VERMONT LAKE CHAMPLAIN PHOSPHORUS TMDL PHASE 1 IMPLEMENTATION PLAN

SEPTEMBER 15, 2016

VERMONT

PREPARED BY THE STATE OF VERMONT FOR THE
U.S. ENVIRONMENTAL PROTECTION AGENCY

VERMONT

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Vermonters value a clean Lake Champlain. We swim and fish in the lake, we boat on it, we drink its water, and we deeply appreciate its beauty. A clean lake attracts businesses and tourists to the region and is a major driver of the State's economy.

Phosphorus pollution is the greatest threat to clean water in Lake Champlain. Phosphorus is a nutrient that stimulates excessive growth of algae in the lake, turning the water green. In excessive amounts, algae can impair recreational uses, aesthetic enjoyment, the taste of drinking water, and the biological community. In some cases, algal blooms - particularly cyanobacteria (blue-green algae) - can produce toxins that harm animals and people. Phosphorus is found in eroded soil and runoff from farm fields, barnyards, roads, parking lots, and streambanks, and in wastewater discharges. Efforts to reduce all these sources of phosphorus have accelerated over the past ten years but the lake has been slow to improve.

In 2002, the U.S. Environmental Protection Agency (EPA) approved a Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) prepared by the states of Vermont and New York. The TMDL placed caps on the amount of phosphorus allowed to enter each segment of Lake Champlain, and allocated those maximum amounts among the various sources within each major watershed draining to the lake. In 2011, the EPA revoked its approval of the Vermont portion of the Lake Champlain TMDL. In June 2016 EPA approved a revised TMDL.

Phosphorus loading to Lake Champlain is dominated by "nonpoint sources," which are generated by runoff and erosion across the landscape, as opposed to "point sources" such as wastewater and certain stormwater discharges that are conveyed by a pipe or other discrete conveyance and are more closely regulated. For a TMDL to be approved in a situation where reductions in nonpoint source loading are relied upon to achieve the TMDL, the EPA must find "reasonable assurances" that the necessary nonpoint source reductions will actually occur. Insufficient reasonable assurance was the primary reason given by the EPA for reversing its approval of the 2002 TMDL.

EPA's expectations of Vermont for the new Lake Champlain TMDL are divided into two distinct planning phases. For the first phase, EPA expects Vermont to provide policy commitments relating to nonpoint source phosphorus reductions in a basin-wide scale implementation plan. This Vermont Lake Champlain TMDL Phase 1 Implementation Plan (Phase 1 Plan) contain those policy commitments. The State also agreed to develop a sub-basin tactical implementation plan (Phase 2 Implementation Plans) for each lake segment following EPA's completion of the final TMDL. Each tactical sub-basin plan will have an implementation table that identifies in more detail the specific point source and nonpoint source measures and practices to be implemented by identified dates. Implementation of discretionary projects will be subject to availability of funds and landowner approval. This implementation table will outline the priorities of DEC and partner organizations for protection or restoration of specific stream/river or lake segments affected by specific pollution sources, and present a specific focus on best management practice (BMP) or programmatic implementation necessary to reduce phosphorus loading to the Lake. The table will describe the types of BMP or other implementation strategies that are needed, by sub-watershed and source sector. The Phase 2 tactical basin plan will present best-available estimates of likely

phosphorus reductions by allocation category and related regulatory authority, aggregated at the appropriate geographic scale. These tables will be frequently updated to reflect the implementation of practices that are required as a result of regulatory program requirements.

Note that tactical plans themselves are not standalone regulations or permits. Tactical basin plan implementation tables may identify the appropriate restoration strategies based on monitoring and assessment data, but implementation authority continues to be under the purview of the regulatory programs. Moreover, agricultural BMPs will be identified in the Phase 2 section and implementation table at a geographic scale sufficiently fine so as to transparently present areas of planned intervention for each tactical planning cycle, but also at a level sufficiently coarse so as not to trigger confidentiality provisions of the federal Agricultural Act (a.k.a. Farm Bill), section 1619, pertaining to agricultural practice installation.

This Phase 1 Plan was developed by the Vermont Agency of Natural Resources (ANR) and the Vermont Agency of Agriculture, Food, and Markets (AAFM). These agencies worked diligently to develop the types of policy commitments requested by EPA to provide, or reduce the need for, reasonable assurances in the new TMDL. A proposed set of commitments, the Draft State of Vermont Proposal for a Clean Lake Champlain, was issued for public comment in November 2013. ANR met frequently with other state agencies, including the Vermont Agency of Transportation (VTrans), to refine the proposed commitments. ANR and AAFM, in conjunction with EPA, held six public meetings in December 2013 and took public comments on the draft proposal. Over 500 people attended those meetings. ANR, in partnership with VTrans and the regional planning and development agencies, held 12 additional meetings with municipalities across the State to discuss the draft proposal.

The State received over 100 comments on the November 2013 Proposal for a Clean Lake Champlain as well as a January 17, 2014 letter from the EPA, and used those comments to inform the development of a second and more detailed March 31, 2014 Draft TMDL Phase 1 Implementation Plan. A summary of the public comments and a list of Frequently Asked Questions with responses are available online. A May 8, 2014 letter from EPA provided further review and comment on the March 31 draft plan, which guided revisions incorporated into the present document. The Phase 1 Plan was updated in July 2015 to conform to Act 64, Vermont's Clean Water Act, which was passed by the Vermont Legislature and signed into law on June 16, 2015. A copy of Act 64 is included as Appendix F to this Plan.

The State prepared the July 2016 final draft Phase 1 Plan to fully reflect EPA's final "Phosphorus TMDLs for Vermont Segments of Lake Champlain," ("the Lake Champlain Phosphorus TMDLs" or "the TMDLs") released on June 17, 2016. [1] The State has now finalized this Plan following the public comment period to comply with Act 64, which requires the State to update the Plan no later than three months after EPA's issuance of the final Lake TMDLs.

[1] USEPA, Region 1, New England. Phosphorus TMDLs for Vermont Segments of Lake Champlain, June 17, 2016.

The policy commitments described in Chapters 3, 5 and 6 of this Phase 1 Plan are summarized in Table 1a, 1b, 1c and Figure 1, and address all major sources of phosphorus to the lake, including the following:

- Wastewater treatment facility discharges;
- Untreated/unmanaged runoff from existing developed lands;
- Discharges from farmsteads and agricultural production areas;
- Poorly managed cropland;
- Unmanaged or poorly managed pasture;
- River and stream channel modifications;
- Floodplain, river corridor and lakeshore encroachments;
- Stormwater runoff from developed lands and construction sites;
- Road construction and maintenance;
- Forests and forestry management practices;
- Wetland alteration and loss;
- Legacy effects of historic phosphorus loading; and
- Additional phosphorus contributions anticipated due to climate change.

The commitments presented in this Phase 1 Plan include new and enhanced regulation, funding and financial incentives, and technical assistance, and build on work already done by the State over the past 10 years to reduce phosphorus contributions to the lake. They will require new and increased efforts from nearly every sector of society, including state government, municipalities, farmers, developers, businesses and homeowners. The Vermont Department of Environmental Conservation (DEC) is employing a twenty-year implementation schedule to allow for communities to plan and stage the necessary improvements to roads, stormwater and wastewater infrastructure into long-term capital funding plans as a means of keeping costs and funding burdens down.

The EPA conducted modeling to determine the total loading capacities for each lake segment watershed and the wasteload and load allocation numbers for point and nonpoint sources, respectively. EPA published the final loading capacities and wasteload and load allocations in the Lake Champlain Phosphorus TMDLs.[2] These numbers fully define the level of phosphorus reductions needed by point and nonpoint sources in each of the 12 individual Vermont lake segment watersheds. DEC used the models and load allocations developed by EPA to further refine these commitments. Although many of the commitments described in this plan are expressed as statewide commitments, the State will tailor these commitments in scope, intensity and timing based on individual lake segment assessments during the second phase of implementation planning.

Based on EPA modeling results, some uncertainty exists about whether the tasks and commitments presented in this plan will be sufficient to fully achieve the required phosphorus load reductions in the Missisquoi Bay watershed. Additional and enhanced implementation efforts for Missisquoi Bay are described in Chapter 6, and elsewhere in this plan. Vermont is committed to learning as it implements this plan and to adapting management to incorporate lessons learned along the way as a means to address the special challenges presented in the Missisquoi Bay.

Act 64, the Vermont Clean Water Act that was signed into law in June of 2015, includes both

[2] *Id.*

increased fees and revenue generating mechanisms for the funding and implementation of this Plan. In sum, the Act provides:

1. Clean Water Fund: The Vermont Clean Water Act established a Clean Water Fund to assist municipalities, farmers and partners in making additional strategic investments in water pollution control. The Act imposes for three years a 0.2% increase in Vermont's property transfer tax, which will raise approximately $5.3 million annually. The Act creates a Clean Water Fund and Board to receive and manage the funds and requires an annual Clean Water Investment Report summarizing public investments and results of those investments. To support implementation of the TMDL and other clean water initiatives over time, Act 64 directs the Office of the State Treasurer, in consultation with state agencies, to prepare a recommendation to the Legislature for supporting and financing water quality improvements beyond the current three-year funding mechanism.
2. Ecosystem Restoration Grants: In 2015, the Vermont Capital Bill increased the amount of grant funding to support implementation of polluted stormwater runoff control projects to $3.75 million per year (from the 2014 level of approximately $2.5 million).
3. Increased Agency Capacity: The State of Vermont Fiscal Year 2016 budget includes funding to support eight new positions within AAFM and thirteen positions within DEC, all dedicated to implementation of the Vermont Clean Water Initiative and Lake Champlain TMDL.

Table 1a – Vermont Phase 1 TMDL Plan Summary of Point Source Commitments

* *Tasks correspond with the Gantt Chart.*
*** The light blue-shaded tasks are milestones specified in the Lake Champlain TMDLs Accountability Framework – the guide for monitoring progress in the restoration of Lake Champlain*[3]

Task *	Description	Start Year	End Year
A. WASTEWATER TREATMENT FACILITIES (WWTFs)			
National Pollutant Discharge Elimination System (NPDES) Permitting			
Issue National Pollutant Discharge Elimination Systems (NPDE) permits with TMDL-based phosphorus limits to WWTFs	Issue discharge permits to 59 direct discharging WWTFs in the Lake Champlain watershed on a five-year rotation and in coordination with tactical basin planning cycle	2017	2021
	Issue discharge permits to 9 WWTFs located in the North Lake Champlain Basin	2016	2017
	Issue discharge permits to 15 WWTFs located within the Lamoille and Missisquoi Basins	2017	2018
	Issue discharge permits to 6 WWTFs located in the South Lake A & B Basins	2018	2019
	Issue discharge permits to 17 WWTFs located in the Winooski Basin	2019	2020
	Issue discharge permits to 12 WWTFs located in the Otter Creek Basin	2020	2021
Update Combined Sewer Overflow (CSO) Rule	Rule change adopted by Vermont Legislature	2016	2016
B. STORMWATER MANAGEMENT			
Develop and issue State Highway Stormwater General Permit	Develop and issue general permit to regulate stormwater discharges from the entire state-operated transportation system	2015	2016
Implement State Highway Stormwater General Permit	Implement the general permit to regulate stormwater discharges from the entire state-operated transportation system	2017	2036
Develop and issue Municipal Roads Stormwater General Permit	Develop and issue general permit to require development and implementation of stormwater management plans for municipal roads	2016	2017
Implement Municipal Roads Stormwater General Permit	Implement the general permit to require development and implementation of stormwater management plans for municipal roads	2018	2036

[3] *Id.* at 55-59.

Develop and issue Existing Developed Lands Stormwater General Permit	Develop and issue general permit to address stormwater from existing developed lands equal to or greater than 3 acres	2016	2017
Implement Existing Developed Lands Stormwater General Permit	Implement the general permit to address stormwater from existing developed lands equal to or greater than 3 acres	2018	2036
Revise Existing MS4 General Permit	Existing Municipal Separate Storm Sewer System General Permit will be revised following adoption of the TMDL to require existing regulated municipalities to control discharges consistent with the wasteload allocation.	2016	2017
Update Vermont Stormwater Management Manual (VSMM)	Projects requiring a state-law based operational stormwater permit must have a stormwater system that meets the requirements of the VSMM. The Department has completed a stakeholder process to update the Manual and increase the level of phosphorus removal achieved by approved practices. The Department will commence rulemaking in 2016 to adopt the Manual.	2014	2016

Table 1b – Vermont Phase 1 TMDL Plan Summary of Vermont Commitments

** Tasks correspond with the Gantt Chart.*
*** The light blue-shaded tasks are milestones specified in the Lake Champlain TMDLs Accountability Framework – the guide for monitoring progress in the restoration of Lake Champlain*[4]

Task *	Description	Start Year	End Year
A. AGRICULTURE			
Water Quality Permitting Programs – LFO, MFO, CAFO			
Inspect potential Concentrated Animal Feeding Operations (CAFOs)	DEC and AAFM to inspect medium and large farms that could potentially be CAFOs under VT CAFO permit Inspect 75 potential CAFOs annually	2014 2019	2036 2036
Inspect MFOs and LFOs	AAFM to inspect medium farm Operations (MFOs) a minimum of every 3 years and large farm operations (LFOs) annually.	2014	2036
Update agricultural enforcement MOU	Update the MOU between DEC and AAFM regarding enforcement of agricultural regulations and program coordination	2016	2016
Accepted Agricultural Practice Rule Update and Compliance			
Amend the State Accepted Agricultural Practices (AAP)	Amend the AAPs to become the Required Agricultural Practices (RAPs) through rulemaking. Rules changes will include: • Develop small farm certification program • Increased buffer sizes on small farms to 25' (consistent with medium and large farm regulations) • Strengthen erosion risk tolerances on all farms to T (from 2T) • 10' buffer requirements for field ditches • Required stabilization of field gully erosion • Strengthening the livestock exclusion requirements. • Develop and require certification of custom manure applicators and ongoing training • Develop and require educational trainings for farmers • Establish standards for soil conservation practices such as cover crops • Require additional site-specific BMPs where necessary to meet water quality standards • Establish standards to increase nutrient management on farms with high soil test phosphorus	2015	2016

[4] *Id.*

Expand AAP and RAP education and outreach	Begin extensive education and outreach and enforcement of revised Required Agricultural Practices	2014	2036
Develop the Small Farm Inspection program	Establish a SFO inspection group (4 inspectors, 1 supervisor) on Missisquoi Bay and St. Albans Bay	2014	2036
Increase SFO dairy inspections	Complete assessment of all small dairy farms in Missisquoi Bay and St. Albans Bay watersheds; Require BMP installation where needed according to CLF Settlement Agreement; Complete assessment of all small dairies in South Lake and Otter Creek basins; Require BMP installation where needed on significant livestock operations in the South Lake Basin	2017 2018 2021 2022	2022 2026 2036 2036
Increase SFO inspections to other significant livestock operations	Expand small farm inspection program to any significant livestock operations in the Lake Champlain Basin and require BMP installation where needed	2025	2036
Require small farm certification	Require small farms to submit annual certification forms	2017	2036
Nutrient Management Planning			
Increase NMP efforts	Review NMP standards and revise as necessary Provide increased financial support for NMP development and management tools Expand small farm NMP development courses and workshops, trainings for farmers, manure applicators and technical service providers	2016 2018 2016	2018 2036 2036
Mandate manure applicator certification as part of RAP revision	Mandate certification of custom manure applicators	2016	2036
Expand implementation efforts	Provide education and outreach support grants Provide alternative phosphorus reduction grants. Provide organizational capacity building grants. Increase participation and re-enrollment in CREP program	2016	2036
Address tile drains	Report to VT Legislature on recommendations for tile drain management to mitigate and prevent the contribution of tile drainage. Revise RAPs to include requirements to reduce nutrients from tile drains	2017	2018

Additional Efforts in Critical Watersheds			
Increase inspections in critical watersheds	Target CAFO and SFO inspections Conduct North Lake Farm Survey in Missisquoi Bay and St. Albans Bay watersheds Expand this comprehensive evaluation to other critical watersheds Deploy the strategy outlined in the CLF Settlement Agreement in critical watersheds	2014 2015 2018 2016	2036 2016 2020 2036
Increase implementation in critical watersheds	Prioritize personnel in these areas for water quality improvement projects. Use $16M Regional Conservation Partnership Program (RCPP) grant funding to implement high priority practices primarily in these watersheds	2014 2015	2036 2020
Increase technical assistance in critical watersheds	Hire three contractors on retainer to immediately work with farmers following site-specific farm assessment. Target education and support for farmer groups	2016	2018
Develop and pilot ESP	Develop and pilot the Environmental Stewardship Program to incentivize additional practice adoption	2016	2020
Create grassed waterways program	Target funding to critical source areas in coordination with partners	2017	2036
Tile drain research	NRCS grant funding testing of two treatment media for tile drain outflows on farms in Franklin county. Lake Champlain Basin Program funded literature review of tile drain research and expanded tile drain monitoring and assessment in Jewett Brook watershed Encouraging farmers to utilize NRCS *Edge of Field Monitoring* practice to test additional tile treatment options	2015 2016	2017 2018
Capital Equipment Assistance Program	Reactivate this program to provide funding for the purchase of equipment such as precision record keeping equipment	2016	2036
B. NON-REGULATORY STORMWATER MANAGEMENT			
Implement non-regulatory stormwater management for unregulated sources	Complete stormwater infrastructure mapping and illicit discharge and elimination studies in order to incentivize municipal stormwater management. Provide technical assistance on stormwater master planning to identify and prioritize actions. Develop stormwater management practices on-line handbook & factsheets for sub-jurisdictional activities by December 2016 and final handbook by January 2017	2014	2036

Implement stormwater master planning for non-MS4 municipalities in the Lake Champlain Basin	Develop stormwater master plans for a minimum of 30 percent of the non-MS4 municipalities in the Lake Champlain Basin; integrate projects into tactical basin plans	2016	2036
Support municipal stormwater ordinance adoption	Support municipal adoption of model stormwater ordinances to prevent or minimize stormwater impacts from future development	2014	2036
Use Green Stormwater Infrastructure to reduce impacts from stormwater runoff	Implement green stormwater infrastructure practices to reduce the volume of runoff and to provide water quality treatment. Develop cooperative agreement with Lake Champlain Sea Grant at the University of Vermont to enhance green infrastructure technical assistance in Lake Champlain Basin	2013	2036
C. RIVER CHANNEL STABILITY			
River Corridor and Floodplain Management			
Implement a No Adverse Impact Standard	Further develop Program capacity to implement the new state floodplain rule and Flood Hazard Area and River Corridor Protection Procedures. Establish Memoranda of Understanding (MOUs) with other state agencies to regulate developments within their purview to be consistent with the new state floodplain rule. Support the municipal adoption of enhanced model floodplain and river corridor protection bylaws that exceed the NFIP minimum requirements	2014	2018
Expand technical and regulatory assistance	Implement general permits and establish a regional Certified Floodplain Technician Program to also increase the regulatory and technical assistance capacity for floodplain protection. Develop and implement both field and web-based project authorization capacities and the data management systems for project to tracking	2015	2022
Establish statewide river corridor mapping	Implement a statewide river corridor and floodplain mapping center that is developing and maintaining inundation, erosion hazard, and riparian buffer maps as per the adopted Flood Hazard Area and River Corridor Protection Procedures. Develop and carry-out a training program to establish greater statewide capacity for assisting municipalities with river corridor updates	2015	2036
Update and expand flood inundation mapping	Obtain Light Detection and Ranging (LiDAR) data for the entire state	2017	2022
Increase the number of land conservation projects	Increase the number of conservation projects which incorporate channel management and riparian buffer provisions (8-12 projects per year)	2015	2036

Enhance strategic river corridor project identification	Integrate field assessment data, river corridor plans, and statewide river corridor mapping to support municipal resiliency plans, road erosion assessments, tactical basin plans, and project identification within state, regional, and local hazard mitigation plans	2016	2023
Enhance incentives for municipal adoption of regulations	Enhance the Flood Resilient Communities Program with funding and technical assistance incentives for municipalities	2014	2036
Enhance and maintain an education and outreach program	Enhance a "Flood Ready" web page to promote cross-agency flood resiliency planning, peer-to-peer learning, and tools to increase municipal adoption of enhanced floodplain and river corridor protection bylaws and other mitigation measures to minimize flood risks and maximize floodplain function	2015	2036
Preventing Adverse Channel Modifications			
Expand technical and regulatory assistance	Increase the Program's capacity to provide technical and regulatory assistance for stream alterations, including emergency and next-flood protective measures to maximize equilibrium conditions (i.e., river-based storage functions) in the Lake Champlain Basin. Develop and implement both field and web-based project authorization capacities and the data management systems for project and permit tracking	2014	2022
Establish agricultural stream channel stabilization practices	Work with AAFM and NRCS to establish stream channel stabilization practices consistent with the Vermont Stream Alteration Rule for minimizing fluvial erosion hazards as per the Act 65 revisions to 10 V.S.A. §1021	2015	2018
Increase the number of river and floodplain restoration projects	Capitalize on opportunities to implement restoration projects involving the removal of river, river corridor, and floodplain encroachments and the completion of projects that restore equilibrium conditions	2015	2036
Expand training, education, and outreach programs	Develop and continually edit standard river management principles and practices (SRMPP) to maximize equilibrium conditions when managing conflicts between human activities and the dynamic nature of rivers. Develop and implement a 3-tiered outreach and training program by offering courses to VTrans Operations Technicians, municipal roads workers, contractors, and other river technicians. Conduct outreach and train municipalities and contractors in the use of the SRMPP and authorizations under the new ANR Stream Alteration Rules and General Permit that contain equilibrium-based performance standards	2014	2018

Achieve consistent standards across jurisdictions	Achieve FEMA recognition of state-adopted river management and stream crossing codes and standards for conducting emergency protective measures	2014	2018
D. FOREST MANAGEMENT			
Revise Forestry Acceptable Management Practices (AMPs)	Revise AMPs to specify compliance with standards in state stream alteration general permit, referencing stream crossings. Enhance standards for skid trails, truck roads and temporary stream crossings on logging operations.	2016	2016
Provide Education on AMPs	Provide AMP education and technical assistance to loggers, landowners and consulting foresters.	2017	2036
Provide incentive financing to reduce pollution risks on logging jobs	Pending available funding, provide qualified logging professionals access to low-interest financing through a Vermont Forestry Direct Link Loan Program to support logging BMPs and equipment	2018	2036
Abate soil erosion occurring on forest roads	Provide technical assistance for delivering NRCS cost-share practice to address soil erosion and sedimentation associated with logging roads and stream crossings on private lands	2015	2036
Enhance forest cover to improve watershed health	Establish forest cover goals, secure public funding to restore riparian buffers and developed land forest cover. Prepare and mitigate impacts to forest cover from invasive tree pests	2016	2036
Develop and promote climate-smart forest adaptation strategies	Publish and distribute guide, "Creating and Maintaining Resilient Forests in Vermont: Adapting forests to climate change," to promote climate-smart forestry practices. Create funding priorities within the Working Lands Enterprise Fund to support environmentally sound harvesting technologies. Conduct demonstration projects	2015	2036
E. WETLAND PROTECTION AND RESTORATION			
Designate several wetlands within the basin as Class I	Enhance state protection for several wetlands within the basin which provide sediment and phosphorus retention or provide erosion control of waterways.	2015	2016
Increase permit compliance	Conduct permit compliance checks on 80% of construction projects within the Lake Champlain Basin.	2016	2036
Coordinate wetland restoration projects	Coordinate with federal, state and local partners to identify and implement restoration opportunities.	2014	2025
Expand technical, educational and regulatory assistance	Enhance ability of program to focus significant time on restoration efforts.	2013	2017

F. UPLAND LAKES PROTECTION AND MANAGEMENT			
Apply new nutrient criteria for lakes	Identify upland lakes at risk for nutrient impairment	2016	2017
Upland lake management plans	Develop and implement management plans for upland lakes at risk for nutrient impairment on a five-year rotation and in coordination with tactical basin planning cycle	2016	2036
Expand technical and educational assistance	Implement the Lake Wise Program. Enhance ability of program to focus significant time on restoration efforts.	2014	2024
Created new permitting program for activities in shorelands.	Developed permit program procedures and standards that implemented the provisions in the Shoreland Act.	2014	2014
Develop forest management plan standards compliant with Shoreland Protection Act	FPR developed forest management plan standards and procedures for compliance with the Vermont Shoreland Protection Act in 2015.	2015	2015
Implement the new Shoreland Protection Act.	Permit activities in lake shorelands. Establish a contractor training program for work in shorelands. Conduct outreach and technical assistance.	2015	2036
Conduct rulemaking under the Shoreland Protection Act.	As dictated by experience implementing the program, enter rulemaking to clarify or strengthen the requirements of the Shoreland Permit Program.	2017	2018
G. INTERNAL PHOSPHORUS LOADING IN ST. ALBANS BAY			
Control internal phosphorus loading in St. Albans Bay	Conduct treatment design study, secure permits and funding, and implement in-lake treatment.	2032	2036
H. MISSISQUOI BAY – ENHANCED IMPLEMENTATION			
AAFM North Lake Survey	Visits to all livestock operations to assess water quality	2015	2015
Address RAP violations; install BMPS	Farms to install site specific BMPs as required and address RAP violations	2015	ongoing
Regional Conservation Partnership Program	Target agricultural and forest landowners to accelerate implementation of NRCS cost-share practices to improve water quality (including land conservation easements and wetland restoration and easements)	2015	2020
Increase portable skidder bridge program	Provide portable skidder bridges watershed wide in Missisquoi Bay	2015	2019
Reduce erosion from inactive forest roads, trails and logging landings	Use LiDAR mapping to map eroding, abandoned and retired forest roads, skid trails and log landings to identify restoration projects for funding.	2015	2017
Re-establish connections to floodplains	Enhance effort to identify opportunities for re-establishing connections to floodplains and working with landowners	2015	2036

Identify opportunities for active intervention in stream channel erosion processes	Enhance effort into identification of opportunities to implement projects involving active intervention to prevent stream channel erosion	2015	2036
I. PHOSPHORUS DETERGENT AND FERTILIZER USAGE			
Determine effectiveness of state restrictions on phosphorus-containing detergent and fertilizers	Conduct an evaluation of the effectiveness of Vermont laws that restricts the sale of household cleaning agents containing phosphorus and prohibits application of phosphorus fertilizer to turf	2017	2020

Table 1c – Vermont Phase 1 TMDL Plan Summary of Vermont Commitments

* *Tasks correspond with the Gantt Chart.*
*** The light blue-shaded tasks are milestones specified in the Lake Champlain TMDLs Accountability Framework – the guide for monitoring progress in the restoration of Lake Champlain*[5]

A. WATERSHED PROTECTION AND RESTORATION			
Clean Water Initiative Program			
Increase implementation for priority clean water improvement projects	Create a program that will oversee the ecosystem restoration grants and coordinate, manage, track and report on implementation of TMDLs and other priority actions statewide. Expand the availability of state funds to increase implementation of water quality improvement projects across all sectors.	2015	2036
Expand technical assistance and education	Provide grant funding to meet technical and educational assistance needs of municipalities and other local partners	2016	2036
Expand program to help municipalities control runoff from gravel and paved roads	Expand financial and technical assistance to municipalities in managing road runoff and erosion via the VTrans Municipal Mitigation Grant Program	2014	2036
Support to address municipal stormwater infrastructure needs	Expand the state revolving fund that is dedicated to providing low interest loans and incentives for municipal stormwater management. Provide technical assistance in stormwater asset management	2016	2036
B. FUNDING AND CAPACITY			
Establish a Vermont Clean Water Fund	Create a statewide sustainable fund to support, over the long-term, compliance with water quality requirements and implementation of priority water quality improvement projects using existing grant, contract and loan programs and a board to administer the fund	2015	2017
Maintain a sustainable funding source for the Clean Water Fund	Establish a long-term revenue source to support water quality improvement via the Clean Water Fund (Act 64, Sec. 40)	2016	2017
Five-year reports to EPA on updated spending plans	December 30, 2016 and every five years thereafter: Provide a report to EPA with an updated spending plan for TMDL plan implementation based on available federal and state funds obtained or requested, and funds for plan implementation as contained in the Vermont Fiscal Year 2017 (or relevant year for future spending plans) budget as passed by the Vermont General Assembly	2016	2036

[5] *Id.*

C. TACTICAL BASIN PLANNING			
Maintain existing tactical basin planning program	Maintain base program including monitoring and assessment staff, data management staff, and watershed coordinators. Support integration of existing assessment processes, stormwater master planning, stream geomorphic assessment, road erosion inventory and assessment, and agricultural environmental management	2014	2036
Develop a critical source area identification system	Construct an optimized and flexible modeling tool to prioritize watersheds (NHD+ catchment scale) for BMP placement within tactical basin plans. This system will be used by DEC and organizational partners (AAFM, VTRANS, NRCS) in the development of tactical basin plans and tracking of resulting BMP implementation. Such a system will be constructed to incorporate the EPA Scenario tool, LIDAR, relevant satellite imagery and other continually refreshed geodetic source information.	2016	2017
Support modeling and BMP tracking	Construct a watershed modeling BMP planning tool by 2017 and implement watershed modeling	2016	2036
Enhance the watershed coordinator presence in Lake Champlain Basin	Enhance basin coverage, and accelerate updates of plan implementation tables with watershed modeling results	2015	2036
Update Vermont Water Quality Standards	Update the Vermont Water Quality Standards, including anti-degradation by adding a new tier that allows for an upward reclassification of designated uses	2015	2017
Construct Phase 2 Plans	Tactical Planning staff, in partnership with other Division, AAFM, ACCD, and VTRANS staff will construct the Phase 2 implementation base set of interventions for inclusion into Tactical Basin Plans	2015	2016
Publish South Lake Champlain Tactical Basin Plan	Publish tactical basin plan in 2014 and every five years thereafter, with Phase 2 TMDL Plan update in 2017. required phosphorus load reductions.	2014	2034
Publish North Lake Champlain Tactical Basin Plan	Publish tactical basin plan in 2015 and every five years thereafter, with Phase 2 TMDL Plan update in 2017, and interim update in 2019	2015	2035
Publish Lamoille Tactical Basin Plan	Publish tactical basin plan in 2016 to include Phase 2 TMDL plan, and every five years thereafter, with interim updates in 2018 and 2020	2016	2036

Publish Missisquoi Tactical Basin Plan	Publish tactical basin plan in 2016 to include Phase 2 TMDL plan and every five years thereafter, with interim updates in 2018 and 2020.Identify additional measures as necessary to achieve the required phosphorus load reductions	2016	2036
Publish Winooski Tactical Basin Plan	Publish tactical basin plan in 2018 to include Phase 2 TMDL plan and every five years thereafter, with interim updates in 2020 and 2022	2018	2032
Publish Otter Creek Tactical Basin Plan	Publish tactical basin plan in 2019 to include Phase 2 TMDL plan and every five years thereafter, with interim updates in 2021 and 2023	2019	2032
Support implementation of Tactical Basin Plans by establishing local teams that consist of Regional Planning Commissions, watershed groups and other partners	Create and support local teams that involve RPCs and other partners and conduct municipal BMP outreach, support, implementation, tracking and reporting	2015	2036
D. TRACKING TMDL IMPLEMENTATION			
Develop Tracking System	DEC tracking database is fully operational, June 2016 and DEC tracking database contains phosphorus accounting functionality, July 2016	2016	2016
Develop accounting and tracking protocol	Draft BMP accounting and tracking protocol developed, December 2016; stakeholder input on BMP accounting and tracking protocol collected and incorporated, January 2017; and BMP accounting and tracking protocol finalized and posted on web, February 2017	2016	2017
Develop BMP verification protocol	Draft BMP verification protocol developed, January 2017; stakeholder input on BMP accounting and tracking protocol collected and incorporated, February 2017; and BMP accounting and tracking protocol finalized and posted on web, March 2017	2017	2017

Figure 1a – Gantt Chart: Vermont Phase 1 TMDL Plan Summary of Point Source Commitments (Tasks Correspond with Table 1a)

*** The blue-shaded tasks are milestones specified in the Lake Champlain TMDLs Accountability Framework – the guide for monitoring progress in the restoration of Lake Champlain.*

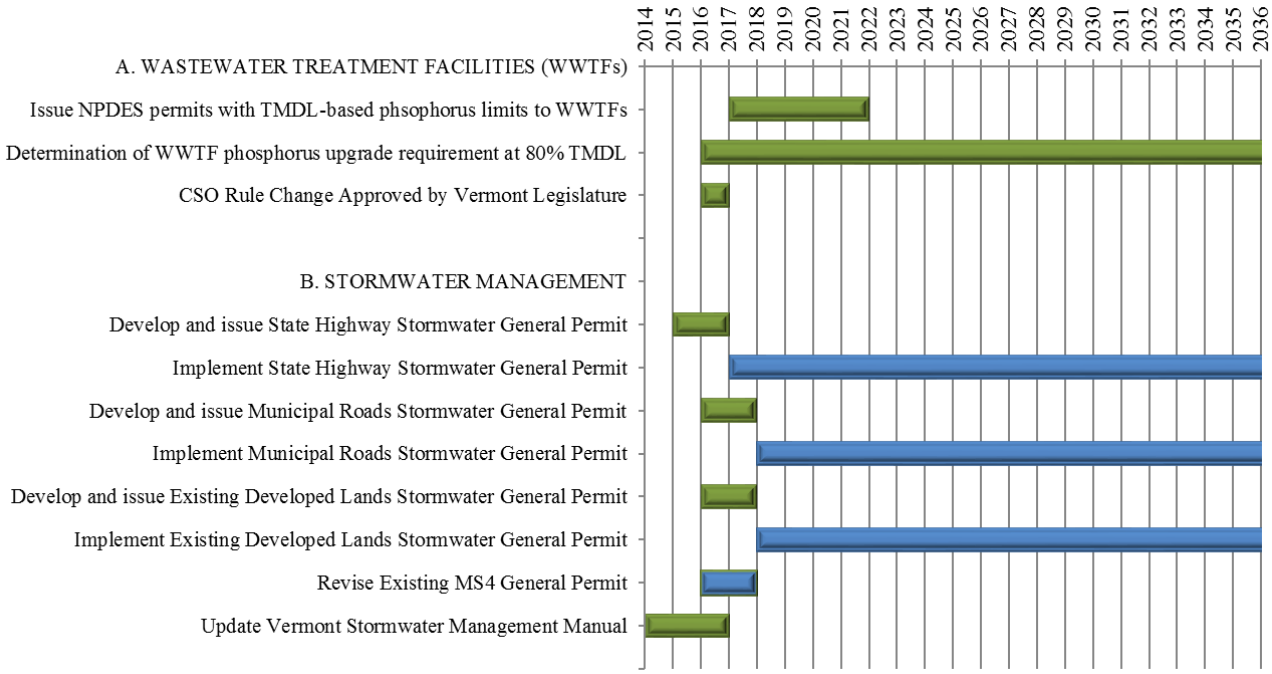


Figure 1b – Gantt Chart: Vermont Phase 1 TMDL Plan Summary of Vermont Commitments (Tasks Correspond with Table 1b)

*** The blue-shaded tasks are milestones specified in the Lake Champlain TMDLs Accountability Framework – the guide for monitoring progress in the restoration of Lake Champlain.*

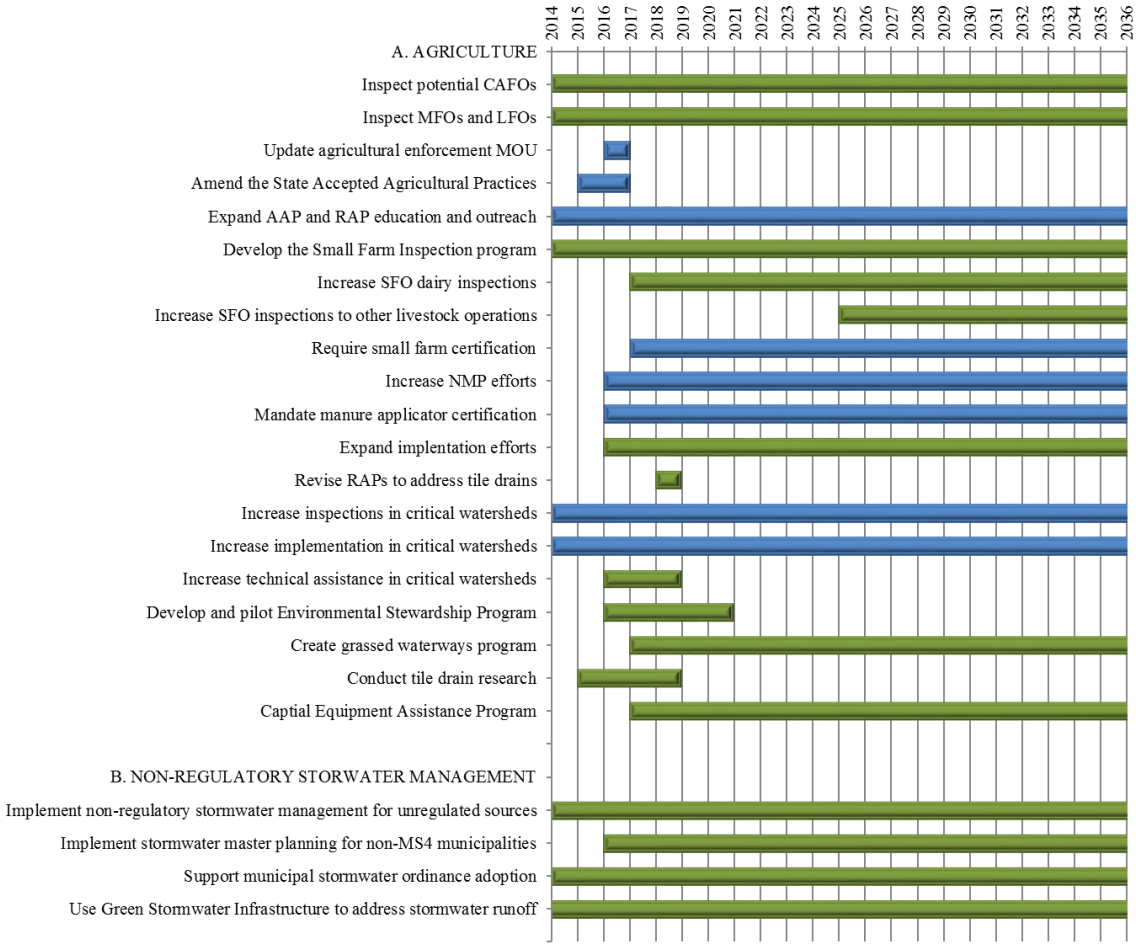


Figure 1b, Continued - Gantt Chart: Vermont Phase 1 TMDL Plan Summary of Vermont Commitments (Tasks Correspond with Table 1b)

*** The blue-shaded tasks are milestones specified in the Lake Champlain TMDLs Accountability Framework – the guide for monitoring progress in the restoration of Lake Champlain.*

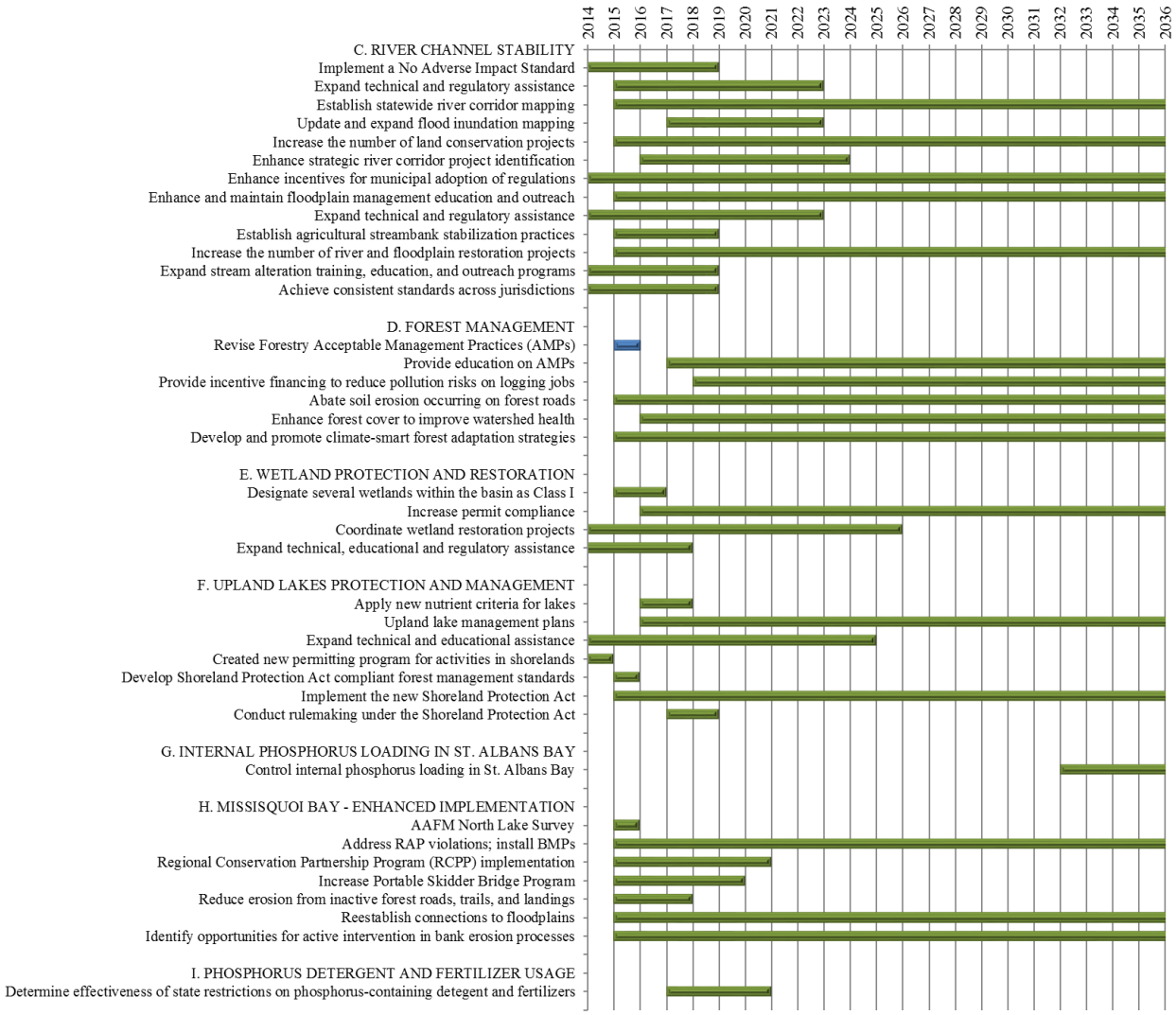
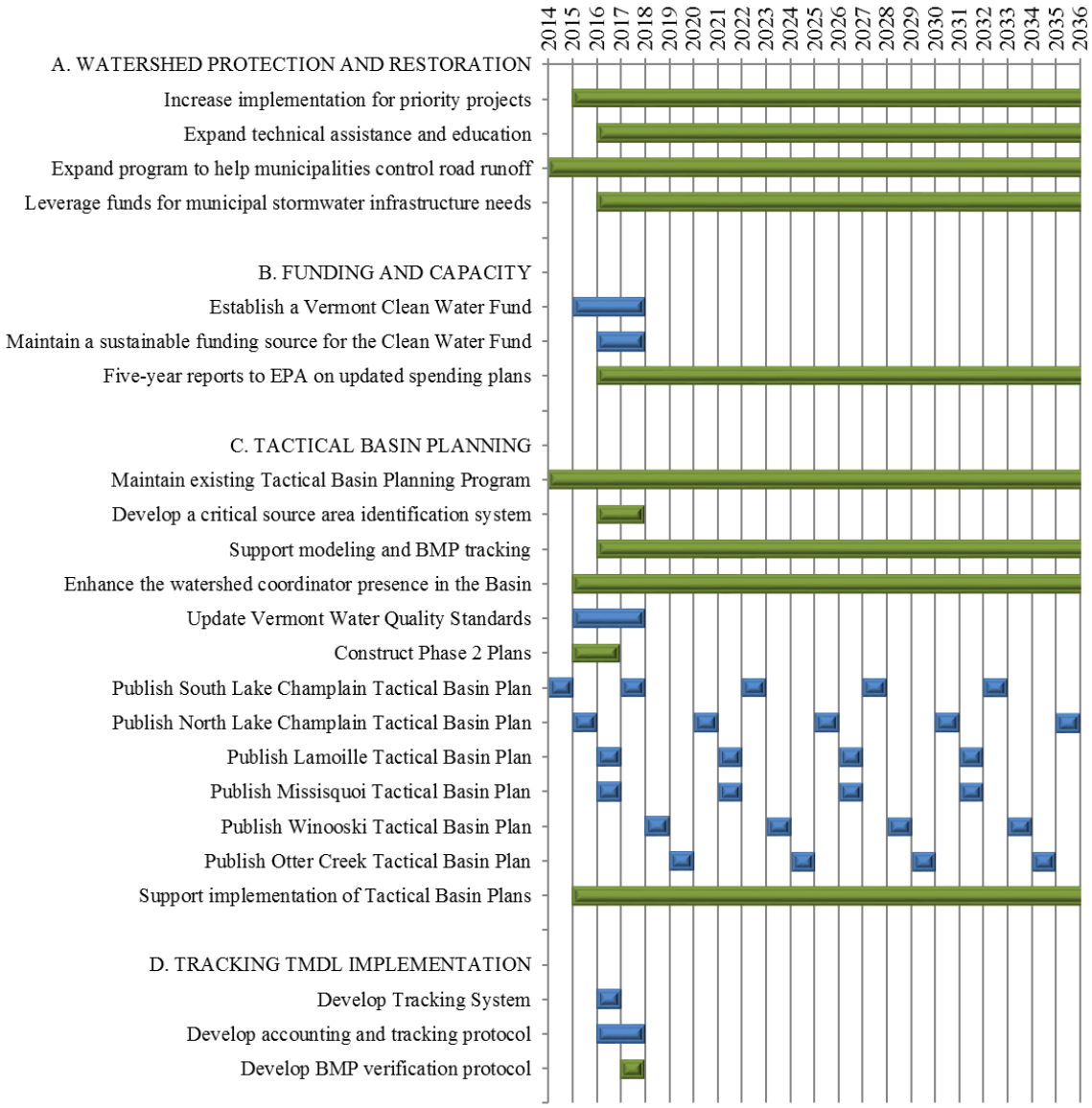


Figure 1c – Gantt Chart: Vermont Phase 1 TMDL Plan Summary of Watershed-Based Commitments (Tasks Correspond with Table 1c)

*** The blue-shaded tasks are milestones specified in the Lake Champlain TMDLs Accountability Framework – the guide for monitoring progress in the restoration of Lake Champlain.*



CHAPTER 1- INTRODUCTION

A. PHOSPHORUS IMPAIRMENT OF LAKE CHAMPLAIN

Phosphorus pollution is the greatest threat to clean water in Lake Champlain. Phosphorus is a nutrient that stimulates excessive growth of algae in the lake, turning the water green. In excessive amounts, phosphorus and the associated algal growth can impair recreational uses and aesthetic enjoyment, reduce the quality of drinking water, and alter the biological community. In some cases, algal blooms – particularly cyanobacteria (or blue-green algae) can produce toxins that harm animals and people.

Vermont's Water Quality Standards include total phosphorus concentration criteria for each of Vermont's twelve lake segments. These criteria vary among the different lake segments, and are expressed as the annual average phosphorus levels that must be achieved in order to support the many values and uses of the lake.

Long-term monitoring of phosphorus levels throughout Lake Champlain by Vermont and New York with the Lake Champlain Basin Program has documented phosphorus concentrations in excess of the water quality standards in most areas of the Lake (Figure 2). Despite significant efforts to reduce phosphorus loading to the Lake in recent years, the trend lines are still moving upward.

Excessive phosphorus is delivered to Lake Champlain as a result of the collective activities of all residents of the Lake Champlain basin, past and present. Stormwater runoff from the roofs of homes and driveways and other developed land contributes phosphorus that is washed into streams when it rains or as snow melts. Similarly, in an agricultural setting, rain washes soil and manure off of crop lands, pastures, hay lands, and barnyards into nearby streams. Erosion of roadside banks, ditches, and around unstable culverts delivers sediment and phosphorus to the road drainage network and then to nearby streams.

Channelization of streams undertaken to protect development, and encroachment of buildings and roads on floodplains and river corridors, prevents floodwater storage and the attainment of the least erosive, stream equilibrium conditions. Loss of floodplain function increases river bank erosion and the loading of sediments and nutrients such as phosphorus. River bank and bed erosion is also the result of traditional drainage methods that increase runoff directly to streams, thereby increasing volume and velocity of stream flows during storms.

Phosphorus is naturally present in small amounts even in runoff from pristine forest land, but logging activities such as construction of roads and stream crossings can cause erosion of sediment and phosphorus into streams. Finally, inadequately treated wastewater, whether from a septic system or a wastewater treatment facility, also contributes phosphorus to the lake.

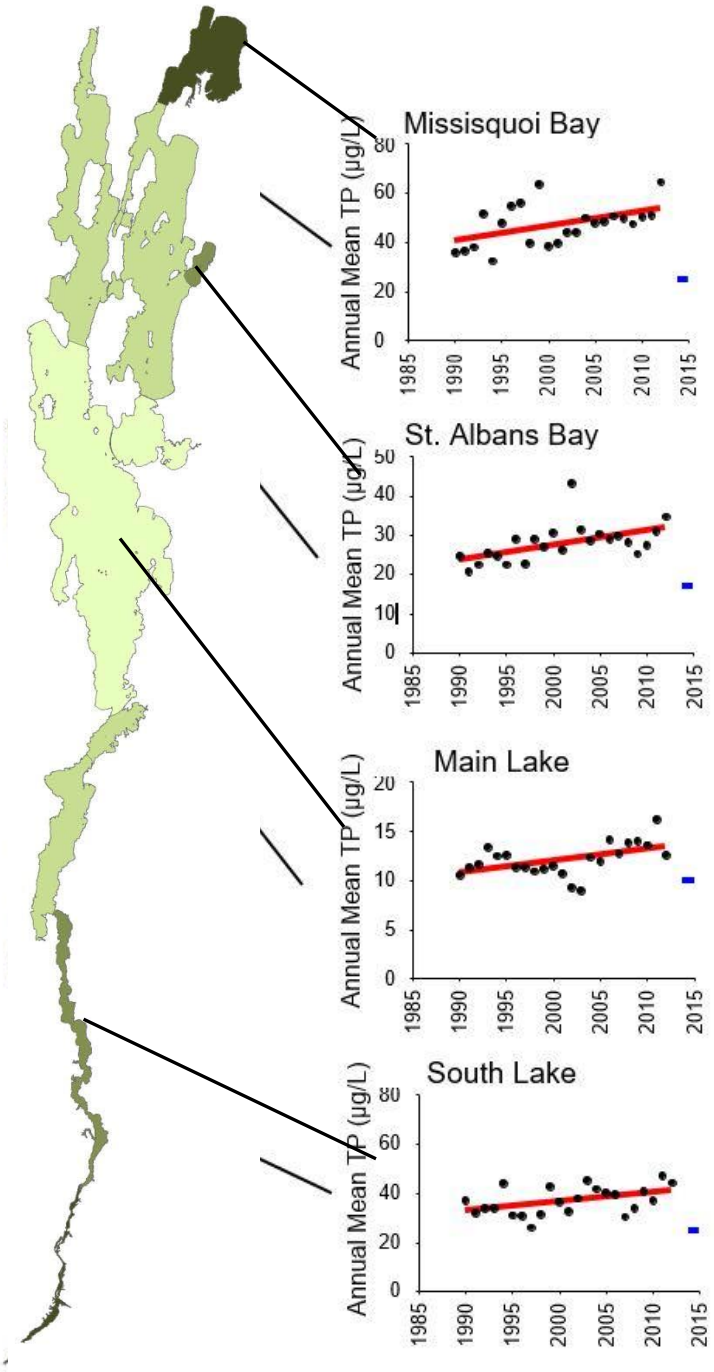


Figure 2 – Annual mean total Phosphorus concentrations (TP, Micrograms per liter) in four Lake Champlain Segments, 1990-2012. Solid red lines are statistically significant trend lines. Dotted blue lines are the in-lake phosphorus water quality standard.

As part of the development of the new Lake Champlain Phosphorus TMDL, EPA supported a watershed modeling analysis that produced estimates of the phosphorus contribution from each major source category. As shown in Figure 3, the relative magnitude of each source varies by watershed, but agricultural land, developed land, and stream channel erosion are major sources across all watersheds. Forest land appears as a large source in Figure 3 primarily because forests occupy over 70% of the landscape in the basin. Phosphorus runoff rates per acre from forest land are typically very low. On the other hand, some sources such as farmsteads and back roads that occupy a small percentage of land use of actually shown in Figure 3 can contribute some of the highest rates of phosphorus loading per acre. Both the total amount of the phosphorus load and the loading rate per unit of land area should be considered in setting phosphorus reduction priorities.

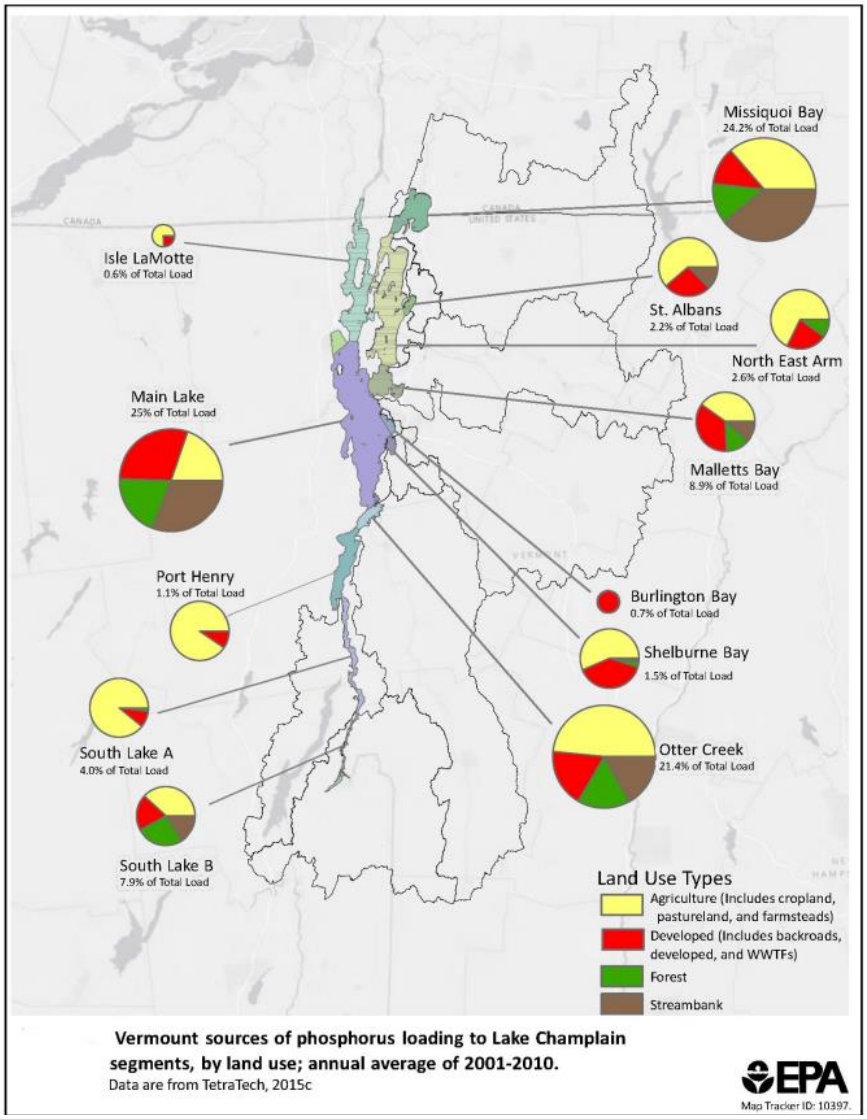


Figure 3 - Sources of Phosphorus loading to Lake Champlain from Vermont Watersheds[6]

[6] USEPA, Region 1, New England. Phosphorus TMDLs for Vermont Segments of Lake Champlain, June 17, 2016, Table 4 at 14.

B. TMDL DEVELOPMENT AND IMPLEMENTATION PLANNING

Section 303(d) of the federal Clean Water Act requires states to develop a total maximum daily load (TMDL) for water bodies that do not currently meet water quality standards. A TMDL is a "pollution budget" that calculates the amount of pollution the water body can tolerate and still maintain water quality standards. This "budget" is comprised of two components – the "wasteload allocation" which describes the amount of phosphorus reductions required from point source discharges, and the "load allocation" which describes the amount of phosphorus reduction required from nonpoint sources. Point sources include discharges from pipes or other discrete conveyances, for example discharges from wastewater treatment facilities or channelized municipal stormwater runoff. Non-point sources include more diffuse overland discharges to waters, such as runoff from agricultural fields, developed lands and back roads, and from stream erosion due to channelization and increased runoff from developed lands.

The 2002 Lake Champlain Phosphorus TMDL was developed and submitted jointly by the States of Vermont and New York to the U.S. Environmental Protection Agency in 2002, following an extensive public participation process in each state. The TMDL built upon a sequence of studies, plans, and agreements completed during the preceding twelve years. EPA Region 1 approved the Vermont portion of the Lake Champlain TMDL, and EPA Region 2 approved the New York portion of the TMDL. A subsequent water quality agreement between Vermont and Quebec was signed in 2002 to define phosphorus load reduction targets and responsibilities for the shared Missisquoi Bay portion of the lake.

The 2002 TMDL included a Vermont-specific implementation plan describing a suite of action items and attendant funding needs to reduce the phosphorus load delivered annually to Lake Champlain. The 2002 implementation plan, as amended in 2010, served as a basis for the efforts of ANR and AAFM by guiding annual funding requests, staffing levels, and program priorities for the past twelve years. Despite these numerous efforts, and in response to a lawsuit filed in federal court by Conservation Law Foundation, EPA reconsidered its previous approval of the 2002 TMDL, and disapproved the Vermont portion of the TMDL in January 2011. One of the bases for this disapproval was EPA's finding that Vermont had not provided sufficient "reasonable assurances" that reductions in nonpoint sources of phosphorus would be attained.

Under federal law, upon such disapproval, EPA is required to establish a new TMDL to meet water quality standards. EPA initiated the process for developing a new TMDL in 2011 in cooperation with the State of Vermont. The New York portion of the 2002 TMDL remains in effect. The new TMDL was approved in June, 2016.

In order to ensure efficient and cost-effective implementation of a TMDL, the responsible agencies develop an implementation plan. A TMDL implementation plan identifies a suite of measures that will be taken to reduce pollution levels in order to reach the "pollution budget" for both point and non-point sources specified in the TMDL. Conceptually, the TMDL process of establishing a pollution budget is straightforward – uncertainty, however, makes writing a single, detailed, long-term plan that charts a specific course to water quality extremely challenging.

Relevant processes and stressors within a watershed are not always fully understood, and the effectiveness of recommended control measures is often highly variable. In order to continue to

make progress in reducing pollution and improving water quality, while at the same time minimizing the potential for costly errors, adaptive implementation is essential. The ability to revisit, reevaluate, and modify the implementation plan is fundamental, applying what has been learned from past watershed-based actions and producing improvements in the landscape and water quality in as efficient and effective a manner as possible. The benefits of this approach include:

- Providing a measure of quality control, given the uncertainty that exists;
- Helping to ensure the most cost effective practices are implemented as soon as possible; and
- Allowing for the routine reevaluation of the adequacy of implementation efforts in achieving the necessary TMDL reductions and water quality standards.

The Lake's 2002 TMDL implementation plan, as amended in 2010, and finalized here, has guided program priorities and annual funding requests and served as the framework for both ANR and AAFM in controlling phosphorus. As a result, numerous water quality programs in ANR and AAFM that existed prior to the TMDL have been substantially expanded and enhanced, and a number of new efforts have begun. These programs work to reduce the phosphorus load delivered to the state's waters from sources such as wastewater discharges, barnyards, agricultural fields, unstable river channels, urban centers, residential areas, construction sites, back roads, and other areas.

The Phase 1 Plan and Phase 2 implementation plans (Tactical Basin Plans) requested by EPA in its January 17, 2014 letter will build upon the 2016 Lake implementation plan and help to further refine and direct efforts and monies spent to reduce phosphorus contributions to Lake Champlain. As described in more detail in Chapters 4 and 5, the Phase 2 basin-specific implementation plans will reflect a tactical basin planning process, which will identify the highest priority projects for each basin and ensure that available funding is prioritized and targeted toward those projects.

C. VERMONT'S TMDL IMPLEMENTATION EFFORTS TO DATE

Since 2002, ANR, AAFM and VTrans, in cooperation with federal, state, and local partners, have made significant progress in implementing practices and programs to reduce phosphorus inputs to the Lake. Examples of Vermont water resource protection programs and initiatives that have been developed or greatly enhanced over the past decade include:

- Stormwater Management Program (ANR);
- Green Infrastructure/Low Impact Development Initiative (ANR);
- Vermont Better Roads Program (formerly called, the Vermont Better Back Roads program, VTrans/ANR);
- Rivers Program (ANR);
- Lake Wise Shoreland Management (ANR);
- Shoreland Permitting (ANR);
- Wetlands Program (ANR);
- Water Quality Section of the Agricultural Resource Management Division (AAFM); and
- Stormwater Mitigation and Upgrade Grants (STAG, SIWRF, Safetea-LU, Orphan).

Examples of water quality implementation projects that have received federal/state funding to reduce phosphorus pollution in the Lake include:

- Stormwater runoff mitigation projects;

- River channel, lake shoreland stability projects;
- Road infrastructure stability/runoff mitigation projects;
- Agricultural runoff mitigation projects; and,
- River corridor and wetland easement acquisition.

The original Center for Clean and Clear was established in 2007 to enhance Vermont's commitment to improve water quality in Lake Champlain. That Program brought together resources dedicated to improving water quality that were previously spread among many state programs. In 2011, the former Center was restructured to become the Vermont Department of Environmental Conservation (DEC) Watershed Management Division (WSMD) Ecosystem Restoration Program (ERP). This Program guides state and federal water quality grants and contracts to address high priority water quality needs. Grant and contract recipients include municipalities, watershed organizations, lake associations, conservation districts, and regional planning commissions − important partners in the effort to safeguard the rivers, lakes, ponds, and wetlands of the State. In 2015, the program was again restructured into the Vermont Clean Water Initiative Program (CWIP). In addition to managing grants and contacts, the program coordinates implementation of clean water restoration activities, tracks and reports on the Vermont's progress in achieving and maintaining clean water statewide.

VERMONT CLEAN WATER INITIATIVE PROGRAM'S CAPITAL GRANTS

Since 2007, the Vermont Clean Water Initiative (CWIP) has provided capital funds to support construction grants for projects that accelerate the reduction of sediment and nutrient pollution, including phosphorus, from uncontrolled runoff into the State's surface waters. Typical project budgets range from $40,000 to $85,000.

CWIP directs funds toward implementation of priority projects identified in the WSMD Monitoring, Assessment and Planning Program's (MAPP) tactical basin planning process. That process involves the development of plans that assess water quality throughout a basin and identify and prioritize actions to improve water quality. Throughout the process of tactical basin plan development, partner organizations are encouraged to participate in identifying the highest priority projects for state funded support. As a component of the tactical planning process, watershed coordinators serve as facilitators in the development of CWIP grant applications. Projects that are specifically identified in Tactical Plans, and associated river corridor, stormwater master plans and other relevant assessment plans, receive higher scoring in the grant application review process.

CWIP recently submitted its Annual Report 2015 to the Vermont Legislature: http://dec.vermont.gov/sites/dec/files/wsm/erp/docs/VCWIP.Annual-Report-SFY2015-2016.pdf. Table 2 and Figure 4 shown below from the Report, illustrate the types of projects that are funded annually by CWIP, which include projects in the Lake Champlain basin that result in reductions in phosphorus pollution. In total, 61 grants and contracts, totaling over $2 million of State Fiscal Year (SFY) 2015 funds were awarded to municipalities, watershed organizations, natural resources conversation districts, regional planning commissions, and university programs to improve water quality.

These SFY 2015 dollars and projects represent a small fraction of the projects and dollars spent over the past thirteen years in reducing phosphorus contributions to the Lake and improving water quality statewide. Table 3 shows both program administration costs and implementation project costs funded by the CWIP (and former ERP and Clean and Clear Program). Figure 5 and Table 4 show the percent of CWIP funds spent in the Lake Champlain basin from SFY 2006-2013.

Table 2 - Projects and dollars awarded by each major Vermont watershed, SFY15 Funds

River Basin number and name	Number of Projects	Total SFY15 Amount
(01) Batten Kill-Walloomsac-Hoosic	2	$84,182
(02) Poultney-Mettawee	4	$198,200
(03) Otter, Little Otter, Lewis Creek	4	$118,180
(04) Southern Lake Champlain	0	$0
(05) Northern Lake Champlain	4	$153,468
(06) Missisquoi	6	$254,810
(07) Lamoille	6	$227,542
(08) Winooski	13	$299,705
(09) White	2	$88,663
(10) Ottauquechee-Black	3	$80,888
(11) West-Williams-Saxtons	0	$0
(12) Deerfield	0	$0
(13) Lower Connecticut	0	$0
(14) Stevens-Wells-Waits-Ompompanoosuc	2	$152,395
(15) Passumpsic	5	$138,409
(16) Upper Connecticut	1	$51,736
(17) Lake Memphremagog	4	$95,648
Multiple Basins (Most projects applied statewide)	5	$277,900
TOTAL for SFY15	**61**	**$2,221,726**

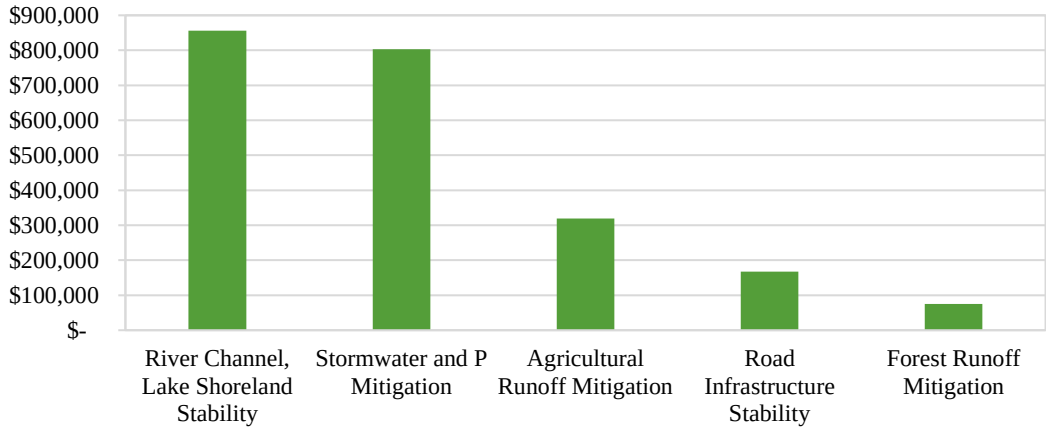


Figure 4 - Number of aggregate SFY15 dollars spent by broad project type

Table 3 - Ecosystem Restoration: Agencies of Agriculture, Transportation, and Natural Resources

	SFY05 Total	SFY06 Total	SFY07 Total	SFY08 Total	SFY09 Total
Agency of Agriculture, Food & Markets					
Agricultural Best Management Practices	$900,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000
Conservation Reserve Enhancement Program	$750,000	$133,500	$133,500	$150,000	$650,000
Nutrient Management Planning (ICM)	$300,000	$500,000	$750,000	$725,000	$493,700
Natural Resources Conservation Districts	$100,000	$200,000	$200,000	$270,000	$190,000
Environmental Farm Water Quality Reg.	$150,000	$133,500	$133,500	$150,000	$150,000
Water Quality Engineering		$315,000	$65,000	$75,000	$75,000
Farm Agronomic Practices Cost-share		$0	$25,000	$25,000	$70,000
Subtotal	**$2,200,000**	**$3,082,000**	**$3,107,000**	**$3,195,000**	**$3,428,700**
Agency of Transportation					
Vermont Better Back Roads (Federal Funds make up approximately 50% of funds up to FY2013)	$254,333	$362,700	$362,700	$523,581	$523,581
Agency of Natural Resources					
Vermont League of Cities and Towns Municipal Technical Assistance	$75,000	$96,000	$96,000	$96,000	$64,000
Monitoring, Research, Special Projects	$55,000	$30,000	$105,000	$125,000	$125,000
Ecosystem Restoration – Capital Funds	$1,250,000	$1,620,000	$1,500,000	$1,450,000	$1,350,000
Ecosystem Restoration	$106,225	$231,000	$431,500	$431,500	$513,340
Subtotal	$1,486,225	**$1,977,000**	**$2,132,500**	**$2,102,500**	**$2,052,090**
TOTAL	**$3,940,558**	**$5,421,700**	**$5,602,200**	**$5,821,081**	**$6,004,371**

Table 3 continued - Ecosystem Restoration: Agencies of Agriculture, Transportation, and Natural Resources

	SFY10 Total	SFY11 Total	SFY12 Total	SFY13 Total	SFY14 Total	SFY15 Total
Agency of Agriculture, Food & Markets						
Agricultural Best Management Practices	$1,600,000	$1,500,000	$1,250,000	$1,200,000	$0	$1,000,000
Conservation Reserve Enhancement Program	$325,000	$316,731	$160,964	$160,964	$177,117	$402,132
Nutrient Management Planning (ICM)	$445,952	$150,000	$150,000	$150,000	$150,000	$150,000
Natural Resources Conservation Districts	$190,000	$190,000	$220,000	$302,000	$112,000	$155,500
Environmental Farm Water Quality Reg.	$150,000	$141,731	$214,218	$214,218	$239,737	$357,866
Water Quality Engineering	$75,000	$70,865	$20,601	$20,601	$57,520	$34,808
Farm Agronomic Practices Cost-share	$95,000	$366,674	$366,674	$366,674	$381,674	$381,674
Subtotal	**$2,880,952**	**$2,736,001**	**$2,382,457**	**$2,414,456**	**$1,118,048**	**$2,481,980**
Agency of Transportation						
Vermont Better Back Roads (Federal Funds make up approximately 50% of funds up to FY2013)	$522,998	$522,998	$522,998	$522,998	$440,000	$440,000
Agency of Natural Resources						
Vermont League of Cities and Towns Municipal Technical Assistance	$64,000	$50,000	$50,000	$50,000	$50,000	$50,000
Monitoring, Research, Special Project	$175,000	$175,000	$175,000	$175,000	$175,000	$175,000
Ecosystem Restoration – Capital Funds	$1,700,000	$1,900,000	$2,500,000	$2,500,000	$2,250,000	$2,573,732
Ecosystem Restoration	$530,340	$532,840	$342,840	$342,840	$342,840	$342,840
Subtotal	**$2,469,340**	**$2,657,840**	**$3,067,840**	**$3,067,840**	**$2,817,840**	**$3,141,572**
TOTAL	**$5,873,290**	**$5,916,839**	**$5,973,295**	**$6,005,295**	**$4,375,888**	**$6,063,552**

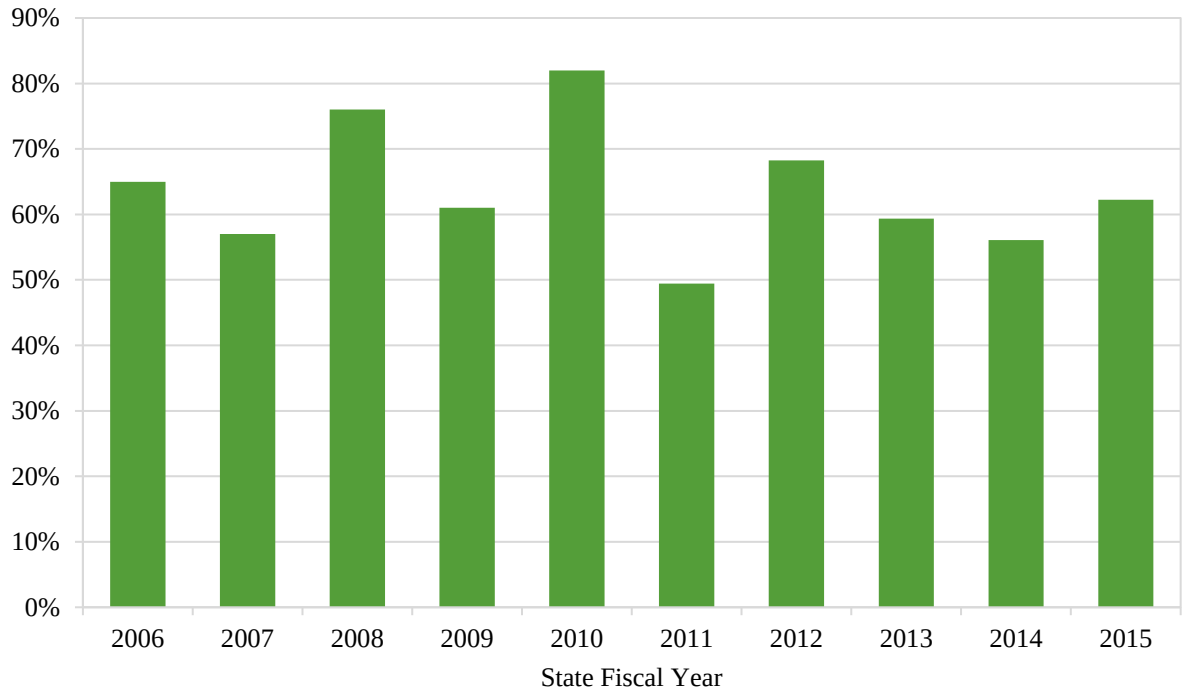


Figure 5 - Percent of funds spent in Lake Champlain Basin by State Fiscal Year (SFY2006-2015)

Table 4 - Ecosystem Restoration Grants Spent in Lake Champlain Basin by Fiscal Year

State Fiscal Year	Number of Grants	Total Dollars in Lake Champlain Basin	% of Total Grant Dollars
2006	59	$1,599,031	65%
2007	27	$1,157,397	57%
2008	27	$800,849	76%
2009	41	$913,340	61%
2010	44	$1,123,383	82%
2011	31	$1,058,018	49%
2012	40	$1,575,962	68%
2013	32	$1,303,946	59%
2014	26	$1,255,319	56%
2015	40	$1,415,855	62%
Total	**364**	**$12,203,100**	**62%**

SECTION 319 FUNDING

In addition to the dedicated capital construction funds described above, CWIP also manages federal Clean Water Act "Section 319" grants. The federal Section 319 program is a national program which provides funds for the abatement of nonpoint sources of water pollution. Section 319 projects generally fall into two categories, either outreach, planning and assessment projects or implementation projects. Table 5 lists Section 319 funded projects for Federal Fiscal Year (FFY) 2006-13 within the Lake Champlain Basin.

Table 5 - Section 319 funded nonpoint source projects in the Lake Champlain Basin

Key: Type of Project:
(I): implementation to address nonpoint source pollution problem
(O): Other nonpoint source effort (e.g. outreach, assessment, inventory or planning)

Project Name	Grantee	Grant Amount	Type of Project
***** FFY2006 *****			
Backroads sediment control demonstration grants	No. VT RC&D	$18,000	I
Sucker Brook avulsion restoration project	Town of Williston	$42,419	I
Wilkins Ravine stormwater mitigation project	Town of Morristown	$25,950	I
Vermont Pasture Network: grazing for clean water (phase 3)	University of Vermont (UVM)-CSA	$39,212	O
Castleton & Hubbardton River watershed restoration project: implementation of high priority recommendations	P-M NRCD	$23,000	I
Trees for Streams expansion in Lamoille River watershed (YR 2)	Lamoille NRCD	$10,000	I
Not as Easy as Rye: Alternative strategies to increase cover cropping in Vermont	UVM-EXT	$32,112	I
Gully stabilization & hydrologic restoration for sediment reduction in Allen Brook	Winooski NRCD	$45,000	I
Reducing stormwater impacts on heavily developed areas: demonstrating rain gardens throughout the City of Winooski	UVM Sea Grant	$15,000	I/O
Youth-based watershed restoration	VYCC	$25,000	I

*** FFY2007 ***			
Logging skidder bridge loan & education pilot program	No. VT RC&D	$40,000	I/O
Storm sewer mapping & illicit discharges detection (phase 1)	City of St Albans	$17,145	O
Grazing for clean water-management intensive grazing (YR 4)	UVM-CSA	$30,000	O
Farmer driven approach to increase adoption of nutrient management practices to improve water quality	UVM-EXT	$25,089	O
Using low impact development strategies in the St Albans area to educate residential, commercial & municipal landowners on lot-level stormwater management	UVM Sea Grant	$13,765	I/O
Rock River & Saxe Brook sediment abatement demonstration program	Friends of Missisquoi Bay (FMB)	$40,000	I
Allen Brook watershed restoration & stormwater mitigation	Winooski NRCD	$49,135	I
Youth-based watershed restoration	VYCC	$30,000	I
*** FFY2008 ***			
Detecting & eliminating illicit discharges to waters impaired by indicator bacteria in central VT	Friends of the Winooski River	$31,257	O
Youth based watershed restoration	VYCC	$40,000	I
Implement Lake Carmi phosphorus reduction plan	Franklin Watershed Committee	$49,100	I
Safe roads & clean water in Goshen	Town of Goshen	$35,118	I
West Shore Road lakeshore stabilization	Town of Isle LaMotte	$37,320	I
Rock River/Saxe Brook sediment abatement demonstration/technical assistance program (YR 2)	FMB	$20,000	I
Missisquoi NPS reduction fieldwork	MRBA	$18,900	I

*** FFY2009 ***			
Farmer to farmer education: facilitated discussion groups & on-farm workshops to improve pasture management & water quality	UVM-CSA	$30,832	O
Youth based watershed restoration program	VYCC	$35,000	I
Rock River/Saxe Brook sediment abatement plus Mill River/Jewett/Rugg/Stevens Brooks	FMB	$45,000	I
Allen Brook stream buffer & fish habitat restoration project	Town of Williston	$7,650	I
Trees for Streams	Lamoille NRCD	$12,700	I
Tri-district cover cropping program	Winooski NRCD	$25,000	I
A comprehensive approach to addressing agricultural & urban NPS in the Mettowee River watershed	P-M NRCD	$12,900	I
Phosphorus, E. Coli, & suspended solids reduction from agricultural drainage tile via steel slag filtration	UVM-P+SS	$20,000	O
Implement Lake Carmi P reduction plan (YR 2)	FWC	$45,000	I
*** FFY2010 ***			
Reducing WQ impacts from rural town roads: workshop series & implementation	NRPC	$27,900	I/O
Simple phosphorus mitigation projects for small farms	VACD	$31,454	I
Urban tree canopy projects	City of St Albans & Burlington	$31,193	I
Trees for Lamoille River drainage streams	Lamoille NRCD	$10,000	I
Sediment abatement in Rock River/Saxe Brook & St Albans Bay tributaries	FMB	$42,500	I
Tri-district conservation tillage demonstration program	Winooski NRCD	$25,000	I
Implement Lake Carmi phosphorus reduction plan (YR 3)	FWC	$25,000	I

*** FFY2011 ***			
Implementation of the Lake Carmi phosphorus reduction plan (YR 4)	FWC	$35,000	I
Grazing education for farmers: innovations	UVM-CSA	$31,000	O
Stormwater disconnection in the City of Rutland	Rutland NRCD	$12,000	I/O
Trees for Streams–expansion	Lamoille NRCD	$10,800	I
Accelerating adoption of conservatio tillage in the northern Lake Champlai	UVM-EXT	$38,741	I
Effectiveness of low-cost/low-tech practices for stormwater in Englesby Brook	Winooski NRCD	$27,993	I
Reducing WQ impacts from our local roads: workshop series & implementation	Northwest RPC	$27,200	O
Simple phosphorus mitigation projects fo small farms (YR 2)	VACD	$12,463	I
Phosphorus/sediment reduction in Rock/Saxe (YR 5) & St Albans Bay watershed (YR 3)	Friends of No. Lake Champlain	$35,321	I
*** FFY2012-2016 ***			
No NPS projects undertaken. DEC did not make available 319 grant funding due to federal budget cuts to this program and the Department's decision to exercise an option to leverage 319 funds to better implement state funded projects and activities.	n/a	n/a	n/a

SECTION 604B FUNDING

CWIP also manages the State's Clean Water Act Section 604(b) water quality planning grants. CWIP makes approximately $40,000 available annually to regional planning commissions for water quality planning purposes. In 2012, ERP established a process to guide the use of those funds to support planning needs as part of tactical basin plan development. Each year, the grant application identifies eligible planning-related activities to support the three general phases of tactical basin plan development:

1) Monitoring and assessment,
2) Plan development, and
3) Implementation.

CWIP will continue to link 604(b) grants with tactical basin planning to support a greater targeting of available funds to address priority water quality needs.

WATERSHED GRANT FUND (CONSERVATION LICENSE PLATES)

The Vermont Fish and Wildlife Department (FWD) manages the Watershed Grant Fund that is supported by the sale of Vermont's conservation license plates (sales also support the FWD's

Nongame Wildlife Fund). The Watershed Grant Fund provides small grants (under $15,000) to towns, local groups, and regional organizations to implement watershed projects. The three watershed grant project types are education and outreach; planning, assessment, inventory, monitoring; and on-the-ground implementation.

CHAPTER 2 - EPA'S DEVELOPMENT OF PHOSPHORUS ALLOCATIONS

The process of developing a new Lake Champlain Phosphorus TMDL for Vermont began when EPA issued its January 24, 2011 disapproval letter for the Vermont portion of the 2002 TMDL in response to a lawsuit filed by Conservation Law Foundation. In reaching its decision, EPA concluded that two legally contested elements of the TMDL were not consistent with federal regulation and guidance. The two reasons cited by EPA for its disapproval were that the TMDL did not provide an: (1) adequate margin of safety and (2) sufficient reasonable assurances that the necessary nonpoint source load reductions would be achieved.

In addition to addressing these legal inadequacies in the TMDL, EPA determined that, once reopened, all aspects of the Vermont TMDL should be reviewed and updated in light of new data, research, and policy considerations. Consequently, EPA has invested significant time and resources in developing new lake and watershed models for Lake Champlain for use in setting new total loading capacities, developing new wasteload and load allocations, evaluating phosphorus load reductions possible from watershed management practices, and considering climate change impacts.

Lake and tributary monitoring data used for the lake model indicated that the current (2001-2010 average) phosphorus load to Lake Champlain from Vermont is 631 metric tons per year (mt/yr). Application of the lake model suggests that the total loading capacity from Vermont is about 418 mt/yr. A net lakewide load reduction of 213 mt/yr is needed from Vermont sources, representing an overall 34% reduction when a 5% margin of safety is provided. However, in order to achieve water quality standards throughout the entire lake, the individual Vermont lake segment total loading capacities must be achieved in each case. Table 6, excerpt from the final TMDL, shows the percent reductions needed to achieve the phosphorus load reductions for the twelve Vermont lake segment watershed.[7]

The percent load reductions required range between 12-64% among the lake segment watersheds (Table 6). In order to assess the potential load reductions obtainable from an enhanced set of watershed management practices, EPA applied a Lake Champlain Scenario Tool (Scenario Tool). The results of this analysis indicated that the percent load reductions achievable from the practices simulated were sufficient to achieve the TMDL targets in Table 6 in all lake segments except Missisquoi Bay. Enhanced efforts will be required in the Missisquoi Bay watershed. Refer to EPA's final document, "Phosphorus TMDLs for Vermont Lake Champlain," released by EPA on June 17, 2016, for information about phosphorus loading allocations.[8]

The wasteload and load allocations contained in the TMDLs and summarized in Table 6 below demonstrate that achieving the necessary load reductions will present an enormous management challenge. This Phase 1 Plan was developed with an understanding of the magnitude of the effort needed.

The final wasteload and load allocations allow for Vermont to develop and issue Phase 2 basin-specific plans that will further refine Vermont's policy commitments and implementation strategy for all contributing sectors in each lake segment.

[7] *Id.*, Table 8.
[8] *Id.*

Table 6 - Percent load reductions needed to meet TMDL Allocations[9]

Lake Segment	Total Overall	Wastewater[1]	CSO	Developed Land[2]	Agricultural Production Areas	Forest	Streams	Agriculture Nonpoint
1. South Lake B	41.4%	0.0%		21.1%	80.0%	40.0%	46.7%	62.9%
2. South Lake A	55.5%	0.0%		18.1%	80.0%	5.0%		62.9%
3. Port Henry	55.4%			7.6%	80.0%	5.0%		62.9%
4. Otter Creek	23.6%	0.0%		15.0%	80.0%	5.0%	40.1%	46.9%
5. Main Lake	20.5%	61.1%		20.2%	80.0%	5.0%	28.9%	46.9%
6. Shelburne Bay	11.6%	64.1%		20.2%	80.0%	5.0%	55.0%	20.0%
7. Burlington Bay	31.2%	66.7%	11.8%	24.2%	0.0%	0.0%		0.0%
8. Malletts Bay	17.6%	0.2%		20.5%	80.0%	5.0%	44.9%	28.6%
9. Northeast Arm	12.5%			7.2%	80.0%	5.0%		20.0%
10. St. Albans	24.5%	59.4%		21.7%	80.0%	5.0%	55.0%	34.5%
11. Missisquoi	64.3%	51.9%		34.2%	80.0%	50.0%	68.5%	82.8%
12. Isle LaMotte	11.7%	0.0%		8.9%	80.0%	5.0%		20.0%
TOTAL	33.7%	42.1%	11.8%	20.9%	80.0%	18.7%	45.4%	53.6%

[1]Percent change from current permitted loads

[2] Includes reductions needed to offset future growth

[9] *Id*, at 45.

CHAPTER 3 – VERMONT COMMITMENTS TO REDUCE POINT SOURCE POLLUTION

A. INTRODUCTION

A TMDL is a "pollution budget" that describes the amount of pollution a water body can tolerate and still maintain water quality standards. This pollution budget can be described as the sum of point source discharges, or waste load allocation (WLA), nonpoint source discharges, or load allocation (LA), a margin of safety (MOS) and an allocation for future growth. In the Lake TMDLs, EPA has categorized phosphorus discharges to the Lake as follows:

- Point source discharges:
    - Wastewater Treatment Facility (WWTF) discharges
    - Stormwater runoff from developed land, excluding gravel roads
    - Stormwater from gravel roads
    - Treated combined sewer overflow (Burlington Main WWTF only)
    - Agriculture production areas
- Nonpoint source discharges:
    - Forest land
    - Stream channel instability/erosion
    - Agricultural land

EPA considers point source discharges to include discharges subject to regulation under the National Pollutant Discharge and Elimination System (NPDES) or other state regulatory programs. All other discharges are considered nonpoint sources subject to the federal Clean Water Act's "reasonable assurances" requirement.

This Chapter provides a brief description of the regulatory programs applicable to the point source discharges that make up the WLA in the Lake TMDLs. The nonpoint sources subject to reasonable assurances are addressed in Vermont's policy commitments in Chapter 4.

B. WASTEWATER TREATMENT FACILITIES (WWTFS)

EPA developed the waste load (WLA) and load (LA) allocations in the Lake TMDLs in consultation with the State. Given the predominant role of precipitation driven runoff from certain point and nonpoint sources, the initial focus of Vermont state agencies was on policies and programs to address these sources. Vermont committed early in the process to a Lake Champlain basin-wide approach to measure and control loads from developed lands, agricultural lands, forested lands and stream channels. EPA focused on the WWTFs to determine what reductions might be necessary to achieve the water quality standards, both lake-wide and within each segment.

The Lake TMDL indicates that the largest source of phosphorus is the agricultural sector, followed by stream channel erosion, developed lands, and forests. However, the relative contribution of phosphorus from each sector varies considerably by lake segment watershed. The 59 WWTFs that

contribute phosphorus to the Lake generate a very small percentage to the overall phosphorus loading (currently only about 3%). Certain WWTFs, however, constitute a significantly higher percentage of the load to some lake segments, particularly when the permitted load at the design capacity of a WWTF is considered. In determining which WWTF's must implement more stringent phosphorus controls, EPA examined each lake segment and considered both the relative contribution from the WWTFs and the degree of reduction required for developed land and nonpoint sources, ultimately concluding that a targeted approach is appropriate -- reductions in allowable WWTF phosphorus discharges are a necessary component of the WLA in some, but not all, lake segments.

In determining which WWTF require necessary reductions, EPA first established a baseline by looking first at the allowable discharges from each WWTF, that is, the amount of phosphorus the facility is authorized to discharge at design flow rates under the current NPDES permit. These permits reflect the WLAs made in the 2002 TMDLs.

For the Port Henry, Otter Creek, Malletts Bay, Northeast Arm, and Isle LaMotte segments, where the combined WWTF permitted discharges comprised less than 10% of the total phosphorus base load, and the developed land and nonpoint reduction needed was 30% or less, EPA's WLAs for the WWTFs are the same WLAs for those facilities as in the 2002 TMDLs. EPA determined that this is reasonable because the WWTFs' phosphorus contributions are relatively small, and reductions at these WWTFs would not meaningfully change the reductions needed from non-WWTF sources.

In the Main Lake, Shelburne Bay, Burlington Bay and St. Albans segments, the loads allocated to the WWTFs in the 2002 TMDL range between 16% and 97% of the segments' base loads. EPA considers these to be significant contributions and has determined that further WWTF phosphorus load reductions are necessary in these segments.

In the South Lake A and B and Missisquoi Bay segments, although the loads allocated to the WWTFs in 2002 TMDL are less than 5%, of the base loads, the necessary load reductions from developed lands and nonpoint sources exceed 50%. This percent reduction was considered high enough to consider further phosphorus discharge reductions by WWTFs in these segments. For the South Lake segments, the EPA determined that there is reasonable assurance that the modeled, non-point source reductions will be achieved and, therefore, did not require additional reductions in the larger WWTFs, instead establishing the same allocation as in the 2002 TMDL. For the Missisquoi Bay segment, however, the EPA concluded that the necessary total loading reductions for the segment could not be achieved via non-point source reductions alone, and has therefore assigned waste load allocations consistent with the overall allocation approach for the 2016 TMDL.

Having established the lake segments that require WWTF reductions, EPA then considered which factors should be used to determine how the allocations would be set. EPA evaluated the annual loading impacts of these facilities and subdivided them into three groups. The first group includes facilities with design flow capacities less than 0.10 million gallons per day (MGD). These small facilities typically have simple treatment systems and discharge very small phosphorus loads. The second group consists of facilities with design flows between 0.10 and 0.20 MGD. The third group comprises facilities with design flows greater than 0.20 MGD. These facilities are generally the most technically sophisticated treatment plants, contribute the largest portion of the total WWTF load, and provide the best opportunities to achieve significant reductions.

EPA then considered a range of phosphorus loads for each of the three groups. Given the minor contribution of the small facilities, EPA determined that further reductions would have negligible impact. Thus, they were given the same allocations as in the 2002 TMDLs. EPA next considered the range of phosphorus concentration limits that are achieved in practice at facilities throughout New England. EPA determined that a phosphorus discharge limit of:

- 0.10 milligram per liter (mg/l) is currently considered to represent very good treatment practices;
- 0.20 mg/l is routinely achievable at facilities with flow greater than 0.20 MGD; and
- 0.80 mg/l is achieved widely and is already required of all Vermont facilities with flow greater than 0.20 MGD.

After further consideration of the contributions of the WWTFs within each affected segment, EPA made total segment WWTF WLAs equivalent to setting the phosphorus limit at 0.20 mg/l at design flow for the facilities with flow greater than 0.20 MGD and at 0.80 mg/l at design flow for the WWTFs in the middle-sized group. EPA determined that extra reductions that could be achieved by requiring a WLA that reflects a limit of 0.10 mg/l at the facilities with flow greater than 0.20 MGD were small relative to the nonpoint source contribution and Vermont agreed that investments in nonpoint source reductions should be a higher priority.

As described in more detail in the TMDL, eleven facilities (Burlington Main, East and North, Enosburg, Fair Haven, Middlebury, Montpelier, Richford, Rutland, St. Albans and Vergennes) have combined sewers in at least part of their sewer system and are subject to DEC's new Combined Sewer Overflow (CSO) rule for reducing CSO discharges. EPA has not made separate allocations for phosphorus loads from CSOs except for the partially treated CSO at Burlington Main. For the remaining ten combined systems, as well as the two untreated CSOs in the Burlington Main combined system, EPA has included the load from CSOs in the developed land WLA for the applicable lake segment watershed.2.

Consistent with the 2002 TMDLs, individual WLAs are specified for each WWTF discharge to Lake Champlain or to a lake tributary. Since EPA has evaluated the WWTF allocations at the segment level and then made assignments to individual facilities, EPA is providing in these TMDLs an option for Vermont to make changes to the individual WWTF allocations within a lake segment as long as the adjusted combined allocations do not exceed the total WWTF allocation for that segment. The Main Lake and the relatively small and closely connected Burlington Bay and Shelburne Bay segments may be treated as a single lake segment for the purpose of wastewater load reallocations, since loads from each of these segment's watersheds have an approximately equal impact on phosphorus concentrations in the critical Main Lake segment. If reallocations are to be made, DEC will follow its established WLA Process (VT Agency of Natural Resources, 1987 or any subsequent revision), which requires public notice and at least one public meeting. DEC must provide written notification to EPA if and when it commences proceedings under the WLA Process to reallocate WWTF loads within any Lake segment. When implementing the Lake TMDLs through NPDES permits, EPA supports DEC's commitment to employ flexible approaches including:

- Expressing effluent phosphorus limits in permits as total annual mass loads.

- Providing a period of time for optimization to be pursued and the corresponding load reduction results to be realized, and then commencement of the process to upgrade phosphorus treatment facilities will be required when actual phosphorus loads reach 80% of the TMDL limits.
- Establishing phosphorus compliance schedules in discharge permits that allow adequate time for planning, engineering and municipal budgeting.
- Providing other forms of flexibility that support achieving the WLA in an optimally cost effective manner, including phosphorus trading and integrated planning and permitting.

DEC will begin reissuing National Pollutant Discharge Elimination System (NPDES) permits for the 59 direct discharge facilities in the Lake Champlain watershed on a five-year rotation, according to the table below. Each permit will be developed and issued in synchronization with the DEC Monitoring, Assessment, and Planning Program (MAPP) tactical basin planning cycle. This will ensure that permits are developed using the most up-to-date monitoring and scientific information available. Permits will be issued in accordance with the schedule in Table 7. DEC reserves the right to issue permits for WWTFs at an earlier date if necessary.

Table 7 - Lake Champlain NPDES Permit Issuance Schedule

North Lake Basin	Missisquoi & Lamoille Basins	South Lake A & B Basins	Winooski Basin	Otter Creek Basin
by 6/30/17	**by 6/30/18**	**by 6/30/19**	**by 6/30/20**	**by 6/30/21**
Alburgh	Enosburg Falls	Benson	Barre	Brandon
Burlington - Main	Fairfax	Fair Haven	Burlington Electric	Middlebury
Ed Weed F.C.S.	Hardwick	Orwell	Burlington – North	Otter Valley
Hinesburg	Jeffersonville	Pawlet	Burlington – River	Pittsford
NWCF	Johnson	Poultney	Cabot	Pittsford F.C.S.
Shelburne Plant #1	Milton	Castleton	Essex Jct.	Proctor
Shelburne Plant #2	Morrisville		IBM*	Rutland
South Burlington - BB	Newport Center		Marshfield	Salisbury F.C.S.
St. Albans	North Troy		Montpelier	Shoreham
	PBM Nutritionals		Northfield	Vergennes
	Richford		Plainfield	Wallingford F.D.
	RockTenn Co.		Richmond	West Rutland
	Sheldon Springs		South Burlington –AP	
	Swanton		Stowe	
	Troy/Jay		Waterbury	
			Williamstown	
			Winooski	

* The IBM permit was reissued in 2015 in order to facilitate the impending sale of the facility to Global Foundries. The reissued permit contained a reopener clause allowing it to be modified in 2019 in order to implement the requirements of the TMDL following completion of the Tactical Basin Plan for the Winooski River.

C. URBAN STORMWATER - MS4S

There are currently 12 communities and 3 non-traditional entities (Vermont Transportation Agency, University of Vermont and the Burlington Airport) designated as "municipal separate storm sewer systems" (MS4s) in the entire basin that drains to the Lake. Under the MS4 permitting program, permittees must develop a stormwater management program that includes six Minimum Control Measures (MCMs) designed to reduce the potential for pollutants to enter the MS4 system and discharge to surface waters. The MCMs include public education and outreach, public participation/involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention/good housekeeping. The regulated MS4s submit annual reports detailing their progress on MCM implementation.

In addition, 14 of the 15 regulated MS4s discharge to stormwater impaired waters and are required to develop Flow Restoration Plans to implement the stormwater TMDLs. The extensive deployment of stormwater-management infrastructure associated with this requirement will contribute substantially to phosphorus reduction in Lake Champlain. Further, regulated MS4 municipalities are required to track phosphorus reductions associated with the deployment of BMPs.

D. NPDES CONSTRUCTION STORMWATER DISCHARGES

The construction stormwater permit program addresses stormwater runoff from earth disturbance activity of one or more acres of land, and is a requirement of the federal Clean Water Act. In general, compliance with the construction stormwater permit requires the development of an erosion prevention and sediment control plan. The goal of the plan is to minimize the erosion of disturbed land and to minimize or eliminate the discharge of sediment (which carries phosphorus) to waters of the State through the implementation of appropriate erosion prevention and sediment control measures. There are currently approximately 800 active state construction stormwater permits in Vermont.

E. STORMWATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITIES

The Multi-Sector General Permit (MSGP) 3-9003 addresses stormwater runoff associated with industrial facilities. A facility must obtain coverage under the MSGP if it falls within a Standard Industrial Classification (SIC) code listed in Table D-1 of the permit. All regulated activities are required to implement BMPs such as good housekeeping, erosion prevention, and minimizing exposure; all of which serve to reduce potential pollutant discharges. Facilities manufacturing agricultural chemicals are required to monitor specifically for phosphorus in their stormwater discharges. If monitoring results are above the level set in the permit, the facilities must modify their plans to reduce the phosphorus discharge.

F. RESIDUAL DESIGNATION AUTHORITY DISCHARGES

In 2009, the Department issued a NPDES general permit for stormwater "residually designated discharges" (RDA) pursuant to the authority of the federal Clean Water Act. The RDA General Permit 3-9030 covered certain designated discharges not covered by the MS4 permit in five of the urban stormwater-impaired streams in Chittenden County. Properties were designated if their impervious surface discharged directly to a stormwater impaired stream. Designated properties were divided into three categories. Fifty-three properties without a previously issued state stormwater permit and less than one acre of impervious surface were directed to implement the Small Sites Guide which includes good housekeeping and low impact design practices. Five properties without a previously issued state stormwater permit and more than one acre of impervious had to complete a site assessment, gathering information on current site conditions to be used in the development of the flow restoration plans (FRPs). Twenty sites with previously issued state stormwater permits were required to conduct an Engineering Feasibility Analysis (EFA) to upgrade their existing stormwater treatment practices. The EFA directs property owners to infiltrate or detain the 1-year design storm, which will provide phosphorus reductions as well as benefiting flows. DEC plans on expanding the RDA permit to the remaining urban stormwater impaired waters in the near future in order to assist in the implementation of the TMDL for Lake Champlain.

G. CONCENTRATED ANIMAL FEEDING OPERATION DISCHARGES

The Vermont statewide concentrated animal feeding operation (CAFO) general permit was issued in June 2013. While the permit is not phosphorus-specific, any farm that discharges pollutants to a surface water body can be required to obtain a permit. The CAFO general permit is for medium farms, but an individual permit can be required for a small or large farm.

The CAFO permit requires farms to properly design, construct, operate, and maintain production areas to control waste and to develop and implement a nutrient management plan which is available to the public. The permit prohibits a discharge of manure, litter, or wastewater, except when direct precipitation equivalent to or greater than a 25-year, 24-hour storm event causes a discharge. As of July 2016, DEC has not issued any CAFO permits.

H. DEVELOPED LANDS - STORMWATER

Developed lands involve the construction of buildings, roads, parking areas and other impervious surfaces that reduce the infiltration of stormwater and speed the delivery and quantity of runoff into surface waters. The vast majority of existing developed lands is not regulated under federal/state stormwater permits, does not manage or treat stormwater, and yet is responsible for significant water quality impacts.

Based on the modeling efforts to date, phosphorus loading from developed areas is approximately 12.4% of the total Lake Champlain Basin phosphorus load, or 18% of the Vermont portion of the

Basin's phosphorus load. When compared to the agricultural sector land use, developed lands contribute a relatively minor portion of phosphorus loading. However, on an acre-for-acre basis, develop land areas generate a disproportionate share of the phosphorus load to the Lake. Hence, numerous statewide and targeted management programs are in place for nonpoint source runoff from developed lands as described below.

OPERATIONAL STORMWATER PERMITS

DEC's Stormwater Program issues separate permits for runoff from impervious surfaces, construction sites and industrial facilities. All new projects, redevelopment projects and expansion projects are evaluated to determine whether coverage under a state stormwater permit and/or a construction permit is needed in order to comply with state law and the federal Clean Water Act. Also, if a new project is industrial in nature or is an existing industrial facility, then it may also need to seek coverage under a Multi-Sector General Permit. Many projects require both a state stormwater permit and a construction permit; some projects may require all three permits.

DEC has issued operational permits under state authority since the late 1970s, with the scope of the permit program expanding substantially over time. Program technical standards were updated in 1980, 1987, 1997, and 2002. The jurisdictional threshold has also been revised over time, and since 2005 it has been set at one acre of impervious cover. Projects requiring permit coverage must design a management system in compliance with the Vermont Stormwater Management Manual (VSMM) standards developed by the Center for Watershed Protection. DEC is currently in a stakeholder process to update the VSMM with a goal of increasing the application of Low Impact Development (LID) practices.

The construction stormwater permit was originally issued in 1997 and was applied to sites with a minimum of five acres of disturbance. In 2006, the permit was reissued to be applied to sites with one acre of disturbance. The Multi-Sector General Permit was originally issued in 2006.

State Stormwater Permit Program (a.k.a. operational or post-construction)

This DEC permit program regulates discharges (runoff) from impervious surfaces (i.e. rooftops, paved/gravel roads, etc.). The Stormwater Permit Program has specific jurisdictional thresholds based on the amount of impervious surface, per the Stormwater Management Rules (Stormwater Management Rule for Stormwater Impaired Waters). In general, projects creating more than one acre of new impervious surface, or projects that expand existing impervious surfaces where the total resulting impervious surface is greater than one acre require permit coverage. Projects requiring permit coverage must apply for coverage under General Permit 3-9015, unless the project is located within a watershed impaired for stormwater, in which case individual permit coverage is required.

Projects that require permit coverage must implement a stormwater management system designed in compliance with the Vermont Stormwater Management Manual (VSWMM). The VSWMM was developed by the Center for Watershed Protection, and includes sizing criteria to meet water quality, groundwater recharge, channel protection, overbank flood protection and extreme flood control. Table 7 is taken from the VSMM which gives reasonable estimates of phosphorus and other removal efficiencies for the general groups of accepted practices allowed under the permit.

Table 8 - Pollutant Removal Matrix from the Vermont Stormwater Management Manual

Practice	TSS [%]	TP [%]	TN [%]	Metals[1] [%]	Bacteria [%]	Hydro-carbons [%]
Wet Ponds	80	51	33	62	70	81[2]
Stormwater Wetlands	76	49	30	42	78[2]	85[2]
Filtering Practices	86	59	38	69	37[2]	84[2]
Infiltration Practices[3]	95[2]	80	51	99[2]	N/A	N/A
Open Channels[4]	81	34	84[2]	70	N/A	62[2]
Quantity Control Ponds[2, 5]	3	19	5	7.5	78	N/A

. Average of zinc and copper. Only zinc for infiltration
. Based on fewer than five data points (i.e., independent monitoring studies)
. Includes porous pavement, which is not on the list of approved practices for Vermont. At this time, there are no known field studies that have measured sediment removal in infiltration trenches. However, it can logically be presumed that a properly operating infiltration trench will remove nearly 100% of the TSS load associated with the design treatment volume.
. Higher removal rates for dry swales.
. Quantity control ponds (a.k.a. dry detention basins or vaults) do not meet the WQ_v requirement and must be used in conjunction with acceptable water quality STPs. N/A: Data not available Removals represent median values from R. Winer (2000) National Pollutant Removal Performance Database for Stormwater Treatment Practices, version 2.

Stormwater impairments in Vermont's Urban Areas

Twelve of Vermont's waters are listed as impaired due to urban stormwater runoff. These waters fail to meet the Vermont Water Quality Standards. The Department has issued EPA-approved stormwater TMDLs that use long-term flow duration curves as the TMDL targets. The use of flow duration curves has the primary benefit of addressing the physical impacts to the stream channel caused by stormwater runoff such as sediment release from channel erosion and scour from increased flows. DEC has issued EPA-approved hydrologic TMDLs for the twelve urban stormwater impaired watersheds. Remediation of the twelve urban stormwater-impaired waters has commenced through a combination of an enhanced MS4 permit and an RDA permit for impervious surfaces within the impaired watersheds. Under the MS4 permit, permittees must develop a Flow Restoration Plan for any stormwater impaired water to which they discharge. A computer-based best management practice decision support system (BMPDSS) was developed by TetraTech and is being used by DEC to help the MS4 communities to identify different BMP options and associated costs. As part of the BMPDSS tool, MS4s can estimate the amount of phosphorus reduced from the BMP options selected.

Stormwater impairments and water quality remediation plans

Five mountain watersheds associated with ski area development are listed on the 2014 303(d) List as impaired primarily due to stormwater runoff. One of these watersheds is within the Lake Champlain basin. These mountain watersheds differ substantially from other stormwater impaired areas which are more urbanized "lowland" watersheds in terms of density of development, geographic position, hydrology, impairment source, and land ownership. Based on these factors, DEC is using a non-TMDL approach to remediation, whereby it is working with responsible parties in developing watershed-specific Water Quality Remediation Plans (WQRPs). The watersheds in the Lake Champlain basin cover approximately 1117 acres and will ultimately receive extensive stormwater retrofits in order to alleviate local stream impairments. Implementation of these retrofits to existing impervious areas as well as high erosion areas should result in significant phosphorus reductions.

I. DEVELOPED LANDS - TRANSPORTATION

A major sub-sector of the Developed Lands sector consists of state and local highways and roads which contribute significant amounts of phosphorus laden runoff to the Lake. There are over 14,000 miles of public roads in Vermont, nearly all of which require ditches and culverts for drainage. Approximately 80% of these road miles are maintained by Vermont municipalities; three quarters of these municipal roads need erosion control improvements. Two thirds of these roads are unpaved gravel or unimproved roads, and nearly all require ditches and culverts for water drainage. If these structures are not properly constructed and maintained, there is significant potential for erosion of sediment carrying phosphorus into the drainage network and adjoining streams and eventually into the Lake. Water quality improvement and protection has become a major focus in recent years as it relates to the roads network generally and to BMP implementation and project development specifically. Programs of note include:

TITLE 19

VTrans regulates "drain on" activities into the State right-of-way, within its authority under Title 19, and requires proposed dischargers to the right-of-way treat stormwater prior to discharging into the right-of-way. Furthermore, VTrans prohibits the illegal connection or illicit (non-stormwater) discharge to its right-of-way statewide.

VERMONT TRANSPORTATION ROAD AND BRIDGE STANDARDS

The Federal Emergency Management Agency (FEMA) adopted a policy in 1999 that describes municipalities' eligibility for FEMA benefits following federally declared natural disasters. Prior to federally declared disaster declarations (which make available Public Assistance funds for public infrastructure repairs), municipalities are to adopt road infrastructure "codes and standards" (referred to as "Road and Bridge Standards" or "Codes and Standards"). These municipal codes and standards apply to road and stream crossing upgrades and other infrastructure that are not governed by state or federal standards. FEMA provides Public Assistance funding to support rebuilding to those standards.

In 2010, the Vermont Legislature passed Act 110 which modified 19 V.S.A. §309b to establish an

incentive program to encourage municipal adoption of codes and standards. That incentive involves increasing state cost share of two grant programs – the Town Highway Class 2 Roadway and Town Highway Structures grant programs. FEMA also required a change to the VTrans' codes and standards template, prohibiting municipalities from modifying its codes and standards for fiscal reasons.

Following a series of federally declared flood disasters in 2008, a number of towns pursuing FEMA Public Assistance reimbursements could not produce copies of their adopted codes and standards. Thus the Act also required municipalities to file an annual certificate of compliance with their codes and standards.

Act 110 also required VTrans to revise its Road and Bridge Standards template to include a suite of practical and cost-effective best management practices (BMPs) to better control road-related stormwater runoff. Those practices address construction, maintenance, and repair of municipal road network. VTrans is to review and revise the standards, as appropriate, every four years to ensure that they are protective of water quality, and the Secretary of the Agency of Natural Resources is to approve all revisions.

In the aftermath of Tropical Storm Irene, the State of Vermont added another incentive to encourage municipalities to adopt the VTrans Road and Bridge Standards. The State modified its policy for managing the State's Emergency Relief and Assistance Fund (ERAF). The new standard, effective for any disaster after October 23, 2014, is structured to encourage municipalities to take four basic steps to prepare their communities before the next disaster; one of those steps involves adopting the most recent VTrans Road and Bridge Standards. Following a federally declared flood disaster, FEMA requires a 25% local match for public assistance funding. Municipalities that do not adopt the four basic steps including adoption of Road and Bridge Standards receive a reduced amount of state aid to cover the local match (7.5% of the repair costs). Municipalities that adopt the steps receive state aid to cover half of the local match (12.5% of the repair costs). Municipalities that adopt the basic steps and the state model floodplain and river corridor protection bylaws receive a large share of state aid (17.5% of the repair costs).

DEC'S MUNICIPAL ROADS GENERAL PERMIT AND STANDARDS

Act 64, the Vermont Clean Water Act, requires DEC to develop a draft Municipal Roads General Permit (MRGP) by December 2016 and final MRGP by December 2017. Towns will begin applying for coverage under the permit in fall of 2018 (proposed). As part of the development of the MRGP, new municipal road practice standards will be developed. MRGP standards will be developed for different road types, such as paved roads with catch basins, paved and gravel roads with drainage ditches, and Class 4 roads. The MRGP coverage and required standards will apply to all priority road segments (hydrologically-connected road segments). The VTrans Road and Bridge Standards will continue to be voluntarily adopted by municipalities. DEC and VTrans are currently proposing to extend the existing VTrans Road and Bridge Standards until the MRGP coverage begins.

VTRANS FINANCIAL AND TECHNICAL ASSISTANCE

Over the past decade, VTrans has made significant financial investments to ensure that state highways comply with water quality regulations and to assist municipalities in doing the same for local roads. Examples include:

Vermont Better Roads Program

Since 1997, the Vermont Better Roads Program, formerly the Vermont Better Back Roads Program, has been providing grants and technical assistance to towns to correct erosion problems and adopt road maintenance practices that protect water quality while reducing long-term highway maintenance costs. Better Roads financial and technical assistance demonstrates to towns that the proper fixes and maintenance practices are cost-effective. A long-term goal for the Better Roads Program is to enable and encourage towns to practice best management practices in road maintenance and repairs and institutionalize these practices into town capital budget priorities.

The Vermont Better Roads Program is a grant program that is part of the VTrans Municipal Assistance Bureau. The Vermont Local Roads Program is another VTrans program that provides information, training and technical assistance to Vermont municipalities regarding transportation issues. After receiving a Better Roads grant, most towns adopt the recommended practices for future road maintenance work, therefore, the grants leverage improved maintenance practices that both reduce pollution and save towns money. The Better Roads Program offers improved infrastructure and maintenance practices for eroding ditches, unstable culvert inlets or outlets and eroding roadside banks which can also help prevent flash flood damage during heavy rain events. Grants are provided for four general categories of projects:

1) Road inventory and capital budget planning;
2) Correction of a road related erosion problem and/or stormwater mitigation;
3) Correction of a stream bank or slope-related problem; and
4) Structure/culvert upgrades.

Vermont Local Roads

VTrans administers the Vermont Local Roads program, a partnership program that brings together VTrans department staff, staff from other state agencies and representatives from local and regional organizations to provide education, training and general technical support to municipal road maintenance crews. The program facilitates training, offers “roundtable” discussions and provides technical assistance to the towns on a variety of topics, including the use of BMPs to better manage stormwater management, sound road maintenance practices and financial support via the Better Roads Program and other VTrans grant programs.

Municipal Town Highway (TH) Grants

VTrans administers and provides grants to municipalities under the TH Structures, Class 2 Roadway, and TH Emergency Fund appropriations. A significant amount of this funding is tied either directly or indirectly to stormwater related activities. By adopting TH Road and Bridge Standards, municipalities will receive an additional 10% match in funding for the Structures and Class 2 Roadway grants. These Standards include stormwater best management practices directly tied to improving water quality.

Town Highway Aid

VTrans administers and provides an annual appropriation for State aid to municipalities based on their number of miles of Class 1, 2, and 3 town highways. These funds must be used solely for town highway construction, improvement, and maintenance purposes, following their adopted Town Road and Bridge Standards. A portion of these funds are directly tied to stormwater treatment.

Transportation Alternatives Program

VTrans administers this federally funded program for non-traditional transportation-related projects. One eligible activity under this program involves environmental mitigation of stormwater runoff. VTrans was successful in setting aside $1.1 million of the program amount, or approximately one-half of the funds, for environmental mitigation projects if there are enough worthy projects sought.

FEMA Public Assistance Program

VTrans administers and provides grants to eligible applicants/owners of publicly-owned facilities who suffered damage during a federally declared disaster (primarily municipal roads/bridges not on federal-aid highways). The vast majority of these grants involve repairs, improvements, and mitigation activities associated with stormwater. FEMA funds 75% and the State & applicant split 25%.

FHWA SAFETEA-LU

VTrans administered the earmark funds to municipalities over the past five years, allowing the implementation of $5.4 million worth of highway stormwater mitigation, with roughly 50% spent in Chittenden County and 50% spent elsewhere.

J. ADDED COMMITMENTS TO ADDRESS STORMWATER RUNOFF FROM STATE ROADS AND NON-ROADS

Stormwater runoff from roads and existing developed lands will be addressed in a staged and prioritized manner through a system of watershed-based stormwater permitting. The enhanced programs will be applied in combination to achieve the required reductions in phosphorus.

Act 64 of the 2015 Vermont State Legislature amended Vermont's stormwater statute (10 V.S.A. 1264) to address existing developed land with more than three acres of impervious surface, to implement a municipal roads stormwater general permit, and to provide the Department the ability to regulate any other discharges necessary to implement the TMDLs.

STORMWATER RUNOFF FROM STATE HIGHWAYS

Description

The first stage of implementation will include permitting all state roads and other VTrans facilities to achieve the necessary level of pollutant reduction to meet TMDL targets. Permitting will generally involve requirements to develop management plans, followed by an implementation

scheduled informed by the relative significance of the source, on a watershed basis.

The State highway system will be addressed via a TS4 Stormwater General Permit. The TS4 would regulate all stormwater discharges from the transportation network and associated transportation facilities by consolidating the permit requirements from the existing Municipal Separate Storm Sewer System (MS4), Multi-sector General Permit (MSGP) and post-construction stormwater permits. Implementation of a comprehensive TS4 GP approach could allow for the prioritization of maintenance, upgrade of stormwater infrastructure, and implementation of remediation activities based on environmental benefit. Stormwater management practices, under the State's Stormwater Management Program's jurisdiction, will be consistent with the Vermont Stormwater Management Manual, with an emphasis on surface infiltration where feasible to maximize phosphorus reduction.

Implementation Mechanism

The State will establish a TS4 Stormwater General Permit.

Implementation Steps and Timeframe

1.	Revise MS4 Procedure for Designation of Regulated Small MS4s	2016
2.	Issue Draft TS4 General Permit	2016
3.	Issue Final TS4 General Permit	2016
4.	VTrans to implement program	2017-2036

STORMWATER RUNOFF FROM MUNICIPAL ROADS

Description

Vermont municipalities maintain approximately 11,000 miles of road; three-quarters of these municipal roads need erosion control improvements. Two-thirds of these roads are unpaved gravel or unimproved roads, and nearly all require ditches and culverts for water drainage. Road structures, particularly along gravel roads, can cause erosion and sedimentation into adjoining streams. Stormwater runoff from paved roads can accumulate and deliver debris, oils, salts, and other chemicals, sediment, nutrients, and other pollutants to surface waters. Paved roads can also affect the volume of stormwater runoff being generated, which in turn, can alter the hydrology and ecological health of receiving waters.

Act 64 of the 2015 Vermont State Legislature requires the Department to issue a general permit for stormwater discharges from municipal roads. The final permit shall be issued by the end of 2017. All municipalities in the Champlain basin shall apply for permit coverage by 2021. The permit will require development of management plans based on local road conditions including road slope, connectivity to receiving waters, and other factors, that identify the type and scope of BMPs necessary for the municipality. The management plan will include an implementation schedule informed by sub-watershed phosphorus reduction priorities. At a minimum, BMPs shall be as protective as those identified in the 2011 Town Road and Bridge Standards and focused on the prevention of erosion and the transport of sediment containing phosphorus. The precise level of BMPs, and associated phosphorus reduction, will be determined during development of the general permit and will be sufficient to ensure the regulated discharges are consistent with the pollutant

load allocation for developed land.

DEC developed remote sensing information for municipalities to initially identify hydrologically-connected road segments that have the potential to be at risk of erosion and may be a source of sediment and phosphorus pollution to surface waters. DEC has developed draft Municipal Road General Permit standards by different road types. DEC, VTrans, and regional planning commissions have also developed a road erosion inventory template, based on the draft MRGP standards. As the final MRGP is implemented, all hydrologically-connected municipal road segments will be evaluated to determine if they meet MRGP standards. For road segments not meeting standards, capital budgets including road remediation recommendations, cost estimates, and implementation schedules, will be included. Road segments that have been identified in the inventory and capital budget will be prioritized for VTrans, DEC, and federal grant funding. Towns will submit annual implementation reports updating DEC on their municipal road remediation progress.

Implementation Mechanism

DEC will use existing authorities to develop a permit program for issuing a municipal road stormwater permit and reporting requirements. The program will emphasize the use of road- related best management practices. All affected municipalities will be notified of the draft general permit. The adoption of a municipal roads general permit by the end of 2017 is required under Act 64.

Implementation Steps and Timeframe

1.	Issue Draft Municipal Road General Permit	2017
2.	Issue Final Municipal Road General Permit	2017
3.	DEC to administer permit program with VTrans to provide technical assistance, training and funding support	2017-2036

STORMWATER RUNOFF FROM EXISTING DEVELOPED LANDS

Description

Stormwater runoff from existing developed land, exclusive of surfaces regulated under the State or municipal roads stormwater programs, will be addressed in a staged and prioritized manner through a system of watershed-based stormwater permitting. Stormwater management on VTrans-owned developed lands will be addressed under the TS4 permit.

Three Acres of Impervious Surface

The first stage of implementation will require permit coverage for all stormwater discharges on sites where impervious surfaces exceed 3 acres. Act 64 of the 2015 Vermont State Legislature requires the Department to issue a general permit for existing impervious surfaces greater than 3 acres where the discharge did not previously obtain permit coverage, or where the discharge was permitted under standards prior to adoption of the Vermont Stormwater Management Manual. The Department must issue the final general permit on or before January 1, 2018. All affected parcels in the Champlain basin shall obtain permit coverage by 2023. The precise level of BMPs, and associated phosphorus reduction, will be determined during development of the general permit and

will be sufficient to ensure the regulated discharges are consistent with the pollutant load allocation for developed land.

MS4

Municipalities regulated under the Municipal Separate Storm Sewer System (MS4) are required to develop Flow Restoration Plans for stormwater-impaired waters in accordance with the MS4 General Permit. The extensive deployment of stormwater-management infrastructure associated with this requirement will contribute substantially to phosphorus reduction in Lake Champlain. Further, regulated MS4 municipalities are required to track phosphorus reductions associated with the deployment of BMPs. Finally, with the issuance of the completed TMDL, the Department will re-issue the MS4 General Permit in 2017. The TMDL will be considered an "approved TMDL" under section IV.C.1. of the MS4 General Permit. This will require the MS4 permittees to develop and implement a phosphorus control plan to control discharges consistent with the assumptions and requirements of the wasteload allocation.

Implementation Mechanism

The State will establish a general permit program to address stormwater from existing developed land.

Implementation Steps and Timeframe

1.	Issue Draft Developed Lands General Permit	2017
2.	Issue Final Developed Lands General Permit	2017
3.	Re-issue Final MS4 General Permit	2017
4.	DEC to administer existing developed lands program	2017-2036

STORMWATER RUNOFF FROM NEW DEVELOPMENT

Description

DEC's Stormwater Program administers a post-construction stormwater permit program pursuant to state statute. Regulated projects are required to implement BMPs in accordance with the Vermont Stormwater Management Manual (VSMM). The VSMM was initially developed by the Center for Watershed Protection, and is currently undergoing revision to increase the use of green-stormwater infrastructure practices, and to increase the required levels of phosphorus removal in approved practices. The revisions are primarily focused on revising Water Quality Volume, Groundwater Recharge, and Channel Protection criteria, to increase the use of distributed highly-effective treatment (i.e. pollutant removal) practices. Criteria associated with preventing increases in peak flows associate with larger storms (i.e. the Qp10 and Qp100 standards) are to be retained. Precipitation volumes used for the various criteria will be revised based on best-available local data, including the past 10-years of record to account for changes in precipitation volumes, and regional variability. The final revised VSMM will then be adopted via state rulemaking process. The final adopted Manual will employ state-of-the-art stormwater BMPs designed to maximize phosphorus removal. These practices combined with Vermont's regulatory program that requires permits for all new and redevelopment projects with over one acre of impervious surface, as well as expansions greater than 5,000 square feet, will prevent substantial phosphorus loading.

Implementation Mechanism

This strategy is implemented via DEC's post-construction stormwater permit program.

Implementation Steps and Timeframe

1.	Complete VSMM stakeholder process	2014-2016
2.	Develop Draft Revised VSMM	2015-2016
3.	Public Comment on VSMM	2016
4.	Final VSMM commence rule making	2016
5.	Adopt Final VSMM with enhanced phosphorus removal	2017

CHAPTER 4 - CURRENT PROGRAM CAPACITY TO REDUCE NONPOINT SOURCE POLLUTION

A. INTRODUCTION

Controlling nonpoint source pollution is the key element in reducing phosphorus loads to the Lake and meeting water quality standards. The control of nonpoint source pollution presents a major challenge both in the Lake Champlain basin and nationwide. This is due to the diffuse nature of nonpoint source contributions, which originate from runoff from buildings and parking lots, farm fields, forests, gravel roads, and stream erosion. These sources can be difficult to identify, quantify and control.

In working to control phosphorus pollution, Vermont has invested heavily in programs to enhance the natural stability of streams and rivers, improve management of Vermont's network of parking lots and roads and limit polluted runoff from construction sites. (Refer to Chapter 3). Vermont has also invested in programs to protect and restore wetlands, implement soil-based conservation practices such as cover cropping, and provide technical and financial assistance to farmers to prevent discharges from barnyards and fields. Despite the magnitude of these efforts, further pollution reductions are needed.

In response to EPA's request for further action, ANR, AAFM, and other state and local partners have spent considerable time evaluating existing state and local "program capacity" to control phosphorus. "Program capacity" is the current legal, regulatory, programmatic, financial, staffing and technical capacity available to meet the TMDL target goals. This evaluation, which included significant stakeholder and public input, was necessary to ensure that future efforts are focused on the highest priority sources in the most cost-effective manner possible. This evaluation also served to identify enhancements needed in existing programs and new programs needed to protect the Lake.

The major categories of policy tools used to implement the TMDL include:

- Regulatory requirements: providing specific legally required steps that must be taken to control pollution and reduce impacts, including permitting programs;
- Financial incentives: linking funding eligibility to specific actions or using subsidies to control pollution and reduce impacts;
- Technical assistance: sharing technical information with state, local and private partners regarding the water quality impacts of their current or planned actions, and suggesting techniques to reduce impacts;
- Monitoring, Assessment and Planning: monitoring and assessing the status of surface waters to ensure that implementation efforts are planned, targeted and funded to ensure the best use of available monies with the highest rate of success.
- Funding: targeting funding efforts geographically, and setting priorities for which practices should be implemented first in order to achieve the greatest benefit at the lowest cost.
- Education and outreach: sharing information with stakeholders and the general public in order to create a broad-based understanding of nonpoint source pollution and to foster needed behavior changes.

ANR currently administers a combination of these tools as the foundation upon which TMDL implementation is built. In addition, ANR coordinates with AAFM to ensure regulatory, and technical and financial assistance programs are available to the agricultural community, and with VTrans to ensure water quality controls are provided in road construction and maintenance activities. ANR, AAFM and VTrans also work closely with federal, state and local partners to promote regulatory and voluntary programs to ensure implementation, and to seek necessary funding.

This Chapter describes the most significant existing policy tools to reduce the major sectors of nonpoint pollution agriculture, forests, wetland alterations, and stream erosion. The WSMD's Vermont Surface Water Management Strategy describes in much greater detail the full range of current programs for reducing both point and nonpoint sources of surface water pollution in Vermont. The Strategy is available on-line at: http://dec.vermont.gov/watershed/map/strategy.

B. ILLICIT DISCHARGE DETECTION AND ELIMINATION

In 2000, the Vermont Legislature required DEC to implement a statewide program to promote detection and elimination of improper or illegal connections and discharges. (Sec. 3. 10 V.S.A. § 1264 (b)(9)). Illicit discharges are discharges of untreated wastewater or industrial process water into a stormwater-only drainage system or directly into waters of the state. The Legislature's intent was to expand illicit discharge detection and elimination (IDDE) efforts from the communities—all in the greater Burlington area—required to perform IDDE in compliance with the EPA's Phase 2 Stormwater Rule to encompass all developed areas of the Vermont. Following the Legislature's mandate, DEC has assisted municipalities not subject to the Phase 2 Stormwater Rule by mapping drainage systems and performing IDDE. This work, funded through CWIP ecosystem restoration grants, USEPA Section 319 and the Lake Champlain Basin Program, has been completed for all major urbanized areas in the Missisquoi, Lamoille, Winooski (outside the greater Burlington area), Otter Creek, Poultney River, Lake Memphremagog Basins the three largest Connecticut River Basin towns and the Town of Bennington. It is ongoing in the Upper Connecticut, Passumpsic, White, Black and Williams-West River Basins.

About one-hundred communities have had GIS (Geographic Information System) drainage maps completed. Stone Environmental, Watershed Consulting Associates and Aldrich-Elliott Engineers in conjunction with several watershed associations (Memphremagog Watershed Association, Friends of the Winooski River and Friends of the Mad River) have or are currently conducting IDDE surveys in sixty-five non-designated MS4 communities. Consultants have identified 3,586 discharge points, 1,065 of which were flowing when inspected. A wastewater source was indicated at 204 discharge points. Other types of contamination included petroleum, treated drinking water, heated water, pet waste, mop water, paint and road salt. By combining drainage mapping, environmental investigative work, and municipal cooperation, this effort has eliminated numerous wastewater discharges, decreasing phosphorus by an estimated 275 kg per year to Lake Champlain, and reducing the risk of pathogen exposure.

C. GREEN STORMWATER INFRASTRACTURE

Since 2009, DEC has played a critical role in promoting and supporting greater adoption of low impact development (LID) principles and implementation of green stormwater infrastructure (GSI) practices. DEC works to implement strategies identified within the GI Strategic Plan, which was developed by the Green Infrastructure Roundtable, an ad hoc group of individuals from the public and private sector which serves as a steering committee for Green Infrastructure activities in the State. The GI Strategic Plan targets four key audiences: design professionals, municipalities, property owners and state agencies.

The Roundtable members use a "Google Group" – an interactive listserv interface – for communication and coordination of activities. To date, the group includes over 200 members. This year alone, there were over 60 posts highlighting GSI webinars, trainings, technical specifications and details, discussions, news articles, funding sources and announcements that are of interest to members.

The Strategic Plan was followed by the signing of Executive Order 06-12 (EO) in March of 2012. The EO further defines the role of State Agencies and calls for the creation of an Interagency Green Infrastructure Council which includes the Secretaries of the Agencies of Natural Resources, Transportation, Commerce and Community Development, and the Commissioner of Buildings and General Services or their designees. The Council is tasked with identifying opportunities for integration of GSI practices in existing programs, initiating a process for developing GSI technical guidance, establishing a plan for implementing GSI on state properties and projects, identifying agency liaisons, identifying and undertaking GSI research and monitoring, and identifying sustainable funding sources. Members of the Council are also tasked with developing a GSI Implementation Work Plan for their respective Agency/Department. Work plans were completed on July 1, 2013 and lay out opportunities and strategies for moving the GSI initiative forward. The EO is in effect for five years.

In 2015, DEC worked with the Lake Champlain Sea Grant Program at the University of Vermont to create the Green Infrastructure Collaborative to advance awareness and practice of green infrastructure across Vermont. This Collaborative supports the Roundtable activities, reporting of the Council, conducts outreach to a variety of audiences and provides communities with technical assistance.

D. AGRICULTURE

As estimated by the previously discussed modelling efforts, agricultural nonpoint sources of phosphorus account for approximately 40% of the overall phosphorus load delivered to the Lake from Vermont. Therefore, management efforts in this sector have the potential to contribute to significant reductions.

In Vermont, a strong agriculture conservation partnership exists between state and federal agencies, as well as the non-profit sector that provides non-regulatory outreach and education to the farming community. These partners include USDA/Natural Resources Conservation Service, the University of Vermont Extension System, the VT Association of Conservation Districts, and

other non-governmental groups and watershed organizations.

An advisory group was added to this statewide conservation partnership in 2013, with the creation of the Ag Workgroup. The Ag Workgroup members were mostly farmers, with the balance being technical service providers who work directly with farmers. This group provided extensive assistance to the Agency of Agriculture, Food and Markets (AAFM) and DEC in the development of the proposed revisions in the TMDL and stands as an ongoing advisory group to the Agencies.

The major agricultural programs described below include regulatory, technical assistance and funding measures to assist in phosphorus reduction efforts.

REGULATORY PROGRAMS

The Agency of Agriculture, Food and Markets (AAFM) administers a combination of regulatory and voluntary programs, with the goal of protecting water resources and helping Vermont's farming community maintain financial viability. This includes ensuring that farms meet or exceed the standards established by the federal water quality regulations (Clean Water Act) while providing the financial and technical tools in order to do so. The AAFM regulatory programs are set up in a three-tiered structure that is designed to provide a logical progression in regulatory oversight as a farm may increase in size.

Required Agricultural Practices

Act 64 requires significant changes to Vermont's Accepted Agricultural Practices, including a name change to "Required Agricultural Practices" or "RAPs," thereby reflecting the fact that these practices are not and never have been optional.

The Vermont Accepted Agricultural Practice Rule (AAPs) requires that all farms in the state, regardless of size and type of operation, adopt and implement a set of minimum conservation practices to protect water quality. These rules were developed in 1995 and updated in 2006. The AAPs were designed to reduce non-point pollutant discharges through implementation of improved farming techniques rather than investments in structures and equipment, however the AAPs do not allow for any discharge from the farm and in these situations, a Best Management Practice (BMP) may be needed and often requires more financial investment to install and maintain. State law requires that these improvements must be practical as well as cost effective for farmers to implement, as determined by the Secretary of Agriculture, and shall be designed to achieve state standards.

Prior to 2013, the AAP program was overseen on a complaint-driven basis due to limited resources. AAFM had never received funding specific to enforcing the AAPs when they were originally created, nor for the 18 years that followed. In 2013, AAFM hired the first inspector specifically charged with AAP education and enforcement. This position is prioritizing outreach and evaluation efforts in the agriculturally impaired watershed of Franklin County. In recent years with the support of the medium and large farm (4 staff), new small farm (1) and existing pesticide, feed and seed (4) inspection staff AAFM has investigated between 160 and 215 complaints on small, medium and large farms. AAFM still continues to respond to complaints as in previous years and intends to hire three additional inspectors in 2015-2016 to further expand this.

Medium Farm Operations

The Medium Farm Operations (MFO) program provides coverage under a single state general permit and is managed by the AAFM. All dairy farms with 200-699 mature animals, whether milking or dry, qualify as a MFO. Other common MFOs include beef operations (300-999 cattle or cow/calf pairs), horse operations (150-499 horses), turkey operations (16,500-54,999 turkeys), and egg laying facilities (25,000-81,999 laying hens without liquid manure handling system). The general permit prohibits discharges of wastes from a farm's production area to waters of the state and requires manure, compost, and other wastes to be land applied according to a nutrient management plan that meets the NRCS 590 standard. AAFM was previously required to inspect all farms permitted under these rules at least once every five years (increasing to every three years through Act 64) however most are inspected more often and many receive additional technical assistance as practices are implemented. The MFO general permit has been in existence since 2007 and was revised in 2012.

Large Farm Operations Program

Farms with more than 700 mature dairy cows, 1,000 beef cattle or cow/calf pairs, 1,000 young stock or heifers, 500 horses, 55,000 turkeys, or 82,000 laying hens for example, must obtain a Large Farm Operations (LFO) permit from the AAFM. A LFO permit prohibits the discharge of wastes from a farm's production area to waters of the state and requires the farm to land apply manure, compost, and other wastes according to a NRCS 590 compliant nutrient management plan. Unlike the MFO Program, LFO permits are individual to each farm and also regulate odor, noise, traffic, insects, flies, and other pests, construction siting and setbacks. All LFOs are inspected annually by AAFM.

Concentrated Animal Feeding Operation Permits

The Vermont statewide Concentrated Animal Feeding Operation (CAFO) general permit is administered by the VT Department of Environmental Conservation and is a federal National Pollutant Discharge Elimination System (NPDES) permit. The CAFO general permit was issued in June, 2013. Any farm that discharges to a surface waterbody can be required to obtain a permit. The CAFO general permit is for medium farms, and an individual permit can be required for a small or large farm.

The CAFO permit requires farms to properly design, construct, operate, and maintain production areas to control waste and to develop and implement a nutrient management plan, which is available to the public. The permit prohibits a discharge of manure, litter, or wastewater, except when direct precipitation equivalent to or greater than a 25-year, 24-hour storm event causes a discharge. This exception is only allowable when all permit requirements are met.

Best Management Practices Program

The agricultural Best Management Practices (BMP) Program is a funding program for farmers relating to the construction of farm improvements designed to abate non-point source agricultural waste discharges to waters of the state of Vermont. AAFM, through their inspection process, identifies farms that present a risk to water quality and where the AAFM has determined that current infrastructure and practices are not sufficient to address the potential risk to water quality. BMPs must be constructed in a manner that meets the federal Water Pollution Control Act and state water quality standards, according to the Required Agricultural Practice rules.

Prior to 2015, Vermont statute required the Secretary to determine that sufficient funding was available before requiring a BMP. Act 64 now requires that when BMPs are mandated, the farmer will be made aware of all available resources and it continues to be a goal of AAFM to prioritize available funding where a water quality impact has been identified. Commonly funded production area practices include waste storage facilities, silage leachate systems, milkhouse waste systems, and barnyard runoff collection, most of which are expensive and unaffordable without financial support.

Conservation Reserve Enhancement Program

In partnership with the USDA, the Conservation Reserve Enhancement Program (CREP) is an enhanced version of the federal USDA Conservation Reserve Program and provides supplemental payments with state funding. CREP encourages the installation of conservation buffers along waterways by providing land owners with a yearly rental payment and by assisting with the cost of planting the buffer. Additionally, CREP covers the cost of installing fencing and livestock watering systems where animals on pasture are excluded from waterways. In 2013, the rental payment rates from the federal government were drastically cut, and this, along with limited support staff, has been a contributing factor to the decreased signups for CREP. Since then, soil rental rates have increased, but support staff for outreach and planning has not increased; and in fact has decreased at AFFM from two full time staff in 2010 as part of rescissions to one person currently.

In 2016, State staff, along with conservation partners, worked with USDA partners to address a significant rule change needed in federal law that would have disallowed a farm from participating in both CREP and the federal conservation easement programs. Without this change, farms that sold their development rights in order to conserve the agricultural use of the lands would not have been able to install CREP buffers to further enhance the water quality protections. This change allows for the continuance of the CREP restrictions into the conservation easement and increases the buffers that are protected in perpetuity.

The latest effort in the CREP program revolves around contracts that are nearing the end of their term. Nationally, the CRP program is allowing re-enrollments after the terms end and Vermont is in the process of an evaluation to increase re-enrollment as well as new applications. The federal government provides a 4:1 match for this program, and its value on the Vermont landscape is very high.

Farm Agronomic Practices Program

The Farm Agronomic Practices (FAP) program provides farmers with state financial assistance of up to $5,000 per farm per year for implementation of soil-based practices that improve soil quality, increase crop production, and reduce erosion and agricultural waste discharges. Eligible practices are nurse crops, strip cropping, conservation crop rotation, alternative manure incorporation, cross-slope tillage, conservation tillage and educational activities. Interest in the FAP program has grown in the past few years and requests for funding far exceed available funds. For this reason, FAP has worked with NRCS to encourage farms to utilize their funding programs for cover crops as a means to expand implementation of these practices

Vermont Seeding and Filter Strip Program

The Vermont Seeding and Filter Strip program offers a 10-year maximum agreement for the installation of conservation grassed buffers on cropland along streams or ditches. Unlike the CREP program, this program allows planting harvestable grassed buffers. Areas in crop fields that are prone to erosion caused by flood events, which can be classified as flood chutes, are also eligible under this program to be planted into grass and harvested.

US DEPARTMENT OF AGRICULTURE FEDERAL PROGRAMS

Federal programs, funded through the US Agriculture Act of 2014 (commonly known as the Farm Bill), assists Vermont farmers in water quality improvements, including reductions in phosphorus loading to Vermont's surface waters. The USDA Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA) provide technical and financial support for conservation practices and program implementation, as well as funding through the national Conservation Innovation Grant program and the new Regional Conservation Partnership Grant Program.

In 2014, the newly passed Farm Bill reorganized many of the historic conservation programs. Over the next five years, $18.7 billion has been authorized nationally and due to "regional equity" provisions, Vermont has received substantial water quality improvement funding in recent years. For the federal fiscal year 2016, NRCS has received over $11 million statewide for the Environmental Quality Incentives Program (EQIP). The primary federal funding program for forestry, and farm production area and field practice installation. Examples include: barnyard improvements, manure pit installation, silage leachate collection systems, cover crops, reduced tillage and stream crossings. In addition, EQIP funds the development and implementation of forest management plans and agricultural nutrient management plans. NRCS also received over three million dollars through the Agricultural Land Easement Program (ACEP). These funds will restore and protect high priority wetlands and conserve critical agricultural lands.

Approximately 75% of these funds will be obligated to producers in the Lake Champlain Basin. In addition, NRCS has also set aside specific funding pools for the highest priority watershed areas as identified by DEC basin planning and the Lake Champlain TMDL. This is the first time NRCS has done such a process, and by doing so, decreased the competition for producers in these critical areas. These EQIP and ACEP funds are in addition to the RCPP funds described below.

USDA allocations have also funded several individual projects in Vermont that directly have an impact agricultural water quality.

- National Water Quality Initiative ($80,000 in FY 2015) which targets funds to eligible farmers in the impaired Rock River and Missisquoi Bay watersheds.
- Edge-of-Field monitoring (approx. $220,000). Paired watershed research projects that are assessing the water quality improvement value of key farm BMPs such as cover crops, manure aeration, reduced tillage and water and sediment control basins. Funding in 2016 will include evaluation of tile drains.
- Conservation Innovation Grants ($225,000). These competitive grants are funding a web-based tool for BMP tracking, research on soil health, the viability of reduced tillage systems on heavy clay soils, cover crops on clay soils as an alternative to fall plowing, and evaluating media for reducing phosphorus in tile drain outflows.

Each of these programs provides extensive water quality technical assistance as well as critical research and education opportunities.

Regional Conservation Partnership Program

The 2014 Farm Bill also authorized a new funding program, the Regional Conservation Partnership Program (RCPP). RCPP is designed to promote coordination between NRCS and its partners to deliver conservation assistance to landowners. A key goal of RCPP is to increase the number and diversity of partners involved in conservation activities, including easements, restoration and best management practices.

DEC and AAFM submitted a successful application to the highly competitive RCPP program, and in May 2015, was awarded the second largest grant in the country, $16 million over 5 years. This was a bi-state application with the State of New York, and funds are being shared with partners in NY who will focus on Lake Champlain drainage water quality improvement in the high priority South Lake segment. The RCPP grant provides over $20 million as match to the federal funds from 26 partners, many of whom are new to conservation efforts, and bring non-traditional opportunities for outreach, education and assistance. The program is being coordinated by DEC, and the State has provided a position to assist with this effort.

The $16 million, five-year grant helps agricultural producers and private forest landowners in the Lake Champlain Basin invest in conservation practices to protect and improve water quality. By 2020, RCPP funding will result in over 100 new EQIP contracts for farm and forest management practices, 30 new land easements, and over 200 acres of wetlands restored and protected. Each project will directly address water quality, with priority given to projects in the Missisquoi, St. Albans Bay and South Lake watersheds of Lake Champlain. Most of the funds are targeted to conserved lands, which as of the 2014 Farm Bill, are now required to develop and implement a water quality focused conservation plan. This RCPP grant also provides over three million dollars of additional technical assistance, through NRCS and partners who are collaborating with DEC. Three conservation planners have been hired through a contract with the VT Association of Conservation Districts as well as a forester, and engineering services.

In the first year of this five-year grant, five agricultural farmstead projects were approved as well as 14 water quality improvement practices on private forestland, five wetland restoration and

projection projects on 275 high priority acres, and 9 conservation easements.

USDA's RCPP program also provided funds for individual state awards, and the Vermont Association of Conservation Districts received $800,000 to increase development and implementation of nutrient management plans on dairy farms, primarily in the Lake Champlain Basin. Both RCPP programs are coordinating their efforts, and also working closely with a third RCPP effort in the Connecticut River Watershed.

PARTNER PROGRAMS

In addition to the state and federal-level programs discussed above, there are a number of local programs through Vermont's non-profit partners that are geared toward phosphorus reduction from Vermont farms. In addition to these organizations, numerous nonprofit watershed groups provide extensive outreach, education and implementation assistance.

Vermont Association of Conservation Districts

VACD and its 14 member districts provide education and technical assistance in all natural resource areas, including agriculture, forestry, river management, invasives, stormwater and low-impact development. Districts help agricultural producers by providing non-regulatory assessment and technical assistance, and by leveraging additional funding through grants or other programs.

Conservation District programs include:

1. Land Treatment Planners: Land Treatment Planners (LTPs) assist farmers in developing land treatment plans (LTPs), the foundation of a full nutrient management plan (NMP). LTPs include field inventories and assessments, documentation of soil erosion loss on individual fields ("T"), practices that are or need to be installed to minimize erosion, and field maps. This free program is provided to farmers through a partnership between the USDA NRCS, Conservation Districts, and AAFM. Land treatment planners coordinate with NRCS or private consultants to complete a NMP, or provide this service to farmers who are taking the University of Vermont (UVM) Extension NMP development class.
2. VACD Implementation Programs: VACD, through grants and pass-through funds, administers many programs that directly benefit agricultural water quality improvement. Examples include:
    - Trees for Streams – a state funded effort that installs riparian buffers;
    - BMP implementation – small farm projects;
    - Livestock exclusion – direct funding to farmers for fencing and water systems;
    - Soil, manure and water testing programs;
    - Cover crop incentive programs; and
    - Equipment rental programs.

Each District works to assess needs and provide services and assistance most appropriate and critical to that region.

3. Agronomy and Conservation Assistance Program: The Poultney Mettowee Conservation District supports one of the three Lake Champlain basin agronomists who work one-on-one with agricultural producers on BMP and field practice implementation.

University of Vermont (UVM) Extension Program

UVM Extension has multiple programs and staff located throughout the Lake Champlain basin. Staff agronomists advise farmers on topics such as crop production to reduce erosion and nutrient loss from fields, farmstead best management practices for improved manure and water management, animal exclusion fencing, field practices such as soil aeration and alternative manure applicator systems, whole-farm nutrient balances and other identified BMPs.

Implementation programs include:

1. Agronomy and Conservation Assistance Program: UVM Extension supports two of the three Lake Champlain basin agronomists;
2. Champlain Valley Crops, Soil and Pasture Team: provides technical assistance in the southern Lake Champlain watershed with research and practical applications;
3. Northwest Crops and Soils Team: provides the best and most relevant crop information, both research based and experiential;
4. Research: extensive research on corn trials and short season corn, alternative crops, cover crops, nutrient management and new equipment technologies;
5. goCrop: mobile application for nutrient management;
6. Equipment: equipment rental and education programs;
7. Workshops: workshops, seminars and symposiums of research and program results.

Vermont Housing and Conservation Board/Vermont Land Trust

The Vermont Housing and Conservation Board (VHCB) farmland conservation program has conserved more than 600 farms comprising 144,000 acres since 1987. Landowners work with the Vermont Land Trust (VLT), a private non-profit land conservation organization that raises funds to permanently land, to apply for the purchase of development rights, and an agricultural advisory committee reviews applications and prioritizes purchases. VHCB receives funding from USDA/NRCS, as well as the State of Vermont to assist with land conservation and recent legislation required that water quality be considered as a priority in agricultural land conservation. In addition, as part of the 2014 Farm Bill, lands conserved with USDA funds must have a conservation plan in place for addressing water quality and natural resource concerns. In FY 15 and FY 16, 7,129 acres on 49 farms were conserved in Vermont. $5.5 million state dollars were used to leverage an addition $5.5 million in NRCS funds and $1.56 million in other funds.

VHCB and VLT are working closely with DEC and AAFM to coordinate efforts with the RCPP funding project to increase land conservation and implementation of conservation plans on current and prior conserved farms.

Watershed Partners

In addition to the partners above, there are many strong essential watershed groups and non- profit organizations assisting in the education, outreach and implementation of critical water quality improvement on agricultural land. DEC and AAFM provide resources to assist these efforts and work closely with all partners to ensure coordination of efforts. Both agencies work to ensure consistent communication of programs, resources and regulations, and to maximize the value of each partner in water quality improvement efforts.

E. FORESTRY

Sediment, which carries phosphorus, is the most common pollutant associated with timber harvesting. Soil is carried by rainwater after timber harvesting equipment and trees dragged or carried over the ground loosen and expose the soil. Bare ground exposed during harvesting operations can be eroded by rainwater and enter nearby streams. Stream crossings used during harvesting are a particular area of concern. An estimated 16% of the total phosphorus load delivered to Lake Champlain comes from forestland. With forest covering more than 4.4 million acres state-wide and representing 75% of Vermont's total land base, forestry is an important area of focus for reducing phosphorus loading to state waters. The most significant programs that address forestry practices and phosphorus loading are described below.

VERMONT ACCEPTABLE MANAGEMENT PRACTICES (AMP)

In 1987, Vermont adopted the Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont. The AMPS are intended to prevent any mud, petroleum products and woody debris (logging slash) from entering State waters and to otherwise maintain water quality and minimize erosion. Since adoption of the AMPs, the Vermont Department of Forests, Parks and Recreation (FPR) has worked with the Vermont forest industry to support the Department of Environmental Conservation (DEC) Compliance and Enforcement Division in an effort to eliminate discharges resulting from logging operations.

In 1990, a Memorandum of Understanding (MOU) between the DEC Compliance and Enforcement Division and FPR was developed to establish a process to assist loggers or landowners when there is a discharge. Under the MOU, five AMP Technical Advisory Teams were created to directly assist any logger or landowner when there is a potential discharge, complaint or request for assistance. Enforcement would be pursued in instances where:

1. There is substantial failure to comply with the AMPs which has resulted or is likely to result in substantial environmental degradation;
2. Efforts to obtain voluntary compliance have been unsuccessful; and
3. There is a history of non-compliance with the AMPs coupled with discharges to State waters.

The MOU and this process have been successful in reducing water quality impacts and controlling soil erosion in connection with logging operations in Vermont.

PORTABLE SKIDDER BRIDGE INITIATIVE

Portable skidder bridges are designed and intended for use as temporary structures for crossing streams during logging. They are becoming widely viewed as a Best Management Practice for controlling nonpoint source pollution associated with timber harvesting operations. They create less stream bank and stream bed disturbance as compared to other alternatives such as culverts or poled fords. Portable skidder bridges will reduce the potential for sedimentation, channeling, and degradation of aquatic habitat to occur.

The goals of this initiative are three-fold:

1) Inform loggers, landowners and foresters about the benefits of using portable skidder bridges through workshops and presentations, field demonstrations, informational

brochures, static displays, video and web production, and news articles;
2) Provide portable skidder bridges to loggers for purchase, loan and rental using a variety of means and partners; and
3) Provide assistance and support for existing and start-up businesses that would fabricate and sell portable skidder bridges.

REGIONAL CONSERVATION PARTNERSHIP PROGRAM (RCPP)

This $16 million grant from the USDA Natural Resources Conservation Service includes $357,000 in funding for addressing soil erosion occurring on forest trails and log landings, and designing and installing stream crossing structures to reduce potential water quality impairment from forestry operations. Additional technical assistance funds are also provided through RCPP for on-site foresters who provide technical assistance to land owners participating in RCPP.

F. RIVER AND FLOODPLAIN MANAGEMENT

An estimated 22.3% of the total nonpoint phosphorus load delivered to the Lake comes from stream erosion and the loss of floodplain function. While fluvial systems are dynamic by nature, DEC has documented stressors including channel confinement, straightening, berming, dredging and armoring that have precipitated channel evolution to an extent and rate beyond the natural deposition and erosion processes expected in a post-glacial environment like Vermont. The evolution of stream channels, driven largely by flood events, may take decades to occur.

Therefore, erosive stages of the evolution process will result in increases in phosphorous loads from some stream segments before equilibrium or least erosive conditions occur. Managing rivers toward equilibrium conditions and allowing access to floodplains, by avoiding the development of buildings, roads, and other investments in the floodplain or river corridor, provides for climate adaptation and reduces sediment transport and phosphorus pollution.

Reducing the need to channelize rivers in attempts to protect encroachments, allows rivers to evolve back and remain in their least erosive, equilibrium condition. Rivers have the energy to perform the work of restoration, with or without human intervention, and therefore, the nutrient load reduction sought through restoration is also achieved through corridor and floodplain protection.

The goal of DEC's Rivers Management Program is to resolve conflicts between human investments and the dynamics of rivers in an environmentally and economically sustainable manner. The Program supports and implements channel assessment and management practices that recognize the functions and value of floodplains, conservation flows, and streams in their equilibrium condition. The Program provides regulatory review and technical assistance for protection, management, and restoration projects that affect the flow and physical nature of streams and rivers. The objective is to guide and encourage projects that provide increased property and infrastructure protection and maintain or restore the ecological functions, economic values, and restorative processes of river and floodplain systems.

Act 64 passed with only minor policy and program development in the areas of river and

floodplain management. This is due to the fact that, since 2010, four separate legislative acts focused on stream stability and floodplain function with the goals of reducing Vermont's vulnerability to flood and fluvial erosion hazards and improving water quality. Vermont laws establish stream equilibrium and river corridor protection as explicit management objectives. These new public policies have put the DEC Rivers Program in the vanguard of implementing an avoidance-centric approach to watershed restoration by protecting floodplain and riparian features where natural fluvial process enhances and sustains water, sediment, and nutrient storage.

The aftermath and recovery from Tropical Storm Irene in 2011 and 2012 reminded everyone that unregulated, post-flood channel management can erase decades of progress in restoring stream equilibrium. Consequently, Act 138 (2012) gave municipalities the authority to conduct instream emergency protective measures as long as they were consistent with rules established by ANR. State policies focused on flood hazard mitigation now address stream erosion.

The major sub-programs within DEC's Rivers Program that manage rivers, river corridors and floodplains, thereby reducing phosphorus loading to the Lake, are described below.

RIVER CORRIDOR AND FLOODPLAIN PROTECTION PROGRAM

Regulatory Programs

The River Management Program has established state floodplain rules that set a high standard of "no adverse impact" (NAI) in floodplains and river corridors and address all developments exempt from municipal regulation, including state buildings and transportation facilities, utility projects, and agricultural structures. Flood Hazard Area and River Corridor Protection Procedures have also been adopted by the Department to guide the regulation of Act 250 and Section 248 developments; establish map amendment and revision procedures; and river corridor best management practices (e.g., establishment and maintenance of riparian buffers).

To meet the No Adverse Impact Standard, a proposed project shall not:

a) Be located within a river corridor;
b) Increase flood elevations or velocities or decrease storage capacity within the FEMA designated Flood Hazard Area.

With the primary objective being the protection of undeveloped floodplain and river corridors, the Rules and Protection procedures spell out exceptions to the NAI standard that acknowledge and encourage infill and redevelopment. The Program has established a general permit to expedite authorization of low risk activities under the new Rule.

The Program is currently staffed with Floodplain Managers and River Scientists that review projects subject to municipal floodplain and river corridor bylaws (in accordance 24 VSA Chap.117, Section 4424); regulating activities under the new Rule; providing floodway determinations; and making NAI regulatory recommendations for Act 250 projects. At present only a third to half of Vermont towns actively seek floodplain manager regulatory assistance, which results in approximately 50-70 municipal floodplain projects per manager per year. Larger municipal and Act 250 projects often require extensive interaction with project proponents and consultants including pre-application design consultation, site visits, formal project review, and

attending District Commission and Development Review Board Hearings.

Technical Assistance Programs

Technical assistance is available to communities wishing to better protect floodplains and river corridors from potential encroachments that will cause conflicts with stable channel functions and potentially increase future flood and erosion damages. In addition, the Program provides support to the state agencies, communities, watershed associations, Regional Planning Commissions (RPCs) and individuals to help plan for, design and implement floodplain restorations, as well as flood hazard avoidance, reduction, mitigation and recovery planning and projects.

Under an annual cooperative agreement with the Federal Emergency Management Agency (FEMA), DEC provides technical support to 248 communities enrolled in the National Flood Insurance Program (NFIP). The River Corridor and Floodplain Protection Program provides technical assistance on floodplain management, flood hazard and river corridor mapping, and flood insurance. In addition, the Program is required to conduct community compliance reviews and serve in a liaison capacity on FEMA enforcement actions. Floodplain Managers and River Scientists work with multiple municipal planning commissions toward the adoption of enhanced river corridor and floodplain bylaws.

Technical assistance is also provided through a "Flood Ready" web page which provides all manner of planning and implementation tools to increase Vermont municipal adoption of enhanced floodplain, river corridor, and riparian buffer protection bylaws and other mitigation measures to minimize flood and erosion risks and maximize floodplain function.

Financial Incentives

As required by Act 138, a Flood Resilient Communities Program has been established to create funding and technical assistance incentives for municipalities to adopt regulations for floodplains, river corridors, and riparian buffers. For example, the Emergency Relief and Assistance Fund (ERAF) increases the state cost share recovery in municipalities where enhanced bylaws have been adopted.

Program engineers, floodplain managers and scientists provide technical assistance and state funding, and use FEMA flood hazard and pre-disaster mitigation grants to assist non-government entities and municipalities with the planning and implementation of flood and erosion hazard mitigation projects. Mitigation projects and the Program's assistance are increasingly used as leverage to get landowners and communities involved in greater river corridor and floodplain protection.

Assessment, Planning, and Funding

The River Scientists each cover 4 or 5 major watersheds in Vermont and work with the Program's partners to conduct stream geomorphic assessments and develop river corridor plans. This science informs a host of activities across the Program and Division including tactical basin planning, regulatory work, and technical assistance in the development and prioritization of river protection and restoration projects, i.e., for ERP and other funding. They also support a robust planning program with any community willing to seek the hazard mitigation and water quality benefits of dynamic equilibrium streams and floodplains.

The scientists are responsible for development, quality assurance and upkeep of river corridor maps in their respective watersheds. The Program leverages state and federal funding to develop Phase 2 stream geomorphic assessment data and river corridor plans that identify river corridor protection and restoration projects consistent with the achievement of equilibrium conditions. A statewide river corridor map layer has been completed as of January 2015 providing a delineated corridor for every stream over 2 square miles in drainage. The publication of a statewide layer has created a level playing field with respect to implementing regulations and promoting incentive programs. As yet, the Program's extensive stream geomorphic data and river corridor planning outputs have not been completely attributed to the statewide layer, limiting the identification of strategic protection and restoration projects at the basin or statewide level.

The Program has recently developed a mapping program with a staff person focused on the development of river corridor maps to support the municipal adoption of enhanced model floodplain and river corridor protection bylaws that exceed the NFIP minimum requirements.

A River Corridor Easement Program has been established by the Rivers Program to conserve river reaches identified as high priority sediment and nutrient attenuation areas. The opportunity to purchase river corridor easements was created to augment the state and municipal fluvial erosion hazard zoning, which, if adopted, avoids future encroachment and flood damage, but does not restrict channelization practices. The key provisions of a river corridor easement are the purchase of channel management rights and the maintenance of an undisturbed riparian buffer. The Program works closely with state and federal farm service agencies, the Vermont Housing and Conservation Board, and land trust organizations to combine corridor easements with other land conservation programs. The purpose of the river corridor easement is to allow the river to re-establish a natural slope, meander pattern, boundary conditions, and access to floodplains in order to provide flood inundation and fluvial erosion hazard mitigation benefits, improve water quality through hydrologic, sediment and nutrient attenuation, and protect riparian habitats and the natural processes which form them.

FEMA pre-disaster and hazard mitigation planning funds in Vermont are being used to help communities develop strategic hazard mitigation plans to restore, remove, or retrofit infrastructure likely to become damaged during or after floods. Recent Stafford Act amendments (44 CFR Part 201.6) required local governments to adopt Hazard Mitigation Plans in order to retain eligibility for certain FEMA grant programs. The State Hazard Mitigation Plan and Hazard Mitigation Plans for 150+ municipalities throughout the State all set high priority on mitigation and avoidance of fluvial erosion hazards through river corridor protection. In this way, Vermont hazard mitigation planning is complementary to water quality objectives and can be a powerful local planning tool.

Education and Outreach

The Program, in cooperation with a host of planning organizations and the Vermont League of Cities and Towns, conducts outreach and education and annually reports on the status and impact of river corridor zoning and easements, including development of river corridor mapping. The regional scientists, working with DEC Watershed Coordinators, educate communities about stream instability and fluvial erosion hazards, and provide incentives for their adoption and implementation of river corridor plans and bylaws. The Program has provided the RPCs and

municipalities with a suite of Enhanced Model Flood Hazard Area Regulations including river corridor protection. These Program activities are conducted pursuant to 10 V.S.A. Chapters 32 and 49, and 24 V.S.A Chapter 117 as amended by Acts 110 and 138 (passed in 2010 and 2012).

The establishment of a "Flood Ready" web page has promoted cross-agency, flood resiliency planning (Act 16) by offering peer-to-peer learning and community progress barometers in the Flood Resilient Communities Program.

The program uses three river flumes at public meetings, fairs, workshops, and trainings. These live demonstrations have transformed the education and outreach around river dynamics and the impacts of human activities with respect to erosion and sedimentation. Conservation Districts are now purchasing flumes and developing curricula to educate both adults and school children in their communities.

RIVER MANAGEMENT PROGRAM

Regulatory Programs

Regulation and permitting is conducted pursuant to 10 V.S.A., Chapters 41 and 32 and Section 401 of the Clean Water Act. State Stream Alteration Rules and a General Permit have been adopted that establish first-in-the-nation equilibrium and connectivity standards and regulate next-flood and emergency protective measures. This new regulatory program is supported by the publication and continual refinement of standard river management principles and practices (SRMPP) to maximize equilibrium conditions when managing conflicts between human activities and the dynamic nature of rivers. To meet the equilibrium and connectivity standards, a proposed project shall not:

a) Result in conditions that cause or perpetuate the unnatural aggrading (raising) or degrading (lowering) of the channel bed elevation.
b) Create a significant disconnect in the stream bed, banks, or floodplain that will cause damage related to erosion or deposition in the stream; or create a barrier to the movement of aquatic life.

Technical Assistance Programs

River Management Engineers are experienced in river dynamics, conflict resolution, and the environmental damage and human suffering that occur when projects fail during floods. It is their day-to-day field exposure to Vermont river systems and the people and communities that live along them that has created accountability back and forth between the service provider and the communities they serve and toward sustainable relationships at larger natural and economic scales. The number of stream alteration permits issued in a year is a small fraction of the field visits and face to face technical assistance provided to help project proponents understand the eventual river response and the risks they create to the environment, themselves, and their neighbors. On average, Vermont has experienced a flood disaster every year for the past twenty years and a major regional-scale (>100 year) flood every 15 years. The River Management Engineers work with local officials in putting things back together after a disaster.

The River Management Program provides technical assistance to landowners, municipalities, non-governmental organizations and other agencies to help determine the appropriate stream channel management practices necessary to resolve and avoid conflicts with river systems. The practices

selected are designed to recognize and accommodate, to the extent feasible, the stream's natural stable tendencies (equilibrium conditions). The conflicts are resolved with the recognition of a stream's long-term physical response to past and proposed management practices. The resulting work is intended to provide increased property and infrastructure protection and maintain or enhance the ecological functions, economic values, and restorative processes of the river system.

Financial Incentives

The State has yet to achieve FEMA recognition of the state-adopted river management and stream crossing codes and standards for conducting emergency protective measures. This is an important goal because to date FEMA Public Assistance funding, rather than serving as an incentive for post-flood restorative practices and right-sized structures, is perpetuating activities and structures that exacerbate stream instability and erosion hazards.

Assessment, Planning, and Funding

The River Management Engineers, working with the river scientists, capitalize on opportunities to implement projects involving the removal of river, river corridor, and floodplain encroachments (e.g., floodplain fills, undersized stream crossings, flood-damaged structures, or dams) and the restoration of floodplain functions. Elevating stream beds and reconnecting floodplains is increasingly recommended by the Engineers as a restoration alternative when working to stabilize road embankments.

Education and Outreach

The fluvial geomorphic-based river management principles and practices necessary to mitigate flood hazards and maximize equilibrium conditions are not well understood outside of the Program. This creates inefficiencies and compliance issues particularly in post-flood situations. The Program is working to develop training and outreach programs for VTrans, municipalities and contractors in the use of practices that will meet the DEC's equilibrium-based performance standards.

A River and Roads Training Program has been developed through the Tier 2 level. Tier 1 is an online course that introduces the science and management principles and practices. Tier 2 training is a 2-3-day session with classroom and field exercises. Thus far all VTrans operations staff, many municipal road workers, contractors, and other professionals have attended. Detailed Tier 3 project design trainings are under development. The Program has also begun outreach and training of municipal officials on the web-based authorization process for emergency protective measures under the new ANR Stream Alteration Rules and General Permit designed to maximize technical assistance during post-flood recovery.

STREAMFLOW PROTECTION PROGRAM

Regulatory Programs

The Streamflow Protection Program issues Section 401 water quality certifications to moderate or cease streamflow and reservoir level fluctuations, including those associated with hydroelectric projects and other dams. In their extremes, peaking operations at hydropower stations result in rapid increases in downstream discharges in river reaches which are vulnerable to erosion under higher velocity flows. Large daily to seasonal decreases in reservoir water levels may result in the

erosion of saturated shoreline soils. The Streamflow Protection Program considers these impacts and seeks flow regimes that maximize the stability of steam channels and shorelines.

The goal of the Streamflow Protection Program is to maintain conservation flows necessary to protect aquatic habitat and stream ecology. In addition to conservation flows, the Program aims to protect components of the natural flow regime, including the timing, frequency, duration and magnitude of both high and low flow events and their influence on the physical and biological attributes of a stream or river.

Technical Assistance Programs

Program staff partner with the Public Service Department and have developed guidance for small hydro power developers. Providing this guidance is important at a time when there are numerous drivers or incentives for small-scale, independent, non-carbon burning power production. Small power developers often do not have access to the professional environmental and engineering consultants that the large power producers or utilities may have. These projects may result in the same type of bed and bank erosion as larger dams and diversions. The Program, also works with the Lakes Program, providing technical assistance to lake shore owners concerned about water level fluctuations as the source of erosion along their shoreline and effects on the near shore habitat. Additionally, the Program has partnered with NGO partners to develop guidance for project managers of dam removal projects.

Assessment, Planning, and Funding

Dam inventory data, maintained by the Program, is provided to support the DEC tactical basin planning process. The Program has supported efforts to assess, design, and find the funding for numerous restoration projects identified in tactical planning, and from the work of the state Dam Task Force, comprised of NGOs and state and federal agencies.

Each year, the Program identifies priority stream sections where flow studies are completed to determine compliance with flow criteria in the Vermont Water Quality Standards. These studies are primarily done below unlicensed hydropower projects and for the basis to determine the remedial actions necessary. Over time, the Program has also sponsored statewide studies of production capacity and environmental impacts of both existing and potential hydropower sites.

G. WETLANDS PROTECTION

The Vermont Wetlands Program in DEC is responsible for identifying and protecting wetlands which provide significant functions and values for the people of Vermont. Wetlands function as water quality protection, flood storage, wildlife habitat, erosion control, and have recreational value. The goal of the Wetlands Program is to achieve no net loss of significant wetlands or wetland function through regulatory and non-regulatory means. This goal is mainly achieved by assisting the Vermont public and professional community in avoiding impacts to wetlands and wetland buffers through personal contact with District Wetland Ecologists. The number of wetland permits issued in a year is a small fraction of the field visits and face to face technical assistance provided to help effectively avoid and minimize wetland impacts.

Wetlands are natural flood regulators which temporarily store floodwaters and then slowly release waters downstream. While floodwaters are being stored in wetlands, sediments and nutrients, including phosphorus settle and are retained. As much as 80-90% of sediments in water may be removed while moving through natural wetlands, resulting in cleaner water. A recent study (Wang et. al., 2010) using the Soil and Water Assessment Tool (SWAT) coupled with the hydraulic equivalent wetland concept (HEW) concluded that the loss of 10-20% of the wetlands in their study watershed would lead to an increase in sediment discharge by 40% and total phosphorus load by 18%. Indeed, wetlands are one of the most important microtopographic features abating non-point source nutrients across a watershed. Between 1780 and 1980 Vermont lost over 35% of its natural wetlands, subsequently losing phosphorus sinks throughout the Champlain Basin. The potential increase in phosphorus retention from restoring the natural hydrology of these lost wetlands would be substantial for the health of Lake Champlain.

In 2006, the Agency of Natural Resources commissioned a study to identify and prioritize wetland restoration opportunities in the basin, and this plan was finalized on December 31, 2007 and will be updated with more current data in 2016. Since 2007, data from the plan have been widely distributed to federal, state, and local governmental and non-profit organizations with an expressed interest in wetland restoration and protection. Program staff visited with numerous communities and groups to give locally-focused presentations on the plan results, and to highlight funding mechanisms for landowners interested in restoration. Opportunities for wetland gains and restoration occasionally occur as a result of repairing a violation, through mitigation to offset permitted impacts, or as a result of voluntary measures. VANR currently works with federal, state, and local partners to offer technical assistance and financial incentives to encourage landowner implementation of wetland conservation and restoration opportunities, retain forested buffers, and discourage land conversion. These partners include but are not limited to NRCS, the Army Corps of Engineers, Ducks Unlimited, The Nature Conservancy, and VFWS.

In May, 2009, Vermont passed legislation (Act 31) to strengthen the State's wetlands protection statute. A key change to the statute transferred authority from the former Water Resources Panel of the Natural Resources Board to ANR to make administrative determinations to re-classify wetlands for protection. Before the authority transfer, ANR was only able to protect mapped wetlands which included an estimated 61% of wetlands across the state. Now ANR is able to protect thousands of additional wetland acres. Act 31 also allows ANR to update wetland mapping and interpret jurisdictional buffer zone widths to accommodate individual wetland needs. The updated Vermont Wetland Rules which reflect the change in statute began September of 2010. Since the rule changes, ANR has been working to increase the wetlands program capacity to fully realize the new jurisdictional ability.

Vermont also recognizes the importance of maintaining native plant vegetated buffers along streams, lakes, and wetlands to maintain water quality. Buffers filter and absorb nutrients in runoff and support the integrity of stream banks to help guard against erosion. Healthy vegetated buffers offer additional benefits such as support fish habitat function, provide habitat and movement corridors for wildlife. The Vermont Wetlands Program often recommends the inclusion of buffers during project review under other authorities, such as Act 250 and Section 248 reviews and water quality certifications under Section 401 of the federal Clean Water Act.

H. UPLAND LAKES PROTECTION AND MANAGEMENT

Upland lake ecosystems provide benefits to the watershed in a manner similar to wetlands. They retain and assimilate phosphorus, preventing it from continuing downstream to Lake Champlain. They are also vulnerable to the impacts of excess nutrient loading from activities in the watershed as well as along the lakeshore. The Lakes and Ponds Program tracks water quality and littoral habitat condition on upland lakes through a variety of monitoring activities conducted by staff and volunteer monitors. Data are assessed every two years as part of the Water Quality Assessment process and used to inform lake-specific management approaches focused on protection of existing water quality, the integrity of littoral habitat, and reduction of nutrient inputs. Management priorities are chiefly implemented through partnerships with lake associations and prioritized through the tactical basin planning process. In some cases, management activities for upland lakes may be formalized through a TMDL process.

Development on lake shorelands is the densest residential development in the state. Studies in Vermont have shown that the majority of shoreland development includes the removal of most of the natural vegetation on the shore. The 2013- 2014 session of the Vermont Legislature passed a Shoreland Protection Act that requires DEC to establish a permit program for development within 250 feet of the water's edge on lakes greater than 10 acres in size. The Act establishes a 100-foot-wide naturally vegetated protected area, regulation of the creation of cleared or impervious areas, and the use of low-impact development best management practices when needed. The Act will ensure that new shoreland development will have minimal impact on the lake in terms of phosphorus and sediment runoff and degradation of aquatic habitat. In addition, areas proposed for redevelopment will not increase their impact on lake and water quality.

LAKE WISE PROGRAM

Lake Wise is a recent addition to the Lakes and Ponds Program designed to provide outreach and technical assistance around shoreland management. Launched in the summer of 2013, the Program provides on-site review of shoreland conditions and recommendations for lessening the impact of existing shoreland development on a lake. More importantly, the program is designed to recognize and reward good shoreland management by providing landowners with an attractive sign to post on their property that indicates they are "Lake Wise." Landowners wishing to retrofit their property to meet Lake Wise standards are given a list of BMPs that can be easily implemented. Participation will be tracked and a cumulative benefit of the program in terms of improved property management will be calculated.

MUNICIPAL REGULATION

The WSMD has a long history of providing technical assistance to towns wishing to improve lake protection through effective shoreland management with the town zoning process. For many years DEC staff provided model bylaws, information, technical review, workshops and meetings with planning commissions, select boards and regional planning commissions to inform and encourage towns to adopt effective shoreland management measures. In 2004, DEC began funding a position at the Vermont League of Cities and Towns (VLCT) to provide assistance to towns on a variety of municipal measures that reduce flood damage and nutrient and sediment pollution, and including shoreland ordinance review and assistance. The Lakes and Ponds Program works closely with VLCT to review and develop model standards for shoreland management and assist with review

and outreach as needed.

SHORELAND STABILIZATION

As part of promoting good shoreland management, and in particular to promote the value of a well vegetated shore in flood resilience and protection of aquatic habitat, DEC supports the use of vegetated stabilization means over those that are primarily structural where technically feasible. DEC staff participated in the development of "The Shoreline Stabilization Handbook" (Northwest Regional Planning Commission, St Albans, VT) and subsequently funded workshops and outreach about the handbook's stabilization designs. Since the historic Lake Champlain basin floods of 2011, DEC funded a grants program managed by the Regional Planning Commission to promote and demonstrate the use of vegetated stabilization measures.

ENCROACHMENT PERMITTING

Lake Encroachment Permits (LEP) are issued under 29 V.S.A Chapter 11 (Management of Lakes and Ponds). Docks, walls, boathouses, bridges, water intakes, dredging and filling all have implications for immediate and long-term water quality, shoreline integrity and littoral habitat. Technical staff provide assistance and work with permit applicants to identify appropriate structural approaches to maintain stability. In general, staff encourage nonstructural approaches which maintain a natural shoreline whenever feasible.

CHAPTER 5 - INTRODUCTION TO WATERSHED RESTORATION USING TACTICAL BASIN PLANNING AND FUNDING

A. INTRODUCTION

As described in earlier chapters, multiple programs are in place to both prevent and reduce excess phosphorus runoff to Lake Champlain. However, without an overall plan to identify, prioritize, fund and implement the necessary phosphorus control measures, time and money are likely to be wasted. In order to promote the most efficient and cost-effective implementation of phosphorus controls, DEC's Watershed Management Division (WSMD) has developed a coordinated watershed assessment, planning, project identification and funding effort. The development of "tactical basin plans" by the WSMD's Monitoring, Assessment and Planning Program, supported by targeted funding efforts provided by the WSMD's Clean Water Initiative Program's ecosystem restoration grants, provides the required synergy between identified priority projects and available funding.

This integration between planning and funding began in 2010, when the WSMD reorganized itself to promote the implementation of integrated water resources management. This reorganization provides a coordinated, efficient means of managing water resource issues through entire watersheds, with the primary objective of maximizing environmental benefit and water resource protection. This reorganization effort included four primary components:

- As a first step, the WSMD integrated its monitoring, assessment and planning sections into a new Monitoring, Assessment and Planning Program (MAPP). Effective watershed management begins with effective planning, which must have a solid, scientific foundation for decision-making. The water resource planning process is closely linked to and dependent upon monitoring and assessment activities. The creation of MAPP enhanced integration of monitoring, assessment and planning.
- The second step in promoting integrated watershed management was the WSMD's development of the Vermont Surface Water Management Strategy. The Strategy serves as an overall guide during the development of basin plans by focusing management, planning, regulatory and funding efforts on basin-specific stressors, thereby allowing for prioritization of efforts to maximize environmental gain. The Strategy is used by basin planners, stakeholders and the public to identify and collectively prioritize the stressors impacting each basin and sub-basin. This strategy and its periodic updates satisfy provisions of Act 64 which call for development of a comprehensive water quality management strategy
- The third step, described in detail below**,** is the tactical basin planning process, which is WSMD's revised approach to watershed-specific management planning. This new process was created based on years of planning and resource management experience by the WSMD. The WSMD recognizes that the tactical basin planning process needs "buy in" from a large constituency, including federal, state, local agencies, the Legislature, watershed councils, planning groups, and the public. Over the past several years, the WSMD has engaged all of these constituencies in discussions regarding the benefits of the tactical planning process. The implementation of the tactical planning process described herein, as augmented by Chapter 5F, satisfies provisions of Act 64 regarding basin plan development.
- The fourth step, described more fully below**,** was the transformation of the former Ecosystem Restoration Program into the WSMD's CWIP which now works closely with MAPP to identify priority projects in each basin and link available funding to ensure cost-effective and

timely implementation. CWIP also works with other state agencies to track and communicate on the State's progress towards achieving TMDL targets and other water quality goals.

B. TACTICAL BASIN PLANNING

As part of the state's Surface Water Management Strategy, Vermont uses tactical basin planning to identify the highest-priority opportunities for sediment and nutrient load reductions in surface waters. The current process for developing and implementing tactical basin plans is described in this section, whereas details on the planning process to implement the Lake Champlain TMDL are set forth in Chapter 7D.

As developed during the period 2010-2014, tactical basin planning uses monitoring and assessment results, combined with sector-specific planning processes, to identify and prioritize implementation projects.

As defined in Vermont's Surface Water Management Strategy, a stressor is a phenomenon with quantifiable deleterious effects on surface waters resulting from the delivery of pollutants (or the production of a pollutant within a waterbody) or an increased threat to public health and safety. Stressors result from certain activities on the landscape, although occasionally natural factors result in stressors being present. Managing stressors requires management of associated activities, and the Surface Water Management Strategy articulates 10 specific stressors that are managed with unique sets of programmatic and implementation tools. When landscape activities are appropriately managed, stressors are reduced or eliminated, resulting in the objectives of the Strategy being achieved, and goals met. Of these 10 stressors, five: land erosion; channel erosion; non-erosion nutrient and organic loading; thermal stress; and to a degree flow alteration, are responsible for the phosphorus runoff which pollutes Lake Champlain.

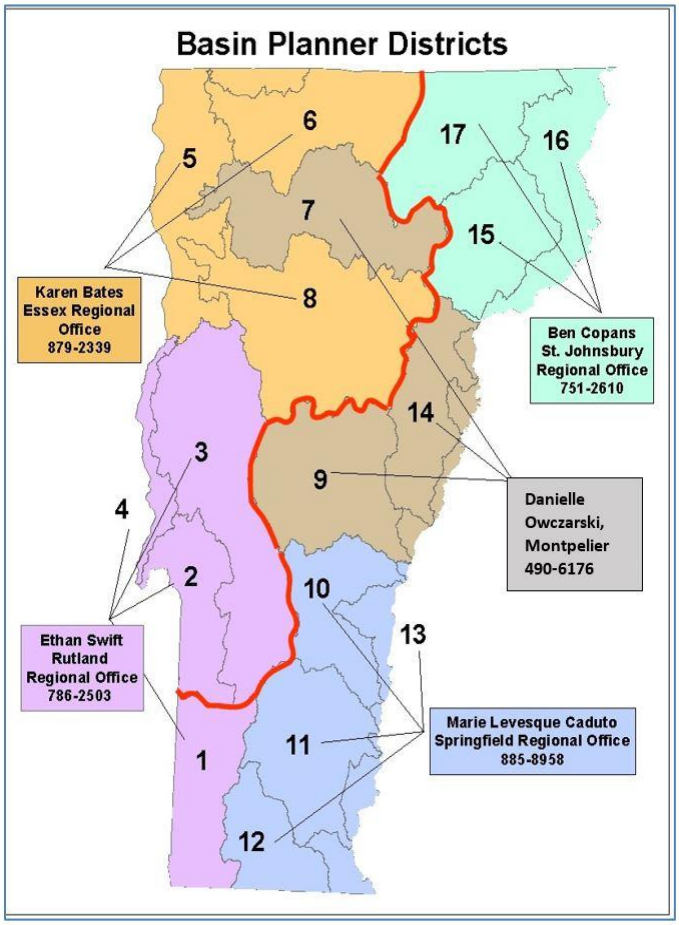


Figure 6 - Watershed planning districts, with associated coordinators. Basins 2 through 8 comprise the Champlain Basin

WSMD relies on tactical basin plans to ensure that funds are directed to the highest-merit implementation opportunities based on identification, targeting, and treatment of specific sites on the landscape determined to be at greatest risk of delivering nutrient and sediment loading to surface waters. These critical sources are identified within land use categories including agricultural land, urban and developed land, road networks, and river corridors. Tactical basin planning is carried out by a group of WSMD planners, each of whom is assigned a district comprised of three major watershed planning units. Watershed planning districts are shown in Figure 6.

Within each planning district, the responsible WSMD planner develops a tactical basin plan on a five-year recurring cycle. Tactical basin planning is WSMD's approach to integrate and focus TMDL implementation for all watersheds in Vermont that are subject to TMDLs. With respect to the Champlain TMDL, the core component of the tactical plan is the Chapter 4, implementation table. The table outlines the priorities of DEC, and partner organizations, for protection or restoration of specific stream or lake/pond segments affected by discrete and specific pollution sources, which are addressed by application of one or more suites of interventions outlined in the Surface Water Management Strategy. The implementation table serves to notify municipalities and partner organizations, such as Conservation Districts, Regional Planning Commissions, Watershed Associations, and other nonprofits of the types and locations of projects that WSMD will support with Ecosystem Restoration Program grants or promote to other funding sources where DEC has leverage.

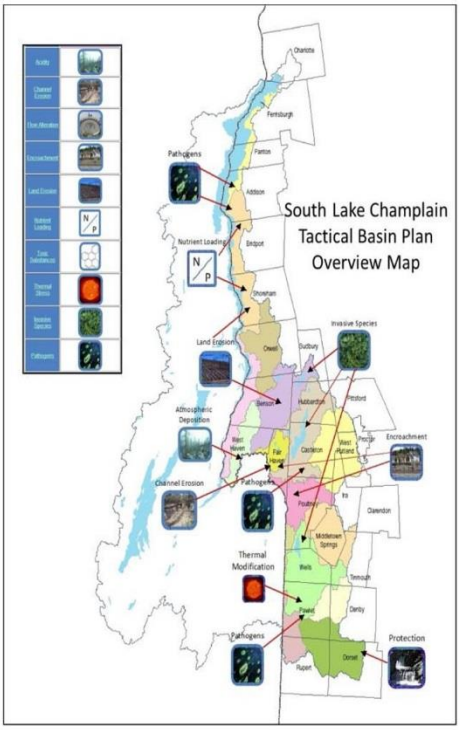


Figure 7 - Example Stressor Targeting Map Summarizing the South Lake Champlain Tactical Basin Plan

The implementation table is updated to support implementation in each basin. The planners biennially review the progress attained in the implementation of specific items, and during that time, conduct public outreach to revisit the projects identified, and insert new priority items that were more recently identified. As such, the implementation table is a living chronicle of the identified priority interventions needed to implement sediment and nutrient load reductions in the Champlain watersheds. As described by Chapter 7, the tactical planning process has been further modernized during the period 2015-2016 to include the development of detailed, Phase 2 TMDL intervention actions, by TMDL allocation category.

TACTICAL BASIN PLANNING – COMPONENT PROCESSES:

In addition to water quality testing, there are five specific assessment processes that are integrated in producing a tactical basin plan. The priorities identified by each assessment are integrated into priorities for implementation. Each assessment process also yields critical on-the-ground information on the types of stressors at play. In sum, the assessment processes used in developing tactical basin plans include:

- Water Quality Monitoring (WQMon);
- Stream Geomorphic Assessment (SGA);
- Stormwater Master Planning (SWMP);
- Better Roads Capital Inventories (BBRCI);
- Agricultural Environmental Management (AEM); and
- Stormwater Mapping and Illicit Detection Discharge and Elimination (IDDE)

Figure 7 shows an example where subwatersheds have been prioritized by stressor, based on the assessment processes listed above, for the South Lake Champlain Basin.

CURRENT IMPLEMENTATION MECHANISMS

Thus far, the mechanisms by which tactical basin plans are developed and implemented are described in detail in the Vermont Surface Water Management Strategy, Chapter Four, at: http://dec.vermont.gov/watershed/map/strategy#SWMS Ch4. The process of implementing the actions identified in the tactical plans relies on a business process developed in 2011 in DEC, which ties the disbursement of the CWIP's ecosystem restoration funds to the specific priorities outlined in the implementation tables of tactical plans. DEC envisions that the Vermont Clean Water Fund will bolster implementation by enhancing the CWIP and other state clean water funding programs.

TACTICAL BASIN PLANNING SCHEDULE

The schedule for issuance of tactical basin plans is found in the Vermont Surface Water Management Strategy, Chapter Four, at: http://dec.vermont.gov/watershed/map/strategy#SWMS Ch4.

This schedule as revised for this Phase 1 Plan is summarized as follows:

	Completion Date
1. Complete South Lake Champlain Tactical Plan	March, 2014
2. Complete North Lake Direct Tactical Plan	June, 2015
3. Complete Lamoille Tactical Plan	September, 2016
4. Update 2013 Missisquoi Tactical Plan	December, 2016
5. Update 2014 South Lake Champlain Tactical Plan	December, 2017
6. Update 2012 Winooski Tactical Plan	December, 2018
7. Update 2012 Otter Creek Tactical Plan	December, 2019

CURRENT CAPABILITY OF TACTICAL BASIN PLANS TO ADDRESS THE LAKE CHAMPLAIN TMDL

The robustness of the implementation table in a tactical basin plan is predicated upon the availability of up to date surface water monitoring and watershed assessment results. As each tactical basin plan is brought forward for revision, either biennially for implementation table review or as a full five-year revision, the revision benefits from the availability of new monitoring data and assessment information. The watershed assessments are scheduled to precede each iteration of a tactical basin plan. Table 8 describes the current priority status of assessments for each major Lake Champlain watershed in Vermont.

Table 9 - Priority for Assessments undertaken in support of Tactical Basin Planning, by major watershed, based on current tactical plan status

	WQMon	SGA	SWMP	BBR	AEM	IDDE
Missisquoi	Medium	Low	Low	Medium	High	Low
North Lake Champlain	Medium	Low	Low	Medium	Medium	Low
Lamoille	High	Medium	Low	High	High	Low
Winooski	Medium	Low	Medium	Medium	Medium	Medium
Otter Creek	Medium	Low	High	High	High (SFO)	Medium
South Lake Champlain	High	Low	High	High	High (SFO)	Low
	Low: Majority of subwatersheds or relevant land use areas have coverage for the assessment type. Medium: Half or more of subwatersheds have coverage for the assessment type. High: Over half of the subwatersheds are in need of this assessment type.					

CURRENT FUNDING SOURCES TO SUPPORT TACTICAL BASIN PLANNING

The watershed planners are currently supported by existing appropriations of general funds. Development of tactical basin plans is reliant on consistent support of the watershed assessment processes for agricultural land, urban and developed land, road networks, and river corridors, and necessitates that funding is available to support the partner organizations that undertake these assessments.

C. VERMONT CLEAN WATER INIATIVE PROGRAM

The original Center for Clean and Clear was established in 2007 to enhance Vermont's commitment to improve water quality in Lake Champlain. Clean and Clear brought together resources dedicated to improving water quality that were previously spread among many state programs. In 2008, the former Center was restructured into the WSMD's Ecosystem Restoration Program to guide the award of state water quality grants and contracts to municipalities, watershed organizations, conservation districts, regional planning commissions, and other partners across the entire state. As part of the Ecosystem Restoration Program's ongoing efforts to reduce surface water pollution from nutrients and sediment, the state budget has included capital funds to support ecosystem restoration projects.

In 2015, the ERP was again restructured to become the Vermont Clean Water Initiative Program (CWIP). Restructuring expanded the program's mission, which now involves:

- Coordinating implementation of priority clean water restoration activities throughout Vermont;
- Managing ecosystem restoration funding programs to support implementation of priority water quality improvement projects; and
- Tracking and reporting on the State's progress in achieving and maintaining clean water statewide.

Implementation activities continue to focus on nonpoint pollution sources, some of which are regulated under a state permitting program and included in the wasteload allocation portion of the Lake Champlain Phosphorus TMDLs. Nonpoint sources are diffuse water pollution sources caused by precipitation or snowmelt running off of developed areas, roads, agricultural lands, and logging areas. Nonpoint source pollution, often referred to as polluted runoff and erosion, delivers excessive amounts of sediment, nutrients, and other pollutants to surface waters, and is the leading cause of water quality degradation in Vermont.

Implementation activities are to address specific requirements of the new Vermont Clean Water Act, commonly referred to as "Act 64," the Lake Champlain Phosphorus TMDLs and this Phase 1 Implementation Plan, Phase 2 Plans (Tactical Basin Plans) as well as other approved TMDLs.

As described in the TMDLs' accountability framework, EPA will assess the State's progress in carrying out the Lake Champlain Phosphorus TMDLs based on the degree to which the State implements priority measures in each of the Phase 2 (Tactical Basin Plans). Thus, it is the goal of WSMD to ensure that implementation priorities identified in tactical basin plans become priority items to be funded using the CWIP's grant monies or other available funds. To this end, the process by which CWIP and other water quality planning and remediation funds are distributed are aligned with the tactical planning process. Throughout the process of plan development, partner organizations are encouraged to participate in a meaningful prioritization exercise to identify the highest priority items for funding support. DEC Watershed coordinators also serve as facilitators in the development of CWIP grant applications. Projects that are specifically identified in tactical plans and associated watershed assessments receive higher scoring in DEC's grant allocation rubric.

CWIP also manages "Section 319" grants. In 1987, Congress enacted Section 319 of the Clean

Water Act which established a national program to abate nonpoint sources of water pollution. These grants are made possible by the federal funds provided to DEC by EPA, and are available to assist in the implementation of projects to promote restoration of water quality by reducing and managing non-point source pollution in Vermont waters. Projects generally fall into two categories, either outreach, planning and assessment projects or implementation projects. For the most part, Section 319 grants are awarded for the control of sediment and nutrients for the improvement of localized water quality, either through direct implementation or through planning efforts that set the stage for project identification and implementation. Overall, these types of management efforts can have significant benefits in the control of phosphorus loading to the Lake.

Finally, CWIP administers a small planning grant program, which consists of federal pass through dollars (about $40,000 annually) provided by EPA under Section 604b of the federal Clean Water Act. These funds are granted to regional planning commissions for water quality planning purposes. For the last few years, in an effort to coordinate implementation and funding through tactical basin planning, ERP has announced that 604b grants are only available for a specific set of identified monitoring, assessment, planning and implementation related projects. ERP will continue to support the regional planning commissions by linking 604b grants with these types of projects. Beginning in state FY2017, CWIP anticipates integrating 604b funding with new state tactical basin planning funds, as directed by Act 64, the Vermont Clean Water Act, to expand the regional planning commissions' capacity to provide planning assistance during the tactical basin planning process.

CHAPTER 6 - VERMONT COMMITMENTS TO FURTHER REDUCE NONPOINT SOURCE POLLUTION

Over the past twelve years, Vermont has spent millions of dollars to reduce nonpoint sources of phosphorus to Vermont's surface waters, including Lake Champlain, and has developed comprehensive stormwater, rivers, wetlands, and agricultural programs to tackle this issue. Despite significant reductions in nonpoint sources, additional work is needed to restore the Lake and meet water quality standards.

As described in Chapter 1 of this Plan and shown in Figure 3, the most significant remaining nonpoint sources of phosphorus include agricultural lands, developed lands, roads, forests and stream channel erosion. EPA approval of the Lake Champlain Phosphorus TMDLs required Vermont to provide additional policy commitments to further reduce phosphorus loading to the Lake. These commitments enabled EPA to find that there are "reasonable assurances" that phosphorus pollutant sources will be reduced so as to meet the TMDLs' load allocation target and water quality standards.

The State recognizes that periodic revisions are an integral element of the Lake Champlain phosphorus cleanup. Armed with experiences gained through more than twelve years of implementation efforts, ANR and AAFM, with assistance from VTrans, were well positioned to respond to EPA's request by:

- Reviewing the effectiveness of programs and strategies currently employed to improve Lake Champlain water quality;
- Identifying targeted program enhancements and new actions to further reduce phosphorus loading to the Lake; and
- Developing a prioritized schedule for implementation to most cost effectively and efficiently implement additional phosphorus reduction efforts.

In November 2013, ANR and AAFM distributed for public comment a draft "State of Vermont Proposal for a Clean Lake Champlain" (http://dec.vermont.gov/sites/dec/files/wsm/erp/Champlain/2013-11-20_DRAFT_Proposal_for_a_Clean_Lake_Champlain.pdf). The Proposal included suggested policy commitments for enhancing existing programs and developing new programs to continue to reduce nonpoint sources. In developing this proposal, ANR met frequently with other state agencies, including VTrans, to refine these commitments. ANR and AAFM, in conjunction with EPA, held six public meetings and took public comments on the draft Proposal; over 500 people attended those meetings. ANR, in partnership with VTrans and the regional planning and development agencies, held 12 additional meetings with municipalities across the State to discuss the draft proposal. The State received over 100 comments, most of which were in support of increasing protection for the Lake and the proposed policy options in the Proposal. These comments were taken into consideration in developing this Phase 1 Plan. A summary of these public comments is available online at: http://dec.vermont.gov/sites/dec/files/wsm/erp/Champlain/docs/2014-04-01Final_Summary_of_Public_Comment_Champlain_TMDL.pdf. In addition, a factsheet containing a list of Frequently Asked Questions is available online at: http://dec.vermont.gov/sites/dec/files/wsm/erp/docs/Lake%20Champlain%20Phosphorus%20TMDL%20Fact%20Sheet.pdf.

The policy commitments evolved into an early version of this plan, released to EPA and presented to the public at a press event in May, 2014. Six months later, the State and EPA hosted four more public meetings in November, 2014 to discuss progress in drafting the TMDL and describe examples of success stories from implementing pollution reduction management practices across all sectors. EPA released the draft TMDL in August, 2015, held three more public meetings with the State and announced a 30-day public comment period on the draft TMDL (which was later extended to a 60-day comment period).

The State completed this update to the Phase 1 Implementation Plan to be better align the Plan with the EPA's final Lake Champlain Phosphorus TMDLs, released on June 17, 2016. The commitments described below are designed to address the major sectors of phosphorus loading to the Lake in an efficient and cost effective manner. As shown in Figure 3, the relative magnitude of each sector varies by watershed, but agricultural land, developed land, and stream channel erosion are major sources across all watersheds. Forest land appears as a large source in Figure 3 primarily because forests occupy over 70% of the landscape in the basin, although phosphorus runoff rates per acre from forest land are typically very low. On the other hand, some sources such as farmsteads and back roads that appear small in Figure 3 can contribute some of the highest rates of phosphorus loading per acre. Both the total amount of the phosphorus load and the loading rate per unit of land area were considered in developing Vermont's policy commitments, which will determine phosphorus reduction priorities over the next twenty years. Vermont perceives a twenty-year planning horizon as a reasonable goal for implementation of these commitments given the enormity of this task and realities of existing funding.

Each commitment includes a description of the new program or enhancement to an existing program, the implementation mechanism, and the implementation steps and timeframe. The Gantt Chart in the Executive Summary summarizes the proposed implementation milestones and timeframes.

A. AGRICULTURAL PROGRAMS

The Vermont Agency of Agriculture, Food & Markets (AAFM) is the lead Agency in Vermont in addressing agricultural nonpoint source pollution. The Agency has several regulatory programs in place to manage nonpoint source pollution and is proposing revisions to these programs in order to more comprehensively address agricultural pollution concerns in Vermont, including Lake Champlain. These proposed revisions embody the vision of the Agency to meet water quality goals and will be applied, as informed by tactical basin planning and adaptive management, to achieve the required reductions in phosphorus.

Substantial improvements have been made in recent years as AAFM has increased permit and inspection programs along with enforcement efforts. AAFM recognizes that a lag time exists between installation of BMPs and resulting phosphorus reductions. For example; development of the Medium Farm Operations (MFO) general permit in 2007, generated a significant amount of technical and financial assistance that resulted in extensive practice implementation but due to the nature of the practices, there may be a lag time before reductions of phosphorus are seen. Implementation of the full suite of practices in nutrient management plans, such as crop rotations,

erosion improvement and cover crops requires time to gain the full practice benefits. AAFM is committed to continued and strengthened efforts focused on ensuring that medium and large farms meet permit standards and to bring the small farm operations under similar inspections and compliance efforts. Further details are described below.

WATER QUALITY PERMITTING PROGRAMS – LFO, MFO, CAFO

Description

Vermont has three permitting programs regulating the management of agricultural wastes to prevent contamination of surface waters – the Medium and Small Farm Operation Rules and supporting Medium Farm Operations (MFO) General Permit and the Small or Medium Farm Individual Permits, the Large Farm Operations (LFO) Rules and Individual Permits, and a Concentrated Animal Feeding Operations (CAFO) Permit.

Medium and Small Farm Operations Permits

The Medium and Small Farm Operational Rule, managed by the Vermont Agency of Agriculture, Food and Markets (AAFM), applies a Vermont state general permit to farms with animal numbers that meet the minimum thresholds, such as dairy farms with 200-699 mature animals, 300-999 cattle or cow/calf pairs, 150-499 horses, 16,500-54,999 turkeys, and 25,000-81,999 laying hens without liquid manure handling system. The rule also provides for an individual permit for small or medium farms that meet specific criteria, such as utilizing new or innovative technologies or a history of non-compliance.

The Medium and Small Farm Operation Rule prohibits and prevents discharges of wastes from a farm's production area to waters of the state and requires manure, compost, and other wastes to be land applied according to a nutrient management plan. Prior to Act 64, AAFM was required by law to inspect all farms permitted under these rules at least once every five years (20% annually) and many farms are visited more often, due to permit compliance needs, project management assistance, and practice implementation. Due to the passage of Act 64, MFOs will now be inspected a minimum of once every three years.

The MFO general permit has been in existence since February, 2007 and was revised in 2012. Currently, there are 141 farms, (with 230 facilities), under the MFO general permit throughout Vermont, and 104 of these farms, (172 separate facilities), are in the Vermont portion of the Lake Champlain basin.

Large Farm Operations Permit

The LFO program, also managed by the AAFM, applies an individual permit to farms with animal numbers that meet the minimum thresholds, such as having more than 700 mature dairy cows, 1,000 beef cattle or cow/calf pairs, 1,000 young-stock or heifers, 500 horses, 55,000 turkeys, or 82,000 laying hens without a liquid manure handling system. An LFO permit prohibits and prevents the discharge of wastes from a farm's production area to waters of the state and requires the farm to land apply manure, compost, and other wastes according to a nutrient management plan. An LFO permit also regulates odor, noise, traffic, insects, flies, and other pests, construction siting, and setbacks. AAFM inspects all LFOs throughout Vermont and the Lake Champlain basin annually. The LFO Rules have been in effect since 1999, and were updated in 2007 There are 27

permitted LFO farms, (80 facilities), 20 farms are in the Lake Champlain basin.

Inspections of MFO and LFO

AAFM currently has four inspectors and a supervisor who also assists with inspections of the MFO and LFO permitted farms. In 2012, AAFM changed the inspection protocol for MFO/LFO inspections to include increased spot checks of field practices. Through this requirement, inspectors visit a minimum of three fields at each inspection, confirming compliance with the farm's mandatory nutrient management plan. This increases the length of time to complete each inspection but ensures better compliance with the mandatory nutrient management plans on these farms. In 2015-2016, the Agency focused on assessing the quality of nutrient management plans being provided to farmers by certified planners in addition to the level of compliance. This information is the foundation for establishing a sound program of certified nutrient management planners and re-establishing the expectations on record keeping and notification when farms alter their plans.

AAFM will increase the number of inspections, increase time on farms with field checks and accommodate for future size and technology growth of permitted farms. AAFM will coordinate enforcement information to ensure consistent progress, and maintain a database to ensure ranking of high priority farms.

Small Farm Inspections and Compliance

2014 was the first year that AAFM had a staff person solely dedicated to small farm inspections. The number of inspectors at the Agency increased from one to four in 2015-2016 which will allow for increased inspection of small farms. Act 64 requires that AAFM develop a small farm certification program, which is incorporated in the draft Required Agricultural Practices (RAPs); currently undergoing the rule making process. The draft RAPs state that farms that house 50 dairy cows, (and comparable numbers for other species of animals) and use 10 or more acres of land for raising and feeding livestock will be required to be certified by AAFM. Additionally, farms that do not have livestock but cultivate 50 or more acres in vegetable or annual crop production would have to be certified farms. AAFM will be developing the certification process and forms in 2016. Historically, small farms were not inspected regularly, and primarily on a complaint driven basis. The draft RAPs state that AAFM will inspect certified small farms once every seven years and more frequently as needed based on water quality and/or compliance issues. Certified small farms will also be required to develop and implement a nutrient management plan that meets the USDA NRCS 590 standard which is currently required for MFOs and LFOs.

Enforcement

The passage of Act 64 increased the ability of AAFM to enforce on water quality regulations. This new authority allowed for emergency assistance orders to protect water quality, mandatory corrective actions and the authority of AAFM to require the reduction of livestock where livestock waste exceeds farm capacity and no remediation is possible. This legislation also provides AAFM with civil enforcement authority through the Attorney General to enjoin activities, order corrective actions and levy civil penalties of up to $85,000 for violations.

Also under this new legislation, the Vermont Property Valuation and Review can remove agricultural land or a farm building from the Vermont Use Value Appraisal program if the owner/operator has been identified by AAFM as out of compliance with water quality requirements or not in compliance with an enforcement order for an agricultural water quality violation.

CAFO Permit

The Concentrated Animal Feeding Operations (CAFO) general permit is a federal Clean Water Act permit for MFOs managed by the Vermont Department of Environmental Conservation (DEC) since June 2013. It requires farms to properly design, construct, operate, and maintain production areas to prevent waste. The permit prohibits a discharge of manure, litter, or wastewater, except when direct precipitation equivalent to or greater than a 25-year, 24-hour storm event causes a discharge. Any farm, regardless of size, that directly discharges to a surface water body could be required to obtain a CAFO individual permit. There are currently no CAFO permitted farms in Vermont. DEC is responsible for inspecting a minimum of 12 farms each year to evaluate the need for a CAFO permit, per agreements with EPA. The farms are chosen based on discussion with AAFM and review of past water quality concerns and are of all sizes. Priority is given to farms with previous violations and those in priority watersheds. The State will increase this level of inspection with a focus on farms in critical watersheds in the Lake Champlain Basin.

Implementation Mechanism

AAFM and DEC will continue to prepare annual compliance reports as required to meet the goals outlined below in the implementation steps. The compliance reports will contain state-verified information, including but not limited to compliance with nutrient management plan requirements, and the nature of any documented discharges. DEC, AAFM and the Attorney General's office have also increased regular coordination, resulting in substantial enforcement and penalty actions in 2014.

Implementation Steps and Timeframe

1. AAFM will inspect all LFOs and MFOs within the Lake Champlain basin
    a. All LFOs — Annually
    b. All MFOs — Every three years
    c. Enhance MFO inspection protocols — 2014
    d. Enhanced NMP compliance (3 field checks) — 2012
2. AAFM and DEC to inspect 75 potential VT CAFOs Annually
3. DEC and AAFM will continue to conduct on-farm multi-agency inspections to ensure consistency in the inspection process
    a. Agencies will conduct a minimum of 10 joint inspections — Annually
    b. DEC and AAFM will hold trainings for inspection staff — Bi-annually
    c. AAFM and DEC will continue to produce compliance reports that will be shared between agencies — Annually
4. DEC and AAFM will continue to coordinate inspection and enforcement actions and has begun quarterly compliance meetings to increase coordination.
    a. DEC and AAFM representatives will meet to share current activity — Monthly
    b. DEC, AAFM, Attorney General and DEC Compliance and Enforcement Division (CED) will meet to share current activity — Quarterly
    c. DEC and AAFM will update the 2007 MOU — 2016

REQUIRED AGRICULTURAL PRACTICE RULE UPDATE AND COMPLIANCE

Description

Act 64 required significant changes to Vermont's Required Agricultural Practices[10], including a name change to the "Required Agricultural Practices" or "RAPs", reflecting the fact that these practices are not and never have been optional. The Vermont Required Agricultural Practice regulations (RAPs), previously required all farms in the state, regardless of size and type of operation, to adopt and implement a set of minimum conservation practices to protect water quality. Examples include the winter spreading ban which forbids spreading between December 15 and April 1, no allowance for any direct discharges, minimum 10' buffers along surface waters, no stacking or storage of manure on lands subject to annual overflow, and mortality management requirements. The RAPs did not require a written nutrient management plan (NMP), however the rules required compliance with many aspects of nutrient management planning, including required soil tests every five years, applying nutrient applications consistent with soil tests, and meeting 2T (soil erosion tolerance). Education and enforcement of these provisions of the RAPs was limited due to lack of resources.

AAFM began revising the RAPs in 2015 through an extensive outreach and public comment process. The first draft of the revisions was released in October of 2015. A public comment period ended in December and the RAPs were revised and re-released for public comment in February of 2016. The third revision was released in May of 2016 when the proposed rule was filed with the Vermont Secretary of State. A public comment period was held through July and included 6 public hearings and two webinars. Statewide 89 meetings were held with more than 2,000 attendees, and included multiple presentations to specific farm-related groups. The proposed effective date for the RAPs is currently October 2016 following the required legislative rule-making process.

Act 64 also required that the RAPs be modified in 2018 to include requirements for reducing nutrient contribution to waters of the state from tile drains. Draft regulations will be developed in 2016 and presented to the legislature, as required by Act 64, in January of 2017. When the RAPs are revised in 2018, AAFM has also committed to evaluating the current status of effectiveness of the RAPs, the implementation of additional best management practices, and the current water quality condition of waters of the State. At that time, the Secretary of Agriculture may consider additional changes to the RAPs, as appropriate, to meet the water quality goals of the state.

Farm Outreach, Education and Assessments

In June, 2015, AAFM initiated the North Lake Farm Survey. Through this process, AAFM staff were redirected from their statewide territories to focus on all known agricultural operations in the priority Missisquoi Bay and St. Albans Bay watersheds in Franklin and Orleans Counties. AAFM visited 375 farms to assess water quality concerns and needs. Farms were informed of water quality concerns and resources available for assistance. Farms with direct discharges were referred to DEC as required by state statute.

This same process will be duplicated in additional watersheds. AAFM will begin the evaluation process for all small dairies, MFO and LFO farms in South Lake Basin of Lake Champlain by the

[10] Note: The Required Agricultural practices are currently in draft form and proceeding through the Vermont rule-making process. Elements of the RAPs (other than those already required in Act 64) are subject to change.

end of 2021. AAFM will begin the evaluation process for all other significant livestock operations in the South Lake by the end of 2027. AAFM intends on training staff to conduct whole farm inspections as part of the investigation process. AAFM believes that each inspector can address 75 farm facilities per year (including inspection and enforcement).

Vermont recognizes that further reductions of agricultural nonpoint source pollution will necessitate taking additional, aggressive actions pertaining to the RAPs to reduce water pollution and achieve a more consistent and equitable regulatory environment for all farms. AAFM also recognizes the enormous need for education about the current regulations as well as any proposed additional requirements, and are working closely with non-regulatory partners who can, and have already taken steps to help with that outreach.

Act 64 requires specific changes to the RAPs which are outlined below. As of this date, the RAPs have been filed with the Interagency on Administrative Rules (ICAR) and are expected to be finalized through the rule making process in the late fall of 2016. Each of these actions will require extensive outreach and education towards implementation of the rules and remediation of water quality problems.

Upon completion of the RAP rulemaking, AAFM has the immediate authority to enforce any violations, and does not need additional statutory changes to proceed with compliance.

PROPOSED REGULATORY UPDATES TO THE REQUIRED AGRICULTURAL PRACTICES

Buffers and erosion

MFOs and LFOs are required to have 25 foot buffers and meet an erosion standard of "T", while prior to the RAPs and Act 64, small farms were allowed to have 10 foot buffers, with 25 feet at points of runoff, and meet "2T". ("T" value stands for "Tolerable soil loss". It is the maximum amount of soil loss that can be tolerated and still permit a high level of crop productivity to be sustained. A lower "T" is beneficial to water quality and for the economics of the land manager.)

Research has proven the value of larger buffers for water quality, and reducing the erosive loss from fields and gullies has been well documented as a great potential for decreasing sedimentation to surface water.

The draft RAPs require consistent 25' buffers and manure setbacks from surface water across all farm sizes, 10 foot buffers and manure setbacks on all ditches, stabilization of field borne gully erosion, and reducing the field tolerable soil loss for fields in annual crop production to "T". In addition, the draft RAPs also state that any ditch that is determined to potentially transport significant waste or nutrients to surface water shall be buffered with a minimum of 25 feet of perennial vegetation. This is consistent with the USDA 590 standard nutrient management requirements.

Nutrient Management in the RAPs

All MFOs and LFOs are required to have nutrient management plans (NMPs) that meet the federal NRCS 590 standard. Following the approval of the revised RAPs, all certified small farms will also be required to have a 590 NMP. The enforcement of this new standard will be accomplished with field spot checks on farms in the NMP cost-share programs and inspections on the permitted and certified farms to ensure compliance with the NMP. Small farms that are below the limit required for certification and still under the authority of the RAPs must follow nutrient management criteria including soil sampling every three years, accounting for all sources of nutrients and keeping records, and applying nutrients based on soil tests and crop uptake.

The draft RAPs also include substantial changes in field practices and nutrient management. Some of these proposed changes have received numerous comments from farmers and the public during the public comment period and the Agency is in the process of considering that input for the final draft rule that will be filed with the Legislative Committee on Administrative Rules (LCAR).

- The Secretary of Agriculture will have the authority to extend the winter ban on spreading manure beyond the current regulatory December 15-April 1 window when weather and soil conditions indicate that manure application would pose a significant potential of runoff to waters of the state.
- As currently drafted, manure and other wastes cannot be spread on fields that are subject to frequent flooding (as described in the USDA Soil Survey Flooding Frequency Class) after Oct 15 or before April 15. Wastes cannot be spread when field conditions are conducive to flooding, runoff, ponding or other off-site movement, or on lands that are saturated, frozen, snow-covered, or have exposed bedrock.
- Also as currently drafted, manure and other wastes cannot be applied to annual croplands where the average field slope exceeds 10% unless a 100’ permanent vegetated buffer zone has been established.

These changes are important for water quality improvement but also for the agricultural community. These rule changes will require extensive outreach and education to farmers, especially changes in regards to erosion tolerance. Many small farms are not aware of their current erosion rates, and lack the technical knowledge and software to determine this and the appropriate practices changes without some form of technical assistance. Management changes will be necessary on many farms to meet the required “T” level.

Livestock Exclusion

The AAPs previously required that adequate vegetation be maintained on streambanks by limiting animal access and trampling. The proposed change to the RAPs will explicitly exclude livestock from perennial streams where erosion is prevalent and in all production areas. This change will clarify the requirement for livestock exclusion in critical source areas.

The Agency believes that targeting the highest priority locations for livestock exclusion will yield the greatest cost-benefit for water quality. With limited resources to implement a wide variety of non-point source agricultural pollution strategies, targeting resources to the highest priorities is the best strategy for the near term phosphorus reduction benefits. EPA estimated that pasture accounts for 3.8% of the total phosphorus loading to Lake Champlain and AAFM believes this RAP change will significantly reduce a major portion of this. Extensive research has clearly demonstrated that eroding land is a substantial contributor to nutrient loading, and this approach of targeting eroding

banks will provide focused attention to the higher benefit opportunities. Prioritizing these targeted areas will also provide the opportunity to focus remaining resources on addressing the cropland loadings which are estimated to be 35.2% of the total phosphorus loading to Lake Champlain.

Under this proposed change in the RAPs, erosion at any section of a stream where animals have access, except at defined stream crossings, would trigger the requirement for mandatory exclusion or a major change in management that would keep the livestock out of the stream. Exclusion would be required for the length of the stream and will address any areas where erosion is of high potential, and will not be limited only to the eroding section. The Secretary will evaluate any questionable sites on a case-by-case basis and maintain the option of requiring exclusion where any water quality impacts exist.

Small Farm Certification Program

Currently, small farmers are not required to submit any type of certification of compliance (COC) with the RAPs (unlike MFOs and LFOs which must obtain permits and submit annual reports). The revised RAPs will require all small farms that meet certain criteria to submit an annual certification form that indicates compliance with the RAPs. The COC process will initially start with printed reports completed by the farmer, similar to the MFO and LFO annual reports. AAFM will begin the process of developing a web-based online submission option for COC compliance for farmers with internet accessibility. The target release date of the web-based submission option is 2020.

AAFM is currently in the process of developing a water quality database which may expand the ability for online submission of MFO and LFO reports. Ideally, technical staff will have the ability to assist landowners with submission during field visits. SFOs will be required to submit COC by 2017. Certified small farms will also need to meet a regular inspection schedule, mandatory water quality training, and development and implementation of a USDA 590 standard nutrient management plan.

Additional Proposed RAP Changes

All farms above specific criteria, but not included in an LFO or MFO permit or small farm certification will be required to comply with the RAPs. This includes all farms with either a gross annual income of agricultural products above $2,000 or is raising, feeding or managing at least five cows, four horses (or other comparable sizes in other species) on no less than 4.0 contiguous acres. The complete proposed requirements in the RAPs can be found at www.agriculture.vermont.gov.

Other additions or updates to the draft RAPs include:

1. Permitted or certified farmers will be required to obtain a minimum of four hours of approved water quality training at least once every five years.
2. Custom applicators of manure or other agricultural wastes must be certified and must obtain a minimum of eight hours of training every five years.
3. AAFM will be working with partners to develop training programs for both requirements.
4. Increased requirements for field stacking of manure to ensure no discharges
5. Increased requirements for the management of mortalities and on-farm composting
6. Increased clarification and references with regards to groundwater, construction of farm structures and streambank management.

Implementation Mechanism

The rulemaking process will be conducted to enable the proposed changes to the state regulatory RAPs. The proposed rule changes include the following practices as well as additional requirements:

1. A minimum 25 foot perennial vegetated buffers along all perennial streams
2. 10-foot perennial vegetated buffers along field ditches
3. Stabilization of field borne gully erosion
4. All farms meet "T" for tolerable soil loss, as defined by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), for the prevalent soil type and applied to all farm fields in annual crop production
5. Increased livestock exclusion requirements
6. Development and implementation of a small farm certification process

Implementation Steps and Timeframe

Note: All efforts will begin in prioritized critical source areas and targeted priority watersheds. Priority watersheds are those most impacted by agricultural activities.

1. Update the RAP rule with additional practices and begin implementation by all farms in the Lake Champlain basin
    a. Initiate rulemaking — 2015
    b. Complete rulemaking — 2016
    c. Begin education of potential new regulations — 2014
    d. Begin enforcement of new regulations — 2017
2. Conduct small farm evaluation process in priority watersheds
    a. Survey all small dairies in Missisquoi and St. Albans Bay under current RAPs (North Lake Farm Survey) — 2015-2016
    b. South Lake Farm Survey all small dairies in South Lake — 2021-Ongoing
    c. Deploy the Conservation Law Foundation Settlement Agreement — 2016-2041
3. Develop small farm certification of compliance (COC) process
    a. Adopt rules for COC — 2016
    b. Develop COC program and certification forms — 2016-17
    c. Develop online COC process — 2020
    d. Conduct an extensive education and outreach process for COC — 2016-19
    e. Require SFO to submit certification — 2017
4. Require livestock exclusion in production areas and where erosion exists
    a. Develop a livestock exclusion incentive program that will include a declining scale cost-share with a time provision to encourage early adoption — 2017
5. Update the RAPs to include requirements for addressing tile drains, evaluate effectiveness of the RAPs and consider additional changes, as appropriate, to meet the water quality goals of the state. — 2018

Nutrient Management Plans

Under the draft RAPs all certified small farms, and under the MFO and LFO rules, all MFO and LFO farms are required to develop, update and implement a nutrient management plan (NMP) that meets the USDA/NRCS 590 standard. Both AAFM and NRCS provide funding to help develop and update these plans.

A 590 plan includes a nutrient application plan, with additional requirements to minimize nutrient runoff into surface waters. The full document includes maps, soil and manure test results, current and planned crop yields, location of sensitive areas, each field's tolerable soil loss ("T"), field nutrient indices (to calculate potential for phosphorus runoff and nitrogen losses), and other possible requirements and goals. The plan indicates all structural practices that are related to nutrient storage and application and ensures that they are installed and maintained to NRCS standards. The NRCS standards are designed based on rainfall data and the current standard is to collect the 25 year, 24-hour storm event. As climate changes, this value will be updated by NRCS. This is also the structural standard required by the VT CAFO permit and in the RAPs for any new waste storage structure built after July 1, 2006. The MFO and LFO permits also reference the federal NRCS standard.

The nutrient management plan can be quite large depending on farm size, requires a level of knowledge and equipment for certain calculations, and can be expensive to develop despite cost-share funding. AAFM inspectors review NMPs at the time of inspection on MFOs and LFOs, and increased field inspection protocols in 2014. Further enforcement, has been limited but will increase with increased inspection staff at AAFM.

Act 64 requires the RAPs to include nutrient management standards for farms. The Ag Workgroup recommended that a matrix be developed that would look at not only farm size and number of animals but also animal density, proximity to water and other factors related to potential nutrient runoff. Farms above these criteria could be required to create a 590 standard plan. Farms below could either be required to either use a small farm NMP template (to be developed) or meet current RAPs (for very small operations that do not require an NMP).

Field Practices and Nutrient Management

Nutrient management planning involves evaluation of field soil loss and the careful application of nutrients to cropland and pastures to ensure that nutrients do not exceed the needs of the crop and contribute to water quality impairments. An NMP outlines the best field practices to reach these goals. Substantial work has been done in the Lake Champlain basin in the past five years with the assistance of agronomists and partners, to educate farmers about current land and management practices that may be new to particular areas and soil types. Funding for equipment to demonstrate and implement these practices has also increased and is critical to increased practice implementation and acceptance. Many of these practices and equipment require extensive education to minimize risk (e.g. transitioning from traditional plowing to reduced tillage) or ensure successful implementation (e.g. timing and seeding of cover crops, or manure injection around tile drainage). It is essential that the current staff working directly with farmers continue in that capacity and that outreach opportunities increase.

Examples of field practices determined by AAFM and DEC to be of greatest value to water quality and in need of continued resources are listed below. This list is not meant to be exclusive of new and adaptive management opportunities. The current NRCS-funded "edge-of-field monitoring" research, being conducted on 8 farms in the Lake Champlain Basin includes many of the below conservation practices to help determine the local value of implementation. As additional research documenting the reduction values of these specific practices becomes available, an adaptive management approach will be taken to further commitments to increase implementation and implementation.

- Cover Crops: Cover cropping is a challenge on heavy clay soils that require tillage and even on lighter soils when weather does not allow for seeding in a timely manner for adequate fall cover. New programs such as aerial seeding by helicopter and equipment that can seed cover crops during the corn growing season are being evaluated and other alternatives such as shorter day corn options and new seeding equipment need continued funding, education and research, as requirements for cover crops increase in the RAPs.
- Reduced tillage: The AAFM Capital Equipment Assistance Program (CEAP) has previously provided funding for on-farm purchase of tools such as no-till planters that are increasing the acreage dedicated to reduced tillage practices that decrease soil erosion and provide cover to bare fields. Education about this practice is crucial to adoption by traditional farmers. Reduced tillage is a practice that can require substantial management change, and can be challenging especially in the first few years of implementation, however may be a good alternative on some fields where meeting the soil erosion (T) requirements are more difficult. AAFM intends to reactivate the CEAP program in 2017 to support precision nutrient application technologies (see below).
- Manure injection or aeration: CEAP has also provided funding for the purchase of manure injection equipment. Increased use of this equipment is valuable especially in areas close to surface water. Manure injectors are able to apply nutrients into hay ground versus the typical surface application which can be prone to runoff. This equipment is extremely expensive and the CEAP funds will be used to incentivize equipment purchase where most appropriate. Education is also critical to ensure that injection equipment is used appropriately in tile-drained fields to address the potential for increasing connections to tile.
- Improving soil health and soil quality: Improving soil health and quality by decreasing compaction increases the infiltration of water, reducing erosion and nutrient runoff, and further education about these impacts as well as the economic benefits of good soil health needs to be conducted. Lower compaction rates can be attained through changes in land practices such as reduced tillage and precision nutrient management that decreases use of heavy equipment. Improved soil health has benefits beyond water quality by increasing water holding capacity and potentially flood resilience.
- Precision nutrient application: Precision nutrient application allows for site-specific (in-field) detailed application of nutrients using GPS technology on farm equipment. These units are expensive and require training on how to use the technology and computer operating systems, but can more specifically allocate nutrients within individual fields to decrease any potential for nutrient losses. This equipment can also assist farmers in NMP data collection and reporting. The CEAP program is currently providing 50% cost-share for the installation of flow meters, data loggers and GPS units.
- Management of farm roads: Many farm roads, including roads that access sugaring

operations, are highly compacted areas and can act as conduits for nutrient runoff. Additional resources should be allocated for road management similar to forest road practices.

- Controlled tile drainage: Tile drains are currently being installed in VT by farmers to increase productivity. While well drained fields are less likely to have gully erosion and soil loss, research has shown that drainage from tile can contain high nutrient levels, especially dissolved phosphorus. Research and education about control structures as well as appropriate installation and management of tile drains is necessary. Several research studies are ongoing in Vermont to evaluate tile drain loading potential, management of tiles and media for tile drain outlets. AAFM and ANR jointly submitted an interim report to the VT Legislature in February, 2016 on the current known status of tile drains in Vermont, and will be providing a final report with ANR by January 15, 2017 which will include recommendations for tile drain policies and regulations. The RAPs will be revised to include requirements for tile drainage by January, 2018.
- Updates to the NRCS 590 standard: Through a USDA Conservation Innovation Grant, NRCS is funding a study to evaluate the phosphorus index for updating in the 590 standards. The P-index is a key part of conservation planning and assesses the potential for phosphorus runoff from individual fields based on multiple characteristics. The CIG study will also include developing a risk factor for phosphorus loading from tile drains and adaptation of subsurface loss methods using phosphorus indices from other states. Following this, NRCS intends to work with the State and partners to evaluate any needed changes in the current 590 standard to potentially address nutrient management and tile drains.
- Federal Farm Bill: Provide support and assistance to NRCS in development of screening and ranking procedures for Farm Bill funds that increase opportunities for implementation of high priority EQIP practices (e.g. transitioning from annual crops to permanent hay land).
- CREP program: The federal Conservation Reserve Enhancement Program provides an annual compensation rate for removing environmentally sensitive land from production and adding practices such as extended buffers. Vermont is able to leverage a 4:1 return on state investment in this program; however, producer enrollment has dramatically decreased in recent years due to earlier cuts in the rental rate payments, and limited resources for outreach and education to producers. This program needs rule updates to address program growth and complexity, and agreements are becoming more legally challenging as land transitions occur from the original participant. AAFM intends to evaluate their policies and possible adaptations to the CREP program structure to increase re-enrollment as well as additional new enrollments. This evaluation will occur in 2017.

Implementation of all BMPs must increase but with limited resources, AAFM is prioritizing efforts by focusing on potential critical source areas that have a high risk of causing or contributing to phosphorus loading. Mapping has occurred throughout the Lake Champlain watershed, using LIDAR technology, to identify the highest areas for phosphorus loading and erosion risk, through contractual work and extensive NRCS assessments. This prioritization of risk potential is included in the individual inspections conducted by AAFM as well as in the broader tactical basin planning.

Research

Implementation of current practices will be encouraged, funded and incentivized, but additional research is also needed to allow for adaptive management in agricultural water quality. AAFM and DEC will continue to encourage and support initiatives that show promise through funding and collaboration and explore external funding opportunities. Some current examples of areas of interest to the agencies for continued research include but are not limited to:

- On-farm digesters that increase the use of manure as bedding and the transport of P off-farm.
- An evaluation of tools other than RUSLE that will be more applicable as a water quality measurement
- Opportunities for increased implementation of precision nutrient and management and the connection to computerized/streamlined NMPs (indicated above)
- Alternative buffers and cover crops that will provide necessary water quality needs but have other potential value such as fruit or fiber bearing buffers.
- Alternative technologies for addressing agricultural phosphorus removal. Additional opportunities for end-of-pipe mitigation for tile drains in addition to current research being conducted in Franklin County. Further action on this will follow the 2016 release of a tile drain literature review being developed with funding from the Lake Champlain Basin Program.
- Market incentives (e.g. environmental branding for dairy products, opportunities through the VT Environmental Stewardship Program) for agricultural sustainability that will increase ability for farmers to fund additional water quality improvements.
- Assessing whether a nutrient trading program between agricultural operations has merit to reduce phosphorus loading in key watersheds

Partner Assistance

AAFM and DEC acknowledge the value of other governmental partners (USDA/NRCS, US Fish and Wildlife), educational partners (UVM Extension System) and non-profit partners (VT Association of Conservation Districts, watershed groups, farmer coalitions), and private for- profit consulting firms, all of whom are non-regulatory and have valuable connections in the agricultural community. Collaborating with these partners and assisting in their support are priorities for both agencies, and critical to the success of the state's water quality improvement efforts. AAFM and DEC will support funding to assist our partners in these efforts as much as possible. AAFM assumes the operational capacity of key federal partners such as the US Department of Agriculture Natural Resource Conservation Service (NRCS) remains constant at current levels in development of this implementation plan. AAFM and DEC also support increased funding to partners for the critical educational needs as new regulations are required of agricultural producers.

Implementation Mechanism

As part of the RAP revisions, AAFM will standardize nutrient management planning across all agricultural operations, work to increase trainings and educational and outreach opportunities with partners, and provide technical assistance to increase the implementation of NMPs and critical field practices that lead to improvements in water quality.

Implementation Steps and Timeframe

1. Increase development and implementation of Nutrient Management Plans
    a. Create a workgroup, perhaps akin to the Chesapeake Bay Nutrient Management Commission, which is charged with reviewing, revising and keeping NMP standards up to date and ensuring NMP planners are appropriately certified and professionally accountable 2016-2018
    b. Provide increased education, outreach and cost-sharing funds for NMP development and implementation 2014-2020
    c. Expand small farm NMP development courses/workshops through partners such as UVM Extension and VACD 2015-2020
    d. Support farmer groups (e.g. Framers Watershed alliance, Champlain Valley Farmers Coalition) and support additional efforts in the South Lake. Provide farmer groups with BMP funds and small project implementation as funding allows 2016-2036
2. Improve field practice implementation
    a. Support RAP and BMP implementation on small farms by key partners and staff who will focus on the key areas of field practices indicated above Ongoing
    b. Address tile drainage
        i. Develop final report for legislature with recommendations 2017
        ii. Revise RAPs to include requirements to reduce nutrients from tile drainage 2018
    c. Increase targeted outreach in the key watershed areas of St. Albans Bay, Missisquoi Bay and South Lake 2015-2019
3. Increase training and certification programs
    a. Provide funding to develop and coordinate water quality trainings for farmers
        i. Adopt requirements for trainings (in RAP) 2016
        ii. Adopt a schedule for water quality trainings for farmers 2017
        iii. Develop educational courses for farmers with partners 2016-2018
        iv. Develop online courses for farmer educational credits 2020
    b. Provide funding to develop and offer a NMP training program for TSPs 2017
    c. Provide funding to develop and offer a training program for manure applicators 2016
    d. Certification of manure applicators
        i. Obtain statutory authority for certification processes 2015
        ii. Provide outreach and education 2015-2018
        iii. Mandate certification 2017

ADDITIONAL EFFORTS IN CRITICAL WATERSHEDS (MISSISQUOI BAY, ST. ALBANS BAY, SOUTH LAKE)

Description

Higher nutrient loading from agricultural runoff and a legacy of historic phosphorus loads residing in the lake sediments along with large drainage areas flowing into small water basins in the subwatersheds of Missisquoi Bay, St. Albans Bay and South Lake will require that additional measures be implemented in these areas to achieve the Lake Champlain TMDL requirements. Priority will be given to these areas through increased education, outreach and funding

opportunities, targeted funding, and higher cost-share opportunities. Specific practices are described above.

Implementation Mechanism

In addition to prioritizations mentioned in previous sections, additional funding and outreach is currently and will continue to be targeted to critical source areas in these priority watersheds. Critical source areas (CSA) and areas of erosion risk potential identified by NRCS will be the focus of education, new initiatives, and enforcement. This focus is based on recent research by Stone Environmental, Inc. which demonstrated that approximately 80% of the nutrient reduction goals can be achieved by focusing on 20% of the area (i.e. CSA). Addressing these areas will provide the greatest reductions required by the TMDL. Focusing on higher benefit areas in no way indicates that other areas of concern, especially those with water quality violations or lack of state required conservation practices will be ignored. The following additional implementation steps are seen as initiatives above and beyond current programs and practices in recognition of the greater nutrient reduction needs of these watersheds. AAFM and DEC remain committed to addressing all water quality concerns, violations, and needs through ongoing programs and creative, innovative new efforts.

The focus on prioritized planning and implementation in critical watersheds has been supported by partner efforts. After an extensive evaluation process with DEC, AAFM and partners, NRCS in Vermont committed to focusing funding in four priority subwatersheds of Missisquoi Bay, St. Albans Bay and South Lake. This year, NRCS conducted an extensive strategic planning process to assess the exact needs and opportunities in each of these watersheds and developed detailed subwatershed plans that identify priority BMPs from the TMDL and propose targeted phosphorus reductions in these regions. Funding from NRCS was provided in their FY 2015 and 2016 budgets for these key watersheds. Based on an evaluation of this process, NRCS hopes to continue this methodology in close coordination with the DEC Tactical Basin Planning process.

Additional efforts are also being piloted in these critical watersheds. One example is the Environmental Stewardship Program, still in development with partners and farmers. In 2012, grants from multiple sources, including the EPA and USDA/NRCS, as well as private local foundations, provided funding for a concentrated outreach program with the agricultural community. A key deliverable was to evaluate the feasibility of an environmental recognition program for the State of Vermont. Hundreds of farmers, through meetings, focus groups, and surveys, participated in this discussion, as well as many members of the environmental community. AAFM is developing an incentive-based program, that will reward farmers who install or employ additional BMPs above regulatory requirements. This approach was approved by the Ag Workgroup and a set of levels of incentives is in development. After further refinement, a pilot will be implemented in 2016 as part of the RCPP grant effort.

Another effort being considered was the concept of a water quality nutrient trading program for phosphorus in Vermont. A feasibility analysis on such a program was conducted in 2015, which examined the potential supply and demand for phosphorus credits between NPS loads from agriculture and municipal stormwater phosphorus sources. This analysis revealed that due to the high regulatory requirements for agriculture in Vermont, a trading program between agriculture and stormwater does not seem feasible without allowing credit generation from efforts that bring agriculture into compliance. AAFM is now looking into the potential of an agriculture-to-

agriculture NPS trading program, which might allow farms to trade phosphorus credits with other farms in their watershed. This analysis is expected to be complete by the end of 2016.

CLF Agreement

In 2014, the Secretary of Agriculture was petitioned by the Conservation Law Foundation (CLF) to require that agricultural operations identified within critical source areas in the Missisquoi Bay Basin be subject to mandatory BMPs. The Secretary initially denied this request, and following Act 64 and a further appeal by CLF, the Secretary revised the earlier decision. The Secretary determined that BMPs are generally necessary on farms in the Missisquoi Bay Basin to achieve state water quality goals and made commitments for AAFM to conduct assessments of farms in this watershed to assure the implementation of BMPs on specific farms in accordance with the framework and timelines of the final settlement. The timeline includes dates for education and assessments in the watershed, requires a plan to be developed for farms where an assessment confirms the need for additional BMPs, and include a schedule for BMP implementation within 10 years from the date of the completion of the assessment. AAFM will exercise its existing authority to require the farms to implement the BMPs needed.

Implementation Steps and Timeframe

1.	Target CAFO inspections in these watersheds	2014
2.	Conduct a comprehensive North Lake Farm survey to assess all known livestock operations in St. Albans Bay and Missisquoi Bay watersheds	2015-2022
3.	Prioritize inspections of SFOs in these areas	2017
4.	Extend this comprehensive evaluation to other critical watersheds	2016-2036
5.	Provide targeted and prioritized funding for BMP and NMP implementation in these watersheds	2015-2036
6.	Provide $16M of RCPP funding to conserved farms, and increase wetland restoration and forestry practice	
7.	Prioritize NRCS funding to four subwatershed	
8.	Continue NRCS National Water Quality Initiative (NWQI) funding in the Rock River (part of Missisquoi Bay watershed).	
9.	Increase state cost-share rates to support regional efforts	
10.	Evaluate higher rental payment rates for CREP projects in these watersheds	
11.	Revise state BMP rules to include cost-share prioritization.	
12.	Provide targeted education in these watersheds	2015-2019
13.	Provide support for the 2 current farmer groups (Farmers Watershed Alliance and Champlain Valley Farmers Coalition)	
14.	Provide support for a farmer group in the South Lake Region	
15.	Increase CREP outreach for Missisquoi Bay and South Lake	
16.	Contract with partners to implement SFO BMPs including livestock exclusion and NMPs following inspection	
17.	Develop the *Environmental Stewardship Program* for these watersheds that provides increased compensation and incentive opportunities for producers who go above and beyond state and federal regulations.	2016
18.	Target funding for a grassed waterways program to critical source areas in priority watersheds.	2017
19.	Conduct research of media for tile drain outlet phosphorus reduction	2015-2017
20.	Reactive the AAFM Capital Equipment Assistance Program to provide funding	

for the purchase of equipment by farmers 2016-2017
21. Require additional BMPs as needed 2016-2036

B. NON-REGULATORY STORMWATER MANAGEMENT FOR NON-MS4 MUNICIPALITIES

NON-REGULATORY STORMWATER MANAGEMENT

Description

About three percent of the land area in the Lake Champlain Basin is impervious surface (such as driveways, sidewalks, streets, and parking lots), but these areas generate a disproportionate amount of the phosphorus loading to Lake Champlain. Only six percent of this impervious surface area in the Lake Champlain basin is currently subject to regulation under a state operational stormwater permit, and only 12% of the impervious area is covered by the Municipal Separate Storm Sewer System (MS4) permit.

Stormwater Master Planning (SWMP) is an analytical process designed to prevent and reduce stormwater runoff from the impervious areas that are currently not regulated by the DEC. The process serves as the basis for targeting management actions in areas of the developed landscape thought to be critical sources of phosphorus. The process directs a variety of mitigation actions, including green stormwater infrastructure and low impact development approaches. This process also promotes municipal adoption of the Vermont League of Cities and Town's model stormwater ordinance to protect water quality and save municipalities money by avoiding the increasing costs of collecting and treating stormwater runoff. Recommended actions identified by a stormwater master planning process are then integrated into tactical basin plans.

Vermont will continue to complete stormwater system mapping and illicit discharge detection and elimination (IDDE) studies in all Lake Champlain Basin towns not regulated by the MS4 permit. Several of the largest non-MS4 communities such as Barre and Montpelier and Rutland City have had and will continue to have ongoing investigations of their stormwater systems to find and locate chronic illicit discharges. All smaller urbanized areas with centralized wastewater systems will have IDDE studies completed as well as numerous villages with only on-site disposal systems. The correction or repair of failed septic or sewer systems discharging to or in close proximity (<1000 feet) to receiving waters is a very cost-effective nutrient reduction tool.

Implementation Mechanism

DEC is using existing authorities to manage the stormwater management program. DEC will develop, employ, and offer trainings for municipalities and other partners on the stormwater master planning protocol as a tool to identify and prioritize stormwater remediation actions. Implementation of discretionary projects will be subject to availability of funds and landowner approval.

Implementation Steps and Timeframe

DEC will continue to support stormwater management of unregulated stormwater sources according to the following schedule:

1. Provide technical assistance to municipalities in stormwater system mapping and IDDE studies — Ongoing
2. Provide technical assistance to municipalities on stormwater master planning as a tool to identify priority actions and integrate project priorities into tactical basin planning processes — Ongoing
3. Provide technical and financial assistance to municipalities on stormwater project implementation — Ongoing
4. Enhance outreach and technical assistance to support municipal adoption of model stormwater ordinances to prevent or minimize stormwater impacts from future development — Ongoing

Milestones for Partial implementation

1. Create a cooperative agreement with the Lake Champlain Sea Grant Program to continue to provide technical assistance to municipalities in Green Infrastructure and stormwater master planning — 2015
2. Develop and finalize a standardized stormwater master planning protocol — 2015
3. Provide technical assistance to municipalities on stormwater master planning — Ongoing
4. Provide technical and financial assistance to municipalities on stormwater project implementation — Ongoing
5. Integrate priority actions identified in stormwater mater planning into tactical basin planning for project implementation — Ongoing
6. Develop and conduct a statewide GIS analysis of Class 3 and 4 roads — 2014
7. Develop a road erosion inventory methodology — 2015
8. Complete stormwater master planning for 10 percent of non-MS4 municipalities in the Lake Champlain Basin, integrate into tactical basin plans priority-ranked lists of problem sites and proposed corrective actions, and present plans to municipalities — 2020
9. Complete stormwater master planning for 20 percent of non-MS4 municipalities in the Lake Champlain Basin, integrate into tactical basin plans priority-ranked lists of problem sites and proposed corrective actions, and present plans to municipalities — 2025
10. Complete stormwater master planning for 30 percent of non-MS4 municipalities in the Lake Champlain Basin, integrate into tactical basin plans priority-ranked lists of problem sites and proposed corrective actions, and present plans to municipalities — 2030
11. Provide technical and financial assistance to municipalities on stormwater project implementation — Ongoing
12. Conduct outreach and technical assistance to support municipal adoption of model stormwater ordinances to prevent or minimize stormwater impacts from future development — Ongoing

GREEN INFRASTRUCTURE INITIATIVE

Description

Since 2009, ANR has played a critical role in efforts to increase the adoption of low impact development (LID) principles and implementation of green stormwater infrastructure (GSI) practices in Vermont. In an effort to advance the merits and provide municipalities greater support in the use of green stormwater infrastructure, DEC is entering into a cooperative agreement with the Lake Champlain Sea Grant Program to pool resources and work collaboratively.

DEC is continuing to work with partners to implement strategies identified within the GSI Strategic Plan, which was developed by the Green Infrastructure Roundtable, an ad hoc group of individuals from the public and private sector who come together on a quarterly basis. The Plan targets four key audiences and lists major objectives for each:

- Design Professionals: Design professionals (Engineers, Landscape Architects, Architects, Design/Build Contractors) statewide are trained in promoting and utilizing LID principles and GSI practices;
- Municipalities: Help municipalities recognize the impacts from stormwater runoff and work to mitigate the effects;
- Property Owners: Property owners voluntarily implement GSI practices on their property(s); and,
- State Agencies: State Agencies secure and commit funding to develop policies and programs to support GSI.

The Strategic Plan was followed by the signing of Executive Order 06-12 (EO) in March of 2012. The EO further defines the role of State agencies and calls for the creation of an Interagency Green Infrastructure Council, which includes the secretaries of the agencies of Natural Resources, Transportation, Commerce and Community Development, and the Commissioner of Buildings and General Services or their designees. The Council is tasked with identifying opportunities for integration of GSI practices in existing programs, initiating a process for developing GSI technical guidance, establishing a plan for implementing GSI on state properties and projects, identifying agency liaisons, identifying and undertaking GSI research and monitoring, and identifying sustainable funding sources. Members of the Council are also tasked with developing a GSI Implementation Work Plan for their respective Agency/Department. Work plans were completed on July 1, 2013 and lay out opportunities and strategies for moving the GSI initiative forward. The EO is in effect for five years, through March 2017.

Incorporating LID and GSI into the framework of the Vermont Stormwater Management Manual (VSMM) is an identified task in ANR's Implementation Work Plan. The existing manual was seen as a barrier to GSI implementation for some time. The Stormwater Program is currently revising the manual to incorporate and incentivize LID and GSI concepts and to enhance nutrient removal rates. The revised Stormwater Manual will be adopted via rulemaking as described above.

Implementation Mechanism

ANR will continue to support the green infrastructure projects and participate in the Green Infrastructure Roundtable and support implementation of the GSI Strategic Plan and the ANR Implementation Work Plan.

Implementation Steps and Timeframe

1.	ANR will implement and continue to revise the Strategic Plan and Agency work plans	Annually
2.	Partner with Lake Champlain Sea Grant to enhance visibility and support for green stormwater infrastructure	2015
3.	Research the use of GSI in other states to meet regulatory requirements	2015
4.	Provide training opportunities to ANR staff and external partners to increase knowledge of GSI	Annually
5.	Provide technical assistance and financial support for GSI projects	Ongoing
6.	Work with partners to enhance and disseminate model LID Bylaws	2016
7.	Revise and redistribute Vermont Low Impact Development Guide for Residential and Small Sites	2017
8.	Convene GSI Roundtable	Quarterly
9.	Convene Green Infrastructure Council	Quarterly
10.	Revise Strategic Plan and Agency Work Plans	Annually/Semi-Annual

C. RIVER CHANNEL STABILITY

MINIMIZING RIVER CORRIDOR AND FLOOD PLAIN ENCROACHMENTS AND RESTORING RIPARIAN FLOOD PLAIN FUNCTIONS AND VALUES

Description

Managing rivers and floodplains to attain and maintain dynamic equilibrium conditions (i.e., the vertically stable and least erosive conditions achieved when there is a balance between erosion and deposition processes) provides for greater climate adaptation and public safety, while reducing sediment and nutrient pollution. Avoiding new buildings, utilities, or public infrastructure in river corridors and floodplains and maintaining floodplain connectivity, as well as native plant-vegetated buffers are essential to attaining and maintaining equilibrium conditions. Avoiding new encroachments decreases adverse river channel modifications and increases the capacity of valley landforms to store floodwaters, sediments, and phosphorus.

Floodplains, wetlands, and meanders with vegetated buffers: (a) dampen flood energy and soil erosion by moderating stream flow velocities when floodwaters spill onto them; (b) allow for sediment deposition on floodplains during floods, which account for the greatest volumes of sediment over time; and (c) moderate streambank failures due to the root strength, root depth, and root density of the vegetated buffer.

With respect to implementing the Lake Champlain TMDL, the current River Corridor and Floodplain Protection Program is limited in the following areas:

- Many developments in floodplains and river corridors, falling outside state jurisdiction are not currently regulated. In addition, ANR has not completed MOUs with all other state agencies to regulate developments within their purview to be consistent with the State Flood Hazard Area and River Corridor Rule.
- It would be helpful to train and certify floodplain technicians to assist municipalities and landowners in floodplain and river corridor protection and to promote enhanced model bylaws that exceed the National Flood Insurance Premium (NFIP) minimum requirements and ideally

mirror the State No Adverse Impact Standard.

- Floodplain mapping is very limited and very antiquated in eight counties. Light Detection and Ranging (LiDAR) data would help modernize inundation and river corridor mapping for streams and lakeshores.
- The Program would benefit from an increased outreach program to promote cross-agency, flood resiliency planning, peer-to-peer learning, and community progress barometers to increase Vermont municipal adoption of enhanced floodplain, river corridor, and riparian buffer protection bylaws, and other mitigation measures to minimize flood risks and maximize floodplain and riparian function.

Minimizing river corridor and floodplain encroachments will not only serve as a back-stop to limit future increases in phosphorus loading, but, overall, is the most effective form of stream and riparian restoration and the reduction of the existing load. Promotion dynamic equilibrium river conditions ensures that, given the space, rivers will evolve, under their own power, to a least erosive form (i.e. equilibrium conditions).

Implementation Mechanism

DEC will use existing statutory authority to manage the program, including the Flood Hazard Area and River Corridor Rules, Protection Procedures, General Permits, and Inter-Agency Floodplain and River Corridor Management MOUs. Implementation of discretionary projects will be subject to availability of funds and landowner approval.

Implementation Steps and Timeframe

1. Further develop the Program implementing the new state floodplain rule that sets a standard of no adverse impact (NAI) in floodplains and river corridors and addresses all developments exempt from municipal regulation. Establish MOUs with other state agencies to regulate developments within their purview to be consistent with the new state floodplain rule. Continue to refine and implement the new Flood Hazard Area and River Corridor Protection Procedures to regulate Act 250 developments and establish map amendment and revision procedures and river corridor BMPs (e.g., establishment and maintenance of riparian buffers). 2014-18
2. Increase the Program's capacity to regulate municipally exempt activities and Act 250 developments to the higher standards established in Step 1, and review all development proposals (under state and municipal jurisdiction) on floodplains in the Lake Champlain Basin. Implement general permits and establish a regional Certified Floodplain Technician Program to increase the regulatory and technical assistance capacity for floodplain protection. Develop and implement both field and web-based project authorization capacities and data management systems to track results for protecting, restoring, enhancing and maintaining river corridor and floodplain functions. 2015-22
3. Provide technical assistance to a greater number of communities and landowners each year to actively restore floodplains and riparian areas (where opportunities arise) and secure the municipal adoption of enhanced model floodplain and river corridor protection bylaws that exceed the NFIP minimum requirements. 2014-36
4. Secure funding to obtain Light Detection and Ranging (LiDAR) data to modernize inundation and river corridor mapping statewide for streams and lakeshores. 2017-22
5. Implement a statewide river corridor and floodplain mapping center that is developing and maintaining inundation, erosion hazard, and riparian buffer maps as per the adopted Flood

Hazard Area and River Corridor Protection Procedures. Develop and carry-out a training program for RPC staff and other planners to establish greater statewide capacity for assisting municipalities with river corridor map updates and administrative revisions 2015-36

6. Integrate field assessment data, river corridor plans, and statewide river corridor mapping to support municipal resiliency plans, road erosion assessments, tactical basin plans, and project identification within state, regional, and local hazard mitigation plans. This work is critically important for the strategic application of technical assistance programs and project funding through Clean Water Initiative and FEMA Hazard Mitigation Fund programs. 2016-2023
7. Increase the role of land conservation in river corridor and floodplain protection and restoration (i.e., securing river corridor, channel management, and riparian buffer provisions in land conservation projects) 2015-36
8. Enhance the Flood Resilient Communities Program with funding and technical assistance incentives for municipalities to adopt regulations for floodplains, river corridors, and riparian buffers (e.g., the Emergency Relief and Assistance Fund (ERAF), effective 10/2014, increases the state cost share for flood recovery in municipalities where enhanced bylaws have been adopted). 2014-36
9. Enhance and maintain a "Flood Ready" web page to promote cross-agency, flood resiliency planning by offering peer-to-peer learning, community progress barometers in the Flood Resilient Communities Program, and all manner of planning and implementation tools to increase Vermont municipal adoption of enhanced floodplain, river corridor, and riparian buffer protection bylaws and other mitigation measures to minimize flood risks and maximize floodplain function. 2015-36

PREVENTING ADVERSE RIVER CHANNEL MODIFICATIONS

Description

Widespread and historic stream channelization (i.e., entrenchment with dredging, berming, straightening, and armoring practices) has resulted in increased erosion and therefore increased sediment and nutrient loading. Land drainage activities and structural controls such as riprap may prevent flooding and erosion at one site, but increase erosion downstream and contribute to destabilizing the stream system. These activities increase the power of floods thereby increasing stream bed and bank erosion, property damages, and risks to public safety. Valley streams and rivers in the Champlain drainage were, by nature, evolving to a least erosive, equilibrium condition where sediment erosion and deposition (storage) are in balance. Now, due to channelization, they function primarily as transport (or non-storage) streams. The floodplain deposition of fine sediment, so critical to nutrient retention, has been drastically reduced (>50%) throughout the Lake Champlain Basin. Stream alteration activities that result in conditions that depart from, further depart from, or impede the attainment of an equilibrium condition should be limited.

With respect to implementing the Lake Champlain TMDL, the current River Management Program is limited in the following areas:

- The fluvial geomorphic-based river management principles and practices necessary to mitigate flood hazards and maximize equilibrium conditions are not well understood outside of the Program. This creates inefficiencies and compliance issues particularly in post-flood situations. The Program needs to enhance its training and outreach program for municipalities and contractors in the use of the practices that will meet the DEC's equilibrium-based performance standards.

- Agencies that fund stream structures and practices may not currently recognize state-adopted river management and stream crossing codes and standards for conducting emergency and next flood protective measures.
- A fully-functional and seasoned Incident Command System is needed to manage and authorize emergency measures in large scale flood disasters (i.e., when most modern-day channelization occurs). A network of river scientists, engineers, and habitat restoration specialists are needed to assist VTrans and municipalities as resident experts on larger disaster recovery sites.

Implementation Mechanism

DEC will use existing statutory authority to manage the River Corridor and Floodplain Protection program, including the implementation of Stream Alteration Rules, General Permits, River Management Training Programs, and MOUs regarding inter-agency coordination during flood response periods. Implementation of discretionary projects will be subject to availability of funds and landowner approval.

Implementation Steps and Timeframe

1. Further develop the River Management Program to implement the State Stream Alteration Rules and General Permit that establish equilibrium and connectivity standards as well as standard practices for next-flood and emergency protective measures. Continually update the standard river management principles and practices (SRMPP) to maximize equilibrium conditions when managing conflicts between human activities and the dynamic nature of rivers. Achieve federal agency recognition of state-adopted river management and stream crossing codes and standards for conducting emergency protective measures, and promote the municipal adoption of these codes and standards (e.g., with the Vermont Transportation Agency's Road and Bridge Standards). 2014-2018
2. Increase the Program's capacity to provide technical and regulatory assistance for stream alterations, including emergency and next-flood protective measures to maximize equilibrium conditions (i.e., river-based storage functions) in the Lake Champlain Basin. Develop and implement both field and web-based project authorization capacities and the data management systems to track results for protecting, restoring, enhancing, and maintaining fluvial processes and least erosive river forms. 2014-22
3. Establish and maintain a River Operations Center within an ANR Incident Command System prepared to manage and authorize emergency measures in large scale flood disasters (i.e., when most modern-day channelization occurs). This Center would include a network of river scientists, engineers, and habitat restoration specialists, to assist VTrans and municipalities as resident experts on larger disaster recovery sites. 2015-36
4. Work with AAFM and NRCS to establish streambank stabilization practices consistent with the Vermont Stream Alteration Rule for minimizing fluvial erosion hazards as per the Act 65 revisions to 10 V.S.A. §1021. 2015-2018
5. Working with the river scientists, capitalize on opportunities to implement projects involving the removal of river, river corridor, and floodplain encroachments (e.g., floodplain fills, undersized stream crossings, flood-damaged structures, or dams). Target restoration and protection funds to high priority critical source areas identified in tactical basin plans or river corridor plans, recognizing that restoration measures will vary from avoidance-based to active interventions to restore stream equilibrium conditions, including floodplain restoration and establishing riparian buffers, depending on site characteristics, plan recommendations, and

willing landowners. 2015-36

6. Conduct outreach and train municipalities and contractors in the use of the SRMPP and authorizations under the new ANR Stream Alteration Rules and General Permit. Further develop and implement a 3-tiered outreach and training program by offering courses to VTrans Operations Technicians, municipal roads workers, contractors, and other river technicians. 2014-36

D. FOREST MANAGEMENT

ACCEPTABLE MANAGEMENT PRACTICES

Description

Vermont adopted rules in 1987 for Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont. The AMPs are intended and designed to prevent any mud, petroleum products and woody debris (logging slash) from entering the waters of the State and to otherwise minimize the risks to water quality. The AMPs are scientifically proven methods for loggers and landowners to follow for maintaining water quality and minimizing erosion.

Vermont Department of Forests, Parks, and Recreation (FPR) is in the final phase of the state rule-making process to amend the AMP rule. It is expected that the final rule will be effective before the end of 2016. Key modifications include:

- Require compliance with standards set forth in the DEC Stream Alteration Rule and General Permit for actions including the installation and sizing of permanent stream crossing structures on perennial streams.
- Strengthen standards pertaining to temporary stream crossing practices on logging operations. The proposed standards include:
    - Better management of ditch water on approaches to stream crossings. The proposal is to prohibit drainage ditches along truck roads from terminating directly into streams and to specify a minimum distance for installing turn-outs. Drainage ditches approaching stream crossings must be turned out into the buffer strip a minimum of 25 feet away from the stream channel, as measured from the top of the bank.
    - Better management of surface water runoff from skid trails, truck roads and temporary stream crossings on logging operations. The proposal is to prevent surface runoff from entering the stream at stream crossings from skid trails and truck roads and to specify a minimum distance for installing surface water diversion practices, such as drainage dips. Surface runoff is to be diverted into the buffer strip as close to 25 feet from the stream channel, as measured from the top of the bank.
    - Better management of stream crossings after logging. The proposal is to prevent erosion and to specify a minimum distance from the stream for diverting runoff. Upon removal of the temporary stream crossing structures, the site is to contain water bars 25 feet from the stream channel on downhill approaches to the stream crossing to divert runoff into the buffer to capture sediment before entering the stream. Additionally, all exposed soil, at a minimum of 50 feet on each side of the crossing, must be stabilized with seed and mulch according to application rates specified in the AMPs.
- Include a new AMP to address the management of petroleum products and other hazardous

materials on logging operations. Such materials must be stored in leak-proof containers, place outside of buffer strips, and must be removed when logging is completed.

- Enhanced stream buffer guidance in the AMPs. Metrics have been established for minimum residual stand density, stand structure and crown cover.
- Enhanced options and guidance with metrics provided for soil stabilization to establish temporary and permanent ground cover.
- Better clarification provided for selection and spacing of water diversions on skid trails and truck roads both during and immediately after logging.
- Increased seeding/mulching of exposed soil adjacent to streams and other bodies of water from 25 feet to 50 feet.

Sediment and other pollution discharges on logging jobs are subject to enforcement under the State's water pollution control statute (10 V.S.A. 1259(a)). The DEC Compliance and Enforcement Division conducts necessary enforcement actions under a Memorandum of Understanding with FPR. The circumstances and outcomes of field inspections are documented and summarized in annual reports.

Vermont's Use Value Appraisal Program, also known as the "Current Use Program," provides property tax benefits to forest land owners enrolled in the program. To maintain eligibility in the Use Value Appraisal program, all timber harvesting operations on enrolled land must comply with the AMPs. Harvesting operations on forest land owned or controlled by the ANR and land enrolled in the Forest Legacy Program must also adhere to the AMPs. Similar water quality protection requirements apply to logging operations on the Green Mountain National Forest.

As shown in Table 10, AMPs or equivalent requirements are mandatory on nearly 60 percent of forest land in the state, and a similar percentage applies to forest land within the Lake Champlain basin in Vermont. This percentage is expected to increase over time as: (a) the U.S. Forest Service conducts new land acquisitions within the Green Mountain National Forest proclamation boundary; (b) land acquisitions by VANR; (c) enrollment of forest land into the Forest Legacy Program and the Current Use Program. Between 2007 and 2015, acreage enrolled in the Current Use Program within the Lake Champlain basin increased from 600,207 acres to 710,670 acres, showing an approximate 18 percent increase.

Table 10 - Amount of State and Lake Champlain Basin forestlands subject to water quality management practices as of 2015

Forest Land Category	State Acres (Approximate)	Lake Champlain basin Acres (Approximate)
Use Value Appraisal	1,780,000	710,670
Agency of Natural Resources	475,650	186,570
Forest Legacy Program	50,630	11,570
Green Mountain National Forest	400,000	265,490
Sub-Total	2,706,280	1,174,300
Total forest in state	4,591,000	1,953,420

Phosphorus inputs will be reduced by:

- Requiring compliance with standards set forth for perennial streams in the state stream alteration general permit.
- Strengthening enforceable standards in the AMPs for stream crossing practices.
- Strengthening enforceable standards in the AMPs for managing surface runoff from truck roads and skid trails.

Additional Forestry Management Actions

Two separate and recent initiatives being undertaken by the Agency of Natural Resources on state lands will have benefit for the Lake Champlain TMDL. These initiatives include (1) improving flood resiliency and (2) enhanced protection of riparian areas. State lands are predominantly located in forested headwaters and are managed by foresters with the Department of Forests, Parks and Recreation and give managers an opportunity to address stormwater generation and sediment production at the source. There are 186,570 acres of state lands within the Lake Champlain Basin and another 11,570 acres conserved through the Forest Legacy Program, where recommendations adopted through these two initiatives are being implemented. This represents 10% of the total forested land area in the Lake Champlain Basin.

Enhancing Flood Resilience and Improving Water Quality on ANR Lands

A blueprint for enhancing flood resiliency and improving water quality on ANR lands was adopted by the Agency of Natural Resources in June 2016. Despite the great work that has already been accomplished or is underway on state lands to address flood resilience and related water quality issues, state land managers agree there is much more that can be accomplished if adequate resources were made available. State lands are often located in forested headwater areas which due to their topography and geologic setting, may be especially susceptible to generating runoff during storm events. The inherent vulnerability of these uplands is sometimes exacerbated by a legacy of old road networks with inadequate stream crossings and drainage, and other land use modifications. Addressing these "legacy" impacts associated with state lands is a major challenge that will require substantial additional resources. Short-term and long-term actions have been identified and an implementation plan has been developed. These actions, once implemented, will enhance flood resiliency and improve water quality on ANR lands.

ANR Riparian Management Policy and Guidelines

The Riparian Area Management Policy and Guidelines for ANR state lands were adopted by the Agency of Natural Resources in December 2015. The new policy and management guidelines provide for a greater level of protection of stream and lakeshore buffers than what had been in place. Buffer widths along streams and other bodies of water, as prescribed in the AMPs (minimum buffer width of 50 feet), were generally the default for forestry practices on state lands. The newly adopted riparian guidelines prescribe a minimum buffer width of 100 feet for streams greater than ½ square mile drainage area, 50 feet for streams less than ½ square mile drainage area and 100 feet for all lakes and ponds. Protection of ephemeral streams is also addressed and 100 foot buffers are prescribed for wetlands. This exceeds the 50-foot buffer requirement under the Vermont Wetland Rules. Management strategies that have been developed for riparian buffers will protect, enhance and restore the full range of their values and functions, including water quality and sediment retention.

Implementation Mechanism

FPR is undertaking a rulemaking process to update the AMPs and revise the AMP manual.

Implementation Steps and Timeframe

1.	Update AMP Rule and AMP manual	2016

Interim Milestones

1.	Technical Steering Committee (TSC) formed	2012
2.	Technical review completed	2012
3.	ANR comments solicited	2012
4.	Public Stakeholder Meetings held	2013
5.	Final recommendations submitted by TSC to Director of Forests	2013
6.	Additional round of comments received from ANR	2014
7.	ANR and AG legal review	2015
8.	FPR Commissioner review	2015
9.	Initiate State Rulemaking	2016
10.	New rule adopted and becomes effective	2016
11.	Release revised AMP manual	2017
12.	Conduct workshops	2017

INCENTIVE FINANCING TO REDUCE NON-POINT SOURCE POLLUTION RISKS ON TIMBER HARVESTING OPERATIONS.

Description

Pending available funding, qualified loggers would obtain low-interest financing from participating banks through a loan program. The purpose of providing this financial incentive is to increase the use of BMPs and environmentally friendly logging equipment in the logging industry. This, in turn, will help to protect and improve water quality in and around logging operations.

FPR will:

1) Determine the feasibility of this program;
2) Determine items that could be eligible for financing;
3) Determine eligibility guidelines and a process to ensure that the logger meets qualification requirements;
4) Ensure that the logger retains, on file, a BMP check list for each operation; and
5) Monitor the improvements and practices of the logger.

DEC could work with the Vermont Municipal Bond Bank (VMBB) to:

1) Enter into a memorandum of understanding with FPR to implement the program;
2) Work with local banks to participate in the program; and
3) Provide oversight within the context of managing loan program.

Phosphorus inputs will be reduced through increased use of low-impact harvesting systems and other technologies to protect forest water resources.

Implementation Mechanism

FPR will, in partnership with DEC, evaluate and coordinate this initiative.

Implementation Steps and Timeframe

1. FPR evaluates the feasibility of a loan program 2017
2. If feasibility assessment supports project implementation and funding is available, FPR will work with DEC and EPA to establish program 2018

ADDITIONAL ACTIONS TO REDUCE PHOSPHORUS LOADINGS IN THE MISSISQUOI BAY AND SOUTH LAKE SUB-WATERSHEDS

Regional Conservation Partnership Program

The Department of Forests, Parks and Recreation is targeting outreach efforts to forest landowners within the Lake Champlain Basin with a focused effort aimed at the Missisquoi Basin to accelerate implementation of NRCS cost-share practices funded through the Regional Conservation Partnership Program (RCPP) to improve water quality and reduce phosphorus.

These practices include controlling erosion on active forest trails and landings; designing and installing permanent stream crossing structures; restoring riparian areas; and stabilizing critical areas. In addition to these outreach efforts, FPR will provide two foresters who will prioritize technical outreach and assistance to the forest landowner community on the effective implementation of these practices. This effort will take place over a five-year period starting in 2015.

Implementation Mechanism

FPR in coordination with DEC and NRCS.

Implementation Steps and Timeframe

1. Grant awarded 2015
2. Outreach to forest landowners 2015-2019
3. Practice implementation prioritized to these watersheds 2015-2025
4. Continue to provide technical assistance to address soil erosion and sedimentation associated with logging roads and stream crossings on private lands 2015-2036

Increasing Access to Portable Skidder Bridges

The Portable Skidder Bridge Rental Program, an existing program, supported by FPR and administered by the Natural Resource Conservation Districts provides loggers and private forest landowners access to portable skidder bridges. Portable skidder bridges are used as temporary stream crossing structures when conducting logging operations. The utilization of these bridges provides for stream channel stability and reduces sediment and nutrient runoff into waters. The recent expansion of this program in 2015 now provides complete coverage for the entire Missisquoi Bay.

Implementation Mechanism

Natural Resource Conservation Districts and FPR

Implementation Steps and Timeframe

1. Enhanced coverage attained for Missisquoi and South Lake Basins 2015
2. Enhance portable skidder bridge capacity throughout the Lake Champlain Basin by 25% 2016

REDUCING EROSION FROM INACTIVE FOREST ROADS, TRAILS, AND LOG LANDINGS IN PRIVATE FORESTS

The State will use select LiDAR (Light Detection and Ranging) mapping currently being conducted by the UVM Spatial Analysis Lab in the Lake Champlain Basin to explore the effectiveness of LiDAR to map eroding, abandoned, and retired forest roads, skid trails, and log landings. This type of inactive infrastructure is considered a significant source of sediment and nutrient loss from forest land, and ANR has little information about the extent of these networks and their connectivity to streams. ANR will use this information to identify priority areas and target restoration projects with priority given to Missisquoi and South Lake Basins.

Implementation Mechanism

FPR will facilitate and support this effort.

Implementation Steps and Timeframe

1. FPR collaborates with NRCS to develop this as a topic for funding through the NRCS Conservation Innovation Grant Program 2015
2. Grant proposal submitted and grant awarded 2015
3. Contract signed 2015
4. Pilot study area selected 2016
5. LiDAR mapping and ground checks conducted 2016-2017
6. Final report submitted 2017

HEALTHY FOREST COVER STRATEGY

Description

Forests produce the cleanest water of any land use. Research indicates that on a watershed scale and for riparian forest buffers water quality impacts can be seen when forest cover goes below 65% and 70% respectively. Vermont is approximately 75% forested with fluctuations from watershed to watershed, and site to site. A forest cover strategy of no net forest cover loss supports the creation of a system to promote forest cover goals in priority zones, including riparian and developed areas, coupled with mechanisms to ensure the health, maintenance and conservation of existing cover. Healthy forests translate into functional ecosystems that bind phosphorus and water, preventing additional runoff. Given that 86% of Vermont forests are privately owned and managed, successfully achieving our no net loss of forest cover relies on landowners reaping some financial benefits from their forestlands. Economic incentives for forest products, therefore, become an integral part of keeping healthy forestland.

Climate change poses a significant amount of uncertainty with respect to understanding forest response to disturbance, and effectiveness in meeting forest management goals. Increased temperatures, heavy precipitation events, mild winters, and extreme wind and ice storms are all predicted to increase. The best risk management at this point in time is to manage forests to be more

resilient to a variety of weather conditions, and to build forest harvest plans that account for extreme weather influences.

Estimating Phosphorus Reductions and Other Benefits

- Healthy forest cover in the Lake Champlain watershed will improve watershed health through water interception, filtration and evapotranspiration, and nutrient attenuation.
- Trees and forests reduce stormwater runoff by capturing and storing rainfall in the canopy, thereby reducing runoff volumes and delaying the onset of peak flows. Research studies suggest forest canopy interception measured for conifer stands ranges from 15% to 51% of annual precipitation, and interception in hardwood stands ranges from 8% to 20%.
- The growth of tree roots, as well as the decomposition of roots and leaf litter, increase soil infiltration rates and overall infiltration capacity.
- Through evapotranspiration trees draw moisture from the soil surface, providing an increased soil water capacity. Conifers transpire 10-12% of precipitation, while deciduous trees during leaf-on transpire up to 25% of precipitation.
- Trees and forests directly reduce soil and water phosphorus through root uptake; 1 acre of riparian forest buffer will remove 2 pounds (lbs) of phosphorus and 2,500 lbs of sediment annually.
- Forest cover reduces soil erosion by buffering the impact of raindrops on barren surfaces.
- In addition to these water quality benefits, trees and forests provide a host of ecological, social and economic benefits including wildlife habitat, forest based industry, improved health and well-being, and recreation and aesthetic values.

Implementation Mechanism

FPR will work with partners to implement the following general strategies for no net loss of forest cover in the watershed.

1. Maintain watershed forest cover goals
2. Restore riparian forest buffers
3. Restore developed land forest cover
4. Prepare for and mitigate impacts to forest cover from invasive tree pests
5. Publish, distribute and provide outreach opportunities with the guidebook on forest adaptation to climate change: "Creating and Maintaining Resilient Forests in Vermont: Adapting forests to climate change."

Implementation Steps and Timeframe

1.	Adopt legislation to include maintaining forest cover as part of town plans for surface water protection (Act 171)	2015
2.	Assess, identify, and prioritize forest cover for surface water protection and no net forest cover loss.	2016-Ongoing
3.	Increase funding for forestland conservation and target resources towards high priority forests for surface water protection.	Ongoing
4.	Support outreach and education on forest values for water quality protection including assistance to landowners, professionals, towns, regional commissions, and watersheds groups.	Ongoing

5.	Promote and support the land use planning goals to have development undertaken in accordance with smart growth principles including local and regional plans that indicates those areas that are important as forest blocks and habitat connectivity and plan for development in those areas to minimize forest fragmentation and promote the health, viability, and ecological function of forests.	Ongoing
6.	Increase landowner incentives to keep forests forested including supporting Use-Value Appraisal (UVA), and monetizing ecosystem services.	Ongoing
7.	Identify, prioritize, and offer incentives to plant or regenerate 35-foot or greater buffers: targeting 70% forest cover within riparian forest buffers and 50% of the riparian buffer miles.	2015-Ongoing
8.	Support communities in the Urban Landscape Zone to assess developed land forest cover and implement strategies to increase and maintain forest cover: targeting 40% forest canopy.	2016-Ongoing
9.	In consideration of future forest mortality from emerald ash borer invasions and the valuable water quality protection role of ash in some parts of this watershed, short-term and long-term strategies include: implementing detection surveys, policies and management practices to slow the impact of the emerald ash borer; identify and prioritize areas where ash plays a vital role in forest cover and water quality protection; assist high-priority communities to develop invasive tree pest preparedness and recovery plans; and identify, prioritize and offer incentives for site restoration that involve forest management and replanting after infestation.	2015-Ongoing
10.	Promote recommended forest adaptation strategies to foresters and landowners to implement climate-smart practices that maintain healthy forest cover, sustain ecological functions such as water holding capacity of forest soils, and promote water quality.	2015-Ongoing
11.	Develop and implement climate-smart forestry practices on state land	2015-Ongoing
12.	Create funding priorities through the Working Lands Initiative (Working Lands Enterprise Fund (WLEF) for new forest harvesting technologies that improve protection of soil and water.	2016-Ongoing
13.	Establish demonstration areas on state land to train foresters and landowners on climate-smart forest management techniques that can then be implemented on the 86% of Vermont's forestlands that are privately owned.	2017-Ongoing
14.	Identify vulnerable forest stands within the Lake Champlain basin, develop forest health strategies to maintain forest cover and water holding capacity, and identify funding to implement strategies on priority forests.	2018-2036

E. WETLAND PROTECTION AND RESTORATION

Description

One of the most commonly cited functions of wetlands is the ability to maintain and improve water quality and flood storage of adjacent streams, rivers, and lakes. Wetlands are natural flood regulators which temporarily store floodwaters and then slowly release waters downstream.

While floodwaters are being stored in wetlands, sediments and nutrients settle and are retained. As much as 80-90% of sediments in water may be removed while moving through natural wetlands, resulting in cleaner water. A recent study (Wang et. al., 2010) using the Soil and Water Assessment Tool (SWAT) coupled with the hydraulic equivalent wetland concept (HEW) concluded that the loss of 10-20% of the wetlands in their study watershed would lead to an increase in sediment discharge by 40% and total phosphorus load by 18%. Indeed, wetlands are one of the most important microtopographic features abating non-point source nutrients across a watershed.

The economic benefits from the ecosystem services that natural wetlands offer can be significant to Vermont communities. For example, the town of Middlebury experienced approximately $3 million in damages from Tropical Storm Irene. The Gund Institute at the University of Vermont estimated that the Otter Creek wetlands complex upstream of Middlebury helped the town avoid an additional $5 million in flood damages.

Between 1780 and 1980 Vermont has lost over 35% of its natural wetlands, subsequently loosing phosphorus sinks throughout the Lake Champlain basin. The potential increase in phosphorus retention from restoring the natural hydrology of these lost wetlands would be substantial for the health of Lake Champlain. It is imperative that ANR include protection for natural wetland services and encourage wetland restoration to increase wetland water quality protection in this Phase 1 Plan.

The Vermont Wetlands Program is responsible for identifying and protecting wetlands which provide significant functions and values for the people of Vermont. Wetlands often function as water quality protection, flood storage, wildlife habitat, erosion control, and have recreational value. The goal of the Wetlands Program is to achieve no net loss of significant wetlands or wetland function through regulatory and non-regulatory means. This goal is mainly achieved by assisting the Vermont public and professional community in avoiding impacts to wetlands and wetland buffers through personal contact with District Wetland Ecologists. The number of wetland permits issued in a year is a small fraction of the field visits and face to face technical assistance provided to help effectively avoid and minimize wetland impacts.

In 2006 the Agency of Natural Resources commissioned a study to identify and prioritize wetland restoration opportunities in the basin, and this plan was finalized on December 31, 2007 and will be updated with more current data in 2016. Since 2007, data from the plan have been widely distributed to federal, state, and local governmental and non-profit organizations with an expressed interest in wetland restoration and protection. Program staff visited with numerous communities and groups to give locally-focused presentations on the plan results, and to highlight funding mechanisms for landowners interested in restoration. VANR is funding, as part of the RCPP grant agreement, a third party to create restoration project packets for NRCS and others to help initiate restoration efforts throughout the basin. Also through the RCPP, VANR is providing incentive funds to landowners within the basin to increase enrollment. Opportunities for wetland gains and

restoration occasionally occur as a result of repairing a violation, through mitigation to offset permitted impacts, or as a result of voluntary measures.

In May, 2009, the State of Vermont passed legislation (Act 31) to strengthen the State's wetlands protection statute. A key change to the statute transferred authority from the former Water Resources Panel of the Natural Resources Board to VANR to make administrative determinations to re-classify wetlands for protection. Before the authority transfer, VANR was only able to protect mapped wetlands which included an estimated 61% of wetlands across the state. Now VANR is able to protect thousands of additional wetland acres. Act 31 also allows VANR to update wetland mapping and interpret jurisdictional buffer zone widths to accommodate individual wetland needs. The updated Vermont Wetland Rules which reflect the change in statute began August of 2010.

Vermont also recognizes the importance of maintaining native plant vegetated buffers along streams, lakes, and wetlands to maintain water quality. Buffers filter and absorb nutrients in runoff and support the integrity of stream banks to help guard against erosion. Healthy vegetated buffers offer additional benefits such as support fish habitat function, provide habitat and movement corridors for wildlife.

Implementation Mechanism

Because opportunities for wetland restoration occasionally arise as a result of supportive field visits, it is important all District Wetland Ecologists have the capacity to handle such requests. DEC's goal is to have sufficient staffing such that all Ecologists may provide technical assistance to landowners and municipalities in restoring and protecting wetlands. The Program will assign one District Ecologist to dedicate a significant amount of his/her time towards restoration coordination with federal, state, and local partners.

The State of Vermont categorizes wetlands into three classes: Class I, Class II, and Class III. Class I wetlands are exceptional or irreplaceable in their contribution to Vermont's natural heritage and, therefore, merit the highest level of protection. This protection includes larger protected buffer zones and more rigorous standards for permitting impacts. As of July of 2016, there were only three wetlands with this rigorous protection status, all within the Lake Champlain Basin. The Wetlands Program has identified several exceptional or irreplaceable wetlands within the Lake Champlain basin which function as erosion and flood control for streams and improve water quality. These wetlands will advance through the rulemaking process to designate as Class I so that their core is preserved and the impaired fringes have the opportunity to restore. The area of potential Class I protection within the Lake Champlain Basin is estimated at 28,000 acres.

ANR will work with federal, state, and local partners to offer technical assistance and financial incentives to encourage landowner implementation of wetland conservation and restoration opportunities, retain forested buffers, and discourage land conversion. These partners include but are not limited to NRCS, the Army Corps of Engineers, The Nature Conservancy, Ducks Unlimited, and VFWS. Implementation of discretionary projects will be subject to availability of funds and landowner approval.

Implementation Steps and Timeframe

DEC will enhance wetland conservation and restoration using the following schedule:

1. DEC continues to implement wetlands rules Ongoing

2. DEC will work with federal, state, and local partners to offer technical assistance and financial incentives to encourage landowner implementation of wetland conservation and restoration opportunities, retain forested buffers, and discourage land conversion — Ongoing
3. DEC will implement the Wetland Reserves Easement portion of the RCPP grant. — 2015-2019

Milestones for Implementation

1. Establish new Wetland Rules — 2010
2. Initiate rules for Class I designation of several wetlands in the Lake Champlain basin — 2015-2016
3. DEC to conduct site visits for wetland protection, conduct permitting, and track enforcement actions and outcomes throughout the state — Ongoing
4. Conduct permit compliance checks on 80% of construction projects within the Lake Champlain basin — Ongoing
5. DEC will work with federal and state agencies and local partners to identify and implement wetland conservation and restoration opportunities, targeting Missisquoi and South Lake basins — 2017
6. DEC will work with federal and state agencies and local partners to identify and implement wetland conservation and restoration opportunities, targeting other priority watersheds subject to increases in runoff from land uses — 2019
7. DEC will work with federal and state agencies and local partners to identify and implement wetland conservation and restoration opportunities, targeting Lake Champlain Basin that are at risk of land conversion — 2020
8. Create technical assistance/public education programs to work with landowners, municipalities, regional planning commissions, Conservation districts, businesses and environmental groups to support protection and restoration of vegetated buffers and aquatic habitat function, targeting Lake Champlain basin. — 2017
9. Expand technical assistance/public education programs to work with landowners and other partners to support protection and restoration of vegetated buffers and aquatic habitat function, targeting the rest of the State and aligned with tactical basin planning — 2019

F. UPLAND LAKES PROTECTION AND MANAGEMENT

Description

Nutrient Criteria allow identification of upland lakes at-risk for phosphorus impairment. Detailed management approaches will be developed for at-risk upland lakes and incorporated into Tactical Basin Plans.

The Shoreland Protection Act ensures that new shoreland development will have minimal impact on the lake in terms of phosphorus and sediment runoff and degradation of aquatic habitat. In addition, areas proposed for redevelopment will not increase their impact on lake water quality.

Implementation Mechanism

Act 64 supports action steps required to improve upland lake watersheds. By identifying upland lakes at risk for nutrient impairment, we can prioritize action steps in their watersheds. These

prioritized strategies will be included in Tactical Basin Plan implementation tables.

Lakes at-risk for nutrient impairment will be identified through the Lakes and Ponds Program's monitoring and assessment process, in conjunction with the first two years in the Tactical Basin Planning cycle (Year 1 = Monitoring, Year 2 = Basin Assessment). Management plans for at-risk lakes will be developed in collaboration with local stakeholders and incorporated into Tactical Basin Plans during the third year of the cycle. Years 4 and 5 of the cycle focus on implementation of tactical basin plan priorities and monitoring to determine the effectiveness of projects accomplished on the ground. This five-year adaptive management cycle will continue, with revised lake management plans included in each iteration of the Tactical Basin Plan.

The Shoreland Protection Act established a permit program to be administered by DEC's Lakes and Ponds Program. It includes development review standards in the statute and the program was required to be implemented beginning July 1, 2014.

Related to forest lands adjacent to lake shorelands, FPR developed forest management plan standards and procedures for compliance with the Vermont Shoreland Protection Act were developed in 2015.

Implementation of discretionary projects will be subject to availability of funds and landowner approval.

Implementation Steps and Timeframe

1.	Created a permit program that meets the statutory requirements	2014
2.	Provided information to the public on permit requirements in advance of the permit program effective date	2014
3.	Began permit program implementation July 1, 2014	2014
4.	Ensure coordination with the Lake Wise program such that the Lake Wise BMPs are used as mitigation measures in project review and that Lake Wise is used effectively to promote property management improvements where projects do not fall under jurisdiction of the statute	Ongoing
5.	Develop forest management plan standards and procedures that are compliant with the Shoreland Protection Act	2015
6.	Use new Nutrient Criteria for lakes to identify upland lakes at risk for nutrient impairment and in need of tailored lake watershed management planning	Ongoing
7.	Develop lake watershed management priorities for incorporation into Tactical Basin Plans, including specific strategies for implementation tables	Ongoing
8.	Begin implementation and monitoring for improvement, following the tactical basin plan rotation and updating implementation tables in real time	Ongoing

G. INTERNAL PHOSPHORUS LOADING IN ST. ALBANS BAY

Description

The 2002 Lake Champlain Phosphorus TMDL included a discussion of the internal phosphorus loading problem in St. Albans Bay. The Bay has been subject to excessive phosphorus loading over a period of many decades, resulting in severe algae blooms during the summer. A major

phosphorus removal upgrade of the St. Albans City Wastewater Treatment Facility in 1987 significantly reduced phosphorus loading to the Bay. However, phosphorus concentrations in the Bay did not decline as expected after the treatment plant upgrade. Internal phosphorus loading from phosphorus stored in the Bay's sediments, along with ongoing, excessive phosphorus loading from the Bay's watershed, were found to be responsible for the continued high phosphorus concentrations in St. Albans Bay.

The phosphorus modeling analysis used to derive the total loading capacity for St. Albans Bay in the 2002 Lake Champlain TMDL assumed that net internal loading to the Bay would decline to zero over time once external watershed loads were reduced. The same calculation has been used in EPA's lake modeling analysis for the new Lake Champlain TMDL. This assumption was considered to be conservative since most other Lake Champlain segments have negative net internal loading rates (i.e., there is net sedimentation of phosphorus).

To test the assumption that internal loading would decline within a reasonable time period without in-lake intervention, DEC sponsored research on the phosphorus content of St. Albans Bay sediments and the chemical mechanisms that lead to its release into the water column. The study by Druschel et al. (2005) concluded that there remains a substantial reservoir of phosphorus in the sediments of St. Albans Bay which has the potential to contribute phosphorus to the water in the Bay for a long period of time into the future.

In light of these findings, DEC initiated a Phase 1 Feasibility Study for the Control of Internal Phosphorus Loading in St. Albans Bay which was completed by ENSR Corp. (2007). The study evaluated several alternative methods for controlling internal loading in the Bay as to technical feasibility, cost, and environmental impacts. Methods evaluated included circulation, dredging, chemical phosphorus inactivation in the sediments, and tributary dosing.

After considering the results of the Phase 1 Feasibility Study along with other research information on St. Albans Bay, DEC began to pursue a Phase 2 Project Design Study with the Army Corps of Engineers. The purpose of the Phase 2 Study was to develop a detailed design for an in-lake treatment project including refined cost estimates, and to prepare a full environmental evaluation with all information needed for state and federal permitting. The specific treatment methods to be evaluated by the Phase 2 study were sediment phosphorus inactivation with aluminum compounds within the Black Creek Wetland and inner St. Albans Bay (approximately 700 acres), and hydraulic dredging of an area limited to the open-water portion of the Black Creek Wetland. However, the Phase 2 study was never conducted because of difficulties in gaining Corps of Engineers funding for the work.

Phosphorus concentrations in the tributary streams draining to St. Albans Bay are among the highest in the Lake Champlain basin because of uncontrolled nonpoint sources in the Bay's watershed. If these external phosphorus sources are not adequately reduced before an in-lake treatment takes place, the longevity and effectiveness of an internal treatment would be seriously compromised. The 2002 Lake Champlain TMDL stated that progress in reducing nonpoint source phosphorus loading to St. Albans Bay should be a prerequisite before any in-lake treatment is attempted to control internal phosphorus loading. The Phase 1 Feasibility Study consultant's report reiterated this strong recommendation.

Based on the extensive research and modeling done on internal phosphorus dynamics in St. Albans Bay, it is unlikely that control of external watershed phosphorus loading sources alone will result in the full attainment of water quality standards in the Bay. An in-lake treatment to control internal phosphorus loading will likely be necessary as a final step in the restoration of the Bay.

The Phase 2 Project Design Study should be conducted when all watershed phosphorus reduction steps applicable to St. Albans Bay are nearing substantial completion. The treatment could be conducted on an earlier date than indicated by the schedule below if the necessary watershed implementation actions in the St. Albans Bay watershed are accelerated.

Implementation Mechanism

Design and implementation of an in-lake treatment project for St. Albans Bay.

Implementation Steps and Timeframe

1. Complete Phase 2 Project Design Study, including detailed in-lake treatment design and full environmental permitting information needs 2034
2. Secure treatment project funding 2035
3. Secure environmental permits 2035
4. Conduct in-lake treatment 2036

H. MISSISQUOI BAY - ENHANCED IMPLEMENTATION

Lake modeling conducted by LimnoTech Inc. (2012) and the EPA for the Lake Champlain TMDL indicates that a net overall phosphorus load reduction of about 64% from Vermont sources in the Missisquoi Bay watershed will be needed to achieve the 25 µg/L water quality criterion in the bay. Such extensive reductions are needed because of the high rates of present-day phosphorus loading from the Bay's watershed, and because of the historical legacy of phosphorus stored in the bay's sediments that is being recycled back into the water during the summer.

Watershed modeling and scenario analyses conducted by EPA indicate that a phosphorus load reduction of 64% in the Missisquoi Bay watershed cannot be fully accomplished using the practices and policies simulated for other Vermont lake segment watersheds. Enhanced phosphorus reduction efforts will therefore be directed at the Missisquoi Bay watershed in a phased manner involving agricultural and forestry sources of phosphorus, as described below.

As described above in earlier sections of this Plan, there are additional Forestry and Agricultural implementation activities that will focus on the critical watersheds, including Missisquoi Bay. In addition, this section describes additional enhanced implementation activities for Missisquoi Bay.

AGRICULTURAL SOURCES

The State has managed water quality through the use of management practices, known as the Required Agricultural Practices (RAPs), since the 1990's.[11] The RAPs apply to all agricultural operations above a mandated level[12] and address both agronomic and water quality practices on farms, however, resources to educate farmers about these practices and to enforce them has been limited. AAFM has developed a program to require site specific practices on farms in the Basin to address agricultural phosphorous contributions. The program began in June 2015 with the North Lake Survey where AAFM is visiting all known livestock operations in Franklin County and assessing them for water quality violations and concerns. The program will expand to additional watersheds in the future and includes an evaluation of site-specific practices by assessing farm infrastructure, nutrient management planning, and management practices. Farms will then be required to address any RAP violations as well as install site-specific BMPs where necessary to comply with state water quality standards. These site specific practices may include: expanded perennial vegetated buffers, increased stabilization of field borne gully erosion, achievement of "T" or better soil loss, increased livestock exclusion requirements, manure injection, manure incorporation, cover cropping, and improvements to farm infrastructure and practices for managing or reducing nutrients and waste, amongst other practices.

FORESTRY SOURCES

Three additional efforts will be undertaken by the State in order to enhance phosphorus reductions in Missisquoi Bay watershed. These include a Regional Conservation Partnership Program, increasing access to portable skidder bridges and reducing erosion from inactive forest roads, trails and logging landings in private forests in the Missisquoi Bay watershed.

REGIONAL CONSERVATION PARTNERSHIP PROGRAM

FPR is engaged in a focused outreach effort to target forest landowners within the Missisquoi Basin to accelerate implementation of NRCS cost-share practices funded through the Regional Conservation Partnership Program (RCPP) to improve water quality and reduce phosphorus. These practices include erosion control on active forest trails and landings; installation of bridges, fords, and culverts at stream crossings; restoring forest riparian areas; and mulching. In addition to these outreach efforts, FPR will prioritize technical outreach and assistance to the forest landowner community on the effective implementation of these practices in these key watersheds. This effort will take place over a five-year period.

INCREASING ACCESS TO PORTABLE SKIDDER BRIDGES

[11] Note, prior to Act 64, the RAPs were referred to as the "Accepted Agricultural Practices" or "AAPs." The State's Portable Skidder Bridge Program**,** an existing program, supported by FPR and administered by the Natural Resource Conservation Districts provides loggers and private forest landowners access to portable skidder bridges. Portable skidder bridges are used as temporary stream crossing structures when conducting logging operations. The utilization of these bridges provides for stream channel stability and reduces sediment and nutrient runoff into waters. The recent expansion of this program in 2015 now provides complete coverage for the entire Missisquoi Bay

[12] The draft RAPs, which are scheduled for implementation in the fall of 2016 pending legislative approval, are currently required for all farms above a set criteria. The minimum criteria for RAP compliance is $2,000 of sales from agricultural products, or more than 4.0 acres of crops for sale, or above a minimum number of animals (5 cows, 4 horses, 100 laying hens, and numbers of other species.) The Secretary of Agricultural retains the authority to require any operation of mixed numbers or with water quality concerns to comply with the RAPs, or if necessary, fall under small farm certification.

The State's Portable Skidder Bridge Program, an existing program, supported by FPR and administered by the Natural Resource Conservation Districts provides loggers and private forest landowners access to portable skidder bridges. Portable skidder bridges are used as temporary stream crossing structures when conducting logging operations. The utilization of these bridges provides for stream channel stability and reduces sediment and nutrient runoff into waters. The recent expansion of this program in 2015 now provides complete coverage for the entire Missisquoi Bay.

REDUCING EROSION FROM INACTIVE FORESTY ROADS, TRAILS AND LOG LANDINGS IN PRIVATE FORESTS

The State will use select LiDAR (Light Detection and Ranging) mapping in the Missisquoi Basin to demonstrate the effectiveness of LiDAR to map eroding, abandoned, and retired forest roads, skid trails, and log landings. This type of inactive infrastructure is considered a significant source of sediment and nutrient loss from forest land, and ANR has little information about the extent of these networks and their connectivity to streams. This mapping will be used as a demonstration project to expand this effort throughout the Missisquoi Basin. ANR will use this information to identify and fund restoration projects.

STREAM CHANNEL SOURCES

DEC has committed to the following enhanced implementation for Missisquoi Bay:

1. The State will put extra resources/effort into identification of opportunities for re-establishing connections to floodplains, and working with landowners to make these reconnections happen; and
2. The State will invest extra resources/effort into identification of opportunities where active intervention in channel erosion processes could be most effective, and then implementing projects to;
3. Slope back and re-vegetate stream banks when a stream reach is **not** at or near equilibrium condition; and
4. Apply bioengineering or other revetments for the purpose of arresting lateral bank migration:
5. On stream reaches that are at or near equilibrium conditions;
6. Where the eroding bank is at the edge of a meander belt within a ANR delineated corridor that is either conserved or protected through land use regulations; or
7. At mass wasting sites where the stream is eroding a high glacial lake terrace.

Both of these measures have been shown to be effective at reducing phosphorus loading from streambanks, and the extra effort DEC is committing to these actions provides assurance that the additional phosphorus reductions assumed (in EPA's modeling analysis) from streambank erosion in the Missisquoi Bay watershed will eventually be achieved.

RCPP Funding and Implementation

Funding through the Regional Conservation Partnership Program (RCPP) grant is being prioritized to Missisquoi Bay, St. Albans Bay and the South Lake watersheds. Practices implemented in Missisquoi Bay will address forestry erosion, agricultural nutrient runoff, wetland restoration and agricultural land conservation.

Implementation Steps and Timeframe

1.	AAFM North Lake Study	2015-16
2.	Address RAP violations; install BMPs	2015-36
3.	Regional Conservation Partnership program	2015-20
4.	Increase portable skidder bridge program	2015-36
5.	Reduce erosion from inactive road forests	2015-17
6.	Re-establish floodplain connections	2015-36
7.	Identify opportunities for bank stabilization	2015-36
8.	RCPP Implementation	2015-20

Reference

LimnoTech, Inc. 2012. Development of a phosphorus mass balance model for Missisquoi Bay. Lake Champlain Basin Program Tech. Rep. No. 65. Grand Isle, VT. http://www.lcbp.org/wp-content/uploads/2013/03/65_PhosphorusMassBalanceModel_MissisquoiBay_2012.pdf

I. PHOSPHORUS DETERGENT AND FERTILIZER USAGE

Description

Vermont has had a law in effect since 1978 prohibiting the sale of household cleaning agents (e.g., laundry detergents) containing more than a trace amount of phosphorus (10 V.S.A §1382). Effective in 2010, the exemption given to automatic dishwasher detergents was removed from the statute. This change was estimated to reduce wastewater phosphorus loading to Lake Champlain by 0.8 - 3.2 metric tons per year.

Vermont adopted legislation effective in 2012 (10 V.S.A §1266b) that prohibits the application of phosphorus fertilizer to turf unless the grass is being established during the first growing season, or a soil test indicates the need for phosphorus. Fertilizer applications to impervious surfaces or within 25 feet of surface waters are prohibited.

Implementation Mechanism

Although Vermont has already passed legislation, DEC will evaluate the effectiveness of that legislation to determine how well it is working and whether additional outreach strategies or policy options are necessary to ensure the legislation's effectiveness.

Implementation Steps and Timeframe

DEC will evaluate the legislation to determine its effectiveness. Upon that evaluation, DEC will prepare recommendations to ensure effectiveness of the legislation.

Milestones for Partial Implementation

1.	Conduct an evaluation of the effectiveness of legislation and if necessary, prepare recommendation	2017-2020

CHAPTER 7 – ENHANCEMENTS TO THE WATERSHED PROTECTION AND RESTORATION PROGRAMS

A. FUNDING AND CAPACITY

Implementing the new Lake Champlain phosphorus TMDLs require a heightened level of implementation. Success in accomplishing the State's clean water goals relies on more funding to support implementation, greater collaboration among all parties – local, state and federal government, partners and other stakeholders – to implement, track and report on progress and additional staff resources to administer the work.

Some of the resource needs can be met by shifting existing staff resources and funding priorities. Some of the work requires building new capacity and funding. An important component of the plan is the formation of a "Vermont Clean Water Fund," described below, which provides coordinated financial and technical support to communities, businesses, farmers, foresters, developers, state agencies and watershed protection partners.

A first step in describing the state's needs for additional funding and programmatic capacity involved developing a preliminary description of funding needs required to implement this plan and recommendations requiring legislative action by the Vermont General Assembly. On November 15, 2014, DEC presented this information as part of a legislative report on statewide water quality improvement programs, as required by statute. (2014 Acts and Resolves No. 97, Sec. 1(c) as amended by H.650). (Appendix G).

Implementation Mechanism

Act 64, passed by the Vermont General Assembly and signed into law in June, 2015, includes both increased fees and revenue generating mechanisms for the funding and implementation of this Plan. The State of Vermont Fiscal Year 2016 budget includes funding to support eight new positions within AAFM and thirteen new positions within DEC all dedicated to implementation of the Vermont Clean Water Initiative and Lake Champlain TMDL

The State continues to work with EPA, the U.S. Department of Agriculture, and other federal agencies, in cooperation with our federal Congressional delegation, to seek additional federal funding commitments to address phosphorus pollution into Lake Champlain, similar to the RCPP grant currently funding prioritized practices in key Lake Champlain watersheds.

Implementation Steps and Timeframe

1. Provide a report to EPA with an updated spending plan for TMDL plan implementation based on available federal and state funds — 2016 and every five years thereafter
2. Prepare a legislative report that recommends revenue tools and Financing strategies to provide the Clean Water Fund with adequate and sustainable funds to support the State's long-term clean water needs — 2016
3. Establish long-term revenue sources to support water quality improvement via the Clean Water Fund, as described in the TMDLs' Accountability Framework — 2017

B. CLEAN WATER INITIATIVE PROGRAM

Description

DEC restructured the Ecosystem Restoration Program to become the Vermont Clean Water Initiative Program (CWIP). The purpose of the restructuring was to work collaboratively with state, federal and local governments and other partners to coordinate, manage and fund implementation of TMDLs and other priority clean water improvement activities throughout the state. The Program is responsible for tracking, reporting and communicating on the State's progress in achieving and maintaining clean water statewide. The Program also provides administrative support to the Clean Water Fund Board in the management of the Clean Water Fund.

CWIP manages a competitive grant program to reduce nutrient and sediment pollution into the Lake Champlain basin and other surface waters of the state from nonpoint sources. The program relies on tactical basin plans to identify priority projects for implementation. CWIP ecosystem restoration grants help to:

- Reduce stormwater runoff from developed areas;
- Reduce runoff from farms where there are gaps in support from the Agency of Agriculture, Food and Markets;
- Upgrade road networks with best road-related stormwater management practices where there are gaps in support from the Agency of Transportation; and,
- Restore and protect floodplains, river corridors, wetlands, and riparian areas along rivers, streams, lakes, ponds, and wetlands.

The additional support from the Clean Water Fund enables CWIP to support the delivery of technical and educational assistance to municipalities, farmers, loggers and foresters, developers, businesses, and landowners in practices to reduce nonpoint source pollution runoff and improve flood resilience. Activities include:

- Delivery of technical assistance to municipalities, farmers and other partners;
- Support for priority agricultural programs, such as an emerging small farm assistance program at AAFM, the UVM Extension/Poultney-Mettowee Conservation District's Agronomy and Conservation Assistance Program (ACAP);
- Watershed restoration work of key partners including the Regional Planning Commissions, the water resources coordinator at the Vermont League of Cities and Towns Municipal Assistance Program, the natural resources conservation districts, watershed-based groups, and lake associations;
- Technical assistance to loggers, landowners, and foresters about acceptable management practices (AMPs) and other water quality practices, such as the use of portable skidder bridges, for controlling runoff from timber harvesting operations,
- Expanding the federal USDA cost-share programs that encourage landowners to address soil erosion and sedimentation associated with logging roads and landings; and,
- Educational assistance from organizations such as the Vermont Youth Conservation Corps, the Student Conservation Association, and the NorthWoods Stewardship Center.

In 2015, the Vermont General Assembly increased the ecosystem restoration capital grant funds to $3.75 million per year (up from a funding level of $2.0-$2.5 million per year in prior years) to

support implementation of clean water improvement projects. The program also uses the ecosystem restoration grant process to administer DEC's share of funds from the Clean Water Fund. Grant recipients include municipalities, watershed and lake organizations, regional planning commissions, and other local and regional partners. Generally, about two-thirds of the grants support projects within the Lake Champlain basin.

Implementation Mechanism

The Program continues to manage annual state capital bill and Vermont Clean Water Fund appropriations to implement priority actions, as described in tactical basin plans.

Implementation Steps and Timeframe

DEC will undertake the following actions:

1.	Develop an annual capital and Vermont Clean Water Fund budget that addresses clean water need	Annually
2.	Provide management support to the Vermont Clean Water Fund Board	2015-2036
3.	Support interagency coordination regarding TMDL implementation	Annually
4.	Dispense funds for implementation of priority actions	Annually
5.	Support expansion of a state revolving fund for stormwater management	2015-2036
6.	Establish tracking system to measure and track progress	2016
7.	Continue to coordinate, manage, track, communicate and report on TMDL implementation	Annually
8.	Conduct technical assistance on nonpoint source controls	Ongoing

C. CLEAN WATER FUND

Description

Act 64 created the Vermont Clean Water Fund a dedicated source of funding that strategically targets priority water quality improvement programs. The Vermont Clean Water Fund's priorities, set forth in 10 V.S.A. §1389(e), include addressing significant contributors to water quality pollution; providing assistance across sectors; and funding outreach, education, and demonstration projects. Among the state partners who may receive support from Vermont Clean Water Fund are municipalities, nonprofit organizations, regional associations and other entities undertaking community-based programs or projects.

The Act created a Clean Water Fund Board to receive and manage the funds, comprised of the Secretaries of Administration, ANR, AAFM, ACCD and VTrans, or their designees. The Fund consists of appropriations from the Vermont General Assembly, and can also be supported by gifts, donations and impact fees. Act 64 requires a Clean Water Initiative Annual Performance Report that summarizes public investments and results of those investments.

The Fund is currently supported by a 0.2 percent surcharge on the property transfer tax on properties over $100,000 for the first three years of the Fund's operation. This funding mechanism is expected to generate approximately $5 million annually for the purpose of making additional strategic investments in water pollution control.

The Vermont Clean Water Fund supports the following existing programs:

- Grants and contracts that support the use of incentives and on-farm implementation projects managed at the Agency of Agriculture, Food and Markets;
- DEC's CWIP Ecosystem Restoration grants and contracts to aid municipalities, landowners, and other partners in implementation of priority clean water improvement projects;
- VTrans' grants programs, such as its Vermont Better Roads Program, a grant program to help municipalities implement best management practices pertaining to runoff from roads, as part of VTrans' Municipal Mitigation Grant Program.
- DEC Facilities Engineering Division municipal support programs, such as technical assistance in infrastructure planning and asset management for public wastewater treatment facilities

Implementation Mechanism

The Clean Water Initiative Program will continue to work with the Vermont General Assembly to support the Clean Water Fund.

The property transfer surcharge as the Clean Water Fund's sole revenue source will sunset by July, 2018. Thus, the State is in the process of developing a long-term funding solution for the Fund. Act 64 directs the Office of the State Treasurer to prepare a report to the state General Assembly that recommends A set of revenue tools to provide the Clean Water Fund with adequate and sustainable funds needed to support the implementation of the Lake Champlain Phosphorus TMDLs and other state clean water priorities. The State Treasurer is working in collaboration with the agencies of Administration, Commerce and Community Development, Agriculture, Food and Markets and Transportation to establish a long-term funding solution.

Implementation Steps and Timeframe

DEC will undertake the following actions:

1.	Secure legislation to support the creation and long-term sustainability of the Clean Water Fund	2015

Milestones for Partial Implementation

1.	Work with state partners to develop an administrative framework for managing the Fund	2015-2016
2.	Create a Clean Water Fund Board	2015-2016
3.	Establish administrative controls to manage billing, tracking, progress, communicating, reporting and enforcement	2015-2018
4.	Establish an initial and permanent funding mechanism to support the Vermont Clean Water Fund	2015-2019

D. TACTICAL BASIN PLANNING AND CRITICAL SOURCE AREA

IDENTIFICATION – NEXT-GENERATION STRATEGY FOR TARGETED IMPLEMENTATION AND PHASE 2 WATERSHED-LEVEL PLANNING

Description

In order to promote the most efficient and cost-effective implementation of phosphorus controls, DEC's Watershed Management Division (WSMD) developed a tactical basin planning process to coordinate watershed assessment, planning, project identification and funding. The identification of priority implementation projects in tactical basin plans is directly linked to targeted funding efforts, currently provided by WSMD's CWIP. This linkage provides synergy between identified priority projects and available funding.

RELATIONSHIP OF TACTICAL BASIN PLANNING AND PHASE 2 WATERSHED PLANS

With respect to implementing the Lake Champlain TMDL, DEC is committed to further improving the tactical planning process in several ways, such that each associated Lake subwatershed tactical basin plan serves as the Phase 2 Implementation Plan for the execution of the Lake Champlain TMDL. In addition to the expected chapters featured in present tactical plans, DEC is committed to significantly expanding the implementation table for each tactical plan. This implementation table will outline the priorities of DEC, and partner organizations for protection or restoration of specific stream/river or lake segments affected by specific pollution sources, and present a specific focus on BMP or programmatic implementation necessary to reduce phosphorus loading to the Lake. The table will describe the types of BMP or other implementation strategies that are needed, by sub-watershed and source sector. A Phase 2 section of the tactical basin plan will present best-available estimates of likely phosphorus reductions by allocation category and related regulatory authority, aggregated at the appropriate geographic scale. The table will also serve to notify partner organizations of the types and locations of projects that DEC will support with CWIP's Ecosystem Restoration grants, the Clean Water Fund, or other Federal, State or public-private funding sources available to DEC.

Tactical basin plans will facilitate implementation by translating the results of integrated basin assessments into specific geographically defined areas for project-level intervention. While tactical plan implementation tables, housed within the DEC TMDL Tracking Database, will be frequently updated to reflect the implementation of practices that are required as a result of regulatory program requirements, the tactical plans themselves are not standalone regulations or permits. Tactical basin plan implementation tables may identify the appropriate restoration strategies based on monitoring and assessment data, but implementation authority lies with the regulatory programs. Agricultural interventions will be identified in the Phase 2 section and implementation table at a geographic scale sufficiently fine so as to transparently present areas of planned intervention for each tactical planning cycle, but also at a level sufficiently coarse not to trigger confidentiality provisions of the Farm Bill, section 1619, pertaining to agricultural practice installation.

As part of the Phase 1 Plan for Lake Champlain, WSMD intends to capitalize on partnerships with Regional Planning Commissions and Vermont's Natural Resources Conservation Districts to assist

in the final prioritization of tactical plan implementation actions. Conservation Districts provide capacity for implementation of water quality BMP's, while Regional Planning Commissions possess unique locally-relevant planning capabilities that complement the Division's efforts. As provided in Act 64, Regional Planning Commissions may conduct one or more functions in the development of a tactical basin plan:

- Identify projects or activities within a basin that will result in the protection and enhancement of water quality by assisting the Secretary in implementing a project evaluation process to prioritize water quality improvement projects within the region to ensure cost effective use of State and federal funds;
- Ensure that municipal officials, citizens, watershed groups, and other interested groups and individuals are involved in the basin planning process;
- Provide technical assistance and data collection activities to inform municipal officials and the State in making water quality investment decisions;
- Ensure regional and local input in State water quality policy development and planning processes;
- Provide education to municipal officials and citizens regarding the basin planning process;
- Develop, in consultation with the applicable regional planning commission, an analysis and formal recommendation of conformance with the goals and objectives of applicable regional plans;
- Provide for public notice of a draft basin plan; and for the opportunity of public comment on a draft basin;
- Coordinate municipal planning and adoption or implementation of municipal development regulations to better meet State water quality policies and investment priorities.

Beginning in the spring of 2015, using funds allocated pursuant to Act 64, DEC contracted with the 11 Regional Planning Commissions to carry out many of these functions. This has improved regional and municipal awareness of and participation in the implementation of the Vermont Clean Water Act, including participation in the development of the Tactical Basin Plans. As this partnership matures, DEC anticipates a significant expansion in the ability of the State, RPC's and other partners such as Conservation Districts to meaningfully implement tactical basin plans.

While tactical plans are redrafted every five years, DEC is also committing to periodic review of the progress of implementation programs and efforts. During that time, DEC will conduct public outreach to highlight implementation efforts, and insert new priority items that are more recently identified through on-going assessment. As such, the tactical basin plan's implementation table is a living chronicle of the identified priority interventions needed to implement sediment and nutrient load reductions in the Lake Champlain watersheds to achieve the necessary phosphorus targets in the Lake Champlain TMDLs. Insofar as the implementation tables outline opportunities for phosphorus reduction through improved flood resilience, climate adaptation strategies are also promoted through the tactical plans.

EXPANDING CAPACITY FOR WATERSHED MODELING AND INTEGRATION

The five sector-specific assessment processes (see Chapter 5) that are integrated to produce current tactical basin plans yield prioritized prospective projects to address multiple stressors. As of 2014, these assessments were targeted using non-empirical approaches, based to a degree on the organizational interest and availability of partners who would conduct the assessment. The tactical

planning process is presently conducted at the scale of individual waters and subwatersheds. For comprehensive management to occur at the scale of the Lake Champlain TMDL, there is a need for additional geographically-based prioritization approaches to target assessments where they are not yet in-place, and where general water quality monitoring data are not available. For example, it is easy to target a Better Roads project in a municipality in which impaired waters have been identified using biological monitoring, and available stream geomorphological assessments (SGA) implicates road runoff. Absent this information, where should implementation be targeted first, to achieve the most effective phosphorus reductions? DEC is committing to answer this fundamental question by significantly increasing reliance on high-resolution spatial landscape modeling to target assessments and BMP implementation by adopting and evolving tools such as those described in the following.

MISSISQUOI BAY BASIN SWAT MODEL

The 2011 Lake Champlain basin Program (LCBP) project to map critical phosphorus source areas in the Missisquoi Bay Watershed provides an example of a technologically evolved approach to generating on-the- ground areas for implementation. This 2012 assessment integrated a Soil Water Assessment Tool (SWAT) modeling effort with an in-stream channel erosion model called Bank and Toe Stability Erosion Model (B-Stem) to map critical runoff source contributing areas at a scale of 30 meters. The tool separates out critical source areas among developed and agricultural areas, mapping likely phosphorus runoff. Using that tool, DEC, LCBP, and AAFM have been able to prioritize outreach and implementation of specific watershed fixes at specific farms, and to more precisely target the need for specific for assessment work. This is the type of information that permits the development of highly targeted BMP implementation. Figure 8 shows the total estimated yield of phosphorus from the area surrounding Enosburg Falls. Modeling results of such precision are not, however, available in other parts of the Lake Champlain Basin.

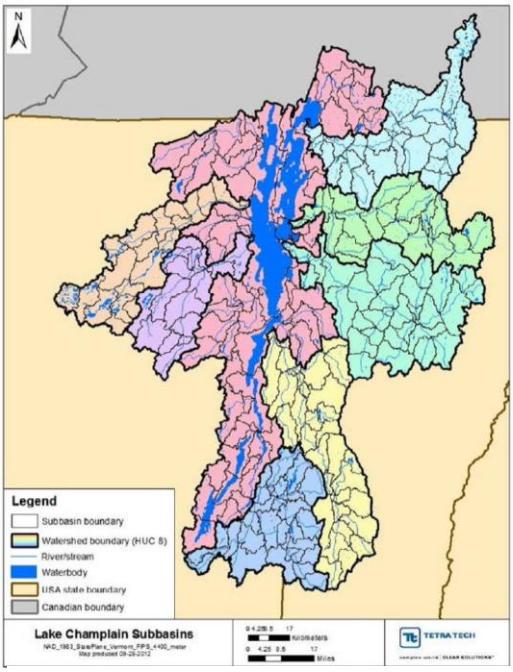


Figure 8 - HUC-12 Subwatersheds modeled by USEPA to produce estimated Phosphorus loads and load reduction potential, for the Lake Champlain TMDL

USEPA SCENARIO TOOL

For the entire Lake Champlain basin, the USEPA has contracted the development of a HUC-12[1] level SWAT analysis (Figure 10) to substantiate the reasonable assurances for the TMDL analysis. The results of this analysis have been used to develop an estimation of current phosphorus loads, by major and sub-watershed, and by land-use sector. A synthesis of the modeling results called the "scenario tool" has been developed to allow planners to rapidly obtain more focused estimates of phosphorus loading at the HUC-12 level, by presenting the specific loads associated with particular land uses. This tool presents the relative effectiveness of a suite of management practices to reduce phosphorus. The Scenario Tool has been used to derive a set of scenarios by which the Lake TMDL load allocation may be attained. While the Scenario Tool is not as precise as the Missisquoi Bay Basin Critical Source Area (CSA) Model, it does present a dataset which may be used to target

sub-watersheds for follow-on specific planning and implementation, as shown below.

An examination of the Scenario Tool output for the Otter Creek (Figure 10) indicates that the areas of greatest phosphorus export occur in the northwest, or downstream-most areas of the watershed. For each subwatershed identified, the Scenario Tool provides the range of P export by land use. The highlighted subwatershed, which comprises part of the Little Otter Creek, is one dominated by corn-hay and hay lands. In addition, the largest phosphorus export category for this subwatershed is unpaved roads.

The BMP implementation scenario to achieve standards in Lake Champlain presented in the Scenario Tool gives a starting point to target specific assessments and possible BMP counts by major (HUC 8) watershed. However, the tool does not attempt to break these down to smaller subwatersheds such as those presented in Figure 10. EPA's "HUC 12" tool provides additional geographic specificity as to phosphorus loads by HUC 12 subwatershed, which presents one option by which the base BMP scenario may be parsed among smaller subwatersheds, and expressed through the programs and regulatory mechanisms described in this Phase 1 Plan.

WSMD will build upon these tools to achieve geographically explicit nutrient load estimation and load prioritization by relying on such tools as the Missisquoi Bay Basin CSA model, and a series of geographic analyses as described below, to support implementation of the Lake Champlain TMDL.

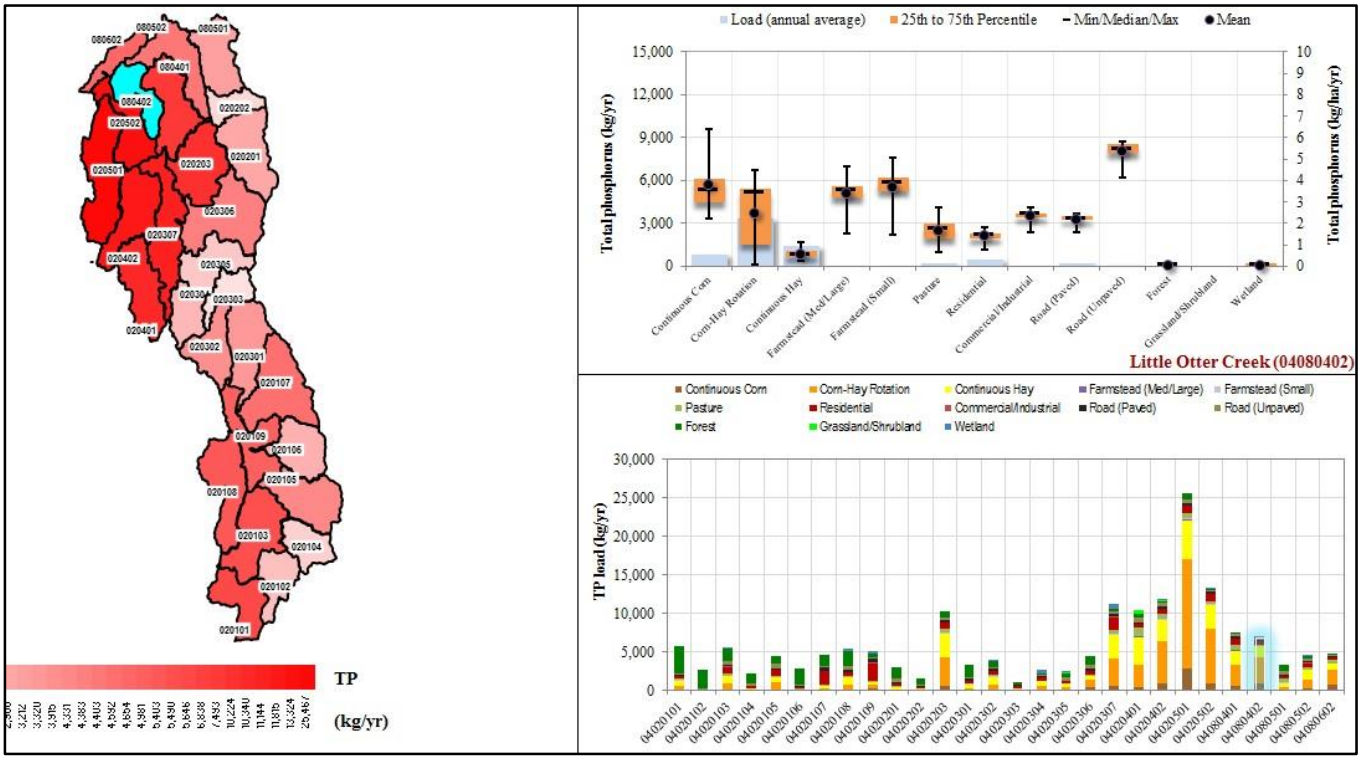


Figure 9 - Little Otter Creek sub-watershed or the Otter Creek (left, blue), showing Phosphorus export by land use (lower right, highlighted bar) relative to other subwatershed, and estimated total loads by land use sector (upper right)

Clean Water Roadmap

To implement the TMDL in a manner envisioned by DEC, including the ability to identify the highest-priority BMP installations and regulatory interventions for any given tactical planning cycle, an optimized and flexible critical source area modeling tool is being constructed for the Vermont portion of the Lake Champlain Basin. Developed as a partnership between Keurig Green Mountain Coffee Roasters and DEC, with technical assistance and input from The Nature Conservancy, NRCS, and other partners, the system is designed to present, at geographically-explicit scales, a downscaling of the Lake Champlain SWAT model and associated HUC 12 Tool output for any user to understand which areas of the landscape are appropriate for specific practices, by Transsector. This new modeling and data retrieval tool, called the Clean Water Roadmap will:

- Be continually maintained, with update cycles co-incident with the five-year tactical planning cycle for each Lake Champlain watershed;
- Incorporate the most up-to-date land cover and use and LiDAR-derived topography, which can be used to track changes in land use and impervious cover;
- Incorporate key physical factors driving the export of phosphorus, including source proximity and effective connection to surface waters;
- Overlay available stream geomorphic assessment information to determine the likelihood for controllable phosphorus by addressing stream disequilibrium;
- Present a series of geographically-based analyses aimed at identifying the highest priority stressors;
- Geographically target BMP-level implementation options derived from the Scenario tool and other assessment types identified in Chapter 4; and
- Cross-reference prospective critical source areas that are specific to land-use sectors with these projects or BMPs to produce the next five-year iteration of implementation steps.
- Allow for practices that are implemented and tracked (see Tracking section, below) to be presented on a map interface.

In the section below entitled Phase 2 Plan Outline, a series of example maps and tabular output is presented.

Public Availability of Data and Assessments

In addition to the mapped and tabular information above, as required by Act 64, the Division will also present a coordinated assessment of all available data and science regarding the quality of the waters of the State, including:

- Light detection and ranging information data (LIDAR);
- Stream gauge data;
- Stream mapping, including fluvial erosion hazard maps;
- Water quality monitoring or sampling data;
- Cumulative stressors on a watershed, such as the frequency an activity is conducted within a watershed or the number of stormwater or other permits issued in a watershed.

Phase 2 Plan Outline for Each Tactical Basin Plan

Coincident with the promulgation of the EPA TMDLs for Lake Champlain and the development of the Clean Water Roadmap, the Division has also developed, with input from EPA, Agency of Agriculture, NRCS, and other partners, information that will be presented for each Tactical Basin Plan that serves as the Phase 2 Plan to implement the TMDL at the tactical basin scale. The purpose of the information is to present, with as much precision as is justifiable given the resolution of the available modeling data, a proposed division of the TMDL allocations among source sectors and land uses. These planning-level "sub-allocations" can be considered the best-available estimates of the contribution of phosphorus from each land-use sector to the receiving segment of Lake Champlain, and are described in relation to the regulatory program responsible for reducing that source sector load. In the text below, a proposed TMDL Chapter for each Tactical Basin Plan will contain tables and maps that are intended to serve as planning tools for the regulatory and non-regulatory programs implementing the reductions. In this section, the reader should note that references to maps or tables are for illustrative purposes, and the final planning-level "sub-allocations" will be published in each Tactical Basin Plan.

Description of LC TMDL

A brief textual discussion of the Lake Champlain TMDL will be provided that sets the stage for the presentation of subsequent Phase 2 analyses. This will be followed by a proposed summary table of allocations, which in essence re-states the allocations promulgated in Table 7 of the TMDLs for Lake Champlain. The summary table, shown below, also serves as a roadmap of specific tables or maps that allow the reader to access specific analyses of interest.

Example - Summary Table of Allocations

Source	Category	Allocation category	Total allocation for basin	% reduction required for basin
Forest	All lands	Load	XX kg/yr	YY%
Stream Channels	All streams	Load	XX kg/yr	YY%
Agriculture	Fields/pastures	Load	XX kg/yr	YY%
	Production Areas	Wasteload	XX kg/yr	YY%
Developed Land	Summary		XX kg/yr	YY%
	Roads TS4	Wasteload		
	Roads MRGP	Wasteload		
	MS4	Wasteload		
	Larger unregulated parcels	Wasteload		
Wastewater	WWTF discharges	Wasteload	XX kg/yr	YY%
	CSO discharges	Wasteload	0 kg/yr	na

Example map showing total load reductions achieved by full TMDL implementation for the Lamoille Basins. This map, in conjunction with those presented subsequently, serve as valuable planning tools to determine areas where implementation will achieve a larger phosphorus reduction benefit.

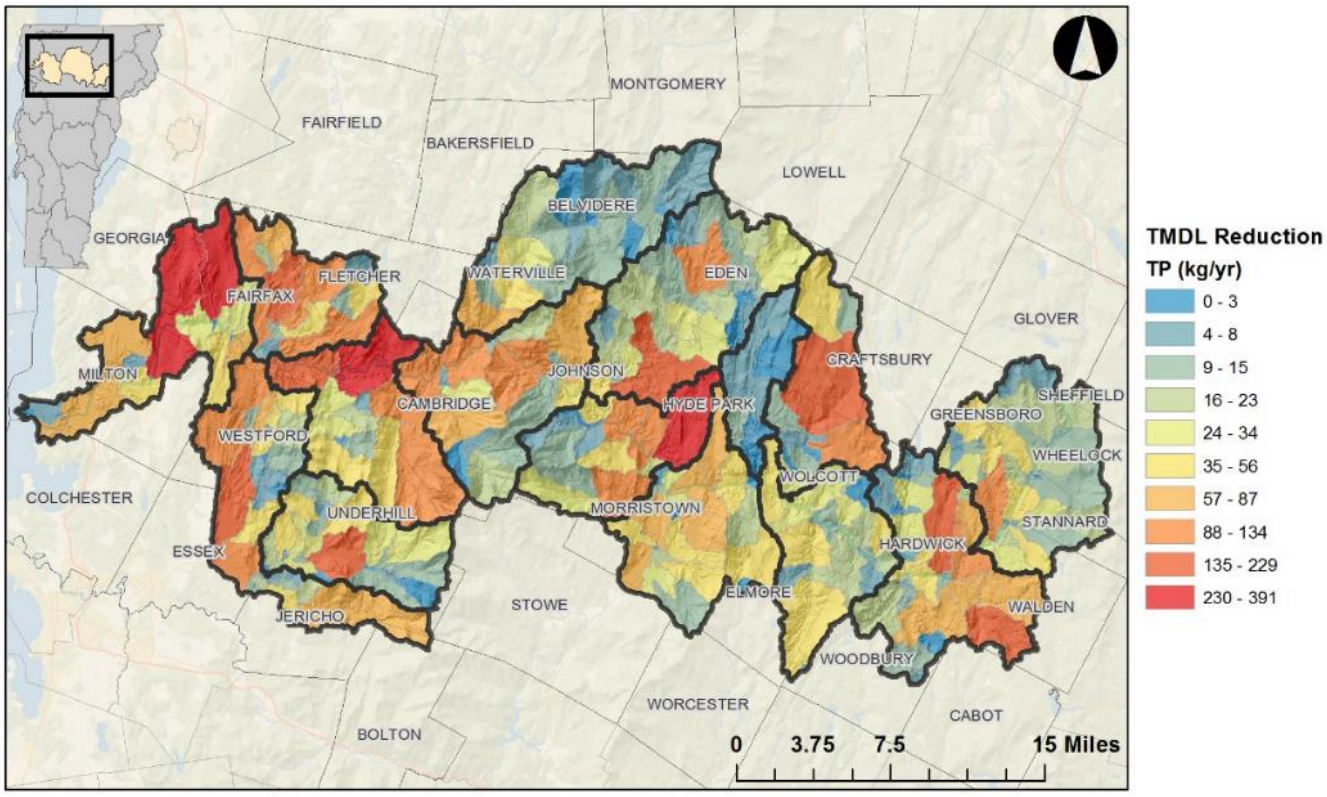


Figure 10 - Total TMDL Reduction Potential

Basin Specific Analyses by Source Category

In this section, a description of the applicable nonpoint source practices will be provided, along with a tabular description of prospective BMP's that have been suggested by the Reasonable Assurance Scenario presented by EPA's HUC 12 Scenario Tool, or other, more refined sources. In each tactical basin plan, analyses will be presented that provide Champlain TMDL suballocations at geographically meaningful scales, to guide implementation, and to provide initial estimates of the likely phosphorus reductions achievable, using appropriate BMPs, and in specific geographic areas. In the example map below, total phosphorus runoff estimates from agricultural lands are shown, based on "downscaled" USEPA SWAT model information.

Controlling Phosphorus from Developed Lands

In the Lake Champlain TMDLs, all developed land phosphorus loads are considered part of the wasteload allocation, in consideration of the regulatory authorities conferred by Act 64. As such, this section will describe the four regulatory programs identified to address phosphorus and other impairment pollutant discharges from developed lands. They are the: Transportation Separate Storm Sewer System Permit (TS4); Municipal Roads General Permit; Municipal Separated Storm Sewer Permit; and, the so-called Operational Three-acre Permit. For the TS4, the applicable scale at which to portray the subdivided allocations is the HUC 12 scale. For the remaining programs, the municipal scale is most relevant. In Table WLA-2, a summary of which regulatory program is applicable for which municipalities is envisioned. Subsequent Tables WLA-3 thru WLA 5 and associated maps will provide specific proposed subdivided planning-level allocations.

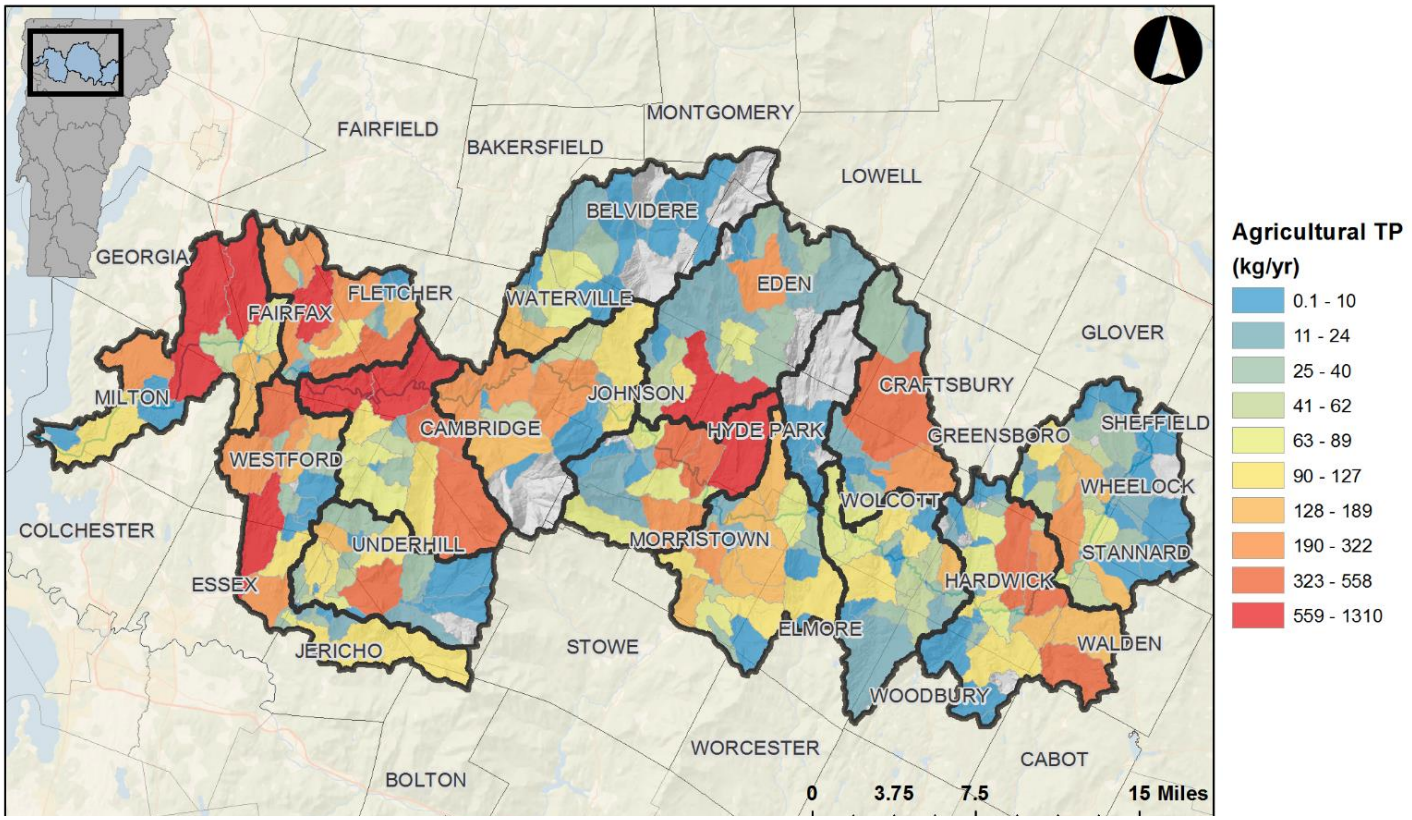


Figure 11 - Estimated Agricultural Total Phosphorus

Example Table WLA-2. Summary of Regulatory Programs addressing the Developed Lands wasteload allocation, by jurisdiction.

Jurisdiction	Total load	Load reduction targeted %	Applicable Regulatory Program to address Phosphorus (could be Y/N, or year planned for issuance)			
			TS4	MRGP	MS4	Operational Three-acre
State of Vermont	X kg/yr	X%	√			
Municipality 1	Y kg/yr	Y%			√	√
Municipality 2	Z kg/yr	Z%		√	√	√
Municipality 3	A kg/yr	A%		√		√
Municipality 4	B kg/yr	B%		√		

Example Table WLA-3A. Breakdown of wasteload allocation for State-managed highways.

HUC12	Total modeled load	Load reduction targeted % in TMDL.	Total road miles	
			Roads managed by Catch Basins	Roads Managed by Ditching
4050101	X kg/yr	X%		
4050102	Y kg/yr	Y%		
4050103	Z kg/yr	Z%		

Example map at showing total phosphorus load estimated from paved roads on well-drained soils, at the catchment scale. HUC 12 boundaries are shown in bold lines.

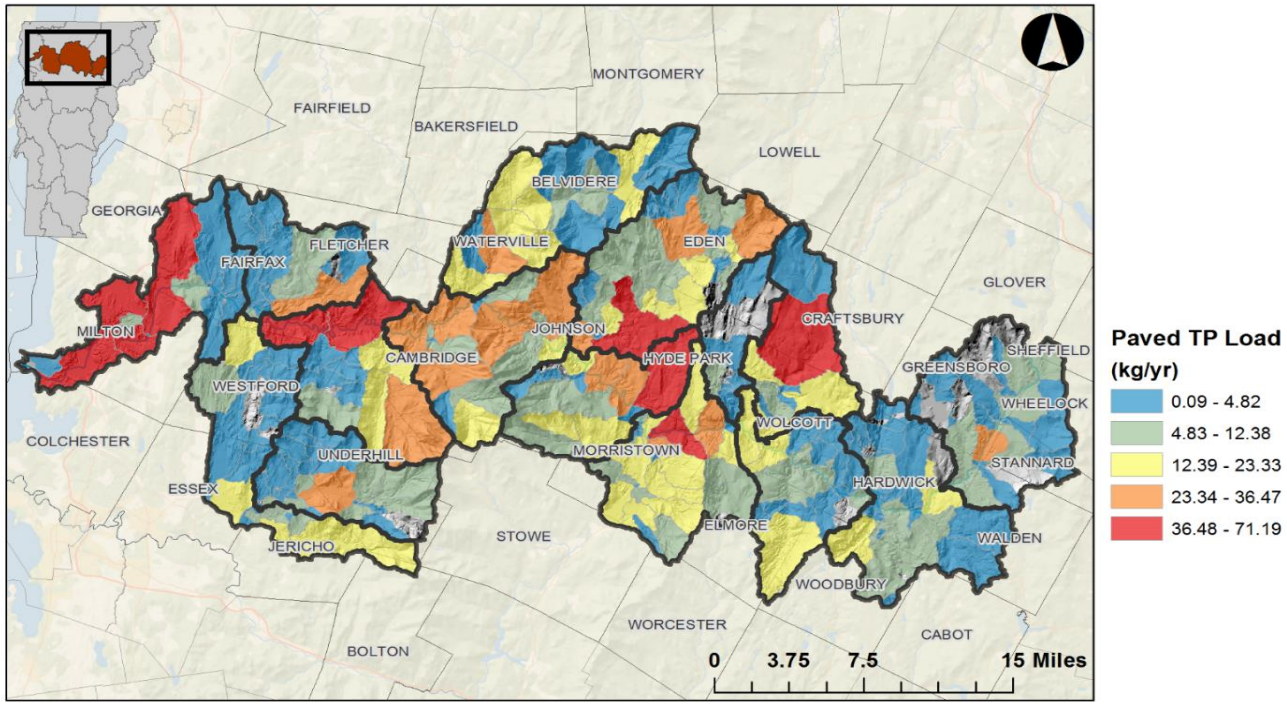


Figure 12 - Total Phosphorus load (kg/yr) from paved roads on A and B soils

Municipally Managed Roads (Municipal Roads General Permit)

This general permit is intended to achieve significant reductions in stormwater-related erosion from municipal roads, both paved and unpaved. Municipalities will implement a customized, multi-year plan to stabilize their road drainage system. The plan will include bringing road drainage systems up to basic maintenance standards, and additional corrective measure to reduce erosion as necessary to meet a TMDL or other water quality restoration effort. Insofar as different road types are managed with different management practices, the road miles projected to require management subject to the MRGP are separated into four categories: paved roads with catch basins; paved roads draining to a network of ditches; gravel roads; and, Class 4 roads. Maps will also be presented that provide geographic specificity as to where the opportunities for phosphorus reduction are highest.

Example Table WLA-3A. Subdivision of basin-wide wasteload allocation for Municipally-managed roads, expressed by mileage of road types within municipalities in the Missisquoi Bay Basin.

Municipality	Total modeled load	Load reduction targeted %	Total Road Miles by Road Type with Connection to Surface Waters, Assessed as Medium and High Risk			
			Paved roads Catch Basins	Paved Roads Ditched	Gravel Roads	Class 4
Muni A	X kg/yr	X%				
Muni B	Y kg/yr	Y%				
Muni C	Z kg/yr	Z%				

Municipally-Separated Storm Sewer Systems (MS4)

In the Lake Champlain TMDLs and this Phase 1 plan, municipalities whom are part of the MS4 permit have the ability to manage their loads in aggregate across source sectors.. The tabular output will also reflect other impairments for which MS4 permit coverage is in place (e.g., flow restoration).

Example Table WLA-4. Division of basinwide wasteload allocation among MS4 communities

Municipality	Total modeled load	Load reduction targeted %	Total (untreated?) Impervious Acres	Other impairments
1	X kg/yr	X%		
2	Y kg/yr	Y%		
3…	Z kg/yr	Z%		

Operational three-acre permit program

This analysis will catalogue the total acres of impervious cover in three-acre or larger parcels, and provide an initial estimate of phosphorus reduction potential by coverage under the new "Operational Three-acre" permit.

Example Table WLA-5. Component of basinwide wasteload allocation associated with impervious surfaces of three-acres or larger.

Municipality	Total load	Load reduction targeted %	Total (untreated?) Impervious Acres
Municipality 1	X kg/yr	X%	X
Municipality 2	Y kg/yr	Y%	Y
Municipality 3	Z kg/yr	Z%	Z
Municipality …	…	…	…

Wastewater

Each tactical basin plan will provide a tabular description of each facility, its wasteload allocation, current usage of design capacity, and other factors. Also included will be a brief discussion of specific facilities that may be undergoing upgrades or renovations.

TACTICAL PLANNING BY NRCS FOR AGRICULTURAL PRACTICE IMPLEMENTATION

In addition to the planning-level suballocations presented in the Phase 2 section of a Tactical Basin Plan, NRCS-Vermont has committed to developing supporting, high-resolution assessments for use in identifying on-the-ground opportunities for BMP placement in agricultural settings. These assessments are being conducted for the highest-priority subwatersheds as identified by DEC, AAFM, and NRCS resource staff. In these watersheds, NRCS watershed modeling specialists, relying on the privileged agricultural land-use information contained in the Federal databases will develop specific geographic targeting tools for particularized BMP placement situations. The high-resolution assessments developed by the Vermont NRCS are intended to address the need for more effective practice implementation of conservation plans on agricultural lands in the Lake Champlain Basin. These agricultural watershed plans will provide a comprehensive inventory of land use and resource conditions in each of the targeted watersheds, and present detailed practice implementation tables that are specific to the subwatersheds.

This information will then be used by Local Watershed Teams as part of the Regional Conservation Partnership Program, working in each watershed to identify and target specific farms and for practice alternatives. These Local Watershed Teams will be initially established by NRCS, but will be directed by a local partner to bring all agricultural partners together to work in a coordinated and strategic effort to optimize BMP installations. The specific watersheds to which NRCS has committed development of these high-resolution plans in the Lake Champlain Basin to date, for 2016 and 2017, are shown below. As these assessments are completed, it is envisioned that the subsequent, next highest priority subwatersheds will be selected for high-resolution planning.

Basin	Subwatershed	Year
Missisquoi	Rock River	2016
Missisquoi	Pike River/Lake Carmi	2016
North Lake Champlain	St. Albans Bay	2016
South Lake Champlain	Mackenzie Brook*	2016
South Lake Champlain	East Creek	2017
South Lake Champlain	Poultney River	2017
Otter Creek	Lemonfair River	2017

** The so-called Mackenzie Brook refers to the named NUC12 subwatershed surrounding the northern area of South Lake Champlain. The specific tributaries include Whitney and Hospital Creeks, Braisted and Stony Brooks, and the minor streams in between.*

NRCS intends to include the following high-precision GIS analyses in these subwatershed plans:

a) Farmstead mapping
b) Annual crop, hay land, and pasture maps
c) Cropland and steep slope adjacency
d) Wetland restoration potential
e) Riparian buffer gap analysis
f) Corrected hydrography
g) Conservation practice implementation maps
h) No-till practice application – lower priority
i) Cover crop practice analysis – lower priority
j) Manure injection analysis – lower priority
k) Agricultural ditch and tile drainage location maps – lower priority
l) Animal access to streams maps –lower priority
m) Perennial annual cropland and perennial hay land maps – lower priority

INTEGRATING PHASE 2 PLANS AND TACTICAL BASIN PLAN IMPLEMENTATION TABLES

To date, Tactical Basin Plans have been published with a fixed, or printed Chapter 4 - Implementation Table. As a result of a concerted effort between MAPP and CWIP, a new system has been envisioned, and developed, which eliminates stand-alone implementation tables, and replaced these with a more robust, extensible, and updatable Implementation Tracking Database. The database, as described more fully below, identifies geographically and sector specific activities, down to the project type and specific location, and will include prioritization factors that allow the public to understand where any given project is in its lifecycle, be it an assessment, feasibility or scoping analysis, design, or installation.

Capacity for Implementation

The roles of the WSMD watershed coordinators are to develop the tactical basin plans on a five-year recurring basis; and update the implementation table on a frequently recurring basis. CWIP will coordinate, manage and fund TMDL implementation and oversee tracking, reporting and communicating on the State's progress. Regional planning commissions, natural resource conservation districts and watershed organizations are core partners in the implementation of tactical basin plans.

Implementation Steps, Timeframe, Milestones

The following tabular description of tasks and timelines presents the milestones towards the transition to the augmented tactical planning process as described above. According to this schedule, DEC is committing to a first-iteration basin-wide Phase 2 roster of implementation steps by spring, 2016. In addition, DEC is committing to updating all tactical basin plans in the Lake Champlain watershed such that they will include first-five-year Phase 2 implementation actions by December, 2017.

Task	Timeline	Milestone
Completion of South Lake Champlain Basin Tactical Plan	May, 2014	Standard Tactical Plan issued
Completion of North Lake Champlain Direct Basin Tactical Plan	July, 2015	Standard Tactical Plan issued
Initial development of modeling capacity	Fall, 2015	Modeling and GIS analysts on staff.
Development of Phase 2 Overall Tactical Actions Plan	Fall 2015 to Fall 2016	Initial Phase 2 roster of interventions necessary, basin- wide, using Scenario Tool and initial coarse modeling.
Development first five-year implementation scenarios – Lamoille, Missisquoi, South Lake Champlain	Summer through Fall 2016	Geospatial and tabular representation of intervention locations and BMP options.
Completion of Lamoille Basin Tactical Plan – Implementation Table to reflect first five-year Phase 2 cycle	Dec., 2016	Plan issued, Implementation Table to reflect first five-year Phase 2 cycle. All active basin plans for the Lake Champlain Basin reflect modern Tactical Plan Design.
Update Missisquoi Tactical Plan	Dec., 2016	Implementation Table to reflect first five-year Phase 2 cycle.
Update South Lake Champlain Tactical Plan	Dec., 2017	Implementation Table to reflect first five-year Phase 2 cycle.
Development first five-year implementation scenarios Winooski, Otter Creek	Winter, 2016 to Spring, 2017	Geospatial and tabular representation of intervention locations and BMP options.
Update Winooski Tactical Plan	Dec., 2018	Implementation Table to reflect first five-year Phase 2 cycle.
Update Otter Creek Tactical Plan	Dec., 2019	Implementation Table to reflect first five-year Phase 2 cycle.

E. TRACKING PHASE 2 TMDL IMPLEMENTATION & BEYOND

As described in the Tactical Basin Planning and Critical Source Area Section, Tactical Basin Plans (TBP) will serve as TMDL Implementation Plans for Phase 2 implementation and beyond. Each plan will cover a five-year period and include Implementation Tables that identify specific actions to be taken by specific dates to meet a projected phosphorus reduction target within that five-year period. In order to determine actions necessary to meet interim TMDL targets, TBPs will translate the results of assessments into geographically explicit areas for project-level intervention to guide and prioritize the installation of BMPs.

Implementation Tables will be housed within the DEC project database, and will be managed and updated by Basin Planners. The DEC project database will include a project grading system, addressing project readiness and prioritization factors, including estimates of environmental benefits, to assist Basin Planners in prioritizing projects for implementation and funding. Implementation Tables will also address actions to be taken as a result of regulation, including compliance with RAPs, as well as various stormwater permit programs. Stormwater permit programs include the MS4 Permit, the TS4 Permit, operational permits, and the MRGP. As TMDL actions listed in Implementation Tables are implemented, the same DEC project database where Implementation Tables are housed will be used to track progress, managed by the Clean Water Initiative Program.

To gauge progress meeting the TMDL targets, DEC will quantify phosphorus load reductions achieved using two categories of accounting methods. First, reductions from wastewater treatment facility optimizations and upgrades will be reflected in a summary of annual loading based on each facility's monthly discharge monitoring reports, as described previously. Second, reductions achieved by structural and non-structural stormwater and nonpoint source BMPs will be quantified using the Lake Champlain BMP Accounting and Tracking Tool (BATT), as described previously.

Each year, DEC will summarize estimates of phosphorus reductions achieved in the Lake Champlain Basin and compare those estimates to TMDL targets by wasteload allocation (WLA) and load allocation (LA) categories. The following tables articulate the framework for how progress implementing the TMDL will be measured (Table 10) and a summary of activities tracked and accounted for by Lake Champlain TMDL WLA and LA category (Table 11). For each WLA or LA category, progress will be measured using the TMDL base load (by sector and lake segment) as the baseline. Each year the status of TMDL implementation will be evaluated to determine changes in phosphorus loading as a result of implementation and land use conversions. Overtime, the cumulative change in loading will be measured based on all ongoing actions to determine the trend of TMDL implementation toward meeting the target WLA and LA by category and lake segment.

Table 11 - Framework for measuring TMDL implementation, to be generally applied to each WLA and LA category

Baseline	For each WLA or LA category, progress will be measured using the TMDL base load (by sector and lake segment) as the baseline. Base loads were determined by the SWAT modeled base load for phosphorus, by lake segment and sector, during the modeling period 2001-2010. In some cases, one baseload may apply to multiple WLA or LA categories; for example, the Agriculture Baseload applies to both the Agriculture Production Area WLA and the Agriculture LA.
Status	Each year the status of TMDL implementation will be evaluated to determine changes in phosphorus loading as a result of BMP implementation and land use conversions. Changes in annual average total phosphorus loading associated with land use conversions and BMP implementation will be estimated using the functionality of the Lake Champlain BATT, incorporated within the DEC Tracking System.
Trend	Overtime, the cumulative change in loading will be measured based on all land use conversions and active BMPs to determine the trend of TMDL implementation toward meeting the target WLA and LA by category and lake segment. In order to track the cumulative reductions achieved by BMPs, the lifespan of BMPs must be accounted for and the functionality of BMPs must be verified (verification protocol to be developed).
Target	The ultimate goal for TMDL implementation is to reach the total loading capacity of Lake Champlain that is allocated by source-sector category and lake segment through the TMDL's established WLA and LAs. Overtime, cumulative annual average phosphorus load reductions will be tracked to determine progress reducing the baseload to reach the TMDL by source-sector category and lake segment.

Table 12 - Summary of TMDL implementation activities to be tracked and accounted for by WLA and LA category

Wastewater WLA	Annual average load per WWTF based on phosphorus concentration and flow reported in Discharge Monitoring Reports, by lake segment relative to the Wastewater Baseload and WLA.
CSO WLA	Annual average load reduction achieved through stormwater BMP implementation in CSO drainage areas relative to the Developed Lands Baseload and CSO WLA (the CSO WLA only applies to the treated CSO drainage area in the City of Burlington; other CSO systems fall under the Developed Lands WLA).
Developed Lands WLA	Annual average load reduction achieved through stormwater BMP implementation on developed lands through funding programs and permit programs, including the MS4 permit, TS4 permit, MRGP, and operational permits, by lake segment relative to the Developed Lands Baseload and WLA; also addresses stormwater BMP implementation in CSO drainages, with the exception of the City of Burlington that is addressed with the CSO WLA.
Future Growth WLA	Annual average change in phosphorus load as a result of new development, accounting for increased load from new jurisdictional impervious cover, factoring the amount of the increased load treated by BMP installations, by lake segment relative to the Developed Lands Baseload and Future Growth WLA.
Agriculture Production Area WLA	Annual average load reduction achieved from agriculture production areas as a result of BMP implementation through funding programs and compliance with RAPs based on the Agricultural Partners' Database and the Agency of Agriculture, Food and Markets' (AAFM) tracking of compliance during inspections, by lake segment relative to the Agriculture Baseload and Agriculture Production Area WLA (AAFM will send DEC data on active agricultural BMPs annually, summarized at HUC12 watershed-level).
Agriculture LA	Annual average load reduction achieved from agricultural lands (e.g., pasturelands, croplands) as a result of BMP implementation through funding programs and compliance with RAPs based on the Agricultural Partners' Database and AAFM's tracking of compliance during inspections, by lake segment relative to the Agriculture Baseload and Agriculture LA (AAFM will send DEC data on active agricultural BMPs annually, summarized at HUC12 watershed-level).
Streams LA	Annual average change in phosphorus load as a result of stream channel evolution that may be the result of passive or active stream restoration; change of a stream to more stable conditions results in a decreased load and change of a stream to a less stable condition results in an increased load; methods for accounting approach are under development (for some lake segments, the Streams LA is included in the Developed Lands WLA and Agriculture and Forest LAs).
Forest LA	Annual average change in phosphorus load as a result of BMP implementation on forest roads and stream crossings, consistent with the Accepted Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont.

TRACKING IMPLEMENTATION OF THE TMDL WASTEWATER WLA

DEC has been tracking phosphorus loading from wastewater treatment facilities in the Lake Champlain Basin since 1996. These facilities, Basin-wide, have made great progress reducing phosphorus loading into Lake Champlain. Under the new Lake Champlain TMDLs, DEC will continue to track phosphorus loading from these facilities to ensure that loads remain below the Wastewater WLA. DEC tracks WWTF phosphorus loads using monthly Discharge Monitoring Reports (DMRs) submitted by each facility to DEC to comply with their NPDES permit reporting requirements. Average annual phosphorus loads are calculated using average monthly flow and concentration data. Each year, DEC will measure the status of meeting the TMDL WLA for wastewater by comparing the annual average phosphorus loading to the TMDL Wastewater WLA, by facility and lake segment.

TRACKING IMPLEMENTATION OF STORMWATER AND NONPOINT SOURCE WLAS AND LAS

Quantifying the benefits of stormwater and nonpoint source BMPs has historically been a challenge due to the geographic scale and distribution of these practices. Nonetheless, these BMPs will play a critical role in meeting the Lake Champlain TMDL targets, as the majority of loading into Lake Champlain comes from stormwater and nonpoint sources. In order to quantify reductions associated with actions to address stormwater and nonpoint sources of phosphorus, DEC's tracking system will incorporate the functionality of the Lake Champlain BATT.

BATT is a tool developed by Tetra Tech with EPA Region 1 contract support. BATT estimates annual average phosphorus load reductions from stormwater, agricultural, and other nonpoint source BMPs in a series of steps. First, based on the Lake Champlain TMDL SWAT model, BATT estimates the phosphorus load exported from an area of land treated by a BMP (i.e., BMP drainage area). Land loading rates for each unit of land treated are estimated based on the combination of land use type, hydrologic soil group, and average slope, consistent with the SWAT model. Second, based on the BMP type and BMP specifications (e.g., BMP soil type, storage volume, infiltration rate, etc.), BATT calculates and applies a BMP phosphorus removal efficiency (percentage) to the phosphorus load exported from the BMP drainage area. The result is an annual average estimate of phosphors load reduced by the BMP.

To document the methods built into BATT, DEC plans to develop a stormwater and nonpoint source BMP tracking and accounting protocol that will specify methods for estimating nutrient load reductions by BMP type. In the process of developing this protocol, DEC plans to offer opportunities for stakeholder input.

MANAGING NONPOINT SOURCE AND STORMWATER BMP DATA

Due to the geographic scale and distribution of nonpoint source and stormwater BMP implementation, BMP data and information will be collected through various reporting channels associated with state funding and regulatory programs. These data and information will be managed through various databases managed by the Agency of Agriculture, Food and Markets, Agency of Transportation, and DEC. Of the databases involved in tracking TMDL implementation, the DEC tracking system is the only system with the functionality to estimate phosphorus load reductions. For this reason, the DEC tracking system will serve as the hub to track TMDL implementation, and is designed to receive BMP data (at the BMP level or aggregated) from other programs and agencies. The various databases and their roles in tracking TMDL implementation, to date, are described as follows.

Agricultural BMP Data and Information

Implementation of Agriculture LAs and Agriculture Production Area WLAs will primarily be tracked through the Agricultural Partners' Database, which is a multi-organizational geospatial BMP implementation database managed by AAFM. The purpose of this database is to track agricultural BMP planning and implementation efforts in Vermont among nine partner organizations working to improve water quality by reducing agricultural non-point source pollution. This is the first database that will house NRCS BMP implementation data next to State agency and other partner data. Since NRCS is the largest supplier of financial and technical assistance for agricultural BMP implementation, it is crucial to include their activity when reporting on BMP implementation progress. This database will capture data and information on all agricultural BMPs implemented with any state or federal cost share. In addition, agricultural partners providing technical assistance to farmers may record data and information on BMPs implemented voluntary by farmers or to comply with RAPs. To further bridge data and information gaps on the scale of agricultural BMP implementation, AAFM will track the level of RAP compliance during farm inspections, and summarize, to the extent practicable, the level of RAP compliance to incorporate into TMDL implementation tracking. Due to confidentiality provisions, pursuant to Section 1619 of the Food, Conservation, and Energy Act of 2008, it is necessary to limit public presentation of BMPs implemented to protect proprietary information of farmers. Therefore, data and information on agricultural BMPs will be managed through AAFM, aggregated, and submitted to DEC periodically at the appropriate geographic scale to mask proprietary information.

Nonpoint Source and Stormwater BMP Data and Information

Implementation of structural and non-structural stormwater and road-related BMPs will be tracked through a combination of state regulatory and funding programs, including DEC's stormwater permit programs, DEC's Ecosystem Restoration Grants, and VTrans' Better Roads Grants. All stormwater BMPs tracked will address implementation of the TMDL Developed Lands and Future Growth WLAs. Implementation of BMPs to comply with stormwater permits will be tracked primarily using a combination of the WSMD Stormwater Program's existing stormwater database and DEC tracking system. Data and information on these stormwater BMPs will then be aggregated and imported into the DEC tracking system. Data and information on stormwater BMPs funded through Ecosystem Restoration Grants will be collected through final performance reports, submitted by grantees and entered into the DEC tracking system upon project completion. Finally, any road-related stormwater BMPs funded through the VTrans Better Roads Program will be tracked in a newly developed VTrans Better Roads Program database. VTrans will submit data and information on road-related BMPs funded annually to DEC for import into the DEC tracking system. BMPs implemented through the Better Roads Program will eventually support implementation of the Municipal Roads General Permit, and will be accounted for in a manner consistent with the MRGP, currently under development.

In addition to agricultural and stormwater BMPs, DEC will track natural resource restoration along rivers, lake shorelands, and wetlands, as well as practices along forest roads and stream crossings to capture the full range and impact of TMDL implementation activities. These natural resource restoration activities are critical to meet long term TMDL implementation goals, and are often accompanied by additional environmental benefits, including flood resiliency, habitat function, and socioeconomic values.

Reporting the Status of TMDL Implementation

In coordination with agency partners, DEC will report on the status of TMDL implementation, Basin-wide, as part of the Vermont Clean Water Initiative Annual Performance Report, to be submitted to the legislature as required under the Vermont Clean Water Act (Act 64). In addition, DEC will periodically summarize the status of TBP implementation tables and the status and trend toward meeting TMDL implementation targets (i.e., WLAs and LAs) based on all active BMPs. These reports will be provided to EPA for their consideration in issuing interim and final report cards on the State's progress meeting the TMDL targets based on the status of implementing the five-year TBPs (i.e., Phase 2 TMDL Implementation Plans and beyond). These report cards will be issued on a rotating basis, by basin, in sync with the TBP schedule. Finally, DEC plans to create an online, continuously updated portal summarizing the status of TMDL implementation to provide an additional level of transparency for the public.

Nonpoint Source and Stormwater BMP Verification Protocol

The State of Vermont is making great progress in transparently tracking the level of TMDL implementation by developing a tracking system that captures the level of nonpoint source and stormwater BMP implementation. However, these BMPs will only have a long lasting impact on TMDL implementation if they are functioning and maintained as intended. To ensure that phosphorus load reductions estimated and claimed for BMPs reflect the level of implementation on the ground, DEC plans to develop a BMP Verification Protocol that will set forth specific operation and maintenance requirements based on BMP type. The Verification Protocol will also propose a plan to periodically inspect and certify a sampling of BMPs to ensure BMPs are properly maintained overtime.

Implementation Mechanism

- Develop tracking database, including functionality to account for phosphorus reductions resulting from BMP implementation
- Develop and seek stakeholder input on an accounting and tracking protocol, documenting the methods behind the BMP Accounting and Tracking Tool, including BMP phosphorus removal efficiencies
- Develop and seek stakeholder input on a BMP verification protocol, designed to confirm that BMPs are functioning as intended, and to ensure that claimed phosphorus reductions reflect the level of TMDL implementation on the ground

Implementation Steps and Timeframe

- DEC tracking database is fully operational, June 2016
- DEC tracking database contains phosphorus accounting functionality, July 2016
- Draft BMP accounting and tracking protocol developed, December 2016
- Stakeholder input on BMP accounting and tracking protocol collected and incorporated, January 2017
- BMP accounting and tracking protocol finalized and posted on web, February 2017
- Draft BMP verification protocol developed, January 2017
- Stakeholder input on BMP accounting and tracking protocol collected and incorporated, February 2017
- BMP accounting and tracking protocol finalized and posted on web, March 2017

CHAPTER 8 - CLIMATE CHANGE AND RESILIENCE

A. INTRODUCTION

Climate trend data for Vermont and regionally serve as a helpful guide in understanding risks associated with climate change impacts we face today and in the future, and actions we need to take to minimize those risks. Scientists have documented changes in Vermont's climate over the past 50 years. Trends indicate warmer surface temperatures and precipitation patterns. Referencing "Vermont Climate Change Indicators," (Betts, A., 2001a) in the 2013 VANR report, *Climate Change Adaptation Framework*, average air temperatures over the past 50 years have increased approximately 4.5 degrees Fahrenheit -- a rate of 0.4 degrees Fahrenheit per decade. These trends are projected to continue.

Warmer surface temperatures are changing precipitation patterns and snowpack. More precipitation is falling as rain during the winter months, reducing snowpack. Trend data show earlier snow melt and peak flow of spring runoff. (Karl et al, 2009; Hayhoe et al. 2007).

Trends towards more frequent high intensity precipitation events are a particular concern for the northeast region. Precipitation in Vermont has increased by 15-20 percent over the past 50 years, and increases in more frequent and intensive severe weather are projected to continue. (Betts 2011a, UCS 2006, Hayhoe et al. 2007, Karl et al. 2009). The ANR 2011 report entitled, *Resilience: A Report on the Health of Vermont's Environment*, released in the aftermath of Tropical Storm Irene, reported that storms "release 67 percent more rain than they did 50 years ago."

Lake Champlain's phosphorus loading problems are largely associated with stormwater runoff and erosion across all sectors – developed areas, roads, agricultural and forest lands. Climate change impacts on precipitation appear to magnify the effects of our land uses on water quality, placing a greater burden on already stressed ecological systems. The greater frequency of severe precipitation events, brought on by climate change, couple with increases in impervious surfaces will generate more stormwater runoff and erosion, and more water quality degradation.

Therefore, the climate change strategy included in this Phase 1 Plan is a "no regrets[13]" strategy built on known actions designed to secure multiple objectives and benefits. The actions described below will:

- Benefit the public;
- Focus on reducing impacts from stormwater runoff, erosion, and flooding; and
- Include policies that restore and safeguard the hydrology of watersheds and the natural and beneficial functions of floodplains, river corridors, wetlands, riparian buffer areas, and lake shorelands.

Vermont knows all too well, following the aftermath of Tropical Storm Irene, about the potential

[13] NO regrets means a strategy in response to the threat of climate change which argues that energy saving measures should be undertaken immediately to help reduce global warming and climate change. Even if the threat of climate change is not as pronounced as we now fear, the supporters of this strategy say there would not need to be any regrets because we would have benefited from saving the energy.

devastating impacts caused by severe flooding. Flooding can disrupt the local and state economies, displace businesses, raise public health concerns, degrade water quality, threaten infrastructure (such as transportation networks, wastewater treatment facilities, and water supplies), damage agricultural production and private property, and hurt recreation. Thus, Vermont's "no regrets" or "best bet" climate adaptation actions described here are pragmatic programs and activities that are designed to enhance flood resilience, minimize impacts from stormwater runoff, and improve water quality.

While much uncertainty remains about climate change, its magnitude and the extent of impacts on precipitation, temperature, and other variables, such as soil moisture, uncertainty should not be an excuse for inaction. Uncertainty requires a process of reevaluation of progress, incorporation of monitoring and assessment data, and adjustment of actions. This Phase 1 Plan, specifying actions and milestones, allows for an adaptive management approach. This approach accommodates new information and provides a means to minimize negative consequences of climate change.

Additionally, the cost of inaction may be far higher than the costs associated with minimizing the negative consequences of climate change. Vermont has experienced, on average, one federally declared flood disaster each year for the past twenty years, and the costs of recovery are significant. The year 2011 will be remembered by the spring flooding in Lake Champlain and the devastation caused by Tropical Storm Irene. Irene took the lives of six people, destroyed more than 500 miles of state roads, damaged 200 bridges, and destroyed 1,000 homes. The state and federal governments spent more than $565 million in flood recovery, which does not capture the recovery costs borne by local communities and private landowners. (Irene: Reflections on Weathering the Storm, and Irene By The Numbers).

Such severe storm events can also cause significant increases in phosphorus loading to Lake Champlain. In fact, the majority of the annual phosphorus load to Lake Champlain comes during a relatively few major runoff events each year. The spring floods during 2011 carried 62 percent of the annual phosphorus load from the Winooski River (Figure 11). Tropical Storm Irene brought another 13 percent of the annual load during just a few days in late summer.

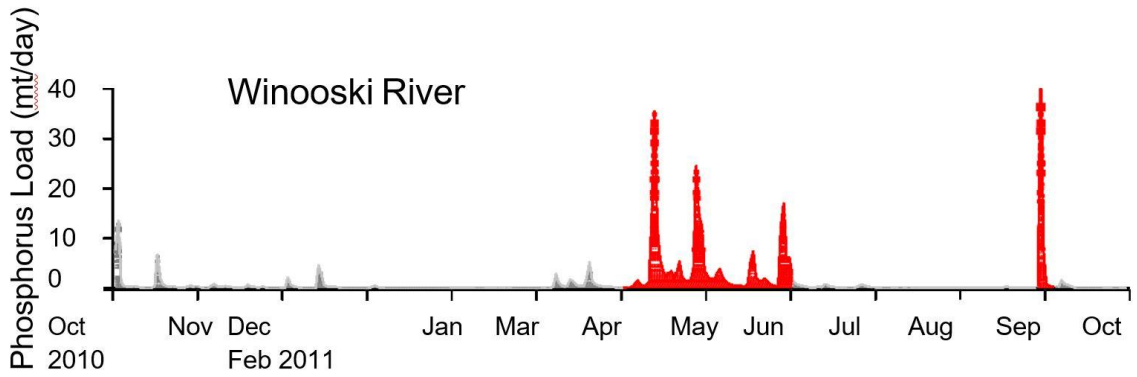


Figure 13 - Daily Phosphorus load to Lake Champlain from the Winooski River (metric tons/day) during water year 2011. Loads during the spring floods and Tropical Storm Irene are highlighted in red

Vermont's approach is a precautionary response to climate change-driven impacts projected for this region. Major storm events are predicted to occur with increasing frequency and severity in the future in the Lake Champlain region as reinforced by the United States National Climate Assessment, released in draft form in January, 2014. This draft assessment reports, "Floods are projected to intensify in most regions… especially in areas that are expected to become wetter, such as the Midwest and the Northeast…. More intense runoff and precipitation generally increase river sediment, nitrogen, and pollutant loads." (United States Global Change Research Program, page 107.)

The next segment to this chapter lays out a discussion of the climate response modeling report prepared for EPA by Tetra Tech, Inc. in May 2013. The purpose of that study was to analyze projected future phosphorus loading to Lake Champlain due to climate change.

The degree and extent of impact associated with climate change is a function of localized factors – the current condition of Vermont's landscape that either heightens or minimizes its vulnerability to stormwater runoff and erosion. Therefore, the final segment to this chapter describes the State's measures to offset the projected climate change-induced phosphorus loading. These actions will provide for cleaner water for this and future generations, while helping to make our communities, businesses, farms, and forests more resilient to the economic and social impacts caused by flooding.

B. SUMMARY AND PERSPECTIVE ON THE TETRA TECH CLIMATE RESPONSE MODELING REPORT

A Lake Champlain basin SWAT Climate Response Modeling report was prepared for EPA by Tetra Tech, Inc. in May 2013. The analysis used the Soil and Water Assessment Tool (SWAT) watershed model in concert with six regionally downscaled climate change scenarios based on several different underlying global climate change models. The purpose of the study was to facilitate the analysis of climate change impacts on future phosphorus loading to Lake Champlain for consideration during the development of the Lake Champlain Phosphorus TMDL.

The report analyzed changes in annual flows and total phosphorus loading rates for each major tributary to Lake Champlain by comparing baseline period rates (1980-2010) with future predictions for the period of 2040-2070. For the Lake Champlain basin as a whole, the median predicted changes across all six climate scenarios were a 12.5% increase in annual flow volume and a 29.8% increase in total phosphorus loading rate. These predicted changes varied among the individual tributaries, with predicted flow rate increases ranging from 7.8% to 26.6%, and predicted increases in phosphorus loading rates ranging from 2.7% to 54.6%.

The Tetra Tech analysis did not, however, take into account the increases in the Lake's assimilative capacity for phosphorus that would accompany the increased flow rates. As a result, the future phosphorus loading rate predictions in Table 11 overstate the extent to which climate change could cause phosphorus concentration increases in the lake. A direct analysis of the interplay between future increased flow volumes and tributary phosphorus loads would require a mass balance modeling analysis of the lake similar to what was done for the development of the TMDL. However, an indication of the combined effects of flow and phosphorus loading increases on the

in-lake phosphorus concentrations can be provided by calculating changes in the flow-weighted average phosphorus concentration in each tributary (i.e., the total annual phosphorus loading rate divided by the total annual flow rate).

Changes in the flow-weighted average tributary phosphorus concentrations were calculated from the Tetra Tech predictions and shown in Table 10. Median changes in the flow-weighted average tributary phosphorus concentrations were estimated to be 15.4% for the basin as a whole, with a range among individual tributaries of -7.6% to 27.7%. These predicted changes in average inflow phosphorus concentrations are substantially more modest than the predicted loading rate increases, but still represent a potentially significant future source of phosphorus that will require adaptation measures in the watershed in order to achieve phosphorus concentration standards in the Lake.

Table 13 - Median predicted changed in annual flow rates, Total Phosphorus (TP) loading rates, and flow-weighted average TP concentrations in Lake Champlain tributaries resulting from climate change

Tributary	Flow Rate[a]	TP Loading Rate[a]	Flow-Weighted Average TP Concentration
Poultney	13.9%	34.6%	18.2%
LaPlatte	22.1%	54.6%	26.6%
Lewis	12.8%	42.0%	25.8%
Little Otter	14.9%	46.8%	27.7%
Otter	12.2%	35.5%	20.7%
Winooski	8.8%	23.0%	13.0%
Lamoille	14.6%	43.4%	25.2%
Missisquoi	12.0%	25.2%	11.8%
Rock	26.3%	42.7%	12.9%
Pike	26.6%	17.1%	-7.5%
Mettawee/Barge Canal	14.2%	39.0%	21.8%
Ausable	7.8%	6.6%	-1.1%
Little Ausable	25.5%	37.7%	9.7%
Saranac	11.1%	2.7%	-7.6%
Salmon	18.1%	33.4%	13.0%
Boquet	11.4%	30.5%	17.1%
Great Chazy	15.0%	20.1%	4.4%
Little Chazy	15.7%	19.4%	3.2%
Lake Champlain watershed	12.5%	29.8%	15.4%

Values are the medians of the predictions of six regionally downscaled climate change scenarios. The modeled future period of 2040-2070 was compared with the baseline period of 1980-2010, except for the LaPlatte River.

[a]Median percent change in flows and TP loads are from TetraTech (2013).

[b]Percent changes in flow-weighted average TP concentration were calculated as ((1+[Load percent change])/(1+[Flow percent change]))-1.

C. ACTIONS TO MINIMIZE THE CURRENT AND FUTURE WATER QUALITY IMPACTS OF CLIMATE CHANGE

The final segment to this chapter discusses specific actions the State of Vermont will take to minimize current and future climate change-induced phosphorus load impacts. Most of these actions are already included as part of this Phase 1 Plan, since climate change is expected to exacerbate the contribution of nutrient loading from land-based, nonpoint sources. Along the theme of a "no-regrets" strategy, actions to minimize the water quality impacts of climate change in Vermont are comparable to actions that minimize impacts from stormwater runoff and erosion.

AGRICULTURAL PROGRAMS

Background

A robust agricultural-based economy is important to Vermonters. Agriculture in this State supports a working landscape that offers important aesthetic, cultural, environmental, and recreational benefits. Yet climate change poses a number of threats to the State's agricultural economy. (The Potential Impacts of Climate Change on Agriculture in Vermont). The seasonal shift in temperature and precipitation patterns will affect not only water quality but also crop production, milk productivity and the spread of pests and pathogens.

Increased erosion due to increases in precipitation amounts, frequency and intensity, and the resultant runoff is arguably the greatest concern to water quality impacts due to the soil and nutrient loss. However, as crop production is affected by increased temperatures and rainfall, producers may make crop management decisions, such as conversion of forested land to cropland. This could potentially increase the acreage to annual crops but may increase stormflows by as much as 10% (Hewlett, 1982). Producers may change to different crops that may have a greater or lesser ability to retain soil on fields (hay land versus annual crops). As increased crop production is needed, producers are increasing the acreage in tile drainage, which may decrease the nutrient runoff that occurs from field and gully erosion but can add dissolved phosphorus and hydrology concerns through high volume outflows.

Actions

Many of the current policy commitments in this Plan will have a positive impact on water quality as climate change becomes a greater challenge in the future.

- The RAPs increase buffer widths, require setbacks on field ditches, require stabilization of field gullies and improved manure management on frequently flooded fields and on fields with steep slopes. Additional changes to the RAPs in 2018 will include requirements for management of tile drains. Increased precipitation will have a dramatic effect on surface and subsurface runoff and these requirements will substantially decrease the water quality impacts;
- Licensing of manure application operators will increase the knowledge of these companies, and require training and oversight that will decrease the over-application of manure in sensitive areas, and prior to heavy rainfall events;
- Additional agency inspectors will increase compliance of nutrient management and field practices;

- An increase in the technical staff in the field to help implement positive land practices such as reduced tillage, cover crops, and alternative manure management has already proven to be an asset to implementation of beneficial BMPs;
- Nutrient management planning will increase and be required on most farms. Certified small farms will be required to develop and implement a state-approved nutrient management plan (already required in medium and large farm permits). As a result, all farms above 50 cows (or numbers of other species)[14] will be required to document their nutrient applications, soil tests, and other field practices that will decrease any potential for nutrient runoff;
- Focused outreach, BMP funds and additional NRCS funds through the Regional Conservation Partnership Program are being directed to critical source areas in watersheds of Missisquoi Bay, St. Albans Bay and South Lake.
- LiDAR technology allows for mapping of high potential runoff areas, down to partial field levels, and prior targeted outreach to these producers resulted in increased site-specific BMP implementation in Franklin County; and
- Site-specific research into new technologies and methodologies will provide local information to producers to help with cost-effective management decision-making.

While these commitments will address some of the hydrologic impacts from climate change, additional work is needed to ensure that farmers have the necessary education, tools and resources to address climate change impacts in a way that will improve water quality and protect their investments and livelihoods.

It is also important that this work is done in a way that will address the individual needs of each farm, and recognize the human behavior impacts of implementing change. The Agricultural Work Group that was formed by DEC and AAFM to help develop the proposed changes in the TMDL, listed as one of their three priorities, strategies that allow farmers the option to develop "smart" tailored plans. They recognized that flexibility in programs and requirements is necessary to appropriately address the uniquely individual needs and concerns on Vermont farms. A timely recent survey conducted by the UVM RACC effort (Research on Adaptation to Climate Change), showed that the ability to have control over decisions was the most statistically significant driver in creating change, above the impact of regulatory control. In developing programs that will address future issues, providing options as well as resources will be critical to successfully protecting our water quality.

Recommendations

In determining how to efficiently move forward in addressing the temperature and rainfall effects of future climate change, three key areas stand out as having the greatest potential to help mitigate the potential negative impacts of climate change on water quality; soil health, tile drain issues, and increased implementation of key BMPs.

Soil Health

Improving soil health is a long-term process that provides extensive and multiple benefits in addressing climate change issues. Good soil health results in increased organic matter, increased soil pore space for water infiltration, increased soil water holding capacity, and decreased flow speed and volume to surface waters. Increased organic matter also helps address drought adaptation

[14] Pending legislative approval 2016

that also may result from climate change. For every percent increase in organic matter, another inch of water is available to plants, increasing production and decreasing the need for additional land converted to crops (Emerson, 1995). Soil resiliency hinges on infiltration – rainfall that infiltrates and does not run off, cannot cause erosion, and can potentially be stored for plant use. The major problem is not runoff but infiltration.

Implementation Steps and Timeframe

- Provide specific soil health training to outreach staff for their work with individual farmers.
- Increase demonstration projects and events to educate about biological approaches to compaction that can improve infiltration, specific soil quality BMPs and resources available to help with practice changes.
- Coordinate with UVM Extension to develop specific education programs for producers to increase knowledge of soil health.
- Coordinate with USDA/NRCS and their new healthy soils initiative "*Unlock the Secrets of Soil"*, which has extensive new educational materials and tools for helping farmers recognize the value of soil health.
- Use CSA mapping to evaluate priority areas for landscape infrastructure such as storage ponds that can increase water holding capacity that will address drought and prevents runoff of nutrients and sediment and related erosion. Use new personnel to work with landowners in key areas (potentially headwaters)
- Develop an incentive program that provides additional resources to producers who implement management changes that improve soil health. (This will be part of a larger incentive effort).

TILE DRAINS

As farms increase in size, a need for increased production per acre is a factor in the dramatic increase in the installation of tile drains in many sections of the Lake Champlain basin. While there is no currently method for accurately tracking this practice, NRCS estimates as much as 50% of agricultural fields in some watersheds may contain tile drains (Potter, 2012). DEC has provided funding for an analysis of opportunities for assessing the locations and quantity of tile drains. This will be conducted in 2016-2017.

When installed and managed appropriately, tile drainage can be an important part of environmental farm management and can dramatically reduce soil erosion and phosphorus losses from fields by decreasing surface runoff and increasing infiltration (Fraser and Fleming, 2001). However, timing and quantity of field nutrient applications, as well as soil quality and installation methods all affect the impacts of tile drains. Studies have shown that tile drain outflows can contain high levels of dissolved phosphorus as well as nitrogen. These levels can be affected by timing and quantity of manure application around rainfall events, and the macropores in the soil that affect nutrient passage through soil to the drains. Tile outflows can also negatively impact stream channels by increasing the velocity of outflow to the receiving water, and resulting soil erosion.

A literature review is currently being conducted with funding from the Lake Champlain Basin Program and will be finalized in 2016. Additionally, several research projects, in Vermont and at Miner Institute in NY, are consider the potential contribution of tile to water quality, the impacts of

agricultural management practices on tile drained fields, and different media and treatment systems for installation at the end of tile drains.

In February, 2016, DEC and AAFM jointly submitted an interim report to the Vermont Legislature regarding the current status of tile drains in Vermont. The two agencies will evaluate the literature review and coordinate a workgroup of academics, farmers, and technical advisors in preparation for a final report in January of 2017 that will include recommendations for regulations to be added to the RAPs by July, 2018.

Implementation Steps and Timeframe

- Conduct demonstration projects on Vermont farms in priority watershed to demonstrate well-installed and managed tile drain systems, and compare water quality impacts.
- Work with partners to develop an extensive education program on the impacts and potential improvements to tile drain installation and management that would include an educational conference, factsheets, website additions and mailings.
- Provide training to outreach staff to assist them in providing education to producers and increase implementation of NRCS tile drain practice.
- Coordinate with partners to share results of tile drain research.

INCREASE IMPLEMENTATION OF KEY BEST MANAGEMENT PRACTICES

Many traditional BMPs that improve water quality will also help in mitigating the effects of climate change. As rainfall amounts and intensity increase, these BMPs will become even more necessary and more valuable. Specific BMPs such as conservation tillage, buffers, cover crops and alternative manure management will help address these climate concerns. In one Vermont study, conservation tillage decreased agricultural stormwater runoff by between 50-63% (Claussen and Potter, 1990). A Canadian study showed that soil loss can decrease from 8 tons/acre/year on some fields with conventional tillage to less than 1 ton with no-till practices (Herbek, www2.ca.uky.edu). No-till practices can also increase organic matter in fields from 2.5 to 4.1% (Quarles, 1994).

These particular BMPs help by decreasing field erosion, improving soil health and infiltration, and decreasing nutrient runoff. However, some of these practices require very site-specific adaption, resources and education. Transitioning from conventional to reduced or no-till requires individual technical assistance and an understanding of the long-term benefits. Alternative manure management technologies such as manure injection are extremely expensive and require financial assistance to producers. Larger buffers take valuable land out of production and compensation through programs such as CREP must be commensurate with the lost crop value. Cover crops in heavy clay soils can be challenging to implement in the time frame necessary for successful growth.

Implementation Steps and Timeframe

- Continue to secure necessary BMP, FAP and CEAP (equipment cost-share) implementation funds for specific practices.
- Incentivize practice implementation by providing additional funding and benefit opportunities for BMPs that are implemented in priority watersheds, sensitive riparian areas

and other critical source areas. Development of a pilot of a comprehensive incentive program (Environmental Stewardship Program) that will address priority areas will be done by 2016.

- Provide adequate ongoing training for technical staff about BMP information, available resources and site-specific implementation opportunities.

Summary

Vermont is fortunate to have current support from partners and other agencies that will provide assistance in our ability to share timely and appropriate new technologies and practices to address climate change in the future. The "edge of field monitoring" project that was funded with USDA/NRCS funds is an example of this. UVM Extension hired an agricultural climate change expert in 2013 who has brought educational and research knowledge and opportunities from the Chesapeake Bay area. In 2014, one of the national "climate hubs" was established in Durham, New Hampshire, and is increasing capacity to provide information and guidance on technologies and risk management practices at the regional and local scale to partners and producers.

DEC and AAFM also intend to continue to seek funds for additional outreach methods such as online training programs for producers, demonstration sites and educational workshops and materials to provide a diverse and flexible way for all producers to receive knowledge and technical assistance.

STORMWATER MANAGEMENT

Background

Climate change, stormwater runoff and phosphorus loading are inextricably linked. The intensity of precipitation events has a direct impact on the amount of stormwater runoff generated from impervious and semi-impervious surfaces. This in turn has a direct impact on erosion and sedimentation rates, the pollutant removal and detention capacity of existing BMP's, and the integrity of critical infrastructure such as bridges and culverts. This relationship has significant implications for stormwater management in Vermont.

Currently, any project that exceeds the jurisdictional threshold for stormwater in Vermont is required to adhere to the standards set forth in the Vermont Stormwater Management Manual (VSMM). The current version of the VSMM was adopted in 2002 and presents a unified approach for designing and sizing stormwater treatment practices to meet specified treatment standards for water quality, channel protection, groundwater recharge, overbank flood protection, and extreme flood control. The unified sizing approach is intended to manage the entire frequency of storms anticipated over the life of the stormwater management system and the associated development.

From a climate change/flood resilience perspective, there are several issues associated with the current version of the VSMM:

- Under the unified sizing approach, stormwater treatment practices are designed according to a targeted design storm. The magnitude of the design storm is based on a probability distribution of observed precipitation events over a period of many decades. These precipitation values may not reflect the trend of greater frequency of severe storm events throughout the Northeast. The Vermont Stormwater Management Manual incorporated most recent available data at the time of adoption. Since this time, more recent data including data

published by the Northeast Regional Climate Center at Cornell ("Extreme Precipitation in New York and New England.")

- The Vermont Stormwater Management Manual was adopted prior to the common use of terms like "LID" and "GSI." However, the Manual includes a range of practices intended to minimize the creation of impervious surfaces, and to allow for the management of runoff through disconnection and infiltration. These practices were state of the art at the time of adoption, but do not represent all the advances that have been made in stormwater management since 2002.
- Reducing water quality impacts from road runoff is another strategy described in this plan with climate resilience benefits. Prior to federally declared disaster declarations (which make available public assistance funds for public infrastructure repairs), municipalities are to adopt road infrastructure "codes and standards" (referred to as "Road and Bridge Standards" or "Codes and Standards"). These municipal codes and standards apply to road and stream crossing upgrades and other infrastructure that are not governed by state or federal standards.

EPA's Lake Champlain Accountability Framework requires an updated manual by December, 2016. These issues and others will be addressed in that context.

Implementation Steps and Timeframe

DEC's Stormwater Program has identified six major actions – five are associated with managing stormwater infrastructure development and the sixth action addresses runoff from road networks. The first five actions that address permitted stormwater infrastructure ensure that such projects are appropriately designed and adequately sized to effectively manage predicted increases in stormwater runoff. Stormwater systems designed and managed per standards that incorporate current precipitation data as well as LID and GSI, ensure resilience against increases in higher intensity precipitation, higher precipitation volumes, and snowmelt events. The sixth action includes incentivizing adoption and compliance with VTrans Road and Bridge Standards. (Act 110, passed in 2010, required that VTrans undergo rulemaking to include in the model Road and Bridge Standards practical and cost-effective best management practices to better control road-related stormwater runoff), as well as the requirement for DEC to develop a stormwater general permit for all municipal roads (MRGP). The DEC MRGP standards will correspond to all municipal hydrologically-connected road segments. DEC and VTrans are currently in discussions, as they update the 2013 VTrans Road and Bridge Standards, to determine their relative geographic applicability. For example, future versions of the VTrans Road and Bridge Standards may only apply to municipal road segments that are not hydrologically-connected.

- Require recent and localized rainfall data, where possible, to size stormwater practices. An important step toward greater climate adaptation and flood resilience is to ensure that any permitted stormwater system is designed and sized using data that accurately reflects precipitation trends in the Northeast. This data should include: (a) current data and the past 10 years of record; (b) local and regional precipitation data, including the Northeast Regional Climate Center Extreme Precipitation data; and (c) where appropriate, location- specific data to account for regional variation in precipitation patterns. The Vermont Stormwater Management Manual (VSMM) is currently being revised and adopted via rulemaking to incorporate best-available precipitation data.
- The VSMM is also currently being revised to promote greater use of LID and GSI. LID is focused on avoiding and minimizing impacts to natural features and functions to reduce the

amount of stormwater runoff generated both during and after construction. LID places a high value on hydrologic and ecological function, recognizing that those functions are difficult, if not impossible, to replace if lost through development. Requiring LID ensures that stormwater runoff resulting from new development is minimized. This helps to reduce flashy streamflow regimes, caused by stormwater runoff, that can increase stream instability and pollutant loading from stream bed and bank scouring.

- Promote GSI practices where minimization is not possible. GSI can be used in new development and redevelopment situations. GSI takes advantage of natural processes to treat and manage stormwater. Where soils are adequate, stormwater runoff from small and even large storms can be fully infiltrated into the ground by GSI, thus reducing the volume of water traveling as surface flow. In marginal soils, engineered soil media and soil restoration techniques (aeration, organic amendments, etc.) can be used to increase infiltration rates and improve soil water retention, thus decreasing excessive flows. Those GSI practices that include robust vegetation provide additional resilience to climate change through interception and evapotranspiration, which can collectively amount to a large export of water from the land surface. Where vegetation remains healthy and conditions are suitable, evapotranspiration rates in particular can be significant, sometimes even exceeding precipitation rates, especially during the growing season. This results in a soil column with greater capacity to infiltrate and absorb stormwater runoff during subsequent storms.
- The Stormwater Program is updating the VSMM to incorporate and incentivize LID and GSI concepts. Successful application of GSI has the potential to reduce stormwater runoff enough to reduce the need for conventional and costly drainage and treatment infrastructure, reduce the number of culverts deemed undersized that otherwise would need to be replaced, improve onsite storage of rainwater and snowmelt that can reduce and delay the runoff peak discharge, and minimize hydrologic impacts to the stream channel from stormwater runoff.
- Promote adoption of state stormwater standards at the local level and work to develop and disseminate model stormwater ordinances such as the VLCT Low Impact Development Ordinance. These actions will help to address stormwater runoff associated with new developments that fall below state stormwater management jurisdiction.
- All municipalities in the Lake Champlain Basin are required to have coverage under the municipal roads general permit by 2021. This permit program will build on the existing incentivization program managed by VTrans by requiring development and implementation of road management plans that address road and drainage erosion, and that promote substantially-enhanced resilience to precipitation events that cause road infrastructure failure as well as pollutant discharges. Technical assistance will be provided by a coalition of partners providing expertise on planning, transportation, water quality, and river science.

RIVER CHANNEL STABILITY

Background

With the increased risk of severe weather events causing water quality degradation as well as economic and public safety impacts, it becomes increasingly important to manage rivers to meet and maintain dynamic equilibrium conditions. Equilibrium refers to the condition in which a stream channel achieves a naturally stable slope, meander pattern, channel dimensions (width and depth), and access to its floodplain. This condition is the least erosive, even at flood stage. This policy requires that floodplains and river corridors are protected and reserved for flooding, and that stream channels themselves are managed in ways that are consistent with the objective of achieving equilibrium conditions over time. Well-functioning floodplains under an equilibrium condition keep people and infrastructure out of harm's way, reduce property damages and flood recovery costs, reduce the need to channelize rivers in order to protect encroachments and, specific to the Lake Champlain TMDL's goals, reduce nutrient and sediment loading by minimizing erosion.

Implementation Steps and Timeframe

The following commitments described in this Phase 1 Plan support the State policy to manage rivers towards long-term establishment and maintenance of dynamic equilibrium:

- Reserve, restore, and maintain floodplains and river corridors for flood storage and pollutant attenuation by minimizing floodplain encroachment:
    - Established a river corridor easement program to conserve river reaches identified as high priority nutrient and sediment attenuation areas. The key provision of a river corridor easement is the purchase of channel management right;
    - Act 110 (enacted in 2010, effective 2011) established, as State policy, the management of rivers and streams to achieve and maintain dynamic equilibrium, the least erosive and naturally stable stream condition. The Act established a river corridor and floodplain management program, integrating floodplain management under the FEMA National Flood Insurance Program with fluvial erosion hazard avoidance, river corridor, buffer protection, and river science;
    - Act 138 (effective 2012), directs ANR to create new state floodplain rules for activities exempt from municipal regulation, increase regulatory oversight and technical assistance in floodplain protection, and improve floodplain mapping;
    - Act 138 also directs the development of a Flood Resilient Communities Program to create financial incentives that will encourage municipal adoption of bylaws that protect river corridors, floodplains, shorelands, and buffers;
    - The State policy for managing the State's Emergency Relief and Assistance Fund (ERAF), added an incentive to encourage municipal adoption of the state model floodplain and river corridor protection bylaws. Effective in October, 2014, those municipalities that adopt such measures will receive a larger share of state aid (from 12.5% to 17.5% of the repair costs) following federally declared flood disasters; and
    - Act 16, enacted in 2013 and effective in 2014, requires that municipal and regional land use plans include protection and restoration of floodplains and upland forested area in order to moderate impacts from flooding.
- Ensure that stream alteration activities are aligned with and do not depart from attainment of stream equilibrium condition:
    - Act 110 also modified stream alteration statutes expanding state jurisdiction to all

perennial streams (i.e., those with year-round flows). Prior to Act 110, the regulations only applied to streams with a watershed greater than 10 square miles;
    - Act 138 required the adoption of rules and a stream alteration general permit to regulate Emergency Protective Measures (effective in 2014);
    - Effective in 2014, the VTrans Road and Bridge Standards, clarify that the VTrans Hydraulics Manual (which provide the VTrans technical analysis for sizing of stream crossings) and the Stream Alterations General Permit are aligned to support the management of streams, including stream crossings, to achieve equilibrium conditions. Sizing stream crossings based on equilibrium conditions minimize erosion, scour, and structure failure. It also improves connnectivity that supports aquatic organism passage;
    - Act 138 required that DEC develop a comprehensive "rivers and roads" training program. The targeted audience includes municipal, state and federal transportation network professionals, municipal employees, regional planning commissions and contractors. The goal of the training program is to explain how to design, construct and maintain roads and bridges to create greater river stability and more flood resistant transportation infrastructure. DEC, in partnership with VTrans and FWD, is developing a three-tiered training course. Tier 1 (introductory level) and Tier 2 (intermediate level) are currently available; Tier 3 (advanced level) training, focused on design and construction, will be available in early 2017. In 2014, DEC released a document entitled, "Standard River Management Principles and Practices: Guidance for Managing Vermont's Rivers Based on Channel and Floodplain Function." This document will serve as the technical foundation and reference document for the Tier 3 training.
- Restoring and protecting native woody vegetation in riparian buffers;
    - Increases in nutrient and sediment pollution loading, unstable streambanks, and loss of ecological function result when woody riparian vegetation is removed from the riparian or near stream area. Best management practices entail restoring and maintaining an undisturbed area that consists of trees, shrubs, groundcover plants, and the duff layer. ANR adopted Riparian Buffer Guidance in December, 2005, which articulates a framework for Agency recommendations in the Act 250 process. The Agency updated the Buffer Guidance in tandem with adopting River Corridor Procedures and revising the Agency Floodway Procedures used in Act 250. The new "Riparian Area Management Policy and Guidelines were adopted in December 2015.

CLIMATE-SMART FOREST ADAPTATION STRATEGIES

Background

Forest management has been based on an historical understanding of forest response to given treatments. Under climate change, meeting forest management goals is less certain than it has been in the past. Increased temperatures, heavy precipitation events, mild winters, extreme wind and ice storms and threats from invasive species are all predicted to increase. The best risk management at this point in time is to manage forests to be more resilient to a variety of weather conditions, and to build forest harvest plans that account for extreme weather influences.

Implementation Steps and Timeframe

Publish and distribute the draft forest adaptation strategy document: "Creating and Maintaining Resilient Forests in Vermont: Adapting forests to climate change."

1. Promote recommended forest adaptation strategies to foresters and landowners to implement climate-smart practices that maintain healthy forest cover, sustain ecological functions such as water holding capacity of forests, and promote water quality.
2. Develop and implement a policy to use climate-smart forestry practices on state lands.
3. Create funding priorities through the Working Lands Initiative (Working Lands Enterprise Fund (WLEF)) for new forest harvesting technologies that improve protection of soil and water.
4. Establish 3 demonstration areas on state land to train foresters and landowners on
5. climate-smart forest management techniques that can then be implemented on the 86% of Vermont's forestlands that are privately owned.
6. Identify vulnerable forest stands within the Lake Champlain basin, develop forest health strategies to maintain forest cover and water holding capacity, and identify funding to implement strategies on priority forests.

WETLAND PROTECTION AND RESTORATION

Background

Global wetlands store carbon at an amount similar to total atmospheric carbon. Wetlands are able to accumulate carbon from agriculture, forestry, and other land uses by storing sediment and organic materials. The emission of carbon dioxide is slowed by vegetation intake of carbon and by the anaerobic conditions which slow organic decomposition by hundreds or thousands of years. Studies have estimated that 6% of global carbon emissions can be attributed to the destruction of artic and tropical peatlands alone. The protection and restoration of wetlands is a crucial component in offsetting climate change impacts in Vermont.

Wetlands are more sensitive to climate change than other landscape and deep water features in Vermont. A change in inches in water table depth can cause the presence or absence of a wetland at marginally wet locations. Wetland fragmentation and low biodiversity make many wetland plant communities less robust and adaptable to changes in climate. Vermont wetlands which are especially sensitive to climate change include: peatlands, seasonal wetlands (including vernal pools), spruce/fir swamps, wetlands with small watersheds, and wetlands surrounded by high nutrient and sediment load.

Climate impacts on wetland functions are expected to be significant, including hydrologic stresses from earlier spring runoff and hotter and drier summer months. Less consistent precipitation will expose peatlands and cause an increase in carbon dioxide release due to faster decomposition. More intense storm events will increase sediment and pollutants which may overwhelm the water quality protection function of the wetland. Stressors to wetland plant communities will make wetlands more susceptible to invasive species adapted to warmer climates. Loss or degradation of wetland function could, in turn, degrade water quality of the streams and lakes that benefit from the wetlands' natural filtering capacity. The expected increased groundwater withdrawal to support future irrigation needs, brought about from climate change-induced drier summer months may also lead to further wetland loss.

Wetland management, conservation, and restoration are effective and cost-effective climate adaptation strategies that:

- Enhance wetlands' filtering capacity of pollutants;
- Reduce carbon dioxide emissions;

- Minimize flood hazards by absorbing and attenuating floodwaters;
- Protect populations of species at their range extent;
- Promote groundwater recharge, which, in turn supports base flow in streams, which is particularly important during hotter and drier summer months; and,
- Sustain fish and wildlife habitat and support recreational activities that depend on them.

Programs to support the restoration and maintenance of vegetated buffers along waterways are also important strategies that:

- Reduce sediment load in waterways by slowing water velocities and stabilizing channels;
- Support cold-water aquatic organisms through shading;
- Increase resilience of native plant communities by preventing invasive plant establishment;
- Protect adult habitat of sensitive vernal pool dependent species; and,
- Increase and maintain carbon sequestration by vegetation.

Implementation Steps and Timeframe

Promote wetland conservation and restoration:

- Promote adequate buffers and protection to maximize their capacity to attenuate floodwaters, sediment and pollutants. DEC is able to change size of wetland buffers to accommodate this need;
- Focus protection and restoration efforts on wetlands which effectively sequester carbon, such as bogs. DEC has identified several peatlands throughout the State and will increase their protection standards.
- Establish a wetlands technical assistance program to implement wetlands conservation and restoration projects with local and federal partners; and
- Strengthen wetland protection statute
    - Act 31 (enacted in May, 2009) strengthened the State's wetlands protection statute, to give DEC the authority to conduct:
        a) Administrative determinations to re-classify wetlands;
        b) Update wetland mapping, and,
        c) Interpret jurisdictional buffer zone widths to accommodate wetland function needs.

UPLAND LAKES PROTECTION AND MANAGEMENT

Background

Shoreland management plays an important role in providing climate change resiliency along lakeshores. Naturally vegetated shorelands are known to be more resistant to erosion during flooding events. Eroding shorelands are a source of sediment and phosphorus to the lake, although the exact quantity of these pollutants due to shoreland erosion has not been studied or estimated. During the spring of 2011 floods across the Lake Champlain basin, shoreland erosion was much more common in areas where the woodland had been removed and replaced with lawn, than in areas where natural vegetation had been left in place. Structural stabilizations can deflect wave energy to adjacent shore areas, thus increasing erosion potential on neighboring properties. In

addition, structural stabilization measures were in some cases overtopped by the flood waters and eroded from behind.

Well vegetated shorelands provide sustainable stability by making use of the "ecosystem services" of a variety of species and root types which resist erosion due to high water level and wave action. Numerous trunks and stems absorb and break up wave energy, minimizing its impact on the soil layer itself. Shorelands which are yet undeveloped generally have reached an equilibrium where erosion is minimal or non-existent. Where development or other land uses have removed the woodlands, stabilization measures may need to be implemented. Bio-technical and bio-engineering designs can be used to implement stabilization projects. Such projects are ideally designed to mimic the natural shore and be self-sustaining over time.

Implementation Steps and Timeframe

Promote well vegetated shorelands as sustainable erosion prevention along Lake Champlain and upland lakes:

- Require the use of stabilization methods that incorporate vegetation through the Lake Encroachment Program or the Shoreland Permit Program;
- Provide technical and grant support to project demonstrating and implementing vegetative shoreland stabilization measures;
- Incorporate BMPs for vegetative shoreland stabilization measures into the Lake Wise Program to provide technical assistance to landowners; and
- Continue to coordinate with the Rivers Management Program on the development of model municipal shoreland ordinances that meet federal flood protection standards and provide good shoreland management to benefit both flood resiliency and pollution abatement.

D. CONCLUSION

Vermont faces important decisions about how to effectively minimize or avoid impacts from climate change. In 2010, The Nature Conservancy published a report entitled, "Climate Change in the Champlain Basin: What Natural Resource Managers Can Expect and Do." (Stager, J.C, M. Thill, 2010). That report's conclusions underscore an important message that the best strategies to minimize undesirable impacts from climate change are already known; such strategies do not require a new set of conservation tools. That report provides a comprehensive list of climate- ready strategies, among which are the following that address the anticipated water quality impacts from climate change:

- Acceleration of best management practices across land uses to reduce runoff and erosion;
- Stormwater control structures that reduce erosion and nutrient transport;
- Stormwater control regulations that use the current precipitation period of record;
- River corridor and floodplain protection;
- Policy that supports establishment and maintenance of stream equilibrium conditions and natural floodplain functions;
- Re-establishment and maintenance of vegetated buffer zones along rivers, wetlands, and lakes to support stream channel integrity, minimize erosion and runoff, and provide shade;
- More accurate flood hazard mapping;
- Wetland conservation;

- Ecologically sound and sustainable shoreland erosion mitigation strategies,
- Forestland conservation; and,
- Public education.

The climate change policy commitments described in this Chapter incorporate these strategies.

Promoting greater resilience in the Lake Champlain basin to the water quality impacts of climate change requires actions that reduce loadings from these traditional stressors. Actions described in this chapter are designed to accomplish that objective. These actions also enhance flood resilience locally and statewide – a top priority of the State and an important "co-benefit" of the implementation of the Lake Champlain TMDL. Thus, investments in the implementation of this Plan to achieve clean water will also pay dividends in contributing toward reduction in the State's vulnerabilities to climate change.

CHAPTER 9 - IMPLEMENTATION SCHEDULE AND ACCOUNTABILITY FRAMEWORK

DEC is employing a twenty-year implementation schedule, which allows for communities to plan and stage the necessary improvements to roads and stormwater infrastructure into long-term capital fund plans as a means of keeping costs and funding burdens down. DEC's general schedule for implementation of the TMDL is as follows:

1. Department seeks authority and funding for implementation of the Phase 1 Plan 2014-2015
2. State finalizes Phase 1 Plan 2016
3. Department of Environmental Conservation develops and implements Phase 2 Plans for each basin (tactical basin plans) 2016-2036

Detailed implementation schedules for Vermont's policy commitments are included in Table One in the Executive Summary and Gantt Chart.

EPA views the Phase 1 and Phase 2 Plans as the core of a broader, ongoing assessment of the State's progress in achieving the TMDLs. EPA is using an Accountability Framework to track implementation, assess progress towards fulfilling pollution reduction targets identified in the TMDL.

Refer to the TMDLs for a complete discussion of the accountability framework.[15] EPA will use this accountability framework to make a determination whether there is a need for additional actions necessary to meet the TMDLs' wasteload and load allocations and, ultimately, the state's water quality standards. Since the water quality of many of the Vermont Lake Champlain segments are dominated by nonpoint pollution sources, EPA is using this accountability framework to provide a "sufficient backstop to ensure a high likelihood that implementation of the nonpoint source measures will occur."[16]

In its January 17, 2014 letter, EPA asked that Vermont discuss the State's commitment to track implementation progress and to enter both BMP installations and programmatic progress into a tracking tool that EPA is helping to develop. The accountability framework is built upon the State's commitments described in this Phase 1 Plan.

In addition to key programmatic milestones that evaluate the state's completion of critical tasks authorized in Act 64, the accountability framework has milestones for reporting and evaluating progress towards goals in the implementation plans. The accountability framework describes EPA's tasks of issuing interim report cards on the state's implementation efforts halfway in each five-year tactical basin planning cycle and formal assessments at the end of each five-year cycle. Consequences are described in the Phosphorus TMDLs.[17]

[15] Phosphorus TMDLs for Vermont Segments of Lake Champlain at 54-59.
[16] *Id*. at 50.
[17] *Id*. at 57-59.

REFERENCES

Betts, A. K. 2001a. Vermont Climate Change Indicators. Weather, Climate and Society 3:106- 115.

Dupigny-Giroux, Lesley-Ann. Personal Communication, March 30, 2014. Vermont State Climatologist, Department of Geology, University of Vermont.

Hayhoe, K., C.P. Wake, T.G. Huntington, L. Luo, M. Schwartz, J. Sheffield, E. Wood, B. Anderson, J. Bradbury, A. DeGaetano, T. Troy, and D. Wolfe. 2007. Past and future changes in climate and hydrological indicators in the U.S. Northeast. Climate Dynamics 28:381-407.

Karl, T.R., J.M. Melillo, and T.C. Peterson, (eds). 2009. Global Climate Change Impacts in the United States. Cambridge University Press, 189 pp. Available online: http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts

Stager, J.C. and Thill, M. 2010. Climate Change in the Champlain Basin: What natural resource managers can expect and do. The Nature Conservancy. TNC/NEAFWA. 2011. Northeast Terrestrial Habitat Mapping Project.

Union of Concerned Scientists (UCS). 2006a. Climate Change in the U.S. Northeast – A Report of the Northeast Climate Impacts Assessment. Available on line: http:www.climatechoices.org/assets/documents/climatechoices/NECIA_climate_report_final.pdf

Union of Concerned Scientists (UCS). 2006b. Vermont – Confronting Climate Change in the U.S. Northeast. Available online: http:www.climatechoices.org/assets/documents/climatechoices/Vermont_necia.pdf

United States Environmental Protection Agency, "Lake Champlain basin SWAT Climate Response Modeling," May 2013. Available online: https://www.epa.gov/sites/production/files/2015-09/documents/swat-climate-response-modeling.pdf

United States Global Change Research Program, United States National Climate Assessment, draft January 2014. Available on-line: http://ncadac.globalchange.gov/

Vermont Agency of Natural Resources, "Climate Change Adaptation Framework," Prepared by Tetra Tech. May, 2013. Available online: http://www.anr.state.vt.us/anr/climatechange/Pubs/2013.0610.vtanr.NR_CC_Adaptation_Framework_Report.pdf

Vermont Agency of Natural Resources, "Resilience: A Report on the Health of Vermont's Environment," 2011. Available online: http://anr.vermont.gov/sites/anr/files/aboutus/documents/Resilience%202011.pdf

Vermont Agency of Natural Resources, Department of Environmental Conservation, "Statewide Surface Water Management Strategy, May, 2011. Available online: http://dec.vermont.gov/watershed/map/strategy

Vermont Division of Emergency Management & Homeland Security, "Irene: Reflections on Weathering the Storm." Available online: http://www.vermontdisasterrecovery.com/sites/www.vermontdisasterrecovery.com/themes/vdr/uploads/pdfs/2013-IRO-final-report.pdf

Vermont Agency of Natural Resources, "Tropical Storm Irene: By the Numbers." Available online: https://anrweb.vt.gov/PubDocs/DEC/WSMD/Other/Irene_Facts.pdf

Vermont Journal of Environmental Law, "Volume 17 – Issue 4, Spring 2016." Available online: http://www-assets.vermontlaw.edu/Assets/news/VJEL_VOL_17_ISSUE_4_LAKE_CHAMPLAIN.pdf