LAKE CARMI
CRISIS RESPONSE PLAN

Version 3.0 Issued June 1, 2022

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VERMONT

AGENCY OF NATURAL RESOURCES
AGENCY OF AGRICULTURE, FOOD & MARKETS
AGENCY OF TRANSPORTATION

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I. Executive Summary

This plan provides details of ongoing Critical Path Projects as well as those planned for the 2023 fiscal year (July 1, 2022 - June 30, 2023) in the context of many years of work by partners across the watershed, fulfilling the requirement in Act 168 (S. 260) section 1311 that the Secretary of Natural Resources (the Secretary) shall issue a Crisis Response Plan. The Secretary is charged with coordinating with the Secretary of Agriculture, Food and Markets, and the Secretary of Transportation in the development of the crisis response plan; therefore, this plan focuses on actions planned by the State. The Secretary recognizes that several local and regional organizations play integral roles in the ongoing work of managing Lake Carmi's water quality, including the Franklin Watershed Committee, Lake Carmi Campers Association, Town of Franklin, and Northwest Regional Planning Commission.

Critical Path Projects are high priority actions planned across multiple sectors: agriculture, natural resources, groundwater, roads, and the lake. State Agencies anticipate refinement of nutrient management plans on farms in the watershed, updating of best management practice tracking, verification of modeling assumptions regarding phosphorus loading from groundwater, buffer plantings along tributaries, improvement of roads, and operation of an artificial aeration/circulation system. DEC and its partners, including UVM Extension, Franklin Natural Resources Conservation District, Franklin Watershed Committee, the Agency of Agriculture, Food and Markets, and other partners are actively working on water quality improvement projects with landowners in the watershed. As projects become more formalized with landowners, these projects will be included in reporting efforts for Total Maximum Daily Load (TMDL) tracking. Progress toward completing actions described in this plan will be reported at quarterly meetings of the Lake Carmi Implementation Team and on the Restoring Lake Carmi web page.

Restoration work in the Lake Carmi watershed has been in progress for many years, with concentrated efforts over the fourteen years since a phosphorus budget (Total Maximum Daily Load or TMDL) was developed to guide restoration work in the watershed. The State's approach to restoring waters entails a multi-sector strategy detailed herein.

The Agency of Natural Resources (ANR), along with partners in the Agencies of Agriculture and Transportation (VTrans), uses a strategic planning process to reduce nutrient loadings in the lake. Passage of the Vermont Clean Water Act in 2015 allowed partners to develop a more aggressive timeline for implementation of strategies to meet the goals of the Lake Carmi TMDL. Nutrient control projects and required management approaches have been implemented across all sectors, including: septic systems, roads, agriculture, natural resources, and shorelands. In some cases, such as the Lake Carmi State Park waste water treatment facility, managers have gone beyond required reductions in nutrient runoff.

Funds and projects being implemented in the Lake Carmi watershed are tracked and modeled for phosphorus reductions. A report on Lake Carmi investments and projects is updated on an annual basis. After a 2020 review of projects funded by state and federal partners, our estimates demonstrate

that we have achieved 41% of the phosphorus reduction target across all sectors. This is a conservative estimate, not including projects implemented without state/federal funding; however, even if we are closer to the TMDL targets than currently estimated, we recognize that time is needed for legacy phosphorus to move out of the watershed and out of the lake. In addition, changes in land use may indicate a higher level of success in achieving our reduction goals; agricultural land use in the Carmi watershed has decreased from 2,748 acres to 1,906 acres since the 2009 TMDL, for example.

Since the original land use land cover map developed for the TMDL in Lake Carmi there have been improvements in the data available to detect variations in land use for mapping purposes. The Agencies have worked together and with the Lake Carmi community to gather data and information to complete an updated land use land cover map for the watershed. Work on refining this map continues and is included among the Critical Path Projects. With this new map and the data accounting on implementation efforts since the approval of the TMDL, the Agencies will refine the remaining phosphorus reduction targets for each sector in the watershed.

Tracking efforts led by University of Vermont Extension, funded by the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS), have documented that farmers operating in the Carmi watershed have made significant strides in implementation of conservation practices to attenuate phosphorus losses from their farm fields. This tracking effort has documented that over 1500 acres of conservation practices have been implemented on cropland between 2010 and 2022 in the Carmi Watershed—practices that include: installation of vegetative buffers on ditches and surface waters, manure injection, conservation crop rotation, cover cropping, and the implementation of conservation tillage among others.

The authors of this report note there may be other factors in the Lake and on the land draining to the lake—factors not incorporated into our models—that negatively affect our ability to meet pollution reduction targets. Climate change, for example, may alter underlying assumptions of the models.

Water quality monitoring data will allow us to determine when legacy phosphorus has flushed from the watershed, regardless of how climate change impacts the ecosystem. Citizen groups and Department of Environmental Conservation (DEC) teams monitor Lake Carmi in the spring and summer months for a broad array of water quality parameters. Monitoring results show an overall improvement in water clarity in recent years, along with stable phosphorus concentrations; however, summertime mean phosphorus concentrations continue to range between 30 and 40 μg/L (ppb).

The restoration target for Lake Carmi is a summertime mean phosphorus concentration of 22 μg/L (ppb). This target is based on monitoring results correlated with a timeframe when residents of Lake Carmi were satisfied with the lake's condition. During the best three years in the monitoring record (1997, 1998, and 2002) the mean summertime phosphorus concentration did not exceed 23 μg/L, expressed as the average annual summertime concentration.

To reduce the intensity and frequency of cyanobacteria blooms, while the watershed flushes excess phosphorus, ANR has implemented a whole-lake aeration project, with installation completed in 2019.

Since the installation of the aeration system, it has operated intermittently over three seasons (2019-2021) due to a series of technical challenges that have prevented continuous operation. A summary of the impact of the system after the 2020 season is below:

- Aeration substantially decreased Lake Carmi's water column stability making it more susceptible to wind-driven mixing
- Aeration triggered substantial decreases in phosphorus internal loading in 2019 and 2020
- Aeration was unable to continuously maintain oxygen concentrations above the target nor fully suppress internal loading of phosphorus in either year, some of which was due to intermittent shutdowns of the system during crucial summer months
- Aeration appears to have altered the timing and composition of cyanobacteria blooms in Lake Carmi, however additional monitoring and analysis is required to confirm these impacts.

A summary of the system's impacts on the lake's biogeochemistry from the 2021 operational season will be available in April 2022, which saw a later start to blooms but an intense period of near-shore blooms from August to October, particularly in the northern half of the lake. DEC is optimistic that after three seasons, most if not all the major technical challenges with the system have been identified and repaired, and that the 2022 operational season will allow for continuous operation. DEC plans one final season of high-frequency monitoring in 2022, and our aim is to collect data on the ability of the system, operating continuously, to mix the lake and suppress internal phosphorus loading.

Finally, it is worth noting that this update, version 3.0 of the Crisis Response Plan, attempts to update the Executive Summary and Critical Path Projects sections of the plan only, and it is not a complete update of the entire document. Section III through VIII of the 2.0 Plan remain largely accurate and did not warrant a comprehensive update at this point. We look forward to continued collaboration with the board range of Lake Carmi stakeholders as we continue to work towards the established TMDL targets, improve water quality, and reduce the frequency and magnitude of cyanobacteria blooms on the lake.

II. Critical Path Projects

Critical Path Projects are comprised of actions intended to improve water quality in the lake that are ongoing, in project planning or development stages, or project concepts under discussion during Vermont state fiscal year 2022 and 2023 across multiple sectors: agriculture, groundwater, natural resources, roads, and the lake. Total funding required for these projects is approximately $1.35 million, and total funding allocated as of March 2022 is close to $1 million. Progress toward completing these actions will be tracked by the Agency of Natural Resources and reported on a quarterly basis to the Lake Carmi Coordination Team and on the Restoring Lake Carmi web page on Vermont Department of Environmental Conservation (DEC) website.

A. Agriculture

Project Name: Agricultural conservation practice accountability

- **Agency Lead/Partners**: AAFM/ANR DEC
- **Location**: Lake Carmi watershed
- **Description**: Continue to compile, verify, and maintain a dataset of agricultural conservation practices installed by farmers in the Carmi watershed. Practices may be installed through state and federal programs as well as voluntarily to comply with the Required Agricultural Practices and to steward soil health and water quality. Practice data is uploaded into the DEC Watershed Projects Database and phosphorus reductions are quantified.
- **Estimated Cost**: AAFM/ANR DEC staff time, estimated at $5,000 (minimum).
- **Timeline**:
  - Data collection – ongoing
  - Data review and verification by ANR DEC – mid-summer 2022
  - Pollutant reductions quantified – January 2023 (annual Performance Report)
- **Outcome**: Quantified best management practice implementation and phosphorus reductions

Project Name: Agronomy and conservation practice state and partner technical assistance

- **Agency Lead/Partners**: AAFM, UVM Extension System, USDA NRCS, VACD
- **Location**: Carmi watershed
- **Description**: These organizations are working together to individually assist every farm in the watershed to provide technical and financial assistance in developing and implementing conservation plans and related practices on farms. Priority efforts are implementation of nutrient management plans (which are current on each farm in the watershed), increasing agronomic practices (cover crops, manure injection), and addressing any critical source areas to reduce erosion and nutrient loss.
- **Estimated Cost**: $250,000 (AAFM contracts, DEC contracts, USDA). The financial support for many of these efforts are through cost-share programs to the farmers and technical support grants that provide staffing capacity for these organizations from USDA farm bill programs and the AAFM Clean Water Fund grants.

- **Timeline**: Ongoing
- **Outcome**: Implementation of best management practices improving water quality and soil health

Project Name: Water Quality Regulatory Programs

- **Agency Lead/Partners**: AAFM/ANR DEC
- **Location**: Carmi watershed
- **Description**: AAFM and DEC each receive complaints and inspect sites to assess whether water quality violations exist and manage appropriately to ensure compliance. These investigations will continue independently and jointly and will be reported annually in enforcement reports. AAFM, in addition to investigations of complaints, also performs inspections on farms under the Required Agricultural Practices Rules, Medium Farm Operations Rules, and the Large Farm Operation Rules. These inspections are regularly performed according to the statutory requirements and the coordination between inspection findings and technical assistance support will ensure that conservation plans are appropriately including the necessary practices for continued compliance with agricultural water quality regulations. Beyond working with individual landowners, AAFM also regulates Custom Manure Applicators, contractors that spread manure for farmers, to ensure they understand how to interpret and implement a nutrient management plan to meet water quality regulatory requirements.
- **Estimated Cost**: AAFM/ANR DEC staff time, estimated at $5,000 (minimum).
- **Timeline**: Ongoing
- **Outcome**: Compliance with the Required Agricultural Practice Rules, Medium Farm Operations Rules, and the Large Farm Operation Rules

Project Name: Implementation of the grassland manure injector

- **Agency Lead/Partners**: AAFM/ANR; UVM Extension
- **Location**: Carmi watershed
- **Description**: AAFM provided funds to support the purchase of a grassland manure injector and DEC has provided funding to support the increased cost of implementation. In addition, UVM has secured funds for a detailed evaluation of the direct water quality benefits of the injector and will be providing a report after the project is complete.
- **Estimated Cost**: $25,000
- **Timeline**: Starting in 2021 field season, and continuing into 2023
- **Outcome**: Increase acres of grassland injected with manure

Project Name: Evaluation of agricultural soil health

- **Agency Lead/Partners**: ANR; UVM Extension; University of Vermont faculty.
- **Location**: Carmi watershed
- **Description**: UVM Extension, with the assistance of a post-doc from the UVM Gund Institute, is evaluating the state of agricultural soil health. Funding from DEC has been

provided to cover the cost of sampling specifically in the Carmi watershed. UVM will conduct the sampling and provide a summary of results and recommendations by December 2022.

- **Estimated Cost**: $4,000
- **Timeline**: Starting in 2021 field season, and continuing into 2022
- **Outcome**: Analysis of agricultural soil health in the Carmi watershed

B. Groundwater

Project Name: How Does Groundwater from the Fractured Bedrock and Surficial Aquifers Affect Nutrient Levels (i.e., phosphorous and nitrate) in Surface Waters from the Lake Carmi Watershed?

- **Agency Lead/Partners**: Vermont Geological Survey, Middlebury College, Vermont AAFM
- **Location**: Lake Carmi Watershed.
- **Description**: To use a multi-part, field-based study to determine whether groundwater influences phosphorous and nitrate levels in Lake Carmi and the streams feeding it.
- **Estimated Cost:** $25,000
- **Timeline**: Field work completed by the end of fall 2021, final report by June 30th, 2022.
- **Outcome**: Specific outcomes include:
  - Increased understanding of the role that groundwater plays in transporting nutrients from source(s) to surface water bodies will impact management of water quality in Lake Carmi and other surface waters in Vermont and the northeastern United States.
  - Preliminary visualization of ground- and surface water interaction in the Lake Carmi watershed.

Project Name: Groundwater from Shallow Monitoring Wells and Phosphorous.

- **Agency Lead/Partners**: Vermont Geological Survey/ DEC, Middlebury College, SUNY at Plattsburgh, Vermont AAFM.
- **Location**: Lake Carmi Watershed
- **Description**: Nine monitoring wells were installed in surficial materials/"soils" in October 2020. These wells will be used to determine whether phosphorous is transported to the lake by shallow groundwater. These wells were sampled for the first-time during July 1, 2021. We plan to sample them in ~May and ~October 2022, but as part of project called "Further Sampling and Analysis of Groundwater and Surface Water from the Lake Carmi Watershed" below. Graham Bradley has funds to pay for the VAEL chemical analyses of these monitoring wells for the ~May and October 2022 sampling.
- **Estimated Cost**: $20,000.
- **Timeline**: October 2020- installation; Summer 2021- sampling groundwater from these wells for chemical analysis.

- **Outcome**: Increased understanding of the role that shallow groundwater within surficial deposits/ "soils" plays in transporting phosphorous to Lake Carmi and other surface waters in Vermont.

Project Name: Further Sampling and Analysis of Groundwater and Surface Water from the Lake Carmi Watershed .

- **Agency Lead/Partners**: Vermont Geological Survey/ DEC, Middlebury College, SUNY at Plattsburgh, Vermont AAFM.
- **Location**: Lake Carmi Watershed
- **Description**: We will sample ~50% of the wells (n=~12) and surface water sites (n=~12) in project name 1 in this section for the second (~May 2022) and third (~October 2022) times, as well as sample all nine monitoring wells from project name 2 above in ~May 2022 and ~October 2022 for herbicides and any necessary chemical parameters, which are not covered by Graham Bradley's funding previously described .
- **Estimated Cost**: $15,000
- **Timeline**: ~May 2022 and ~October 2022 sampling events.
- **Outcome**: A look at how phosphorous and many other chemical parameters change over the course of a >year in shallow and deep groundwater and surface water.

C. Natural Resources

Project Name: Marsh Brook Buffer Planting

- **Agency Lead/Partners**: FWC
- **Location**: Marsh Brook reaches, M4T2.3S8.03-A & M4T2.3S8.03-B
- **Description**: Plant trees in areas of need.
- **Estimated Cost**: $15,000
- **Timeline**: ongoing
- **Outcome**: Improved riparian cover in erosion prone sites along Marsh Brook, and reduced erosion / sediment transport to Lake Carmi.

Project Name: Marsh Brook small tributary /wetland restoration preliminary alternative analysis

- **Agency Lead/Partners**: FNRCD
- **Location**: Marsh Brook reaches, M4T2.3S8.02-C // M4T2.3S8.5S1.01
- **Description**: Determine potential alternatives available for improving conditions of historically channelized and managed reach through preliminary design process.
- **Estimated Cost**: $20,000
- **Timeline**: 2021 /2022
- **Outcome**: An alternative analysis of strategies for improving channel and 30% of selected alternative.

Project Name: River Corridor Easement

- **Agency Lead/Partners: potential partners**: VRC, TNC
- **Location**: Marsh Brook reach M4T2.3S8.04-B
- **Description**: Secure long-term protection of portions of the stream and corridor to allow channel adjustments and sediment /nutrient attenuation to occur in upper watershed
- **Estimated Cost**: $100,000
- **Timeline**: 2024/2025
- **Outcome**: Protection of this area would reduce landowner conflict with beaver impacts and/or future channel adjustments. Area important in upper part of the watershed for long term sediment/nutrient attenuation
- **Additional information:** Landowner approached in 2020 regarding this project and was not interested at that time. In a few years reach out to landowner again for continued discussions.

Project Name: Marsh Brook stream fords and trail crossing

- **Agency Lead/Partners**: FWC
- **Location**: Marsh Brook reaches: M4T2.3S8.03-B , M4T2.3S8.04-A, ,M4T2.3S8.04-B
- **Description**: Explore options to reduce erosion under bridge Contact landowner to determine potential interest in exploring this project
- **Estimated Cost**: $5,000
- **Timeline:** 2022/2021
- **Outcome**: Reduce erosion around small structures and trails/ford crossing the brook

Project Name: Potential Floodplain/Wetland restoration

- **Agency Lead/Partners**: FWC, FNRCD
- **Location**: Marsh Brook reach M4T2.3S8.03-A
- **Description**: Localized area of incision that can be improved. Contact landowner to determine potential interest in exploring this project. Engage Wetlands and Rivers Program for strategies for this area and permitting requirements.
- **Estimated Cost**: $30,000
- **Timeline**: 2022/2023
- **Outcome**: Improved floodplain connection for sediment/nutrient attenuation.

Project Name: Lake Wise

- **Agency Lead/Partners**: FWC; FNRCD, NRPC as Basin Clean Water Service Provider
- **Location**: Lake Carmi shoreline
- **Description**: Work with lakeshore camps to implement Lake Wise strategies to reduce runoff from lakeshore areas and improve riparian vegetation along the lake for water quality and habitat benefits. 15 camp owners expressed interest in response to FWC outreach. FWC conducted 6 site visits in fall 2021. DEC is working through a staff transition for the Lake Wise Program oversight but should be able to follow up in 2022.

- **Estimated Cost**: $10,000 for Lake Wise Assessments, $40,000 for project development implementation.
- **Timeline**: Lake Wise Assessments and subsequent design, development, and implementation of shoreline BMPs to reduce erosion, nutrient pollution, and surface water runoff from shoreland properties are ongoing efforts around Lake Carmi. In 2022, DEC and shoreland property owners will work to complete Lake Wise assessments, identify projects for support from DEC project development and/or project design and implementation block grants, and complete the necessary funding applications.
- **Outcome**: Camps along the lake become Lake Wise Certified.

Project Name: Small Stream and ditch drainage network assessment

- **Agency Lead/Partners**: Rivers Program, FNRCD, Agency of Agriculture
- **Location**: Lake Carmi watershed
- **Description**: Inventory and begin basic assessment /stream walk of small tributaries and drainage ditches that drain into larger tributaries to determine possible sources of erosion that can be addressed. Approximately 7 miles of small stream/drainage network initially identified for this work.
- **Estimated Cost**: $25,000
- **Timeline**: 2022/2023
- **Outcome**: Improved understanding of conditions of small stream/ditch network that have not been assessed up to the point as to what their potential contributions of sediment/nutrients are and identify possible strategies and areas for project to improve conditions.

D. Roads

Project Name: Stormwater management at State Park Road Park entrance

- **Agency Lead/Partners**: FWC
- **Location**: Either side of Marsh Brook crossing at Route 136
- **Description**: Reduce erosion of stormwater swale, vegetate lawn area
- **Estimated Cost**: Project development grant received by FWC, will identify rough costs, placeholder cost for this document is $10,000.
- **Timeline**: 2022/ 2023
- **Outcome**: Reduction of sediment and road pollutants into Marsh Brook

Project Name: Marsh Brook Culvert replacement at Towle Neighborhood Road

- **Agency Lead/Partners**: Town
- **Location**: Towle Neighborhood Road – Marsh Brook crossing @ 44.95334 N, -72.84557 W
- **Description**: Hydrologic study completed and recommended replacing metal 57X38 " culvert with a cement box culvert 5 foot by 3 foot concrete box.
- **Estimated Cost**: $30,000 (rough estimate)

- **Timeline**: 2025
- **Outcome**: Reduced scouring of stream channel, increase AOP capacity and reduced runoff and erosion from road and road shoulder (last part was identified in Franklin Stormwater Master Plan)

Project Name: Private camp roads and driveways and State Park Road inventory

- **Agency Lead/Partners**: NRPC with FNLC and Franklin Natural Resources Cons. District with funding from LCBP
- **Location**: All hydrologically connected private and state park roads and driveways in the Lake Carmi watershed
- **Description**: Hydrologically connected private and park roads and driveways will be inventoried using a modified version of the Municipal Roads General Permit (MRGP) road erosion inventory methodology. Priority projects will be identified and BMPs designed for implementation.
- **Estimated Cost**: $10,000
- **Timeline**: Inventory field work is complete. Prioritization and project identification anticipated summer 2021.
- **Outcome**: Technical designs for BMPs are being developed by Watershed Consulting for 3 high priority locations

Project Name: Phase I - Best Management Practices construction projects on private and park roads and driveways in the Lake Carmi watershed Phase I

- **Agency Lead/Partners**: NRPC with funding from the LCBP
- **Location**: TBD
- **Description**: 2-5 High priority projects completed that were identified in the Lake Carmi private and park roads and driveways inventory completed 2021.
- **Estimated Cost**: up to $75,000
- **Timeline**: 2021-2022
- **Outcome**: 2-12 segments of road and/or driveways with stormwater BMPs constructed from the VT Better Roads Manual, the Vermont Guide to Stormwater Management for Homeowners and Small Business, Lake Wise, and/or other appropriate manuals.

Project Name: Phase II - Best Management Practices construction projects on private and park roads and driveways in the Lake Carmi watershed Phase II

- **Agency Lead/Partners**: Unknown with EPA funding
- **Location**: TBD
- **Description**: 2-5 High priority projects completed that were identified in the Lake Carmi private and park roads and driveways inventory completed 2021.
- **Estimated Cost**: up to $150,000
- **Timeline**: 2022-2023

- **Outcome**: 2-12 segments of road and/or driveways with stormwater BMPs constructed from the VT Better Roads Manual, the Vermont Guide to Stormwater Management for Homeowners and Small Business, Lake Wise, and/or other appropriate manuals.

Project Name: Private Road and Driveway Stormwater Management Workshops

- **Agency Lead/Partners**: NRPC with Watershed Consulting, funding from LCBP
- **Location**: virtual
- **Description**: Online workshop/webinar for residents and homeowners on private roads
- **Estimated Cost**: $2,000
- **Timeline**: July 14, 2021
- **Outcome**: Increased knowledge about road water quality issues, and better-informed homeowners and private road residents that will be more likely to take stewardship action. Workshop slides and video are available online at https://www.fcsvt.org/driveway

Project Name: Dewing Shore Road stormwater management

- **Agency Lead/Partners**: FWC
- **Location**: Dewing Shore Road from second crest of Dewing Road to 297 Dewing Road and brook
- **Description**: Identify stormwater management opportunities to reduce runoff that is culverted directly to lake at 297 Dewing Road as well as buffer planting opportunities at Dewing Brook crossing. FWC received grant to develop project to allow a design grant application to be developed
- **Estimated Cost**: Project development $3,000. Implementation cost TBD
- **Timeline**: Design grant application by October 15, 2022/ Completion date estimated 2023
- **Outcome**: Potential solutions identified for runoff carrying sediment to lake. Initial sketch of riparian planting on Dewing Brook, contact with camp owner.

Project Name: Stormwater management off State Park Road entrance

- **Agency Lead/Partners**: FWC, DFPR,
- **Location**: Either side of Marsh Brook culvert at Route 236
- **Description**: Manage stormwater to reduce erosion in existing ditch or to spread out through proposed plantings. Project development grant received by FWC to develop design application
- **Estimated Cost**: Project development grant received by FWC will identify rough costs by September 2022, placeholder cost for this document is $10,000.
- **Timeline**: Project design application complete by September 2022; project completion estimated 2023
- **Outcome**: Reduction of sediment and road pollutants into Marsh Brook

Project Name: Stormwater management off State Park Beach parking areas

- **Agency Lead/Partners**: FWC, DFPR
- **Location**: Lake Carmi State Park

- **Description**: Stormwater management improvements to Lake Carmi beach parking and associated areas that are prone to stormwater runoff, to reduce this runoff into the lake
- **Estimated Cost**: To be Determined, placeholder cost for this document is $10,000.
- **Timeline**: To be determined, ongoing
- **Outcome**: Reduce sedimentation into Lake Carmi near beach area.

Project Name: Culvert replacement for 65838 (culvert on route 236 over Marsh Brook)

- **Agency Lead/Partners**: VTrans
- **Location**: Rt 236 at mile marker 1.82
- **Description**: Determine need for replacement. Hydraulic assessment first.
- **Estimated Cost**: 225,000 for culvert replacement
- **Timeline**: request submitted 3/19/21
- **Outcome**: Reduced scouring of stream channel and improved geomorphic conditions, increase AOP capacity and reduced runoff and erosion from road and road shoulder

Project Name: 65685 (culvert on Rt 120 at mile marker 1.44)

- **Agency Lead/Partners**: VTrans
- **Location**: Franklin VT120 (North Sheldon Road) over unnamed stream (Prouty Brook). Site about 1 mile north of TH 4 (Swamp Road). GPS coordinates: N 44.9537° W 72.9056°
- **Description**: 2015 hydraulic analysis completed on 6/24/21 identified need for increase from 3' to 6' x 4'opening, concrete headwall with flared wingwalls at the inlet and outlet
- **Estimated Cost**: $35,000
- **Timeline**: Not determined
- **Outcome:** Reduced scouring of stream channel, increase AOP capacity and reduced runoff and erosion from road and road shoulder

E. Lake Management

Project Name: Whole-lake Aeration/Circulation

- **Agency Lead/Partners**: DEC, Town of Franklin, Franklin Watershed Committee, Lake Carmi Campers, Everblue Lakes
- **Location**: 80+ Diffusers throughout the Lake, with two onshore compressors, one on the state park property and a second on the Evans' property
- **Description**: The Lake Carmi aeration system is designed to mix the water column and allow dissolved oxygen to reach the lake bottom. The presence of dissolved oxygen at the lake bottom is important to reduce internal phosphorus loading (release of phosphorus from the sediments which can become available to microorganisms and fuel algal blooms). This strategy of aeration/circulation has been determined to be the best in-lake approach to reduce the release of legacy phosphorus from sediment in the oxygen-depleted deep zone

of the lake during the summer, and in turn cut down the amount of nutrients available to support harmful cyanobacteria blooms.

- **Estimated Cost**: Initial Capital Costs of $1Million, Annual Electric Costs of $20,000, Annual O&M Costs of $25,000.
- **Timeline**: The system is operational, with plans to continue operation of system for foreseeable future, with transfer of system ownership from DEC to the Town of Franklin by the end of 2022
- **Outcome**: The system is designed to: 1) prevent oxygen depletion in the hypolimnion (lowest lake layer) during summer stratification, thereby decreasing release of legacy phosphorus from the sediments, and 2) create physical conditions that hinder cyanobacteria blooms.

Project Name: Lake Carmi Dam Repair Project

- **Agency Lead/Partners**: ANR DEC Dam Safety Program (Ben Green, Steve Hanna), DEC Agency Facilities (David Webb)
- **Location**: Lake Carmi Dam/Mill Pond Dam
- **Description**: Based on the results from the 2018 study on the dam, repairs of the dam have been planned, including obtaining temporary construction easements, embankment improvements including tree and brush clearing, re-grading and armoring, replacement of the stoplog channels with a low-level outlet, formal decommissioning of the existing outlet, minor concrete repairs, signage, fencing, and general site cleanup.
- **Estimated Cost:** Approximately $250,000, funded using DEC Dam Safety Program Capital Funds
- **Timeline**: Project currently on hold
- **Outcome**: Repairs to the dam to improve functionality and safety bringing it into compliance with current dam safety standards and requirements.

Project Name: UVM High-Frequency Automated In-Lake Monitoring to assess effectiveness of aeration in Lake Carmi

- **Agency Lead/Partners**: DEC Lakes and Ponds, University of Vermont
- **Location**: Lake Carmi
- **Description**: Researchers from the University of Vermont (UVM) and the Vermont Department of Environmental Conservation (VTDEC) are monitoring Lake Carmi to assess how the availability of phosphorus—an essential nutrient that feeds cyanobacteria blooms in the lake—and cyanobacteria populations have responded to aeration that began in 2019. Post-aeration data will be compared to pre-aeration data from the same locations. Automated sensors include: a float with six vertically-distributed dissolved oxygen and temperature sensors collects data every 15 minutes, two pressure transducers – one on land, and one fixed to a dock in the water – assess water level every 15 minutes, a sensor attached to a winch suspended from a platform in the lake moves vertically from the lake surface to its bottom to assess physical, chemical and biological properties of the water

once every hour, a weather station monitors changing weather conditions, and an automated water sampling system collects one water sample per day to measure nutrient concentrations just above the lake's sediment. Sediment and biological samples are also collected by hand.

- **Estimated Cost**: $250,000
- **Timeline**: The buoy is operational and will remain in place until October 2021. It is unclear at this time if the buoy will be redeployed in 2022.
- **Outcome**: The diverse and comprehensive suite of data collected will allow the research team to know if, when, and under what conditions the lake's sediment is releasing phosphorus into the water and how that impacts cyanobacteria blooms. Information will be used to advise on the functioning of the aeration system.

III. Introduction

A. Watershed Description

Lake Carmi is a large, relatively shallow lake located in northwestern Vermont in the Town of Franklin. It is 1,402 acres in size and has a watershed area of 7,710 acres. Its maximum depth is 33 feet. The lake's long axis runs north-south and measures approximately three miles. The watershed is made up of low hills, with only a 485-foot difference between the lake elevation (435 feet) and the highest point in the basin. A small, wetland-edged pond, Little Pond, is located within the watershed on the eastern side, and its outlet, Marsh Brook, is the largest tributary to the lake. Lake Carmi has extensive wetlands in its watershed, most notably Franklin Bog at its southern end. The divide between the Pike River and Missisquoi River watersheds lies within the Franklin Bog.

The Pike River watershed is in northern Franklin County and originates in the hills of Berkshire, Vermont (Figure 1). The river then flows southerly for ~4 miles to the confluence of Mineral Brook before meandering around to the west then flowing northerly and into Quebec. In Quebec, the Pike River makes a large arc northwesterly and then southerly into Missisquoi Bay north of Phillipsburg, Quebec in Canada.

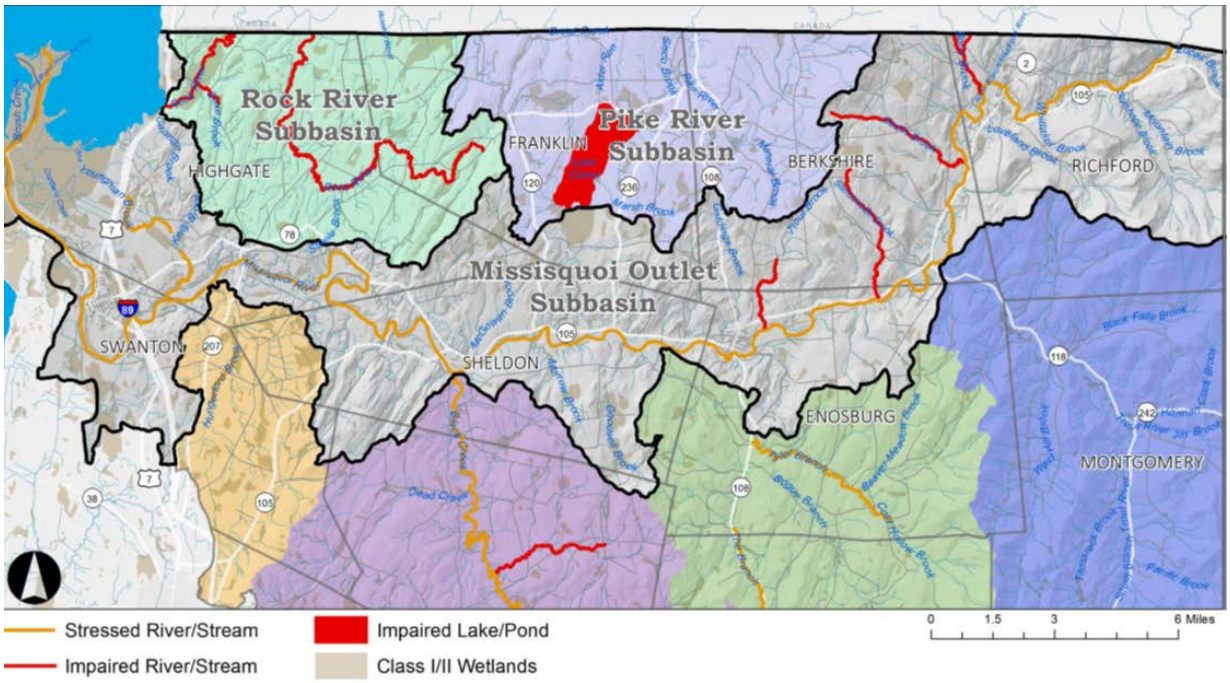

Figure 1. Rock and Pike River watersheds.

The total Pike River watershed area on the U.S. side of the border is 25,119 acres. The landscape is very rural, with a significant amount of acreage in agriculture. Data from the National Cropland Database (NCD) estimates that agriculture is 36% of the watershed, 11% in annual cropland and 25% is in pasture or hayland (NCD, 2011). The Pike River Watershed includes Lake Carmi, which is subject to

periodic cyanobacteria blooms. Lake Carmi is nested within larger watersheds, which together comprise the Missisquoi Bay Watershed, where agriculture is the dominant landcover.

Currently, 21 – 25% of acreage in the watershed is tilled or untilled farmland. There are many acres of hay, corn, and pasture fields leased by farms located outside of the Carmi watershed. Forty-five percent of the watershed is wooded or wetland, including a large portion of Franklin Bog. Apart from intensive shoreline development, low-density residential development is spread throughout the watershed.

Lake Carmi State Park is one of the most used state parks in Vermont. In addition to a large swimming beach, 2.9 miles of undeveloped shoreland (38% of the total shoreline) are included in the park and comprise the bulk of the undeveloped shore lake-wide. The remaining 62% of shoreland is heavily developed, including 282 seasonal camps, 30 year-round homes, 20 camp lots, 14 camp ground/seasonal rentals, three farms, three commercial properties, and an extensive road network within 1,000 feet of the shoreline (Lisa Larivee, Franklin Town Clerk, personal communication). Many of the shoreline camps are located within 50 feet of the shoreline, and most do not have significant vegetation other than a lawn between the camp driveway and the lake. In addition to a boat launch ramp in the State Park, there is a Department of Fish and Wildlife Access at the northern end directly on Route 120. Many town residents park along Route 120 and swim off the shore adjacent to the boat ramp during the summer.

The lake is natural, but a dam controls the water level and elevates the water about two feet over its natural level. The dam is located at the north end of the lake and drains north into the Pike River. The dam, originally constructed in the mid-1800s to provide power for a sawmill, was rebuilt in the early 1970s and is now owned by the Vermont Department of Environmental Conservation (VT DEC). The Lake Carmi dam, also known as the Mill Pond Dam, is located about 2,400 feet from the lake itself, having been built downstream of the outlet. Therefore, the outlet stream leaves Lake Carmi and passes under Dewing Shore Road and through Mill Pond before reaching the dam.

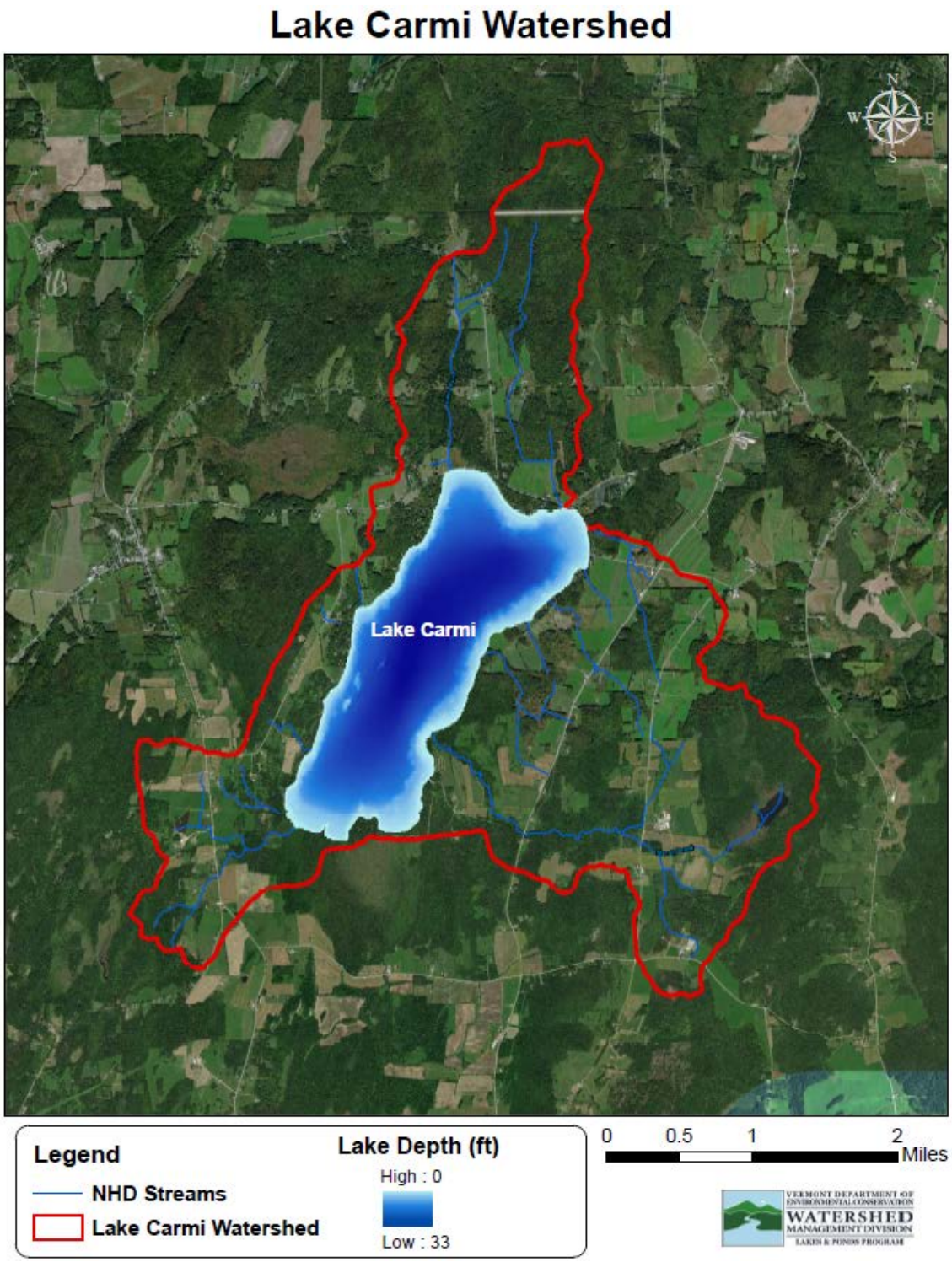

Figure 2.Draft map of Lake Carmi and its watershed, showing lake bathymetry (lake depths) as mapped by the Vermont Lakes and Ponds Program and streams as represented in the National Hydrography Dataset (NHD).

[1] See Critical Path Project titled "Land Use Land Cover Map Update."

B. Background on Water Quality Issues

Lake Carmi was identified as a prime candidate for a restoration effort by the state in the late 1970's. Water quality monitoring has been conducted by lay monitors since 1979 and has provided a very good base of information for assessing water quality over the period. Water quality monitoring has focused on three main tests: clarity, chlorophyll-a concentration and phosphorus concentration. Water clarity has improved in recent years, while chlorophyll-a and phosphorus values have stabilized.

Lake Carmi has a history of late summer algae blooms, resulting in conditions that residents find objectionable and not swimmable. These algae blooms date back to the late 1800s, with DEC documenting the first cyanobacteria (blue-green algae) outbreak in October of 1981. According to monitoring data, there was a period in the 1990s when conditions improved, but they have since worsened. Residents report that an algae bloom can occur anytime during the summer, with late summer still being the usual time of cyanobacteria blooms.

The Franklin Watershed Committee (FWC) was formed in 1994 (originally the Carmi Watershed Committee) to investigate and address sources of phosphorus to the lake. The group has accomplished many projects since then and received funding through the Vermont Watershed Grants Program, U.S. Environmental Protection Agency (EPA) Section 319 – Nonpoint Source Pollution, the Lake Champlain Basin Program (LCBP), the Town of Franklin and the Lake Carmi Campers Association (LCCA), DEC and AAFM.

Today, Lake Carmi does not meet State Water Quality Standards, it is classified as an impaired waterbody with an EPA approved Total Maximum Daily Load (TMDL) for phosphorus. In Franklin's Municipal Plan there are goals outlined to maintain, improve, and protect the quality of Franklin's water resources, including groundwater and surface water.

C. Problem Description

Phosphorus is a nutrient that causes excess plant and algae growth. While some phosphorus is necessary for aquatic life, too much phosphorus has contributed to cyanobacteria blooms, reduced water clarity, and excess aquatic plant growth. Changing weather patterns also play a role in exacerbating phosphorus-fueled conditions. Abnormal temperature and precipitation patterns led up to intense, prolonged cyanobacteria blooms during late summer and into the fall of 2017, akin to conditions documented in October of 1981. These cyanobacteria blooms cut short Lake Carmi's summer recreational season and caused many to ask what actions had been taken to improve water quality and what else could be done (Appendix A – *Implementation Timeline*).

D. The Lake Carmi Phosphorus TMDL – Estimated Base Load as of 2008

Section 303(d) of the Federal Clean Water Act requires waters that do not meet state water quality standards to have a Total Maximum Daily Load (TMDL) analysis prepared. A "TMDL" identifies a daily amount ("load") of phosphorus, or a pollution budget, that estimates phosphorus pollution

reaching a lake, for example, from sources in the watershed and establishes phosphorus pollution targets that can enter the lake without causing water quality problems.

The State's plan for reducing phosphorus loading to Lake Carmi and Lake Champlain emphasizes education and outreach while providing financial and technical assistance to implement both voluntary and required actions. Inspection and enforcement programs are important compliments to ensure reductions are met. The Lake Champlain Phosphorus TMDL Phase I Implementation Plan, dated September 2016, outlines the strategies that are expected to reduce phosphorus loads to meet water quality goals throughout the Lake Champlain Basin, including the Missisquoi Bay watershed, where Lake Carmi is located. Load reductions from ongoing work are being assessed annually.

In addition, many partners have worked expeditiously to implement the 2008 Lake Carmi Phosphorus Reduction Plan. This includes work by Franklin Watershed Committee (FWC), The Vermont Agency of Natural Resources (ANR), Vermont Agency of Agriculture, Food and Markets (AAFM) and other partners. The specific actions identified in the 2008 reduction plan are focused on helping the community direct resources towards phosphorus reduction efforts with financial and technical assistance from ANR. The Crisis Response Plan is meant to augment the efforts provided by existing regulatory and technical and financial resource programs. These programs are spelled out in the Phase I plan mentioned above and are now substantially more robust with the resources provided by Act 64 of 2015.

The Department of Environmental Conservation (VT DEC) determined the target in-lake phosphorus concentration for Lake Carmi using monitoring results correlated with a timeframe when residents of Lake Carmi were satisfied with the lake's condition. During the best three years in the monitoring record (1997, 1998, and 2002) did not exceed 23 µg/L, expressed as the average annual summertime concentration (in micrograms per liter or µg/L). Based on these data, DEC set the TMDL target at 22 µg/L. Since Lake Carmi currently exceeds the standard of 22 µg/L annual load, the lake is listed as impaired, which requires a TMDL by the federal Clean Water Act.

In 2008, DEC developed the Lake Carmi Phosphorus TMDL, which was approved by the EPA in 2009. The Lake Carmi TMDL provides guidelines as to how much the load needs to be reduced. If achieved, the TMDL should result in the correction of water quality problems.

The TMDL must allocate a total loading capacity for Lake Carmi, including estimates of phosphorus sources in the watershed. The total loading capacity is divided into three components: margin of safety (MOS), wasteload allocation, or WLA (point sources of phosphorus pollution) and load allocation, or LA (non-point sources of phosphorus pollution). The TMDL must allocate its total loading capacity between point and non-point sources, as shown below.

$$TMDL = MOS + WLA + LA$$

The margin of safety for the total loading capacity is explicit. DEC has selected 10% of the total loading capacity with the target concentration.

$$1{,}027\ kg * 0.1 = 103\ kg\ MOS$$

The total loading capacity for Lake Carmi is 1,027 kg/yr. No point-source discharges currently exist in Lake Carmi, therefore no WLA is provided in the 2008 TMDL. Any new point source discharges will require re-opening of the TMDL.

$$0\ kg\ WLA$$

The non-point source LA is a remainder of the total loading capacity.

$$1{,}027\ kg - \ 103\ kg - \ 0\ kg = 924\ kg\ LA$$

The total loading capacity of 1,027 kg/yr is the total amount of phosphorus Lake Carmi has, but there needs to be a phosphorus load reduction from 2008 modeled contributions to restore the lake. The load reduction required for the lake is 611 kg/yr, which is a 40% reduction across all sectors.

E. Checking Assumptions of the 2008 TMDL and Phosphorus Reduction Plan

Annual phosphorus loading estimates to Lake Carmi were derived using land use information and an export coefficient-based load estimation procedure. Detailed land use information was compiled for the Lake Carmi watershed using a Geographic Information System, relying on the data provided through the Lake Champlain Basin Program Technical Report No. 54: Updating the Lake Champlain Basin Land Use Data to Improve Prediction of Phosphorus Loading**.** By the export coefficient load estimation procedure, the annual phosphorus loss per unit land area (in kg P/Ha/yr) is identified for each land use type and corrected using modeling analyses to predict the measured in-lake phosphorus concentrations. The table below shows these values and compares land use loads to those estimated and aggregated from Lake Carmi subwatersheds using the new Clean Water Roadmap (Vermont Department of Environmental Conservation, 2016a) designed for the Lake Champlain TMDL.

Table 1. Total export, by land use, from the Lake Carmi watershed. Comparison of 2008 TMDL data with Clean Water Roadmap.

Land Use	Acres	Export coefficient (kg/ha/yr)	Initial load (kg/yr)	Corrected load (kg/yr)	Loading %	*Clean Water Roadmap acres*	*Clean Water Roadmap load (kg/yr)*
Agriculture	2,748	1.78	1979	1188	85%	*1,851*	*1,313*
Urban – lakeshore	100	2.52	102	61	5%	*472*	*320*
Urban – low density	62		63	38	2%		
Forest	2,090	0.04	34	20	1%	*3,088*	*136*
Wetlands[1]	722	0.15	44	26	2%	*354*	*25*
Other water[2]	586	0	0	0	0%		
Lake Surface[1]	1,402	--	88	88	5%		
Total	7,710	--	2,310	1,421	100%	*5,764*	*1,794*

1) Direct deposition of phosphorus to contiguous wetlands and the lake surface was calculated using the approach of the Lake Champlain TMDL (VTDEC and NYSDEC, 2002).
2) Direct deposition of phosphorus to non-contiguous ponds and tributaries was considered negligible.

The most recent update of this Crisis Response Plan reflects resources provided by the adoption of the 2016 Lake Champlain Phosphorus TMDL Implementation Plan. The Lake Champlain Implementation Plan outlines how we will reduce phosphorus loading within the entire Lake Champlain Basin, which includes Lake Carmi. The Legislature made resources available to support implementation through

passage of the 2015 Vermont Clean Water Act (Act 64). Both the Lake Champlain Implementation Plan and Act 64 directly support efforts to achieve clean water in Lake Carmi. Vermont's tracking and reporting systems measures progress toward meeting phosphorus targets (see Section IV – *Tracking & Reporting Progress*).

F. Approach

1. Purpose

This Crisis Response Plan is written to encompass improvements needed in all land use sectors, as all are sources of phosphorus. Partners promote the view that phosphorus reductions are needed across the board to both address all possible sources as well as encourage the responsibility and involvement of all land owners and users.

This document fulfills the requirement in Act 168 (S. 260) section 1311 that the secretary issues a Crisis Response Plan. Per section 1312 actions may be required by the secretary and designated as Lake in Crisis orders. Note that actions described in this plan do not constitute regulatory requirements unless a Lake in Crisis Order is issued pursuant to Act 168, Section 1312.

2. Goals

A 40% reduction in phosphorus loading is required across all land uses in the Carmi watershed, including agricultural lands, state and municipal roads, and lakeshore properties. This requires a long-term commitment from all stakeholders.

Partners have played multiple roles, including funder, technical resource or project manager, as well as for Lake Carmi providing guidance during the planning process (Appendix C – *Partners*).

3. Objectives

Projects have been identified and implemented to meet the target phosphorus concentration and required loading reduction goals identified in the Total Maximum Daily Load (TMDL). Implementation actions (Appendix B), which identify the specific priority actions to reduce phosphorus pollution to meet the Lake Carmi Phosphorus TMDL goals, and the Watershed Projects Database[2] include explicit actions to protect and restore Lake Carmi. These actions are supported by the following top objectives:

- **Increase knowledge of water quality conditions in the watershed,** through short-term intensive and long-term monitoring programs.
- **Implement agricultural Best Management Practices (BMPs)** throughout the watershed.
- **Manage stormwater from developed areas** through the development and implementation of a stormwater master plans (Franklin) and private road assessments.

[2] An online database that contains priority monitoring, assessment, scoping, design, implementation, and reclassification projects (visit: https://anrweb.vt.gov/DEC/IWIS/ARK/ProjectSearch.aspx).

- **Improve shoreland management to protect water quality and protect wildlife habitat along Lake** through direct outreach with landowners to encourage participation in the Lake Wise Program, which promotes implementation of lakeshore BMPs.
- **Inventory and prioritize municipal road erosion features that discharge into surface water and implement high priority actions in existing road erosion inventoried sites.**
- **Provide technical and, as available, financial assistance to the wastewater treatment facility and septic systems in meeting TMDL** goals to reduce phosphorus loading to Lake Carmi.
- **Provide technical and financial assistance to assist private landowners** in the maintenance of septic systems (once shoreland property owners have taken the top priority actions of revegetating their shore or adding vegetative Best Management Practices to soak up stormwater).

4. Strategies

This Crisis Response Plan, the Missisquoi Basin Tactical Basin Plan (Vermont Department of Environmental Conservation, 2016b), the Lake Champlain Total Maximum Daily Load Implementation Plan (U.S. Environmental Protection Agency, 2015b), and the Vermont Clean Water Act (Act 64,Vermont General Assembly, 2015) identify the actions, tools, and resources needed to achieve clean water. The Crisis Response Plan Implementation Table (Appendix B – *Implementation Actions*) identifies specific actions in the watershed to meet phosphorus targets, as well as additional monitoring and assessment needs, and is a working document, updated as needed. The Department of Environmental Conservation (DEC) collaborates with state, federal and municipal organizations, local conservation groups, businesses, and a variety of landowners and interested citizens to develop and implement phosphorus reduction goals.

IV. Monitoring & Assessment Process

A. Lay Monitoring Program

Since 1979, Lake Carmi has been monitored annually by volunteers through the Department of Environmental Conservation (DEC) Lay Monitoring Program (LMP), which trains citizen volunteers to sample a lake for total phosphorus (nutrient) concentration, chlorophyll-a (algae and cyanobacteria) concentration, and Secchi depth (water transparency) every week to 10 days from Memorial Day to Labor Day. A minimum of eight samples must be collected to calculate summer annual means (Figure 3). Based on a 39-year record, the mean total phosphorus is 31 µg/L, the mean chlorophyll-a is 17 µg/L, and the mean Secchi depth is 2.1 meters (Figure 4).

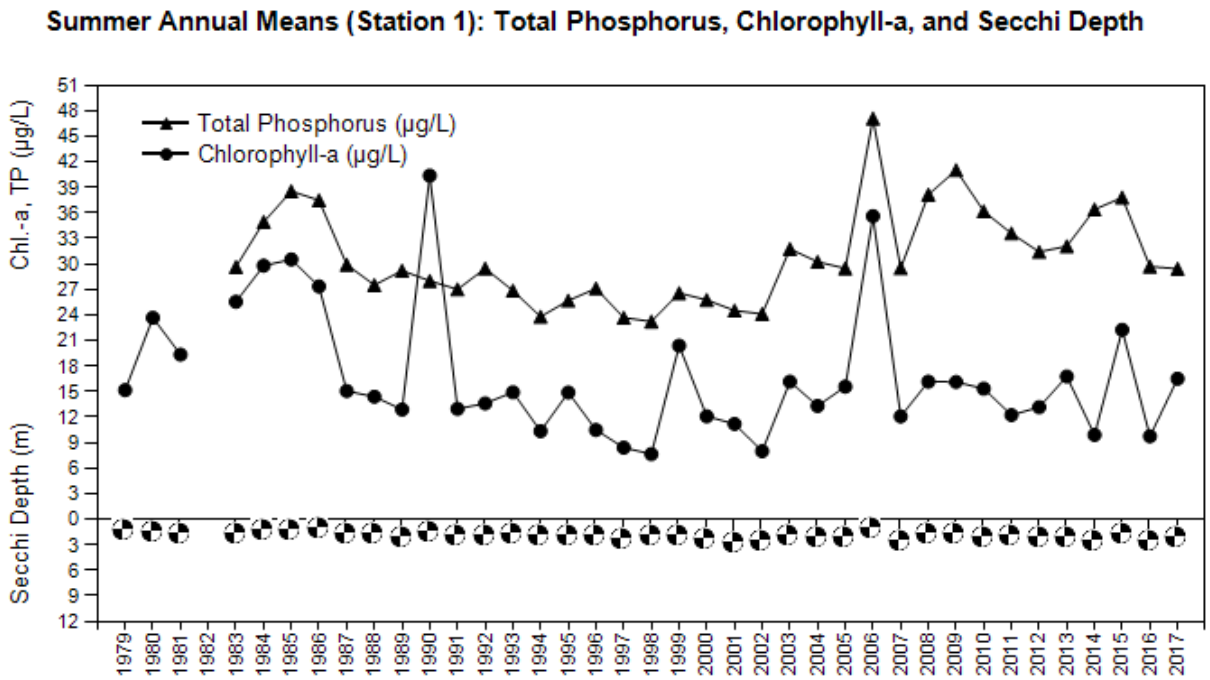

Figure 3. Lay Monitoring summer annual means for total phosphorus, chlorophyll-a and Secchi depth.

B. Spring Phosphorus Program

Soon after the ice goes out in the spring, most of Vermont's inland lakes "turn over," fully mixing the water column. Phosphorus readings taken at this time indicate the amount of phosphorus a lake will have available for the growth of primary producers like phytoplankton, algae and aquatic plants when the hours of daylight grow longer, and summer temperatures arrive.

Vermont lakes and ponds 10 acres and greater have been sampled by DEC since 1977 for a variety of water quality parameters including total phosphorus, total nitrogen, alkalinity, chloride, Earth metals, Secchi depth, color, temperature, dissolved oxygen, pH, conductivity, chlorophyll-a, and turbidity. While not all lakes are sampled annually, Lake Carmi has a 26-year record since 1979, with an overall mean spring total phosphorus of 27 µg/L (Figure 4).

View data and trends for individual lakes using the Lake Score Card or the Spring Phosphorus data portal.

C. Lake Carmi Score Card Assessment

According to the 2017 Lake Score Card water quality trend analyses (Figure 5), Lake Carmi is stable overall since 1979 in both summer Lay Monitoring total phosphorus (TP) and chlorophyll-a (algae and cyanobacteria) and spring total phosphorus, while summer Secchi depth (water transparency) is statistically significantly improving with some interannual variability. However, summer TP remains consistently above the standard of 22 µg/L but shows some indication of recent improvement, even with increased precipitation during those years (Figure 6). For Assessment and Listing reports, DEC uses five continuous years of data to determine if the lake is no longer impaired. Therefore, watershed and shoreland best management practices along with in-lake phosphorus management should continue to be implemented until all applicable water quality standards are met.

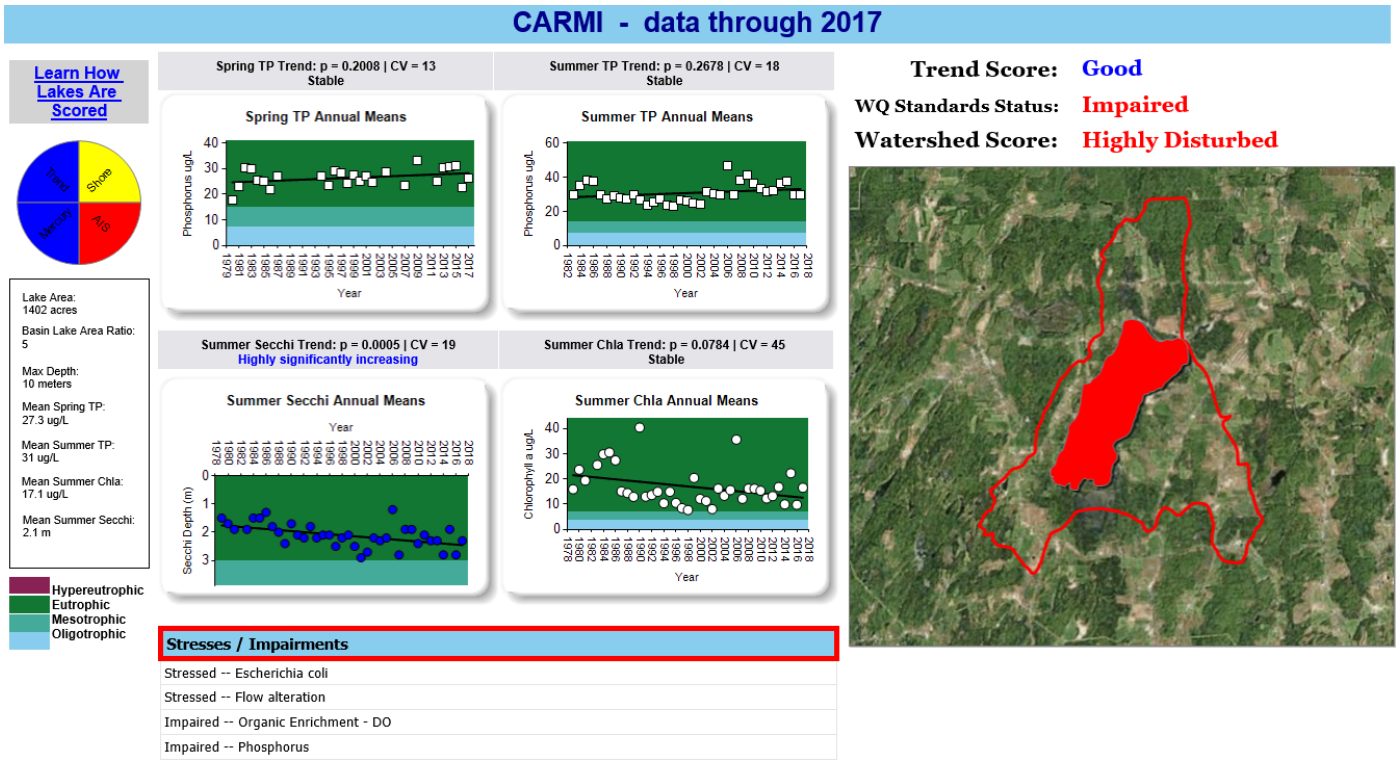

Figure 4. Lake Carmi Score Card with data from 1979 through 2017.

D. Lake Carmi Supplemental Monitoring 2016-2017

The Lake Carmi Implementation Team has been in place since 2015 to support communications among partners working to reduce phosphorus in the Lake Carmi watershed. Partner organizations implement actions legislated by the Vermont Clean Water Act of 2015 (Act 64). In support of the Implementation Team's efforts, the VT DEC conducted supplemental biweekly lake monitoring similar to the Spring Phosphorus Program at Stations 1, 2, and 3 (Figure 5) during the field seasons of 2016 and

2017. This will continue indefinitely to measure the effects of the upcoming aeration project. DEC is also partnering with the University of Vermont to deploy and maintain buoys to monitor temperature and dissolved oxygen concentrations at 15-minute intervals.

Figure 5. Lake Carmi Monitoring Stations 1, 2, and 3.

Summer 2017 brought a perfect storm of factors. Unusually high levels of rainfall early in the season caused increased watershed runoff that likely led to early summer cyanobacteria blooms triggered by warm temperatures. During summer stratification, typical anoxic conditions occurred in the lowest lake layer (hypolimnion), allowing release of phosphorus from the sediments. This phosphorus usually stays trapped in the lowest layer until September brings cooler temperatures (as occurred in 2016); however, in August 2017 an unusual cold spell caused destratification and full mixing of lake waters, bringing an extra pulse of phosphorus into surface waters and supercharging cyanobacteria. The intense blooms continued through unusually warm fall days into November (Figure 6).

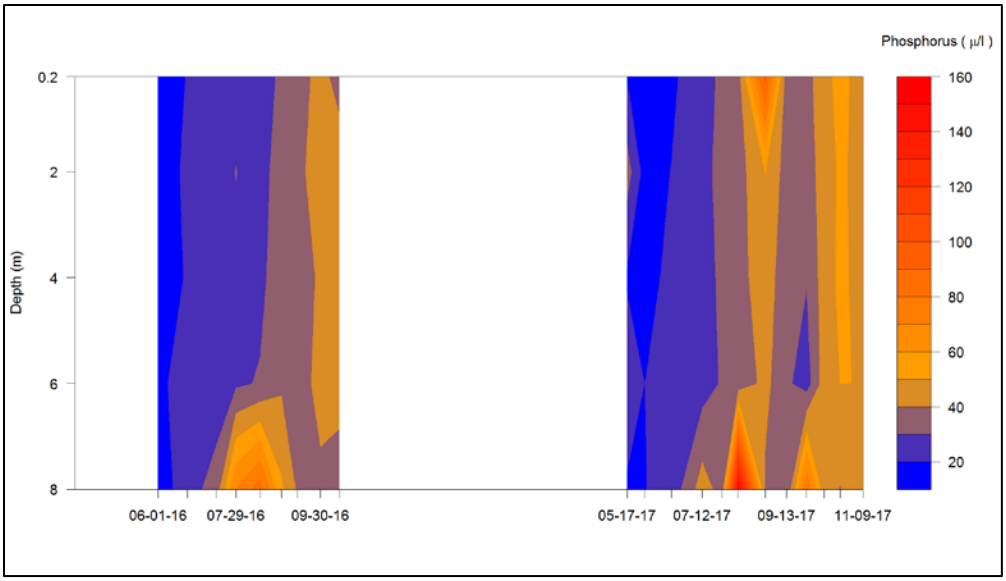

Figure 6. Lake Carmi Station 1 Total Phosphorus Vertical Profiles 2016-2017. Total phosphorus accumulated near the lake bottom (8 m) during early August and late September 2017 and then mixed into the water column fueling intense cyanobacteria blooms. Note: The scale on this graph is consistent. Tics represent sampling dates. Sampling started earlier and continued later in 2017, as compared to 2016.

E. La Rosa Partnership Program

The LaRosa Partnership Program (LPP) was developed in 2003 with the purpose of helping lake and watershed associations and other monitoring groups across the State of Vermont implement new and/or ongoing surface water monitoring projects for waters in need of water quality assessment, by helping alleviate the financial burden of laboratory analysis costs.

The DEC also supports volunteer water quality monitoring effort through the LaRosa Partnership Program, which provides analyses services to the volunteer group through a grant program. The most common parameters requested include total and dissolved phosphorus (TP and DP), total nitrogen (TN) and total suspended solids (TSS). In the Missisquoi Basin, the program assists the Franklin Watershed Committee (FWC) in sampling the Lake Carmi tributaries, Missisquoi River Basin Association (MRBA) in sampling sites throughout the basin, and Friends of Northern Lake Champlain in sampling sites to determine effectiveness of agricultural Best Management Practices (BMPs). Once the samples are analyzed, the Vermont Agricultural and Environmental Laboratory (VAEL) organizes all volunteer water quality monitoring data available to groups for use in their annual reports. Data and reports can be found at the LaRosa Volunteer Monitoring webpage.

Analyses of the data collected by the FWC and the MRBA through the LaRosa Partnership Program, completed through a contract with DEC (Gerhardt 2015 & 2018), were conducted to assist efforts to protect and improve water quality in Lake Carmi. "Previous studies had indicated that several of these tributaries exhibited very high phosphorus levels and were likely significant sources of the nutrients and sediment flowing into Lake Carmi, though actual phosphorus amounts contributed by each

tributary were not measured" (Gerhardt 2015). In the 2015 study, Gerhardt analyzed and reported on the total phosphorus concentrations measured by FWC during 2008-2014.

The water quality data collected by the FWC was analyzed and reported on the three most recent years of water quality data to update and inform water quality management along these tributaries of Lake Carmi (Gerhard 2018). During 2015-2017, staff and volunteers continued to collect water quality data at 19 sites along nine tributaries of Lake Carmi (Figure 7). These 19 sites had all been sampled prior to 2015 as well. Using these data, Gerhardt analyzed spatial patterns in water quality conditions along these tributaries, compared these results with those obtained during earlier years, and developed recommendations for future monitoring and assessment efforts.

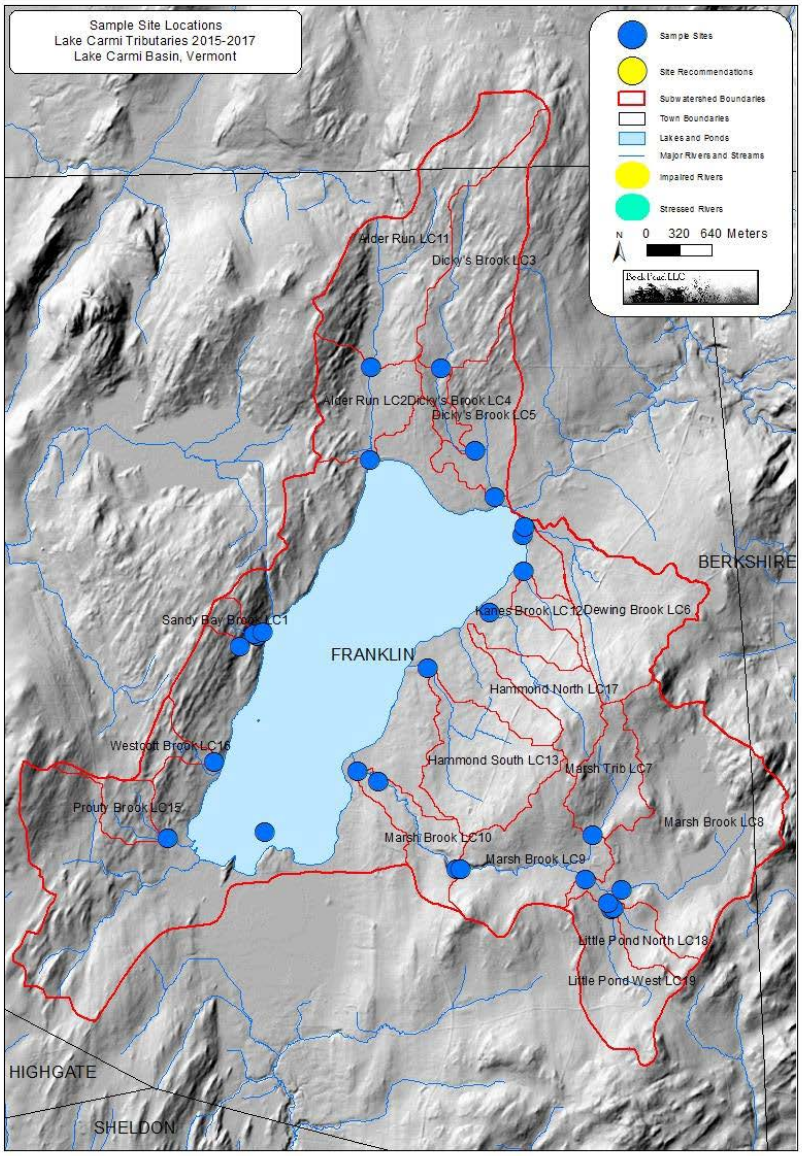

Figure 7. Lake Carmi Tributary Sampling Sites. Locations of 19 sites sampled by the Franklin Watershed Committee in the Lake Carmi watershed during 2015-2017.

The 2018 Gerhardt study concluded:

- During 2008-2017, total phosphorus (TP) concentrations decreased significantly at four sites along four tributaries, including Marsh Brook, Sandy Bay Brook, Dicky's Brook, and Dewing Brook. In contrast, TP concentrations increased significantly at one site along Hammond Brook North.
- During 2015-2017, TP concentrations at the 19 sites ranged between 9.86-1,724 µg/L. TP concentrations differed dramatically among the different sites and tributaries of Lake Carmi (Figure 8). Mean TP concentrations were very high along Sandy Bay Brook and Marsh Brook; moderately high along Kane's Brook; and low to moderate along the remaining tributaries (Alder Run, Dewing Brook, Dicky's Brook, Hammond Brook North, Hammond Brook South, and Westcott Brook).

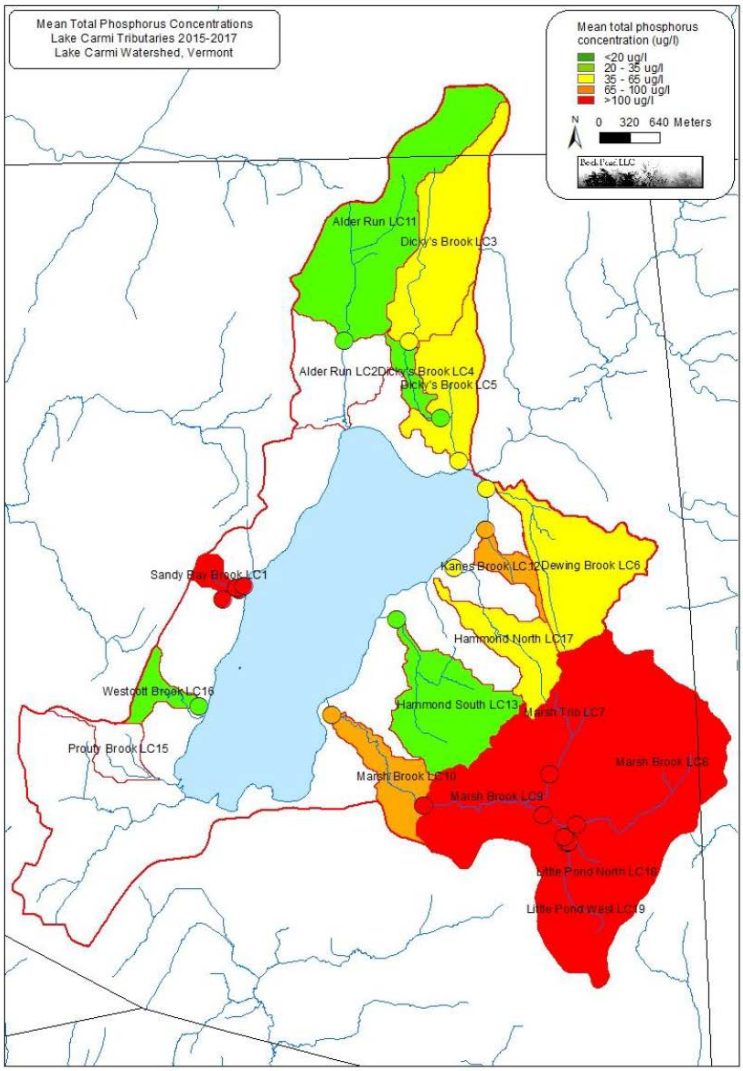

Figure 8. Mean total phosphorus concentrations at 19 sites along the tributaries of Lake Carmi during 2015-2017. The sample site symbols and the sub-watersheds drained by each sample site are color-coded according to the mean total phosphorus concentrations measured at each site. The color of the watershed is not indicative of phosphorus concentrations throughout the watershed, but only of the sample site.

Restoration and protection projects are already underway or are being planned along many of these tributaries. In addition, protection and restoration projects may be needed in shoreline areas that drain directly into the lake, as these areas represent some of the most highly developed lands in the basin but were not sampled. With these data, it will be easier to identify, develop, and evaluate the success of protection and restoration projects that most effectively reduce phosphorus exports from these watersheds into Lake Carmi (Gerhardt 2018).

F. Cyanobacteria Monitoring Project

The cyanobacteria monitoring supported by the Vermont Department of Health (VDH), the Lake Champlain Committee (LCC), Department of Environment Conservation (DEC) and Lake Champlain Basin Program (LCBP) provides information about cyanobacteria conditions to support recreational safety, but may also lead to a better understanding of bloom frequency. Both Missisquoi Bay and Lake Carmi are included in the program. The program at Lake Carmi began in 2013.

Each summer, routine weekly monitoring for cyanobacteria conditions is conducted by resident volunteers, state park staff, and DEC staff. Annual training sessions review the assessment and reporting methods. Reports are provided weekly at several locations around the lake. DEC and VDH staff also collect water samples for cyanobacteria identification and toxin analysis at selected locations. All reports are evaluated and approved by state staff before posting to the CyanoTracker website hosted by the VDH (Figure 9). The increase in reports for 2015 is due to an increased number of locations being monitored on the lake. In 2013 and 2014 only one site was monitored, while six sites were monitored in 2015-2016 and a seventh additional site in 2017.

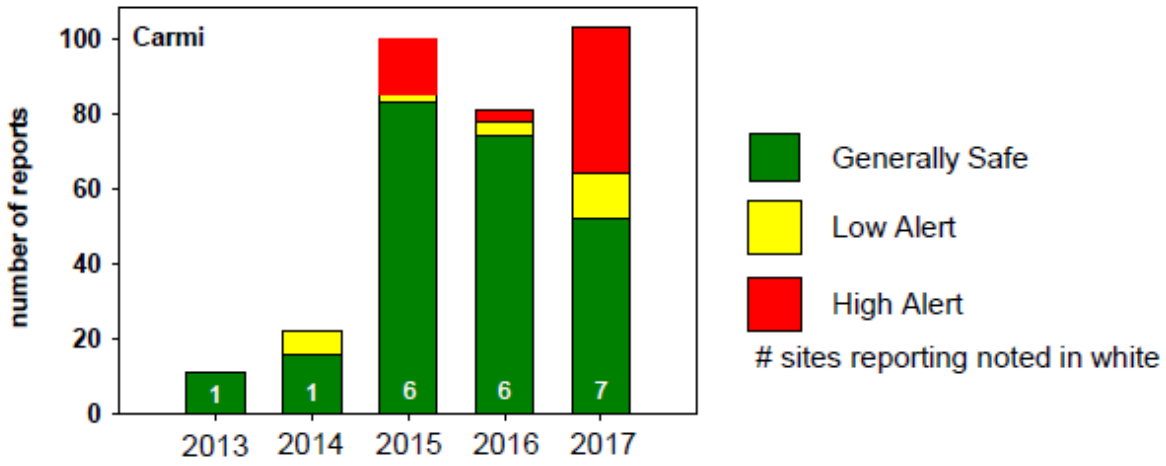

Figure 9. Cyanobacteria reports for Lake Carmi, 2013 – 2016. Green indicates generally safe conditions, yellow indicates some recreational impact, and red indicates high recreational impact. See the Cyanobacteria Monitoring Program Annual Report for more information.

In the event of a bloom on Lake Carmi, VDH staff work directly with the town health officer and state park staff to get information to residents and visitors. Typically, this involves signage at affected areas during the bloom and follow-up testing at beach locations to confirm that conditions are safe for

recreation. Because conditions can vary greatly around the lake, and can change rapidly, we encourage residents and visitors alike to learn how to recognize cyanobacteria. Factsheets, videos and other information are available through the VDH and DEC webpages.

G. Requests for Additional Monitoring Resources

1. Agronomy & Conservation Assistance Program (ACAP) Services RFP

The Department of Environmental Conservation (DEC), in close partnership with the Vermont Agency of Agriculture, Food and Markets (AAFM), is requesting assistance in assessing the agricultural practices in the Lake Carmi watershed. Tasks will include but are not limited to, conducting a detailed assessment of agricultural data in the watershed, developing site-specific water quality improvement plans for agricultural land in the Lake Carmi watershed, and working directly with farmers who own, manage, or rent land in the watershed to increase the development and implementation of Best Management Practices (BMPs) that address nutrient and sediment runoff from agricultural facilities and practices. The State anticipates signing one contract, starting in 2018, for up for to three years. Funding for this project is through the Vermont Clean Water Fund.

2. BMP Monitoring Proposals

Watershed associations submit yearly proposals to the DEC's Monitoring, Assessment, and Planning Program's (MAPP) LaRosa Partnership Program (LPP), to request capacity in the Vermont Agricultural and Environmental Laboratory (VAEL) to analyze routine water quality monitoring tests free of charge to the applicants. These groups then work with the Watershed Management Division's (WSMD) watershed coordinators and other staff to seek grant funding to fix identified problems, effectively furthering the WSMD's primary mission to protect, maintain, enhance and restore the quality of Vermont's surface water resources. In this manner, the LPP helps to build new watershed constituencies.

Volunteer associations across Vermont are eligible for Laboratory Analytical Service Grants (LASG) and Organizational Support Grants (LOSG). Such associations include river, lake, watershed groups, and water quality and conservation committees associated with local municipalities. The Franklin Watershed Committee (FWC) has two rounds of sampling, one in the spring (from April to March) and another in the summer (from mid-May to mid-October). In the spring of 2018, FWC has submitted two proposals for funding from the LPP to assist with BMP monitoring for Lake Carmi. The FWC considers LPP a tremendous asset in their efforts to reduce phosphorous loads to Lake Carmi. FWC is approved to collect water quality samples for the 2018 field season for LASG and has an anticipated project completed date of July 2019 for LOSG, which are described in further detail below.

LaRosa Analytical Services Grant

FWC has participated in the LaRosa Partnership since 2008 and have requested assistance from LaRosa Analytical Services since 2007. The LaRosa LASG is made available to interested lake, river, and

watershed associations with the purpose of helping these groups implement new and/or ongoing surface water monitoring projects for waters in need of water quality assessment.

FWC's initial project proposal, is to extract samples every other Wednesday from mid-May to mid-October at approximately 20 sites. Attempts will be made to sample during significant rain events as well. Samples will also be collected periodically during March and April to capture the spring runoff. The Wednesday collection day coincides with tje Lay Monitoring Program's (LMP) scheduled pick up in Franklin of separate in-lake samples. Absent the LMP pickup, the samples will be delivered to the lab in Burlington by the Project Coordinator or other FWC personnel.

The data from the sampling of Lake Carmi tributaries has been instrumental in the development and implementation of projects to reduce phosphorous loads to the lake. The data is always a focal point in all discussions for improving the Lake Carmi Watershed. It serves as an essential basis to the identification of all projects. It is imperative that the Lake Carmi Tributary Monitoring Program continue in partnership with the LPP.

LaRosa Organizational Support Grant

The WSMD's Clean Water Initiative Program (CWIP) and MAPP have offered the LaRosa Organizational Support Grant (LOSG) for since 2017. The LOSG provides organizational and logistical support of LPP-enrolled watershed groups that are also engaged in the planning and execution of water quality improvement projects. Specifically, the CWIP and MAPP seek to support the LPP organizations to monitor the effectiveness of water quality improvement practices aimed at reducing nutrients and sediments. Awards intend to be used to assist with these operations and support staffing of the targeted monitoring efforts. Funding can be used to support logistical coordination of sampling, data analysis activities, outreach and reporting.

The approved LOSG proposal from FWC will carry out water quality monitoring to measure the outcomes of a remediation project. The remediation project proposed will monitor two different restoration projects in the Lake Carmi watershed: the Kittel farm pond and Marsh Brook headwaters. Both projects are within the Lake Carmi watershed which has a Total Maximum Daily Load (TMDL) where phosphorus loading was estimated in 2008 for the watershed. There has not been a phosphorus loading study since, despite numerous regulations and projects being implemented in the last 10 years.

3. Possible Next Steps

DEC is assessing how to obtain improved nutrient load monitoring to better understand the overall contributions each tributary discharges into the Lake. To date, the LPP program is only gathering concentration data and their samples are by design are geared toward higher concentration (rainfall and spring melt) events. By understanding more about the overall contribution of nutrients from each tributary, DEC will be able to better understand whether nutrient reductions are being achieved towards meeting the TMDL. One option could be to partner with another entity and establish

monitoring stations on major tributaries into Lake Carmi to quantify total loading from discrete watersheds.

H. Current Conditions and Needs

The Vermont Surface Water Management Strategy (DEC 2012) (VSWMS) lays out the goals and objectives of the Department of Environmental Conservation's Watershed Management Division (WSMD) for addressing pollutants and stressors that can negatively affect the designated uses of Vermont surface waters. The strategy discusses 10 major stressors relating to water resource degradation. Of those 10, Carmi is affected by four major stressors: channel erosion, encroachment, land erosion, and nutrient loading. Although not rising to the level of altering the lake, invasive species are currently under management by town. In addition, the State is currently studying the potential impacts of Lake Carmi dam to aquatic habitat from altered flows.

Lake Carmi is an impaired waterway in the Missisquoi Basin and is a priority water that comprises the 303(d) and the State priority surface waters lists. The goals of the Lake Carmi Crisis Plan include addressing the stressors and/or pollutants degrading the waterbody through specific actions (Table 2). The types of actions prescribed are based on the stressor specific practices outlined in the Vermont Surface Water Management Strategy. State supported assessment of a natural resource or land use activity are used to identify priority areas for implementation of actions. The assessment results provide a basis for identifying remediation actions as Lake Carmi has been identified as providing significant phosphorus and sediment loads to the watershed. In addition, assessments have provided information about appropriate strategies and actions to address stressors. The actions in the Watershed Projects Database were informed by these priority actions.

Table 2. Lake Carmi monitoring and assessment needs with accompanying strategies and actions.

Issue	Stressor(s)	Concern	Existing Data Supporting Goal	Priority Strategy	Recommended, Proposed & Priority Actions
Phosphorus	Channel Erosion, Land Erosion, Nutrient Loading, Encroachment	Algae blooms, excessive aquatic plant growth	Study reviewed existing monitoring sites and provided suggestions (Gerhardt, 2015)	Phosphorus reduction	a. New locations of sampling sites (see Gerhardt, 2015 or Watershed Projects Database), field residential and road BMPs, and floodplain and shoreline restoration, phosphorus TMDL. b. Monitoring gauge stations for nutrient load
Flow Alteration	Flow Alteration	Water level manipulation may alter aquatic habitat		Mill Pond Dam (Refer to Appendix D – *Flow Alteration and the Mill Pond Dam*)	See flow assessment (Appendix D).

V. Implementation Plan

A. Introduction

A Total Maximum Daily Load (TMDL) is a "pollution budget" that describes the amount of pollution a water body can tolerate and still maintain water quality standards. For Lake Carmi, this pollution budget can be described as the sum of point and nonpoint source discharges, or load allocation (LA), and a margin of safety (MOS).

For the purpose of this report, point sources are septic systems and the Lake Carmi State Park Wastewater Treatment Facility (WWTF). Nonpoint source discharges include: roads, agriculture, natural resources and shorelands. Controlling nonpoint source pollution is the key element in reducing phosphorus loads to Lake Carmi and meeting water quality standards. The control of nonpoint source pollution presents a major challenge both in the Lake Carmi watershed, Lake Champlain, 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. 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 erosion and nutrient losses from barnyards and fields. Despite the magnitude of these efforts, further pollution reductions are needed.

In response to the Environmental Protection Agency's (EPA) request for further action, the Agency of Natural Resources (ANR), the Agency of Agriculture, Food and Markets (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 Lake Carmi, as well as the broader Lake Champlain Basin. Additional resources were provided to the State agencies and partners after this evaluation, and as part of Act 64.

The major categories of policy tools used to implement Vermont's TMDLs (Lake Champlain and Lake Carmi) include:

- Education and outreach: is a critical tool to ensure all environmental regulations are understood and followed by the regulated communities; 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.

- Technical assistance: sharing technical information with state, local partners, and the regulated community regarding the water quality impacts of their current or planned actions and suggesting techniques to improve water quality outcomes.
- Financial incentives: linking funding eligibility to specific actions or using direct financial assistance to support the installation of practices to control pollution and reduce or eliminate impacts;
- Regulatory requirements: providing specific legally required steps that must be taken to control pollution and reduce impacts, including permitting programs;
- 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 to achieve the greatest benefit at the lowest cost.

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 the Agency of Transportation (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 section provides a brief description of the regulatory programs applicable to the point source discharges that make up the wasteload allocation (WLA) in the Lake TMDLs. As estimated based on 1996 land use data, in Lake Carmi septic systems only account for about 1.1 % of the estimated phosphorus load (Figure 3). However, as the Department of Environmental Conservation (DEC) plans to work with other sectors, it is equally important to gather updated information on septic systems near the Lake, including the functionality of the system, assessing the quality of soils and ability to properly prevent nutrients from entering the Lake. This section also describes the most significant existing policy tools to reduce the major sectors of nonpoint pollution roads, agriculture, natural resources and shorelands. The Watershed Management Division's (WSMD). 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.

This Crisis Response Plan identifies specific actions in the watershed to meet phosphorus targets, as well as additional monitoring and assessment needs. The Lake Champlain Phosphorus TMDL Phase I Implementation Plan outlines how the State of Vermont will work to reduce phosphorus loading within the entire Lake Champlain Basin, which includes Lake Carmi. Based on the 2008 Lake Carmi

Phosphorus TMDL, the load reduction required for the lake is 611 kg/yr, which is a 40% phosphorus reduction across all sectors. This reduction will come from implementing projects in the Lake Carmi watershed.

Below is the implementation plan for Lake Carmi, separated by sector. The plan outlines state actions (regulatory and non-regulatory), as well as partner roles and actions, that have been or will be completed. The sectors in this plan are as follows:

- Septic/Wastewater Treatment Facility (WWTF)
- Roads (private, local and state)
- Agriculture
- Natural Resources
- Shorelands (including stream shorelines)

The single WWTF within the Lake Carmi watershed, which is permitted as an indirect discharge using a leachfield design, is in Lake Carmi State Park. The roads sector includes stormwater developed lands, stormwater developed roads, and private and public roads project types. The natural resources sector is comprised of wetland, river and floodplain, stream, forest and lake project types. To see a complete table of implementation actions, refer to *Appendix B*. To see the implementation actions timeline, refer to *Appendix A*.

B. Septic/Wastewater Treatment Facility

The Lake Carmi State Park Wastewater Treatment Facility (WWTF) utilizes a recirculating textile filter for effluent treatment, storage in a lagoon, and, traditionally, spray disposal. A renovation, completed during the past year, upgraded the facility to reduce discharge far below the maximum discharge of 15,500 gallons per day. There are strict requirements within the facility's State-issued indirect discharge permit for spray effluent and down-gradient groundwater sampling. Significant downstream phosphorus (P) removal occurs from groundwater percolation. While the spray effluent itself has total phosphorus (TP) concentrations in parts-per-million range, groundwater monitoring data indicate that maximum soil-P levels achieve only ~0.215 mg/L (215 μg/l). Accordingly, the effluent infiltration and groundwater transport has a profound phosphorus removal effect. The facility is a seasonal one, in operation during the summer months.

The 2017 – 2018 renovation of Lake Carmi State Park's WWTF involved two key pieces: improvements to the existing lagoon treatment system and construction of a wetland to reduce, and eventually eliminate, the need for the spray field system currently used to distribute the highly treated effluent. The state park's new system will aerate and recirculate wastewater through the existing lagoon as well as having an evapotranspiration feature prior to the water moving into a new constructed wetland. The wetland will feature a shallow zone (2 feet) planted with wetland vegetation. Submerged aeration installed throughout the wetland will increase evaporation and enhance water quality by adding oxygen. The second zone (6 feet deep) will look like a pond. This zone will have floating aquatic

ecosystems with native wetland plants that help remove excess nutrients from the water. These systems will also infuse oxygen, cutting down on odor and algae growth. The wetland system will move water through the treatment stages and further increase evapotranspiration. For more information, see the ANR press release (http://anr.vermont.gov/node/1041).

1. Septic

The DEC has collaborated with partners and have provided technical assistance with allocating grants to pump out systems, educating Lake Carmi residents on water reduction practices, hosted annual pump out events, administered septic surveys, held septic socials, and has created a study for septic engineering feasibility for 224 systems in the Carmi watershed. For specific project and partner information, refer to Appendix B – *Implementation Actions*.

C. Roads

1. Department of Environmental Conservation's Municipal Roads General Permit and Standards

As required by Act 64 of 2015 (the Vermont Clean Water Act) the Department of Environmental Conservation (DEC) issued a Municipal Roads General Permit (MRGP) in January of 2018. This general permit is intended to achieve significant reductions in stormwater-related erosion from municipal roads, both paved and unpaved. Under the MRGP, municipalities will develop Road Stormwater Management Plans which will include road erosion inventories to determine baseline road conditions and road management needs. Municipalities will implement practice upgrades to meet new MRGP standards so that all hydrologically-connected roads meet new standards as soon as possible, but no later than December 31, 2036. Towns are required to apply for coverage under the MRGP by July 31, 2018. It is anticipated that the Vermont Agency of Transportation (VTrans) Road and Bridge Standards will continue to be voluntarily adopted by municipalities. DEC and VTrans are currently evaluating the future of the VTrans Road and Bridge Standards.

2. VTrans Financial and Technical Assistance

VTrans has made significant financial investments and provided technical support to assist municipalities in complying with water quality regulations. Examples include:

Vermont Better Roads Program

Since 1997, the Vermont Better Roads Program (BRP) has been providing grants and technical assistance to towns to correct erosion problems and implement road maintenance practices that protect water quality while reducing long-term highway maintenance costs.

The Vermont BRP is a grant program that is part of the VTrans Municipal Assistance Bureau. VTrans staff is available to provide technical assistance to municipalities as needed, helping them identify solutions for existing highway issues. The program offers funding for road erosion inventories, now required in the MRGP. The BRP offers construction funding for improving infrastructure, including

but not limited to repairing or replacing eroding ditches, unstable culvert inlets or outlets, and eroding roadside banks. Addressing these issues 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.

Other programs within the VTrans Municipal Assistance Bureau include the Transportation Alternatives and Municipal Highway and Stormwater Mitigation Programs. These programs, primarily funded with funding VTrans receives from the Federal Highway Administration, offer grants to municipalities for "any environmental mitigation activity, including pollution prevention and pollution abatement activities and mitigation to address stormwater management, control, and water pollution prevention or abatement related to highway construction or due to highway runoff."

VTrans also provides technical assistance to municipalities through its district staff and through the Vermont Local Roads Program. The Vermont Local Roads Program provides training and other resources to Vermont municipalities regarding transportation issues in addition to technical assistance.

3. VTrans State Highway and Non-Road Developed Lands Clean Initiatives, Stormwater Investments and Water Quality Regulatory Compliance.

Impervious roadway surfaces can quickly convey polluted stormwater runoff to nearby waterways. VTrans is responsible for stormwater collection, conveyance, and treatment along its highways and at other transportation facilities (airports, maintenance yards, park & rides, welcome centers, gravel pits). Linear Transportation stormwater management differs from city, town, retail, and commercial entities:

- State highways stretch for many miles, crossing multiple waterways, watersheds, and jurisdictions.
- Transportation stormwater conveyance systems are linear and often discharge stormwater and associated pollutants that originate outside of the transportation right-of-way.

VTrans has a role to play under Vermont's Clean Water Act (Act 64 of 2015), under its Statewide Transportation Separate Storm Sewer System (TS4) General Permit and under pre-Act 64 regulations addressing stormwater from its highways and non-road developed lands. Refer the list of VTrans' Stormwater Regulatory Requirements as of January 2018 below for a list of clean water permit programs VTrans must comply with.

The TS4 General Permit is a new permit that covers stormwater discharges from all VTrans owned or controlled impervious surfaces.

The TS4 combines the stormwater requirements for VTrans associated with its designated regulated small municipal separate storm sewer systems (MS4s); industrial activities, commonly regulated under the Multi-Sector General Permit (MSGP); and previously permitted, new, redeveloped, and expanded impervious surface, commonly regulated under State Operational Stormwater permits.

Additionally, in order to meet the requirements of the Lake Champlain Phosphorus total maximum daily loads (TMDLs) and to ensure water quality protection across the entire State, the permit requires VTrans to develop a Phosphorus Control Plan (PCP) for its stormwater discharges in the Lake Champlain Basin and requires VTrans to reduce the discharge of pollutants from the TS4 to the maximum extent practicable (MEP) through compliance with the six minimum control measure requirements throughout the entire State.

For construction activities, VTrans complies with the Construction General Permit 3-9020 which authorizes permittees to discharge stormwater runoff from construction activities provided the project is in compliance with the requirements of the permit. Additionally, the VTrans EPSC Protocol, established in February 2007 and revised in May 2009 sets guidelines for Consultants, VTrans Designers, VTrans Construction Management Staff and District field staff for creating and implementing consistent EPSC Plans that meet the requirements of CGP 3-9020 and for those projects disturbing less than one acre with any potential to impact resources.

See Appendix E for a list of VTrans' Stormwater Regulatory Requirements as of January 2018.

4. DEC Support for Road Improvements

Other state actions include offering technical assistance for private road outreach. The DEC has allocated grants for Franklin Watershed Committee (FWC) and the Town of Franklin to generate a Stormwater Master Plan (SMP) for the Town of Franklin. The state has collaborated with other partners and provided technical assistance for designing a town garage stormwater treatment, completed erosion assessments and improvements for private roads, and conducted private and public road maintenance workshops. In addition, the Northwest Regional Planning Commission has provided valuable technical assistance to the Town of Franklin, the Lake Carmi Implementation Team, and the Franklin Watershed Committee regarding improvement and maintenance of municipal and private roads.

For specific project and partner information, refer to Appendix B – *Implementation Actions*.

D. Agriculture

1. State Actions (Regulatory and Non-Regulatory)

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 State and 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 four-tiered structure that is designed to provide a logical progression in regulatory oversight as a farm may increase in size.

The Water Quality Division within AAFM utilizes farmer assistance, education, research, regulations, monitoring, and compliance and enforcement that simultaneously promote the long-term viability of farms and the health of our state waterways. To achieve these outcomes, the Water Quality Division engages in the following areas of work with Vermont's agricultural producers:

Engagement and Outreach	Invest in and enhance outreach and engagement to build partnership, expand participation, increase compliance, and identify connections with local, state, and federal agencies.
Technical Assistance (TA) & Financial Assistance (FA)	Increase technical assistance, early planning, coordination among provisions and providers, and award grants for action and innovation.
Inspection	Provide standardized inspections through the execution of clear and consistent procedures and practices, resulting in a meaningful way to advance compliance with water quality rules and regulations.
Enforcement	Implement standardized enforcement procedures and practices and exercise enforcement authority in a clear, consistent, and meaningful way to advance compliance with water quality rules and regulations.
Rules, Regulations, and Permits	Promulgate new rules as required by law and revise and renew existing rules and permits based on learning, scientific research, and experience to date.

Required Agricultural Practices and State of Vermont Farm Certification and Permit Programs

Required Agricultural Practices

The Required Agricultural Practices (RAPs) set baseline farm management practices to ensure environmental protection. The RAPs (formally the Accepted Agricultural Practices [1995-2015]) are nonpoint source rules for agriculture which have been state law since 1995. The RAPs used to be known as the Accepted Agricultural Practices and were last comprehensively revised on December 5th, 2016. This 2016 revision will result in a significant increase in conservation practice implementation by farms over the next several years as farm of all sizes work to achieve compliance. The changes to the RAPs that are expected to result in the greatest positive impact on water quality include:

- Nutrient Management Planning and Implementation on All Farms (New Requirement for Small Farms)
- Creation and implementation of a Custom Manure Applicator Certification Program
- Required educational credits for farmers to ensure they are informed about water quality regulations

- Creation of Small Farm Certification Program
- Stabilization of Ephemeral Gullies
- 10 ft. grassed filter strips on all field ditches
- Increase in grassed filter strip and manure spreading setback width from 10 ft. to 25 ft. on surface waters for small farms (already 25ft requirement for Medium and Large Farms)
- Establishment of cover crops on fields containing frequently flooded soils
- Increased manure spreading ban duration on fields containing frequently flooded soils
- Increase in grassed filter strip and manure spreading setback from 25ft to 100ft on surface waters adjacent to fields with a slope greater than 10%
- Reduction in maximum soil erosion rates by ½ on small farms
- Increased setbacks for construction of waste storage facilities from surface water (50′ to 200′)
- Increase setbacks for unimproved stacking of ag wastes from surface water (100′ to 200′)
- Livestock exclusion from production areas
- Livestock exclusion from surface waters in pastures when degradation of a stream is evident`

Implementation of this rule will result in a dramatic increase in the implementation of Nutrient Management Plans, Cover Crops, Grassed Waterways, and Grassed Filter Strips and Riparian Buffers by farms of all sizes. Any of these conservation practices implemented as part of the many existing financial assistance and technical assistance programs will be tracked and reported on as part of the State's accountability requirements for the TMDL and clean water funding. Finally, through the creation of the Small Farm Certification program, inspections will be conducted on every small farm that meets the certification thresholds over the next seven years at minimum with Lake Carmi being a priority location for early implementation.

Act 64 of 2015 shortened the inspection cycle on Medium Farms from 5 to 3 years, and with the additional staffing the Agency received last year has allowed the Agency to perform more comprehensive inspections on medium and large farm facilities. The Agency will continue to perform annual inspections on large farm operations and the regulatory inspections on small and medium farms, all of which will result in a significant increase in compliance with the management practices set forth in the permit programs and the RAPs. The Agency has also made an effort to prioritize fields in the Lake Carmi watershed that are associated with medium and large farms as part of the field inspection process.

Rule updates and revisions are already underway for all three of these regulatory programs. The RAPs are in the final process of being revised to include tile drainage requirements and will again be revised to include certification of technical service providers who write nutrient management plans in Vermont. The Medium Farm Operations General Permit has been very recently revised and available for farms to submit Notices of Intent to Comply. The Large Farm Operation rule is currently

undergoing a LEAN process to help streamline and improve the permitting aspects and the outcome will lead into a revised rule that will still need to go through the rule making process.

Certified Small Farm Operation (CSFO) Program

As part of Act 64, the Vermont Clean Water Act signed into law June of 2015, Certified Small Farm Operations above a particular farm size are now required to annually self-certify their operation**.** Farms that meet the definition of a Small Farm Operation (SFO) rather than a Certified Small Farm Operation (CSFO) must still comply with the RAPs. The goal of this program is to support farmers to ensure their clear understanding of new statewide agricultural management rules the RAPs, while providing assistance to assess, plan and implement any necessary conservation and management practices that might be necessary to meet water quality goals.

As part of the certification process, operators of CSFO will;

- Complete the 1-page CSFO certification form annually beginning July 1, 2017
- Develop and implement a written USDA NRCS 590 Nutrient Management Plan,
- Obtain 4 hours of approved water quality training every 5 years,
- Be inspected by AAFM Ag on at least a 7-year cycle
- Comply with the standards set forth in the RAPs

Operators of a Small Farm Operation (SFO) will:

- Comply with the standards set forth in the RAPs

Farms who will annually certify as a CSFO include farms:

- Growing more than 50 acres of annual cropland (e.g. corn, sweet corn, soybean, or pumpkin), OR
- Growing more than 50 acres of vegetables, OR
- That house and manage at least the following animal numbers;
    - 50-199 mature dairy cows (200-699 is a Medium Farm Operation and 699+ is a Large Farm Operation)
    - 75-299 youngstock or heifers
    - 75-299 veal calves
    - 75-299 cattle or cow/calf pairs
    - 188-749 swine weighing over 55 pounds
    - 750-2,999 swine weighing less than 55 pounds
    - 40-149 equines
    - 750-2,999 sheep or goats
    - 4,125-16,499 turkeys
    - 2,250-8,999 laying hens or broilers or 375-1,499 ducks (w/ liquid manure system)

- 6,250-24,499 laying hens or broilers or 2,500-9,999 ducks (without a liquid manure system)
- A combination of animals with total live weight exceeding 90,000 pounds

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 an 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 of 2015) however most are inspected more often and many receive additional technical assistance as conservation practices are implemented. The MFO general permit has been in existence since 2007 and was revised in 2012 and 2018.

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. An 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 and all LFO facilities are inspected annually by AAFM.

Custom Manure Applicator Certification Program

Act 64 of 2015 directed AAFM to revise the RAPs to include required training and certification of custom manure applicators that operate within the State of Vermont. A "custom applicator" means a person who is engaged in the business of applying manure or other agricultural wastes to land and who charges or collects other consideration for the service including full-time employees of a person engaged in the business of applying manure or agricultural wastes to land. All custom applicators must be certified with AAFM to operate within the state of Vermont.

Custom applicators must be certified by AAFM, these certifications last for 5 years and the certified applicators must receive 8 hours of training each five-year period of certification. Custom Applicators

have to demonstrate knowledge of the RAPs and all other applicable agricultural rules and permits – in addition, custom applicators have to train all of their employees and seasonal workers in methods or techniques to minimize runoff to surface water. There are 125 custom manure applicators currently certified to operate in Vermont.

Concentrated Animal Feeding Operation Permits

In addition to the agricultural programs administered by AAFM, 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.

Revised Secretary's Decision

In the *Revised Secretary's Decision* issued in response to the *Conservation Law Foundation (CLF) Petition to Require Mandatory Pollution Control Best Management Practices (BMPs) for Agricultural Non-Point Sources Identified in the Missisquoi Basin Plan*, the Secretary of Agriculture made the threshold determination that BMPs are generally necessary in the Missisquoi River watershed to achieve compliance with water quality goals, but that in certain instances the practices required by the RAPs are sufficient and BMPs are not required for a specific farm due to the farm's physical and operational characteristics, its proximity to surface water, and the farm's current implementation and maintenance of RAPs that prevent the potential for agricultural pollutants to enter waters of the state or groundwater. The Revised Decision provides a framework for outreach, education and assessment of farms in the watershed and a process for farm-specific development and implementation of a Farm Plan to address identified water quality resource concerns, where needed. Farm Assessments may conclude that practices required by the RAPs are sufficient to protect water quality and that BMPs may not be required due to a farm's specific characteristics or management.

The Revised Decision lays out a timetable by which VAAFM will provide outreach and conduct Assessments of farms in the Watershed pursuant to the terms of this Revised Secretary's Decision and will assure the implementation of BMPs on specific farms in accordance with the framework and timeframes outlined in the Decision. Farmers will need to develop plans which are reviewed and approved by VAAFM and they will then implement them to ensure water quality standards are met by their operation. This process can extend for up to 20 years in the Missisquoi Bay Basin Watershed, and the Agency must conduct assessments in St. Albans, Otter Creek, and South Lake Watersheds to

ascertain whether or not additional BMPs are needed in those watersheds. This agreement sets out a significant body of work for plan and practice development and implementation. The Revised Secretary's Decision planning and implementation framework will deployed first in the Lake Carmi watershed. The implementation plan by which VAAFM will implement the *Revised Secretary's Decision* is in process and the Agency will meet the agreed upon timeline to assess all dairy's in the watershed, of which Lake Carmi is a part, within the next five years and all livestock operations within the next nine years.

2. Vermont Agency of Agriculture, Food and Markets Technical and Financial Programs

The Vermont Agency of Agriculture, Food and Markets (AAFM) oversees multiple support programs that provide outreach, education, technical and financial support farmers in order to improve agricultural practices that increase farm viability and protect water quality. Examples are the Best Management Practice (BMP) program which provides technical and financial assistance for the installation of water quality improvement infrastructure, the Farm Agronomic Practices (FAP) program which funds field-based water quality improvement projects, and a new program that funds the installation of grassed waterways that convey concentrated runoff to surface waters to decrease erosion. The Agency has several program options that provide assistance to fence livestock out of sensitive water areas, mainly the Conservation Reserve Enhancement Program, the BMP Program and the Pasture and Surface Water Fencing Program. Another program that provides support for farms to delve into more innovative agronomic practices is the Capital Equipment Assistance Program. This program can help make an investment in a reduced tillage, precision nutrient application or other phosphorus reduction tools that otherwise might be prohibitive to a farm. The full suite of programs is continually updated with specific program details and full information is available at http://agriculture.vermont.gov/water-quality/farmer-assistance.

Beyond cost-sharing programs, the Agency is staffed with engineers who can provide more detailed technical assistance to design structures that collect and manage and nutrient losses from the farm's production area and staff that can provide design and implementation assistance on fencing livestock out of surface waters and planting streamside buffer planting. The Agency is also engaged in research including tile drain sampling to understand the nutrient concentrations from varying site conditions, and surface runoff nutrient and sediment losses under different field management techniques. All of this research data is utilized to improve programs and implementation efforts and to fine tune the accountability in the Total Maximum Daily Load (TMDL) tracking process.

3. U.S. Department of Agriculture Federal Programs

Federal programs, funded through the U.S. 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 2018, NRCS has received almost $14 million statewide for the Environmental Quality Incentives Program (EQIP), along with additional funds for easements, wetland restoration and other conservation programs. 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 four highest priority watershed areas as identified by Department of Environmental Conservation (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 and increases their likelihood of receiving funds. One of these four priority watersheds targeted for funding is the Pike/Carmi watershed, providing an additional funding pool to farmers in this area.

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.
- Conservation Innovation Grants. 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.

The State of Vermont received the second largest RCPP grant in the country, $16M over five years, in 2015. These dollars are additional NRCS program funds, including EQIP for agricultural and forestry BMPs, ACEP-ALE for agricultural easements, and ACEP-WRE for wetland restoration. The funds are available to farmers and forest landowners in the Lake Champlain Basin. EQIP funds are limited to farms with any conserved land, however the other programs are available to all NRCS eligible producers.

RCPP also provides over $3M of additional technical assistance, through NRCS and DEC partners. Three conservation planners have been hired through a contract with the Vermont Association of Conservation Districts (VACD), as well as a forester, and engineering services.

VACD was also awarded a small state RCPP grant to increase the development and implementation of nutrient management plans on dairy farms, primarily in the Lake Champlain Basin.

Both RCPP programs are available in the Lake Carmi watershed. Further information is available here http://dec.vermont.gov/watershed/cwi/rcpp.

Regional Conservation Partnership Program

4. 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 (see Appendix C – *Partners)*.

Vermont Association of Conservation Districts

VACD helps coordinate and support the efforts of Vermont's 14 conservation districts. The Franklin County Conservation District is a partner with FWC, UVM Extension and the State Agencies in the Lake Carmi watershed. https://www.vacd.org/conservation-districts/franklin-county/.

University of Vermont (UVM) Extension Program

UVM Extension has a strong Northwest Crops and Soils Program that has worked closely with all producers in the Lake Carmi watershed, and continues to provide non-regulatory agronomic, research, and technical support. All Extension programs are available in the Lake Carmi watershed. http://www.uvm.edu/extension/cropsoil/.

Vermont Housing and Conservation Board (VHCB)/Vermont Land Trust (VLT)

VHCB matches federal funds from the Farm Bill to purchase development rights on farms to perpetually protect and preserve agricultural and forest lands for multiple conservation purposes, including the protection of surface waters and associated natural resources. VHCB relies on partners such as the Vermont Land Trust and other land trusts to work directly with farmers interested in conserving their land. VLT's Farmland Access Program also connects farmers with affordable farmland. VHCB's programs and policies are available at https://www.vhcb.org/our-programs/conservation/farmland-conservation. VLT's programs and policies are available at www.vlt.org.

Watershed Partners

DEC has provided funding for other collaborative projects through the Ecosystem Restoration Grant Program (ERP), such as facilitating initial adoption of cover crops and manure injection, improving manure storage and management and infrastructure projects. For specific project and partner information, refer to Appendix B – *Implementation Actions*.

E. Natural Resources

The Department of Environmental Conservation (DEC) River's staff is working with the community and the Town of Franklin to understand potential stream corridor, restoration and conservation options. Within the natural resources sector, project types include: wetland protection and remediation, river corridor protection and remediation, floodplain protection, stream assessments and remediation, forest erosion and lake assessments, DEC has collaborated with Franklin Watershed Committee (FWC) and provided funding for stream geomorphic assessments and river corridor easements through the ERP grant program. The state has also provided technical support for streambank stabilization projects and culvert replacements/repairs funded by the Vermont Agency of Transportation (VTrans) and the Better Roads Program (BRP).

Multiple partners, including The Nature Conservancy (TNC), the US Fish and Wildlife Service, the Natural Resources Conservation Service (NRCS), the Agency of Agriculture, Food and Markets (AAFM) and the DEC are also actively working on water quality improvement projects with landowners in the watershed. As projects become more formalized with landowners, these projects will be included in reporting efforts for Total Maximum Daily Load (TMDL) tracking. Due to the need to respect landowner considerations, projects in the development stage are not included in this Crisis Response Plan. Efforts in the watershed by partners may include, but are not limited to, riparian buffer plantings, stream and wetland restoration, river corridor easements and partnering with other groups as opportunities become available.

For specific project and partner information, refer to Appendix B – *Implementation Actions*.

F. Shorelands

1. 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 into one that meets the Lake Wise standards are given a list of Best Management Practices (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.

For specific project and partner information, refer to Appendix B – *Implementation Actions*.

VI. Tracking & Reporting Progress

A. Department of Environmental Conservation (DEC) Watershed Projects Database

Most actions taken under this response plan will be captured by the State of Vermont clean water tracking system. This system is housed in the DEC Watershed Projects Database and is used to track and account for the results of clean water projects across multiple sectors, primarily through funding and regulatory programs (see Figure 17, below). Work completed under federal funding programs or voluntarily by land owners will be captured where data are available. The purpose of the system is to provide transparency and accountability for the results of investments in clean water projects and the results of project implementation, generally, in improving water quality relative to water quality goals and pollutant reduction targets. The system tracks project-level data associated with project costs, outputs, and estimates annual average pollutant reductions.

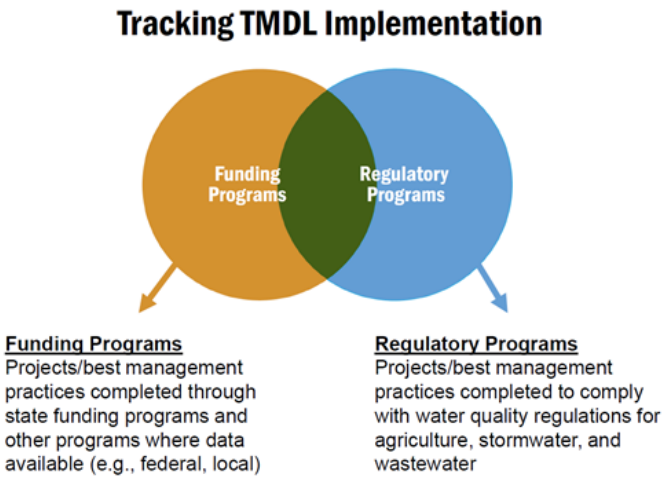

Figure 17. DEC's scope of tracking TMDL implementation.

Demand for tracking and accountability was initially driven by the Lake Champlain Total Maximum Daily Load (TMDL), which contains an accountability framework where the U.S. Environmental Protection Agency will issue report cards on progress achieving phosphorus reduction targets. However, the Vermont Clean Water Act, passed in 2015, leveraged these tracking requirements statewide. The tracking system tracks project location, which allows a narrowing of focus to evaluate progress within specific watersheds, such as the Lake Carmi watershed.

DEC uses TMDLs as the basis for tracking progress in meeting nutrient pollution reduction targets. DEC will measure progress implementing the Lake Carmi TMDL for phosphorus by quantifying phosphorus pollutant reductions achieved by projects installed in the Lake Carmi watershed. The Lake Carmi TMDL baseline phosphorus loads represent conditions in 2009 and will serve as the baseline for measuring progress. Implementation of the TMDL began in 2010. The TMDL calls out phosphorus load reductions that must be achieved to restore water quality in Lake Carmi, which will serve as the target for this response plan. As projects are implemented, DEC will quantify pollutant reductions associated with those practices, and measure progress toward meeting the TMDL's target phosphorus load.

B. Best Management Practices (BMP) Accounting and Tracking Tool (BATT)

The state's new tracking system estimates nutrient pollutant reductions at the project-level using the BMP Accounting and Tracking Tool (BATT). Estimating nutrient pollution reduced by clean water projects requires two key pieces of data and information:

1. **Data are needed on the rate of nutrient pollution from different land uses.** With these data, the state can estimate the total nutrient load treated by a project based on the area of land treated.
2. **Information is needed on the average annual performance of specific project types in reducing nutrient pollution.** This information is based on research of project performance relevant to conditions in Vermont. Project performance is expressed as an average annual percentage of nutrient pollution reduced.

The average annual performance of the project is applied to the nutrient pollution delivered from the land treated to estimate the annual average pollutant reduction. The ability to estimate the pollutant reductions achieved by a project can be limited by lack of data on nutrient pollution loading rates for the land treated and/or lack of information on the performance of a project in treating nutrient pollution. In Lake Carmi, phosphorus pollutant loading rates are available for different land uses, so item #1, above, is not a limiting factor.

The state's tracking goal is to quantify pollution reductions for all types of state-funded clean water projects implemented/constructed, including agriculture, stormwater, road erosion control, natural resources restoration, and forestry and logging erosion control projects. However, gaps exist in understanding the annual average performance of all project types (item #2, listed above). Table 3,

Table 3. Summary of Vermont's ability to account for phosphorus pollution reductions by project type in the Lake Carmi watershed as of June 2018.

below, summarizes DEC's ability to account for phosphorus pollution reductions by project type as of June 2018. DEC is working to track all projects, even if pollutant accounting methods are not in place, as these pollutant reductions can be quantified once methods are in place.

Key
Currently have ability to account for nutrient pollution reduction
Do not currently have ability to account for nutrient pollution reduction

Project Type	Status of Accounting Methodology
Agricultural cropland and pasture conservation practices	Methodology in place for most practice categories
Agricultural forested riparian buffers	Methodology in place
Barnyard and production area management practices	Methodology in place, but requires AAFM inspection data
Agricultural easements for water quality	Involves protection of practices already in place to qualify for easement, but no land use management change
River and floodplain restoration (includes in-stream culverts)	Methodology under development, requires river scientists to measure change of stream to least erosive condition
Riparian buffer restoration	Methodology in place
Lake shoreland restoration	Methodology to be developed
Wetland restoration	Methodology to be developed
Forest erosion control	Methodology to be developed
Stormwater treatment practices	Methodology in place
Road erosion control linear practices	Methodology in place
Wastewater treatment upgrades	Methodology in place, no discharges in Lake Carmi
Combined sewer overflow abatement	No combined sewer systems in Lake Carmi

C. Accountability Framework

The Lake Champlain Accountability Framework requires U.S. Environmental Protection Agency (EPA) to issue report cards on the state's progress reducing phosphorus pollution loading into Lake Champlain, summarized in Figure 18, below. Lake Carmi is part of the Lake Champlain basin, and is in the Missisquoi basin. DEC will report to EPA on progress in the Missisquoi basin on a five-year rotating basis, aligned with DEC's tactical basin planning process. An interim report card will be issued in 2019 and a final report card will be issued in 2021, and the cycle repeats (see Figure 19, below). DEC will report on progress implementing the Lake Carmi TMDL in line with the Missisquoi basin Lake Champlain TMDL report cards. Additionally, all state-funded clean water projects across state government will be reported annually in the Vermont Clean Water Initiative Annual Investment

Report, which includes projects in the Lake Carmi watershed. The Vermont Clean Water Initiative Annual Investment Report is available at: http://dec.vermont.gov/watershed/cwi/cwf#report.

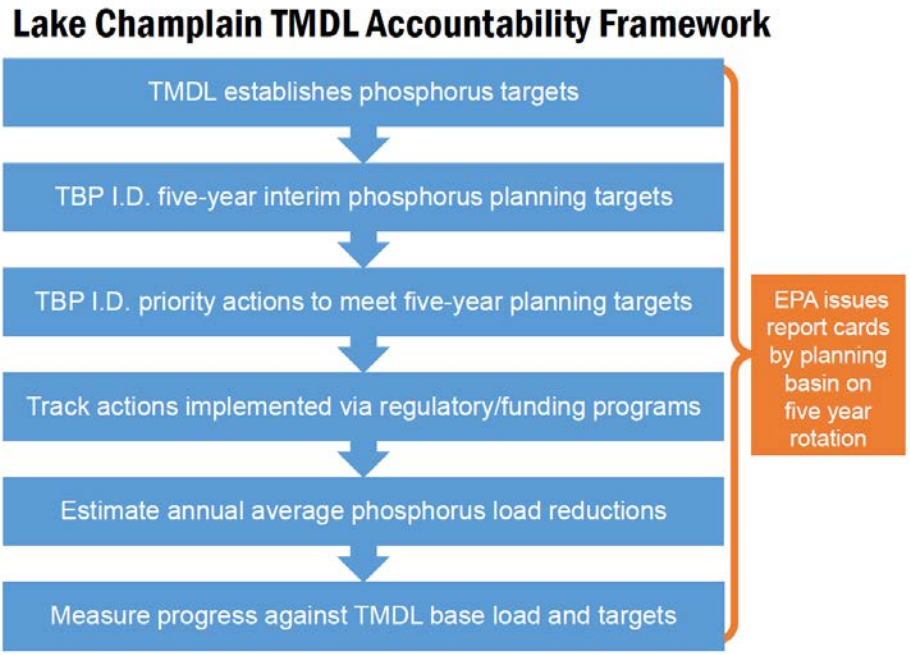

Figure 18. Lake Champlain TMDL accountability framework and report card process.

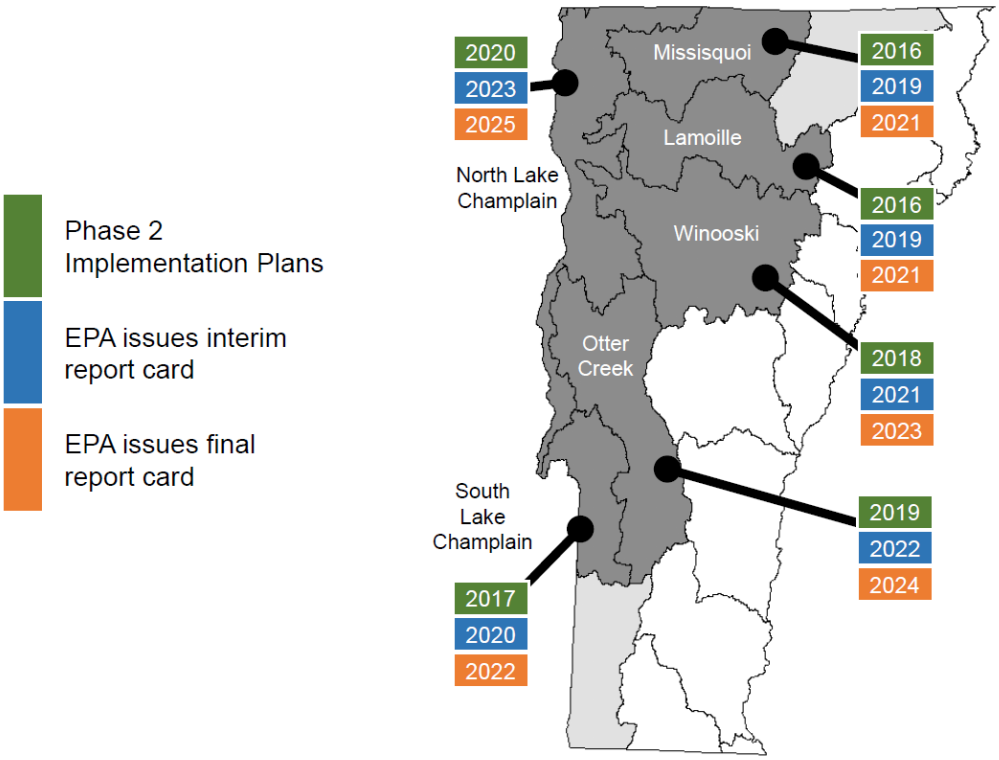

Figure 19. Lake Champlain TMDL accountability framework and report card schedule.

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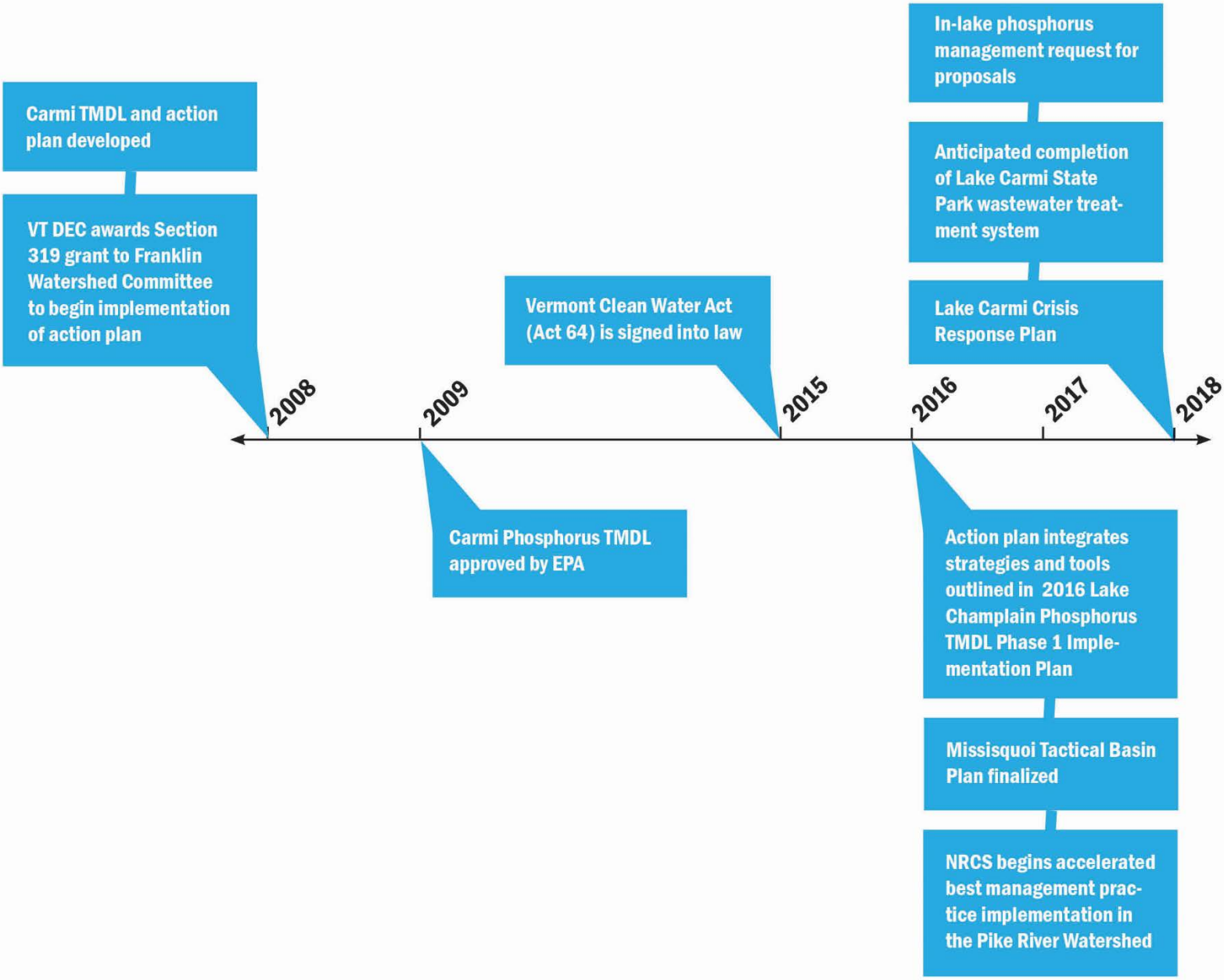
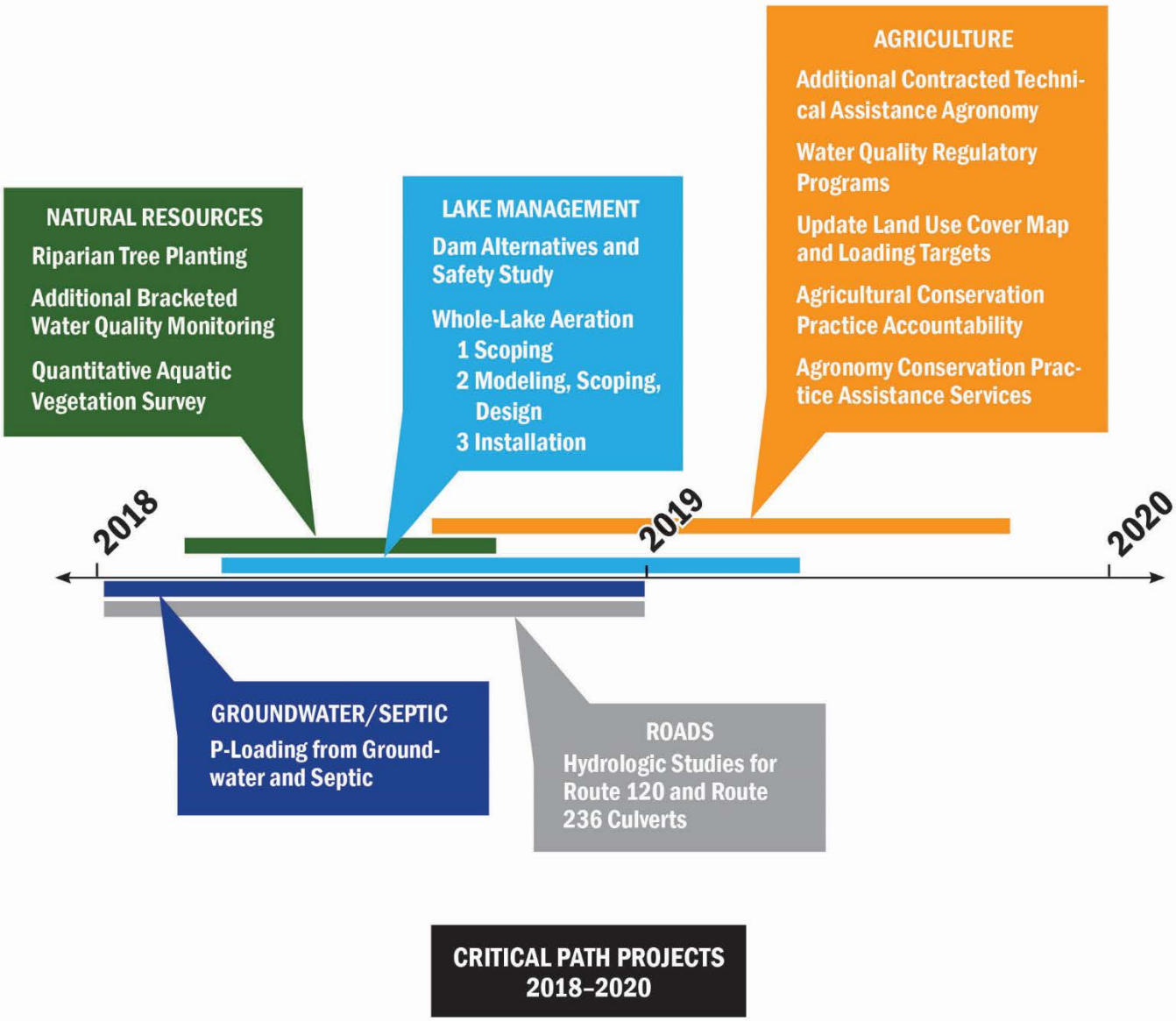
VIII. Appendices

A. Appendix A – Implementation Timeline



A timeline of Lake Carmi restoration actions.



A timeline of Lake Carmi Critical Path Projects through the September 2020.

B. Appendix B – Implementation Actions

Septic/Wastewaster Treatment Facilities (WWTF)						
Status	Responsible Party	Project Name	Project Description	Source	Lead & Supporting Partners (lead partner listed first)	Potential Funding Source
Action required	DEC	Wastewater Feasibility Study Follow-up	Determine interest in using study to identify additional strategies including development of a community wastewater system.	Lake Carmi TMDL Action #2	DEC, LCCA, DEC staff	
On going	FWC	Septic Social	Offer Septic Socials once a year to provide information to landowners about effective wastewater treatment systems.	Lake Carmi TMDL Action #2	FWC, LCCA, DEC staff	DEC staff
On going	FWC	Septic Tank Pumpouts	Offer discounts on pumpouts.	Lake Carmi TMDL Action #3	FWC	LCBP, ANR Watershed Grants
On going	FWC	Water Reduction Practices	Provide devices to reduce use of water.	Lake Carmi TMDL Action #3	FWC, LCCA, DEC staff	LCBP, ANR Watershed Grants
Roads						
Status	Responsible Party	Project Name	Project Description	Source	Lead & Supporting Partners (lead partner listed first)	Potential Funding Source
On going	FWC	Improving Private Roads: Assessment	Continue assessments on private roads.	Lake Carmi TMDL Action #15	FWC, Roads Association or Camp Owner	ERP, landowner
Completed	FWC, Town of Franklin	Franklin Stormwater Master Plan (FSMP)	Stormwater master plan for Pike River and Lake Carmi watersheds.	Franklin Stormwater Master Plan, Lake Carmi TMDL Action #14	FWC, Town of Franklin	ERP, BR
On going	FWC, Town of Franklin	Franklin Stormwater Master Plan (FSMP) Implementation *(see specific projects below)*	Stormwater master plan implementation for Pike River and Lake Carmi watersheds.	Franklin Stormwater Master Plan, Lake Carmi TMDL Action #14	FWC, Town of Franklin	ERP, BR
Action required	Town	FSMP: LC-05 (Middle Rd., 1/2	Culvert outlet is perched two feet above the current streambed. Stream banks	Franklin Stormwater Master Plan	Town	BR

		mile west of Gallup Rd.)	immediately downstream are actively eroding. Nearby ditches are narrow and incising.			
On going	VTrans	FSMP: LC-06 State Route 120, (N. Sheldon Rd.), 1/2 mile south of Riley Rd.	Culvert is too short for the current road width. Bank above culvert outlet is very steep and has collapsed over the opening. Pavement surface above the outlet is beginning to collapse. VTrans plans a hydrologic study in 2018 to determine if culvert opening is adequate. LC-06: To prevent the problem from expanding we plan to place stone around the collapsed banks to stabilize the erosion. A hydraulic study request has been submitted in the case that a culvert replacement is needed.	Franklin Stormwater Master Plan	VTrans	VTrans
On going	VTrans	FSMP: LC-08 State Route 236, (State Park Rd.), 350 ft south of intersection with Dewing Rd.	Sinkhole in the road shoulder has formed above the upstream end of culvert; rocks have been installed to stabilize the scour pool at downstream end of culvert. VTrans plans a hydrologic study in 2018 to determine if culvert opening is adequate. LC-08: This culvert is in for a hydraulic review right now. The review can take 4-6 months, so we don't expect to hear anything until late summer. A culvert replacement could be one alternative that is contingent on the culvert hydraulic study and funding availability.	Franklin Stormwater Master Plan	VTrans	VTrans

Completed	VTrans	FSMP: LC-09 State Route 236, (State Park Rd.)	Logging road and landing on the east side of State Park Rd, ~500 ft north of Kennison Rd, has not been properly closed out and is actively eroding. Undersized culvert used to convey existing roadside drainage under access. VTrans site visit in 2017 and is reviewing. LC-09: Looks like a state route access permit problem. There should be an access permit with conditions to give the district the ability to have the property owner fix this area up.	Franklin Stormwater Master Plan	VTrans	VTrans
Completed	VTrans	FSMP: LC-10 State Route 236, (State Park Rd.)	Recent ditching along State Park Rd in from of #3306 and across from the entrance to the park is actively failing. LC-10: Fixed. Shortened a private drive culvert that was directly discharging to an erosion problem. A stone lined ditch was established to slow the water down to prevent any further erosion.	Franklin Stormwater Master Plan	VTrans	VTrans
Agriculture						
Status	**Responsible Party**	**Project Name**	**Project Description**	**Source**	**Lead & Supporting Partners** (lead partner listed first)	**Potential Funding Source**
On going	AAFM	Agricultural Sector Commitments in Lake Champlain Basin Phosphorus TMDL	Plan which outlines engagement and outreach, technical and financial assistance, inspection, enforcement and rules and permit activities to be conducted by AAFM and partners to meet the Lake Champlain Basin Phosphorus TMDL.	AAFM	AAFM	AAFM

On going	AAFM	Act 64 Farm Related Permits	Enhanced engagement and outreach: conduct assessments on livestock farms in watershed to discuss RAPs, identify water quality concerns and provide outreach regarding cost-share assistance opportunities.	AAFM, Lake Carmi TMDL Action #12	AAFM	AAFM
On going	USDA NRCS	Implementation of NRCS Watershed Priority Plan for Pike	Providing funding priorities for field practices in the Pike/Carmi watershed and education and outreach to agriculture.	NRCS	NRCS, AAFM, UVM Extension	USDA
On going	VACD	VACD LTP	Help farmers develop land treatment plans to incorporate into conservation plans as a component of the revised Secretary's decision.	VACD	NRCS/UVM	AAFM
On going	VACD	VACD RCPP	Work with small farms to develop nutrient management plans that will help position farmers to do additional conservation practices, working closely with UVM Extension to have farmers develop their own NMPs through the Digging In Program.	AAFM, Lake Carmi TMDL Action #12	FNRCD/VACD/ UVM Extension	VACD
On going	DEC	State of Vermont RCPP (DEC Lake Champlain RCPP)/USDA Natural Resources Conservation Service Programs	Water quality improvement projects on: agricultural and forest lands, Wetland Reserve Program, Agricultural Conservation Easement Program, education & outreach, fostering partner relationships.	Agricultural Water Quality Factsheet NRCS	DEC/USDA/NRCS	USDA NRCS, RCPP program
On going	AAFM	Cost-share and grant programs	Continue to provide cost-share to farmers through the BMP, CREP, CEAP, FAP PSWF, and GWW/FS programs and grant opportunities to partners to work directly with farmers through the CWF.	Statute	AAFM, DEC, FWC, UVM, VACD, NRCD, FWA, etc.	AAFM General Fund and Clean Water Fund

Shorelands						
Status	Responsible Party	Project Name	Project Description	Source	Lead & Supporting Partners (lead partner listed first)	Potential Funding Source
Action required	Multiple	Riparian Planting	Consider Marsh Brook below State Park Road, above Towle Neighborhood Road (in addition to plantings already completed under CREP); and Alder Run.	Lake Carmi TMDL Action #9	FWC, DEC, AAFM, USFWS	ERP, CREP
Completed (Summer 2018)	VT FPR	Riparian planting	Add 250 riparian trees to 4500 feet of Lower Marsh Brook to ensure a 100-foot buffer on state park land (1 acres total planted).	Lake Carmi TMDL Action #9	VT FPR, VT DEC	VT FPR
On going	FWC	Lake Wise Evaluations	Continue to encourage landowners to participate in evaluation and acknowledge their efforts to improve the shoreline.	Lake Carmi TMDL Actions #4, #5 and #17	FWC	LCBP, or DEC Watershed grants
On going	VT DEC	Lake Wise Implementation	Prioritize and implement projects proposed through Lake Wise evaluations.	Lake Carmi TMDL Action #4	DEC, FWC	ERP
On going	VT DEC	Lake Wise Implementation	Continue to scope for demonstration projects.	Lake Carmi TMDL Action #5	DEC, FWC	ERP
Natural Resources						
Status	Responsible Party	Project Name	Project Description	Source	Lead & Supporting Partners (lead partner listed first)	Potential Funding Source
On going	DEC	Stream Geomorphic Assessments	Complete (full or lite) stream geomorphic assessments on all streams to identify projects.	Lake Carmi TMDL Actions #7 and #8	DEC/volunteers, FWC	ERP, DEC
On going	FWC	Lake Carmi Tributaries Volunteer Water Quality Sampling Program	Continue to support and consider adopting sampling site recommendations, as shown in Fritz Gerhardt study. Bring online a method for monitoring nutrient loading in the major tributaries.	Fritz Gerhardt recommendations, Lake Carmi TMDL Action #18	FWC, DEC	DEC LPP

On going	FWC	Lake Carmi Lay Monitoring Program	Continue to support volunteers collecting seasonal lake water quality samples.	Lake Score Card	FWC, DEC	DEC
On going	DEC	Wetland Protection	Coordinate with funding agencies, conservation organization and landowner to identify potential protection opportunities.	USDA/NRCS ALE Programs, Non-game Natural Heritage Program, Lake Carmi TMDL Action #19	DEC/TNC	ERP, USDA/NRCS
On going	DEC/NRCS	Wetland Restoration	Coordinate with funding agencies, conservation organization and landowner to identify potential restoration opportunities.	Lake Champlain Phosphorus TMDL	DEC, NRCS, USFWS	ERP, NRCS
On going	DEC	River Corridor Restoration	Coordinate with funding agencies, conservation organization and landowner to identify potential restoration opportunities.	Lake Carmi TMDL Action #10	DEC, AAFM, UVM Extension, NRCS	ERP, NRCS
On going	DEC	River Corridor Protection	Coordinate with funding agencies, conservation organization and landowner to identify potential protection opportunities, including purchase of conservation easements.	Lake Carmi TMDL Actions #10 and #19	VRC, VLT, DEC, FWC, TNC	ERP
On going	DEC	Cyanobacteria Monitoring	Gather data on the occurrence of cyanobacteria blooms. Reach out to campers and visitors about cyanobacteria so that they recognize blooms and know to avoid them. Outreach should also make the connection between extensive prolonged blooms and high nutrient levels, and the changes in land practices	DOH, DEC	DEC/DOH/LCC/LCCA	

			that are needed to reduce bloom occurrence.			
Phase 1 Complete *Phase 2 In Progress*	DEC	In-Lake Management of Phosphorus (Internal Loading)	Investigate emerging phosphorus reduction opportunities. Three phases (Requests for Proposals (RFPs) for each): 1. Scoping (completed February 2018). 2. Modeling/design to be completed by June 2018. 3. Installation anticipated in 2018.	DEC, Lake Carmi TMDL Action #13	Lake Carmi Implementation Team	DEC
Complete	DEC	Determining Phosphorus Loading from Lake Sediments (Internal Loading)	Biweekly monitoring (2016 and 2017) data analyzed by consulting team during Phase I of In-Lake Management of Phosphorus	Lake Carmi TMDL Action #1B	DEC, FWC, Consultant	DEC

C. Appendix C – Partners

Group Name	Association	Description
Franklin Watershed Committee (FWC) http://www.franklinwatershedvt.org/index.php	Non-profit	*A community group focused on reducing phosphorus loads into the Pike (Lake Carmi) and Rock River watershed. The group works with farmers, campers, and other watershed land owners to carry out projects that improve the land's natural ability to utilize phosphorus and reduce the effect of erosion on land in the watershed. These projects range from efforts to improve septic systems on lakeshore properties, to cover crop incentive programs, to culvert and ditch repair*
USDA Natural Resources Conservation Service (NRCS) https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/	Federal	*NRCS provides cost-share, technical assistance, and targeted support of agricultural best management practices. Additionally, NRCS provides funding and technical assistance for forestry and wildlife habitat projects.*
Agency of Natural Resources (ANR) http://www.anr.vermont.gov/	State	*All Departments within ANR (Fish & Wildlife Department, Forest, Parks, and Recreation, and DEC) and Divisions within them, work collaboratively on several watershed assessment, restoration and protection projects. Additionally, FWD and FPR own and manage hundreds of acres of state-owned lands within the basin. Annual stewardship plans are prepared by District Stewardship Teams and includes staff from FWD, FPR, and DEC. Long Range Management Plans of state-owned properties include restoration and protection of water resources*
VT Agency of Agriculture, Food and Markets (VAAFM) http://www.agriculture.vermont.gov/	State	*VAAFM facilitates, supports and encourages the growth and viability of agriculture in Vermont while protecting the working landscape, human health, animal health, plant health, consumers and the environment.*

VT Agency of Transportation (VTrans) http://vtrans.vermont.gov/	State	*One of VTrans' goals is to "Preserve, maintain, and operate the transportation system in a cost effective and environmentally responsible manner." Information on VTrans' own efforts as well as grant opportunities for municipalities can be found at the below links:* *http://vtrans.vermont.gov/operations/technical-services/environmental/stormwater* *http://vtrans.vermont.gov/highway/local-projects*
Lake Carmi Implementation Team	State	
Farmer's Watershed Alliance http://farmerswatershedalliance.org/	Local non-profit	
Friends of Northern Lake Champlain http://www.northernlakechamplain.org	Local non-profit	*An organization dedicated to the rehabilitation and protection of northern Lake Champlain and all the waters that flow into it. The organization works collaboratively with local communities, farmers, government, lake associations, regional planning, and policy developers to reduce polluted land use runoff.*
Lake Carmi Campers Association http://lakecarmi.mylaketown.com/	Local non-profit	*An association dedicated to conserving our unique natural resources, improving and enhancing the quality of life and the environment, for all Lake Carmi residents and visitors. In cooperation with local and state authorities, the association shall provide educational, cultural and recreational activities, as well as, water quality management and safety education initiatives. Further, the association will provide a medium through which information and educational programs and materials may be distributed throughout the community*
Northwest Regional Planning Commission http://www.nrpcvt.com/	Regional	*Statutory partners to the basin planning process, and help towns to complete road erosion inventories, stream geomorphic assessments, and stormwater master plans in addition to helping towns update their regulations to protect water quality. As part of the implementation of Act 64 (Sec. 43), DEC has contracted with RPCs to fulfill the specific roles and responsibilities around the development of tactical basin plans that should substantially enhance DEC's ability to reach municipalities and other relevant stakeholders. Further, the contracted activities are developing augmented capacity in RPCs to support water quality protection and restoration.*
Town of Franklin https://www.franklinvermont.com/	Municipality	

D. Appendix D – Flow Alteration and the Mill Pond Dam

1. Flow assessments

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

The water level of Lake Carmi has been managed seasonally with a drawdown of the water occurring in the late fall by removing stop logs at the dam. The stop logs are replaced in late spring to restore the water level. Winter drawdowns are known to have negative impacts to the near-shore habitat of lakes effecting overwinter, spawning and incubation of organisms. The dam that controls the water level of Lake Carmi (the Mill Pond Dam) is owned by DEC. In 2016, the Department worked with the town and LCCA to end this drawdown. DEC will no longer permit removal of the stoplogs at the dam and they will be locked in place.

2. Dams

The Mill Pond Dam controls the water level and elevates the water about 2 feet over its natural level. The dam is located at the north end of the lake and drains north into the Pike River which flows into Canada and eventually into the Missisquoi Bay of Lake Champlain. The dam, originally constructed in the mid-1800s to provide power for a sawmill, was rebuilt in the early 1970s and is now owned by VT DEC. The Lake Carmi dam is located about 2400 feet from the lake itself, having been built downstream on the outlet. Therefore, the outlet stream leaves Lake Carmi and passes under Dewing Shore Road and through Mill Pond before reaching the dam. The culvert that passes under the road can have lower capacity than the dam itself, so at times of high flow it determines the water level in the lake.

The Future of Mill Pond Dam

In 2016/2017, the Dam Safety Program procured funding to perform a maintenance program at the dam, including concrete repairs, tree and brush removal around the dam, downstream channel cleaning, stoplog replacement, and gate repairs. However, after the 2017 Summer cyanobacteria outbreaks in Lake Carmi and unauthorized operations of the boards at the dam, it was decided that the maintenance funds would be better spent on an engineering study of the dam to address potentially larger shortcomings.

In the Spring of 2018, the Dam Safety Program contracted with Gomez & Sullivan Engineers to perform a study with the following objectives:

- Analyze alternatives to improve the condition of the dam as well as improve its ability to safely pass large storms. The intent of this preliminary study is to book end the range of possible alterations to the dam to improve its condition. Alternatives that will be studied include:
    - no action (i.e. keep the dam as is; no change)
    - raise or lower the dam,
    - increase the ability of the dam to pass flows, and
    - dam removal.
- In order to analyze these alternatives, the following engineering work is planned:
    - Engineering analysis of storms in the Lake Carmi/Mill Pond drainage area and the ability of the dam and road culvert at Dewing Road to pass them.

- Field work including survey cross sections at the Dewey Road Bridge and dam, and underwater survey of Mill Pond to develop estimates of the quantity and quality of accumulated sediments.
- A hazard classification review of the dam (i.e. is the dam really a LOW hazard, or could it have a higher hazard rating)

While this work is not to directly address the cyanobacteria issues in Lake Carmi, the study results will be examined by those involved in the cyanobacteria issues to determine if the alternatives will have positive, negative, or no impact on water quality in the lake relative to cyanobacteria.

It is our hope that following the completion of this report by October 2018 and technical/public review and presentation, that an alternative will be collaboratively selected. From there, the Dam Safety Program hopes to move forward in future years with design, permitting, and implementation of the selected alternative.

For more information visit:
http://dec.vermont.gov/sites/dec/files/Common%20Questions%20on%20Mill%20Pond%20Dam.pdf

E. Appendix E – Agency of Transportation Guidance

VTRANS CLEAN WATER INITIATIVES & STORMWATER INVESTMENTS

Provided by VTrans for January 2018 Legislative Session

Specific to Water Quality Initiatives and Investments Targeting Regulatory Compliance for VTrans' Highways and Developed Lands

Why does stormwater matter?

- Stormwater runoff is generated when precipitation from rain and snowmelt flows over land or impervious surfaces and does not infiltrate into the ground.
- Impervious surfaces and concentrated drainage conveyances increase the frequency, volume, and flow rate of stormwater runoff and pollutants, causing cumulative impacts throughout a watershed.
- Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, or wetland. Unmitigated, this may result in environmental and economic impacts to downstream waters.

Photo: Stormwater runoff from impervious surfaces

How do roads impact stormwater?

- Impervious roadway surfaces can quickly convey polluted stormwater runoff to nearby waterways.
- VTrans is responsible for stormwater collection, conveyance, and treatment along its highways and at other transportation facilities (airports, maintenance yards, park & rides, welcome centers, gravel pits).
- Linear Transportation stormwater management differs from city, town, retail, and commercial entities:

Photo: Road stormwater collection

- Highways stretch for many miles, crossing multiple waterways, watersheds, and jurisdictions.
- Transportation storm conveyance systems are linear and often discharge stormwater and associated pollutants that originate outside of the transportation right-of-way.

What is Vermont's Clean Water Act?

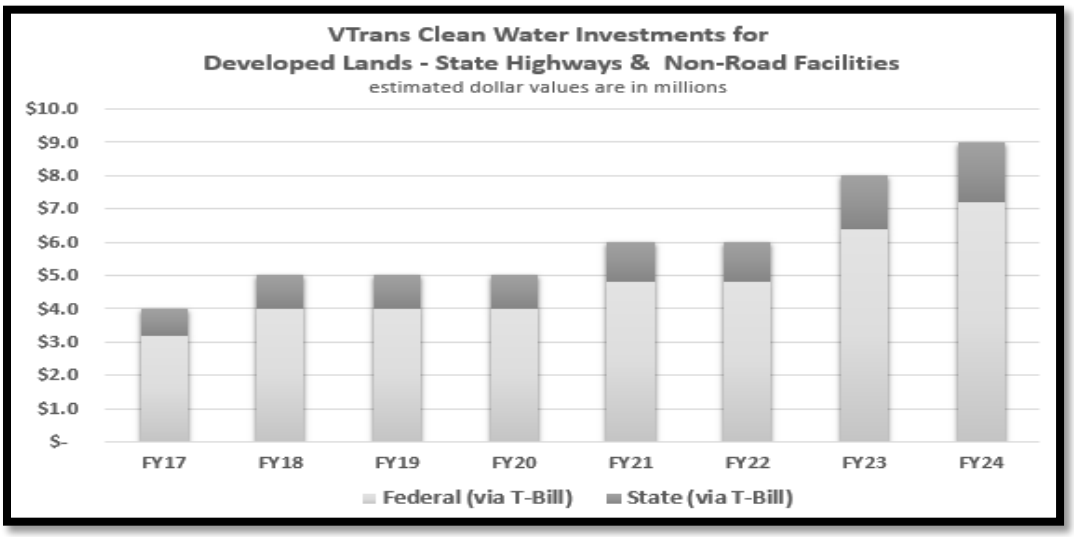
- Referred to as Vermont's Clean Water Act – laid the foundation for the protection and restoration of Vermont's waters by adopting a cross-sector "all in" approach, with a broad suite of programs and regulations addressing: agricultural practices, stormwater runoff from roads and non-road developed lands, and natural infrastructure (river corridors, wetlands and forest management).
- In addition, The U.S. Environmental Protection Agency, in June 2016, established Total Maximum Daily Loads (TMDLs) and reduction targets for phosphorus in the 12 lake segments of Lake Champlain Basin.

Photo: Algal Bloom

How is VTrans investing in clean water?

- VTrans has a role to play under Vermont's Clean Water Act and under pre-Act 64 regulations addressing stormwater from its highways and non-road developed lands. *Refer to back page for Clean Water Programs and Regulations VTrans must comply with.*
- VTrans' Clean Water Initiatives and Stormwater Regulatory Compliance Investments for the State Highway System and VTrans non-road developed lands are anticipated to be covered by the Transportation Bill and Federal Funds where eligible. *See estimated costs below through SFY24 which include Project Development, Construction, O&M and FTE.*

Photo: St. Albans I-89 Median Stormwater Retrofit



VTRANS' STORMWATER REGULATORY REQUIREMENTS

PERMIT PROGRAMS	COVERAGE AND APPLICABILITY	COMPLIANCE ACTIVITIES
TS4 GP **Transportation Separate Storm Sewer System General Permit** **TS4 GP ENCOMPASSES:**	♦ Permit effective on 11/29/2017 ♦ Regulates stormwater discharges from the Statewide VTrans TS4 (including road and non-road developed lands) ♦ Specific to the unique linear nature of VTrans' infrastructure ♦ Allows several stormwater programs to be rolled into one comprehensive regulatory program (*4 programs listed below*)	♦ VTrans applied for TS4 coverage in early December 2017 ♦ ANR authorization anticipated in early 2018 ♦ Requires development of a Stormwater Management Plan addressing all of the requirements set forth in the TS4 GP ♦ Requires, at a minimum, compliance with all of the regulatory standards of those programs rolled into the TS4 GP
MS4 –> Municipal Separate Storm Sewer System	♦ Spread across 10 stormwater impaired watersheds ♦ Includes VTrans highways and non-road developed lands in 12 MS4 communities including: Burlington, Colchester, Essex, Essex Junction, Milton, Rutland Town, Shelburne, South Burlington, St. Albans City and Town, Williston, Winooski	♦ Public Education & Participation, Training & Education ♦ Compliance with State Stormwater Regulations and TMDLs ♦ Installation of Stormwater Treatment Practices ♦ Asset Management & Illegal Connection & Run-on Control ♦ Spill Prevention and Stormwater Pollution Source Control
TMDL –> Total Maximum Daily Load	♦ Establishes reduction targets for specific pollutants (e.g. stormwater flow, phosphorus, E. coli, etc.) in order to attain water quality standards ♦ Applies to watersheds with identified impairments for which a TMDL has been issued by ANR and approved by EPA	♦ Flow Restoration Plans (FRP) in 10 stormwater impaired watersheds ♦ Phosphorus Control Plans (PCP) in the Lake Champlain Basin ♦ Construct stormwater treatment practices targeting pollutants of concern in VTrans ROW and on non-road developed lands. Currently VTrans has identified through FRPs 58 stormwater retrofit practices and has installed 4 practices. Development of PCPs has been initiated
MSGP –> Multi-Sector Industrial Stormwater	♦ Covers discharges of stormwater from industrial facilities which conduct activities and use materials that have the potential to impact the quality of Vermont's waters ♦ Regulated VTrans facilities including 9 State Airports and 3 State Gravel Pits	♦ Facilities are required to examine potential sources of pollution, implement measures to reduce the risk of stormwater contamination, and test stormwater discharges for sources of pollution ♦ VTrans develops and maintains Stormwater Pollution Prevention Plans (SWPPPs) at each facility that include training and education, stormwater management, asset management, erosion control, spill prevention, and stormwater pollution source control

State OSW –> Operational Stormwater Discharges	• Coverage under the general permit is required for discharges of regulated stormwater runoff from the construction, expansion, and redevelopment of impervious surfaces pursuant to the permit threshold triggers established in Vermont Statutes	• Construct and maintain permanent stormwater management and treatment practices for projects that trigger jurisdiction • In 2017 VTrans had 24 projects in design/permitting and 13 projects installing stormwater treatment practices • As of 2017 VTrans in managing compliance on 72 projects constructed over many years with stormwater permits and treatment practices requiring ongoing operation, maintenance, inspection and reporting
State CSW Construction Stormwater Discharges *(not included under TS4)*	• Regulates discharge of stormwater runoff from construction activities	• Construct temporary stormwater management and treatment practices designed to control erosion and prevent sediment transport • In the 2017 construction season, 37 of the 80 projects under construction had CSW coverage, requiring 100 compliance visits

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