

Vermont Clean and Clear Action Plan 2009 Annual Report



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Vermont Agency of Natural Resources
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Executive Summary

The Vermont Clean and Clear Action Plan was initiated in 2003 with the goal of accelerating the reduction of phosphorus pollution in Lake Champlain and reducing related pollutants in waters statewide. Vermont, in conjunction with our federal, municipal, and non-government partners, has made an unprecedented commitment to Lake Champlain. Under the Clean and Clear program, the state has invested more than \$50 million dollars in its efforts to improve water quality in the lake, and in turn has leveraged an additional \$52 million in federal funding. As a result, the Agencies of Natural Resources, Agriculture, and Transportation have been able to greatly expand their programs to implement the phosphorus loading reductions outlined in the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL), and to address similar water quality needs statewide.

Each year since the initiation of Clean and Clear, these agencies have jointly prepared an annual report describing the broad scope of the Clean and Clear effort and the accomplishments to date. Act 130 of the 2008 legislative session established a requirement that the Agency of Natural Resources continue to submit to the Legislature an annual *“Clean and Clear program summary reporting on activities and measures of progress for each program supported by funding under the Clean and Clear Action Plan.”* This report is submitted in accordance with the requirements of 10 V.S.A. §1386(d).

Center for Clean and Clear

The Center for Clean and Clear was established in May 2007 to enhance Vermont’s commitment to improve water quality in Lake Champlain by placing the resources dedicated to water quality in Lake Champlain under a single Director. The Center established a multi-agency core group to ensure a coordinated, collaborative approach, calling on our partners and reaching out to broad public and private constituencies. In addition to staff from AAFM and all three of ANR’s departments, the core work group involves representatives from the U.S. Natural Resources Conservation Service and the U.S. Fish and Wildlife Service.

The Center also operates an Ecosystem Restoration Grants Program, focusing on projects to improve stream function and stability, restore riparian wetlands for water quality and wildlife benefits, and control stormwater runoff from developed land. Since 2007, the Center has received more than 200 proposals and awarded partial or full funding to over 100 ecosystem restoration projects.

The Center recently completed a revised implementation plan for the Lake Champlain Phosphorus TMDL, which was sent to the General Assembly on January 15, 2010. This was a significant undertaking which involved technical staff from multiple departments and agencies, and public participation by over 300 Vermonters.

The Center also provided leadership in drafting revisions to the Lake Champlain Basin Program management plan *Opportunities for Action*. The Center Director worked to ensure a high degree of commonality between the priorities established in the revised TMDL implementation plan and the forthcoming version of *Opportunities for Action*, and encouraged partners in New York, Quebec, and federal agencies to develop similar commitments to phosphorus reduction.

Agencies of Natural Resources and Transportation Programs

The Agency of Natural Resources administers a broad variety of Clean and Clear programs within the Departments of Environmental Conservation, Forests, Parks, and Recreation, and Fish and Wildlife. The Agency of Transportation administers the Vermont Better Backroads Program in cooperation with the Agency of Natural Resources and other program partners. These programs are aimed primarily at reducing nonpoint source nutrient and sediment pollution, but most have other environmental and economic benefits as well.

Wastewater Discharges

Vermont's long-term commitment to upgrade wastewater treatment facilities for phosphorus removal has resulted in an 83% decrease in wastewater phosphorus loading to Lake Champlain from Vermont facilities since 1991, and represents a major success story. The total wastewater phosphorus load to Lake Champlain from Vermont's 60 treatment facilities was 21.1 metric tons per year during 2008, well below the aggregate limit of 55.8 metric tons per year specified in the Lake Champlain Phosphorus TMDL. There is only one municipal facility (Waterbury) still needing an upgrade in order to meet its phosphorus wasteload allocation under the TMDL, and this project will soon complete preliminary engineering to establish the basis of design.

River Management

Analysis of stream geomorphic assessment data collected during the first six years of the Clean and Clear Program is providing important insights regarding the condition of Vermont's streams and rivers. Of the nearly 1,400 assessed river miles in Vermont, nearly three-quarters (74%) have become confined to deeper, straighter channels and no longer have access to historic floodplains. In response, the program now emphasizes an avoidance strategy in order to one day get ahead of the decline in river stability by promoting and investing in river corridor protection.

Corridor protection in combination with the active removal of physical constraints (e.g., berms, floodplain fills, and undersized bridges/culverts) are the mainstays of the River Management Program restoration efforts. For example, soils were excavated to create a floodplain along 2,000 feet of Wanzer Brook in Fairfield which had become deeply incised. The quantity of soils deposited on the new floodplain contained 5.9 metric tons of total phosphorus.

The River Management Program, in collaboration with the state's regional planning commissions, leverages Clean and Clear funding annually to attract Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation Program planning grants to support corridor protection. A River Corridor Easement Program has been established in Vermont to conserve river reaches identified as high priority sediment and nutrient attenuation areas. To date, the program and land trusts have or will shortly secure easements on 12.35 miles of river, reconnecting streams to over 450 acres of floodplain.

River Management Program engineers, floodplain managers and scientists provide technical assistance and state funding, and use FEMA flood hazard and pre-disaster mitigation grants, to assist non-government entities and municipalities with the planning and implementation of flood and erosion hazard mitigation projects. To date, 69 communities have completed draft fluvial erosion hazard maps, and nine communities have adopted fluvial erosion hazard language and/or maps as municipal ordinances.

The River Management Program provides technical assistance and grants to a variety of watershed organizations to pursue a sequence of river assessment, project identification, project development, and project implementation, all based on fluvial geomorphic principles. A total of \$569,000 in of Ecosystem Restoration grant funds was awarded for river related projects during 2009.

Better Backroads

A total of \$397,000 in Better Backroads Program grant funds was awarded to Vermont towns and other organizations in 2009 for inventories, capital budget planning, and erosion correction projects, including the stabilization of ditches, culverts, and roadside banks. The Vermont Better Backroads Program continues to grow annually, with 65 new towns participating with Clean and Clear funding between 2005 and 2009. Statewide, 63% of Vermont towns have applied for and received a grant at some point.

Stormwater Management

The Stormwater Management Program issued 193 individual or general permits for new developments or redevelopment projects in 2009, of which 175 were operational general permits. In 2009, Stormwater Program staff conducted 147 operational site visits, of which 57% were generally compliant.

In 2003, the Stormwater Program commenced an effort to address a backlog of 1,757 expired permits. As of December 2009, there are fewer than 20 outstanding permits out of over 2,700 permitted facilities.

As of November 2009, all twelve of the lowland (non-mountain) TMDLs for stormwater-impaired watersheds have been approved by EPA. To develop the basis for the implementation plans for these TMDLs, the DEC undertook a multi-year effort to fully characterize these watersheds, and to establish a process for developing the most cost-effective remediation strategies. This process resulted in The Agency's November 2009 plan titled "*Final Report - A Framework for Remediation of Vermont's Stormwater-Impaired Waters.*"

With support from the Clean and Clear program, Stone Environmental, Inc. and the Vermont DEC have collaborated on illicit discharge and detection elimination studies in the Missisquoi and Winooski River basins. To date, seven illicit wastewater discharges have been located and have been or will soon be eliminated.

Erosion Control at Construction Sites

The total acreage of planned disturbance permitted in 2009 under the Construction General Permit (2,059 acres) was substantial, despite a decrease in new housing starts. The Stormwater Management Program conducted a total of 60 construction site visits during 2009. Construction site visits declined in 2009 from previous years due to a decrease in available staff and a decline in total construction activity. In response to instances of significant non-compliance, the Stormwater Program participated in the issuance of approximately six Notices of Alleged Violation (NOAV) during 2009, and was involved in several formal enforcement actions. However, compliance remains an area in need of additional focus.

Local Municipal Actions

The Vermont League of Cities and Towns (VLCT) Water Quality Coordinator has continued to work with towns primarily in the Lake Champlain Basin providing technical assistance to support water quality enhancements to town zoning regulations and other municipal ordinances. In 2009, the Coordinator provided assistance to 45 towns within the Lake Champlain Basin and nine towns outside the basin.

The VLCT Water Quality Coordinator completed the necessary training during 2009 and achieved the designation of Certified Floodplain Manager from the Association of State Floodplain Managers. The Coordinator is now qualified to assist municipalities in reviewing their existing flood hazard regulations and recommending enhancements that will better protect floodplains and their values as well as decrease the risk of inundation and flood erosion hazards in communities.

In 2009, the VLCT Water Quality Coordinator helped eight communities in Chittenden and Washington Counties exceed minimum NFIP standards through updating their flood hazard regulations. In addition to decreasing exposure to inundation and flood erosion hazards, these enhanced flood hazard regulations will better protect the sediment and nutrient attenuation capacity of floodplains in the Lake Champlain Basin.

Based on an evaluation of the most current town zoning or other applicable regulations, 29 out of the 136 towns in the Lake Champlain Basin are considered to have fully met criteria for having “good” local regulations in place for water quality protection. Other towns have adopted some, but not all elements of good water quality protection in their regulations.

Wetland Protection and Restoration

To date, through the Clean and Clear program, Vermont has dedicated \$1 million to wetland protection and restoration projects. In addition, changes enacted as part of the 2008 Farm Bill dramatically increased the amount of federal funding available for wetland protection and restoration through the Wetlands Reserve Program (WRP). The 2008 Farm Bill has made available more than \$2 million annually for Vermont projects - representing a five-fold increase in available federal funds. As a result of the unprecedented levels of federal funding and interest in WRP, Clean and Clear has shifted its focus to the active support of NRCS in seeking new sign-ups for WRP. The rate at which wetland protection and restoration projects are being developed and completed has greatly accelerated with the availability of WRP funds. The program had approximately 315 acres of new sign-ups for wetland restoration projects during 2008, and an additional 940 acres were enrolled in 2009.

Forest Watershed Management

Department of Forests, Parks, and Recreation staff continued to work with the Vermont forest industry to support compliance with Forestry Acceptable Management Practices (AMP's) for maintaining water quality. Technical assistance was provided to forest landowners and loggers during investigations of possible violations. Department staff also conducted and participated in AMP and Forest Water Quality workshops for loggers and landowners each year. These workshops attracted 144 participants during 2009.

The Portable Skidder Bridge Initiative provided opportunities for loggers to loan or rent bridges for temporary stream crossings on log jobs to protect water quality. During 2009, nearly 20

bridges were rented or loaned for use by loggers. Demand for bridges and logger participation in this program is expected to increase.

St. Albans Bay Internal Phosphorus Loading Control

The Agency of Natural Resources has worked with the U.S. Army Corps of Engineers and the Lake Champlain Basin Program to secure technical approval and funding under Section 542 of the U.S. Water Resources Development Act of 2000 for Phase 2 of the Feasibility Study for Control of Internal Phosphorus Loading in St. Albans Bay. The specific treatment alternatives that will be the focus of the Phase 2 analysis are (1) phosphorus inactivation of the sediments within the Black Creek Wetland and inner St. Albans Bay using aluminum compounds (alum and sodium aluminate), and (2) hydraulic dredging of an area limited to the open-water portion of the Black Creek Wetland. By proceeding with feasibility studies for the control of internal loading concurrently with renewed efforts to reduce nonpoint source loads from the bay's watershed, a future in-lake treatment could be closer to realization once a judgment is made that watershed loads are sufficiently reduced to justify such a treatment. A Project Management Plan is currently in preparation by the Corps of Engineers. It is expected that the Phase 2 study will begin during 2010.

Monitoring and Research

Much of the monitoring and research work related to the Clean and Clear Program is being done in close cooperation with the Lake Champlain Basin Program. Data collected as part of the Lake Champlain Long-Term Water Quality and Biological Monitoring Program were analyzed and presented in a December 2009 technical report titled "*Lake Champlain phosphorus concentrations and loading rates, 1990-2008.*"

Close to 100 volunteers were involved in the Vermont Lay Monitoring Program during 2009. Since 1979, volunteers have obtained valuable water quality data on 79 of Vermont's inland lakes and 40 stations on Lake Champlain. The Vermont Lay Monitoring Program also conducts a unique professional development program for teachers called "A Watershed for Every Classroom," which is offered to educators teaching in the Lake Champlain Basin.

The Agency of Natural Resources conducted a special one-year sampling program during 2008-2009 to identify tributaries to the Rock River within the Missisquoi Bay watershed that are contributing the highest amounts of phosphorus and other pollutants. The Agency of Natural Resources is working with the Agency of Agriculture, Food, and Markets and the U.S. Natural Resource Conservation Service to obtain and analyze a variety of relevant geospatial data for the Rock River watershed in order to identify the catchment areas that contribute the highest pollutant levels, and the features of those catchments that are most responsible.

Clean and Clear funds were combined with additional funding from the Lake Champlain Basin Program to support a research project at the University of Vermont on "*An Environmental Accounting System to Track Nonpoint Source Phosphorus Pollution in the Lake Champlain Basin.*" A draft final report from this project was issued in December 2009 and is currently under technical review.

DEC Watershed Initiative

In 2009, draft water quality management plans for the drainages emptying into northern Lake Champlain and the Lamoille River were finalized and approved by the ANR Secretary. The plans are labeled as draft and approved (versus final and adopted) as these documents do not contain recommendations for water management typing.

The five DEC Watershed Coordinators play a critical role in making these plans into reality. Three of the five Watershed Coordinators are engaged in water quality management planning and project implementation in the seven river basins that empty into Lake Champlain.

Work continued with the Province of Quebec to address pollution problems in the waters that drain to Lake Memphremagog. Basin planning continued in the Otter Creek drainage, Southern Lake Champlain Direct, Winooski, and Ottauquechee/Black River watersheds. Basin planning efforts to revise the 2002 White River Plan began in 2009.

In addition to conducting the statutorily-required basin planning activities, DEC Watershed Coordinators are actively working with watershed councils, stream teams, watershed groups, other state and federal agencies, landowners, and other stakeholders to address water quality problems and threats throughout the state. In 2009, the five DEC Watershed Coordinators engaged close to 1,800 people across Vermont in forums and meetings designed to generate participation in projects, and developed or substantially assisted with dozens of watershed projects.

Agency of Agriculture, Food and Markets Programs

The Agency of Agriculture, Food and Markets (VAAFM) 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 farms meet, or exceed, the standards established by the federal water quality regulations (the Clean Water Act and Concentrated Animal Feeding Operation (CAFO) rules) while providing the financial and technical tools in order to do so.

Regulatory Programs

The water quality regulatory programs are set up in a three-tiered structure that is designed to provide a logical progression in regulatory oversight as a farm grows from a small farm to a large farm operation.

Accepted Agricultural Practices (AAPs)

Originally implemented in 1995, the AAPs were revised in the current 2006 rule in order to meet evolving water quality needs. The AAPs are the base-level of management required of all farms. Under these rules, farms are prohibited from having a production area discharge of wastes to surface waters and are required to implement erosion, sediment, and nutrient control measures for their farmland. The AAPs are intended to be low-cost, low-tech solutions to improving water quality and are not intended to require a capital investment.

Medium Farm Operations (MFO) Program

In response to federal CAFO rule-making in 2003, VAAFM developed the Medium and Small Farm Rules for Issuance of General and Individual Permits (MFO Rules) in April 2006 and issued the General Permit for Medium Farm Operations (MFO GP) in February 2007. The MFO Rules require all medium-sized farms, for instance those dairies with 200-699 mature animals, to seek coverage under, and meet the conditions of, the MFO GP. Like the AAPs, the MFO GP prohibits production area discharges to surface waters. In addition, the MFO GP requires that manure, compost, and other wastes be applied according to a Nutrient Management Plan that meets the USDA Natural Resource Conservation Service standard for nutrient management ("590 Standard"). A total of 155 farms have sought coverage under the MFO since February 2007 and Initial Facility Evaluations were completed on all farms last year to ensure these farms are complying with the permit.

Large Farm Operations (LFO) Program

Environmental regulation of Vermont's largest farms began in 1997 and underwent a substantial revision in November 2007 with the adoption of new Rules. There are 20 permitted LFOs statewide and the majority of them are dairy operations with greater than 1,000 animals. Like the MFO General Permit, the LFO Rules prohibit production area discharges to surface waters and requires farms to operate according to a "590 Standard" Nutrient Management Plan. However, LFOs are each required to operate under an individual permit and are regulated for odor, noise, traffic, flies, insects, flies, and other pests. The 2007 LFO Rule revision addresses new statutory requirements for advisory groups, siting and setbacks for new barns, groundwater investigation procedures, updated operation and maintenance requirements, and updated engineering and design requirements.

Financial and Technical Assistance Programs

In addition to implementing regulatory programs to protect Vermont's waters, VAAFM offers several financial and technical assistance programs in order to help the agricultural community meet these responsibilities. Farmers can receive assistance for structural production area improvements, groundwater testing, buffer installation along streams, and Nutrient Management Plan development and implementation.

Best Management Practices (BMP)/Alternative Manure Management (AMM) Program

The BMP program provides financial cost-share assistance for the implementation of practices that allow for more efficient use of manure nutrients and proper handling of agricultural wastes in order to improve water quality and help farmers comply with regulations. Typically these practices require a substantial capital investment and otherwise would not be affordable without the state's assistance. Common practices include manure storage facilities, silage leachate collection and treatment systems, and clean water diversions. Through the BMP program, farmers who are not receiving other financial assistance can receive 50% to 80% of the cost of implementing a single practice up to a \$50,000 cap, and multiple practices up to \$75,000 per farm. For projects that have been deemed as a significant water quality improvement and completed in 2009, the project was eligible to receive up to 90% of the approved cost of installation. In an effort to increase the buying power of state capital funds, the state partners

with other programs such as the USDA Natural Resources Conservation Service's Environmental Quality Incentives Program, which also helps reduce the costs to the farmer.

The BMP program worked directly with 37 farms to install engineering practices. Approximately \$1,400,000 was awarded to these farms in fiscal year 2009 with an average grant award of \$40,000 per farm. Twelve farms received 90% cost-share for projects that provided significant water quality improvements. Roughly half of the farm projects implemented silage leachate collection and treatment systems or diversion of clean water around silage bunkers.

Similar to the BMP program, the AMM program provides financial assistance to more efficiently use manure nutrients on farms and to help improve the handling of agricultural wastes to reduce the overall risks to water quality. However, AMM projects are demonstrations that help to develop new waste management technologies. Of the \$1.4 million spent in the BMP program, approximately \$165,000 was committed for alternative manure management. The majority of the AMM practices contracted are anaerobic digesters; however one manure separator was installed.

Nutrient Management Plan Incentive Grant (NMPIG) Program

Established in 2005, the NMPIG program was developed to help farmers meet the demand for nutrient management created by the new MFO Rules and anticipated LFO Rule revision. NMPIG grants span four years and include a payment for the development of a Nutrient Management Plan (NMP) and an additional three years of plan updates. Grants in fiscal year 2009 provided \$9/acre, \$15/soil test, and \$35/manure test for plan development, and \$5,000 for three years of plan update, up to a maximum of \$14,000 per farm.

From FY 2005 through 2009, 249 grants have been approved to receive cost-share funding for implementing NMPs on more than 134,000 acres statewide. The total state funding allocation for these grants equals \$2,201,138, which includes the cost of development and then three years of update maintenance costs. So far 178 grants totaling roughly 102,311 acres have completed the process of developing a nutrient management plan and were reimbursed for the plan development costs. Of these, 110 grants have completed at least one annual update and received the first reimbursement payment from the Agency. In 2009, 11 grants were approved for cost-share funding pending the approval of the final nutrient management plan. A total of \$104,518 was allocated to these 11 plans, which again includes the development and update payment amounts.

Farm Agronomic Practices (FAP) Program

The FAP program was first made available in 2006 to help farmers implement those practices typically required when implementing a NMP. These soil-based practices improve soil quality, increase crop production, and reduce erosion and agricultural runoff from cropland. In 2009, farmers could have received \$30/acre for cover cropping, \$25/acre for conservation crop rotation, \$25/acre for strip cropping, \$10/acre for cross-slope tillage, \$10/acre for conservation tillage, \$8/test for pre-sidedress soil nitrate test, and \$3/acre to update an existing NMP through the FAP program. Funding for NMP maintenance and update will continue to be increasingly important as farmers' NMP Incentive Grants expire and continued assistance is needed to keep the plans current.

Fiscal year 2009 exceeded 6,500 acres of cover cropping and nearly 260 acres of conservation crop rotation. Fiscal year 2010 is already proving to be another record year for the program. To

date, enrollment has increased compared to fiscal year 2009 and for the first time all allocated program funds have been obligated for FAP Program practices.

Conservation Reserve Enhancement Program (CREP) and Vermont Agricultural Buffer Program (VABP)

By establishing perennially vegetated buffers between agricultural land and surface waters, sediment-bound phosphorus in runoff can be intercepted before it reaches water. The Conservation Reserve Enhancement Program, a partnership with the USDA and U.S. Fish and Wildlife Service, provides financial compensation in order to encourage farmers to install these buffers and maintain them for 15 or 30 years. The compensation attempts to cover the replacement costs of the lost agricultural production and is paid in the form of rental and incentive payments. Enrollment in 2009 (220.1 acres) was down compared to 2008 (338.7 acres), however 2010 enrollment started out very strong with 264.5 acres to date, an indication that many of the 2009 contracts were completed in the next fiscal year. Total enrollment (2002 through the end of fiscal year 2009) has reached 2,313 acres statewide.

VABP is similar to CREP as it provides financial compensation for the installation and maintenance of vegetated buffers along surface waters. Unlike CREP, VABP allows farmers to harvest the buffer at certain times of the year. Because CREP offers higher incentive payments, it remains the dominant of the two programs. In 2010, the Agency of Agriculture hopes to expand the potential of the VABP program to make intermittent streams and ditches eligible for filter strips and to add water and sediment control basins as a practice that can be installed in ditch networks. These changes will help address erosion issues by improving ditch maintenance.

Pesticide and Groundwater Monitoring Program

The Pesticide and Groundwater Monitoring Program provides drinking water testing and technical assistance at no cost to farmers and their neighbors. The program was founded to investigate the quality of drinking water on Vermont farms because of concerns for the potential contamination of groundwater by pesticides. The program was expanded to test for nitrate and has found this to be a more common drinking water contaminant. Since 1986, the program has sampled 1,830 private drinking water supplies in 186 towns representing each of Vermont's 14 counties. The number of nitrate violations above the 10 ppm standard has steadily decreased during each of the five-year rolling averages for each period since 2002-2006.

Introduction

Vermont's Clean and Clear Action Plan was initiated in 2003 with the goal of accelerating the reduction of phosphorus pollution in Lake Champlain and reducing related pollutants in waters statewide. The Clean and Clear Action Plan involves implementation of a suite of programs, most based in either the Agency of Natural Resources or the Agency of Agriculture, Food, and Markets, that support the pollution reduction blueprint forged in the Lake Champlain Phosphorus TMDL, as approved by the U.S. Environmental Protection Agency. In general, these programs are designed to better manage the landscape in order to "turn off the spigot" and reduce the annual load of phosphorus pollution being delivered to Lake Champlain. The state has appropriated more than \$50 million for Clean and Clear over the first six years of this effort, and Vermont's commitment to Clean and Clear has stimulated an additional \$52 million in federal funds for supporting programs.

Each year since the initiation of Clean and Clear, these agencies have jointly prepared an annual report describing the broad scope of the Clean and Clear effort and the accomplishments to date. State law (10 V.S.A. §1386(d)) now directs that *"Beginning February 1, 2009 and annually thereafter, the secretary shall submit ... a clean and clear program summary reporting on activities and measures of progress for each program supported by funding under the Clean and Clear Action Plan."*

To address this requirement, this report provides a program-by-program summary of Clean and Clear funded activities and measures of progress through 2009. Each program chapter includes a description of the phosphorus generating processes that the program is addressing, an overview of the program structure, a summary of accomplishments during 2009 and previous years, and indicators of progress.

Programs and projects funded through Clean and Clear include efforts to install the necessary structures in barnyards to prevent direct farmstead discharges, minimize the further loss of floodplain function in order to maximize watershed storage of sediment and nutrients, reduce stormwater erosion in urban and suburban areas as well as along backroads, and eliminate discharges of improperly or untreated sewage. Since its inception in 2004, the Clean and Clear program has supported hundreds of water quality projects throughout the state that include: using financial incentives to "green-up" municipal infrastructure projects to incorporate stormwater management and treatment in towns from St. Albans to Burlington to Benson; planting more than 7,000 acres of annual cropland with a cover crop of winter rye to reduce spring erosion and improve soil health; and partnering with the ECHO Lake Aquarium and Science Center to create a working demonstration project – installing stormwater management practices that will become interpretative exhibits in a "science park."

In 2009, the Agency of Natural Resources also undertook an extensive public process to revise the implementation plan for the Lake Champlain Phosphorus TMDL. The Agency engaged a broad-based group of stakeholders in evaluating threats to Lake Champlain water quality and in identifying and prioritizing strategies for water quality improvement. In all, more than 300 Vermonters participated in and supported the Agency's effort to revise the implementation plan, which will guide Clean and Clear and the related water quality programs for years to come. The revised implementation plan was delivered to the General Assembly under separate cover on January 15, 2010.

Center for Clean and Clear

The Center for Clean and Clear (“the Center” or “CCC”) was established in May 2007, to enhance Vermont’s commitment to improve water quality in Lake Champlain by placing the resources dedicated to improving water quality in Lake Champlain – resources that are currently spread through many state programs – under a single director. Over the past two and a half years, the Center has established a functional structure that has resulted in strong lines of communication across programs, departments, agencies, and organizations. Key roles that Center staff played in 2009 are described below.

Multi-Agency Coordination Activities

The lead agencies within the Center – those of Natural Resources (ANR) and Agriculture, Food, and Markets (AAFM) – have formed a core group to ensure a coordinated, collaborative approach, calling on our partners and reaching out to broad public and private constituencies.

In addition to staff from AAFM and all three of ANR’s departments – Environmental Conservation, Fish & Wildlife, and Forests, Parks & Recreation – the core work group has involved representatives from the U.S. Natural Resources Conservation Service (NRCS) and the U.S. Fish and Wildlife Service. There is great value in periodically bringing together all of the parties working in a particular area, so in addition, and as appropriate, representatives from watershed groups and other nonprofit organizations, such as conservation districts and regional planning commissions, have participated in work sessions. Work sessions typically address geographic- or program-specific needs and opportunities, identify areas for collaboration, and seek to minimize potential overlap between programs.

Ecosystem Restoration Grant Program

In 2008, the Center restructured the framework used to guide the award of grants and contracts to support development and implementation of Clean and Clear projects. The Center established a project review committee (PRC) comprised of ten staff – the Center Director, five representatives from DEC’s Water Quality Division, two from the Department of Fish and Wildlife, and one each from the Department of Forest, Parks and Recreation and Agency of Agriculture.

Twice per year, the PRC solicits proposals for ecosystem restoration projects. The PRC is specifically interested in proposals designed to improve water quality, including but not limited to projects that:

- improve stream stability;
- incorporate the science of fluvial geomorphology in river corridor management decisions;
- protect against flood hazards;
- improve in-stream and riparian habitat;
- mitigate the effects of hydrologic modification associated with either agricultural operations or urban development;
- protect and restore riparian wetlands;
- re-establish lake shoreline native vegetation and related shoreline erosion corrections; and
- enhance the environmental and economic sustainability of agricultural lands.

The first round is generally limited to priority projects identified by state agency staff, or “internal” projects. Although the majority of internal projects are brought forward by ANR staff, proposals have also been received from AAFM, the Agency of Transportation (AOT), and the Department of Buildings and General Services. For example, ANR is partnering with AOT to install a stormwater treatment demonstration project at a Park and Ride facility in St Albans.

For the second round, project proposals are sought from Vermont municipalities, local or regional governmental agencies, nonprofit organizations, and citizens groups. Individuals and federal agencies are not eligible to receive funds directly, but may partner with an eligible project sponsor. Proposed projects run the gambit from watershed assessment and project identification to restoring and replanting riparian vegetation, to hiring “big yellow machines” for more extensive construction projects.

In both instances, the proposals are reviewed, ranked, and prioritized by the PRC for funding. While budgets for projects vary widely, typical budgets fall between \$5,000 and \$50,000. Since the grant program was restructured, more than 200 proposals have been received, and the PRC has awarded partial or full funding to over 100 projects for a total of approximately \$2.5 million.

Lake Champlain TMDL Implementation Plan Revisions

Center staff recently completed work on a revised implementation plan for the Lake Champlain Phosphorus TMDL, which was sent to the General Assembly on January 15, 2010. The implementation plan has guided program priorities and annual funding requests and served as the framework for the Clean and Clear program since its founding in 2003. Armed with experiences gained through years of implementation efforts, the Center endeavored to:

- define and prioritize, based on current data, threats to water quality in Lake Champlain;
- review the effectiveness of strategies currently employed to improve Lake Champlain water quality;
- identify a wide range of potential actions that could be used to further efforts to implement the Lake Champlain Phosphorus TMDL; and
- develop a prioritized list of water quality programs and projects that will support attainment of the in-lake water quality standards and phosphorus loading targets specified in the TMDL.

The process of revising the TMDL implementation plan was defined by extensive public involvement, which included a mix of stakeholder workshops, targeted consultations, more formal public hearings, and wide distribution of a public review draft and solicitation of comments. In all, more than 300 Vermonters participated in the public process, sharing potential strategies to improve water quality in Lake Champlain and highlighting individual priorities.

From the feedback received, it appears that there is general agreement on the priorities identified in the revised implementation plan – referred to as the “next ten steps.” With agreement on the priorities, the Center is prepared to begin the work of developing work plans for each of the priority strategies that describe major tasks and assigns responsibilities, provide spatial or geographic context for the proposed action, identify possible funding scenarios, and propose a timeline. Work plans will be task-specific, and a cross-section of staff and stakeholders will be involved in the development and review of each.

Opportunities for Action Plan Revisions

The Center also took a leading role in supporting the Lake Champlain Basin Program's revision of their management plan entitled *Opportunities for Action*. *Opportunities for Action* is more comprehensive than the TMDL implementation plan in that it considers a broader range of issues, including not only the improvement of water quality, but also the protection of habitat and the preservation of the region's cultural heritage. The Center's involvement with *Opportunities for Action* focused on the water quality portions of document.

Previous versions of *Opportunities for Action* identified broad areas of programmatic need, but stopped short of assigning specific responsibilities and/or program specific indicators. The Center worked with staff in ANR and AAFM to identify specific actions, implementation timelines, and target implementation levels for each of the areas of programmatic need identified by LCBP. The Center also worked to ensure a high degree of commonality between the priorities established in the revised TMDL implementation plan and the forthcoming version of *Opportunities for Action*. Further, in leading by example, the Center was able to encourage partners in New York, Quebec, and federal agencies to develop similar commitments.

Agencies of Natural Resources and Transportation Programs

Wastewater Discharges

The Problem

Untreated wastewater contains high concentrations of phosphorus. Much of the phosphorus in wastewater can be removed through advanced treatment processes. There are 60 wastewater treatment plants discharging phosphorus in the Vermont portion of the Lake Champlain Basin. These facilities include municipal and private industrial plants, and other facilities such as fish hatcheries. Wastewater discharges represent a regulated and readily measurable source of phosphorus to Lake Champlain.

The Program

Vermont has been making capital investments to upgrade wastewater treatment facilities for phosphorus removal for many years. Between 1979 and 2001, before the Lake Champlain Phosphorus TMDL was adopted, 30 municipal facilities in the Lake Champlain Basin were upgraded for phosphorus removal at a capital cost of \$39 million.

State law limits the concentration of phosphorus in the effluent from larger facilities in the Lake Champlain and Lake Memphremagog basins to a monthly average of 0.8 milligrams per liter. In addition, the Lake Champlain Phosphorus TMDL established individual, annual mass loading limits (in metric tons per year) for phosphorus at each wastewater discharge in the basin. Compliance with the loading limits in the TMDL required the additional construction of phosphorus removal upgrades at five aerated lagoon type treatment plants. The state currently provides grants to municipalities for 100% of the capital cost of constructing needed phosphorus removal upgrades.



An advanced wastewater treatment facility.

Program Accomplishments

Richford

This facility upgrade has been completed and phosphorus removal became operational in September of 2006.

Troy/Jay

This project is proceeding to construction. To accommodate expansion of the Jay Peak Resort, as well as development in the Town of Jay, the treatment capacity will be increased from 200,000 gallons per day to 800,000 gallons per day. To comply with the current mass limit for the discharge of phosphorus, the enlarged facility will be required to achieve a phosphorus concentration of 0.2 milligrams per liter at full capacity. In order to comply with the facility's discharge permit, which required phosphorus removal implementation by September 30, 2006, the town installed interim phosphorus removal facilities which will serve to achieve their stricter permit limits until the facility enlargement project is completed.

Hardwick

This project, which includes an anaerobic reactor zone in the first lagoon as a pilot project to determine performance and operational benefits that may result, is complete and in operation.

Waterbury

This project is in the final phases of preliminary engineering to establish the basis of design of the selected facility. It is anticipated that the project will soon proceed to final design, with construction in 2011.

Proctor

This project is effectively complete and became operational in the fall of 2009.

Aerated Lagoon Wastewater Phosphorus Removal Projects in the Lake Champlain Basin			
Facility	Estimated Capital Cost	Phosphorus Reduction (mt/yr)^a	State Fiscal Year of Funding^b
Richford	\$585,000	2.20	2005/2006
Troy/Jay	\$500,000	1.16	2005
Hardwick	\$745,000	2.15	2007/2008
Waterbury	\$1,860,000	2.96	2007-2010
Proctor	\$520,000	1.89	2009/2010
TOTAL	\$4,210,000	10.36	

^a Reduction in permitted load (metric tons per year).

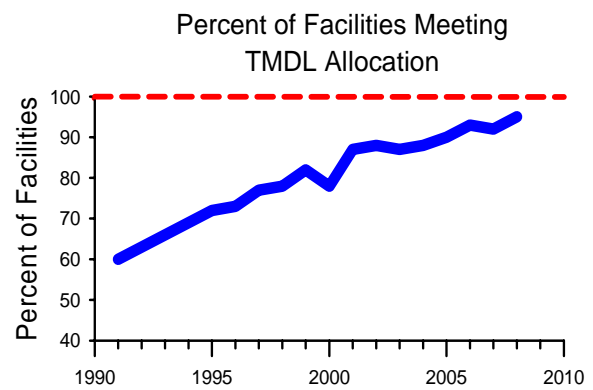
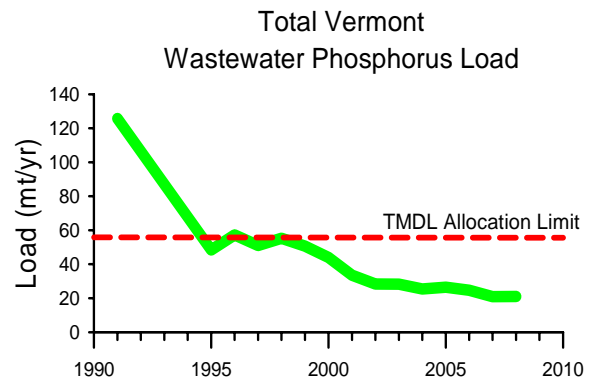
^b Year of actual or proposed appropriation.

Indicators of Progress

As a result of these past investments, phosphorus loading to Lake Champlain from Vermont treatment plants has declined by 83% since 1991. The total wastewater discharge of phosphorus from Vermont is well below the overall TMDL limit of 55.8 metric tons per year, largely because of the improved treatment, but also because most of these facilities are operating below their capacity. The total wastewater phosphorus load to Lake Champlain from Vermont wastewater treatment facilities was 21.1 mt/yr during 2008.

Vermont's long-term program to reduce wastewater discharges of phosphorus to Lake Champlain represents a major success story. All but three of Vermont's 60 facilities in the basin achieved their annual TMDL wasteload allocations during 2008. These three discharges included aerated lagoon plants in Waterbury and Proctor, and one very small facility in Newport Center. The Proctor facility became operational with phosphorus removal in late 2009, and it is anticipated that the facility will achieve their phosphorus allocation in 2010.

During the 1970s, wastewater discharges made up nearly half of the total phosphorus load to Lake Champlain. Recent river monitoring data indicate that Vermont wastewater discharges are now only about 3% of the total phosphorus load to the lake from Vermont.



River Management

The Problem

Analysis of stream geomorphic assessment data collected during the first five years of the Clean and Clear Program is providing important insights regarding the condition of Vermont's rivers and streams. Of the nearly 1,400 assessed river miles in Vermont, nearly three-quarters (74%) have become confined to deeper, straighter channels and no longer have access to historic floodplains. The increased power of larger floods, contained within the channel, has led to higher rates of bed and bank erosion. Millions of dollars are spent annually in Vermont to protect property. These armaments attempt to keep rivers disconnected from their floodplains and static in the landscape. Erosion hazards and flood losses are increasing. One of the most significant new insights is that river management has become a vicious cycle. Flood recovery and structural constraints (i.e., channel straightening, berming and rip-rapping) give a sense of security and lead to developments along rivers where they formerly meandered and flooded. Inevitably, and often decades later, a large flood occurs, structures fail, and the cycle repeats itself. Economic, social, and environmental costs are increasing.

Statewide Stream Geomorphic Assessment Results			
Evolution Stage	Adjustment Processes	Miles	Percent
I	In dynamic equilibrium, only minor vertical and lateral adjustment	342	25
II	Major channel degradation, annual floods not accessing a floodplain	305	22
III	Channel widening, as increased flood energy erodes stream banks	503	37
IV	Major channel aggradation, juvenile floodplains begin forming	203	15
V	New floodplains formed, and dynamic equilibrium restored	18	1

The Vermont River Management Program has evolved with the premise that the cycle must be broken. Otherwise, land-based enterprises will continue to suffer economically because, in addition to erosion hazards, channelization leads to a loss of sediment storage and a net export of life-giving soil and nutrient from a watershed. Rivers that have down-cut and lost access to their floodplains will erode their banks until new floodplains are formed. During the early stages of this channel evolution process, floods remain within deepened channels, and have much more power to erode and carry away anything that enters them. Without floodplains and meanders, it is often the lakes and reservoirs that are the first quiet waters in which rivers deposit the eroded soil and nutrients. Floodplains are essential to stable streams and sustainable water quality management.

The Program

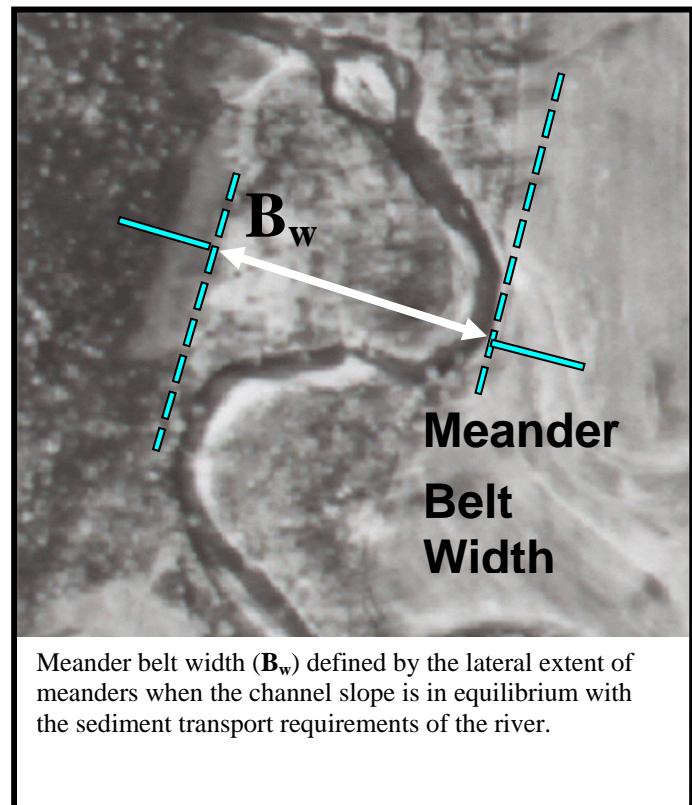
The Vermont Agency of Natural Resources has adopted an avoidance strategy to restore and protect the natural stability of rivers and minimize flood damage. River corridor protection has become the primary tool in the Agency's avoidance tool box. River corridors consist of lands adjacent to and including the present channel of a river. Delineations are based primarily on floodplain function, the lateral extent of stable meanders (i.e., the meander belt width, see

Figure), and a wooded riparian buffer to provide streambank stability. The meander belt width is governed by valley landforms, surficial geology, and the length and slope requirements of the river in its most probable stable form.

A river is considered stable or in a state of “dynamic equilibrium,” if it can adjust its channel geometry (width, depth, and slope) to efficiently discharge, transport, and store water, sediment, and debris without significant aggradation or degradation of its bed (i.e., changes in vertical channel bed position in relation to annually accessed floodplains)^{1,2}. A river requires a sufficient corridor to accommodate equilibrium conditions and the channel adjustments that occur when stream geometry is changing vertically and laterally to achieve equilibrium³. Failure to provide a sufficient corridor will constrain the river from achieving the equilibrium

condition. Thus, managing corridors to accommodate equilibrium and associated channel adjustment processes serves to reduce damages to existing structures and property, avoid new damages, protect public safety, achieve the general health of the river system, and avoid the high cost to install and maintain channelization practices⁴. Precluding the use of channelization practices, in turn, avoids the unintended consequences of transferring bank erosion and other damaging effects from concentrated flow and vertical channel adjustments to other locations along the river^{5,6,3}.

The River Management Program is providing river corridor delineations as an important spatial context for restoring and maintaining the river processes and dynamic equilibrium associated with floodplain storage of nutrients and high quality aquatic habitats. River corridors are also intended to provide landowners and town, state, and federal agencies with a science-based river and riparian land use planning and management tool to avoid fluvial erosion hazards (FEH). Reducing current and future near-stream investment and achieving natural stream stability promotes a sustainable relationship with rivers over time, minimizing the costs associated with floods and maximizing the benefits of clean water and healthy ecosystems. Vermont ANR river



¹ Leopold, L.B. 1994. A View of the River. Harvard University Press, Cambridge, MA.

² Rosgen, D. and L. Silvey, 1996. Applied River Morphology, Wildland Hydrology, Pagosa Springs, CO.

³ Brierley, G.J., and K.A. Fryirs. 2005. Geomorphology and River Management: Applications of the River Styles Framework. Blackwell Publishing.

⁴ Piegay, H. et al. 2005. A Review of Techniques Available for Delimiting the Erodible River Corridor: A Sustainable Approach to Managing Bank Erosion. John Wiley and Sons, River Res. Applic. 21: 773-789.

⁵ Brookes, A. 1988. Channelized Rivers; Perspectives for Environmental Management. John Wiley & Sons, Chichester.

⁶ Huggett, R.J., 2003. Fundamentals of Geomorphology. Routledge Fundamentals Physical Geography.

corridor protection, supported by the Clean and Clear Program, consist of technical assistance to a host of municipal, state, and federal river resource and floodplain management programs, Act 250 floodway protections, municipal fluvial erosion hazard zoning, and river corridor easements.

The restoration of floodplain function and stream equilibrium represents long-term insurance against future flood hazards and increased nutrient loading to Lake Champlain. Restoration simply can not occur if river corridors are developed. It is critical that future land use development patterns recognize the dynamic nature of rivers and floodplains. Since most land use decisions occur on the local level, offering incentives is the most effective way of raising public awareness about river corridor and floodplain values and motivating landowners and municipalities to take proactive steps to reduce property loss, protect water quality, and build greater resilience to future flood damages. Protecting natural processes that maintain water quality and aquatic habitat enables the State to avoid the cost of developing and maintaining artificial structures to capture and retain sediments and nutrients. These actions also represent an important step for the State to combat the ill effects of climate change, particularly in light of the hydrologic models that predict a greater frequency of flash flood events.

River Corridor, Buffer, and Floodplain Protection

The River Management Program will continue to emphasize the state river corridor and municipal FEH programs, established by Clean and Clear in response to Act 137 (passed by the 1997-98 General Assembly), which required the State to develop appropriate flood hazard mitigation and avoidance measures. A dialogue among state agencies and departments is being pursued to provide meaningful incentives to landowners and communities for more effective buffer protection and flood hazard regulations. State legislation to support this incentive-based approach and ensure involvement at the municipal level may become a part of this dialogue.

Financial incentives for municipalities include qualifying criteria in grants, pass-through funds, technical assistance, and educational support that encourages municipalities to adopt and implement bylaws that conserve and restore river stability, floodplains, wetland and riparian buffer function. Three River Management Program regional scientists and the Fluvial Erosion Hazard Coordinator assist municipalities in developing maps depicting the river corridors, flood attenuation assets, and FEH zones. The ANR, in cooperation with a host of planning organization and the Vermont League of Cities and Towns, conducts outreach and education and annually reports on the status and impact of river corridor easements and zoning, including development of FEH mapping.

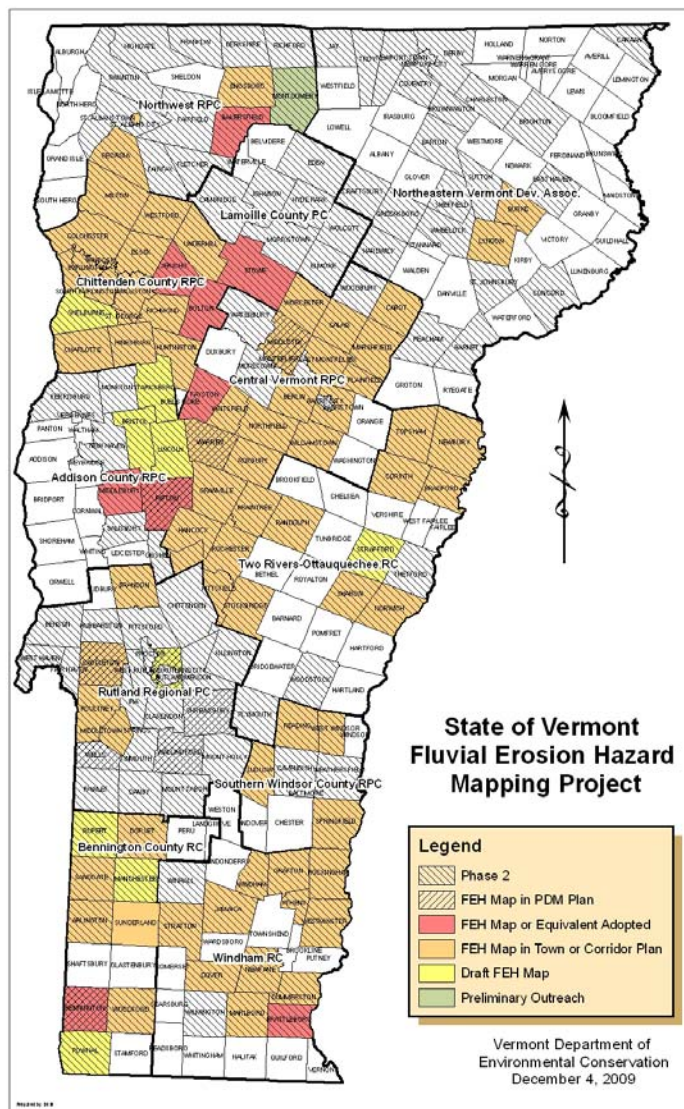
The potential phosphorus reduction through river corridor and floodplain protection was revealed through the study of a Clean and Clear funded floodplain restoration project (cost-shared with the USDA) where in just one year, 1.3 metric tons of total phosphorus were captured in sediments deposited on 3 of the 7 restored floodplain sites, available to the Black Creek for first time in 150 years following the removal of a rail levee.

On another project, soils were excavated to create a belt width sized floodplain along 2,000 feet of Wanzer Brook (Fairfield, VT), which had become deeply incised. The quantity of deposited soils that would have, over time, been eroded to the lake contained 5.9 metric tons of total phosphorus.

These measurements of total phosphorus in soils probably overstate the amount of phosphorus that would actually be available to the aquatic ecosystem in streams or the lake, but nevertheless they demonstrate a large potential for phosphorus reduction benefits from floodplain restoration projects.

The River Management Program, in collaboration with the state's regional planning commissions (RPCs), leverages Clean and Clear funding annually to attract Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation Program planning grants to support corridor protection. The work involves developing Phase 2 stream geomorphic assessment data, generating FEH maps, working with communities to educate them about fluvial erosion hazards, and encouraging and supporting their adoption and implementation of fluvial erosion hazard zoning bylaws including provision of maps and model by-laws. Fluvial erosion hazard data are being incorporated into the Regional Hazard Mitigation Plans. The River Management Program has technically supported the work of the RPCs and their consultants and recently provided the RPCs with a suite of Enhanced Model Flood Hazard Area Regulations including fluvial erosion hazard area protection.

A River Corridor Easement Program has been established in Vermont to conserve river reaches identified as high priority sediment and nutrient attenuation areas. The opportunity to purchase and sell river corridor easements was created to augment the state and municipal fluvial erosion hazard zoning which, if adopted, avoids future encroachment and flood damage, but does not restrict channelization practices. The societally-ingrained notion to stop all erosion, even where few investments are at risk, may limit the channel evolution process and slow the attainment of equilibrium conditions. The key provision of a river corridor easement is the purchase of channel management rights⁷.



Total number of communities involved in river corridor planning	168
Phase 1 geomorphic assessment underway or recently completed	33
Phase 2 geomorphic assessment underway or recently completed	42
FEH projects underway or completed as part of town and/or river corridor plans	27
Draft FEH maps completed	69
FEH language, maps, or equivalent adopted as an ordinance	9

⁷ Kline, M. 2008. A Guide to River Corridor Easements. Vermont Agency of Natural Resources, Waterbury, VT.

The program works closely with state and federal farm service agencies, the Vermont Housing and Conservation Board, and land trust organizations to combine corridor easements with other land conservation programs. The purpose of the river corridor easement is to allow the river to re-establish a natural slope, meander pattern, and access to floodplains in order to provide flood inundation and fluvial erosion hazard mitigation benefits, improve water quality through hydrologic, sediment and nutrient attenuation, and protect riparian habitats and the natural processes which form them. The easements give the holder, or grantee, the right and opportunity within the corridor to establish a naturally vegetated, floating buffer measured from the river banks as they may move. The landowner may continue to conduct activities such as agriculture and timber harvesting within the river corridor, but is restricted from placing, repairing, or modifying structural elements such as bank armor, levees, or earthen fills. Within the corridor, the easement ensures that watercourses and wetlands are not manipulated so as to alter the natural water level or flow, or intervene in the natural physical adjustment of the water bodies. To date, the program and land trusts have completed, or nearly completed, easements on 12.35 miles of river, which when in equilibrium will have access to over 450 acres of floodplain.

River Name	Stream Length (ft)	Easement acres
White River	1,360	16.3
Little River	1,460	8.4
LaPlatte River	15,100	160.0
North Branch Winooski	900	3.9
Ayers Brook	19,790	50.8
Browns River	2,800	20.3
Hungerford Brook	1,700	7.3
Middlebury River	1,340	11.7
Green River (Arlington)	2,300	11.4
Batten Kill	900	8.9
Mettowee River	3,700	7.5
Wanzer Brook	2,050	4.0
New Haven River	4,318	9.1
Lewis Creek	7,700	147.3
Totals	65,218	450.6

Flood and Erosion Management and Hazard Mitigation

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

corridor and floodplain protection. FEMA pre-disaster mitigation planning funds in Vermont should also be used to help communities develop strategic hazard mitigation plans to restore, remove, or retrofit infrastructure likely to become damaged during or after floods.

Regional engineers, through their relationships with private, municipal, and governmental entities, reduce erosion and economic losses associated with flooding through regulation and personal influence (based on trust and respect). The engineers have swayed societal attitudes toward water resource issues, and represent a highly visible and engaged cadre of trained professional with boots on the ground.

Managing human activities to minimize alteration of channel and floodplain hydraulics and to restore the natural hydrology and sediment regimes of rivers is critically important to minimizing erosion and the costs of maintaining property and infrastructure typically lost or damaged during floods. Generally, this work involves using engineering, fluvial geomorphology, and hydrology sciences in the review of proposed projects and minimizing the impacts often inherent in human/river conflicts and conducting the planning and development of pre-disaster mitigation projects. River Management Program regional engineers are in the field constantly, maintaining the face-to-face contact with Vermont residents that is critical in staving off a multitude of flood-related failures. Technical and community assistance develops both trust and acceptance of program management goals and avoids the selection of least-cost structural alternatives that represent expensive long-term costs and public safety threats during floods. These projects typically address impacts associated with channel and floodplain fills and structures used to control river flows and erosion. Mitigation objectives included flood hazard reduction, stream equilibrium, and water quality and aquatic habitat.

State floodplain management staff provide technical assistance and coordination as required in the State's Community Assistance Program and Cooperating Technical Partner grant agreements with FEMA. The Community Assistance Program provides technical support to National Flood Insurance Program (NFIP) enrolled communities. In addition to providing general technical assistance, education, and outreach, staff provides floodplain development reviews in accordance 24 VSA Chap.117, Section 4424. Over the past five years the program has worked diligently to increase the number of NFIP enrolled towns that actively engage and request development reviews by the program as required by law. At present only 30% of the 245 enrolled towns are so engaged. Greater municipal participation is sought as a means to not only achieve NFIP objectives, but achieve the state water resource objective of avoiding flood hazards and protecting beneficial floodplain functions. Under the Cooperating Technical Partner grant, floodplain management staff works with municipalities, Regional Planning Commissions, and FEMA to coordinate and oversee the flood hazard map update process underway in the state. Activities of the floodplain management program, and the need to expand the program (currently a staff of three), will increase as the number of participating municipalities increases.

The quantity of sediment and nutrient loading that occurs during flood events is enormous. It cannot be over-stated that the failure of improperly engineered watershed infrastructure is a huge part of the loading that impairs water quality. Flood recovery is a related program area that deserves special attention in working toward load reduction targets for Lake Champlain. River Management Program engineers save taxpayers significant dollars every year, both in the short and long-term, averting more damage and loss to both infrastructure and the environment. There is also the real threat of loss of life as it relates to people in very vulnerable locations. The

program works through the State Hazard Mitigation Grant Program and makes recommendations to move individuals out of harm's way.

Floodplain Management Program Activities	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	FY09 Total
Community Assistance Visits	3	2	2	4	11
Community Assistance Contacts	2	1	4	2	9
Floodplain Development Technical Reviews	18	18	33	30	99
Workshops and Outreach events	6	4	7	4	21
Site visits and meetings re: floodplain develop.	4	16	19	9	48
DRB/PC/Selectboard meetings or hearings	3	3	1	1	8
Flood Hazard Bylaw Reviews	7	10	15	14	46
General Tech Assistance - phone calls	296	354	342	279	1,271
General Tech Assistance - emails	426	498	558	421	1,903
Meetings w/State agencies	9	16	4	2	31

Active Restoration

Proactive restoration of water quality and aquatic/riparian habitats differentiates this program activity from the management activities described above. Restoration and remediation activities are critically important in order for Vermont to meet the goals of the Federal Clean Water Act and the State Water Pollution Control Statutes. Fluvial geomorphic and physical habitat assessments are being used to develop river corridor plans for river reaches at the sub-watershed level. Strategic river corridor restoration and protection projects are being identified, developed, and implemented in partnership with local and regional entities. These partnerships, typically supported through grants, create critically important watershed constituencies that raise local awareness, acceptance, and action toward achieving River Management Program goals.

The Lake Champlain Phosphorus TMDL recognized the need for protecting river corridors, and called for a much larger investment in active stream restoration. The River Management Program pursued large-scale river restoration projects using natural channel design techniques in the attempt, using mechanical means, to quickly establish stream equilibrium. It was anticipated that \$2 million in capital funds would be spent annually to restore stream stability. Several federal agencies were involved in matching the state's commitment to these projects.

During the construction of active restoration projects in Vermont, however, it became evident that other river corridors and floodplains in the state were being permanently lost due to the continued placement of permanent investments and infrastructure. New encroachments occur at a faster rate than large active restoration projects can be designed, permitted, and implemented. Preventing erosion and damage of new encroachments requires an ongoing commitment to stream channelization, i.e., attempting to make streams static in the landscape.

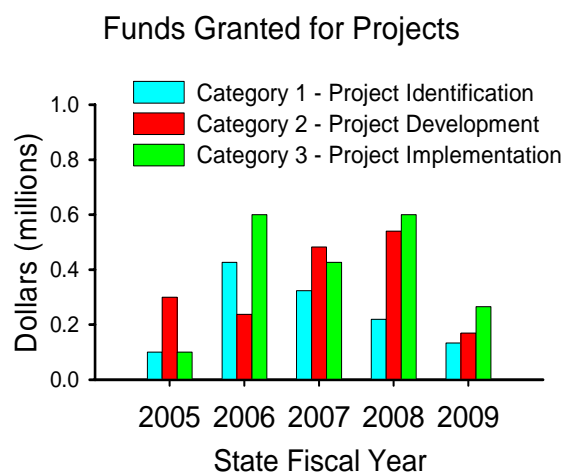
In response, the program now emphasizes an avoidance strategy in order to one day get ahead of the decline in river stability by promoting and investing in river corridor protection.

A change in primary emphasis does not indicate a lesser need for retrofit and restoration practices. Restorative construction techniques, learned during the early years of the program, remain as valuable assets to be employed where permanent conflicts exist between river processes and infrastructure, but the program now approaches each project with the objective of protecting the river corridor from further encroachment if possible. Corridor protection in combination with the active removal of physical constraints (e.g., berms, floodplain fills, and undersized bridges/culverts) are the mainstays of the River Management Program restoration efforts. Geomorphic data, collected as a part of the Clean and Clear Program and in consideration of fluvial processes, have allowed the River Management Program to set restoration objectives more truly at the intersect of hazard mitigation, water quality, and habitat improvement.

The River Management Program works with its sister agencies and partners to offer funding and technical assistance in support of local projects that are part of a larger river corridor protection initiative. For instance, floodplain restoration projects, riverbed and bank stabilization within village centers, bridge and culvert work at frequent road washout areas, and property relocation have all been offered and implemented as incentives to achieve the larger objective of corridor protection. A key aspect of this strategy is the collaboration and consistency with state, federal, municipal, and non-profit programs. The River Management Program is diligent in working with its public and private partners to integrate geomorphic data and corridor planning outputs into agricultural, forestry, transportation, land use, stormwater, and fish and wildlife planning through funding and technical assistance programs. Under the new Vermont river protection and restoration approach, landowners and towns seeking to resolve their river conflicts will increasingly get consistent guidance and support for corridor protection and working towards natural stream stability.

Program Accomplishments

The River Management Program provides technical assistance and grants to a variety of watershed organizations to pursue a sequence of (1) river assessment and project identification, (2) project development, and (3) project implementation (Category 1, 2 and 3 River Corridor Grants, respectively), all based on fluvial geomorphic principles. Category 1 grants support river assessments conducted through a two-phase stream geomorphic assessment process in order to understand observed problems and identify remediation opportunities within a larger watershed context. This is done using nationally recognized and peer-reviewed protocols developed by the River Management Program. Category 2 grants support the creation of river corridor management plans, fluvial erosion hazard maps, and corridor restoration and protection project designs to address channel



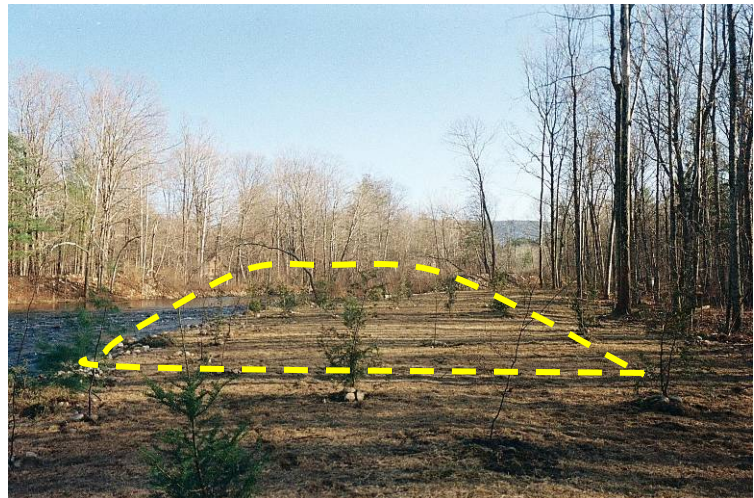
instability in a holistic, technically sound and socially feasible manner. Category 3 grants fund project implementation.

Vermont River Management Program activities during 2009 are summarized for each Vermont river basin below.

Basin 1 – Batten Kill, Walloomsac, and Hoosic Rivers

The Rivers Program continued working with the **Batten Kill** Corridor Planning Steering Committee and has been successful at moving projects toward implementation on the Batten Kill River. Many projects are in the pike including a large easement acquisition on the main stem of the Batten Kill River where the group is working to partner an ongoing habitat restoration project sponsored by the Vermont Fish and Wildlife Department, the U.S. Forest Service and the Batten Kill Watershed Alliance with an easement acquisition to ensure long-term protection of the river corridor.

A high priority berm removal project is currently underway at the confluence of the **Batten Kill** and the **Roaring Branch** in Arlington. Removal of the large berm will allow the stream to flood into the floodplain and deposit sediment upstream of the confluence, and will take the pressure off a large mass failure on the Batten Kill main stem that is contributing a lot of sediment to the system. Funding for this project was secured through collaboration between state and federal dollars, including the Center for Clean and Clear, U.S. Forest Service, and Battenkill Watershed Alliance.



Looking up the Branch over the area where the berm was.

In addition, a high priority easement on the **Green River** is about to be acquired and many trees have been planted at strategic sites along the mainstem and tributaries. Years of hard work are starting to pay off as projects get implemented on the ground to restore the river corridor of the **Batten Kill**.

Work continued on the **Walloomsac** Berm Relocation Project. The design and funding are in place to relocate a section of the berm located along the **Roaring Branch** mainstem in Bennington. The project will restore a section of floodplain to the river and reduce sediment loads and property damage downstream of the project. Great strides have been made in Bennington County toward educating towns of the importance to include river corridors in their local planning and zoning ordinances to improve water quality and prevent flood hazards. The towns of Arlington and Sunderland have both agreed to include supportive language in their Town Plans. Bennington has adopted an overlay district to prevent further encroachment on the **Roaring Branch and Walloomsac River**.

Phase 1 and 2 stream geomorphic assessments were completed on the **Hoosic River** in Pownal.

Basin 2 – Poultney and Mettowee rivers

River restoration work continues in thy **Poultney & Mettowee** basin. The Nature Conservancy applied for and received Clean and Clear restoration funding to complete a project on their clay plain forest reserve in West Haven. They completed Phase 1 of this project which involved installing over 20 woody debris jams. Site difficulties were overcome by the use of horses to move large wood logs to the restoration locations. The River Management Program also partnered with the Vermont Land Trust to develop a multitude of river easement projects on the **Mettowee River**.



Example of a woody debris jam installed on a small tributary to the Hubbardton River. The wood jams help to reduce the velocity of the stream and will improve sediment storage within the river corridor.



Horse drawn wood being delivered to lands that are inaccessible to large machines for the river restoration work.

Basin 3 – Otter Creek

Watershed partners worked together to use stream geomorphic assessment data to identify key areas within the watershed, contact landowners, and develop budgets and grant proposals to conserve the important riverside lands. This is proving to be a very productive partnership.

Work continues with corridor planning on the **Middlebury River**. In Ripton some of the Clean and Clear grant funds were used to leverage federal FEMA dollars to assist with protecting the historic village while simultaneously improving floodplain function and reducing hazards in both the Village of Ripton and downstream in East Middlebury. Many other corridor planning activities are in the planning stages on the **Middlebury River** including easement acquisition on the South Branch in Ripton and tree plantings on the main stem. The first river corridor easement was acquired in Southern Vermont using Clean and Clear funds in 2009 in East Middlebury in a highly dynamic section of river. The easement is being held by the Vermont River Conservancy and the easement lands will provide both sediment and flood storage. The two towns along the **Middlebury River**, Ripton and Middlebury, have both made great strides toward improving

water quality and reducing hazards through local planning and zoning. They have both adopted erosion hazard zones to keep further encroachments out of the river corridor.

In the Town of Lincoln the Vermont River Conservancy secured a 1.2 acre easement along the corridor of the **New Haven River** and is currently working with the town to secure a donated easement on an adjacent 10 acre parcel that is owned by the town.

Lewis Creek Corridor planning and project development continued throughout the year. River Management Program staff worked with the Vermont River Conservancy and the Lewis Creek Association to develop purchase and sale agreements on a critical reach of river on the Lewis Creek main stem. The group partnered with the Department of Fish and Wildlife Landowner Incentive Program (LIP) to try to leverage federal dollars to match the Clean and Clear money spent on the project.

Basin 4 – South Lake

A Stream Geomorphic Assessment is getting underway on the **East Creek** direct drainage to Lake Champlain in the South Lake. The assessment will be used to assist the basin planning effort that is just starting up in that region. The River Management Program partnered with the Green Mountain College Geology Department to get students involved in creating and field verifying the reaches that will be assessed in the upcoming field season.

Basin 5 – North Lake

In the **LaPlatte watershed**, river corridor planning and project development efforts continue, with a current emphasis on the lower reaches of the LaPlatte in Charlotte. Discussions with landowners are underway regarding potential river corridor easements and riparian plantings, as well as an effort to overlay results from the bridge and culvert geomorphic compatibility and aquatic organism passage screening tool with town infrastructure replacement priorities.

Basin 6 – Missisquoi River

In the Town of Fairfield, a 400-foot driveway that separated the **Wanzer Brook** from its floodplain and included an undersized culvert that exacerbated spring flooding has been relocated to an area that is away from the brook. An appropriately sized culvert was installed that will allow for sediment transport and aquatic organism passage. This work allowed for an expansion of the acreage enrolled in the Conservation Reserve Enhancement Program (CREP). Work continues with the Vermont Land Trust, the Vermont Housing and Conservation Board, the Vermont Agency of Agriculture, Food, and Markets, and the Boomhower family to permanently protect approximately 2,000 feet of the **Wanzer Brook** through the purchase of a river corridor easement along the brook as it passes through the Boomhower's dairy farm.

In the Town of Highgate a high priority river and wetland restoration project was completed this fall on a tributary to the **Rock River**. The project was along a 3,600-foot stretch of historically straightened stream and degraded wetlands. To restore the wetlands, a 700- foot berm was removed from the floodplain to allow the reconnection of the stream and floodplain wetlands. Ten wetland depressions were also created in the floodplain to provide wetland habitat as well as the storage of sediment and nutrients. Wood structures and debris jams were placed in the stream to provide habitat and hydraulic diversity in an otherwise totally straight stretch of stream. A 100-foot buffer was established along the length of stream. In conjunction with a CREP project

just upstream of the project site, over a mile of stream is now buffered that previously had corn up to the edge of the stream or was hay that was mowed to the edge of the stream.

Phase 2 field assessments were completed along the **Black Creek** and **Tyler Branch**. These assessments continue to build on efforts by the communities to have a better understanding of their rivers and next steps toward holistic management.

Two high priority easements are underway, one on the **Tyler Branch** and one on the **Hungerford**. These should be acquired by 2010. These projects are helping to protect key sediment attenuation assets in the watersheds.



Looking at the removed berm area and the created wetland in the Rock River watershed.

In the **Trout River**, work with the Missisquoi River Basin Association (MRBA) has been moving projects forward that were identified in the Trout River corridor plan. The MRBA has had several “work days” to assist the town of Montgomery and community members to implement projects that reduce sediment and runoff from back roads, and private property.

Basin 7 – Lamoille River

Work continues with the Lamoille Regional Planning Commission to build on data collection efforts within Lamoille County. Phase 2 field assessments were conducted and river corridor plans were developed on the **Wild Branch, Elmore Branch, Gihon, Foote Brook, and Rodman Brook**.

A “Trees for Streams” project continues with the Caledonia County, Orleans County, Chittenden County and Lamoille County Natural Resource Conservation Districts to accomplish buffer plantings along stretches of the Lamoille main stem and tributaries. Over 962 hours of volunteer time were coordinated by the Conservation Districts to plant over 3,238 linear feet of stream with 1,845 trees.

An important project was developed with the Lamoille Anglers group, with assistance from the State Lamoille Basin Planner and River Management Program staff. The project will remove old junk cars from the stream bank and establish a planted 50-foot buffer.

A high priority easement project is underway on the **Browns River** to protect an important sediment attenuation area in the Town of Jericho. The easement will be acquired by 2010. Continued project development is also happening, including one to remove old abutments that are causing constrictions and erosion in the river.

Basin 8 – Winooski River

In the **Winooski watershed**, a Phase 2 stream geomorphic assessment was completed on several main stem reaches to fill in assessment gaps and synthesize the new and existing data into a River Corridor Plan encompassing East Montpelier and Plainfield. Project development is underway in the **Kingsbury and North Branch subwatersheds**, with one River Corridor Easement on the North Branch ready for execution. An update to the **Huntington River** Corridor Plan was completed to incorporate upper main stem and tributary reaches assessed in 2008. Opportunities to develop projects with individual landowners in the Huntington watershed have largely been exhausted at this time, and project development focus has shifted towards addressing water quality and geomorphic instability issues resulting from road maintenance practices and geomorphically incompatible stream crossing infrastructure.

In the **Mad River**, work continues to improve Phase 2 data in support of ongoing efforts with the Friends of the Mad River and the towns of Waitsfield and Warren to consider the adoption of Fluvial Erosion Hazard zoning.



River corridor easement in development in Worcester. This reach of the North Branch Winooski River has been historically straightened and is very sensitive to channel adjustment. The easement will encompass approximately 4 acres within which the river will be allowed to redevelop meanders and a state of dynamic equilibrium. This parcel is adjacent to an agricultural parcel that is a very high conservation priority.

Basin 9 – White River

In the **White River watershed**, project development continues on the **Upper White and Tweed Rivers**. These efforts have included discussions with landowners about corridor easements and riparian plantings, as well as identifying culverts that are geomorphically unstable and/or barriers to fish passage, and in need of retrofit or replacement. Three culverts in the town of Rochester are currently under consideration for retrofit to address aquatic organism passage barriers. A Phase 2 stream geomorphic assessment was completed on the White River and major tributaries in the Town of Sharon, and a River Corridor Plan is in development for these reaches. This community has expressed interest in addressing fluvial erosion hazards through municipal

planning, and discussions to this effect will continue upon completion of the Corridor Plan and Fluvial Erosion Hazard map in the spring of 2010.

Basin 10 – Ottauquechee and Black Rivers

In the Connecticut River drainage, Phase 2 stream geomorphic assessment and corridor planning was initiated on the **Black River** between Lake Rescue and Echo Lake, as well as some of the major tributaries upstream of Lake Rescue. It is anticipated that results of this assessment will provide some insight into potential sources of sediment causing anecdotally reported changes in aggradational features in Round Pond in the northern end of Lake Rescue.

Basin 11 – West, Williams, and Saxtons Rivers

The **Saxtons River** stream geomorphic assessment and corridor planning is well underway. Work has already begun to partner with the Vermont Land Trust on an easement acquisition of a high priority site in the Saxtons watershed.

Basin 13 – Southern Connecticut Direct Drainage

Corridor planning activities continue to flourish on the **Crosby Brook** in Brattleboro. Three of the highest priority projects have been moving toward implementation and are awaiting funds to be completed.

Project implementation continues on the **Whetstone Brook**. The River Corridor Steering Committee partnered with the Vermont River Conservancy and the West Brattleboro Association to raise funds to conserve one of the few remaining functioning floodplains along the Whetstone. The group has made great strides toward raising the funds needed to buy the land. Once the Vermont River Conservancy owns the land, a permanent river corridor easement will be put on the property to conserve the river function forever.

Basin 14 – Wells, Waits, and Ompompanoosuc rivers

Corridor plans were recently completed on the **Wells and Waits Rivers**, and it is anticipated that work to develop corridor conservation and restoration projects, as well as working with communities to address fluvial erosion hazards through municipal planning, will continue as it has in other watersheds in central Vermont.

Basin 15 – Passumpsic River

In the **Upper Passumpsic watershed** Phase 2 assessment work on the **Millers Run, West Branch, and East Branch** filled in data gaps from past work and supported the writing of corridor plans for those rivers. This represents the completion of a year's worth of work in the Upper Passumpsic and will support future work with the individual towns and landowners to develop protection and restoration projects. Phase 1 and 2 assessment was conducted on the **Moose River** to fill in data gaps from previous work, which will support protection and restoration activities on the Moose.

Basin 16 – Northern Connecticut Direct Drainage

Phase 1 and Phase 2 assessments were conducted on the **Nulhegan River** and a report documenting historic and current stressors and the existing geomorphic condition of the

watershed has been written. The assessment report will support future conservation activities to be undertaken by the Vermont River Conservancy.

Basin 17 – Black, Barton, and Clyde rivers

In the Lake Memphremagog watershed, Phase 1 and Phase 2 assessments were conducted on the **Black River** to gather data to serve as a foundation for the writing of a River Corridor Plan.

Outreach

Each year the River Management Program hosts a number of flume workshops. These are hands-on workshops that provide the program and its partners a way to do education and outreach with a wide range of community members and groups interested in river issues. Workshops are offered to municipal groups, school groups, road crews, watershed groups, and at state and regional conferences.

The flume is a stream model that allows the River Management Program to set up real-life examples of river-related issues. In each workshop, the basics of river dynamics and getting familiar with your watershed are covered. Demonstrations are run to show the potential impacts and long-term effects on our rivers from projects such as bank stabilization, stormwater inputs, development in the floodplain, and infrastructure installations. Topics such as aquatic organism passage and habitat issues are also covered. Discussion focuses on stream processes and how our communities interact with the rivers, potential human impacts on the systems, and how communities can work to reduce their impacts. More knowledge about fluvial erosion hazards and inundation hazards is also gained. By having participants actively participate through discussion and some hands-on demonstration, knowledge and information is shared between participants.



Participants at a river flume workshop.

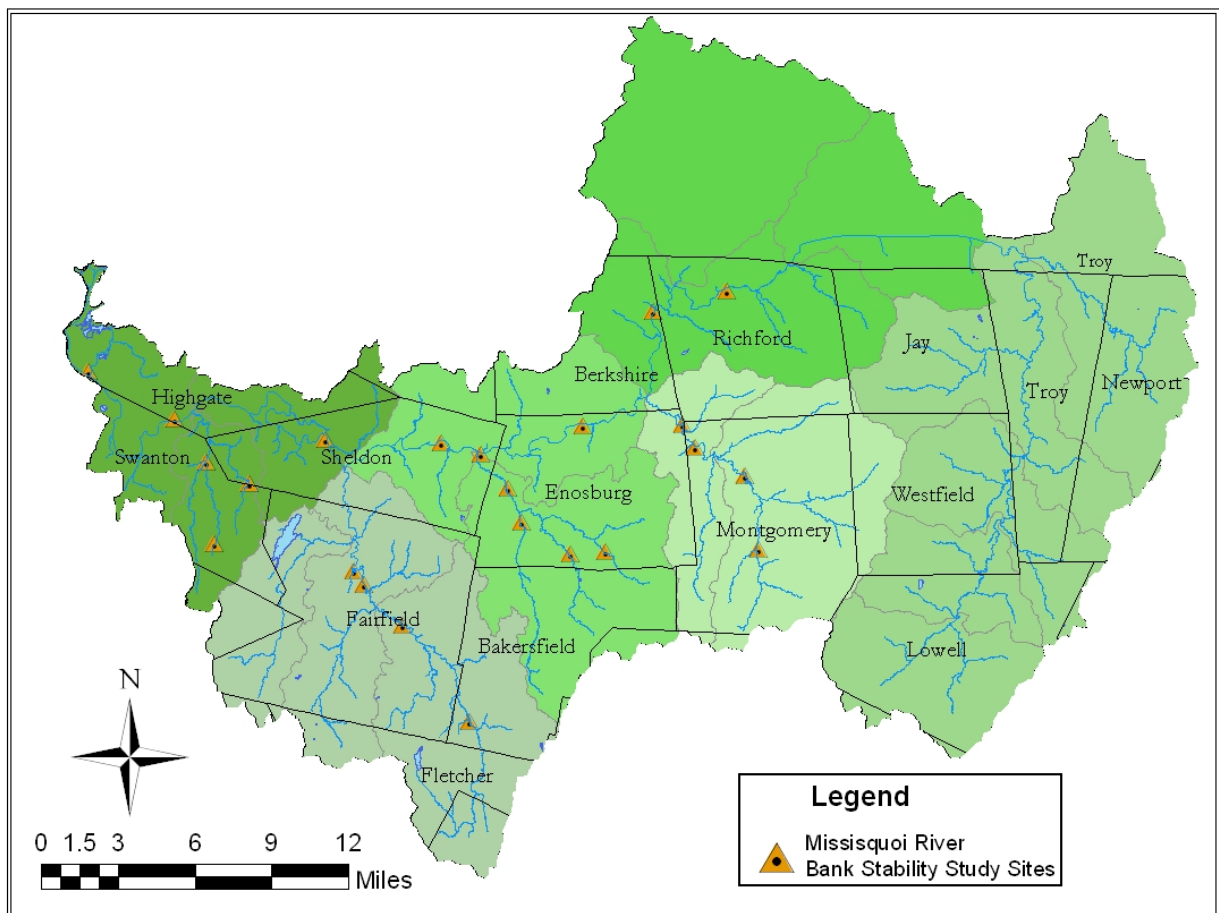
Type of Workshop	Number of workshops	Participants
General Public Education and Outreach	12	Community members, students, watershed groups, and watershed residents
Fish Passage	2	road crews, town officials, and VTrans officials
Municipal Stormwater	2	towns officials, road crews, engineers, and stormwater utility managers
Regional / Basin Planning	2	Regional Planning Commission, town officials, and watershed residents
Lakeshore and River Erosion	2	Regional Planning Commission, community members, and town officials
Total	20	

Research

USDA Agricultural Research Station (ARS) Bank Stability and Toe Erosion Model

A fundamental question which has remained unaddressed in the modeling of sediment and nutrient loading to Lake Champlain is how much of the load is coming from stream instability. To date, load allocations have been for wash-off from urban, agricultural, and forest land covers. This past year the River Management Program in partnership with the Center for Clean and Clear and the Lake Champlain Basin Program developed a cooperative agreement with the USDA Agricultural Research Station (ARS) in Oxford, Mississippi to carry out research employing the Bank Stability and Toe Erosion Model (BSTEM) in the Missisquoi Watershed.

Geotechnical tests of bank materials have been conducted at 20 sites in the Missisquoi Basin to determine appropriate input parameters for the modeling effort. Discharge data from USGS gauging stations will be converted to flow depths for each significant storm event for input into the toe-erosion sub-model. Modeling will be conducted iteratively to simulate bank-toe erosion and upper-bank stability for annual hydrographs representing the 99th, 95th, 90th, 75th, 50th, and 25th percentile flow years. Simulation results from the 20 representative reaches along the Missisquoi River main stem and selected tributaries will provide unit loading data by stream reach and particle-size class. These results will be extrapolated to the reaches not modeled using field and aerial reconnaissance of the current extent of streambank failures.



The primary objectives of the USDA BSTEM research are the following:

1. Estimate of the percentage of the total suspended sediment yield/load entering Lake Champlain from the studied portion of the Missisquoi River watershed that is coming from stream channel erosion processes. These results will be combined with total phosphorus data collected from the eroded soil strata to give insight into P loading into Lake Champlain as a result of stream erosion processes.
2. Increase our understanding of the correlation between stream equilibrium and bank stability in Vermont. Study a range of geomorphic conditions (via careful site selection) to see if geomorphic condition can be used to explain the quantity and rate of bank erosion and planform adjustment. This information will help inform river corridor protection work and the selection of specific floodplain restoration projects.
3. Model the effectiveness of different best management practices in reducing fluvial process derived sediment and nutrient loading. Best management practices modeled would include watershed, floodplain, and channel management practices consistent with the State's goal of managing river systems toward equilibrium conditions over time.

Vermont ANR Water Center Partnership with the University of Vermont

The Vermont ANR River Management Program and the University of Vermont Water Resources and Lake Studies Center have pooled resources in recent years in order to jointly support a Watershed and Water Quality Research Program. Clean and Clear funds are used to match federal USGS funds to support grants awarded by the Water Resources and Lake Studies Center through a competitive process. The general objectives of the program are to:

1. Advance scientific understanding of the dynamics, management, and contribution of sediment and nutrients derived from fluvial processes in Vermont's rivers.
2. Establish the socio-economic justifications, costs, and benefits associated with or represented by river corridor protection in Vermont.
3. Contribute to Vermont's river corridor management, restoration, and protection programs.

Projects funded through this joint ANR and University of Vermont program that are currently in progress include the following:

- Improvement of Phosphorus Load Estimates through the use of Enzyme-Hydrolysis Measures of Phosphorus Bioavailability. University of Vermont School of Engineering.
- Quantifying Sediment Loading due to Stream Bank Erosion in Impaired and Attainment Watersheds in Chittenden County, VT Using Advanced GIS and Remote Sensing Technologies. University of Vermont School of Engineering and Rubenstein School of Environment and Natural Resources.
- A Soil-Landscape Modeling Approach to Estimate Riparian Phosphorus Concentrations along Erodible Stream Corridors in Chittenden County, Vermont. University of Vermont Department of Plant and Soil Science.

Better Backroads

The Problem

The backroads of Vermont are integral to the state's rural image and quiet, tranquil nature. Hidden from view is the fact that these rural roads, whether gravel or paved, can be a significant source of phosphorus if they are not properly maintained. The Better Backroads Program enables towns to fix chronic erosion problems in an optimal way so they can avoid annual repairs and reduce phosphorus and sediment pollution.

Roadside drainage ditches and culverts become part of the stream network during rainstorms or snowmelt events. Sediment eroding from road surfaces and ditches washes into the drainage network and delivers phosphorus that is transported downstream, eventually to Lake Champlain, Lake Memphremagog, the Connecticut River or the Hudson River. With an average of 46 miles of backroads per town, the impact can be significant.

The Program

Proper correction of these roadside erosion problems has the dual benefit of reducing long-term road maintenance costs while protecting water quality. Our goal is to provide sufficient administrative assistance, technical support, and grant funding to eventually involve all Vermont towns in the program. Financial and technical support demonstrates to towns that the proper fix pays for itself in a few years, increasing the likelihood that towns will implement such projects on their own.

The Vermont Better Backroads Program started in 1997. It provides grants and technical assistance for towns to correct erosion problems and to adopt road maintenance practices that protect water quality while reducing long-term highway maintenance costs. It is a partnership formed with the Vermont Local Roads Program, the Vermont Agency of Transportation, the Vermont Agency of Natural Resources, and the Northern Vermont and the George D. Aiken Resource Conservation and Development Councils. The program is administered by the Northern Vermont Resource Conservation and Development Council. The Clean and Clear Action Plan significantly enhanced the capacity of the program beginning in 2004, by adding staff for grants management and technical assistance and by increasing the dollar amounts available for grants.

The road maintenance practices advocated by the Better Backroads Program are typically cost-effective in the long run. The one-time investment to fix a chronic erosion problem properly (e.g., rock-line a steep roadside ditch) generally pays for itself many times over in reduced long-term maintenance costs. The modest



New grass flourishes on the reinforced stream/road bank in Fairfax.



Town crew installing a new culvert with a stone header in Whitingham.

grants provided by the Better Backroads Program also demonstrate the benefits of recommended maintenance practices to local road commissioners and enable them to garner support for additional projects. It has been our experience that most towns adopt the recommended practices for all their road maintenance work, so that the grants we provide can leverage their cost in improved maintenance practices that will both reduce pollution and save towns money in the future.

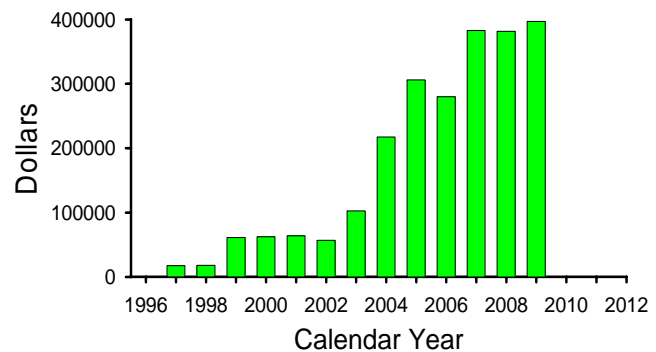
The Better Backroads Program offers improved infrastructure and maintenance practices for eroding ditches, unstable culvert inlets or outlets, and eroding roadside banks which can also help prevent flash flood damage during heavy rain events. Grants are provided for two general categories of projects including (A) developing a town-wide inventory of erosion control needs and a capital budget plan to address these needs, and (B) correcting existing erosion control problems.

Program Accomplishments

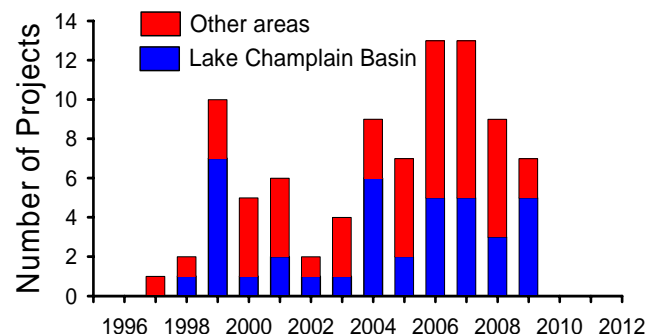
A total of 158 Vermont towns have participated in the Better Backroads Program since 1997 by conducting at least one grant-funded project, including 89 towns in the Lake Champlain Basin. In 2009, eleven new towns received grants through the program. Since the addition of significantly increased funding from Clean and Clear in 2004, participation by Vermont towns has increased from 26% to 63%, and participation by towns in the Lake Champlain Basin has increased to 71%. In addition, substantial efforts were made by the Backroads Technician to contact towns in the Lake Champlain Basin that have not participated so far to encourage them to apply for a grant.

In addition to municipal projects, 27 non-municipal organizations have received grants since 1997. However, in 2009 no organizations received grants, due to new restrictions imposed by VTrans. In the past, this funding has enabled such projects as private road erosion corrections (often along a lakeshore), road erosion inventories conducted by lake or river associations or a regional planning commission, and the purchase and promotion of a hydroseeder which is shared among towns in a region.

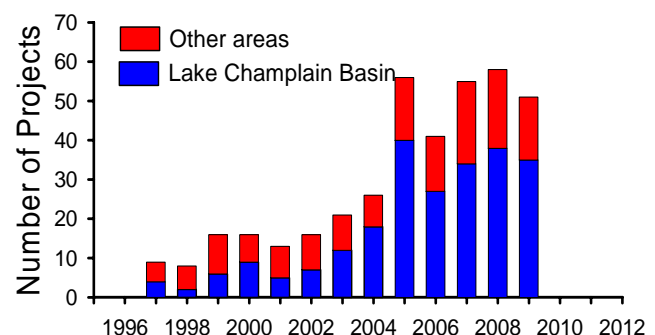
Grant Dollars Awarded Statewide



Road Inventory and Capital Budget Planning Projects



Erosion Correction Projects



During 2009 the Better Backroads Program continued cooperation with the Vermont Youth Conservation Corps. Manual labor supplied by the VYCC was used to implement certain aspects of projects in Woodstock, Montgomery, Jamaica, and Brattleboro. Using additional Clean and Clear funding, VYCC crews assisted with projects involving substantial manual labor.

Since 2008, the grant application period has been in the fall instead of the spring. This schedule provides adequate time to review each project by VTrans and the Federal Highway Administration, and allows project implementation the following field season.

The 2009 projects reported here were approved by the Better Backroads Steering Committee in the fall, will be reviewed at VTrans during the winter of 2010, and will be ready for implementation in the 2010 construction season.

Through on-site technical assistance, publications, and participation in workshops, the Better Backroads Program is able to provide information on a wide variety of techniques that towns can use to reduce sediment and phosphorus loading to waters, while at the same time protecting the investment a town has in its roads. In 2009, Backroads program staff led seven workshops on erosion control and the road bank/stream bank interface in coordination with the River Management Program. In addition, program staff led two workshops on culverts and aquatic organism passage with the Vermont Local Roads Program, the Vermont Department of Fish and Wildlife, and the River Management Program. This year these popular workshops included a new field component, where a biologist “shocked” and temporarily captured fish in nearby streams so participants could see the types of aquatic life their construction and maintenance activities are affecting.

Indicators of Progress

The Vermont Better Backroads Program continues to grow annually, with 65 new towns participating with Clean and Clear funding between FY 2005 and FY 2009. Statewide, however, only 63% of Vermont towns have applied for and received a grant. A Better Backroads Program goal is to achieve 100% participation of Lake Champlain Basin towns.

In 2004, the program began annual tracking (by calendar year) of phosphorus reduction indicators such as the total length of road ditches, number of culverts, and area of eroding road bank stabilized by Better Backroads projects. The number of projects correcting road erosion has been increasing, but the total number of roadside ditches, culverts, and banks that have been stabilized so far represents only a small fraction of what needs to be done statewide. By hiring a Backroads Technician in 2005, the Better Backroads Program has been able to tackle this challenge by visiting nonparticipating towns, encouraging their involvement, and offering on-site

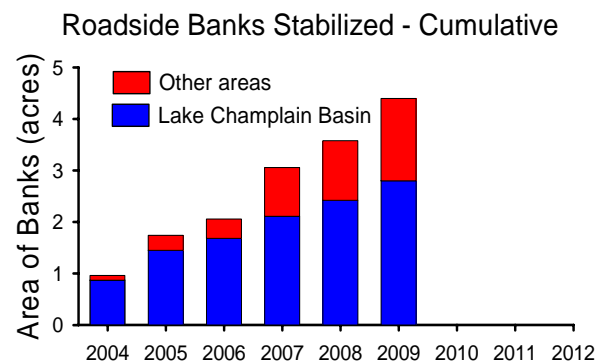
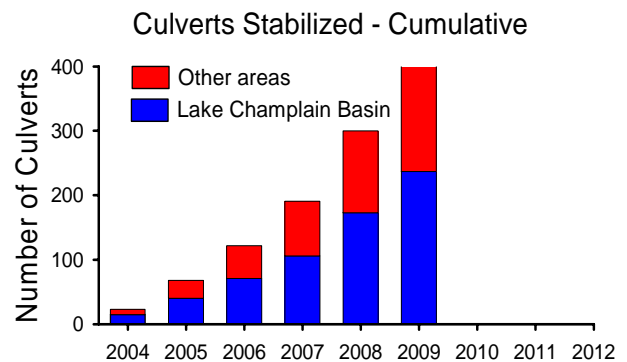
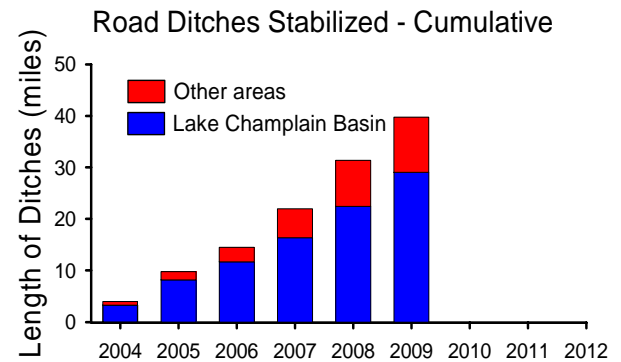


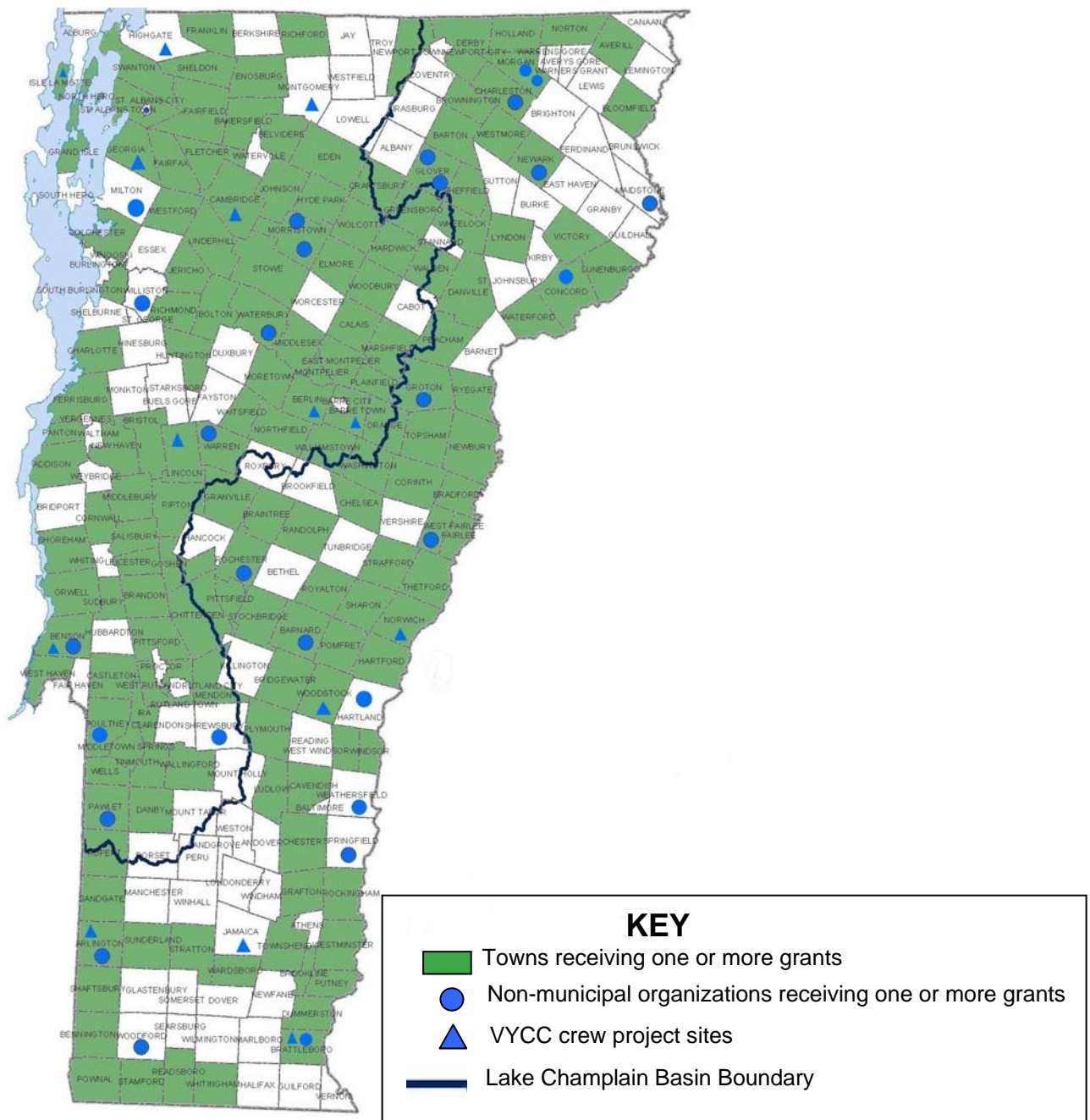
Culvert headers constructed by the Vermont Youth Conservation Corps crew in Montgomery.



A State fish biologist and a river scientist capture shocked fish in the Neshobe River as workshop participants look on.

technical assistance in project development. In addition, the Technician is able to more thoroughly monitor implemented projects, evaluate their effectiveness, and offer follow-up suggestions. The Better Backroads Program has found that on-site assistance is a critical factor in gaining participation. In addition, the program has found that by offering a town a grant for an erosion control project, town staff learn how to accomplish erosion control and are more likely to implement such procedures in the future even without grant funding.





Vermont towns participating in the Better Backroads Program, 2005-2009.

Stormwater Management

The Problem

Urbanization of the landscape creates surfaces that are impervious to water such as roads and driveways, parking lots, and roof tops. When rainwater and snowmelt run off impervious surfaces without infiltrating into the soil, sediment, phosphorus and other pollutants are washed directly into streams. Stream flows rise more rapidly during storms as the volume of runoff increases. These hydrologic changes destabilize and erode the stream banks and channels, resulting in further sediment and phosphorus pollution.

The Program

The Vermont DEC's Stormwater Management Program is a regulatory program charged with issuing permits for stormwater discharges statewide, and restoring acceptable water quality in stormwater-impaired watersheds. A 25-year backlog of expired stormwater permits has been almost eliminated. State-of-the-art standards for stormwater treatment systems are required for all newly permitted discharges. TMDLs and watershed remediation strategies are being developed for the 17 stormwater impaired watersheds in Vermont, including 14 within the Lake Champlain Basin. These 14 stormwater impaired watersheds represent about 1% of the total area of the Lake Champlain Basin in Vermont.



Stormwater Impaired Watersheds in Vermont

Program Accomplishments

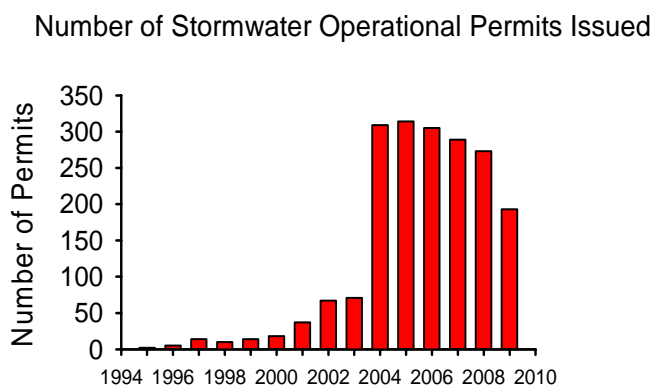
Operational Permits

In 2003, the Stormwater Program commenced an effort to address a backlog of 1,757 expired permits. As of December 2009, there are fewer than 20 outstanding permits out of over 2,700 permitted facilities. Although the comprehensive effort to resolve the backlog of expired permits has been essentially completed, efforts to bring the remaining, and any future expired permits, into compliance will continue.

The Stormwater Management Program issued 193 individual or general permits for new developments or redevelopment projects in 2009, of which 175 were operational general permits. In 2009, Stormwater Program staff conducted 147 operational site visits, of which 57% were generally compliant.

TMDL Development

As of November 2009, all twelve of the lowland (non-mountain) watershed TMDLs



have been approved by EPA. Additionally, the Department is pursuing alternative approaches to the five mountainous stormwater-impaired watersheds. These alternative approaches include the so-called “4b alternative” of a non-TMDL based water quality remediation plan. Remediation plans for two of the mountain watersheds were received in October, 2008. All remaining TMDLs must be developed by January 15, 2010 as currently mandated by Act 43 (2007).

To develop the basis for the implementation plans, the Department has undertaken a multi-year effort to fully characterize the subject watersheds, and to establish a process for developing the most cost-effective remediation strategies. These efforts include contracting for stream geomorphic assessments, sub-watershed mapping, streamflow and precipitation monitoring, and high-resolution impervious surface mapping for each of the stormwater impaired waters. In addition, computer modeling projects were undertaken for both flow duration curve development, and to create a best management practice decision support system (BMP DSS). The BMP DSS is a robust computer modeling tool the Department is using to estimate the most cost-effective array of BMPs needed to meet TMDL targets. To date, more than \$1million has been dedicated to the implementation plan effort. Throughout the summer of 2008, the Department met with the Stormwater Advisory Group to develop an implementation plan framework. The Agency’s plan for implementation titled, “*Final Report - A Framework for Remediation of Vermont’s Stormwater-Impaired Waters,*” can be accessed at:

http://www.vtwaterquality.org/stormwater/html/sw_swag.htm

Residual Designation Authority (RDA) Permit

In November 2009, the Stormwater Management Program issued General Permit 3-9030 for Designated Discharges to the Bartlett, Centennial, Englesby, Morehouse and Potash Brook watersheds. This general permit was issued pursuant to the Department’s federally delegated National Pollutant Discharge and Elimination System (NPDES) program. Coverage under General Permit 3-9030 is required for designated discharges to Bartlett, Centennial, Englesby, Morehouse, and Potash Brook watersheds. The program has designated discharges to these receiving waters if the discharge is not covered under the NPDES municipal separate storm sewer system (MS4), another NPDES permit covering stormwater discharges, or has been issued a state stormwater discharge permit resulting in no net contribution to the receiving water. The General Permit requires different application requirements for three specified categories of discharges: (1) property with a previously issued state stormwater permit, (2) property with equal to or greater than one acre existing impervious surfaces, or (3) property with existing impervious surfaces less than one acre.

Illicit Discharge Detection and Elimination

Many Vermont communities have aging sanitary sewer systems. Cross-connections and leakage from sanitary sewers to stormwater collection systems can be common, even in relatively new sewer lines. As a consequence, pollutants such as phosphorus, toxic substances, and pathogenic organisms can bypass the wastewater treatment facility and be discharged at stormwater outfalls.

With support from the Clean and Clear program, Stone Environmental, Inc. and the Vermont DEC have collaborated on illicit discharge and detection elimination studies in the Missisquoi and Winooski River basins. To date, seven discharges of non-stormwater runoff have been located and have been or will be eliminated. These discharges ranged in size from a large

municipal trunk sewer line that was broken down to single-family homes. The project also provided each community with a comprehensive stormwater drainage map identifying sites where installation of additional stormwater treatment measures may be feasible. Funds are being sought to extend this work to other watersheds in the Lake Champlain Basin.

In Chittenden County, the twelve regulated entities subject to the Municipal Separate Storm Sewer System (MS4) federal permit have located and eliminated 36 illicit discharges since 2003. The majority of these discharges were from single-family homes.

Phosphorus samples, flow measurements, and other information were used to develop estimates of the phosphorus loading rate from these discharges. In total, the illicit discharges discovered to date by the Vermont DEC and municipal programs were contributing about 315 kg/yr of phosphorus loading to the receiving waters. For perspective, 315 kg/yr is larger than the phosphorus load discharged by most wastewater treatment facilities in Vermont, and is about 1.5% of the total phosphorus load from all wastewater treatment plants in the Vermont portion of the Lake Champlain Basin during 2008.

Erosion Control at Construction Sites

The Problem

Construction activities that involve earth disturbance expose soil to rainfall and runoff, making it much more vulnerable to erosion. As a result, improperly managed stormwater runoff from construction sites can be a significant source of phosphorus-laden sediment reaching receiving waters. To minimize erosion and associated sediment transport by stormwater runoff from construction activities, construction site operators must implement and maintain a suitable suite of Best Management Practices (BMPs).

The Program

The Stormwater Section of the Water Quality Division issues federally mandated construction stormwater discharge permits for projects involving one or more acres of earth disturbance. The goal of the construction stormwater permitting program is to protect Vermont's waters by preventing the pollution of construction site stormwater runoff with sediment and phosphorus.

Accomplishing this aim requires equipping contractors with well-developed Erosion Prevention and Sediment Control Plans, training them in the proper installation and maintenance of BMPs, and providing clear direction on their obligations as well as the motivation to fulfill them. In short, the program strives for meaningful water quality protection by thorough and efficient permitting, effective education and outreach, and fair and equitable compliance and enforcement.

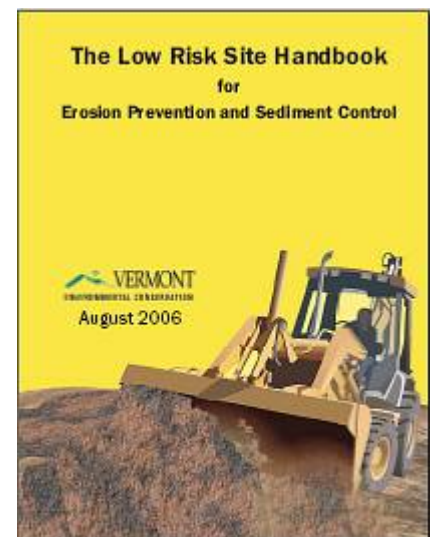
In September, 2006, the Construction General Permit was reissued with a drop in the regulatory threshold from five acres to one acre of earth disturbance. In conjunction with this new permit, the program has made important strides in the three core areas: permitting, outreach and education, and compliance.

Permitting

The Construction General Permit employs a novel, risk-based permitting system. Projects that qualify as Low Risk, based on the project location, site conditions, and volunteered limits on earth disturbance, are obliged to implement the practices in a BMP manual designed for use by the layperson. Because these projects do not pose a significant risk to water quality, permitting for Low Risk projects is expedited, allowing technical staff to devote more of their resources to the review of more complex projects that pose a higher risk of discharging sediment to waters of the state. These types of projects, which either qualify as Moderate Risk or require a customized Individual Permit, must submit a professional quality, site-specific Erosion Prevention and Sediment Control Plan for review by technical staff.

Outreach and Education

Historically, site visits were focused in areas of the state with the largest number and size of projects, mostly in Chittenden County and ski area developments. In late 2006, the construction and post-construction stormwater technical staff



were cross-trained and assigned responsibility for permitting and compliance in regional districts. In their district roles, technical staff members have become familiar to the local regulated and consulting communities, thereby improving knowledge of the construction stormwater program and its requirements.

Compliance

The Stormwater Management Program conducted a total of 219 site visits during 2009, including 60 projects authorized under the Construction General Permit (others were operational projects). In response to instances of significant non-compliance, the Stormwater Program participated in the issuance of approximately six Notices of Alleged Violation (NOAV) during 2009, and was involved in several formal enforcement actions.

Indicators of Progress

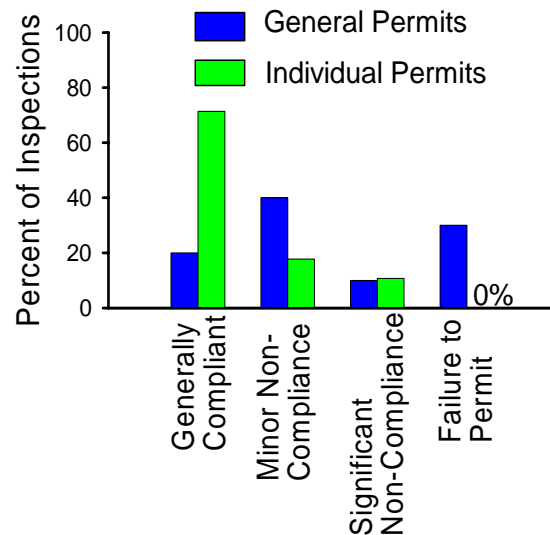
Permitting

The total acreage of planned disturbance permitted in 2009 (2,059 acres) was substantial, despite a decrease in new housing starts. This increase includes “Low Risk” projects authorized in 2007 for two years that have either not completed construction or have not broken ground and now require re-authorization.

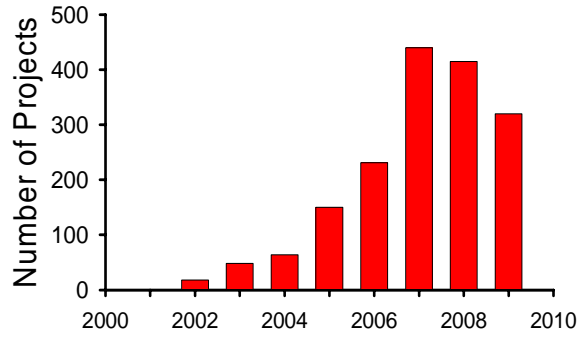
Compliance

Compliance remains an area in need of additional focus. Nine sites were identified in 2009 that did not obtain the required permit before beginning construction, and some permittees did not take sufficient steps to address identified non-compliance issues. Increased compliance assurance, including additional enforcement penalties and a sustained program of site inspections, are needed to help improve overall awareness of the permit program and deter intentional noncompliance. The Stormwater Program anticipates dedicating a single staff person to focus exclusively on compliance efforts commencing in 2010.

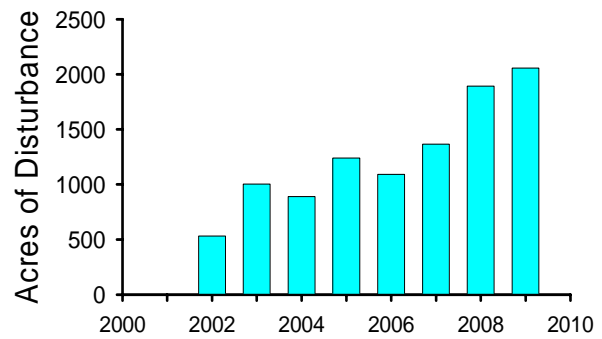
2009 Compliance Inspection Findings



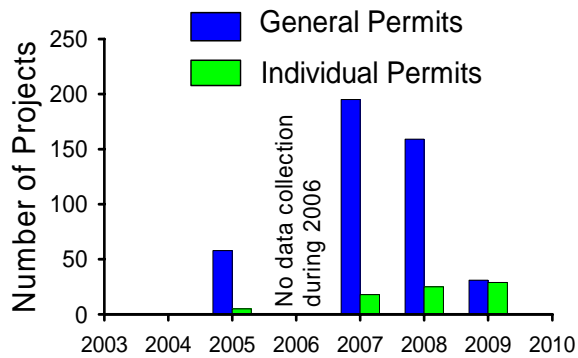
Number of Projects Authorized



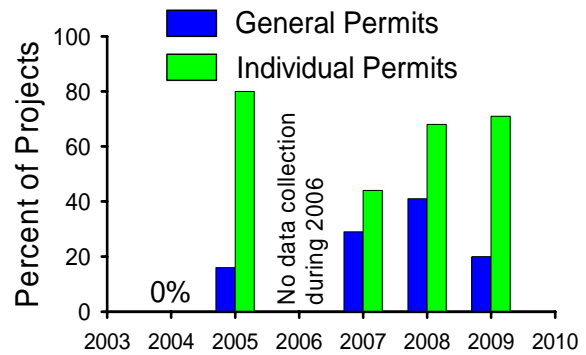
Area of Disturbance Authorized



Number of Projects Inspected



Percent of Inspected Projects in Substantial Compliance



Local Municipal Actions

The Problem

State programs do not cover all activities that may cause phosphorus and other discharges to Vermont waterways. Municipalities that want to incorporate good water quality protective language into their land-use plans and regulations often lack the time and technical expertise to do so entirely on their own.

The Program

Regulations requiring measures such as vegetated riparian buffers, building setbacks from water, and appropriate erosion control provisions can be implemented at the local level to ensure that all projects meet minimum water quality protection standards. Some of the specific measures that can be implemented at the town level to control phosphorus and generally protect water quality include the following:

- Streambank and lakeshore setback requirements
- Floodplain management
- Vegetated buffer protection
- Low impact development standards that minimize the creation of new impervious surfaces
- Small construction site erosion control standards to minimize site disturbance and erosion
- Nonregulatory options such as the purchase of conservation easements, the re-planting of streambanks and shoreline, and educational events

Through the Clean and Clear Action Plan, funds have been provided to the Vermont League of Cities and Towns (VLCT) to support a Water Quality Coordinator to engage and work with towns primarily in the Lake Champlain Basin. This position provides technical assistance to planning commissions, conservation commissions, selectboards, development review boards, zoning boards and professional municipal staff to support water quality enhancements to their zoning regulations and other municipal ordinances. Due to budget restraints in FY2009, this funding was reduced and the VLCT Water Quality Coordinator is currently working on a part-time status.

Program Accomplishments

Floodplain Management and Flood Hazard Assistance

In 2009, the Water Quality Coordinator sought out an opportunity to help municipalities better protect water quality through river corridor and floodplain management. With ANR consent and Vermont Emergency Management authorization, the VLCT Water Quality Coordinator was accepted by FEMA to attend a weeklong training session in March on managing floodplain development at the Emergency Management Institute in Emmitsburg, MD. Subsequently, she passed the exam to achieve the designation of Certified Floodplain Manager (CFM) from the Association of State Floodplain Managers, Inc. (ASFPM). The Coordinator is now qualified to assist municipalities in reviewing their existing flood hazard regulations and recommending

enhancements that will better protect floodplains and their values as well as decrease the risk of inundation and flood erosion hazards in communities.

Efforts are underway in 2009 and 2010 in Chittenden and Washington Counties to update flood hazard maps. Both counties had Preliminary Digital Flood Insurance Rate Maps (DFIRMs) available in the summer of 2009. By the spring of 2010, all communities in the two counties that participate in the National Flood Insurance Program will need to update their flood hazard regulations.

In 2009 and continuing into 2010, VLCT is participating as a partner in a Hazard Mitigation Grant Program (HMGP) grant awarded to the Chittenden County Regional Planning and Central Vermont Regional Planning Commissions (CCRPC and CVRPC) providing ongoing assistance and a nonfederal, in-kind match for the project. The VLCT Water Quality Coordinator reviews existing flood hazard regulations and helps municipalities in Chittenden and Washington Counties update their flood hazard regulations for compliance with the National Flood Insurance Program (NFIP). The Water Quality Coordinator encourages communities to adopt language from the ANR Floodplain Management Section's enhanced model flood hazard bylaws and promotes the implementation of Fluvial Erosion Hazard (FEH) zoning.

In 2009 and continuing into 2010, the Coordinator helped the following communities in Chittenden and Washington Counties exceed minimum NFIP standards through updating their flood hazard regulations: Worcester, Calais, Charlotte, Shelburne, Essex, Middlesex, Hinesburg and South Burlington. In addition to decreasing exposure to inundation and flood erosion hazards, these enhanced flood hazard regulations will better protect the sediment and nutrient attenuation capacity of floodplains in the Lake Champlain Basin.

Also in 2009, the Coordinator was accepted by FEMA into a weeklong course in August/September on the National Flood Insurance Program Community Rating System (CRS). When communities go beyond the minimum standards for floodplain management, the CRS can provide discounts up to 45% off flood insurance premiums for its residents. Among the objectives of the CRS are water quality protection and stormwater management, which are consistent with the objectives of the Clean and Clear program. The following are examples of the types of activities that would receive CRS credits and subsequently decrease municipal exposure to inundation and flood erosion hazards:

- Establishing buffer and set back requirements for development adjacent to riverine floodplains;
- Establishing open space zoning for some floodplains;
- Allowing for the transfer of development rights from floodplain to non-floodplain parcels;
- Prohibiting development in floodplains;
- Regulating activities consistent with the 500 year flood rather than the 100-year flood;
- Establishing more stringent floodway standards such as preventing activities which would cause any substantial increase in flood heights; and
- Establishing tight restrictions on the rebuilding of nonconforming uses.

After receiving the FEMA sponsored CRS training, the Coordinator is now qualified to assist municipalities interested in applying for CRS credits. The only towns in Vermont that are currently taking part in the CRS program are Bennington, Brattleboro and Montpelier, and they

are participating at the minimum level, receiving a 5% insurance premium credit for residents located inside the Special Flood Hazard Area. These towns have the potential to increase their CRS credit points and other towns are expressing interest in this beneficial program. The Coordinator is currently working with Barre City and Montpelier with their CRS enrollment, and hopes to assist other communities interested in the CRS program in 2010.

Outreach, Presentations and Workshops

Prompted by the VLCT Model Low Impact Development (LID) Stormwater Management Bylaw produced in 2008, the Coordinator helped plan, prepare and organize a LID workshop that took place at NRG Systems in Hinesburg in February 2009. Approximately 35 planners, engineers, landscape architects, state and town officials, and stormwater aficionados attended the workshop, which featured an interactive design exercise. The Coordinator memorialized the event in an article published in the April 2009 *VLCT News* titled “*Low Impact Development (LID) – It Just Makes Sense.*”

Also in 2009, VLCT’s Technical Paper #5 – *Managing Stormwater through Low Impact Development (LID) Techniques* and the *VLCT Model Low Impact Development Stormwater Management Bylaw – May 2008*, was published by the American Planning Association (APA) in their Planning Advisory Service Essential Info Packet focusing on low impact development regulatory tools. The APA materials have nationwide exposure.

The Coordinator wrote two articles pertaining to floodplain management that were published in the *VLCT News: Floodplain Management 101*, and *Flood, Sweat and Tears: Substantial Improvement and Substantial Damage Under the NFIP*. The Coordinator also served on the Advisory Review Committee and was a contributing editor for the document *Preparing for the Next Flood: Vermont Floodplain Management*, published by the Vermont Law School Land Use Institute.

In 2009, the Coordinator delivered customized PowerPoint presentations to the following 21 towns and watershed groups: Fayston, Waitsfield, Warren, Essex, Westford, Underhill, Newbury, Barnet, Ryegate, South Royalton, Windham, Proctor, Plymouth, Orwell, Brandon, the Mad River Planning District, The Federation of Vermont Lakes and Ponds, the Lower Winooski Watershed Council, Thetford, Franklin and New Haven. These presentations covered the benefits of low-impact development over conventional stormwater management practices and local opportunities for water quality protection through riparian buffer, floodplain, wetland and tree canopy protection.

There were several VLCT-sponsored events in 2009 in which the Coordinator took part. She helped prepare and moderated the VLCT Vermont Interactive Television (VIT) workshop “Managing Stormwater through Low Impact Development – A Primer for Planning and Zoning Officials,” held on September 17th. The Coordinator organized and proctored a workshop titled “Water Issues: Wetlands, Flood Hazards and Stormwater” at the VLCT Annual Town Fair on October 1st. She participated in the VLCT sponsored “Local Government Day” on February 18th at the State House. She helped prepare the “Wetlands Roundtable” at VLCT’s “Planning and Zoning Forum” in November.

Municipal Assistance

In 2009, the Coordinator offered assistance to the following 45 towns within the Lake Champlain Basin:

Hinesburg	Underhill	Waterbury	South Burlington	New Haven
North Hero	Proctor	Marshfield	Westford	Montpelier
Franklin	Plymouth	Cabot	Colchester	Shoreham
Richmond	Orwell	Berlin	Barre Town	Tinmouth
Calais	Brandon	Northfield	Worcester	Essex Junction
Barre City	Waitsfield	Shelburne	Woodbury	Williston
Fayston	Warren	Charlotte	Duxbury	Ferrisburg
Essex	Plainfield	Milton	Williamstown	Middlesex
Westford	East Montpelier	Huntington	Burlington	Monkton

The Coordinator also offered assistance to nine towns outside the Lake Champlain Basin:

Woodstock	Newport Town	Barnet	South Royalton	Arlington
Thetford	Newbury	Ryegate	Windham	

The Coordinator is working one-on-one with town officials from a subset of these towns who are currently writing or re-writing their zoning bylaws, flood hazard bylaws or other water quality-related ordinances, and is available to assist all towns within and outside the Lake Champlain Basin as their municipal boards engage in adopting or revising bylaws and ordinances.

In 2009, the Coordinator continued her work on the Board of Directors for the Association of Vermont Conservation Commissions (AVCC), where she was appointed Treasurer, and the Friends of the Winooski River (FWR). She helped establish AVCC's Community Conservation Grant Program and participated in riparian restoration projects on the North Branch of the Winooski River in Worcester and the Nasmith Brook in Marshfield, and assisted with geomorphic assessment on the Jail Branch of the Winooski River in Williamstown. She hosted monthly Upper Winooski Basin Planning meetings and attended and participated in several Lake Champlain Phosphorous TMDL stakeholder meetings. She is an active participant in the Chittenden County Regional Stormwater Education Program (RSEP), and a member of the Addison County River Watch Collaborative.

In 2007, the Water Quality Coordinator was appointed to the Mayor of Burlington's Stormwater Task Force whose charge was to produce a comprehensive stormwater plan for the City that included both construction and post construction stormwater management. In April 2009, this work was completed with the passage of a comprehensive ordinance that regulates stormwater discharges from development that disturbs 400 square feet or more and /or where any changes of hydrology are proposed. The ordinance also encourages low impact development alternative practices based on the VLCT Model Low Impact Development Stormwater Management Bylaw.

The VLCT Coordinator re-evaluated a number of the most current town zoning or other applicable regulations for the 136 towns in the Lake Champlain Basin for the existence of water quality protective language in conjunction with Vermont DEC. The criteria used to evaluate zoning regulations include:

- Streambank and lakeshore setback and buffer requirements
- Permitted and conditional uses in the buffer and setback
- Existence of zoning districts relevant to water quality protection

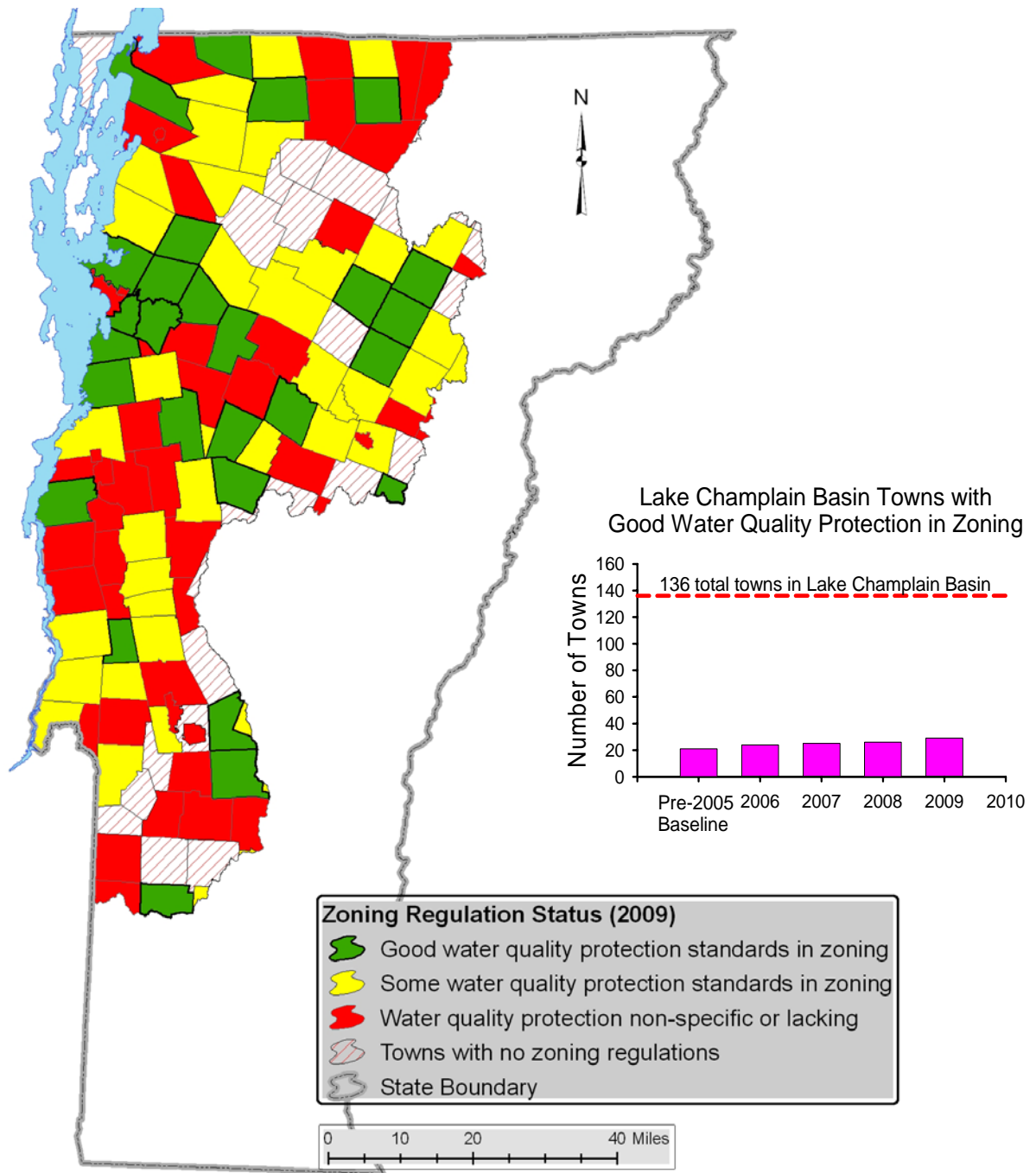
- Flood hazard regulations with water quality protections above the standards necessary for NFIP coverage
- Steep slope development restrictions
- Impervious cover limitations
- Stormwater treatment criteria
- Erosion and sediment control standards
- Low impact development standards
- Highway/driveway curb cut standards

This review can be somewhat subjective due to the considerable variation in zoning regulations and the need to make a judgment on the degree of protection provided by any given standard or regulation. In addition, in some instances, stormwater management standards, road standards and floodplain protection language exists in a stand-alone ordinance outside the purview of zoning regulations. The goal of the Local Municipal Actions program within Clean and Clear is to have all towns in the Lake Champlain Basin adopt good water quality protection standards in their zoning bylaws, ordinances or other non-regulatory tools and practices.

Indicators of Progress

Activity	2006	2007	2008	2009	Comments/Information
Number of town contacts made	31	67	31	58	Any contact where information or technical assistance was provided on water quality topics. Of these 58 towns, 26 were offered flood hazard related assistance.
Number of town board or commission meetings attended	21	35	41	37	
Articles written	4	3	3	3	
Information materials produced	38	33	76	24	
Number of meetings with partners	81	43	42	36	
Zoning regulations with new or enhanced water quality protection components	25	6	7	8	Towns where there was some water quality protection language added and the town went from red to yellow, or green or yellow to green, on the map, or perhaps didn't change color but there were enhancements in the zoning as indicated in the database.
Number of towns with good water quality protections in their zoning*	24	25	26	29	Determined based on a review of the zoning regulations for setbacks from water, vegetated buffer strips, erosion control standards, stormwater standards, flood hazard regulations, limited permitted or conditional uses in shoreland areas, protective conditional use or site plan review standards. The final determination takes into account all these factors and more but is of necessity subjective to a degree.

* These values are likely underestimates because it is not possible to review every zoning regulation and there are likely to be water quality related improvements in zoning ordinances that are missed in any given year.



Wetland Protection and Restoration

The Problem

Many wetland areas in Vermont have been altered or destroyed to support land development or agriculture. This is a concern because wetlands serve an array of critical environmental functions; the protection of water quality foremost among them. Surface runoff often flows through wetlands prior to discharging into streams, rivers, or lakes. This runoff can contain a variety of contaminants, including excess sediments and nutrients such as phosphorus, which is the main focus of the Clean and Clear Action Plan. Riparian wetlands can reduce phosphorus loading through sediment deposition, the binding of phosphorus to soil particles, and plant uptake. Protecting existing wetlands and restoring the functions of altered wetlands will expand the natural barriers to phosphorus loading in Lake Champlain and other state waterways.

The Program

The State of Vermont has jurisdiction over wetlands through a variety of regulatory programs including the Vermont Wetland Rules, Act 250, and Section 401 Water Quality Certifications. There are also some federal restrictions on wetlands that are administered by the U.S. Army Corps of Engineers. These regulatory programs help maintain the water quality benefits and other functions of existing wetlands. To date, however, the state has already lost more than a third of its pre-colonial wetland acreage. In an effort to increase the total wetland acreage within the Lake Champlain Basin, capital funds have been provided through Clean and Clear to protect and restore critical riparian wetlands.

In 2006, the Agency of Natural Resources contracted for a study to identify and prioritize wetland restoration opportunities in the basin, and the *Lake Champlain Basin Wetland Restoration Plan* was finalized in December 2007. Since that time, data from the plan have been widely distributed to federal, state, local government agencies, and nonprofit organizations with an expressed interest in wetland restoration and protection.

Program Accomplishments

Wetland Restoration and Protection Projects

To date, through the Clean and Clear program, Vermont has dedicated \$1 million to wetland protection and restoration projects. In addition, the changes enacted as part of the 2008 Farm Bill dramatically increased the amount of federal funding available through the Wetlands Reserve Program (WRP) for wetland protection and restoration. WRP is a voluntary program that provides technical and financial assistance to private landowners to restore, protect, and enhance wetlands in exchange for retiring marginal land from agriculture. The 2008 Farm Bill has made available more than \$2 million annually for Vermont projects, representing a fivefold increase in available federal funds. It is anticipated that the high level of funding available for WRP will continue through the full five-year life of the current farm bill. Further, this increase in available funding occurred at the same time that the U.S. Natural Resources Conservation Service (NRCS) significantly increased the amount it pays, per acre, for WRP easements – making the program much more attractive to landowners.

As a result of the unprecedented levels of federal funding and interest in WRP, Clean and Clear has shifted its focus to the active support of NRCS in seeking new sign-ups for WRP. Clean and

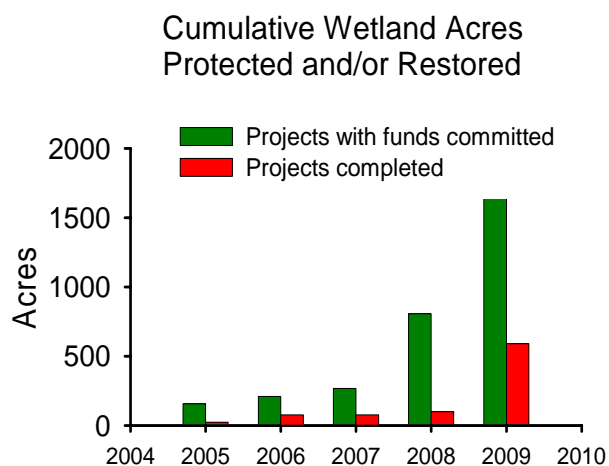
Clear has assisted with WRP project development through a combination of direct staff support and a grant to Ducks Unlimited.

As a result, WRP had approximately 315 acres of new sign-ups for wetland restoration projects in the towns in 2008 and an additional 940 acres were enrolled in 2009. All of these lands will be permanently conserved via an easement that is held by NRCS. NRCS will pay for the easements to conserve these lands, and for the restoration expenses.

The reach of the Clean and Clear partnership with federal agencies was further extended by the U.S. Fish and Wildlife Service (USFWS) Partners for Wildlife Program. Restoration plans can now be developed, designed, and implemented significantly more quickly than they have in the past.

Indicators of Progress

The process of bringing a wetland restoration project to completion can take several years since such projects usually involve complex negotiations and agreements among landowners, state, local, and federal government agencies, and nonprofit organizations. The success of wetland protection and restoration efforts under the Clean and Clear Action Plan is therefore tracked by documenting the acreage of wetlands protected and restored, as well as the acreage committed to be protected and restored. The rate at which wetland protection and restoration projects are being developed and completed has greatly accelerated with the availability of federal Wetland Reserve Program funds.



Forest Watershed Management

The Problem

Sediment is the most common pollutant associated with timber harvesting. Soil can be carried by rainwater after timber harvesting equipment and trees dragged or carried over the ground loosen and expose the soil. Bare ground exposed during harvesting operations can be eroded by rainwater and enter nearby streams causing sedimentation. The presence of an intact forest floor on the soil surface protects soil from being eroded. The forest floor is composed of the litter layer, underlying organic layer (humus), and fibrous roots.

A 2007 report for the Lake Champlain Basin Program estimated that 8-15% of the total nonpoint source phosphorus load delivered to Lake Champlain comes from forest land. Work continues to accelerate the implementation of practices to protect water quality during timber harvesting operations. Stream crossings used during harvesting have been a particular area of concern in eliminating discharges of sediment. With forests covering more than 4.6 million acres and representing 78% of Vermont's total land base⁸, forestry continues to be an area worthy of efforts to reduce sedimentation and phosphorus loading to state waters.

The Program

The Watershed Forestry Program is focused on efforts to reduce nonpoint source pollution associated with forest management activities. Education, outreach, and technical assistance is provided to forest landowners, loggers, forestry professionals, and the general public in regards to forestry principles and practices associated with protecting forest water quality and preventing soil erosion. The program also administers the "Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont" and Vermont's "Heavy Cutting Law" (Act 15).

Program Accomplishments

AMP Program

The AMPs were developed and adopted as rules to implement Vermont's water quality statutes, and became effective on August 15, 1987. The AMPs are designed to prevent sediment, petroleum products, and logging slash from entering waters of the state. The AMPs are based on principles that have been scientifically proven and tested over time. When implemented correctly, they have proven to be effective in maintaining water quality and preventing erosion on timber harvesting operations.

Since adoption of the AMPs, the Department of Forests, Parks and Recreation (FP&R) has worked with representatives from the Vermont forest industry to support the Agency of Natural Resources (ANR) Enforcement Division in an effort to reduce the number and severity of water quality violations resulting from timber harvesting operations. In 2008, FP&R staff provided technical assistance on 61 cases. There continues to be a high level of cooperation and voluntary

⁸ 1997 Forest Statistics for Vermont; USDA Forest Service; Northeastern Research Station; Resource Bulletin NE-145.

compliance among loggers and landowners to bring operations into compliance with Vermont's water quality statutes.

Portable Skidder Bridge Initiative

The goals of this initiative are threefold:

1. Inform loggers, landowners and foresters about the benefits of using portable skidder bridges through workshops and presentations, field demonstrations, informational brochures, static displays, video and web production, and news articles.
2. Provide portable skidder bridges to loggers for purchase, loan and rental using a variety of means and partners.
3. Provide assistance and support for existing and start-up businesses that would fabricate and sell portable skidder bridges.

Portable skidder bridges are designed and intended for use as temporary structures for crossing streams during logging. Portable skidder bridges are becoming widely viewed as a Best Management Practice for controlling nonpoint source pollution associated with timber harvesting operations. When properly installed, used, and removed, they create less stream bank and stream bed disturbance as compared to other alternatives such as culverts or poled fords. They are also economical since they are reusable, easy to install and can be transported from job to job. Portable skidder bridges will reduce the potential for sedimentation, channeling, and degradation of aquatic habitat to occur while allowing loggers to harvest timber in compliance with Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont (AMPs).



Loggers have the opportunity to use portable skidder bridges by participating in the **Portable Skidder Bridge Rental Program** or the **Portable Skidder Bridge Loan and Education Program**. The use of portable skidder bridges as a method for crossing streams during logging operations is gaining popularity as loggers, landowners, and foresters realize their environmental and economic advantages.

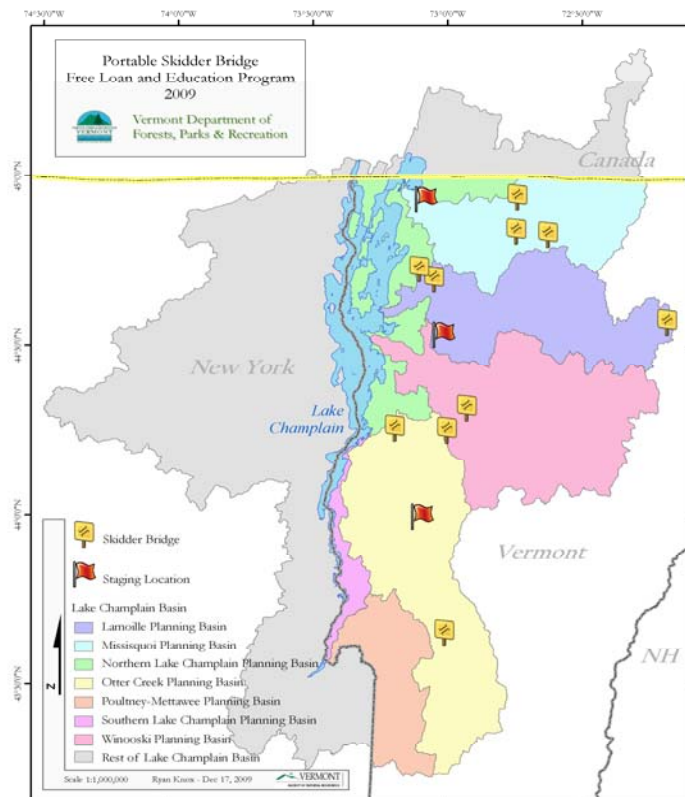
Portable Skidder Bridge Rental Program

This is a statewide program for loggers and landowners. The program is administered by the Natural Resources Conservation Districts (NRCD). This program was established as part of a joint effort between the Department of Environmental Conservation (DEC) Basin Planning Program, the FP&R Forest Watershed Program, and the NRCDs. It was started in 2007 with two pilot projects getting underway in Lamoille and Rutland counties. During 2009, three more rental programs were launched by the Windham, Winooski, and Caledonia County Conservation Districts. Caledonia partnered with the Essex County Conservation District to serve the greater Northeast Kingdom area. Another rental program in Bennington County is scheduled for startup in 2010.

Loggers who do not own portable skidder bridges can rent them from Conservation Districts offering this program for \$100 a month. The bridges are located at six different participating sawmills and log yards around Vermont for loggers to conveniently pick up and return. Loggers who rent bridges are provided an educational packet illustrating guidelines to follow for installation, use, and removal of the bridges while following the “Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont.” Eleven bridges were rented to loggers during 2009.

Portable Skidder Bridge Free Loan and Education Program

This program is designed to (1) provide for technology transfer to loggers, landowners, and sawmills and (2) build capacity for producing portable bridges within Vermont’s forest industry. The program is administered by the Northern Vermont Resource Conservation and Development (RC&D) Council. It was launched in 2008 with an initial geographic focus area of the northern Lake Champlain Basin. It has now expanded to cover the entire Lake Champlain Basin in Vermont. Loggers participating in this program are entitled to one free loan event. They are provided an educational packet that illustrates guidelines to follow for installation, use, and removal of the bridges while following the “Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont.”



Eight bridges, built by Dave Stratton of Dave’s Sawmill in Hardwick, are being staged in various quantities for loggers to pick up and return at the Burlington Electric Department chip yard facility in Swanton, Lamell Lumber in Essex, and Canopy Timber Alternatives wood yard in East Middlebury. A project coordinator provides technical assistance and instruction to loggers using the bridges to ensure proper use to prevent sedimentation, monitor AMP compliance, and collect information on acreage accessed and volume harvested using portable bridges. The project coordinator is also responsible for tracking the bridges, geo-referencing installation sites, and performing bridge safety inspections.

This effort will lead to an increased use of portable bridges as loggers experience and realize the environmental and economic benefits of using a portable design. During 2009, loggers working in the Lake Champlain Basin entered into ten free loan agreements for portable bridges. A total

of 470 acres of wood were accessed and 4,008 cords⁹ of wood were transported across the bridges.

Education and Outreach

The Vermont Department of Forests, Parks and Recreation provides support to Vermont logger education and training programs by offering and participating in workshops for loggers. The Watershed Forestry Program has extended this effort to also include opportunities for landowners, private consulting foresters and high school vocational forestry students.

Portable Skidder Bridge Training: During 2009, the Watershed Forestry Program facilitated four portable skidder bridge workshops for loggers. The workshops were held as “kick-off” events to launch the three new rental programs that were started this year. An inside morning presentation that covered the economic and environmental benefits of using portable skidder bridges was followed by a hands-on session where participants had the opportunity to build a bridge. Sixty-one loggers attended these workshops.

Vocational Forestry Program Training: Training and educational opportunities are also offered to vocational high school forestry programs. During 2009, twenty-four vocational forestry students from Saint Johnsbury Academy and the Windham Regional Career Center in Brattleboro participated in workshops or received education and training on how to build portable skidder bridges. Each class had the opportunity to build a portable skidder bridge in support of their local Portable Skidder Bridge Rental Program.

Logger Education to Advance Professionalism (LEAP): The Vermont Division of Forests supports logger education efforts through participation in workshops offered through LEAP. AMP training is regularly provided to loggers through the Forest Watershed Program. In 2009, fourteen loggers attended a full day of training on the topic of “Protecting Forest Water Quality and Wetlands during Logging Operations.”

White River Basin Class IV Town Road Assessment

The Department of Forests, Parks and Recreation Watershed Forestry Program and the Department of Environmental Conservation Basin Planning Program partnered with the Two Rivers Ottauquechee Regional Planning Commission (TRO-RPC) and the White River Partnership (WRP) to perform an assessment of Class IV town roads in the White River watershed. The purpose of the assessment was to locate and identify water quality impairments associated with these public roads, prioritize restoration projects and develop recommendations for mitigation.

There are more than 1,500 miles of mapped Class IV town roads in Vermont¹⁰. These roads provide multiple uses and benefits to the public. Many serve as vital links for both motorized and nonmotorized recreational trail systems. They also provide access for hunting and fishing, forest management activities, and to camps and residential homes.

⁹ Total volume of timber harvested was converted into cords. This figure represents sawlogs, pulpwood, firewood and wood biomass.

¹⁰ Vermont Agency of Transportation (2008)

Towns do not receive grant aid from the State to maintain Class IV town roads. As a result, many of these roads have fallen into disrepair. Class IV town roads are eligible for funding from the Better Back Roads Grant Program. However, Class IV town roads are generally perceived as a low priority by towns compared to their overall road maintenance needs.

Erosion and water quality concerns on Class IV town roads have been regularly documented through the Acceptable Management Practices (AMP) Program for maintaining water quality on logging jobs in Vermont. The Department of Forests, Parks, and Recreation administers this program. The AMP's are intended and designed to prevent mud, petroleum products and woody debris (logging slash) from entering waters of the state.

There are 377 Class IV town roads (206 miles) in the White River Basin. These roads cover 28 towns in east-central Vermont. A coarse and fine filter geographic information system (GIS) analysis was conducted by TRO-RPC staff to select 75 Class IV town road segments (81 miles) for field analysis. Criteria and protocols were developed for the field evaluation that was conducted by WRP staff during July and August. Examples of issues identified that resulted in sedimentation and stream bank erosion include: lack of road surface drainage features, inadequate ditching, and undersized/improperly installed culverts. The results of the field assessment were evaluated and prioritized by severity of water quality impairment into categories of "High," "Medium," and "Low." Twenty-seven of the 75 road segments that were evaluated in the field were categorized as "High" or "Medium" priority for mitigation. Narratives were developed for each road segment to summarize the issues for town officials, user groups, and other stakeholders. An effort is currently underway to (1) secure funding through a variety of means to alleviate water quality impairments associated with Class IV town roads in the White River Basin, and (2) perform education and outreach to those affected towns, user groups, and other stakeholders

Indicators of Progress

AMP Program Technical Assistance

There is no apparent upward or downward trend in the number of AMP technical assists as indicated by statistics for the last several years. However, FP&R staff has observed that the water quality violations are becoming less severe. AMP records from 1999 to present indicate that the number of technical assists on timber harvesting operations ranged from a low of 26 during 2005 to a high of 62 during 1999. The numbers vary due to many variables such as amount and distribution of annual rainfall, number and timing of timber harvesting operations, market conditions, etc.

AMP Program Enforcement Actions

Since adoption of the AMP's, the Department of Forests, Parks and Recreation has worked with Vermont's forest industry to support the Agency of Natural Resources Enforcement Division in an effort to eliminate discharges resulting from logging operations. In 1990, a Memorandum of Understanding (MOU), was developed between the Agency of Natural Resources Enforcement Division and the Department of Forests, Parks, and Recreation. The MOU establishes a protocol that the Department of Forests, Parks, and Recreation and Vermont forest industry representatives may use to assist loggers or landowners when there is a discharge while maintaining the legal enforcement responsibilities assigned the ANR Enforcement Division. According to the agreement, AMP Technical Advisory Teams have been created to directly assist any logger or landowner when there is a discharge or a request for technical assistance. Enforcement is pursued in instances where:

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

The number of AMP cases referred to the ANR Enforcement Division remains low in comparison to the total number of cases investigated.

Year	Number of AMP Technical Assists	Number of Enforcement Actions¹¹
1999	62	3
2000	57	4
2001	43	0
2002	48	4
2003	36	2
2004	56	5
2005	26	2
2006	65	9
2007	41	9
2008	61	2
2009	60	8

Forest Water Quality Education and Training

This indicator of success illustrates the sustained effort on the part of FP&R and the Watershed Forestry Program to provide education and training on the topic of forest water quality to loggers, landowners, private consulting foresters and high school vocational forestry students. Number of workshops and attendance will vary annually.

Indicator	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of training events	3	3	2	4	4	2	5	4		3	8
Number of participants	195	52	34	174	202	150	172	121	42	39	144

Portable Skidder Bridge Free Loan and Education Program

Indicators of progress for this program include (1) number of bridges available for free loan, (2) number of loans with loggers, (3) acres accessed using portable skidder bridges, and (4) volume of timber transported across portable skidder bridges. This year, 2009, was the first full year that portable bridges through this program have been available to loggers and landowners in the Lake

¹¹ At a minimum, a "Notice of Alleged Violation" was served by an ANR Environmental Enforcement Officer.

Champlain Basin. Demand for bridges and logger participation in this program is expected to increase.

Indicator	2009
Number of portable skidder bridges available for free loan	8
Number of free loan agreements	10
Acres accessed using portable skidder bridges	470
Volume of timber transported across portable skidder bridges (cords)	4,008

Portable Skidder Bridge Rental Program

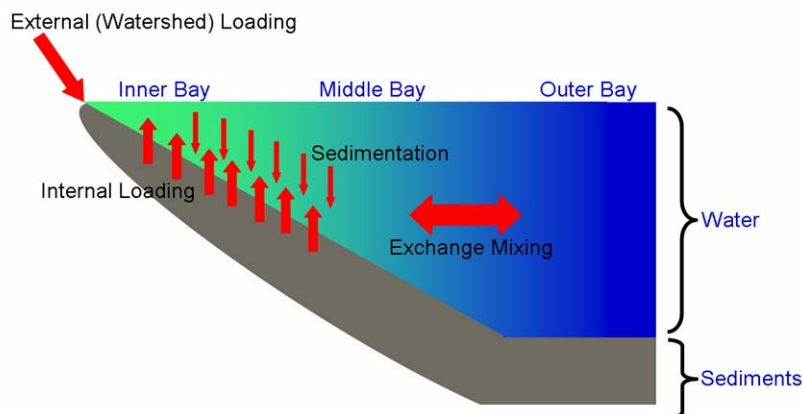
Indicators of progress for this program include (1) number of Conservation Districts administering the program, (2) number of bridges in the rental pool and (3) number of bridges rented. 2009 marks the second full year of operation for this program. Demand for bridges and logger participation is expected to increase.

Indicator	2008	2009
Number of Conservation Districts offering a rental option	2	5
Number of portable skidder bridges in the rental pool	6	14
Number of bridges rented	7	11

St. Albans Bay Internal Phosphorus Loading Control

The Problem

Phosphorus has accumulated in the sediments of St. Albans Bay from decades of excessive loading from point and nonpoint sources in the watershed. This sediment store of phosphorus is now recycling back into the water and is continuing to feed algae blooms in the bay in a process called “internal loading.” Water quality standards in St. Albans Bay may not be achieved until this internal phosphorus loading from the bay’s sediments declines.



The phosphorus cycle in St. Albans Bay, showing internal phosphorus loading from the bay’s sediments.

The Program

The Lake Champlain Phosphorus TMDL proposed consideration of treating the sediments with alum (aluminum sulfate) to control the internal loading. The TMDL plan indicated that such a treatment should be conducted only if it is shown to be technically feasible and environmentally acceptable, and only after progress is made in reducing the existing nonpoint source phosphorus loading from the bay’s watershed.

A St. Albans Bay sediment core study funded by Clean and Clear and conducted by the University of Vermont Department of Geology during 2004 found that a substantial reservoir of phosphorus remains in the sediments of St. Albans Bay and that this stored phosphorus has the potential to recycle back into the water of the bay for an indefinite period of time into the future¹². Given these findings, the Agency of Natural Resources initiated a feasibility study for the control of internal phosphorus loading in St. Albans Bay using Clean and Clear funds.

The feasibility study was designed to be conducted in two phases. The purpose of the first phase was to compare treatment options for the control of internal phosphorus loading in St. Albans Bay as to their feasibility, likelihood of success, environmental impacts, and cost. Phase 1 of the feasibility study was completed by ENSR Corp. in 2007¹³. The report included an evaluation of

¹² Gregory D., A. Hartmann, R. Lomonaco, and K. Oldrid. 2005. Determination of sediment phosphorus concentrations in St. Albans Bay, Lake Champlain: Assessment of internal loading and seasonal variations of phosphorus sediment-water column cycling. Prep. for Vermont Agency of Natural Resources. Waterbury, VT. <http://www.anr.state.vt.us/cleanandclear/StAlbansBaySedimentPstudy.pdf>

¹³ ENSR Corp. 2007. Feasibility Study for the Control of Internal Phosphorus Loading in St. Albans Bay, Lake Champlain. Prep. for Vermont Agency of Natural Resources. Waterbury, VT. <http://www.anr.state.vt.us/cleanandclear/StAlbansBay-FinalReport-Phase1.pdf>

several alternatives including artificial circulation, hydraulic dredging, and phosphorus inactivation in lake sediments and/or tributary inflows with chemicals such as alum.

Program Accomplishments

Phase 2 Feasibility Study

After considering the findings and recommendations in the Phase 1 study report and the advice from a Project Advisory Committee composed of basin scientists, resource managers, and local citizens, the Vermont ANR has determined that the next phase of the feasibility study should proceed. The purposes of Phase 2 will be to develop a detailed design for an in-lake treatment project including refined cost estimates, and to prepare a full environmental evaluation including all information needed for state and federal permitting. By proceeding with feasibility studies for the control of internal loading concurrently with renewed efforts to reduce nonpoint source loads from the bay's watershed, a future in-lake treatment could be closer to realization once a judgment is made that watershed loads are sufficiently reduced to justify such a treatment.

The Vermont ANR worked successfully during 2008 with the U.S. Army Corps of Engineers and the Lake Champlain Basin Program to secure technical approval and funding for the Phase 2 study through Section 542 of the U.S. Water Resources Development Act of 2000. While little progress was made during 2009, a Project Management Plan is currently in preparation by the Corps of Engineers. It is expected that the Phase 2 study will begin during 2010.

The specific treatment alternatives that will be the focus of the Phase 2 analysis will be (1) phosphorus inactivation of the sediments within the Black Creek Wetland and inner St. Albans Bay using aluminum compounds (alum and sodium aluminate), and (2) hydraulic dredging of an area limited to the open-water portion of the Black Creek Wetland.

Monitoring and Research

The Problem

The ultimate goals of the Lake Champlain Phosphorus TMDL implementation plan are to take all the actions necessary to attain the loading limits specified in the TMDL for each sub-watershed, and to achieve the in-lake phosphorus water quality criteria for each lake segment. Long-term water quality and land use monitoring is needed to determine whether these targets are being achieved, and to understand the reasons when goals are not being met.

The Program

Much of the monitoring and research work related to the Clean and Clear program is being done in close cooperation with the Lake Champlain Basin Program. A summary of the major monitoring and research projects operating during 2009 is provided below.

Program Accomplishments

Lake Champlain Long-Term Water Quality and Biological Monitoring Program

The states of Vermont and New York jointly conduct the Long-Term Water Quality and Biological Monitoring Program on Lake Champlain with support from the Lake Champlain Basin Program. The program measures phosphorus and many other parameters in the lake and its tributary rivers. The tributary monitoring results are analyzed with data from the network of stream flow gauges in the basin operated by the U.S. Geological Survey. All chemical analyses are conducted by the Vermont Department of Environmental Conservation's Environmental Laboratory.

Water quality monitoring continued during 2008 on Lake Champlain and its tributaries. This information is made freely available on the Lake Champlain Long-Term Monitoring Program website¹⁴ to researchers, students, consultants, and the general public. The monitoring data were analyzed and presented in the Lake Champlain Basin Program's 2008 State of the Lake Report¹⁵ to show the current status and long-term trends in phosphorus levels in Lake Champlain and its tributary rivers.



Lake Champlain phosphorus concentration and tributary loading data from 1990-2008 were analyzed in a jointly authored report by Vermont, New York, and Quebec staff. The report was

¹⁴ Lake Champlain Long-Term Monitoring Program website.
http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp_longterm.htm

¹⁵ Lake Champlain Basin Program. 2008. State of the Lake and Ecosystem Indicators Report. Grand Isle, VT.
<http://www.lcbp.org/lcstate.htm>

published by the Lake Champlain Basin Program in December 2009¹⁶. This report found that four lake segments had significant increasing trends in phosphorus concentrations over the 1990-2008 time period, while no significant decreasing phosphorus trends were observed in any lake segment. There were few statistically significant trends either upward or downward in phosphorus loads for any individual tributary or lake segment watershed over the 1991-2008 time period.

While overall progress in reducing phosphorus in Lake Champlain has been disappointing, there were some positive signs in the results. Phosphorus loads and flow-weighted mean phosphorus concentrations in the inflows to most regions of the lake were stable or decreasing during 1991-2008 in spite of ongoing land use conversion and development in the watershed.

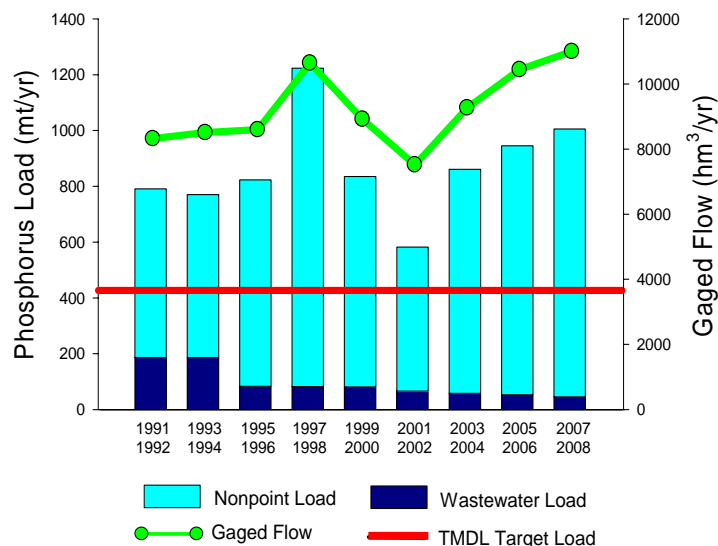
Further insights are expected from a study in progress by the U.S. Geological Survey for the Lake Champlain Basin Program. This USGS study will employ the most current statistical methods to account for the effects of hydrologic variations and phosphorus management efforts on trends in phosphorus loading to Lake Champlain.

Lay Monitoring Program

The Vermont Lay Monitoring Program is a cooperative effort between the Vermont DEC and volunteer lake monitors. Volunteer lake monitoring is a cost-effective approach because it provides valuable data at reduced cost while informing and involving lake residents in lake protection efforts. The goals of the program are to:

- Describe lake conditions on each lake participating in the program.
- Establish a database on each lake for tracking long-term water quality trends.
- Promote shared responsibility for lakes by educating and involving the public in lake protection.

Volunteers are trained and equipped to take weekly lake samples during June, July, and August. Since 1979, Lay Monitors have sampled 90 inland lakes and 40 stations on Lake Champlain. In 2009, there were close to 100 volunteer monitors involved in the program. In total over the last 31

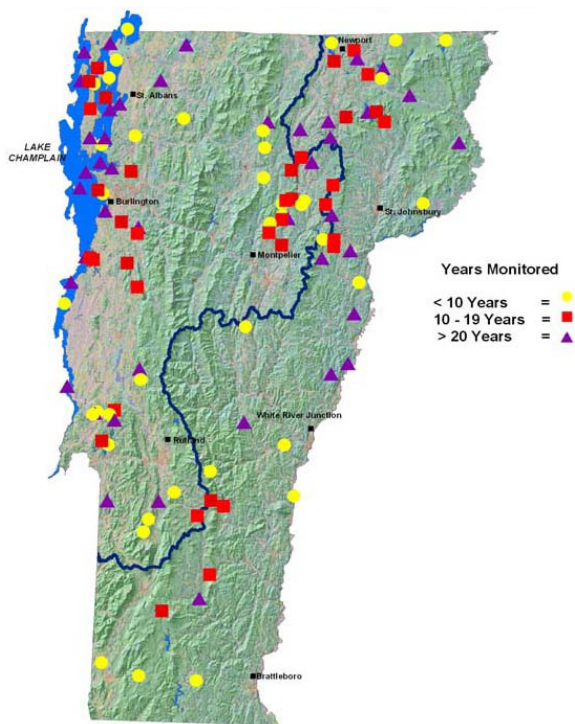


Total basinwide phosphorus loading rates (metric tons per year) to Lake Champlain during 1991-2008 compared with the total loading capacity of 427mt/yr established in the Lake Champlain Phosphorus TMDL, and with the total gaged tributary flow rates during each interval.

¹⁶ Smeltzer, E. F. Dunlap, and M. Simoneau. 2009. Lake Champlain phosphorus concentrations and tributary loading rates, 1990-2008. Lake Champlain Basin Program Technical Report No. 57. Grand Isle, VT. http://www.lcbp.org/techreportPDF/57_Phosphorus_Loading_1990-2008.pdf

summers, volunteers have monitored 79 (50%) of Vermont's 158 lakes greater than 50 acres in surface area. All chemical samples are analyzed at the Department of Environmental Conservation's Environmental Laboratory. A report with graphical summaries of the data is prepared by Vermont DEC staff and provided to the volunteer monitors each year.

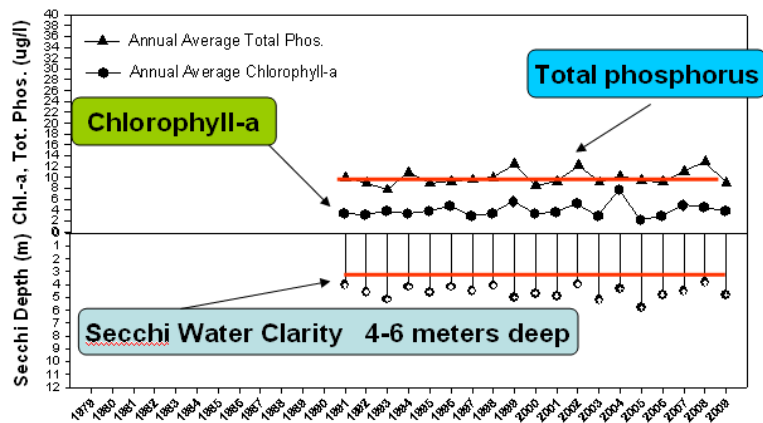
The Vermont Lay Monitoring Program also conducts a unique professional development program for teachers called "A Watershed for Every Classroom" (WEC), which is offered to Lake Champlain Basin educators. A Watershed for Every Classroom uses the Lake Champlain Basin as the integrating concept to teach science, math, history, art, geology, and language arts. WEC teachers reach hundreds of students annually and are committed to providing educational opportunities that benefit both the student and the lake. During 2009, WEC alumni events were offered to support teachers with their Lake Champlain study programs.



Lake Champlain stations and Vermont inland lakes included in the Lay Monitoring Program since 1979, with years of monitoring data indicated.



A Watershed for Every Classroom activities.



Lay Monitoring Program results for South Pond in Eden showing stable conditions since 1991.

Rock River Watershed Monitoring

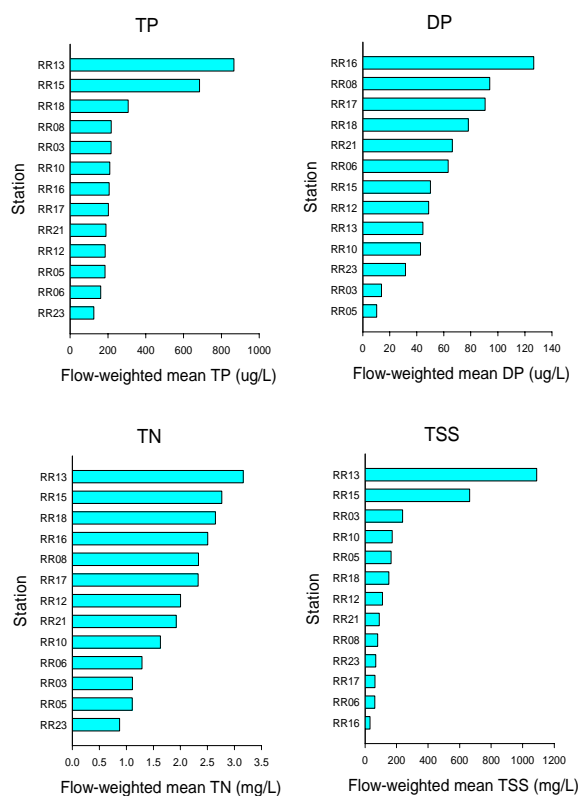
The Agency of Natural Resources conducted a special one-year sampling program to identify tributaries to the Rock River within the Missisquoi Bay watershed that are contributing the highest amounts of phosphorus and other pollutants. A total of 22 sites were sampled for concentrations of total phosphorus, total dissolved phosphorus, total nitrogen, and total suspended solids on 12 dates during 2008-2009.

The sampling methods were simple and limited to concentration results only, without accompanying flow measurements at each site. The purpose of the program was to determine whether this simple monitoring approach would be useful in identifying small catchment areas within the Rock River watershed that were critical source areas. These simple sampling methods are feasible for volunteers to employ if laboratory analytical services are available, and several watershed organizations in Vermont conduct this type of sampling. If appropriate methods of data analysis can be developed using this approach, then these methods could be used by local watershed organizations for identifying critical source areas throughout the Lake Champlain Basin.

It will be important in this analysis to interpret the water quality monitoring results in relation to the physical and land use characteristics of each sampled catchment area in order to determine why certain catchments are contributing disproportionately large amounts of pollutants. The Agency of Natural Resources will work with the Agency of Agriculture, Food, and Markets and the U.S. Natural Resource Conservation Service to obtain and analyze a variety of relevant geospatial data for the Rock River watershed. A report will be issued during 2010 indicating the catchment areas that contribute the highest pollutant levels, and the features of those catchments that appear to most responsible.

Phosphorus Accounting System

Clean and Clear funds were combined with additional funding from the Lake Champlain Basin Program to support a research project at the University of Vermont on *An Environmental Accounting System to Track Nonpoint Source Phosphorus Pollution in the Lake Champlain Basin*. The purpose of the project was to develop a framework and model that can be used to account for major sources and potential reductions of phosphorus across the landscape. This



Flow-weighted mean concentrations of total phosphorus (TP), dissolved phosphorus (DP), total nitrogen (TN), and total suspended solids (TSS) at 13 monitoring stations in the Rock River watershed. Daily flow data from the USGS gage on Stevens Brook in St. Albans were used to flow-weight the concentration data.

project is intended to help Vermont ANR address the requirement in 10 V.S.A. §1386 to develop a method of accounting for changes in phosphorus loading to Lake Champlain due to implementation of the TMDL and other factors.

The project used process-based watershed modeling methods to analyze primarily agricultural sources in the upper portions of the Rock River watershed. This narrow geographic focus was necessary for practical implementation of the model, but the intent was to develop methods and gain insights and that could be transferred to other phosphorus source types in other watersheds within the Lake Champlain Basin.

A draft final report from this project was issued in December 2009 and is currently under technical review¹⁷. The study found that 80% of the total phosphorus load came from only 24% of the watershed land area. Factors most responsible for the high phosphorus loading from the critical 24% of the watershed area included lack of cover vegetation on cropland, erosive soil types, steep slopes, and high soil phosphorus availability due to manure and fertilizer applications.

The study accounted for phosphorus loads on two scales, including the farm level and the watershed-level scales. An Integrated Farm System Model was used to account for farm level phosphorus inputs and outputs on three dairy farms of varying types. All three farms had a positive phosphorus balance (i.e., an excess of inputs over outputs), which suggested that phosphorus was accumulating in the soils, causing an increased potential for phosphorus runoff. The modeling analysis found that the best ways to reduce the farm phosphorus balances were to reduce the purchase and use of dietary phosphorus supplements, maximize the on-farm forage production and utilization, and minimize the purchase of off-farm feeds as protein and energy supplements. These strategies to reduce the phosphorus balance could improve farm profitability, as well.

Another model (SWAT) was applied at the watershed level to estimate phosphorus loads to the Rock River resulting from hydrologic processes and agricultural activities in the watershed. The model was used to analyze several scenarios of best management practice (BMP) implementation. A key finding of the analysis was that phosphorus load reduction targets for the watershed can, in fact, be achieved by applying the right combination of BMPs to critical source areas.

The report recommended that a similar modeling analysis be applied to urban watersheds to estimate nonpoint source loads and quantify the impact of management strategies. A general conclusion of the study was that a strategic approach to interventions based on mass balance considerations combined with targeting of critical source areas of phosphorus will lead to the most effective use of management resources over the long term.

¹⁷ Ghebremichael, L. and M. Watzin. 2009. An environmental accounting system to track nonpoint source phosphorus pollution in the Lake Champlain Basin. December 15, 2009 draft report submitted to the Vermont Agency of Natural Resources and the Lake Champlain Basin Program.

DEC Watershed Initiative

The Problem

About 90% of the phosphorus pollution affecting state waters comes from a variety of nonpoint sources, including runoff from lawns, farms, streambanks, roadways, parking lots, construction sites. Unlike the piped, point source wastewater discharges that have been so successfully managed in Vermont over the last 35+ years, nonpoint sources of pollution create challenges concerning source isolation and source treatment. Those challenges are captured in the pages of text preceding this program description. It is the collective impact of all our activities on the land surface that results in nonpoint source pollution. Because we are all part of the problem, we all need to be part of the solution, a solution involving a variety of structural and non-structural practices and behavioral changes.

The goals of the DEC Watershed Initiative are to:

1. Educate people in each watershed or river basin about what they can do to help reduce pollution.
2. Coordinate the various pollution prevention and pollution reduction activities in the drainage.
3. Engage a broad, cross-section of the public in the river basin and its smaller watersheds in establishing priorities and making decisions about the best way to manage and protect waters in the watershed community.
4. Prepare a water quality management plan for each of Vermont's seventeen river basins reflecting those priorities.

The Program

The Lake Champlain Phosphorus TMDL established phosphorus load allocations for each major lake watershed and included a general implementation plan containing major basin-wide program efforts that will be needed to achieve those allocations. Translating TMDL load allocations and river basin plans into real, "on-the-ground" actions requires a locally coordinated action process. The five DEC Watershed Coordinators play a critical role in making these plans into reality. Three of the five Watershed Coordinators are engaged in water quality management planning and project implementation in the seven river basins that empty into Lake Champlain.

The Watershed Coordinators lead the development of individual basin water quality management plans based on a public involvement process. They serve as a vital communication link between all the various state and federal agencies and local organizations that are contributing to water quality improvement efforts. They help educate individual landowners and business owners to prevent or abate nonpoint source pollution from their property. They facilitate the completion of projects, large and small, that correct locally identified problems and restore water quality. Watershed Coordinators in each major basin will help ensure successful follow-through and implementation of the Lake Champlain Phosphorus TMDL and other water quality management plans throughout the state. Involving the public in the development of action-oriented strategies for protecting and improving water quality at the watershed, community level is both a recommendation in the Lake Champlain Phosphorus TMDL and a requirement of state law. The Agency of Natural Resources is committed to a river basin planning process that is action-oriented and inclusive of a broad cross-section of the public in each watershed.

The DEC Watershed Coordinators develop partnerships with other organizations on projects designed to improve water quality such as buffer plantings, rain garden projects, and stream assessments and clean-up projects. The coordinators meet with municipal and regional authorities, conduct presentations and talk with the news media about the projects they are involved with. A considerable amount of each coordinator's efforts is devoted to preparing a water quality management plan that meets state and federal requirements.

The river basin water quality management plans required by statute involve in-the-field actions to restore waters. The public helps in developing strategies for water quality improvement and protection at the community and sub-watershed level in watersheds throughout Vermont. Watershed councils are established in each basin to ensure a broad cross-section of public involvement. The Agency prepares a full report on watershed action planning for the Vermont General Assembly each year. The legislative report provides detailed information about activities in these watersheds. The full report will be available online at the DEC Water Quality Division home page: www.vtwaterquality.org

Program Accomplishments

Starting with the two Watershed Coordinator positions first approved by the General Assembly in 2005, DEC now has watershed action planning underway across Vermont in each of the four major regional drainages: Lake Champlain, Lake Memphremagog, Connecticut River, and Hudson River.

The White River Basin Plan (Basin 9) and the Poultney-Mettowee Basin Plan (Basin 2) were completed and adopted by the ANR Secretary in 2002 and 2005, respectively. Consistent with legislation enacted by the General Assembly in 2007, water quality management plans for the West-Williams-Saxtons River (Basin 11) and the Waits-Wells-Ompompanoosuc-Stevens River (Basin 14) were finalized and adopted by the ANR Secretary in June 2008.

In 2009, draft water quality management plans for the drainages emptying into northern Lake Champlain (Basin 5) and the Lamoille River (Basin 7) were finalized and approved by the ANR Secretary in October 2009. The plans are labeled as draft and approved (versus final and adopted), as neither document contains recommendations for water management typing.

Basin planning continued in the Otter Creek drainage (Basin 3), Southern Lake Champlain Direct (Basin 4), Winooski (Basin 8), and Ottauquechee/Black (Basin 10). Basin planning efforts to revise the 2002 White River Plan (Basin 9) began in 2009.

An overview of the basin planning process and the major steps leading towards the development of a river basin water quality management plan is outlined in the following table. The progress or status of each planning step is presented for each river basin.

One required aspect of the river basin planning process is to develop recommendations for surface water classification and water management typing. Once a river basin plan is finalized and adopted, a petition, consistent with the classification and typing recommendations contained in the adopted plan, is prepared and submitted to the Water Resources Panel to be adopted as a rule. Only one such petition affecting surface waters in the White River basin has been submitted (2003). That petition was subsequently withdrawn. No water management type concerning any Class B water in Vermont has been adopted. The four basin plans that were signed by the ANR Secretary in 2008 and 2009 (Basins 11, 14, 5, 7) do not contain any recommendations concerning water management typing. Uncertainties and issues with water management typing have slowed

considerably the process of attaining fully completed plans and rulemaking actions for Vermont's seventeen river basins. ANR will be working to find an alternative method to ensure that the goals of water management typing can be carried out in a practical manner. Further discussion on this issue with interested parties and the Legislature is expected in 2010.

Importantly, difficulties with water management typing have not slowed the action-oriented aspect of the watershed initiative in which the DEC Watershed Coordinators are facilitating fixes to water quality problems and threats. In addition to conducting the statutorily-required basin planning activities, DEC Watershed Coordinators are actively working with watershed councils, stream teams, watershed groups, other state and federal agencies, landowners, and other stakeholders to address water quality problems and threats throughout the state.

In 2009, the five DEC Watershed Coordinators engaged close to 1,800 people across Vermont in forums and meetings designed to generate participation in projects, and developed or substantially assisted with dozens of watershed projects. Many water quality and aquatic habitat projects were initiated or completed during the reporting period. A more complete enumeration of actions leading to or involving water quality remediation is presented on a river basin by river basin fashion in the Department's 2009 Annual Progress Report on River Basin Water Quality Management Planning, which was submitted to the Vermont General Assembly in January 2010.

Watershed Initiative Status (as of December 2009) Current Status of Major Planning Process Components by River Basin Identification Number																	
Components of the basin planning process	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Public forums held	I,O	C	C	I	C	C	C	I,O	C	C	C	O	O	C			C
Watershed council formed	C	C	C	I	C	C	C	I,O	C	O	C	I		C			C
Local WQ concerns identified	I,O	C	C	I	C	O,C	C	I,O	C	O	C	O	I,O	C			C
Panel discussions on WQ issues held	C	C	C	O	C	I, O	C	I	C	O	C	I	I,O	C			I
Strategies for WQ issue formulated	I,O	C	C		C	I, O	C	I	C	I	C		I,O	C			I
Review of town plans & zoning regulations	I	C	C	C	C	I	C	I	C	I,O	C		I	C			I
Develop water management type classification proposal		C					C		C		C						
Meetings with towns on classification proposal		C					C		C		C						
Watershed plan draft	I	C	O		C	I	C		C	I	C			C			
Public hearings on draft plan		C	I		C		C		C		C			C			
Final basin plan		A			*		*		A		A			A			
Outreach to schools & local groups	I,O	O	O	O	O	O	O	O	O	O	O		I,O	O			O
Basin assessment report	C	C	C	I	C	C	C	C	C	C,O	C	C	O,C	C	C		C
Phase I SGA	I,O,C	O,C	O,C	C	I,C	O,C	O,C	O,C	O,C		O,C	O,C	O	O,C			I,C
Phase II SGA	I,O,C	O,C	O,C	C	I,C	O	O,C	O,C	O,C		O,C	O,C	O	O,C			I,C
Bridge & culvert inventory	I,O,C	O,C	O,C	C	O	O,C	C	C		O	O,C	I,O	O	O,C			I,C
Dam inventory		O	O	O	C		C	I,O	C		I						
Biological monitoring	O,C	O	O	O	O,C	O	O,C	O,C	O,C	O	O	O		O			
Restoration projects	O	O,C	IOC	O,C	I	O,C	O,C	O,C	O,C	I,O	IOC		I	O			O,C

Table notes: I = initiated; O = ongoing; C = completed; WQ = water quality; SGA = stream geomorphic assessments

A = ANR adopted plan

(*) Draft plan signed and “approved” by ANR. Document lacks state mandated water management typing recommendations.

Basin 1 = BattenKill/Walloomsac/Hoosic; Basin 2 = Poultney-Mettowee Rivers; Basin 3 = Otter Creek; Basin 4 = Southern Lake Champlain direct; Basin 5 = Northern Lake Champlain; Basin 6 = Missisquoi River; Basin 7 = Lamoille River; Basin 8 = Winooski River; Basin 9 = White River; Basin 10 = Ottauquechee/Black; Basin 11 = West/Williams/Saxtons; Basin 12 = Deerfield; Basin 13 = lower CT River direct; Basin 14 = Waits/Wells/Ompompanoosuc/Stevens; Basin 15 = Passumpsic; Basin 16 = upper CT River direct; Basin 17 = Lake Memphremagog

Agency of Agriculture, Food, and Markets Programs

Accepted Agricultural Practices Program

The Problem

Nitrogen and phosphorus are essential plant nutrients. In agriculture, these nutrients are supplied to crops through livestock manures and fertilizers. When these nutrients leave the fields via runoff or groundwater, they have the potential to fuel algae blooms in surface water and nitrate contamination in groundwater and estuary environments. All of these outcomes negatively impact aquatic ecosystems and are the focus of Vermont agricultural water quality programs. In Lake Champlain, areas with elevated phosphorus levels have reoccurring algae blooms, thereby making phosphorus the focus of water quality initiatives in this basin. Along the Connecticut River, which drains into Long Island Sound, there are deep sand deposits which are susceptible to nitrate leaching, making nitrogen more of a concern in that basin. Nitrates in drinking water reduce the amount of available oxygen in the body, making it harmful to humans. Nitrogen in surface water can produce algae blooms in coastal environments, and is suspected to be a driving force in forming harmful algal blooms of *Pfiesteria* and other organisms.

Agricultural activities provide for our food and fiber, however there are often waste by-products that require management to assure there are no negative water quality impacts. Wastes such as liquid manure and compost, and whey from cheese making, must all be land applied properly to minimize the health and environmental risks. With a wide variation in the type and size of farming operations in Vermont, the AAPs aim to set a base standard that all farms must comply with. For instance, whether a vegetable or livestock operation, both must properly store on-farm nutrients and chemicals in such a way that protects both surface and ground water.

The Program

Accepted Agricultural Practices are statewide restrictions designed to reduce nonpoint pollutant discharges through the implementation of improved farming techniques and land management practices rather than investments in structures and equipment. Accepted Agricultural Practices are intended to reduce, not eliminate, pollutants associated with common agricultural activities. The AAPs have been in place since 1995, and the rules were revised in 2006. AAPs require, among other things; setbacks along surface water and around wells, management of production areas to prevent discharges, standards for manure storage, application, and management, streambank standards, nutrient management activities such as soil sampling and applying nutrients at agronomic rates, and standards for the protection of ground water quality. The AAPs apply to all farm operations, regardless of type or size.



An example of an AAP crop land buffer required on farms.

Program Accomplishments During 2009

The AAP program is generally reported on a calendar year basis, so all values reported in this section are as such. To date, the Agency has conducted 1,180 AAP inspections from the inception of the program in 1995. Since 2003, the number of investigations into alleged violations of the AAPs has increased due to the increase in Agency staff and more public attention to water quality concerns. As of December 1, 2009, 118 investigations have been conducted. Investigations are conducted both in response to complaints received from the public and in the course of conducting routine AAP compliance checks. In 2009, 40% of investigations were initiated in response to complaints from the public, while 60% were initiated as a result of in-field observations or referrals from other Agency staff members (Table 1). Over the past 5 years, from 2005 to December 2009, 85 to 91% of the farms investigated were successful in meeting the AAP requirements. This success rate includes farms that may have been found in violation of the AAPs, but made immediate corrections in response to assistance from Agency field agents. In 2009, one administrative penalty, eleven corrective action letters, two cease and desist orders, and four assurances of discontinuance were issued for situations in which the farms were not complying with the AAPs (Table 2). [Note – these numbers also reflect enforcement actions sent to medium and large farms.]

The majority of complaints and compliance checks, as in past years, were related to manure (Table 1). General manure complaints address alleged manure impacts associated with production area and field practices, while complaints addressing alleged spreading during the winter ban are tracked separately. We continue to see an increase in the number of complaints associated with “backyard” farming operations involving chickens, swine, turkeys and goats. It is likely that given the current economic climate, more

Table 1. General Nature of Complaints Received and Subject of Compliance Checks

Nature of Complaint / Subject of Compliance Check	# Complaints	# Compliance Checks
Carcass Disposal	5	1
Composting - Livestock		
Composting - Non-livestock	2	
Construction of Farm Structures	2	
Crop field Runoff - Erosion		
Ditch Maintenance / Impacts to Water	1	1
Livestock Access to Water	4	2
Manure - General	23	13
Manure - Spreading During Ban	5	30
Milkhouse Waste		1
Silage Leachate	2	4
Streambank Impacts / Erosion		3
Vegetative Buffers		6
Enforcement Action Follow-Up / General AAP/MFO/LFO Compliance Check	3	13
Miscellaneous	4	

Table 2 . 2009 Enforcement Actions issued by AAP Section, MFO General Permit, and LFO Individual Permit. In 9 cases, the violation(s) was corrected on-site (verbal), so no written enforcement action was initiated. [Note - A number of CALs, and one CDO, address more than one section of the AAPs, so numbers exceed the total number of enforcement actions taken.]

AAP Section	# violations / enforcement actions
4.01 - Discharges	CAL (5); CDO (2); Verbal (2)
4.02 - Nutrient and Pesticide Storage	CAL (2); CDO (1); Verbal (4)
4.03 - Nutrient and Pesticide Application	CAL (1); Verbal (1)
4.04 - Soil Cultivation	
4.05 - Agricultural Waste Management	CDO (1); Verbal(2)
4.06 - Buffer Zones	
4.07 - Construction of Farm Structures	
4.08 - Ground Water Quality	
MFO General Permit	
Production Area Concerns / Manure Storage	CAL (4)
Buffer Zones	
LFO Individual Permit	
Production Area Concerns / Manure Storage	AOD (4); AP (1)
Buffer Zones	

people are raising their own meat and are not aware that their actions must be in compliance with AAPs.

In 2009, the Agency continued its focus on enforcing the standard that all small farms must have a 10 foot vegetative buffer or setback from the top of a streambank on crop lands. The setback cannot be tilled or have manure applied to it. This year, the Agency observed improved compliance with the ten foot buffer requirement and no enforcement actions were issued for buffer violations. Each medium and large farm in the state was inspected in 2008-2009 and compliance with 25 foot buffer requirements on crop land was examined on selected fields as part of these inspections. As a result of these inspections, two farms were cited for a buffer violation in 2008 and each instance was corrected in the 2009 field season when crops were planted.

In addition to checking for compliance with the AAP buffer requirements, staff-generated investigations and compliance checks focused on farmer preparation for the winter spreading ban, ensuring that spreading was not occurring during the ban, and general compliance with the AAPs. The staff visited 33 farms that had in the past years received manure spreading exemptions to ensure they took adequate measures to avoid another exemption request. During the spreading ban 363 farms were visited to assure they were not spreading illegally.

To keep the regulated community informed and up to date on AAP requirements, presentations on the regulations are made at agricultural meetings and articles on various aspects of the AAPs are included in the Agency's publication *Agriview*. In addition, ARMES Division field agents provide technical assistance on AAPs while conducting routine AAP compliance checks on agricultural operations.

Although all farms are subject to the AAPs, medium and large farms are inspected for permit compliance. Small farms have no programmatic system for inspection other than complaints from the public or staff initiated visits. There are approximately 1,026 farms in Vermont of which about 900 are dairies. Of the total farms, roughly 175 are medium and large farms that raise dairy, beef and poultry. More information is needed about the small dairy farms and other livestock/vegetable operations. In 2006, the Agency began surveying small farm livestock operations in Addison, Rutland, Franklin, Lamoille, Washington and Chittenden counties. These surveys collected data about the existing waste management structures and water quality needs of 156 farms. These data are used to compile information about the current need on most farms and to guide the Agency management decisions based on those needs.

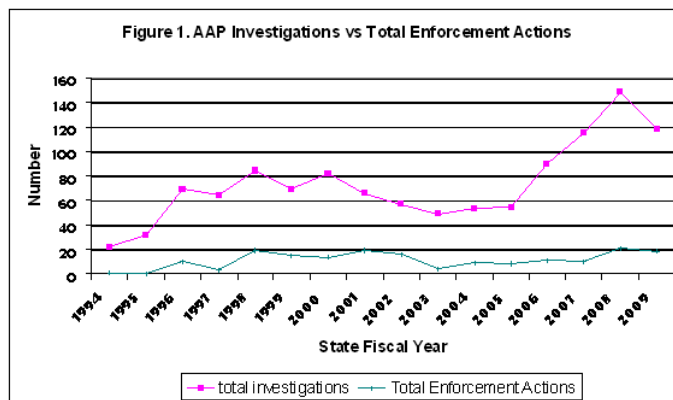
In 2008, the Agency continued the small farm survey efforts by collecting data in the Rock River and St. Albans Bay watersheds in northern Franklin County. As the survey work is done, technical assistance is offered to farms either directly from the Agency, or the landowner is connected with other agencies/organizations to get the appropriate technical assistance they need. These surveys provide a one-on-one ability to educate farmers about the available programs and to learn new ideas or perspectives from within the farming community about improvements that can be made on farms to benefit water quality.

The number of small horse farming operations has been increasing statewide and so has the amount of water quality complaints about these operations. Education and outreach of the AAPs were difficult to provide to such a widespread audience who are often unavailable during the work day, and a new approach was needed. Through partnerships with the Center for Clean and Clear and the Vermont Association of Conservation Districts, financial resources were made

available in 2009 to host several weekend small horse farm composting workshops. These workshops allowed many small farmers to be reached more efficiently, plus the education and financial assistance provided at the workshop allowed the farms to build their own composting system to improve manure management.

Indicators of Progress

The goal of the AAP program is to reduce all nonpoint source pollutants from agricultural operations, including phosphorus. In the last few years the number of AAP violations identified by on farm investigations has remained relatively low, while the number of investigations has significantly increased (Figure 1). If the program was not successful, the number of violations would have increased proportionately as the number of inspections increased. Additionally, the AAPs were recently revised, making them more stringent in a number of areas, including streambank management, handling of animal mortalities, and enhanced vegetative buffer requirements.



Medium Farm Operation Program

The Problem

Vermont farms have seen an increase in the number of animals being managed on a single land base as many family farms have merged or grown in size to support multiple families working on a single farm. This growth generally has occurred on farms that once housed fewer than 100 animals and therefore significant infrastructural improvements were required as the animal numbers grew. Farms either built new structures or expanded older structures to store the additional animals, feed, and other wastes such as manure. To assure that these expanded farms have the appropriate land base for the nutrient loads they manage and adequate waste storage and treatment facilities to avoid creating a water quality issue, the MFO program has been created in Vermont.



Winter cover crop on a MFO corn field lowers erosion and phosphorus runoff and helps to build healthy soils.

The Program

The General Permit for Medium Farm Operations (MFO) parallels the current Large Farm Operation (LFO) rules to create a seamless regulatory program to protect water quality. A Medium Farm Operation is defined by the number of mature animals (by animal type) on the farm. Over 90% of all MFOs in Vermont are dairy farms. As an example, a dairy farm that has between 200 and 699 mature dairy animals falls under the definition of an MFO and requires coverage under the state General Permit. There are animal number thresholds that trigger other types of livestock operations (poultry, swine, etc) for coverage under the state's MFO General Permit.

The development of the state's three-tiered approach to water quality has created a logical progression of regulatory oversight for farms as they grow in size. The MFO General Permit is designed to mimic the federal EPA water quality regulations for Confined Animal Feeding Operations (CAFO). The MFO Rules and General Permit require farms to implement practices that prevent the discharge of agricultural wastes from the farm's production area to waters of the state. The General Permit also requires all MFOs to operate under a Nutrient Management Plan and to maintain a 25-foot perennially vegetated buffer on all crop fields adjacent to surface waters. Manure application is prohibited in buffer areas. The rules represent a level of farm management above and beyond the AAPs and more stringent than the federal CAFO rules.

Program Accomplishments During 2009

In February 2007, the proposed General Permit for Medium Farm Operation was signed by the Secretary of Agriculture. The General Permit provided six months for all current MFOs to seek coverage by submitting their Notice of Intent to Comply (NOIC) to the Agency. At the end of the six months 100% of all identified MFO NOICs were received at the Agency.

Following submission of the NOIC, the Agency was required to conduct an Initial Facility Evaluation (IFE) of each farm to determine permit compliance. The Agency began permit evaluations in the fall of 2007 and completed this process in 2009. Evaluations centered on determining if conservation practices were in place to assure there are no discharges, verifying that 25 foot vegetated buffers were installed adjacent to surface waters, and that the farm had a current nutrient management plan, as is required by the General Permit. Verbal verification of permit compliance was given at the time of the IFE and each farm afterward received an extensive report detailing the evaluation.



A high-flow silage leachate treatment system preventing a discharge to surface water.

As anticipated, the most common permit concern was silage leachate. The majority of these farms have responded by working to make the requested upgrades either through the BMP or federal EQIP programs. MFO field staff assisted Agency engineers throughout 2009 in helping farmers to implementing these improvements.

The Agency began Follow-Up Evaluations (FEs) in August of 2009. To date, 20 FEs have been conducted; 12 of which were conjunction with the Agency of Natural Resources (ANR). As a result of the Follow-Up Evaluations, ANR has issued four Notices of Alleged Violations (NOAVs) and the Agency has issued two Corrective Action Letters (CALs)

Indicators of Progress

Since its inception, the MFO program has generated interest in the other conservation programs offered at the Agency. All six farms that received either a NOAV or CAL are actively working with either the Agency through the Best Management Practices (BMP) program or the USDA NRCS through the Environmental Quality Incentive Program (EQIP) to put structural practices on the ground and obtain permit compliance. Five of these projects are either under construction or nearing completion now.

In addition, many additional MFOs are enrolled in the BMP and/or EQIP program to address water quality concerns documented during the Initial Facility Evaluation. The MFO regulatory program continues to generate interest in other state conservation programs including the nutrient management plan incentive grant program, alternative manure management programs, the farm agronomic practices program, and the conservation reserve enhancement program. Enrollment in these programs is a true indicator that the MFO program has and is successful in getting farms to improve their facilities and land management techniques. These programs will continue to provide technical assistance and cost-share assistance to medium sized farms.

Large Farm Operation Program

The Problem

The US Environmental Protection Agency administers a regulatory program for larger farms known as the Concentrated Animal Feeding Operation Rule, CAFO. The CAFO program is one part of the National Pollutant Discharge Elimination System (NPDES) program. If a state is delegated the authority to implement the NPDES program, or wishes to become delegated, that state can choose to establish their own regulations to manage this national program. The Agency of Natural Resources in Vermont has the delegated authority to manage the NPDES program, and through a memorandum of understanding the Agency of Agriculture has developed a state level water quality program, developed regulations, and administers the permitting, compliance, and enforcement for the program. In general, these farms are regulated by higher standards due to the volume of wastes they manage. Some large farms manage more wastes annually than a small municipality, illustrating the importance of having a management plan and secondary systems to reduce the risk of creating a discharge or negative water quality impacts.



These are man-made, very sturdy gutters, diverting roof water away from the barnyard. This type of system allows winter ice to slide off the roof without destroying the gutter.

The Program

The state LFO program was authorized in 1995. Under this state program, Large Farm Operations are eligible for individual permits only. There is no state general permit for large farms. The goal of the Large Farm Operations (LFO) program is for all larger farms to have structures in place in the production area for managing wastes, and nutrient management plans to appropriately land apply these wastes. Farms that are managed in compliance with these requirements should not have discharges, and therefore would not need a federal National Pollutant Discharge Elimination System (NPDES) permit. To date, all large farms (700 + mature dairy livestock, etc.) have received state LFO permits. Of permitted LFOs at this time, 16 are dairy producers, one is an egg producer, one is a beef producer, and one is a replacement heifer operation.

The Vermont Agency of Agriculture recently began regulating the state's medium sized farms to a greater standard than is expected of smaller farms. In the process of determining which farms fall in to the MFO program, we have discovered some farms that are near the LFO threshold. Most will be regulated as medium farms; however some may be required to apply for an LFO permit due to the fluctuation of the herd size to assure they can freely conduct business while complying with the regulations. As a benefit to farms of this nature, the LFO rules have recently been revised to mirror many requirements of the Medium Farm Operation Rules; however the

LFO rules have additional restrictions such as controlling odor, noise, traffic, insects, flies, and other pests.

The revisions in the rule are aimed at bringing LFO standards up to the more recently adopted MFO standards, to address new statutory requirements for advisory groups (when new farms are proposed), to include siting and setback standards for new barns, to include groundwater investigation procedures, to update the operation and maintenance requirements, and to update the engineering and design standards to the current NRCS technical practice standards. Several of these revisions exceed the requirements of the federal Concentrated Animal Feeding Operations (CAFO), the federal equivalent to the LFO standards in Vermont. For instance, CAFO does not require a farm to have a nutrient management plan unless there is a discharge from the fields, whereas the LFO requires all these farms to have an up-to-date NMP on site. CAFO does not regulate groundwater, and the LFO program addresses both groundwater quality and quantity. Lastly, under the federal CAFO program, a farm can begin building a barn without a permit and then still be denied the permit, whereas in Vermont the permit to construct and operate must be approved before the farmer can begin building the barn.

Program Accomplishments During 2009

Each permitted LFO received at least one additional technical assistance visit during the summer to ensure necessary operational changes and continued compliance under their individual permit. The U.S. Environmental Protection Agency conducted inspections on five large Vermont farms during the spring and fall. EPA selected the sites and no more than 24 hours notice was given to the farms.

The LFO coordinator continues to work with farmers who are interested in obtaining an LFO permit for future expansions. With the MFO program staff providing outreach and education to farmers that were not part of the initial large farm sector, the Agency now has additional, earlier opportunities to connect with farmers who may be considering consolidation, expansions, and construction. Several MFO facilities have been identified as farms at or near the LFO threshold. The Agency is working with these farms in developing permit applications, building structures required to control runoff, and providing technical and financial assistance for field management techniques that meet or exceed the nutrient management and setback requirements.

One new large farm facility was permitted in 2009, and three amendments were sought and issued. The Agency received a few applications from existing, permitted LFOs to amend their permit to include additional farm(s) under that original permit. Adding farms, versus physical expansions, is a different type of expansion than the program has seen thus far. It seems that agricultural land is being kept in production as larger farms purchase smaller farms to add to their land base. This appears to be a trend, and the Agency will continue to work with farms, and perhaps anticipate those farms that may expand in this manner that may require assistance.



The first of three cells in a silage leachate treatment system. After settling in the first cell, where solids fall out and some slow filtration occurs, the runoff moves on to subsequent cells. Each subsequent cell offers more treatment for high flow leachate (low concentrate) from a feed bunker. Note the lush vegetative growth.

Best Management Practices and Alternative Manure Management Programs

The Problem

Phosphorus on farms is usually found in the production area and in the fields. The production area has the greatest potential for discharges on a farm since the majority of the animal manure, hay and corn silage, and milkhouse waste is stored there. Additionally, the cost to install structures that prevent discharges is much greater for the production area as compared to field practices. Two state agricultural water quality programs, the Best Management Practice (BMP) Program and the Alternative Manure Management (AMM) Program, were established to help defray farmers' construction costs as they comply with increasingly stringent state and federal water quality regulations.



Construction of a new silage leachate collection and distribution system in Franklin County.

The Program

The Best Management Practice Program enables farmers to improve water quality by installing various practices designed by engineers. By constructing BMPs, farmers are able to more cost effectively use nutrients and handle agricultural wastes. For many of the participants in the program, BMP construction would not be affordable without the state's grant. Implementation of BMPs assures the significant public benefit of reducing phosphorus loading to waters of the state. The Best Management Practices Program is closely tied to the federal funding program offered by the USDA Natural Resources Conservation Service known as the Environmental Quality Incentives Program (EQIP). The Agency of Agriculture supplements additional cost-share to EQIP, thereby increasing the overall funding and value to a farmer receiving EQIP. These BMP cost-share programs have widespread support from the agricultural and environmental communities, and the general public.



Silage leachate treatment area for high-flow in Franklin County.

The Alternative Manure Management (AMM) projects are demonstration projects designed to develop new waste management technologies that will help to reduce pollutants leaving the production area or minimize impacts such as odor to adjacent landowners. This program is a joint program between the Vermont office of the NRCS and the Vermont Agency of Agriculture. Dollars available each year vary, as do the projects that are submitted. Projects in the past that have been funded through this program include manure solid separation, nutrient removal, and

waste treatment systems. In previous years, this money has been used to support the installation of digesters.

Program Accomplishments During 2009

The BMP Program contracted with 37 farms of all sizes in FY 2009 for a total state allocation of \$1.4 million. These BMP practices include but are not limited to constructing manure storage facilities, fencing livestock out of water sources, and silage leachate collection and treatment systems. The total state allocation also includes four Alternative Manure Management practices valued at \$165,000 for FY 2009. These four practices include the construction of anaerobic digesters and a manure separation system.

The monetary need for the BMP program is expected to continue as state and federal water quality standards and regulations continue to be tightened. The State's BMP Program is evaluated on four criteria when providing cost-share assistance: type of practice, environmental impact, regulatory responsibility, and farmer commitment. This steady state source of monetary resources will continue to be appreciated by farmers and their neighbors alike.

The Agency of Agriculture provides technical assistance to many farming operations utilizing, or considering, manure or crop digestion and alternative manure technologies. Those farms that apply to and meet the BMP or AMM program qualifications are accepted for funding, as funds are available. Today there are eight operating anaerobic digesters, giving Vermont an installed capacity of over two megawatts. These digesters produce enough electricity to power over 1,000 homes. Two additional existing digesters are newer designs and are considered to be more in a development phase, for a total of ten systems. In the past year, milk prices have slowed the speed of project implementation. Construction is occurring on only two digesters being built in the winter of 2009-2010. Indicating what the future holds for the industry, fourteen digesters have been signed up for the VT SPEED Standard Offer Program in the fall of 2009, with special renewable energy electrical rates, and are expected to go online in the next three years. The time it takes to choose a vendor, prepare a design, and construct a system is normally about three years. Most of the digester systems are built by overseas or out-of-state companies. Today, Vermont has the highest number of digesters per capita of farms in the nation.



A newly constructed clay lined manure storage structure in Addison, VT.

Indicators of Progress

The BMP program only funds projects that are expected to provide a water quality improvement on the farm. This requirement assures that the BMP program is making progress towards reducing nonpoint phosphorus pollution; however it does not quantify by how much. Scientific research can provide some insight into the reduction potentials but certainly has its drawbacks as many of these practices are site specific. More research is needed in order to reliably quantify the phosphorus reduction expected from specific BMPs. The Agency has kept detailed data on all projects and could tally the phosphorus reductions that have occurred since the program's inception, once reliable quantitative estimates of phosphorus reduction are available.

Nutrient Management Grant Incentive Program

The Problem

The Nutrient Management Incentive Grant Program was developed to assist farms with nutrient management plan development and implementation, and to provide grants to establish nutrient management education programs for the farming community. The goal is to provide sufficient cost-share assistance as well as technical support to Vermont farms of all sizes and livestock type to enhance resource utilization on the farm to improve water quality.

The process of nutrient management utilizes proper nutrient distribution on cropland and farm management techniques in order to closely match crop needs and limit nutrients entering water resources. This concept is achieved by testing manure and soil nutrient levels and then creating crop recommendations for manure and/or fertilizer applications on individual fields. Other tools that identify erosion or phosphorus loading potential using computer modeling equations are run on individual fields to best determine where the critical areas are on the farm. For instance, a field that is prone to greater soil erosion should be in a hay rotation more often and a site with above optimum soil test phosphorus levels should have very little or possibly no additional phosphorus applied to it. Site-specific farm management techniques such as these can lower the threat of phosphorus entering surface water and are all summarized for a farm in a nutrient management plan.



Soil sampling is a very important part of developing a NMP.

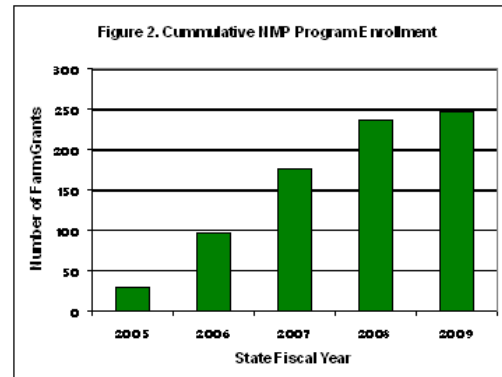
The Program

The NMP program was established in 2005 to meet the expected demand for Nutrient Management Plan development created by the new Medium Farm Operations Rules, the amendments to the Accepted Agricultural Practices, and the anticipated revisions to the Large Farm Operations Rules. All of these regulatory programs changes have been finalized, and all now require some form of a nutrient management plan depending on the size of the farm. The nutrient management cost-share program helps cover the upfront costs of hiring a consultant or for a farmer to spend their own time to develop a NMP, plus the first three years of updates that are made to the plan. However, once the initial work is done, the participants are no longer eligible for additional funding through the NMP program. Instead, the Farm Agronomic Practices Program offers a minimal payment for NMP update maintenance; however the majority of the costs are transitioned to the farmer after the fourth year.

Program Accomplishments During 2009

Since its inception in 2005, the NMP cost-share program has been a very popular program for the farming community. The program requires a farmer to turn in an application stating the number of acres they intend to develop a NMP for. The Agency then reviews the acreage and approves the eligible acres under a grant that covers the initial development costs and three years of update maintenance costs. Payments are only made after the Agency has reviewed and approved the NMP plan and/or the updates.

From FY 2005 through 2009, 249 grants have been approved to receive cost-share funding for implementing NMPs on more than 134,000 acres statewide (Figure 2). The total state funding allocation for these grants equals \$2,201,138, which includes the cost of development and then three years of update maintenance costs. So far 178 grants totaling roughly 102,000 acres have completed the process of developing a nutrient management plan and were reimbursed for the plan development costs. Of these, 110 grants have completed at least one annual update and received the first reimbursement payment from the Agency. In 2009, 11 grants were approved for cost-share funding pending the approval of the final nutrient management plan. A total of \$104,518 was allocated to these 11 plans, which again includes the development and update payment amounts.



This program has been very successful in enrolling a number of farms, partly because as of April 2008 all medium and large size farms were required to operate under a nutrient management plan. To meet this demand, the commercial realm has increased the capacity to develop NMPs and created more efficient processes to collect and assimilate the data into uniform plans. It is expected that NMPs will arrive at the Agency on a regular basis in the next year as much of the NMP work is currently in progress by commercial enterprises and farmers.

Continued emphasis on the importance of nutrient management is needed by all agricultural field technical assistants to increase the level of water quality protection in Vermont. Enrollment in the NMP program was lagging in 2009, indicating that the bulk of MFO and LFO sized farms have developed their NMPs and are no longer seeking out the program. There is still a number of small farms that could benefit from a NMP that meets the state incentive program standards. From the MFO surveys done in 2004, a handful of farms was found to be just below the 200 dairy cow limit to be regulated as an MFO. These farms could and should develop NMPs, especially if they are planning to expand, or merging with other family farms. However, there are also many small farms that do not need this elevated level of planning as the amount of nutrients they produce and the available land base to allocate those nutrients is more than in balance. As small farms decide to develop NMPs that meet the State standard, they will need cost-share assistance. The unit costs for an NMP is typically higher for small farms, and the economic return is smaller. Thus, the incentive program is vital to reaching a goal where all farms have an enhanced management plan in place.

Indicators of Progress

Specific information pertaining to these plans can be used to measure the success of nutrient management planning in Vermont. The type of information provided by NMPs includes the number of acres with nutrient management plans, soil test phosphorus levels, and the acres of farm land meeting specific erosion requirements. With this information, the Agency hopes to document trends in increased acreages under NMPs, improved balance in soil test phosphorus levels among all fields on a farm, and an increase in the acres managed to the tolerable soil loss rate, which is an indication that less soil is eroding from fields that could potentially enter streams.

Farm Agronomic Practices Program

The Problem

While the NMP Incentive Grant program provides initial financial assistance for the development and update of the plan, there is a growing need for further financial assistance to implement the soil-based conservation practices, which the FAP program supports.

The Program

The goal of the Farm Agronomic Practices (FAP) Program is to provide Vermont farms with state financial assistance for the implementation of soil-based conservation practices that improve soil quality, increase crop production, and reduce erosion and agricultural waste discharges.

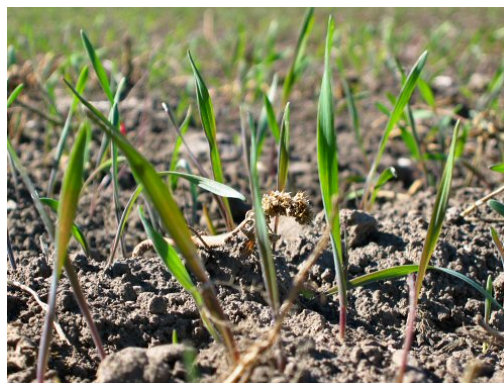
The FAP program provides for:

- NMP Maintenance/Update, \$3 per acre up to \$1,000 maximum
- Cover Cropping, \$30 per acre
- Strip Cropping, \$25 per acre
- Conservation Crop Rotation, \$25 per acre
- Cross-Slope Tillage, \$10 per acre
- Conservation Tillage, \$10 per acre
- Pre-Sidedress Soil Nitrate Test, \$8 per test, up to \$1,000 maximum for Educational and Instructional Activities

Cover cropping is the establishment of a seasonal (winter) cover on annual cropland. Strip cropping is the management of row crops, forages, small grains, and/or fallow land in a systematic arrangement of equal width strips across a field. Conservation crop rotation is the growing of crops in a recurring sequence on the same field to reduce soil erosion over time. In Vermont, a conservation crop rotation typically consists of a perennial crop such as hay grown in between annual crops such as corn. Cross-slope tillage is a system of crop rows on planned grades (with the contour of the field). Conservation tillage manages the amount of crop and plant residues on the soil surface and limits soil disturbance to only practices necessary to place nutrients and plant crops. The pre-sidedress soil nitrate test (PSNT) program is used to improve the efficiency of nitrogen (N) fertilization in corn. This PSNT allows N fertilizer recommendations to be adjusted to field-specific conditions that can influence N requirements of corn. Each of these practices helps to lower erosion, therefore limiting phosphorus transport to surface waters, improves soil quality and tilth, and can help increase crop production.



Strip cropping example



Cover cropping example

The FAP program also provides for NMP maintenance and update where a farm is no longer eligible for state or federal assistance and for educational and instructional activity grants. The goal of the educational and instructional activity grants is to increase farmer and citizen awareness on the impact of agriculture on water resources and on federal and state water quality regulations for agriculture.

Program Accomplishments During 2009

While eight practices are available through the FAP Program, the majority of applicants have enrolled in cover cropping and conservation crop rotation. In total, all 95 farms that submitted applications were approved for practices on 7,809 acres, a financial commitment of \$221,530.

Roughly 95% of the requested acreage had FAP practices implemented on them. Several factors can deter implementation such as custom cropping companies coming too late in the season, poor field conditions limiting the ability to drive on the fields, not enough time or staff on the farm, and/or broken equipment. The final implemented practices in 2009 include 78 farms that planted a winter rye cover crop on 6,549 acres, a financial commitment of \$196,483. Twelve farms rotated 260 acres from annual to perennial crops for a financial commitment of \$6,500.

Most of the farming operations using cover cropping are dairy farms growing field corn; however there are a few vegetable operations that are also using cover cropping. Farms of all sizes have enrolled in the program. Numerous medium and large farms were not approved for all of their requested acreage as the program has a cap of \$5,000 maximum per farm, which covers ~167 acres of cover cropping. In 2009, there were over 1,459 acres that were not approved for cover cropping because they were beyond the ~167 acre cap. Fiscal year 2009 was the first year that farms implemented cross-slope tillage, strip cropping, and conservation tillage practices through the FAP Program. In addition, farms also requested NMP update and maintenance for the first time in 2009 and while the FAP Program encourages outreach on agricultural water quality impacts and agricultural water quality regulations through educational and instructional activity grants, there was no enrollment this year.

Indicators of Progress

The FAP program in 2009 attained a 255% increase in the number of farms enrolled compared to 2008. Already, the data for 2010 are showing an increase over 2009 enrollment. It is clear that the program's popularity is increasing and even more, the feedback from the farming community has been very positive. Farmers enjoy seeing the green fields in the winter, and all are well aware of the importance to reduce erosion and the benefits of improved soil tilth.

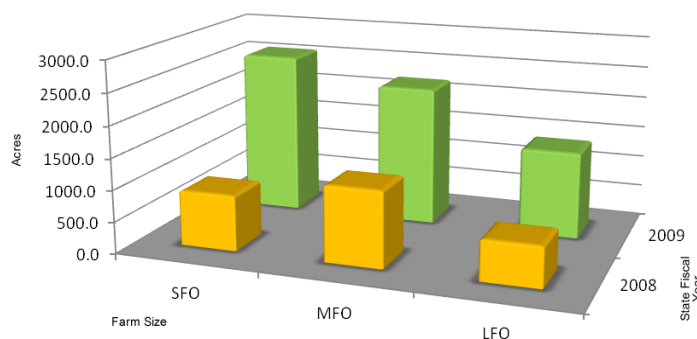


Figure 3. FAP enrollment trends

One indicator of this program is the increases in the number of acres enrolled and the number of farms participating, which roughly doubled the first two years of the program and has now more than quadrupled since the program's inception. Another true indicator of success of this program, however, is the sustained sales receipts of cover crop seed from the dealers when no financial

assistance is provided. For example, many of the larger farms exceeded the acreage cap in the program, but their receipts for the amount of seed purchased reflected the additional acres that were not cost-shared. The practices in the FAP program all have stigmas to overcome. It was once thought that cover crops and no-till corn would not work in Vermont, yet both are gaining more attention as farmers try these practices on limited acres. In time, the farming community will decide if the added benefits are worth the time and money, and hopefully will be able to quantify these in terms of increased or level crop yields, less soil erosion, and reduced pesticide/herbicide use.

Conservation Reserve Enhancement Program

The Problem

Vegetated buffers planted between annual crops, pasturing livestock, and areas where manure is spread, helps to reduce agricultural nutrient inputs to lakes and streams. Buffers help by lengthening the distance a soil particle or nutrients must travel before entering surface water. As the distance is traveled, the sediment and nutrient movement slows, allowing them to settle out in the buffer. Buffers therefore must be designed based on the land topography, soil type, and the expected agricultural use.

Vermont is unique compared to most areas of the country, as surface water is plentiful here. There are also extensive drainage networks in many agricultural areas to lower the water table, which allows crops to be grown. The close proximity of these ditches and streams make buffers a very adaptable tool for Vermont agriculture. The drawback is that having a buffer reduces the amount of land available for agriculture, and buffers generally do not provide an economic return to the farm.



Lack of vegetative buffers at the edge of fields can lead to significant erosion when slopes are present.

The Program

The goal of the Conservation Reserve Enhancement Program (CREP) is to encourage agricultural landowners to voluntarily install conservation buffers. In order to reasonably expect the farming community not to farm the land adjacent to streams, CREP has been established to provide compensation for planting these buffers. CREP covers the costs associated with planting the buffer and installing practices such as fencing and watering that may be needed when livestock are present, and provides a rental payment for the land while it is under contract. The rental and incentive payments paid in the program were established to cover the cost of lost production. Contracts can be for 15 or 30 years and a buffer can be comprised of either trees and/or grasses. The minimum buffer distance is 25 feet for grass and 35 feet for trees, and the expected phosphorus reduction from surface runoff is roughly 75% when a buffer is planned according to the slope, soils, and hydrology.

Program Accomplishments During 2009

At the close of the 2009 fiscal year, total CREP enrollment reached 2,162.7 acres, which can be estimated to cover over 357 miles of streambank assuming average buffer widths. For contracts with livestock exclusion, more than 0.6 million feet of fence have been planned since the program's inception in 2003. For all of these CREP projects, the state has spent \$1.2 million, which is matched 4:1 with Federal funds from the USDA Commodity Credit Corporation.

Addison county is still the area with the most CREP contracts with more than 1,000 acres planted along rivers and streams. Franklin county is the runner-up with approximately 528 acres (Figure 4). Overall CREP enrollment was down in 2009 and unfortunately explaining fluctuations in enrollment is always very difficult. Possible reasons for declined enrollment can be the high number of contracts written in 2007 and 2008, and the time it takes to make sure all the planned practices such as fence and tree planting are completed. This takes time away from planning new contracts and hence new contracts would be delayed. Increased enrollment for the start of 2010 provides evidence that the newly developed contracts had been temporarily delayed.

The most popular land use types enrolled in CREP include pasture and permanent hay land with more than 1,745 acres (Figure 5). Cropland enrollment in 2009 (28

acres) was down from 2008 enrollment which boasted the highest number of acres in any one year for a total of 82 acres. For several years the program has aimed to increase crop land acreage. Unfortunately, however, the definition of crop land was not updated with the recent farm bill. This is a very important definition as it defines the payment rates. Crop land receives a much higher rate than pasture or hay land, hence this definition can equate to thousands of dollars in lost value if the farmers were to enroll that land in CREP. Until this changes, it will continue to be difficult to increase crop land acreage enrollment.

Figure 4. CREP Acres by County

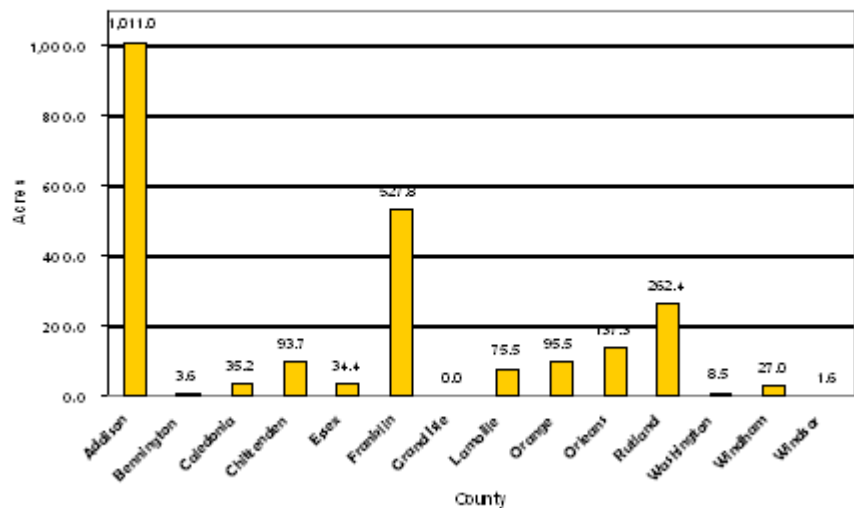
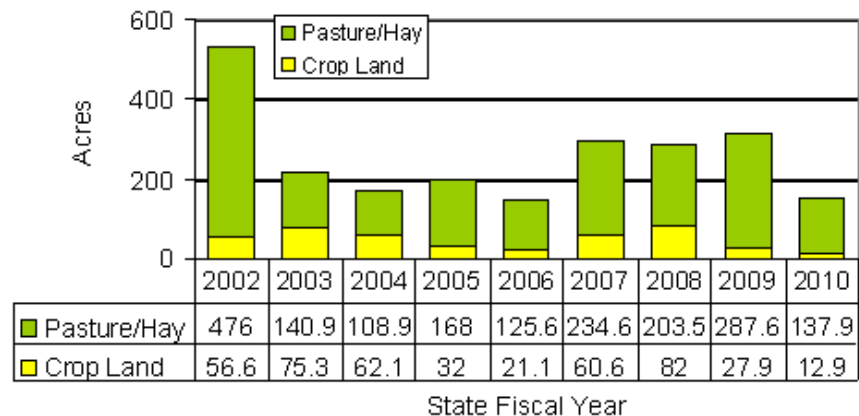


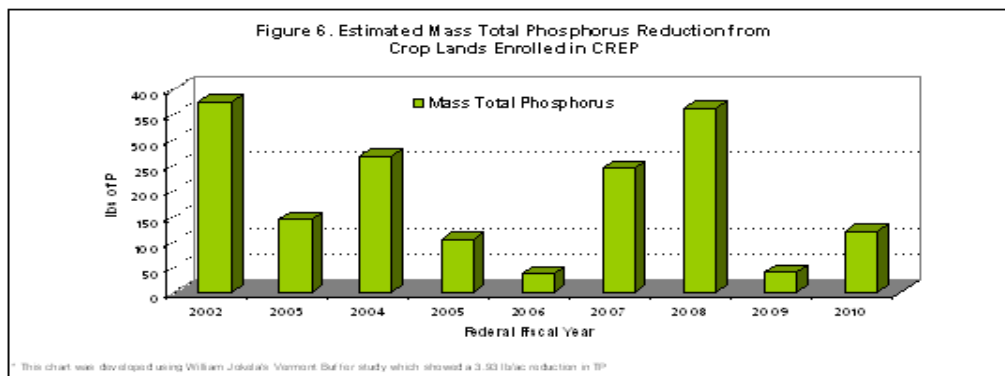
Figure 5. Acres of CREP Contracts Enrolled by Land Use Type



Indicators of Progress

Although the CREP program is a targeted program to reduce phosphorus losses from the edge of fields, it is very difficult to determine the exact amount of phosphorus reductions occurring. By using data collected in Vermont by the University of Vermont Extension, some very general assumptions can be made. Overall since the beginning of CREP, an estimated 1,691 pounds of phosphorus may have been trapped by CREP buffers (Figure 6).

This estimation was developed by reviewing buffer runoff studies performed by W. Jokela on a farm in Addison county. He was able to quantify cumulative phosphorus reductions from vegetative buffers on cropland and thereby create a per acre reduction value. These data were then extrapolated to estimate the potential reductions on the total crop land acres in CREP.



Vermont Agricultural Buffer Program

The Agency of Agriculture was granted the authority in 2006 to begin a new conservation practice program called the Vermont Agricultural Buffer Program. The goal of this program is to plant harvestable grass buffers on cropland to help remove nutrients through the uptake of the grasses, and reduce the amount of feed that might otherwise be brought onto the farm. To date, this program has one participant in a 0.6 acre contract along the Connecticut River. The program has not been very popular due to the reduced payments compared to CREP. With the state being the only financial partner, it is not as lucrative as CREP to the participant.

In 2010, the Agency of Agriculture has proposed statutory language to provide more flexibility in the Vermont Agricultural Buffer Program in order to address critical areas on the landscape where sediment and nutrient losses can be significant. The focus is on annual croplands where ditch drainage systems have been installed, such as the low-lying Champlain valley clay floodplains. These areas are very fertile; however, the soils drain slowly, which is why the lands were cleared and drained many years ago. As a means to protect surface runoff into the ditches, the program aims to provide grassed buffers on ditches and intermittent streams, something the current CREP program does not address. The other goal is to include wascobs, a practice being used in Quebec on fields within the Missiquoi Bay watershed. “Wascobs” stand for Water And Sediment CONTROL BasinS, and have typically been built by creating low-lying areas where the water can exit through a standpipe, and the sediment settles out right in the low area. The Canadians took this one step further and used wascobs at the end of ditches before they enter a stream to hold back the sediment which can then be cleaned out of the ditch during normal maintenance.

Pesticide and Groundwater Monitoring Program

The Problem

The Pesticide and Groundwater Monitoring Program was founded to investigate the quality of drinking water on Vermont farms because of concern for the potential for groundwater contamination by pesticides. Results show the occurrence of nitrate in groundwater and surface water drainage is more common than the detection of pesticides. The recognition of nitrate in groundwater as a significant agricultural water quality concern stimulated the merger of program priorities and water sampling activities between the Pesticide Program and the Agricultural Nonpoint Source Control Program. The Agency of Agriculture now conducts surface water and groundwater sampling projects and water quality investigations as part of a coordinated Agricultural Water Quality and Resource Management Program.

The Program

In 1986, The Vermont Agency of Agriculture initiated the Pesticide and Groundwater Monitoring Program for pesticides and nitrate. This program has conducted 23 years of sampling groundwater for farm operators and their neighbors with drinking water supplies adjacent to agricultural lands. The Agency has sampled a total of 1,830 private drinking water supplies in 186 towns representing each of Vermont's fourteen counties. Farm wells account for approximately 55% of all drinking water wells sampled. Non-farm, neighboring wells account for approximately 44%. The final 1% of wells represents the 21 public water supplies sampled by the program.



Monitoring well and soil lysimeter sampling station for nutrient management plan investigation conducted by NRCS National Water Center and Agency of Agriculture.

Program Accomplishments During 2009

Nitrate and Herbicide Results

In 2009 the program tested 146 wells and collected 226 samples. A total of 92 new well sites were sampled during 2009, which is a decrease from previous years. The results showed that of 146 wells, only seven exceeded the drinking water standard of 10 ppm. This represents a short-term (annual) violation rate of 5%. Detections below the drinking water standard were found in 85 of 146, or 58% of the wells tested. The Agriculture Laboratory tested 115 of the 146 wells for herbicides. For sampling conducted during 2009, there were no drinking water wells with a detection of herbicide that exceeded a state or federal drinking water standard. There were eight wells that had a positive detection for one or more herbicides; however these results were below the drinking water standards. The remaining 107 wells (93%) had no detections for herbicides.

Between 2005 and 2009, the Agency tested 730 wells and collected 1,337 samples (Table 3). Of these wells, 47% had no detections for nitrate. During this most recent five year period, 53 wells exceeded the drinking water standard of 10 ppm at some point in time. This represents a long term violation rate of 7% (Table 4). For sampling conducted during 2005-2009, there were no drinking water wells with a detection of herbicide that exceeded a state or federal drinking water

standard. However 67 wells had a positive detection for one or more herbicides. This represents a detection rate of 9% for the reporting period.

Table 3 - Five Year Summary of Nitrate and Herbicide Results.

Data represents a total of 1,337 individual drinking water samples analyzed by the Agency.

2005 – 2009	# Wells Sampled	# Wells Not Detected	# Wells w/ Detections		# Wells Above Standard
Herbicide Results	730	663 (91%)	68 (9%)		0 (NA)
2005 – 2009	# Wells Sampled	# Wells Not Detected	# Wells Below 5 ppm	# Wells 5 - 10 ppm	# Wells Above 10 ppm
Nitrate Results	730	344	270	63	53
		(47%)	(37%)	(9%)	(7%)

Water quality sampling for the assessment of conservation practices and the evaluation of nutrient management plan implementation is also incorporated as part of the Agricultural Environmental Management (AEM) assessments conducted by the Agricultural Resource Specialists (ARS) employed by the Natural Resource Conservation Districts (NRCDs). During 2009, ARS staff conducted approximately 80 AEM farm assessments that included water sampling. Groundwater sampling related to pre/post construction evaluations of certified manure storage structures, barnyards, and silage leachate collection systems funded through the NRCS EQIP Program and the State of Vermont BMP Cost-share Grant Program continues to be a focus of the Agricultural Water Quality Monitoring Project.

Indicators of Progress

Table 4 represents the long term violation rates for nitrate detections above 10 ppm during each of the past five year periods. The rolling average trend toward lower levels of nitrate detection has continued since 2006.

The groundwater monitoring program provides well sampling results, and education and outreach to individual well owners and farm operations. At present, elevated nitrate detections are decreasing statewide (Table 4) which demonstrates the progress the

Table 4. Nitrate Violation Rate Above 10 ppm Standard	
2001-2005	14 %
2002-2006	14 %
2003-2007	12 %
2004-2008	11 %
2005-2009	7 %

Agency is making in responding to known and potential sources of contamination and in educating landowners and agricultural operators on nitrate management issues and contamination pathways. Given that nitrogen has multiple agricultural sources, the decrease may be indicative of improvements in the management of on-farm nutrients and the link between nutrient management plan implementation and water quality monitoring. The effort to focus sampling activities on farms with known occurrence of nitrate detections in groundwater or surface water has successfully contributed to a reduction in nitrate contamination but also has the consequence of reducing the number of wells sampled for statewide baseline surveillance.

Site Investigations and Remediation Projects

The effectiveness of combining nutrient management planning and water quality monitoring to respond to and remediate documented cases of contamination has been demonstrated by two specific site investigation projects in recent years. During the 2006-2009 period, the Agency has completed site investigation and remediation projects at farms in Washington and Franklin Counties. In each case, the drinking water wells of farm neighbors exceeded the drinking water standard for nitrate. A total of nine drinking water wells were impacted at these two sites.

Site investigations to characterize the soils, groundwater, and geology were conducted by a team from the Agency of Agriculture, the Vermont Geological Survey, and the NRCS. At both sites, it was determined that field cropping practices rather than manure storage structures or a barnyard were the source of elevated nitrate. A response and investigation approach that helped to confirm the source of contamination and to characterize the groundwater system that affected the drinking water wells provided the farm operator with the opportunity to correct the problem by making changes to crop production and nutrient application practices on land that directly impacted the non-farm, neighboring wells. The nutrient management plan approach to solving water quality problems was successful. Changes to the farm nutrient management and crop rotation plans were implemented over a three to four year period, and the nitrates level in all the non-farm, neighboring wells are now below the state and federal drinking water standard. The Agency of Agriculture is committed to this investigation-based approach to water quality protection and is currently conducting ongoing investigations at farm sites in Orleans, Caledonia and Bennington Counties.