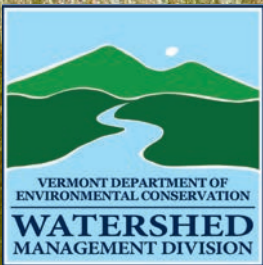




State of Vermont  
Department of Environmental Conservation  
**Watershed Management Division**

# 2017 Annual Report



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**Cover: Miles Pond, Concord—Jim Deshler, Monitoring, Assessment, and Planning Program**

**Inside front cover: Echo Lake, Charleston—Lindsay Miller, Lakes and Ponds Program**

**Inside back cover: Flint Brook, Roxbury—Blaine Hastings, Monitoring, Assessment, and Planning Program**

# Director's Message: Taking the Long View

Clean water helps define who we are and what we value in the Green Mountain State. It is essential to our health and well-being, and vital to a high quality of life and a strong economy. Our waters provide for diverse recreational opportunities, serve as a major source of drinking water, and support critical fish and wildlife habitat. Fully protecting and restoring Vermont's surface waters will require our shared and long-term commitment. We must plan for an overall process that extends over a decades-long timeline, with future generations of Vermonters in mind. However, we also must act decisively now—to ensure clean water for ourselves and our neighbors today. Each water quality restoration project implemented, every new permit condition applied or protective easement acquired today helps prevent water pollution from degrading our favorite swimming hole, the wetland where we love to bird-watch, or the pond where our family gathers each summer.

The Watershed Management Division's 2017 Annual Report provides a snapshot of our combined efforts to protect and restore clean water over the last year. The first section, **Who We Are**, outlines the division's mission, vision, and goals, and introduces our organizational design, paralleling the elements and interactions of water within a watershed. The interrelationship of land use impacts and the connectivity of surface water resources are the primary reasons why monitoring, assessment, management, and restoration are most effective when conducted at a watershed scale. This concept of holistic watershed management is foundational to our division's structure and methods.

**How We Work** describes the role of monitoring and assessment, along with the suite of pollution prevention tools we use to accomplish our division's goals of protecting, enhancing, maintaining, and restoring surface waters. The four main tools are: Project Review and Permitting; Outreach, Education, and Training; Protective Easements and Designations; and Restoration Projects Funded and Implemented.

Next, the division's eight integrated programs—**Business and Operational Support Services; Clean Water Initiative; Lakes and Ponds; Monitoring, Assessment, and Planning; Rivers; Stormwater; Wastewater; and Wetlands**—are profiled. Each program summary highlights the pollution prevention tools used, and the scope, quantity, and results of this work in 2017. In addition, each program highlights a case study that provides an example of these tools in action.

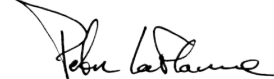
2017 was a significant year for the Watershed Management Division. Some of our important highlights are bulleted below, with page numbers referenced in parentheses where additional details are provided.

- Active implementation of the Lake Champlain Total Maximum Daily Load (TMDL), with new wastewater treatment facility permits (p. 21), stormwater general permits (p. 19), tactical basin plans (p. 5), and enhanced tracking systems (p. 11).
- Revised the Wetlands Rule, designated three new Class I wetlands (p. 23), updated the Vermont State Water Quality Standards, and revised the Stormwater Management Manual.
- Garnered operating efficiencies through database development, process improvement efforts (p. 9), and technical capacity building.

The final section, **Measuring Our Impact**, describes our water monitoring and assessment results, and the progress we've made toward achieving clean water goals. For those interested in learning more about our division overall, I invite you to visit the resources referenced on page 6.

Looking ahead to the work that will be necessary over the coming years, the road to clean water will be long and challenging. This is due primarily to the nature of the pollution sources we must address—numerous and diverse, spread across large watersheds, and primarily driven by precipitation and runoff. There is a justifiable impatience for realizing improvements quickly, and we are committed to an optimized implementation process guided by three fundamental principles—prioritization of actions, maximizing cost effectiveness of implementation, and efficiently working on a watershed-wide basis, across all sectors. We will continue to comprehensively pursue our long-term goals to protect, maintain, enhance, and restore Vermont's most vital resource—clean water. In doing so, we will also be working to create a better future for Vermont—one that is more resilient to flooding and the impacts of extreme weather events, where wildlife habitat and recreational opportunities are abundant, and where our natural resources are also our assets, supporting a vibrant and robust state economy.

We invite you to join us in pursuing this long view toward a shared clean water future.



Pete LaFlamme, Director  
Watershed Management Division

# Who We Are

**Mission:** To efficiently and effectively manage Vermont's surface water resources through a comprehensive, integrated, and holistic watershed-based system

**Vision:** To achieve full support of both healthy ecosystems and public uses in all Vermont's surface waters

## Goals

**Protect:** Safeguard Vermont's pristine or "special" waters from deleterious change over the long-term through proactive protection tools



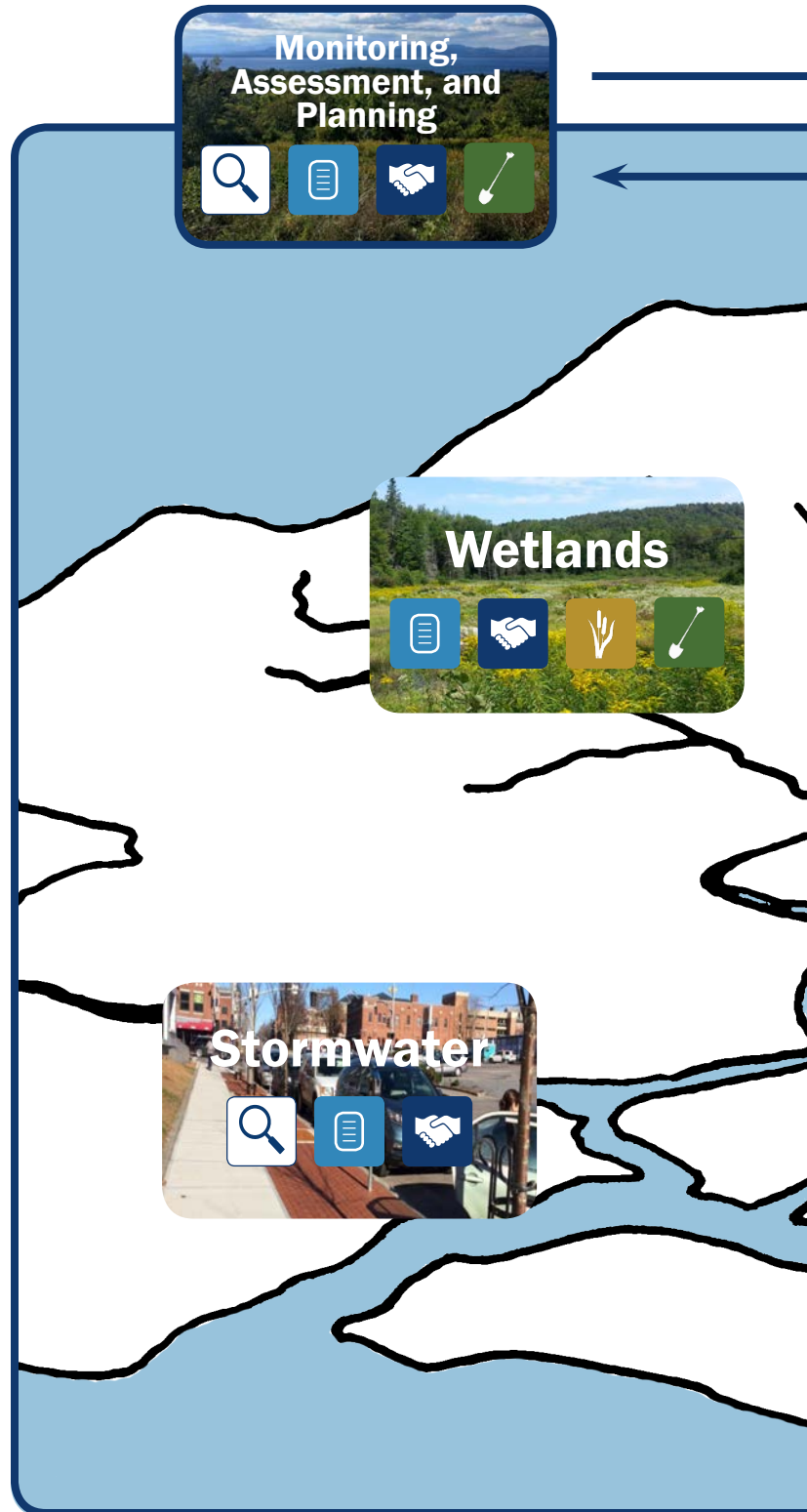
**Enhance:** Improve the condition of Vermont's surface waters by managing cumulative and legacy impacts



**Maintain:** Improve and expand ongoing maintenance of Vermont's unimpaired waters



**Restore:** Target technical and funding resources to reduce pollution inputs to impaired waters



The Watershed Management Division's organizational design parallels how water moves through a watershed. The way we use the land impacts not just the immediate surface waters, but all waters downstream. This is why monitoring and assessment, management, and pollution prevention must be conducted at a watershed scale.


Monitoring and Assessment, and  
Project Identification and Prioritization

Funding, Tracking, and Reporting Clean Water Progress


**Clean Water Initiative**




**Lakes and Ponds**



**Rivers**








**Wastewater**



**Business and Operational Support Services**



-  Sites Monitored and Assessed
-  Outreach, Education, and Training
-  Project Review and Permitting
-  Protective Easements and Designations
-  Restoration Projects Funded and Implemented

# How We Work

## Monitoring and Assessment

**1,410 sites monitored**

The Watershed Management Division has monitored and assessed surface waters since 1977. Monitoring and assessment are critical to establishing baseline conditions, tracking long-term changes in water quality and designated uses (for example,

swimmable and fishable), and informing management and permitting efforts. In 2017, division staff and citizen volunteers monitored sites throughout Vermont to measure chemical, physical, and biological water quality parameters.

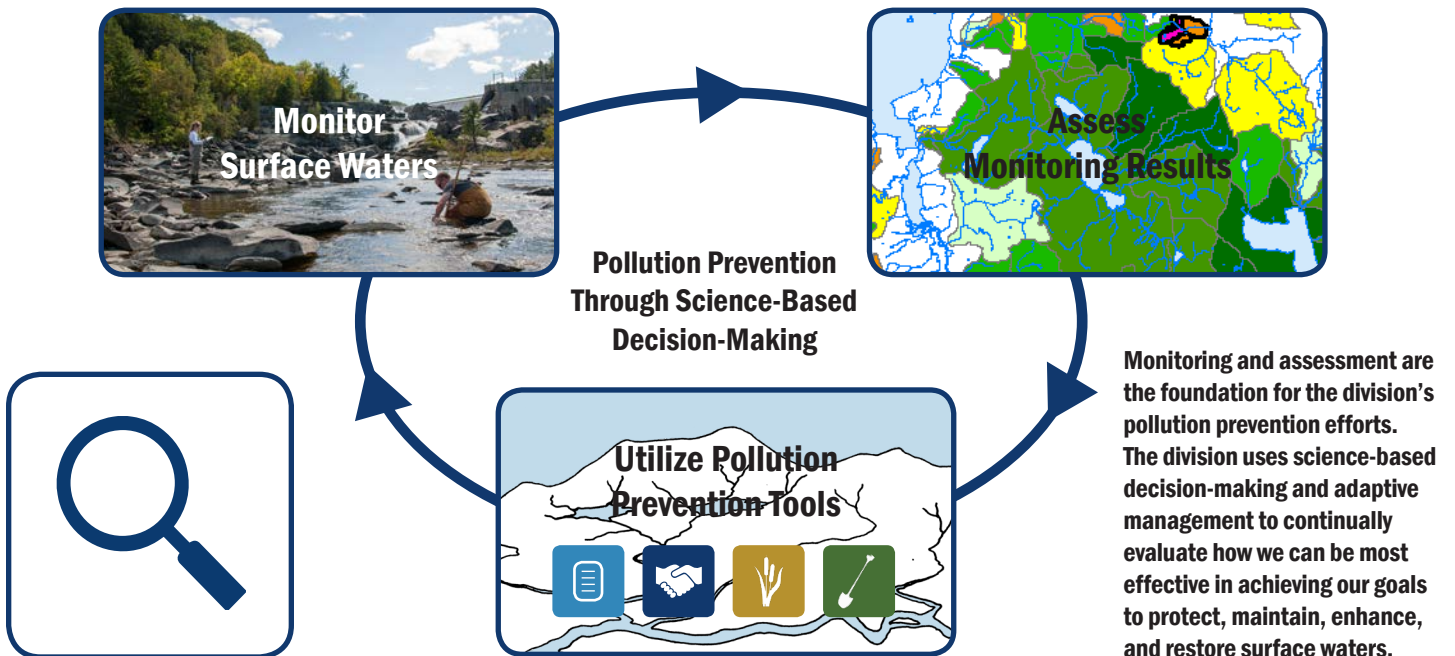
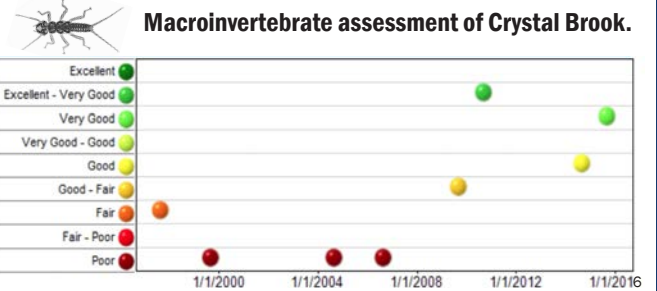
Division staff also inspected sites for compliance with permit requirements to ensure water quality is maintained. This included visual inspections, water quality sampling, and assessment of monitoring data.

The assessment of monitoring data enables the division to gauge compliance with the Vermont State Water Quality Standards, compare Vermont's water quality to that of other states, and examine trends over time. Staff use monitoring and assessment results to identify where protection, restoration, enhancement, and maintenance efforts should be targeted through tactical basin planning.

### Case Study: Stream Health Improves After Implementation of Best Management Practices

Nutrient-laden runoff from agricultural sources in the Crystal Brook watershed in Derby degraded the brook's health to the point where a segment of it no longer met Vermont State Water Quality Standards. A watershed assessment identified several pollution sources at a nearby farm. Division staff worked with the farmer and local, state, and federal partners to improve manure storage and capture barnyard runoff, reducing nutrient inputs to Crystal Brook, which ultimately drains into Lake Memphremagog.

Monitoring after the implementation of agricultural best management practices showed a reduction in phosphorus, as well as an improvement in the aquatic life in the stream (see macroinvertebrate assessment below). Crystal Brook now meets Vermont State Water Quality Standards.



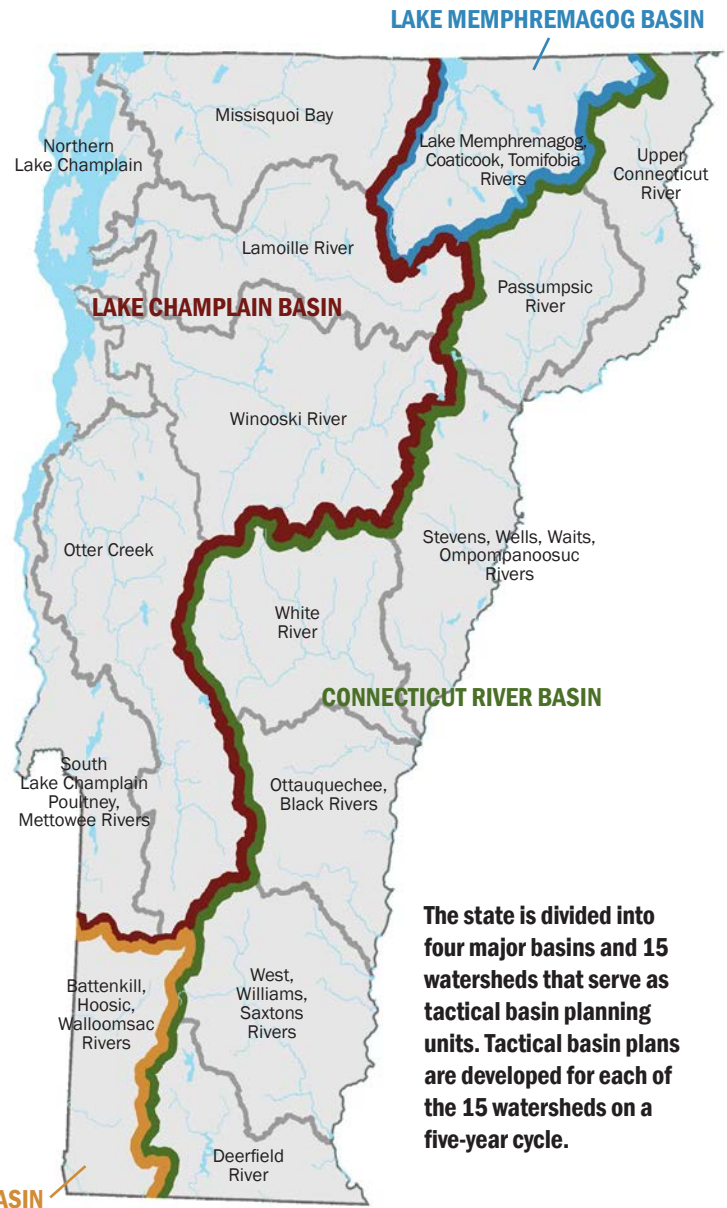
## Tactical Basin Planning

Tactical basin planning integrates monitoring and assessment results, targets surface waters for protection or restoration actions, and builds partnerships for efficient and effective implementation. There are 15 major watersheds that serve as tactical basin planning units (see map at right). Tactical basin plans are developed and updated on a five-year cycle for each watershed (see diagram below).

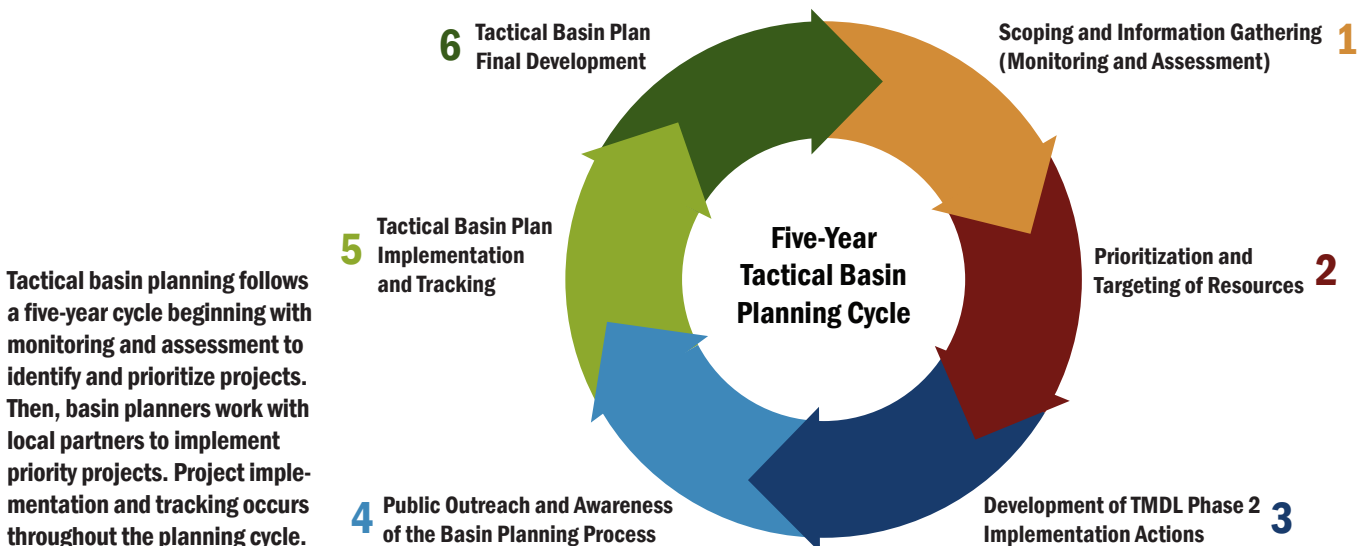
Tactical basin plans summarize current and past water quality and habitat assessment data. They also identify specific opportunities for water quality protection or restoration, available management tools, a prioritized list of clean water projects, potential funding sources, and recommendations for community-based planning or implementation actions.

Public and stakeholder engagement throughout the tactical basin planning process is imperative. Tactical basin plans are developed to empower people with the information and tools needed to take effective actions that protect and restore water quality.

Each tactical basin plan is complemented by the Watershed Projects Database, an online database that contains priority monitoring, assessment, scoping, design, implementation, and reclassification projects (visit: <https://anrweb.vt.gov/DEC/IWIS/ARK/ProjectSearch.aspx>). The division relies on tactical basin plans to ensure funds are directed to priority clean water improvement projects.



The state is divided into four major basins and 15 watersheds that serve as tactical basin planning units. Tactical basin plans are developed for each of the 15 watersheds on a five-year cycle.





# How We Work

The Watershed Management Division uses monitoring and assessment and the four pollution prevention tools, described on the following page, to protect and restore the health of our lakes and ponds, rivers and streams, and wetlands statewide. The use of these tools and their results are tracked through Results Base Accountability (a link to the report is provided at right), which is one of several ways we measure short- and long-term progress toward clean water goals. Program summaries on the following pages highlight monitoring and assessment efforts, and use of pollution prevention tools in 2017.

Short-term progress can be gauged through increased operational efficiency and performance measures like the number of projects reviewed or permitted by staff; the hours of education given to consultants, regulated entities, and the public; the number of wetland and floodplain acres protected through easements and designations; and the number of clean water improvement projects implemented and amount of funds awarded.

We measure the impact of these efforts by looking at water quality trends over several years, such as increasing or decreasing phosphorus levels in our lakes. Results of our pollution prevention efforts will initially be measured in smaller streams and ponds. However, long-term progress in achieving clean water goals in larger waterbodies, like Lake Champlain or the Connecticut River, will be measured over decades.

Our statewide water quality indicators presented at the end of this report give an overview of the status and trends in lake and stream health statewide. It is important to understand that many of the division's clean water efforts also increase flood resilience, enhance recreational opportunities, and improve wildlife habitat, which support a strong economy and high quality of life for Vermonters.

## Watershed Management Division Guiding Documents and Reports

### Strategic Plan (2016–2018)

[dec.vermont.gov/watershed/business-support/reports](http://dec.vermont.gov/watershed/business-support/reports)

### Surface Water Management Strategy

[dec.vermont.gov/watershed/map/strategy](http://dec.vermont.gov/watershed/map/strategy)

### Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan

[dec.vermont.gov/watershed/cwi/restoring/champlain](http://dec.vermont.gov/watershed/cwi/restoring/champlain)

### Clean Water Initiative Annual Investment Report

[dec.vermont.gov/watershed/cwi/cwf#report](http://dec.vermont.gov/watershed/cwi/cwf#report)

### Results Based Accountability Reports

[dec.vermont.gov/watershed/business-support/reports](http://dec.vermont.gov/watershed/business-support/reports)



Division scientist samples Lake of the Clouds, Cambridge.

Lake Willoughby, Westmore





### Sites Monitored and Assessed

The division's monitoring efforts provide information on the progress of management activities, adherence to permit conditions, impacts of natural and man-made change, and climate effects. Frequent data assessment, combined with adaptive management, allows us to make progress toward clean water goals.



### Project Review and Permitting

Division staff provide technical assistance to municipalities, landowners, developers, and non-governmental organizations through project review to ensure water quality is maintained by avoiding resource impacts or, if impacts are unavoidable, minimizing them through permitting.



### Outreach, Education, and Training

Preventing water pollution means employing sound land use practices (also known as best management practices) and technologies. Education about polluted runoff sources and prevention strategies is often needed before individuals can act to ensure clean water. This is summarized as hours received by participants (for example, a two-hour workshop with 20 participants would be reported as 40 hours).



### Protective Easements and Designations

Some of the most effective tools for safeguarding the health of our surface waters are easements and designations, which place restrictions on activities in wetlands and floodplains. This protects water quality, reduces future flood hazards, enhances habitat, and supports recreational opportunities.



### Restoration Projects Funded and Implemented

Pollution from developed lands, roads, farms, and logging areas can degrade the health of our waters. The division supports the implementation of priority projects that will reduce surface water pollution through financial and technical assistance, permit requirements, and restoration plan implementation.



# 2017 Watershed Management Division Pollution Prevention Summary

**5,025**  
projects reviewed  
**1,779**  
permits issued

**14,000+**  
training  
hours

**2,550**  
acres  
protected

**583**  
projects  
implemented

## Business and Operational Support Services

The Business and Operational Support Services (BOSS) Program provides administrative and technical assistance for the division's permitting and resource-based programs, as well as advanced operational support. The BOSS team administratively reviews and processes permit applications, tracks permit compliance, performs permit billing and accounts receivable functions, and coordinates database and website development. BOSS staff support the division in achieving the overall mission of protecting, maintaining, enhancing, and restoring Vermont's surface water resources by promoting efficiency and consistency, and leveraging technology. The program supports the use of the division's pollution prevention tools in the following ways:

**Project Review and Permitting:** The BOSS Program facilitates permitting processes for nearly 80% of the division's permits. BOSS staff provide the initial administrative review, communicate with applicants and consultants about application deficiencies, enter data, process and track application and operating fees, coordinate public noticing and comment processes, and assist with final permit issuance (see "Average Permit Issuance Time Decreased by 20%" on the following page). The program also helps with permit compliance monitoring by reviewing compliance reports and entering monitoring and inspection data.

**Outreach, Education, and Training:** The BOSS Program coordinates course registration and assists with administration of division education and training efforts. Specifically, the BOSS team tracks and manages registration for Natural Shoreland Contractor Certification courses and assists the Wastewater Program with outreach to wastewater treatment facility operators. BOSS staff also



**A stormwater permit prevents this construction site from being a source of polluted runoff. Additional permits may be required if the site is in a shoreland area, river corridor, floodplain, or wetland.**

offer assistance to permit applicants on new systems and technologies, and changes or updates to processes and requirements.

**Protective Easements and Designations:** The BOSS Program administers public notice processes for designations. This includes sending notifications to all property abutters and publishing notifications in the appropriate newspapers to increase public awareness and engagement. This past year, the division protected over 2,500 acres through easements and designations. Three Class I wetland designations, which accounted for 1,500 of these acres, required notifying more than 100 landowners.

**Restoration Projects Funded and Implemented:** Program staff assist with database and report development to better track projects and their results.

## Average Permit Issuance Time Decreased by 20%

Environmental permitting is a regulatory tool used to prevent pollution from degrading surface waters. The Watershed Management Division permits a wide range of activities that include construction and operational stormwater management, aquatic nuisance control, wastewater discharges, shoreland development, stream alterations, and activities in wetlands. Our division's permits all have a common goal—to protect water quality statewide for Vermonters and visitors alike. BOSS staff help applicants navigate the permitting process and assist with the administrative components, allowing division scientists and analysts to focus on technical review of permit applications and drafting permits.

In 2017, the division saw a 20% increase in the number of permits issued. This was largely due to additional regulatory authority from the Vermont Clean Water Act (Act 64) and an increase in development and construction activities. Despite this significant increase in volume, the division was able to decrease the average time it takes an applicant to receive their permit by 20%, from 47 days to 40 days.

BOSS staff played a critical role in reducing this time. They cut administrative review and processing time in half by streamlining the administrative process, which allowed permit applications to be routed sooner for technical review, and ultimately the permit to be issued faster.

BOSS staff have reduced permitting times by:

- Digitizing permit applications into fillable forms;
- Improving internal tools for tracking progress from application receipt to permit issuance (see permitting process diagram below);
- Clarifying permit application instructions and guidance materials;
- Implementing an electronic reporting system for permit compliance reporting; and
- Sending reminder notices to permittees regarding upcoming permit expiration dates and renewal requirements.

The program strives to streamline and improve the permitting process, and is currently identifying common sources of confusion and errors in permit applications. Identifying these issues, and evaluating and implementing solutions will help increase the number of administratively and technically complete applications received. Applications that are received administratively and technically complete upon submittal are issued in half the time compared to those submitted with deficiencies. By increasing the number of applications received complete, we will be able to further decrease the average permit issuance time, which we recognize is important to permit applicants. We will continue diligently working to make the permitting process easier and more efficient.

### New Online Hub for Environmental Permit Notices

A new public noticing system, the Environmental Notice Bulletin (ENB), launched January 1, 2018. This online hub puts information into the hands of Vermonters, allowing them to easily track permit applications and submit public comments. Visit: [enb.vermont.gov](http://enb.vermont.gov).



The diagram above outlines each step in the permitting process, from when an application is received until the permit is issued. BOSS staff support permitting programs division-wide by facilitating this process, and are directly responsible for completing steps 1-3, 5, 7, and 8.

# Clean Water Initiative Program

The Clean Water Initiative Program (CWIP) funds, tracks, and reports on priority projects to restore Vermont's waters, and communicates progress toward meeting water quality restoration targets outlined in long-term remediation plans known as Total Maximum Daily Loads (or TMDLs). CWIP supports the Clean Water Fund Board in the administration of the Clean Water Fund, and coordinates funding, tracking, and reporting of clean water efforts for federal and state partners, including the Agencies of Agriculture, Food and Markets; Commerce and Community Development; Natural Resources; and Transportation—and the Lake Champlain Regional Conservation Partnership Program (RCPP) of the U.S. Department of Agriculture Natural Resources Conservation Service. In addition, CWIP offers technical expertise in stormwater master planning, illicit discharge detection and elimination, and green stormwater infrastructure.



**A bioretention system captures runoff from Morey Road in Hyde Park. This project was completed by the Lamoille County Conservation District with Ecosystem Restoration Grant funds.**

## 2017 Program Summary

**141**  
projects  
reviewed

**2,424**  
training  
hours

**399**  
acres  
protected

**105**  
projects  
**\$6.1**  
million awarded

**Project Review and Permitting:** CWIP staff provide technical assistance through Ecosystem Restoration Grant application review, stormwater master planning, and RCPP coordination and assistance. The number of projects reviewed by CWIP staff doubled from 2016 to 2017.

**Outreach, Education, and Training:** CWIP more than doubled its education and training efforts over the last year, which included coordinating informational webinars on the implementation of Act 64 (also known as the Vermont Clean Water Act) and a statewide celebration of clean water through the first ever Clean Water Week. The program is also responsible for tracking and reporting clean water outreach for Clean Water Initiative partner state agencies (see “Partners Exemplify Vermont’s ‘All In’ Approach to Clean Water” on the following page).

**Protective Easements and Designations:** The number of easement projects and acres protected doubled from last year. One particularly noteworthy project was a partnership with RCPP for a 190-acre easement, which connected prior conserved wetland parcels along Otter Creek.

**Restoration Projects Funded and Implemented:** In State Fiscal Year 2017 (July 1, 2016–June 30, 2017), 105 projects were funded through the Ecosystem Restoration Grant Program, putting over \$6 million on-the-ground for the design and construction of water quality improvement projects, including stormwater treatment practices and floodplain restoration projects.

## Partners Exemplify Vermont's "All In" Approach to Clean Water

Vermont's "all in" approach to achieve clean water goals recognizes that everyone—municipalities, businesses, farmers, landowners, federal and state agencies, and the public—must work together to prevent water pollution.

Vermont's success in bringing these audiences together relies on the tremendous work of partner organizations across the state, including regional planning commissions, natural resources conservation districts, farmer groups, watershed and lake associations, business alliances, conservation groups, and the public. The work and leadership of these partner organizations in delivering education, outreach, and technical assistance helps audiences learn about the problems caused by polluted runoff and the actions needed to improve water quality.

Our partners are fundamentally our "boots-on-the-ground" when it comes to pollution prevention. Their involvement helps the state achieve important objectives with our clean water investments. These include making our communities, businesses, and road networks more resilient to flooding; helping farmers protect their soils from erosion; supporting businesses as they invest in their future; helping Vermonters and visitors alike enjoy our waters as important community and recreational assets; and improving fish and wildlife habitat.

Examples of our partners' efforts include:

- **Clean Water Week:** Vermont's first annual Clean Water Week was held in August 2017. It involved nearly 100 organizations, businesses, institutions, and municipalities, and showcased more than 70 events statewide. Clean Water Week highlighted and celebrated the accomplishments of our collective clean water actions. Most importantly, Clean Water Week acknowledged and celebrated the many efforts, investments, and initiatives undertaken by Vermont partner organizations and businesses, farms, municipalities, and citizens who are working to keep our waters clean. Events included farm visits, water treatment plant tours, a celebration of the Wild and Scenic Upper Missisquoi and Trout Rivers, and rain garden tours by bicycle in Rutland.
- **Tracking Outreach and Technical Assistance:** Reducing nutrient and sediment pollution sources means changing or adjusting land uses and employing sound land use management practices and tech-



**Clean Water Week 2017 celebrated the multitude of benefits clean water affords, and the actions of our partners to achieve healthy lakes, rivers, and wetlands. (Photo credit: Friends of the Winooski River)**

nologies, which require outreach and education. CWIP is working across state government to track the delivery of outreach and technical assistance by state agencies and partner organizations. In 2017, approximately 430 outreach events were held, including workshops, trainings, and public meetings, reaching more than 10,000 attendees and providing over 1,000 hours of education.

- **Municipal Roads Grant-in-Aid:** More than \$2.5 million was awarded to support municipalities' early adoption of the Municipal Roads General Permit (MRGP) Standards, developed to reduce road erosion and associated sediment and phosphorus pollution. Regional planning commissions administered the program and were instrumental in its success. Over 40 miles of roads were brought up to MRGP Standards in one year.

**Rock-lined ditch prevents soil erosion and phosphorus pollution.**



# Lakes and Ponds Program



Shadow Lake, Concord

The Lakes and Ponds Management and Protection Program works to protect, maintain, enhance, and restore the health of Vermont lakes and the public uses that healthy lake ecosystems provide, such as swimming, boating, and fishing. To do this, Lakes and Ponds staff conduct education and outreach, assessment and monitoring, and regulatory programs. A current focus is to preserve or restore the natural lakeshore to protect and improve water quality, aquatic and terrestrial wildlife habitat, and lake ecosystem functions into the future.

## 2017 Program Summary



**Sites Monitored and Assessed:** Lakes and Ponds staff and citizen volunteers collect water and biological samples from dozens of lakes each year. Core monitoring projects track changes in key lake indicators (nutrients, clarity, and chlorophyll) over time, the presence of invasive species, lake warming due to climate change, cyanobacteria bloom frequency, and effects of land use on aquatic life. Regular assessment of this data informs the tactical basin planning process, raises public awareness of land use activities that harm lakes, and provides early warning of new or unexpected threats. Permitted site inspections ensure projects meet permit conditions.

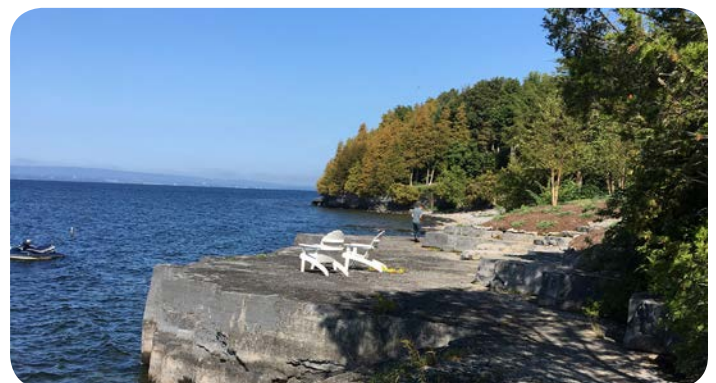
**Project Review and Permitting:** Project review and permitting by program staff increased 10% from 2016 to 2017. This includes review of permit applications as well as projects in which technical assistance redirects activities to avoid resource impacts. Permitting programs include: aquatic nuisance control, lake encroachment, and shoreland protection.

**Outreach, Education, and Training:** Lakes and Ponds staff provide a variety of educational workshops and technical trainings for shoreland property owners, recreational users, contractors, and realtors, often using a train-the-trainer model to broaden outreach impacts. Examples include: aquatic

invasive species spread prevention (Access Area Greeters) and early detection (Vermont Invasive Patrollers), cyanobacteria monitoring, implementation team development, water quality sampling (Lay Monitoring), Natural Shoreland Erosion Control Certification, and shoreland best management practices (Lake Wise).

**Restoration Projects Funded and Implemented:** The 12 projects implemented through the Lake Wise Program included septic improvement, shoreland renaturalization, and shoreland stabilization (see “Lake Wise Practices Benefit Properties and Lakes in 2017” on the following page).

Natural ledge on Lake Champlain.



## Lake Wise Practices Benefit Properties and Lakes in 2017

The Shoreland Protection Act of 2014 prescribed protective measures for the 55% of Vermont shorelines not yet developed. However, it left restoration of previously developed shorelands to voluntary efforts. Replanting cleared areas and stabilizing eroding shorelines are critical actions for protecting water quality and shallow-water habitat, which is important for fish and other aquatic life. The Lake Wise Program provides technical assistance to shoreland property owners seeking to restore previously developed or altered shorelines. Several highlights of the Lake Wise Program in 2017 are described below.

- The Lake Raponda community in Wilmington collaborated to install an erosion control project to protect the town beach and lake. There is still work to do at the Raponda Town Recreational Area to control more of the upland runoff, but for starters, fiber coir rolls and plantings, installed by the Vermont Youth Conservation Corps, have stabilized what had been chunks of grass slumping off the shore and washing into the lake (lawns along the shore are not good for the lake because they don't filter runoff or have roots that grip the bank). Coir fiber is made from coconut husks and often used to make ropes and matting.
- Sand is not stable, especially in man-made beach areas. The town beach at Shadow Lake in Glover was washing into the lake, eroding the beach area and degrading water quality and shallow water habitat. Simply adding more sand to the beach was not a sustainable or ecological solution. To protect the beach and lake, upland stormwater treatments were installed, including plantings along the slope between the road and the recreational area, waterbars in the pathway to the beach, and two rain gardens to help absorb and infiltrate upland runoff.
- Ever since Champion International Paper sold off its land around Maidstone Lake in the Northeast Kingdom in 1998, there has been a surge in private shoreland development. Recently, Maidstone shoreland owners have participated in Lake Wise with assistance from the Essex County Natural Resources Conservation District and the NorthWoods Stewardship Center. Shoreland best management practices (BMPs) used included structural techniques, like waterbars in driveways to slow and dissipate runoff and infiltration stairs to create stable permeable pathways. Several non-structural BMPs were also used, including native plantings that increased storm resilience on properties while providing filtration, bank stability, and wildlife benefits.
- Brighton State Park on Island Pond received a permeable, ADA compliant, meandering pathway through a shoreline stabilized with fiber coir rolls and encapsulated soil lifts held together with hundreds of newly planted native species. Agency of Natural Resources engineers designed this beautiful ecological plan according to Department of Forests, Parks, and Recreation needs and Lake Wise criteria.
- In 2017, two lakes achieved the Lake Wise Gold Award for their work protecting and restoring natural shorelines. On Echo Lake in Charleston and Lake Seymour in Morgan, 15% or more of shoreline owners have participated in the Lake Wise Program. These properties showcase how lake-friendly landscaping benefits the lake, the owner, and the local community.



**ADA compliant path installed at Brighton State Park.**



**Shoreland best management practices at Brighton State Park.**



# Monitoring, Assessment, and Planning Program

The Monitoring, Assessment, and Planning Program (MAPP) integrates three essential components of the division's strategy to prevent water pollution—water quality sampling, assessment, and tactical basin planning. MAPP measures water quality indicators, uses monitoring data to assess the condition of surface waters, then develops tactical basin plans that target waters for enhanced protection or restoration. MAPP also conducts water quality modeling, oversees water quality remediation planning for regulated entities, and maintains a comprehensive water quality database for surface waters statewide.



Macroinvertebrate sample collection at the Saxtons River, just downstream of the village and wastewater treatment facility. Macroinvertebrates, like this stonefly (right), are indicators of stream health and water quality.



## 2017 Program Summary



**Sites Monitored and Assessed:** MAPP monitors and assesses biological and chemical water quality indicators in our rivers and streams. These efforts help us understand current water quality, track changes over time, and evaluate the effectiveness of our regulatory and non-regulatory programs (see “Water Quality Sampling Results Inform Project Identification and Prioritization in the Memphremagog Watershed” on the following page).

**Project Review and Permitting:** MAPP provides the scientific analyses and data that inform our wastewater treatment facility permit limits. MAPP staff collect samples and analyze them to determine nutrient concentrations in the rivers and streams where facilities discharge. This information is then used to establish wastewater treatment facility permit limits to ensure water quality is maintained.

**Outreach, Education, and Training:** MAPP staff offer a diversity of trainings, with a focus on helping partners and members of the public understand water quality issues. These include workshops and outreach on tactical basin planning, clean water projects, and reclassification efforts.

**Restoration Projects Funded and Implemented:** MAPP staff, through water quality sampling, assessment, and modeling, as well as tactical basin planning, identify and prioritize areas for water quality improvement projects. The six projects implemented represent large successes in water quality remediation, including when a previously impaired waterbody attained Vermont State Water Quality Standards.

Division scientist collects data at Pike Hill Brook, Bradford.



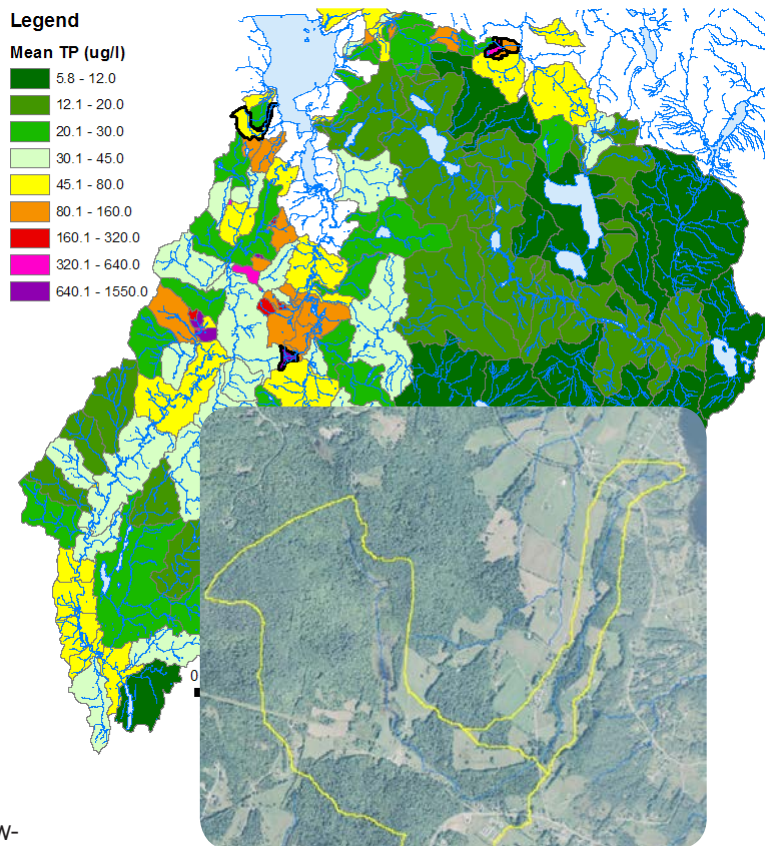
## Water Quality Sampling Results Inform Project Identification and Prioritization in the Memphremagog Watershed

Excess phosphorus in Lake Memphremagog contributes to occasional cyanobacteria (also known as blue-green algae) blooms, and supports increased plant and algae growth that can limit recreational use. Targeted water quality sampling in the Memphremagog watershed has helped identify the most significant phosphorus sources and informed the Memphremagog Tactical Basin Plan, which was finalized in 2017.

The watershed shown at right, known as Strawberry Acres, encompasses 818 acres of agricultural and residential land, along with extensive forests and wetlands, and is a significant source of phosphorus to Lake Memphremagog. Sampling data from the watershed has helped demonstrate to farmers the need to implement best management practices to reduce phosphorus and sediment-laden runoff, and where installation of those practices would be most effective.

With support from the Natural Resources Conservation Service, and technical assistance from MAPP staff and the Orleans County Natural Resources Conservation District, several farmstead and water quality improvement projects were installed at a farm on the Strawberry Acres tributary.

Water quality sampling in the tributary after their installation showed a significant decrease in phosphorus concentrations. Moreover, many of the practices installed to improve water quality, including a new barnyard and pasture watering system, have also improved the overall farm operations and dairy herd health.



**The watershed outlined above, known as Strawberry Acres, encompasses 818 acres of agricultural and residential land, along with extensive forests and wetlands. Water quality sampling demonstrated it was a significant source of phosphorus to Lake Memphremagog.**

**The upgraded barnyard, below, now drains to a manure pit, reducing nutrient runoff to the Strawberry Acres tributary.**



# Rivers Program

The Rivers Program provides technical and regulatory assistance for projects affecting the flows and physical integrity of streams, rivers, river corridors, and floodplains. Two primary objectives guide this work: (1) to avoid and mitigate flood and erosion hazards, and (2) to restore and protect stream processes, floodplain functions, and critical habitat. The Rivers Program carries out stream geomorphic assessments and river corridor planning to support river diagnostics, river corridor easements, channel maintenance and restoration designs, and technical assistance during flood recovery operations. The program also maintains and restores natural stream flows by regulating water withdrawals and hydropower projects, and manages the National Flood Insurance Program (NFIP) for Vermont.



West River, Dummerston

## 2017 Program Summary

**2,769**  
projects reviewed  
**651**  
permits issued

**5,174**  
training  
hours

**477**  
acres  
protected

**397**  
projects  
implemented

**Project Review and Permitting:** Through project review and technical assistance, Rivers Program staff seek a mutually agreeable solution that will lead to a less erosive river overall, where it has room to move and flood with minimal damage to infrastructure. In some cases, a permit is unavoidable, and Rivers staff ensure permit conditions maintain water quality and stream channel stability.

**Outreach, Education, and Training:** Rivers Program outreach increased by 60% from 2016 to 2017. Trainings included: rivers and roads courses on smart road development and culvert design, in partnership with the Agency of Transportation, and certified floodplain managers training.

**Protective Easements and Designations:** Nearly 500 acres were protected in 2017 through river corridor easements and Federal Emergency Management Administration (FEMA) buyouts, improving flood resilience and water quality (see “Reconnected Rivers Enhance Flood Resilience in our Villages and Downtowns” on the following page).

**Restoration Projects Funded and Implemented:** These include restoration and enhancement projects completed in stream channels, as part of flow protection projects, and in floodplains and river corridors.

**The high water mark on the trees in this forested floodplain demonstrates their critical role in attenuating floodwaters.**



## Reconnected Rivers Enhance Flood Resilience in Our Villages and Downtowns

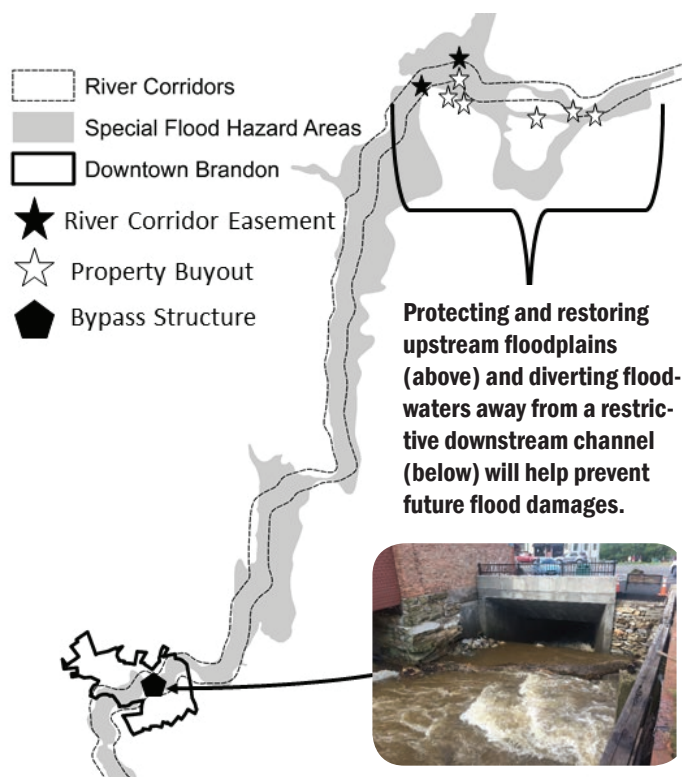
With technical and regulatory assistance from Rivers Program staff, Vermont communities—from Bennington to Brattleboro, Stowe to Montgomery, and Brandon to Barre City—are improving their flood resilience while restoring the natural functions of rivers and floodplains. The program's efforts to reduce damages from flooding and erosion in these villages and downtowns, and to reconnect rivers and floodplains statewide, will reduce the cost of flood recovery over time. Communities will also enjoy enhanced riverside recreation, and the improved water quality and fish and wildlife habitat that result from river and floodplain restoration.

Two projects in Rutland County illustrate this work—one that's just beginning in Clarendon and a second in Brandon that is well underway.

In Clarendon, the Cold River has been historically straightened and bermed after flood events, which has increased flood velocities and left North Clarendon, just downstream, vulnerable to flood damage. The Town of Clarendon, with assistance from the Rivers Program, is reconnecting the Cold River with its floodplain by supporting the berm's removal and, through the establishment of a river corridor easement, allowing the river to redevelop meanders away from developed properties. The town has also expressed interest in adopting a river corridor bylaw, which Rivers Program staff recently explained would protect the river corridor from the impacts of future development during a joint meeting of the Clarendon Planning Commission and Selectboard.

About twenty miles north, the Neshobe River has raged through the Village of Brandon during major floods, damaging both commercial buildings and infrastructure. Other areas of town, like Forest Dale, also have been damaged repeatedly. Lowering the flood heights and velocities in Brandon became the clear objective for the "Vermont Economic Resiliency Initiative," sponsored by the Agency of Commerce and Community Development, with technical assistance from the Rivers Program.

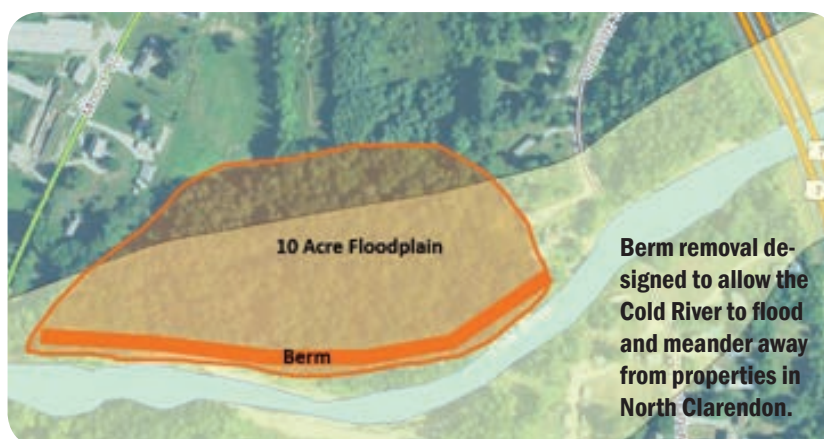
To date, this effort has included the installation of a floodwater bypass structure in Brandon Village, which worked beautifully during the July 1, 2017 flood, and several projects upstream between Brandon Village and Forest Dale. Two river corridor easements, a berm removal, and



**Protecting and restoring upstream floodplains (above) and diverting floodwaters away from a restrictive downstream channel (below) will help prevent future flood damages.**



several property buyouts (some in the application phase) have been executed in the floodplains above Brandon. Giving the Neshobe River room upstream to flood and meander should help reduce flood damages in the more heavily developed areas downstream. The key to maintaining this new resilience will prove to be the river corridor bylaw that Brandon adopted to limit future encroachments in the Neshobe floodplains and meander corridor.



# Stormwater Program

The Stormwater Program provides regulatory oversight and technical assistance to ensure proper design and construction of stormwater treatment and control practices, as well as construction-related erosion prevention and sediment control practices, necessary to minimize the adverse impacts of stormwater runoff to surface waters throughout Vermont. Stormwater Program regulations address discharges from new and existing development, roads, industrial sites, municipal stormwater systems, and construction sites.

## 2017 Program Summary



Town administrator, selectboard member, and road foreman on a Grant-in-Aid site visit in Highgate. (Photo credit: Northwest Regional Planning Commission)



**Sites Monitored and Assessed:** Stormwater permitted sites are inspected by program staff to ensure permit requirements are being upheld, including maintenance of best management practices.

**Project Review and Permitting:** The number of stormwater permits issued annually continues to rise due to an increase in construction activities. Operational permits remain in effect beyond initial project construction and development, and require ongoing compliance oversight and monitoring. The long-term nature of these permit requirements is designed to ensure water quality is maintained. In 2017, there were over 3,800 active stormwater permits. Stormwater staff reviewed 997 total projects, which includes 747 permits issued and 250 determinations. Stormwater permitting programs include: construction, operational, multi-sector, and municipal separate storm sewer system (MS4).

**Outreach, Education, and Training:** Many of the education and training efforts in 2017 focused on the new Vermont Stormwater Management Manual and its updated standards, as well as the new Municipal Roads General Permit requirements (see “Reducing Road-Related Pollution Through Implementation of the Vermont Clean Water Act” on the following page).



Watershed Management Division and Vermont Agency of Transportation staff facilitate discussion on the Municipal Roads General Permit Standards during a Road Roundtable Forum in Bethel.

## Reducing Road-Related Pollution Through Implementation of the Vermont Clean Water Act

Roads and other developed lands are a significant source of nutrient and sediment pollution in Vermont. When rain and snowmelt run off impervious surfaces like parking lots, roadways, and rooftops, instead of being absorbed into the ground, it carries pollutants to nearby waterways, which can threaten the health of our rivers, lakes, and wetlands. The Stormwater Program addresses this stormwater-related pollution from municipalities, industries, and developments through its permitting programs and associated technical assistance.

In 2017, the Stormwater Program developed two new permitting programs designed to help clean up Lake Champlain and protect high quality waters statewide, as required by the Vermont Clean Water Act (Act 64)—the TS4 General Permit and the Municipal Roads General Permit. Both programs will not only significantly reduce road-related runoff, they will also improve the flood resilience of our road networks across Vermont.

The TS4 General Permit covers all state-operated highways, and most other Agency of Transportation (VTrans) facilities like district garages and park-and-rides. The new general permit will result in the installation of best management practices at existing facilities, minimizing water quality impacts from new and expanded roads, and the implementation of “phosphorus control plans” for the portion of state highways in the Lake Champlain basin. Phosphorus control plans will require VTrans to develop and implement projects that reduce phosphorus pollution from their lands.

The Municipal Roads General Permit (MRGP) was developed to improve the condition of municipal roads to reduce road-related stormwater erosion. The MRGP Standards, including maintaining proper road crowning, stone-lining steeper ditches, and properly sizing replaced culverts, will significantly reduce the amount of sediment and nutrients

transported from roads to surface waters. Bringing roads up to MRGP Standards will reduce phosphorus by 40–80%. Implementation of the standards will also improve flood resilience—roads that meet standards can better withstand larger rainstorms.

To assist municipalities in better understanding the requirements of the MRGP and to jump-start implementation, the Stormwater Program and the Clean Water Initiative Program, in partnership with VTrans and regional planning commissions, developed and implemented the municipal roads Grant-in-Aid (GIA) program. The GIA pilot program, administered by regional planning commissions, made funding available to municipalities to proactively implement best management practices, bringing more than 40 miles of roads up to MRGP Standards. It also dramatically reduced grant application, review, and administration time, benefiting both the state and municipalities. More than \$2.5 million supported 186 municipalities in their early adoption of MRGP Standards.

**The Class 4 road demonstration project in Calais (before, left; after, right) included culvert replacement, culvert headwall and stone apron outlet protection installation, stone-lined ditching, road crowning, berm removal, and armored turnouts, bringing this section of road up to the new standards.**



# Wastewater Program

The Wastewater Program is responsible for protecting Vermont's surface waters from discharges of industrial and municipal wastewater and other direct discharges. These discharges can carry chemicals, toxics, and pathogens that are harmful to water quality, fish and wildlife habitat, and public health. If not properly treated and controlled, these discharges can negatively impact surface water quality and limit recreational opportunities. The program's work includes:

**Direct Discharge and Pretreatment Permitting:** Wastewater Program staff administer the federal Clean Water Act's National Pollutant Discharge Elimination System (NPDES) program (delegated by the Environmental Protection Agency

or EPA) for permitting direct discharges to surface waters, including wastewater treatment facility discharges, industrial facility discharges, and other direct discharges. The program is also delegated by EPA to administer the NPDES program for the permitting of industrial wastewater generators that discharge to municipal wastewater treatment facility collection systems.

**Inspection and Compliance Oversight:** The Wastewater Program is responsible for conducting facility inspections of wastewater and industrial facilities, as mandated by federal and state regulations. Staff provide compliance oversight of facilities and ensure compliance with permit limits and conditions. Staff also provide technical assistance to facilities.

## 2017 Program Summary



**Sites Monitored and Assessed:** Wastewater permitted sites are inspected to ensure facilities are operating in accordance with their permit requirements. As a part of these inspections, staff review facility operations, validate monitoring data reported by facilities, and collect samples for independent assessment, as needed. In addition to sites monitored through inspections, program staff also provide oversight of wastewater permitted sites by reviewing monitoring reports and providing technical assistance to operators, all of which help ensure permit requirements are being met and water quality is maintained.

**Project Review and Permitting:** The program has 230 active permits, and in 2017, staff issued or renewed 28 of these and made 5 determinations. In total, staff reviewed 33 projects. With the finalization of the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL), the Wastewater Program is now issuing municipal permits in the Lake Champlain basin under the new TMDL requirements (see "New Wastewater Permits Lower Phosphorus Limits for Nine Facilities in the Lake Champlain Basin" on the following page).

**Outreach, Education, and Training:** Wastewater Program staff provided education and training to municipal officials and wastewater treatment facility operators on the new permit standards and reporting requirements.

**At the Montpelier Wastewater Treatment Facility, clarifiers remove total suspended solids from untreated wastewater.**



## New Wastewater Permits Lower Phosphorus Limits for Nine Facilities in the Lake Champlain Basin

As mentioned on the previous page, the Wastewater Program is responsible for protecting Vermont's surface waters from direct discharges. Through permitting and technical assistance, the Wastewater Program ensures these direct discharges are properly treated and controlled, avoiding potential impacts to lake and river health, and recreational use and enjoyment.

In 2017, the Wastewater Program issued nine permits to wastewater treatment facilities in the Lake Champlain watershed, which reduce the allowable phosphorus discharges by 15,235 pounds annually. In total, 59 wastewater treatment facilities contribute phosphorus to Lake Champlain in Vermont, though they comprise a very small percentage of the phosphorus load in the watershed—approximately 3%.

The Wastewater Program is issuing new permits for these facilities on a five-year rotation, coinciding with the tactical basin planning cycle. The new permits will meet wasteload allocations developed by the Environmental Protection Agency and outlined in the Vermont Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) Phase 1 Implementation Plan, which describes the actions needed to meet phosphorus pollution targets in the Lake Champlain basin. A few facilities that discharge into nutrient impaired rivers and streams will have stricter phosphorus limits than those required by the TMDL.

Wastewater Program staff supported municipalities throughout the permit issuance process. They conducted several trainings in conjunction with the Vermont Rural Water Association (VRWA) that covered the stricter phosphorus limits, changes to the permits since they

were last issued, and how recent updates to the Nutrient Criteria of Vermont's Inland Lakes and Wadeable Streams might impact their facilities. These trainings included "Wastewater Phosphorus Removal Options," "Interpreting Your Permit," and "Phosphorus Optimization Plan Workshop." Program staff also presented at the biannual Green Mountain Water Environment Association meeting and annual VRWA meeting.



**At the Montpelier facility, secondary clarifiers provide a final settling area for material from the aeration basin. Effluent flows over the secondary clarifier weirs to be disinfected and is then safe to be discharged to the Winooski River.**

**The main wastewater treatment facility in Burlington, located on the waterfront, treats approximately 4 million gallons per day.**





# Wetlands Program

Wetlands, commonly called swamps, marshes, or bogs, are transitional areas between open water and land. Wetlands provide important ecosystem services such as flood protection, water quality improvement, and wildlife habitat.

The mission of the Wetlands Program is to identify, monitor, and protect wetlands that provide significant functions and values; to encourage the restoration and enhancement of impaired wetlands; and to teach Vermonters about wetland issues and the importance of wetland stewardship. The program also has a goal of no net loss of wetland acreage, function, or value.

The Wetlands Program is responsible for the administration and implementation of the Vermont Wetland Rules, which require permitting for certain activities within wetlands or their buffer zone. In accordance with these rules, the program provides advisory recommendations on Act 250 projects with potential wetland impacts to the District Environmental Commissions, and reviews wetland projects that fall under federal jurisdiction (Section 404 of the Clean Water Act) to ensure that Vermont State Water Quality Standards are met.

## 2017 Program Summary



**Project Review and Permitting:** A strength of the Wetlands Program is providing technical assistance to landowners or developers that results in the avoidance of wetlands and therefore water quality impacts. In some cases, wetland impacts are unavoidable and a permit is issued. These permits ensure wetland functions and values are maintained.

**Outreach, Education, and Training:** Education and training opportunities offered by Wetlands Program staff increased greatly this past year. Trainings focused largely on the Vermont Wetland Rules and Class I designations. Wetlands staff also provided workshops and outreach materials on wetland functions and values, such as water quality protection, flood storage, and erosion control.



**Protective Easements and Designations:** The designation of three Class I wetlands accounted for 1,585 acres (see “Class I Wetland Protections Double in 2017” on the following page). Class I wetland designations protect exceptional or irreplaceable wetlands from impacts. The remaining 89 acres were protected through wetland easements.

**Restoration Projects Funded and Implemented:** Projects included wetland and buffer restoration.



Before (left) and after (right) wetlands restoration.



## Class I Wetland Protections Double in 2017

Wetlands provide vital functions and values—habitat for fish, wildlife, and plants (including rare species); flood control; water quality protection; aquifer recharge; and recreational opportunities.

Class I designations are reserved for those wetlands that are exceptional or irreplaceable in their contribution to Vermont's natural heritage. They are protected from impacts unless there is a compelling need to protect public health or safety. Class I wetlands also receive a larger protected buffer zone.

In 2012, the Agency of Natural Resources was given rulemaking authority over the Vermont Wetland Rules, including the ability to initiate Class I wetland protection. Since 2012, the program has assessed over 30 wetlands potentially eligible for Class I designation.

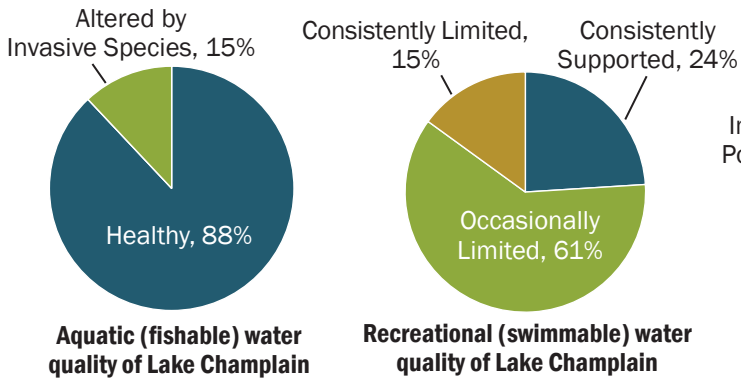
In 2017, the Vermont Wetland Rules were updated to include three new Class I wetlands, more than doubling the area with this protection from 1,010 acres to 2,595. The program has filed rulemaking for two additional Class I wetlands and continues to evaluate eligible wetlands throughout the state.

# Measuring Our Impact: Statewide Indicators

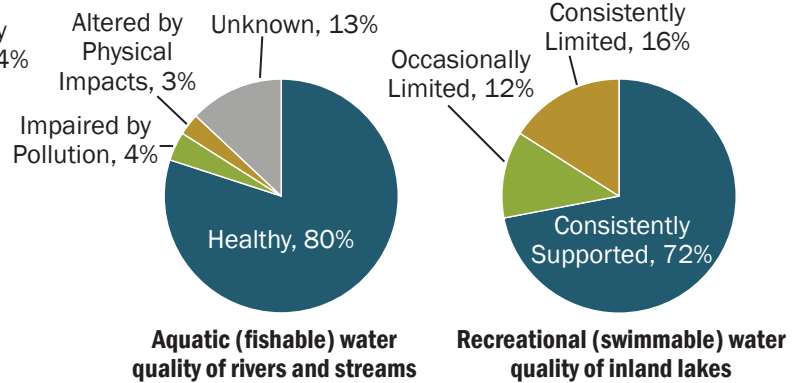
Statewide water quality indicators, informed by monitoring and assessment data, help us understand the effectiveness of our pollution prevention tools. Below are the percentages of waters that meet Vermont State Water Quality Standards. It's important to remember, for large waterbodies like Lake Champlain (below, left), we are not likely to see significant changes in water quality for many

years. Where we may see changes over a shorter time-frame are in our smaller lakes and streams (summarized statewide below, right). Recent assessment of long-term monitoring data highlights changes in inland lake water quality that are informing future management actions (see "Phosphorus Increasing in Lowest Nutrient Lakes and Decreasing in Nutrient Rich Lakes").

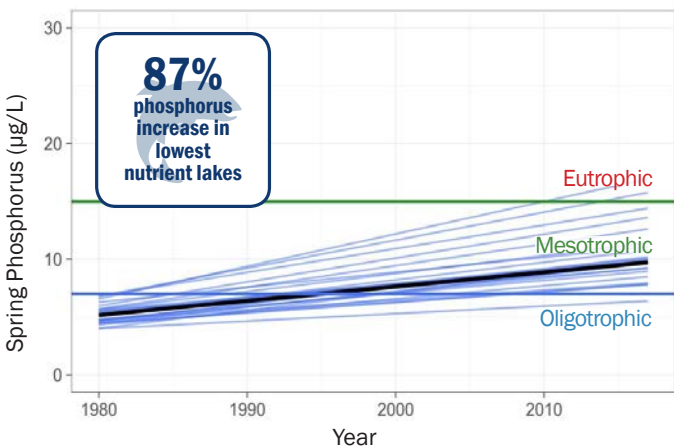
**Percent of Lake Champlain Meeting Water Quality Standards**



**Percent of Inland Waters Meeting Water Quality Standards**

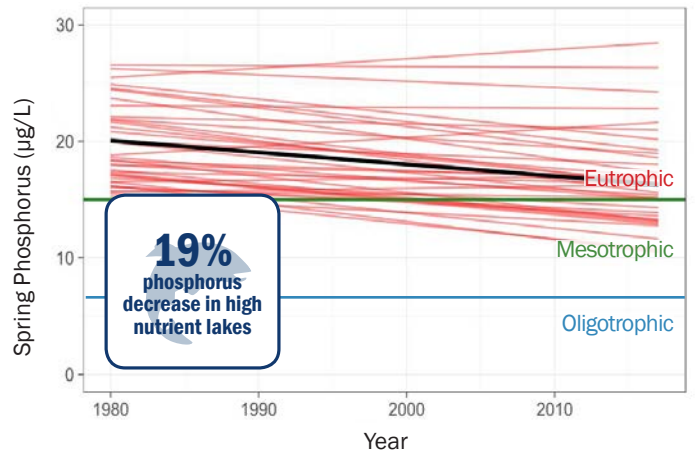


## Phosphorus Increasing in Lowest Nutrient Lakes and Decreasing in Nutrient Rich Lakes



Division staff have monitored spring phosphorus concentrations in Vermont lakes for more than 40 years. Phosphorus is a nutrient essential for all life, but too much can lead to poor water quality and frequent algae blooms. Lakes naturally accumulate phosphorus as they age; however, human activity significantly increases the amount that reaches our lakes.

Evaluation of long-term trends with models utilizing the monitoring data indicates that all of Vermont's low phosphorus (oligotrophic) lakes now have much higher phosphorus concentrations than they did 40 years ago. Nearly all inland lakes now fall into the moderate phosphorus (mesotrophic) category. Over that same period, one out of four of Ver-



mont's nutrient-rich (eutrophic) lakes experienced a decline in phosphorus concentration. Many of these are also now in the mesotrophic category.

Division scientists and partners are investigating what might be causing phosphorus to increase in our oligotrophic lakes. Since monitoring began, more than half of Vermont's lakeshores have been developed, frequently in ways that increase the amount of phosphorus reaching the water. Land use changes in the watershed and along streams also play a role. Going forward, we will continue to employ strategic, targeted restoration tools to improve our eutrophic lakes while focusing protective measures around our oligotrophic lakes.

