Vermont Agency of Natural Resources

Watershed Management Division

Missisquoi Bay

2016 TACTICAL BASIN PLAN

Missisquoi River, Orleans County

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION

Vermont Surface Water Management Strategy

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The Missisquoi Bay Water Quality Management Plan (Basin 6) was prepared in accordance with 10 VSA § 1253(d), the Vermont Water Quality Standards, the federal Clean Water Act and 40 CFR 130.6, and the Vermont Surface Water Management Strategy.

Approved:

________________________ 12/28/16

Alyssa B. Schuren, Commissioner — Date

Department of Environmental Conservation

________________________ 12-27-16

Deb Markowitz, Secretary — Date

Agency of Natural Resources

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Executive Summary

The Vermont Clean Water Act requires the development of Tactical Basin Plans for each of Vermont's 15 river basins to be adopted on a five-year recurring cycle. These plans integrate watershed modeling, water quality monitoring, sector-specific pollution source assessments, and stakeholder input to document geographically explicit actions necessary to protect, maintain, enhance, and restore surface waters. The Agency of Natural Resources is assisted in the implementation of plan through a combination of federal and State funding sources, partner support (Appendix A) and for certain protection efforts, the public rulemaking process.

The Missisquoi Bay (Basin 6) Tactical Basin Plan focuses on the Vermont portions of the Missisquoi, Rock and Pike River watersheds as well as the Lake Champlain shoreline within the Missisquoi Bay. DEC Basin 6 Water Quality Assessment Report provides background to support the Plan's actions including assessments of wetlands, lakes and rivers. The Plan's goal for Lake Champlain's Missisquoi Bay and all of the surface waters in its drainage basin is the sustained ecological health and human use by meeting or exceeding Vermont Water Quality Standards.

The surface waters in Basin 6 provide recreational opportunities, drinking water and support for wildlife habitat and plant communities. The health of the surface water is directly connected to these uses. The DEC Basin 6 Water Quality Assessment Report as well as additional assessments and monitoring results described in Chapter 2 identify the pollutants or processes most responsible for degraded water quality and habitat. Pollutants include phosphorus, sediment, pathogens and toxins as well as aquatic invasive species. The Missisquoi Bay has excessively high phosphorus levels due to phosphorus loading from the watershed, leading to frequent algal blooms.

The main souces of the elevated phosphorus, sediment and pathogen levels include agricultural, urban and road runoff, and eroding river channels due to a lack of equilibrium in the river system. Many of the actions to address these stressors in the basin will also achieve required reductions in phosphorus loading to Lake Champlain's Missisquoi Bay. Chapter 3 includes specifics on the Total Maximum Daily Load (TMDL) and cleanup plan to meet those reductions.

In Chapter 4, the plan also describes management goals for basin 6 surface waters and includes new classifications or candidates for reclassification (see Summary of Classification Opportunities below).

The heart of this plan is Chapter 5 and the Watershed Projects Database, which includes geographically explicit actions to protect or restore surface waters in the basin. The actions are supported by the following top objectives and strategies for priority watershed (and associated towns):

Top Objectives and Strategies

Protect river corridors to increase flood resilience and allow rivers to reach equilibrium through protection of river corridors with conservation easements and municpal adoption of appropriate ordinances, focusing on the Upper Missisquoi, Trout and Tyler Branch and implementation of DEC river corridor plans.

Increase knowledge of water quality conditions in the basin, including the identification of high quality lakes through the establishment and/or continuation of short-term intensive and long-term monitoring programs**.**

Implement agricultural Best Management Practices (BMPs) in areas that are a significant source of phosphorus and where BMPs are best suited to conditions with a focus on the watersheds of the Rock and Pike Rivers, Hungerford Brook, Black Creek and Mud Creek**.**

Resolve E. coli impairments in Berry, Godin and Samsonville Brooks by addressing discernable bacteria sources from agriculture and residential sources to meet bacterial TMDL.

Manage stormwater from developed areas through the development and implementation of stormwater master plans (Enosburgh, Fairfield, Franklin, Highgate, Richford, Sheldon, Swanton).

Improve littoral zone habitat along Lake Champlain, Fairfield Pond and Lake Carmi through direct outreach with landowners to encourage participation in the Lake Wise Program, which promotes implementation of lakeshore BMPs.

Inventory and prioritize municipal road erosion features that discharge into surface water and implement high priority actions in existing road erosion inventoried sites

Provide technical and as available, financial assistance to wastewater treatment facilities in meeting TMDL goals to reduce phosphorus loading to Lake Champlain.

Prioritize wetland and floodplain restoration projects on agricultural lands for phosphorus retention and sediment attenuation with a focus on the watersheds of Rock, Pike Rirves and Hungerford Brook.

Prioritize remediation of forest roads and log landings with high erosion risks with focus on sugaring operations and Upper Missisquoi and Trout River watersheds

Summary of Classification Opportunities

Waters proposed for reclassification to Class B(1) for fishing use:

- South Branch Trout River upstream of Highland Spring Road (river mile 5.5)

Wetland candidates for Class I:

- Missisquoi Delta, including Maquam Bog in the Missisquoi National Wildlife Refuge

In addition to the actions supported by priority objectives and the classification opportunities, the basin plan also includes actions for addressing stressed and impaired waters listed in Table 3.

The Vermont Agency of Natural Resources has prepared an online mapping tool, the ANR Natural Resources Atlas, that allows the reader to identify the locations of many Basin features.

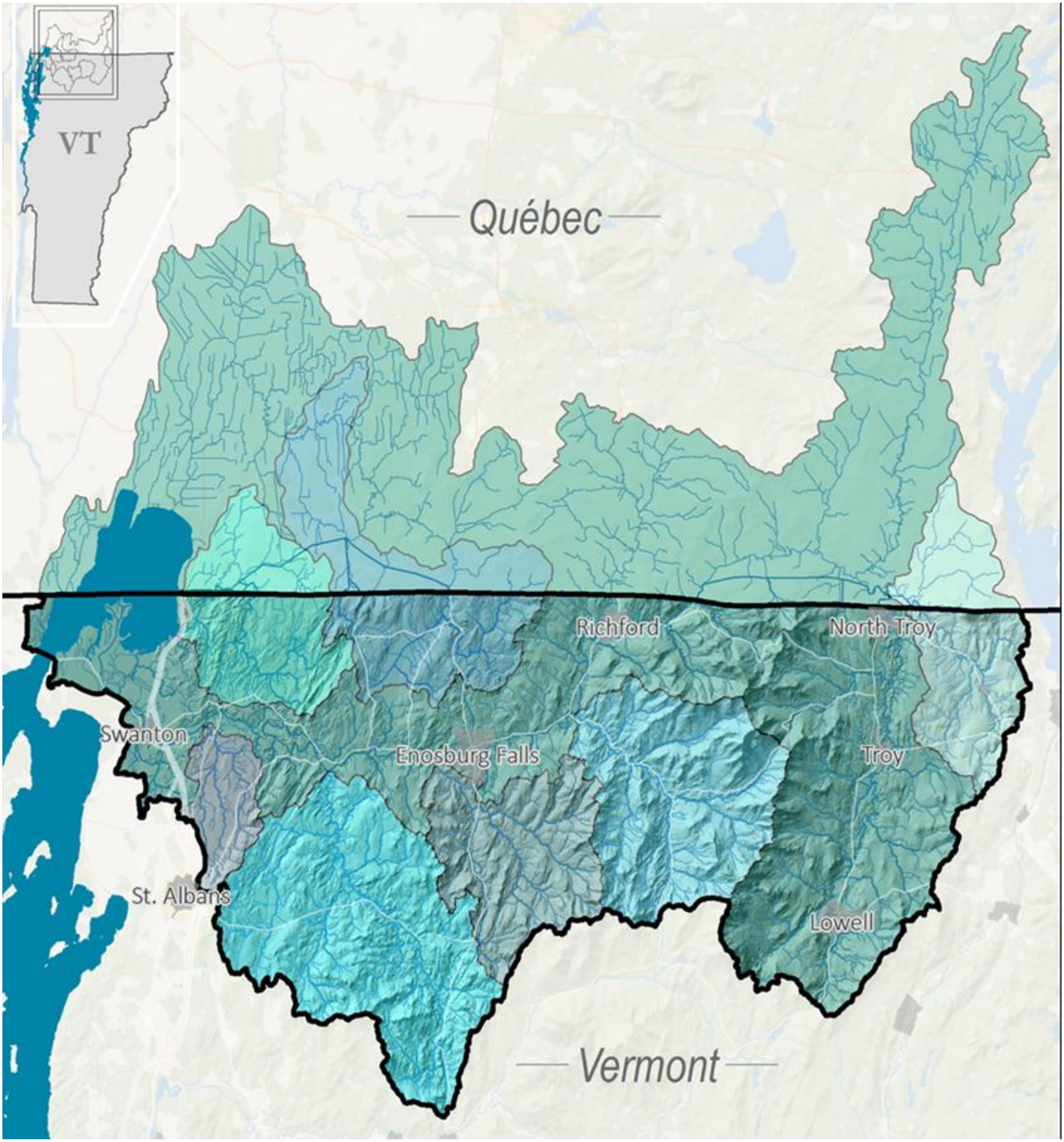


Figure 1. The Missisquoi Bay Watershed

Chapter 1 – Planning Process and Watershed Description

The Tactical Basin Planning Process

The Vermont Department of Environmental Conservation's (DEC) tactical basin planning process identifies actions that will protect, maintain, and improve surface waters by managing the activities that cause the known stressor(s) and address the resulting pollutants. The DEC Basin 6 Water Quality Assessment Report provides background to support the Plan's actions including description of wetlands, lakes and rivers water and their health.

Using integrated watershed modeling, water quality monitoring, sector-specific pollution source assessments, and stakeholder input, these actions are strategically targeted to sub-basins (see Table 15 and Map A, B and C) and specific waters where their implementation would achieve the greatest benefit to water quality and aquatic habitat while being cost-effective.

For the purposes of assessing and reporting water quality information, the state is divided into 15 major drainage basins. Each basin includes one or more major river watersheds[1]. The DEC is responsible for preparing Tactical Basin Plans, a water quality management plan, for each of the basins and updating them every five years. The resulting plans meets the goals and objectives of the Vermont Surface Water Management Strategy (VSWMS) to protect, maintain 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 planning process is outlined in Chapter 4 of the VSWMS.

The DEC collaborates with State, federal and municipal organizations, local conservation groups, businesses, and a variety of landowners and interested citizens to develop and implement the Tactical Basin Plan (see Appendix A). Partners have played multiple roles, including funder, technical resource (see resources in the VSWMS) or project manager as well as providing guidance during the planning process.

In 2015, the passage of Act 64, the Vermont Clean Water Act, strengthened multiple statutes related to water quality in Vermont. Act 64 was passed specifically to set in

[1] A watershed is a distinct land area that drains into a particular waterbody through either channelized flow or surface runoff. Preparing a plan at a watershed level allows for the consideration of all contributing sources of runoff to the surface waters.

place statewide requirements necessary to achieve the phosphorus reduction targets in USEPA's Lake Champlain Phosphorus TMDL, and to establish the regulatory authorities necessary to implement the Lake Champlain Phase I Plan. This Tactical Basin Plan is the tool for establishing five-year goals and actions related to the implementation of Act 64 directives.

Act 64 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. In addition, through the Department of Forests, Parks and Recreation, the Act addresses water quality runoff from silviculturale activities.

Act 64 also establishes the requirement that all water quality improvement actions undertaken by the State be integrated by means of Tactical Basin Plans (TBP), and establishes partnerships with Regional Planning Commissions, Natural Resource Conservation Districts, and other organizations to support this work. Lastly, Act 64 establishes a cleanup fund to dedicate resources towards the highest priority water quality remediation actions.

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 Tactical Basin Plan encourages communities to take protective measures that will restore, maintain and enhance water quality in all areas that in turn protect human health, ecological integrity, and water-based recreational uses. The TBP does not preclude any development that is consistent with municipal zoning, regional and municipal plans and with applicable State and federal regulations.

The Tactical Basin Plans are also consistent with the U.S EPA's framework for developing watershed-based plans. EPA's framework consists of nine key elements that ensure that the contributing causes and sources of nonpoint source pollution are identified, key stakeholders are involved in the planning process and restoration and protection strategies, addressing water quality concerns are identified. The resulting tactical basin plan uses adaptive management, has strong implementation sections, is an effective plan for restoration or protection, and identifies projects that are eligible for federal and State funding.

In order to implement the high priority actions required to protect, enhance, maintain and restore water quality, the TBP spells out clear attainable goals and targeted strategies to achieve goals laid out in Act 64, the Lake Champlain Phosphorus TMDL and EPA's nine elements. The Watershed Projects Database is a tool by which progress can be tracked with regard to measurable indicators of each major goal. In addition, the database 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, including Acts 110[2] and 64.

The Tactical Basin Plan builds upon the Agency's previous Missisquoi Bay Tactical Basin Plan, signed in 2013 (DEC 2013). That plan contains strategies that addressed river corridor protection, stormwater management, drinking water protection, aquatic invasive species management, and installation of agricultural Best Management Practices. Through efforts of the Agency and its watershed partners, many of these have been implemented or are in progress. This plan builds upon those original plan recommendations by providing additional geographically explicit actions in areas of the basin identified for intervention based on monitoring and assessment data, and high-resolution phosphorus modeling.

The Tactical Basin Plan actions are described in Chapter 5's implementation table summary and the Watershed Projects Database and will be addressed over the five-year life of the Missisquoi Bay Tactical Basin Plan. The plan will not be a static document. It is expected that the Agency and its partners will have to develop adaptive management techniques as new natural and anthropogenic events present themselves.

Successes and challenges in implementing actions will be reviewed in biannual meetings with watershed partners. In addition, the implementation table will be modified accordingly to best address newly emerging information, unanticipated events, and new requirements such as are anticipated by the Lake Champlain Phosphorus TMDL (see Chapter 3 for additional information on the TMDL).

[2] Act 110 directed the Secretary of Natural Resources to establish a river corridor management program and a shoreland management program, effective February 1, 2011, to provide municipalities with maps of designated river corridors and develop recommended best management practices for the management of river corridors, shorelands, and buffers.

Contributing Planning Processes

Complementary planning processes in the watershed also direct resources towards surface water protection and remediation strategies. The strategies, associated resources and partnerships identified in these plans contributed to the development and implementation of actions in Chapter 5. These planning processes can be further explored through the links provided below:

- Lake Champlain Basin Program's 2010 **-** Opportunities for Action
- Rock and Pike River NRCS Priority Watershed Planning Process 2016
- Wild and Scenic Study Management Plan for the Upper Missisquoi and the Trout Rivers 2013
- The International Joint Commission's 2011 Missisquoi Bay Critical Source Area Study

The Missisquoi Bay Watershed

The Missisquoi Bay is located at the northern end of Lake Champlain. The 19,150 acre bay is shallow, only reaching a depth of 14 feet. In all, more than 767,246 acres of land comprise the watershed of Missisquoi Bay with approximately 58% of the watershed located in Vermont and 42% in the Canadian Province of Quebec (Figure 1, Maps A, B and C). In Vermont, the watershed extends over most of Franklin County, as well as parts of Orleans and Lamoille Counties.

The land use in the Missisquoi Bay watershed is 66% forested, 25% agricultural, and 6% urban (Troy et al., 2007). Table 1 further breaks down landuse by subwatershed. The health of a waterbody is dictated for the most part by the landuse or landcover in its watershed. A forested watershed provides the best protection as it absorbs or detains the precipitation that in a developed or agricultural landscape will pick up pollutants as stormwater runoff and carry it to waterbodies. See Vermont Surface Water Management Strategy (VSWMS) for a more in depth explanation of pollution sources.

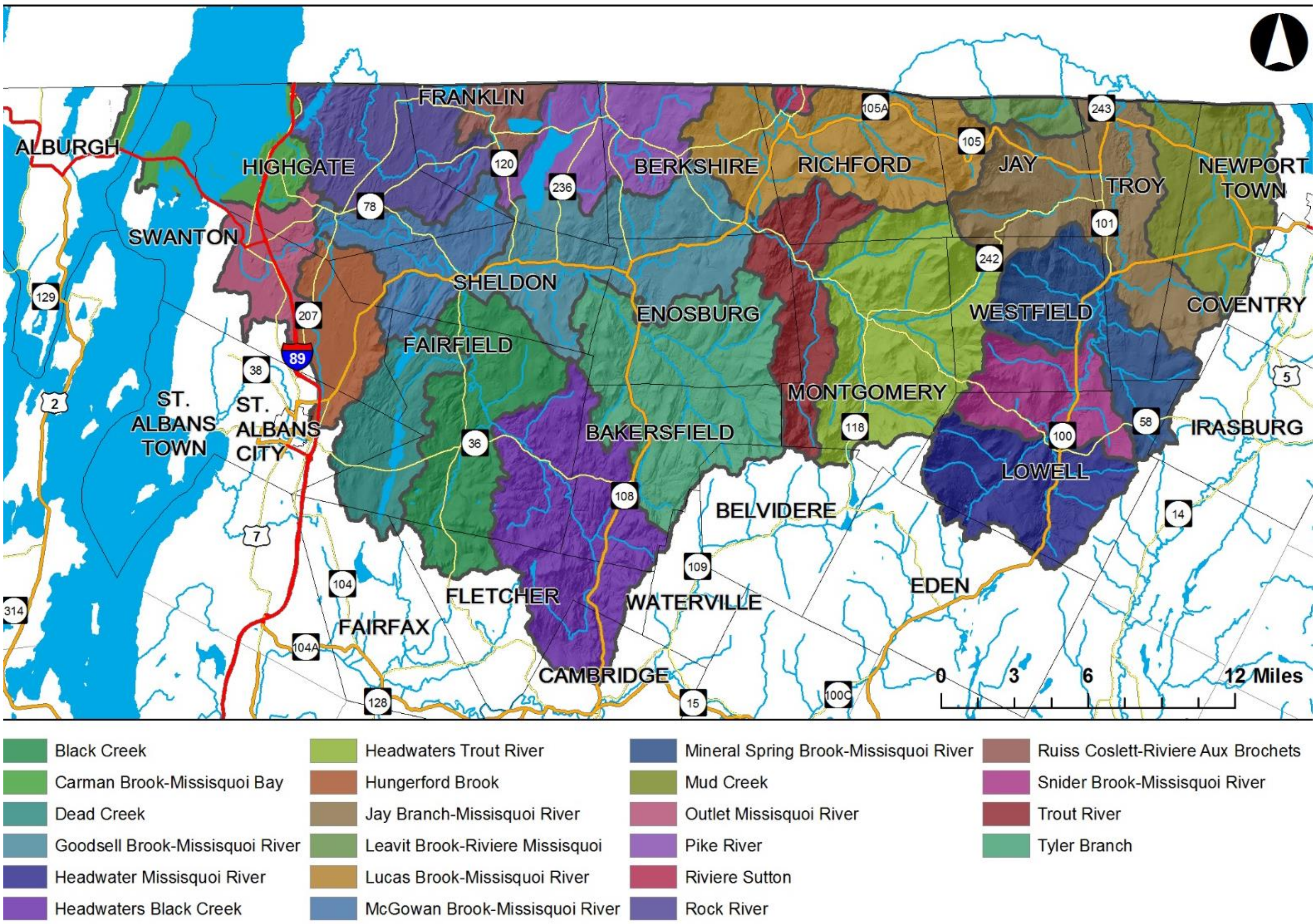


Figure 2. HUC12 subbasins for Missisquoi Bay watershed.

Subwatersheds

The Missisquoi River is the largest tributary of the Missisquoi Bay, followed by the Rock and Pike Rivers. For tactical basin planning purposes, the Missisquoi River subwatershed is further divided into five subwatersheds: Hungerford Brook, Black Creek, Tyler Branch, Trout River, and Mud Creek (Table 1). A detailed description of the bay's subwatersheds are contained in the DEC Basin 6 Water Quality Assessment Report. Figure 2. identifies these subwatersheds as part of HUC12s, a hydrologic unit used for modeling landscape processes that affect water quality. The use of modeling results in the planning process is discussed in Chapter 3.

Table 1. Subwatershed characteristics

Subwatershed	Land Use Land Cover Type	% of Subwatershed[3]	Prominent Stressors[4]
Rock River	Urban	5%	Land Erosion, Channel erosion, Nutrient loading
	Agricultural	41%	
	Forested	40%	
Pike River	Urban	5%	Land erosion, Channel erosion, Encroachment Aquatic invasives
	Agricultural	34%	
	Forested	51%	
Missisquoi River	Urban	5%	Land erosion, Channel erosion, Nutrient loading,
	Agricultural	24%	
	Forested	61%	
Mud Creek	Urban	4%	Land erosion, Nutrient runoff
	Agricultural	27%	
	Forested	61%	
Trout River	Urban	3%	Channel erosion, Encroachment
	Agricultural	7%	

[3] The total landcover includes wetlands and other waterbodes that are not included in this table
[4] See Vermont Surface Water Management Strategy and chapter 2 for more about stressors

	Forested	84%	
Tyler Branch	Urban	4%	Land erosion, Channel erosion
	Agricultural	14%	
	Forested	74%	
Black Creek	Urban	4%	Land erosion, Channel erosion, Nutrient loading, Encroachment
	Agricultural	21%	
	Forested	63%	
Hungerford Brook	Urban	6%	Land erosion, Channel erosion, Nutrient loading,
	Agricultural	44%	
	Forested	34%	

Chapter 2 - Water Resource Assessments

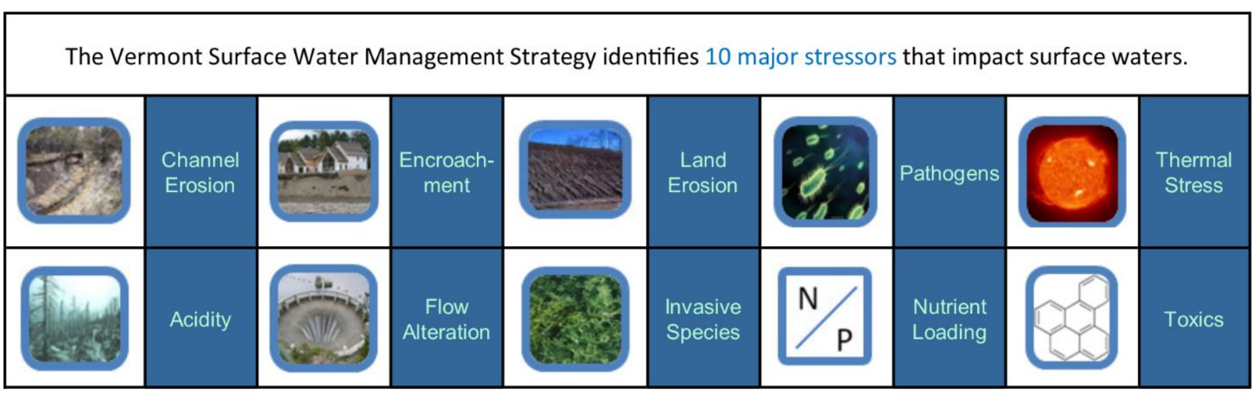
Assessment Methodology

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 accessed through the Vermont Integrated Watershed Information System, online data portal.

The results of assessments are the basis for the biennial statewide 303(d) List of Impaired Waters and List of Priority Surface Waters Outside the Scope of 303(d) (Table 3). These priority waters lists also includes preliminary information on responsible pollutant and/or physical alterations to aquatic and riparian habitat, the stressor and if known, the source. DEC Basin 6 Water Quality Assessment Report provides additional information about these waters. The waterbodies included on these lists are included as a focus for remediation efforts in this plan

The Vermont Surface Water Management Strategy (DEC 2012) (VSWMS) lays out the goals and objectives of DEC's Watershed Management Division for addressing pollutants and stressors that can negatively affect the designated uses of Vermont surface waters. The strategy discusses 10 major stressors (Table 2), and as of this writing is being updated to reflect new provisions of Act 64 and the Lake Champlain TMDL.

Table 2. Stressors relating to water resource degradation with links to in-depth information
(Click on a stressor to learn more)



The Vermont Surface Water Management Strategy identifies 10 major stressors that impact surface waters.				
Channel Erosion	Encroach-ment	Land Erosion	Pathogens	Thermal Stress
Acidity	Flow Alteration	Invasive Species	Nutrient Loading	Toxics

Stressors, Pollutants and Physical Alterations to Aquatic and Riparian Habitat

A stressor is defined as a phenomenon with quantifiable damaging effects on surface waters resulting from the delivery of pollutants to a waterbody, or an increased threat to public health and safety. For the most part, stressors result from human activity on the landscape; however, when landscape activities are appropriately managed, stressors are reduced or eliminated.

Table 2 provides links to the stressor chapters of the VSWMS that describe in detail the stressor, its causes and sources, and DEC's approach to addressing the stressor through monitoring, technical assistance, regulations and funding.

In this plan, the stressors responsible for the impaired, altered and stressed waterbodies in the basin are listed next to the waterbody in Table 3 and both are located on Maps A, B and C. In addition to the stressor, Table 3's priority waters lists also identify the pollutant or physical alteration responsible for degraded water quality or physical condition of each priority water.

Pollutants enter surface waters either as a point source, a discrete source from a pipe, or as non-point source, carried in precipitation that runs off the landscape (i.e., stormwater runoff). Physical alterations result from the inadvertent introduction of aquatic invasive species (AIS), or with a change in surface water levels because of dams or water withdrawal. The landuse and other activities that are responsible for non-point source pollutants as well as DEC's remediation strategies, are described in detail in the Vermont Surface Water Management Strategy (VSWMS).

Climate Change: increasing pollutant loads and impacts to waterbodies

Climate change predictions for Vermont are expected to intensify stressors, leading to increased pollutant loads from the landscape as well as loss of native species. Predictions include increased intensity of storms and resulting increases in stormwater flows. In response, management of landscape activities will need to intensify to effectively address stressors that are intensified with additional flows. These stressors include channel and land erosion, nutrient loading and thermal stress.

Increased temperatures are also predicted, which will increase thermal stress to waterbodies. In addition, warmer temperatures will also allow invasive species to gain a competitive edge, requiring changes in management strategies to better protect native species. The Lake Champlain TMDL was developed with consideration of the effects of climate change, and the Lake Champlain Phase I Implementation Plan has a dedicated chapter as well.

Overview of Water Resources

The following is an overview of water resource health in Basin 6. Information on the condition of specific water bodies is included in Table 3.

Rivers

Sediment and nutrients are the most prevalent pollutants in Basin 6[5] in streams and rivers. Prominent stressors responsible include land erosion, channel erosion, and nutrient loading. Physical alterations are also present throughout the watershed, ranging from habitat alteration, general stream channel instability and encroachment into the flood hazard zone. The next most prevalent stressors are thermal modification and pathogens. More isolated stressors specific to particular reaches[6] include toxics from hazardous waste sites and flow alteration.

Despite these impacts, the Upper Missisquoi and Trout Rivers are both federally designated Wild and Scenic Rivers based on unique cultural, scenic and recreational qualities. In addition, the Big Falls of the Missisquoi River at Troy is a natural candidate for Outstanding Resource Water (see Chapter 4) in consideration of spectacular aesthetic value and swimming use.

Lakes and ponds

The basin includes 22 lakes or ponds, 10 acres or larger. Encroachment, by way of shoreland development, is the greatest stressor to Vermont lakes, as recently reported in the National Lake Survey study (USEPA, 2012). In Basin 6, other threats to aquatic habitat and water quality in the lakes include sedimentation and increased eutrophication due to nutrient loading-related stressors. The nutrient loading has resulted in regular algal blooms in Missisquoi Bay and Lake Carmi, with intense cyanobacteria blooms (blue-green algae) becoming seasonal occurrences. In the Missisquoi Bay, fish and freshwater mussel die offs have been noted associated with algal blooms in recent years

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[5] Definition of these pollutants can be found in VSWMS http://www.anr.state.vt.us/dec/waterq/wqd_mgtplan/swms_appB.htm.

[6] The waters and associated problems are listed in the EPA and state lists (see Table 2)

Additional stressors include flow alterations (e.g, water level fluctuations). Aquatic Invasive Species (AIS) pose a threat to the five of the lakes and acidity to one lake (see Table 4).

All of the Basin 6 lakes, along with all but one other lake in Vermont, are under a Vermont Department of Health Fish Consumption Advisory for exceeding the USEPA mercury limits in fish. Mercury is a chemical that becomes toxic at high concentrations. As big fish eat smaller fish, the mercury concentrations increase in the fish tissues, and through this process of bioaccumulation, mercury levels become unsafe for human consumption of the fish.

Healthy lakes with vibrant ecosystems exist in the basin as well: Little Pond in Franklin falls in the top 25% of Vermont lakes with excellent water quality, intact shoreline, high biodiversity, and scenic features. McAllister Pond and Lake Carmi (notwithstanding the lake's high phosphorus levels) both are in the top 20 and 25% respectively for biodiversity.

Wetlands

The Missisquoi Bay watershed contains a great diversity of wetlands, ranging from open water habitats to rich forested swamps, with Missisquoi Delta, Franklin Bog, Fairfield Swamp as a few examples. The Missisquoi Bay and Delta wetlands complex was recognized as Wetlands of International Importance under the Ramsar Convention on Wetlands in 2013

The wetlands in the basin are identified on the Vermont Wetlands Inventory Map (up to 39% of Vermont wetlands may not be mapped). More than 35% of the original wetlands in Vermont have been lost. In recent years, residential, commercial and industrial development have been the primary causes of wetland loss.

The USEPA's National Wetland Condition Assessment 2011 survey included Vermont wetlands with assistance from the WSMD Wetlands Program. The assessment of Eastern Mountains wetlands, including Vermont's, estimated that 52% of the estimated wetland area is in good condition; 11% is in fair condition, and 37% is in poor condition. Presently, the WSMD Wetlands Program is developing a biomonitoring program to measure wetland health to allow assessment of data specific to Vermont.

Condition of Specific Water Resources

Impaired Waters and Priority Surface Waters

The Department of Environmental Conservation (DEC) uses monitoring and assessment data[7] to assess individual surface waters in relation to Vermont Water Quality Standards as outlined in the 2016 DEC Assessment and Listing Methodology . The four categories used in Vermont's surface water assessment are **full support, stressed, altered** and **impaired**. Waters that support designated and existing uses and meet water quality standards are placed into the full support or stressed categories. Waters that do not support uses and do not meet standards are placed into the altered or impaired category (See page 13 2016 DEC Assessment and Listing Methodology.

Table 3 lists the known stressed, impaired or altered waterbodies in Basin 6. These priority waters comprise the 303(d) and the state priority surface waters lists. Maps A, B and C also identify location of these waters. For a more detailed description of monitoring results use the Vermont Integrated Watershed Information System, online data portal. The goals of the Tactical Basin Plan include addressing the stressors or pollutants degrading the listed waters in Table 3 through geographically specific actions (see Chapter 5 Implementation Table). The types of actions prescribed are based on the stressor specific practices outlined in the Vermont Surface Water Management Strategy. Additional monitoring and assessment needs are outlined in Tables 3, 5 and 10.

Table 3 Vermont 2016 Priority Waters for the Missisquoi Bay Watershed and Stressed Waters List (see also Maps A, B and C)

IMPAIRED SURFACE WATERS IN NEED OF TMDL				
Description	**Pollutant**	**Stressor**	**Problem**	**Proposed Action**
Rock River – Mouth to VT/QUE Border	Nutrients, Sediment	CE, LE, NL*	Algal Growth, Agricultural Runoff, Fish Kill	See Lake Champlain P TMDL Subwatershed-specific Agric. TMDL in development
Rock River – Upstream 13 mi from VT/QUE Border	Nutrients, Sediment	CE, LE, NL	Agricultural Runoff, Nutrient Enrichment	See Lake Champlain P TMDL Subwatershed-specific Agric. TMDL in development
Saxe Brook – Mouth to RM 1	Nutrients	CE, LE, NL	Agricultural Runoff	See Lake Champlain P TMDL Subwatershed-specific Agric. TMDL in development
Burgess Brook, RM 4.9 to 5.4	Sediment	LE, Toxics	Asbestos Mine Tailings Erosion, Asbestos Fibers	Resources could be obtained from EPA as Superfund site when town is willing. Landowner presently maintaining EPA installed erosion control. Natural Resources Damage Assessment funds

[7] (see Appendix A of the Vermont DEC Water Quality Monitoring Strategy 2011-2020

Burgess Brook trib. #11, mouth to RM .5	Sediment	LE, Toxics	Asbestos Mine Tailings Erosion, Asbestos Fibers	Resources could be obtained from EPA as Superfund site when town is willing. Landowner presently maintaining EPA installed erosion control
Berry Brook – Mouth to RM1	Sediment, Nutrients	CE, LE, NL	Agricultural Runoff, Aquatic Habitat Impacts	Subwatershed-specific Agric. TMDL in development and See Lake Champlain P TMDL
Godin Brook	Sediment, Nutrients	CE, LE, NL	Agricultural Runoff, Aquatic Habitat Impacts	Subwatershed-specific Agric. TMDL in development and See Lake Champlain P TMDL
Samsonville Brook	Sediment, Nutrients	CE, LE, NL	Agricultural Runoff, Aquatic Habitat Impacts	Subwatershed-specific Agric. TMDL in development See Lake Champlain P TMDL
Trout Brook – Mouth to RM 2.3	Nutrients	CE, LE, NL	Agricultural Runoff	See Lake Champlain P TMDL, Subwatershed-specific Agric. TMDL in development
Wanzer Brook – Mouth to RM 4	Nutrients, Sediment	CE, LE, NL	Agricultural Runoff	See Lake Champlain P TMDL Subwatershed-specific Agric. TMDL in development
Coburn Brook – Mouth to RM .2	Nutrients	CE, LE, NL	Agricultural Activity and Runoff	See Lake Champlain P TMDL Subwatershed-specific Agric. TMDL in development
Mud Creek –VT/QUE Border to RM 6.5	Undefined	CE, LE, NL	Agricultural Runoff, Nutrient Enrichment	See Lake Champlain P TMDL, Subwatershed-specific Agric. TMDL in development
South Mountain Branch (Trib # 7) (2.2 Mi.)	Sediment	CE, LE,	Macroinvert. Impacts; potential sediment from roads, development	See Lake Champlain P TMDL, See additional approved BMP in 2015 amendments to Jay Peak Resort[8] Water Quality Remediation Plan (WQRP)
Ace Brook, Rm0.7 To Headwaters (1.0 Mi.)	Sediment	CE, LE	Apparent sediment discharges and hydro change from logging activity	See Lake Champlain P TMDL,

[8] Jay Peak Resort 2015 WQRP performance report

IMPAIRED SURFACE WATERS – NO TOTAL MAXIMUM DAILY LOAD DETERMINATION REQUIRED				
Description	**Pollutant**	**Stressor**	**Problem**	**Proposed Action**
Jay Branch – RM 7.3 to 9.1	Sediment	CE, LE	Erosion from Land Development Activities.	Water Quality Remediation Plan (WQRP) Jay Peak Resort and §1272 order. Additional BMPs scheduled to be implemented
Jay Branch – Tributary #9	Sediment	CE, LE	Erosion from Land Development Activities	WQRP and §1272 order. Additional BMPs scheduled to be implemented.
South Mountain Branch, Tributary #3	Sediment	CE, LE	Erosion from parking areas and on-mountain activities	WQRP and §1272 order, Additional BMPs scheduled to be implemented
STRESSED SURFACE WATERS				
Description	**Pollutant**	**Stressor**	**Problem**	
Missisquoi River, Mouth to Tyler Branch	Sediment, Nutrients, Turbidity, Temp	CE, LE, NL, Encroachment	Ag, Streambank Erosion, Loss Of Riparian Vegetation	See Lake Champlain Phosphorus TMDL (LC P TMDL)
Missisquoi River, from Sampsonville Bk to RM 45.3	Sediment, Nutrients, Turbidity, Temp	CE, LE, NL, Encroachment, Thermal stress	Ag, Streambank Erosion,	See LC P TMDL
Youngman Brook –1.8 RM above mouth to headwaters	Undefined (Sediment, Nutrients)	CE, LE, NL	Agricultural Runoff	See LC P TMDL
Hungerford Brook	Nutrients, Sediment	CE, LE, NL	Ag activity suspected	See LC P TMDL
Kelly Brook, downstream from Youngs Landfill	Inorganics, SVOCs in sediment	Toxics	Landfill	Continue monitoring, conduct site investigation work to further characterize the impact identified over the years on this property
Black Creek – Mouth to East Fairfield (12 miles)	Sediment, E. Coli, Nutrients	CE, LE, NL, Pathogens	Agricultural Runoff	See LC P TMDL; Continue DEC biomonitoring and support of MRBA volunteer monitoring
The Branch, Beaver Meadow Brk, to E. Bakersfield rd bridge	Sediment, physical alterations	CE, LE, NL	Streambank Erosion, Channelization	See LC P TMDL; Continue DEC biomonitoring and support of MRBA volunteer monitoring
Tyler Branch	Sediment, E. Coli, Nutrients	CE, LE, NL, Pathogens	Agricultural Runoff, Morphological Instability (W. Enosburgh to Cold Hollow Brook)	See LC P TMDL; Continue DEC biomonitoring and support of MRBA volunteer monitoring
East Branch Missisquoi R. Gravel Pit access to Cheney Rd	Sedimentation, likely Temp	CE, LE, Encroachment, Thermal stress	Eroding streambanks, pasture with no buffers, road to gravel pit	Act 250 permit; Continue DEC biomonitoring and support of MRBA volunteer monitoring, town road assessment
Jay Branch – River Miles 7.3 to 5.6	Sediment, Stormwater	CE, LE	Potential Impacts from Construction, Erosion, Watershed Hydrology	Continue DEC biomonitoring

IMPAIRED WATERS WITH COMPLETED & EPA-APPROVED TMDLS				
Description	**Pollutant**	**Stressor**	**Problem**	
Missisquoi River – Mouth Upstream to Swanton Dam	Mercury	Toxics	Elevated Levels of Hg in Walleye	Mercury TMDL: Support EPA's efforts to control emissions from Vermont and other states
Lake Carmi	Phosphorus	CE, LE, NL, Encroachment	Algae Blooms	Phosphorus TMDL
Missisquoi Bay – Lake Champlain	Phosphorus[9], Mercury	CE, LE, NL, Encroachment, Toxics	P Enrichment, Elevated Levels of Mercury in Walleye	Phosphorus TMDL and Mercury TMDL
Berry Brook, Mouth to and including N. Trib.	E. coli	Pathogens	Elevated E. coli Levels	Bacterial TMDL
Godin Brook	E. coli	Pathogens	Elevated E. coli Levels	Bacterial TMDL
Samsonville Brook	E. coli	Pathogens	Elevated E. coli Levels	Bacterial TMDL
Kings Hill Pond (Bakersfield)	Acid	Acidity	Atmospheric Deposition; extremely sensitive to acidification; episodic	Acid TMDL: Support EPA Support EPA's efforts to control emissions from Midwest
WATERS ALTERED BY EXOTIC SPECIES				
Description	**Pollutant**	**Stressor**	**Problem**	
Missisquoi Bay – Lake Champlain	Exotic Species	AIS	Eurasian Watermilfoil Infestation, Zebra Mussel Infestation	Assist landowners with management strategies
Metcalfe Pond, Fletcher	Exotic Species	AIS	Locally Abundant Eurasian Watermilfoil Growth	Assist landowners with management strategies
Fairfield Swamp Pond, Swanton	Exotic Species	AIS	Locally Abundant Eurasian Watermilfoil Growth	Assist landowners with management strategies
Fairfield Pond, Fairfield	Exotic Species	AIS	Locally Abundant Eurasian Watermilfoil Growth	Ongoing local non-chemical control program. Continue to assist landowners with management
WATERS ALTERED BY FLOW REGULATION				
Description	**Pollutant**	**Stressor**	**Problem**	
Lake Carmi	Flow Alteration	Flow Alteration	Water Level Mgmt May Alter Aquatic Habitat	See flow assessment section
Missisquoi River – Below Enosburg Falls Dam	Flow Alteration	Flow Alteration	Artificial Flow Regulation & Condition by Hydro Station	FERC License expires in 2023. See flow assessment section
Stanhope Brook	Flow Alteration	Flow Alteration	Insufficient conservation flows below the intake	Richford water supply – see flow assessment section.
Jay Branch – 4.7 Miles	Flow Alteration	Flow Alteration	Artificial/Insufficient Flow Snowmaking Water Withdrawal.	See flow assessment section
**CE: channel erosion; LE: Land Erosion; NL: Nutrient loading CE: channel erosion; LE: Land Erosion; NL: Nutrient loading*				

[9] EPA approved Lake Champlain phosphorus TMDL September 25, 2002 and later disapproved in 2011. EPA is developing a new TMDL which is expected 2013.

Additional Lake and Pond Assessment Results

In addition to the 303(d) List of Impaired Waters and List of Priority Surface Waters above (Table 3), the WSMD's Lakes Program includes assessment results in the Vermont Lake Score Card to identify the overall conditions of each lake in Vermont (Table 4). The results for aquatic invasive species (AIS) and the water quality condition are also reflected in Table 4.

The score card's evaluations for the 22 lakes in Basin 6 (Table 4), covers four categories: Shoreland and Lake Habitat, Invasive Species, Atmospheric Pollution and Water Quality. The condition for each category is described using colors: blue signifying good, yellow fair, and red reduced conditions. No color represents assessment needs.

Table 4. Scores for the 22 basin 6 lakes, ten acres or larger

Lake Name	Town	Lake Area(acres)	WQ 2014	Inv 2014	Atmos 2014	Shore 2014
Adams	Enosburgh	11				
Bakersfield-N;	Bakersfield	10				
Beaver Meadow Brk-L;		18				
Beaver Meadow Brk-U;		14				
Browns		10				
Fairfield	Fairfield	446				
Fairfield Swamp	Swanton	152				
Fairfield-Ne;	Fairfield	12				
Fairfield-Se;	Fairfield	18				
Goodsell;		10				
Guillmettes	Richford	12				
Mcallister	Lowell	25				
Mcgowan-E;		18				
Mcgowan-W;		10				
Metcalf	Fletcher	81				
Oxbow;		27				
Shawville;		11				
South Richford;	Richford	12				
Bullis;	Franklin	11				
Carmi	Franklin	1402				
Little (Franln)	Franklin	95				
Cutler	Highgate	25				

To increase DEC's awareness of higher quality lakes, additional water quality data collection at Little, South Richford, McAllister and Cutler Ponds is warranted based on the lack of invasives and/or the presence of an intact shoreline (see Table 4).

Stressors, Pollutant and Project Identification

In addition to supporting surface water assessments to identify water quality degradation or reference conditions [10], DEC and partners also support assessments that can lead to a better understanding of the stressor or pollutants and therefore appropriate remediation efforts. The assessments, described in this section, cover most landuse activity as well as the condition of river corridors.

During the tactical basin planning process, the results of the assessments are considered along with modeling results (see end of Chapter for more explanation on modeling analyses). to prioritize geographic areas for project development and to identify priority projects for inclusion in the Tactical Basin Plan's Watershed Projects Database (Chapter 5). These projects can then be used to help meet regulatory requirements or support voluntary efforts. Specific assessment needs for each subwatershed are included in Tables 5 and Table 10.

Table 5. Status of Basin 6 assessments that lead to stressor/project identification.

	Sub-Basin	Water Quality Monitoring (volunteer)	Geomor-phic Assessment	Illicit Discharge Detection	Stormwater Master or Flow Restoration Plans	Road Assessment
Rock River		U	C	NA	NA	X
Pike River		U	PC/X	NA	C	U
Missisquoi River	Upper Missis.	U	C	NA	NA	X
	Mud Creek	U	C	NA	NA	X
	Mid- Missis	U	C	NA	NA	U
	Trout River	PC/X	C	NA	NA	X
	Tyler Branch	PC/X	C	C	NA	U
	Black Creek	PC/X	C	C	U	U
	Lower Missis.	U	C	C	C	U
	Hungerford Brook	PC/X	C	NA	NA	U

X= proposed in plan C= Completed PC= Partial Completion U=Underway[11] NA=Not Applicable

[10] Appendix A of the Vermont DEC Water Quality Monitoring Strategy 2011-2020

[11] Assessment that are underway also include long-term monitoring efforts taken on by volunteer watershed groups, municipalities or the State.

Water Quality Monitoring by Citizen Groups

In addition to data collected by DEC staff, DEC also considers stream and lake chemical data collected by other organizations, including volunteer monitoring groups. The results can be important for identifying stressors and sources.

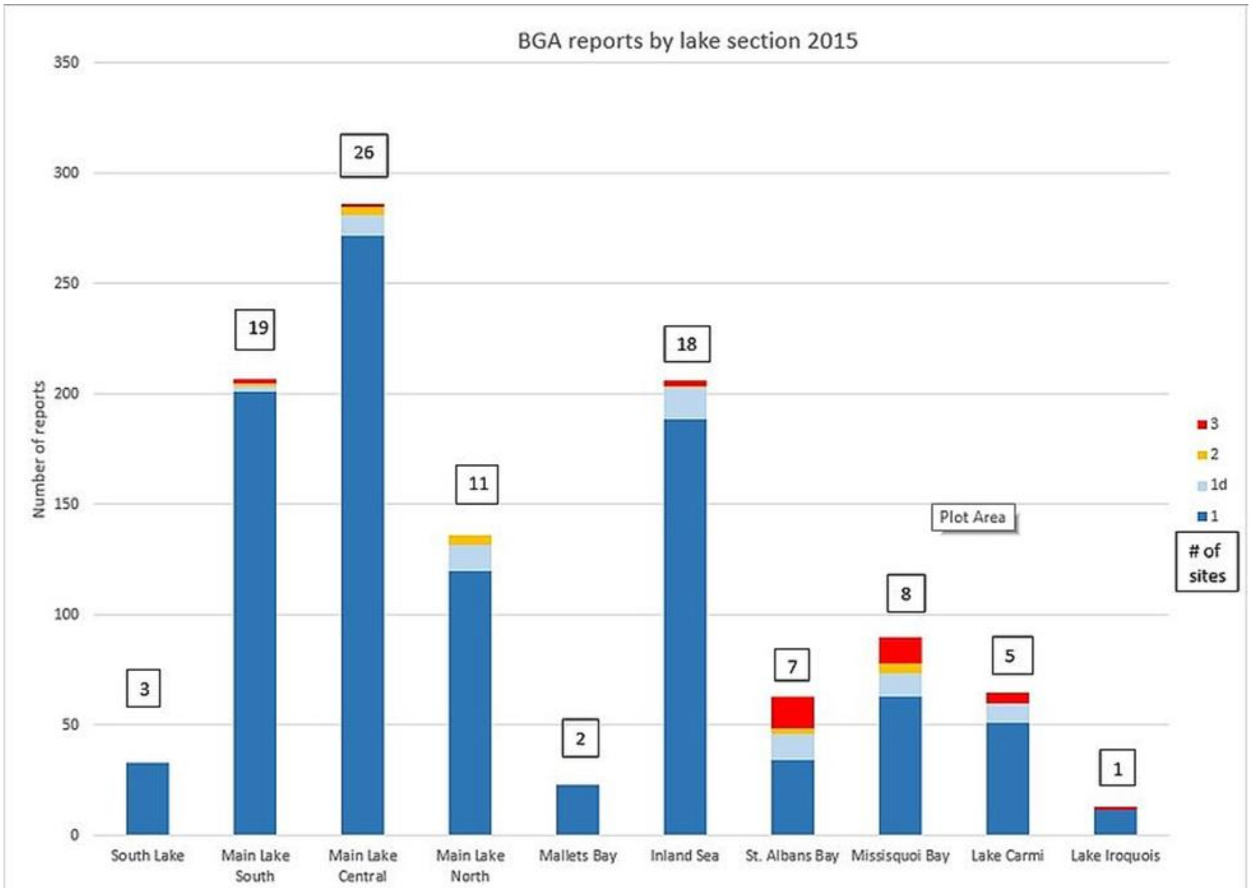

Figure 3 Blue Green Algae (BGA) 2015 monitor reports by lake section.

Explanation of categories: 'little or no blue-green algae present' (category 1), 'little blue-green algae present but enjoyment of water not impaired (category 1d), 'blue-green algae present – less than bloom levels – enjoyment of water slightly impaired' (category 2), or 'blue-green algae bloom in progress – enjoyment of water substantially impaired' (category 3). Numbers in boxes are the number of sites in each segment. Lake Champlain Committee - https://www.lakechamplaincommittee.org/lcc-at-work/algae-in- lake/#c4033

The Cyanobacteria monitoring that is supported by the Vermont Department of Health, the Lake Champlain Committee, DEC and the Lake Champlain Basin Program (LCBP) provides information about cyanobacteria conditions that can lead to a better understanding of bloom frequency. Both Missisquoi Bay and Lake Carmi are included in the program. The program at Lake Carmi just recently grew from one station to seven, which does not allow for analysis of trends at this time. Missisquoi Bay has been monitored for cyanobacteria since 2010 (for additional information about the program and resulting data see the LCBP monitoring programs webpage). Drinking water supplies are also regularly tested for cyanobacteria-based toxins.

The DEC supports volunteer water quality monitoring effort through the LaRosa Lab Program, which provides analyses services to the volunteer group through a grant program. The most common parameters requested include total and dissolved phosphorus, total nitrogen and total suspended solids.

In Basin 6, the program assists the Franklin Watershed Committee (FWC) in sampling the Lake Carmi tributaries, the Missisquoi River Basin Association (MRBA) in sampling sites throughout the basin and the Friends of Northern Lake Champlain in sampling sites to determine effectiveness of agricultural BMPs. Once the samples are analyzed, the lab organizes all volunteer water quality monitoring data for easy downloaded to an excel file available to groups for use in their annual reports. Data and reports can be found at the LaRosa Volunteer Monitoring webpage

An analysis of the data collected by the FWC and the MRBA, completed through a contract with DEC (Gerhardt, 2015) , concluded:

"…. total phosphorus concentrations were extremely high in the watersheds of Hungerford and Godin Brooks and two of the tributaries of Lake Carmi (Marsh and Sandy Bay Brooks). Total phosphorus concentrations were moderately high in the watersheds of Black and Mud Creeks and several tributaries of Lake Carmi. Finally, total phosphorus concentrations were low or moderate along Tyler Branch and several other tributaries of Lake Carmi. Based on these analyses and discussions with other stakeholders, possible sources of the high phosphorus levels were identified for several watersheds, including Godin, Marsh, and Sandy Bay Brooks." (Gerhardt, 2015). The study also provided recommendations for changes to sampling sites, see Table 10.

The Critical Source Area "SWAT"modeling (Lake Champlain Basin Program, 2011) completed for the Missisquoi predicts phosphorus loading levels in line with the Gerhardt analysis (Table 6). The model predicted the highest phosphorus loadings for the Missisquoi Bay in the watersheds of the Rock, with the Pike, Hungerford, Mud Creek and Hungerford and Pike Rivers in the next highest loading category.

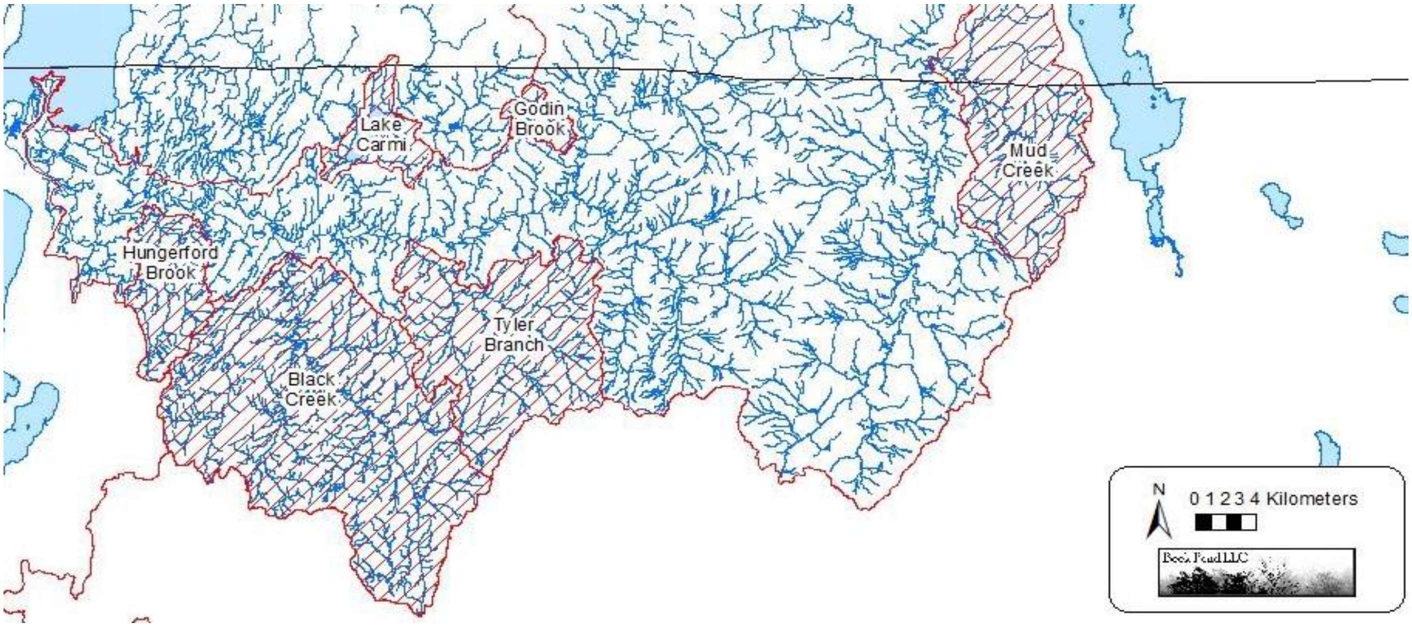

Figure 4 Subwatershed (hatched in red) where MRBA and FWC data have been analyzed in detail. Source: Gerhardt, 2015

An earlier water quality study of a limited number of tributaries also indicated that total phosphorus concentrations were highest in Hungerford Brook, but they also found that total phosphorus concentrations in Tyler Branch were more similar to those measured in Black and Mud Creeks (Howe et al. 2011).

Different conclusions among the studies are expected, especially between the LCBP modeling study and the water quality studies as the first provided predicted responses, while the water quality studies identified actual concentrations at the time sampled. Model estimates are always compared against observed values to assess fit, and understanding fit is vital if model results are going to be used to inform and prioritize management actions.

Conflicting results amont the water quality studies is due to differences in sampling design, for example when and how often samples were collected. The Howe study may have caught higher pollutant loads from the Tyler Branch than the other studies because the sampling plan intensionally included high flow days, where pollutant concentrations are higher when land activity and channel erosion is the source.

A summary of the water quality data in Table 6 includes prioritization of areas for focus of efforts to reduce phosphorus loading.

Table 6 Areas of focus for phosphorus reduction in this plan highlighted in red and orange based on analyses of phosphorus water sampling or critical source area modeling from 4 studies in Basin 6.

Green represents streams that most likely meet the numeric Vermont Water Quality Standards for phosphorus concentrations, orange represents moderately high concentrations (above VWQS) and red high concentrations.

Subwatershed	1. Short term monitoring (Howe et al. 2011)	2. CSA modeling (LCBP, 2011)	3. MRBA and 4. FWC data (Gerhardt, 2015)
Rock		High	
Pike		High	
Hungerford	High	High	High
Black	Moderate	Moderate High	Moderately high
Mud Creek	Moderate	High	Moderately high
Tyler	Moderate	Moderate Low	Moderate to Low
Trout	Low	Low	
Godin			High
Marsh			High
Sandy Bay .			High

Stream Geomorphic Assessments

Geomorphic assessments measure and assess the physical dynamics of an entire watershed or collection of river reaches. Physical aspects of river dynamics are assessed using maps, existing data, and windshield surveys (Phase 1), using field observation and simple measurements (Phase 2) and/or using surveying techniques and quantitative analysis (Phase 3 or River Corridor Plans). See Vermont River Management Section - Geomorphic Assessment for more information.

In addition, in 2009, the DEC River Management Program and the Lake Champlain Basin Program initiated a project with the USDA Agricultural Research Service in Oxford, Mississippi to better understand the sediment and nutrient loading caused by stream channel erosion. Employing the Bank Stability and Toe Erosion Model (BSTEM), 30 sites were evaluated throughout the Missisquoi Bay watershed. Results show that stream bank erosion contributes approximately 29-42% of the total suspended sediment load (TSS), and approximately 36% of total phosphorus (TP) at the mouth of the Missisquoi River. Best management practices were evaluated for reductions in TSS and TP load, and can achieve reductions of approximately 5-90% and

35-90%, respectively. These practices involve long-term protection of river corridors and riparian vegetation to achieve the highest load reductions (Langendoen, E. 2012).

The assessed tributaries in Basin 6 are experiencing incision and subsequent and ongoing planform adjustments in lower reaches. It is estimated that up to 75% of the waterways in the Missisquoi Bay Basin are undergoing channel adjustments due to historic modifications (NRCS, 2008). In the basin, the most common causes of disequilibrium are dams, diversions, culverts, drainage practices including ditches and tile drains and channelization practices, such as dredging, berming, and armoring. A significant amount of legacy phosphorus and sediment loading is attributable to in-channel erosion (Lake Champlain Basin Program, 2011).

Another source of disquilibrium is related to increased discharge of stormwater associated with increased development (impervious surfaces) within the watershed of each tributary.

This Tactical Basin Plan presents results of a comprehensive review of all priority river protection and restoration projects listed in the Stream Geomorphic Assessments (SGA) corridor plans (Table 7) as well as the results from the BSTEM study (see above). Projects are included in the Watershed Projects Database (Chapter 5).

Priority projects include actions that will lead to least erosive channels as well as increased flood resilience for communities. Examples include riparian buffer planting, increasing or protecting areas that provide flood and sediment attenuation and reducing stormwater runoff volumes.

Priority streams for river corridor protection include Upper Missisquoi, Trout and Tyler because of disequilibrium (high level of sensitivity and incision rates). Soils are also not as cohesive as in other areas, allowing for stream channel movement over a shorter time period than in areas with finer soils. Providing protection to the river corridor through property easement will support the movement of these streams towards an appropriate planform over time. The protection of the river corridor in the Black Creek watershed is appropriate to protect existing floodplain access.

Floodplain restoration will be a focus in the Hungerford Brook, Rock River and the mid-Missisquoi where the stressor, channel erosion, results in a loss of floodplain connection, sending fine sediment particles into the Missisquoi.

Riparian plantings are a priority where a mature woody buffer can establish itself without significant loss from channel erosion. Appenix B includes description of a modeling tool that can prioritize prioritize riparian buffer enhancement planting sites on the Rock and Pike Rivers based on stable condition of reach as well as high potential for overland runoff.

Culvert and bridge replacement to conform with the geomorphic condition of streams will be mostly limited to deteriorating structures because of the significant cost to the towns. Towns will be assisted by the Northwest Regional Planning Commission and the Northern Vermont Development Association in prioritizing and planning for expense, see Appendix B for description of culvert replacement prioritization process and Appendix C for list of culverts whose size or alignment is incompatible with the stream's geomorphic condition.

Table 7 Stream Geomorphic Assessments and River Corridor Plans for Basin 6

Date	*Stream Reach*	*Sub Watershed*	*Title* [12]	*Priority Actions for TBP*
12/01/2005	Wanzer Brook	Black Creek Head	Wanzer Brook Watershed Phase 2	Protect, riparian buffer planting
4/01/2009	Black Creek	Black Creek Mouth	Black Creek Corridor Plan	Riparian buffer planting, protect floodplain access, reduce sediment input from upland sources (cropland)
4/01/2008	Hungerford Brook	Hungerford Brook	Hungerford Brook Corridor Plan	Restore hydrology: restore floodplain and wetlands
10/01/2006	Hungerford Brook	Hungerford Brook	Hungerford Brook Phase 2 Report	See above
3/01/2008	Missisquoi	Missisquoi - Canada to Trout	Missisquoi River Mainstem Phase 2	Riparian buffer protection, control urban stormwater
1/26/2007	Rock River	Rock River	Rock River Phase 2 Report	Restore floodplain and wetland, reduce sediment input from upland sources (cropland)
4/01/2007	Trout River Watershed Towns of Berkshire, Enosburgh, Richford, and Montgomery	Trout River Head	Trout River Watershed Phase 2	Increase woody riparian buffer, control sediment from upland sources (roads), protect river corridors
3/01/2007	Tyler Branch	Tyler Branch	Tyler Branch Corridor Plan	Increase woody riparian buffer, Protect or increase areas for attenuation of sediment; control sediment from upland sources

[12] https://anrweb.vt.gov/DEC/SGA/finalReports.aspx

Date	Stream Reach	Sub Watershed	Title [12]	Priority Actions for TBP
6/02/2009	Tyler Branch	Tyler Branch	Tyler Branch Corridor Plan	See above
3/27/2008	Missisquoi Mainstem, Jay Branch, Mud Creek	Upper Missisquoi	Missisquoi Mainstem, Jay Branch, Mud Creek Phase 2	Reduce sediment and stormwater inputs from upland sources. Protect river corridor in upper Missisquoi.
9/30/2011	Upper Missisquoi	Upper Missisquoi	Upper Missisquoi River Corridor Plan	Allow channel to regain planform by protecting river corridor. Increase woody riparian buffer.

Stormwater Master Plans and Mapping

Stormwater runoff from developed areas carries pollutants as well as increasing flows in streams, causing streambank erosion. Regulations that work towards the management of stormwater to protect receiving water bodies are discussed in Chapter 4. In addition, The Department of Environmental Conservation (DEC) has supported town stormwater mapping and master plans as well as illict discharge detection to help both with regulatory requirements and voluntary efforts.

The Department of Environmental Conservation (DEC) has supported the development of stormwater master plans to identify and address priority areas for stormwater management for Enosburgh, Fairfield, Franklin, Highgate, Richford, Sheldon, and Swanton. The department encourages the use of Low Impact Development (LID) and Green Stormwater Infrastructure (GSI) systems and practices that manage stormwater 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.

These plans took into account work identified in DEC's stormwater mapping inventories, see below.

Completed stormwater mapping inventories exist for the following urbanized areas: Swanton Village, Swanton Town around Swanton Village, Missisquoi Valley Union High School, Highgate Village, Sheldon Rock-Tenn Facility, Enosburg Falls Village, Richford Village, Montgomery Village, North Troy Village, Troy Village and Newport Town Village. Each Town report and overall drainage map can be found on the DEC Clean Water Initiative Program web site. 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 Department also supported illicit discharge and detection elimination (IDDE) surveys to find and locate discharges of municipal or industrial wastewater. They were completed for all of the villages in 2010. The following three identified discharges remain to be addressed:

Town	*Identification*[13]	*Description*
Richford	RF-010X	Unresolved sewer leak from old discharge pipe,
Richford	RF-045	Sewer manhole overflow needs to be plugged
North Troy	140 Main St/NT060	Incorrect residential laundry lateral, water turned off to house. Owner never home. Town unable to contact or get in.

The Watershed Projects Database includes priority projects from stormwater master plans and the illicit discharge detection surveys. The master planning process includes the review of projects identified in the stormwater mapping projects. Priority projects are identified based on significance in comparison to projects throughout the basin and additional information collected relating to the feasibility of a proposed project.

Road Erosion Inventories

Road Erosion Inventories (REI) are used by Vermont municipalities to identify sections of local roads in need of sediment and erosion control, assess the degree of need for sediment and erosion control, rank road segments that pose the highest risks to surface waters, and estimate costs to remediate those sites using Best Management Practices. The implementation of the priorities identified in REI's will support the reduction of sediment, phosphorus pollutants and other contaminants generated from unpaved municipal roads that contribute to water quality degradation.

[13] See illicit discharge and detection elimination survey for the town report and additional location information

With the assistance of the Northwest Regional Planning Commission and the Northern Vermont Development Association, towns in the basin are beginning the process of developing inventories based on the protocols developed by DEC. The plan recommends that technical and financial assistance be prioritized for interested towns based on water quality benefit of projects. Criteria to assess water quality benefit may include location of project in area prioritized for phosphorus reduction from roads (see Chapter 4). The resources would assist with development of designs, capital budgets, cost estimates and implementation. Completion of these projects may be counted towards meeting the requirements of the Municipal Road General Permit that is scheduled to be released in fall or winter of 2017. For additional information see the DEC municipal Roads Program.

Wetland Restoration

An important function of wetlands is the ability to attenuate nonpoint source phosphorus (P) and thereby maintain and improve downstream water quality. The 2007 VT Agency of Natural Resources's Lake Champlain Basin Wetland Restoration Plan includes the identification and prioritization of wetlands in the Vermont portion of the Lake Champlain Basin (LCB) with the greatest potential for P removal through restoration. The plan identified the need for a higher percentage of wetland restoration needs in Basin 6 compared to other areas. The plan identified over 7000 potential restoration sites for a total of over 10,000 acres for restoration within the Missisquoi basin, which is 16% of the total number of sites identified in the Plan. The DEC-WSMD is updating the plan to include changes in landuse and improvements in datalayers (2016) where site specific profiles will be created for over 200 potential restoration sites in this basin.

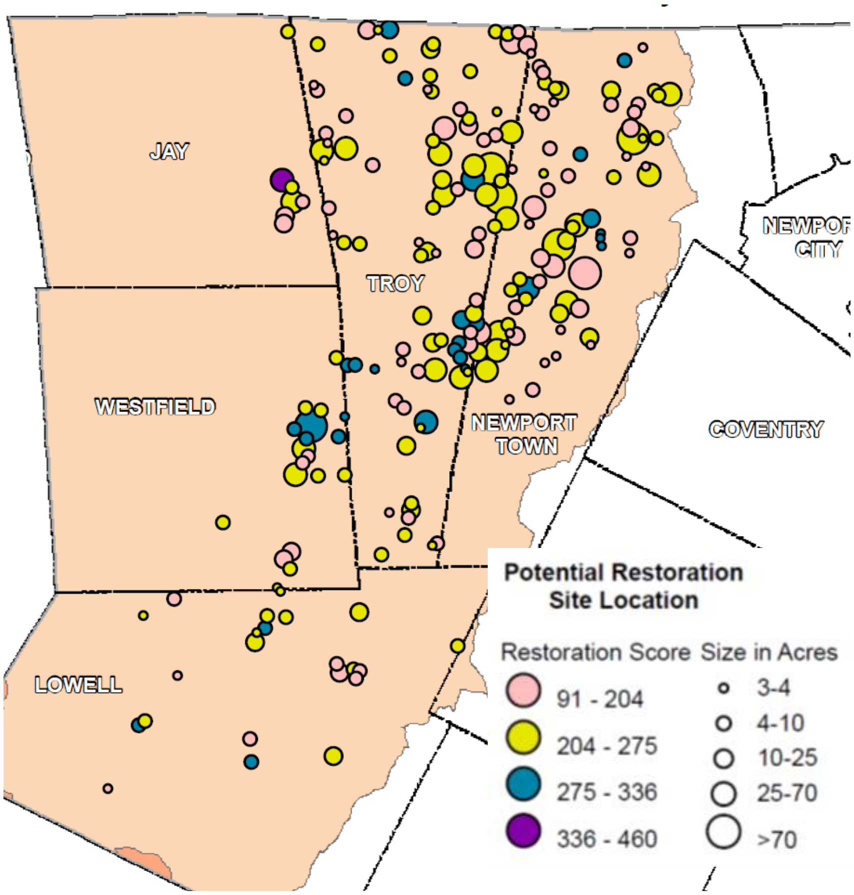

Figure 5. Lake Champlain Basin Wetland Restoration Plan: Potential restoration sites in Basin 6 within Orleans County.

Flow Alteration

Flow alteration is any human-induced change in the natural flow of a river or stream or water level of a lake or reservoir. Flow alteration is associated with instream structures and practices that regulate flows or water levels or withdraw water, i.e., activities that obstruct, dewater, or artificially flood aquatic and riparian habitats. Regulating flows impacts habitat and water quality, including changes to temperature and water chemistry (e.g., pH, dissolved oxygen, and toxicity), which may significantly lower habitat suitability for certain aquatic organisms. Flow alteration can also occur due to small-scale practices such as road culverts and ditches, up to large-scale dams, reservoirs and irrigation networks.

The Department of Environmental Conservation reviews hydroelectric generating dams as a flow alteration activity and issues a certification pursuant to Section 401 of the Clean Water Act (CWA) that the project as operated meets the Vermont Water Quality Standards The following are currently operating hydroelectric generating dams in the Missisquoi Basin. Additionally, Swanton Hydro, LLC holds a preliminary permit from the Federal Energy Regulatory Commission (FERC) to investigate the feasibility of developing a hydroelectric project at the lower Swanton dam. The surface waters impounded by and downstream of these facilities are classified to maintain designated uses at a Class B(2) level of quality.

Table 8. Hydroelectric generating dams in Basin 6

Dam Name	*Stream*	*Comments*
Enosburg Falls	Missisquoi River	will begin FERC relicensing in 2017-2018
Highgate Falls	Missisquoi River	will begin FERC relicensing in 2018-2019
Sheldon Springs	Missisquoi River	will begin FERC relicensing in 2019
Bakers Falls	Missisquoi River	operating under a FERC exemption and 401[14] issued in 2011
North Troy Hydoelectric Project	Missisquoi River	operating under a FERC exemption and 401 issued in 1987
Alder Brook Project	Missisquoi River	active FERC exemption and was issued 401 in March 2010. It is unclear whether the project was ever built.

Flow assessments

Managing water levels in a stream to meet human needs for property protection or a water source can compete with the need to protect aquatic habitat. Assessments have identified flow alterations that the DEC addresses to ensure compliance with the Vermont Water Quality Standards as well the Vermont Surface Level Rules either through regulatory processes or as owner of a dam (see also Watershed Projects Database)

Lake Carmi*:* The water level of Lake Carmi has been managed seasonally with a drawdown of the water occurring in the late fall by removing stop logs at the dam. The stop logs are replaced in late spring to restore the water level. Winter drawdowns are known to have negative impacts to the near-shore habitat of lakes effecting overwinter, spawning and incubation of organisms. The dam that controls the water level of Lake Carmi is owned by DEC. In 2016, the Department worked with the town and Lake

Carmi Campers Association to end this drawdown. The Department's Dam Safety Program will be no longer permit removal of the stoplogs at the dam and they will be locked in place.

Missisquoi River – below Enosburg Falls dam: The Enosburgh hydroelectric project current operation results in flow alterations that impact aquatic habitat below the dam. The Federal Energy Regulatory Commission license for the project expires in 2023 with the relicensing process beginning in approximately 2018. As part of the relicensing the project will require a Section 401 water quality certification from the State. As part of the Agency review of the project, flows needed to support aquatic habitat below the dam will be evaluated.

Jay Branch: Jay Peak currently operates a water withdrawal on the Jay Branch for snowmaking at the resort. The conservation flow below the intake does not meet current requirements under the Agency's Snowmaking Rules. Jay Peak is evaluating alternative sources for snowmaking, including the construction of a new intake on the Missisquoi River in Troy.

Stanhope Brook: The town of Richford withdraws water from Stanhope Brook for its water supply. The Department's analysis of the water withdrawal operations indicate that the project may exacerbate low stream flow conditions (summer months), impacting aquatic biota and habitat. The Department intends to conduct further studies. In addition, the DEC Drinking Water and Ground Water Program will support the town in using Drinking Water State Revolving funds to support any infrastructure changes that would reduce demands on Stanhope Brook.

Dams

While some of the dams in the basin provide power generation (Table 8) and recreational opportunities, and can be aesthetically or culturally important, others may be obsolete, providing little or no public benefit, or constituting a hazard. Removal of dam provides benefits to stream stability, and run of stream opportunities for boating as well as aquatic organism passage. Removal is considered when dams no longer provide benefits and/or have become structurally unsafe. Table 9 includes dams that could be considered for removal. These are also included in the Watershed Projects Database.

Table 9. Potential actions for dams: Blue=evaluation needed; orange - candidate for removal; yellow - review drawdown schedule

State ID	Dam Name	Stream	Dam Hazard Class[15]
9.01	Johnsons Mill	Bogue Branch	3
9.02	Browns Pond	The Branch	3
19.02	Trout Brook Reservoir	Trout Brook	3
19.03	East Berkshire	Missisquoi River-TR	
71.03	Webster (Upper)	Black Creek	3
71.02	Webster (Lower)	Black Creek	3
71.05	Fairfield	Fairfield River	
96.02	East Highgate[16]	Missisquoi River	
	Delvin Warner Hydro	East Branch Missisquoi	
142.01	Sleeper Pond	Mud Creek	3
165.03	Guilmettes Pond	Missisquoi River-TR	3
165.01	Richford Reservoir	Missisquoi River-OS	3
187.02	Sheldon-2	Goodsell Brook	3
205.02	Swanton	Missisquoi River	3
205.01	Fairfield Swamp Pond	Dead Creek	3
232.01	Coburn Brook Reservoir	Coburn Brook	3
	Lake Carmi dam[17]	Pike River	

Agricultural Assessments for Project Identification

In the past decade, the Agency of Agriculture, Food and Markets, the USDA Natural Resource Conservation Service, the Lake Champlain Basin Program (2011), and USEPA have conducted surveys, modeling, or planning efforts to help identify agricultural activity that potentially results in water resource degradation and to prioritize remediation. The results of these efforts have and will continue to direct technical and financial assistance in the most effective and efficient manner. In addition to this work, two recent agricultural assessments were instrumental in developing actions in the Watershed Projects Database.

[15] Dam Hazard Class: The hazard class is based upon the potential of damage or loss of life if the dam were to fail and is not related to the condition of the dam, which could be an indication of the potential to fail. A hazard class of 3 indicates a low hazard to downstream uses were the dam to fail. For more detailed explanation, see DEC dam-safety inspection program.

[16] Northern Forest Canoe Trail, supported by town of Swanton, is moving forward with removal.

[17] This action was completed during the tactical basin planning process. DEC discontinued drawdown in summer of 2016.

North Lake Farm Survey

The AAFM's[18] plan for assessing agricultural operations in the Lake Champlain Basin begins with Missisquoi River Basin and St. Albans Bay watershed (Franklin and Orleans Counties). The resulting North Lake Farm Survey (NLFS), quantifies the impacts of agriculture on Lake Champlain by surveying all 309 agricultural producuers. The survey work by VAAFM staff includes working closely with farmers to assess their potential impact on water quality and to help them to understand Vermont's new water quality regulations. See Chapter 3, page 75 for additional information on the survey.

As a result of the needs identified in the 2015 North Lake Farm Survey, VAAFM staff manages three contractors from the University of Vermont Extension Service, Vermont Association of Conservation Districts and Friends of Northern Lake Champlain who are working with agricultural producers to develop plans to resolve existing or potential water quality resource concerns on farms that have been surveyed during the North Lake Farm Survey. The RCPP Project Coordinator has worked directly with each contractor to coordinate their work with any conserved farms and to ensure complete knowledge of RCPP opportunities.

Natural Resources Conservation Service Priority Watershed Planning

Natural Resources Conservation Service (NRCS)'s Lake Champlain Strategic Watershed Planning Approach was created to accelerate improved water quality in critical areas by collaborating with partners to provide outreach, education, technical, and financial assistance to agricultural producers. This effort will help farmers in meeting the agricultural phosphorus reductions identified in the Lake Champlain Total Maximum Daily Load (TMDL).

State, federal and local partners developed a multi-factor ranking process to identify the most critical subwatersheds for accelerated agricultural conservation practice implementation. In the Missisquoi watershed the Rock River and Pike River subwatersheds were selected for this effort. NRCS then developed high-resolution watershed plans for each of the selected watersheds. These plans include: a resource assessment for the watershed, development of watershed phosphorus reduction goals that are tied to the new TMDL requirements, and detailed action plans to implement the plan.

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[18] The Agency of Agriculture, Food and Markets (AAFM) reviews agricultural activity for compliance with Accepted Agricultural Practices (AAP)[18] and opportunities for installation of Best Management Practices (BMPs). A description of agriculture in the basin is provided in Appendix C of the previous basin plan (DEC, 2009). Resources available to assist in BMP implementation are outlined in Appendix E.

The development of the plans was guided by local watershed groups, comprised of state and federal partners, local watershed groups, concerned citizens, and local farmers.

The watershed plans will be used by NRCS and partners to:

- Identify potential critical areas on farms for conservation practice implementation
- Set phosphorus reduction and practice implementation goals for each watershed
- Estimate funding required to implement needed conservation practices
- Identify actions required to meet goals in each watershed
- Track progress in reaching goals over time

Beginning in 2016, these watersheds will receive accelerated and targeted agricultural practice implementation over the next 5 years. Additional funds from NRCS's Environmental Quality Incentive Program (EQIP) will be allocated to these subwatersheds each year. Targeted phosphorus reduction goals for each of the subwatersheds was based on a percentage of the required TMDL phosphorus reduction for the Missisquoi watershed. A 5 year reduction goal of 40% of the TMDL goal was established for the Rock River subwatershed, while the 5 year goal for the Pike River watershed is 65%.

The NRCS developed plans for the Rock River and Pike River watersheds are further described in Chapter 3, and can be accessed at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/vt/water/watersheds/

For additional information relating to resources in basin 6 available to the agricultural sector, please see Appendix E, USDA NRCS/Vermont State Funding Summary.

Modeling Tools to Identify Remediation and Protection Efforts

The Department of Environmental Conservation and its partners use modeling techniques to predict sources of pollutants, estimate pollutant loads and also to identify where practices might be most effective at addressing the pollutant. Modeling tools play a significant role in the development of the Lake Champlain Phosphorus TMDL Phase II planning-level "sub-allocations." They are used to estimate phosphorus loads to lakes and rivers from specific geographic areas and landuse activities, as well as to determine effective practices (also known as a best management practices) for addressing load reductions from a specific landuse activity within a subbasin or even more specific geographic areas. The models and the results are included in Chapter 3's section about the Lake Champlain Phosphorus Phase II.

Modeling can never achieve a 100% accurate representation of actual conditions on the ground. For that reason, model estimates are always compared against observed values to assess fit. The assessments and plans described at the beginning of Chapter 2 are based on the results of field work and therefore include those observed values. The results from observations, monitoring, assessments, and modeling are used in the development of the management actions in this plan (see [Watershed Projects Database]).

Modeling tools, complemented by site visits to verify conditions, can be used by technical staff in developing proposals for landowners or by programs to support planning, (e.g, estimate load reductions from BMPs, see below). Such work has already been underway relying on the Lake Champlain Basin Program's very high resolution "SWAT model." A further example would include promoting corn-hay rotation as one BMP for areas with clay soils, where modeling indicates that continuous corn produces excess phosphorus runoff (Figure 6).

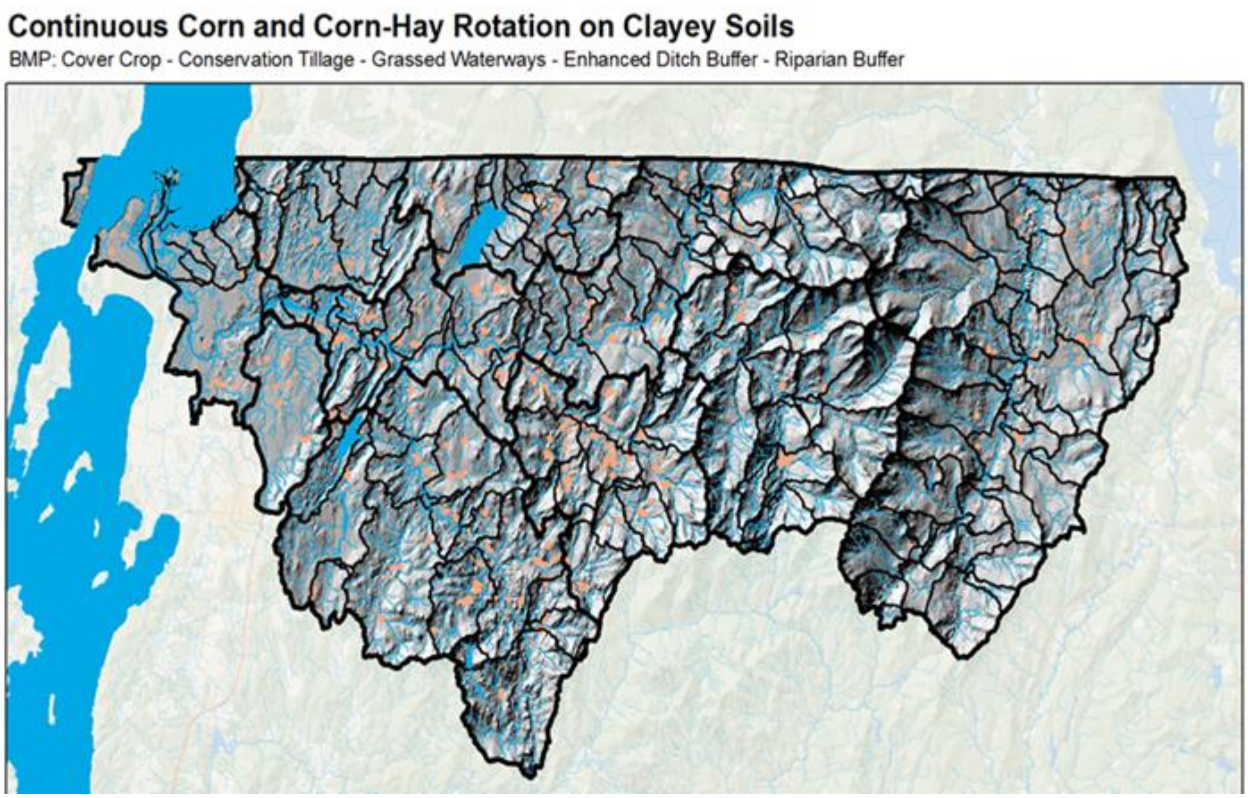


Figure 6. Modeling to show where BMPs would be most appropriate based on site conditions such as soils.

An example would include prescribing corn-hay rotation as the BMP for areas with clay soils, where modeling program has been able to identify fields where corn has been cultivated continuously over multiple years. The BMPs listed are examples from USEPA's Lake Champlain TMDL analyses.

The following modeling or data analyses listed below have and will continue to be part of the process for identifying the efficacy of actions included in the [Watershed Projects Database](#) along with the assessments and plans described earlier in this chapter. The modeling tools are described in more detail in Chapter 3 or Appendix B, and include information about how the information will be made available to any organization responsible for assisting in BMP implementation.

The following modeling tools and other assessments used to identify remediation and protection actions are described in greater detail in Chapter 3 or Appendix B:

- SWAT model
- HUC12 Tool
- EPA Scenario Tool
- ANR tracking Tool
- Clean Water Road Map Tool (in development)
- Prioritizing agricultural fields for BMP
- Prioritizing Riparian Buffer Enhancement
- Field gully identification
- Floodplain restoration

Water Quality Monitoring and Assessment Needs

In addition to waters identified as needing further monitoring and assessment in Table 3, Table 10 includes additional monitoring and assessment needs based on conclusions from assessments previously described in this chapter or the results of the DEC MAPP monitoring work[19] or the ANR Department of Fish and Wildlife. In large part, the locations listed bleow are identified for the purpose of collecting information that would support reclassification of one or more designated use to a higher class of protection.

[19] The use of macroinvertebrate and fish communities to assess water quality and uses is described in the Vermont Water Quality Standards as well as the 2016 DEC Assessment and Listing Methodology

Table 10. Additional proposed monitoring and assessment needs to inform remediation or protection strategies.

Water body	Town	Assessment Goal	Existing data supporting goal	Monitoring needs
Cutler Pond	Highgate	Confirm Best Lake status	Lack of invasives and intact shoreline	Water chemistry
Little Pond	Franklin	Confirm Best Lake status	Lack of invasives and intact shoreline	Water chemistry
McCallister Pond	Lowell	Confirm Best Lake status	Lack of invasives and good water quality conditions	Shoreline inventory
Jay Branch (2002) – RM 2.5 Revoir Flats Road –	Jay	Explore as Class B(1) for fishing use	238 trout/mile, 21.7 lbs/acre.	Additional trout density data
Jay Branch (2002) – RM 5.3 Lucier Road –	Jay	Explore as Class B(1) for fishing use	779 trout/mile, 34.1 lbs/acre	Additional trout density data
Jay Branch upstream of RM 9.1.	Jay	Explore as Class B(1) for fishing use	DFW Fisheries biologist Best Professional Judgement	Additional trout density data
Jay Branch Trib 10	Jay	Confirm as Class B(1) for aquatic biota and wildlife	Biomonitoring data supporting higher classification than Class B2	One more year of fish data
Jay Branch Tributaries 12 above Lower Access Road, Jay (above RM.2) and 13	Jay	Confirm as Class B(1) for aquatic biota and wildlife	Biomonitoring data supporting higher classification than Class B2 or other: Macroinvertebrates	One more year of fish data
East Branch Missisquoi River Tributary 8 and Trib 10		Confirm as Class B(1) for aquatic biota and wildlife	Biomonitoring data supporting higher classification than Class B2 or other: Macroinvertebrates	One more year of fish data
Mineral Springs Brook (above Rm .2)	Troy	Confirm as Class B(1) for aquatic biota and wildlife	Biomonitoring data supporting higher classification than Class B or other: Macroinvertebrates and fish 2016	One additional year of macroinvertebrate and fish data
Truland Brook (above RM1.8)	Lowell	Confirm as Class B(1) for aquatic biota and wildlife	Biomonitoring data supporting higher classification than Class B2 or other: Macroinvertebrates 2016	One additional year and find new fish monitoring station
Taft Brook (above	Westfield	Confirm as Class B(1) for aquatic	Biomonitoring data	One additional year of

Water body	Town	Assessment Goal	Existing data supporting goal	Monitoring needs
RM 2.1)		biota and wildlife	supporting higher classification than Class B2 or other: Macroinvertebrates and fish 2009	Macroinvertebrates and fish
Tamarack (above RM 1.6)		Confirm as Class B(1) for aquatic biota and wildlife	Biomonitoring data supporting higher classification than Class B2 or other: Macroinvertebrates and fish 2013	One additional year of fish data
Beaver Meadow Road (above RM 2)	Bakersfield	Confirm as Class B(1) for aquatic biota and wildlife	Biomonitoring data supporting higher classification than Class B or other Macroinvertebrates and fish 2004	One additional year of data
McGowan Brook above RM 1	Sheldon	Confirm as Class B(1) for aquatic biota and wildlife	Biomonitoring data supporting higher classification than Class B2 or other Macroinvertebrates 2013	One additional year
Lake Carmi	Franklin	Identify nutrient sources	Study reviewed existing monitoring sites and provided suggestions (Gerhardt, 2015)	See (Gerhardt, 2015) or Watershed Projects Database for recommended location of new sampling sites
Missisquoi River	Multiple	Identify nutrient sources	Study reviewed existing monitoring sites and provided suggestions (Gerhardt, 2015)	See (Gerhardt, 2015) or Watershed Projects Database for recommended location of new sampling sites

Existing biomonitoring data for aquatic communities suggest that the rivers in Table 10 potentially meet either Class B1 or A1 standards (see Chapter 4). DEC will conduct additional monitoring and assessment of these waters to confirm.

Priority Subbasins for Remediation

The assessment results described throughout this Chapter as well as the EPA and state-listed waters (Table 3) provide a basis for identifying priority subbasins (Table 11) for remediation. These priority subbasins have been identified as providing significant phosphorus and sediment loads to the watershed and/or are in need of protection for purposes of flood resilience. In addition, assessments have provided information about appropriate strategies and actions to address stressors. The actions in the Watershed Projects Database were informed by these priority actions.

Table 11. Strategies and actions for priority subbasins.

Priority subbasins	Stressor	Priority strategy	Priority actions
Hungerford Brook - **hydrologically modified due to intense ditching, resulting in increased erosion of stream channels. The intensive use of fields for annual crops has also resulted in erosion.**	Channel erosion, land erosion, nutrient loading	Phosphorus reduction, hydrologic restoration	Field BMPs, floodplain and wetland restoration
Rock River - **high sediment loads due to clay soils, limited floodplain access, multiple riverbank slides (mass failures) and intensive cropping/farm land use**	Channel erosion, land erosion, nutrient loading	Phosphorus reduction, sediment reduction	Field and Road BMPs; riparian plantings; floodplain and wetland restoration
Lake Carmi - **intensive agricultural landuse, and shoreline development.**	Channel erosion, land erosion, encroachment	Phosphorus reduction, Stormwater management	Field, residential and road BMPs, and floodplain and shoreline restoration
Black Creek - **good floodplain access and cohesive soils, limiting river channel erosion. Annual crop cultivation in floodplain allows for**	Nutrient loading, land erosion	Phosphorus reduction; sediment reduction;	Riparian plantings, field BMPs

Priority subbasins	Stressor	Priority strategy	Priority actions
land erosion outside of growing season.			
Tyler Branch **- Outside of the Branch, which is in good condition, other areas include more intense landuse including agricultural and roads.**	Channel erosion, land erosion,	Flood resilience, sediment reduction	River corridor protection, field and road BMPs
Tributaries to the Mid Missisquoi including Godin, Sampsonville and Berry Brooks **- small watersheds with intensive agricultural activity.**	land erosion, nutrient loading, pathogens,	Phosphorus and Pathogen reduction	Field, barnyard and road BMPs
Mud Creek **- The fine soils, and agricultural practices and roads on steeper slopes all increase nutrient loading to the creek.**	land erosion, nutrient loading	Phosphorus reduction	Field, barnyard and road BMPs, riparian plantings
Upper Missisquoi River**- mostly forested, with roads and development on steep slopes. Instability of the channel and steep roads leads to high sediment loads in stream. Agriculture in valleys.**	Channel erosion Land erosion	Flood resilience; sediment reduction	River corridor protection, Field and road BMPs
Trout River **- mostly forested, with roads and development on steep slopes. Instability of the channel and steep roads leads to high sediment loads in stream. Agriculture in valleys.**	Channel erosion, land erosion,	Flood resilience; sediment reduction	River corridor protection, field and road BMPs

Chapter 3 –Addressing Stressors and Pollutants through TMDLs and Regulatory Programs

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

The passage of Act 64 in 2015 resulted in the creation of the State's Clean Water Initiative Program (CWIP). The CWIP provides additional resources toward sediment and phosphorus reduction, based upon the assessments and integrated implementation table action (Watershed Projects Database) in this tactical basin plan. The goals of the Initiative are to satisfy the State's legal obligations under both the Vermont Clean Water Act and the federal Clean Water Act. At the highest level, priorities include:

- Implementing Agriculture Best Management Practices
- Treating Stormwater Runoff and Erosion from Developed Lands
- Installing Pollution Controls on State and Municipal Roads
- Restoring and Protecting Natural Infrastructure (e.g., wetlands) for Flood Resiliency and Water Quality Improvements
- Increasing Investments in Municipal Wastewater Treatment Infrastructure

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

- Required Agricultural Practices
- Town road permit
- VTrans road permit
- Management of stormwater on under or un-treated 3 acre parcels

The new and existing regulations will be importants tool that ensure Vermont's water quality standards are met. While the Watershed Projects Database (see Chapter 5) includes numerous actions that will be implemented on a voluntary basis, other actions will be required by permits. Partners as well as DEC will support education and outreach efforts to facilitate regulatory compliance. As appropriate, Clean Water Initiative funding may provide municipalities and landowners with financial and technical assistance to develop and implement requirement management plans under the new permits.

Total Maximum Daily Load Implementation Plans are also products of regulatory requirements. The Missisquoi Bay and numerous tributaries do not currently meet several water quality standards for bacteria, mercury and/or phosphorus. These standards assure that beneficial uses of the river and tributaries, such as swimming, fish consumption and fish habitat, are protected. When water quality standards are not met, the federal Clean Water Act requires states to establish a Total Maximum Daily Load (TMDL) for polluted waters.

A TMDL is the maximum amount of a pollutant a water body can receive without violating water quality standards, and an allocation of that amount to the pollutant's sources. Vermont develops implementation plans for each waterbody with a TMDL that provides reasonable assurance that the waterbody will meet goals by a specific date. Basin 6 includes surface waters with TMDLs for Mercury, bacteria, phosphorus and agricultural sources of pollutants (see Table 3).

The mercury TMDL will be addressed through EPA's efforts to control emissions from Vermont and other states. The other TMDLs are addressed through implementation plans developed by ANR and approved by EPA. These TMDLs and associated implementation plans are explained in further detail below. The bacterial TMDLs will be met in part by the Lake Champlain phosphorus TMDL. In addition, the development of the agricultural TMDLs are under contract and will build off the Lake Champlain TMDL development process (see below).

Lake Carmi Phosphorus TMDL

The Lake Carmi TMDL was approved by USEPA in 2009 and subsequently, DEC completed the Lake Carmi Phosphorus Reduction Action Plan, 2008. Currently, an implementation team consisting of the Franklin Watershed Committee, Lake Carmi Campers Association and other area partners are working with DEC to assist in the updating and implementation of the plan.

The TMDL development was based on intensive water quality investigations carried out in Lake Carmi since 1994. From 1994 to 1996, the lake was intensively monitored on a bi-weekly basis to develop an understanding of the internal phosphorus dynamics in the lake. The goal of that sampling campaign was to determine the relative importance of watershed-based vs. internal sources of phosphorus to the lake. In 2007, volunteer monitors from the Franklin Watershed Committee collected samples on a weekly basis during the summer of 2007 in locations of the Marsh Brook watershed, as well as at the mouths of Tributaries 4, 5, 6, and the Alder Run.

The Watershed Projects Database includes actions from the 2008 plan as well as additional actions including additional monitoring and assessment strategies to better understand the lake's internal phosphorus loading.

The Lake Champlain Phosphorus TMDL Phase II

The Lake Champlain Phosphorus Total Maximum Daily Load (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 or drainages (Lamoille, Missisquoi, etc.). The Missisquoi Bay watershed includes the Missisquoi River drainage as well as the Rock and the Pike river drainages that are officially part of the Northern Lake Champlian drainage (See Figure 7). Due to the large size of the Lake Champlain watershed in Vermont, the modeling techniques used to estimate loading were necessarily implemented at a rather coarse scale. For example, the modeled loading at the mouth of the major river basins is relatively accurate and well represents the collective inputs from the various land uses and physical features of the watershed. On the whole, this is useful to estimate the level of phosphorus reducing BMPs

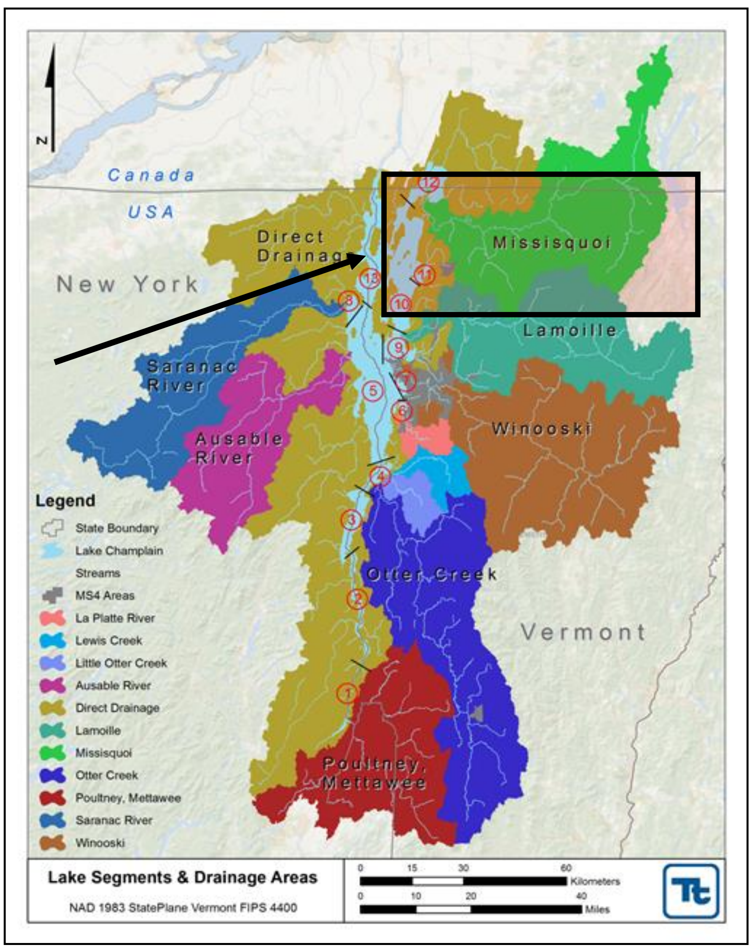


Figure 7. The Missisquoi Bay watershed includes the Lake Champlain drainage areas: Missisquoi and direct drainages.

necessary. However, when looking at smaller scale areas such as a municipality, a particular farm or a local road network, it's necessary to do further, more detailed analysis to determine to appropriate actions for the particular area.

As part of the 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 and implementation of the Tactical Basin Plans that even more precise opportunities for BMPs can be identified and prioritized for implementation.

The Lake Champlain phosphorus 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 Champlain 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 VTDEC 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 TMDL reductions will be most effectively targeted to implement the TMDL. The underlying data from which many of the following analyses originate is the USEPA 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/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, and Figure 8 displays these geographic scales in order of decreasing size: HUC8, HUC12, catchment.

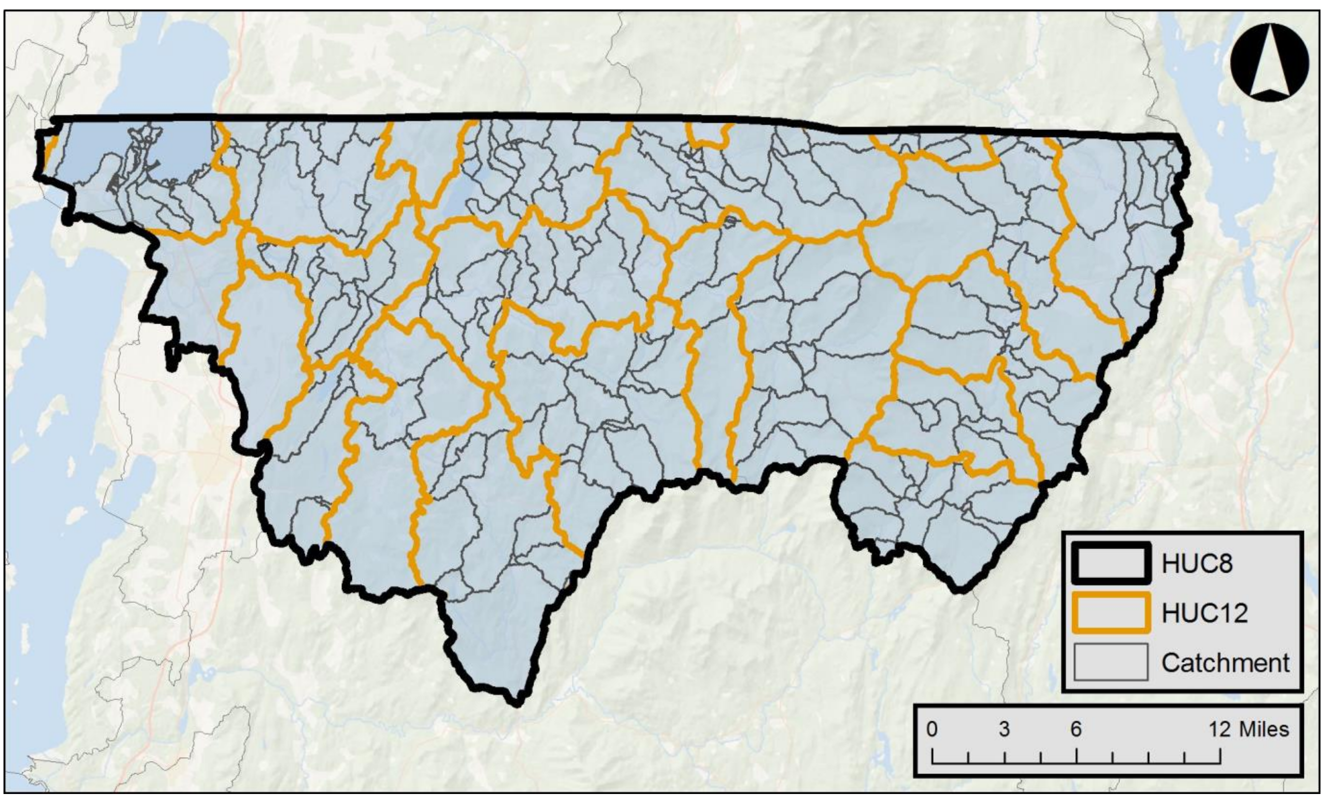


Figure 8 Comparison of HUC8, HUC12, and catchment watershed scales in the Missisquoi bay basin.

HUC12 Tool

The HUC12 Tool (Figure 9) 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 12). In addition, detailed annual load (kg/yr) and areal loading rate (kg/ha/yr) estimates can be displayed by land use for each HUC12. The 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 HUC12s in a lake segment basin as well as different land use categories within a HUC12.

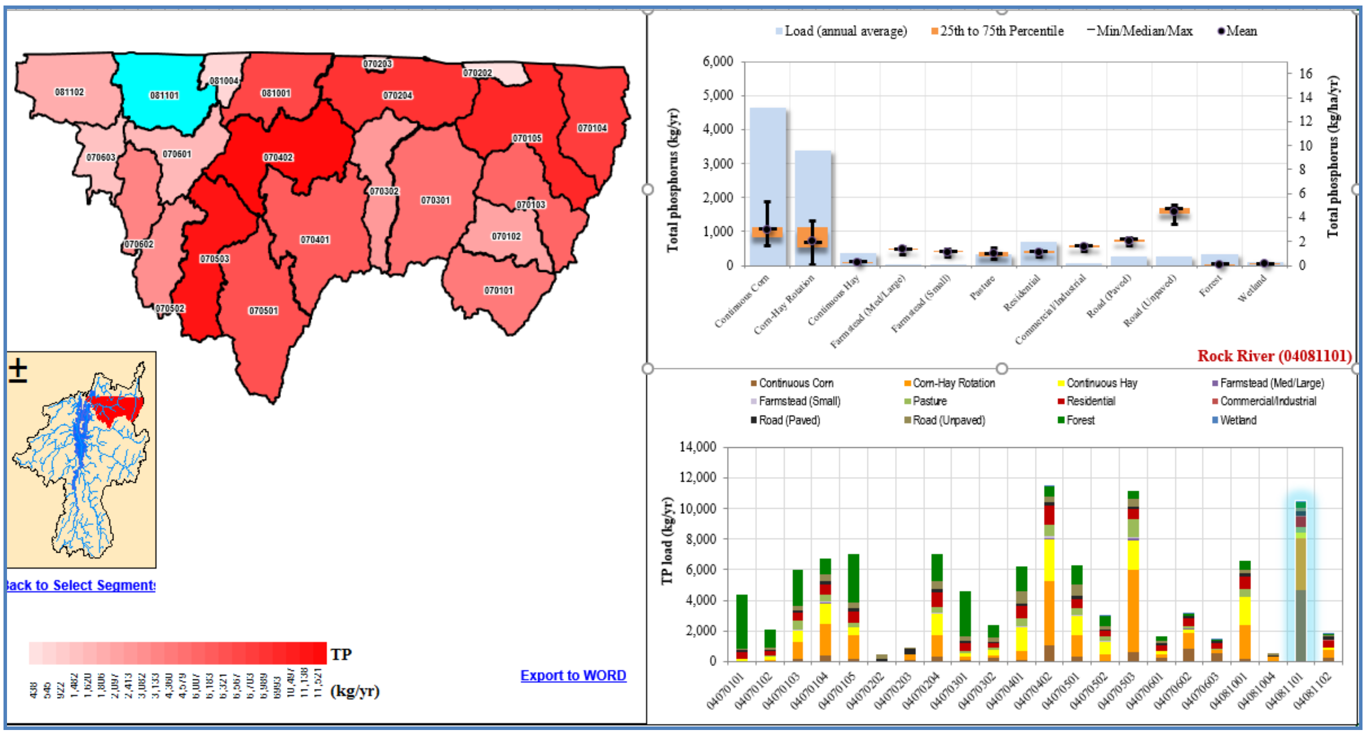


Figure 9 Screenshot of HUC12 Tool display for Missisquoi Bay lake segment. The Rock River HUC12 is highlighted

Table 12. 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 VT DEC, 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 DEC's Tactical Basin Plan implementation tables and tracking systems. The CWR will provide a description of *one way* the Lake Champlain 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 DEC'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 DEC 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, more assessment information will more accurately inform the identification of BMP opportunities and it's the goal of the Tactical Basin Plans to present the most up-to-date information available to facilitate implementing the Lake Champlain TMDL.

TMDL allocations for the Missisquoi Bay segment of Lake Champlain

Vermont contributes about 69 percent (631 MT/yr) of the total phosphorus (TP) load per year to Lake Champlain in comparison to Quebec at 9 percent (77 MT/yr) and New York at 23 percent (213 MT/yr). On average, Missisquoi Bay receives about 24 percent (136 MT/yr) of the total load to Lake Champlain, which is second highest of all segments[20].

In order to meet the Lake Champlain Phosphorus TMDL expectations, total annual TP loading into the Missisquoi Bay is required to be decreased by 64.3 percent or by approximately 46 MT/yr.

[20] 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.

Table 13 below provides the final phosphorus allocations and the resulting reductions required for the Missisquoi Bay segment of Lake Champlain. These values are taken directly from the final Lake Champlain TMDL.

Table 13. Summary table of allocations for the Missisquoi 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 for basin (MT/yr.)*	*% reduction required for basin*	*Analysis*
Forest	All lands	Load	10.03	50%	Figure LA-1 Tables LA-1, 2
Stream Channels	All streams	Load	12.66	68.5%	
Agriculture	Fields/pastures	Load	9.35	82.8%	Figures LA-2, 3 Tables LA-3, 4, 5
	Production Areas	Wasteload	0.64	80%	Tables WLA1, 2
Developed Land	Summary		11.19	34.2%	Tables WLA-3, 4, 5, 6 Figure WLA-1, 2
	VTrans owned roads and developed lands	Wasteload			Figure WLA-3 Table WLA-7
	Roads MRGP	Wasteload			Figure WLA-4 Table WLA-8, 9
	MS4	Wasteload			
	Larger unregulated parcels	Wasteload			Table WLA-10
Wastewater	WWTF discharges	Wasteload	2.00	51.9%	Table WLA-11
	CSO discharges	Wasteload	NA	NA	

Figure A1 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 (Table13, 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.

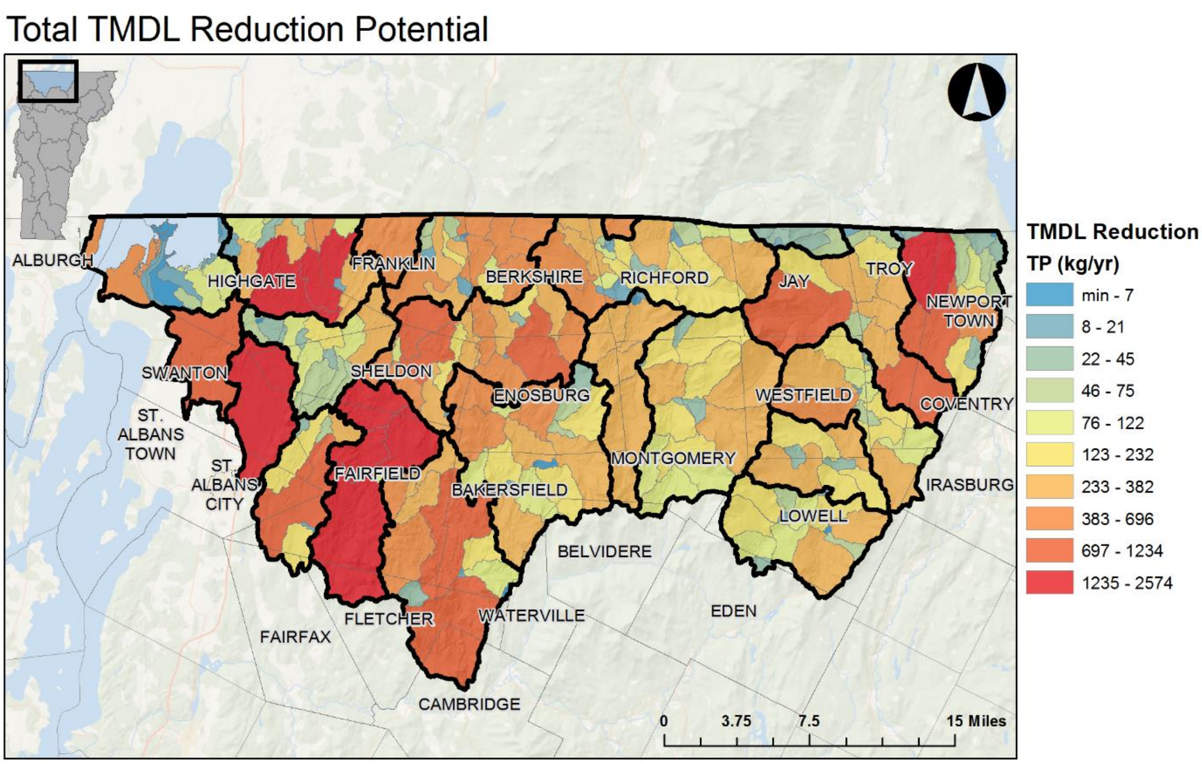


Figure A1. The necessary TP reductions specified by the TMDL if applied uniformly across the entire Missisquoi, at the catchment scale

Within the basin, the top 20 catchments with the greatest overall identified TP reductions are identified in Table A3. 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 TMDL reductions were applied to these top 20 catchments, then 39% of the overall needed basin reduction would be realized. For context, there are 254 total individual catchments in the Missisquoi Bay Basin.

Table A3. 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)	Total TP Reduction (kg/yr)
4590503	Fairfield	**1118**	**238**	**61**	**168**	1585
4590269	Franklin	**1181**	**89**	**12**	15	1297
4590883	Swanton	**712**	**295**	**46**	64	1116
4590875	Highgate	**772**	**154**	**34**	29	989
4590475	Jay	50	**140**	4	**673**	867
4590501	Bakersfield	**478**	**176**	**18**	**162**	834
166176984	Swanton	**413**	**381**	4	23	820
4590395	Fairfield	**643**	**82**	**19**	42	786
4590223	Troy	**619**	75	**30**	60	785
932010015	St. Albans Town	**433**	**173**	11	124	741
4590479	Enosburgh	**547**	**119**	11	50	727
4590453	Cambridge	**328**	**138**	**16**	**243**	725
4590331	Newport Town	319	**99**	12	**206**	636
4590397	Fairfield	**498**	66	**29**	29	622
4590375	Sheldon	**442**	**112**	**24**	39	618
4590303	Newport Town	**412**	72	**25**	81	592
4590545	Sheldon	**468**	73	**14**	13	568
932010376	Highgate	**322**	**127**	11	73	534
4590291	Enosburgh	**398**	71	**14**	17	500
4590533	Enosburgh	**338**	**116**	10	23	488
Percent of total TP reduction if all sector allocations are applied to these catchments						**39%**

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.

The Vermont Department of Forests, Parks, and Recreation (FPR) updated the AMPs effective as of October, 22 2016. Key modifications include:

- Require compliance with standards set forth in the DEC 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. Metrics have been established 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 Missisquoi Bay segment of Lake Champlain, an overall TP reduction target of 50% 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 50% reduction called for in the Reasonable Assurance scenario is aggressive but attainable.

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's these areas that could receive the most activity oversight to control erosion.

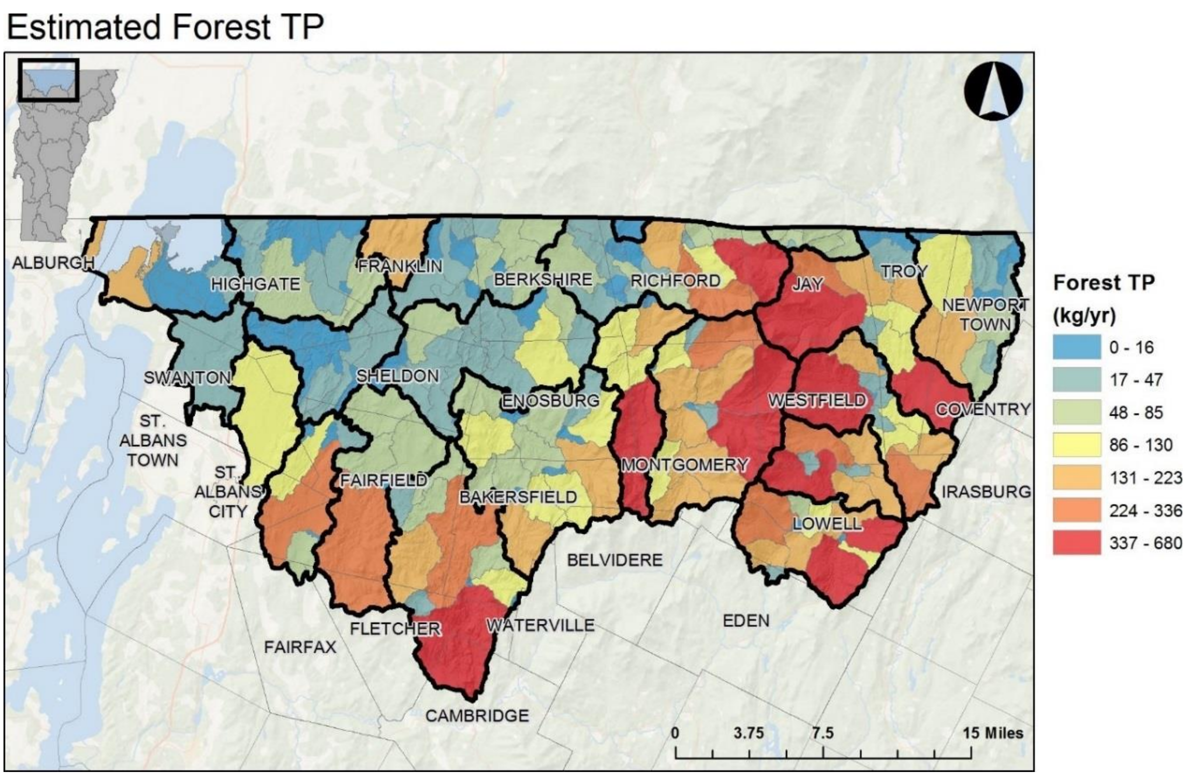


Figure LA-1. Estimated forest TP loading for the Missisquoi basin at the catchment scale.

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 (50%). 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 60% of the required reductions from forest land could be realized.

Table LA-1. The top 3 modeled catchments for forest TP load export (red catchments in Figure LA-1).

Catchment ID	*Town Name*	*Forest TP (kg/yr)*	*Potential Phosphorus Reduction (kg/yr)*
4590475	Jay	1346	673
4590497	Lowell	605	302
4590453	Cambridge	487	243
Percent of total TP reduction if sector allocations are applied to these catchments			**13%**

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

HUC12 Waterbody	*Forest (kg/yr)*	*TMDL Reduction (kg/yr)*
Headwater Missisquoi River	3492	1746
Jay Branch-Missisquoi River	3154	1577
Headwaters Trout River	2911	1456
Mineral Spring Brook-Missisquoi River	2340	1170
Lucas Brook-Missisquoi River	1744	872
Percent of total TP reduction if sector allocations are applied to these HUC12		**60%**

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, in addition to protection of river corridor (see Flood Resilience Efforts section, 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 Two of this Plan, in the Implementation Table summary in Chapter 5, and also in the Watershed Projects Database.

DEC 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, to develop a restoration practice scoring matrix to be able to score each type of project pursued on the ground by the ANR and its partners.

Controlling Phosphorus from Agriculture

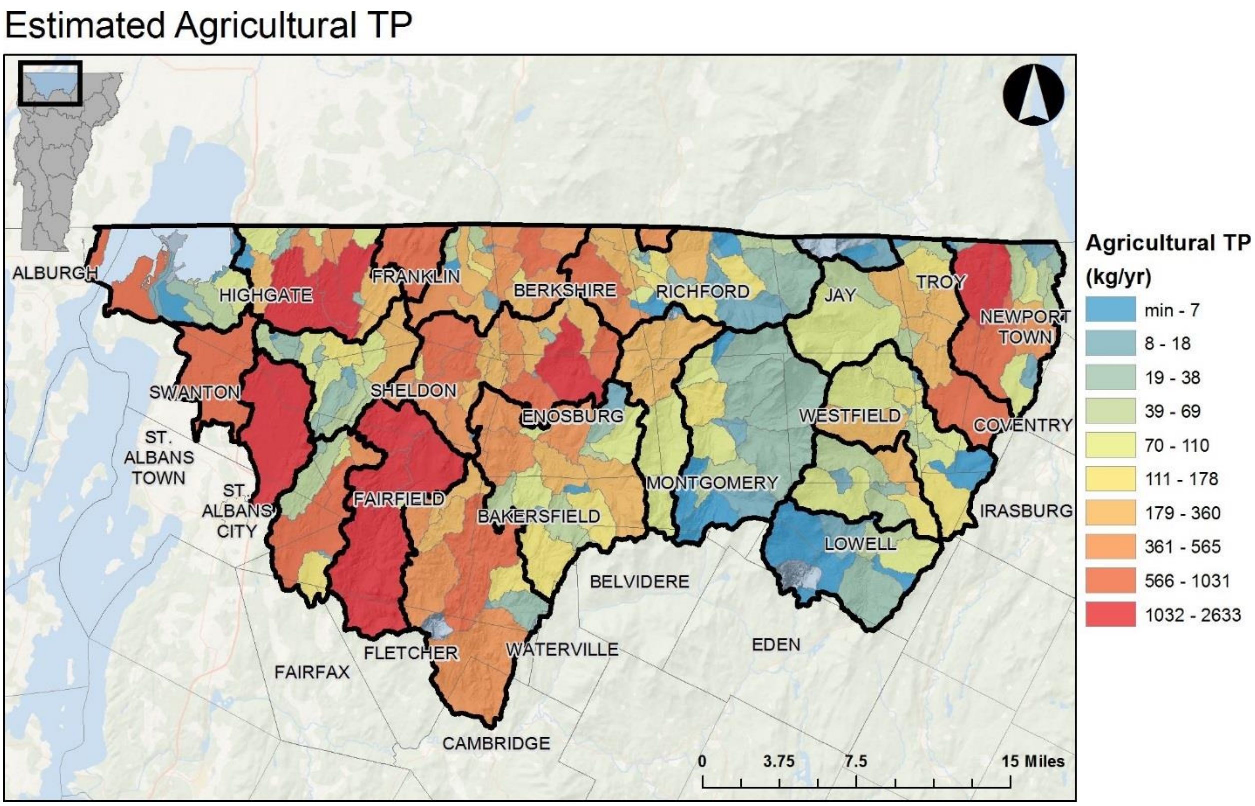
Load Allocation

In the Lake Champlain TMDLs, all permissible nonpoint source agricultural land phosphorus loads are considered part of the load allocation. As such, this section describes the estimated phosphorus loading areas in the basin, potential reductions based on the Reasonable Assurance Scenario, as well as the regulatory programs or provisions that are part of the load allocation for agricultural lands. 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; and the Revised Secretary's Decision Settlement Agreement (see In re: CLF Petition to Require Mandatory Pollution Control Best Management Practices for Agricultural Non-Point Sources Identified in the Missisquoi Basin Plan, AAFM Docket # 2014-6-04 ARM). Additionally, other, non-regulatory activities that are aimed at reducing phosphorus loading from the agriculture will be discussed in this section as well

Estimated Phosphorus Loading

Estimated modeled phosphorus loading from agricultural land uses is given in Figure LA-2 at both the catchment and HUC-12 scales.

**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 82.8%

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.

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)*
4590269	Franklin	1426	1181
4590503	Fairfield	1350	1118
4590875	Highgate	933	772
4590883	Swanton	860	712
4590395	Fairfield	777	643
4590223	Troy	748	619
4590479	Enosburgh	660	547
4590397	Fairfield	602	498
4590501	Bakersfield	577	478
4590545	Sheldon	565	468
4590375	Sheldon	534	442
932010015	St. Albans Town	523	433
166176984	Swanton	499	413
4590303	Newport Town	498	412
4590291	Enosburgh	481	398
4590225	Berkshire	444	367
4590533	Enosburgh	409	338
4590453	Cambridge	396	328
4590243	Berkshire	391	324
932010376	Highgate	206	171
Percent of total TP reduction if sector allocations are applied to these catchments			**48%**

Figure LA-3 presents the total phosphorus load and projected reduction, by agricultural land-use type, for the 12 HUC12-scale watersheds that comprise the Missisquoi Basin.

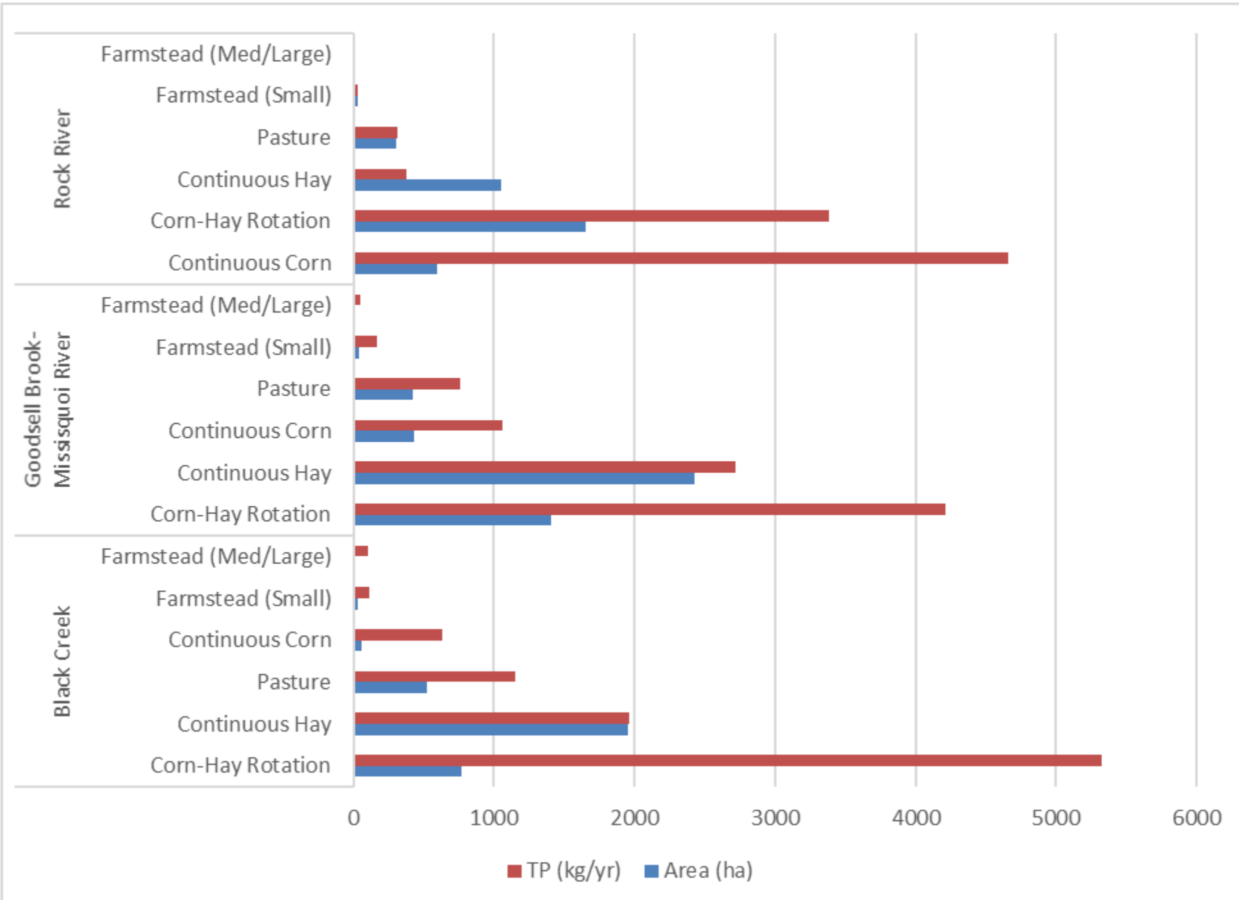


Figure LA-3. SWAT loading estimates and areas for agricultural sources in the Missisquoi Bay basin HUC12 watersheds (4 separate graphics).

Figure LA-3. continued

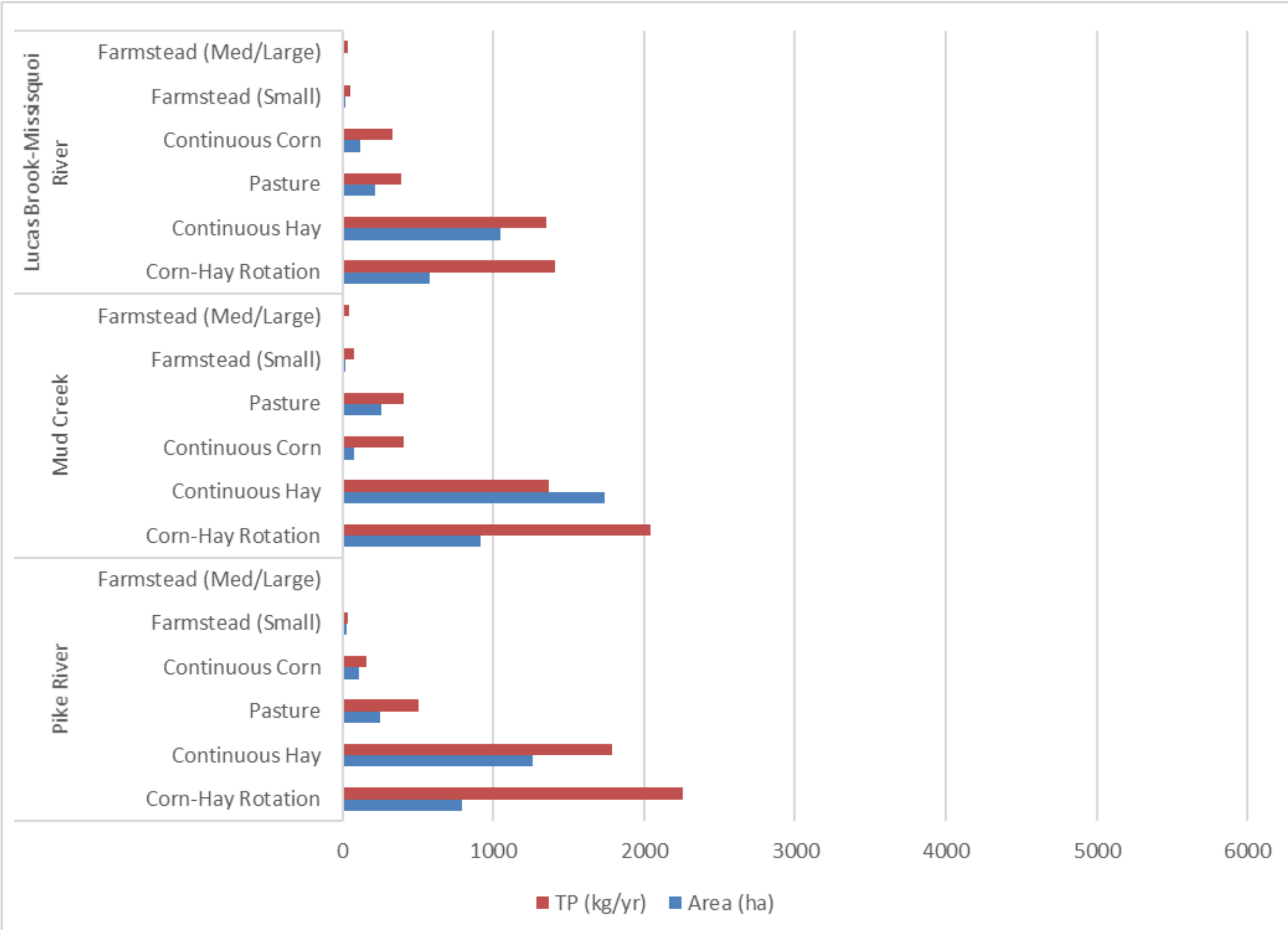


Figure LA-3. continued

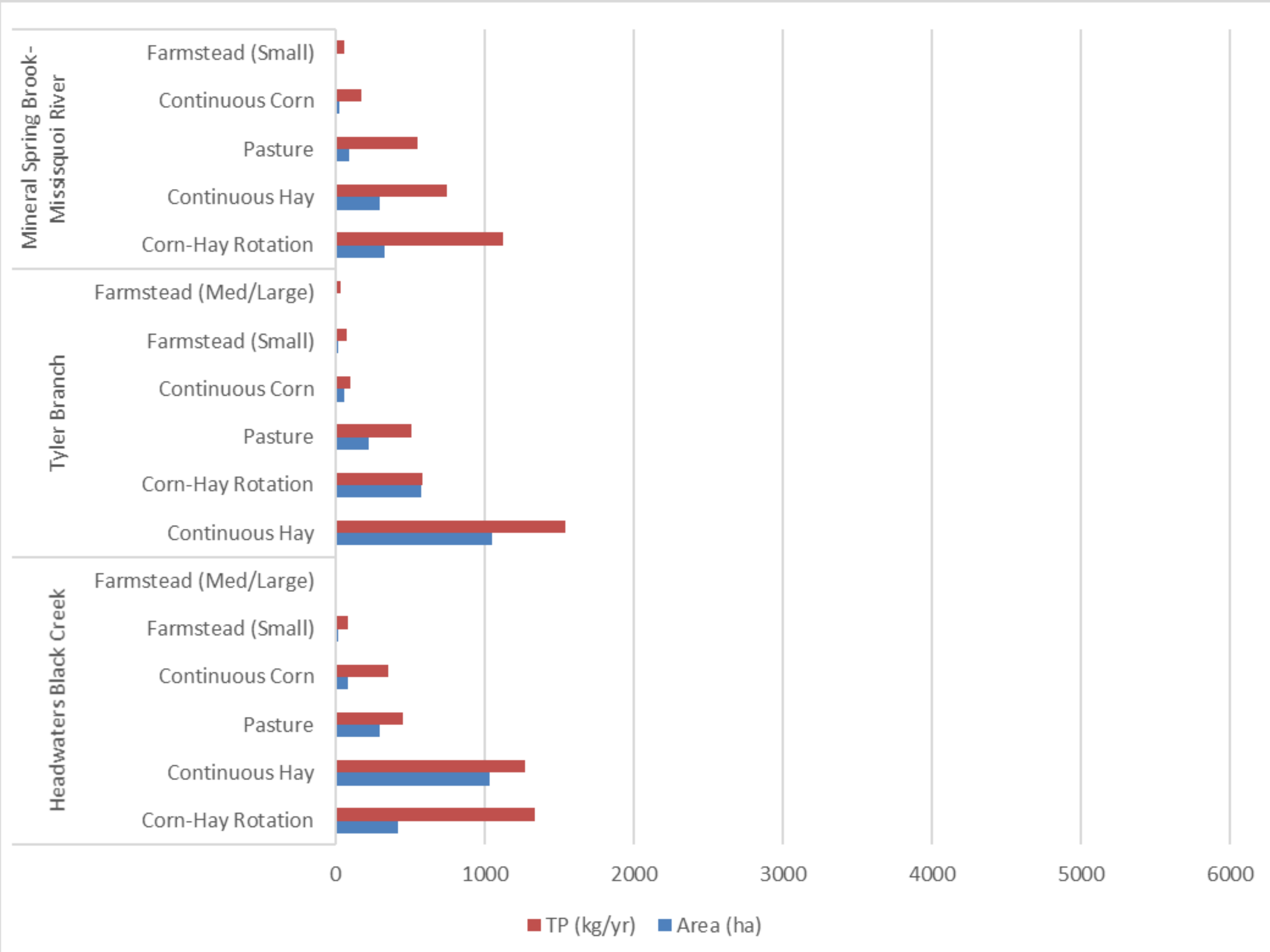


Figure LA-3.
continued

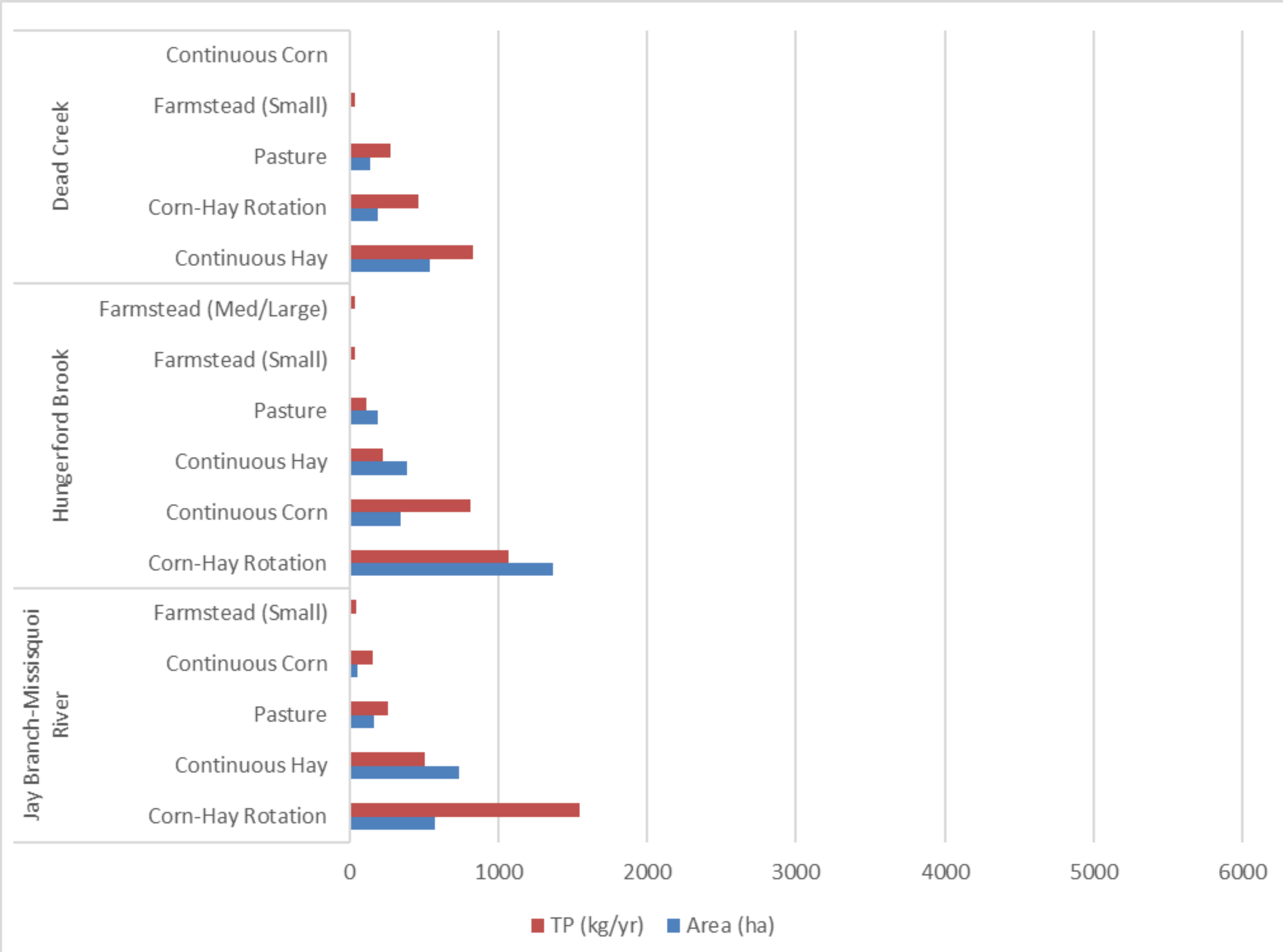


Table LA-4 provides information regarding agricultural practice efficiencies that were used to estimate the necessary TMDL reductions as presented in the Scenario Tool.

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	55.00	55.00	55.00	SWAT

without riparian buffer				
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

Required Agricultural Practices and Permit Programs

The Required Agricultural Practices (RAPs) and existing Medium and Large farm permit programs set baseline farm management practices to ensure environmental protection. Medium and Large farm permits have been in place for nearly 10 years, but the RAPs (formally the Accepted Agricultural Practices) have been in place as the current regulatory standard since 2006 and are in the process of being revised. This revision is expected to result in a significant increase in conservation practice implementation over the next few years, especially in the Missisquoi Bay watershed. The proposed changes to the RAPs that are expected to result in the greatest impact include:

- Nutrient Management Planning and Implementation on all farms
- Creation of Small Farm Certification Program
- Stabilization of Ephemeral Gullies
- 10 ft. grassed filter strips on all field ditches
- Increase in grassed filter strip and manure spreading setback width from 10ft to 25ft on surface waters for small farms (already 25ft requirement for Medium and Large Farms)
- Establishment of cover crops on fields containing frequently flooded soils
- Increased manure spreading ban duration on fields containing frequently flooded soils
- Increase in grassed filter strip and manure spreading setback from 25ft to 100ft on surface waters adjacent to fields with an average slope greater than 10%
- Reduction in maximum soil erosion rates by ½ on small farms
- 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′)
- Livestock exclusion from production areas
- Livestock exclusion in pastures where erosion or water quality issues are present

It is impossible for us to estimate the exact impact that these rules will have, because doing so would require a detailed understanding of the current management on all farms. However, we are confident that as a result of this rule we will see a dramatic increase in the implementation of Nutrient Management Plans, Cover Crops, Grassed Waterways, and Grassed Filter Strips and Riparian Buffers. Any of these practices that are implemented as part of the many existing financial assistance programs will be tracked and reported on in the next planning cycle. Finally, through the creation of the Small Farm Certification program, inspections will be conducted on every small farm that meets the certification thresholds over the next seven years at minimum. Act 64 shortened the inspection cycle on medium farms from 5 to 3 years, and with the additional staffing the Agency received last year has allowed the Agency to perform more comprehensive inspections on medium and large farm facilities. The Agency will continue to perform annual inspections on large farm operations and the regulatory inspections on small and medium farms, all of which will result in a significant increase in compliance with the management practices set forth in the permit programs and the RAPs.

Conservation Law Foundation Settlement Agreement

In February, 2016, the Secretary of Agriculture issued a revised Secretary's decision which resulted in a settlement regarding a petition to the Secretary of Agriculture to require additional BMPs on farms in the Missisquoi Bay watershed. This settlement will result in a comprehensive process for assessing, planning, and implementing practices on farms in the Missisquoi Bay area, relative to other watersheds. The settlement will require detailed farm assessments of every farm over the next 10 years, with all large farms, medium farms, and shipping dairies assessed within the next 5 years. These assessments will identify any additionally needed conservation practices above those required by existing regulations. Problems identified will need to be outlined in a plan with a timeline to implement the appropriate conservation practices. While this timeline does not fully match the tactical basin planning timeline, a good portion of these assessments (all dairies, MFO and LFO) will occur over the next 5 years, and will all (remaining livestock and non-dairy SFO's) be completed by the end of the next planning cycle. The next plan will detail assessments made at that point in time, as well as any related implementation activity.

North Lake Farm Survey and Case Management

A survey of all known agricultural facilities in the Missisquoi Bay and St. Albans Bay occurred in 2015 and 2016. The final North Lake Farm Survey analysis will be available early 2017, but a preliminary analysis revealed an approximation of the status of compliance in key areas (production area and land management). Farm facilities were surveyed for needed water quality improvements in the entirety of their production area, and in at least three fields. To get a sense of the type of water quality problems associated with farms of varying sizes in the Missisquoi Bay watershed, surveyed farms were marked as either having production area or land management problems present, regardless of the quantity of the problems surveyed.

Overall, 309 farm facilities were surveyed in the Missiquoi Bay Basin, 238 of which were small farm operation (SFO) facilities, 47 were medium farm operation (MFO) facilities, and 24 were large farm operation (LFO) facilities. Basin wide, 45% of surveyed facilities had at least one production area issue, while 41% of facilities had at least one land management issue. Figure LA-4 shows the number of facilities that where surveyed by HUC12 in the Missisquoi Bay Basin. Figures LA-5 and LA-6 show the proportion of farms surveyed that had production area issues and land management issues, respectively. Figure LA-7 shows the proportion of surveyed farms that had both a production area and a land management issue, just one type of issue observed, or no issues at all.

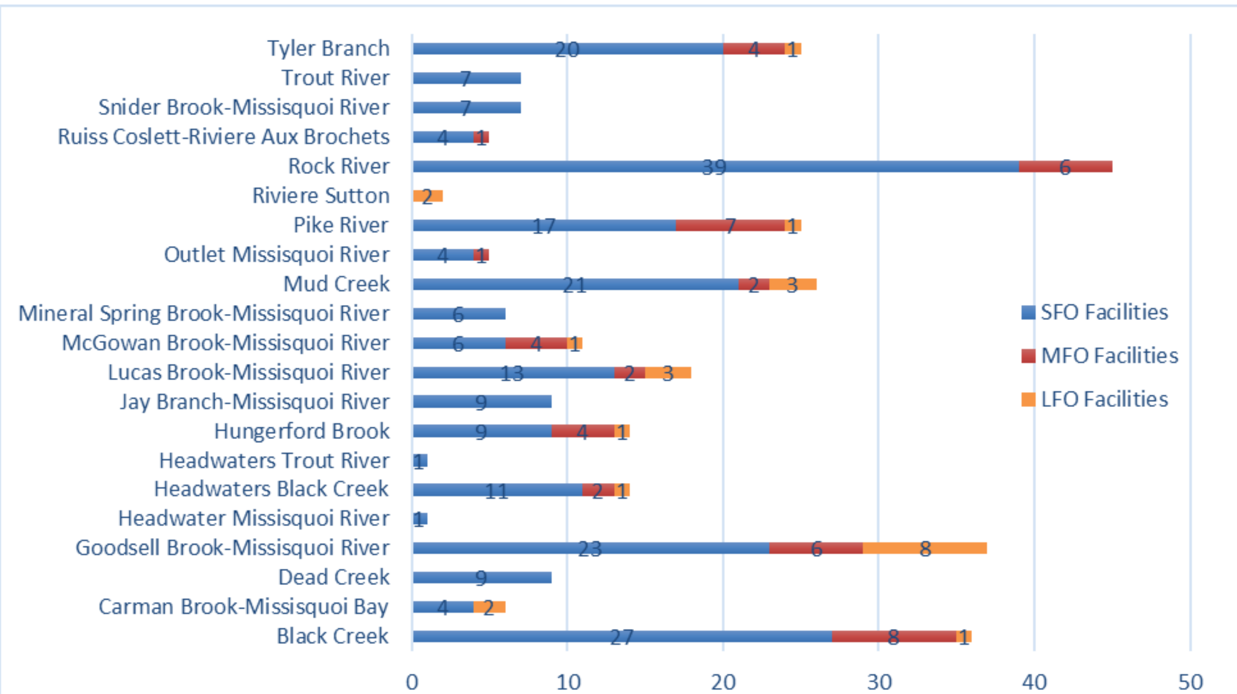


Figure LA-4. Facilities surveyed in each HUC12 watershed in the Missiquoi Bay Basin by farm size. *Small farm operations (SFO), medium farm operation operations (MFO), and large farm operations (LFO) are depicted as a portion of the total farms surveyed for each watershed.*

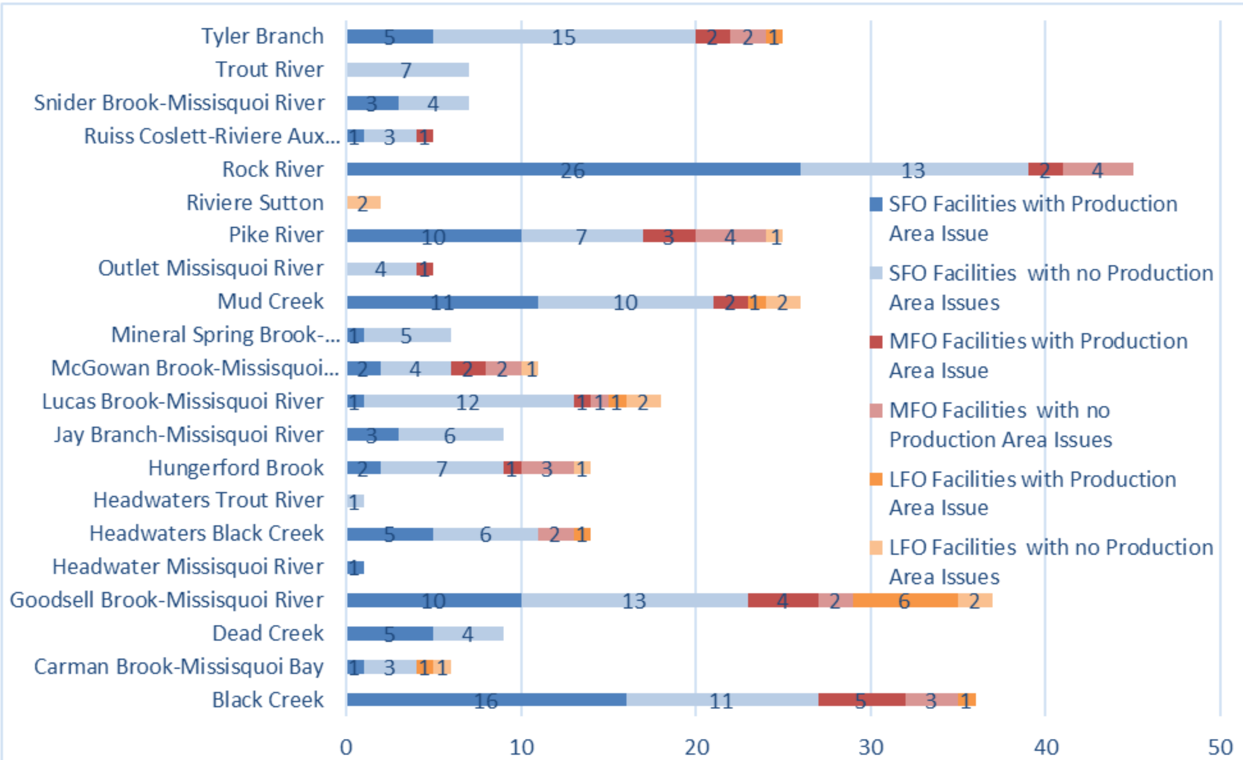


Figure LA-5. Surveyed facilities by size showing proportion with at least one production area issue observed, *as well as the proportion of facilities with no observed production area issues.*

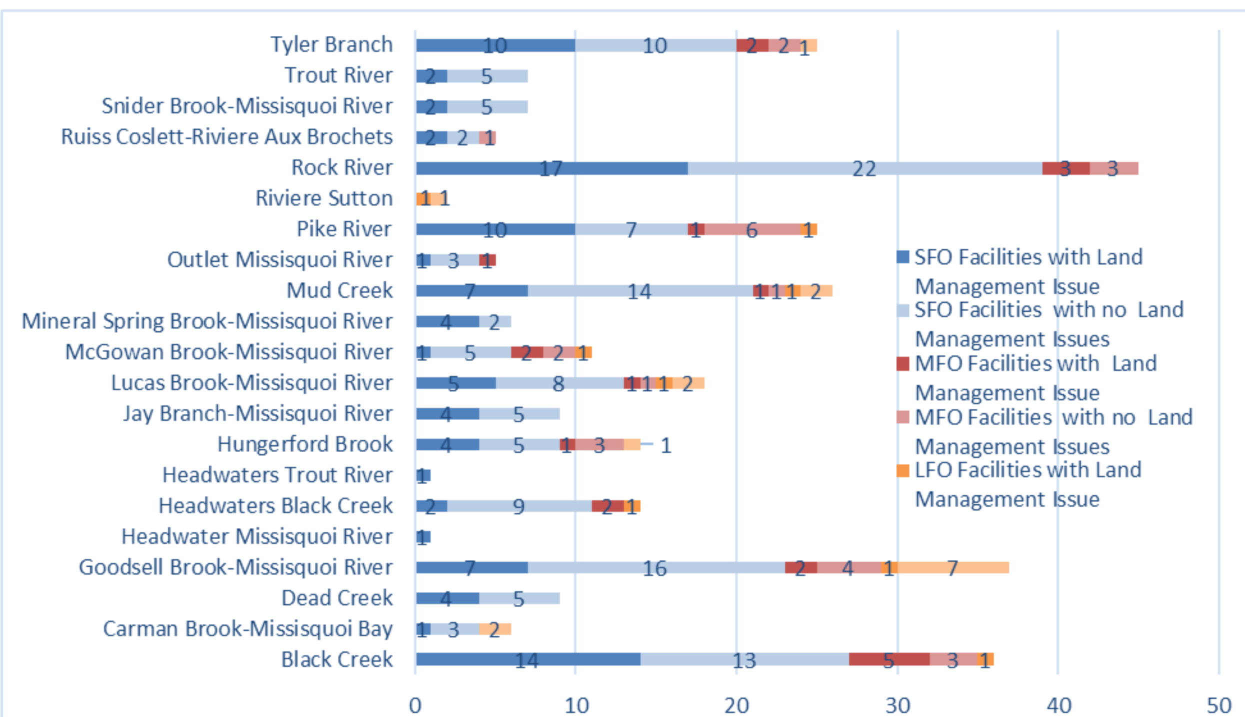


Figure LA-6. Surveyed facilities by size showing proportion with at least one land management issue observed, *as well as the proportion of facilities with no observed land management issues.*

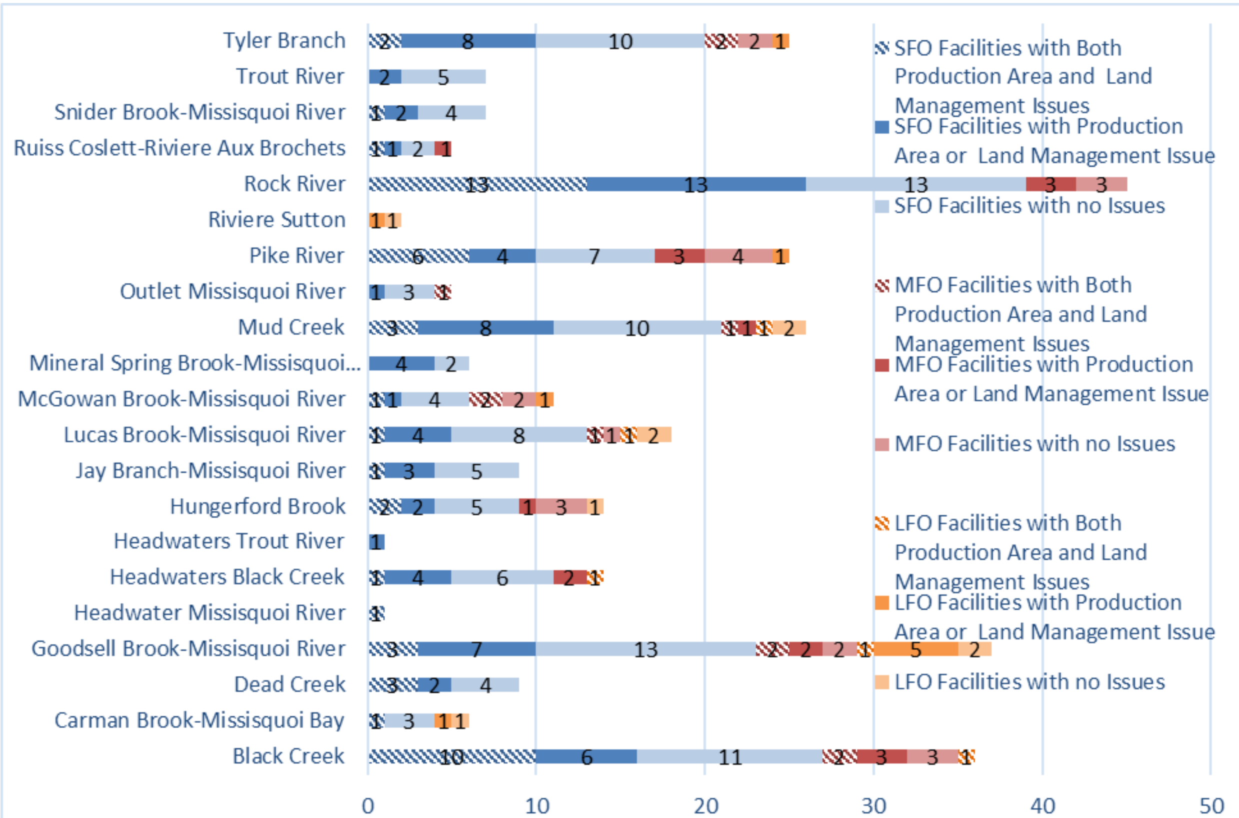


Figure LA-7. Surveyed facilities by size showing the proportion of facilities that had both a production area and land management issue observed, as well as farms that had no issues observed.

The Agency of Agriculture has contracted with three vendors to provide case management and conservation planning services to the highest priority facilities identified in the survey, and work under these contractors is expected to continue in the coming years. The vendors primary task is to assist farms in identifying solutions and connecting with cost-share programs in order to finalize the design and installation aspects. The Agency is also working with the Farm Viability program to ensure the vendors and farmers have access to financial planning resources to help strategize a path that allows the farm to cover the implementation costs as farmers still retain a substantial investment in projects despite cost-share opportunities.

Vermont Environmental Stewardship Program

Starting in 2017, the Agency of Agriculture will pilot a Vermont Environmental Stewardship Program that will recognize and certify farmers who achieve high standards pertaining to sediment and nutrient management, pasture condition, and soil health. This program is designed to increase the recognition of farms that manage their lands in a way that provides environmental benefits, with the goal of fostering a shift toward more ecologically based farm management in the agricultural community. The pilot is expected to launch in in 2017 with 10-12 farms, with the full program starting in 2019.

Natural Resource Conservation Service Targeted Watersheds Implementation

In collaboration with VTDEC, AAFM, and Conservation Districts, NRCS is performing high-resolution planning activities for targeted watersheds in the highest phosohorus-yielding areas of the Lake Champlain Basin. In the Missisquoi Bay Basin, those subwatersheds include the Rock and the Pike Rivers (including Lake Carmi). The resulting NRCS-developed watershed plans contain practice implementation schedules with cost estimates. Those schedules are incorporated here as a component of this Basin Plan. It is understood that the implementation of the practices described is envisioned to occur during the lifespan of this Tactical Basin Plan, within the next five years. For additional information, see assessment information here and practices, estimated reductions and costs in Table 17.

Wasteload Allocation

In this section, a description of the applicable agricultural phosphorus runoff control regulations will be provided. 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 permitted Large and Medium Farm operations. As mentioned earlier, a small farm certification program is being created that will bring many farms into a permitted program, but the exact number of farms for each watershed has not been estimated at this point. Table WLA-1 shows the number of LFO and MFO permitted facilities in the Missisquoi Bay Basin by HUC12.

Table WLA-1. Permitted LFO and MFOs in the Missisquoi Bay Basin by HUC12.

HUC12 Number	HUC12 Name	LFO	MFO
041504070503	Black Creek	0	6
041504070501	Headwaters Black Creek	0	1
041504070402	Goodsell Brook-Missisquoi River	2	5
041504070602	Hungerford Brook	1	2
041504070204	Lucas Brook-Missisquoi River	1	2
041504070601	McGowan Brook-Missisquoi River	0	3
041504070104	Mud Creek	1	1
041504081001	Pike River	0	3
041504070203	Riviere Sutton	0	1
041504081101	Rock River	0	3
041504070302	Trout River	0	1
041504070401	Tyler Branch	1	1
041504070603	Outlet Missisquoi River	1	0
	Total:	7	29

Table WLA-2 shows the estimated TP farmstead export for each HUC-12. It is important to note that the farms counted are the primary facilities, and that other facilities are often associated with the primary facilities but are captured under the same permit. For this reason, these numbers are not equivalent to the facility numbers shown in the North Lake Survey.

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

HUC 12 Name	*Farmstead (Med/Large)*	*Farmstead (Small)*	*Total*	*Overall 80% TMDL Reduction*
Headwater Missisquoi River	0	8	8	7
Snider Brook-Missisquoi River	0	17	17	14
Mineral Spring Brook-Missisquoi River	0	57	57	46
Mud Creek	43	80	123	98
Jay Branch-Missisquoi River	0	42	42	34
Leavit Brook-Riviere Missisquoi	0	3	3	2
Riviere Sutton	10	2	13	10
Lucas Brook-Missisquoi River	36	56	92	73
Headwaters Trout River	0	8	8	6
Trout River	0	23	23	18

Tyler Branch	38	80	117	94
Goodsell Brook-Missisquoi River	45	166	211	169
Headwaters Black Creek	1	86	87	70
Dead Creek	0	38	38	30
Black Creek	108	112	220	176
McGowan Brook-Missisquoi River	23	20	43	35
Hungerford Brook	40	42	81	65
Outlet Missisquoi River	0	5	5	4
Pike River	10	40	50	40
Ruiss Coslett-Riviere Aux Brochets	0	6	6	4
Rock River	13	32	45	36
Carman Brook-Missisquoi Bay	7	24	31	25
		Total	1318	1055

Controlling Phosphorus from Developed Lands

In the Lake Champlain 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	34.2%	✓			
All 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 34.2% were applied to each of these catchments. Summarized at the bottom is the percentage, 37%, of total TP reduction identified in the TMDL that could be realized if the developed lands TMDL reduction of 34.2% were applied. In other words, if the basin-wide TMDL allocation of 34.2% reduction were applied to just these high exporting catchments, 37% of the total necessary reduction would be realized.

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

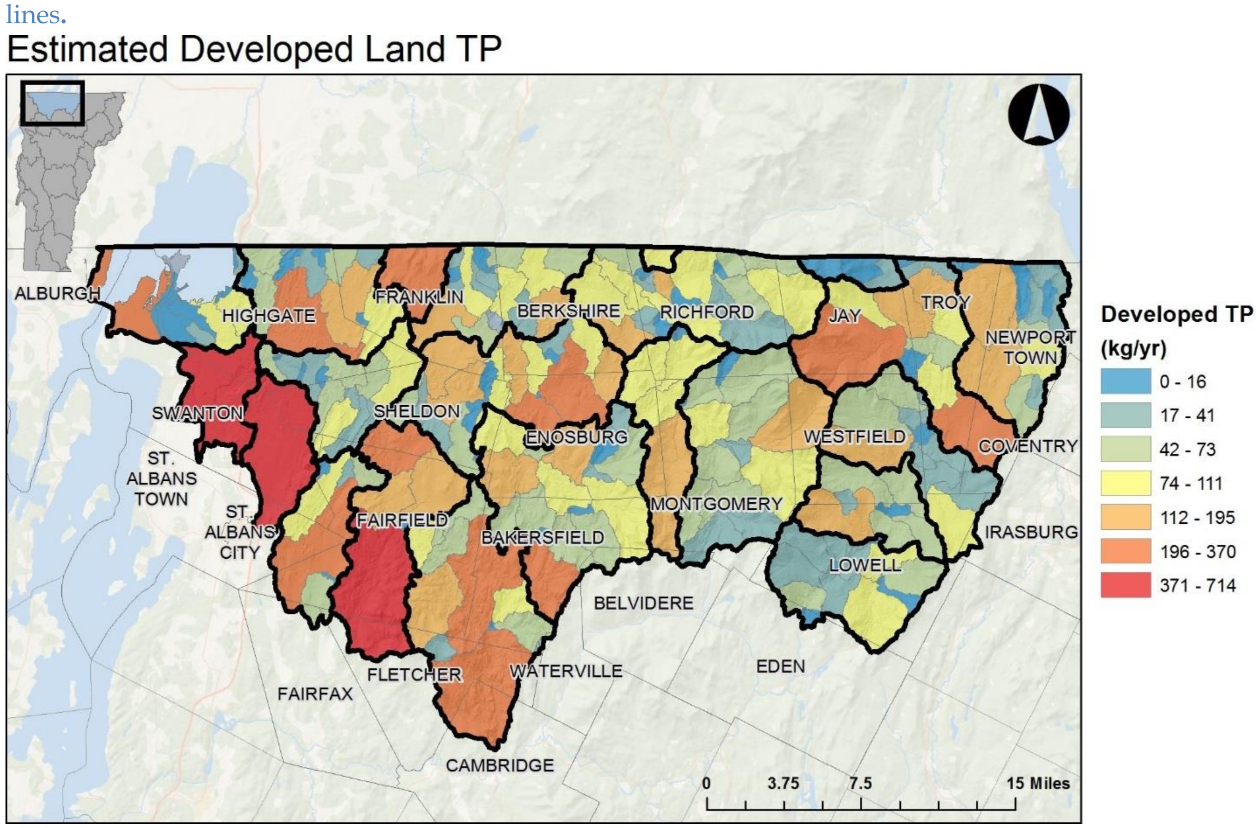


Table WLA-4. Catchments with the highest estimated TP developed lands export. Catchments are associated with individual towns if the majority of the area of that catchment occurs within a given town boundary.

Catchment ID	Town Name	Developed Lands TP Load (kg/yr)	Developed lands TP reduction (34.2%) based on overall TMDL basin allocation (kg/yr)
166176984	Swanton	1113	381
4590883	Swanton	862	295
4590503	Fairfield	697	238
4590501	Bakersfield	515	176
932010015	St. Albans Town	506	173
4590875	Highgate	450	154
4590475	Jay	410	140
4590453	Cambridge	402	138
932010376	Highgate	372	127
4590479	Enosburgh	348	119
4590533	Enosburgh	341	116
4590375	Sheldon	329	112
4590331	Newport Town	289	99
4590345	Westfield	273	93
4590445	Bakersfield	263	90
4590269	Franklin	259	89
4590215	Richford	248	85
4590395	Fairfield	240	82
4590419	Montgomery	230	79
4590273	Berkshire	224	77
Percent of total TP reduction if sector allocations are applied to these catchments			**37%**

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 Missisquoi Bay 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 34.2%. If this overall 34.2% reduction were achieved for all these catchments, approximately 36% and 43% 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 Missisquoi Bay basin at the catchment scale. Bolded lines represent the HUC12 watersheds.

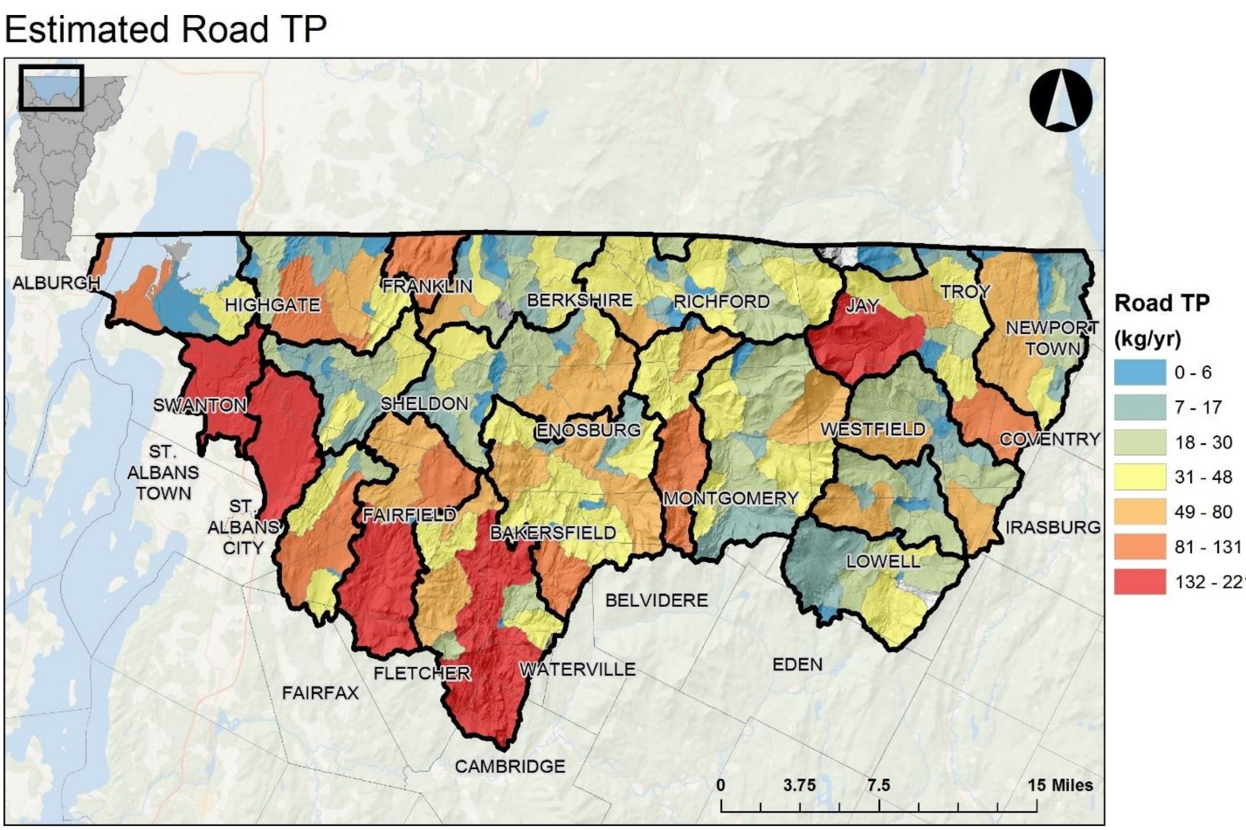


Table WLA-5. Catchments with the highest estimated TP export from paved roads.

Catchment ID	Town Name	Paved TP Load (kg/yr)	Paved TP Reduction (kg/yr)
166176984	Swanton	203	69
4590883	Swanton	154	53
4590503	Fairfield	151	52
4590475	Jay	121	41
4590501	Bakersfield	112	38
4590453	Cambridge	108	37
932010015	St. Albans Town	87	30
4590331	Newport Town	75	26
4590419	Montgomery	74	25
4590875	Highgate	74	25
4590345	Westfield	65	22
932010376	Highgate	61	21
4590445	Bakersfield	59	20
4590395	Fairfield	56	19
4590479	Enosburgh	54	18
4590375	Sheldon	50	17
4590405	Lowell	47	16
4590533	Enosburgh	47	16
4590519	Franklin	46	16
4590303	Newport Town	45	15
Percent of total TP reduction if sector allocations are applied to these catchments			**36%**

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)
4590501	Bakersfield	80	27
4590503	Fairfield	70	24
4590445	Bakersfield	64	22
4590453	Cambridge	53	18
932010015	St. Albans Town	43	15
4590395	Fairfield	43	15
4590419	Montgomery	42	14
4590331	Newport Town	38	13
4590447	Fairfield	36	12
4590421	Bakersfield	30	10
4590475	Jay	28	10

4590479	Enosburgh	26	9
4590385	Enosburgh	25	8
932010376	Highgate	24	8
4590283	Berkshire	21	7
4590423	Fairfield	21	7
4590329	Newport Town	19	7
4590297	Enosburgh	19	7
4590397	Fairfield	19	6
4590375	Sheldon	18	6
Percent of total TP reduction if sector allocations are applied to these catchments			**43%**

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, DEC estimated the miles of state roads per HUC12 in the Missisquoi Bay 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 Missisquoi Bay basin.

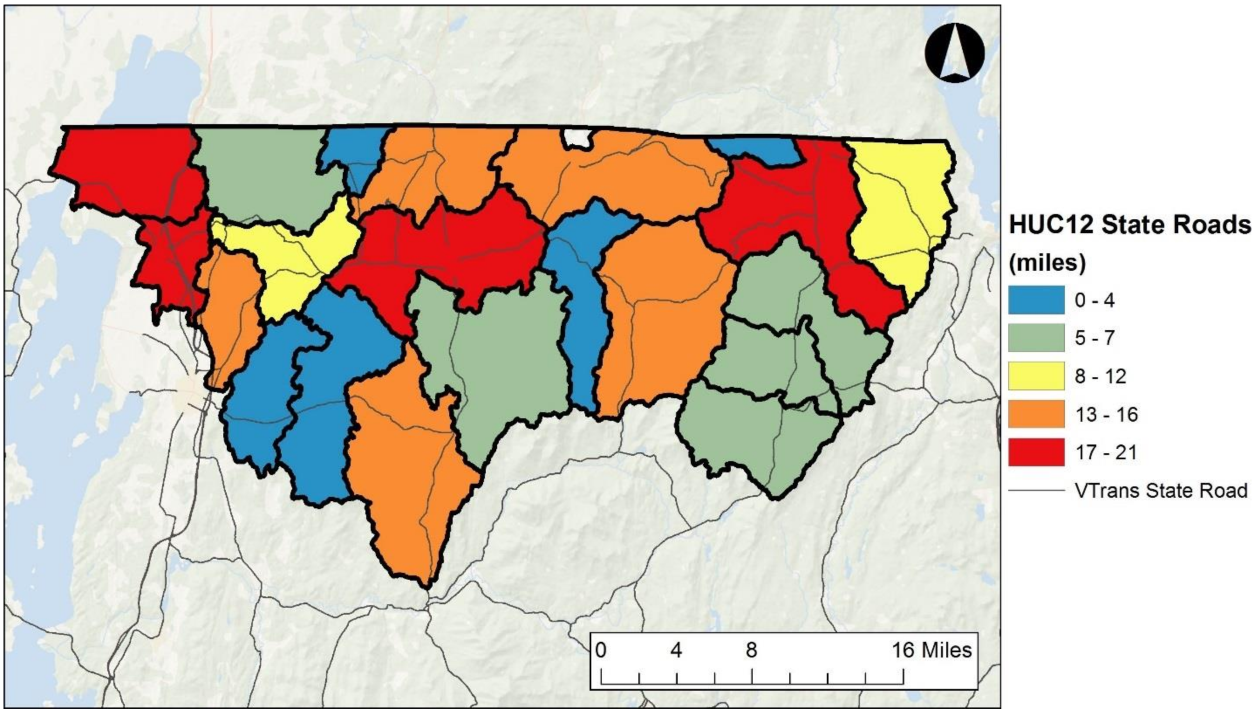


Table WLA-7. Estimated miles for State-managed highways (does not include other VTrans owned and controlled infrastructure)

HUC12	*River Name*	*State managed road miles*
41504070101	Headwater Missisquoi River	7.2
41504070102	Snider Brook-Missisquoi River	4.9
41504070103	Mineral Spring Brook-Missisquoi River	6.5
41504070104	Mud Creek	12.2
41504070105	Jay Branch-Missisquoi River	21.3
41504070202	Leavit Brook-Riviere Missisquoi	0.1
41504070204	Lucas Brook-Missisquoi River	15.6
41504070301	Headwaters Trout River	15.3
41504070302	Trout River	3.9
41504070401	Tyler Branch	7.4
41504070402	Goodsell Brook-Missisquoi River	20.9
41504070501	Headwaters Black Creek	15.7
41504070502	Dead Creek	4.1
41504070503	Black Creek	3.0

41504070601	McGowan Brook-Missisquoi River	11.1
41504070602	Hungerford Brook	15.4
41504070603	Outlet Missisquoi River	20.4
41504081001	Pike River	15.6
41504081004	Ruiss Coslett-Riviere Aux Brochets	3.4
41504081101	Rock River	5.6
41504081102	Carman Brook-Missisquoi Bay	18.2
41504070101	Headwater Missisquoi River	7.2
	Total miles VTrans managed roads	228
	Total estimated P load from VTrans managed roads	1986
	Total estimated reduction	679

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 34.2% 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, DEC 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, DEC will be able to use this data to estimate the reductions in TP loading and confirm progress in meeting the Lake Champlain TMDL.

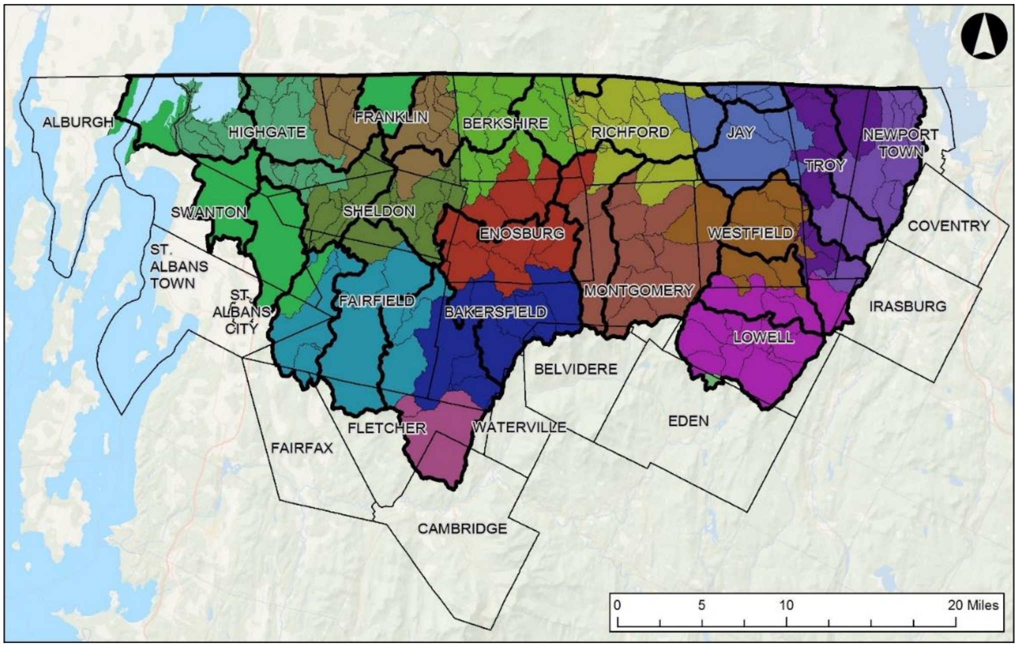


Figure WLA-4. Association of catchments to towns in the Missisquoi Bay Basin.

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

Town	*Paved Roads (kg/yr)*	*Unpaved Roads (kg/yr)*		*Town*	*Paved Roads (kg/yr)*	*Unpaved Roads (kg/yr)*
Bakersfield	332.5	263.4		Jay	249.5	70.1
Belvidere	---	---		Lowell	316.6	67.4
Berkshire	291.5	144.4		Montgomery	302.7	119.3
Cambridge	108.4	53.3		Newport Town	256.2	104.4
Eden	4.7	---		Richford	280.3	81.0
Enosburgh	357.8	177.4		Sheldon	240.9	56.7
Fairfax	0.1	---		St. Albans Town	87.1	43.5
Fairfield	398.4	232.5		Swanton	398.6	27.0
Fletcher	11.0	10.6		Troy	210.2	58.1
Franklin	247.8	59.4		Westfield	196.7	43.9
Highgate	402.9	66.4				
Total loading from all roads (kg/yr)			6374			
Total reduction based on overall basin allocation of 34.2% reduction (kg/yr)			2180			

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*
Bakersfield	23.5	Jay	9.6
Belvidere	7.3	Lowell	21.3
Berkshire	18.7	Montgomery	21.6
Cambridge	30.4	Newport Town	17.3
Eden	13.6	Richford	16.2
Enosburgh	30.4	Sheldon	19.0
Fairfax	22.0	St. Albans Town	19.9
Fairfield	40.0	Swanton	25.5
Fletcher	21.7	Troy	19.1
Franklin	16.7	Westfield	8.9
Highgate	23.2		

Municipally-Separated 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. At this time there are no designated MS4 communities in the Missisquoi Bay basin.

Operational three-acre 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-10).

Table WLA-10. Estimated three-acre parcels and associated impervious cover for Missisquoi Bay basin towns.

Town	*Parcels (#)*	*Impervious (acres)*
Eden	1	0.1
Highgate	8	75.5
Jay	4	74.0
Lowell	2	22.0
Montgomery	2	15.8
Richford	4	25.6
Swanton	8	38.1
Troy	1	3.6
Total	30	254.7

The initial estimate of the three-acre parcel coverage will require additional screening by DEC 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. DEC 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. With the exception of publishing the new TMDL-allocated wasteload load and percent of current design flows, this table is unchanged from those contained in Tactical Basin Plans for many years. Information is also provided that describes any planned upgrades contemplated for each facility. In the Missisquoi Bay basin, three wastewater facilities have been identified for upgrade to reduce phosphorus in compliance with the TMDL. The total cost of these upgrades has been estimated at a cost of $11.6M. Other facilities in the basin are subject to customary operations and maintenance requirements, and periodic performance engineering analyses.

Table WLA-11. Summary of permit requirements for the wastewater treatment facilities in the Missisquoi Bay lake segment watershed.

WWTF Facility (permit ID)	Permit expiration date	Planned permit re-issuance year	Design flow MGD	IWC* 7Q10 /LMM	Current permit-ed load (mt P/yr)	TMDL WLA (mt P/yr)	2015 Avg Flow (MGD) / Percent of Design Flow	Treatment type	Number of	Receiving water
Rock-Tenn (Sheldon) (3-1118)	**12/31/13**	**2017**	**2.500**	**0.052/ NA**	**1.260**	**0.691**	**0.196 / 8%**	**Aerated lagoon**	**0**	**Missis-quoi River**
Sheldon Springs (3-1108)	**6/30/12**	**2017**	**0.054**	**0.003/ 0.001**	**0.373**	**0.373**	**0.016/ 30%**	**Extended aeration**	**0**	**Missis-quoi River**
Swanton Village (3-1292)	**12/31/08**	**2017**	**0.900**	**0.015/ 0.004**	**0.746**	**0.249**	**0.474/ 53%**	**Aerated lagoon**	**0**	**Missis-quoi River**
Enosburg (3-1234)	**3/31/13**	**2017**	**0.450**	**0.010/ 0.003**	**0.373**	**0.124**	**0.277/ 62%**	**Extended aeration**	**1**	**Missis-quoi River**
Richford (3-1147)	**6/30/14**	**2017**	**0.380**	**0.010/ 0.003**	**0.42**	**0.105**	**0.330/ 87%**	**Aerated lagoon**	**2**	**Missis-quoi River**
North Troy (3-1139)	**9/30/13**	**2017**	**0.110**	**0.008/ 0.003**	**0.760**	**0.122**	**0.070 / 64%**	**Extended aeration**	**0**	**Missis-quoi River**
Troy/Jay (3-1311)	**9/30/14**	**2017**	**0.800**	**0.018/ 0.006**	**0.221**	**0.221**	**0.088/ 11%**	**Sequentia l batch reactor**	**0**	**Missis-quoi River**
Newport Town (3-1236)	**3/31/09**	**2017**	**0.042**	**NEED THIS**	**0.006**	**0.116**	**0.022/ 51%**	**Sand filtration and GW infiltratio n**	**0**	**Mud Creek**

[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

Rock-Tenn

The Rock-Tenn facility is engaged in the production of recycled boxboard using corrugated and non-corrugated furnishes. The discharges are treated process wastewater combined from paper process wastes and miscellaneous cooling waters.

The wastewater treatment system includes a 120 foot diameter primary clarifier and a 20 million gallon aerated lagoon which has an area dedicated to settling.

Sheldon Springs WWTF

The Sheldon Springs WWTF is an extended aeration plant which provides secondary treatment of domestic wastewater. Disinfection is completed by the addition of chlorine. There are no CSOs associated with this facility.

Swanton Village WWTF

The Swanton Village WWTF consists of two partially aerated facultative lagoons followed by phosphorus removal in two solids contact clarifiers. Disinfection is accomplished by ultraviolet light. A CSO elimination/combined sewer separation project was completed in the 1990's resulting in no known sewer overflow points in the collection system. Necessary upgrades to the Swanton facility to provide advanced phosphorus control have been estimatesd at a cost of $2.97M.

Enosburgh WWTF

The Village of Enosburg Falls owns and operates this WWTF which is an extended aeration/activated sludge treatment system servicing the Village of Enosburg Falls. The facility discharges secondary treated, chlorinated/dechlorinated wastewater. There is one CSO discharge at the Route 108 Bridge. In December 2011, Enosburgh installed an offline emergency tank, upgraded the headworks and added a second chlorine contact chamber at the WWTF to handle the high flows. According to an Effectiveness Study conducted in 2012/13, the improvements are working as intended and have prevented overflows.

Richford WWTF

The Richford WWTF utilizes the aerated lagoon process of biological treatment to achieve secondary treatment of domestic wastewater via two lagoons. Total phosphorus removal is achieved through chemical treatment using alum. Disinfection is achieved through chlorination/dechlorination. There are two documented CSOs associated with the collection system – Playground pump station and River Street. Necessary upgrades to the Richford facility to provide advanced phosphorus control have been estimates at a cost of $7.9M.

Newport Town WWTF

The Newport Town WWTF consists primarily of a 60,000 gallon septic tank where the treatment process is initiated. From the septic tank, effluent flows to the effluent filter tank and then the dosing siphon tank. In the dosing tank, effluent is stored until a specified volume is reached whereby it is then released to one of two sand filters. Within the sand filter beds is where the final effluent treatment is performed prior to distribution to the disposal fields. Ultimately, effluent is released to the groundwater and in turn Mud Creek.

North Troy WWTF

The North Troy WWTF utilizes an extended aeration process which is a modification of the conventional activated sludge treatment process and chlorine is used for disinfection. The treated sludge is pumped to drying beds and eventually the dried solids are landfilled. There are no CSOs associated with this facility. Necessary upgrades to the North Troy facility are estimates at $875K to provide for advance phosphorus control.

Troy/Jay WWTF

The Troy/Jay Wastewater Treatment Facility replaced its four aerated lagoons with a new facility that started up on May 14, 2012. The new WWTF generally consists of headworks with a mechanical fine screen and aerated grit chamber, two Sequencing Batch Reactors (SBRs) with a fine bubble aeration system, chemical precipitation with polyaluminum chloride for total phosphorus removal, and an ultraviolet light disinfection system. The sludge handling consists of an aerated sludge storage lagoon with a new mixer, centrifuge, and solar greenhouse with two robotic tillers for sludge dewatering/drying.

Summary of Phase II Plan for the Missisquoi Basin

The information provided in the foregoing provides the best-available information regarding the locations of the Missisquoi Bay 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 TMDL is envisioned to be implemented over a 20-year timeframe. Figure A-2 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.

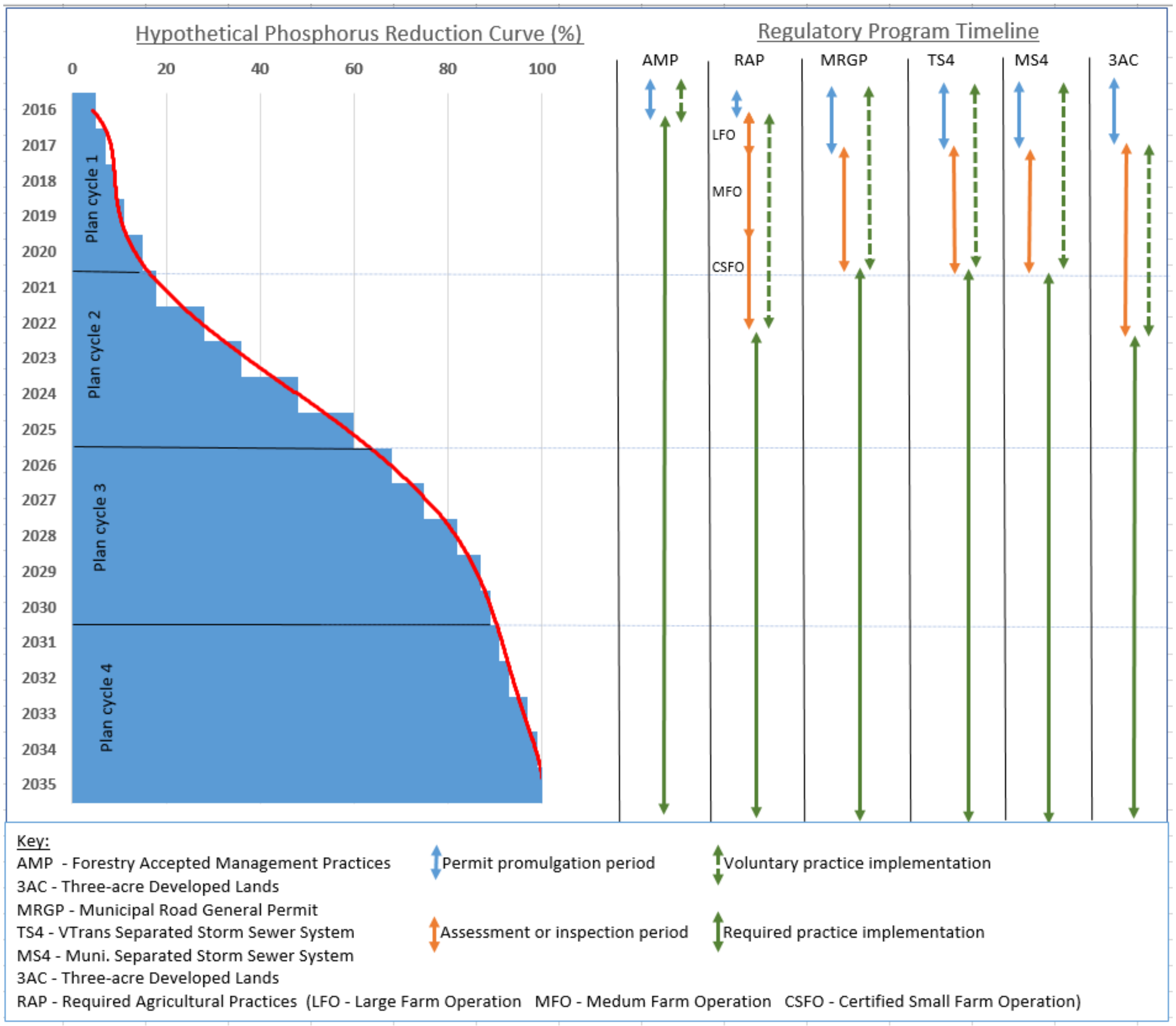
The capability for the State to compel reductions in the first five-year iteration of this tactical plan cycle is limited by the timelines set forth by Act 64 for the establishment and re-promulgation of the permit programs. In other words, the State cannot compel, for example, the reduction of phosphorus 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 A-2 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. The education and outreach efforts outlined in Table 16 and included in the Watershed Projects Database will encourage timely compliance.

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 Missisquoi Bay 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. The following links provide access to the database resources discussed in this Plan:

VTDEC Watershed Projects Database and Tracking System

NRCS Targeted Planning for High Priority Agricultural Watersheds

Figure A-2. Theoretical phosphorus reduction, relative to the load and wasteload reductions required by the Lake Champlain TMDL. *The timelines for regulatory programs are also shown.*



In regards to funding, this current tactical basin plan cannot yet articulate a precise estimation of the total cost of implementation to achieve the full completion of TMDL activities. However, the following information provides a cost perspective based on a statewide view of clean water funding needs, and also a sector-specific estimated cost per unit reduction for phosphorus.

The forthcoming State of Vermont Treasurer's report describes the full costs of implementing Act 64 to achieve clean water for the entire State of Vermont. Figures available as of this writing suggest a total *statewide* annualized cost of $115M, and a total gap, derived from currently available clean water funding, of $67M. These figures pertain to the entire implementation lifecycle of the Lake Champlain TMDL, identified as 20 years based on the Lake Champlain Phase I Implementation Plan.

From the perspective of sector-specific costs, Figure A-3, adapted from the Phase I Plan, presents useful practice-level cost estimates. These latter estimates indicate a gradient of cost efficiency, with highest efficiencies associated with agricultural practices, followed by roads, developed lands, and wastewater infrastructure.

Over the course of this tactical basin plan lifecycle, as projects are documented as a result of assessments, they will be entered into the implementation tracking system, and incremental, project-level costs can begin to be aggregated.

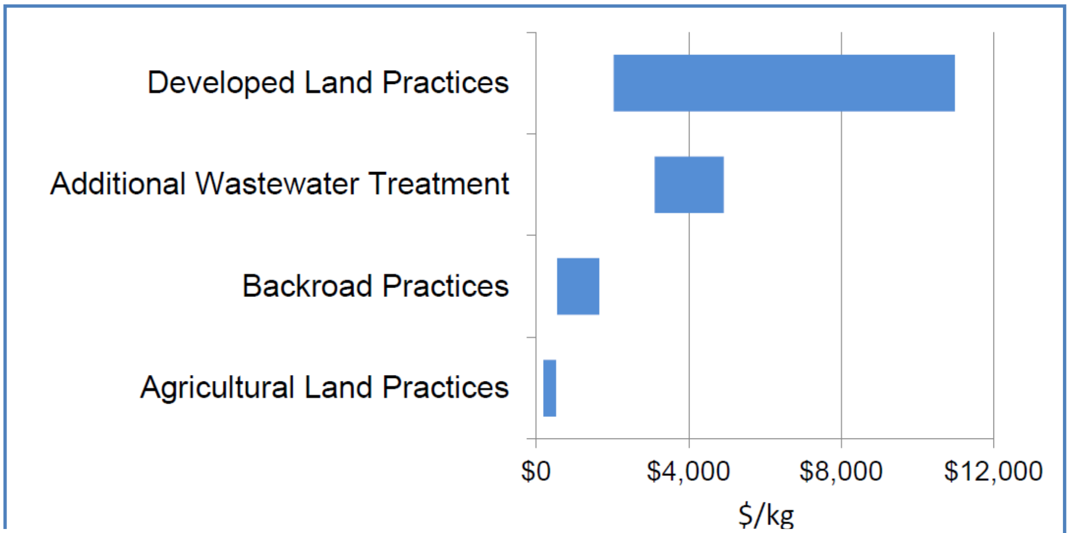


Figure A-3. General costs of practices, by land use sector, expressed by kilogram of phosphorus reduced.

As has been described in this Chapter, a robust phosphorus reduction tracking approach is being put into place to document implementation of on-the-ground practices and projects. It is through this system that accurate phosphorus reduction projections, and documented accomplishments will be tracked. These accomplishments will be reported publicly, as required by Act 64 on an annual basis. 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, costs, and as appropriate, success stories documenting incremental water quality improvement.

Vermont Statewide TMDL for Bacteria-Impaired Waters

Twenty-one of Vermont's waters are impaired at least in part due to bacterial contamination; 3 of those are located in Basin 6 and include:

- A 2.6 mile reach of Berry Brook,
- a 4.4 mile reach of Godin Brook and
- a 4.5 mile reach of Samsonville Brook

These waters fail to meet the Vermont Water Quality Standards for biological criteria.

A Vermont Statewide TMDL Report[21] was designed to support bacteria pollution reduction and watershed restoration throughout Vermont. The TMDL, which established bacterial load targets for each impaired waterbody, was completed in September 2011. The report's appendices include specific data monitoring and watershed information about each of the impaired waterbodies.

Agricultural land represents a significant portion of the watershed area of the three Basin 6 streams with dairy production as the predominant activity. The TMDL report supports the implementation of the following actions to allow the streams to meet their targeted bacterial loads. The actions, which are included in the Chapter 5 Implementation Table, include:

- Improve NMP and other land treatments that reduce runoff of animal waste into streams.
- convert grazing land in the riparian area into permanent livestock exclusion areas is recommended.
- Finally, the bacterial concentrations of each stream will need monitoring to show improvements.

Flood Resilience Efforts

As part of its effort to address climate change, the Agency is working with communities to enhance their flood resilience. Working towards resilience means both proactively

[21] http://wsmd.vt.gov/mapp/docs/mp_bacteriatmdl.pdf

reducing vulnerabilities to flooding and flood damage, and improving response and recovery efforts when flood events do occur, so that communities bounce back quickly from natural resource, social and economic impacts. Reducing vulnerabilities includes efforts to diffuse stormwater flows from buildings, over roads, especially in areas with slope and erodible material.

The importance of flood resilience was highlighted in the aftermath of tropical storm Irene and other recent flooding events across Vermont. Act 16, effective July 2014, requires municipal and regional plans to incorporate a "flood resilience" component.

DEC's efforts to help towns improving flood resilience has included mapping local flood hazard areas, identifying flood attenuation zones (including floodplains, river corridors, forests and wetlands) and recommending specific actions and policies to towns that will help protect these areas and reduce the risks facing existing development. All available information is located on DEC's Flood Ready website.

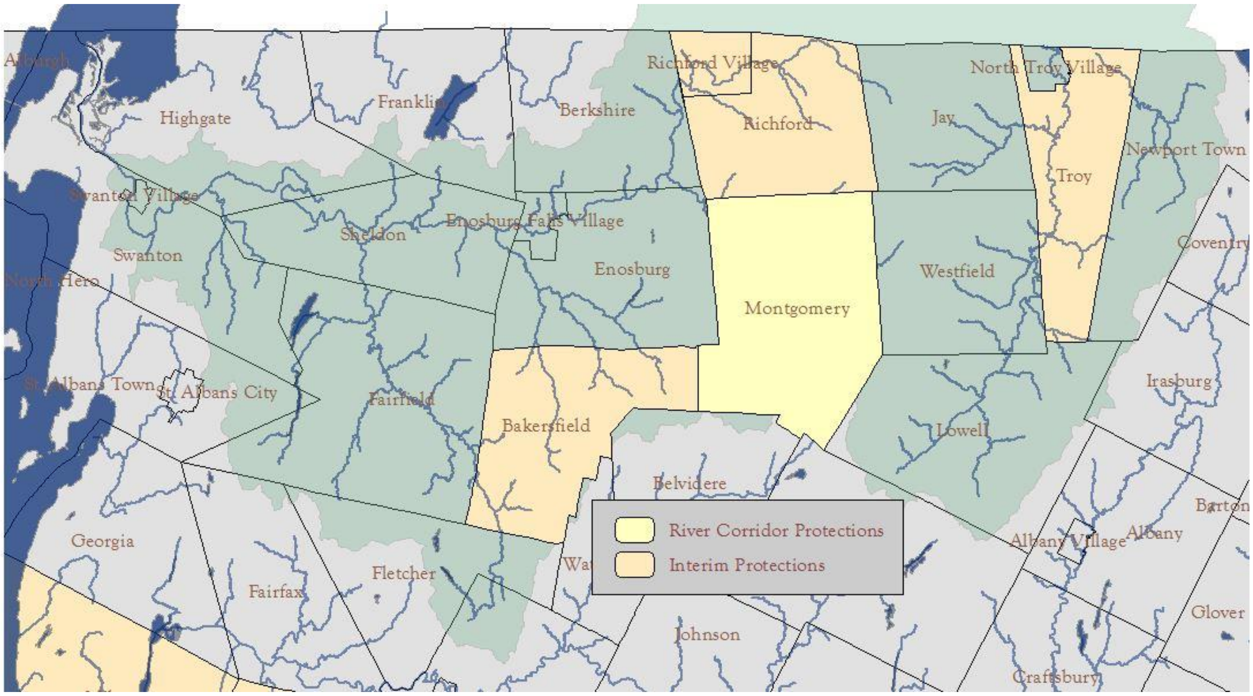
The Northwest Regional Planning Commission and the Northern Vermont Development Association and DEC are coordinating efforts to provide education and assistance to municipalities to protect river corridors as part of their systematic efforts for both flood resilience and improved water quality (see Appendix D for each town's status with regard to flood resilience and water quality protection actions).

Figure 11 identifies the towns in the Basin that have adopted municipal river corridor and floodplain protection bylaws to date.

All communities in Basin 6 have bylaws in place that allow them to participate in the National Flood Insurance Program. Two communities – Bakersfield and Troy have adopted standards to protect Special Flood Hazard Areas from new encroachments.

Because Bakersfield and Troy acted to protect flood hazard areas at a time when river corridor maps were not yet available they are recognized as providing river corridor protection based on the best available data.

Under the criteria for Vermont's Emergency Relief and Assistance Fund (ERAF) the actions of Bakersfield and Troy are recognized as proving river corridor protection on an "interim" basis.



Communities with River Corridor Protections have adopted bylaws that specifically protect River Corridors. Communities with Interim Protections indicate that they acted before 2015 to protect Special Flood Hazard Areas and/or a limited Fluvial Erosion Hazard Area where River Corridor maps were not available yet

Figure 10. Basin 6 municipalities with river corridor and floodplain protection bylaws..

Chapter 4 - Management Goals for Surface Waters

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 goals for particular bodies or stretches of water. The management goals describe the values and uses of the surface water that are to be protected or achieved through appropriate management. In Chapter 2 of this plan, a number of waters were identified as being notable high quality, and these, as well as other unique areas, may be candidates for establishing alternate management goals 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 warm and 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 goals established for the associated surface water. Before the Agency recommends management goals 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 goals 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 goals, 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 state that *"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. Additional information relating to management goals for surface waters is located in Chapter 4 of the Vermont Surface Water Management Strategy (VSWMS)

A number of rivers and streams, lakes and ponds, and wetlands in the Missisquoi Bay 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 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 BioFinder, provides a statewide application identifying surface water and riparian areas with a high contribution to biodiversity.

Classification, and Recent Revisions to the Vermont Water Quality Standards

Since the 1960s, Vermont has had a classification system for surface waters that establishes management goals and supporting criteria for each use in each class of water (see Table 14). 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 goals.

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) if the quality of those uses are demonstrably and consistently of higher quality than Class B(2).

Through the tactical planning process, surface waters where one or more uses is of consistently and demonstrably higher quality than Class B(2) are to be identified, and proposed for reclassification to Class B(1) for the use(s) in question. Basin plans may also identify surface waters that merit reclassification to Class A(1).

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

With the exception of the waters listed below, all waters in Basin 6 are Class B(2) for all designated uses, pursuant to the proposed new Standards.

1) Waters above 2,500 feet in elevation, are classified A(1) by Vermont statute.
2) The following surface waters are classified as A(2) and are managed to be suitable for use as a public water source with disinfection, and filtration when necessary:

- Mountain Brook and a tributary and all waters within their watersheds upstream of two separate water intakes in Jay.
- Coburn Brook and Coburn Brook Reservoir in Westfield and all waters within their watersheds upstream of the water intake in Coburn Brook.
- Unnamed tributary to the Trout River in Enosburgh and all waters within its watershed upstream of the water intake.
- Hannah Clark Brook in Montgomery and all waters in its watershed upstream of the water intake.
- Stanhope Brook in Richford and all waters in its watershed upstream of the water intake.
- Trout Brook in Berkshire and all waters within its watershed upstream of the outlet of Enosburgh Reservoir.
- Loveland Brook in Richford and all waters within its watershed upstream of the water intake.
- Black Falls Brook in Montgomery and Richford and all waters within its watershed upstream of the water intake.

Table 14. A list of designated uses that can be individually classified into each of the water classes 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 may be classified to Class A(1) if the Secretary finds that it is in the public interest, pursuant to 10VSA1253d.
Class A(2)	Public Water Source
Class B(1)	One or more of Aquatic Biota and Wildlife, Aquatic Habitat, Aesthetics, Fishing, or Boating may be classified to Class B(1) when that use is demonstrably and consistently attained.
Class B(2)	Aquatic Biota and Wildlife, Aquatic Habitat, Aesthetics, Fishing, Boating, Swimming, and Irrigation are all to be supported at Class B(2) for all waters in the State not presently classified to a higher class.[22]

Class B(1) Proposals

The following list represents waters in which one or more uses are of demonstrably and consistently higher quality than Class B(2) waters, and so are proposed for reclassification to Class B(1).

River	*Town*	*Use*	*Substantiating Information*
South Branch of the Trout River	Montgomery	Confirm as Class B(1) for fishing	DFW Survey, 1996 – RM 5.5 Averys Gore WMA – 4,446 trout/mile, 27.5 lbs/acre; current landuse which includes Avery Gore, DFW Wildlife Management Area

[22] Class B(2) management objectives and supporting criteria are the same as with the former Class 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) or higher. These uses include swimming, boating, and fishing, aquatic biota, 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 14. In addition, under the anti-degradation policy of the Vermont Water Quality Standards, if the Agency of Natural Resources identifies in a waterbody, a use, the existing condition of which exceeds its classification criteria, then that use 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 DEC for the Missisquoi Bay watershed to date should therefore be viewed as only a partial accounting of known existing uses based upon limited criteria. The list does not change protection under the Clean Water Act or Vermont Water Quality Standards for waters not listed. Appendix G presents the current list of Existing Uses determined for the Missisquoi Basin, while Table 10 identifies those surface waters where additional data will be obtained to demonstrate the consistent attainment of Class B(1) criteria for aquatic life and wildlife.

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 permits for stream alteration, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects and other activities.

There are currently no ORW designated waters in Basin 6. The Big Falls of the Missisquoi River at Troy is a natural candidate for ORW in consideration of spectacular aesthetic value and swimming use.

As part of the implementation of this tactical basin plan, the Department will evaluate the values of Big Falls for consistency 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

Class I 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 I or Class II wetland

As part of the development of this tactical basin plan, several surface waters have been identified as prospective candidates for Class I, which are presented below. These wetlands have passed a cursory review by the Vermont Wetlands Program Ecologists. In addition, there are at least three wetlands that warrant study for Class I potential. These wetlands are listed below. 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.

Prospective candidates in Basin 6 for reclassification to Class I status include:

- Missisquoi Delta, including Maquam Bog in the Missisquoi National Wildlife Refuge

Wetlands in Basin 6 that warrant further study for Class I potential include Fairfield Swamp and the Franklin Bog, Franklin.

Warm and Cold Water Fish Habitat designations

The following waters are designated as warm water fish habitat for purposes of the Vermont water quality standards along with the following ponds:

- Lake Carmi, Franklin
- Cutler Pond, Highgate
- Rock River from the Canadian boundary to its confluence with Lake Champlain
- Metcalf Pond, Fletcher
- Fairfield Pond, Fairfield
- Fairfield Swamp Pond, Fairfield
- Missisquoi River from the outfall of the Enosburgh Falls wastewater treatment facility to the Swanton Dam, Swanton

No changes to warm water fish or cold-water habitat designations are proposed by this plan.

Chapter 5- Implementation: Protection and Remediation Actions

The Tactical Basin Plan addresses all impaired, stressed and altered waters (Table 3) in the basin as well as protection needs for high quality waters; however, the focus of the plan is the identification of specific priority actions to reduce nutrient and sediment loading in priority subbasins as part of the effort to meet the Lake Champlain Phosphorus TMDL goals. The list of actions cover future assessment and monitoring needs (Table 10.), as well as implementation projects that protect or remediate waters and related education and outreach.

Action items are supported by the objectives in the Lake Champlain Phosphorus TMDL Phase I Implementation Plan as well as the Statewide Surface Water Management Strategy. The actions are located in the Watershed Projects Database and summarized in Table 15 and 16.

The objectives and strategies specific to the plan are identified in Table 15. A summary (Table 16) of the Watershed Projects Database is intended to present a broad view of the over 600 individual project entries in the database. DEC and its partners will proceed to make progress in all areas of the summary table.

The process for identifying priority actions were the result of a comprehensive compilation and review of both internal ANR monitoring and assessment data and reports, and those of our watershed partner organizations (see Chapter 2). The monitoring and assessment reports include, but are not limited to, stormwater mapping reports, geomorphic assessments, river corridor plans, bridge and culvert assessments, Hazard Mitigation Plans, agricultural modeling and assessments, road erosion inventories, TMDL reports, biological and chemical monitoring, lake assessments, fisheries assessments, and natural communities and biological diversity mapping.

The Watershed Projects Database, the Summary of the Implementation Actions (Table 16), along with Appendix A are resources to Basin 6 stakeholders in their efforts to pursue and secure technical and financial support for implementation of high priority projects. Together, these resources include location information, project description, the source of the project if an assessment supports the project, any partners that may have expressed interest in implementing the project, and potential funding sources. The database allows for the addition of new actions as DEC identifies them with the assistance of partners. It is envisioned that the action items currently in the database as of the signing of the plan will be accomplished within the next five years as resources allow.

Table 15. Objectives of Tactical Basin Plan to meet goals for the plan

Plan Objectives	Focus Areas (not to exclude work in other areas)	Strategies
Implement agricultural BMPs	Rock, Pike, Hungerford Brook, Black Creek and Mud Creek	Complete surveys of farm needs; Increase USDA funds through RCPP grant; provide case managers to operators to assist with resource assessment and applications; provide modeling analysis to identify most effective BMP
Manage stormwater	Enosburgh, Fairfield, Franklin, Highgate, Sheldon, and Swanton	Identify projects through Stormwater Master Plan Assessments, Road Erosion Inventories; provide technical assistance to towns.
Protection and remediation river corridors	Upper Missisquoi, Trout, Black and Tyler Branch	Corridor protection Riparian buffer/ Floodplain restoration, dam removal
Remediate logging roads and landings	Fairfield and Upper Missisquoi and Trout River watersheds	Promote programs that protect riparian forests, identify old logging roads and landings for remediation with high erosion potential.
Restore wetland and floodplains	Rock, Pike and Hungerford	Work with TNC and USFWS to identify and restore candidates
Identify and Protect High Quality Lakes	Cutler Pond Little Pond McCallister Pond	Continue to collect monitoring data to confirm as high quality lakes.
Reduce the spread of Aquatic Invasive Species	All waterbodies	Provide education and outreach to boaters to reduce spread; provide technical and financial resources to assist with spread.
Increase knowledge of water quality conditions in the basin	See Table 10	Support watershed groups, NRCDs

DEC will track progress throught both implementation progress and monitoring results. Lake Champlain BMP Accounting and Tracking Tool (BATT) will be used 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. Chapter 2 includes a description of monitoring programs available to DEC.

In the instance that the pollution reductions are inadequate, based on the monitoring data, but the implementation progress is adequate, based on project tracking and modeling, adaptive management will be required.

With regard to education and outreach efforts, workshops and participants at events supported through the Act 64, will be tracked and reported in the Vermont Clean Water Initiative Program annual report to the Legislature.

It is DEC's goal to prioritize staff time and direct internal and external grant funding opportunities towards the recommended actions. These actions include all water media within the basin and all the spectrums of land use that could potentially impact water quality and aquatic habitat. It is our hope that these tables outline priorities that are realistic to implement over a five-year period, noting that there are many unforeseen variables, like landowner willingness and funding availability.

Table 16. Summary of Implementation Actions (Watershed Projects Database). The objectives (yellow)and strategies supporting priority actions in Basin 6. The on-going detailed list of actions can be viewed via Watershed Projects Database)

Priority Subbasin	Priority Towns	Strategies	Source	Stressor addressed	Partners[23]	Funding (see also VSWMS Appendix D)
AGRICULTURE: Implement BMPs						
Missisquoi Bay		**Expand small farm NMP development courses** and workshops, trainings for farmers, manure applicators and technical service providers	TMDL Phase I	Nutrients, pathogen	VACD, UVM extension	
Missisquoi Bay		**Increase inspections in critical watersheds**: Finalize reporting of North Lake Farm Survey (NLFS) in Missisquoi Bay watersheds and target implementation based upon the results	TMDL Phase I	Land erosion, nutrients, pathogens	AAFM, FNLC. NRCD	
Pike, Rock Rivers and Mud Creek and farms identified in Northern Lake Farm Survey (NLFS)		**Increase implementation in critical watersheds**: 1.Provide farms with access to case managers to increase conservation practice implementation through participation in State and federal financial and technical assistance programs; 2 provide modeling analyses as needed to identify most effective BMPs	TMDL Phase I	Land erosion, nutrients, pathogens	AAFM, DEC, NRCD	RCPP[24], USDA
Pike, Rock, Mud Creek and farms identified in NLFS		**Increase technical assistance in critical watersheds**: Hire technical staff to work with farms to meet RAP and higher BMPs based on Northern Lake Farm survey; and other partners as needed for Mud Creek	TMDL Phase I	Land erosion, nutrients, pathogens	FNLC, FWC, NRCD, VACD	RCPP, USDA
Missisquoi Bay		**Develop and pilot the Environmental Stewardship Program** to incentivize additional practice adoption 2016 2020	TMDL Phase I	Land erosion, nutrients, pathogens	VAAFM	RCPP, USDA
MIssisquoi Bay		**Create grassed waterways program** Target funding to critical source areas in coordination with partners	TMDL Phase I	Land erosion, nutrients, pathogens	NRCD	RCPP, USDA
STORMWATER: Reduce pollutants and volume						
Mid Missisquoi,	Richford	**Provide technical assistance on stormwater master planning** to identify and prioritize actions	TMDL Phase I	Land Erosion, Channel erosion, pathogens	DEC, NRPC, FNLC	CWIP

[23] See Appendix A for additional description of partners
[24] See Appendix E for State and federal funding sources

Priority Subbasin	Priority Towns	Strategies	Source	Stressor addressed	Partners[23]	Funding (see also VSWMS Appendix D)
Multiple	Enosburgh, Fairfield, Franklin, Highgate, Sheldon, Swanton	**Support implementation of completed stormwater master plans**	TMDL Phase I		DEC, NRPC, FNLC	CWIP
Upper Missisquoi, Trout (West Hill Brook)	Lowel, Troy, Westfield, Jay, Montgomery, Bakersfield Berkshire Enosburgh Enosburg Falls Fairfield, Highgate Richford, Franklin and Swanton	**Help municipalities control runoff from gravel and paved roads**: implement road assessment protocol to assist with prioritization; provide technical and financial resources to assist with implementation; implement Municipal Roads General Permit	TMDL Phase I	Land Erosion	NRPC, NVDA, VTrans, NRCD, DEC, Municipalities	CWIP
	Towns with Stormwater master plan	**Support municipal stormwater regulation adoption, include incorporation of LID and GSI practices; Implement "Three-acre" permit.**	DEC	Land erosion, nutrients, pathogens	Municipality, NRPC, NVDA, DEC, UVM Sea Grant	CWIP
RIVER CORRIDOR: Reach stream equilibrium and flood resilience						
Hungerford, Mid-Missisquoi	Sheldon, Enosburgh, Berkshire	**Increase the number of river and floodplain restoration projects** Re-establish connections to floodplains	TMDL Phase I	Channel erosion, flood resilience	DEC, TNC	CWIP
Upper Missisquoi	Montgomery, Orleans County	**Replace geomorphologically incompatible culvert and bridges:** RPCs work with towns to identify, add to capital budget, seek additional funding sources	DEC	Channel erosion, flood resilience	municipalities , RPC, Vtrans,	federal hazard mitigation funds, Municipalities, VTrans
Trout, Upper Missisquoi, Tyler and Black Creek	Franklin and Orleans Counties	**Increase River Conservation Easements**: support projects which incorporate channel management and riparian buffer Provisions	TMDL Phase I	Channel erosion, flood resilience	DEC	CWIP
Upper Missisquoi, Trout, Tyler Branch	Franklin and Orleans Counties	**Enhance the Flood Resilient Communities Program** with funding and technical assistance incentives for municipalities	TMDL Phase I	Channel erosion, flood resilience	DEC, NRPC, NVDA	CWIP

Priority Subbasin	Priority Towns	Strategies	Source	Stressor addressed	Partners[23]	Funding (see also VSWMS Appendix D)
All	All	**Support studies to investigate benefits of removal of dams listed in Table 9**	DEC	Channel erosion, encroachment	DEC	CWIP, LCBP, Watershed Grant
FOREST MANAGEMENT: Abate soil erosion						
All	All	Develop LiDAR mapping to map eroding, abandoned and retired forest roads, skid trails and log landings to assist in identification of remediation projects	DEC, TMDL Phase I	Land erosion	DFPR	RCPP
All	All	Prioritize work with landowners based on contribution of erosion features on logging roads(see above LiDAR) to water quality impairment. Provide technical and financial assistance	TMDL Phase I	Land erosion	State foresters, DFPR	RCPP
All	All	Provide loggers with access to portable skidder bridges through rental program. Promote building and ownership of bridges by logging as part of their general practices	DFPR	Land erosion	Cyr Lumber, DFPR, NRCDs, VACD	CWIP
All	All	Enhance forest cover to improve watershed health by promoting the use of Ecologically Sensitive Treatment Areas for managed forest in current-use.	Phase I TMDL	Land erosion, Channel erosion	DFPR	
WETLANDS: Protect and restore						
Lower Missisquoi	Swanton	Designate wetlands within the basin as Class I: Propose Missisquoi Delta as Class I	TMDL Phase I, DEC	Protection	DEC, Missisquoi National WIdlife Refuge	
Entire Basin	All	Identify potential wetland restoration sites based on Lake Champlain wetland restoration map and additional resources and restore	DEC	pathogens, land erosion, nutrients, channel erosion	DEC, USFWS, TNC	USDA, RCPP, CWIP
LAKE and SHORELINE: Protect and restore						
Lake Carmi, Fairfield Pond, Lake Champlain	multiple	Implement the Lake Wise Program: promote the Lake Wise Program and associated Lake Leaders training sessions to encourage lake-friendly shoreline property maintenance	TMDL Phase I	Shoreline encroachment, land erosion	DEC	LCBP, Watershed Grants, CWIP
Lake Carmi, Fairfield Pond,	Franklin, Fairfield	Incorporate materials specific to spiny water flea into signs, greeter program. Place spiny water flea spread prevention information at all lake accesses	DEC	Aquatic invasive species	DEC, lake associations	LCBP

Priority Subbasin	Priority Towns	Strategies	Source	Stressor addressed	Partners[23]	Funding (see also VSWMS Appendix D)
Lake Carmi, Fairfield Pond, Lake Champlain	Franklin, Fairfax, Highgates	Support community's efforts to control Eurasion watermilfoil	DEC, lake assn.	Aquatic invasive species	DEC	AIS grant-in-aid program
Lake Carmi, Lake Champlain		Assist development of a cyanobacteria (blue-green algae) volunteer monitoring program and response plan	DEC	Land erosion, channel erosion	DEC, VDH, LCC	DEC, VDH staff time
Other						
Entire Basin	All	Assist wastewater treatment facilities in meeting TMDL goals to reduce phosphorus loading to Lake Champlain	DEC FED	Pathogens, nutrients	municipalitie s	State Revolving Fund
Entire Basin	See Table 10	Monitor and assess surface waters to gain better understanding of condition and potential pollution sources, including internal phosphorus loading in lakes	DEC	Pathogens, land erosion, channel erosion	DEC, watershed groups,	DEC including LaRosa Partnership Program, Lay Monitoring Program

Table 17. Five Year Project Goals for the Rock and Pike River Watersheds, exerpted table 7 from the Resource Assessment and Watershed Level Plan for Agriculture (NRCS, 2016)

https://www.nrcs.usda.gov/wps/portal/nrcs/main/vt/water/watersheds/

Rock River - Five Year Project Goals
March 2015

Based on a Watershed Team Reduction Goal of 48% from the Total Estimated Watershed Loading (TMDL Target is 83%)

Cropping System	No. of Acres	
Corn in 2014	4,995	
Hay in 2014	3,707	
Pasture in 2014	1,162	
Farmstead in 2014	294	71 HQ's
Cont. Corn*	500	* Assumed 10% of corn in 2014 was continuous corn
Cont. Hay**	1,112	**Assumed 30% of the hay in 2014 was continuous hay
Corn-Hay Rotation***	7,090	*** Acres of corn/hay rotation equals the remainder from above

Acres of Practice by Year and Total

Scenario Components	Selected BMP	No. of Acres Available	2016	2017	2018	2019	2020	Total Practice Acres Applied	Percent of Total Acres	TP Load Reduction (lbs/yr)	Practice Cost per Acre	Total Cost
Cont. Corn	Cover Crop-Conservation Tillage-Manure Injection	500	30	30	30	30	30	150	30%	126	$164	$73,800
Corn/Hay	Cover Crop-Conservation Tillage-Manure Injection	7,090	355	355	425	355	355	1,843	26%	1309	$164	$906,952.80
Cont. corn	Cover Crop	500	50	50	50	50	0	200	40%	110	$79	$79,000
Corn/Hay	Cover Crop	7,090	1064	1064	1064	1064	0	4,254	60%	1914	$79	$1,680,330
Cont. Corn	Crop Rotation	500	75	75	75	75	0	300	60%	144	$16	$14,400
Corn/Hay	Crop Rotation	7,090	709	709	709	709	709	3,545	50%	1276	$16	$170,160
Cont. Corn	Riparian Buffer	8	1	1	1	1	1	4	50%	16	$750	$3,000
Corn/Hay	Riparian Buffer	120	12	12	12	12	12	60	50%	195	$750	$45,000
Corn/Hay	Grassed Waterays	54	5	5	5	5	5	27	50%	130	$5,000	$135,000
Cont. Corn	Reduced Manure P (Nutrient Management and CAP)	500	50	50	50	50	50	250	50%	43	$19	$14,250
Corn/Hay	Reduced Manure P (Nutrient Management and CAP)	7,090	709	709	709	709	709	3,545	50%	355	$19	$202,065
Cont. Corn	Ditch Buffer	12	1	1	1	2	2	8	70%	55	$550	$0
Corn/Hay	Ditch Buffer	162	16	16	16	32	32	113	70%	476	$550	$0
Hay	Reduced P inputs and Injection	3,708	371	371	371	371	371	1,854	50%	185	$70	$389,340
Pasture	Livestock Exclusion	1,162	29	29	29	29	29	145	13%	334	$50,000 ea.	$72,625
Pasture	Livestock Exclusion and Riparian Buffer (CREP)	1,162	58	58	58	58	58	291	25%	901	N/A	$0
Farmstead	Waste Management Improvements	71 HQ's	2	5	5	2	2	16	23%	160	$200,000	$3,200,000
			3537	3540	3610	3554	2365	16,606				
Total Estimated Reduction										7,727	48% of TMDL Reduction = 7,700	
TMDL Estimated Reduction										16,000	83% of Total Load	
Total Watershed Load										19,248		
Total Cost												$6,985,923

Cost by Year

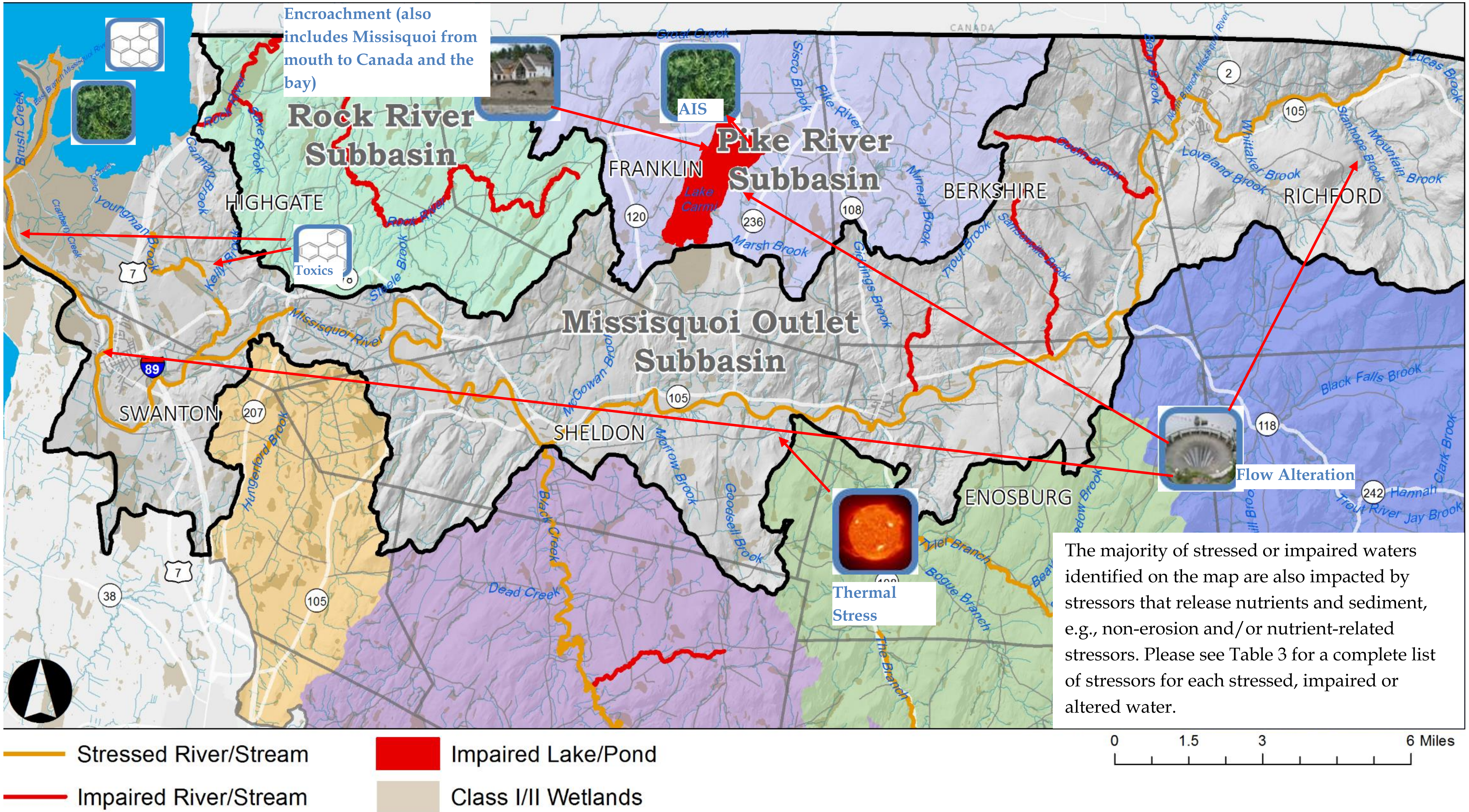
Scenario Components	Selected BMP	2016	2017	2018	2019	2020	Total
Cont. Corn	Cover Crop-Conservation Tillage-Manure Injection	14,760	14,760	14,760	14,760	14,760	73,800
Corn/Hay	Cover Crop-Conservation Tillage-Manure Injection	174,414	174,414	209,297	174,414	174,414	906,953
Cont. corn	Cover Crop	19,750	19,750	19,750	19,750	0	79,000
Corn/Hay	Cover Crop	420,083	420,083	420,083	420,083	0	1,680,330
Cont. Corn	Crop Rotation	3,600	3,600	3,600	3,600	0	14,400
Corn/Hay	Crop Rotation	34,032	34,032	34,032	34,032	34,032	170,160
Cont. Corn	Riparian Buffer	600	600	600	600	600	3,000
Corn/Hay	Riparian Buffer	9,000	9,000	9,000	9,000	9,000	45,000
Corn/Hay	Grassed Waterays	27,000	27,000	27,000	27,000	27,000	135,000
Cont. Corn	Reduced Manure P (Nutrient Management and CAP)	$2,850.00	$2,850.00	$2,850.00	$2,850.00	$2,850.00	14,250
Corn/Hay	Reduced Manure P (Nutrient Management and CAP)	$40,413.00	$40,413.00	$40,413.00	$40,413.00	$40,413.00	202,065
Cont. Corn	Ditch Buffer	0	$0	$0	$0	$0	0
Corn/Hay	Ditch Buffer	0	$0	$0	$0	$0	0
Hay	Reduced P inputs and Injection	$77,868.00	$77,868.00	$77,868.00	$77,868.00	$77,868.00	389,340
Pasture	Livestock Exclusion	14525	14525	14525	14525	14525	72,625
Pasture	Livestock Exclusion and Riparian Buffer (CREP)	0	$0	$0	$0	$0	0
Farmstead	Waste Management Improvements	400,000	1,000,000	1,000,000	400,000	400,000	3,200,000
		1,238,895	1,838,895	1,873,777	1,238,895	795,462	6,985,923
Total Estimated Reduction							
TMDL Estimated Reduction							
Total Watershed Load							
Total Cost							

Pike River - Five Year Project Goals
March 2015

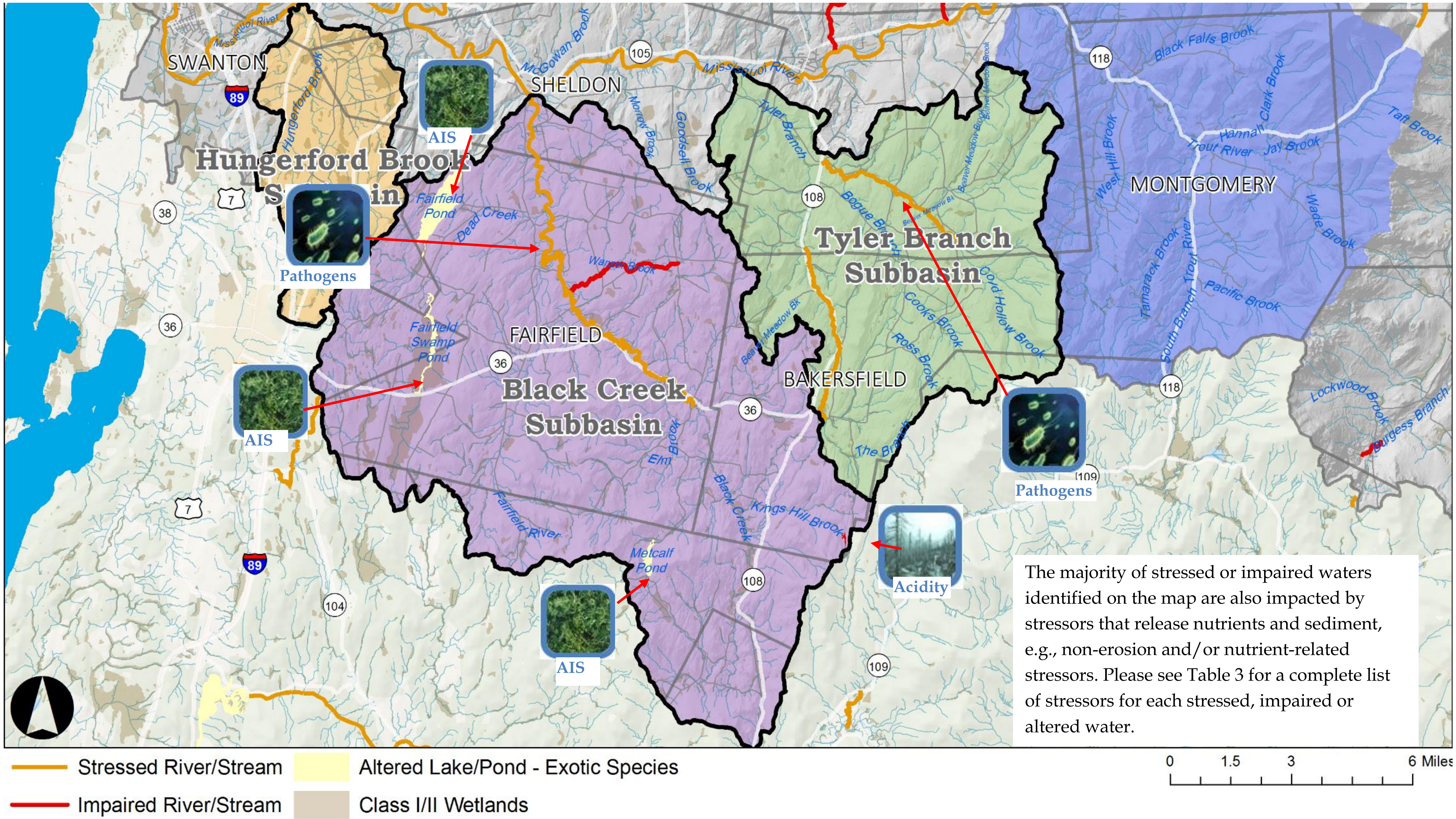
Based on a Watershed Team Phosphorus Reduction Goal of 65% of the Target TMDL Reduction (estimated TMDL Target is 9,600 lbs/yr)

Cropping System	No. of Acres	
Corn in 2014	2,763	
Hay in 2014	3,740	
Pasture in 2014	1,704	
Farmstead in 2014	264	70 HQ's
Cont. Corn*	1,382	* From data estimated 50% of corn in 2014 was continuous corn
Cont. Hay**	1,122	**Assumed 30% of the hay in 2014 was continuous hay
Corn-Hay Rotation***	2,618	*** Acres of corn/hay rotation equals the remainder from above

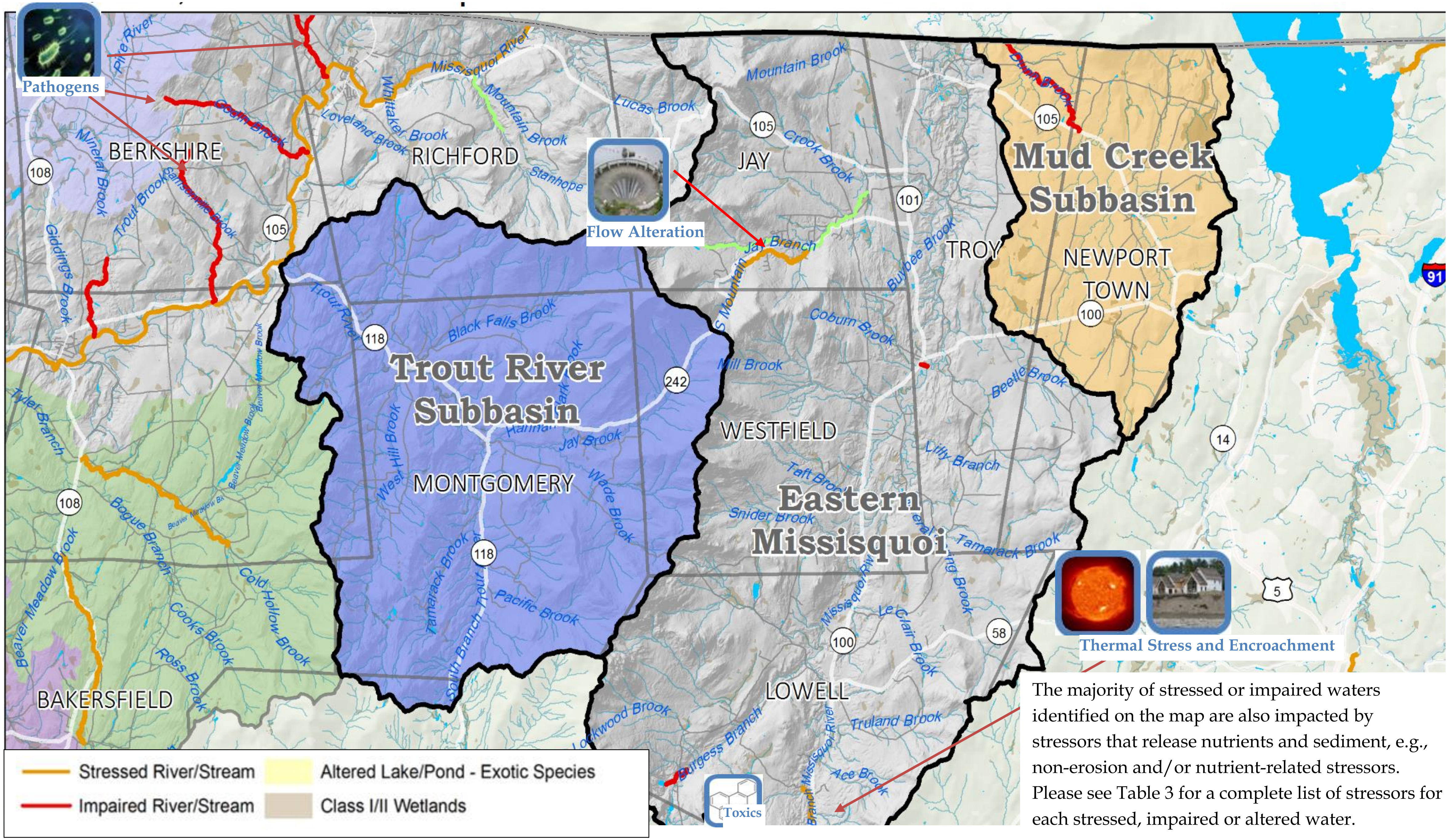
			Acres of Practice by Year and Total										NRCS Cost by Year					
Scenario Components	**Selected BMP**	**No. of Acres Available**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total Practice Acres Applied**	**Percent of Total Acres**	**TP Load Reduction**	**NRCS Practice Cost per Acre**	**Total Cost**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Cont. Corn	Cover Crop-Conservation Tillage-	1,382	110	110	110	110	110	550	40%	462	$164	$270,600	54,120	54,120	54,120	54,120	54,120	270,600
Corn/Hay	Cover Crop-Conservation Tillage-	2,618	160	160	160	150	150	780	30%	554	$164	$383,760.00	78,720	78,720	78,720	73,800	73,800	383,760
Cont. corn	Cover Crop	1,382	110	110	110	110	110	550	40%	303	$79	$217,250	43,450	43,450	43,450	43,450	43,450	217,250
Corn/Hay	Cover Crop	2,618	300	300	300	300	100	1,300	50%	585	$79	$513,500	118,500	118,500	118,500	118,500	39,500	513,500
Cont. Corn	Crop Rotation	1,382	120	120	110	100	100	550	40%	264	$16	$26,400	5,760	5,760	5,280	4,800	4,800	26,400
Corn/Hay	Crop Rotation	2,618	210	210	210	210	200	1,040	40%	374	$16	$49,920	10,080	10,080	10,080	10,080	9,600	49,920
Cont. Corn	Riparian Buffer	64	5	5	6	8	8	32	50%	125	$750	$24,000	3,750	3,750	4,500	6,000	6,000	24,000
Corn/Hay	Riparian Buffer	136	10	14	14	15	15	68	50%	221	$750	$51,000	7,500	10,500	10,500	11,250	11,250	51,000
Cont. Corn and Corn/Hay	Grassed Waterays	40	3	3	3	3	3	15	38%	72	$5,000	$75,000	15,000	15,000	15,000	15,000	15,000	75,000
Cont. Corn	Reduced Manure P (Nutrient Management	1,382	160	160	170	170	170	830	60%	141	$19	$47,310	$9,120.00	$9,120.00	$9,690.00	$9,690.00	$9,690.00	47,310
Corn/Hay	(Nutrient Management and CAP)	2,168	250	260	260	260	260	1,290	60%	129	$19	$73,530	$14,250.00	$14,820.00	$14,820.00	$14,820.00	$14,820.00	73,530
Cont. Corn	Ditch Buffer	3	0	0	0	0	0	2	50%	10	$550	$0	0	$0	$0	$0	$0	0
Corn/Hay	Ditch Buffer	24	2	2	2	2	2	12	50%	50	$550	$0	0	$0	$0	$0	$0	0
Hay	Reduced P inputs and Injection	3,740	300	300	300	300	300	1,500	40%	150	$70	$315,000	$63,000.00	$63,000.00	$63,000.00	$63,000.00	$63,000.00	315,000
Pasture	Livestock Exclusion	1,704	50	60	75	75	75	335	20%	771	$50,000 ea.	$167,500	25000	30000	37500	37500	37500	167,500
Pasture	Livestock Exclusion and Riparian Buffer (CREP)	1,704	50	50	50	50	55	255	15%	791	N/A	$0	0	$0	$0	$0	$0	0
Farmstead	Waste Management Improvements	70 HQ's	0	5	5	5	5	20	29%	200	$200,000	$4,000,000	0	1,000,000	1,000,000	1,000,000	1,000,000	4,000,000
			1841	1870	1886	1869	1664	9,129					448,250	1,456,820	1,465,160	1,462,010	1,382,530	6,214,770
Estimated Reduction										**5,201**	65% of Target Load = 5,200							
TMDL Target										**7,967**	**83% of Total Load**							
Total Load										**9,600**								
Total Cost												**$6,214,770**						



MAP A - Rock and Pike River watersheds



MAP B - Hungerford, Black and Tyler Watersheds



MAP C - Trout, Upper Missisquoi and Mud Creek watersheds

List of Acronyms

319 -Federal Clean Water Act, Section 319
604(b) -Federal Clean Water Act, Section 604b
A(1) – Vermont Class A(1) water
A(2) – Vermont Class A(2) water
AAP -Accepted Agricultural Practice
ANR -Vermont Agency of Natural Resources
AMP -Acceptable Management Practice
AIS -Aquatic invasive species
AOP -Aquatic Organism Passage
BBR -Better Backroads grant
BMP -Best Management Practice
CWSRF -Clean Water State Revolving Fund
CREP -Conservation Reserve Enhancement Program
CWA-Federal Clean Water Act
CWI – Clean Water Initiative
DEC - Vermont Department of Environmental Conservation
DFPR -Vermont Department of Forests, Parks and Recreation
DWSRF -Drinking Water State Revolving Fund
ERP – Ecosystem Restoration Program grant
EQIP -Environmental Quality Incentive Program
EU -Existing Use
FEH -Fluvial Erosion Hazard
FERC -Federal Energy Regulatory Commission
FSA -Farm Service Agency (USDA)
FWD Vermont Fish and Wildlife Department
GSI- Green Stormwater Infrastructure
IDDE – Illicit Discharge Detection and Elimination
LID -Low Impact Development
MAPP -Monitoring, Assessment and Planning Program
NPDES -National Pollution Discharge Elimination System
NPS -Non-point source pollution
NRCD -Natural Resource Conservation District
NRCS -Natural Resources Conservation Service
ORW -Outstanding Resource Water
PDM -Pre-Disaster Mitigation
RAP – Required Agricultural Practices
RCP -River Corridor Plan
RCPP – NRCS Regional Conservation Partnership Program
RMP -River Management Program
RPC -Regional Planning Commission
SGA -Stream Geomorphic Assessment
TBP – Tactical Basin Plan
TMDL -Total Maximum Daily Load
USDA -United States Department of Agriculture
USEPA -United States Environmental Protection Agency
USFWS -United States Fish and Wildlife Service
UVM -University of Vermont
VAAFM -Vermont Agency of Agriculture, Food and Markets
VTrans -Vermont Agency of Transportation
VDH -Vermont Department of Health
VGS Vermont Geological Survey
VIP -Vermont Invasive Patrollers
VLCT -Vermont League of Cities and Towns
VLT -Vermont Land Trust

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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.

Acceptable Management Practices (AMP) - methods of silvicultural activity generally approved by regulatory authorities and practitioners as acceptable and common to that type of operation. AMPs may not be the best methods, but are acceptable.

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.

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.

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

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.

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).

Missisquoi Bay Basin Plan Appendices

Appendix A – Partners

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

Group Name	Association	Description
Regional Planning Commissions (RPC): Northwest (NRPC); Lamoille (LCPC); Northeastern Vermont Development Association (NVDA);	Regional	Statutory partners to the basin planning process, and 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. As part of the implementation of Act 64 (Sec. 43), DEC has contracted with RPCs to fulfill the specific roles and responsibilities around the development of tactical basin plans that should substantially enhance DEC's ability to reach municipalities and other relevant stakeholders. Further, the contracted activities are developing augmented capacity in RPCs to support water quality protection and restoration.
Natural Resource Conservation Districts (NRCD): Franklin County (FNRCD); Orleans County (ONRCD).		Statutory partners to the basin planning process, playing a critical role in implementing actions identified in basin plans. They also partners with Regional Planning Commissions on stormwater master planning, river corridor assessments, and road erosion assessments. NRCDs also work with the agricultural community to identify and assess natural resource concerns and implement farm BMPs to protect water quality.
Franklin Watershed Committee (http://www.franklinwatershedvt.org/index.php)	Non-profit	A community group focused on reducing phosphorus loads into the Pike (Lake Carmi) and Rock River watershed. The group works with farmers, campers, and other watershed land owners to carry out projects that improve the land's natural ability to utilize phosphorus and reduce the effect of erosion on land in the watershed. These projects range from efforts to improve septic systems on lakeshore properties, to cover crop incentive programs, to culvert and ditch repair
Friends of Northern Lake Champlain (http://www.northernlakechamplain.org/)	Local non-profit	An Organization dedicated to the rehabilitation and protection of northern Lake Champlain and all of the waters that flow into it. The organization works collaboratively with local communities, farmers, government, lake associations, regional planning, and policy developers to reduce polluted land use runoff
Lake Carmi Campers Association (http://lakecarmi.mylaketown.com/)	Local non-profit	An association dedicated to conserving our unique natural resources, improving and enhancing the quality of life and the environment, for all Lake Carmi residents and visitors. In cooperation with local and state authorities, the association shall provide educational, cultural and recreational activities, as well as, water quality management and safety education initiatives. Further, the association will provide a medium through which information and educational programs and materials may

Group Name	Association	Description
		be distributed throughout the community
Lake Champlain Committee	Local non-profit	Abi-state organization that is solely dedicated to protecting Lake Champlain's health and accessibility. The committee uses science-based advocacy, education, and collaborative action to protect and restore water quality, safeguard natural habitats and ensure recreational access. The program is also the home organization for the Lake Champlain Paddlers' Trail, providing a safe, recreational corridor for human-powered craft on the lake. The Lake Champlain Committee also leads citizen- based efforts to conduct blue-green algal surveillance and reporting for Lake Champlain and adjacent waterbodies. These efforts are coordinated with ANR and the VT Department of Health
Lake Champlain Basin Program	Non-profit	a congressionally designated initiative to restore and protect Lake Champlain and its surrounding watershed. The program works with partners in New York, Vermont, and Québec to coordinate and fund efforts to address challenges in the areas of phosphorus pollution, toxic substances, biodiversity, aquatic invasive species, and climate change. The LCBP also administers the Champlain Valley National Heritage Partnership, which builds appreciation and improves stewardship of the region's rich cultural resources by interpreting and promoting its history
Lake Champlain International (LCI)	Non-profit	Actively involved in shaping the future of Lake Champlain's water and fisheries health for the well-being of the people who depend on it today and tomorrow. To protect, restore, and revitalize Lake Champlain and its communities, LCI educates, advocates, and motivates to ensure that Lake Champlain is swimmable, drinkable, and fishable, understanding that healthy water resources are essential for a healthy economy and a healthy community
Lake Champlain Sea Grant	University	develops and supports research, outreach and education programs to empower communities, businesses and other stakeholders in the Lake Champlain Basin to make informed decisions regarding the management, conservation, utilization and restoration of their aquatic resources for long-term environmental health and sustainable economic development
Missisquoi River Basin Association (https://mrbavt.com/about-us/)	Non-profit	Dedicated to the restoration of the Missisquoi River, its tributaries, and the Missisquoi Bay, bringing together diverse interest groups within the community – teachers, farmers, summer residents, loggers, business owners, environmental experts, outdoor enthusiasts, municipal officers, woodland owners, and concerned citizens. Activities range from education and community outreach to tree planting and fieldwork. We work with landowners on stabilizing stream banks, we cost-share

Group Name	Association	Description
		with farmers to implement conservation practices, and we manage a volunteer-led water-sampling program to monitor phosphorus, nitrogen, and turbidity throughout the watershed.
Vermont Youth Conservation Corps (VYCC)	Statewide non-profit	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.
Better Roads (BR)	State	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)	Federal	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.
The Upper Missisquoi and Trout Rivers Wild and Scenic Committee (http://www.vtwsr.org/)	Non-profit	The committee was formed after the federal designation of the Upper MIssisquoi and Trout Rivers as a Partnership Wild and Scenic River to develop and implement a management plan. The goal of this Partner approach is to maintain local governance and control of the rivers and their valleys. The Management Plan presents a series of recommendations that can be voluntarily implemented by area residents, riverfront landowners, local municipalities, and partnership state and federal agencies to help protect these river-related resources and maintain the quality and way of life valued by so many people.
Watershed Municipalities	Municipal	Nine Vermont towns completely in the watershed: Highgate, Franklin, Berkshire, Richford, Jay, Troy, Sheldon, Enosburgh, and Westfield. Fourteen towns partially in the watershed: Newport, Lowell, Coventry, Irasburg, Lowell, Eden, Montgomery, Bakersfield, Fletcher, Cambridge, Fairfax, Fairfield, St. Albans, wanton. 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 Resources (ANR) Internal Partners: Fish and Wildlife (VFWD); Forests, Parks and Recreation (VFPR); Environmental Conservation (VDEC)	State	All Departments within ANR (Fish & Wildlife Department, Forest, Parks, and Recreation, and DEC) and Divisions within them, work collaboratively on a number of watershed assessment, 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

Group Name	Association	Description
		staff from FWD, FPR, and DEC. Long Range Management Plans of state-owned properties include restoration and protection of water resources.
The Vermont Lake Wise Program (LWP)	State	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
The Missisquoi National Wildlife Refuge	Government	The Missisquoi National Wildlife Refuge was established in 1943 to provide habitat for migratory birds. It consists of 6,729 acres, mostly wetland habitats, which support a variety of migratory birds and other wildlife. The 900 acre Maquam bog is designated as a Research Natural Area and the refuge was designated as an Important Bird Area in partnership with the Audubon Society. The Refuge in partnership with other publicly owned (State of Vermont) lands has been designated a Wetland of International Importance under the Ramsar Convention.
Northern Forest Canoe Trail (http://www.northernforestcanoetrail.org/)	Non-profit	the Northern Forest Canoe Trail (NFCT) is a 740-mile inland paddling trail tracing historic travel routes across New York, Vermont, Québec, New Hampshire, and Maine. The mission is to connect people to the Trail's natural environment, human heritage, and contemporary communities by stewarding, promoting, and providing access to canoe and kayak experiences along this route. NFCT delivers its mission and strategic goals through 3 program areas: Waterway Stewardship, Community Economic Development, and People and Place.

Appendix B - Modeling Tools and Assessments for Identifying Remediation and Protection Efforts

Tool	*Description and Use*	*User*	*Info available in following format*	*Use/ BMP*[25]
SWAT model	Model used to estimate phosphorus (P) loading in the Lake Champlain watershed. Discrete SWAT models were calibrated/validated for each HUC8 watershed and direct drainage. P estimates based on land use, soil type, slope, climate, and other variables. Used in development of the TMDL.	ANR, NRCS	Tables, figures, maps	Prioritize areas of high P loading; identify potential BMPs at watershed scale.
HUC12 Tool	Summary of SWAT P estimates by general land use sector. Reported at HUC12 (sub-basin) scale for each lake segment basin.	ANR	Tables, figures	Compare loading estimates across land use sectors at HUC12 scale.
EPA Scenario Tool	Used to evaluate scenarios for P reduction in the Lake Champlain watershed based on SWAT estimates of P loading and BMP efficiencies. Identifies potential load reductions based on the type and coverage of specified BMPs.	ANR – (LC P TMDL[26])	Tables, figures, maps	Evaluate impact of various BMP implementation scenarios.
Clean Water Roadmap Tool (in development)	A partnership between VT DEC, Keurig-Green Mountain Coffee Roasters, the Nature Conservancy (TNC), and other stakeholders. The overall goal 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 DEC's Tactical Basin Plan implementation tables and tracking systems. The CWR can be used to	by regional planners, the public, and DEC staff	A map-based application that allows users to click on a specified watershed and receive a summary report of relevant best	The CWR will provide a description of one way the Lake Champlain TMDL phosphorus reductions can be achieved, largely based on EPA's reasonable assurance scenario.

[25] Best Management Practice
[26] Lake Champlain Phosphorus TMDL

	identify priority areas and actions for Lake Champlain phosphorus reductions.		management practices (BMPs)	
ANR tracking Tool	Tracks project implementation: calculates P loading reductions for implemented BMPs. Can provide P reduction estimates for BMPs not included in SWAT.	ANR (LC P TMDL)	Report	Track implemented BMP reductions relative to TMDL goals.
Prioritizing agricultural fields for BMP	Process that uses SWAT and associated tools to develop a list of priority P loading sectors at NHD+ catchment (sub-HUC12) scale. Identify potential BMPs and/or other management actions.	case managers; NRCS, NRCD; UVM extension	Maps	Identify priority areas and potential BMP implementation.
Prioritizing Riparian Buffer Enhancement	Combines NRCS estimates of buffer gaps with stream and watershed characterstics to prioritize riparian planting efforts.	NRCS, Partners that plant trees,	NRCS has developed for Rock and Pike River. Develop for other priority basins based on partner interest and data availability	Identify areas for riparian plantings
Field gully identification	Model framework that uses high-resolution elevation data to predict gully locations. Predicted gullies can be checked against aerial imagery and/or land use data to identify locations in agricultural lands. Under RAPs/AAPs, farmers are responsible for addressing field gullies. Restorations of edge of field gullies may also be eligible for funding.	AAFM, case managers, NRCS	Maps	Develop for priority areas. Dependent on availability of LiDAR.

Floodplain restoration	Projects are identified using stream geomorphic assessment data as well as site visits to confirm conditions. Priority sites include high incision rate in stream channel, but small watersheds to limit amount of land needed to restore flood plain, which would be more amendable to agricultural landowners.	ANR	Develop for priority areas where hydrology significantly altered by ditching/tile drains; dependent on landowner interest	Flood plain restoration; two-tiered ditch
Wetland restoration	In 2007, Agency of Natural Resources (ANR) released the Lake Champlain Wetland Restoration Plan, which identified opportunities to restore wetlands and the benefits they provide. The plan identified approximately 16,000 acres of potential wetland restoration sites in the Missisquoi Watershed based on their ability to reduce phosphorus loading to Lake Champlain. These sites are now being targeted by the NRCS Wetland Reserve Program. In 2016, DEC will create site profiles for high ranking wetland restoration sites in the Missisquoi. In addition, The Nature Conservancy will also provide resources for ecological restoration, including wetlands.	ANR, NRCS, USFWS	Maps	Wetland restoration

Road Erosion Risk Layer	A data layer on the ANR atlas which identifies road segments by erosion risk to surface waters as well as potential hydrologic connectivity. Road projects may be further prioritized by finding documented points of stormwater input to rivers using Stream Geomorphic Assessments. High priority road remediation sites will likely include hydrologically connected segments on steep slopes, where significant road-related erosion is present, and/or where road BMPs are currently lacking or insufficient.	ANR, municipalities, Vtrans	Data layer on ANR Atlas; list of priority road segments	Road BMPs include: grass and stone-lined drainage ditches, the installation of properly sized drainage culverts, culvert header and outlet stabilization, road crowning, regular catch basin clean outs and street sweeping, and addressing erosion from municipal sand piles. The Interim Guidance for completing municipal road erosion inventories and capital budgets 2016-2018 (June 2, 2016, DEC Municipal Roads Program) outlines the steps for developing the list of priority road segments for remediation.
Culvert replacement and prioritization	Prioritization of muncipal culvert replacement using VTrans culvert database. Criteria include structural integrity, conformance with geomorphology, and aquatic organism passage. The NRPC and NVDA both assist towns with prioritizing as well as financial budgeting through use of a capital budget. The VTrans culvert database will be provided to towns as a resource (see Appendix C)	Municipalities with help from RPC	List of culverts by town; prioritization based on aquatic organism passage	VTrans culvert database will be provided to towns as a planning resource.

Appendix C - Assessed Missisquoi Bay Watershed Culverts mostly to completely incompatible with stream geomorphology

Incompatibily rating with geomorphology of named stream : 0-5 Completely and 5-10 mostly. Aquatic Organism passage for these streams are rated impassable. (VANR stream database 2013)

Town	River	Road	Geomorphic Compatability Score	Latitude	Longitude
BAKERSFIELD		JORDAN RD	9	44.73739	-72.82632
BAKERSFIELD	Branch, The	PUDVAH HILL RD	9	44.82477	-72.8043
BAKERSFIELD		ROUTE 108 S	9	44.76822	-72.81278
BAKERSFIELD		BASSWOOD HILL RD	10	44.78044	-72.77363
BAKERSFIELD		BUTTERNUT HOLLOW RD	10	44.83506	-72.75319
BAKERSFIELD		EGYPT RD	10	44.79796	-72.8186
BAKERSFIELD		EGYPT RD	10	44.80122	-72.81986
BERKSHIRE		AYERS HILL RD	4	45.00957	-72.74301
BERKSHIRE		LOST NATION RD	6	45.00533	-72.72881
BERKSHIRE		ROUTE 105 E BERKSHIRE	7	44.9684	-72.68933
BERKSHIRE		BERRY RD	7	45.01124	-72.7173
BERKSHIRE		NORTH RD	8	45.00217	-72.77293
BERKSHIRE		MARVIN RD	9	44.98728	-72.69484
BERKSHIRE		MARVIN RD	10	44.98539	-72.69555
BERKSHIRE		RICHFORD RD	10	44.9819	-72.72237
BERKSHIRE		ROUTE 105 E BERKSHIRE	10	44.96252	-72.69225
CAMBRIDGE		POND RD	8	44.69945	-72.85854
CAMBRIDGE		KINSLEY RD	9	44.69709	-72.85656
CAMBRIDGE		ROUTE 108 N	9	44.69228	-72.82711
ENOSBURGH		BUTTERNUT HOLLOW RD	8	44.8426	-72.75491
ENOSBURGH		DAVIS RD	8	44.90781	-72.77602
ENOSBURGH	Missisquoi River	SAMPSONVILLE RD	9	44.92115	-72.74254
ENOSBURGH		ENOSBURGH MOUNTAIN RD	9	44.84465	-72.67825
Enosburgh	Unnamed trib of Tyler Branch	BOSTON POST RD	10	44.86587	-72.75716
ENOSBURGH		HOPKINS BRIDGE RD	10	44.92078	-72.67242
ENOSBURGH	Missisquoi River	SAMPSONVILLE RD	10	44.92131	-72.74252
FAIRFIELD		CHESTER A ARTHUR RD	9	44.83621	-72.88047
FAIRFIELD		PARADEE RD	10	44.84948	-72.92531
FAIRFIELD		CHESTER A ARTHUR RD	10	44.83657	-72.86716
FAIRFIELD		CHESTER A ARTHUR RD	10	44.83636	-72.86531
Fairfield	unnamed (dead creek)	SWAMP RD	10	44.78787	-73.01301
Fairfield	unnamed (Black Creek)	JOHNNY BULL HILL	10	44.80521	-72.91122
FAIRFIELD		BUCK HOLLOW RD	10	44.75987	-72.96986

Town	River	Road	Geomorphic Compatability Score	Latitude	Longitude
FAIRFIELD		WEST ST	10	44.76099	-73.00471
FAIRFIELD		ROUTE 36	10	44.78802	-73.01314
Fletcher	unnamed (Fairfield River)	FAIRFIELD RD	7	44.75049	-72.95629
FLETCHER		POND RD	10	44.72098	-72.88059
FLETCHER		TAYLOR RD	10	44.73633	-72.88393
FRANKLIN		STATE PARK RD	6	44.96554	-72.85582
FRANKLIN		STATE PARK RD	6	44.9602	-72.8585
FRANKLIN	Marsh Brook	STATE PARK RD	7	44.95419	-72.862
FRANKLIN		SANDY BAY RD	8	44.97755	-72.88499
FRANKLIN		STATE PARK RD	8	44.97954	-72.84411
FRANKLIN		STATE PARK RD	9	44.96791	-72.85459
Franklin	Rock River	TH 37	10	44.97348	-72.93066
FRANKLIN		STATE PARK RD	10	44.9418	-72.86234
HIGHGATE		BALLARD RD	4	44.9977	-73.06182
HIGHGATE	Kelly Brook	CAMPAGNA RD	7	44.95335	-73.07233
HIGHGATE		ROLLO RD	7	44.98447	-73.05483
HIGHGATE		CARTER HILL RD	7	44.94644	-73.07465
HIGHGATE	Kelly Brook	CARTER HILL RD	8	44.94804	-73.07697
HIGHGATE	Youngman Brook	CARTER HILL RD	9	44.94866	-73.08445
HIGHGATE		RHEAUME RD	9	45.00613	-73.07706
HIGHGATE		ROLLO RD	9	45.00706	-73.03951
HIGHGATE		ROUTE 7	9	44.93496	-73.11871
HIGHGATE		MOREY RD	10	44.92071	-73.01634
HIGHGATE		ROLLO RD	10	44.99453	-73.03083
JAY	Mountain Brook	JOURNEYS END RD	4	44.99887	-72.44938
JAY		N JAY RD	7	44.98043	-72.44933
JAY		SHALLOWBROOK RD	7	44.93228	-72.47769
JAY		ROUTE 105	7	44.96564	-72.43479
JAY	Crook Brook	ROUTE 105	9	44.97287	-72.45607
JAY		PARTRIDGE HOLLOW RD	9	44.9791	-72.44646
JAY		ROUTE 242	9	44.92742	-72.50169
JAY		ROUTE 242	9	44.93565	-72.49072
JAY		ROUTE 105	10	44.97115	-72.52235
JAY		ROUTE 242	10	44.9287	-72.50143
JAY		SHALLOWBROOK RD	10	44.93291	-72.47684
JAY		STEVENS MILL RD	10	44.96413	-72.46953
JAY	Crook Brook	CROSS RD	10	44.96573	-72.44762
LOWELL		MINES RD	3	44.77261	-72.51894
LOWELL		ROUTE 100	5	44.76478	-72.45711
LOWELL		CARTER RD	7	44.80898	-72.4397
Lowell	Unnamed-2 to	ROUTE 100	9	44.75661	-72.4562

Town	River	Road	Geomorphic Compatability Score	Latitude	Longitude
	Missisquoi-R47				
LOWELL		VALLEY RD	9	44.80096	-72.4673
LOWELL		IRISH HILL RD	9	44.79177	-72.40588
LOWELL	Le Clair Brook	CARTER RD	9	44.82195	-72.41386
Lowell	Unnamed-3 to Missisquoi-R45	Private Road #2	10	44.77796	-72.45094
LOWELL		MINES RD	10	44.77895	-72.51786
LOWELL		PAGE RD	10	44.76644	-72.46947
Montgomery	South Branch Trout River, Unnamed trib to	ROUTE 118	4	44.82291	-72.61021
MONTGOMERY		S MAIN ST	5	44.8241	-72.60986
Montgomery	South Branch Trout River, Unnamed trib to	ROUTE 118	6	44.83809	-72.609
MONTGOMERY	Trout	AMIDON RD	7	44.87807	-72.5631
MONTGOMERY	Trout	MOUNTAIN RD	8	44.88411	-72.54171
Montgomery	Wade Brook	ROUTE 58	8	44.85187	-72.5498
MONTGOMERY	Trout	S MAIN ST	8	44.86568	-72.61028
MONTGOMERY		W HILL RD	8	44.83711	-72.65311
Montgomery	Wade Brook	ROUTE 58	9	44.86551	-72.57118
MONTGOMERY		RUSHFORD VALLEY RD	9	44.83328	-72.59511
MONTGOMERY		S MAIN ST	9	44.84613	-72.61041
MONTGOMERY		S MAIN ST	9	44.82087	-72.61183
MONTGOMERY		HILL WEST RD	9	44.85602	-72.64904
MONTGOMERY		N HILL RD	9	44.90914	-72.59238
MONTGOMERY		BLACK FALLS RD	9	44.92029	-72.59005
MONTGOMERY	Trout	S MAIN ST	10	44.8671	-72.61028
NEWPORT TOWN		ROUTE 105	6	44.93697	-72.29269
NEWPORT TOWN		BONIN RD	7	44.87145	-72.34341
NEWPORT TOWN	Dunn Brook	NILES RD	8	44.92196	-72.3033
NEWPORT TOWN	Dunn Brook	POGINY HILL RD	9	44.90685	-72.30904
NEWPORT TOWN		NUMBER 12 RD	9	44.95195	-72.33336
NEWPORT TOWN		BONIN RD	10	44.86891	-72.34631
NEWPORT TOWN		LEADVILLE RD	10	44.98639	-72.26791
RICHFORD		CORLISS RD	6	45.0012	-72.64033
RICHFORD		S RICHFORD RD	7	44.93556	-72.64545
RICHFORD		GUILMETTE RD	8	44.96028	-72.66872
RICHFORD		CORLISS RD	8	45.00219	-72.60604
RICHFORD		GLENN SUTTON RD	9	44.99747	-72.61016
RICHFORD		S RICHFORD RD	10	44.92858	-72.64738

Town	River	Road	Geomorphic Compatability Score	Latitude	Longitude
RICHFORD		S RICHFORD RD	10	44.92483	-72.64782
RICHFORD		S RICHFORD RD	10	44.92253	-72.6477
RICHFORD	Loveland Brook	ST ALBANS RD	10	44.98238	-72.68453
SHELDON		ST PIERRE RD	6	44.86295	-72.84024
SHELDON		RICE HILL RD	9	44.92191	-72.95179
SHELDON		CENTRAL ST	9	44.87521	-72.93494
SHELDON		E SHELDON RD	10	44.89193	-72.92889
SHELDON		SWEET HOLLOW RD	10	44.89562	-72.98879
SHELDON		SWEET HOLLOW RD	10	44.89556	-72.98848
SHELDON		SHAWVILLE RD	10	44.91615	-72.96585
SHELDON		ROUTE 105	10	44.90257	-72.99484
ST. ALBANS TOWN		FISHER POND RD	10	44.81743	-73.05959
SWANTON		WOODS HILL RD	6	44.89663	-73.08549
SWANTON		RUSSELL RD	9	44.88297	-73.03333
SWANTON		POND RD	9	44.85659	-73.02969
SWANTON		POND RD	10	44.85735	-73.01395
Town	Stream Name	Other Road Name	Geomorphic Compatability Score	Latitude	Longitude
TROY	Jay Branch	ROUTE 101	6	44.96279	-72.41405
TROY		ROUTE 105 E	7	44.98648	-72.36311
Troy	Tributary to Jay Branch	VIELLEUX RD	9	44.9605	-72.4028
TROY	Missisquoi River	RIVER RD	10	44.97718	-72.38678
Troy	Jay Branch	ROUTE 101	10	44.96282	-72.41368
TROY		ROUTE 243	10	45.00272	-72.41326
Westfield	Jay Brook, Unnamed trib to	ROUTE 242	6	44.90015	-72.51726
Westfield	Jay Brook, Unnamed trib to	ROUTE 242	8	44.89236	-72.52682
WESTFIELD	Trout	ROUTE 242	8	44.89723	-72.51965
WESTFIELD		BALANCE ROCK RD	9	44.86573	-72.45143
WESTFIELD		ROUTE 58	10	44.84021	-72.51741
WESTFIELD	Trout	BIRCH RD	10	44.8938	-72.52761
WESTFIELD	Trout	PARK DR	10	44.89271	-72.5307

Culvert replacement incurs a substantial cost for a town or the state, yet the replacement with suitable sizes helps with supporting the stream geomorphic stability and fish passage to additional habitat (the aquatic organism passage). The additional functions that the culvert provides can be useful in finding grants that are based on improving the health of the river or fisheries. The chart can be used by towns to help prioritize culvert replacements, suitable replacement size as well as appropriate funding sources. The RPC transportation planner often works with the towns and may be able to use the chart during their discussions. See the Stream Geomorphic Assessment Data Management System for additional culvert and bridge informational that may be helpful.

Appendix D –Status of flood resilience and water quality protection at municipal level

Program	Status	Jay	Troy	Westfield	Lowell	Newport T.	Richford	Montgomery (T/V)	Berkshire	Enosburgh (T/V)	Bakersfield	Fletcher	Fairfax	Fairfield	Sheldon	Franklin	Highgate	Swanton (T/V)	St. Albans Town
National Flood Insurance Program (NFIP)	Enrolled?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Road and Bridge Standards	Adopted?	Y	Y	Y	Y	Y	N	Y	Y	Y (Town) and N(Village)	Y	Y	Y	Y	Y	N	Y	Y (Town & Village)	Y
Emergency Operations Plan (LEOP)	Completed?	Y	Y	N	Y	N	Y	N	Y	N (Town & Village)	N	N	Y	Y	N	Y	Y	N (Town & Village)	Y
Hazard Mitigation Plan (LHMP)	Adopted?	N	N	N	N IN PROCESS	N	N	N	N	Y (Town) and N(Village)	N	N	Y	Y	N	N	Y	N (Town & Village)	Y
River Corridor Protection	Adopted?	N	N	N	N	N	N	Y	N	N (Town & Village)	Y	N	N	N	N	N	N	N (Town & Village)	N
ERAF	Percent	7.5	7.5	**7.5**	**7.5**	**7.5**	7.5	7.5	7.5	7.5	7.5	7.5	12.5	12.5	7.5	7.5	12.5	7.5	12.5
Flood Hazard By-law	Adopted?	Y	Y	Y	Y	Y	Y	Y	Y	Y/Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Comment							Town and Village since bylaw		**Village:** Bylaws are currently being revised; Town and Village bylaws separate - both have adopted		Town updating bylaws, current proposal is to increase protection to 1 foot above BFE						Single bylaw for both the village and town	
Flood Resiliency in Town Plan	Completed?	Y	N	N	Y	Y	N	Y	Y	Y	Y	N	N	Y	Starting adoption	N	Y	Y	N

Program	Status	Jay	Troy	Westfield	Lowell	Newport T.	Richford	Montgomery (T/V)	Berkshire	Enosburgh (T/V)	Bakersfield	Fletcher	Fairfax	Fairfield	Sheldon	Franklin	Highgate	Swanton (T/V)	St. Albans Town
Flood Resiliency in Town Plan cont.	Comment						Town Plan expires in 2018, RPC will plan to assist town with this requirement	Town Plan Adopted in 2016 and Ch.15 is the flood resiliency section	Town Plan adopted in 2015 and includes a section on promoting hazard resilient measures, which focuses on the Flood Hazard Bylaw & includes strategies to reduce flood damage	Unified municipal plan between the Town & Village. In the Town Plan, Ch.9 is titled Planning for Hazard Resiliency, which includes a flood resiliency section	Bakersfield Town Plan adopted in 2015 contains a flood resiliency section in Ch.8 Natural Resources	Town Plan expires in 2018, RPC will plan to assist town with this requirement	Town Plan expires in 2018, RPC will plan to assist town with this requirement	A flood resiliency section is included in the Town Plan that was adopted in 2015	Sheldon Town Plan is currently being revised with the help of NRPC and will contain a flood resiliency section	Town Plan expires in 2017 and the RPC plans to assist the town with this requirement	A whole flood resiliency section is avaialble under the "Hazards" section of the town plan, which was adopted in 2015	The 2015 update to the town plan (for the Town of Swanton and village) incorporates a flood resiliency section	Town Plan up for renewal in 2018 and the RPC will plan to assist town with this requirement
Road Erosion Inventory	Completed?	N	N	N	N	N	In Process	N	N	V-In Process, T-N	N	N	N	In Process	N	N	In Process	In Process	N
	Year						2016			V-2016				2016			2016	2016	
	Comment						NRPC conducting a Category A Better Roads grant for town.	Town applied for a Better Roads grant in current round.		Village has a Better Roads grant for Cat A inventory. Town applied for a Better Roads grant in current round.				NRPC conducting a Category A Better Roads grant for town. Currently in the process, should have a majority of the hydrologically connected roads inventoried by the end of Summer 2016			NRPC conducting a Category A Better Roads grant for town. Currently in the process, should have a majority of the hydrologically connected roads inventoried by the end of Summer 2016	NRPC conducting a Category A Better Roads grant for town.	
Stormwater Master Plan	Completed?						N	N	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
	Comment									SMP was created for both the				Created on January 23, 2014	Created on January 24, 2014	Created on March 11, 2015	Created on March 1, 2013 for the Town	Created on February 21, 2013	Created on March 25, 2015 for the Town of

Program	Status	Jay	Troy	Westfield	Lowell	Newport T.	Richford	Montgomery (T/V)	Berkshire	Enosburgh (T/V) Town & Village. It was created on March 1, 2013	Bakersfield	Fletcher	Fairfax	Fairfield	Sheldon	Franklin	Highgate & Village	Swanton (T/V)	St. Albans Town St. Albans
IDDE	Completed?											N	Y						
	Year												2014						
	Comment																		
Stormwater Mapping	Completed?											N	Y						
	Comment																		
Municipal By-law for Water Resource Setback	River/Stream	N	N	Y	N	N	N	Y	Y	T-Y, V-N	Y	N	Y	Y	Y	Y	Y	Y	N
	Comment			50'				As a part of the River Corridor Overlay referring to <2 sq mi watersheds "For these small streams the standards in Section 8.5 shall apply to the area measured as fifty (50) feet from the top of the stream bank or slope" (pg. 57)	Bylaws adopted in 2012 states a 100 ft setback for river/streams	**Village:** Bylaws are currently being revised **Town:** States series of buffers based on size of stream	Bylaws state that a stream setback is required from all streams as mapped in the Vermont Hydrography Dataset surface waters 1:5,000	Town is updating bylaws; proposing stream buffer standards	50 foot vegetated buffer; 50 foot setback from all named streams	All structures should be setback at least 25 feet from a stream	The minimum setback for streams is 50 feet	The setback for a stream is a minimum of 50 feet	Seasonal and intermittent streams require a 25 foot buffer. Unnamed rivers and streams require a 50 foot buffer. Missisquoi and Rock River require a 100 foot buffer	All rivers and streams (Class 1 & 2) are required to have a 50 foot buffer. The Missisquoi River requires a 100 foot buffer and the Hungerford Brook requires a 75 foot buffer	
	Wetland	N	N	Y	N	N	N	N	Y	T-Y, V-N	Y	N	N	N	N	N	N	Y	N
	Comment			50'					100 ft setback for wetlands	**Town:** Bylaws have a wetlands overlay district	Development is restricted 200 meters from the highwater line of a wetland							All wetlands (Class 1 & 2) are required to have a 50 foot buffer	

Program Status	Jay	Troy	Westfield	Lowell	Newport T.	Richford	Montgomery (T/V)	Berkshire	Enosburgh (T/V)	Bakersfield	Fletcher	Fairfax	Fairfield	Sheldon	Franklin	Highgate	Swanton (T/V)	St. Albans Town
Lake/Pond	N	N	Y	N	N	N	N	Y	T-Y, V-N	N	Y	N	Y	N	Y	Y	Y	Y
Comment			50'					100 ft setback for lakes and ponds	**Town:** Bylaws have a 50 foot setback on lakes and ponds		Shoreland-Recreation District - all lands within 500 feet of the shorline of Metcalf and Halfmoon Ponds. Development in this district can be subject to a 40 foot setback from shoreline as an undistrubed or managed vegetative buffer.		All structures should be setback at least 25 feet from a pond. For a lake, there is a high water mark setback of at least 150 feet, side/rear setback of 20 feet, and frontage setback of 200 feet		Shoreland Recreation District - all lands within 500 feet of the shoreline of Lake Carmi, Mill Pond, and Bullis Pond. Development in this district can be subject to a 50 foot setback from shoreline as an undistrubed or managed vegetative buffer.	100 foot buffer required for lakes & ponds	Lakes & ponds require a 50 foot buffer	100 foot setback required from highwater mark for lakes

Lake Champlain Funding Sources	Lake Champlain Initiative Priority Initiative of Sec. Vilsack	RCPP National – Lake Champlain – Ag, Forestry, Conservation Easements and Wetlands Restoration	RCPP State – Nutrient Management Planning

Appendix E – USDA NRCS/Vermont State Funding Summary - January, 2015

Summary of agricultural resources available to Basin 6 since January 2015

Additional staff and funds will be available to assist landowners with implementing BMPs, including:

- Landowner assistance with U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) program enrollment
- Cost-share soil and water conservation programs within CSAs (UVM Extension, ERP funds)
- Regional Conservation Partnership Program (RCCP) funds focused on challenged watersheds identified by EPA, NRCS, ANR and other partners. Challenged watersheds in Basin 6 include: the Pike and Rock Rivers
- Additional RCPP funds received by the VT Association of Conservation Districts will provide funding to develop nutrient management plans on small farms in watersheds including Basin 6.
- North Lake Farm Survey initiative-related projects will be developed and implemented with partners including Farmer's Watershed Alliance, Friends of Northern Lake Champlain and the Vermont Association of Conservation Districts.
- Agricultural engineering firms have been placed on retained with the Agency of Agriculture in order to design and implement structural on farm BMPs.
- Additional AAFM and NRCS engineers to help farmers design projects and oversee the private sector engineering work.

Lead Project Partner	Funded through NRCS Programs using typical process in consultation with State Technical Committee	Vermont Agency of Agriculture and Agency of Natural Resources	Vermont Association of Conservation Districts
Total Funds Available	$45 Million over five years -Almost all FA directly to farmers	$16 Million (FA and TA) -Note: 10% of EQIP funds will be targeted to New York	$710,980 - 800,000 (FA and TA)
Time Frame	FY 2015 – 2019	FY 2015 - 2019	FY 2015 - 2018
Programs	EQIP only – ~$8M/year solely for Lake Champlain Basin	EQIP – 1.8M/year (FA) ACEP-ALE – 750,000 - $1M/year (FA) ACEP- WRE – 230,000/year	EQIP – about $175,000/yr
Primary Practices	All water quality practices including waste management, infrastructure, field agronomic practices, forestry, and wetlands	Cropland – All Agronomic Practices, with limited focus on Farmsteads; Feed Management; Forestry – Forest Trails and Landings, Stream Crossings, Skidder Bridges	Collection of Data Needed to Develop Land Treatment and Nutrient Management Plans
Restrictions		***Funds cannot be used for admin or outreach*** Requires substantial match including: VHCB – $840,000/year DEC - $389,500/year (staff, lab, wetlands contractor) AAFM - $1,998,294/year (staff, FAP, BMP $)	
Priority Locations	FY 2015 – basin wide, but with priorities for Missisquoi, St. Albans Bay, and South Lake FY 2016 – basin wide, but will prioritize Rock River, Lake Carmi/Pike River, St. Albans Bay, and Mackenzie Brook.Future will coordinate with DEC Tactical Basin Planning process	Small Farms in the Missisquoi Bay, St. Albans Bay, and South Lake watersheds (both VT and NY); Critical Source Areas will prioritized in those three priority basins Feed Management, forestry and wetlands restoration – basin wide, Land Conservation - Lake Champlain basin	Lake Champlain, with an option to expand beyond the watershed Small farm nutrient management planning in coordination with UVM Extension NMP development class.
Estimated Number of Participants NOTE - RCPP Numbers Subject to Change due to reduced funding	On average – 300 participants/year in the Lake Champlain watershed	Total Estimated Small Farms – 120-140 Forestry – 100 Wetland Restoration – 20-30 Conservation Easements - 35	Small Farms - 40 per year for a total of 160
Priority Resource Concern	Water Quality	Water Quality, Land Conservation	Water Quality

Program	Total Commitment	Annual Allocation directly to farmers
NRCS	$45,000,000	$8-9,000,000
RCPP – State of Vermont – EQIP	$7,170,000	$1,792,500
RCPP – State of Vermont – ACEP-ALE	$3,890,000	$970,000 first year, $730,000 following years
RCPP – State of Vermont – ACEP-WRE	$924,000	$230,000
RCPP – VACD – Nutrient Management Plans	$800,000	Approx. $175,000
VT Agency of Agriculture – BMP funds		$1,400,000
VT Agency of Agriculture – FAP/NMP funds		$569,544
Total		**~$14M/year average**

Acronyms

RCPP – Regional Conservation Partnership Program

NRCS – Natural Resources Conservation Service

EQIP – Environmental Quality Incentives Program - Field practices, barnyard improvement, waste management

ACEP-ALE – Agricultural Conservation Easement Program/Ag land easement

ACEP – WRE – Wetlands Restoration Easements

FA – financial assistance – payments directly to farmers for projects

TA – technical assistance – people to help design, implement projects for farmers

VACD – VT Association of Conservation District

BMP – Best management practices

FAP – Farm Agronomic Practices

NMP – Nutrient Management Plans

Appendix F - Regulatory and Non-Regulatory Programs Applicable to Protecting and Restoring Waters in Vermont

The Vermont Surface Water Management Strategy maintains a roster of regulatory and non-regulatory technical assistance programs.

Regulatory programs may be accessed at:

http://www.vtwaterquality.org/wqd_mgtplan/swms_appA.htm

Non-regulatory programs may be accessed at:

http://www.vtwaterquality.org/wqd_mgtplan/swms_appD.htm

Appendix G – Existing Use Tables

During the Basin 6 planning process, the Agency collected sufficient information to document and determine the presence of existing uses for swimming (contact recreation, fishing and boating on flowing waters. All surface waters used as public drinking water sources were also identified. The Agency presumes that all lakes and ponds in the basin have existing uses of fishing, contact recreation and boating. This simplified assumption is being used because of the well-known and extensive use of these types of waters for these activities based upon their intrinsic qualities and, to avoid the production and presentation of exhaustive lists of all of these waterbodies across Basin 6. 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. This presumption may be rebutted on a case-by-case basis during the Agency's consideration of a permit application, which might be deemed to affect these types of uses.

The following lists are not intended to represent an exhaustive list of all existing uses, but merely an identification of well-known existing uses. Additional existing uses of contact recreation, boating and fishing on/in flowing waters may be identified during the Agency's consideration of a permit application or in the future during subsequent basin planning efforts.

Table 18 Determination of existing uses in Basin 6.

Area or Reach	Waterbody	Town	Use	Info Source/ Comments
Big Falls	Missisquoi River	Troy	Contact Recreation	(1) (2)
Highgate Falls Dam	Missisquoi River	Highgate	Contact Recreation	(1) (2)
Troy Four Corners	Jay Branch	Troy	Contact Recreation	(1) (2)
Hectorville Bridges	Trout River	Montgomery	Contact Recreation	(1) (2)

Hutchins Covered Bridge	Trout River	Montgomery	Contact Recreation	(1) (2)
Montgomery School House	Trout River	Montgomery	Contact Recreation	(1) (2)
Longley Covered Bridge	Trout River	Montgomery	Contact Recreation	(1) (2)
Kidder's	Tyler Branch	Enosburgh	Contact Recreation	(1) (2)
Creamery Covered Bridge	West Hill Brook	Montgomery	Contact Recreation	(1) (2)
Hippy Hole	West Hill Brook	Montgomery	Contact Recreation	(1) (2)
Jay Branch	Jay Brook	Montgomery	Recreational Boating	(11)
Trout River	Trout River	Montgomery	Recreational Boating	(11)
East Richford to Enosburg Falls	Missisquoi River	Richford/Enosburghh	Recreational Boating	(3) (4) (5)
Troy to Big Falls	Missisquoi River	Troy	Recreational Boating	(11)
Enosburg Falls to Highgate Falls	Missisquoi River	Enosburgh/Sheldon/ Highgate	Recreational Boating	(3) (4) (11)
Highgate Falls to Lake Champlain	Missisquoi River	Highgate/Swanton	Recreational Boating	(3) (4) (5) (6)
Upper Missisquoi River	Missisquoi River	Troy	Fishing	(3)
Swanton to Lake Champlain	Missisquoi River	Swanton	Fishing	(3)
Tyler Branch	Tyler Branch	Enosburgh	Fishing	(3)
Riverside Cemetery (Swanton) to below Swanton Dam	Missisquoi River	Highgate/Swanton	Fishing	(7) Special Regulations
Swanton Dam downstream to water treatment plant	Missisquoi River	Highgate/Swanton	Fishing	(7) Special Regulations

Swanton Dam to Highgate Falls Dam	Missisquoi River	Swanton/Highgate	Fishing	(7) Special Regulations
Highgate Falls Dam to top of the Sheldon Springs Dam in Sheldon Springs	Missisquoi River	Highgate/Swanton	Fishing	(7) Special Regulations
Kane Road (TH-3) bridge to Enosburg Falls Dam	Missisquoi River	Sheldon/Enosburgh	Fishing	(7) Special Regulations
Burgess Branch	Burgess Branch	Lowell	Fishing	(8) Stocked
Hazen Notch Brook	Hazen Notch Brook	Lowell	Fishing	(8) Stocked
Jay Branch	Jay Branch	Jay	Fishing	(8) Stocked
Mississquoi River-East Branch	Missisquoi River	Lowell	Fishing	(8) Stocked
Sheldon Rapids between Sheldon Jct and N. Sheldon	Missisquoi River	Sheldon	Fishing	(8) Stocked
Upper Missisquoi River	Missisquoi River	Troy/Westfield	Fishing	(8) Stocked
Bridge on TH-3 (Kane Rd) upstream to confluence with Tyler Branch	Missisquoi River	Enosburgh	Fishing	(8) Stocked
Confluence w/ Tyler Branch upstream to top of the dam in Enosburg Falls	Missisquoi River	Enosburgh	Fishing	(8) Stocked
The Branch		Enosburgh	Fishing	(8) Stocked
Trout River		Berkshire/Montgome	Fishing	(8) Stocked

		ry		
Tyler Branch		Enosburgh	Fishing	(8) Stocked
Stanhope Brook		Richford	Public Water Source	(9)(10) Class A2
Loveland Brook		Richford	Public Water Source	(9)(10)
Old Spring/Upper Reservoir		Troy	Public Water Source	(9)
Fairfield Pond		Swanton	Public Water Source	(9)
Mountain Brook and tributary		North Troy	Public Water Source	(10) Class A2
Coburn Brook Reservoir and Tributaries		North Troy	Public Water Source	(10) Class A2
Unnamed tributary to Trout River		East Berkshire	Public Water Source	(10) Class A2
Hannah Clark Brook		Montgomery Ctr.	Public Water Source	(10) Class A2
Trout Brook and Enosburgh Reservoir		Enosburg Falls	Public Water Source	(10) Class A2
Black Falls Brook		Montgomery Ctr.	Public Water Source	(10) Class A2
(1) VDEC, 2004 (2) Jenkins and Zika, 1985 (3) DeLorme, 1996 (4) AMC, 2002 (5) Jenkins and Zika, 1992 (6) AMC, 1992 (7) VDFW, 2008 (8) VDFW Website (9) VDEC pers. Com (10) VTWRP, 2008, (11) Vermont Paddlers Club				