Milton		Monitor, assess	VDEC – Lakes and Ponds	VDEC – Lakes and Ponds
M41	Lamoille Trib #4	Continue to monitor sites associated with landfill and upstream from the landfill, investigate sources of contaminants, and develop plan to address sources	Milton	River mile 0.4 to 0.7 ***Impaired***	Monitor, assess / metals	VDEC Water Quality Assessment Report, 2016 Priority Waters List	VDEC, Town of Milton
M42	Lee River	Need one more data point for macroinvertebrates and fish for potential reclassification	Jericho	River mile 2.8	Monitor, assess	VDEC Water Quality Assessment Report	VDEC - Monitoring
M43	Deer Brook	Sample below Deer Brook Gully if remediation measures are implemented before sampling rotation	Georgia	Below "Deer Brook Gully"	Monitor, assess	2016 Priority Waters List	VDEC - Monitoring
M44	Towne Swamp	Wetland Assessment, Class I evaluation	Milton, Westford		Protection, monitor, assess	Lower Lamoille Watershed; Basin 7 Watershed Assessment Report	VDEC, Towns of Milton and Westford
M45	Hidden Swamp	Wetland Assessment, Class I evaluation	Milton, Westford		Protection, assess	Town of Westford	Towns of Milton and Westford, VDEC - Wetlands
M46	Lamoille	Continue to monitor at RM	Georgia,	River mile 15.7 to	Monitor, assess	VDEC Water Quality	VDEC - Monitoring

#	Waterbody	Project Description	Town(s)	Stream segment	Activity/ Stressor addressed	Source	Current or Potential Partners
	River	19.3, need additional bug data for reclassification	Fairfax, Fletcher, Cambridge	33.5		Assessment Report	

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Appendix A. List of Acronyms

319	Federal Clean Water Act, Section 319
604(b)	Federal Clean Water Act, Section 604b
AAFM	Agency of Agriculture, Food, and Markets
AAPs	Accepted Agricultural Practices
AEM	Agricultural Environmental Management
AEP	American Electric Power
AMA	Agricultural Management Assistance Program
AMPs	Acceptable Management Practices (for logging)
ANR	Agency of Natural Resources
ANS	Aquatic Nuisance Species
AOP	Aquatic Organism Passage
ARS	Agricultural Resource Specialists
BASS	VDEC Biomonitoring and Aquatic Studies Section
B&C	Bridge and Culvert
BBR	Better Backroads
BCCD	Bennington County Conservation District
BCRC	Bennington County Regional Commission
BKWA	Batten Kill Watershed Alliance
BMP	Best Management Practices
CCPI	Cooperative Conservation Partnership Initiative
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
CWIP	Clean Water Initiative Program
CWSRF	Clean Water State Revolving Fund
DEC	Vermont Department of Environmental Conservation
DFPR	Vermont Department of Forests, Parks and Recreation
DFW	Vermont Department of Fish and Wildlife
DPW	Department of Public Works
DWSRF	Drinking Water State Revolving Fund
EBTJV	Eastern Brook Trout Joint Venture
EQIP	Environmental Quality Incentive Program
EPA	Environmental Protection Agency
ERAF	Emergency Relief and Assistance Fund
ERP	Ecosystem Restoration Program
EU	Existing Use
FAP	Farm Agronomic Practices
FEH	Fluvial Erosion Hazard

FERC	Federal Energy Regulatory Commission
FPR	Department of Forests, Parks, and Recreation
FSA	Farm Service Agency (USDA)
GIS	Geographic Information System
GSI	Green Stormwater Infrastructure
IDDE	Illicit Discharge Detection (and) Elimination
LFO	Large farm Operation
LID	Low Impact Development
LiDAR	Light Detection and Ranging
LIG	Local Implementation Grants (LCBP)
LIP	Landowner Incentive Program
LTP	Land Treatment Planner
LWD	Large Woody Debris
MAPP	Monitoring, Assessment and Planning Program
MFO	Medium Farm Operation
MWL	Morrisville Water & Light
NEMO	Nonpoint Education for Municipal Officials
NFIP	National Flood Insurance Program
NMP	Nutrient Management Plan
NEGEF	New England Grassroots Environmental Fund
NFWF	National Fish and Wildlife Foundation
NOFA	Northeast Organic Farming Association of Vermont
NPDES	National Pollution Discharge Elimination System
NPS	Non-point source pollution
NRCD	Natural Resource Conservation District
NRCS	Natural Resources Conservation Service
(NY) DEC	New York Department of Environmental Conservation
ORW	Outstanding Resource Water
PDM	Pre-Disaster Mitigation
PFW	Partners for Fish and Wildlife
RTE	Rare, Threatened and Endangered Species
RCP	River Corridor Plan
RMP	River Management Program
RPC	Regional Planning Commission
SEP	Supplemental Environmental Program
SFO	Small Farm Operation
SGA	Stream Geomorphic Assessment
SPA	Source Protection Area
SVNMP	Southern Vermont Nutrient Management Program
SWCD (NY)	Soil and Water Conservation District (New York)

SWMP	Stormwater master plans
TFS	Trees for Streams
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TU	Trout Unlimited
USDA	United States Department of Agriculture
USDA – NRCS	US Department of Agriculture – Natural Resource Conservation District
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
USGS	United States Geological Survey
UVA	Use Value Appraisal program, or Current Use Program
UVM	University of Vermont
VAAFM	Vermont Agency of Agriculture, Food and Markets
VABP	Vermont Agricultural Buffer Program
VANR	Vermont Agency of Natural Resources
VDEC	Vermont Department of Environmental Conservation
VDHP	Vermont Department of Historic Preservation
VDH	Vermont Department of Health
VEM	Vermont Emergency Management
VFB	Vermont Farm Bureau
VFWD	Vermont Fish and Wildlife Department
VGS	Vermont Geological Survey
VHCB	Vermont Housing and Conservation Board
VHQW	Very high quality waters
VINS	Vermont Institute of Natural Science
VIP	Vermont Invasive Patrollers
VLCT	Vermont League of Cities and Towns
VLRP	Vermont Local Roads Program
VLT	Vermont Land Trust
VRC	Vermont River Conservancy
WWLG	Warm water low gradient

Appendix B. Glossary

10 V.S.A., Chapter 47 - Title 10 of the Vermont Statutes Annotated, Chapter 47, Water Pollution Control, which is Vermont's basic water pollution control legislation.

Accepted Agricultural Practices (AAP) - land management practices adopted by the Secretary of Agriculture, Food and Markets in accordance with applicable State law.

Acceptable Management Practices (AMP) - methods to control and disperse water collecting on logging roads, skid trails, and log landings to minimize erosion and prevent sediment and temperature changes in streams.

Aquatic biota - all organisms that, as part of their natural life cycle, live in or on waters.

Basin - one of fifteen planning units in Vermont. Some basins include only one major watershed after which it is named such as the Lamoille River Basin. Other Basins include two or major watersheds such as the Poultney/Mettawee Basin.

Best Management Practices (BMP) - a practice or combination of practices that may be necessary, in addition to any applicable Accepted Agricultural or Silvicultural Practices, to prevent or reduce pollution from nonpoint source pollution to a level consistent with State regulations and statutes. Regulatory authorities and practitioners generally establish these methods as the best manner of operation. BMPs may not be established for all industries or in agency regulations, but are often listed by professional associations and regulatory agencies as the best manner of operation for a particular industry practice.

Classification - a method of designating the waters of the State into categories with more or less stringent standards above a minimum standard as described in the Vermont Water Quality Standards.

Designated use - any value or use, whether presently occurring or not, that is specified in the management objectives for each class of water as set forth in §§ 3-02 (A), 3-03(A), and 3-04(A) of the Vermont Water Quality Standards.

Existing use - a use that has actually occurred on or after November 28, 1975, in or on waters, whether or not the use is included in the standard for classification of the waters, and whether or not the use is presently occurring

Fluvial geomorphology - a science that seeks to explain the physical interrelationships of flowing water and sediment in varying land forms

Impaired water - a water that has documentation and data to show a violation of one or more criteria in the Vermont Water Quality Standards for the water's class or management type.

Improved Barnyards - a series of practices to manage and protect the area around the barn, which is frequently and intensively used by people, animals, or vehicles, by controlling runoff to prevent erosion and maintain or improve water quality. Practices may include: heavy use area protection, access roads, animal trails and walkways, roof runoff management, and others.

Mesotrophic – An intermediate level of nutrient availability and biological productivity in an aquatic ecosystem.

Natural Community - An interacting assemblage of organisms, their physical environment, and the natural processes that affect them.

Natural condition - the condition representing chemical, physical, and biological characteristics that occur naturally with only minimal effects from human influences.

Nonpoint source pollution - waste that reaches waters in a diffuse manner from any source other than a point source including, but not limited to, overland runoff from construction sites, or as a result of agricultural or silvicultural activities.

pH - a measure of the hydrogen ion concentration in water on an inverse logarithmic scale ranging from 0 to 14. A pH under 7 indicates more hydrogen ions and therefore more acidic solutions. A pH greater than 7 indicates a more alkaline solution. A pH of 7.0 is considered neutral, neither acidic nor alkaline.

Point source - any discernible, confined and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which either a pollutant or waste is or may be discharged.

Reference condition - the range of chemical, physical, and biological characteristics of waters minimally affected by human influences. In the context of an evaluation of biological indices, or where necessary to perform other evaluations of water quality, the reference condition establishes attainable chemical, physical, and biological conditions for specific water body types against which the condition of waters of similar water body type is evaluated.

Riparian vegetation - the native or natural vegetation growing adjacent to lakes, rivers, or streams.

River Corridor - the land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition, as that term is defined in 10 V.S.A. §1422, and for minimization of fluvial erosion hazards, as delineated by the Agency in accordance with the VANR River Corridor Protection Guide.

Sedimentation - the sinking of soil, sand, silt, algae, and other particles and their deposition frequently on the bottom of rivers, streams, lakes, ponds, or wetlands.

Thermal modification - the change in water temperature

Turbidity - the capacity of materials suspended in water to scatter light usually measured in Jackson Turbidity Units (JTU). Highly turbid waters appear dark and "muddy."

Waste Management System -a planned system in which all necessary components are installed for managing liquid and solid waste, including runoff from concentrated waste areas and silage leachate, in a manner that does not degrade air, soil, or water resources. The purpose of the system is to manage waste in rural areas in a manner that prevents or minimizes degradation of air, soil, and water resources and protects public health and safety. Such systems are planned to preclude discharge of pollutants to surface or ground water and to recycle waste through soil and plants to the fullest extent practicable.

Water Quality Standards - the minimum or maximum limits specified for certain water quality parameters at specific locations for the purpose of managing waters to support their designated uses. In Vermont, Water Quality Standards include both Water Classification Orders and the Regulations Governing Water Classification and Control of Quality.

Waters - all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs and all bodies of surface waters, artificial or natural, which are contained within, flow through or border upon the State or any portion of it.

Watershed - all the land within which water drains to a common waterbody (river, stream, lake pond or wetland).

Appendix C. 2009 Lamoille River Basin Plan Report Card

Overall, work completed in the watershed since the publication of the previous Tactical Basin Plan has allowed for significant inventory and mapping of the watershed. This includes mapping and assessing road and stormwater infrastructure, stream geomorphic assessments, agricultural lands and wetlands. Extensive work has been done in partnership with RPCs, non-profits, the NRCS and other divisions of state government as well as landowners to work towards healing 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.

An interactive web map or story map developed by the Lamoille County Planning Commission, called Restoring the Lamoille Watershed, describes and highlights restoration projects in progress or completed by organizations and partnerships throughout the Lamoille watershed, and can be viewed at: http://arcg.is/1zjw45G.

Category	Notable Projects and Milestones
Wetlands	Wetlands inventory of lower Lamoille complete, project identification and outreach begun. Extensive buffer work underway. Restoration of converted wetlands beginning- projects inventoried, identified and outreach commenced.
Lakes	Undeveloped shorelines undergoing assessment, mapping project for undeveloped shorelines not completed. Regional and town plans/bylaws relating to lacustrine management reviewed in Lamoille county. NPS surveys for larger lakes underway, Journey's end swimming hole and Zack Woods Pond under protection. Some outreach conducted with lakeshore property owners for more effective lake stewardship.
Controlling Aquatic Invasives	Vermont Invasives Patroller Program (VIP) active in Basin 7, Lake Eden and South Pond sampled in 2015, monitoring continuing through 2016. Lay Monitoring program not yet expanded in the basin.
River Corridor protection and Enhancement	Phase 1 geomorphic assessment complete for Basin 7 in major sub-watersheds, Phase 2 complete for Browns River, Gihon River, Centerville Brook, North Branch, Elmore Branch, Wild Branch, Rodman Brook, Brewster River and most of the Lamoille main stem, with projects identified and entered into implementation table (high and moderate priority projects). Assistance provided to communities for help with erosion projects and buffer projects, as well as riparian easement projects. Miles of buffers planted within the watershed with more projects identified in the SGAs. Vermont Land Trust and the Vermont River Conservancy has been actively working with farmland easement and conservation. Partnerships with private landowners, towns, Conservation Districts and GMP, among others.
Hazard planning	WSMD assisted hazard planning efforts in various towns in the basin. Road Erosion

and road projects	Inventories complete for Lamoille county, many projects implemented—remaining high priority projects identified and entered into implementation table. Landslide hazard inventory of Deer Brook watershed completed. Fluvial Erosion map and plan for Underhill also completed. The majority of the towns in the watershed have completed Local Hazard Mitigation Plans.
Improving Flow-Regulated waters	Work especially on the Browns river to remove constriction, impoundment removed on Johnson State campus. Dam inventory completed for entire watershed in 2012. Jackson Dam removal project stalled due to lack of political/popular support. Five waters will be removed from the flow-altered list and one has been downgraded to stressed.
Addressing the loss of working landscape	Outreach projects with growers identified—projects related to compost, conservation and runoff issues. Low impact timber harvesting practices should be encouraged through workshops with landowners (this was not initiated).
Municipal Development and Erosion	Programs available to rent skidder bridges to reduce erosion, and many communities have participated in LID/GSI projects (*Hardwick, Morrisville, Hyde Park, Wolcott and Cambridge).* Stormwater infrastructure projects underway in Hyde Park and Hardwick. All Lamoille watershed villages of significant size have developed stormwater infrastructure maps, maintenance inventories and illicit discharges and detection (IDDE) surveys.
Built infrastructure	Complete AOP assessment for all of Lamoille County, with retrofits/replacements underway. All culverts entered into implementation table, Wolcott, Walden, Eden and Hyde Park making replacements. Some beaver-road projects completed (2 in Wolcott), some deferred. VLCT is working with towns to create minimum standards for the design, construction and maintenance of the driveways and driveway structures within town plans and ordinances and has created a Model LID/GSI Stormwater Management Bylaw.
Outreach and Education	Lamoille Rail Trail completed, with encroachment removal. Lamoille watershed story map created by LCPC, available on ArcGIS Online at: http://arcg.is/1zjw45G. Buffer plantings conducted with Lamoille Union students, EPA TMDL meeting held in St. Albans and attended by 150 people. Teachers at Waterville Elementary School are planning a multi-discipline watershed unit of study, have contacted Basin Planner, who will provide assistance as needed. Outreach and communications also continuing with Lamoille Paddlers' Association. RPCs are active in outreach for Act 64, the new VT Clean Water Act.
Agriculture and Runoff	North Lake Ag meetings ongoing, partnership with NRCS ongoing. Phase II LC TMDL included in new tactical basin plan, increasing road monitoring and RAP/BMP compliance. Crop rotation and cover crop demonstration project developed by UVM Extension. NRCS Ag funding priorities submitted to direct NRCS funding in the LC basin. More workshops/outreach to farms needed for better nutrient management and NPS prevention.
Forestry	FPR working through Forest Legacy Program: active throughout the state, monitoring lands under perpetual conservation easements. Use of portable skidder bridges for logging available in Johnson, Hardwick and lower Lamoille. Gary Sabourin held a Portable/Free/Loan Skidder Bridge teleconference regarding stats, updates, and plans for the various logging bridge programs in 2013, and portable skidder bridge meetings at least semi-annually since.

Impaired waters	Mill Brook no longer considered impaired. Ongoing work with RPCs. Extensive work with Champlain TMDL management, some stormwater/flood hazard efforts complete. Mercury resampling still needed.

Appendix D. Biological Monitoring Data

Monitoring Results from 2010-2015

Table D1. Biological sampling results for Basin 7 sites from 2010 to 2015.

WBID	Stream or River	Town	River Mile	Date	Macroinvertebrate Assessment	Fish Assessment
UPPER LAMOILLE						
VT07-22	Sawmill Brook	Greensboro	1.8	09/13/2011	Excellent – very good	----
VT07-22	Sawmill Brook	Greensboro	1.8	09/26/2013	Excellent	----
VT07-22	Stannard	Stannard	0.3	09/26/2013	Good to fair	----
VT07-22	Lamoille River	Greensboro	80.8	09/26/2013	Very good	----
WBID	**Stream or River**	**Town**	**River Mile**	**Date**	**Macroinvertebrate Assessment**	**Fish Assessment**
MIDDLE LAMOILLE						
VT07-04	Lamoille River	Johnson	45.0	09/19/2011	Excellent	-----
VT07-04	Lamoille River	Morristown	53.6	09/18/2013	Very good	-----
VT07-06	Foote Brook	Johnson	2.6	09/10/2013	Excellent - very good	-----
VT07-06	Waterman Brook	Johnson	1.2	09/18/2013	Excellent - very good	Poor[1]
VT07-06	Jacob Brook	Morristown	0.6	09/19/2011	Excellent - very good	Poor
VT07-06	Jacob Brook		0.6	09/16/2013	Very good	Good
VT07-06	Smith Brook	Johnson	0.9	09/18/2013	Very good	Very good
VT07-08	Rodman Brook	Morristown	0.6	09/20/2013	Very good - good	Fair
VT07-08	Rodman Brook		0.6	10/02/2014	Excellent	----
VT07-08	Rodman Brook	Morristown	1.1	10/02/2014	Excellent	----
VT07-13	Brewster River	Cambridge	4.2	09/19/2014	Very good	-----
VT07-13	Brewster River		4.5	09/19/2014	Very good	-----
VT07-13	Brewster River	Cambridge	5.0	09/19/2010	Very good - good	-----
VT07-13	Brewster River		5.0	09/13/2012	Excellent - very good	-----
VT07-13	Brewster River		5.0	09/18/2014	Very good	-----

WBID	Stream or River	Town	River Mile	Date	Macroinvertebrate Assessment	Fish Assessment
VT07-13	Brewster River	Cambridge	5.3	09/19/2010	Very good - good	-----
VT07-13	Brewster River		5.3	09/13/2012	Excellent	-----
VT07-13	Brewster River		5.3	09/18/2014	Very good - good	-----
VT07-13	Brewster River Tributary 10	Cambridge	0.4	09/23/2013	Fair	-----
VT07-13	Stream A	Cambridge	0.2	09/19/2010	Good	-----
VT07-13	Stream A		0.2	09/13/2012	Good	-----
VT07-13	Stream A		0.2	09/18/2014	Fair	-----
VT07-13	Stream A	Cambridge	0.4	09/19/2010	Very good - good	-----
VT07-13	Stream A		0.4	09/13/2012	Fair	-----
VT07-13	Stream A		0.4	09/28/2014	Good-fair	-----
VT07-14	North Branch Lamoille River	Waterville	2.0	09/26/2013	Excellent	-----
VT07-14	North Branch Lamoille River	Belvidere	14.0	09/19/2013	Excellent	----
VT07-15	Dark Branch	Eden	3.3	09/10/2013	Fair	Very good
VT07-15	Gihon River	Johnson	0.1	09/09/2013	Very good	-----
VT07-15	Gihon River	Johnson	7.4	09/19/2011	Very good	Good
VT07-15	Gihon River	Eden	10.3	09/26/2013	Excellent	-----
VT07-15	Gihon River	Eden	14.5	09/09/2013	Good[2]	Very good
VT07-16	Kenfield Brook	Morristown	0.2	09/16/2013	------	Poor
VT07-16	Kenfield Brook	Morristown	1.5	09/16/2013	Excellent - very good	-----
VT07-17	Ryder Brook	Morristown	0.8	09/16/2013	Very good	Fair
VT07-18	Green River	Hyde Park	2.9	09/20/2013	Excellent	-----
VT07-19	Wild Branch	Wolcott	0.1	09/19/2011	Good	Fair
VT07-20	Elmore Branch	Elmore	1.7	09/03/2013	Excellent - very good	Good
WBID	**Stream or River**		**River Mile**	**Date**	**Macroinvertebrate Assessment**	**Fish Assessment**
LOWER LAMOILLE						
VT07-01	Lamoille River Trib #4	Milton	0.3	9/29/2015	Good	----
VT07-01	Lamoille River Trib #4	Milton	0.5	10/09/2014	Poor	----
VT07-01	Lamoille River Trib #4	Milton	0.5	9/29/2015	Fair	----

WBID	Stream or River	Town	River Mile	Date	Macroinvertebrate Assessment	Fish Assessment
VT07-01	Lamoille River Trib #4	Milton	1.0	9/29/2015	Good	----
VT07-01	Streeter Brook	Milton	0.6	10/07/2013	Very good – good	----
VT07-02	Lamoille River	Georgia	15.7	10/07/2013	Excellent - very good	----
VT07-02	Lamoille River	Fairfax	19.3	9/19/2011	Very good – good	----
VT07-02	Lamoille River	Fairfax	20.9	9/19/2011	Very good	----
VT07-04	Lamoille River	Cambridge	33.5	9/18/2013	Very good	----
VT07-03	Deer Brook	Georgia	1.4	10/09/2013	Good	----
VT07-03	Deer Brook	Georgia	2.1	9/27/2011	Fair	----
VT07-10[3]	Abbey Brook	Essex	0.4	10/09/2013	Excellent - very good	Fair
VT07-10	Rogers Brook	Westford	0.5	10/06/2014	Very good - good	----
VT07-11	The Creek	Underhill	2.4	10/06/2014	Fair	----
VT07-11	Lee River	Jericho	2.8	10/09/2013	Very good	Very good

[1] Poor rating may be based on natural habitat constraints. Will re-sample to verify.

[2] The community assessment has declined from excellent in 2007 to good in 2013 due to a loss of taxa

[3] Green shading are Browns River watershed sampling sites

Sample Site Locations

Table D2. Biological sampling sites locations for the Lamoille Basin.

WBID	Stream or River	River Mile	Town	Description
UPPER LAMOILLE				
VT07-22	Sawmill Brook	1.8	Greensboro	Below Hillcrest Road culvert 100 meters
VT07-22	Stannard Brook	0.3	Stannard	Above Orton Road which is just above the RR tressle
VT07-22	Lamoille River	80.8	Greensboro	100 meters above the confluence with Mud Pond Brook
MIDDLE LAMOILLE				
VT07-04	Lamoille River	45.0	Johnson	Alongside River Road off of Railroad Street
VT07-04	Lamoille River	53.6	Morristown	Below Lake Lamoille Cady's Falls bridge about 0.4 miles, off of Duhamel Road
VT07-06	Foot Brook	2.6	Johnson	Below Plot Road culvert 50 meters.
VT07-06	Waterman Brook	1.2	Johnson	Off Waterman Road below first bridge crossing but above falls.
VT07-06	Jacob Brook	0.6	Morristown	Downstream of Tyndall Road and "bedrock slider"
VT07-06	Smith Brook	0.9	Johnson	Above VAST trail, railroad bridge, and power line crossing
VT07-08	Rodman Brook	0.6	Morristown	Below old landfill and transfer station off Garfield Road
VT07-08	Rodman Brook	1.1	Morristown	Above old landfill and transfer site off Garfield Road, below first bridge

MIDDLE LAMOILLE				
VT07-13	Brewster River	4.2	Cambridge	Above confluence with Gallup Branch, below proposed spray site for Smugglers Notch
VT07-13	Brewster River	4.5	Cambridge	Below Edwards Road (old Rte 108), upstream of proposed spray field
VT07-13	Brewster River	5.0	Cambridge	Below Route 108 and Unnamed Brook at Smugglers Notch Ski area about 50m.
VT07-13	Brewster River	5.3	Cambridge	Above Route 108 and Unnamed Brook at Smugglers Notch Ski area about 50m, upstream of covered bridge.
VT07-13	Brewster River Tributary 10	0.4	Cambridge	About 50 meters below old leachfield groundwater discharge pipe.
VT07-13	Stream A	0.2	Cambridge	Below new spray field for Smugglers Notch Ski area, immediately above route 108.
VT07-13	Stream A	0.4	Cambridge	Above new spray field for Smugglers Notch Ski area.
VT07-14	North Branch Lamoille River	2.0	Waterville	Below covered bridge west of town about 100 meters.
VT07-15	Dark Branch	3.3	Eden	Below first beaver pond wetland below the asbestos mine
VT07-15	Gihon River	0.1	Johnson	Below WWTF outfall about 75m at first riffle along riprap bank
VT07-15	Gihon River	7.4	Johnson	Just off Route 100C below confluence with Wild Brook
VT07-15	Gihon River	10.3	Eden	Off Route 100 north of North Hyde Park about 1.2 miles
VT07-15	Gihon River	14.5	Eden	Above Route 100 crossing next to the town garage, just below Dark Branch confluence
VT07-16	Kenfield Brook	0.2	Morristown	Upstream from bridge on Cady's Falls Rd about 150m
VT07-16	Kenfield Brook	1.5	Morristown	Above Cote Hill or Tyndol Road about 200m, above a skidoo bridge.
VT07-17	Ryder Brook	0.8	Morristown	Located just upstream of a power station, above a bridge
VT07-18	Green River	2.9	Hyde Park	Below Garfield Rd about 100m
VT07-19	Wild Branch	0.1	Wolcott	below abandoned metal bridge off the West Wolcott Road
VT07-20	Elmore Branch	1.7	Elmore	About 0.7 miles from northerly bend in road from Route 12 to Wolcott
LOWER LAMOILLE				
VT07-01	Lamoille River Trib #4	0.5	Milton	Below Milton Landfill, access from end of Stacy Street
VT07-01	Lamoille River Trib #4	1.0	Milton	Upstream 100 meters from Landfill Road
VT07-01	Streeter Brook	0.6	Milton	Below Sanderson Road, below falls 75 meters

LOWER LAMOILLE				
VT07-02	Lamoille River	15.7	Georgia	Off Route 104A above bridge at head of Arrowhead Mountain Lake about 0.5 miles. Near five chutes in river.
VT07-02	Lamoille River	19.3	Fairfax	Located 100 meters below Route 104 bridge
VT07-02	Lamoille River	20.9	Fairfax	Immediately below Fairfax Falls dam
VT07-04	Lamoille River	33.5	Cambridge	About ¼ miles below Jeffersonville WWTF. Access from dirt road and corn field on south side of the river.
VT07-03	Deer Brook	1.4	Georgia	Below DEE Road down into ravine about ½ mile just below groundwater flux from Georgia Whey
VT07-03	Deer Brook	2.1	Georgia	Immediately (50 meters) below I-89 and Dee Road culvert
VT07-10	Abbey Brook	0.4	Essex	Immediately above Route 128 bridge
VT07-10	Rogers Brook	0.5	Westford	Roadside site above private gate/bridge
VT07-11	The Creek	2.4	Underhill	Route 15 in Underhill across from Rolling Meadows Farm
VT07-11	Lee River	2.8	Jericho	Above Browns Trace Road bridge

Recommended Biological Monitoring Sites

Table D3. Biological monitoring needed in the Lamoille watershed.

WBID	Stream or river	Location/number of sites	Comments
UPPER LAMOILLE			
VT07-22	Greensboro Brook	At least one site	Most of its length through a forested small valley
VT07-22	Sawmill Brook	Sample river mile 1.8 again	Sample for fish for VHQ
VT07-22	Stannard Brook	Sample river mile 0.3 again	Was "fair" in 2002 and "good-fair" in 2013 – this stream has been dredged a number of times and gets sand from the adjacent road
VT07-22	Lamoille River	Sample river mile 80.3 again	Need new sample for fish for VHQ
VT07-21	Tucker Brook	One site	This brook has not been sampled – affected by floods at various times
VT07-21	Haynesville Brook	Two sites; one in forested area upstream in Walden and second along Route 15 in Hardwick	This brook has not been sampled – affected by floods at various times
VT07-21	Porter Brook	One site	No samples from this brook to date
MIDDLE LAMOILLE			
VT07-06	Centerville Brook	at least one site	This stream has never been sampled. An SGA has been done.
VT07-06	Waterman Brook	RM 1.2 sampled again	Re-sample to confirm VHQ or A1.

WBID	Stream or river	Location/number of sites	Comments
VT07-06	Foote Brook	RM 2.6	Macroinvertebrates were sampled in 2013 and were exc-very good. Confirm VHQ.
VT07-14	Rattling Brook	a site or two	Not been sampled ever. Trib to the North Branch.
VT07-14	Calavale Brook	a site or two	Not been sampled ever. Trib to the North Branch.
VT07-14	Basin Brook	re-sample RM 0.5	Last sampled in 1992. Density and richness metrics not meeting.
VT07-14	North Branch Lamoille River	RM 2.0	Macroinvertebrates sampled here in 2013 and were excellent - good to have a second year. Also be great to have fish data.
VT07-15	Wild Brook (to Gihon R)	1 site – upstream from confluence with Gihon above 100c	Never sampled –looks like a well-forested watershed
VT07-15	White Branch (to Gihon R)	1 site – upstream from confluence with Gihon	Never sampled
VT07-15	Gihon River	above or below where Rocky Road crosses; and at RM 14.5 for VHQ	Need some information in this lower stretch (but above the mouth); need fish and macroinvertebrates
VT07-16	Kenfield Brook	two sites – RM 0.2 and RM 1.5	It would be great to have fish data from the bug site and vice versa.
VT07-18	Green River	RM 2.9	Macroinvertebrates were sampled in 2013 and were excellent – confirmation of this with another sample would be great.
VT07-19	Wild Branch	RM 0.1 again and one site upstream more	A lot going on in this stream - more bug and fish sampling would be very helpful
LOWER LAMOILLE			
VT07-01	Streeter Brook	RM 0.6 and another site upstream of sub-division	Macroinvertebrate results have gone from “vgood-good” to “good-fair” and back several times. Needs more investigation.
VT07-03	Stones Brook	RM 5.2	This stream in Fletcher was sampled in 2007 and was “exc-vgood”. It should be sampled at this point again and perhaps a lower site.
VT07-05	Beaver Brook	one or two sites (**no** sites have been sampled over the years)	This six mile stream needs sampling. It flows through Underhill, Westford and Fairfax into the Lamoille River.

Appendix E. Lamoille Basin Lakes and Ponds Information

Program Assessment and Monitoring Information

Table E1. Status table for Basin 7 lakes and ponds.

Name	Town	Lake Area	Lakeshore Assessment	Lake Wise	AIS Spread Prevention	Monitoring
Arrowhead Mountain Lake	Milton	760			Establish an Access Greeter Program: actively seeking volunteers. Maintain AIS signage.	Monitored yearly for zebra mussels, spiny waterflea.
Bear Pond	Cambridge	1				
Belding Pond	Johnson	4				
Big Muddy Pond	Eden	17				
Caspian Lake	Greensboro	789			Continue to support greeter program. Maintain AIS signage.	
Clear Pond	Hyde Park	8				
Collins Pond	Hyde Park	16				
East Long Pond	Woodbury	188				
Flagg Pond	Wheelock	111				
Green River Reservoir	Hyde Park	554			DEC, DFPR	
Gut Pond	Eden	13				
Halfmoon Pond	Fletcher	21				
Hardwick Lake	Hardwick	145			Maintain AIS signage.	
Horse Pond	Greensboro	32			Maintain AIS signage.	
Keeler Pond	Wolcott	5				
Lake Eden	Eden	194			Continue to support greeter program (DEC, LCBP). Maintain AIS signage.	

Name	Town	Lake Area	Lakeshore Assessment	Lake Wise	AIS Spread Prevention	Monitoring
Lake Elmore	Elmore	219			Maintain AIS signage.	
Lake Lamoille	Morristown	148				
Lake-Of-The-Clouds	Cambridge	1				
Little Eligo Pond	Hardwick	15				
Little Elmore Pond	Elmore	24				
Long Pond	Greensboro	100			Maintain AIS signage.	
Long Pond (Belvidere Pond)	Eden	97			Maintain AIS signage.	
Lost Pond	Belvidere	3				
Mackville Pond	Hardwick	11				
Mud Pond	Hyde Park	14				
Nichols Pond	Woodbury	171			Maintain AIS signage.	
Perch Pond	Wolcott	7				
Ritterbush Pond	Eden	14				
Round Pond	Milton	22				
Rush	Eden	14				
Schofield Pond	Hyde Park	29				
Silver Lake	Georgia	27				
Slayton Pond	Woodbury	8				
South Pond	Eden	103				
Tuttle Pond	Hardwick	21				
Unnamed Pond referred to by VDEC as Beaver	Hyde Park	16				
Unnamed Pond referred to by VDEC as Belvidere - NE	Belvidere	9				
Unnamed Pond referred to by VDEC as Cap Hill	Jericho	9				
Unnamed Pond referred to by VDEC as Landfill	Eden	7				
Unnamed Pond referred to by VDEC as Morrisville	Morristown	8				
Unnamed Pond referred to by VDEC as North Underhill	Underhill	12				
Unnamed Pond referred to by VDEC as Ritterbush Meadow	Eden	10				
Wapanacki Lake	Wolcott	21				
Wolcott Pond	Wolcott	74			Maintain AIS signage.	

Name	Town	Lake Area	Lakeshore Assessment	Lake Wise	AIS Spread Prevention	Monitoring
Zack Woods Pond	Hyde Park	23				

* VDEC – Lakes and Ponds Program, DFPR –Dept. of Forests, Parks and Recreation, LCBP – Lake Champlain Basin Program

Table E2. Lakes and Ponds in Basin 7 with no assessment data.

Lake ID	WQ 2014	AIS 2014	Atmos 2014	Shoreland 2014
Boulley	White	White	White	White
Cushing hill	White	White	White	White
Dark	White	White	White	White
Devils	White	White	White	White
Dry Ridge	White	White	White	White
Frying Pan	White	White	White	White
Garfield	White	White	White	White
Hovey	White	White	White	White
Joe's	White	White	White	White
Knob	White	White	White	White
Lanpher meadow	White	White	White	White
Morrisville	White	White	White	White
Mud (eden)	White	White	White	White
Mud (grnsbo)-e	White	White	White	White
Mud (grnsbo)-sw	White	White	White	White
Mud (woodby)-n*	White	White	White	White
Mud (woodby)-w*	White	White	White	White
Number eleven	White	White	White	White
Otter	White	White	White	White
Oxbow - 2	White	White	White	White
Peace	White	White	White	White
Pickett	White	White	White	White
Rogers	White	White	White	White
Round (eden)*	White	White	White	White
Shadow (woodby)	White	White	White	White
Stannard-e	White	White	White	White
Stony	White	White	White	White
Tamarack	White	White	White	White
Upper frying pan	White	White	White	White
Westford	White	White	White	White
Wiley	White	White	White	White

All ponds are less than 10 acres unless marked with an *. White indications no assessment data. Headings refer to scorecard ratings. WQ=water quality, AIS=aquatic invasive species, Atmos=atmospheric pollution, and Shoreland=shoreland and lake habitat

Vermont Invasive Patrollers (VIPs)

VIPs are local volunteers who monitor a waterbody for new invasive species. They are trained to distinguish between native and invasive aquatic plants and animals during routine systematic surveys. These individuals provide a vital line of defense in Vermont's efforts to protect lake ecology and recreation. Finding an invasive organism before it becomes well established in a waterbody increases management options and may make control possible.

For more information, contact Bethany Sargent at bethany.sargent@vermont.gov or (802) 490-6129

The Vermont Public Access Greeter Program

The Lakes and Pond Program partners with local watershed associations and others to operate greeter programs at public access points. Public access greeters educate lake visitors about invasive species, provide courtesy watercraft inspections and STOP introductions while providing needed data on the ways invasive organisms hitch rides on equipment.

For more information, contact Josh Mulhollem at josh.mulhollem@vermont.gov or (802) 490-6121

Aquatic Invasive Species Spread Prevention Signage

The Lakes and Ponds Program maintains aquatic invasive species signs at public boat access points to remind users to practice "Clean, Drain, Dry" spread prevention measures. Species specific posters and brochures are also posted on kiosks to inform about invasions or warn of potential risks, and encourage spread prevention actions. Over 200 public access sites, primarily Department of Fish and Wildlife accesses, have been posted.

For more information, contact Josh Mulhollem at josh.mulhollem@vermont.gov or (802) 490-6121

Appendix F. Existing Uses in the Lamoille Basin

Swimming

There are a number of popular swimming holes both on the Lamoille River mainstem and on its tributaries. The locations described below are also generally some of the most scenic and aesthetically pleasing spots on the river. All sites listed on Table F1 are rated significant for swimming (DEC, 1992). Sites listed here are accessed through publicly owned lands such as stream crossing right-of-ways. Many locations that are privately owned with private access are not included in Table 1. Landowner permission should be sought before using these privately owned resources.

Table F1. Swimming (Contact Recreation) as an existing Use of Specific Waters within the Lamoille River Watershed.

Swimming Site Name	Town	Location
Lamoille River, Dogs Head Falls- lower pool	Johnson	Patch Road
Picnic Ledges	Wolcott	Route 15 east of village
Lamoille River, Wolcott Village	Wolcott	Route 15 in village
Terrill Gorge-Kenfield Brook	Morristown	Duhamel Road-F&W parking lot
Elmore Branch	Wolcott	East Elmore Road
Sheep's Hole- Foot Brook	Johnson	Foot Brook Road
The Ledges- Foot Brook	Johnson	Cherry Hill Road
Power House Bridge Falls-Gihon River	Johnson	School Street
Rogers Bridge-Seymour River	Cambridge	Lower Valley Road
Brewster River Gorge Swimming Hole	Jeffersonville	Route 108 turn on road south and west of Grist Mill
Codding Hollow Covered Bridge- North Branch	Waterville	Codding Hollow Road
Calavale Brook Cascades	Eden	Route 118

Recreational Boating

A number of locations are good whitewater boating stretches in the basin; some highly rated by the Vermont Paddlers Association. The Lamoille main stem is used extensively for flat water canoeing and kayaking by the several local outfitter businesses as well as the general public. All sites listed on Table F2 are rated significant for boating (DEC, 1989) or were otherwise brought to VDEC's attention. Many canoe access areas and dam portages have been established on the main stem. Anyone boating these reaches should carefully scout routes before launching. This basin plan makes no representations as to the suitability or safety of the listed reaches with respect to the individual skills of the reader of this plan or those of prospective boaters.

Table F2. Recreational Boating as an Existing Use of Specific Waters within the Lamoille Watershed.

Location	Documentation	Rating	Characteristics that support that use	Put in	Take out
Lamoille River-Greensboro Bend to Hardwick (7-8 miles)	*Vermont's White Water Rivers*	Highly Important	Class I-III, longest stretch of Class III in northern Vermont	Upstream of Greensboro Bend with portage in East Hardwick	Upstream of Hardwick Village
Lamoille River-Wolcott Ledges (1.4 miles)	*Vermont's White Water Rivers*	Highly Important	Class III can be run in wet summers and fall	Behind the Pottersville Dam powerhouse	Downstream of Wolcott Village
Lamoille River (34 miles) Morristown to Fairfax	*Vermont's White Water Rivers*	High Importance	Class II-IV, whitewater and general touring	Duhamel Road, Morristown below Cady Falls	Upstream of Fairfax Falls (many portages)
Lamoille River (4.6 miles) Fairfax to Georgia	*Vermont's White Water Rivers*	Highly Important	Class II-III, one of two rapids on large rivers in the state	Road southwest of Fairfax Village	Route 104A Georgia
North Branch (9 miles)	*Vermont's White Water Rivers*	Not rated	Class II-IV, excellent to outstanding scenery and pristine	Bog Road Bridge, Belvidere	Church Street covered bridge, Waterville
Gihon River (1.5 miles)	*Vermont's White Water Rivers*	Not rated	Serious Class IV-V used by expert paddlers	Whitcomb Island Road, Johnson	Pearl Street, Johnson
Wild Branch (7 miles)	*Vermont's White Water Rivers*	Important	Fast, twisty, and highly technical Class II-III	North Wolcott Road upstream of Wolcott-Craftsbury line at town bride right-of-way	Route 15 at state bridge
Waterman Brook	*Let it Rain*	Not rated	Class IV-V used by expert paddlers	Waterman Road covered bridge, Johnson	River Road East, town bridge Johnson
Kenfield Brook	Vermont Paddlers Association recommendation	Not rated	Class IV-outstanding scenery	Tyndal Road, Morristown	Duhamel Road, Morristown
Lamoille	Vermont Paddlers	Highly	Class V,	Ritchie	Milton Falls

Location	Documentation	Rating	Characteristics that support that use	Put in	Take out
River – Milton Falls	Club recommendation	Important	outstanding rapids, used by expert paddlers.	Avenue, Milton	Park, Milton
Calavale Brook	Vermont Paddlers Club recommendation	Important	Class IV-V outstanding scenery and rapids used by expert paddlers	Upper end of Newton Valley Road, Eden	Route 118 at State bridge, Belvidere
Basin Brook	Vermont Paddlers Club recommendation	Important	Class IV-V used by expert paddlers	Upper end of Basin Road, Belvidere	Route 109, Belvidere
Foote Brook	Vermont Paddlers Club recommendation	Important	Class IV-V used by expert paddlers	Cemetery Road at Town bridge, Johnson	Route 15 at State bridge, Johnson
Green River	American Whitewater Association Database	Highly Important	Class IV-V, outstanding scenery and rapids, used by expert paddlers.	Garfield Road below Town Culvert, Hyde Park	Route 15 at State Bridge, Wolcott

Recreational Fishing

Table F3 shows those areas in the Lamoille River Basin with recreational fishing as an existing use. The public can access detailed information about fishing access sites that includes images, boat size, water body size, ramp type, fish species, recommended season and more at: https://anrweb.vt.gov/FWD/FW/FishingAccessAreas.aspx?accessarea=5.

Table F3. Recreational Fishing as an Existing Use of Specific Waters within the Lamoille Watershed.

Site Name/Waterbody		Location	Documentation
Fisher Bridge Fishing Access	Lamoille River	Route 15, Wolcott	VFWD access
Wolcott Fishing Access	Lamoille River	Route 15, Wolcott	VFWD access
Rotary Fishing Access	Lamoille River	Route 15, Morrisville	VFWD access
Town Ball Field		Off Route 15, Wolcott	VFWD access
Elmore Pond Road Bridge	Lamoille River	Elmore Pond Road, Wolcott	VFWD access
Cady Falls Bridge	Kenfield Brook and Lamoille River	Cady Falls Road, Hyde Park	VFWD access
Hog Back Road	Lamoille River	Hog Back Road, Johnson	VFWD access

Site Name/Waterbody		Location	Documentation
Horse Pond Fishing Access	Horse Pond	Route 16, Greensboro	VFWD access
Flagg Pond Fishing Access	Flagg Pond	Flagg Pond Road, Wheelock	VFWD access
Wolcott Pond Fishing Access	Wolcott Pond	Wolcott Pond Road, Wolcott	VFWD access
East Hill Wildlife Management Area (WMA)	Carter Brook	Off of Route 15, Wolcott	VFWD WMA
Hardwick Lake Fishing Access	Hardwick Lake	Route 14	VFWD access
Wild Branch WMA	Wild Branch	Off of East Hill Road, Eden	VFWD WMA
Lake Eden Fishing Access	Lake Eden	Route 100, Eden	VFWD access
Green River Reservoir State Park	Green River Reservoir and Zack Woods Pond	Hyde Park and Eden	VFPR State Park
Vaughn M. Douglass Access and Elmore State Park	Lake Elmore	Off of Route 12, Elmore	VFWD access, VFPR State Park
Mount Mansfield State Forest, Johnson Town Forest	French Hill Brook	Reservoir Road, Johnson	VFPR State Forest, Town Forest
Dorothy Smith Fishing Access	Lamoille River	Off of Route 108 and Route 109, Cambridge	VFWD access
Babcock Nature Preserve	Ritterbush Pond	Off of Route 100, Eden	Johnson State College
Eden Forest	Wild Brook, Stony Brook	Off of Route 100, Eden	VFWD Forest Legacy Program
Sears Fishing Access	Lamoille River	Off of Route 2, Milton	VFWD Access
Lamoille River Fishing Access	Lamoille River	Off of Route 2, Milton	VFWD Access
Sand Bar Refuge Fishing Access and WMA	Lake Champlain	Off of Route 2, Milton	VFWD Access and WMA
VFWD owned riparian lands along Lamoille River in Sheffield, Hardwick, Wolcott, Morristown, Hyde Park, and Johnson and along Porter Brook (direct Lamoille River drainage) in Greensboro and Hardwick, Alder Brook in Hardwick, Greensboro Brook in Greensboro and Hardwick, Porter Brook in Hardwick, and Kenfield Brook in Morristown	Lamoille River, Porter Brook, Alder Brook, Greensboro Brook, Porter Brook, Kenfield Brook	ANR Natural Resources Atlas under Fish & Wildlife > Managed Lands > Riparian Lands	VFWD access

Public Water Sources

Table F4 lists water sources as an existing use within the Lamoille River watershed.

Table F4. Water Source as an Existing Use within the Lamoille River Watershed.

Water Body	Location	Documentation
Silver Lake	Georgia and Fairfax	Silver Lake is the drinking water supply for St. Albans
Unnamed Tributary to the Brewster River	Cambridge	This impoundment is a drinking water supply for Smugglers Notch Resort
Caspian Lake	Greensboro	This lake is an emergency drinking water supply for the Town of Greensboro
Arrowhead Mountain Lake	Georgia and Milton	This lake is used by Georgia Dairy Industrial Park and is a non-community privately owned water system
French Hill Brook	Johnson	This stream had been the drinking water supply for the Town of Johnson until the Town developed an aquifer

Appendix G. In-Service Dams of the Lamoille Basin

There are currently 47 in-service dams of different types, sizes, and condition in the Lamoille River Watershed. The majority of the major dams in the watershed are listed as *Surface Waters Altered by Flow Regulation* Part F on the List of Priority Waters (DEC 2016). The Part F sites are considered by the state to be priority waters for management action (Table 14).

Table F1. List of in-service dams in the Lamoille River Basin.

Dam Name	Town	Stream	Reservoir Type	Drainage (mi^2)	Purpose(s)	Year Built	State Reg	Fed Reg
Bryan	Cambridge	Brewster River	-	2.29	-	-	VDEC	None
Smugglers Notch Village	Cambridge	Brewster River-TR[1]	Artificial	2.12	Water Supply	1966	VDEC	None
Smugglers Notch Snow Pond Diversion Structure	Cambridge	Brewster River -TR	-	0.59	Recreation	-	None	None
Rood	Cambridge	Brewster River-TR	Artificial	0.1	Recreation	1971	VDEC	None
Edwards Snowmaking	Cambridge	Brewster River-TR	-	0.02	Recreation	2001	VDEC	None
Smugglers Notch Snow Pond	Cambridge	Brewster River-TR	Artificial	0.02	-	1992	VDEC	None
Morses Mill - Partially Breached	Cambridge	-	-	-	-	-	None	None
Lake Eden	Eden	Gihon River		6.9	Recreation	1900	VDEC	None
South Pond	Eden	Gihon River-TR	Natural with Artificial Control	2.16	Recreation	1922	VDEC	None
Lake Elmore	Elmore	Elmore Brook	Natural with Artificial Control	8.71	Hydroelectric, Recreation	1943	VDEC	FERC
Essex-2	Essex	Browns River-TR	-	-	-	-	None	None
Fairfax Falls	Fairfax	Lamoille River	-	529	Hydroelectric	1919	VDEC	FERC
Silver Lake North Dike	Fairfax	Beaver Meadow Brook-TR	Artificial	0.2	Water Supply	1895	VDEC	None
Silver Lake South Dike	Fairfax	Beaver Meadow Brook-TR	Artificial	0.2	Water Supply	1873	VDEC	None

Dam Name	Town	Stream	Reservoir Type	Drainage (mi^2)	Purpose(s)	Year Built	State Reg	Fed Reg
Ferguson	Fletcher	Stones Brook	-	0.04	Recreation	1969	VDEC	None
Stone's Brook	Fletcher	Stone's Brook	-	-	-	-	None	None
Silver Lake	Georgia	Beaver Meadow Brook-TR	Artificial	0.2	Water Supply	1912	VDEC	None
Caspian Lake	Greensboro	Greensboro Brook	Natural with Artificial Control	7.05	Recreation	1929	VDEC	None
McGrath	Greensboro	Esdon Brook	Artificial	0.34	Recreation	1989	VDEC	None
Greensboro-2	Greensboro	Caspian Lake	-	-	-	-	None	None
Hardwick Lake	Hardwick	Lamoille River	Artificial	122.1	Hydroelectric	1920	VDEC	None
Mackville Pond	Hardwick	Nichols Brook	Artificial	10.7	Recreation	1900	VDEC	None
Winter	Hardwick	Alder Brook	-	0.18	Recreation	1969	VDEC	None
Hyde Park	Hyde Park	Gihon River	Artificial	45	Hydroelectric	1911	VDEC	FERC
Green River Reservoir	Hyde Park	Green River	Artificial	14.18	Hydroelectric, Recreation	1947	VDEC	FERC
Green River Reservoir Dike	Hyde Park	Baldin Brook	Natural with Artificial Control	13.8	Hydroelectric	1947	VDEC	FERC
Beaver Lake	Hyde Park	Green River-TR	Natural with Artificial Control	1.12	Recreation	1967	VDEC	None
Lamoille Union High School	Hyde Park	Lamoille River-TR	Artificial	0.45	Fire Protection or Small Farm Pond	-	None	None
Hill	Hyde Park	Green River-TR	Artificial	0.05	Recreation	1971	VDEC	None
Cilley Hill	Jericho	Browns River	-	0.06	-		None	None
Johnson State Lower	Johnson	Lamoille River	Artificial	0.03	Recreation	1960	None	None
Peterson	Milton	Lamoille River	Artificial	700	Hydroelectric	1949	VDEC	FERC
Clarks Falls	Milton	Lamoille River	Artificial	690	Hydroelectric, Recreation	1937	VDEC	FERC
Milton	Milton	Lamoille River	-	690	Hydroelectric	1929	VDEC	FERC

Dam Name	Town	Stream	Reservoir Type	Drainage (mi^2)	Purpose(s)	Year Built	State Reg	Fed Reg
Cadys Falls	Morristown	Lamoille River	Artificial	268	Hydroelectric	1894	VDEC	FERC
Morrisville	Morristown	Lamoille River	-	239	Hydroelectric	1924	VDEC	FERC
Bryan[2]	Morristown	Mud Brook-TR	Artificial	0.41	Recreation	1964	VDEC	None
Ransom	Morristown	Mud Brook	-	0.11	-		None	None
Simonds	Morristown	Lamoille River-TR	-	0.08	-	1982	VDEC	None
Anderson	Stannard	Stannard Brook	-	-	-	-	None	None
Wolcott	Wolcott	Lamoille River	Artificial	134.7	Hydroelectric	1920	VDEC	None
Wolcott Pond	Wolcott	Wolcott Pond Brook	Natural with Artificial Control	1.44	Recreation	1968	VDEC	None
Wapanacki Lake	Wolcott	Tucker Brook	-	1	Recreation	1790	VDEC	None
Nichols Pond	Woodbury	Nichols Brook	Natural with Artificial Control	4.56	Recreation, Other	1900	VDEC	None
East Long Pond	Woodbury	Nichols Brook	Natural with Artificial Control	3.47	Recreation, Other	1930	VDEC	None
Travelstead	Woodbury	Elmore Brook -TR	Artificial	0.01	Recreation	-	None	None
Shadow Pond	Woodbury	Cooper Brook	-	-	Recreation	-	VDEC	None

[1] TR = tributary

[2] Dam issue ordered in 2016 for removal of the Bryan Pond Dam.

Appendix H. Hazardous Waste Sites in the Lamoille Basin

The Waste Management and Prevention Division (WMPD) oversees the use, treatment and handling of hazardous and solid wastes. The Division performs emergency response for hazardous materials spills, issues permits for federal and state programs regulating hazardous wastes, solid wastes, and underground storage tanks, and manages cleanup at hazardous sites under state and federal authorities, including the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA, also known as Superfund).

Active sites in contact with surface waters that have been identified in the Lamoille River Basin are described in summary below with recommendations for follow-up. All landfills and hazardous waste sites can be viewed on the ANR Natural Resources Atlas. Additionally, each RPC in the watershed manages a brownfields programs, and may have funding available to assess and develop clean-up plans for these sites.

Hazardous Waste Sites in Proximity to Surface Waters

Table H1. Salvage yards within 500-ft of surface waters in Basin 7.

Distance to surface water (ft)	Landfill Name	Longitude	Latitude	Date Created
≤500	Gates Salvage	-72.376149	44.522609	6/10/2011
≤500	Gates Salvage	-72.376149	44.522609	6/10/2011
≤500	All Metals Recycling	-72.409264	44.517959	7/24/2013
≤500	ClarkTruck/Underhill Garage	-72.943653	44.527219	1/3/2014
≤500	Jewett's Salvage Yard	-72.54806	44.717895	1/3/2014
≤500	Paradise Salvage	-72.482296	44.611965	1/3/2014
≤500	Morrisville Used Auto Parts	-72.517002	44.573195	1/3/2014
≤500	Robert Tenney	-72.449592	44.539579	8/18/2015
≤500	Sam Ovitt	-73.000161	44.716866	11/18/2015
≤500	Hess Used Auto & Parts	-72.614309	44.54817	1/15/2016
≤500	Foster-Fell	-72.436994	44.603794	2/3/2016

Table H2. Landfills within 500-ft of surface waters in Basin 7.

Distance to surface water (ft)	Site Name	Town Name	Date Last Active	Acres	Status	WQ Monitoring	Latitude	Longitude
≤100	Eden Town	Eden	1957	1	Closed	N	44.747827	-72.534557
≤500	Waterville Town	Waterville	1971	1	Closed	N	44.709772	-72.759015
≤500	Mcguinn, G.	Fairfax	1974	0	Closed	N	44.664216	-72.979026
≤500	Milton Landfill	Milton	1993	0	Closed	Y	44.6286	-73.1294
≤500	Cambridge Town	Cambridge	1969	1	Closed	N	44.633106	-72.827905
≤500	Cambridge Landfill	Cambridge	1992	0	Closed	Y	44.6431	-72.9053
≤500	Greensboro Town	Greensboro	1972	0.5	Closed	N	44.577553	-72.281493
≤500	Westford Town	Westford	1974	2	Closed	N	44.641716	-73.003192
≤500	Johnson Landfill	Johnson	1994	0	Closed	Y	44.6569	-72.6183
≤500	Wolcott Town Landfill	Wolcott	1971	1	Closed	N	44.542831	-72.458443
≤500	Wolcott Landfill	Wolcott	1994	2	Closed	Y	44.5597	-72.4769
≤500	Underhill Town	Underhill	U	60	Closed	N	44.532551	-72.882625
≤500	Shera, R.	Underhill	1979	10	Closed	N	44.524774	-72.885403
≤500	Underhill Town	Underhill	1965	1	Closed	N	44.522829	-72.88568
≤500	Lamoille Landfill & Salvage Depot	Morristown	1993	0	Closed	Y	44.5717	-72.5592
≤500	Rowell Brothers	Hardwick	NU	2	Closed	N	44.513665	-72.371218
≤500	Smith, G.	Elmore	U	1	Closed	N	44.53172	-72.53039
≤500	Tarbox, L.	Jericho	1960	0.25	Closed	N	44.483385	-72.982903
≤500	Eden Town	Eden	U	1	Closed	N	44.706994	-72.541502

Table H3. Hazardous Waste Sites in Basin 7 within 100-ft of surface water and 500-ft of surface water with land use restrictions.*

Distance to surface water (ft)	Site Name	Town	Land Use Restriction	Contaminant	Latitude	Longitude
≤100	Sweet and Burt	Elmore	No		44.540526	-72.523453
≤100	BFA	Fairfax	No		44.664013	-73.011265
≤100	AOT - Georgia	Georgia	No		44.696483	-73.106618
≤100	Smith's Store	Greensboro	No	Gasoline	44.550399	-72.261595
≤100	Brochu's Citgo	Hardwick	No	Gasoline, MTBE	44.504405	-72.365268
≤100	Hardwick Wastewater Treatment Plant	Hardwick	No	Heating Oil	44.51511	-72.376526
≤100	Miller Residence	Hyde Park	No	Heating Oil	44.603054	-72.598866
≤100	Johnson Cold Springs	Johnson	No	Other Petroleum	44.634321	-72.676418
≤100	Former Arrowhead Body Shop	Milton	No	Gasoline	44.643015	-73.11605
≤100	Milton General Store	Milton	No	Gasoline	44.636406	-73.105315
≤100	Wells Country Store	Underhill	No	Gasoline, MTBE	44.50789	-72.903588
≤100	McConnell Residence	Westford	No	Heating Oil	44.584267	-73.046172
≤100	Abandoned Tank	Wolcott	No		44.547133	-72.460467
≤100	Camp Wapanacki	Wolcott	No	Gasoline	44.5568	-72.396311
≤500	Clutes Market	Eden	Yes	Gasoline	44.71337	-72.525654
≤500	Evergreen Manor Mobile Home Park	Hardwick	Yes	Heating Oil	44.49985	-72.368536
≤500	47 Railroad Street	Wolcott	Yes	Chlorinated Solvents, Lead, PAH	44.543926	-72.458565

*There are currently 150 hazardous waste sites within 500-ft of surface waters in Basin 7, only those within 100 feet and with land use restrictions are listed here.

Appendix I. Municipal Protectiveness Matrix for the Lamoille Basin

Table I1. Municipal protectiveness matrix for all the towns in the Lamoille Basin.

	National Flood Insurance Program (NFIP)	Road and Bridge Standards	Emergency Operations Plan (LEOP)	Hazard Mitigation Plan (LHMP)	River Corridor Protection	ERAF	Flood Hazard By-law	Flood Resiliency in Town Plan	Road Erosion Inventory		Storm-water Master Plan	IDDE		Storm-water Mapping	Municipal By-law or Zoning District for Water Resource Setback		
	Enrolled?	Adopted?	Completed?	Adopted?	Adopted?	Percent	Adopted?	Completed?	Completed?	Year	Completed?	Completed?	Year	Completed?	Rivers and Streams	Wetlands	Lake and Ponds
Hardwick	Y	Y	Y	Y	N	12.5	Y	Y	N		N	Y	2014	Y	N	N	N
Hardwick Village	Y	Y	Y	Y	N	12.5	Y	Y	N		N				N	N	N
Stannard	Y	N	N	N	N	**7.5**	Y	N	N		N	N		N	N	N	N
Wheelock	N	N	Y	N	N	**7.5**	N	Y	N		N	N		N	N	N	N
Walden	N	N	Y	N	N	**7.5**	N	N	N		N	N		N	N	N	N
Greensboro	Y	Y	Y	N	N	12.5	Y	Y	N		N	N		N	Y	Y	Y
Craftsbury	Y	Y	N	N	N	**7.5**	Y	N	N		N	Y	2015	Y	N	N	N
Eden	N	Y	Y	Y	N	**7.5**	N	N	Y	2014	N	N		N	N	N	N
Elmore	Y	Y	Y	Y	N	12.5	Y	N	Y	2013	N	N		N	Y	Y	Y
Wolcott	Y	Y	Y	Y	N	12.5	Y	N	Y	2013	N	Y	2014	Y	Y	Y	Y
Johnson	Y	N	Y	Y	N	**7.5**	Y	N	Y	2014	N	Y	2014	Y	N	N	N
Johnson Village	Y	Y	Y	Y	N	12.5	Y	N			N				N	N	N
Hyde Park	Y	Y	Y	Y	N	12.5	Y	N	Y	2011	Partial	Y	2014	Y	Y	Y	Y
Hyde Park Village	Y	Y	Y	Y	N	12.5	Y	N			Partial				N	Y	Y
Morristown	Y	N	Y	Y	N	**7.5**	Y	Y	N		N	Y	2014	Y	Y	Y	

	National Flood Insurance Program (NFIP)	Road and Bridge Standards	Emergency Operations Plan (LEOP)	Hazard Mitigation Plan (LHMP)	River Corridor Protection	ERAF	Flood Hazard By-law	Flood Resiliency in Town Plan	Road Erosion Inventory		Storm-water Master Plan	IDDE		Storm-water Mapping	Municipal By-law or Zoning District for Water Resource Setback		
Morrisville	Y	Y	Y	Y	N	12.5	Y	Y			Partial						
Belvidere	Y	Y	Y	Y	N	12.5	Y	Y	Y	2014	N	N		N	N	N	N
Cambridge	Y	Y	Y	Y	N	12.5	Y	N	Y	2013	N	Y	2014	Y	N	N	N
Cambridge Village	Y	Y	Y	Y	N	12.5	Y	N			N						N
Jeffersonville	Y	N	Y	Y	Y	17.5	Y	Y			N				N	N	N
Waterville	N	N	Y	Y	N	**7.5**	N	N	Y	2014	N	N		N	N	N	N
Georgia	Y	Y	Y	Y	N	12.5	Y	N	N		Y	Y	2014	Y	Y	N	Y
Fletcher	Y	Y	N	N	N	**7.5**	Y	N	N		N	N		N	N	N	Y
Fairfax	Y	Y	Y	Y	N	12.5	Y	N	N		N	Y	2014	Y	Y	N	N
Woodbury	Y	Y	Y	Y	N	12.5	Y	N	partial		N	N		N	N	N	Y
Underhill	Y	Y	Y	Y	Early Adopter	12.5	Y	Y	N		N	Y	2014	Y	Y	Y	N
Jericho	Y	Y	Y	Y	Early Adopter	17.5	Y	Y	N		N	Y	2014	Y	Y	Y	N
Westford	Y	Y	Y	Y	Early Adopter	17.5	Y	Y	N		N	N		N	Y	Y	Y
Essex	Y	Y	Y	Y	Early Adopter	17.5	Y	Y	N		N/A	N		N/A	Y	Y	Y
Milton	Y	Y	N	Y	Early Adopter	12.5	Y	N	N		N/A	N		N/A	Y	Y	Y

Appendix J. Lamoille Watershed Partners

Table J1. Partners and stakeholders in the Lamoille basin.

Group/Program Name		Description
Natural Resource Conservation Districts (NRCD)	Caledonia County (CCNRCD); Lamoille County (LCCD); Winooski (WNRCD);	NRCDs play a critical role in implementing actions identified in basin plans. They also aid Regional Planning Commissions with stormwater master planning, river corridor assessments, and road erosion assessments. NRCDs also work with the agricultural community to identify and implement farm BMPs to protect water quality.
Regional Planning Commissions (RPC)	Central Vermont (CVRPC); Chittenden County (CCRPC); Lamoille County Planning Commission (LCPC); Northeastern Vermont Development Association (NVDA); Northwest (NRPC)	Regional Planning Commissions help towns to complete road erosion inventories, stream geomorphic assessments, and stormwater master plans in addition to helping towns update their regulations to protect water quality. RPCs play a critical role in carrying out basin plan priorities and are now contractually bound to help basin planners with drafting and public outreach.
Lamoille River Paddlers' Trail (LPTA)		Lamoille River Paddlers' Trail is an emerging, community effort to develop new opportunities for paddling and fishing along the Lamoille River. Their vision is of a network of well-maintained river access points, primitive campsites, and portage trails from the river's headwaters west to Lake Champlain. LPTA recognizes the region's rich ecology and productive working landscape and seeks to facilitate recreational use compatible with the river valley's natural and social character.
Friends of Green River Reservoir (FGRR)		Friends of Green River Reservoir supports the Green River Reservoir by providing educational information regarding how GRRSP is understood and experienced. They support research related to the ecology, history, health and sustainability of the Green River Reservoir watershed and provide expertise and resources to further protect of area within and adjacent to GRRSP that are of geological, ecological, biological interest or are of a sensitive nature. They also provide financial support to the Department of Forests, Parks and Recreation to bring about projects that further the FGRR Vision of GRRSP and would be instrumental in any reclassification of waters in and around the state park lands.

Greensboro Land Trust (GLT)		The Greensboro Land Trust (GLT) is a partnership of Greensboro area people working together to ensure that open and forest land in Greensboro is protected. They help to permanently protect irreplaceable fields, woods, and shoreline in Greensboro essential for recreation and scenic enjoyment.
Smuggler's Notch Resort (SNR)		SNR is a large landowner in the headwaters of the Brewster River Watershed and has taken part in stormwater management projects with the town LCPC, VDEC, and LCCD. A continued partnership with SNR is important to address stressors in the watershed in proximity to the operations of the ski resort.
Vermont Youth Conservation Corps (VYCC)		The VYCC works on Class IV road projects by assessing and implementing BMPs in high risk areas. The role of the VYCC in helping to implement actions in the basin plan continues to evolve as funding and needs change.
VT Agency of Transportation (VTrans)		VTrans manages and maintains miles of State highway and stream crossings within the basin including Routes 15, 100, 108, 128, 104, 12, and 14. VTrans provides technical assistance in the form of hydraulic modeling for bridge and culvert replacements and transportation maintenance. VTrans also provides grant funding to basin municipalities including Structures and Transportation Enhancement grants.
Better Roads (BR) - VTrans		BR provides technical assistance, grant funding, and educational workshops related to transportation infrastructure and water quality. BR provides funding for municipalities through the Better Roads Grants. Grant funding can be used to undertake road erosion inventories and capital budgets and to implement transportation infrastructure best management practices (BMPs) that address road erosion and improve water quality and aquatic habitat.
USDA Natural Resources Conservation Service (NRCS)		NRCS provides cost-share, technical assistance, and targeted support of agricultural best management practices. Additionally, NRCS provides funding and technical assistance for forestry and wildlife habitat projects.
Watershed Municipalities		There are thirty-four towns wholly or partially within the Lamoille River Watershed within the six counties of Caledonia, Chittenden, Franklin, Lamoille, Orleans, and Washington. Municipalities can protect water resources through town plan language and zoning bylaws. Additionally, towns are responsible for managing large networks of roads, drainage ditches, and stream crossings.
VT Agency of Natural	Fish and Wildlife (VFWD); Forests, Parks and Recreation	All Departments within VANR (Fish & Wildlife Department, Forest, Parks, and Recreation, and VDEC) and Divisions within them, work collaboratively on a number of watershed assessment,

Resources (ANR) Internal Partners	(VFPR); Environmental Conservation (VDEC)	restoration and protection projects. Additionally, FWD and FPR own and manage hundreds of acres of state-owned lands within the basin. Annual stewardship plans are prepared by District Stewardship Teams and includes staff from FWD, FPR, and VDEC. Long Range Management Plans of state-owned properties include restoration and protection of water resources.
The Vermont Lake Wise Program (LWP) - VDEC Lakes and Ponds Program		The Lake Wise Program is offered through the Vermont Lakes and Ponds Section to provide trainings in lake friendly shoreland management to Lake Associations and shoreland property owners. Through Lake Wise, participants receive technical assistance to evaluate specific landscaping practices for fixing erosion and polluted runoff, while improving lake quality and wildlife habitat. Lake Wise participants passing all four categories for driveway; structures and septic systems; recreation areas; and shorefront receive the Lake Wise Award, which can include a beautiful Sign that can be proudly displayed on the property. Lake Associations are also awarded the "Gold Award," depending on the percentage of shoreland owners participating in Lake Wise. Vermont LakeWise Link

If you or your organization is interested in becoming an active partner or stakeholder, please contact your basin planner.

Appendix K. Proposed and Recommended Class I Wetland Information

Recommended Class I Wetland Evaluation Matrix

The table below (Table K1) provides supporting information to watershed groups and communities who are interested in petitioning the wetlands below for a Class I wetland determination. The determination for a Class I wetland is based on an evaluation of the extent to which the wetland (1) serves the functions and values of the Vermont Wetland Rules, (2) is exceptional or irreplaceable in its contribution to Vermont's natural heritage and, therefore, (3) merits the highest level of protection.

The criteria heading in table K1 represents large categories that determine whether a wetland is exceptional and/or irreplaceable. These types of wetlands typically rate high in function and value. A **representative example** of wetland type (i.e. shrub swamp, emergent marsh, northern white cedar swamp) is based on size, condition, quality and function. A representative example wetland represents a reference condition for wetland type, and is therefore exceptional. **Rare community** wetlands are types of wetlands that are unique, uncommon and/or slow forming, and are therefore irreplaceable. **Community Assemblage/Wetland Complex** wetlands are larger wetland complexes usually associated with bodies of water, which have high species diversity and function. These provide exceptional function and value. A wetland with **landscape association** is a wetland that provides function specific to their landscape position, such as delta wetlands that represent the transition between river and lake. They are irreplaceable because of the critical nature of their landscape position, and the corresponding functions in that landscape. They are often exceptional because of their size, function and value.

The sub-criteria heading in table K1 refers to qualities, functions and values that would contribute to a wetland being exceptional and irreplaceable. Wetlands that are considered to be in **undisturbed condition** are those wetlands in a relatively undisturbed condition with little evidence of disturbance to wetland vegetation, soils and hydrology. **Intact landscape** wetlands are those wetlands that are part of an intact and landscape with little or no fragmentation by development or land use. Wetlands with **connectivity** are those wetlands that serve as important wildlife or waterfowl corridors, connecting natural areas and/or serving in migration.

Both criteria and sub-criteria should be evaluated by natural resource professionals and supported by reliable documentation. Additional wetland functions and values may be identified by further evaluation. The VT Wetlands Program has created a Class I website with an interactive map. This website has the determinations for the 3 existing Class I wetlands, and materials about the four candidates which are currently on public notice, including Sandbar Wetland Complex. Over time new materials will be added, such as, a Class I petition form and a list of other wetlands which likely qualify. The web address is: http://dec.vermont.gov/watershed/wetlands/class1wetlands.

Table K1. Recommended and Proposed Class I wetland evaluation matrix.

Wetland Name	Town	Criteria[1]	Subcriteria[2]	Function and Value	Acres	Natural Communities	# RTE	# Uncommon	Notes
Molly Bog Wetland Complex and Joe's Pond Wetland Complex, Morristown	Morristown	Rare community, community assemblage	Surface and groundwater protection, flood storage in developed area	Water Storage for Flood Water and Storm Runoff; RTE Species Habitat; Surface & Ground Water Protection; Education and Research in Natural Sciences; Fish Habitat; Wildlife Habitat; Exemplary Wetland Natural Community; Erosion Control through Binding and Stabilizing the Soil	296	Dwarf Shrub Bog, Spruce-fir swamp	4	3	Kettle hole bog, spruce-fir swamp, contains highest diversity of mosses in the state, provides educational opportunities to study past glacial activities
Sandbar Wetland Complex	Milton, Colchester	Representative example, rare community, community assemblage/wetland complex, landscape association	Undisturbed condition, connectivity	Water Storage for Flood Water and Storm Runoff; RTE Species Habitat; Surface & Ground Water Protection; Education and Research in Natural Sciences; Fish Habitat; Wildlife Habitat; Recreational Value and Economic Benefits; Open Space and Aesthetics; Exemplary Wetland Natural Community; Erosion Control through Binding and Stabilizing the Soil	1359	Alder Swamp; Deep Bulrush Marsh; Lakeside Floodplain Forest; Red/Silver Maple- Green Ash Swamp; Silver Maple-Ostrich Fern Riverine Floodplain Forest; Vernal Pool; Wet Sand	29	13	

						Over Clay Forest			
Flagg Pond Cedar Swamp	Wheelock	Representative example, community assemblage/wetland complex	Connectivity, intact landscape	RTE Species Habitat; Fish Habitat; Wildlife Habitat; Recreational Value and Economic Benefits; Open Space and Aesthetics; Exemplary Wetland Natural Community; Erosion Control through Binding and Stabilizing the Soil	110	Northern White Cedar Swamp	3	4	
North Branch Wetland Complex	Belvidere	Representative example, Community assemblage/wetland complex, landscape association	Connectivity, undisturbed condition of the sedge meadow along the brook	Water Storage for Flood Water and Storm Runoff; RTE Species Habitat; Education and Research in Natural Sciences; Fish Habitat; Wildlife Habitat; Recreational Value and Economic Benefits; Open Space and Aesthetics; Exemplary Wetland Natural Community; Erosion Control through Binding and Stabilizing the Soil	375	Dwarf Shrub Bog; Northern White Cedar Swamp; Black Spruce Woodland Bog; Poor Fen; Sedge Meadow; Shrub Swamp	1	1	High quality cold water fisheries habitat, recreation, high quality wildlife habitat because of large intact tract of wetland and riparian land, deer wintering area directly downstream of sedge meadow

Proposed and Recommended Class I Wetland Maps

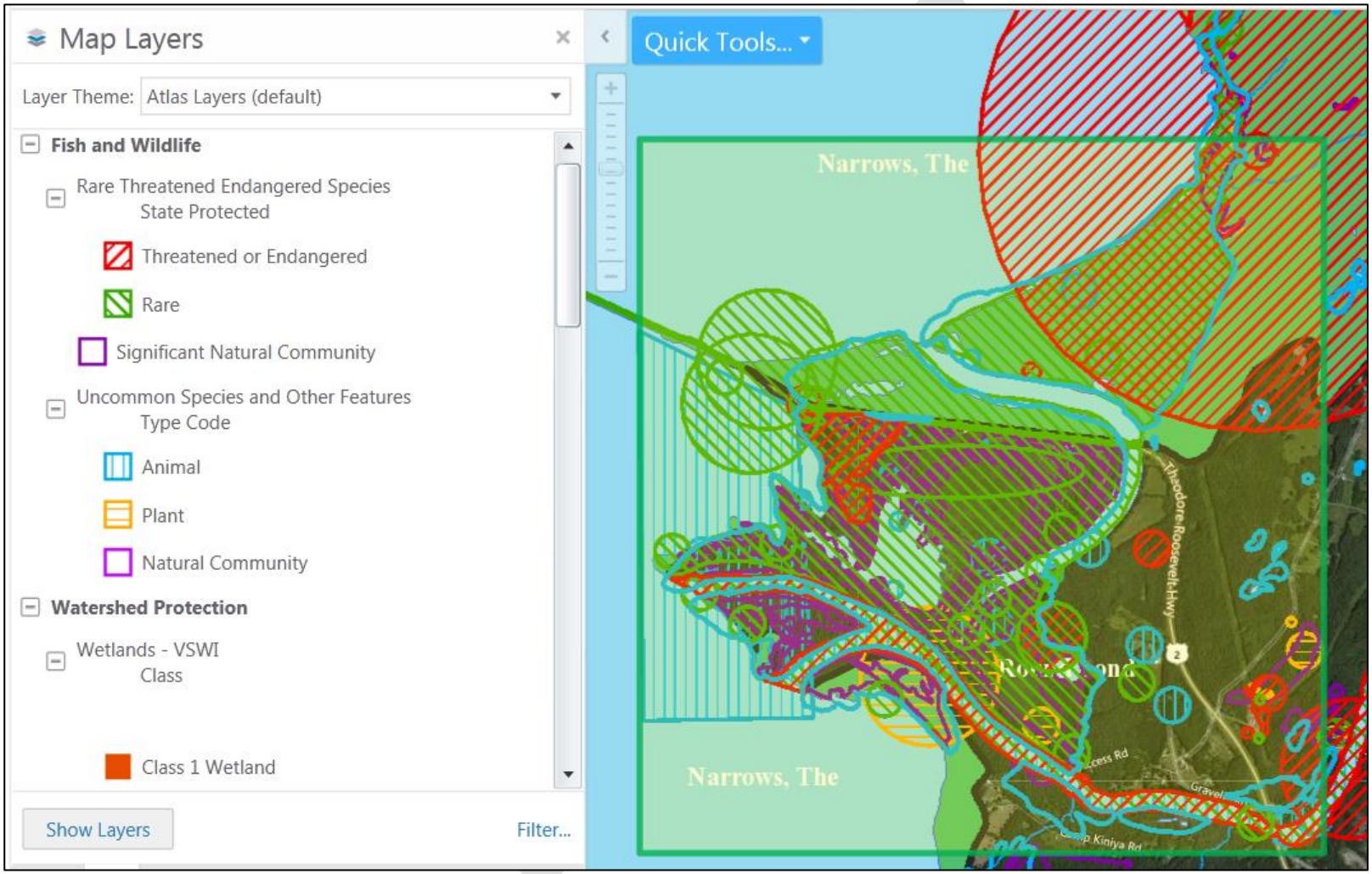

Figure K1. Location of Sandbar wetland complex along the mouth of the Lamoille River in Colchester and Milton. Green polygon indicates Class II wetlands.

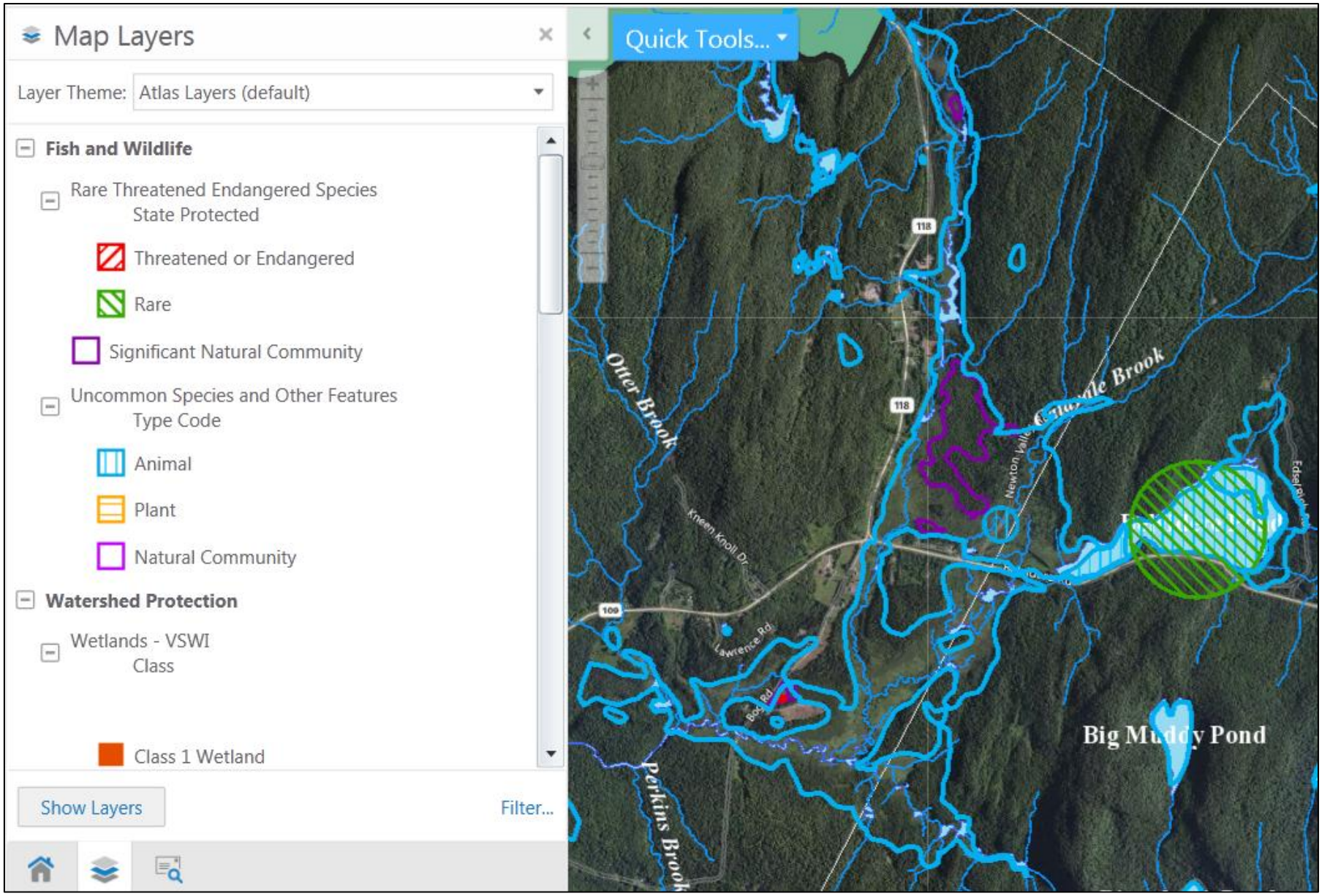

Figure K2. Location of North Branch wetland complex and Belvidere Bog in Belvidere and Eden. Blue polygons indicate Class II wetlands.

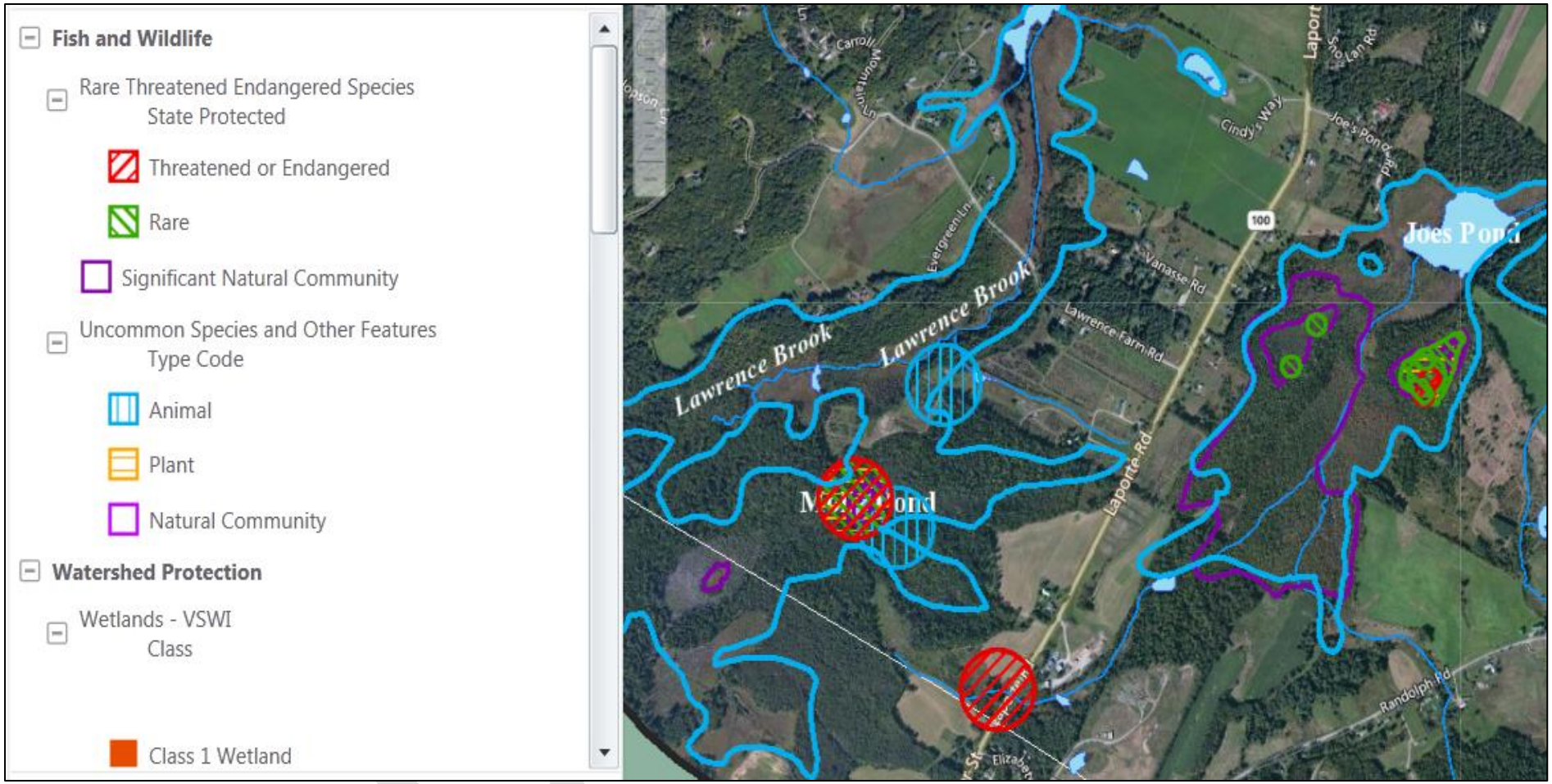

Figure K3. Location of Morristown Bog, Molly's Pond and Joes Pond wetlands in Morristown and Stowe. Blue polygons indicate Class II wetlands.

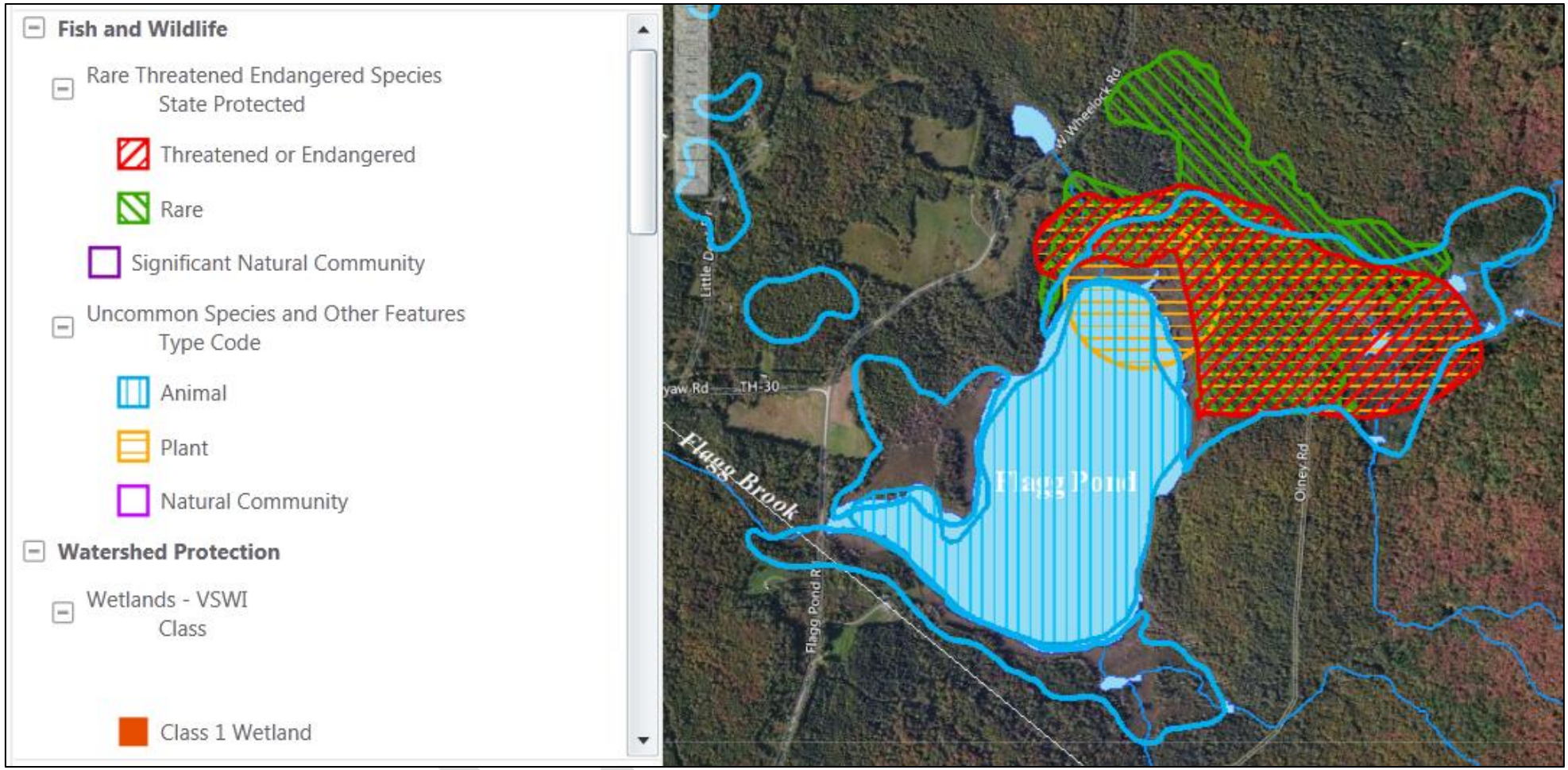

Figure K4. Location of Flagg Pond cedar swamp in Wheelock. Blue polygons indicate Class II wetlands.