Vermont Clean Water Initiative 2021 Performance Report

VERMONT

AGENCY OF ADMINISTRATION
AGENCY OF AGRICULTURE, FOOD & MARKETS
AGENCY OF COMMERCE & COMMUNITY DEVELOPMENT
AGENCY OF NATURAL RESOURCES
AGENCY OF TRANSPORTATION

VERMONT CLEAN WATER INITIATIVE 2021 PERFORMANCE REPORT

Submitted by the Vermont Agency of Administration
January 15, 2022

Relevant Reporting Requirements:	Fulfilled by:
10 V.S.A. § 1389a (a) The Report shall summarize all investments, including their cost-effectiveness, made by the Clean Water Board and other State agencies for clean water restoration over the prior fiscal year	Chapter 2
10 V.S.A. § 1389a (b)(1) Documentation of progress or shortcomings in meeting established indicators for clean water restoration	Chapter 3
10 V.S.A. § 1389a (b)(2) A summary of additional funding sources pursued by the Board, including whether those funding sources were attained; if it was not attained, why it was not attained; and where the money was allocated from the Fund	Report of the Working Group on Water Quality funding under 2017 Act 73[1]
10 V.S.A. § 1389a (b)(3) A summary of water quality problems or concerns in each watershed basin of the State, a list of water quality projects identified as necessary in each basin of the State, and how identified projects have been prioritized for implementation	Chapter 1
10 V.S.A. § 1389a (b)(4-5) A summary of any changes to applicable federal law or policy related to the State's water quality improvement efforts, including any changes to requirements to implement total maximum daily load plans in the State; a summary of available federal funding related to or for water quality improvement efforts in the State	2021 Report on Federal Funding Related to Water Quality Improvement Efforts in Vermont[2]
10 V.S.A. § 1264 (k)(1-3) Report on installation of stormwater treatment practices through operational stormwater permits, including: (1) permitted new development is achieving at least a 70 percent average phosphorus load reduction; (2) estimated total phosphorus load reduction from new development, redevelopment, and retrofit of impervious surface permitted; and (3) number and percentage of projects that implemented Tier 1, 2, or 3 stormwater treatment practices	Chapter 3
10 V.S.A. § 1386(e) A summary of activities and measures of progress of water quality ecosystem restoration programs.	Chapter 2
Lake Champlain TMDL Progress Report Chapter 3 (1) estimated phosphorus reductions from clean water projects in the Lake Champlain basin; (2) monitored phosphorus loading to Lake Champlain (3) estimated total phosphorous load reductions by lake segment watershed. Chapter 6: External variables affecting phosphorus loading to Lake Champlain; and (3) Appendix A-C: status of priority actions from Tactical Basin Plan "Implementation Table" for Basins 6,7, and 8.	Chapter 3 and Appendix A, B, & C

[1] Report of the Working Group on Water Quality funding under 2017 Act 73, available at: https://anr.vermont.gov/sites/anr/files/specialtopics/Act73WorkingGroup/2017-11-15-FINAL-act-73-water-quality-funding-report.pdf.

[2] 2021 Report on Federal Funding Related to Water Quality Improvement Efforts in Vermont, available at: https://dec.vermont.gov/sites/dec/files/documents/2021%20Vermont%20Federal%20Clean%20Water%20Funding%20Report_09172021.pdf.

ACKNOWLEDGEMENTS

This report was prepared by the Vermont Agency of Natural Resources Department of Environmental Conservation (DEC) Clean Water Initiative Program on behalf of the Vermont Secretary of Administration with assistance from partner agencies. The Clean Water Initiative Program coordinated with staff of the Vermont Agency of Administration; Vermont Agency of Agriculture, Food and Markets; Vermont Agency of Commerce and Community Development; Vermont Agency of Transportation; Vermont Fish and Wildlife Department; Vermont Department of Forests, Parks and Recreation; DEC's Water Investment Division; DEC's Watershed Management Division; Vermont Housing and Conservation Board; U.S. Department of Agriculture Natural Resources Conservation Service; and Lake Champlain Basin Program to complete this report. Vermont Agency of Digital Services supported data management and database development.

Report available electronically at: https://dec.vermont.gov/water-investment/cwi/reports

VERMONT CLEAN WATER INITIATIVE - **cleanwater.vermont.gov**

VERMONT CLEAN WATER INITIATIVE AGENCIES

Agency of Administration - aoa.vermont.gov
Agency of Agriculture, Food and Markets - agriculture.vermont.gov
Agency of Commerce and Community Development - accd.vermont.gov
Agency of Natural Resources - anr.vermont.gov
Agency of Transportation - vtrans.vermont.gov

VERMONT CLEAN WATER INITIATIVE AFFILIATE ENTITY

Vermont Housing and Conservation Board – vhcb.org

Cover photo: Agricultural field in the Lamoille River Basin planted with cover crop to reduce erosion and field runoff through the winter season. Implemented by the Agency of Agriculture, Farm and Markets (AAFM) in October 2020 with Lake Champlain Basin Program Funds.

Table of Contents

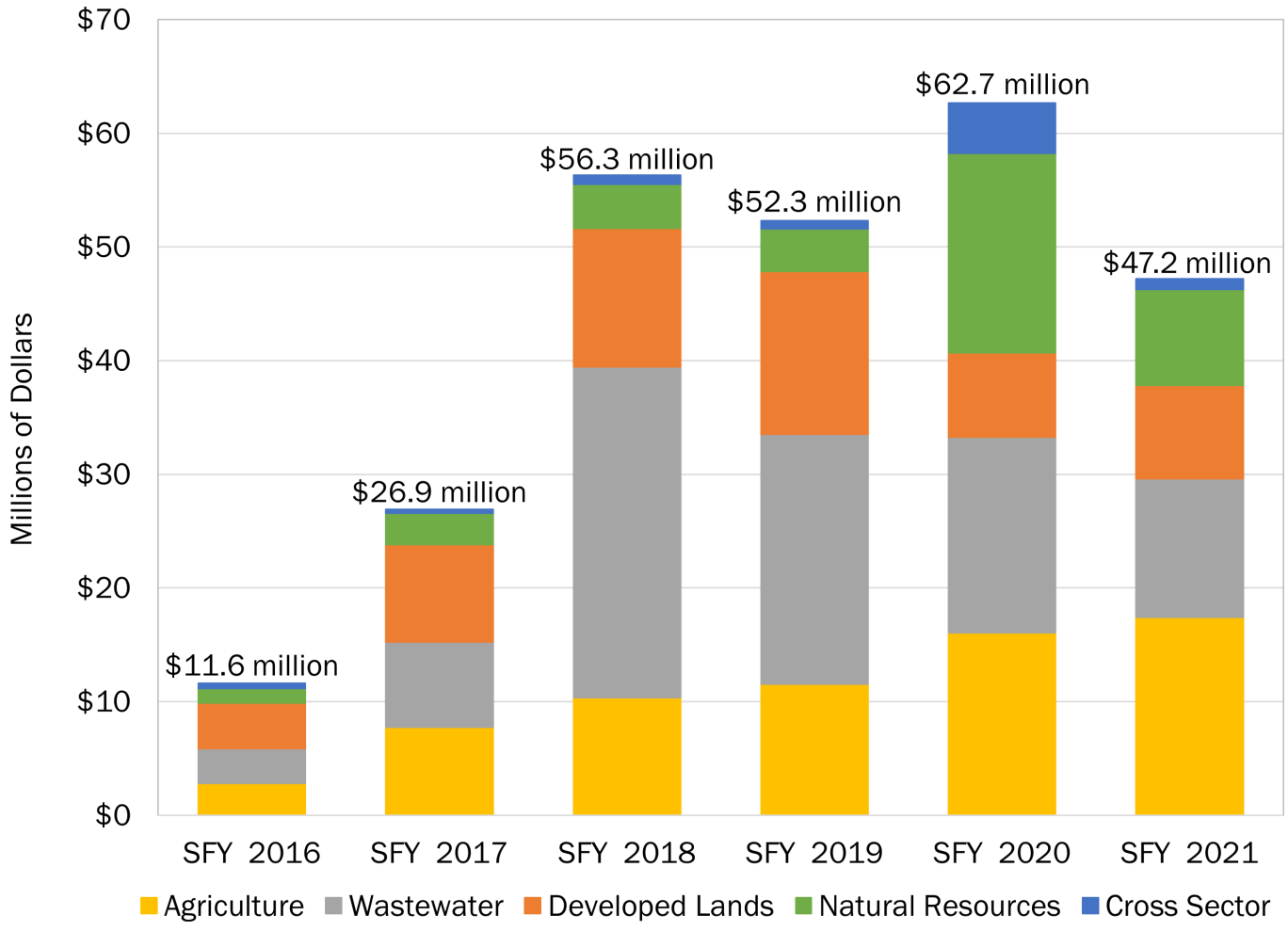
Vermont Clean Water Initiative 2021 Performance Report

Executive Summary

Vermont's lakes, rivers, wetlands, and reservoirs are important environmental and economic resources for residents and visitors. Protecting and restoring water quality is a priority for Vermont. The State of Vermont funds clean water projects to reduce pollution from washing into waters from the landscape. The *Vermont Clean Water Initiative 2021 Performance Report* (Report) summarizes efforts of state government and its partners to improve water quality across Vermont from State Fiscal Year (SFY) 2016 through 2021 (July 1, 2015 – June 30, 2021). View the full Report here: tinyurl.com/CWIProjects.

Clean Water Investments and Results

The State of Vermont invested over $257 million in clean water projects through grants, contracts, and loans from SFY 2016 to 2021. The following figure summarizes state clean water investments by land use sector statewide. Reaching Vermont's water quality goals requires investments across all land use sectors. Annual clean water investments have increased more than four-fold

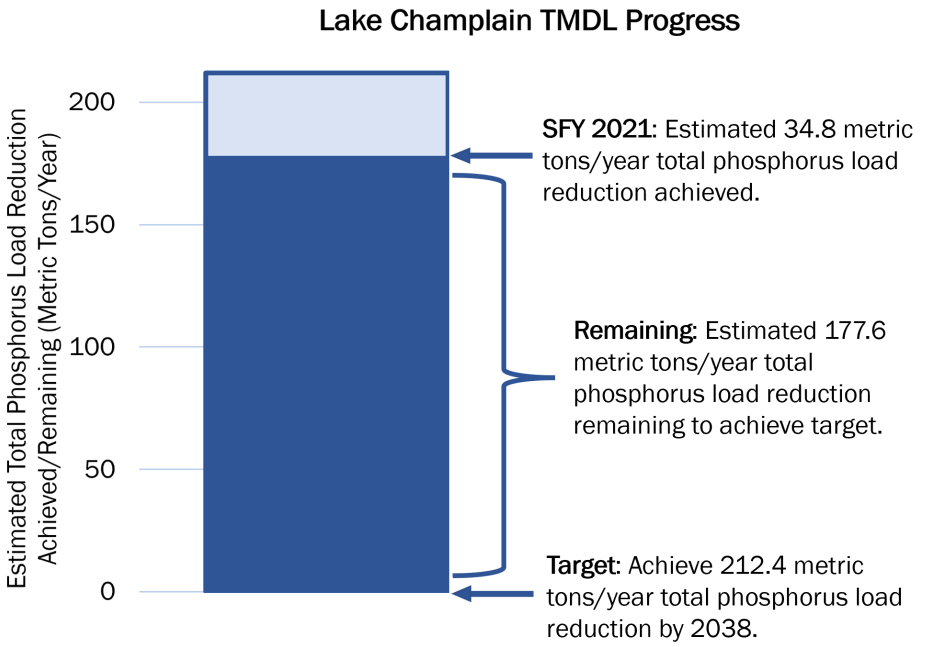


Clean water projects target nutrient and sediment pollution statewide across land use sectors to improve Vermont's water quality. The following figure highlights the results of state-funded projects completed SFY 2016-2021. See Report Chapter 2 for more information/results.

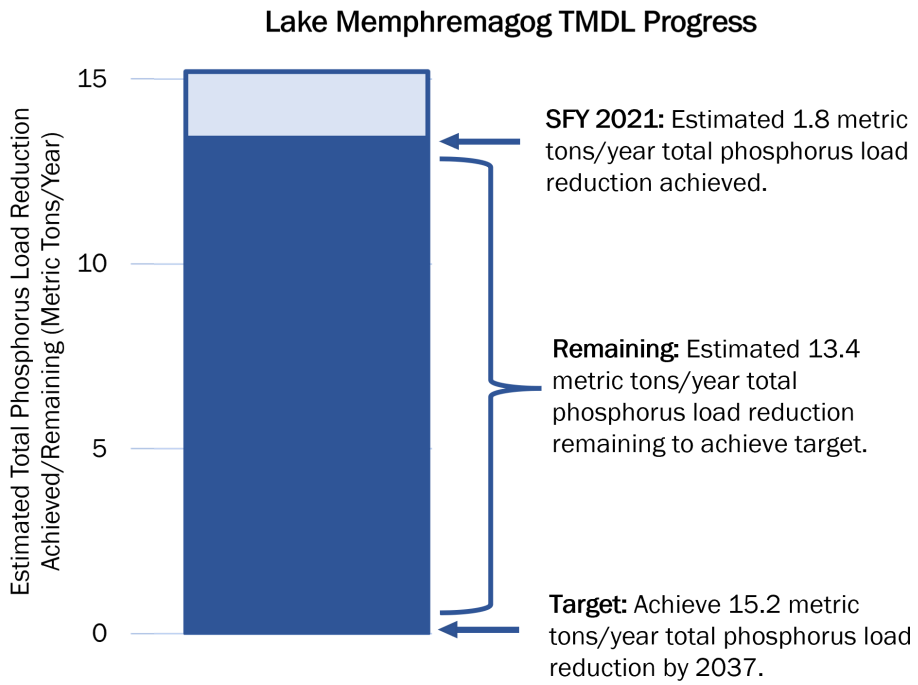
Land Use	Clean Water Project Objectives	Highlights by Land Use Sector SFY 2016-2021
 AGRICULTURE	Addresses runoff and soil erosion from farm production areas and farm fields.	• Over 155,000 acres of agricultural conservation practices implemented on fields and pastures • Over 600 structural practices installed in barnyards/production areas
 NATURAL RESOURCES	Restores functions of "natural infrastructure" – river channels, floodplains, lakeshores, and wetlands	• Over 360 riparian acres (adjacent to rivers, lakes, and wetlands) actively restored through buffer planting and floodplain and lakeshore restoration • Over 1,800 riparian acres passively restored through river corridor and wetland easements
 ROADS STORMWATER DEVELOPED LANDS	Addresses stormwater runoff form developed lands, such as parking lots, sidewalks, rooftops, and roads	• 260 municipal road miles improved through drainage and erosion control best practices • Over 440 acres of existing impervious/hard surfaces treated by stormwater practices
 WASTEWATER	Decreases nutrients (phosphorus and nitrogen) through enhanced wastewater treatment and addresses aging infrastructure	• 6 wastewater treatment facility upgrades completed • 6 combined overflow abatements completed

Total Maximum Daily Load (TMDL) Progress and Results

The 2021 Performance Report summarizes the state's progress implementing the Lake Champlain and Lake Memphremagog phosphorus Total Maximum Daily Loads (TMDLs). TMDLs identify water pollution (e.g., phosphorus) reductions required to restore water quality. The figures on the following page present the estimated total phosphorus load reduction (metric tons per year) achieved by clean water projects that support implementation of the Lake Champlain TMDL and Lake Memphremagog TMDL completed/in effect SFY 2016-2021. See Report Chapters 3 and 4 for more information. Estimates include activities implemented through state and federal funding programs and regulatory programs.



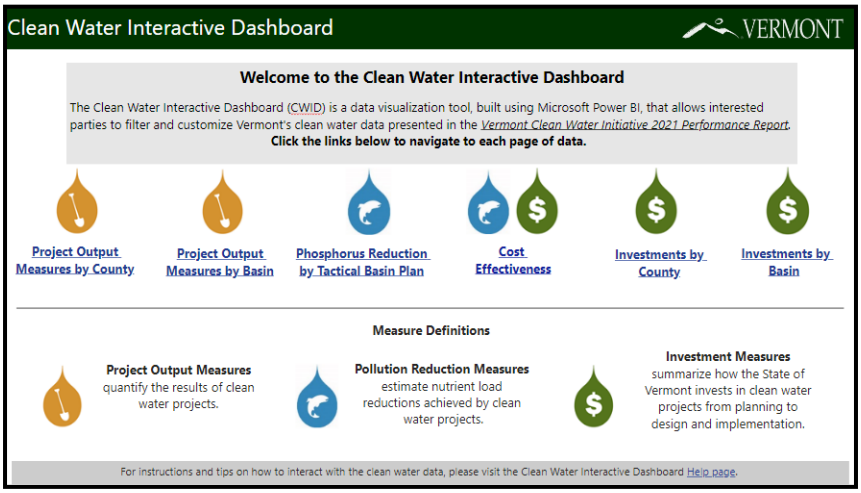
The Lake Champlain TMDL requires a phosphorus reduction of 212.4 metric tons per year by 2038. As of 2021, an estimated 34.8 metric tons of phosphorus reduction has been achieved. This represents 16 percent of the reduction required to achieve Vermont's water quality goals.



The Lake Memphremagog TMDL requires a phosphorus reduction of 15.2 metric tons per year by 2037. As of 2021, an estimated 1.8 metric tons of phosphorus reduction has been achieved. This represents 12 percent of the reduction required to achieve Vermont's water quality goals.

Learn More and Explore Data

Explore investment, results, and phosphorus data behind the *Vermont Clean Water Initiative 2021 Performance Report* in the online Clean Water Interactive Dashboard via the Clean Water Portal at: tinyurl.com/CWIProjects.



Chapter 1: Introduction

Vermont's lakes, rivers, wetlands, and reservoirs are important environmental and economic resources for residents and visitors. Vermont's waterways provide safe drinking water and recreational opportunities for thousands of people and support local economies by fostering tourism and influencing property values. High-quality streams, lakes, and wetlands also support wildlife habitat and increase flood resiliency for local communities. Maintaining, protecting, and restoring water quality is a priority for Vermont. The State of Vermont and its local and federal partners are committed to restoring impacted waters and protecting high-quality waters. This report summarizes the efforts of state government and its partners to improve water quality across Vermont over the past six state fiscal years.

Clean Water Restoration

Vermont's waters are generally high quality, but some waters suffer from excess pollution leading to unhealthy ecosystems which can negatively impact human health and economic activity.[3] In Vermont, most water quality problems are caused by excess sediment and nutrients (e.g., phosphorus and nitrogen) from nonpoint source pollution. Nonpoint source pollution transports sediment and nutrients from the landscape to waterways by rainfall and snowmelt (e.g., runoff from agricultural fields, roads, and parking lots). Nonpoint source pollution is more difficult to manage than point source pollution that enters waterways from an easily identified and confined place (e.g., discharge from a wastewater treatment facility).

Figure 1. Cyanobacteria bloom in Lake Champlain caused by excess phosphorus runoff.

Excess phosphorus loading can lead to cyanobacteria blooms in Vermont's inland lakes (Figure 1). Cyanobacteria, also known as blue-green algae, are a natural component of surface waters. They provide important ecological services, such as photosynthesis and the transfer of nitrogen from the atmosphere to the aquatic environment through nitrogen fixation. However, high concentrations of cyanobacteria can produce potent toxins harmful to people and animals and create other harmful environmental impacts. The Vermont Department of Health and Vermont Department of Environmental Conservation (DEC) monitor blooms around the state and suspend water-based recreational activities, if needed, to protect the public from the health impacts of cyanobacteria blooms.

[3] Gourevitch, J., Koliba, C., Rizzo, D., Zia, A., Ricketts, T., "Quantifying the social benefits and costs of reducing phosphorus pollution under climate change", Journal of Environmental Management, Volume 293, 2021, 112838, Available: https://www.sciencedirect.com/science/article/pii/S0301479721009002

Clean water restoration plans known as "Total Maximum Daily Loads" (TMDLs) identify pollutant reductions required for an impaired waterbody to meet the State of Vermont's water quality standards. TMDLs set up long term pollutant reduction targets to mitigate both nonpoint source and point source pollution. Most of the State of Vermont is covered by three large-scale TMDLs that require nutrient loading reductions, as shown in Figure 2 . Lake Champlain and Lake Memphremagog TMDLs target phosphorus pollution to address cyanobacteria blooms and other excess algae and aquatic plant growth. The five-state Long Island Sound TMDL targets nitrogen pollution, which causes low dissolved oxygen and dead zones in the Sound.

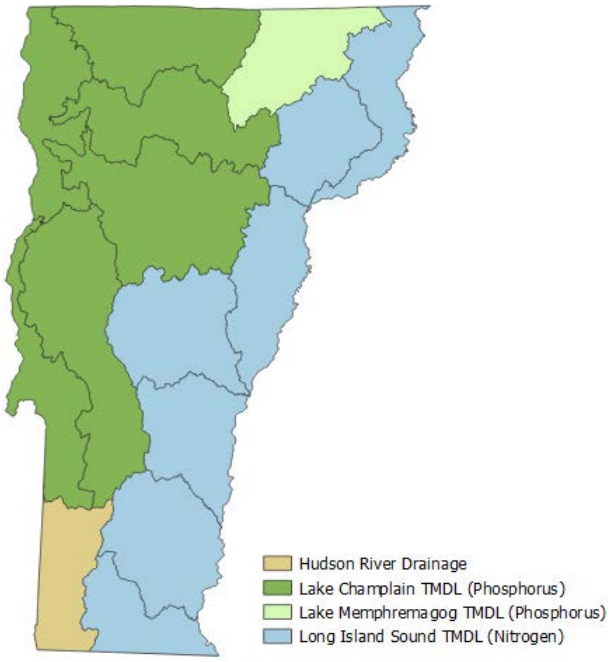


Figure 2. Vermont's large-scale TMDLs that require nutrient pollutant reductions.

The State of Vermont also has numerous small-scale nutrient TMDLs. For example, Lake Carmi in Franklin County also suffers from cyanobacteria blooms, thus the *Phosphorus Total Maximum Daily Load for Lake Cami* was established in 2009.[4] Since Lake Carmi is located in the Lake Champlain basin, actions to reduce phosphorus pollution in Lake Carmi support both the implementation of the Lake Carmi TMDL and Lake Champlain TMDL. Therefore, implementation of large-scale and small-scale TMDLs can support both local and regional water quality priorities.

Tactical Basin Planning

Given the significant costs of restoring and safeguarding water quality, the state must spend its resources efficiently and effectively. The State of Vermont uses the Tactical Basin Planning process, as summarized in Figure 3, to identify projects that will provide the greatest return on investment.

Figure 3. Five-year Tactical Basin Planning cycle.

Tactical Basin Plans identify and prioritize clean water projects across multiple sectors (i.e., stormwater, rivers, roads, and wastewater treatment) based on scientific monitoring data and assessment results. The prioritized lists of projects necessary to achieve clean water goals, found in each Tactical Basin Plan, are complemented by an online Watershed Projects Database, which is continuously updated. Tactical Basin Plans are integral to identifying and prioritizing specific actions necessary to achieve pollutant

[4] *Phosphorus Total Maximum Daily Load for Lake Carmi* can be accessed here: https://dec.vermont.gov/sites/dec/files/documents/WSMD_mapp_2009_Carmi%20P%20tmdl.pdf

reduction targets identified in TMDLs, the Vermont Clean Water Act (Act 64 of 2015), and the 2016 Combined Sewer Overflow (CSO) Rule.

Community and stakeholder engagement is a key component of Tactical Basin Plan development and implementation. Local partners, including municipalities, natural resources conservation districts, regional planning commissions, and watershed organizations also utilize Tactical Basin Plans to target their clean water activities and projects. Clean water projects are prioritized in Tactical Basin Plans using the following criteria:

1. Expected environmental benefit and cost effectiveness based on:
    - Nutrient and sediment pollution reduction,
    - Improved flood resiliency, and
    - Improved habitat function.
2. Expected feasibility based on:
    - Partner capacity and local support, and
    - Funding availability.

Clean water projects, described in Figure 4 and throughout this report, refers to regulatory or non-regulatory practices or protections that target nutrient and sediment pollution across various land use sectors. Clean water projects also provide many co-benefits for the environment and local communities, such as increasing flood resilience, improving habitat function and biodiversity, supporting carbon sequestration, improving soil health, supporting workforce development, and providing local economic stimulus.

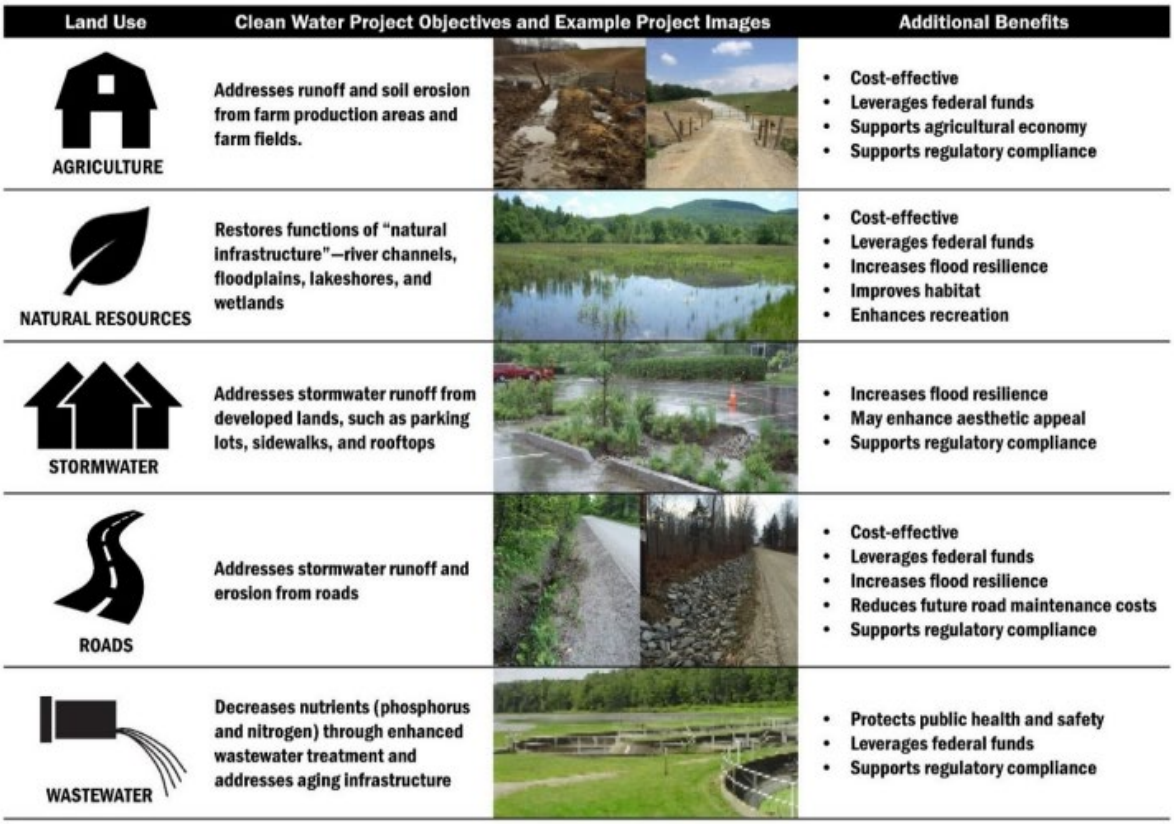


Figure 4. Clean water project land use sectors, objectives, examples, and additional benefits.

Vermont's Clean Water Funding

The State of Vermont is committed to improving and maintaining water quality through financial and technical assistance and regulation. Vermont's clean water funding helps municipalities, farmers, landowners, and nonprofit organizations implement projects that will reduce nutrient and sediment pollution from all sectors. Funds from state programs complement and leverage other funding sources to support clean water efforts statewide. The following table summarizes clean water funding programs managed by the State of Vermont included in this report.

FEDERAL CLEAN WATER FUNDING

United States Department of Agriculture Natural Resources Conservation Service (UDSA-NRCS) and the Lake Champlain Basin Program (LCBP) also provide significant federal funding to clean water projects in Vermont. The results of USDA-NRCS- and LCBP-funded clean water projects are included in this report to show TMDL progress, but federal funding amounts are not included as they are reported elsewhere, and the focus of this report is how state funds are being spent.

Table 1. State of Vermont funding programs reported by agency.

Agency	Clean Water Funding Programs
Agency of Administration (AoA)	Stormwater Utility Incentive Payments
Agency of Agriculture, Food and Markets (AAFM)	Best Management Practice (BMP) Program Capital Equipment Assistance Program (CEAP) Clean Water Fund Grants and Contracts Clean Water Fund Operational Funds Conservation Reserve Enhancement Program (CREP) Farm Agronomic Practice (FAP) Program Grassed Waterway and Filter Strip Program Pasture Surface Water Fencing Program Water Quality (WQ) Grants Vermont Phosphorus Innovation Challenge (VPIC)
Agency of Commerce and Community Development (ACCD)	Better Connections Planning Grant Downtown Transportation Fund Vermont Center for Geographic Information (VCGI)
Agency of Natural Resources (ANR)	Clean Water Initiative Program Grants and Contracts Clean Water State Revolving Fund (CWSRF) Loans CWSRF Land Conservation Interim Financing Program Fish and Wildlife Department Watershed Grants Municipal Pollution Control Grants
Agency of Transportation (VTrans)	Better Roads Program Municipal Roads Grants-in-Aid Program Municipal Highway Stormwater Mitigation Program Transportation Alternatives Program (TAP)
Vermont Housing and Conservation Board (VHCB)	Conservation Grants Farmland Protection Grants Water Quality Grants

Clean Water Regulatory Programs

Several state regulatory programs aim to protect, maintain, and restore Vermont's lakes, rivers, and wetlands by establishing land use/management requirements that minimize discharges and runoff to surface waters and impacts to natural communities. Table 2 summarizes which regulatory programs are included in this report and what programs will be included in the future.

Table 2. Clean water regulatory program results included in this report and planned future additions.

Agency	Included in this Report	Planned Future Additions
Agency of Natural Resources[5]	Operational Stormwater Permits regulating new or redeveloped impervious surface	Transportation Separate Storm Sewer (TS4) Permit
	Municipal Separate Storm Sewer (MS4) Permit	Operational Stormwater Permits regulating sites with more than three acres of existing, unpermitted impervious (i.e., "three-acre permit")
	Municipal Roads General Permit (MRGP)	
	Wastewater National Pollutant Discharge Elimination System (NPDES) Permits	
Agency of Agriculture, Food and Markets[6]	Required Agricultural Practices (RAPs) (Phosphorus reduction data on compliance at barnyards/production areas)	RAPs (Phosphorus reduction data on compliance on croplands and pastures)

Report Purpose and Scope

Collectively, state funding programs, federal funding programs, and regulatory programs drive clean water efforts in Vermont. All three program categories work together effectively to achieve water quality goals, as illustrated in Figure 5. For example, state funds leverage federal funds, and some funding programs support the cost of regulatory compliance. The State of Vermont coordinates across state and federal agencies to track clean water efforts and monitor progress towards achieving water quality goals.

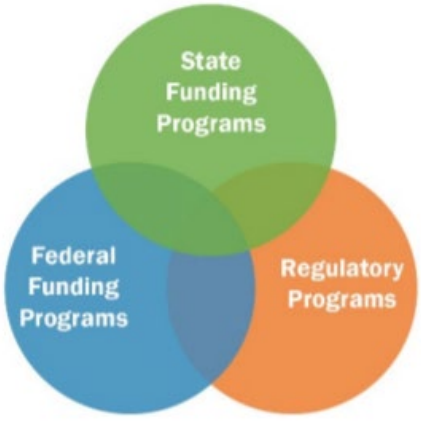


Figure 5. Program categories within the scope of Vermont's clean water tracking and reporting.

The purpose of the *Vermont Clean Water Initiative 2021 Performance Report* is to summarize the results of the State of Vermont's clean water investments, educational programs, and regulatory programs from State Fiscal Year (SFY) 2016 through 2021 (July 1, 2015 – June 30, 2021). The report also summarizes how state funding programs, federal funding programs, and regulatory programs are contributing to progress towards achieving the Lake Champlain and Lake Memphremagog TMDLs. This report fulfills state statutory and federal reporting requirements, as outlined on Page 1.

[5] For more information on regulatory stormwater programs, visit: https://dec.vermont.gov/watershed/stormwater. For more information on wastewater permits, visit: https://dec.vermont.gov/watershed/wastewater

[6] For more information on agricultural water quality regulations, visit: https://agriculture.vermont.gov/water-quality/regulations

The *Vermont Clean Water Initiative 2021 Performance Report* is divided into several chapters based on geographic region. The purpose of each geographically focused chapter is to report progress in our major nutrient TMDL watersheds.[7] Below is a summary of the scope of each chapter of this report.

- **Chapter 2** – Investments in clean water projects by state funding programs, the extent of education provided through outreach and technical assistance, and the results of funding and regulatory programs statewide from SFY 2016-2021.
- **Chapter 3** – Investments in clean water projects by state funding programs, results of state and federal funding programs, and results of regulatory programs in the Lake Champlain Basin from SFY 2016-2021, as well as estimated progress towards achieving the Lake Champlain TMDL.
- **Chapter 4** – Investments in clean water projects by state funding programs, results of state and federal funding programs and results of regulatory programs in the Lake Memphremagog Basin from SFY 2016-2021, as well as estimated progress towards achieving the Lake Memphremagog TMDL.
- **Chapter 5** – Investments in clean water projects by state funding programs, results of state and federal funding programs and results of regulatory programs in the Connecticut River Basin from SFY 2016-2021.

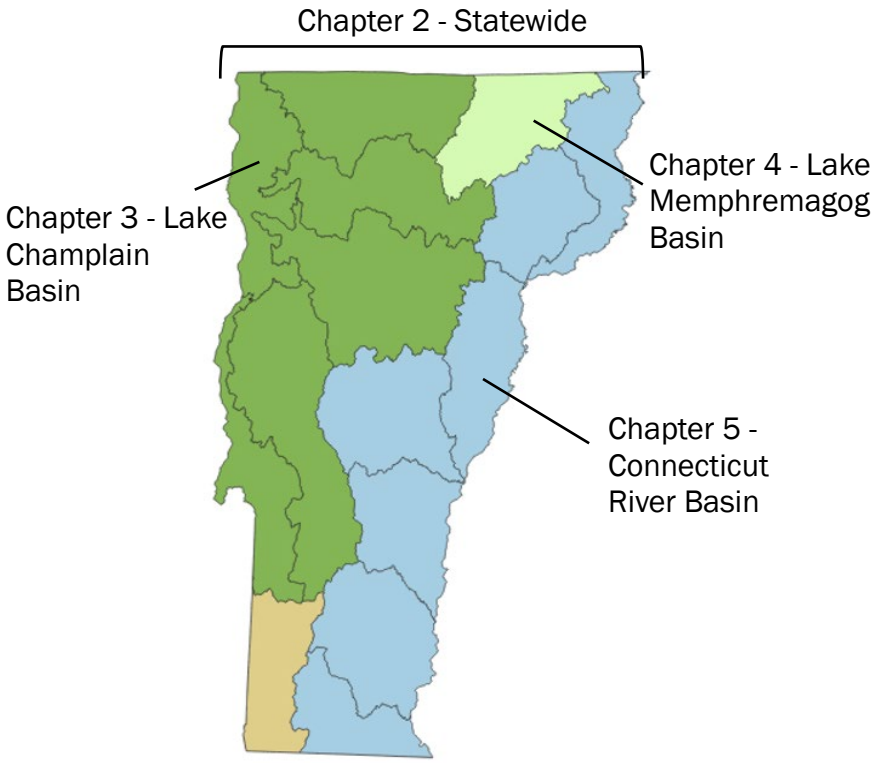


Figure 6. Geographic scope/focus of the *Vermont Clean Water Initiative 2021 Performance Report* chapters.

[7] Note that the Hudson River drainage basin is not highlighted in this report, but the results are included in Chapter 2 statewide results. Hudson River drainage basin results can be found in the Clean Water Interactive Dashboard: https://anrweb.vt.gov/DEC/CleanWaterDashboard/.

Clean water investments and results are presented throughout the report using the following four accountability measures.

Investment measures show how Vermont invests in clean water projects from planning to design and implementation. State investments are defined as dollars obligated or awarded to clean water projects through grants and contracts, or financed through loans, administered by the State of Vermont agencies. Investments reported include state and federal dollars awarded to projects by state agencies, but exclude federal funds awarded to projects directly by federal agencies. Funds are assigned to state fiscal years according to grant or contract execution date. When a project is completed, funding is retroactively updated to reflect the final expended amount. State investments are summarized statewide in Chapter 2 and by large-scale watershed in Chapters 3-5.

Education measures summarize outreach and technical assistance to support, identify, and develop clean water projects. The State of Vermont delivers clean water education through outreach (i.e., workshops, trainings, and public/stakeholder meetings) and technical assistance (i.e., targeted, one-on-one interactions). Hours of education provided are assigned to state fiscal years based on the date of the event. Education measures are summarized statewide in Chapter 2. Education efforts are widespread and often span multiple regions of the state and therefore are not reported in Chapters 3-5.

Project output measures quantify the results of clean water restoration projects. Output measures are standardized across all programs to summarize results of funding and regulatory efforts consistently. This report groups project output measures by land use sector. These results are assigned to a state fiscal year based on the completion date of the project and are only reported on once a project is complete. State funding program, federal funding program, and regulatory measures are reported separately. Project output measures are summarized statewide in Chapter 2 and by large-scale watershed in Chapters 3-5.

Pollutant reduction measures are estimated nutrient load reductions achieved by clean water projects. Pollution reduction estimates are *modeled* at the individual clean water project-level. Measuring pollutant reductions at the project level through water quality monitoring is not always technically feasible and would be cost-prohibitive. Pollution reduction estimates are based on the total pollutant load from the land being treated by a project and the average pollutant reduction efficiency of the project type. Annual pollutant reductions apply throughout the expected lifespan on a project and begin on the date the project is completed.[8] Pollutant reductions reported herein represent the "delivered loads", or the pollutant load reduction after accounting for estimated pollutant storage or loss enroute to the receiving waterbody, rather than the "source load", or the pollutant reduction from the landscape source and does not account for potential storage or loss in the watershed. Prior year estimated total phosphorus load reductions have changed compared to previous reports due to improved clean water project tracking and accounting methods and updating Lake Champlain pollutant load reductions from source loads to delivered loads more accurately represent the impacts for Lake Champlain water quality. Pollutant reduction measures are summarized statewide in Chapter 2 and by large-scale watershed in Chapters 3-4.

[8] Additional information on the methods used to estimate pollutant reductions can be found on the Clean Water Tracking and Accounting webpage: https://dec.vermont.gov/water-investment/cwi/projects/tracking-accounting.

Explore Clean Water Project Data with Online Tools

The State of Vermont coordinates across agencies to track clean water efforts in a centralized database known as the "Clean Water Reporting Framework." The database is used to compile and summarize project data to produce this report. These data and many online tools are made available to the public through the "Clean Water Portal."[9] The Portal's "Clean Water Projects Explorer" allows interested parties to search for and learn details about individual state-funded clean water projects (Figure 7). The Explorer also contains potential projects identified through Tactical Basin Planning. The Portal's "Clean Water Interactive Dashboard" allows interested parties to examine and filter investment data, project output measures, estimated pollutant reduction, and cost effectiveness data from this report by watershed and county (Figure 8).

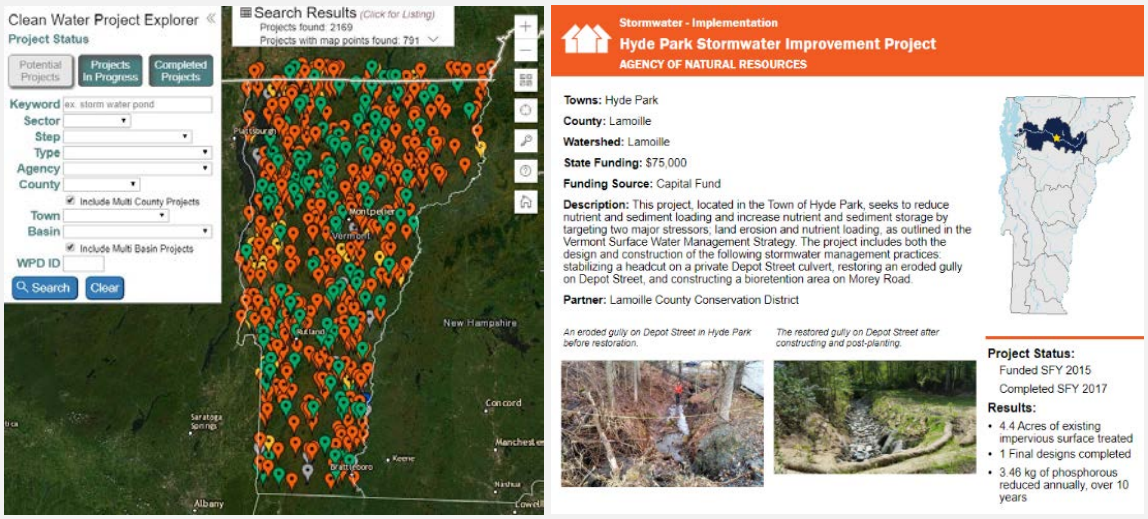


Figure 7. Sample Clean Water Projects Explorer search results (left) and individual project report (right).

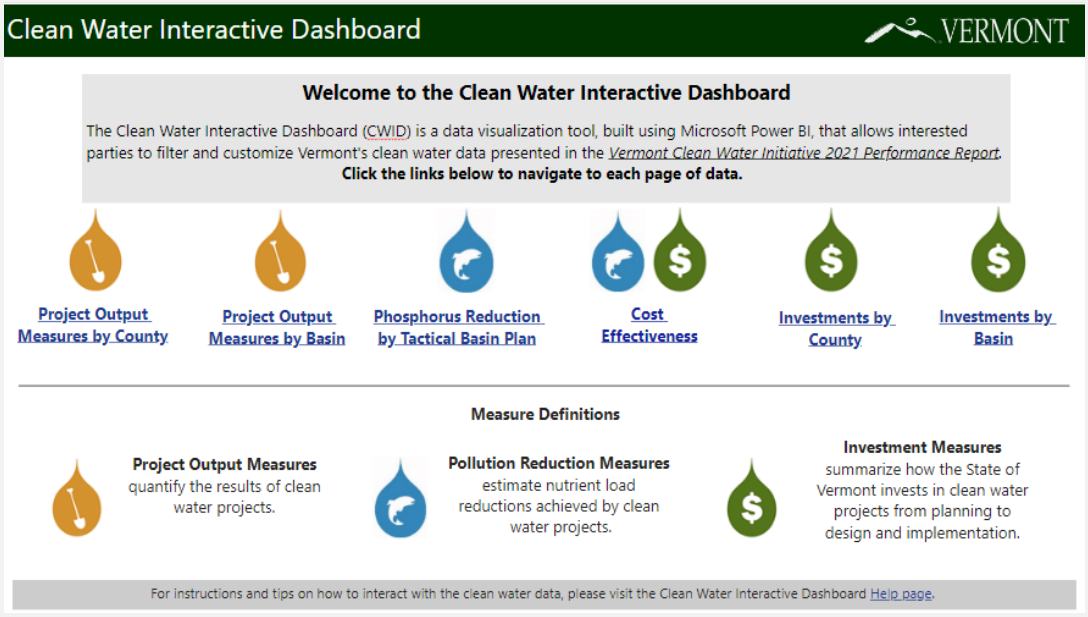


Figure 8. The Clean Water Interactive Dashboard homepage.

[9] The Project Explorer and Clean Water Interactive Dashboard can be accessed via the Clean Water Portal: https://anrweb.vt.gov/DEC/cleanWaterDashboard/

Chapter 2: State Clean Water Investments & Results

The State of Vermont's clean water investments are channeled through grant, loan, and assistance programs to strategically restore and safeguard the state's rivers, streams, lakes, ponds, and wetlands. These funds are used to help identify and prioritize projects, as well as to design and implement projects. Chapter 2 of the report summarizes state clean water investments made through state funding programs.

Vermont's Statewide Clean Water Investments

State Investments by Land Use Sector

Reaching Vermont's water quality goals requires investments across all land use sectors. The following figure summarizes state clean water investments by land use sector statewide over the past six years, from SFY 2016 to 2021.

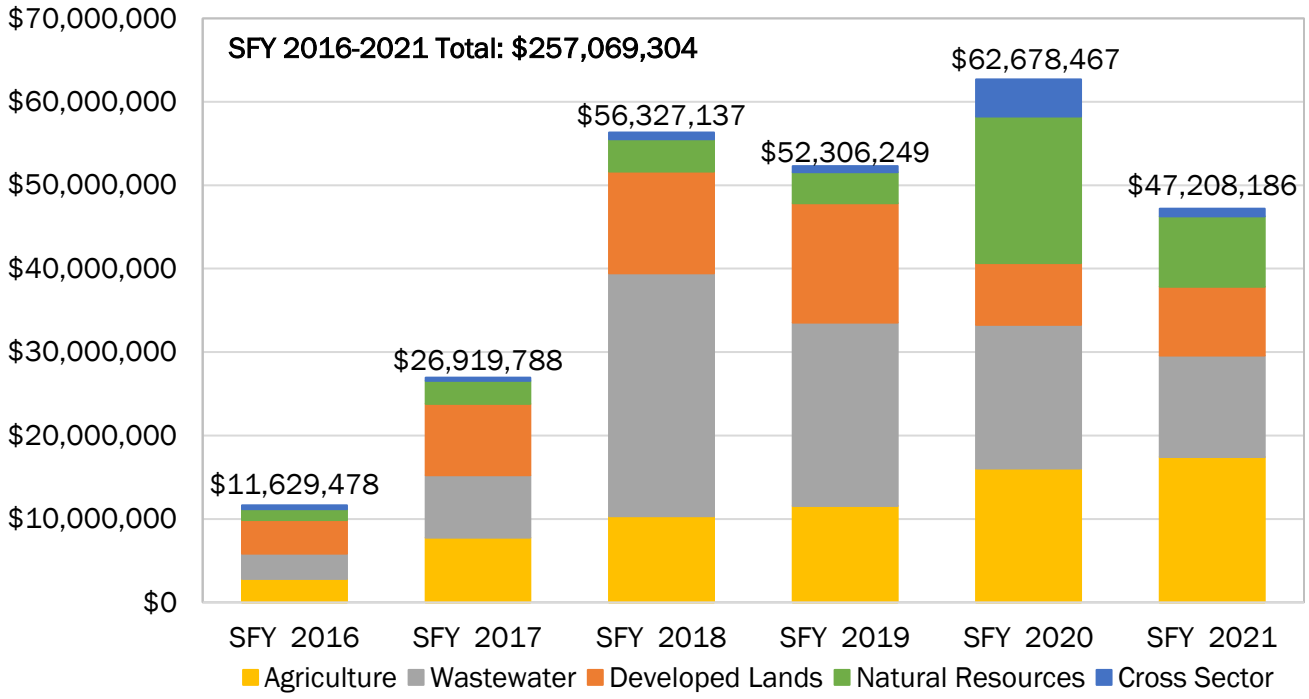


Figure 9. Total dollars awarded by State of Vermont agencies to clean water projects statewide by land use sector, SFY 2016-2021.

EXPLANATION OF FIGURE

The State of Vermont has invested over $257 million in clean water projects statewide from SFY 2016 to 2021. Annual clean water investments have increased more than four-fold statewide since SFY 2016, but funding awarded to projects varies from year-to-year based on project readiness. In SFY 2021, the COVID-19 pandemic's economic impacts affected Clean Water Fund revenue sources, which led to a slight reduction in appropriation and a temporary slowdown of funding programs.

Clean water funding is well-distributed across all land use sectors. Statewide agricultural funding has increased steadily since SFY 2016, and there have been increases in natural resources funding in SFY 2020 and 2021 due to ANR's new Land Conservation Interim Financing Program.

Investments by Funding Source

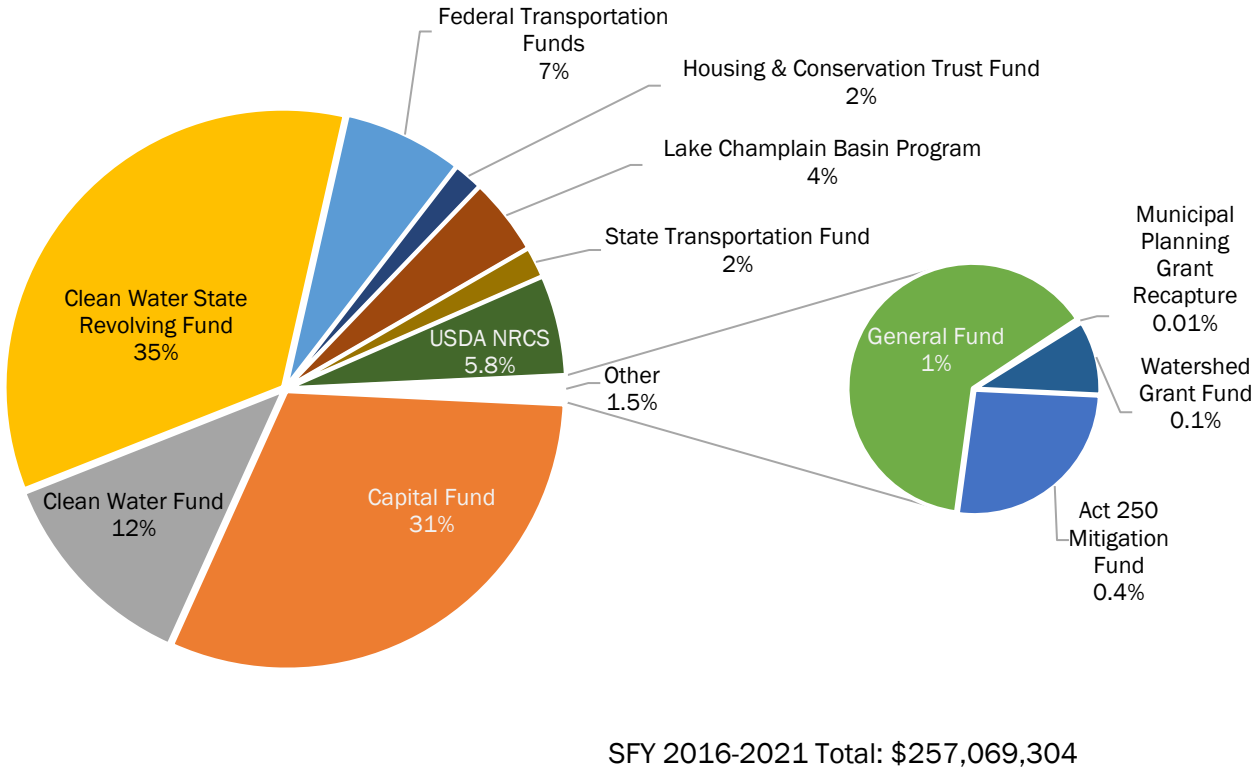


Figure 10. Proportion of dollars awarded to clean water projects through State of Vermont agencies, SFY 2016-2021 by funding or financing source[10]

EXPLANATION OF FIGURE

State agencies' clean water investments are supported by a variety of funding sources. This figure shows the percent of total dollars awarded by state agencies by funding source from SFY 2016 to 2021.

The annual Clean Water Budget is made up of Clean Water Fund and Capital fund dollars, comprising about 43 percent of clean water funding. The Clean Water Board recommends the annual budget, which supports efforts to reduce pollution across all sectors, with representation from five state agency secretaries and four members of the public appointed by the Governor.

Several federal funding sources *administered by state agencies* are considered state investments including Clean Water State Revolving Fund (CWSRF), Federal Transportation Funds, U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), and Lake Champlain Basin Program funds. USDA-NRCS funds are funneled through the Agricultural Conservation Easement Program, Vermont State Conservation Innovation Grant, and the USDA Regional Conservation Partnership Program. Direct investments by federal agencies or other organizations are beyond the scope of this report.

[10] Investments reported include state and federal dollars awarded to projects by state agencies, but exclude federal funds awarded directly by federal agencies and the Lake Champlain Basin Program as the focus of this report is state funding.

Leveraged Contributions by Land Use Sector

State-funded clean water projects leverage local and federal contributions to help cover project costs and to further clean water efforts in Vermont. Loans are considered leverage as they are ultimately paid back to the state. The following figure summarizes leveraged contributions from SFY 2016 to 2021 by land use sector.

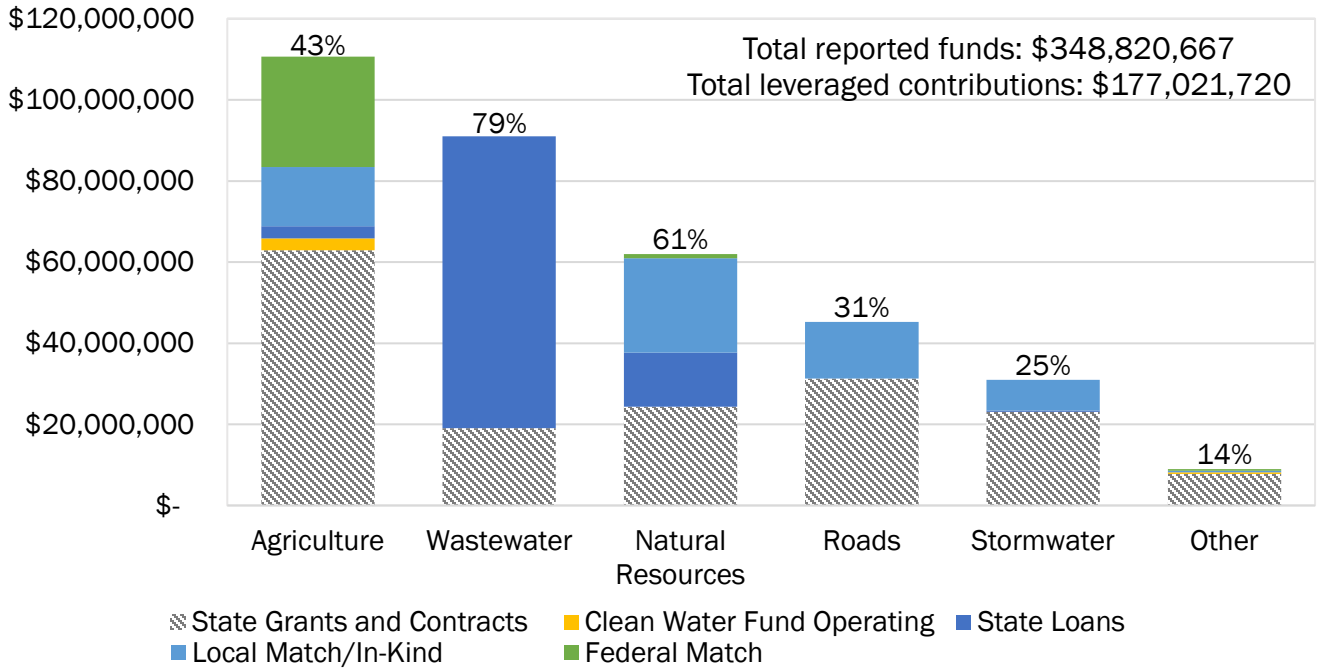


Figure 11. Leveraged contributions (i.e., local match/in-kind, federal match, and loans) reported through State of Vermont agencies in addition to state grants and contracts, SFY 2016-2021. Percent represents proportion of leveraged contributions out of the total reported funds (i.e., leveraged plus state grant and contracts) within each sector[11].

EXPLANATION OF FIGURE

State funded clean water projects leverage local and federal contributions to help cover project costs and to further clean water efforts. Leveraged contributions (i.e., local match/in-kind, federal match, and loans) totaled $177 million in SFY 2021 and represented 51 percent of total funds reported SFY 2016 through SFY 2021. Majority of wastewater funds reported are low-interest loans made to municipalities through the Clean Water State Revolving Fund that will ultimately be paid back to the state (except for some loan subsidy). Match contributions reported here only include local match/in-kind (e.g., private contributions, municipal funds, volunteer labor, etc) and federal match reported through State of Vermont grants and contracts.

"Clean Water Fund Operating" refers to limited AAFM and ANR personnel funded through the Clean Water Fund to support implementation efforts and is not considered leveraged contribution. This report focuses mainly on passthrough funds administered by state agencies. This represents only a fraction of the substantial staffing costs associated with clean water work. State agency investments in personnel, operating, and monitoring activities are beyond the scope of this report.

[11] To further examine leveraged funds, visit the Clean Water Interactive Dashboard: https://anrweb.vt.gov/DEC/CleanWaterDashboard/

State Investments by Project Step

Making wise investments in cost-effective clean water projects requires thorough project planning, analysis, design, and implementation. Investing in the project development process is key to ensuring state investments will yield the greatest water quality improvement per dollar, which includes dismissing lower-value or non-viable projects early in development. The following figure summarizes the percentage of funding awarded to various steps of the clean water project development process during SFY 2016 to 2021.

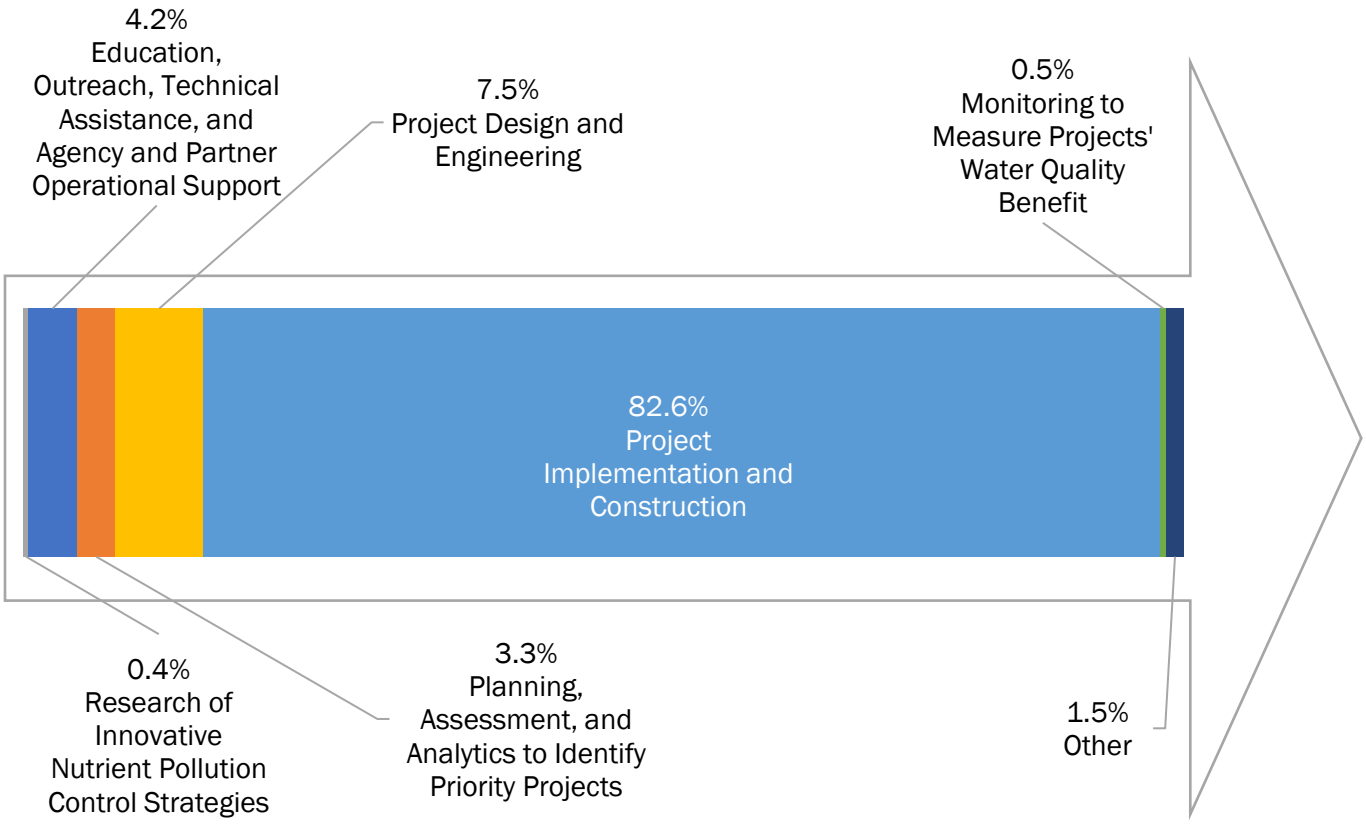


Figure 12. Percentage of dollars awarded by State of Vermont agencies to various steps of the clean water project development process, SFY 2016-2021.

EXPLANATION OF FIGURE

While the state invests in all project steps, over 80 percent of clean water investments are used to construct or implement clean water projects that reduce nutrient and sediment pollution. Approximately 10 percent of clean water investments are used in the planning, design, and engineering phases. The "other" category includes agreements that do not fit squarely into one project step, including multiple block grants issued to partners who will use the money to develop, design, and implement several projects. Once those projects are completed, those dollars will be reallocated to the appropriate step.

State Investments by Watershed

Each of Vermont's 15 Tactical Basin Planning watersheds benefit from state investments in clean water projects. The following figure summarizes clean water investments from SFY 2016 to 2021 by Tactical Basin Planning watershed.

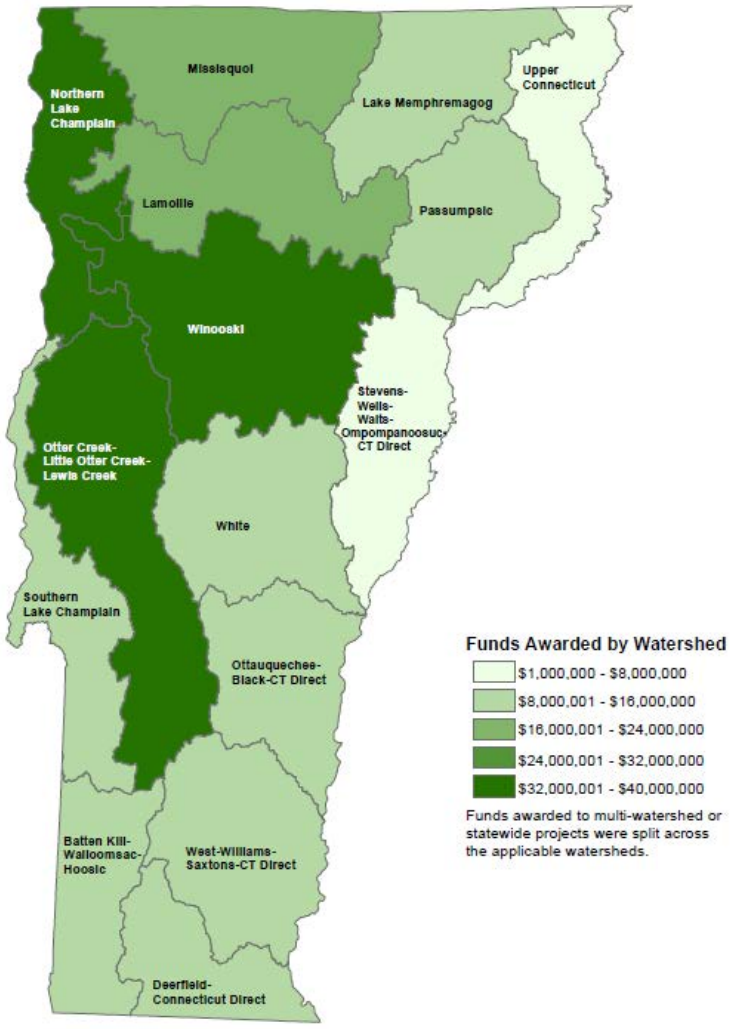


Figure 13. Map of total dollars awarded to clean water projects by State of Vermont agencies by Tactical Basin Plan watershed, SFY 2016-2021.

EXPLANATION OF FIGURE

The Winooski River, Northern Lake Champlain, and Otter Creek/Lewis Creek watersheds received the largest investments since SFY 2016, totaling over $39 million, $38 million, and $36 million, respectively. Investments in the Lake Champlain Basin watersheds are higher due to the Accountability Framework required under the Lake Champlain TMDL. Significant investments in these basins are largely driven by municipal wastewater treatment and CSO abatement requirements, as well as municipal stormwater treatment requirements for Vermont's most populous municipalities (i.e., Municipal Separate Storm Sewer System, or "MS4" communities). See the Clean Water Interactive Dashboard for detail on funding and results by watershed.

Vermont's Statewide Education, Outreach, and Technical Assistance

Reducing nutrient and sediment pollution sources requires employing sound land management practices which can necessitate changes to our cities and towns, farms, and other natural spaces. As a result, education and outreach on clean water projects and programs to all Vermonters is critical to achieve our water quality goals. The State of Vermont delivers clean water education through **outreach** (i.e., workshops, trainings, and public/stakeholder meetings) and **technical assistance** (i.e., targeted, one-on-one interactions). Clean water education, outreach, and technical assistance aim to:

- Increase public awareness and engagement in establishing and implementing clean water priorities;
- Increase landowner acceptance of new and changing policies and willingness to adopt best management practices;
- Support regulated entities in preparing to meet new regulatory requirements in the most cost-effective manner;
- Support clean water project proponents, including regulated entities, in planning and securing resources to implement clean water projects; and
- Increase adoption and effectiveness of best management practices to improve water quality.

Educational efforts support all land use sectors in planning and securing resources to implement clean water projects. The following section summarizes education, outreach, and technical assistance efforts by land use sectors with differing primary target audiences.

Table 3. Primary or target audiences of State of Vermont clean water education, outreach, and technical assistance by land use sector.

Land Use Sector	Primary or Target Audiences
	Businesses, farmers, natural resources conservation districts, nongovernmental organizations (e.g., watershed groups), public
	Businesses, municipalities, natural resources conservation districts, nongovernmental organizations (e.g., watershed groups), public, regional planning commissions, residential landowners
	Municipalities, other governmental organizations, public, regional planning commissions, residential landowners
	Businesses, municipalities, public, residential landowners
	Loggers and foresters, natural resources conservation districts, nongovernmental organizations (e.g., watershed groups), other governmental organizations, public, regional planning commissions, residential landowners

Clean Water Outreach by Agency/Organization

State of Vermont agencies' staff conduct outreach and also provide funding to organizations to conduct outreach. The following figure summarizes the total hours of education provided by outreaching organizations from SFY 2016 to 2021.

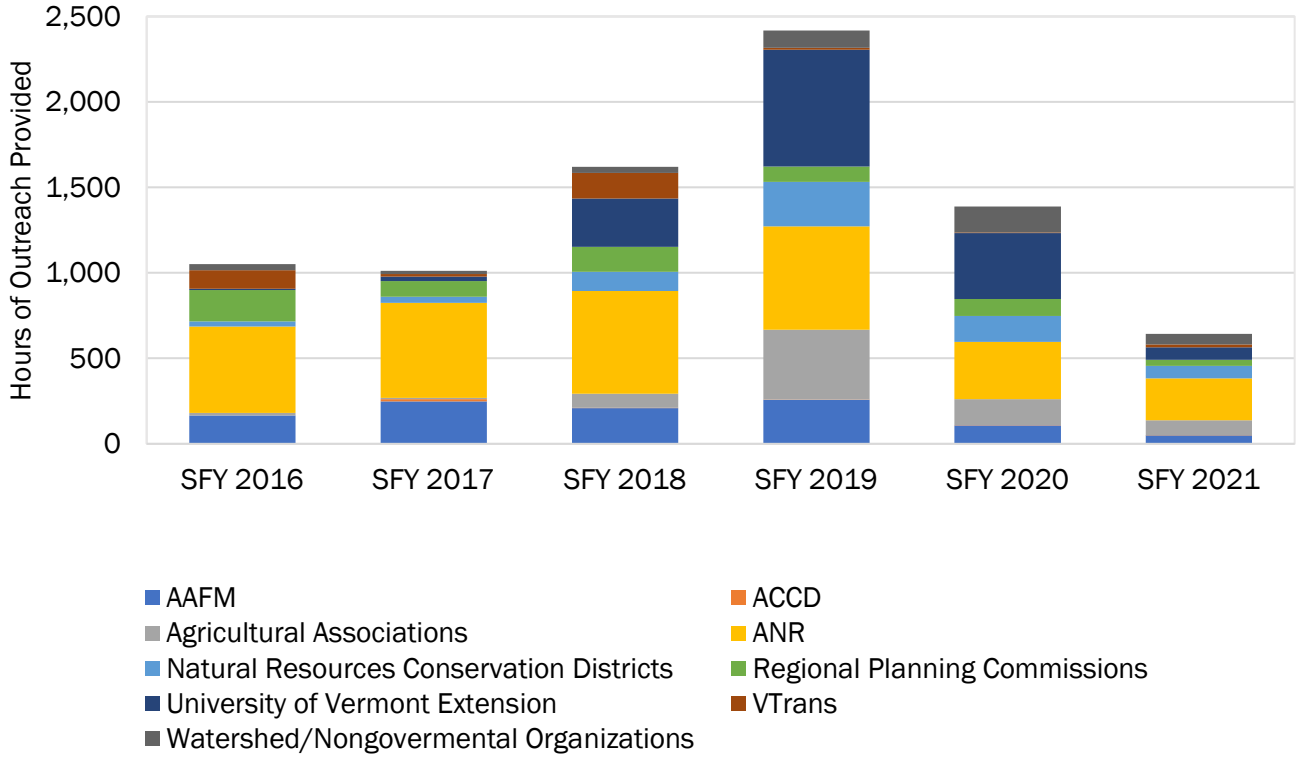


Figure 14. Total hours of education provided to participants of State of Vermont funded clean water outreach events (i.e., workshops, trainings, and public/stakeholder meetings) by outreach organization or organization category, SFY 2016-2021.[12]

EXPLANATION OF FIGURE

In total, 2,392 outreach events have been reported, reaching over 64,000 attendees, with over 296,000 hours of education provided since SFY 2016. In SFY 2020 and 2021, there was a decrease in the overall number of outreach events reported compared to previous years. This is related to the COVID-19 pandemic limiting in-person outreach. Earlier outreach efforts were critical in the development of foundational programs to drive Vermont's clean water efforts, including the initial phases of implementing the Lake Champlain TMDL and the Vermont Clean Water Act (Act 64 of 2015). Note the entities responsible for reporting outreach efforts are ANR, AAFM, VTrans, and external partners conducting outreach under the scope of a state grant or contract agreement, however many events include multiple outreaching organizations.

[12] For presentation purpose, the figure above includes organizations that reported more than 0 hours of education in SFY 2021 grouped into the categories above. "Agricultural associations" include both regional and statewide organizations connecting and supporting the agricultural sector.

Clean Water Outreach by Target Audience

State of Vermont outreach events reach a diversity of audiences. The following figure summarizes the target audiences reached by State of Vermont funded clean water outreach efforts from SFY 2016 to 2021.

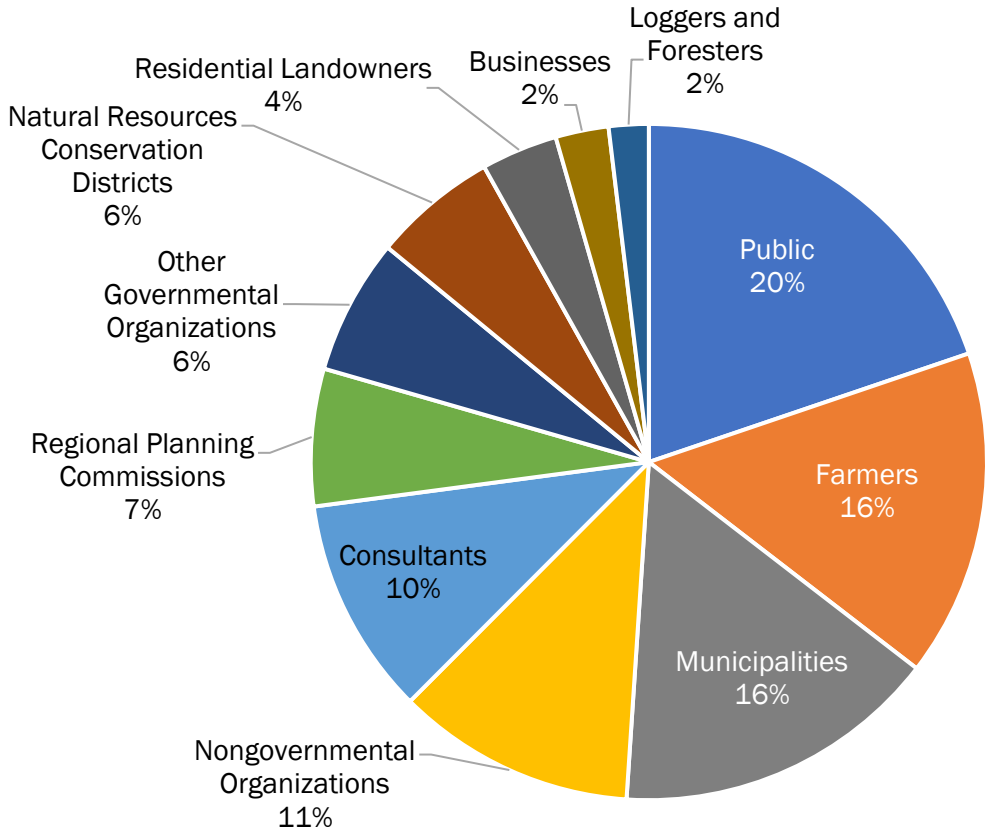


Figure 15. Target audiences reached through State of Vermont clean water outreach efforts (i.e., workshops, trainings, and public/stakeholder meetings), SFY 2016-2021.

EXPLANATION OF FIGURE

This figure demonstrates how the state's outreach efforts target different sector and organization-based audiences. One of the state's water quality priorities is to support municipalities and farmers in addressing stormwater, wastewater, and agricultural sources of nutrient pollution, which is why these audiences represent a large proportion of the target audiences above. In addition, non-governmental organizations, such as watershed groups, regional planning commissions, and natural resources conservation districts, play a very important role working with municipalities, farmers, and other landowners to secure funds to implement priority clean water projects. It is also important to keep the public engaged for broader support of the state's clean water efforts.

Technical Assistance by Land Use Sector

State of Vermont agencies and partners provide technical assistance, in addition to outreach, to regulated and non-regulated audiences who implement clean water projects. While not all technical assistance provided by state agencies can be tracked, the following table summarizes a portion of the technical assistance efforts by land use sector from SFY 2016 to 2021.

Table 4. State of Vermont technical assistance efforts by sector, SFY 2016-2021.

Measures	2016	2017	2018	2019	2020	2021	Total
Agricultural Technical Assistance Measures							
Number of technical assistance visits conducted by AAFM and partners to support implementation of conservation practices	594	348	592	550	720	908	3,712
Number of farms provided technical assistance[13]	32	145	277	245	493	502	1,694
Developed Lands and Wastewater Technical Assistance Measures							
Approximate hours of technical assistance provided by DEC's Water Investment Division engineers on municipal stormwater and wastewater projects	--	5,300	6,400	5,200	3,620	6,232	26,752
Hours of water quality municipal technical assistance provided by VTrans staff	--	1,483	1,489	2,063	569	397	6,001
Natural Resources Technical Assistance Measures							
Number of logging operation site visits to provide Acceptable Management Practices (AMP) technical assistance[14]	11	12	17	19	24	--	83
Square miles of forest lands covered by Use Value Appraisal (UVA) site inspections	296	330	305	350	112	--	1393
Number of communities receiving Urban and Community Forestry Program technical assistance[15]	94	78	78	102	117	137	606

[13] Data collected for FY16-18 is not complete and only reflects farms provided technical assistance from partners.

[14] Data are reported by calendar year rather than state fiscal year. Given the timeline of this report, calendar year 2021 data are not yet available. FPR annual statewide summary reports are available at: https://fpr.vermont.gov/forest/managing-your-woodlands/acceptable-management-practices.

[15] Data are reported by federal fiscal year (October 1, 2020 – September 30, 2021) rather than state fiscal year.

EXPLANATION OF TABLE

In the agricultural sector, AAFM and partnering organizations have conducted over 3,700 technical assistance visits cumulatively from SFY 2016 to SFY 2021 to support implementation of agricultural conservation practices.

In the developed lands sector, DEC and VTrans staff provide technical assistance to prepare municipalities and other regulated entities to comply with water quality-related regulations. DEC Water Investment Division engineers provided over 26,000 hours of technical assistance on municipal stormwater and wastewater projects from SFY 2016 to 2021, while VTrans staff provided 6,000 hours of water quality technical assistance to municipalities.

In the natural resources sector, projects are voluntary and not driven by regulation. Education targeting the public and landowners increases likelihood of natural resource restoration projects moving forward. Department of Forests, Parks and Recreation (FPR) staff conducted 83 site visits to provide technical assistance on Acceptable Management Practices at logging operations. The Vermont Urban and Community Forestry Program visited communities over 600 times to provide technical assistance from SFY 2016 to SFY 2021 related to planning and managing urban trees.

Figure 16. Urban Community Forestry Technical Assistance Coordinator trained a group of volunteers in Brownington on how to inventory roadside trees and discussed tree maintenance and protection issues.

Figure 17. Custom Applicators learn about state regulations and requirements for manure and other agricultural waste application through the Agricultural Clean Water Initiative Program in Cabot. This event was implemented in partnership with UVM Extension, and the Agency of Agriculture, Food and Markets. It was held in September 2021.

Statewide Results of Vermont's Clean Water Investments

Clean water projects target nutrient and sediment pollution across various land use sectors. The following section summarizes the results of state-funded and regulatory clean water projects completed statewide to improve the state's water quality. Note some measures have been rounded to the nearest whole numbers for reporting purposes, but totals have been calculated using unrounded numbers.

Statewide Results of Agricultural Pollution Prevention Projects

Agricultural pollution prevention projects involve the installation or application of conservation practices that reduce sources of nutrient and sediment pollution from farm production areas and agricultural fields. The following table summarizes project outputs associated with state-funded agricultural pollution prevention projects.

Table 5. Outputs of state-funded agricultural pollution prevention projects implemented statewide, SFY 2016-2021.

Project Output Measures[16]	2016	2017	2018	2019	2020	2021	Total
Acres of agricultural conservation practices implemented (excluding practice types listed below)[17]	5,466	3,261	7,908	14,578	25,812	20,661	77,686
Acres of agricultural forested and filter strip buffers installed	52	40	46	–	–	35	172
Acres of pasture with livestock excluded from surface water	258	117	97	47	24	62	605
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures	59	86	96	92	136	134	603
Acres of water quality protections within newly conserved agricultural lands	–	116	200	513	276	143	1,246
Acres of agricultural land treated through innovative equipment	–	2,043	6,606	13,852	25,306	18,680	66,487
Project Output Measures Supported by State Technical Assistance[18]	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of agricultural conservation practices implemented, supported by state-funded technical assistance (excluding practice types listed below)	52	65	83	1,729	2,414	6,605	10,947

[16] Agricultural project output measures can overlap with other project output measures if multiple practices were applied on the same field. For example, 10 acres of manure injection and 10 acres of cover crop applied on the same field will amount to 20 acres of agricultural conservation practices implemented in reported project outputs. Similarly, practices implemented on the same field over multiple years will be counted for each year implemented. For example, 10 acres of cover crop implemented on the same field in 2016, 2017, and 2018 will amount to 30 acres of agricultural conservation practices implemented in reported project outputs. Total agricultural project outputs column represents the total level of effort of state funding programs, rather than the number of distinct agricultural acres addressed.

[17] Acres of agricultural conservation practices includes aeration, conservation crop rotation, cover crop, crop to hay, grassed waterways, manure injection, conservation tillage, and rotational grazing.

[18] Agricultural conservation practices reported through technical assistance represent agricultural conservation practices implemented without financial assistance from state and federal programs reported through technical assistance funded by state programs.

Acres of agricultural filter strip buffer installed, supported by state-funded technical assistance	–	–	–	–	–	6	6
Acres of pasture with livestock excluded from surface water, supported by state-funded technical assistance	53	–	–	19	865	135	1,072
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures, supported by state-funded technical assistance	–	–	–	1	2	1	4
Number of farms receiving nutrient management planning assistance	–	–	2	38	38	9	87
Agricultural Regulatory Measures	2016	2017	2018	2019	2020	2021	Total
Number of water quality compliance farm visits conducted by AAFM to ensure compliance with Required Agricultural Practices (RAPs) and Medium Farm Operation (MFO) and Large Farm Operation (LFO) Rules[19]	186	352	675	614	571	256	2,654
Acres of production area inspected by AAFM for RAP compliance[20]	--	1,407	1,060	2,069	2,734	2,512	9,782

EXPLANATION OF TABLE

The number of agricultural pollution prevention projects implemented statewide has increased significantly since SFY 2016. AAFM's Farm Agronomic Practice (FAP) Program has funded over 77,000 acres of agricultural conservation practices (e.g., cover crops, conservation tillage, and manure injection) since SFY 2016. Equipment funded by the AAFM Capital Equipment Assistance Program, Vermont Housing and Conservation Board, and DEC has resulted in the application of approximately 66,000 acres of agricultural conservation practices since SFY 2017.

AAFM's Best Management Practice Program, Conservation Reserve Enhancement Program, Grassed Waterway and Filter Strip Program, and Pasture and Surface Water Fencing Program have funded 600 structural field and production area practices since SFY 2016 to reduce runoff from fields and agricultural production areas. Structural practices can include waste storage facilities, roof runoff management, fences, and watering facilities.

While state funds are primarily used to provide direct financial assistance to farmers for the implementation of conservation practices, state funds also provide direct financial assistance to partners used to deliver technical assistance to help farmers wishing to implement and report conservation practices. Technical assistance efforts of partners, such as University of Vermont Extension and Natural Resources Conservation Districts, funded through AAFM programs have resulted in nearly 11,000 acres of agricultural conservation practices implemented and over 1,000 acres of pasture with livestock excluded from surface water, among other practices.

[19] The number of water quality compliance farm visits declined in SFY 2021 due to the COVID-19 pandemic limiting in-person inspection efforts.

[20] SFY 2016-2018 datasets are incomplete and do not fully account for all acres of production area inspected by AAFM for RAP compliance due to the initiation of this tracking mechanism. Acres of production area inspected reported in 2021 report differ from acres reported in 2020 report due to 1% of data being updated for accuracy.

Figure 18. Manure injection toolbar attachment to inject manure below the soil surface reducing field runoff purchased in the Missisquoi River Basin. This project was funded through the Vermont Agency of Agriculture, Food and Markets Capital Equipment Assistance Program and completed in April 2021.

Figure 19. Livestock watering tub installed with other rotational grazing system improvements to reduce grazing impacts to waterways in the Missisquoi River Basin. This project was funded through the Vermont Agency of Agriculture, Food and Markets Pasture Surface Water Fencing Program. It was completed in September 2020.

Statewide Results of Natural Resource Restoration Projects

Natural resource restoration projects involve the restoration and protection of "natural infrastructure" functions that prevent and abate nutrient and sediment pollution. Natural infrastructure includes floodplains, river channels, lakeshores, wetlands, and forest lands. The following table summarizes project outputs associated with state-funded natural resources restoration projects.

Table 6. Outputs of state-funded natural resources restoration projects implemented statewide, SFY 2016-2021. Project development measures support the identification, prioritization, and design of projects. Project output measures reflect extent of project implementation/construction.

Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Stream miles assessed by Stream Geomorphic Assessment, River Corridor Plan	113	29	72	9	–	59	282
Number of natural resources restoration projects identified[21]	125	17	136	316	36	44	674
Acres of river corridor scoped for easement	17	14	–	280	–	–	311
Number of preliminary (30%) designs completed	10	–	–	22	9	1	42
Number of final (100%) designs completed	9	6	24	5	8	10	62
Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of forested riparian buffer restored through buffer planting	85	32	63	58	13	52	303
Acres of floodplain restored	1	2	4	1	32	10	50
Acres of lakeshore restored	<1	–	9	1	<1	–	11
Stream miles reconnected for restoring rivers to the least erosive condition and regaining fish passage	32	100	124	157	45	30	488
Acres of wetland conserved and restored through easements	–	131	44	229	167	235	806
Acres of riparian corridor conserved and restored through easements	141	208	236	49	250	174	1,059
Acres of land conserved with natural resources protections	1,560	3,356	1,554	447	11,688	3,547	22,151
Miles of forest road drainage and erosion control improvements	–	<1	–	8	3	–	12
Number of stream crossings improved	–	–	1	19	10	–	30
Square feet of gully erosion remediated	–	–	50,660	135	305	–	51,100

21 Number of natural resources restoration projects identified includes projects resulting from River Corridor Plans, Stream Geomorphic Assessments, and Lake Watershed Action Plans, as well as projects identified for river corridor easement, riparian buffer planting, dam removal, and wetland restoration.

EXPLANATION OF TABLE

State funds supported over 300 acres of forested riparian (adjacent to waterways) buffer plantings from SFY 2016-2021, which capture sediment and pollutant runoff from the landscape and protect streambanks from erosion. State funds have also incentivized the restoration or conservation of over 800 wetland acres, 1,000 riparian corridor acres, and 1,100 forestland acres adjacent to waterways through conservation easements since SFY 2016, supporting water quality, flood resilience, and habitat functions. In addition, state funding and financing has assisted in conserving over 21,000 acres of lands, largely though VHCB conservation grants, as well as the Land Conservation Interim Financing Loan program. Interim financing provides access to capital to act on time-sensitive conservation opportunities and allows partners to secure funds to repay the loan over the course of five years.

From SFY 2016 to 2021, over 480 stream miles have been reconnected by the removal of dams and removal or upgrades of undersized culverts. In addition, there have been 42 acres of floodplain restored or reconnected in SFY 2020 and 2021, as compared to only 8 acres from SFY 2016 to 2019. Reconnecting streams by removing impediments and restoring access to a floodplain allows streams to regain a more natural state of equilibrium, which is the least erosive condition. This allows space for a stream to meander and for floodwaters to spread out and slow down across floodplains, thus removing nutrient and sediment pollution from the stream.

Natural resources restoration projects are voluntary, and results may vary year-to-year depending on landowner willingness to participate and other factors. This highlights the need to continue building partner capacity and outreach to increase participation.

Figure 20. Before (left) and after (right) removal of the Eaton dam, which reconnected 30 miles of the White River. The removal was funded by Clean Water Initiative Program in partnership with the White River Partnership. It was completed November 2020.

Statewide Results of Developed Lands Projects

Developed lands projects treat polluted stormwater runoff and mitigate erosion containing nutrient (e.g., phosphorus and nitrogen) and sediment pollution from impervious surfaces, such as roads, parking lots, sidewalks, and rooftops. Stormwater treatment and road remediation projects are classified under the developed lands sector. Stormwater treatment practices capture and treat flow from parking lots, sidewalks, and rooftops, while road improvement projects reduce erosion and mitigating pollutants from road-related sources. The following table summarizes project outputs associated with state-funded and regulatory developed lands projects.

Table 7. Outputs of stormwater treatment and road erosion remediation projects implemented statewide, reported through state funding programs or regulatory programs, SFY 2016-2021. Project development measures support the identification, prioritization, and design of projects. Project output measures reflect extent of project implementation/construction. Note that regulatory measures are reported through regulatory programs and not tied to state funding programs. State and federal programs may provide funding to satisfy regulatory requirements.

Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Number of projects identified through Stormwater Master Plans	52	120	141	128	197	19	657
Number of illicit/unauthorized discharges confirmed (to be addressed by the responsible municipality or landowner)	40	9	1	52	14	6	122
Number of preliminary (30%) designs completed	19	13	58	30	67	4	191
Number of final (100%) designs completed	9	20	13	20	35	7	104
Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of existing impervious surface treated by stormwater treatment practices	<1	87	34	135	178	9	442
Miles of municipal road drainage and erosion control improvements	1	12	68	88	43	48	260
Number of municipal road drainage and stream culverts replaced	–	104	134	245	119	182	784
Cubic yards of Class 4 road gully erosion remediated	–	–	260	33	–	5	298
Cubic yards of catch basin outlet erosion remediated	–	–	1	784	-	24	809
Acres stabilized through use of seeding/mulching equipment per year	–	–	19	98	248	166	531
Regulatory Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of existing impervious surface treated by stormwater treatment practices under stormwater permits	7	34	97	153	90	22	404
Acres of new impervious surface treated by stormwater treatment practices under stormwater permits	–	–	249	237	142	62	691

Hydrologically connected municipal road miles inventoried[22]	11	799	1,655	1,462	1,183	727	5,836
Hydrologically connected municipal road miles identified as requiring water quality improvements	5	267	675	561	609	355	2,471

EXPLANATION OF TABLE

Stormwater Master Plans and Road Erosion Inventories identify and prioritize stormwater and road erosion remediation projects, respectively. Over 650 stormwater projects have been identified through Stormwater Master Plans since SFY 2016.

State-funded stormwater treatment practices have treated over 440 acres of existing impervious surfaces since SFY 2016; some projects were voluntary, and others were compelled by stormwater regulations. From SFY 2016 to 2021, the Municipal Roads Grants-in-Aid Program and VTrans Better Roads Program have resulted in 260 miles of municipal road drainage and erosion control improvements and replaced 784 municipal road drainage and stream culverts to improve road runoff for water quality.

Operational stormwater permits require treatment of runoff from new development or redevelopment of a certain size and are not funded with state dollars. In addition, Municipal Separate Storm Sewer System (MS4) Permits require designated urbanized communities to manage stormwater discharges from those areas. MS4 communities can receive partial funding for the implementation of MS4 projects that address existing untreated or under-treated impervious surface. Since SFY 2016, nearly 700 acres of new, and 400 acres of existing impervious have been permitted and require treatment to the state standards. See Appendix D for more information on stormwater permit outputs.

The number of hydrologically connected (i.e., road segments adjacent to or intersecting surface waters) municipal road miles inventoried has increased, as municipalities were required to submit Road Erosion Inventories by the end of 2020 to comply with the Municipal Roads General Permit (MRGP). Road Erosion Inventories have covered over 5,800 hydrologically connected municipal road miles, of which, approximately 42 percent were identified as requiring water quality improvements. Since Vermont has approximately 6,500 miles of roads that fall under MRGP jurisdiction, inventories completed and submitted at the close of SFY 2021 represent about 90 percent of required inventories.

Figure 21. (Left) Stormwater runoff from agricultural fields and private land caused significant gully erosion into the West Branch of the New Haven River in the town of Bristol. (Right) The gully was restored and stabilized with a stone lined swale with check dams and plantings in March 2020. Implemented in partnership with Otter Creek Natural Resources Conservation District and funded by the Clean Water Initiative Program.

[22] Note state funding programs supported the implementation of required road erosion inventories. Road erosion inventory data come directly from the MRGP database.

Statewide Results of Wastewater Treatment Projects

Wastewater treatment projects decrease nutrients (e.g., phosphorus and nitrogen) and other pollutants from municipal wastewater systems through treatment upgrades, combined sewer overflow (CSO) abatement, and refurbishment of aging infrastructure. The following table summarizes project outputs associated with state-funded wastewater treatment projects.

Table 8. Outputs of state-funded wastewater treatment projects implemented statewide, SFY 2016-2021. Project development measures support the identification, prioritization, and design of projects. Project output measures reflect extent of project implementation/construction.

Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Number of preliminary (30%) designs completed	–	4	4	8	7	–	23
Number of final (100%) designs completed	4	4	8	1	2	–	19
Number of municipal wastewater asset management plans completed	–	2	4	4	–	–	10
Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Number of combined sewer overflow abatements completed	3	–	–	1	2	–	6
Number of sewer extensions completed	–	1	–	–	–	–	1
Number of wastewater collection systems refurbished	–	1	1	2	2	–	6
Number of wastewater treatment facilities refurbished	–	–	–	2	3	–	5
Number of wastewater treatment facility upgrades completed	1	4	1	–	–	–	6

EXPLANATION OF TABLE

There were no new wastewater projects completed statewide in SFY 2021. Municipal wastewater improvement projects are very large and take a long time to complete so results can vary widely year to year. Some projects improve treatment within facilities while others may extend sewer service area to address failed or failing septic systems in designated centers. State grants and low interest loans capitalized through the Vermont and U.S. Environmental Protection Agency (EPA) Clean Water State Revolving Fund (CWSRF) finance municipal wastewater improvements.

Figure 22. A wastewater disposal mound is a soil absorption system placed above the natural surface of the ground. The Town of Addison installed a community wastewater disposal mound system to treat municipal waste in June 2019. The project was financed by the Clean Water State Revolving fund.

Estimated Total Phosphorus Load Reductions of State Investments

The State of Vermont estimates pollutant reductions associated with clean water projects to track progress towards achieving water quality goals. Currently, phosphorus reductions can only be estimated in the Lake Champlain and Lake Memphremagog basins.[23] Phosphorus reductions are summarized for Lake Champlain in Chapter 3 and Lake Memphremagog in Chapter 4. The following figure summarizes the estimated phosphorus reductions associated with state-funded clean water projects, by land use sector, in both the Lake Champlain and Lake Memphremagog basins.

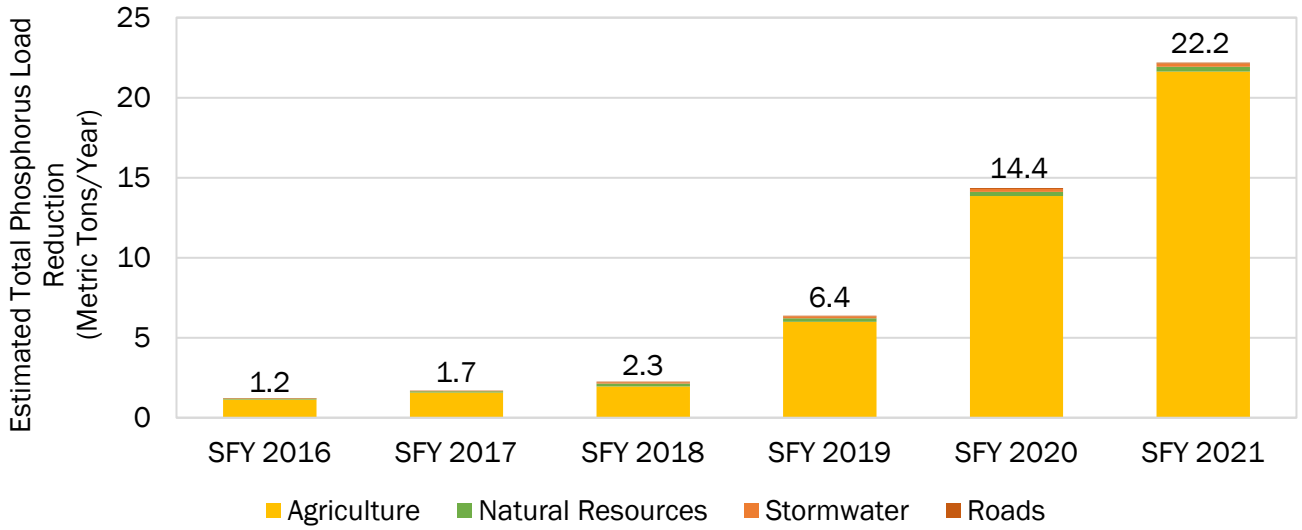


Figure 23. Annual estimated total phosphorus load reductions (metric tons per year) associated with state-funded clean water projects in the Lake Champlain and Lake Memphremagog basins by land use sector, SFY 2016-2021.[24]

EXPLANATION OF FIGURE

State funding programs are estimated to have reduced over 22 metric tons of total phosphorus loading to Lake Champlain and Lake Memphremagog combined in SFY 2021. Estimated total phosphorus load reductions have increased 20-fold from SFY 2016 to 2021. Over 96 percent of the estimated reductions reported at this time are in the agricultural sector. This is partially due to gaps in methods to account for phosphorus reductions in other sectors. Forty-four percent of all state-funded reductions reported in SFY 2021 were due to the implementation of cover crop, which establishes seasonal cover on annual cropland for soil erosion reduction and conservation purposes.

It is important to note that many agricultural reductions have a one-year lifespan (e.g., cover crop, manure injection). If this level of effort is not maintained each year, the phosphorus reductions will not carry through to future years. Structural projects, such as stormwater treatment practices or forested riparian buffers, in contrast, have longer term lifespans (10-20 years or more if properly maintained) and phosphorus reductions achieved by these projects will continue in future years. Note estimated total phosphorus load reductions have changed compared to the *Vermont Clean Water Initiative 2020 Performance Report* due to improved clean water project tracking and accounting.

23 For more information on the methods used to estimate phosphorus reductions: https://dec.vermont.gov/water-investment/cwi/projects/tracking-accounting

24 Note that phosphorus reductions from state regulatory programs (e.g., production area compliance, operational stormwater permits) are not included here in order to illustrate the impact of state funding programs. However, it should be noted that some regulatory projects that receive state funding (e.g., road improvements under the Municipal Roads General Permit) are included.

Cost Effectiveness of State Clean Water Investments

The previous section of this report summarizes the results of state-funded clean water projects completed from SFY 2016 to SFY 2021. Given the significant costs of restoring and protecting water quality, the state must spend its resources efficiently and effectively. The cost effectiveness of clean water projects is expressed as the state-dollars per kilogram of estimated total phosphorus load reduction over the anticipated lifespan of the project. If projects are maintained beyond their anticipated lifespan, cost effectiveness estimates would improve. Cost effectiveness can only be calculated for project types where estimated total phosphorus load reductions and cost data are available at the project level. Local and federal leveraged funds associated with state-funded projects are not included in the calculation of state-funded cost effectiveness. Refer to the Clean Water Interactive Dashboard for information on cost effectiveness including leveraged funds.[25] The "violin plot" below summarizes the cost effectiveness of state clean water investments in reducing phosphorus pollution by project type.

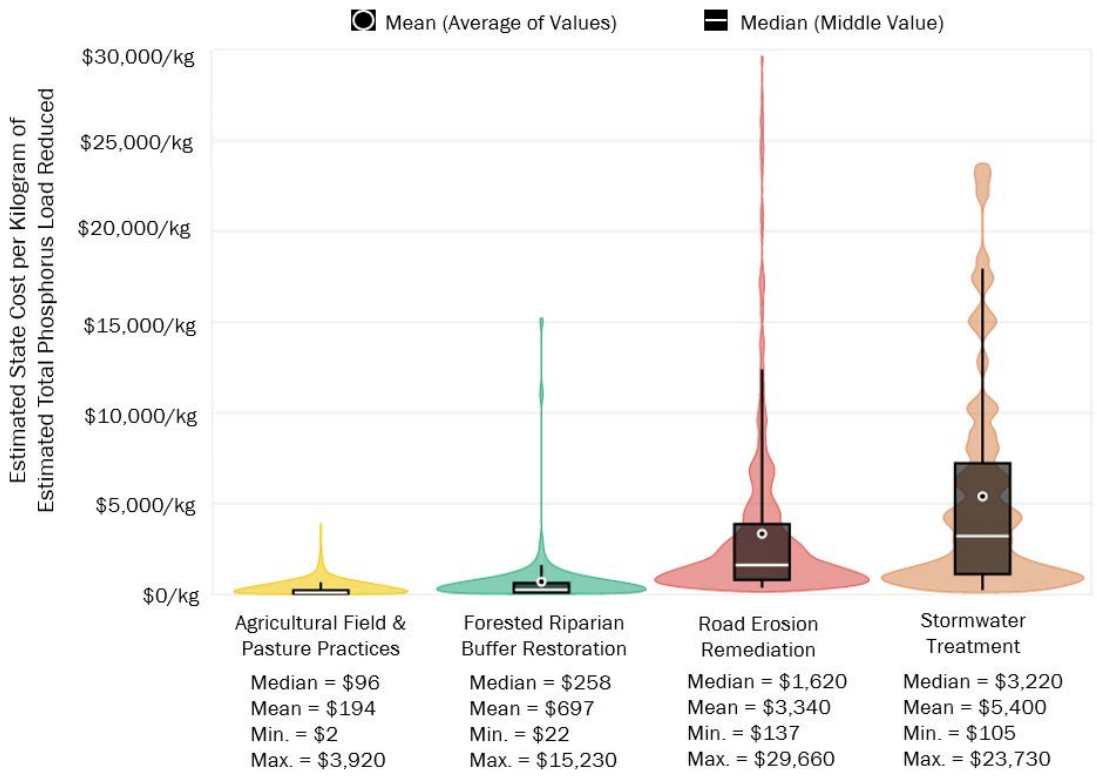


Figure 24. State investment per estimated kilogram of total phosphorus load reduced over the lifespan of each project type, based on clean water projects funded through State of Vermont agencies completed SFY 2016-2021 (excludes local and federal leveraged funds).[26]

FIGURE GUIDE

The violin plots, pictured at left, combine a box plot (see black rectangles/lines) and a density plot (see colored shapes).

A box plot shows the minimum, maximum, median, and average cost effectiveness values.

A density plot shows the relative number of projects falling into each range of cost effectiveness. Wider sections of the colored shapes represent more projects than thinner sections.

25 Access the Clean Water Interactive Dashboard here: https://anrweb.vt.gov/DEC/cleanWaterDashboard/

26 Note that 19 road projects with cost effectiveness greater than $30,000/kg were removed from this analysis due to some project costs being associated with project components not related to phosphorus reductions (e.g., stream culvert upgrades).

EXPLANATION OF FIGURE

Achieving Vermont's water quality goals requires action across all land use sectors. The key is to target funds to the most cost-effective projects within each land use sector. The State of Vermont employs science-based assessments to identify and prioritize projects and incorporates those prioritized actions in Tactical Basin Plans. The figure above shows the variation and distribution of cost effectiveness across four sectors. The cost effectiveness calculation is *only* feasible for projects where cost data and estimated total phosphorus load reductions are available at the project-level.

Agricultural field and pasture practices (e.g., cover crops, conservation tillage, agricultural riparian buffers) are generally the most cost-effective at reducing total phosphorus loading, costing a median of $96 of state investment per kilogram of estimated total phosphorus load reduced annually. Agricultural field and pasture practices, however, generally have shorter lifespans (i.e., generally one year) compared to structural projects (i.e., generally 10-20 years).

Forested riparian buffer restoration is also a relatively cost-effective practice, costing a median of $258 of state investment per kilogram of estimated total phosphorus load reduced annually. Riparian buffers have longer lifespans (i.e., minimum 10-20 years) than most agricultural field and pasture projects. Note that riparian buffers on agricultural lands are included under "agricultural field and pasture projects". The "forested riparian buffer restoration" category refers to buffer plantings on all other land uses (e.g., mixed forest, developed lands). The state is working to account for pollutant reductions in other natural resource projects, such as floodplain and streambank restoration, in future years.

Road erosion remediation projects have the greatest variability in cost effectiveness, ranging from $137 to $29,660 of state investment per kilogram of estimated total phosphorus load reduced annually. Despite the large range, most road projects are clustered near the median of $1,620 of state investment per kilogram of estimated total phosphorus load reduced annually. The large range in the cost effectiveness of road practices may be result of municipalities remediating the highest priority, most complex road segments (and therefore most expensive road segments) first to comply with the Municipal Roads General Permit (MRGP). Additionally, road project costs and complexity can vary based on what practices need to be installed to bring a road segment up to MRGP standards.

Stormwater treatment is the relatively most expensive per unit phosphorus load reduced compared to other project types shown in the figure, costing a median of $3,220 of state investment per kilogram of estimated total phosphorus load reduced annually. Stormwater practices are engineered structural practices that can incur high construction costs, but these practices have relatively longer lifespans and can achieve phosphorus load reductions for 20 years or more, if properly maintained. Incorporating stormwater treatment into an already developed landscape is necessary but could be somewhat expensive due to inherent site constraints. This points to the importance of integrating stormwater mitigation as part of new development and redevelopment moving forward.

The following project types are not included in the cost effectiveness analysis.

- Wastewater treatment is not included, as reductions from wastewater treatment are not measured at the project-level.
- Agricultural barnyard and production area management projects are not included, as estimated total phosphorus load reductions from agricultural barnyard and production area management are estimated based on compliance status for the whole production area and not at the individual project-level.
- CEAP-funded agricultural equipment are not included because state cost data are associated directly with equipment purchases rather than cost of implementing practices.
- Agricultural practices implemented without financial assistance from AAFM but tracked through state funded technical assistance are also not included here because the cost data are associated with technical assistance activities rather than cost of implementing practices.

Chapter 3: Lake Champlain Basin Clean Water Investments, Results, and TMDL Progress

Lake Champlain is one of the largest lakes in North America and its watershed drains nearly half the land area of Vermont, as well as portions of northeastern New York and southern Quebec. Phosphorus levels in Lake Champlain typically exceed Vermont's water quality standards, which contributes to cyanobacteria blooms, low dissolved oxygen concentration, impaired aquatic life, and reduced recreational use. The Lake Champlain restoration plan, titled *Phosphorus Total Maximum Daily Loads for Vermont Segments of Lake Champlain* (i.e., Lake Champlain TMDL), identifies phosphorus load reductions that must be achieved in all 12 segments of Lake Champlain to meet State of Vermont water quality standards.[27] Total phosphorus loading to Lake Champlain from Vermont was modeled to be 631 metric tons per year during the TMDL baseline period of 2001 to 2010. The TMDL states total phosphorus loading to the lake must be reduced to 418 metric tons per year by 2038 to achieve Vermont's water quality standards, a 212 metric ton reduction from the baseline.

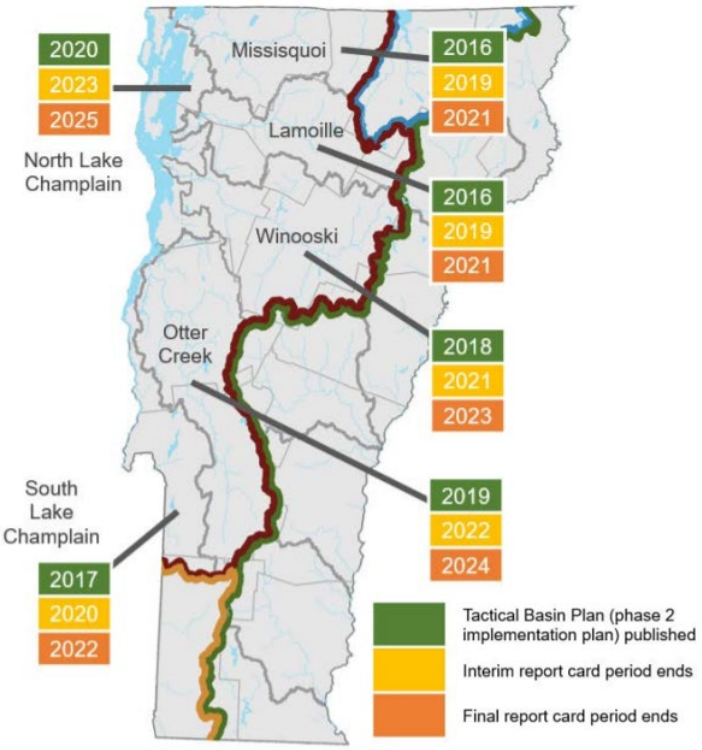


Figure 25. Lake Champlain TMDL Accountability Framework schedule by Tactical Basin Plan watershed

The Lake Champlain TMDL contains an Accountability Framework intended to ensure adequate progress toward reducing phosphorus pollution to Lake Champlain. The Framework sets a schedule for U.S. Environmental Protection Agency (EPA) to issue report cards on the State of Vermont's progress throughout the 20-year implementation timeframe (2017-2038). Tactical Basin Plans are updated on a five-year rotating basis and include Implementation Tables with priority actions to implement the Lake Champlain TMDL. EPA will issue interim report cards halfway through the five-year planning cycle and final report cards at the end of the five-year planning cycle based on progress reports produced by DEC (Figure 25).[28] EPA uses this chapter of the *Clean Water Initiative Annual Performance Report* and its appendices to help determine satisfactory progress for the Lake Champlain TMDL. The following progress reports for the 2021 reporting cycle are included in Appendices A, B, and C respectively: Missisquoi River (Basin 6) final progress report, Lamoille River (Basin 7) final progress report, and Winooski River (Basin 8) interim progress report.

[27] *Phosphorus Total Maximum Daily Loads for Vermont Segments of Lake Champlain* available at: https://dec.vermont.gov/watershed/restoring/champlain.

[28] Further Lake Champlain TMDL Implementation Progress Report information available at: https://www.epa.gov/tmdl/tmdl-implementation-progress-reports-epa-report-cards-and-related-correspondence-between-epa

The following chapter of the report summarizes the state, federal, and regulatory clean water efforts in the Lake Champlain basin that are contributing to Lake Champlain TMDL progress. This section also summarizes high-level information on the health of Lake Champlain, as originally reported in the Lake Champlain Basin Program's *2021 State of the Lake Report*. For more information on the variables that effect realized water quality conditions in Lake Champlain, see Chapter 6 of this report.

Clean Water Investments in the Lake Champlain Basin

Reaching Lake Champlain's water quality goals requires investments across all land use sectors. The following figure summarizes state funding plus direct Lake Champlain Basin Program funding in the Lake Champlain basin from SFY 2016 to 2021.

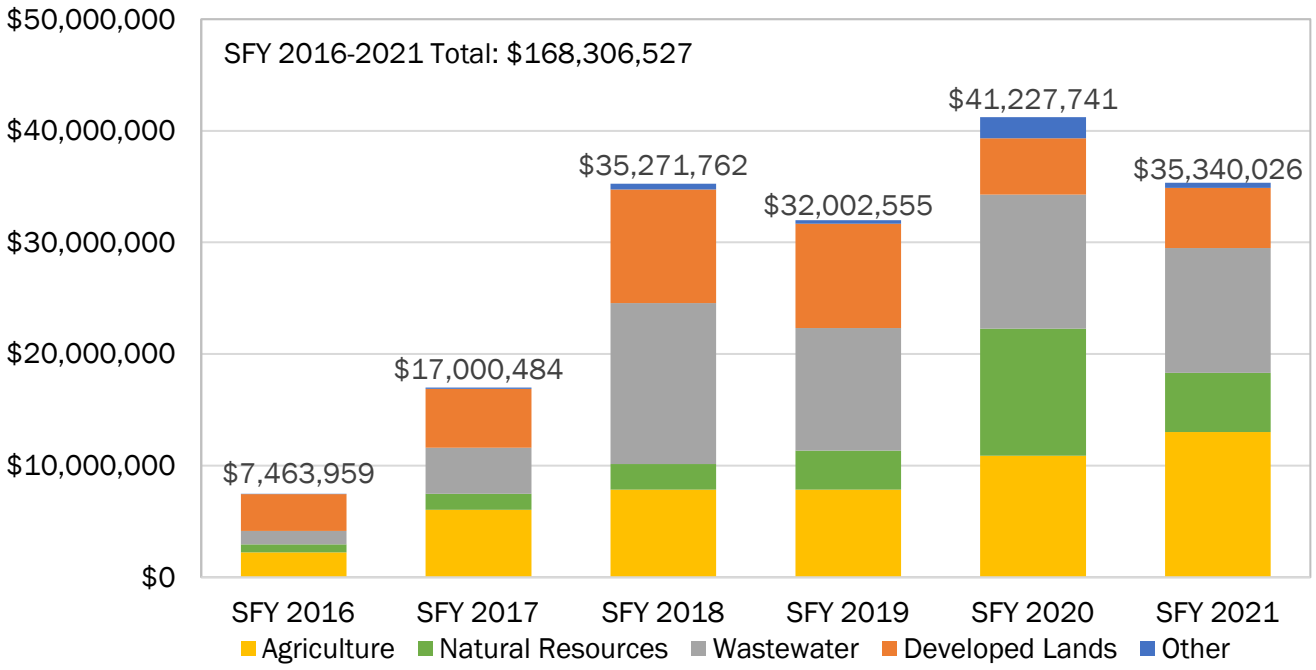


Figure 26. Total dollars awarded by State of Vermont agencies and Lake Champlain Basin Program to clean water projects in the Lake Champlain basin by land use sector, SFY 2016-2021.

EXPLANATION OF FIGURE

The State of Vermont and Lake Champlain Basin Program have invested over $168 million in clean water projects in the Lake Champlain basin, and clean water investments have increased approximately five-fold from SFY 2016 to SFY 2021. Funding is well distributed across all land use sectors across all years, with sectors averaging the following percentages of total funding.

Agriculture = 28%	Natural Resources = 15%	Other = 2%
Wastewater = 32%	Developed Lands = 23%	

Clean water funding awarded to projects varies from year-to-year based on project readiness. However, the COVID-19 pandemic's impact on the economy affected Clean Water Fund revenue sources in SFY 2021. This led to a slight reduction in appropriation and a temporary slowdown of funding programs. Note federal funding data (e.g., USDA NRCS) are not included in this figure as they are outside the scope of this report.

Results of Vermont's Clean Water Investments in the Lake Champlain Basin

Clean water projects in the Lake Champlain basin target nutrient and sediment pollution across various land use sectors. The following section summarizes the project outputs and phosphorus load reduction estimates associated with state-funded, federally funded, and regulatory clean water projects in the Lake Champlain basin. The following tables summarize project outputs of all clean water projects in the Lake Champlain basin from SFY 2016 to 2021. Note some measures have been rounded to the nearest whole numbers for reporting purposes, but totals have been calculated using unrounded numbers.

Table 9. Outputs of clean water projects implemented in the Lake Champlain basin by land use sector reported through state funding programs or regulatory programs, SFY 2016-2021. Project development measures support the identification, prioritization, and design of projects. Project output measures reflect extent of project implementation/construction. Note that regulatory measures are reported through regulatory programs and not tied to state funding programs. State and federal programs may provide funding to satisfy regulatory requirements.

State-Funded Agricultural Project Output Measures[29]	2016	2017	2018	2019	2020	2021	Total
Acres of agricultural conservation practices implemented (excluding practice types listed below) [30]	4,086	2,938	5,544	12,922	20,591	17,313	63,394
Acres of agricultural forested and filter strip buffers installed	33	24	42	–	–	35	134
Acres of pasture with livestock excluded from surface water	166	89	97	47	10	62	471
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures	51	73	68	59	100	106	457
Acres of water quality protections within newly conserved agricultural lands	–	92	167	457	247	137	1,100
Acres of agricultural land treated through innovative equipment	–	1,511	6,025	12,612	23,078	17,047	60,273
Agricultural Project Output Measures Supported by State Technical Assistance[31]	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of agricultural conservation practices implemented, supported by state-funded technical assistance (excluding practice types listed below)	52	65	83	1,668	2,141	6,458	10,467

[29] Agricultural project output measures can overlap with other project output measures if multiple practices were applied on the same field. For example, 10 acres of manure injection and 10 acres of cover crop applied on the same field will result in 20 acres of agricultural conservation practices implemented. Similarly, practices implemented on the same field over multiple years will be counted for each year implemented. For example, 10 acres of cover crop implemented on the same field in 2016, 2017, and 2018 will result in 30 acres of agricultural conservation practices implemented. Total agricultural project outputs column represents the total level of effort of state funding programs, rather than the number of distinct agricultural acres addressed.

[30] Acres of agricultural conservation practices includes aeration, conservation crop rotation, cover crop, crop to hay, grassed waterways, manure injection, conservation tillage, and rotational grazing.

[31] Agricultural conservation practices reported through technical assistance represent agricultural conservation practices implemented without financial assistance from state programs reported through technical assistance funded by state programs.

Acres of pasture with livestock excluded from surface water, supported by state-funded technical assistance	–	–	–	19	824	46	889
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures, supported by state-funded technical assistance	–	–	–	1	2	–	3
Number of farms receiving nutrient management planning assistance	–	–	2	26	25	9	62
Agricultural Regulatory Measures	2016	2017	2018	2019	2020	2021	Total
Number of water quality compliance farm visits conducted by AAFM to ensure compliance with Required Agricultural Practices (RAPs) and Medium Farm Operation (MFO) and Large Farm Operation (LFO) Rules[32]	–	–	–	–	–	128	128
Acres of production area inspected by AAFM for RAP compliance[33]	–	1,294	861	1,728	2,087	1,975	7,945

State-Funded Natural Resources Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Stream miles assessed by Stream Geomorphic Assessment, River Corridor Plan	33	–	46	–	–	30	108
Number of natural resources restoration project identified	51	–	68	260	36	18	433
Acres of river corridor scoped for easement	17	–	–	–	–	–	17
Number of preliminary (30%) designs completed	4	–	–	6	9	1	20
Number of final (100%) designs completed	7	3	9	3	1	1	24
State-Funded Natural Resources Project Output Measures	2016	2017	2018	2019	2020	2021	Total
Acres of forested riparian buffer restored through buffer planting	58	16	27	45	11	28	184
Acres of riparian corridor conserved and restored through easements	21	123	86	49	250	153	683
Acres of floodplain restored	–	2	4	–	12	<1	19
Acres of lakeshore restored	–	–	5	1	<1	–	6
Stream miles reconnected for restoring rivers to the least erosive condition and regaining fish passage	4	2	5	–	30	–	41
Acres of wetland conserved and restored through easements	–	131	40	229	167	235	803
Acres of land conserved with natural resources protections	–	3,049	935	447	8,658	1,101	14,189

[32] The number of water quality compliance farm visits conducted by AAFM to ensure compliance for SFY 2016-2020 and previous years is available on a statewide basis only.

[33] SFY 2016-2018 datasets are incomplete and do not fully account for all acres of production area inspected by AAFM for RAP compliance due to the initiation of this tracking mechanism.

Miles of forest road drainage and erosion control improvements	–	–	–	7	–	–	7
Number of stream crossings improved	–	–	1	13	–	–	14
Square feet of gully erosion remediated	–	–	50,660	81	105	–	50,846

State-Funded Developed Lands Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Number of projects identified through Stormwater Master Plans	29	88	101	107	128	19	472
Number of illicit/unauthorized discharges confirmed	16	–	1	9	8	2	36
Number of preliminary (30%) designs completed	13	9	47	22	49	3	142
Number of final (100%) designs completed	5	20	8	18	27	1	79
State-Funded Developed Lands Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of existing impervious surface treated by stormwater treatment practices	<1	45	27	126	173	9	381
Miles of municipal road drainage and erosion control improvements	1	5	35	39	17	21	117
Number of municipal road drainage and stream culverts replaced	–	34	81	133	41	81	370
Cubic yards of Class IV Road gully erosion remediated	–	–	112	<1	–	3	115
Cubic yards of catch basin outlet erosion remediated	–	–	1	691	-	24	716
Acres stabilized through use of seeding/mulching equipment per year	–	–	1	90	15	166	272
Regulatory Developed Lands Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of existing impervious surface treated by stormwater treatment practices	7	34	84	153	88	22	389
Acres of new impervious surface treated by stormwater treatment practices	–	–	235	236	128	61	660
Hydrologically connected municipal road miles inventoried[34]	11	707	744	568	472	248	2,750
Hydrologically connected municipal road miles identified that require water quality improvements	5	218	220	206	240	143	1,032

State-Funded Wastewater Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Number of preliminary (30%) designs completed	–	3	2	8	6	–	19
Number of final (100%) designs completed	1	–	3	–	2	–	6

[34] Note state funding programs supported the implementation of required road erosion inventories. Road erosion inventory data come directly from the MRGP database.

Number of municipal wastewater asset management plans completed	–	–	1	–	–	–	1
State-Funded Wastewater Project Output Measures	2016	2017	2018	2019	2020	2021	Total
Number of combined sewer overflow abatements completed	1	–	–	–	1	–	2
Number of wastewater collection systems refurbished	–	1	–	2	2	–	5
Number of wastewater treatment facility upgrades completed	1	4	1	–	–	–	6

EXPLANATION OF TABLE

The combination of $166 million of state clean water investments and regulatory requirements in the Lake Champlain basin have resulted in hundreds of clean water projects from SFY 2016 to 2021. Projects are well distributed across sectors as is required by the Lake Champlain TMDL. In the agricultural sector, AAFM's Farm Agronomic Practice (FAP) Program has funded the implementation of over 63,000 acres of agricultural conservation practices (e.g., cover crops, conservation tillage, and manure injection). In the developed lands sector, regulatory programs have bolstered the implementation of clean water projects through the Municipal Roads General Permit (MRGP), Municipal Separate Storm Sewer (MS4) permits and stormwater operational permits. In the natural resources sector, over 680 acres of riparian corridor have been conserved and restored through easements and 184 acres of forested riparian buffer have been restored through buffer plantings. Wastewater funding has resulted in the completion of two CSO abatements, five wastewater collection system refurbished, and six wastewater treatment facilities refurbished. Wastewater projects are large, complex, and expensive; therefore, the magnitude of the project outputs is lower than for other land use sectors.

The State of Vermont works closely with federal partners to make progress towards clean water goals in the Lake Champlain Basin. The following table displays project output data originating from federal partners; the USDA-NRCS and Lake Champlain Basin Program.

Table 10. Outputs of *federally funded* clean water projects completed in the Lake Champlain basin, SFY 2016-2021. Project development measures support the identification, prioritization, and design of projects. Project output measures reflect extent of project implementation/construction.

Federally Funded Agricultural Project Output Measures[35]	2016	2017	2018	2019	2020	2021	Total
Acres of agricultural conservation practices implemented (excluding practice types listed below)	29,693	33,596	35,281	29,648	22,378	20,839	171,435
Acres of agricultural forested and filter strip buffers installed	11	1	20	–	1	42	75
Acres of nutrient management	6,073	6,253	6,853	6,334	7,137	7,102	39,753

[35] Agricultural project output measures can overlap with other project output measures if multiple practices were applied on the same field. For example, 10 acres of manure injection and 10 acres of cover crop applied on the same field will result in 20 acres of agricultural conservation practices implemented. Similarly, practices implemented on the same field over multiple years will be counted for each year implemented. For example, 10 acres of cover crop implemented on the same field in 2016, 2017, and 2018 will result in 30 acres of agricultural conservation practices implemented. Total agricultural project outputs column represents the total level of effort of federal funding programs, rather than the number of distinct agricultural acres addressed.

Acres of pasture with livestock excluded from surface water	8	–	–	–	–	54	62
Number of structural agricultural practices installed in barnyard/ production areas, fields, and pastures	530	402	375	330	375	364	2,376
Agricultural Project Output Measures Supported by Federal Technical Assistance[36]	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of agricultural conservation practices implemented, supported by federally funded technical assistance (excluding practice types listed below)	1,678	2,014	5,188	6,779	4,415	2,952	23,026
Acres of agricultural forested & filter strip buffers installed, supported by federally funded technical assistance	–	–	–	<1	–	6	7
Acres of nutrient management, supported by federally funded technical assistance	4,483	2,773	–	441	488	3,598	11,783
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures, supported by federally funded technical assistance	–	4	–	–	1	–	5

Federally Funded Natural Resources Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Number of natural resources restoration project identified	–	–	–	1	–	78	79
Number of final (100%) designs completed	–	1	–	–	–	1	2
Federally Funded Natural Resources Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of forested riparian buffer restored through buffer planting	4	–	6	5	2	–	17
Acres conserved with natural resources protections	127	–	–	–	–	–	127
Acres of floodplain restored	–	–	–	–	–	2	2
Stream miles reconnected for restoring rivers to the least erosive condition and regaining fish passage	–	–	–	–	–	31	31
Acres of wetland conserved and restored through easements	–	–	11	–	–	–	11
Number of stream crossings improved	–	–	–	–	1	2	3

Federally Funded Developed Lands Project Development Measures	2016	2017	2018	2019	2020	2021	Total

[36] Agricultural conservation practices reported through technical assistance represent agricultural conservation practices implemented without financial assistance from federal programs reported through technical assistance funded by federal programs.

Number of projects identified through Stormwater Master Plans	–	33	10	46	201	–	290
Number of preliminary (30%) designs completed	–	12	–	6	6	–	24
Number of final (100%) designs completed	4	7	4	8	11	1	35
Federally Funded Developed Lands Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of existing impervious surface treated by stormwater treatment practices	6	4	2.2	2	6	1.8	21

Federally Funded Wastewater Project Output Measures	2016	2017	2018	2019	2020	2021	Total
Number of municipal wastewater asset management plans completed	–	–	–	5	–	–	5

EXPLANATION OF TABLE

Federal clean water funding in the Lake Champlain Basin comes from USDA-NRCS and the Lake Champlain Basin Program. USDA-NRCS has funded the implementation of over 170,000 agricultural conservation practices plus an additional 40,000 acres of nutrient management. Nutrient management is managing the amount, source, placement, and timing of plant nutrients and soil amendments to minimize agricultural nonpoint source pollution, maintain or improve soil conditions, protect air quality, reduce input costs, and improve crop production. Federal technical assistance has also resulted in an additional nearly 23,000 acres of agricultural conservation practices and nearly 12,000 acres of nutrient management implemented without direct financial assistance.

The Lake Champlain Basin Program (LCBP) investments are mostly within the developed lands and natural resources sector. LCBP has funded the development of several stormwater master plans and other stormwater design projects that have resulted in 350 stormwater projects identified. LCBP projects have also resulted in 21 acres of existing impervious surfaces treated by stormwater treatment practices. In the natural resources sector, LCBP has funded 17 acres of forested riparian buffer plantings, conserved 11 acres of wetlands through easements, and reconnected 31 stream miles for stream equilibrium and fish passage.

Figure 27. (Left) A berm blocked the floodplain of Beecher Hill Brook at the Hinesburg Town Garage. (Right) Floodplain restoration eliminated encroachments and restored a naturally functioning floodplain to establish a stable long-term channel. This project was funded by the Clean Water Initiative Program in partnership with the Lewis Creek Association.

Estimated Total Phosphorus Load Reductions in Lake Champlain Basin

The State of Vermont estimates the pollutant load reductions associated with clean water projects track progress towards achieving water quality goals. The following figure summarizes the estimated total phosphorus load reductions associated with state, federal, and regulatory projects in the Lake Champlain basin from SFY 2016 to 2021 by land use sector.

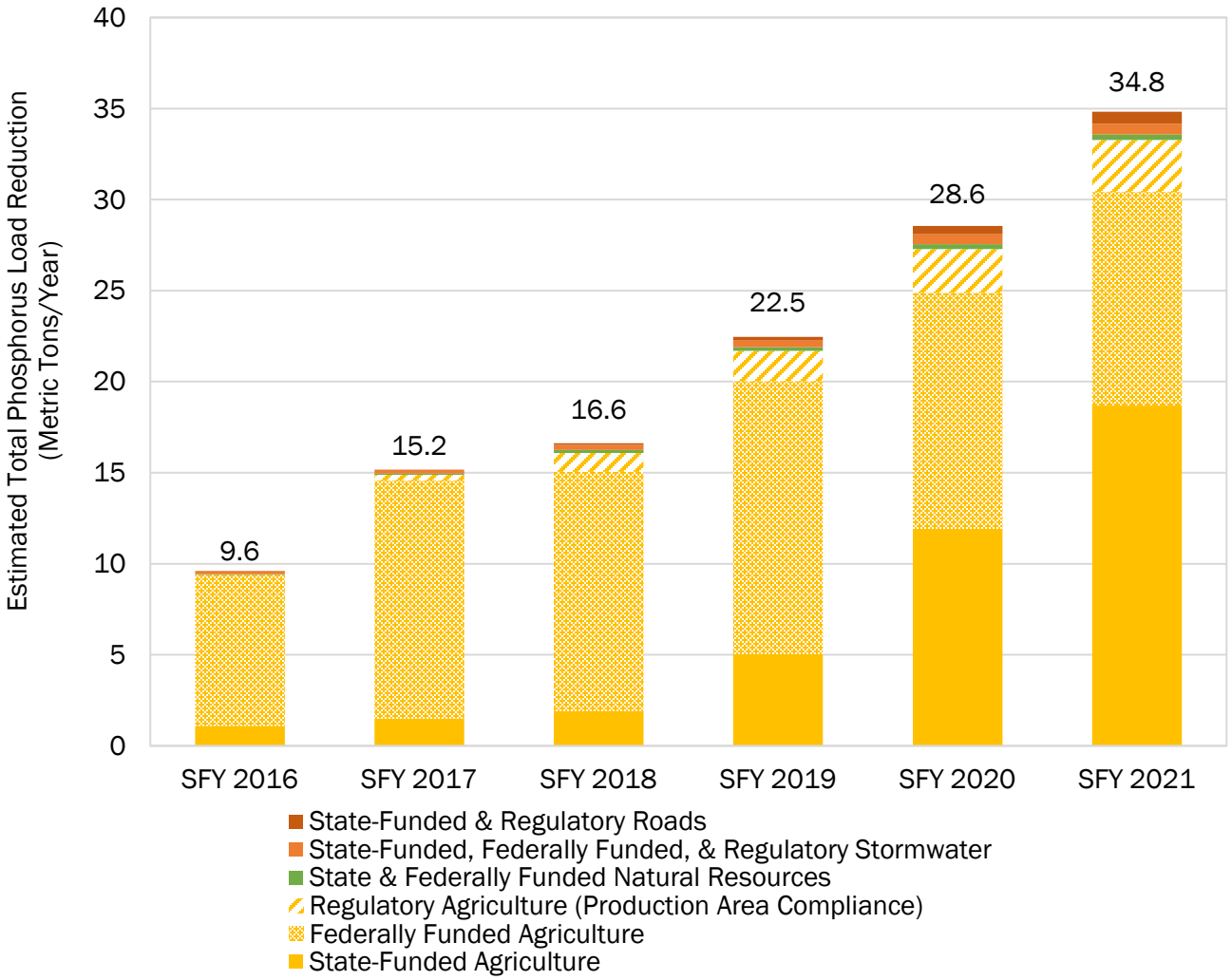


Figure 28. Annual estimated total phosphorus load reductions (metric tons per year) associated with state, federal, and regulatory clean water projects in the Lake Champlain basin in effect during SFY 2016-2021 by land use sector. Annual phosphorus load reductions are cumulative for all completed/operational projects based on start date and anticipated lifespan. Results of USDA-NRCS funded projects completed since SFY 2010 that are still in effect SFY 2016-2021 are included.

EXPLANATION OF FIGURE

State funding programs, federal funding programs, and regulatory programs in the Lake Champlain basin are estimated to have reduced approximately **34.8** metric tons of phosphorus loading to Lake Champlain in SFY 2021. Sixty-six percent of total reductions resulted from state funding and regulatory programs in SFY 2021. Over 96 percent of all estimated phosphorus reductions are associated with agricultural projects for three reasons:

1. Agricultural conservation practices are highly cost-effective at reducing phosphorus loading;
2. Substantial federal funds leveraged through the USDA-NRCS layer on top of state funds to support this work (approximately $17.5 million in Federal Fiscal Year 2021 statewide); and
3. Methods are currently in place to estimate phosphorus load reductions associated with most types of agricultural conservation practices, while other land use sectors have gaps in methods to estimate phosphorus reductions.

It is important to note that 70 percent of the agricultural reductions in the Lake Champlain basin in SFY 2021 were associated with annual practices with a one-year lifespan (e.g., cover crop, manure injection). If this level of effort is not maintained each year, the phosphorus reductions will not carry through to future years. Structural projects, such as stormwater treatment practices or forested riparian buffers, in contrast, have longer term lifespans (10-20 years or more if properly maintained) and phosphorus reductions achieved by these projects will continue in future years.

Note that estimated total phosphorus load reductions have changed compared to the *Vermont Clean Water Initiative 2020 Performance Report* due to improved clean water project tracking and accounting.

Lake Champlain TMDL Progress

Total phosphorus loading to Lake Champlain from Vermont was modeled to be 631 metric tons per year during the Lake Champlain TMDL baseline period of 2001 to 2010. The TMDL states total phosphorus loading to Lake Champlain must be reduced by 212 metric tons per year by 2038 to achieve Vermont's water quality standards. The following figure summarizes the steady progress that has been made towards achieving the Lake Champlain TMDL since SFY 2016.

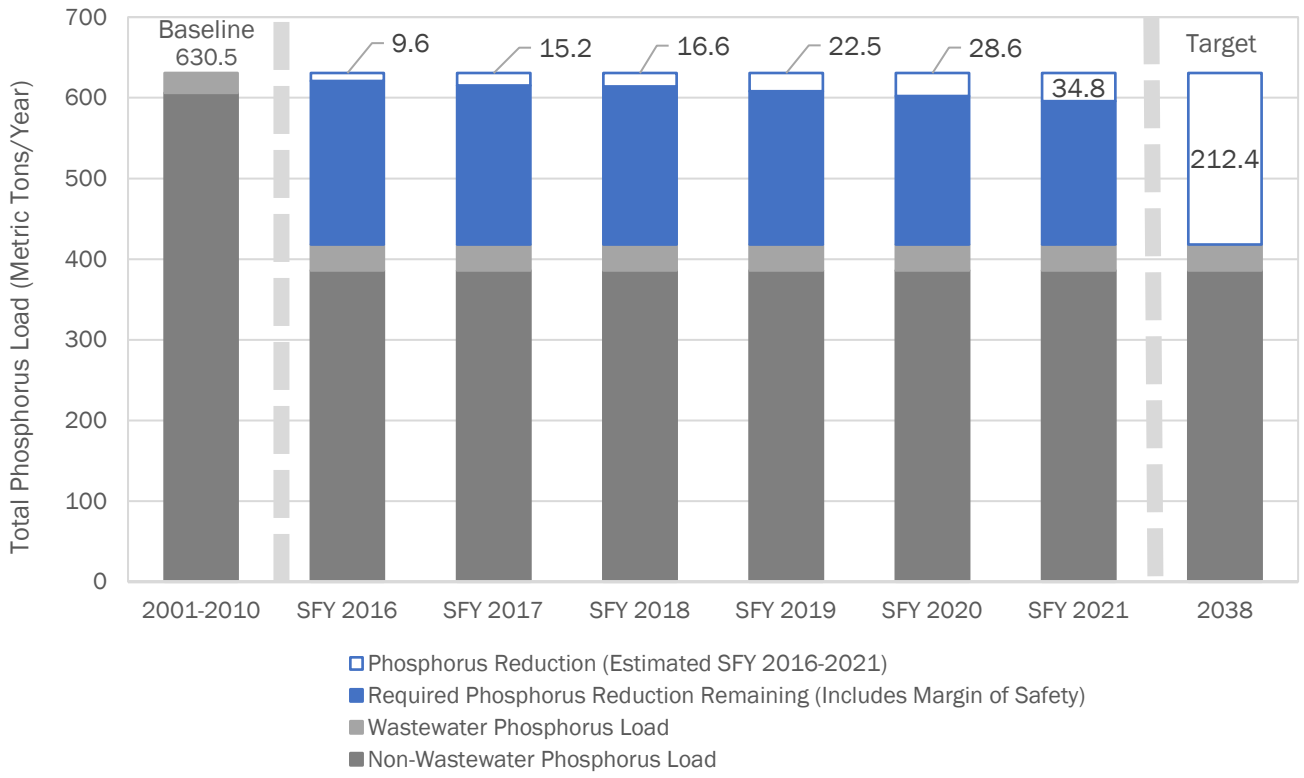


Figure 29. Estimated total phosphorus load reductions in effect during SFY 2016-2021 shown in the context of the Lake Champlain TMDL total phosphorus baseline (2001-2010, at left) and target total phosphorus load (year 2038, at right) in metric tons per year.

EXPLANATION OF FIGURE

The progress made toward reaching Lake Champlain's phosphorus reduction target has been steadily increasing year after year. State, federal, and regulatory clean water programs are estimated to have reduced 34.8 metric tons of phosphorus loading delivered to Lake Champlain in SFY 2021, which represents approximately **16 percent** of the required reduction. This result is expected to increase in the coming years for the following reasons:

1. Lake Champlain TMDL implementation began in 2016 and its Phase 1 Implementation Plan included a "ramping-up" phase of regulatory, financial, and technical assistance programs. New regulatory programs are now in place that will drive an increase in phosphorus reductions from agriculture and developed lands.
2. The State of Vermont is expanding its ability to quantify phosphorus reductions for all project types; however, some gaps still exist. Efforts are ongoing to address these gaps by March 2022, after which changes will need to be put in place to begin accounting for all project types.

Lake Champlain TMDL Progress by Lake Segment Watershed

The Lake Champlain TMDL allocates total phosphorus load reduction targets by "lake segment" watershed, which differ from Tactical Basin Planning watersheds. Figure 30 below presents estimated total phosphorus load reductions in effect SFY 2021 by lake segment watershed compared to the target reduction.

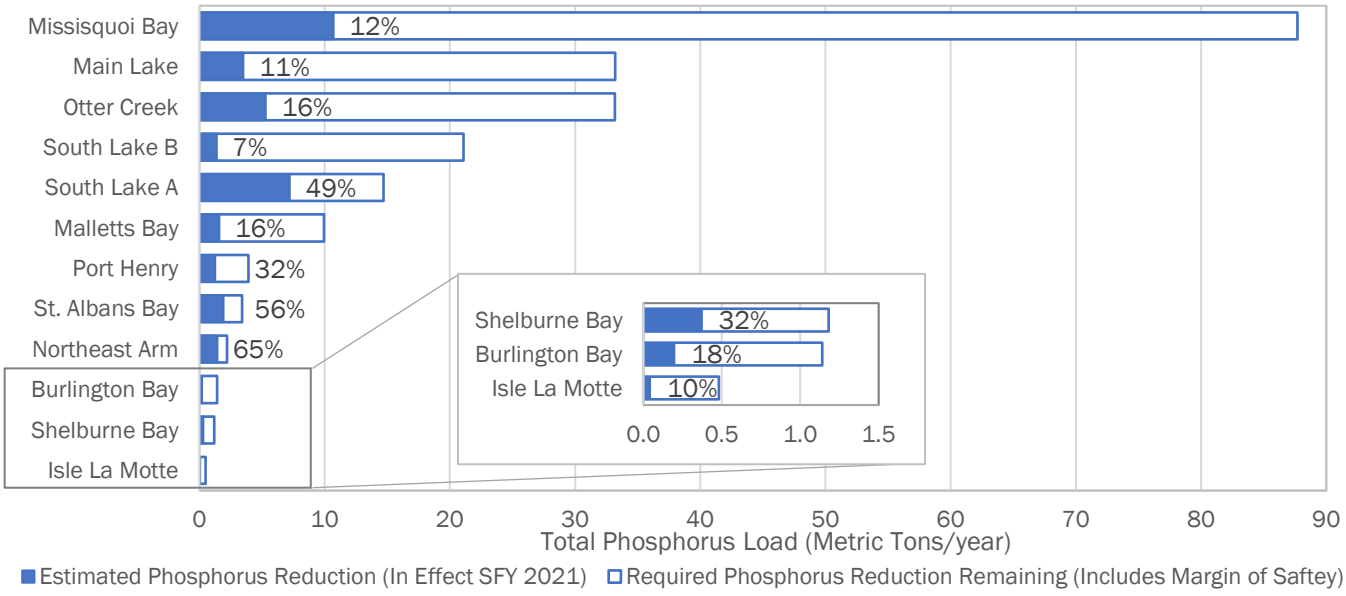


Figure 30. Estimated total phosphorus load reductions in effect during SFY 2021 by lake segment watershed compared to total phosphorus load reduction targets in metric tons per year. Percent represents the proportion of estimated total phosphorus load reductions achieved as of SFY 2021 compared to the lake segment target reduction.

EXPLANATION OF FIGURE

The level of progress varies by lake segment watershed for the following reasons:

1. Lake segment size and level of phosphorus reduction required varies: The TMDL allocated phosphorus loading capacity based on each lake segment's land use characteristics and the reduction required to meet Vermont water quality standards. The level of effort required and the magnitude of phosphorus loading ranges by lake segment. Tactical Basin Plans target efforts to watersheds with the greatest need for reduction.
2. Clean water projects are targeted in priority watersheds: Tactical Basin Plans inform where to prioritize efforts for reducing phosphorus loading to Lake Champlain. The level of progress in the Northeast Arm and St. Albans Bay lake segments is relatively high, as USDA-NRCS has targeted significant agricultural technical and financial assistance to these watersheds.
3. Gaps in the state's ability to estimate phosphorus reductions for all projects: Due to gaps in the state's ability to estimate phosphorus reductions, the phosphorus reductions reported are an incomplete picture of progress. Lake segments dominated by agricultural efforts will show greater progress than lake segments targeting natural resources restoration because there are more methods in place to estimate reductions for agricultural projects. Agricultural reductions are also under-reported due to the implementation of farmer-funded practices not tracked through state or federal funding programs.

Lake Champlain Water Quality

The State of Vermont can estimate progress towards achieving TMDLs by modeling estimated phosphorus reductions from clean water projects; however, measured water quality is the ultimate indicator of clean water progress in Lake Champlain. Coordinated by and in partnership with the Lake Champlain Basin Program, the Vermont Department of Environmental Conservation and New York State Department of Environmental Conservation have been monitoring in-lake phosphorus concentrations in Lake Champlain since 1990. The objective of the Lake Champlain TMDL is to reduce phosphorus concentrations in Lake Champlain back to established limits, in compliance with Vermont water quality standards.

The Lake Champlain Basin Program (LCBP) publishes the State of the Lake report approximately every few years to inform citizens and resource managers about the health of the lake. The *2021 State of the Lake Report* summarizes the status and trends of the following nine ecosystem indicators for Lake Champlain's five major lake segments, as shown in the figure below. Additional information and data on the health of Lake Champlain can be found in the full *2021 State of the Lake Report*.[37]

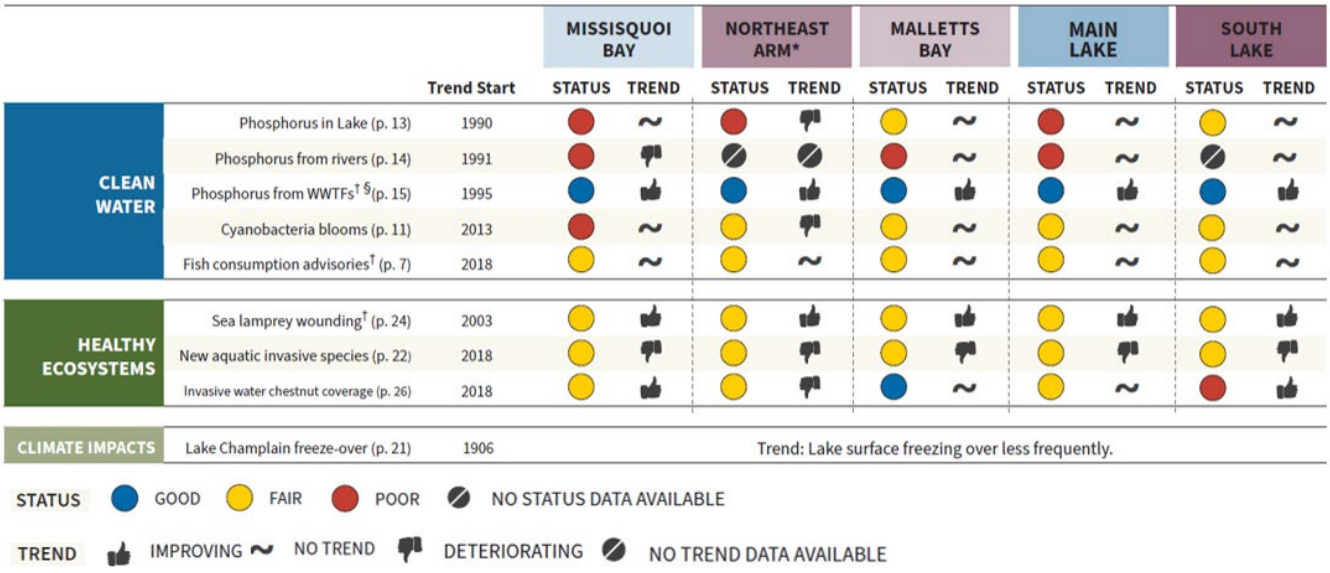


Figure 31. Ecosystem indicators by major Lake Champlain segment. Figure from *2021 State of the Lake* report.

[37] The *2021 State of the Lake Report* can be accessed here: https://www.lcbp.org/wp-content/uploads/2016/03/SOL2021_full-document_for-web.pdf

EXPLANATION OF FIGURE

Since 2013, 95 percent of routine visual assessments on Lake Champlain during the recreational season reported conditions free of cyanobacteria blooms. Cyanobacteria conditions vary significantly among lake segments, and warm weather blooms continue to present a challenge to recreation and public health. Cyanotoxins are rarely detected in Lake Champlain, though it is best to avoid areas with active cyanobacteria blooms. Cyanobacteria bloom conditions in Malletts Bay, Main Lake, and South Lake are considered fair, and the trend has been stable since 2013. Bloom conditions are considered poor in Missisquoi Bay, and the trend is stable since 2013. The trend in the Northeast Arm is deteriorating since 2013.

Many lake segments have in-lake phosphorus concentrations that are often near or below targeted limits, but phosphorus concentrations in Lake Champlain's shallow bays are often above these limits, resulting in harmful cyanobacteria blooms.

- In Malletts Bay and South Lake segments, in-lake phosphorus concentrations are considered fair, meaning phosphorus concentrations are near in-lake limits, and the trend since 1990 is stable.
- For the Missisquoi Bay and Main Lake segments, in-lake phosphorus concentrations exceed in-lake phosphorus limits, and the trend is stable.
- In the Northeast Arm, in-lake phosphorus concentrations exceed recommended limits and in-lake phosphorus concentrations are increasing since 1990. Although the Northeast Arm is estimated to have achieved 65 percent of its required total phosphorus load reduction, many variables affect realized water quality, as described in Chapter 6.

Reductions are required to come from both point sources and non-point sources. Investments in wastewater treatment facilities since 1990 have driven significant reductions in phosphorus loading from these point sources in Vermont, New York, and Quebec. As shown above, phosphorus loading from wastewater treatment facilities (WWTFs) is meeting TMDL loading targets, and the trend continues to improve. Remaining phosphorus load reductions must come from the non-point source sectors (i.e., agriculture, developed lands, natural resources) in order to meet the Lake Champlain TMDL. For more information on phosphorus loading from WWTFs in Lake Champlain, see the State of the Lake Report: https://sol.lcbp.org/table-of-contents/clean-water/nutrients/.

Lake Champlain tributary streamflow and water quality concentrations can be used to estimate total phosphorus loading to the lake. Phosphorus loading from rivers to Lake Champlain varies greatly from year to year but total loading needs to be reduced to meet water quality goals. As shown above, phosphorus loading from rivers draining to the Missisquoi Bay, Malletts Bay, and Main Lake segments exceeds TMDLs limits, and the trend is stable.

Measured phosphorus loading to Lake Champlain is expected to decrease in the coming decades in response to clean water efforts. The Vermont Clean Water Act (Act 64) of 2015 and Clean Water Service Delivery Act (Act 76) of 2019 both established new regulatory, project delivery, and funding sources to accelerate clean water progress, but the full implementation of these programs may not be fully realized for a decade or more. As the implementation of clean water projects increases, it is expected that decreased loading will be first measurable at a local level in individual smaller rivers and streams. While targets may be met at the local scale, it will take many years—possibly decades – before cumulative improvements are observable in larger tributaries and subsequently in Lake Champlain.

Chapter 4: Lake Memphremagog Basin Clean Water Investments, Results, and TMDL Progress

Figure 32. Map of the Tactical Planning Basin 17 (Lake Memphremagog) watershed highlighted in green.

Lake Memphremagog is an international waterbody with the majority of the watershed area in Vermont and a small portion in Quebec (Figure 32). The Vermont portion of the watershed covers most of Orleans County including the three major lake tributary rivers: The Black, Barton, and Clyde in addition to the smaller Johns River. Land use within the Vermont portion of the watershed is largely forest or shrub with about 17 percent in agriculture, and 5 percent in developed lands.[38]

Phosphorus levels in the Vermont portion of Lake Memphremagog are higher than the water quality standard set for the lake. Elevated levels of phosphorus contribute to intermittent cyanobacteria blooms but also support excessive plant and algae growth that limits the quality of the lake for recreational use. The Lake Memphremagog TMDL was established in 2017 to specify the maximum amount of phosphorus that the waterbody can receive and still meet applicable water quality standards and establish targets for reducing phosphorus loading to the lake from its watershed. Total phosphorus loading to Lake Memphremagog from Vermont was modeled to be 52.7 metric tons per year during the TMDL baseline period of 2009 to 2012. The TMDL states total phosphorus loading to Lake Memphremagog must be reduced by 23 percent to 40.7 metric tons per year by 2037 to achieve Vermont's water quality standards.[39]

Tactical Basin Planning is integral to identifying priority projects to achieve water quality goals. The 2017 Lake Memphremagog, Tomifobia, and Coaticook Tactical Basin Plan (Basin 17) provides an assessment of the health of the basin and defines on-going and future strategies to address high-priority surface water stressors.[40] The purpose of the plan is to identify actions necessary to meet or exceed state water quality standards, and to achieve sustained ecological health and human use of surface waters. The plan sets priorities for meeting phosphorus load reduction targets for the Lake Memphremagog watershed as outlined in the Lake Memphremagog TMDL. The following section of the report summarizes the state, federal, and regulatory clean water efforts in Tactical Planning Basin 17, which includes all of the Vermont land that drain to the St. Francis River. Most land in this basin flows to Lake Memphremagog,

[38] The Lake Memphremagog TMDL can be accessed here: https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/Memph%20TMDL%20Final%20EPA%20approved.pdf

[39] Table 10, Lake Memphremagog TMDL, page 25.

[40] The 2017 Lake Memphremagog, Tomifobia, and Coaticook Tactical Basin Plan can be accessed here: https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/Basin17_TBP_Signed.pdf

including the Black, Barton, and Clyde Rivers, but Tactical Planning Basin 17 also includes the Tomifobia and Coaticook watersheds that do not drain to Lake Memphremagog.

Vermont's Clean Water Investments in the Lake Memphremagog Basin

Reaching Lake Memphremagog's water quality goals requires investments across all land use sectors. The following figure summarizes state clean water investments in the Lake Memphremagog basin from SFY 2016 to 2021. Federal funds awarded to projects directly by federal agencies are not included in this report as they are reported on elsewhere.

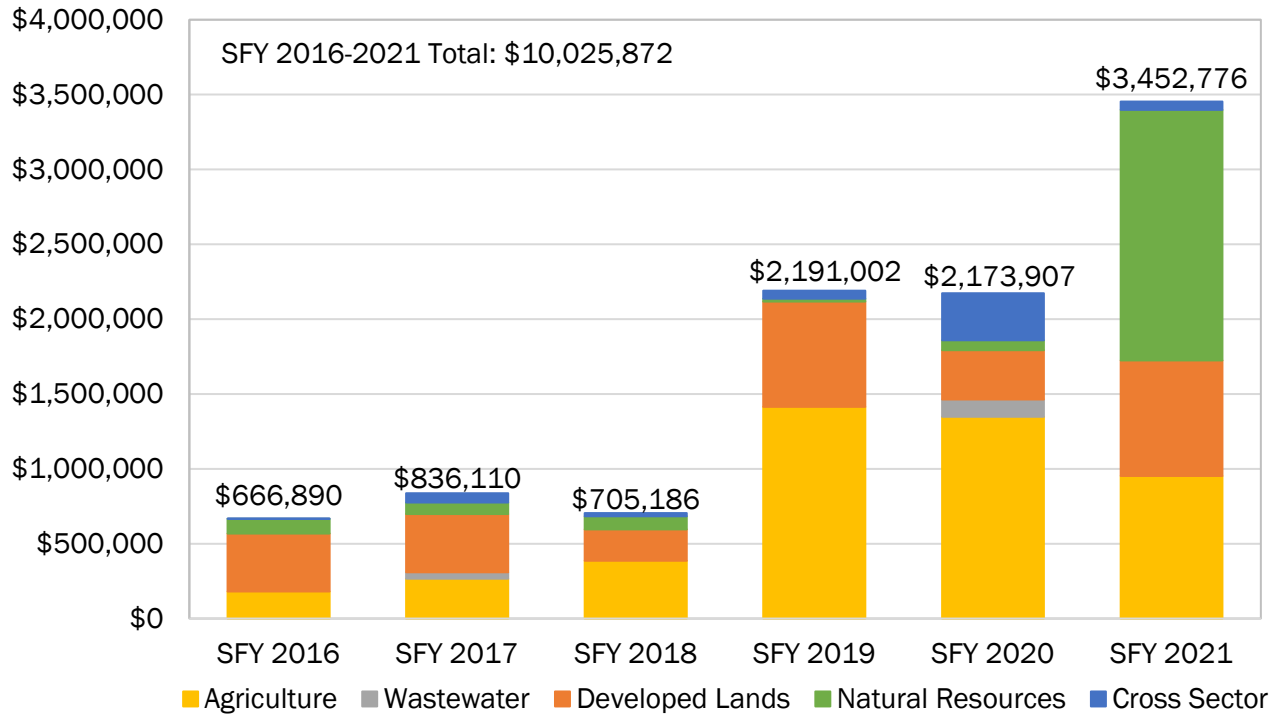


Figure 33. Total dollars awarded by State of Vermont agencies to clean water projects in the Lake Memphremagog basin by land use sector, SFY 2016-2021.

EXPLANATION OF FIGURE

The State of Vermont has invested over $10 million in the Lake Memphremagog watershed since SFY 2016. Clean water funding in the Lake Memphremagog basin has more than tripled since SFY 2018. From SFY 2016 to 2020, the greatest investments in the Lake Memphremagog basin occurred in the developed lands and agricultural sectors. There was a large increase in natural resources funding in SFY 2021 due to the conservation of 129 acres of waterfront land at Bluffside Farm on Lake Memphremagog in Newport. This $1.4 million project was funded by a Clean Water State Revolving Fund Land Conservation Interim Financing Loan provided to Vermont Land Trust. This interim financing program provides partners with upfront access to capital to act on time-sensitive conservation opportunities and affords partners time to secure funds to repay the loan over the course of five years.

Results of Vermont's Clean Water Investments in the Lake Memphremagog Basin

Clean water projects in the Lake Memphremagog basin target nutrient and sediment pollution across various land use sectors. The following section summarizes the results of state-funded, federally funded, and regulatory clean water projects in the Lake Memphremagog basin to illustrate the full scope of clean water efforts occurring to improve the lake's water quality. The following tables summarize project outputs of all clean water projects in the Lake Memphremagog basin SFY 2016-2021.

Table 11. Outputs of state-funded and regulatory clean water projects completed in the Lake Memphremagog basin by land use sector, SFY 2016-2021. Project development measures support the identification, prioritization, and design of projects. Project output measures reflect extent of project implementation/construction. Note that regulatory measures are reported through regulatory programs and not tied to state funding programs. State and federal programs may provide funding to satisfy regulatory requirements.

State-Funded Agricultural Project Output Measures[41]	2016	2017	2018	2019	2020	2021	Total
Acres of agricultural conservation practices implemented (excluding practice types listed below) [42]	650	146	2,209	903	2,896	1,484	8,288
Acres of agricultural forested and filter strip buffers installed	–	–	4	–	–	–	4
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures	7	2	5	17	12	19	62
Acres of water quality protections within newly conserved agricultural lands	–	–	–	6	–	–	6
Acres of agricultural land treated through innovative equipment	–	–	22	470	660	597	1,748
Number of farms receiving nutrient management planning assistance	–	–	–	–	1	–	1
Agricultural Regulatory Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Number of water quality compliance farm visits conducted by AAFM to ensure compliance with Required Agricultural Practices (RAPs) and Medium Farm Operation (MFO) and Large Farm Operation (LFO) Rules[43]	–	–	–	–	–	16	16

[41] Agricultural project output measures can overlap with other project output measures if multiple practices were applied on the same field. For example, 10 acres of manure injection and 10 acres of cover crop applied on the same field will result in 20 acres of agricultural conservation practices implemented. Similarly, practices implemented on the same field over multiple years will be counted for each year implemented. For example, 10 acres of cover crop implemented on the same field in 2016, 2017, and 2018 will result in 30 acres of agricultural conservation practices implemented. Total agricultural project outputs column represents the total level of effort of state funding programs, rather than the number of distinct agricultural acres addressed.

[42] Acres of agricultural conservation practices includes aeration, conservation crop rotation, cover crop, crop to hay, grassed waterways, manure injection, conservation tillage, and rotational grazing.

[43] The number of water quality compliance farm visits conducted by AAFM to ensure compliance for SFY 2016-2020 and previous years is available on a statewide basis only.

Acres of production area inspected by AAFM for RAP compliance[44]	-	63	84	66	276	324	813

State-Funded Natural Resources Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Stream miles assessed by Stream Geomorphic Assessment, River Corridor Plan	–	–	–	–	–	30	30
Number of natural resources restoration projects identified	11	–	6	–	–	12	28
Number of preliminary (30%) designs completed	2	–	–	–	–	–	2
Number of final (100%) designs completed	1	–	6	–	–	–	7
State-Funded Natural Resources Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of forested riparian buffer restored through buffer planting	4	6	15	1	–	–	27
Acres of lakeshore restored[45]	<1	–	<1	–	–	–	<1
Acres conserved with natural resources protections	–	29	–	–	–	129	158
Square feet of gully erosion remediated	–	–	–	–	200	–	200

State-Funded Developed Lands Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Number of projects identified through Stormwater Master Plans	4	20	–	–	–	–	24
Number of illicit/unauthorized discharges confirmed	14	–	–	1	–	<1	16
Number of preliminary (30%) designs completed	1	4	–	–	–	1	6
Number of final (100%) designs completed	3	–	–	–	1	1	5
State-Funded Developed Lands Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of existing impervious surface treated by stormwater treatment practices	–	–	7	–	–	–	7
Miles of municipal road drainage and erosion control improvements	–	3	4	10	6	5	28
Number of municipal road drainage and stream culverts replaced	–	11	12	17	41	30	111
Acres stabilized through use of seeding/mulching equipment per year	–	–	1	8	–	–	9

[44] SFY 2016-2018 datasets are incomplete and do not fully account for all acres of production area inspected by AAFM for RAP compliance due to the initiation of this tracking mechanism.

[45] Acres of shoreland restored reported here are an underestimate while the State of Vermont is working to expand tracking mechanisms for lake shoreland projects. Note that not all lake shoreland restoration project outputs are reported under this measure. For example, some lake shoreland projects incorporate green stormwater infrastructure and results are included in the developed lands sector.

Regulatory Developed Lands Project Output Measures	2016	2017	2018	2019	2020	2021	Total
Acres of existing impervious surface treated by stormwater treatment practices	–	–	13	–	2	<1	15
Acres of new impervious surface treated by stormwater treatment practices	–	–	14	1	13	2	31
Hydrologically connected municipal road miles inventoried[46]	–	8	58	75	112	13	267
Hydrologically connected municipal road miles identified that require water quality improvements	–	1	20	42	66	7	136

State-Funded Wastewater Project Output Measures	2016	2017	2018	2019	2020	2021	Total
Number of municipal wastewater asset management plans completed	–	–	1	–	–	–	1

The State of Vermont works closely with federal partners to make progress towards clean water goals in the Lake Memphremagog Basin. The following table displays project output data originating from USDA-NRCS.

Table 12. Outputs of *federally funded* clean water projects completed in the Lake Memphremagog basin, SFY 2016-2021.

Federally Funded Agricultural Project Output Measures[47]	2016	2017	2018	2019	2020	2021	Total
Acres of agricultural conservation practices implemented (excluding practice types listed below)	172	2,331	2,673	4,214	1,678	2,482	13,549
Acres of nutrient management	253	115	1,191	398	–	1,543	3,499
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures	35	59	18	85	74	65	336
Agricultural Project Output Measures Supported by Federal Technical Assistance[48]	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of agricultural conservation practices implemented, supported by federally funded technical assistance (excluding other practices listed below)	–	–	–	874	3	–	877
Acres of nutrient management, supported by federally funded technical assistance	–	767	–	–	606	–	1,373

[46] Note state funding programs supported the implementation of required road erosion inventories. Road erosion inventory data come directly from the MRGP database.

[47] Agricultural project output measures can overlap with other project output measures if multiple practices were applied on the same field. For example, 10 acres of manure injection and 10 acres of cover crop applied on the same field will result in 20 acres of agricultural conservation practices implemented. Similarly, practices implemented on the same field over multiple years will be counted for each year implemented. For example, 10 acres of cover crop implemented on the same field in 2016, 2017, and 2018 will result in 30 acres of agricultural conservation practices implemented. Total agricultural project outputs column represents the total level of effort of state funding programs, rather than the number of distinct agricultural acres addressed.

[48] Agricultural conservation practices reported through technical assistance represent agricultural conservation practices implemented without financial assistance from federal programs reported through technical assistance funded by federal programs.

EXPLANATION OF TABLE

Federal funding in the Lake Memphremagog basin comes from USDA-NRCS. USDA-NRCS has funded the implementation of over 13,500 acres of agricultural conservation practices plus an additional 3,500 acres of nutrient management plan implementation in the Lake Memphremagog basin. Federal technical assistance has also resulted in over 2,000 acres of agricultural conservation practices and nutrient management plan implementation. Nutrient management plan implementation is managing the amount, source, placement, and timing of plant nutrients and soil amendments to minimize agricultural nonpoint source pollution, maintain or improve soil conditions, protect air quality, reduce input costs, and improve crop production.

Estimated Total Phosphorus Load Reductions in Lake Memphremagog Basin

The State of Vermont estimates the pollutant load reductions associated with clean water projects to track progress towards achieving water quality goals. The following figure summarizes the estimated total phosphorus load reductions associated with state, federal, and regulatory clean water projects in the Lake Memphremagog basin from SFY 2016 to 2021 by land use sector.

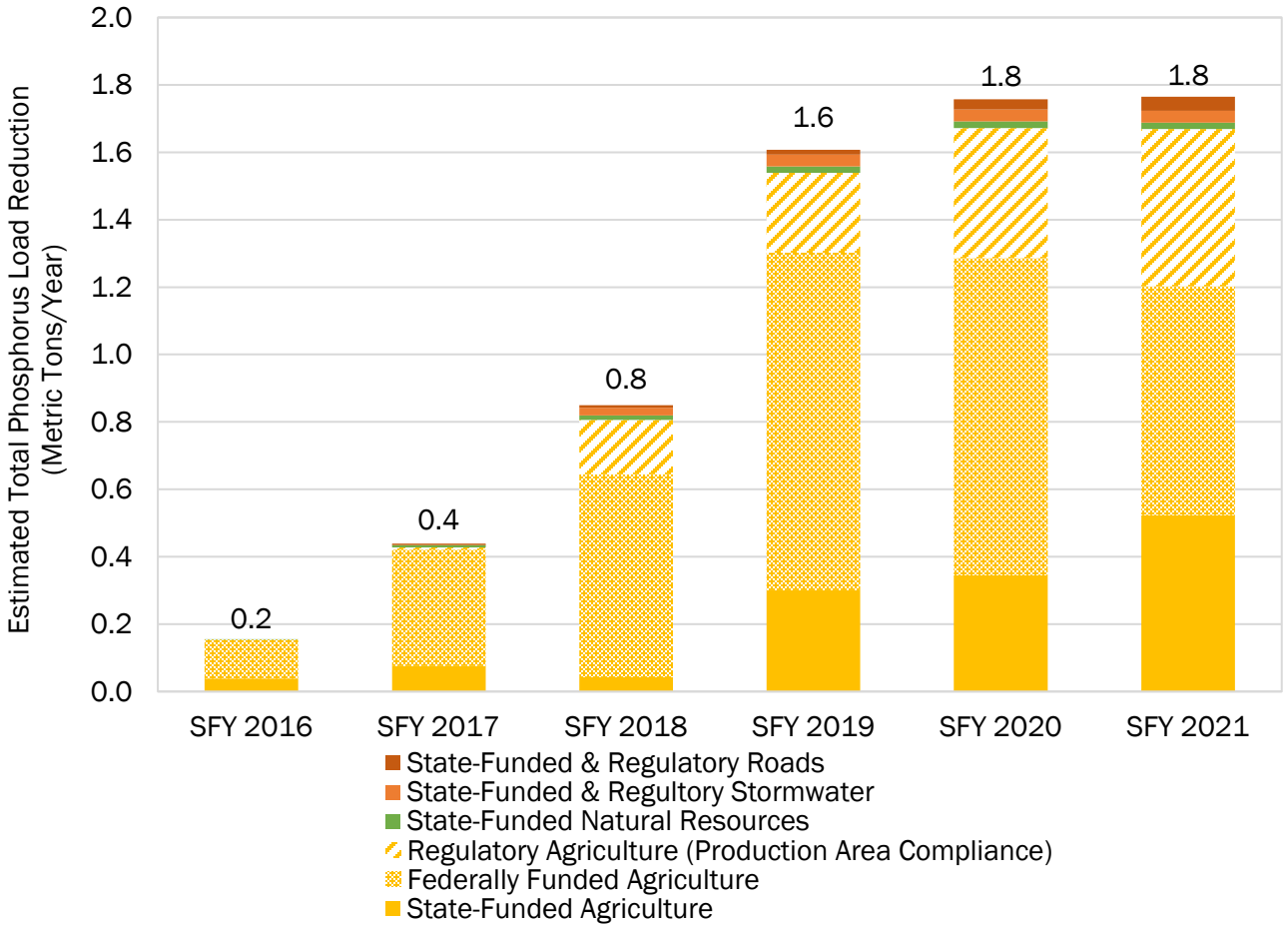


Figure 34. Annual estimated total phosphorus load reductions (metric tons per year) associated with state, federal, and regulatory clean water projects in the Lake Memphremagog basin in effect during SFY 2016-2021 by land use sector and program category. Annual phosphorus load reductions are cumulative for all completed/operational projects based on start date and anticipated lifespan. Results of USDA-NRCS funded projects completed since SFY 2010 that are still in effect SFY 2016-2020 are included.

EXPLANATION OF FIGURE

Estimated phosphorus reductions achieved by state funding programs, federal funding programs, and regulatory programs in the Lake Memphremagog basin have increased more than six-fold from SFY 2016 to 2021. There was a large increase in agricultural phosphorus reductions from SFY 2018 to 2019 due to an increase in the cover crop and crop to hay practices funded by USDA-NRCS and AAFM. Over 95 percent of estimated phosphorus reductions achieved in SFY 2021 are associated with agricultural projects for three reasons:

1. Agricultural conservation practices are highly cost-effective in treatment of phosphorus (note these are mostly annual practices and need to be reimplemented each year to maintain the reductions shown);
2. Substantial federal funds leveraged through the USDA-NRCS layer on top of state funds to support this work (approximately $17.5 million in Federal Fiscal Year 2021 statewide); and
3. Methods are currently in place to estimate phosphorus load reductions associated with most types of agricultural conservation practices, while other land use sectors have gaps in methods to estimate phosphorus reductions.

The decline in federally funded agricultural phosphorus reductions in SFY 2021 is due to the year-to-year variability in the adoption of agricultural conservation practices, as shown in Table 12 above. Acres of agricultural conservation practices declined from 4,200 acres in SFY 2019 to 1,700 acres in SFY 2020, then increased to 2,500 acres in SFY 2021. The temporary slowdown in practices in SFY 2020 was due, in part, to reduced conservation practice implementation by farmers during the COVID-19 pandemic. Phosphorus reductions decreased in SFY 2021 in response to reduced practice implementation in SFY 2020 because phosphorus reductions for any given practice can span multiple years based on the practice implementation date (i.e., phosphorus reductions from practices installed in SFY 2020 carry over into SFY 2021 based on the lifespan of the project).

It is important to note that 90 percent of the agricultural reductions in the Lake Memphremagog basin in SFY 2021 were associated with annual practices with a one-year lifespan (e.g., cover crop, manure injection). If this level of effort is not maintained each year, the phosphorus reductions will not carry through to future years. Structural projects, such as stormwater treatment practices or forested riparian buffers, in contrast, have longer term lifespans (10-20 years or more if properly maintained) and phosphorus reductions achieved by these projects will continue in future years.

Note estimated total phosphorus load reductions have changed compared to the *Vermont Clean Water Initiative 2020 Performance Report* due to improved clean water project tracking and accounting.

Lake Memphremagog TMDL Progress

The Lake Memphremagog TMDL states total phosphorus loading to Lake Memphremagog must be reduced from 52.7 metric tons per year to 37.5 metric tons per year by 2037 to achieve Vermont's water quality standards. The following figure summarizes progress towards achieving the Lake Memphremagog TMDL.

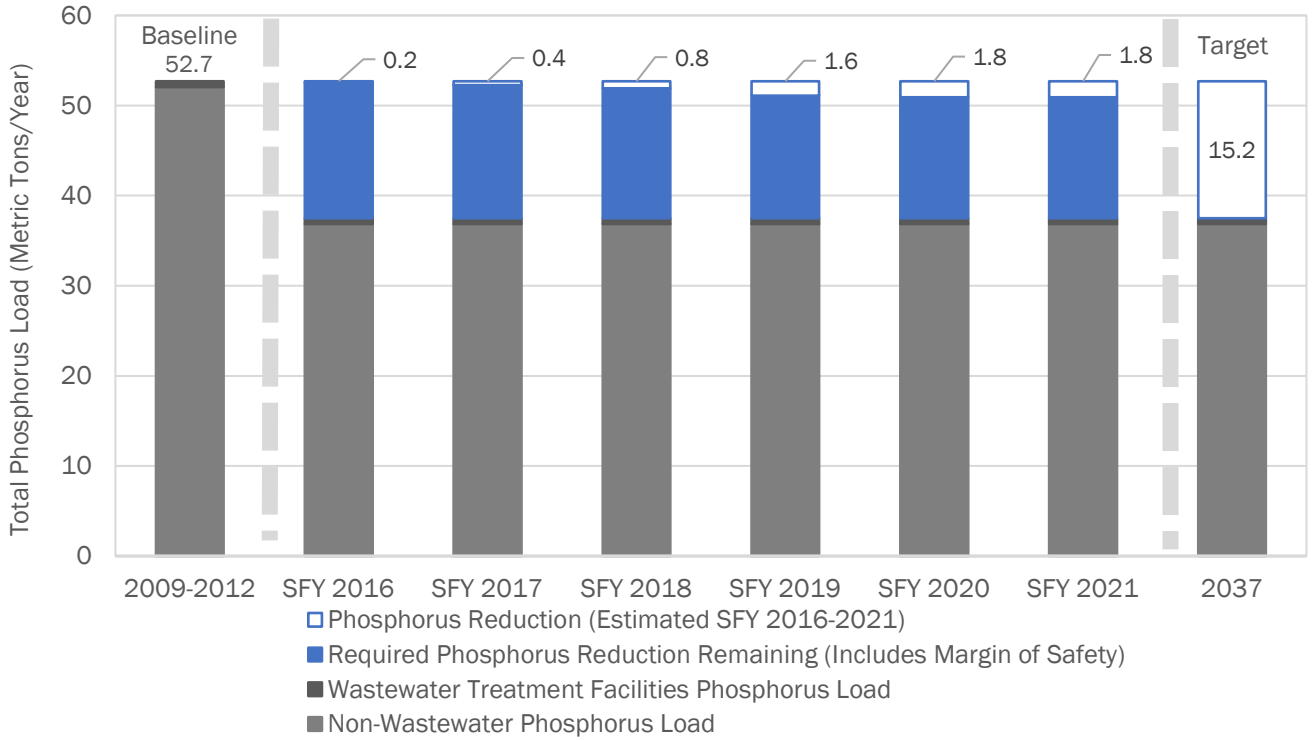


Figure 35. Estimated total phosphorus load reductions in effect during SFY 2016-2021 shown in the context of the Lake Memphremagog TMDL total phosphorus baseline (2009-2012, at left) and target total phosphorus load (year 2037, at right) in metric tons per year.

EXPLANATION OF FIGURE

State, federal, and regulatory clean water programs are estimated to have reduced 1.8 metric tons of phosphorus loading to Lake Memphremagog in SFY 2021, which represents approximately **12 percent** of the required reduction. Phosphorus reductions are expected to increase in the coming years for the following reasons:

1. The State of Vermont has been "ramping-up" clean water regulatory, financial, and technical assistance programs since SFY 2016. Many regulatory programs are now in place that will drive phosphorus reductions from agriculture and developed lands, with meaningful progress expected in the coming years.
2. The State of Vermont is expanding its ability to quantify phosphorus reductions for all project types; however, some gaps still exist. Efforts are ongoing to address these gaps by March 2022 after which changes will need to be put in place to begin accounting for all project types.

Lake Memphremagog Water Quality

The State of Vermont estimates the phosphorus reductions associated with clean water projects in the Lake Memphremagog basin to show progress towards achieving the Lake Memphremagog TMDL. The estimated phosphorus reductions presented in this report, however, do not represent measured load reductions to Lake Memphremagog. Lake Memphremagog tributary streamflow and water quality concentrations can be used to estimate total phosphorus loading to the lake. Vermont DEC has been collecting tributary data to support the estimation of tributary loading since 2005. In 2022, Vermont DEC will have enough data to support the calculation of annual loading rates and trends, and this will be included in subsequent *Performance Reports*.

Although phosphorus reduction estimates can be used to monitor progress towards achieving TMDLs, measured water quality is the ultimate indicator of clean water progress in Lake Memphremagog. Officials from Vermont and the Province of Quebec have been monitoring Lake Memphremagog's in-lake phosphorus concentrations since 1985 and 1999, respectively. Phosphorus concentration limits for South Bay and the Vermont portions of Lake Memphremagog were established in 1991 at 14 µg/L and 25 ug/L, respectively.

The State of Vermont publishes trends on Lake Memphremagog and South Bay water quality as part of the Vermont Inland Lake Scorecard. The following figure summarizes measured water quality trends in Lake Memphremagog since 1984. Although the Lake Memphremagog TMDL covers both South Bay and Lake Memphremagog, only Lake Memphremagog data are presented here for brevity. Water quality scorecards for both Lake Memphremagog and South Bay can be accessed on the Vermont Integrated Watershed Information System.[49]

[49] Water quality scorecards are available at: https://anrweb.vt.gov/DEC/IWIS/ReportViewer3.aspx?Report=LakeScoreCard_Current_TrendsAndStatus&ViewParms=True

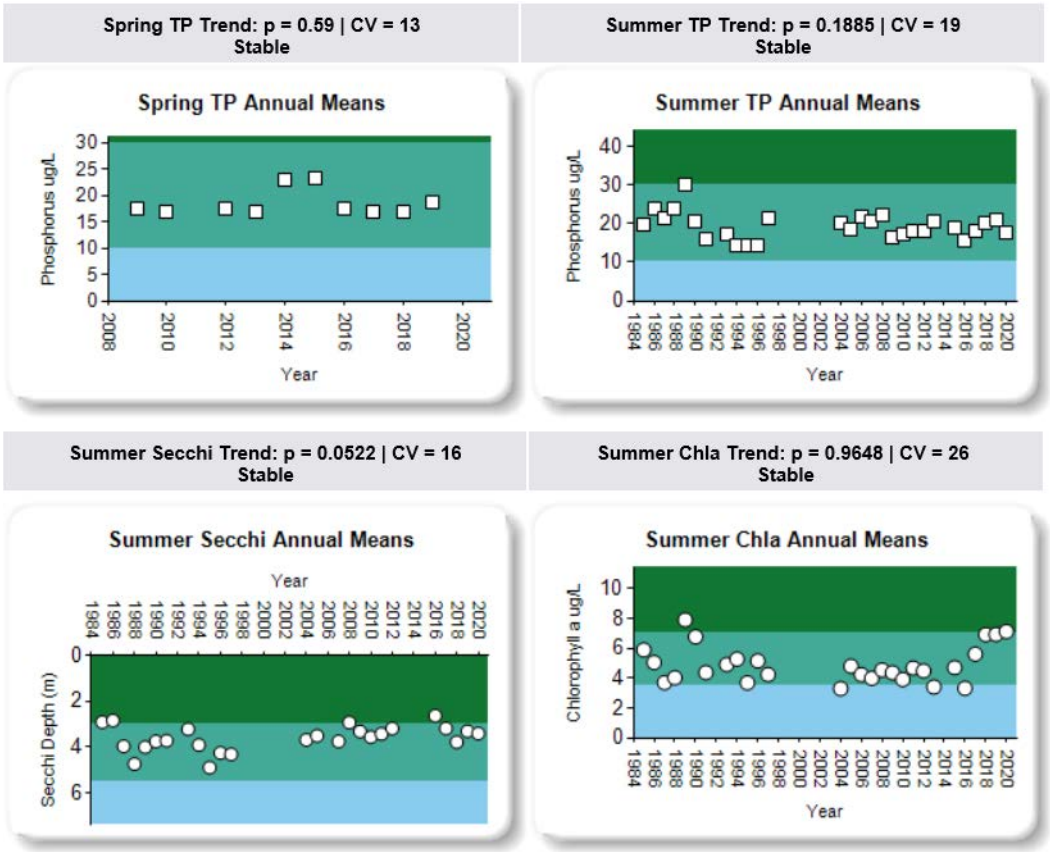


Figure 36. Water quality scorecard for Lake Memphremagog illustrating trends in spring total phosphorus (TP), summer TP, summer water clarity (Secchi depth), and summer algal biomass (chlorophyll-*a*), 1984-2020. Blue, light green, and dark green bands represent oligotrophic (low nutrients), mesotrophic (moderate nutrients), and eutrophic (high nutrients) conditions, respectively. Data from VT DEC Lakes and Ponds Program.

EXPLANATION OF FIGURE

Average annual spring and summer total phosphorus concentrations in Lake Memphremagog have been relatively stable since data collection began in 2008 and 1984, respectively. Average annual summer water clarity (Secchi depth) and average summer algal biomass (chlorophyll *a*) do not show statistically significant trends since 1984, although there have been recent increases in algal biomass since 2016. Algae are the base of the aquatic food chain, and higher algal biomass (chlorophyll *a*) is generally associated with greater nutrients in the lake. However, summer TP has been relatively stable since 2003, suggesting the recent increase in algal biomass (chlorophyll *a*) may be due to other factors affecting algal biomass (e.g., lake temperatures, grazing pressure) or natural variability.

Although the Vermont Inland Lake Scorecard data does not suggest any significant trends in several water quality variables, the Quebec monitoring program has indicated reductions in phosphorus in several lake segments. For more information on nutrient loading to Lake Memphremagog and water quality sampling results in both Quebec and Vermont through 2018, please see the International Joint Commission's Nutrient Loading and Impacts in Lake Champlain, Missisquoi Bay, and Lake Memphremagog report: https://www.ijc.org/sites/default/files/2020-04/Government%20Package%20English.pdf.

Chapter 5: Connecticut River Basin Clean Water Investments and Results

The Connecticut River is New England's longest river running through four states: Vermont, New Hampshire, Massachusetts, and Connecticut. Seven Tactical Planning Basins in the eastern half of the State of Vermont drain to the Connecticut River, which eventually drains to the Long Island Sound. The Long Island Sound is a large estuary that drains a total watershed of over 16,000 square miles, including the Connecticut River as well as areas of Rhode Island and New York according to the Long Island Sound TMDL (Figure 37).[50]

The Long Island Sound is impaired due to nitrogen, which can cause algal blooms and hypoxia (i.e., low dissolved oxygen concentrations) leading to "dead zones" that threaten marine life. To address the excess nitrogen and resulting hypoxia, the EPA approved *A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound* in 2001 to define the nitrogen reductions necessary to meet water quality standards in the Sound.

Clean water efforts in the Vermont drainages to the Connecticut River are contributing to water quality progress for Long Island Sound. The following section of the report summarizes the state, federal, and regulatory clean water efforts in the Connecticut River basin. There are not currently methods in place to estimate total nitrogen load reductions to the Connecticut River, but these will be established in the coming years.

Figure 37. Map of the Long Island Sound watershed. Figure from New England Interstate Water Pollution Control Commission.

[50]A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound can be accessed here: http://longislandsoundstudy.net/wp-content/uploads/2010/03/Tmdl.pdf

Vermont's Clean Water Investments in the Connecticut River Basin

Reaching the Connecticut River basin's water quality goals requires investments across all land use sectors. The following figure summarizes state clean water investments in the Connecticut River basin from SFY 2016 to 2021. Federal funds awarded to projects directly by federal agencies are not included in this report as they are reported on elsewhere.

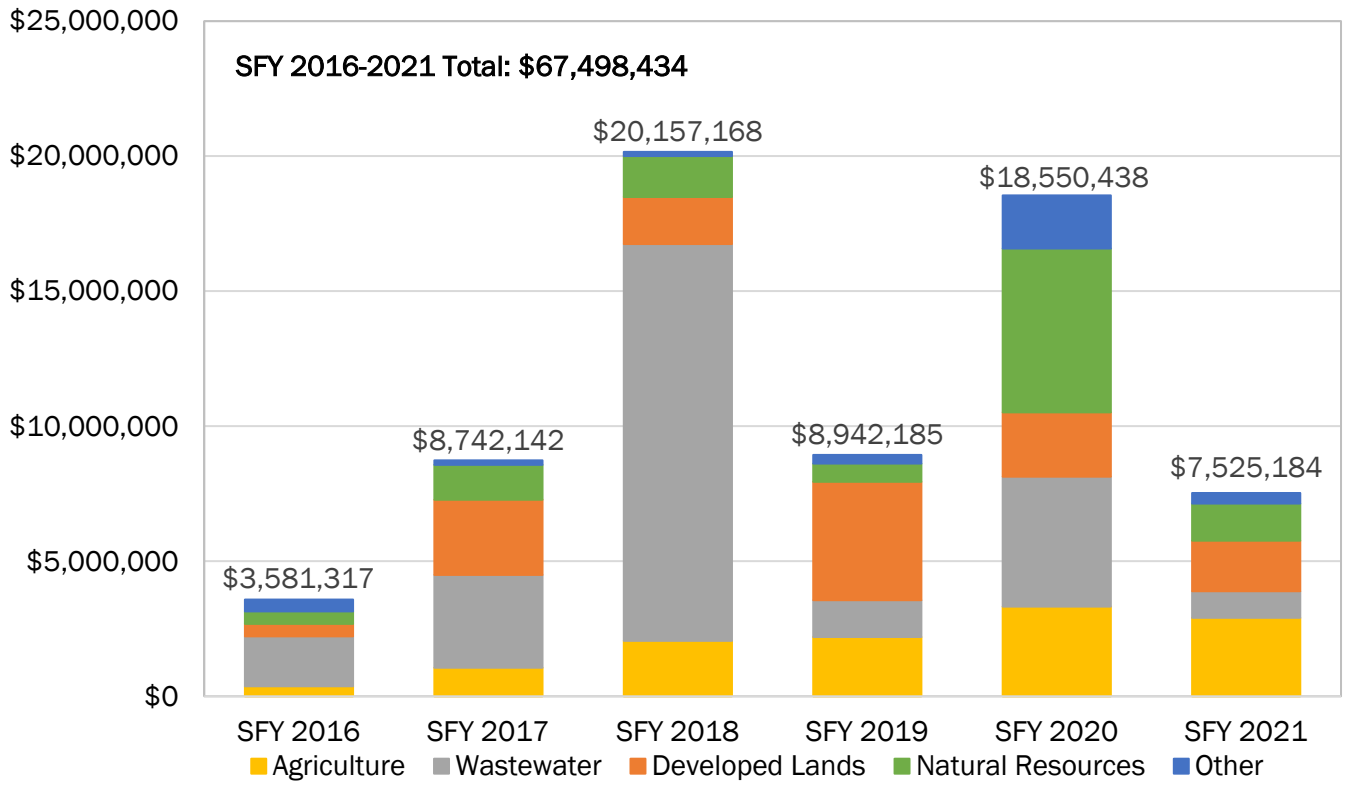


Figure 38. Total dollars awarded by State of Vermont agencies to clean water projects in the Connecticut River basin by land use sector, SFY 2016-2021.

EXPLANATION OF FIGURE

The State of Vermont has invested over $67 million in clean water projects in the Connecticut River watershed since SFY 2016. Clean water funding in the Connecticut River Basin varies from year-to-year based on project readiness. In SFY 2018, the Clean Water State Revolving Fund (CWSRF) and Capital Funding provided significant investments to wastewater refurbishment and combined sewer overflow (CSO) abatement projects in Connecticut River watershed. Two of the largest CWSRF projects in SFY 2018 included the Dover Wastewater Treatment Facility refurbishment costing $4.4 million and the Saint Johnsbury Pleasant Street and Gilman Road CSO Project costing $5.1 million. The large increase in natural resources funding in SFY 2020 was due to the $4 million conservation of Rolston property located in the towns of Chittenden, Mendon, and Killington funded by a CWSRF Land Conservation Interim Financing Loan. This interim financing program provides partners with upfront access to capital to act on time-sensitive conservation opportunities and affords partners time to secure funds to repay the loan over the course of five years.

Results of Vermont's Clean Water Investments in the Connecticut River Basin

Clean water projects in the Connecticut River basin target nutrient and sediment pollution across various land use sectors. The following section summarizes the results of state-funded, federally funded, and regulatory clean water projects in the Connecticut River basin to illustrate the full scope of clean water efforts occurring to improve the lake's water quality. Please note that nitrogen reduction estimates cannot yet be reported for the Connecticut River basin. The following tables summarize project outputs (e.g., acres of agricultural land treated) of all clean water projects in the Connecticut River basin from SFY 2016 to 2021.

Table 13. Outputs of state-funded and regulatory clean water projects completed in the Connecticut River basin by land use sector, SFY 2016-2021. Project development measures support the identification, prioritization, and design of projects. Project output measures reflect extent of project implementation/construction.

State-Funded Agricultural Project Output Measures[51]	2016	2017	2018	2019	2020	2021	Total
Acres of agricultural conservation practices implemented (excluding practice types listed below) [52]	730	177	–	741	2,290	1,783	5,721
Acres of agricultural forested and filter strip buffers installed	18	16	–	–	–	–	34
Acres of pasture with livestock excluded from surface water	92	28	–	–	–	–	120
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures	1	11	23	16	21	9	81
Acres of water quality protections within newly conserved agricultural lands	–	21	33	50	29	6	138
Acres of agricultural land treated through innovative equipment	–	532	559	770	1,569	1,036	4,466
Agricultural Project Output Measures Supported by State Technical Assistance[53]	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of agricultural conservation practices implemented, supported by state-funded technical assistance (excluding practice types listed below)	–	–	–	10	242	123	375

[51] Agricultural project output measures can overlap with other project output measures if multiple practices were applied on the same field. For example, 10 acres of manure injection and 10 acres of cover crop applied on the same field will result in 20 acres of agricultural conservation practices implemented. Similarly, practices implemented on the same field over multiple years will be counted for each year implemented. For example, 10 acres of cover crop implemented on the same field in 2016, 2017, and 2018 will result in 30 acres of agricultural conservation practices implemented. Total agricultural project outputs column represents the total level of effort of state funding programs, rather than the number of distinct agricultural acres addressed.

[52] Acres of agricultural conservation practices includes aeration, conservation crop rotation, cover crop, crop to hay, grassed waterways, manure injection, conservation tillage, and rotational grazing.

[53] Agricultural conservation practices reported through technical assistance represent agricultural conservation practices implemented without financial assistance from state programs reported through technical assistance funded by state programs.

Acres of agricultural filter strip buffer installed, supported by state-funded technical assistance	–	–	–	–	–	6	6
Acres of pasture with livestock excluded from surface water, supported by state-funded technical assistance	53	–	–	–	41	89	183
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures, supported by state-funded technical assistance	–	–	–	–	–	1	1
Number of farms receiving nutrient management planning assistance	–	–	–	9	10	–	19
Agricultural Regulatory Measures	2016	2017	2018	2019	2020	2021	Total
Number of water quality compliance farm visits conducted by AAFM to ensure compliance with Required Agricultural Practices (RAPs) and Medium Farm Operation (MFO) and Large Farm Operation (LFO) Rules[54]	–	–	–	–	–	22	22
Acres of production area inspected by AAFM for RAP compliance[55]	-	34	94	265	343	187	2,115

State-Funded Natural Resources Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Stream miles assessed by Stream Geomorphic Assessment, River Corridor Plan	81	29	17	7	–	–	134
Number of natural resources restoration project identified	64	17	30	51	–	13	175
Acres of river corridor scoped for easement	–	14	–	280	–	–	294
Number of preliminary (30%) designs completed	5	–	–	16	–	–	21
Number of final (100%) designs completed	1	3	9	2	7	9	31
State-Funded Natural Resources Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Acres of forested riparian buffer restored through buffer planting	22	9	20	10	1.7	22	85
Acres of riparian corridor conserved and restored through easements	120	85	150	–	–	21	376
Acres of floodplain restored	1	–	–	1	20	9	31
Acres of lakeshore restored	–	–	5	<1	–	–	5
Stream miles reconnected for restoring rivers to the least erosive condition and regaining fish passage	28	98	119	157	15	30	446

[54] The number of water quality compliance farm visits conducted by AAFM to ensure compliance for SFY 2016-2020 and previous years is available on a statewide basis only.

[55] SFY 2016-2018 datasets are incomplete and do not fully account for all acres of production area inspected by AAFM for RAP compliance due to the initiation of this tracking mechanism.

Acres of wetland conserved and restored through easements	–	–	4	–	–	–	4
Acres conserved with natural resources protections	1,560	278	619	–	3,030	2,317	7,804
Miles of forest road drainage and erosion control improvements	–	1	–	1	3	–	5
Number of stream crossings improved	–	–	–	6	10	–	16
Square feet of gully erosion remediated	–	–	–	27	–	–	27

State-Funded Developed Lands Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Number of projects identified through Stormwater Master Plans	17	12	33	21	20	–	103
Number of illicit/unauthorized discharges confirmed	7	9	–	41	5	3	65
Number of preliminary (30%) designs completed	3	–	12	8	13	–	36
Number of final (100%) designs completed	1	–	5	2	7	1	16
State-Funded Developed Lands Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of existing impervious surface treated by stormwater treatment practices	–	41	–	8	6	–	55
Miles of municipal road drainage and erosion control improvements	<1	4	26	35	17	21	104
Number of municipal road drainage and stream culverts replaced	–	56	35	86	33	68	278
Cubic yards of Class IV road gully erosion remediated	–	–	148	33	–	3	184
Cubic yards of catch basin outlet erosion remediated	–	–	–	93	–	–	93
Acres stabilized through use of seeding/mulching equipment per year	–	–	4	–	233	–	237
Regulatory Developed Lands Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Hydrologically connected municipal road miles inventoried[56]	–	83	808	734	564	400	2,589
Hydrologically connected municipal road miles identified that require water quality improvements	–	48	420	271	292	188	1,219

State-Funded Wastewater Project Development Measures	2016	2017	2018	2019	2020	2021	Total
Number of preliminary (30%) designs completed	–	1	2	–	1	–	4
Number of final (100%) designs completed	3	4	4	1	–	–	12

[56] Note state funding programs supported the implementation of required road erosion inventories. Road erosion inventory data come directly from the MRGP database.

Number of municipal wastewater asset management plans completed	–	2	1	4	–	–	7
State-Funded Wastewater Project Output Measures	2016	2017	2018	2019	2020	2021	Total
Number of combined sewer overflow abatements completed	2	–	–	1	1	–	4
Number of sewer extensions completed	–	1	–	–	–	–	1
Number of wastewater collection systems refurbished	–	–	1	–	–	–	1
Number of wastewater treatment facility refurbished	–	–	–	1	3	–	4

EXPLANATION OF TABLES

The $67 million of state clean water investments in the Connecticut River basin from SFY 2016 to 2021 have resulted in hundreds of clean water projects across all land use sectors. In the agricultural sector, AAFM's Farm Agronomic Practice (FAP) Program has funded the implementation of over 5,700 acres of agricultural conservation practices (e.g., cover crops, conservation tillage, and manure injection), while AAFM's Capital Equipment Assistance Program has funded equipment that has resulted in the application of nearly 4,500 acres of conservation practices.

In the natural resources sector, nearly 400 acres of riparian corridor have been conserved and restored through easements. State funds have also incentivized the conservation of 660 forestland acres through conservation easements since SFY 2016.

In the developed lands sector, over 2,500 miles of hydrologically connected municipal roads have been inventoried to comply with the Municipal Roads General Permit (MRGP) and less than 50 percent of the miles inventoried require water quality improvements. Refer to Appendix D for more information about regulatory measures from stormwater permits.

There have been significant investments in wastewater projects in the Connecticut River basin since 2016. Wastewater funding has resulted in the completion of four CSO abatements, one sewer extension, one wastewater collection system refurbished, and four wastewater treatment facilities refurbished. Wastewater projects are large, complex, and expensive; therefore, the magnitude of the project outputs is lower than for other land use sectors.

The State of Vermont works closely with federal partners to make progress towards clean water goals in the Connecticut River Basin. The following table displays project output data from USDA-NRCS.

Table 14. Outputs of *federally funded* clean water projects completed in the Connecticut River basin, SFY 2016-2021.

Federally Funded Agricultural Project Output Measures[57]	2016	2017	2018	2019	2020	2021	Total
Acres of agricultural conservation practices implemented (excluding practice types listed below)	3,065	5,060	8,178	6,294	4,841	3,775	31,212
Acres of agricultural forested and filter strip buffers installed	7	13	–	–	2	–	22
Acres of nutrient management	245	412	734	923	511	177	3,002
Acres of pasture with livestock excluded from surface water	–	3	–	–	–	–	3
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures	121	91	129	106	68	95	610
Agricultural Project Output Measures Supported by Federal Technical Assistance[58]	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Acres of agricultural conservation practices implemented, supported by federally funded technical assistance (excluding other practices listed below)	1,105	517	379.5	457	22	398	2,877
Acres of agricultural forested and filter strip buffers installed, supported by federally funded technical assistance	<1	2	–	–	–	–	2.2
Acres of nutrient management, supported by federally funded technical assistance	2,657	1,907	–	–	–	256	4,819
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures, supported by federally funded technical assistance	1	1	1	–	–	–	3

[57] Agricultural project output measures can overlap with other project output measures if multiple practices were applied on the same field. For example, 10 acres of manure injection and 10 acres of cover crop applied on the same field will result in 20 acres of agricultural conservation practices implemented. Similarly, practices implemented on the same field over multiple years will be counted for each year implemented. For example, 10 acres of cover crop implemented on the same field in 2016, 2017, and 2018 will result in 30 acres of agricultural conservation practices implemented. Total agricultural project outputs column represents the total level of effort of state funding programs, rather than the number of distinct agricultural acres addressed.

[58] Agricultural conservation practices reported through technical assistance represent agricultural conservation practices implemented without financial assistance from state programs reported through technical assistance funded by state programs.

EXPLANATION OF TABLES

Federal funding in the Lake Memphremagog basin comes from USDA-NRCS. USDA-NRCS has funded the implementation of over 31,000 acres of agricultural conservation practices plus an additional 3,500 acres of nutrient management. Federal technical assistance has also resulted in an additional nearly 3,000 acres of agricultural conservation practices and 5,000 acres of nutrient management. Nutrient management plan implementation is managing the amount, source, placement, and timing of plant nutrients and soil amendments to minimize agricultural nonpoint source pollution, maintain or improve soil conditions, protect air quality, reduce input costs, and improve crop production.

Future Total Nitrogen Load Reduction Tracking

Nitrogen reduction estimates cannot yet be reported for the Connecticut River basin, as the State of Vermont does not yet have baseline nitrogen loading estimates or nitrogen reduction efficiencies for clean water projects in the Connecticut River basin. EPA-supported efforts are underway to develop consistent methods for all five states in the Long Island Sound basin to employ in estimating nitrogen reductions for clean water projects. Vermont's Clean Water Service Delivery Act, Act 76 of 2019, requires setting a schedule to publish methods for other (i.e., non-phosphorus) impairments by November 1, 2023 (10 V.S.A. § 923).

Chapter 6: Variables Affecting Realized Water Quality

Excess nutrient loading to Vermont's waters leads to local and regional water quality issues, including unsightly and potentially harmful algae blooms in Lake Champlain and Lake Memphremagog and low dissolved oxygen and dead zones in the Long Island Sound. The majority of phosphorus loading to Vermont's waters is from nonpoint sources, such as agricultural or stormwater runoff, transported from the landscape to waterways by rainfall and snowmelt. Due to the dispersed nature of nonpoint source pollution, many variables can affect the amount of pollution delivered to a waterbody any given year. The State of Vermont estimates the nonpoint source nutrient reductions associated with clean water projects, but these estimates may differ from realized environmental conditions. The following section of the report summarizes the variables that affect measured water quality conditions, including climate change, land use change, and cyanobacteria ecology, and also provides information on where to access measured water quality monitoring data for Vermont's waters.

Climate Change

Climate change is expected to have numerous environmental effects in Vermont, including altering precipitation patterns and warming air and water temperatures. The figure below illustrates the long-term trends in annual precipitation and the number of days with precipitation greater than one inch in Burlington, Vermont.

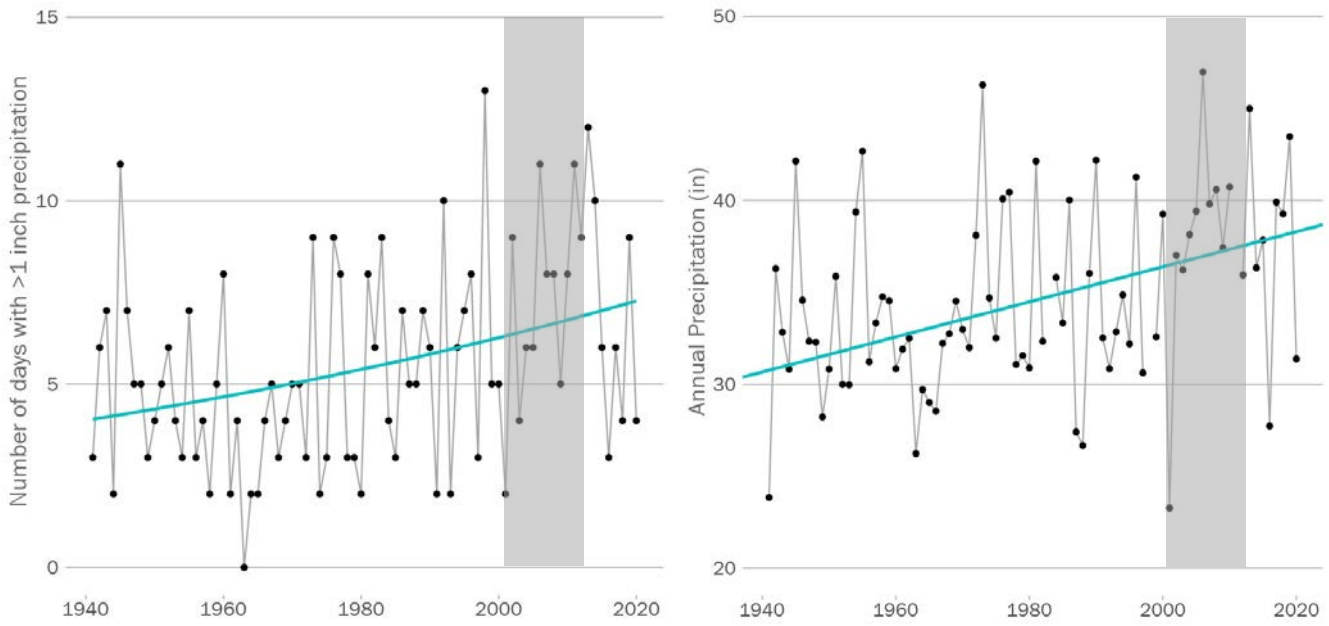


Figure 39. Change in number of days with liquid precipitation (i.e., not snow) greater than one inch (left) and change in annual total precipitation (right) using Burlington to represent Vermont, 1940-2020 (gray shading represents Lake Champlain TMDL and Lake Memphremagog combined baseline modeling periods, 2001-2012, and blue line represents trend). Data from National Oceanic and Atmospheric Administration's Burlington International Airport climate station.

EXPLANATION OF FIGURE

Climate data indicate statistically significant increase in frequency of intense storms and annual total precipitation since 1940. It should be noted the Lake Champlain TMDL model simulated climate change scenarios and added a 5 percent margin of safety to each lake segment's loading capacity to address the likely increases in phosphorus loading from climate change, while the Lake Memphremagog model added an 8 percent margin of safety.

Change in precipitation patterns may increase nonpoint source pollution loading by:

- Increasing erosion of unstable road networks and unstable stream banks and lakeshores;
- Increasing volume of runoff from agricultural fields and production areas; and
- Increasing volume of stormwater runoff from impervious/hard surfaces, such as roads, parking lots, and rooftops.

Changes in precipitation patterns highlight the importance of climate adaptation. Clean water projects may support climate adaptation through:

- Protection and restoration of natural resources (e.g., wetlands, floodplains, lakeshores) to naturally mitigate extreme weather events;
- Implementation of agricultural field practices to improve soil health, water infiltration, and carbon sequestration;
- Implementation of revised road, bridge, and culvert standards for resilience against higher flow and more intense storms; and
- Implementation of Stormwater Management Manual standards that emphasize the importance of infiltrating stormwater runoff into soils.

Weather conditions influence the amount of nutrients like phosphorus that reach surface waters. The increasingly heavy precipitation events expected because of climate change are likely to wash more phosphorus into lakes and ponds. Timing of precipitation events may also change, with more occurring during the warmer months of the year when cyanobacteria are actively growing and using phosphorus.

Climate change is also expected to increase local air and water temperatures. The figure below summarizes the change in average summer (July, August, and September) surface water temperatures in Burlington Bay from 1996 to 2020.

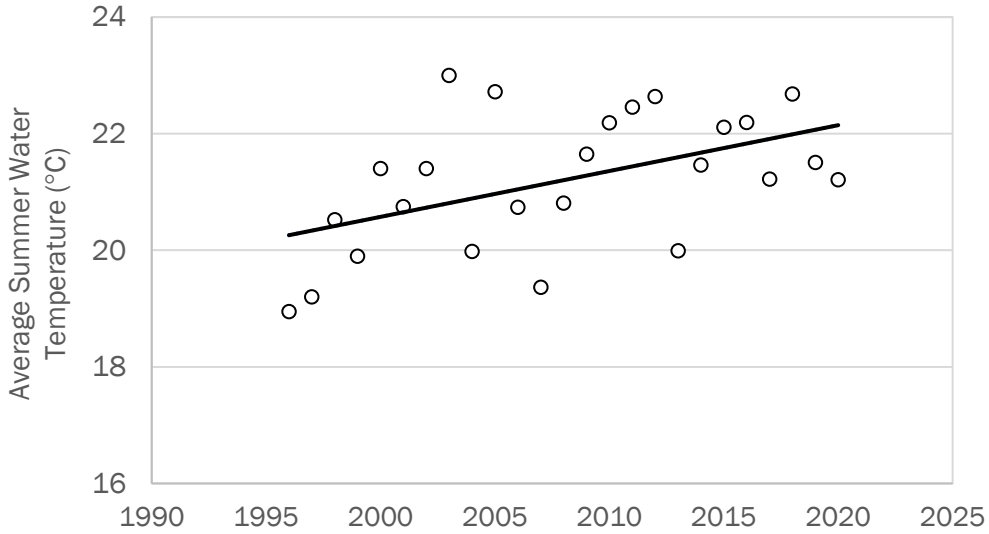


Figure 40. Change in average summer (July, August, and September) surface water temperatures in Burlington Bay from 1996 to 2020. Data from the Lake Champlain Long-Term Monitoring Program.[59]

EXPLANATION OF FIGURE

There is a statistically significant increase in average summer water temperatures in Burlington Bay of Lake Champlain. Average summer water temperature in 1996 was 19.0°C (66.2°F), while the average summer water temperature in 2020 was 21.2°C (70.2°F). This represents a 2°C (4°F) increase in water temperature over the past 24 years.

Water temperatures warm faster in shallow lakes and bays than in deeper lakes and bays. Warming water temperatures are expected to have several effects on lake ecosystems, including:

- Affecting lake water levels by increasing rates of evaporation and causing lake ice to form later than usual. Lower water levels can affect water supplies, usability of infrastructure such as docks and piers, and shoreline ecosystems;
- Altering the composition of fish and invertebrate communities. Cold and cool water fish and invertebrates may be replaced by species better adapted to warmer temperatures;
- Expanding the ranges of current aquatic invasive species or allow new invasive species to establish; and
- Increasing growth rates of harmful cyanobacteria and other nuisance aquatic plants.

[59] Lake Champlain Long-term Monitoring data is available at: https://anrweb.vermont.gov/dec/_dec/LongTermMonitoringLakes.aspx

Climate change is predicted to affect several key factors that regulate cyanobacteria growth—temperature, nutrient availability, and water stability. Warmer summer temperatures and shorter, warmer winters will increase the length of time that cyanobacteria can proliferate each year. Already, the cyanobacteria monitoring program on Lake Champlain since 2003 has documented blooms are occurring earlier in the summer and persisting later into the fall. The monitoring season now begins about two weeks earlier than it did in 2003 and documents blooms occurring into mid-October. In 2019, blooms persisted into late October. Moreover, scientists in Vermont and elsewhere are noting the incidence of cyanobacteria blooms at lower-than-expected phosphorus concentrations, indicating that the factors noted above are equally important in driving the incidence of bloom condition.

Figure 41. Example of a cyanobacteria surface scum. Photo from DEC Lakes and Ponds Program.

Cyanobacteria's ability to regulate buoyancy allow it to move toward sunlight under the calm conditions that often accompany hot summer days and during turbid conditions after intense rainfall. Climate change is expected to increase opportunities for cyanobacteria growth in Vermont. For example, water temperature in Lake Champlain reached a record-breaking 26°C (79°F) on June 23, 2020.[60] The reality is that the State of Vermont will have little control over weather patterns and precipitation. Therefore, Vermont will need to focus on land-use management and control of nutrient pollution loading to surface waters to reduce the number of cyanobacteria blooms.

Land Use Change

As development in Vermont increases, land uses change across the state. Forested lands produce the lowest yield of nutrients and greatest benefit to water quality of all land uses, while developed lands have the greatest phosphorus loading rates followed by agricultural lands. Land use change from forested land to agricultural or developed lands is often associated with an increase in nutrient loading to Vermont's waters, if the increased loading is untreated. The figure below summarizes the percent decrease in forested land use and concurrent increase in developed land uses in Vermont.

[60] National Weather Service data on Lake Champlain extremes and temperature from the Burlington, VT weather station, available at: https://www.weather.gov/btv/lakeTemp?year=2020.

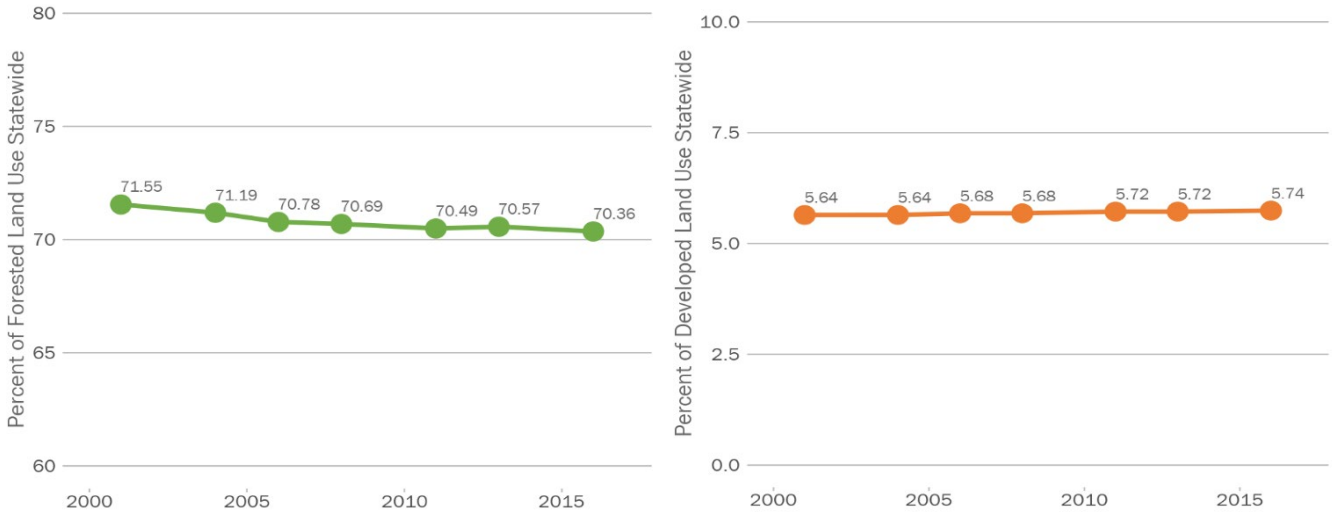


Figure 42. Change in percent of total Vermont area in forested and developed land uses in Vermont, 2001-2016. Data from the National Land Cover Dataset.

EXPLANATION OF FIGURE

Land use data from 2001 to 2016 show an approximate 1 percent decrease in forested land cover statewide since 2001, and a 0.1 percent increase in developed land use statewide (approximately 9.5 square miles). The 1 percent loss of forestland statewide represents 114 square miles of forestland converted to other land uses, such as development, agriculture, and shrub or herbaceous land uses after timbering. Land use change is not evenly distributed across the state. Most development and population growth has occurred in Chittenden County and the broader Lake Champlain basin; however, statewide these growth areas are averaged out by areas that are not growing or shrinking.

The increase in loading from converting forest to developed lands or agricultural lands may affect the realization of Vermont's water quality goals. The loss of forested lands highlights the importance of the clean water efforts underway to protect and restore forested lands, including:

- Conservation easements to help maintain water quality benefits of forest lands; and
- Use Value Appraisal (UVA) Program providing tax incentives for private landowners to keep woodlands intact.

Water Quality Monitoring

Measured water quality is the ultimate indicator of clean water progress. Many agencies and organizations conduct water quality monitoring to track trends in lake and river water quality across the State of Vermont, including:

- Vermont DEC Lakes and Ponds Management and Protection Program
- Vermont DEC Monitoring and Assessment Program
- Vermont DEC Rivers Program
- United States Geological Survey
- Lake Champlain Basin Program
- Municipal Separate Storm Sewer System (MS4) communities

The water quality monitoring data collected by these programs are used to:

- Determine compliance with Vermont's water quality standards and the federal Clean Water Act;
- Identify trends in the condition of Vermont's aquatic and wetland resources;
- Identify existing and emerging threats to Vermont's aquatic and wetland resources;
- Identify where watershed-level activities are impacting aquatic and wetland resources;
- Provide information to support and evaluate management and regulatory programs, including the development of environmental indicators; and
- Respond to citizen complaints and emergency situations regarding Vermont's aquatic and wetland resources (as appropriate).

Vermont DEC's water quality data can be accessed through the Vermont Integrated Watershed Information System (IWIS) or in the Water Quality Integrated Assessment Report produced biannually.[61,62]

[61] The Vermont Integrated Watershed Information System can be accessed here: https://anrweb.vt.gov/DEC/IWIS/

[62] Vermont Water Quality Integrated Assessment Report 2018: https://dec.vermont.gov/content/2018-305b-water-quality-assessment-report

VERMONT INLAND LAKE SCORECARD

The Vermont Inland Lake Score Card is a user-friendly interface developed by the VT DEC Lakes and Ponds Program that shares data on overall lake health with the public. Users can select from more than 800 lakes in the state and learn about four key aspects of lake health:

1. Nutrients
2. Aquatic invasive species
3. Shoreland and lake habitat
4. Mercury pollution

Lake Scores are based on the best available water quality and ecosystem monitoring data and information. While the data upon which a score is based is empirically derived, the actual thresholds differentiating lake scores were based on best professional judgement. Final scores are reviewed by Lakes and Ponds scientists. See the example below for the data available for individual inland lakes.

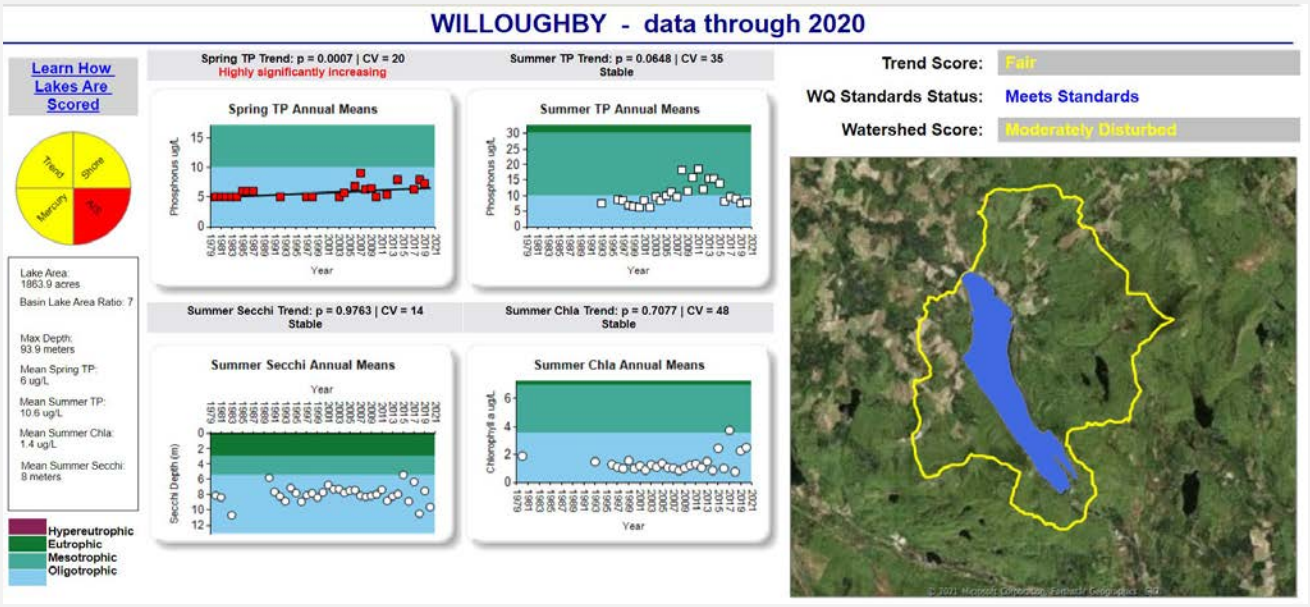


Figure 43. Example Lake Scorecard for Lake Willoughby.

Lake Scorecards can be accessed here: https://anrweb.vt.gov/DEC/IWIS/ReportViewer3.aspx?Report=LakeScoreCard_Current_TrendsAndStatus&ViewParms=True

Appendices:

Appendix A. Missisquoi Bay Watershed (Basin 6) TMDL Implementation 2021 Progress Report

Appendix B. Lamoille River (Basin 7) TMDL Implementation 2021 Progress Report

Appendix C. Winooski River (Basin 8) TMDL Implementation 2021 Progress Report

Appendix D. Stormwater Operational Permit Results

Appendix A. Missisquoi Bay Watershed (Basin 6) TMDL Implementation 2021 Progress Report

The Accountability Framework of the 2016 *Phosphorus Total Maximum Daily Loads (TMDL) for Vermont Segments of Lake Champlain* ensures TMDL implementation moves forward at a steady rate. A major driver of the Accountability Framework is the Vermont Department of Environmental Conservation's (DEC) development of basin-specific Tactical Basin Plans (TBP). TBPs are developed on a five-year rotating basis and include Implementation Tables that identify priority strategies needed to implement the TMDL. It is through review of the Implementation Tables, and the progress made in accomplishing the tasks, that U.S. Environmental Protection Agency (EPA) intends to track implementation progress in each basin. To facilitate EPA's evaluation of progress, DEC describes the status of each strategy midway (2.5 years) through and at the conclusion of the five-year planning cycle in interim and final report cards, respectively.

This Appendix is the final report card for the Missisquoi Bay Watershed (Missisquoi Basin), updating the 2019 interim report card[1]. The five-year reporting period began in January 2016 coincident with the publication of the 2016 Missisquoi Bay TBP and goes through June 30, 2021.[2]

The following sections describe progress towards completing strategies in the 2016 Missisquoi Bay TBP Implementation Table. Each strategy is organized by one of five major sectors – agriculture, developed lands, natural resources, forestry, and wastewater. Progress described for each strategy includes status (defined in Table 1) as well as an explanation of actions taken. The explanation describes how the Agency supported the strategy and resulting outcomes that together show that meaningful results were achieved. Information provided includes performance measures for Agency-supported assistance that were collected as part of the Accountability Framework. These performance measures provide a quantitative measure of implementation.

Estimations of total phosphorus loading reductions to the lake are not presented as part of this exercise. Instead, estimated total phosphorus load reductions are presented in Chapter 3 of the *Vermont Clean Water Initiative 2021 Performance Report* to allow comparison to the TMDL phosphorus allocations.

Basin 6 Update

The 2016 Missisquoi Bay TBP strategies were evaluated, and their associated actions were assigned a status condition using the rationale described in Table 1. To address strategies identified as ongoing in the 2016 Missisquoi Bay TBP, a status of complete, continued, or discontinued has been assigned to previously ongoing projects. Of the 27 strategies, 24 have been completed and 3 are in progress. (Figure 1).

[1] See page 93 of the Vermont Clean Water Initiative 2019 Performance Report
[2] Data in this report aligns with this five-year period and the SFY 2016–SFY 2021 granting period of the Clean Water Reporting Framework (CWRF).

Table 1. Status conditions assigned to strategies and actions in the TBP Implementation Table (Table 2).

Strategy Status for Final Report Card	Description	Example(s)
Complete	A discrete action identified in a strategy with a clear end point that has been implemented. A strategy identified as ongoing in the 2019 interim report card that has been pursued and implemented throughout the TBP's 5-year period.	Provided 3 trainings to partners to evaluate 5 properties for Lake Wise assessments. The Municipal General Permit was implemented and all or most towns are on schedule to meet permit requirements. Five priority projects were implemented that were identified in River Corridor Plans.
In Progress	A discrete action identified in a strategy with a clear end point that is being implemented either as described, or, where needed, with revisions as described in the subsequent plan.	A stormwater master plan that has been funded and is being implemented but is not yet completed.
Continued	A discrete or programmatic strategy that was not initiated or formally pursued.	Strategy was carried over to the next basin plan due to funding or capacity gaps.
Discontinued	A discrete or programmatic strategy that was removed as a strategy and is no longer a priority.	The project was superseded by a project further upstream that treated the problem effectively. The project is no longer a priority for a state program.

This report depicts a community that is pursuing permit compliance and adopting voluntary practices that will work towards meeting ANR's water quality goals. As described in the final status report for the 2016 Missisquoi Bay TBP Implementation Table (Table 2), all of the strategies associated with regulatory programs were completed. Many of these directed financial support and technical assistance to permit holders. Partners were also provided with assistance to in turn support compliance within the community through distributed education, outreach, and technical assistance. Regulatory compliance outcomes include increased implementation of Required Agricultural Practices and agricultural best management practices and stormwater best management practices on roads. In addition, there was a steady increase in resources provided by the state to community and partners, which in turn supported a steady increase of adoption of natural resource restoration practices, and stormwater management on developed land.

The 27 strategies are associated with work that the State of Vermont has and will continue to support. While listed as "Ongoing" in the 2019 interim report, 24 of them are listed as complete in this final report. The expected resources and assistance were provided and resulted in outcomes that showed meaningful progress towards meeting water quality goals. Performance measures are associated with these actions where available.

Phase 3 of the TMDL in the 2021 Missisquoi Bay TBP provides additional information that explains sector progress on meeting TMDL goals. This progress is an outcome of strategy implementation in the 2016 TBP.

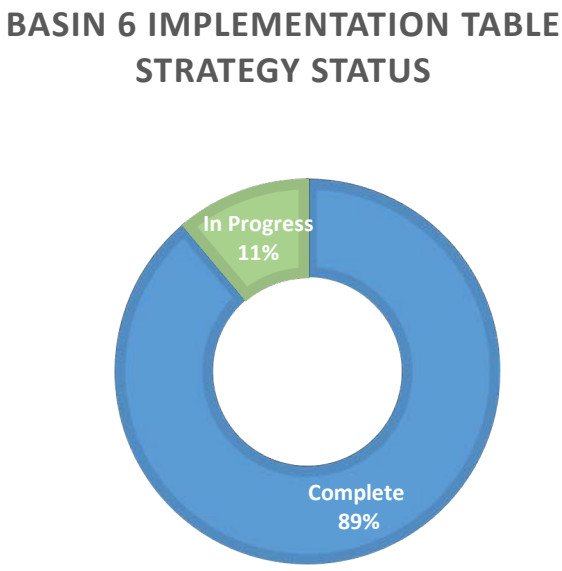


Figure 1. Basin 6 2016 Implementation Table strategy status (27 strategies).

The three strategies in progress have not reached an end point. They include support of the reclassification of a wetland and completion of mapping projects to help in prioritization of critical areas. See narrative in Table 1 for explanation.

In the 2021 TBP, strategies support continued work to complete the three 2016 strategies described above. In addition, a new set of strategies are identified that represent the next phase of work associated with regulatory programs, or improved approaches that partners can take with Agency resources to encourage BMP adoption in the community. The plan also describes the increased capacity available to ensure project implementation as well as a more comprehensive accounting of phosphorus reductions. This includes the roll-out of the Clean Water Service Delivery Act (Act 76), which will increasingly support the delivery of clean water services and increase regional capacity to develop and implement projects that fulfill actions[2]. An explanation of DEC's expected progress based on these additional resources is included in the 2021 TBP's Chapter 3 (LC TMDL Phase 3) and Chapter 4. DEC will submit the interim report 2024 and the final report in 2026.

Basin 6 Implementation Table Status

The status for each strategy (Table 2) was compiled by the Water Investment Division's Watershed Planning Program using data from the DEC, AAFM, NRCDs, RPCs, and additional watershed partners involved in project development and implementation for the five-year planning period.

The Implementation Table is not an exhaustive list of water quality strategies that lead to phosphorus reductions in a basin. A complete description of all the work that the state supports in the basin to meet water quality goals can be found in the *2021 Vermont Nonpoint Source Management Plan*. Additional information about progress associated with each sector can be found in the Chapter 3 of the *Vermont Clean*

Water Initiative Annual Performance Report, which provides comprehensive reporting of estimated total phosphorus load reductions associated with state funding, federal funding, and regulatory programs. These data are also made available to the public through the Clean Water Portal's Clean Water Interactive Dashboard – an online tool that allows interested parties to examine and filter Performance Report data on investments, project outputs, estimated pollutant load reductions and project cost effectiveness. [3] Individual projects in the basin that are included or supported by strategies are described in the Clean Water Project Explorer, also found through The Portal.

[3] Clean Water Portal can be accessed here: https://anrweb.vt.gov/DEC/cleanWaterDashboard/.

Table 2. Final Status Report for the 2016 Missisquoi Bay TBP Implementation Table; includes data from a) SFY 2016 to SFY 2020 and b) calendar year 2016-2021. (Acronyms are listed at the end of the table).

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation
Expand small farm Nutrient Management Plan (NMP) development courses and workshops, trainings for farmers, manure applicators and technical service providers	Missisquoi Bay		Agriculture	Complete	AAFM funds supported the work of the UVM Extension, FCNRCD and the OCNRCD to provide NMP courses to farms, leading to NMP adoption. As of June 2021, 89% of reporting CSFOs in Basin 6 have full NMP. The next phase of this work is to ensure proper implementation of plans, a strategy in the 2021 TBP. To assist in ensuring accurate implementation of NMPs, between December 2016 and June 2021, custom manure applicators attended 791 hours of training. In 2021, there were 64 certified custom manure applicators.
Increase inspections in critical watersheds: Finalize reporting of North Lake Farm Survey (NLFS) in Missisquoi Bay watersheds and target implementation based upon the results	Missisquoi Bay		Agriculture	Complete	In 2015 and 2016, AAFM conducted the North Lake Farm Survey (NLFS), completing full surveys on 339 farm facilities in Missisquoi Bay and the northern half of St. Albans Bay. The resulting report supported additional case management. See below for more detail including targeting of implementation.
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	Pike, Rock Rivers and Mud Creek and farms identified in Northern Lake Farm Survey (NLFS)		Agriculture	Complete	Increased adoption of BMPs in critical watersheds as well as the basin as a whole occurred over the last five years as shown on page 3 of *Missisquoi Basin Agricultural Phosphorus Loading & Reduction* online report. Case management as well as information to help target practices supported BMP adoption: 1. Between 2016 and 2020, AAFM provided funds to three partners to be case managers for approximately 36 priority projects identified in the NLFS. Through 963 hours of technical assistance, 32 farms were assisted, and 31 conservation practices were implemented with AAFM BMP grants addressing NLFS priorities. Project management has since continued through AAFMs technical assistance programs and AgCWIP grants to partners serving the Missisquoi watershed. 2. ANR supported development of modeling analyses identifying high phosphorus loading agricultural areas to help target geographic areas for implementation of specific practices for most effective and efficient reduction of phosphorus loading, see *Missisquoi Basin Agricultural Phosphorus Loading & Reduction* online report
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	Pike, Rock, Mud Creek and farms identified in NLFS		Agriculture	Complete	AAFM's TA staff and AgCWIP funded partner staff provide technical assistance on a variety of water quality topics and project areas and started tracking on site visits in the partner database in 2019, see table below of AgCWIP visits by HUC12. In addition, NRCS has provided additional technical assistance to provide priority conservation planning in the Rock and Pike.

<table>
<tr><th>Strategy Description</th><th>Priority Subbasin(s)</th><th>Priority Towns</th><th>Sector</th><th>Status</th><th>Explanation</th></tr>
<tr><td>partners as needed for Mud Creek</td><td></td><td></td><td></td><td></td><td>
<table>
<tr><th>On Site Visits per HUC12</th><th>FY 2020</th><th>FY 2021</th></tr>
<tr><td>Beetle Brook-Missisquoi River</td><td>11</td><td>3</td></tr>
<tr><td>Black Creek</td><td>5</td><td>9</td></tr>
<tr><td>Carman Brook-Missisquoi Bay</td><td>5</td><td>1</td></tr>
<tr><td>Dead Creek</td><td>2</td><td>2</td></tr>
<tr><td>Enosburg Falls-Missisquoi River</td><td>2</td><td>6</td></tr>
<tr><td>Fairfield River</td><td>5</td><td>6</td></tr>
<tr><td>Goodsell Brook-Missisquoi River</td><td>8</td><td>10</td></tr>
<tr><td>Groat Creek</td><td>2</td><td>1</td></tr>
<tr><td>Headwaters Black Creek</td><td>12</td><td>11</td></tr>
<tr><td>Headwaters Trout River</td><td>1</td><td>2</td></tr>
<tr><td>Headwaters Pike River</td><td>26</td><td>16</td></tr>
<tr><td>Hungerford Brook</td><td>11</td><td>11</td></tr>
<tr><td>Lucas Brook-Missisquoi River</td><td>1</td><td>4</td></tr>
<tr><td>McGowan Brook-Missisquoi River</td><td>3</td><td>4</td></tr>
<tr><td>Mineral Spring Brook-Missisquoi River</td><td>2</td><td>6</td></tr>
<tr><td>Mud Creek</td><td>5</td><td>3</td></tr>
<tr><td>Outlet Missisquoi River</td><td>2</td><td></td></tr>
<tr><td>Outlet Sutton River</td><td>2</td><td>2</td></tr>
<tr><td>Outlet Trout River</td><td>1</td><td>1</td></tr>
<tr><td>Rock River</td><td>36</td><td>34</td></tr>
<tr><td>Snider Brook-Missisquoi River</td><td>15</td><td>9</td></tr>
<tr><td>Tyler Branch</td><td>5</td><td>6</td></tr>
<tr><td>Grand Total</td><td>162</td><td>147</td></tr>
</table>
</td></tr>
<tr><td>Develop and pilot the Environmental Stewardship Program to incentivize additional practice adoption 2016 2020</td><td>Missisquoi Bay</td><td></td><td>Agriculture</td><td>Complete</td><td>In 2018, the AAFM began a pilot of the Vermont Environmental Stewardship Program (VESP). In 2021, 4 farms were awarded Vermont Environmental Stewardship certifications, none in the Missisquoi watershed. While the pilot program has completed, the full launch of the program is currently on hold, as the VT Pay-For-Phosphorus (VPFP) incentive program is in development and the Payment for Ecosystem Services workgroup continues, to assess how the VESP program integrates with current state priorities and initiatives.</td></tr>
<tr><td>Create grassed waterways program Target funding to</td><td>Missisquoi Bay</td><td></td><td>Agriculture</td><td>Complete</td><td>The Grassed Waterway and Filter Strip grant program is managed by AAFM continues to be a funding opportunity for Vermont farmers to address critical source areas, erosion, and surface runoff. This program provides compensation</td></tr>
</table>

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation
critical source areas in coordination with partners					to farmers via incentive payments for participation ($500/acre) and cost-share to cover 90% of the installation costs for establishing perennially vegetated grassed waterways, filter strips, and forage and biomass seedings, and associated infrastructure, if necessary, on agricultural cropland adjacent to surface waters and ditches. Completed practices under this program include 3.14 acres of critical source area restored in the Missisquoi Basin. NRCS provides a similar program that is currently more popular.
Provide technical assistance on stormwater master planning (SWMP) to identify and prioritize actions	Mid Missisquoi,	Richford	Developed lands – other	Complete	DEC ERP grants funded NRPC to develop Richford and Fairfield SWMPS. DEC basin planners aided the NRPC to complete plans, including attending meets and reviewing draft material. Overall, 44 projects were identified during development of 2 SWMP. All of the SWMP identified as needed in the 2016 TBP were completed.
Support implementation of completed Stormwater Master Plans (SWMP)	Multiple	Enosburgh, Fairfield, Franklin, Highgate, Sheldon, Swanton	Developed lands – other	Complete	DEC provided Clean Water Funded grants to support partners in their implementation of projects identified in 6 town SWMP in the basin. NRPC has assisted Richford, Highgate, and Franklin in development of projects. FNLC has assisted Highgate and Sheldon. DEC has also provided additional technical assistance. In total, Clean Water funding has supported projects that have treated 23 acres of existing impervious with most projects identified in SWMP. Additional acres have been treated through projects that received funding sources outside of the CWF including the Highgate school and Franklin Town garage.
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	Upper Missisquoi, Trout (West Hill Brook)	Lowell, Troy, Westfield, Jay, Montgomery, Bakersfield, Berkshire, Enosburgh, Enosburg Falls, Fairfield, Highgate Richford, Franklin and Swanton	Developed lands – roads	Complete	Partners assisted municipalities in completing Road Erosion Inventories REI) to meet the MRGP. Every town but Bakersfield has completed an REI with prioritized road segments. The NRPC has recently encouraged the town to apply for the next grant round to support completion of the towns REI. Clean Water funding through the VTrans Better Roads and the ANR's/VTrans Municipal Road Grants-in-Aid programs support the development of municipal REIs, project implementation and purchase of equipment like hydro seeders. In addition to providing technical assistance partners have assisted municipalities in applying for these grants. All the towns in the basin have taken advantage of the Grants-in-Aid Program to address hydrologically connected roads. The UMATR also assisted Richford with a stone-lined ditch and ONCRD was supported through the Agency TBP-support grants to provided technical support to Orleans County towns in the Basin as part of the Northeast Kingdom Rivers to Roads group. Assistance to municipalities has supported inventory of 1380 segments of hydrologically connect road segments with 716 segments identified as needing

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation
					improvement. As of ending of FYR 2021, 664 segments have been improved to meet MRGP standards, either before inventory or as a result of inventory.
Support municipal stormwater regulation adoption, include incorporation of LID, GSI		Towns with Stormwater master plan	Developed land - other	Complete	Partners provided technical assistance to municipalities to facilitate stormwater regulation adoption. During work with towns on bylaws, NRPC provided technical assistance on using bylaws to enhance stormwater management: Berkshire*, Enosburg Falls*, Fairfield, Fletcher*, Swanton, Bakersfield*. Those that adopted regulations are noted with a *. See also Municipal Protectiveness Matrix).
Increase the number of river and floodplain restoration projects. Re-establish connections to floodplains	Hungerford, Mid-Missisquoi	Sheldon, Enosburgh, Berkshire	Natural Resources	Complete	ANR supported partners in increasing restoration projects, including enhancing floodplain in agricultural ditches: The two-tiered ditch is the most promising approach to reestablishing flood plain in agriculturally dominated area where landowners are reluctant to lose productive land. In total, 1853 linear feet of river corridor was conserved, allowing for passive river and floodplain restoration. In addition, 890 linear feet of buffer was planted with woody vegetation. The UMATR also stabilized 300 linear feet of riverbank using bioengineering techniques in the upper Missisquoi.

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation
Replace geomorphologically incompatible culvert and bridges: RPCs work with towns to identify, add to capital budget, seek additional funding sources	Upper Missisquoi	Montgomery, Orleans County	Natural Resources	Complete	NRPC staff have had conversations and informed communities around undersized culverts and assisted with Better Roads Category D grant applications for Richford, Sheldon, Swanton, Montgomery, St. Albans Town, Franklin, Highgate, and Fairfield in this time period. NRPC will continue to do additional consultations with Towns that include this information as NRPC continues to process REI report and aid in forming the MRGP and capital planning discussions. In addition, partners have collaborated in Orleans County as the Northeast Kingdom Rivers and Roads Group to target assistance, including work with towns on their capital budgets to ensure funding. Collaborative efforts with the USFWS and UMATR have also contributed funding with a focus on AOP compatibility in upper Missisquoi towns (Berkshire, Westfield, North Troy); Clean Water funding supported reconnection of one mile of stream through culvert replacement projects that addressed geomorphic incompatibility.
Increase River Conservation Easements: support projects that incorporate channel management and riparian buffer provisions	Trout, Upper Missisquoi, Tyler and Black Creek	Franklin and Orleans Counties	Natural Resources	Complete	Linear feet of river corridor preserved has increased since 2017, with annual increases occurring except for 2019 and a total of 1853 linear feet of river corridor conserved. The highest concentration of easements is found in the Upper Missisquoi supported by a strong collaborative effort among partners. Partners include VLT, MRBA, NRCS, USFWS, ONRCD. UMATR also provided funding to support conservation easements in Richford. DEC has also begun to encourage partners to combine corridor easements with other land conservation programs. The easement ensures that watercourses and wetlands are not manipulated to alter natural water level or flow or intervene in the natural physical adjustment of the water bodies. A VLT project along the Missisquoi included both river corridor easement and a restored acre of wetland. In total,
Enhance the Flood Resilient Communities Program with funding and technical assistance incentives for municipalities	Upper Missisquoi, Trout, Tyler Branch	Franklin and Orleans Counties	Natural Resources	Complete	The Agency's Flood Ready website hosts supportive materials for municipal officials and DEC has prepared model flood hazard bylaws to assist municipalities in the development of their flood hazard regulations. DEC staff and RPCs have met with towns to provide technical assistance and explain the economic benefits associated with flood resilience. In last several years, MRBA, supported with High Meadow Funds, has worked with headwater towns to increase awareness of flood resilience actions. These actions have supported increased flood resilience in community: of the 18 municipalities that include significant area in the basin, 18 municipalities are participating in the National Flood Insurance Program and have adopted the Town Road and Bridge Standards, and 13 have adopted a Local Hazard Mitigation Plan. By adopting river corridor protection, 2 of the 18 municipalities,

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation
					Bakersfield and Montgomery have been granted "early adopter" status by the DEC. Six towns in the basin are provided additional flood resilience through adoption of River Corridor Protection. Recent partner discussions with Jay, Troy, Swanton and Westfield suggest that these towns are interested in considering adoption of additional protections.
Support studies to investigate benefits of removal of dams listed in TBP's Table 9	All	All	Natural Resources	Complete	Studies funded through state and federal grants were completed on the Black Creek and East Highgate dams as well as an alternatives analyses for Mud Creek Dam and Lake Carmi Dam. Studies were followed by removal of The East Highgate dam, Johnson Mill dam. FCNRCD and USFWS are in discussions with landowner regarding feasibility study to remove Browns Pond Dam. MRBA, supported by Newport Center selectboard will seek fuds to remove Sleeper Pond Dam. In 2020, UMATR funded a phase 1 assessment of the Sampsonville Dam for safety concerns
Develop LiDAR mapping to map eroding, abandoned and retired forest roads, skid trails and log landings to assist in identification of remediation projects	All	All	Forestry	In Progress	DFPR supported a UVM project completed in 2017 that confirmed that LiDAR can be used to visualize forest roads, locate sites with high erosion potential, reveal landscape-level patterns of pollution loading, and highlight units that require further analysis. A subsequent consulting project is currently underway (focusing on the South Lake and Missisquoi Basins) that will further assess forestlands to identify and prioritize legacy erosion associated with critical source areas within forests. Ground truthing of this landscape analysis will be used to calibrate this prioritization framework of critical source areas to address legacy erosion in high priority basins, such as the Missisquoi, to achieve target load allocations for lake segments that will not meet reduction targets through VT AMP compliance alone.
Prioritize work with landowners based on contribution of erosion features on logging roads (see above regarding use of LiDAR). Provide technical and financial assistance	All	All	Forestry	In Progress	The DFPR county foresters and partners are continuing to provide landowners with technical assistance to properly manage forest roads. County foresters also work to ensure landowners are aware of financial assistance, which is most readily available through NRCS EQIP or RCPP practices. To prioritize work, the Agency has supported the development of a forest road erosion inventory (REI) system to facilitate assessment and prioritization of forest road improvements. This is not yet available to private landowners. In all, in the basin: 5 acres of forest road improved and 1 stream crossing structure replaced with state and federal funding. MRBA managed one of these projects in Jay State Forest with DEC funds.
Provide loggers with access to portable skidder bridges through rental	All	All	Forestry	Complete	Starting in 2018, the DFPR has been providing cost-share funding for loggers and foresters to receive temporary portable skidder bridges. Statewide, the DFPR distributed 12 free wooden bridges in 2018 and administered 9 cost-

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation
program. Promote building and ownership of bridges by logging as part of their general practices					share grants for bridges in 2019 and 2020. DFPR expects to distribute over 25 bridges in 2021. In addition, the DFPR Watershed Forester administers a rental program for 5 heavy duty steel bridges for crossing larger rivers. The portable wooden skidder bridge program offered by some Vermont conservation districts, including the OCNRCD has slowed down due to a lack of available bridges, but that program will continue when those bridges are replaced. In Basin 6, 1 stream has been protected during the reporting period using a portable skidder bridge.
Enhance forest cover to improve watershed health by promoting the use of Ecologically Sensitive Treatment Areas (ESTA) for managed forest in Current-use Program	All	All	Forestry	Complete	Promotion of ESTA has resulted in new acres added during the reporting period with new acreage added annually. In comparison of two-time periods, 2010 to 2013 and 2014 to present, the number of Franklin County parcels enrolled in ESTA have increased. Data collected between 2016 and 2019 for Franklin and Grand Isle counties and includes 230.33 acres of ESTA identified in forest management plans, including updated plans. Although some of these acres may have been originally added before 2016, 132.97 acres were newly added in 2019.and 16 acres in 2020. Although numbers of acres are not available for Orleans County, the FPR county forest noted continued interest and new enrollments in ESTAs each year.
Designate wetlands within the basin as Class I: Propose Missisquoi Delta as Class I	Lower Missisquoi	Swanton	Natural Resources	In Progress	DEC addressed barrier identified in 2016 interim report by proposing to define boundaries based on MNWR expectations for wildfowl management and obtained interested from MNWR manager to continue discussions.
Identify potential wetland restoration sites based on Lake Champlain wetland restoration map and additional resources and restore	Entire Basin	All	Natural Resources	Complete	Updated Lake Champlain wetland restoration site prioritization modeling was completed in 2018 utilizing RCPP funds. The updated maps which identify potential wetland restoration areas with the highest likelihood of phosphorus attenuation are now available on the ANR Atlas and the Wetland Inventory Mapper. Partners such as NRCDs, NRCS, VLT, TNC and DFW are using these maps and a subset of project packets to help target wetland restoration outreach, much of which is currently occurring in the Missisquoi watershed. For example, DFW has initiated a wetland restoration and acquisition initiative with funding from EPA. The primary focus of this project is wetland restoration on new and existing F&W acquisitions with a goal of 40% lands restored. Two of the geographic focus areas are in the Missisquoi Bay watershed and the priority mapping is being utilized for outreach. Since 2016, 87 acres of wetland has been restored.

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation
Implement the Lake Wise Program:	Lake Carmi, Fairfield Pond, Lake Champlain	Multiple	Lake	Complete	Over reporting period, 9 additional sites in Lake Carmi met a set of criteria for Lake Wise Program Award or Certification. Seven BMPs were installed at Fairfield Pond with 10 sites meeting criteria.
Promote the Lake Wise Program and associated Lake Leaders training sessions to encourage lake-friendly shoreline property maintenance	Lake Carmi, Fairfield Pond, Lake Champlain	Multiple		Complete	DEC trained one Lake Carmi FWC staff person as a Lake Leader in 2020 to assess lakeshore who in turned educated Lake Carmi shoreline property owners about Lake Wise Program, including visits to 23 sites. DEC staff also promoted the Lake Wise Program at Fairfield Pond, including visits to 17 sites.
Incorporate materials specific to spiny water flea into signs, greeter program. Place spiny water flea spread prevention information at all lake accesses	Lake Carmi, Fairfield Pond,		Lake	Complete	Since the last TBP, Lake Champlain has seen the introduction of the Spiney and Fishhook water flea. No additional spread to inland lakes or ponds in the Basin has been identified. Current DEC AIS program monitoring and outreach messages are focused on current threats, including, but not limited to zebra mussels and the spiny and fishhook water flea. Since 2016, Spiny water flea posters have been placed on FWD Fishing Access Area kiosks. Both the LCBP Boat Stewards housed at Lake Champlain VFWD Fishing Access Areas including Swanton in Basin 6 and the Vermont Public Access Greeters supported by municipalities and lake associations on in-land lakes including Lake Carmi in Basin 6, receive DEC AIS Program training.
Assist development of a cyanobacteria (blue-green algae) volunteer monitoring program and response plan	Lake Carmi, Lake Champlain			Complete	The Agency, the Vermont Department of Health and partners have worked collaboratively to develop and implement education and outreach tools as well as a monitoring program and cyanobacteria tracker website to report results to help communities identify and avoid contact. Volunteer monitoring is supported throughout the basin, including 2 sites on Lake Carmi and at multiple sites in and around Missisquoi Bay. In 2016 and 2018, FNLC and LCC presented monitoring education at FNLC board meetings.
Monitor and assess surface waters to gain better understanding of condition and potential pollution sources, including internal phosphorus loading in lakes	Entire Basin			Complete	The WSMD's surface water monitoring and assessments supported as well as surface water sampling by volunteers. The DEC programs that support volunteer monitoring include the WSMD Lay-Monitoring Program] and the LaRosa Partnership Program (LPP). The volunteer groups include 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, FCNRCD and OCNRD in sampling sites to determine effectiveness of agricultural BMPs. Downloadable data is available through the Vermont Integrated Watershed Information System, IWIS. DEC contracted with UVM in 2019-2021 to monitor along surface water column to determine internal loading events. In addition, a new sampling

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation
					program is being piloted by MRBA with fuds form the River Network in 2020 that focuses on helping better link watershed residents to their rivers and responsibilities they have
Assist wastewater treatment facilities in meeting TMDL goals to reduce phosphorus loading to Lake Champlain	Entire Basin			Complete	Since 2016, DEC has supported following with technical and financial assistance: facility improvements have included CSO removal in Richford. In addition, all facilities except Newport Towns' have been optimizing for phosphorus. Newport Town's system permit will be changed to an indirect discharge permit, with permit conditions that will be based on protecting ground water Swanton and North Troy are planning for improvements. Overall, 1 municipal wastewater asset management plan, 1 30% design and 1 upgrade has been completed in Basin 6.

Acronyms

604(b) -Federal Clean Water Act, Section 604b

AAFM -Vermont Agency of Agriculture, Food and Markets

DEC - Department of Environmental Conservation

DFPR -Department of Forests, Parks and Recreation

ERAF – Emergency Relief and Assistance Fund

FCNRCD – Franklin County NRCD

FWD – Fish and Wildlife Department

ANR -Vermont Agency of Natural Resources

AMP -Acceptable Management Practice

AIS -Aquatic invasive species

AOP -Aquatic Organism Passage

BMP -Best Management Practice

CWSRF -Clean Water State Revolving Fund

CREP -Conservation Reserve Enhancement Program

EPA -United States Environmental Protection Agency

EQIP -Environmental Quality Incentive Program

FWA – Franklin Watershed Association

FMR – Friends of Northern Lake Champlain

LCBP – Lake Champlain Basin Program

LCPC-Lamoille County Planning Commission

LCNRCD – Lamoille County Natural Resource Conservation District

LID -Low Impact Development

MRBA- Missisquoi River Basin Association

MRGP – Municipal Road General Permit

NMP – Nutrient Management Plan

NRPC – Northwest Regional Planning Commission

NRCD -Natural Resource Conservation District

NVDA – Northern Vermont Development Association

OCNRCD – Orleans County NRCD

RAP – Required Agricultural Practices

REI – Road Erosion Inventory

RPC -Regional Planning Commission

SWMP – Stormwater Master Plans

TNC-The Nature Conservancy

TBP – Tactical Basin Plan

TMDL -Total Maximum Daily Load

USFWS -United States Fish and Wildlife Service

UMATR- Upper Missisquoi and Trout Wild and Scenic Committee

UVM -University of Vermont

VTrans -Vermont Agency of Transportation

VLT -Vermont Land Trust

WSMD – DEC Watershed Management Division

Appendix B. Lamoille River Watershed (Basin 7) TMDL Implementation 2021 Progress Report

The Accountability Framework of the 2016 *Phosphorus Total Maximum Daily Loads (TMDL) for Vermont Segments of Lake Champlain* ensures TMDL implementation moves forward at a steady rate. A major driver of the Accountability Framework is the Vermont Department of Environmental Conservation's (DEC) development of basin-specific Tactical Basin Plans (TBP). TBPs are developed on a five-year rotating basis and include Implementation Tables that identify priority strategies needed to implement the TMDL. It is through review of the Implementation Tables, and the progress made in accomplishing the tasks, that U.S. Environmental Protection Agency (EPA) intends to track implementation progress in each basin. To facilitate EPA's evaluation of progress, DEC describes the status of each strategy midway through (2.5 years) and at the conclusion of the five-year planning cycle in interim and final report cards, respectively.

This Appendix is the final report card for the Lamoille River Basin, updating the 2019 interim report card[4]. The five-year reporting period began in January 2016 coincident with the publication of the 2016 Lamoille River TBP and goes through June 30, 2021.[5]

The following sections describe progress towards completing strategies in the 2016 Lamoille River TBP Implementation Table. Each strategy is organized by one of five major sectors – agriculture, developed lands, natural resources, forestry, and wastewater. Progress described for each strategy includes status (defined in Table 1) as well as an explanation of actions taken. The explanation describes how the Agency supported the strategy and resulting outcomes that together show that meaningful results were achieved. Information provided includes performance measures for Agency-supported assistance that were collected as part of the Accountability Framework. These performance measures provide a quantitative measure of implementation.

Estimations of total phosphorus loading reductions to the lake are not presented as part of this exercise. Instead, estimated total phosphorus load reductions are presented in Chapter 3 of the *Vermont Clean Water Initiative 2021 Performance Report* to allow comparison to the TMDL phosphorus allocations.

Basin 7 Update

The 2016 TBP strategies were evaluated, and their associated actions were assigned a status condition using the rationale described in Table 1. To address strategies identified as ongoing in the 2021 Lamoille River Tactical Basin Plan, a status of complete, continued, or discontinued has been assigned to previously ongoing projects. Of the 88 strategies identified to date, 48 have been completed, 21 are in progress, 10 are being continued, and 9 have been discontinued. (Figure 2).

[4] See page 93 of the Vermont Clean Water Initiative 2019 Performance Report

[5] Data in this report aligns with this five-year period and the SFY 2016–SFY 2021 granting period of the Clean Water Reporting Framework (CWRF).

Table 1 Status conditions assigned to strategies and actions in the TBP Implementation Table (Table 2).

Strategy Status for Final Report Card	Description	Example(s)
Complete	A discrete action identified in a strategy with a clear end point that has been implemented. A strategy identified as ongoing in the 2019 interim report card that has been pursued and implemented throughout the TBP's 5-year period.	Provided 3 trainings to partners to evaluate 5 properties for Lake Wise assessments. The Municipal General Permit was implemented and all or most towns are on schedule to meet permit requirements. Five priority projects were implemented that were identified in River Corridor Plans.
In Progress	A discrete action identified in a strategy with a clear end point that is being implemented either as described, or, where needed, with revisions as described in the subsequent plan.	Stormwater master plan was funded and is being implemented but is not yet complete. An updated strategy to support water quality goals was identified during the planning process to focus on monitoring to meet water quality goals.
Continued	A discrete or programmatic strategy that was not initiated or formally pursued due to lack of interest, funding, or capacity gaps.	Strategy was carried over to the watershed projects database to be implemented when there is interest and capacity. Strategy is still a high priority and carried over to the next basin plan.
Discontinued	A discrete or programmatic strategy that was removed as a strategy and is no longer a priority.	The project was superseded by a project further upstream that treated the problem effectively. The project is no longer a priority for the state program.

This report depicts a watershed community that is pursuing permit compliance and implementing voluntary practices that work towards meeting ANR's water quality and phosphorus reduction goals. This is achieved through the implementation of permit programs, installation of green stormwater practices, adoption of flood resilience measures, implementation of farm agronomic practices, and application of riparian restoration and conservation projects. As described in the final status report for the 2016 Lamoille River TBP Implementation Table (Table 2), most of the actions associated with regulatory programs were completed or were in progress in 2019. A majority of those were completed through ANR or Agency of Agriculture Farm and Market's (AAFM) financial support to permit holders as well as partners who distributed education, outreach, and technical assistance. Regulatory compliance outcomes

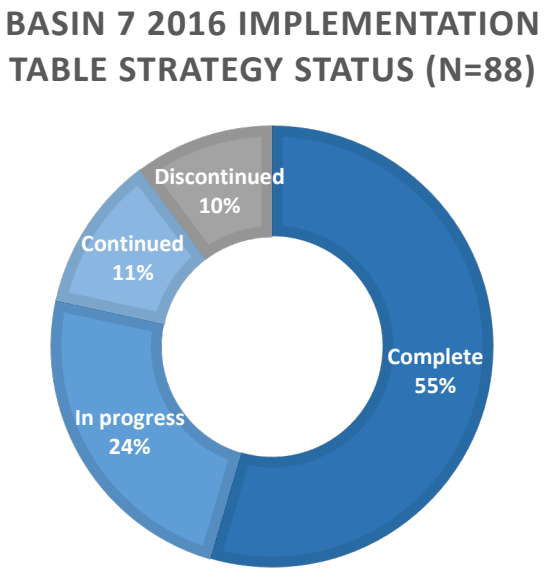


Figure 2. Basin 7 Implementation Table action status, where 'n' represents the number of strategies in the 2016 TBP Implementation Table.

include increased implementation of Required Agricultural Practices and agricultural best management practices and stormwater best management practices on roads. In addition, there was a steady increase in resources provided by the state to community and partners which in turn supported a steady increase of adoption of natural resource restoration practices, and stormwater management of developed land. Available funding and advanced coordination played a critical role in allowing watershed partners and municipalities to work together to complete and pursue 85% of strategies, that were not discontinued, from the 2016 Lamoille TBP.

Phase 3 of the TMDL in the TBP provides additional information that explains sector progress on meeting TMDL goals. This progress is an outcome of strategy implementation in the 2016 TBP.

Twenty-four percent of the 88 strategies in the 2016 plan are still in progress. Those strategies in progress that were pursued and then updated as a new strategy in the 2021 Lamoille TBP, will be reported on during the next planning cycle. The narrative in Table 2 provides additional detail in the explanation column for strategies in progress. Most projects in progress have completed the first phase of action, for example, a design may have been completed for a project, but the implementation of the project will be completed in the next year.

The eleven percent of strategies that were not pursued but carried over to the 2021 Lamoille TBP (continued) have extended timelines for completion contingent upon other programs or permit requirements (e.g., hydroelectric related strategies, toxics impairments, etc.) or are strategies that did not receive enough interest or support to be completed but are still a priority for follow-up. These projects include identifying monitoring volunteers for lakes, assessment of lake shoreland, and stream and lake reclassification. DEC published new webpages on lakes and streams reclassification, which may catalyze reclassification efforts in the next five years. The narrative in Table 2 provides detail in the explanation column for these strategies.

The ten percent of strategies that were discontinued were mostly the result of a change in priority as recommended by a state program, or the project was removed from the strategy table as a discrete project and added to the Watershed Projects Database. The narrative in Table 2 provides more detail in the explanation column for strategies that were discontinued.

In the 2021 TBP, a new set of strategies are identified that represent the next phase of work associated with regulatory programs, or improved approaches that partners can take with agency resources to encourage implementation in the community. Additional accounting methodology will encompass more activity on landscape and show a more accurate representative of total phosphorus reductions achieved.

In addition, the roll-out of the Clean Water Service Delivery Act (Act 76)[6] will increasingly support the delivery of clean water services and increase regional capacity to develop and implement projects that fulfill actions. An explanation of DEC's expected progress based on these additional resources is included in the 2021 TBP's Chapter 3 (LC TMDL Phase 3) and Chapter 4. DEC will submit the interim report for the 2021 Tactical Basin Plans in 2024 and the final report in 2026.

[6] Act 76 website available here: https://dec.vermont.gov/water-investment/statues-rules-policies/act-76.

Basin 7 Implementation Table Status

The status for each strategy (Table 2) was compiled by the Water Investment Division's Watershed Planning Program using data from the DEC, NRCDs, RPCs, and additional watershed partners involved in project development and implementation for the five-year planning period.

The Implementation Table is not an exhaustive list of water quality strategies that lead to phosphorus reductions in a basin. A complete description of all the work that the state supports in the basin to meet water quality goals can be found in the 2021 Vermont Nonpoint Source Management Plan[7]. Additional information about progress associated with each sector can be found in Chapter 3 of the *Vermont Clean Water Initiative 2021 Performance Report* which provides comprehensive reporting of estimated total phosphorus load reductions associated with state funding, federal funding, and regulatory programs. These data are also made available to the public through the Clean Water Portal's[8] Clean Water Interactive Dashboard – an online tool that allows interested parties to examine and filter Performance Report data on investments, project outputs, estimated pollutant load reductions and project cost effectiveness. Individual projects in the basin that are included or supported by strategies are describe in the Clean Water Explorer, also found through The Portal.

[7] Vermont Nonpoint Source Management Plan 2021-2025 available here: https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/Vermont%20NPS%20Management%20Plan%202021-2025.pdf

[8] Clean Water Portal can be accessed here: https://anrweb.vt.gov/DEC/cleanWaterDashboard/.

Table 2. Final Status Report for the 2016 Lamoille River TBP Implementation Table; includes data from a) SFY 2016 to SFY 2020 and b) calendar year 2016 - 2021 and is organized by Sector. (Acronyms are listed at the end of the table).

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Map areas of corn-hay rotation, continuous corn, and continuous hay based on soil type located in floodable soils to identify cover crop and conservation tillage priorities in high priority catchments	Porter Brook, Bailey Brook, Perkins Meadow Brook, Haynesville Brook, Lamoille mainstem, Browns River, Centerville Brook, Lower Gihon, Middle Wild Branch, Seymour River, Lamoille Mainstem, Beaver Meadow Brook, Deer Brook, Stones Brook, Mill Brook, Browns River	Hardwick, Walden, Cambridge, Johnson, Morristown, Hyde Park, Wolcott, Craftsbury, Underhill, Jericho, Essex, Westford, Fletcher, Georgia, Fairfax, Milton	Agriculture	Complete	**A Critical Source Area (CSA) map layer was developed by VAAFM to quantify the relative risk of erosion and runoff to surface water from agricultural fields.** It is being used as an additional tool by VAAFM Inspectors (and potentially other technical assistance providers) to identify and prioritize critical fields to visit during an inspection or site visit. The layer is now available in all Lake Champlain Basin watersheds. Currently being used by VAAFM and shared with others through Partners Database. The soil properties assessed are slope gradient, runoff potential (hydrologic group), erodibility (Kw factor) and flood frequency class. **The VAAFM CSA layer thus quantifies erosion and runoff risk based on properties of the soil types in the field and proximity to surface water.**	A2, A5, A8
Identify areas of nutrient input, identify high priority projects, and implement agricultural water quality practices in high priority catchments	Porter Brook, Bailey Brook, Perkins Meadow Brook, Haynesville Brook, Lamoille mainstem, Centerville Brook, Lower Gihon, Middle Wild Branch, Seymour River, Lamoille Mainstem, Beaver Meadow Brook, Deer Brook, Stones Brook, Mill Brook, Browns River	Hardwick, Walden, Johnson, Morristown, Hyde Park, Wolcott, Craftsbury, Cambridge, Underhill, Jericho, Essex, Westford, Fletcher, Fairfax, Milton	Agriculture	Complete	Inspections and practices installed in high priority catchments through 2016-2020: **236 acres of production areas inspected, 294 barnyard and production area practices installed, and 45 acres pasture with livestock excluded from surface waters.** Practices will be tracked by the Multi-Partner Agricultural Conservation Practice Tracking and Planning Geospatial Database (Partner Database). All practice implementation entered in the Partner Database by authorized field staff of the partnership will be reported to DEC to account for water quality improvement in terms of nutrient and sediment reduction for the TMDL. Enhanced monitoring funded through the LaRosa Partnership Program and supported by Watershed Partners will take place in target watersheds to verify high loading watersheds and identify sources of pollution. A similar strategy is included in the 2021 Lamoille TBP.	A4, A7, A10

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Provide education and assistance to agricultural communities in priority watersheds on agricultural BMPs to meet TMDL requirements in high priority catchments	Porter Brook, Bailey Brook, Perkins Meadow Brook, Haynesville Brook, Lamoille mainstem, Centerville Brook, Lower Gihon, Middle Wild Branch, Seymour River, Lamoille Mainstem, Beaver Meadow Brook, Deer Brook, Stones Brook, Mill Brook, Browns River	Hardwick, Walden, Cambridge, Johnson, Morristown, Hyde Park, Wolcott, Craftsbury, Underhill, Jericho, Essex, Westford, Fletcher, Fairfax, Milton	Agriculture	Complete	Through 2016-2021: **15 farms were directly assisted, 125 individuals received training, and 9 training were held. 17 Education and Outreach Projects and 16 Technical Assistance Projects were completed. 594 acres of nutrient management supported by Federal TA.** Education and Outreach and Technical assistance incudes: FWA Farm Mentorship Program, Agricultural Conservation Practices Technical Assistance, Lamoille Watershed Agricultural Project, Nutrient Management Planning and Land Treatment Planning to support NMPs, Comprehensive Extension Programming to Improve Water Quality in Vermont, Vermont Environmental Stewardship Program, On-Farm Workshops, and Reduction of Nutrient Runoff to Lake Champlain through No-Till Workshops & Equipment Upgrades. Unable to report by sub-basin because reporting is statewide. A similar strategy is included in the 2021 Lamoille TBP.	A3, A6, A9
Work with landowner to identify current sources of nutrients and employ practices to address the sources	Halfmoon Pond	Milton	Agriculture	In progress	No major/recent projects have been implemented since 2011. In 2011 VAAFM BMP program partnered with NRCS on a waste management system in this watershed. There is one permitted MFO that is on a 3-year inspection rotation and continues to work with the Agency in terms of MFO rule and RAP compliance. DEC will continue to monitor water quality in the receiving waters. Stones Brook, which this waterbody drains to, was listed as impaired for Aquatic Life Support in 2020. This stream will be monitored in 2021 through the LaRosa Partnership Program by the Franklin County Natural Resources Conservation District and will be bracketed to determine if this tributary is impacting the aquatic biota in Stones Brook. This is the strategy focus for the 2021 Lamoille TBP.	A11

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Establish Conservation Tillage/Cover Cropping Program for high priority sites along the Lamoille River	Lamoille Watershed with a focus on priority catchments	All towns with priority catchments	Agriculture	Complete	Through 2016-2021: **Over 13,000 acres of agricultural land was treated by conservation practices and 4,262 acres of agricultural land was treated through innovative equipment.** The VAAFM Farm Agronomic Practices (FAP) Program and NRCS invests state funds in soil-based agronomic practices to improve soil quality, increase crop production, and reduce erosion and surface runoff from agricultural fields. **VAAFM has increased funding annually for this program in the last three years.** This strategy is covered by strategies #2 and #6 in the 2021 Lamoille TBP.	A1
Final design and implementation of stormwater projects identified for Johnson State College	Direct tributary to Lamoille	Johnson	Developed Lands - Other	In progress	**The Town and Village of Johnson Stormwater Plan has been completed, which assessed the 3-acre area on the Northern Vermont University (NVU) campus.** One of the 30% designs up for full design and implementation is a stormwater catchment system for College Apartments. NVU is also listed in the Green Schools Funding eligible list and should enroll with Greenprint Partners.	B15
Re-visit gully restoration design and review for implementation; implement stormwater priorities identified in the Georgia Stormwater Master Plan; work with VTrans to replace eroding culverts on I-89. Impaired watershed.	Deer Brook - mouth to 2.5 miles upstream	Georgia	Developed Lands - Other	In progress	**12 stormwater final designs completed as part of the Deer Brook Gully Project. The Friends of Northern Lake Champlain implemented one of the projects and received funding from the Lake Champlain Basin Program to implement the remaining designs. The project complete date is scheduled for 2023.** A 2021 report was developed by the Water Investment Division identifying recommendations for mitigation including the Deer Brook Gully Project and 3 parcels in the lower watershed that will have to implement or improve their existing stormwater discharges by 2028. **During the Halloween Storm of 2019, two interstate culverts that Deer Brook flows through were impacted (one under the exit ramp and one under I-89). The culvert under the exit ramp was replaced and the culvert under I-89 was re-lined. The culvert upgrades should address the iron leachate in this location.**	B16, F8

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Implement priority projects identified in Stormwater Mapping reports	Segments receiving stormwater runoff in priority catchments	Hyde Park, Wolcott, Johnson, Cambridge	Developed Lands - Other	In progress	**Projects complete or in progress: 10 implementation, 18 final designs, and 27 preliminary designs.** Most projects were identified in Stormwater Master Plans that used stormwater mapping reports for project identification. **Priority projects for Wolcott will be determined in 2021 plan.**	B2, B12
Install road erosion BMPs/SW GSI/gully erosion stabilization. *Can also be addressed through town wide road erosion inventory as well	Caspian Lake	Greensboro	Developed Lands - Other	Complete	This strategy will be addressed by the VT MRGP. The **REI for Greensboro is complete** and includes the road around Caspian Lake. Grant-in-Aid has funded two road projects outside of the Caspian Lake Drainage. Segments hydrologically connected to Caspian Lake that are not meeting or partially meeting standards are required to be fixed to meet standards. The Caspian Lake Watershed Action Plan being implemented in 2022-2024 will also evaluate inputs into the lake from land use including public and private roads and identify solutions.	B5
Design and implement green stormwater infrastructure projects to mitigate stormwater runoff along Laurendon Avenue	Greensboro Brook - waters downstream of town center	Greensboro	Developed Lands - Other	Discontinued	**50% complete. 3 final designs were completed for a green stormwater infrastructure project** to mitigate stormwater runoff along Laurendon Ave. in Greensboro, Vermont, and identify and rectify stormwater runoff issues impacting town and residential infrastructure and Greensboro Brook. **The town decided not to apply for project implementation.**	B3
Continue to carry out the minimum control measures outlined the Milton Stormwater Management Plan and develop a phosphorus control plan for lands within the MS4 area.	Lower Lamoille River	Milton	Developed Lands - Other	Complete	**One Stormwater Master Plan (SWMP) and Phosphorus Control Plan was completed for the Town of Milton**, VT, which is located within the Lamoille and Northern Direct-to-Lake Basins. The SWMP was used to **develop the elements of a Phosphorus Control Plan, filed with State on April 1, 2021.** The 2021 Lamoille TBP supports Milton to fulfill their PCP plan goals.	B19

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Identify potential sources of stormwater runoff and nutrient input and prioritize a list of actions to address sources. Stressed watershed.	Streeter Brook - 0.6 miles by falls north and south of Sanderson Road	Milton	Developed Lands - Other	Complete	**1 Stream Stormwater Runoff Assessment. 2 projects identified. DEC** conducted a river walk along the most densely developed area outside the I-89 corridor in the Streeter Brook watershed and no obvious stormwater runoff sources were identified. Most non-point sources are in the I-89 corridor above a large wetland complex. Milton SWMP focused on this area to identify potential stormwater projects. No obvious sites of runoff were identified outside of road projects that will be implemented as part of the MRGP. The Basin Planner is coordinating with the watershed partners to identify sampling plan for LaRosa Partnership Program Funding in 2022.	B18
Implement projects addressing vulnerabilities from flooding and fluvial erosion from county and municipal All-Hazards Mitigation Plans	Lower Lamoille and tributaries - segments receiving stormwater runoff	Milton, Colchester, Westford, Jericho, Underhill, Essex	Developed Lands - Other	Complete	Project reports are submitted to RPCs. Reports may include detailed progress on hazard mitigation actions. Some hazard mitigation priorities are also listed as separate actions in the 2016 Lamoille Tactical Basin Plan (e.g., development of Underhill SWMP). Projects for these counties are being implemented basin wide. Hazard Mitigation planning and implementation efforts are supported in the 2021 Lamoille TBP.	B23, C39
Develop a stormwater management project for implementation for the town sand storage area	Stannard Brook - all connected surface waters	Stannard	Developed Lands - Roads	In progress	Road erosion inventory was completed for the entire town, including Stannard Mountain Road. The NRCD is collaborating with the town and will discuss the REI results for this area when they become available. Additionally, the NRCD is exploring funding for culvert replacement work that could be used in this watershed if beneficial.	B7
Develop a stormwater management project for the Elmore town garage sand storage area	Elmore Lake	Elmore	Developed Lands - Roads	In progress	This will be carried over to the next plan with a different strategy. An alternatives analysis is recommended to consider whether the Town improves the current site or identifies a new property for the Town Garage and Fire Department. LCPC is working with the Town to consider this option and explore possible funding opportunities including re-applying for the VTrans Stormwater Program Grant. **Two stormwater projects in this area were identified**	B14

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
					in the Elmore Lake Watershed Action Plan as a priority for funding.	
Repair eroding access road in VTrans right-of-way along I-89 southbound. Tributary discharges into the Lamoille on the west side of the I-89 crossing on the south bank.	Direct tributary to the Lower Lamoille	Milton	Developed Lands - Roads	In progress	VTrans was made aware of the project and a site visit was completed in 2018. A follow-up site visit will be scheduled for 2022. Funding source needs to be identified if implementation is required. This project will be moved to the Watershed Projects Database.	B17
Re-locate or build a salt shed for salt and sand storage for the Town of Belvidere	North Branch Lamoille	Belvidere	Developed Lands - Roads	Complete	The old sand pile between VT109 and the North Branch Lamoille was relocated, by the town, away from water resources. There remains a small pile in the old location for residents to get sand for residential use.	B13
Develop stormwater master plans and identify priority projects for mitigating runoff using stormwater mapping information with a focus on priority catchments.	Lamoille River	Hyde Park, Morrisville, Johnson, Cambridge, Fairfax, Underhill, Jericho, Hardwick, Milton	Developed Lands - Roads	Complete	**SWMP completed for 9 towns (Fairfax, Jericho, Underhill, Hardwick, Hyde Park, Morristown, Johnson, Milton, and Cambridge). Jericho, Hardwick, Underhill, Morristown, Milton, and Hyde Park have completed implementation of high priority projects.** Project implementation identified in these reports is supported in the 2021 Lamoille TBP.	B4, B10, B20
Implement high priority road projects identified by road erosion inventories	Lamoille River - all connected surface waters	All Lamoille County towns with a focus on Johnson, Hyde Park, Cambridge, Milton, Colchester, Westford, Jericho, Underhill, and Essex	Developed Lands - Roads	Complete	Through 2016 to 2020: **A total of 284 of road implementation projects are in progress (18) or have been completed (266).** Through 2016 to 2021: **A total of 16.6 miles had been upgraded to meet MRGP standards** since the initial MRGP REI was completed for towns that officially submitted their REI data into the portal, signed a REI amendment form, and paid a MRGP processing fee. This information is tracked in the MRGP Implementation Table Portal. Towns are using a combination of Regional Transportation Funds, VTrans Better Roads grants, DEC Grants-in-Aid funds and their own municipal funds to implement projects to bring segments up to MRGP standards. More details on priority of completed projects will be available for the 2026 TBP.	B9, B22

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Inventory and prioritize municipal road erosion features using DEC's MRGP interim road erosion inventory guidance	Lamoille River - all connected surface waters	Walden, Hardwick, Greensboro, Craftsbury, Hyde Park, Morristown, Fletcher, Fairfax, Milton, Georgia, Westford	Developed Lands - Roads	Complete	**Road Erosion Inventories are funded, in progress or completed in all towns in the Lamoille Basin.**	B6, B8, B21
Regional Hydroseeder Program	Middle Lamoille	Regional	Developed Lands - Roads	Complete	Through 2016 to 2021: **771 hours equipment in use and 82 acres stabilized through use of hydroseeder/mulcher equipment.** The Regional Hydroseeder Program was implemented through Lamoille County Conservation District to develop (and continue) a Regional Hydroseeder Program for three Natural Resources Conservation Districts, Lamoille, Caledonia, and Essex Counties in the northeast region of Vermont, and its municipalities. Three hydroseeders were collectively shared with at least four towns within each district. Support for this work is included in the 2021 Lamoille TBP.	B1
Wolcott Town Garage and Fire Station Stormwater management project	Lamoille River	Wolcott	Developed Lands - Roads	Complete	**1 acre of impervious surface treated; 200 Linear feet of road drainage improved.** This project addresses sediment and nutrient loading to the Lamoille River by means of disconnecting roof runoff that currently causes sediment from the parking area to discharge to the river, as well as providing settling pools to treat runoff. The project also helps reduce sediment laden runoff from the sand pile stored at the site.	B11

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Protect headwaters and sensitive surface waters in large forest blocks through conservation easement and land acquisition.	Basinwide	Belvidere, Waterville, Lowell, Eden, Johnson, Hyde Park, Underhill, Jericho, Elmore, Wheelock, Stannard, Walden	Forests	Complete	**2 conservation easements and 1 land acquisition:** Georgia Town Forest and Westford Town Forest with wetland/riparian protection and the acquisition of property referred to as Worcester Woods located in Worcester and Elmore. These protection efforts total 6,943 acres of conserved forestland and 30 acres with special water quality protection (subset of acres conserved). The Town of Cambridge conserved the Krusch Nature Preserve that connects to State Forest north of Cambridge Village.	I1
Continue and expand the Portable Skidder Bridge Program where needed	Basinwide	All areas with forest manage-ment and timber harvest	Forests	Discontinued	Through discussions with Natural Resource Conservation Districts the rental program has come to an end. Instead, the focus is on finding a way to cost share with loggers in owning them. Rentals are infrequent, and ownership is preferable to loggers. DFPR continues to do training with Vermont loggers on properly implementing the AMPs and to actively incentivize loggers to utilize temporary skidder bridges through the availability of cost share programs and low-cost rentals for loggers and landowners.	I2
Identify sensitive surface water sites on UVA parcels and develop outreach to protect identified areas	Basinwide	All towns	Forests	Discontinued	DEC and DFPR collaborated on how this action could be implemented. No action has been taken.	I3
Conserve and protect to prevent degradation to water quality and shoreland and lake habitat	Wolcott Pond	Wolcott	Lakes	Discontinued	No action taken. No immediate threats to water quality.	H10
Determine what is causing the fair shoreland and lake habitat and make improvements if necessary	Round Pond	Milton	Lakes	Continued	Need to identify a stakeholder to coordinate a discussion around interest in lay monitoring and Lake Wise on this pond.	E11

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Develop a lake association to work with DEC to develop an invasive species management plan for the waterbody	Arrowhead Mountain Lake, 114 acres, altered	Georgia, Milton	Lakes	In progress	No progress and still a priority. A partner has been identified in the watershed to develop this strategy focusing on the management plan.	D9
Gather data and evidence for reclassification to B(1)	Little Elmore Pond	Elmore	Lakes	Continued	No lay monitor identified at this time. Difficult access to this site.	H8
Assess AIS on lakes and ponds with no data	Identified Lakes and Ponds	Multiple	Lakes	Continued	The Lakes and Ponds Program will develop a list of lakes for assessment in 2022.	D2
Collect additional lakes data and report to support reclassification	Long Pond	Greensboro	Lakes	In progress	This site needs a lay monitor and outreach has been initiated. Access is difficult and permission is required. This is a high priority for monitoring because it is considered a remote lake.	H4
Determine what is causing the fair shoreland and lake habitat and make improvements	Lake Wapanacki	Wolcott	Lakes	In progress	Watershed Planning Program and Rivers Program visited the lake in 2018 and spoke to landowners who were interested in supporting the health of the lake. Development around the lake is minimal. Recommended that DEC provide Lake Wise Assessment outreach to the landowners. Focus in 2021 TBP is on Lake Wise.	E10
Determine what is causing the fair shoreland and lake habitat and make improvements if necessary	East Long Pond	Woodbury	Lakes	In progress	DEC is working with the town of Woodbury to identify lay monitors for this lake. Focus in 2021 TBP is on monitoring.	E5
Gather data and evidence for reclassification and protect shoreline from new encroachments	Schofield Pond	Hyde Park	Lakes	In progress	Lakes and Ponds Program is working with Forests, Parks and Recreation on identifying lay monitoring volunteers. Focus in 2021 TBP is on monitoring.	H7
Gather data and evidence for reclassification or ORW	Zack Woods Pond	Hyde Park, Wolcott	Lakes	Complete	Lakes and Ponds Program is collaborating with Forests, Parks and Recreation to coordinate a lay monitoring volunteer. These efforts will be tracked and reported on in preceding TBPs.	H6

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Continue Public Access Greeter Program to prevent AIS introduction; install boat washing station	Lake Eden	Eden	Lakes	Complete	The Public Access Greeter Program to prevent AIS introduction was successfully implemented from 2016-2021. A boat washing station has not been implemented for Lake Eden. The 2021 plan provides a strategy to maintain and build the capacity for the Greeter and Vermont Invasive Patroller (VIP) Program. These efforts will be tracked and reported on in preceding TBPs.	D7
Initiate Lake Wise Program to determine projects that will improve shoreland and lake habitat	Caspian Lake	Greensboro	Lakes	Complete	During 2016, **two Lake Wise assessments were completed** and shoreland stabilization practices were recommended. **Two shoreland properties have received Lake Wise Certificates**. A town wide Water Quality group, the Stewards of Greensboro, formed in 2019 with a focus on the Caspian Lake Watershed. They are engaged in implementing Lake Wise around the lake. The Stewards of Greensboro and the Orleans Natural Resource Conservation District with support from DEC **received approval for a LCBP grant to complete a Lake Watershed Action Plan. Water quality monitoring has been implemented on the major tributaries to the Lake during 2019 2020, and 2021**. The group will apply for funding to continue the tributary monitoring in 2022. These efforts will be tracked and reported on in preceding TBPs.	E2
Determine what is causing fair water quality, sedimentation, and shoreland and lake habitat trend and initiate the Lake Wise Program; Full lake assessment is recommended	Lake Eden	Eden	Lakes	Complete	**One Lake Watershed Action Plan completed. Three Lake Wise assessments completed. One site identified as a high priority is in the process of being implemented and further work on the town beach and FWD access is expected.** The Lake Watershed Action Plan was developed for Lake Eden in 2020 to assess causes of increased sedimentation in the lake and water quality decline. The plan identified a list of solutions in cooperation with the Town of Eden, the Eden Lake Association, shoreline landowners, and local recreational users. These efforts will be tracked and reported on in proceeding TBPs.	E7

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Initiate Lake Wise Program to determine projects that will improve shoreland and lake habitat and reduce sedimentation; full lake assessment is recommended	Lake Elmore	Elmore	Lakes	Complete	**Twenty-two Lake Wise site assessments completed in 2018 and 2019. Twelve best management practices implemented in 2018 as a result. One Lake Watershed Action Plan was completed in 2021.** The Lake Association is motivated to continue work. An undeveloped property purchased in 2020 was utilized by the Lake Wise Program and Lamoille County Conservation District to film a walk about on the property and model how to build responsibly. **There is a proposed improvement to the Fish and Wildlife access site.** These efforts will be tracked and reported on in proceeding TBPs.	E6
Continue to monitor and manage AIS	Lake Elmore	Elmore	Lakes	Complete	The Public Access Greeter Program to prevent AIS introduction was successfully implemented from 2016-2021. The 2021 plan provides a strategy to maintain and build the capacity for the Greeter and Vermont Invasive Patroller (VIP) Program.	D6
Continue to support greeter program and maintain AIS signage	Caspian Lake	Greensboro	Lakes	Complete	The Public Access Greeter Program to prevent AIS introduction was successfully implemented from 2016-2021. The 2021 plan provides a strategy to maintain and build the capacity for the Greeter and develop a VIP Program.	D3
Determine what is causing the fair shoreland and lake habitat and make improvements if necessary	Horse Pond	Greensboro	Lakes	Complete	Most of the development along Horse Pond is State Highway. There are two private parcels that make up a small portion of the shoreline. This strategy is a low priority. The shoreline is mostly wetlands, so the threat for development is low.	E3
Maintain AIS signage	Hardwick Lake, Horse Pond, Long Pond, Nichols Pond, Lake Eden, Green River Reservoir, Long Pond, Wolcott Pond	Hardwick, Greensboro, Woodbury, Eden Hyde Park, Belvidere, Wolcott	Lakes	Complete	The signage was checked in 2019 and continues to be maintained. The Lakes and Ponds Program will continue to provide support to maintain signs. These efforts will be tracked and reported on in proceeding TBPs.	D4, D8
Manage and prevent AIS introduction	Long Pond	Eden	Lakes	Complete	Signage has been maintained and a VIP program is recommended. These efforts will be tracked and reported on in proceeding TBPs.	D5

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Determine what is causing the fair shoreland and lake habitat and make improvements	Hardwick Lake	Hardwick	Lakes	Discontinued	This lake is stressed by water level fluctuations and winter drawdown. The shoreland score is fair. The Lakes and Ponds Program identified this strategy as a low priority.	E1
Determine what is causing the fair shoreland and lake habitat and make improvements	South Pond	Eden	Lakes	Discontinued	The Lakes and Ponds Program identified this strategy as a low priority.	E8
Determine what is causing the fair shoreland and lake habitat and make improvements if necessary	Nichols Pond	Woodbury	Lakes	In progress	The Lakes and Ponds Program is working with the town of Woodbury to continue lay monitoring at this site. This is a low priority for shoreland improvements. Focus for 2021 is on monitoring.	E4
Determine what is causing the fair shoreland and lake habitat trend and make improvements	Ritterbush Pond	Eden	Lakes	Discontinued	The Lakes and Ponds Program identified this strategy as a low priority.	E9
Adopt flood hazard by-law	Upper and Middle Lamoille Waters	Wheelock, Walden, Eden, Waterville	Rivers	Continued	This strategy will be combined with the NFIP adoption strategy and carried over to the 2021 plan. Very unlikely for Walden and Wheelock to adopt any regulations in the next few years. Walden does not have a Town Plan or zoning. Wheelock has minimum plan and no zoning.	C12, C16
Pursue conservation flows through appropriate state regulatory processes and Hardwick Electric	Lamoille River	Hardwick, Wolcott, Morristown	Rivers	Continued	Unregulated flow at Wolcott (only hydroelectric) and Jackson Dam (not hydroelectric). No 401 or license. Recommended to conduct a study to identify correct conservation flow levels in the 2021 TBP.	G3
Re-sample the mercury impaired waters within the basin to update data.	Lower Lamoille	Milton, Colchester	Rivers	In progress	No mercury monitoring planned at mercury impaired waters. As part of the EPA National Lakes Assessment in 2022, there will be mercury fish tissue analysis at 10 sites throughout the state. DEC Lakes and Ponds Program could gain funding for 40 additional sites if selected for "State intensification". Sites are chosen at random, however, and will be distributed across the state. EPA likely will not have results to share from the National Lake Assessment until 2027. This will not be carried on to the next plan but will be updated in the VT	F9

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
					List of Waters as additional monitoring information is available.	
Propose and complete alternatives analysis for Jackson Dam	Hardwick Lake and Lamoille River	Hardwick	Rivers	In progress	Alternative analysis option was presented to the town by DEC and Caledonia NRCD. This was not a high priority for the town in 2019 or 2020. The Watershed Planner reached out to Hardwick Electric and the town in May 2021 to assess their interest based on the poor condition of the dam and a new VT statute addressing dam management.	C3*, G2
Remediate iron impairment by developing and implementing a stormwater master plan	Tributary to Brewster River	Cambridge	Rivers	In progress	The Stormwater Program 3-acre permit is expected to address this issue. The site should continue to be monitored for changes.	F6
Work with towns to adopt river corridor protection or strengthen existing river protection by-laws, setbacks, and zoning	Lamoille Basin	Hardwick, Stannard, Wheelock, Walden, Greensboro, Craftsbury, Woodbury, Eden, Elmore, Wolcott, Johnson, Cambridge, Hyde Park, Morristown, Belvidere, Waterville, Georgia, Fletcher, Fairfax, Westford, Underhill	Rivers	In progress	**Elmore, Hyde Park, Jericho, Essex, Milton, and Westford have either adopted River Corridor Protection or have interim protection. Georgia is in the process of reviewing River Corridor for adoption. Outreach provided to Johnson, Hardwick, Wheelock,** but chose not to adopt. **Outreach will be focused on the remaining towns.**	C1, C10, C14, C32, C37
Work with towns to consider joining the	Lamoille Basin	Wheelock, Walden, Eden, Waterville	Rivers	In progress	**None of the target towns have adopted the NFIP.** Outreach will continue to be focused on these towns when the opportunity allows.	C9, C13

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
NFIP as part of an effort to increase ERAF rating						
Develop TMDL plan; Investigate area above the landfill	Lamoille River Trib #4	Milton	Rivers	In progress	Chemical monitoring was conducted on the Lamoille River tributary #4 in 2018. WQ information was reviewed with the DEC Monitoring and Assessment Program (MAP) and additional monitoring of biology will be conducted above and below the landfill sites as a follow up. A SWMP was completed for the town of Milton. Stacy Street (adjacent to Trib #4) was assessed, and a stormwater treatment was recommended to treat stormwater that discharges into the stream. This project is being pursued by CCRPC with Clean Water project development block grant funding. Two projects were also identified on the road accessing the landfill. Funding is needed for all of these projects. Because Milton is an MS4 they require 50% match to complete projects, which limits the number of projects they are able to complete. MAP will follow-up with basin plan recommendations and report as progress is made.	F7
Identify target areas for easements and river corridor protection and restoration and work with landowners to secure easements; SGA and river corridor plan to identify stressors and priority projects to address stressors	North Branch Lamoille - stressed segment	Cambridge	Rivers	Complete	**One River Corridor Easement (RCE) resulting in 164 acres conserved and 42 acres with special water quality protection** and **21 acres of river corridor conserved** including wetland and floodplain protection in a high priority area. This action will continue to be carried out as opportunities present themselves for conservation and restoration. **Field assessment by DEC Rivers Program scheduled for summer of 2021 on stressed segment.** These efforts will be tracked and reported on in proceeding TBPs.	C30

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Increase recreational access to the Lamoille River – upgrade and establish access areas, portage trails and river campsites; develop and implement MWL area recreational plan which includes portages, access improvements and camp sites	Lamoille River	Multiple	Rivers	Complete	MWL need license before there is a recreation plan developed. At federal level in court. Lamoille Paddlers Trail Association has worked on adding and updated numerous portages and campsites. The group has also developed a paddling trail map and website. Northwoods Stewardship Center improved staircases at two sites (Rotary, and Fisher Bridge) in 2020. A new linear state park is in development on the Lamoille Rail Trail. Additional water-based recreational opportunities may be identified with the park's development. This work will continue and be supported in the 2021 Lamoille TBP.	J1
Work with towns to add approved RPC flood resiliency section to town plan	Lower Lamoille waters	Stannard, Walden, Craftsbury, Elmore, Wolcott, Hyde Park, Cambridge, Waterville, Fletcher, Fairfax, Milton	Rivers	Complete	**All town plans except for Stannard and Walden have been updated with a flood resilience element.** This work will continue and be supported in the 2021 Lamoille TBP.	C11, C15, C33, C38
Assess current condition of waters below Mud Brook Dam and evaluate dam removal	Mud Brook	Morristown	Rivers	Complete	The site was visited by DEC staff in 2018 and the status of the stream had not changed. The site can be remedied with a dam removal and FPR is open to exploring dam removal options. Funding is needed to complete this project. These efforts will be tracked and reported on in proceeding TBPs.	F4, G4
Assess and catalogue FWD riparian/streambank parcels for streambank protection and potential easement opportunities	Lamoille River	Multiple	Rivers	Complete	**One assessment completed and 20 projects identified. The Upper Lamoille from Wolcott to Greensboro was assessed.** The projects were identified along the Lamoille River on and adjacent to Fish and Wildlife owned lands and are slated for project development and were assigned to project leads. FWD expects to continue work on FWD owned riparian lands the entire length of the Lamoille River. This also helps to accomplish goals in the Lamoille River Corridor Plans (Upper and HUC2). These efforts will be tracked and reported on in proceeding TBPs.	C2, J2

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Assess condition of water quality at hazardous waste sites and remediate	Gihon River	Eden, Johnson	Rivers	Discontinued	This site will be assessed in the spring of 2022 and will not be carried into the next plan. Updates can be found in the Vermont Priority Waters Lists in 2022.	F2
Complete Lamoille River HUC 1 Corridor Plan and prioritize projects	Lamoille River	Johnson, Cambridge, Fletcher, Fairfax, Georgia, Milton, Colchester	Rivers	Complete	**River Corridor Plan complete with projects prioritized. Five projects have been completed and one is in progress. 4.2 acres of river corridor buffer planted in Fairfax. 6.2 acres of river corridor conserved, and 1000 linear feet of riparian corridor conserved in Jeffersonville with an additional 20 acres in progress. 0.4 acres river corridor buffer planted** in Milton. Additional plantings via the Clean Water Block Grants have been implemented but reporting numbers are not yet available. **The Vermont Land Trust and DEC have funding available for buffer planting.** These efforts will be tracked and reported on in proceeding TBPs.	C29
Continue monitoring surface waters and employ restoration methods if needed	North Branch	Waterville	Rivers	Complete	Since implementation of the Corrective Action Plan, which involved soil vapor extraction, multi-phase extraction, and bioamendment injections, contaminant concentrations have decreased significantly in groundwater monitoring wells. Soil samples were collected in 2018 from the seep locations adjacent to the North Branch and were all non-detect for petroleum compounds. All future monitoring information will be tracked by the Waste Management and Prevention Division. No chemical or biological impacts, to the North Branch of the Lamoille River, have been identified because of this activity. The Waterville LHMP notes that the water quality issue here was fixed.	F3
Evaluate for ORW	Lamoille River	Multiple	Rivers	Complete	Based on review with DEC staff, this waterbody is not likely to meet ORW for water quality given elevated levels of phosphorus at dammed reservoirs. However, watershed partners are still encouraged to explore the possibility for ORW status for other characteristics.	H2

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Follow up on preliminary management strategies identified in the Upper Lamoille River Phase 2 SGA	Upper Lamoille River	Greensboro, Hardwick	Rivers	Complete	Some preliminary management strategies in the 2009 study were pursued. An updated SGA will be discussed with the DEC Rivers Program and Caledonia County NRCD. The FWD riparian lands assessment (C2) also identified sites for project development in the focus area. The development of these projects would help meet the goals for this action. These efforts will be tracked and reported on in proceeding TBPs.	C8
Implement high priority flood mitigation projects identified in the Jeffersonville Flood Mitigation Master Plan	Middle Lamoille waters	Jeffersonville	Rivers	Complete	**6.2 acres of river corridor conserved at 2 sites and 1000 linear feet of riparian corridor conserved. 0.25 acres of floodplain reconnected and restored. Two bypass culverts installed to improve flow conveyance from a flood chute to the Lamoille River. A total of three projects identified in the Jeffersonville Flood Mitigation Master Plan included two river corridor easements and a new bridge installation and floodplain restoration project.** LCPC is currently working with a contractor to develop preliminary designs to restore floodplains and riparian buffers at FWD Access Area off Route 108 and along the Lamoille River. These efforts will be tracked and reported on in proceeding TBPs.	C18
Remediate landfill washout and ensure no further violations	Rodman Brook	Morristown	Rivers	Complete	No new information available. This impairment will be tracked by MAP.	F5
Scope and implement culvert replacements and retrofits in areas of high priority for aquatic organism passage and stream geomorphic compatibility	Basin wide with a focus on streams stressed or impaired by encroachment, channel and land erosion	Multiple	Rivers	Complete	**USFWS is currently working in the Lake Champlain Basin to prioritize high priority culvert replacements. In addition, as culverts are replaced on State and town roads, they are reviewed by the Rivers Program to ensure structures meet current standards for geomorphic compatibility.** Towns are replacing culverts when funding is available. **Current projects under design include Clif Reynolds Rd 730-05 (design completed).** This general action will be carried over to the 2021 plan.	C3*

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Scope and implement priority incomplete projects and actions identified in the HUC 2 Corridor Plan and prioritize projects	Lamoille River	Hardwick, Wolcott, Hyde Park, Morristown, Johnson	Rivers	Complete	**One acre of river corridor buffer planted** in Wolcott. **0.12 acres of river corridor buffer planted, and 1 access area improved to reduce erosion in Morristown. 12.3 acres of river corridor conserved, and 2578 linear feet of riparian corridor conserved in Johnson.** Efforts from the FWD Riparian Lands Assessment will help to achieve priorities in this plan. This action will continue to be carried out as opportunities present themselves for conservation and restoration.	C31
Scope and implement priority incomplete projects and actions identified in the River Corridor Plans for Brewster River, Centerville Brook, Elmore Branch, Gihon River, Rodman Brook, and Wild Branch.	Brewster River, Centerville Brook, Elmore Branch, Gihon River, Rodman Brook, Wild Branch	Cambridge, Hyde Park, Elmore, Eden, Johnson, Morristown, Wolcott, Craftsbury	Rivers	Complete	**At least 8 projects were implemented from the Brewster River Corridor Plan including 6.2 acres of river corridor conserved, 1000 linear feet of riparian area connected, and 0.25 acres floodplain reconnected.** Work completed by LCCD and Smugglers Notch Resort on the Brewster River. The Brewster River Floodplain Restoration was funded in 2017. **12.3 acres of river corridor conserved, and 2578 linear feet of riparian corridor conserved** on the Gihon River. **51.8 acres of river corridor conserved, and 8223 linear feet of riparian corridor conserved** on properties along the Wild Branch and a **wetland and floodplain restoration and bridge removal** project by FWD was completed at the mouth of the Wild Branch in Wolcott in 2020. Elmore Branch was removed from the Stressed Waters List in 2020 based on biological and water chemistry data. Efforts to implement and scope RCP projects will be tracked and reported on in proceeding TBPs.	C23, C24, C25, C26, C27, C28

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Scope, prioritize and implement projects identified in the Browns River Corridor Plan	Browns River - from west of Jericho/Essex line up 7.5 miles and fluvial erosion hazard areas	Underhill, Jericho, Essex, Westford	Rivers	Complete	**1.05 acres of river corridor buffer planted** on three sites in Jericho and Underhill. Trees for Streams plantings by Winooski NRCD. Projects have been prioritized for scoping and a project development grant to complete this task has been applied for but has not been funded. Continue to identify funding for this project. This action will be carried out as opportunities present themselves for conservation and restoration. **Field assessment by DEC Rivers Program completed summer of 2021 on stressed segment.** Efforts to implement and scope RCP projects will be tracked and reported on in proceeding TBPs.	C34
SGA and river corridor plan to identify stressors and priority projects to address stressors. Focus on all stressed segments.	Haynesville Brook, Tucker Brook, Stannard Brook, Bunker Brook, Kate Brook, Seymour River, Ryder Brook	Walden, Hardwick, Woodbury, Cambridge, Underhill, Morristown	Rivers	Complete	**One River Corridor Plan (RCP) completed. Six River Walks or Windshield Tours completed.** Completed SGA and RCP for Seymour River. River Walks and Windshield Tours completed for Ryder Brook, Bunker Brook, Haynesville Brook, Tucker Brook, Kate Brook, and Stannard Brook. Focus is on Seymour River project development for 2021 and 2022.	C5, C6, C7, C19, C20, C21, C23, C22

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Undertake flood modeling and alternatives analysis and implement best choices for flood resiliency, floodplain restoration, buyouts, protection (RCEs)	Lamoille River, Wild Branch	Wolcott, Johnson, Cambridge	Rivers	Complete	**Multiple projects have been funded for project development and are currently underway because of the modeling and alternatives analysis.** The LCPC continues to work with several communities to model the impacts of various flood mitigation alternatives along the Main Stem of the Lamoille River. The model was developed using a similar process used in Jeffersonville in 2013 (see C18). Alternative scenarios tested in Jeffersonville included infrastructure changes, floodplain excavation, natural vegetation, home elevations, and impacts of dams. LCPC is currently working with the Town of Wolcott, a contractor, DEC, and FWD to explore preliminary design options for restoration and flood mitigation along the Lamoille River and Wild Branch. The Flood model will be expanded to include further upstream along the Wild Branch near the Town Recreation Fields in Wolcott. Town/Village of Johnson worked with the Silver Jackets (Army Corps of Engineers) to evaluate restoration solutions (floodplain access/restoration) to mitigate ice jams in Johnson Village. Efforts to implement projects will be tracked and reported on in proceeding TBPs.	C17
Continue to implement remediation measures to reduce erosion and tailing discharges	Lowell asbestos mine-Hutchins Brook, Hutchins Brook Trib 4, Dark Branch	Eden	Rivers	In progress	Based on monitoring information, conditions have not changed at this site since the previous plan. In the absence of remediation, MAP will sample every 10-15 years. If remediation is conducted, MAP will sample in the next monitoring rotation round for the Lamoille River Basin. The recommendation is to bring this forward into the 2021 TBP as: "Continue maintenance of existing erosional control features and if necessary, implement additional remediation measures in needed." The Final Restoration Plan for the Vermont Asbestos Group Mine Site Natural Resource Damage Settlement continues to be implemented by DEC and USFWS in coordination with the towns of Eden and Lowell and should be complete by the 2026 Lamoille TBP. Updates will be provided in the following plan.	F1

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Resume monitoring to determine if dissolved oxygen levels meet Water Quality Standards	Lower Lamoille River	Milton, Colchester	Rivers	Continued	A Low Impact Hydroelectric Certification is recommended to provide an economic incentive to address dissolved oxygen monitoring. The next certification is in 2038. Updates will be provided in the following plan or the Vermont Priority Waters List.	G5
Town petition for reclassification of waters to B1 since it is no longer used as a water supply	Unnamed tributary to the Lamoille River	Hardwick	Rivers	Continued	No action taken. Interest from town needed.	K1
Town petition for reclassification of waters to B1 since it is no longer used as a water supply	Unnamed tributary to the Lamoille River	Fairfax	Rivers	Continued	No action taken. Interest from town needed.	K2
Evaluate best water level to maintain to have the least amount of impacts. Work with landowners to determine flow levels that support aquatic habitat and lakeshore habitat protection.	Caspian Lake	Greensboro	Rivers, Lakes	Complete	DEC and Hardwick Electric have agreed upon a lake maintenance level. No drawdown is allowed.	G1, C4
Complete monitoring to assess streams with exceptional ecological integrity for reclassification	Basinwide	Multiple	Rivers, Lakes, Wetlands	Complete	A list of rivers, streams, lakes, ponds, and wetlands were provided in the 2016 Lamoille TBP. All streams were monitored by the DEC Monitoring and Assessment Program, Lakes and Ponds Program, and Wetlands Program as recommended.	H1
Compile natural resource reports on the swamp and evaluate if wetland meets criteria for potential Class I determination	Hidden Swamp	Milton, Westford	Wetlands	Continued	This wetland has preliminary monitoring information available, but additional updated monitoring would need to be completed to evaluate the Class I wetland potential. 2021 Lamoille TBP has a strategy supporting these efforts.	H14

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Evaluate for Class I potential	Molly Bog & Morristown Bog Complex	Morristown	Wetlands	Continued	This wetland is a high priority for protection due to development and encroachment potential. DEC is willing to provide technical support for reclassification if watershed stakeholders are interested in moving forward with the reclassification. A full assessment of the wetland complex is needed. Studies of the smaller areas are available. 2021 Lamoille TBP has a strategy supporting these efforts.	H9
Work with towns to update wetland mapping. Priority goes to towns with the highest coverage of wetlands, and highest development pressure	Class II Wetlands in Lower Lamoille	Milton, Westford, Essex, Underhill, Fairfax, Fletcher	Wetlands	In progress	This action has been discussed for towns in Chittenden County. Funding is needed. Unsure of town support. **The Wetlands Program is implementing a statewide mapping effort based on watershed boundaries. The date for mapping the Lamoille River Basin is unknown. A pilot project for wetland mapping funded by USFWS in four HUC12 sub-watersheds (Brewster River-Lamoille River, Gihon River, North Branch Lamoille River, and Seymour River-Lamoille River watersheds) with a collective area totaling approximately 149,282 acres, is planned for 2022.** The Lamoille watershed is 7 on a list of 15. Stakeholders can be trained to identify wetlands using citizen science applications that will later be used to help with the mapping updates. 2021 Lamoille TBP focus is on the statewide mapping efforts and the pilot project.	C36
Identify and implement wetland restoration on high priority sites identified by DEC	Browns River - lower part of the watershed	Westford, Underhill, Jericho, Essex	Wetlands	Complete	**One large wetland restoration project is in the works along the Browns River in Westford. This project involves a collaboration with DEC, VAAFM, USFWS, NRCS, and FWD and will result in a new state Wildlife Management Area and the restoration of over 355 acres of wetlands if implemented.** Mapping has been completed in the Lake Champlain watershed to identify areas for restoration. Project development funding to complete additional wetland restoration work was applied for but was not funded. Partners are continuing to search for project funding. This action will be carried out as opportunities present themselves for conservation and restoration.	C35

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk
Evaluate for Class I potential	Flagg Pond Wetland Complex	Wheelock	Wetlands	Complete	The Vermont Wetlands Program completed monitoring of three wetland types in the Flagg Pond Complex: Sweet gale shoreline swamp, poor fen, and tamarack woodland bog. DEC is willing to provide technical support for reclassification if watershed stakeholders are interested in moving forward with the reclassification.	H3
Evaluate for Class I potential	North Branch Wetland Complex	Belvidere	Wetlands	Complete	DEC provided technical support to the Belvidere Planning Commission in 2018 to evaluate the reclassification process and outcomes. The Commission was supportive, but the Selectboard and town did not support moving forward. The area was identified as a Class I wetland proposed for study, but the petition was not developed. Some of the adjoining land that was previously owned by TNC and VLT was sold. In addition to an existing report on the Belvidere Bog, two wetland types within the complex were assessed by the Vermont Wetlands Program in 2018.	H11
Petition for Class I wetland classification	Sandbar Wetland Complex	Milton, Colchester	Wetlands	Complete	Reclassified to Class I in 2016.	H12
Identify and treat purple loosestrife populations in wetlands and riparian areas	Entire Basin	Multiple	Wetlands	Discontinued	The LCCD was working on this action in 2016. The project has been discontinued due to the changing of the District Manager and district priorities. This action will be lumped with general invasive management priorities where funding and interest is there.	D1

Acronyms

ANR - Vermont Agency of Natural Resources

AMP - Acceptable Management Practice

AIS - Aquatic invasive species
BMP - Best Management Practice
CSA – Critical Source Area
DEC – Department of Environmental Conservation
DFPR - Department of Forests, Parks and Recreation
EPA - United States Environmental Protection Agency
ERAF - Emergency Relief and Assistance Fund
FWD - Fish and Wildlife Department
GSI – Green Stormwater Infrastructure
HUC – Hydrologic Unit Code
LCBP – Lake Champlain Basin Program
LCPC - Lamoille County Planning Commission
LCCD – Lamoille County Natural Resource Conservation District
LHMP – Local Hazard Mitigation Plan
MAP - Monitoring and Assessment Program
MFO – Medium Farm Operation
MRGP – Municipal Road General Permit
MS4 - Municipal Separate Storm Sewer System
MWL – Morrisville Water and Light
NFIP - National Flood Insurance Program
NMP – Nutrient Management Plan
NRCD - Natural Resource Conservation District
NRCS – Natural Resources Conservation Service
ORW – Outstanding Resource Water
RAP – Required Agricultural Practices
RCE – River Corridor Easement
RCP – River Corridor Plan
REI – Road Erosion Inventory
RPC - Regional Planning Commission
SGA – Stream Geomorphic Assessment
SWMP – Stormwater Master Plans
TA – Technical Assistance
TBP – Tactical Basin Plan
TMDL - Total Maximum Daily Load
TNC - The Nature Conservancy
USFWS - United States Fish and Wildlife Service
UVA - Use Value Appraisal
VAAFM - Vermont Agency of Agriculture, Food and Markets
VIP - Vermont Invasive Patroller
VLT - Vermont Land Trust
VTrans - Vermont Agency of Transportation

Appendix C. Winooski River (Basin 8) TMDL Implementation 2021 Progress Report

The Accountability Framework of the 2016 *Phosphorus Total Maximum Daily Loads (TMDL) for Vermont Segments of Lake Champlain* ensures TMDL implementation moves forward at a deliberate pace. A major driver of the Accountability Framework is the Vermont Department of Environmental Conservation's (DEC) development of basin-specific Tactical Basin Plans (TBP). TBPs are developed on a five-year rotating basis and include Implementation Tables that identify priority strategies needed to implement the TMDL. It is through review of the Implementation Tables, and the progress made in accomplishing the tasks, that U.S. Environmental Protection Agency (EPA) intends to track implementation progress in each basin. To facilitate EPA's evaluation of progress, DEC describes the status of each strategy midway (2.5 years) through and at the conclusion of the five-year planning cycle in interim and final report cards, respectively.

This Appendix is the interim report card for the Winooski River Basin. The 2.5-year reporting period began in January 2019, coincident with the publication of the Winooski River TBP[9] and goes through June 30, 2021.[10]

The following sections describe progress towards completing strategies in the 2018 Winooski River Basin Implementation Table. Each strategy is organized by one of five major sectors – agriculture, developed lands, natural resources, forestry, and wastewater. Progress described for each strategy includes status (defined in Table 1) as well as an explanation of actions taken. The explanation describes how the Agency and partners supported the strategy and resulting outcomes that together show that meaningful results were achieved. Information provided includes performance measures for Agency-supported assistance that were collected as part of the Accountability Framework. These performance measures provide a quantitative measure of implementation to accompany the description of the collaborative effort.

Estimations of total phosphorus loading reductions to the lake are not presented as part of this exercise. Instead, estimated total phosphorus load reductions are presented in Chapter 3 of the *Vermont Clean Water Initiative 2021 Performance Report* to allow comparison to the TMDL phosphorus allocations.

Basin 8 Update

The 2018 Winooski TBP strategies were evaluated, and their associated actions were assigned a status condition using the rationale described in Table 1. Of the 52 strategies identified to date, 5 have been completed, 2 are in progress, 3 have not been started, and 4 are ongoing (Figure 3).

[9] The 2018 Winooski River Tactical Basin Plan available at: https://dec.vermont.gov/sites/dec/files/documents/2018%20Winooski%20River%20TBP.pdf

[10] Data in this report aligns with this 2.5-year period and the SFY 2019–SFY 2021 granting period of the Clean Water Reporting Framework (CWRF).

Table 1. Potential status conditions used in interim report cards assigned to strategies and actions in DEC's TBP Implementation Tables (Table 2).

Action Status	Description	Example
Complete	A discrete action with a clear end point that has been implemented	Provided 3 trainings to partners to evaluate 5 properties for Lake Wise assessments.
In Progress	A discrete action identified in a strategy with a clear end point that is in process or in the queue	Of the 8 high priority projects identified through the Castleton Stormwater Master Plan, 3 have been implemented and 2 are in progress
Ongoing	A programmatic or multi-layered action that is in progress but has no end date	Towns are replacing culverts when funding is available.
Not Started	A discrete or programmatic strategy that has not been initiated or taken up	The project stalled due to lack of funding

Strategies identified as "in progress" were evaluated based on their likelihood of being completed by 2023. The next plan will also be released in 2023, including the Phase 3 content for the Lake Champlain Phosphorus TMDL. Of the two actions that are in progress, one has a high likelihood of being completed, and one has a medium likelihood of being completed by 2023 (Figure 3).

The strategies with a high likelihood of being completed are those that have received funding, have a strong partner, local support, and positive momentum. They are also farther along in the process. In addition, some strategies are regulatory and are required to be completed. Strategies that have a medium likelihood of completion have been initiated and may have received funding, but the end date for completion is beyond 2023. In many cases, medium likelihood strategies have support, but may be lacking funding or an entity to bring the project to fruition. These projects are next in line to be completed once the high likelihood actions are complete, which will free up capacity for entities that carry out the projects. Strategies with low likelihood of completion by 2023 are those that require significant funding and resources to complete. In some cases, support exists, and funding may be available, but the capacity to develop the associated actions is lacking.

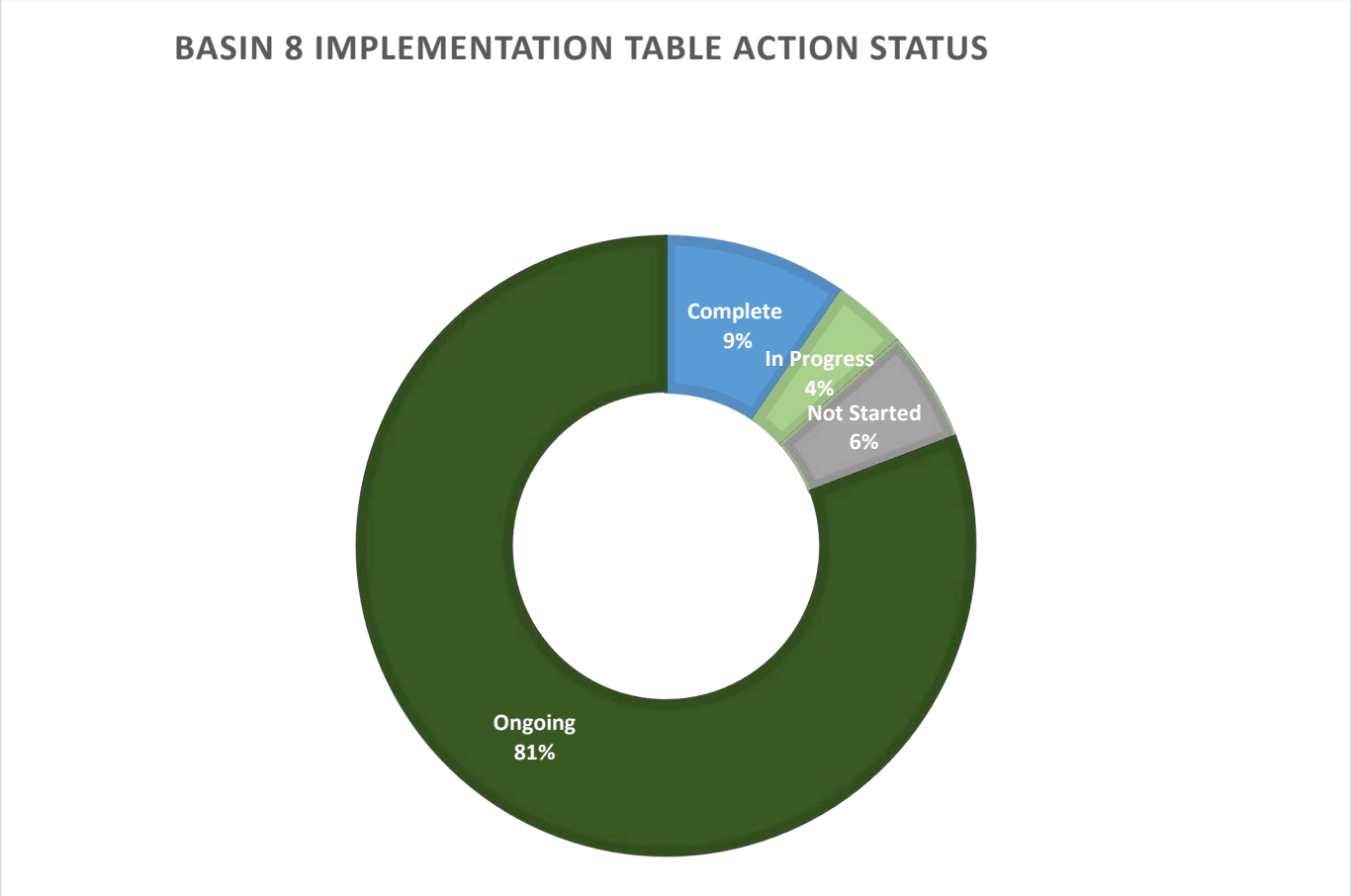


Figure 3. Basin 8 Implementation Table strategy status (52 strategies).

This interim report card depicts a community that is pursuing permit compliance and voluntarily adopting practices that will work towards meeting the Agency's water quality goals. While success is in part documented by performance measures included in the report and the Clean Water Initiative 2021 Performance Report, the narrative adds additional information including a description of the role of the Agency-supported collaborative effort in driving the acceptance of practices within the community.

All of the strategies associated with regulations are on-going as the Agency stands up new regulatory programs meant to ensure phosphorus targets are met. Many of these as well as those associated with support of voluntary actions direct financial support as well technical assistance to permit holders and community members. Partners are also provided with assistance to in turn support the state's work through distributed education, outreach, and technical assistance.

Regulatory compliance outcomes include increased implementation of Required Agricultural Practices and agricultural best management practices and stormwater best management practices on roads. In addition, there was a steady increase in resources provided by the state to community and partners, which in turn supported a steady increase of adoption of natural resource restoration practices, and stormwater management of developed land.

In addition, the roll-out of the Clean Water Service Delivery Act (Act 76) will increasingly support the delivery of clean water services and increase regional capacity to develop and implement projects that

fulfill actions[2]. DEC will submit the final report in 2023. For the Winooski River Basin, the passage of Act 76 and the support of partner organizations to carry out the Act, will increase capacity for clean water projects over the remaining years of this TBP cycle as well as provide funding.

Basin 8 Implementation Table Status

The status for each strategy (Table 2) was compiled by the Water Investment Division's Watershed Planning Program using data from the DEC, NRCDs, RPCs, and additional watershed partners involved in project development and implementation for the five-year planning period.

The Implementation Table is not an exhaustive list of water quality strategies that lead to phosphorus reductions in a basin. A complete description of all the work that the state supports in the basin to meet water quality goals can be found in the *2021 Vermont Nonpoint Source Management Plan*. Additional information about progress associated with each sector can be found in Chapter 3 of the *Vermont Clean Water Initiative 2021 Performance Report* which provides comprehensive reporting of estimated total phosphorus load reductions associated with state funding, federal funding, and regulatory programs. These data are also made available to the public through the Clean Water Portal's Clean Water Interactive Dashboard – an online tool that allows interested parties to examine and filter Performance Report data on investments, project outputs, estimated pollutant load reductions and project cost effectiveness. [11] Individual projects in the basin that are included or supported by strategies are describe in the Clean Water Explorer, also found through the Portal.

[11] Clean Water Portal can be accessed here: https://anrweb.vt.gov/DEC/cleanWaterDashboard/.

Table 2. Interim Status Report for the 2018 Winooski River TBP Implementation Table; includes data from a) SFY 2019 to SFY 2021 and b) calendar year January 2018 to June 2021, unless otherwise noted (Acronyms are listed at the end of the table). References to page, table or figures are for the 2018 plan.

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Expand small farm nutrient management plans (NMP) development courses and workshops, trainings for farmers, manure applicators and technical service providers		Phase II priority catchments for agricultural land Table 17 (2018 Winooski TBP)	Agric.	Complete	State and federal funds support the work of NRCDs and UVM Extension to provide NMP courses and TA to farms developing and implementing NMPs. Nine new NMP developed with WNRCD assistance since 2017, of which 5 were in priority catchments.	high
Target inspections in priority catchments/watersheds: target implementation based upon the results		Phase II priority catchments for agricultural land Table 17	Agric	Ongoing	AAFM inspectors have access to AAFM's Critical Source Area map layer which quantifies the relative risk of erosion and runoff to surface water from agricultural fields, allowing them to target higher risk fields during inspections	NA
Increase conservation practice implementation through participation in State and federal financial and technical assistance programs; and case managers		Phase II priority catchments for agricultural land Table 17	Agric	Ongoing	The AAFM Farm Agronomic Practices Program and NRCS invests state funds in soil-based agronomic practices to improve soil quality, increase crop production, and reduce erosion and surface runoff from agricultural fields. AAFM has increased funding annually for this program in the last three years.	NA

[12] All tables referenced in Priority Subbasin and Towns columns are associated with the 2018 Winooski TBP

Increase technical assistance (TA) in priority catchments/ watersheds: work with farms, including vegetable farms, to meet RAP and adopt BMPs		Phase II priority catchments for agricultural land Table 17	Agric	Ongoing	AAFM's TA staff and AgCWIP funded partner staff provide technical assistance on a variety of water quality topics and project areas and started tracking on site visits in the partner database in 2019, see table below of AgCWIP visits by HUC12. Note that AgCWIP accounts for only a portion of the technical assistance provided, and does not account for all watershed partner technical assistance efforts. **Row Labels** / **FY 2020** / **FY 2021** Dog River 2 Graves Brook-Winooski River 1 Headwaters Dog River 3 Headwaters Little River 7 6 Headwaters Stevens Branch 2 Headwaters Winooski River 7 4 Huntington River 2 Jail Branch 1 5 Kingsbury Branch 1 Little River 1 Mad River 5 7 Mill Brook-Mad River 4 5 Muddy Brook 12 8 Nasmith Brook-Winooski River 7 1 North Branch Winooski River 2 Snipe Island Brook-Winooski River 13 13 Sodom Pond Brook-Winooski River 1 2 Stevens Branch 1 Winooski River 7 9 **Grand Total** **72** **67** Example of AgCWIP supported work completed by one of the partners, WNRCD, includes: hiring specialist to provide resources to diversified vegetable producers and growing technical capacity in water resources management/irrigation assistance. Since 2017, WNCRD reached about 144 farmers to discuss the RAPs. Another 54 farmers attended RAP/BMP related events. Another 23 have received direct on-farm technical assistance of which 8 are located in priority catchments.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
					The TA has supported the implementation of field BMPs on a total of 21,721 acres over the reporting period, with overall increase in acreage.	
Pilot the Environmental Stewardship Program to incentivize additional practice adoption		Phase II priority catchments for agricultural land Table 17	Agric	Complete	In 2018, the AAFM began a pilot of the Vermont Environmental Stewardship Program (VESP). In 2021, 4 farms were awarded Vermont Environmental Stewardship certifications, one in the Winooski Basin. While the pilot program was completed, the full launch of the program is currently on hold, as the VT Pay-For-Phosphorus (VPFP) incentive program is in development and the Payment for Ecosystem Services workgroup continues, to assess how the VESP program integrates with current State priorities and initiatives.	NA
Create grassed waterways program Target funding to critical source areas in coordination with partners		Phase II priority catchments for agricultural land Table 17	Agric	Complete	The Grassed Waterway and Filter Strip grant program is managed by AAFM continues to be a funding opportunity for Vermont farmers to address critical source areas, erosion, and surface runoff. This program provides compensation to farmers via incentive payments for participation ($500/acre) and cost-share to cover 90% of the installation costs for establishing perennially vegetated grassed waterways, filter strips, and forage and biomass seedings, and associated infrastructure, if necessary, on agricultural cropland adjacent to surface waters and ditches.	NA
Provide outreach to support implementation of prescribed pasture practices. Provide financial support for livestock exclusion		Phase II priority catchments for agricultural land Table 17, Huntington River	Agric	Ongoing	In 2018, AAFM launched the Pasture Surface Water Fencing (PSWF) grant program providing technical and financial assistance to improve water quality and on-farm livestock exclusion from surface waters statewide. Since 2018, the PSWF program has supported three farms to implement pasture and livestock exclusion practices in the Winooski watershed. In addition to the PSWF program, AAFM supports partner technical assistance providers through the AgCWIP program. An example of partner support through this program includes WNRCD performing two site visits specific to grazing mgmt. and pasture – although neither in priority catchment areas.	NA

<table>
<tr><th>Strategy Description</th><th>Priority Subbasin [12]</th><th>Priority Towns</th><th>Sector</th><th>Status</th><th>Explanation</th><th>Likelihood of Completion</th></tr>
<tr><td>Increase the availability of equipment for rental or through custom operators</td><td>Huntington, Mad and Dog Rivers</td><td>Phase II priority catchments for agricultural land Table 17,</td><td>Agric</td><td>Complete</td><td>Starting in SFY 2018, AAFM expanded the Conservation Equipment Assistance Program (CEAP) to provide opportunities for farmers, custom applicators, and non-profit organizations to receive grant funding for conservation equipment.

Between SFY19 and SFY21, CEAP provided funding to farmers and partners in the basin to purchase conservation equipment. Since 2018, farms have implemented over 5,000 acres of conservation practices by acquiring conservation equipment through the program, a three-year average of 1766 acres per season.

<table><tr><th>Calendar Year</th><th>Acres of Equipment Use</th></tr><tr><td>2018</td><td>762</td></tr><tr><td>2019</td><td>1862</td></tr><tr><td>2020</td><td>2674</td></tr></table>
On a smaller scale, WNRCD purchased additional soil probes in 2020 that were rented for free to 3 farmers.</td><td>NA</td></tr>
<tr><td>Develop and provide support for equine specific programing including support for installing horse manure compost bins and making pasture improvements</td><td>Mad River</td><td></td><td>Agric</td><td>Ongoing</td><td>WNRCD Hosted equine manure management on-farm tour and spoke at annual Vermont horse council meeting to promote manure management and knowledge of the RAPs (outside of Mad River)</td><td>NA</td></tr>
<tr><td>Provide technical and financial resources to farms below the threshold for AAFM Small Farm Operations</td><td>Upper Winooski</td><td>Phase II priority catchments for agricultural land Table 17</td><td>Agric</td><td>Ongoing</td><td>WNRCD, see above</td><td>NA</td></tr>
</table>

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Complete targeted water quality sampling on 3 farms to help identify source areas		Phase II priority catchments for agricultural land Table 17	Agric	Not Started	A partnership between WNRCD and FMR to address agricultural practices in the Mad River may provide opportunity to address this strategy	Medium
Support the development and implementation of Phosphorus Control Plans and implementation of the Flow Restoration Plans.	Lower Winooski	MS4 entities	Developed Land-Other	Ongoing	DEC and CCRPC support MS4 municipalities in this work. Phosphorus Control Plans were completed and submitted on April 1, 2021 to DEC for the following MS4 municipalities with significant land area within Basin 8: Burlington, Winooski, Essex Junction, Essex, Shelburne, South Burlington and Williston. Numerous projects identified in the Flow Restoration Plans were constructed. See Annual Reports filed by MS4s towns for details on constructed FRP projects	NA
Provide technical assistance to identify and prioritize stormwater management projects.	See next column	Waterbury, Williamstown , Stowe	Developed Land-Other	In Progress (75% Complete)	SWMP in development with DEC funding: Williamstown and Stowe. Waterbury is currently not interested.	Medium
Support implementation of high priority projects in stormwater master Plans and 2015 Smugglers' Notch Parking Feasibility Study	Multiple	See Appendix C	Developed Land-Other	Ongoing	With DEC support, partners are advancing the following stormwater projects from SWMPs, They are in design or headed towards construction (DEC funded unless noted): CVRPC is advancing 11 in upper Winooski: Woodbury – 4;Calais – 2 ; Berlin – 3 (LCBP) . Duxbury; Barre City Auditorium; Plainfield Gully at Health Center. WNRCD is advancing the East Montpelier Morse Farm project FMR is advancing 7 projects in Mad River watershed – 3 in Fayston, 2 in Warren, 1 in Waitsfield, and one in Moretown (5 will have 100% design in 2021) LCRPC is advancing the Smugglers Notch riparian buffer restoration along the Route 108 (LCBP). In all, Clean Water funding has supported projects that have treated 119 acres of existing impervious with most projects identified in SWMP.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Help municipalities control runoff from gravel and paved roads to meet the Municipal Roads General Permit: implement road assessment protocol to assist with prioritization; provide technical and financial resources to assist with implementation, including projects within 250 feet of lakes.	Basin wide	See top 10 prioritized road projects in town road erosion inventories as well as Phase II priority catchments for roads (Tables 23 and 24)	Developed Land - Roads	Ongoing	In addition to providing towns with technical assistance through regulator meetings with road commissioners, the RPCs are assisting towns with development of Road Erosion Inventories (REI), All towns but Barre City, have completed REI. CVRPC has inventoried 70% of the city's outfalls and is advising the city to support the completion of the REI in summer of 2022 with a Better Roads Grant. RPC staff and other partners are working with towns to prioritize MRGP projects and obtain State funds to support implementation. Assistance to municipalities has supported inventory of 126699 segments of hydrologically connect road segments with 699 segments identified as needing improvement. As of ending of FYR 2021, 537 segments have been improved to meet MRGP standards, either before inventory or as a result of inventory.	NA
Support municipal stormwater ordinance adoption, include incorporation of LID and GSI practices; Implement "Three-acre" permit, including the DEC Green Schools' Initiative to help schools meet the three-acre permit	All	Phase II priority catchments for developed land, Table 22	Developed Land- Other	Ongoing	CVRPC has provided comments on Calais Stormwater ordinance to be adopted in 2021. With regard to support for meeting three-acre permit: CVRPC plans to assist Northfield/Cabot Hosiery and is assisting the Vermont Shopping Center, Barre City Auditorium (see above), and Waterbury Square Shopping Center with improving stormwater management to meet compliance.	NA
Implement six minimum control measures (MCM) required in the State TS4 permit	Basin wide		Developed Land - Roads	Ongoing	The BMPs that are being implemented by VTrans to address six MCMs are included in Part 6.0 of a SWMP11 (2018). A summary of annual reporting requirements and progress for each MCM is provided in their annual reports.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Develop and begin implementation of a phosphorus control plan early in the next TS4 permit cycle	Basin wide		Developed – Roads	Completed	Completed in 2021. It included identification of VTrans owned parcels, calculation of P base loads, P reduction targets for each segment of Lake Champlain as well as plans to investigate higher Phosphorus (P) source areas and develop P loading rates to help prioritize the highest source areas. A VTrans ArcGIS StoryMap[13] details this information more fully. On October 1st, 2020, VTrans submitted their first implementation plan, where they seek to meet approximately 25% of the total P reduction target in four years. There will be three subsequent four-year implementation plans that will each seek to meet approximately 25 percent of the reduction target, with the goal of fully meeting their reduction targets by 2036. The 2020 implementation plan focused on the Missisquoi basin,	NA
Intercept and treat runoff from agricultural and silvicultural land before it reaches VTrans right of way		Phase II priority catchments for paved roads (Table 23)	Developed Land-Roads	Not started	Although the Agency and partners are addressing runoff, there is no effort presently to identify runoff from these lands and address before reaching VTrans right-of-way	NA
Support brownfields restoration efforts that mitigate surface water pollution generated from these sites.	Basin-wide	Phase II priority catchments for develop land, Table 22.	Developed Land - Other	Ongoing	Redevelopment of following properties received support through the Brownfields Program: BOLTON: Bolton Valley Resort; BURLINGTON -676 Riverside Avenue, 56-66 North Avenue; COLCHESTER: 2031 Roosevelt Highway; ESSEX JUNCTION: 3 Maple Street, 1 Main Street; WILLISTON: Stirrup Circle, Governor Chittenden Road (Catamount Family Farm); MONTPELIER: 43-65 Granite Shed Lane; Barre City: Keith Ave property.	NA

[13] https://www.arcgis.com/apps/MapJournal/index.html?appid=af0d93d2e55f42f1803ca79e0c492f3f

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Provide education on winter maintenance strategies to businesses and towns to reduce use of Chlorides.	Stevens Branch, Sunny Brook, Lower Winooski tributaries	Barre city, Montpelier, MS4 entities	Developed Land Other and roads	Ongoing	UVM Sea Grant is supporting webinars or workshops on winter maintenance strategies that are advertised to the Winooski Basin community. The most recent webinar was held on 10/18/2021. Sea Grant also contributed to a FMR workshop for Ridge to River municipal leaders. In Chittenden County, businesses and residents are made aware of strategies to reduce use of chlorides through CC RSEP www.rethinkrunoff.org	NA
Support stormwater management education for private landowners, including private driveways		Phase II priority catchments for develop land, Table 22.	Developed Land – Roads	Ongoing	Using DEC, LCBP and private grants, partners support a Storm Smart program that also addresses private driveways. FMR, who created Storm Smart as part of their River to Roof Top initiative completed assessments over 115 properties in the Mad watershed; FWR and WNRCD have provided approximately 40 assessments through Storm Smart. FWR also provides Lakeshore residential site assessments, The LCBP is currently supporting a Winooski Basin project that will further coordinate partners in developing of messaging and additional program components similar to Storm Smart. The result will enhance success in terms of community adoption of practices. In addition, In Chittenden County, residents are made aware of strategies through CC RSEP www.rethinkrunoff.org	NA
Implement high priority projects identified in river corridor plans	Basin wide	See River Corridor plans Table 39	Rivers	Ongoing	WNRCD is currently working on one 100% design for Morse farm, and implementing a project on Shady Rill Brook. In total, river corridor plan implementation or other work has resulted in 27 acres of riparian plantings, 56 acres of river corridor easements and .3 acres of floodplain restoration.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Replace geomorphologically and aquatic organism passage (AOP) incompatible culvert and bridges: RPCs work with municipalities to identify, add to capital budget, seek additional funding sources	Mid and Upper Winooski tributaries	Potential B(1) for fishing watersheds (Table 34)	Rivers	Ongoing	State and town culvert replacement must meet current standards for geomorphic compatibility. In addition, a partnership of RPCs, FMR, WNRCD & USFWS & FWD supports town culvert upgrades by completing watershed prioritizations (Mad River and Upper Winooski) to identify and replace priority culverts for improved geomorphological and AOP compatibility including obtaining funding. Projects under development are located on Kingsbury Branch and Lockwood Brook. Completed projects include one located on Lincoln Brook. In total 11 stream crossing replacements have addressed geomorphology and AOP.	NA
Increase River Conservation Easements (RCE)	Basin wide	See River Corridor Plans Table 39	Rivers	Ongoing	Through DEC support, WNRCD has referred 3 farmers to CREP and RCE program. DEC funding has supported Town of Stowe and Stowe Land Trust efforts to obtain River Corridor property easements along the Little River in the lower village to reduce flooding and stream bank erosion. In total, 56 acres of river corridor easements have been obtained.	NA
Enhance the Flood Resilient Communities Program with funding and technical assistance incentives for municipalities.	Basin wide	Towns with interim ERAF status	Rivers	Ongoing	The Agency continues to encourage municipalities to meet ERAF status through outreach on Flood Ready Website and staff interactions. State funding also supports RPCs technical assistance: • LRPC is updating Stowe and Elmore Hazard Mitigation Plans and Elmore has incorporated River Corridor language into the 2020 unified bylaws update. • CVRPC is working with Calais, Plainfield, Middlesex, and Waterbury on flood resilient regs. and also supports a flood web page and a GIS dashboard for outreach on SFHA and RC protection. • CCRPC and DEC have provided assistance, leading to all 19 towns in Chittenden County meeting the four basic ERAF standards. 14 of 19 have early adopter status. Colchester also receives the 5% Match Bonus as it has adopted Community Rating System. South Burlington has formally adopted River Corridor Bylaws. In addition, the FMR's Rivers to Roof top campaign has also directed outreach to municipalities to explain importance of flood resilience work.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Support studies to investigate benefits of removal of dams listed in Table 9 and where landowner interest exists	Basin wide	See Table 9	Rivers	Ongoing	The Vermont Dam Task Force provides support to partners' work. Along with DEC and other funding supported following partners in conducting 5 dam removal studies with subsequent work noted: FWR removed Bull Run dam and began study/design to remove three Stevens Branch dams. WNRD coordinated Jail Branch's Hand Mill Dam study	NA
Assist towns in accessing and understanding use of the Vermont Geological Survey's landslide inventory to benefit Hazard Mitigation Plan as well as preventing landslides through land conservation.	See Landslide Inventory Map, 2017	Middlesex, Plainfield, Calais, Warren, Jericho, Bolton,	Rivers	Ongoing	CVRPC has been incorporating landslide data into local hazard mitigation plans. Landslides identified as hazard in 2021 include Calais, Marshfield, and Montpelier. The information is also included in Plainfield and Warren LHMPs.	NA
Support gully stabilization and remediation by addressing stormwater inputs and/or through natural channel design	Basin-wide		Rivers	Ongoing	Towns will address areas where road stormwater causing gullies are associated with prioritized road segments in their REI.	NA
Remediate habitat in highly degraded areas and/or areas where extensive channel management occurred by adding woody debris	Mad and Dog River		Rivers	Not Started	The Partners for Fish and Wildlife Program provides financial and technical assistance to design and implement riparian habitat restoration projects in Vermont. The Rivers Program has drafted guidelines for identifying potential projects that meet state regulations as well as eligibility for CWF.	NA
Use community interest in salmon and/or brook trout to engage community in watershed protection actions	Mid Winooski tributaries, Winooski headwaters, Mad River, Dog River, Huntington	See high quality waters map for potential B1 for fisheries watershed (Fig. 27)	Rivers	Ongoing	CVRPC provided outreach to Northfield, Marshfield and Middlesex to gain community support for reclassification of very high-quality waters, many of which support brook trout (DEC financial support). FWR engaged community with education and outreach efforts, including World Fish Migration Day video series and open site day. In addition, FWR and LRPC are involved in developing the LCBP-funded Streamwise program, directed at enhancing stewardship practices of riparian landowners	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Identify and remediate eroding, abandoned and retired forest roads, skid trails and log landings		Phase II priority catchments for forested land (Table 16)	Forests	Ongoing	The DFPR is identifying state forest roads in need of remediation and addressing. In all, 8 drainage structures on forest roads have been installed.	NA
Provide technical and financial assistance to forest landowners to meet AMP		Phase II priority catchments for forested land (Table 16)	Forests	Ongoing	DFPR work with forest landowners and host AMP workshops. Since 2017, FWR working with landowners in headwaters on Forest Management, and Forest Management Plans (High Meadows Fund grants). FMR Rivers to Roof top program supports a forestry working group that is focuses on encouraging landowners and municipalities to protect forest cover. This work helps increase forestland in current use, where management plan required.	NA
Provide loggers with access to bridges	Basin-wide		Forests	Ongoing	Starting in 2018, the DFPR has been providing cost-share funding for loggers and foresters to receive temporary portable skidder bridges. Statewide, the DFPR distributed 12 free wooden bridges in 2018 and administered 9 cost-share grants for bridges in 2019 and 2020. DFPR expects to distribute over 25 bridges in 2021. In addition, the DFPR Watershed Forester administers a rental program for 5 heavy duty steel bridges for crossing larger rivers. The WNRCD has offered portable wooden skidder bridge program but bridge failed in 2019 and district has decided not to continue to support program.	NA
Promote the use of Ecologically Sensitive Treatment Areas for managed forest in current-use.	Basin-wide	All	Forests	Ongoing	DFPR promotes use through county foresters and outreach materials. Anecdotally, the Chittenden County Forester sees increase in ESTA in land management plans since 2016.	NA
Protect forestland	Winooski headwaters, North Branch, Kingsbury Branch,	Berlin, Middlesex	Forests	Ongoing	The Vermont Current Use program provides incentive for landowners to keep land in forest an requires development of a forest management plan that ensure protection of forest. The DFPR provides technical assistance to support protection including the Use Value Appraisal Manual which includes forest management standards, a template for a forest management plan, In total, 5,089 acres have been conserved as forest land.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Determine following wetlands' potential as Class I wetland through collection of additional information: Shelburne Pond, Essex Alder Brook (Essex and Milton), Upper Gleason (Bolton), Kettle Pond south (Marshfield and Groton), Lanesboro Bog (Marshfield) and Mud Pond (Williston)			Wetlands	In Progress (50%)	DEC – Wetlands Program has collected data on all but Upper Gleason and Alder Brook. Data collected to date for these wetlands could be used to support Class 1 designations. Assessment on the remaining two will depend on landowner permission to access the wetlands.	Medium
Prioritize restoration of wetland and floodplains on agricultural lands with highest potential for phosphorus retention and sediment attenuation.		Contact WSMD Wetlands Program for priority areas	Wetlands/ Rivers	Ongoing	Updated Lake Champlain wetland restoration site prioritization modeling was completed in 2018 utilizing RCPP funds. The updated maps identify potential wetland restoration areas with the highest likelihood of P attenuation and are available on the ANR Atlas and the Wetland Inventory Mapper. Partners such as NRCDs, NRCS, VLT, TNC and FWD are using these maps and a subset of project packets to help target wetland restoration outreach. For example, FWD has initiated a wetland restoration and acquisition initiative with funding from EPA through the Lake Champlain Basin Program. The primary focus of this project is wetland restoration on new and existing FWD acquisitions. The Agency's Functioning Floodplain Initiative is currently developing method that DEC will use to prioritize floodplain restoration based on P reduction potential as well as flood resilience. No wetland restoration has been funded during this reporting period.	NA
Prioritize restoration and protection of wetlands, as well as floodplain forests, and river corridors based on potential to filter out pollution			Wetlands/ Rivers	Ongoing	See above.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Promote the Lake Wise Program	Kingsbury Branch	Calais, East Montpelier, Woodbury, including Greenwood Lake	Lake	Ongoing	DEC continues to support Lake Wise Program. Partner assistance was provided by LNRCD to lakeshore landowners in 2020 and by FWR in 2021 where they distributed letter and brochure to every lakeshore landowner in Kingsbury Branch (UVM Sea Grant award). No site visits have been made during the reporting period. Earlier work since 2013, resulted in recognition of 5 shoreline owners on Greenwood and Curtis Pond as meeting Lake Wise Program criteria. In addition, shorelines have been improved with implementation of 6 BMPs on lakes in Calais (Curtis and Mirror), Woodbury (Greenwood) as well as Waterbury (Waterbury Reservoir).	NA
Promote contractor and partner participation in the Natural Shoreland Erosion Control Certification Program		Greenwood Lake	Lake	Ongoing	DEC promotes and holds these trainings with partners, including the WNRCD hosted 2019 Summer Erosion Control Field Day in the Winooski Basin. Six trainings were available to Basin 6 partners. Examples of trained partners include FMR, FWR, UVM Sea Grant, WNRCD as well as ANR and VTrans staff. The entire list can be found here.	NA
Incorporate materials specific to spiny water flea into signs, and greeter program.	Kingsbury Branch	Calais, East Montpelier, Woodbury	Lake	Ongoing	Since the last TBP, Lake Champlain has seen the introduction of the spiney water flea. No additional spread to inland lakes or ponds in the basin has been identified. DEC and LCBP's current monitoring and outreach messages are focused on current threats, including, but not limited to zebra mussels and the spiny and fishhook water flea. Outreach about the spiny water flea includes information incorporated into posters placed at DFW access site kiosks and information provided by boat greeters who are trained by the DEC AIS Program. In the Winooski Basin, a Public Access Greeter is hired to educate boaters using the Waterbury Reservoir.	NA
Support community's efforts to control Eurasian watermilfoil and other invasives	See Table 4 for lakes altered by Eurasian watermilfoil		Lake	Ongoing	DEC provides financial support to community-led efforts through the AIS Grant-in-Aid program as well as technical assistance. State-wide in 2020, 53 Aquatic Nuisance Control Grant in Aid funded projects with awards totaling $450,194. Project awards provided funds for education and outreach, surveys, spread prevention efforts. Funds supported greeter programs at the Waterbury reservoir, Curtis Pond and Colchester Pond.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Grow the access greeter program at Curtis Pond to include other local lakes	Kingsbury Branch	Curtis Pond, Calais	Lake	Ongoing	Since 2002, the Vermont Public Access Greeter Program has expanded operation to access points at 32 lakes and ponds statewide, and those numbers are increasing annually. Greeters intercepted and removed 666 instances of aquatic invasive species. Currently in Basin 6, only Waterbury Reservoir had a program in place, although in 2019 both Curtis and Colchester Ponds' had greeters.	NA
Assist development of a cyanobacteria (blue-green algae) volunteer monitoring program and response plan			Lake	Ongoing	The Agency, the Vermont Department of Health and partners have worked collaboratively to develop and implement education and outreach tools as well as a monitoring program and cyanobacteria tracker website with results to help communities identify and avoid contact. Volunteer monitoring is supported throughout the basin.	NA
Recruit lay monitors for collecting water quality data on high priority lakes	Kingsbury Branch	Buck, Pidgeon, Coits, Turtlehead	Lake	Ongoing	Although 14 lakes and ponds in the basin, including 7 in the Kingsbury Branch have lay monitors, Buck, Pidgeon, Coits and Turtlehead do not. DEC is currently recruiting lay monitors.	NA
Support community efforts to protect lake shoreland	Basin-wide	All	Lake	Ongoing	See Lake Wise Program	NA
Support municipalities pursuing phosphorus optimization, expansion projects and upgrades	Entire Basin	See TBP Table 30	Lake	Ongoing	DEC supports WWTF with technical and financial assistance. The DEC administers the Clean Water State Revolving Fund. Since 2019, 1 municipal wastewater asset management plan, 5 30% design and 1 refurbishment of an existing system has been completed in Basin 8.	NA
Determine the "reasonable potential" that WWTF's have to cause or contribute to downstream water quality impairment		All	Lake	Ongoing	A reissuance of a NPDES permit by DEC includes a Reasonable Potential Determination.	NA
Provide septic system maintenance education to homeowners	Huntington River, Kingsbury Branch, Jail Branch	Calais	Lake	Ongoing	WNRCD hosted a Septic Solutions Conference in Burlington in 2019 and two septic socials (Lake Iroquois and Huntington River) reaching roughly 100 individuals.	NA

Strategy Description	Priority Subbasin [12]	Priority Towns	Sector	Status	Explanation	Likelihood of Completion
Conduct biomonitoring and/or water quality monitoring on lakes, wetlands and streams to gain better understanding of condition and potential pollution sources, including internal phosphorus loading in lakes. In addition, monitor for pathogens at swimming areas and report to community.	Kingsbury Branch, Jail Branch, Muddy Brook	See Table 11	Natural Resources	Ongoing	A list of rivers, streams, lakes, ponds, and wetlands is provided in the 2018 Winooski TBP. Monitoring conducted by the DEC Monitoring and Assessment Program, Lakes and Ponds Program, and Wetlands Program. Volunteering monitoring by WNRCD, FMR, FWR supported through DEC LaRosa Partnership Program and the Regional Stormwater Program supported by Chittenden County MS4s.	NA
Conduct biomonitoring and/or water quality monitoring on lakes and streams that have met "very good" or "excellent" criteria to identify candidates for reclassification		See Table 11	Natural Resources	Ongoing	A list of rivers, streams, lakes, ponds, and wetlands are provided in the 2018 Winooski TBP. Monitoring conducted by the DEC Monitoring and Assessment Program, Lakes and Ponds Program, and Wetlands Program	NA

Acronyms

604(b) -Federal Clean Water Act, Section 604b
AAFM -Vermont Agency of Agriculture, Food and Markets
DEC - Department of Environmental Conservation
DFPR -Department of Forests, Parks and Recreation
ERAF – Emergency Relief and Assistance Fund
FWD – Fish and Wildlife Department
ANR -Vermont Agency of Natural Resources
AMP -Acceptable Management Practice
AIS -Aquatic invasive species
AOP -Aquatic Organism Passage
BMP -Best Management Practice
CCRPC-Chittenden County Regional Planning Commission
CVRPC-Central Vermont Regional Planning Commission
CWSRF -Clean Water State Revolving Fund
CREP -Conservation Reserve Enhancement Program
EPA -United States Environmental Protection Agency
EQIP -Environmental Quality Incentive Program
FMR – Friends of the Mad River
FWR – Friends of the Winooski River
LCBP – Lake Champlain Basin Program
LCPC-Lamoille County Planning Commission
LCNRCD – Lamoille County Natural Resource Conservation District
LID -Low Impact Development
MRGP – Municipal Road General Permit
MS4-Municipal Separate Storm Sewer System
NMP – Nutrient Management Plan
NRCD -Natural Resource Conservation District
RAP – Required Agricultural Practices
REI – Road Erosion Inventory
RPC -Regional Planning Commission
RSEP - Chittenden County Regional Stormwater Education Program
SWMP – Stormwater Master Plans
TNC-The Nature Conservancy
TBP – Tactical Basin Plan
TMDL -Total Maximum Daily Load
USFWS -United States Fish and Wildlife Service
UVM -University of Vermont
VTrans -Vermont Agency of Transportation
VLT -Vermont Land Trust
WNCRD – Winooski Natural Conservation District
WSMD – DEC Watershed Management Division

Appendix D. Results of State Stormwater Regulations

This appendix summarizes the contributions that Operational Stormwater Permits have made toward meeting Vermont's water quality goals.

Scope of Data	
Data include:	Stormwater permit data includes new or amended operational stormwater permits issued in state fiscal year (SFY) 2018 -2021. Permits authorize new, redeveloped, and existing impervious surfaces meeting regulatory thresholds. DEC tracks permit issuance, not actual construction of impervious. Actual construction and change in phosphorus load may occur one to several years behind authorization under the permit.
Data does not include:	Phosphorus load data from outside the Lake Champlain and Memphremagog basins.
Future improvements:	More precise tracking of the drainage area and size of each practice is needed to improve the accuracy of the reductions. Better tracking of permitted retrofit projects, that were also funded by a grant program is needed in future years.

Table 1. Stormwater treatment practice types installed to comply with new operational stormwater permits in SFY 2018-2021 and average estimated phosphorus removal rates.

Practice Tier	Definition and examples	Average Phosphorus Removal	Permitted in SFY 2018[1]	Permitted in SFY 2019[1]	Permitted in SFY 2020[1]	Permitted in SFY 2021[1]
Tier 1 practices	Infiltrating practices, impervious disconnection	>80%	149	107	230	182
Tier 2 practices	Gravel Wetlands and bioretention with underdrains	60-80%	20	37	55	51
Tier 3 practices	Wet ponds, filters and dry swales not designed to infiltrate	50-60%	47	18	15	13
2002 VSMM[2] practices	Grass lined channels, non-structural credits	<50%	48	0	0	0
Total number of practices permitted			264	162	300	246
Average total phosphorus load removal of permitted practices[3]			48% /72%[4]	70.1%	67.6%	74.3%

[1] Through the end of calendar year 2020, the stormwater management database tracks if a practice is present in a drainage area, not the number of practices. The real number of practices is higher. From 2021 onwards, practices are tracked individually.

[2] VSMM is defined as Vermont Stormwater Management Manual.

[3] Phosphorus removal efficiencies were assigned to each practice assuming that it was sized to meet the water quality volume. See Appendix F for phosphorus removal efficiencies.

[4] Average phosphorus removal was 48% for treatment practices permitted under the 2002 Vermont Stormwater Management Manual (VSMM) and 72% for treatment practices permitted under the 2017 VSMM. SFY 2018 was the last year treatment practices were permitted under the 2002 VSMM.

Figure 1. Percent stormwater treatment practices by tier for new operational stormwater permits issued in SFY 2021

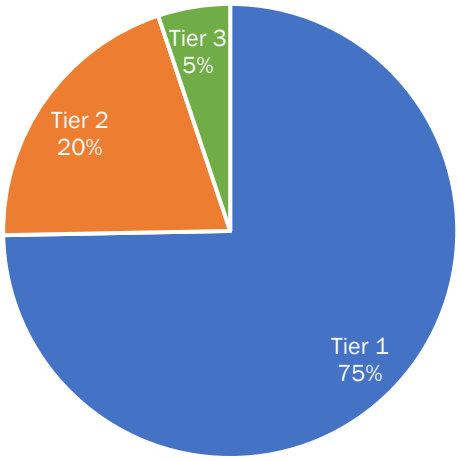


Table 2. Impervious surface area covered by operational stormwater permits issued in SFY 2018-2021 by large drainage areas as shown in the map to the right

Permitted Impervious Surface Type	SFY 2018	SFY 2019	SFY 2020	SFY 2021
Lake Champlain				
New impervious (acres)	127.9	87.6	171.7	155.8
Redeveloped impervious (acres)	20.6	24	29.6	19.9
Existing impervious (acres)	19.6	0.8	6.2	17.3
Total impervious (acres)	168.1	112.3	207.5	193.0
Lake Memphremagog				
New impervious (acres)	10.2	1.1	12.1	8.1
Redeveloped impervious (acres)	3.2	0	2.5	0.1
Existing impervious (acres)	1.5	0	9.8	0.2
Total impervious (acres)	14.9	1.1	34	8.4
Other Drainage Areas				
New impervious (acres)	28.1	26.1	43.7	18.2
Redeveloped impervious (acres)	9.5	8	3.5	10.0
Existing impervious (acres)	20.7	3.1	0.5	8.0
Total impervious (acres)	58.3	37.1	47.6	19.5

Table 3. Estimated change in total phosphorus load associated with operational stormwater permits in the Lake Champlain and Memphremagog basins (kilograms/year), SFY 2018-2021

Estimated Change in Total Phosphorus Load	SFY 2018	SFY 2019	SFY 2020	SFY 2021
Lake Champlain[5]				
Increase in phosphorus from operational permits, prior to treatment (kilograms/year)	103.3	90.7	172.7	47.7
Phosphorus reduced by treatment practices (kilograms/year)	101.6	115.2	202.0	45.8
Net change in phosphorus of operational permits (kilograms/year)	**0.5**	**-26.7**	**-29.3**	**-7.3**
Lake Memphremagog				
Increase in phosphorus from operational permits, prior to treatment (kilograms/year)	42.6	1.5	79.0	9.6
Phosphorus reduced by treatment practices (kilograms/year)	30.0	0.8	51.8	9.8
Net change in phosphorus of operational permits (kilograms/year)	**12.6**	**0.7**	**27.2**	**-0.2**

EXPLANATION OF TABLE

This table shows a net reduction in phosphorus in associated with permitted projects in Lake Champlain. This is likely due to a focus on retrofit projects and redeveloped impervious which result in greater reductions from the existing condition. Most permits issued in Lake Memphremagog basin are likely related to new impervious which results in less net reductions.

Note, permitted impervious and phosphorus load calculations include both new and amended permit authorizations. For amended permits, only the increased impervious acres and phosphorus load relative to the previous permit are summarized here. Phosphorus increase from new development assumed that the permitted area was forested prior to development. Redeveloped and existing impervious does not result in a phosphorus change related to change in land use.

[5] Phosphorus loads in Lake Champlain are expressed as “source loads” which is the pollutant reduction from the landscape source and does not account for potential storage or loss in the watershed prior to reaching a waterbody. In Lake Memphremagog, and elsewhere in the report, phosphorus loads are expressed as “delivered loads” and account for estimated pollutant storage or loss enroute to the receiving water.