Revised Implementation Plan
Lake Champlain Phosphorus TMDL

Prepared by:
Vermont Agency of Natural Resources

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EXECUTIVE SUMMARY

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

The 2002 TMDL included a Vermont-specific implementation plan describing a suite of action items and attendant funding needs to reduce the phosphorus load delivered annually to Lake Champlain. The implementation plan has served as a basis for the efforts of the state agencies of Natural Resources and Agriculture, Food and Markets by guiding annual funding requests, staffing levels, and program priorities for the past seven years. Since 2002, Vermont, in conjunction with our federal, municipal, and non-government partners, has made an unprecedented commitment to Lake Champlain; the state has invested more than $50 million dollars in its efforts to improve water quality in the lake, and in turn has leveraged approximately $52 million in federal funding.

In working to control phosphorus pollution, Vermont has invested in programs to enhance the stability of streams and rivers, improve management of Vermont's vast network of dirt roads, protect and restore wetlands, limit polluted runoff from construction sites, implement soil-based conservation practices such as cover cropping, and provide technical and financial assistance to farmers to prevent discharges from barnyards and fields.

Periodic revisions are an integral element of implementing any program as expansive as the Lake Champlain Phosphorus TMDL. Armed with experiences gained through more than seven years of implementation efforts, the Agency of Natural Resources is well positioned 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.

In undertaking periodic reviews, program changes must be firmly rooted in science and the best professional judgment of our technical practitioners. Reducing excessive phosphorus inputs to Lake Champlain in order to address the most critical and controllable cause of algae blooms is a matter of continuing our steady, deliberate, sustained action to improve the health of the watershed and the lake.

Threats to Lake Champlain Water Quality

During the summer of 2009, the Agency engaged a broad-based group of stakeholders in evaluating threats to Lake Champlain water quality and in identifying the range of potential solutions. Threats were defined as past and current actions taken by humans that degrade the resource (Lake Champlain). Further, it was agreed that for the purposes of this effort, threats would be defined as land-based; therefore threats posed by a lack of funding, education and outreach, and/or enforcement were not included. In the end the work group agreed on thirteen broad categories of threats to Lake Champlain water quality, which are:

- Untreated/unmanaged runoff from existing development

- Land conversion
- Discharges from farmsteads & agricultural production areas
- Poorly managed cropland
- Unmanaged or poorly managed pasture
- Channel modifications
- Floodplain and lakeshore encroachments
- Untreated or improperly treated domestic sewage
- Road construction and/or maintenance
- Failure to implement forest management practices
- Wetland modifications
- Legacy effects (e.g., in-lake sediment accumulation)
- Failure to consider climate change in planning and design

In separate sessions, stakeholders and state and federal agency staff were asked to rank-order the threats. The results of the ranking exercise are presented in Appendix E, and were used to guide follow-up discussion about potential strategies that could be employed to improve water quality in Lake Champlain. Generally, the five highest ranked threats were:

- Discharges from farmsteads & agricultural production areas
- Poorly managed cropland
- Land conversion
- Road construction and/or maintenance
- Untreated/unmanaged runoff from existing development

Strategies to Improve Water Quality in Lake Champlain

The Agency solicited and received ideas that might be employed to address the threats to water quality in Lake Champlain from nearly 200 people. In total, the Agency compiled a list of more than 1,000 potential actions. Agency staff took all of the suggestions, grouped them under more than 40 headings, combined redundant suggestions, and used best professional judgment to narrow the wide range of suggested strategies to approximately 200. The 200 potential solutions were then separated into three groups:

- ***current actions***, meaning current programs and projects with existing funding that should be sustained (notes indicate where additional resources would allow for the needed expansion of current actions);
- ***next steps***, meaning programs and projects that do not currently exist, but that are necessary and timely when additional resources become available; and,
- ***future measures***, meaning programs and projects that may be necessary at some future point in time (e.g., regulatory measures to replace voluntary programs, programs with high cost per pound of phosphorus removed) depending on the efficacy of *current actions* and *next steps*. The role of *future measures* will be periodically re-evaluated as implementation progresses.

Implementation of these strategies will employ one or more of the following policy tools:

- Expanded **regulatory requirements**, providing specific steps that must be taken to control pollution and reduce impacts;
- **financial incentives**, linking funding eligibility to specific actions or using subsidies to control pollution and reduce impacts; and
- **technical assistance**, sharing information regarding the water quality impacts of current or planned actions, and suggesting techniques to reduce impacts.

The Next Ten Steps

The Agency is spending the resources currently available for reducing phosphorus pollution in Lake Champlain on the most effective programs and practices. The additional solutions identified as "next steps" are also likely to be necessary to attain the phosphorus reduction goals for Lake Champlain, as may be some or all of the "future measures." In order to establish priorities for moving forward in the near-term, the Agency has identified the ten programs or projects that it would expand or initiate first should additional resources become available. Funding estimates are in 2009 dollars, and are in addition to any monies currently allocated to the programs or projects. These are:

- Increase the number of extension personnel (agronomists and nutritionists) available for on-farm technical assistance, education and support.
    - $500,000 annually
- Require additional post-construction stormwater management for impervious surfaces using existing stormwater management authorities, such as state operational stormwater permits, MS4 permits, and residual designation authority.
    - $375,000 annually
- Develop and implement a set of water quality-based design standards and best management practices for road maintenance and drainage and link state transportation funding for municipalities to adherence to the standards.
    - $225,000 annually
- Provide technical assistance and financial incentives to encourage municipalities to adopt stream corridor protection that prevents conflicts between streams and infrastructure and provides for stream equilibrium, floodplain function, and vegetated buffers on tributaries and lakeshores.
    - $150,000 annually
- Expand the Farm Agronomic Practices and Nutrient Management Programs to support increased use of soil erosion reduction practices and alternative manure application techniques, such as soil aeration.
    - $300,000 annually
- Increase capacity to provide landowners and municipalities with engineering assistance in the siting and design of infrastructure near or in stream and eliminate the 10 mi^2 drainage area threshold for issuing stream alteration permits.
    - $300,000 annually
- Provide financial incentives to achieve a minimum width (10 feet) of buffer zone along intermittent streams and ditches that pass through annual cropland.
    - $500,000 annually

- Provide incentives for the use of low-impact development (LID) practices in new and existing development.
    - $400,000 annually
- Provide financial and regulatory incentives to install fencing (temporary and permanent), watering systems, and stream crossings in order to improve management of animals in and around streams and rivers.
    - $200,000 annually
- Broaden the conservation purposes of and annually expend all funds made available through the Wetland Reserve Program (WRP) and Farmland Protection Program (FRPP) to permanently protect and restore wetlands and stream corridors.
    - $200,000 annually

A Call to Action

Achieving the tributary loading targets and in-lake standards for Lake Champlain established in the TMDL will require the continued and expanded support of all involved agencies and watershed stakeholders in order to reduce phosphorus pollution and improve water quality.

The Vermont Agency of Natural Resources (ANR) will continue in its leadership role in managing Vermont's efforts to implement the Lake Champlain Phosphorus TMDL, and will coordinate and collaborate on water quality programs throughout the state. ANR administers a combination of regulatory and voluntary programs that form the foundation upon which the TMDL implementation plan was built.

The Vermont Agency of Agriculture will continue to provide the necessary regulatory oversight and technical and financial assistance to agricultural producers to ensure that Vermont farms meet or exceed the standards established by state and federal water quality regulations.

The Vermont Agency of Transportation will continue to research and implement cost effective BMPs, demonstrate best practices to municipalities and other transportation professionals, partner with watershed groups and ANR to undertake water quality improvements and contribute to municipal outreach, education and water quality-related construction projects through the Vermont Local Roads and Better Backroads programs.

The Vermont Legislature must actively weigh the economic, social and environmental values that underpin the Lake Champlain Phosphorus TMDL, including the complex calculus of ability and willingness to pay, in order to support and strengthen the technical, financial, and regulatory capabilities of the state's agencies to implement the TMDL.

Federal partners, most importantly the Lake Champlain Basin Program (LCBP), U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (FWS) and the Natural Resource Conservation Service (NRCS), are central to improving Lake Champlain's water quality.

The Lake Champlain Basin Program should support and conduct targeted research to address critical data needs in order to continually improve the state of science related to Lake Champlain; LCBP should continue to foster and coordinate the cross-boundary transfer of management practices found to be successful in some areas of the basin and applicable in others.

U.S. EPA should provide additional federal funding for state and local water quality programs and provide TMDL implementation guidance that addresses the role of watershed planning and other non-structural management practices to reduce phosphorus pollution.

U.S. FWS should provide technical and financial assistance to private landowners throughout the Lake Champlain basin to assist in the improvement of wetland and riparian habitats to benefit water quality and fish and wildlife resources.

NRCS should expand the number of farmers and number of practices funded in the Lake Champlain basin by providing more proactive outreach to sign up farmers for EQIP and assisting with more detailed pre-planning for EQIP contracts to define needs and estimate total project cost.

Municipalities will continue to provide regulatory oversight of local land-use activity. Some local governments, currently limited to five communities in Chittenden County, have also developed stormwater management programs as required by the MS4 general permit. This permit includes requirements for education, outreach and phosphorus control from municipal operations, and infrastructure mapping.

Nonprofit organizations, ranging from regional planning commissions to watershed groups, are important partners in extending the reach of state and federal agencies. They are able to reach further into their communities and with a higher degree of acceptance. They can lead by example and help change the behavior of Vermonters.

Watershed residents play an essential role – their activities, including farming, lawn care, septic systems, often generate phosphorus. Public outreach, education and participation are central to fully implementing phosphorus controls. Public acceptance and participation in this plan will be essential to successful phosphorus reduction efforts.

Achieving Lake Champlain's Water Quality Goals

In addition to the support and cooperation of government agencies, non-government organizations, and individual Vermonters, there are two other elements critical to the attainment of the water quality goals for Lake Champlain: time and money.

The restoration of Lake Champlain water quality is not a short-term proposition – measured in months or even a handful of years. It is essential to keep the perspective that the current condition of Lake Champlain reflects decades and even centuries of human influence on the Vermont landscape, as well as those of adjacent areas of Quebec and New York – with a total area of more than 8,000 square miles draining to the lake.

The full suite of programs needed to address phosphorus pollution in Lake Champlain will require unprecedented financial resources. The total cost of the wide-reaching collection of programs and projects outlined in this revised implementation plan is estimated at $500 - $800 million (in 2009 dollars). While this is a daunting price tag, it is not an excuse for inaction. The breadth and sheer number of actions described in the implementation plan provide a methodical framework for identifying and attacking the most manageable and effective pieces of this water quality puzzle.

Measuring Progress

It is essential that the effectiveness of efforts to reduce phosphorus loading to Lake Champlain continue to be evaluated as systematically and as quantitatively as possible. This allows for assessment of which programs are most effective and whether overall progress is being made as a result of the significant investments of funding and other resources. That said, predicting and measuring the actual amounts of phosphorus reduced from actions aimed at controlling nonpoint sources of pollution is very difficult.

Metrics developed to predict and measure the expected incremental improvement in Lake Champlain water quality for each dollar spent often overlook important benefits, such as those that are unquantifiable, unexpected, or that take a long time to manifest. As much as 95 percent of the phosphorus pollution generated across the Vermont landscape each year is attributable to wet weather

events – stormwater runoff, snowmelt and flood-related erosion – and weather is highly variable from year to year. Further, many of the best strategies for controlling wet weather pollution rely on natural solutions – allowing woody vegetation to reestablish along stream and river banks, installing rain gardens and other green infrastructure with vegetation to intercept and store stormwater, plugging ditches on marginal farmland to allow wetlands to reform and re-vegetate. For these reasons, progress will not be seen as a steady, incremental reduction in the phosphorus loading rate on a year-to-year basis in direct response to specific funding allocations.

In spite of these technical challenges, progress in reducing phosphorus in Lake Champlain can, has, and will be evaluated through the following combination of efforts:

- direct monitoring of lake phosphorus concentrations and tributary loading rates;
- development and tracking of program-specific indicators;
- watershed modeling; and
- scientific literature review and continued field studies on management practice effectiveness.

The Need for Prevoyance

The ability to routinely revisit, reevaluate, modify, and adapt the implementation plan is essential, applying what has been learned from past watershed-based actions and producing improvements in the landscape and water quality in as efficient and effective a manner as possible. In complex systems we need to act in order to learn; a living implementation plan is central to the process of action.

Historian and author David Hackett Fisher recently completed a biography of Samuel de Champlain, to coincide with the 400th anniversary of Champlain's explorations in New France (Quebec) and New England. In his book, Hackett-Fisher described Champlain's arguments that a leader must be "prevoyant" – a word that has no exact equivalent in modern English. Hackett-Fisher writes:

> *Champlain's idea of prevoyance was different from foresight in its common meaning. It is not a power to foresee the future. To the contrary, prevoyance was the ability to prepare for the unexpected in a world of danger and uncertainty. It was about learning to make sound judgments on the basis of imperfect knowledge. Mainly it is about taking a broad view in projects of large purpose, and about thinking for the long run.*

The need for prevoyance could hardly be more true to the water quality challenges of today – where implementation must occur in the face of uncertainty in order to continue the great good work needed to sustain and enhance water quality both throughout the Lake Champlain basin and in the lake itself.

CHAPTER ONE: INTRODUCTION AND BACKGROUND

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation (40 CFR Part 130) requires states to develop a total maximum daily load (TMDL) for waterbodies that do not currently meet water quality standards. A TMDL is a "pollution budget" that calculates the amount of pollution the waterbody can tolerate and still maintain water quality standards. The process of calculating the TMDL for phosphorus in Lake Champlain was completed in 2002, and was subsequently approved by EPA.

Purpose of a TMDL Implementation Plan

An implementation plan identifies a suite of measures that will be taken to reduce pollution levels in order to reach the "pollution budget" specified in the TMDL. Conceptually, the TMDL process of establishing a pollution budget is straightforward – uncertainty, however, makes writing a single, detailed, long-term plan that charts a specific course to water quality extremely challenging. Relevant processes and stressors within the watershed are not always fully understood, and the effectiveness of recommended control measures is often highly variable.

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

- providing a measure of quality control, given the uncertainty that exists;
- helping to ensure the most cost effective practices are implemented as soon as possible; and
- allowing for the routine reevaluation of the adequacy of implementation efforts in achieving the water quality standard.

The original Vermont-specific implementation plan was drafted in 2002, in conjunction with the TMDL. Although ANR considers the implementation plan to be continually "open" in the sense that we are always learning from our efforts and redirecting our implementation actions as we proceed, with seven years of accelerated implementation efforts completed, a comprehensive review of the implementation plan is timely. Furthermore, Section 2 of Act 130(2008) directs that "o*n or before January 15, 2010, the secretary of natural resources shall issue a revised Vermont-specific implementation plan for the Lake Champlain TMDL."*

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

TMDL Implementation Plan Status

The status of each of the original TMDL action items is described briefly in Appendix A. Of the 55 actions items identified in the TMDL implementation plan, 44 are in progress (some with changes in scope), and seven have been completed. In general, the projects and programs have been highly consistent with the original implementation plan.

It is important to note that, moving forward, many of these actions will require sustained efforts over many years in order to fully accomplish the program purposes and goals. For example, the TMDL implementation plan calls for ANR to "*conduct stream geomorphic assessments*." To date, initial assessments

have been completed for more than 6,800 miles of streams and rivers using orthophotos, topographic maps, geographic information systems (GIS), and quick observation surveys. Further, more quantitative and qualitative geomorphic assessments have been completed for 1,425 river miles through on-the-ground observations. The collection of additional assessment data is now being balanced with the design and implementation of protection and restoration projects identified as part of the river corridor planning process that follows each assessment. ANR anticipates that by the end of 2010 initial assessments will have been completed statewide.

Similarly, the TMDL implementation plan calls for AAFM to "*accelerate the establishment and protection of riparian buffers on agricultural land.*" To date, the Conservation Reserve Enhancement Program (CREP) has enrolled more than 1,700 acres of stream and river corridor in the Lake Champlain basin. Further, AAFM established the Vermont Agricultural Buffer Program in 2007 which provides incentives for installing harvestable filter strips and grassed waterways – creating additional options for farmers to use in protecting riparian areas. Yet significant opportunities remain for improving the extent of riparian buffers. The Natural Resources Conservation Service (NRCS) recently estimated that in the Missisquoi River watershed alone there are more than 8,000 acres of stream and river corridor where riparian buffers are currently insufficient or non-existent.

Clean and Clear Annual Report

ANR, AAFM and the Agency of Transportation have jointly produced annual reports on the Clean and Clear program since 2004, which are delivered to the General Assembly and made available to the public in the spring of each following year. These reports detail activities conducted by each agency in implementing the Lake Champlain TMDL. The purpose of these annual reports is to: explain the sources of phosphorus being addressed by each program; describe the structure of the program; outline the activities conducted each year; and provide indicators and other measures of progress.

Section 2 of Act 130 (2008) 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."* Program summaries for calendar year 2009 are currently under development and the 2009 Clean and Clear Annual Report will be delivered to the General Assembly by February 1, 2010.

CHAPTER TWO: CONSULTATION AND PUBLIC PARTICIPATION

The Lake Champlain Phosphorus TMDL built upon a sequence of studies, plans, and agreements developed during the preceding twelve years, and culminated in the 2002 publication of the TMDL and a Vermont-specific implementation plan. The process of developing the TMDL was defined by extensive public involvement. It is only right therefore that revisions to the implementation plan be contemplated publically.

In addition, Section 2 of Act 130 (2008) requires "*the secretary shall consult with the agency of agriculture, food and markets, all statewide environmental organizations that express an interest in the plan, the Vermont League of Cities and Towns, all business organizations that express an interest in the plan, the University of Vermont Rubenstein ecosystem science laboratory, and other interested parties."* And that *"the secretary shall hold at least three public hearings in the Lake Champlain watershed to describe the amendments and revisions to the implementation plan for the Lake Champlain TMDL."*

In order to fully address the requirements of Act 130 and obtain early input and feedback critical to drafting the plan, ANR devised a public participation process that included a mix of stakeholder workshops, targeted consultations, more formal public hearings, and wide distribution of a public review draft and solicitation of comments.

Stakeholder Workshops

During the summer of 2009 ANR sponsored two stakeholder workshops. More than 50 people participated in each of the workshops, representing a wide range of interests and views. A list of workshop participants is included as Appendix B.

The first workshop was held on July 9th, 2009 and focused on defining threats to water quality in Lake Champlain. Threats were defined as past and current actions taken by humans that degrade the resource – Lake Champlain – by adding excessive amounts of phosphorus. Workshop participants identified thirteen broad categories of threats to Lake Champlain water quality, which are discussed in more detail in Chapter 3 of this report.

A second workshop was held on September 24th, 2009; participants were asked to brainstorm potential solutions to the highest ranked water quality threats, as identified during the first workshop. Participants generated hundreds of ideas, and were then asked to group like ideas and identify preferred solutions. Input from workshop participants served as the basis for the 46 themes presented in Chapter 4 of this report.

Consultations

Although a broad cross-section of stakeholders participated in the workshops, there were several key groups and organizations that were under- or unrepresented. ANR scheduled a series of small group meetings to directly solicit input from these groups and organizations, including:

- Vermont League of Cities and Towns
- Vermont Farm Bureau
- Lake Champlain Chamber of Commerce
- Dr. Mary Watzin, Dean, Rubenstein School of Environment and Natural Resources

Public Review Draft

ANR released a public review draft of the TMDL implementation plan on December 7th, 2009, which included an organized list of more than 200 potential strategies for improving water quality in Lake Champlain and an executive summary to provide context for the strategies. The public review draft was

made available on ANR's website (http://www.anr.state.vt.us/cleanandclear/) and a press release was issued announcing the availability of the draft plan. In addition, an electronic version of the draft plan was sent to all of the participants in stakeholder workshops, as well as those who were consulted.

ANR received nearly 20 sets of written comments on the review draft and incorporated the suggestions, as appropriate, in this version of the implementation plan. A list of those providing written comments on the draft plan is included as Appendix C.

Public Hearings

ANR held three public hearings on the draft implementation plan. The first, on December 8th in Castleton, was co-sponsored by the Poultney-Mettawee Conservation District and was done in conjunction three of the southern Vermont conservation districts who were also seeking public input on water quality priorities. Turn-out for this meeting was dominated by agricultural producers.

The second meeting, on December 14th in Burlington, was hosted by the Vermont Citizens Advisory Committee on Lake Champlain's Future (CAC). This was the most well-attended of the three hearings, with more than 50 people present.

The third meeting, on December 15th in Swanton, was co-sponsored by the Friends of Northern Lake Champlain. Many of those attending represented northern lake watershed groups including: the Missisquoi River Basin Association, the Farmers Watershed Alliance, and the St Albans Watershed Association.

Each meeting began with a 30-minute presentation, offering an overview of the draft plan. A lengthy question-and-answer period followed each presentation. Audio recordings of the hearings are available on-line at: http://www.anr.state.vt.us/cleanandclear/ A list of hearing attendees is provided in Appendix D.

CHAPTER THREE: THREATS TO WATER QUALITY IN LAKE CHAMPLAIN

In revisiting the TMDL implementation plan, it was important to first review the sources of phosphorus pollution in the Lake Champlain basin or, put another way, the "threats" to water quality in the lake. Threats were defined during a public participation process as past and current actions taken by humans that degrade the resource – Lake Champlain – by adding excessive amounts of phosphorus. Further, it was agreed that for the purposes of this effort, threats would be defined as land-based. Thirteen broad categories of threats to Lake Champlain water quality were identified, which are:

- Untreated/unmanaged runoff from existing development
- Land conversion
- Discharges from farmsteads & agricultural production areas
- Poorly managed cropland
- Unmanaged or poorly managed pasture
- Channel modifications
- Floodplain and lakeshore encroachments
- Untreated or improperly treated domestic sewage
- Road construction and maintenance
- Failure to implement forest management practices
- Wetland modifications
- Legacy effects
- Failure to consider climate change in planning and design

A brief description of each threat is as follows.

Untreated/unmanaged runoff from existing development including: limited P-removal from collected stormwater; overuse or application of lawn fertilizers; lack of water quality protective zoning (buffer ordinances); and the limited extent of stormwater treatment retrofitting.

Land conversion includes: loss of forest, wetland, and agricultural land resources; lack of stabilization following conversion/construction; creation of new impervious surfaces (not everything needs a stormwater permit; stormwater practices only reduce the rate of decline); and a lack of a statewide land-use strategy.

Discharges from farmsteads & agricultural production areas including: lack of storage and/or treatment for manure, silage leachate, and milkhouse waste; improperly located and/or managed livestock concentration areas; and allowing clean stormwater runoff to mix with wastes, such as manure.

Poorly managed cropland including: improper fertilizer and/or manure application, amount, timing, and method; soil loss and erosion; use of sensitive lands for annual crop production; and tillage and/or manure application too close to surface water.

Unmanaged or poorly managed pasture including: allowing direct livestock access to surface waters and wetlands; overgrazing and denuded vegetation; and erosion at livestock crossings and other areas of concentration.

Channel modifications including: straightening natural waterways; ditching and tiling in order to drain land; bank armoring; dredging and gravel mining; and the presence of unstable storm drain outfalls.

Floodplain and lakeshore encroachments including: adjacency of historic development to surface water; inadequate or absent buffers; removal of vegetation (new clearing); and lack of municipal zoning.

Untreated or improperly treated domestic sewage including: failed septic systems; inadequate phosphorus removal from wastewater; illicit discharges to storm sewers; sewer line breaks and sewage spills; and overflows from combined sewer systems.

Road construction and maintenance including: poorly installed or undersized culverts; lack of stabilized roadside ditch networks; over-steepened banks; and poor management of over-road flow (lack of grading, crowning, etc).

Failure to implement forest management practices including: inadequately protecting stream and wetland crossings; inadequate design and construction of forest roads, trails and log landings; lack of site maintenance and close-out; and inappropriate timing of logging operations.

Wetland modifications including: filling or other losses of wetlands; modification of wetland vegetation; modification of wetland hydrology (dredging, ditching); and inadequate or absent wetland buffers.

Legacy effects including: erosion from massive land clearing during prior centuries; decades of untreated industrial and municipal wastewater discharges; development/creation of impervious surface without stormwater controls; and historic fertilizer use.

Failure to consider climate change in planning and design including: accounting for increased rainfall depth and intensity, and resulting increases in runoff and storm flows.

Other Threats

Because threats were defined as land-based, lack of education and outreach, enforcement and funding were not considered threats; all three are, however, central to effective implementation. The role of each in achieving the water quality goals of the Lake Champlain TMDL is described below:

Education and Outreach – as much as 95% of the phosphorus pollution Vermont delivers to Lake Champlain each year is from diffuse, nonpoint sources. Nonpoint source pollution can be thought of as "runoff pollution," attributable to wet weather events - stormwater runoff, snowmelt, and flood-related erosion. Nonpoint source pollution cannot be traced to a single, identifiable source such as a pipe or a factory. As a result of the diffuse nature of the problem, the solutions will also be widely distributed requiring important changes in behavior by most, if not all, of the residents of the Lake Champlain basin. Education and outreach are therefore essential in creating a broad-based understanding of how nonpoint source pollution can and should be controlled.

Enforcement – enforcement of environmental laws traditionally involves monitoring compliance by those in the regulated community (e.g., factories, farms, municipalities), ensuring that violations are properly identified and reported, and ensuring that timely and appropriate enforcement actions are taken against violators when necessary. Active enforcement programs can play an essential role in deterring potential violators and ensuring that members of the regulated community cannot gain a competitive advantage by breaking the "rules."

Funding – the total financial resources required to fully implement the TMDL implementation plan is estimated between $500 and $800 million. That said, resources are finite and there are innumerable competing priorities. Further, there are heavy costs to society if finite resources are expended on lower priority problems at the expense of higher-priority risks. The keys therefore are targeting geographically, and setting priorities for which practices should be implemented first in order to achieve the greatest good at the lowest cost. The term most often applied to this process of targeting is "critical source area identification," which is discussed in more detail in Chapter 7 of this report.

Ranking the Threats

In separate sessions, stakeholders and state and federal agency staff were asked to rank-order the thirteen threats to water quality in Lake Champlain. Participants were asked to score the threats using the following criteria:

Scope – how wide an area does the threat affect?

Scale – how significant is the impact of the threat on Lake Champlain water quality?

Recovery Time – if the threat is allowed to or has already occurred, how long will restoration take?

Fixability – if the threat is allowed to or has already occurred, how realistic will it be to attempt to address the threat?

Urgency – how important is it that immediate action take place to deal with the threat?

Other Effects Attributable to the Threat – are there other social, ecological, or economic impacts that are expected to occur as a result of the threat?

The results of the ranking exercise are presented in Appendix E, and were used to guide consideration of potential strategies that could be employed to improve water quality in Lake Champlain. Generally, the five highest ranked threats were:

- Discharges from farmsteads & agricultural production areas
- Poorly managed cropland
- Road construction and/or maintenance
- Land conversion
- Untreated/unmanaged runoff from existing development

Although the relative score for "untreated/unmanaged runoff from existing development" assigned by state and federal agency staff was somewhat lower, a closer look showed that the relative score was pushed lower by low fixability scores. Scope and scale scores, however, were high and therefore it was decided to bring this threat forward as one of the highest ranked.

CHAPTER FOUR: STRATEGIES TO IMPROVE WATER QUALITY IN LAKE CHAMPLAIN

The restoration of Lake Champlain water quality is not a short-term proposition – measured in months or even a handful of years. It is essential to keep the perspective that the current condition of Lake Champlain reflects decades and even centuries of human influence on the Vermont landscape, as well as those of adjacent areas of Quebec and New York.

A continuous process of planning, developing, implementing, evaluating, adapting and enhancing management strategies is necessary to progressively improve Lake Champlain's water quality. In revising the TMDL implementation plan, the Agency solicited and received suggested strategies that might be employed to address the threats to water quality in Lake Champlain from nearly 200 people. In total, the Agency compiled a list of more than 1,000 potential strategies.

In considering all of the strategies, ANR first sought to combine like ideas, grouping them into more than 40 themes. In addition, the Agency identified a number of suggestions that went well beyond what could reasonably be contemplated as part of the Lake Champlain phosphorus TMDL – such as imposing a carbon tax to slow the effects of global climate change – and eliminated these from further consideration. The end result was a narrowed list of suggested strategies – approximately 200 (see Appendix F).

Implementation of the strategies will require the continued and expanded support of all involved agencies and watershed stakeholders in order to reduce phosphorus loads and improve water quality. ANR will continue in its leadership role in managing Vermont's efforts to implement the Lake Champlain Phosphorus TMDL, and will coordinate and collaborate on water quality programs within the state.

Current planning and implementation efforts are discussed in more detail below.

In large waterbodies, like Lake Champlain, with large annual variation in conditions, trends are best assessed by examining long-term data sets, coupled with modeling interpretation. On-going work to evaluate program effectiveness, adapt and enhance implementation strategies, and track progress as part of a coordinated monitoring and assessment program is discussed in considerable detail in Chapter 8 of this report.

Planning

ANR and its partner agencies use the basin planning process to comply with provisions of *40 C.F.R. § 130.6(c);* basin planning is a component of a larger Continuous Planning Process (CPP) required by §303(e) of the Clean Water Act. Basin plans, the product of the basin planning process, incorporate water quality assessments, identification of existing permitted discharges, and identification of waters occurring on priority waters lists. Basin plans also articulate strategies to protect or restore water quality, using one or more of the management programs articulated by the CPP. Completed Basin Plans with relevance to the Lake Champlain TMDL include the Poultney-Mettawee Basin (#2), the Direct Lake Champlain North Drainages (#5), and the Lamoille Basin (#7).

ANR is currently involved in an internal review of its basin planning process, identifying its strengths and weaknesses and opportunities for improvement. This effort is exploring the potential for a realignment of the basin planning process to more fully integrate it across ANR program and leverage efficiencies where possible. The general goal is to enhance coordination of the numerous water-related planning processes within ANR, and develop a statewide plan that spotlights the highest priority strategies needed to protect Vermont's waters in a time of competing resources. Examples where this statewide plan will interact with the Lake Champlain TMDL implementation plan include: prioritized and coordinated use of the River Management Program's corridor planning and protection program;

NPDES stormwater permitting programs (including potential expanded use of ANR's residual designation authority (RDA) permits); and, ANR's State Lands Acquisition Process. A statewide strategic plan might include such components as:

> *State Water Resource Goals and Objectives* - this component would lay out the vision for Vermont waters, including descriptions of healthy, functioning, and supporting watersheds.
>
> *Water Quality Monitoring Program Strategy* – this component would direct how monitoring resources are allocated, how monitoring data are vetted and archived, how information is assessed and how it is delivered to the public.
>
> *Water Quality Education "Teach-Pieces"* – this would establish a statewide roster and description of threats to water quality and quantity that is typically a component of individual basin plans, and provide a statewide educational document on water quality issues.
>
> *Protection and Remediation Programs* – this section would be a compendium of rules, procedures, and best practices that outlines state technical assistance services available to the public in assessing and remediating various stressors. It would also update the current CPP document mentioned above, and highlight the planning and regulatory process for applying anti-degradation provisions of the Vermont Water Quality Standards and Clean Water Act, to identify and support existing uses for waters within each basin.
>
> *Gap Analysis* – this component would identify gaps between the most important threats to water quality, and the regulatory, technical assistance, and cost-share funding programs currently in place. For Lake Champlain, this implementation plan serves as the gap analysis for sources of phosphorus.
>
> *Tactical Basin Implementation Plans* – this would describe how individual, basin-specific strategic plans that document existing uses where known, establish priority monitoring and assessment approaches, and list planning, permitting, or project-level initiatives to protect or restore uses.

While each tactical basin implementation plan would necessarily contain target activities articulated by this Lake Champlain TMDL implementation plan, complimentary strategies that are not explicitly prescribed for phosphorus reduction would also be part of the tactical basin implementation plans. Co-implementation of the Lake Champlain TMDL within the framework of the tactical basin implementation plans would enhance water quality protection and remediation efforts for phosphorus and many other threats to water quality.

After completing an internal review process of current basin planning efforts and opportunities for enhanced planning and coordination, ANR will initiate an open, public process for discussion of these issues.

Implementation

ANR administers a combination of regulatory and voluntary programs that form the foundation upon which the TMDL implementation plan is built. In addition, ANR coordinates with the Vermont Agency of Agriculture to ensure the necessary regulatory, and technical and financial assistance programs are available to agricultural producers to ensure that Vermont farms meet or exceed the standards established by state and federal water quality regulations. Implementation efforts employ one or more of the following policy tools:

- expanded **regulatory requirements**, providing specific steps that must be taken to control pollution and reduce impacts;
- **financial incentives**, linking funding eligibility to specific actions or using subsidies to control pollution and reduce impacts; and

- **technical assistance**, sharing information regarding the water quality impacts of current or planned actions, and suggesting techniques to reduce impacts.

In considering potential strategies, ANR found helpful to group themes of ideas together; in the end 46 themes emerged, which are:

- expand state and municipal programs that address stormwater runoff from existing development
- implement strategic stormwater retrofits capable of managing runoff from multiple sites
- increase on-site stormwater management efforts
- control the use of phosphorus fertilizers and herbicides
- expand state programs that address stormwater runoff from new development
- increase the ability of municipalities to directly address and improve management of stormwater during land conversion
- revise the *Stormwater Management Manual* to better target phosphorus pollution
- promote low-impact development (LID) techniques
- use financial incentives to protect key natural resources
- improve the utility of statewide planning to address water quality issues
- expand financial assistance programs available to agricultural producers to support implementation of best management practices
- expand technical assistance programs available to agricultural producers to support implementation of best management practices
- enhance efforts to target small farms, including dairy, horse and vegetable operations
- improve manure storage and management
- improve management of heavy use areas (barnyards)
- identify and target agricultural operations that disproportionately contribute phosphorus
- evaluate changes to the existing regulatory framework for agriculture that could improve program efficacy
- expand voluntary and regulatory program that target soil loss and erosion from cropland
- expand efforts to develop and implement nutrient management plans (NMPs)
- increase technical assistance available to agricultural producers for improving cropland management
- expand programs that address agricultural drainage practices (ditches and tiles)
- improve the timing, amount, location and methods used in manure application
- improve the management of animals in and around surface water features
- develop tools to improve pasture management
- expand riparian area protection and restoration efforts
- expand the scope of state and federal regulatory programs governing in-stream activities
- provide more outreach for and oversight of projects involving drainage or other channel and floodplain modifications

- use regulation, zoning, and incentives to prevent conflicts between infrastructure and streams/rivers
- expand technical and financial assistance programs that specifically target lakeshore property owners
- further reduce the phosphorus contribution from point sources
- replace or upgrade failing and sub-standard septic systems
- improve the ability of financial assistance program, including the state revolving fund (SRF), to target phosphorus reduction projects
- expand technical and financial assistance programs to accelerate replacement of failed or undersized culverts
- expand technical and financial assistance program that target local (gravel) roads
- develop and implement a suite of accepted management practices (AMPs) for roads that specifically address drainage, maintenance, and erosion control
- use transportation infrastructure planning to address phosphorus pollution and stormwater management
- enhance treatment of stormwater runoff from paved roads
- expand technical assistance offerings to loggers
- use the *Acceptable Management Practices* (AMPs) for logging operations to address erosion prevention and sediment control
- make available additional financial assistance to support forest stewardship
- implement strategies to enhance forest canopy and tree cover in developed areas
- expand voluntary and regulatory programs to protect and restore wetlands
- mitigate for and restore wetlands impacted by agricultural operations
- use financial incentives to protect and restore wetlands
- understand past practice in order to inform future management decisions
- consider the effects climate change could have on strategies to reduce phosphorus pollution in Lake Champlain

Although individual themes vary in terms of their potential to reduce phosphorus pollution delivered to Lake Champlain, it is also important understand the relative priority placed on the strategies within each theme. Agency program staff reviewed the groups of strategies for the themes relevant to their programs and prioritize them for implementation. Specifically, potential solutions were separated into three groups:

- ***current actions***, meaning current programs and projects with existing funding that should be sustained (notes indicate where additional resources would allow for the needed expansion of current actions);
- ***next steps***, meaning programs and projects that do not currently exist, but that are necessary and timely when additional resources become available; and,
- ***future measures***, meaning programs and projects that may be necessary at some future point in time (e.g., regulatory measures to replace voluntary programs, programs with high cost per

pound of phosphorus removed) depending on the efficacy of *current actions* and *next steps*. The role of *future measures* will be periodically re-evaluated as implementation progresses.

The additional solutions identified as "next steps" are likely to be necessary to attain the phosphorus reduction goals for Lake Champlain, as may be some or all of the "future measures."

CHAPTER FIVE: PRIORITY STRATEGIES AND NEXT STEPS

While the list of more than 200 strategies provides a sense of the magnitude of the effort needed to achieve our water quality goals for Lake Champlain, it also has the potential to overwhelm. It is important, therefore, to view the strategies not only as a forest but also trees –individual tasks that can be picked off and addressed as resources are available.

Built on the belief that the Agency is spending the resources currently available for reducing phosphorus pollution in Lake Champlain on the most effective programs and practices, ANR staff reviewed the long list of strategies and identified the ten programs or projects that it would expand or initiate first should additional resources become available. Ideally selecting the "next ten" strategies would be simply a matter of making a "pound of phosphorus reduced per dollar spent" comparison. Unfortunately, predicting the actual amounts of phosphorus reduced from actions aimed at controlling nonpoint sources of pollution is very difficult at best, and often not technically possible. As such, the next ten steps were selected using available data and science, buttressed with on-the-ground experience and best professional judgment. The next ten steps are:

- Increase the number of extension personnel (agronomists and nutritionists) available for on-farm technical assistance, education and support.
    - $500,000 annually
- Require additional post-construction stormwater management for impervious surfaces using existing stormwater management authorities, such as state operational stormwater permits, MS4 permits, and residual designation authority.
    - $375,000 annually
- Develop and implement a set of water quality-based design standards and best management practices for road maintenance and drainage and link state transportation funding for municipalities to adherence to the standards.
    - $225,000 annually
- Provide technical assistance and financial incentives to encourage municipalities to adopt stream corridor protection that prevents conflicts between streams and infrastructure and provides for stream equilibrium, floodplain function, and vegetated buffers on tributaries and lakeshores.
    - $150,000 annually
- Expand the Farm Agronomic Practices and Nutrient Management Programs to support increased use of soil erosion reduction practices and alternative manure application techniques, such as soil aeration.
    - $300,000 annually
- Increase capacity to provide landowners and municipalities with engineering assistance in the siting and design of infrastructure near or in stream and eliminate the 10 mi^2 drainage area threshold for issuing stream alteration permits.
    - $300,000 annually
- Provide incentives to achieve a minimum width (10 feet) of buffer zone along intermittent streams and ditches that pass through annual cropland.
    - $500,000 annually

- Provide financial incentives for the use of low-impact development (LID) practices in new and existing development.
    - $400,000 annually
- Provide financial and regulatory incentives to install fencing (temporary and permanent), watering systems, and stream crossings in order to improve management of animals in and around streams and rivers.
    - $200,000 annually
- Broaden the conservation purposes of and annually expend all funds made available through the Wetland Reserve Program (WRP) and Farmland Protection Program (FRPP) to protect and restore wetlands and stream corridors.
    - $200,000 annually

Implementation of these strategies will necessarily employ all of the available policy tools to achieve a complex mix of brick-and-mortar projects, best management practices, and softer engineering solutions which often rely heavily on natural processes – allowing woody vegetation to reestablish along stream and river banks, installing rain gardens and other green infrastructure with vegetation to intercept and store stormwater, plugging ditches on marginal farmland to allow wetlands to reform and re-vegetate. Funding estimates are in 2009 dollars, and are in addition to any monies currently allocated to the programs or projects.

With general agreement on these priorities, the next step is to develop a work plan for each that describes major tasks and assigns responsibilities, provides spatial or geographic context for the proposed action, identifies possible funding scenarios, and proposes 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.

CHAPTER SIX: PROJECTED COST

As described in the preceding chapter, the suite of programs needed to fully address phosphorus pollution in Lake Champlain includes a wide range of measures. Full implementation of this plan will require unprecedented financial resources. The total cost of the wide-reaching collection of programs and projects outlined in this revised implementation plan is based on our current understanding of needs and is estimated at $500 - $800 million.

ANR employed a number of assumptions in developing the cost estimate, including:

- Considering programs and practices to have a 15-year life, although many of the programs may need to live on in perpetuity in order to ensure the gains made through program implementation are sustained for the long-term;
- Excluding long-term operation and maintenance of the practices; and
- Estimating all costs in 2009 dollars.

The broad cost categories considered were agriculture, stormwater from developed land (including roads), river corridors and wetlands, and other (including forestry and wastewater). A range of estimated cost, by category, is presented in tabular form, below.

Cost Category	**low ($ million)**	**high ($ million)**
agriculture: farmsteads, cropland, and pasture	125	175
stormwater: new and existing development; roads	200	350
river corridor and wetland : protection and restoration	100	150
other: wastewater, forestry, etc.	75	125

A range of costs is provided to account for several forms of exigencies:

- Cost-effective implementation scale (e.g., of the 75,000 acres of annual cropland, how many are cost-effective to cover crop strictly from a phosphorus loading perspective?);
- Overlap between programs (e.g., BMP implementation to reduce peak stormwater runoff rates may also improve stream condition and reduce the need for river corridor easements); and,
- Actual implementation costs.

And although it is mathematically possible, and perhaps somewhat tempting, it is inaccurate to simply divide the total price tag by current (or projected future) funding levels in order to estimate how long it will take to clean up Lake Champlain. Unfortunately, progress in improving water quality will not be seen as a steady, incremental reduction in the phosphorus loading rate on a year-to-year basis in direct response to specific funding allocations.

CHAPTER SEVEN: IDENTIFYING CRITICAL SOURCE AREAS

A critical source area of phosphorus is an area within a watershed with a high potential to release phosphorus to surface waters. Critical source areas contribute a large percentage of the total phosphorus loading from a watershed while occupying only a small portion of the watershed area. If critical source areas can be identified, management practices to reduce phosphorus loading can be targeted in a more cost-efficient manner.

There are several complimentary efforts currently underway to identify critical source areas of phosphorus loading within the Lake Champlain basin. These projects are described below.

Identifying Critical Source Areas of Phosphorus in the Missisquoi Bay Watershed

In 2008, the Governments of the United States and Canada requested the International Joint Commission (IJC) to assist in determining ways to reduce phosphorus loads to Missisquoi Bay. The Lake Champlain Basin Program (LCBP) is conducting this work on behalf of the IJC. A total of $800,000 in U.S. federal funds has been awarded to accomplish this project, with a final report due in November 2011.

This work is being conducted on the U.S. side of the border, and is intended to complement corresponding research in Quebec. The specific elements of the Missisquoi Bay Reference are as follows:

- Organize a workshop to explore the best means to identify and delineate critical source areas, using modeling and other techniques;
- Compile and acquire data needed, such as digital photographic imagery, in order to identify and delineate critical source areas;
- Oversee a short-term tributary monitoring program in Vermont to provide more detail regarding phosphorus, nitrogen, and sediment loads (with an emphasis on phosphorus) to Missisquoi Bay; and
- Compile and analyze information on critical sources of phosphorus, as well as nitrogen and sediment, in Vermont.

The project began with a series of public hearings and technical workshops seeking advice and a better understanding of alternative approaches to identifying critical source areas. The workshops conducted by LCBP brought together members of the basin technical community with national experts to discuss modeling methods and approaches to critical source area identification that have been used in other regions. LCBP will define the specific technical scope for the project based on this information. State agency staff are actively to participating in the technical planning and review of this project to ensure that the needs of the Lake Champlain TMDL implementation plan are being met.

It is likely that the critical source area analysis will include both a strategic and a tactical component. The strategic component will use watershed modeling and other methods to identify critical sources areas at the sub-basin or hydrologic response unit scale, and will be used to rank source categories and establish general funding priorities. The tactical component will identify sources at the local scale (e.g., specific fields or erosion sites) and will aid field personnel in working with landowners to implement specific corrective measures. The tactical component may involve the acquisition of digital imagery using such techniques such as multispectral remote sensing and high-resolution topographic mapping (LiDAR, see below).

The IJC project allowed the network of tributary water quality monitoring stations and U.S. Geological Survey (USGS) stream flow gages within the Missisquoi Bay watershed to be expanded during 2009 to include several tributaries to the Missisquoi River. These new stations, when combined with the previously existing network of long-term monitoring stations operated through the Lake Champlain

Basin Program and the Province of Quebec, provide an exceptional monitoring network for use in identifying sub-basins that contribute high phosphorus loading rates and for documenting trends in phosphorus loading over time.

The IJC-sponsored critical source area analysis is specific to the Missisquoi Bay watershed in Vermont. However, the intent is to develop methods and techniques that can be transferred to perform similar evaluations in other watersheds within the Lake Champlain basin.

LiDAR Imagery

The Agency of Natural Resources, with financial and technical support from LCBP, USGS, the Agency of Transportation, NRCS, UVM's Spatial Analysis Lab, and the Vermont Center for Geographic Information, funded the collection, interpretation, and distribution of LiDAR (Light Detection and Ranging) data on nearly 300 square miles in Franklin and Grand Isle counties. LiDAR data was collected during the fall of 2008 and spring of 2009. LiDAR data present ground elevation at 1.4-metere resolution, as opposed to the currently available elevation data at 30-meter scale. The enhanced resolution reveals topographic features that contribute to nutrient runoff and sediment delivery to streams.

LiDAR data improves accuracy by more than 350 times and:

- Clearly shows stream channels and banks, gullies, and small areas of steep slope on crop fields which are among the primary contributing areas for pollution;
- Identifies areas of flow accumulation, where water may routinely move across the landscape absent the presence of a defined channel or other common indicators;
- Allows for spatial analysis with other layers such as crop field locations, riparian buffer gap maps, road, bridge and culvert data, to assist in targeting limited funds to restore ecological functions in these problem areas; and
- Supports better description and modeling of stormwater runoff characteristics of development.

High-Resolution Aerial Photographs

The Agency of Natural Resources, with technical support from NRCS, collected high-resolution aerial photography (digital resolution of approximately one foot) in the Rock River, Hungerford Brook, and St Albans Bay watersheds. Collected during the 2008 growing season, the photographs have been used to quantify the total acreage planted in corn, soybeans, and hay, as well as active pastureland, within the target watersheds. The photos have also been used to identify areas of active erosion, confirm windshield observations by field staff, and target technical assistance. In addition the photos provide a baseline reference for on-going restoration and protection projects.

Clean and Clear Priorities Workgroup Results

A group of technical staff from the state agencies of Natural Resources and Agriculture, as well as NRCS and U.S. Fish and Wildlife Service meets periodically, and has done so since mid-2007, to discuss Clean and Clear priorities. The workgroup included staff with technical expertise in: stormwater management, stream stability, wetland restoration, forestry, farmstead management, and cropland management. The workgroup focused first on qualitatively ranking the importance of different sources of phosphorus pollution in the Lake Champlain watershed, and then on identifying programmatic needs in order to better address the most important sources of phosphorus pollution.

Developed Areas Critical Source Identification

The Agency of Natural Resources conducted storm drainage mapping, assessment, and prioritization for stormwater retrofits in eleven urbanizing areas (e.g., town centers, historic villages, etc) in the Missisquoi Bay and Winooski River watersheds. Specifically, data on the location and hydraulic connectivity of swales, ditches, catch basins, and separate storm sewer pipes throughout the towns/villages of Swanton, Enosburg Falls, Richford, Highgate Falls, Montgomery Center, Jay Peak Ski Area Village and North Troy, as well as Richmond, Waterbury, Stowe and Waitsfield, were sought. These areas were assessed to determine where cost-effective corrective actions to control stormwater runoff existed. Further, as part of the survey, all stormwater facilities with permits from ANR in the study villages were inspected.

Watershed Modeling

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 primary 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. However, the development of such an accounting system and the use of that system to examine critical source areas and potential reduction scenarios are highly related tasks.

The modeling tools developed from this project are being used to explore which management interventions, in which places, offer the greatest potential for reducing phosphorus loading. Thus, this project has applications for critical source area identification as well as for the primary purpose of accounting for changes in phosphorus loading to Lake Champlain.

The project used process-based watershed modeling methods to analyze agricultural sources in the upper portion of the Rock River watershed, a tributary to Missisquoi Bay known for it high phosphorus loading rate. This narrow geographic focus was necessary for practical implementation of the model, but the intent was to develop methods and gain insights and that can be transferred to other phosphorus source types in other watersheds within the Lake Champlain Basin. A draft final report[1] from this project was issued in December 2009 and is currently under technical review.

The study defined hydrologic response units (i.e., unique combinations of land use, soil type, and slope) and mapped them throughout the upper Rock River watershed. The SWAT watershed model was used to estimate the phosphorus load from each hydrologic response unit. Hydrologic response units yielding the highest phosphorus loads were identified as critical source areas. It was 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 report recommended that similar modeling methods should be used to identify critical source areas elsewhere in the Lake Champlain basin.

Targeted Watershed Monitoring

The Agency of Natural Resources conducted a special one-year sampling program to evaluate tributaries to the Rock River within the Missisquoi Bay watershed to identify those that are contributing the highest amounts of phosphorus and other pollutants. A total of 22 sites were sampled for concentrations of total

[1] 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.

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. No accompanying flow measurements were obtained for use in calculating mass loadings of these pollutants. The purpose of the program was to determine whether this basic 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 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 is currently working with the Agency of Agriculture and NRCS 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 be most responsible for the elevated loading.

CHAPTER EIGHT: MEASURING PROGRESS IN PHOSPHORUS REDUCTION

Challenges in Accounting for Phosphorus Reduction

The Lake Champlain Phosphorus TMDL establishes maximum allowable phosphorus loading rates and reduction targets for each sub-watershed and source category, expressed in terms of metric tons per year of phosphorus. However, predicting and measuring the actual amounts of phosphorus reduced from actions aimed at controlling nonpoint sources is very difficult. This is because of the intermittent nature of runoff events, the large variability in annual runoff rates, and the long time it takes for soils, vegetation, farm fields, and river channels to respond to improved management. In many cases, scientific data are lacking on the quantitative effectiveness of specific nonpoint source control practices. Where effectiveness studies have been done, the results are often highly variable from site to site. The time scale of nature's response to management actions can vary from years to decades, depending on the practices involved. Most nonpoint source control practices also require human behavioral changes that do not occur immediately, and the willingness of private landowners. For these reasons, progress will not be seen as a steady, incremental reduction in the phosphorus loading rate on a year-to-year basis. Results cannot be dictated simply by the amount of funding applied. Expectations that progress will be tracked and reported in this format are not realistic.

One of the recommendations from the January 2008 *Performance Audit of the Vermont Clean and Clear Action Plan*[2] was to define objectives for each Clean and Clear program area expressed in terms of phosphorus load reduction, and then require each program to report on the actual phosphorus reduction amounts achieved. The audit report acknowledged, however, that such program-level phosphorus reduction estimates could not always be verified by monitoring, and may never be quantitatively accurate. A review and summary presented in the audit report of other nonpoint source phosphorus reduction programs in the U.S. provided no examples from other watersheds where phosphorus reductions were quantitatively linked to specific program activities, and concluded that such results were "difficult to show" and that "other variables often mask the effects of program success."

The Lake Champlain Basin Program[3] attempted to account for phosphorus loading reductions from agricultural best management practices implemented between 1991 and 2001. This accounting was based on assumptions about the phosphorus load reduced per animal unit treated by a variety of practices such as manure storage, milkhouse waste systems, etc. While this work provided valuable insights about future reductions needed in the various sub-watersheds, there were situations where the phosphorus reduction amounts calculated for some watersheds exceeded the measured loads.

Subsequent efforts to use this type of accounting system confirmed that it was unrealistic. The cumulative phosphorus reduction credits greatly exceeded any load reductions measured by direct river monitoring, and in some cases exceeded the entire measured load from the sub-watershed. Ultimately, the Lake Champlain Basin Program chose to abandon the use of phosphorus reduction credits.

The Lake Champlain Basin Program is not the only large watershed program that has attempted unsuccessfully to document nutrient reduction progress in this manner. The Chesapeake Bay Program developed a system of accounting for nitrogen and phosphorus reduction based on watershed models.

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[2] Green Mountain Institute for Environmental Democracy. 2008. Performance Audit of Vermont Clean and Clear. Prep. for the Vermont Agency of Administration. Montpelier, VT. http://www.anr.state.vt.us/cleanandclear/news/PerformanceAudit-CleanandClear-Jan142008.pdf

[3] Donlon, A. and M. Watzin. 2000. Preliminary evaluation of progress toward Lake Champlain Basin Program phosphorus reduction goals. Internal Report Prep. for the Lake Champlain Steering Committee. http://www.lcbp.org/techreportPDF/Phos_report2000.pdf

Even with the tremendous scientific resources available in the Chesapeake Bay watershed to model nonpoint source control practices and develop a system of phosphorus reduction credits, however, the predictions ultimately proved overly optimistic and wrong when compared with actual water quality monitoring data[4]. Program managers, under intense pressure to show results from the massive funding investment, were slow to acknowledge the lack of measureable progress, and program credibility has suffered[5].

In spite of the challenges and failures described above, it is essential that the effectiveness of our efforts to reduce phosphorus loading to Lake Champlain be evaluated as systematically and as quantitatively as possible. This approach allows us to assess which programs are most important, which programs are working, and whether overall progress is being made as a result of the significant investments in the program. It is also important, however, to avoid repeating past mistakes. Actual phosphorus reduction estimates should be produced only if they are verifiable and quantitatively accurate.

The need to develop benchmarks and to account for phosphorus load reductions resulting from program actions taken as part of the Lake Champlain TMDL implementation plan will be addressed by the following combination of efforts, as described in more detail below.

- Direct monitoring of lake phosphorus concentrations and tributary loading rates;
- Development and tracking of program-specific indicators;
- Watershed modeling; and
- Scientific literature review and field studies on management practice effectiveness.

Lake and Tributary Monitoring

Vermont's phosphorus-related water quality goals for Lake Champlain are clearly defined. Numeric phosphorus concentration criteria for each segment of the lake are specified in the Vermont Water Quality Standards. Phosphorus loading targets for wastewater discharges and nonpoint sources are listed in the Lake Champlain Phosphorus TMDL.

A long-term monitoring program on Lake Champlain, supported by LCBP, provides phosphorus data that can be used to compare phosphorus levels in the lake and phosphorus loading to the lake in relation to the established water quality goals. This monitoring program is supported by an extensive network of river flow gages operated by USGS. The status and trends of phosphorus in Lake Champlain have been reported in Lake Champlain Basin Program "State of the Lake" reports[6] and other supporting technical documents[7]. These reports have compared lake phosphorus concentrations and watershed phosphorus loads with their respective targets, and have applied appropriate statistical analyses to discern trends over time. This type of regular public reporting of the phosphorus monitoring results will be continued.

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[4] Whoriskey, P. 2004. Bay Pollution Progress Overstated: Government Program's Computer Model Proved Too Optimistic. Washington Post. July 18, 2004. http://www.washingtonpost.com/wp-dyn/articles/A57380-2004Jul17.html

[5] Fahrenthold, D.A. 2008. Broken Promises on the Bay: Chesapeake Progress Reports Painted "Too Rosy a Picture" As Pollution Reduction Deadlines Passed Unmet. Washington Post. December 27, 2008. http://www.washingtonpost.com/wp-dyn/content/article/2008/12/26/AR2008122601712.html?referrer=emailarticle

[6] Lake Champlain Basin Program. 2008. State of the Lake and Ecosystem Indicators Report – 2008. Grand Isle, VT. http://www.lcbp.org/lcstate.htm

[7] Smeltzer, E., F. Dunlap, and M. Simoneau. 2009. Lake Champlain phosphorus concentrations and 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

Further, a study to be completed in 2011 by USGS for LCBP 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. The Lake Champlain Basin Program should continue to take the lead role in reporting this information because of the broad-based technical review procedures, the communication capabilities, and the basin-wide perspective provided by the program.

The phosphorus monitoring data provide the ultimate measure of success in achieving the water quality goals of Clean and Clear, but these in-lake and river-mouth results do not by themselves explain the underlying reasons behind any progress, or lack thereof, in reducing phosphorus from sources upstream in the watershed. Additional indicators at the program level and further research on watershed processes are needed in order to provide a comprehensive assessment of progress, as discussed below.

Program-Specific Indicators

Annual reports on the Clean and Clear Action Plan prepared by the agencies of Natural Resources and Agriculture[8] have included phosphorus reduction indicator graphs for each program area. Most of these graphs do not quantify progress in terms of tons of phosphorus reduced, due to the technical difficulties noted above in making such quantitative estimates. However, all these program indicators track activities from which there are reasonable expectations that phosphorus load reduction will result.

The list of indicators developed for the annual Clean and Clear reports will be expanded and placed in an adaptive management context in which progress is monitored, evaluated, and used to redirect implementation strategies if necessary[9]. A key aspect of adaptive management is defining the acceptable level for each indicator (i.e., the value for the indicator at which the full phosphorus reduction responsibility is met). These acceptable levels will be defined for each Clean and Clear indicator, including near term (1-5 years) and ultimate targets. This will establish program-specific accountability for the implementation of the TMDL implementation plan, and support the monitoring and evaluation aspects of the adaptive management cycle.

The adaptive management cycle.

An initial list of proposed program-specific indicators for the Lake Champlain TMDL Implementation Plan is provided in Appendix G. In some cases, the acceptable levels still need to be defined. Generating the data necessary to report on the status of each indicator and defining the acceptable levels will be a part of the overall TMDL implementation effort during the next five years. This will require a commitment of funds and staff resources, however, beyond what is currently available.

[8] Vermont Agency of Natural Resources and Agency of Agriculture, Food, and Markets. 2009. Vermont Clean and Clear Action Plan 2008 annual report. Prep. for the Vermont General Assembly. Montpelier, VT. http://www.anr.state.vt.us/cleanandclear/rep2008/CleanandClear2008Rpt.pdf

[9] Watzin, M.C. 2007. The promise of adaptive management. Pages 147-158 in: Managing Agricultural Landscapes for Environmental Quality: Strengthening the Science Base, M. Schnepf and C. Cox, eds. Soil and Water Conservation Society Press, Ankeny, IA.

Watershed Modeling

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 project was intended to help 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 modeling methods to analyze agricultural sources in the upper portion of the Rock River watershed. This narrow geographic focus was necessary for practical implementation of the models, 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[10] from this project was issued in December 2009 and is currently under technical review.

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.

Management Practice Effectiveness

Field studies on the phosphorus reduction effectiveness of nonpoint source management practices are difficult to accomplish because they generally require an extensive sampling effort spanning several years of pre-treatment and post-treatment monitoring at sites in both treated and control watersheds. For this reason, relatively few of these studies have been completed in the Lake Champlain basin.

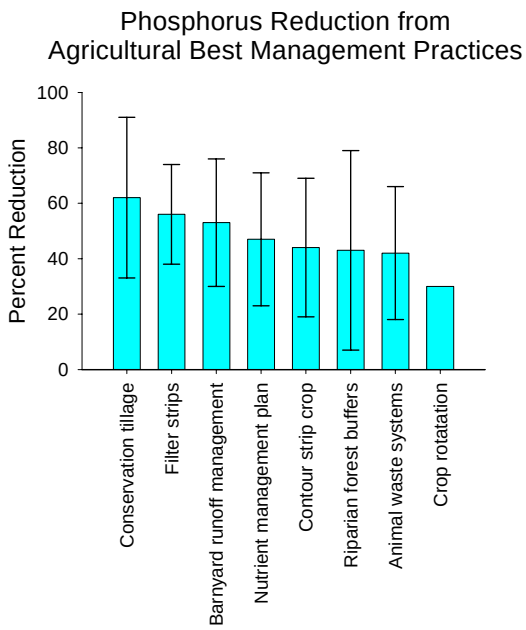
One such study was conducted within the Missisquoi River watershed in Vermont. This project evaluated water quality improvements following riparian zone restoration along small streams adjacent to farmland and documented significant phosphorus reductions from treatments such as animal exclusion

[10] 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.

fencing, provision of alternative water supplies, construction of dedicated stream crossings, and streambank bioengineering[11]. Phosphorus loading in one stream was reduced by 0.8 metric tons per year at a cost of less than $3,800. Sediment and bacteria levels were also reduced by these treatments.

The U.S. Geological Survey has been monitoring the effectiveness of urban stormwater control practices in the Englesby Brook watershed in Burlington since 2000 under two related projects. Final reports from this ten-year effort are expected in 2010 and 2011.

Because of the time and expense required to properly conduct field studies on the effectiveness of nonpoint source management practices, it is not practical to conduct such studies for all relevant practices in Vermont. Opportunities to conduct such studies in the Lake Champlain basin will be sought in the future, but there is also a good deal of relevant information available from the scientific literature. For example, one paper compiled results from multiple published studies comparing the phosphorus reduction effectiveness of eight common agricultural best management practices[12]. These practices typically reduce phosphorus loads by 40-60%, although there can be large variations from site to site depending on factors such as slope, soil type, and geographic location.



Results from a scientific literature review on the phosphorus reduction effectiveness of eight agricultural best management practices. The bars show average percent reductions, with standard deviations, among multiple published studies.

The findings from this literature review are encouraging because they demonstrate that substantial phosphorus reductions can be expected from the types of management practices being pursued in the Lake Champlain basin. The Lake Champlain Phosphorus TMDL requires an overall nonpoint source phosphorus reduction of about 30% from agricultural sources in Vermont. The literature review suggests that if most major agricultural phosphorus sources are treated with the available best management practices, then a 30% loading reduction should be achievable.

As new information on the phosphorus reduction effectiveness of nonpoint source management practices becomes available either from locally conducted field studies or from the scientific literature, the results will be used to improve our estimate of the phosphorus load reductions achieved by implementation of these practices in the Lake Champlain basin. The large uncertainty ranges illustrated in the figure above, however, indicate that precise calculations will not be possible due to the wide variations in response from site to site.

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[11] Meals, D.W. 2004. Water quality improvements following riparian restoration in two Vermont agricultural watersheds. pp. *In* T.O. Manley, P.L. Manley, and T.B. Mihuc (eds.). Lake Champlain: Partnership and Research in the New Millennium. Kluwer Academic/Plenum Publishers. New York.

[12] Gitau, M.W., W.J. Gburek, and A.R. Jarrett. 2005. A tool for estimating best management practice effectiveness for phosphorus pollution control. J. Soil Water Conservation. 60(1):1-10.

APPENDICES

A. Implementation Status of the 2002 Lake Champlain Phosphorus TMDL

B. Stakeholder Workshop Participants

C. Individuals and Organizations Providing Written Comments on the Draft Plan

D. Public Hearing Attendees

E. Results of Threat-Ranking Exercise

F. Strategies for Improving Water Quality in Lake Champlain

G. Program-Specific Indicators for the Lake Champlain Phosphorus TMDL Implementation Plan

APPENDIX A: Implementation status of the 2002 Lake Champlain Phosphorus TMDL (updated January 2010)

TMDL Action Item (2002)		Status	Comments
Wastewater Discharges			
	Upgrade five aerated lagoon facilities	In progress	Upgrades have been completed at Richford, Hardwick and Proctor. A further phosphorus removal upgrade is under construction at Troy/Jay to accommodate a flow expansion. The Waterbury project is in the design phase.
	Fund optional selector zone upgrades	No action	No requests for funding have been received from municipalities.
Watershed Planning			
	Establish watershed coordinators in all seven Lake Champlain planning basins	In progress with shift in scope	Five watershed coordinators are currently at work. The scope has been expanded under Clean and Clear to include river basins statewide.
River Management			
	Conduct stream geomorphic assessments	In progress	Phase 1 assessments have been conducted on 6,804 river miles in the Lake Champlain basin, and Phase 2 assessments have been conducted on 1,425 river miles.
	Establish a statewide river management database	In progress	The database and GIS map serve have been established and operational at approximately a 90% level of projected full capability. Full capability is anticipated within one year.
	Build capacity to utilize and apply assessment data to achieve TMDL objectives	In progress	Dozens of municipal governmental entities, non-governmental organizations, watershed groups and others are engaged collaboratively with ANR in the application of assessment data to develop river corridor plans and identify specific restoration and protection projects to increase sediment and nutrient storage in stream channels and floodplains and resolve broad-based conflicts between fluvial dynamics and the land use investments (e.g., infrastructure) of individuals and communities.
	Create fluvial erosion hazard maps	In progress	Mapping protocols and technology have been developed and river corridor fluvial erosion hazard maps are being drawn. Communities are beginning to embrace and utilize fluvial erosion hazard maps in local land use regulation. The maps are under development and are providing the basis for the drafting and adoption of FEH corridor zoning in 105

TMDL Action Item (2002)		Status	Comments
			municipalities statewide.
	Create incentives for local governments to adopt riparian corridor protection measures	In progress	Limited incentives have been achieved through the River Corridor Grants program and FEMA pass-through grants.
	Expand agricultural BMPs to improve riparian corridor management by government funded programs	In progress	Progress has been made in applying and combining riparian corridor management practices (i.e., CREP and river corridor easements) to achieve sediment and nutrient discharge reductions. Progress is also being made in coordinating the application of USDA farm bill programs with River Management Program efforts.
	Expand forestry AMPs to protect streams draining land that is sensitive to bare ground (non-winter) harvesting	In progress with shift in scope	A watershed forester position has been established in the Department of Forests, Parks, and Recreation to support the AMP program, the Heavy Cutting Law, Act 250 review of high elevation logging, and a portable skidder bridge initiative.
	Improve flood hazard mitigation	In progress	Pre-disaster mitigation activities are underway at 10 of the 11 Regional Planning Agencies, in partnership with Clean and Clear and FEMA.
	Train consultants in stable stream restoration design	In progress	More than ten consultants have been trained by ANR in fluvial assessment, river corridor planning and river corridor restoration and design. Six are currently under contract.
	Conduct stream restoration demonstration projects	In progress	Recent demonstration projects include the Rugg Brook Flood Plain Restoration Project and the Lamoille Valley Rail Trail Flood Plain Restoration Project. Several other active restoration projects have been completed or are in development.
	Conduct courses in fluvial geomorphic assessment	In progress	Three-day training sessions have been conducted for over 40 environmental consulting, planning, and non-profit organization partners. A broader collaboration in support of graduate level courses at academic institutions is currently under development at UVM.
	Prepare educational videos explaining stream channel adjustment processes	In progress	A DVD is available for public distribution and is running on public access TV throughout the state. Improvements and additional resources are planned.
	Prepare fact sheets addressing stable stream science and management topics	In progress	Fact sheets are available on the River Management Program (ANR) website. Additional publications are forthcoming.

TMDL Action Item (2002)		Status	Comments
	Conduct a comprehensive economic analysis of river corridor management alternatives	In progress	Significant progress is being made on generating qualitative conclusions and information. Technical and social feasibility criteria have been adopted as a part of the river corridor planning process to assist the alternatives analysis and watershed level prioritization of restoration and protection projects.
	Establish research partnerships	In progress	A research partnership with the Vermont Water Resources and Lake Studies Center at UVM has been established with state grant funds provided to support research on phosphorus generation mechanisms associated with fluvial processes.
	Coordination with emergency response and recovery activities	In progress	Integration of fluvial geomorphic considerations into flood recovery operations which avoid continued stream channelization and other actions that promote sediment delivery to the lake is an on-going activity.
Stormwater Management			
	Establish an enhanced stormwater management program with requirements for new stormwater operational permits based on the 2002 Vermont Stormwater Management Manual	In progress	The backlog of expired stormwater permits has been effectively eliminated. All new permitted projects are designed to the 2002 Vermont Stormwater Management Manual.
	Issue Watershed Improvement Permits covering stormwater discharges in stormwater-impaired watersheds.	In progress with shift in scope	Stormwater TMDLs have been developed for 12 of the 17 stormwater-impaired watersheds (14 of which are in the Lake Champlain basin), including all of the urban watersheds. ANR expects to implement the TMDLs via the MS4 General Permit, to be re-issued in early 2010. The remaining five so-called mountain watersheds will receive Water Quality Remediation Plans.
Erosion Control at Construction Sites			
	Conduct training for construction contractors and provide inter-agency coordination	In progress	The majority of training in 2009 took place related to project-specific activities.
	Improve permit review, enforcement, and compliance	In progress	Previous increases in staff called for in the TMDL allowed for increased staff field presence throughout the state for compliance and enforcement. Program staff is down 3 technical positions since 2007, thus requiring an adjustment in program activities.

TMDL Action Item (2002)		Status	Comments
	Implement the Construction General Permit	Completed	The new, risk-based, Construction General Permit was issued in 2006, lowering the threshold of earth disturbance that requires permit coverage from five acres to one acre.
	Revise the Erosion Control Handbook	Completed	Three new technical documents were published in conjunction with the 2006 Construction General Permit. These include a new set of technical standards for use by the consulting community, as well as two field guides designed to assist contractors and individual landowners in properly implementing best practices for erosion prevention and sediment control during construction.
Better Backroads			
	Increase grant funds to towns	In progress	Grant funding to towns has been greatly increased, with approximately 70 towns receiving grants annually.
	Increase staffing for grant administrative support for towns	In progress	A 50% position at the Northern Vermont Resource Conservation and development Council is funded to assist town with Better Backroads grant applications and administration.
	Add a circuit rider position for technical assistance to towns	In progress	One position at the Northern Vermont Resource Conservation and Development Council is funded to provide technical assistance to towns for Better Backroads projects.
	Conduct regional workshops	In progress	Several regional workshops per year have been conducted through the Better Backroads Program working with regional partners.
	Update publications	Completed	The Better Backroads Manual and Pocket Manual were updated and reprinted in 2009.
	Develop road AMPs	In progress	A process for developing road AMP's and implementation of them is under discussion as part of the 2010 TMDL implementation plan revision process, and work is expected to begin in 2010.
	Conduct an equipment sharing pilot project	Completed	Groups of towns in both Lamoille County and Addison County jointly own and share hydroseeding equipment.
	Support ANR staff involvement	In progress	ANR staff involvement in the Vermont Better Backroads Program has continued.

TMDL Action Item (2002)		Status	Comments
Local Municipal Actions			
	Provide technical assistance to towns in developing local regulations for water quality protection	In progress	A part-time water quality specialist is being funded by Clean and Clear at the Vermont League of Cities and Towns.
Wetland Protection and Restoration			
	Add position at ANR to support education and planning for wetland protection and restoration	Suspended	The ANR Wetland Restoration Specialist position was lost in 2009 due to a personnel reduction.
	Develop a *Lake Champlain Basin Wetland Restoration Plan*	Completed	The Lake Champlain Basin Wetland Restoration Plan was completed in 2007.
	Implement the *Lake Champlain Basin Wetland Restoration Plan*	In progress	Several wetland restoration projects have been developed using state capital funds appropriated for this purpose, in cooperation with other partner organizations. ANR staff are currently coordinating with the U.S. Natural Resources Conservation Service to use significant federal dollars available from the Wetlands Reserve Program to restore wetlands according to priorities recommended in the Lake Champlain Wetland Restoration Plan.
	Develop and implement a wetland acquisition plan	No action	Clean and Clear funding has not been requested for this item.
St. Albans Bay			
	Conduct a feasibility study for the control of internal phosphorus loading in St. Albans Bay	In progress	Phase 1 of a two-phase feasibility study has been completed. Phase 2 will be initiated by the U.S. Army Corps of Engineers in 2010.
	Conduct a treatment, if recommended by the feasibility study	No action	Specific decisions on a treatment will cannot be made until the Phase 2 feasibility study is complete.
Monitoring and Research			
	Continue the Lake Champlain Monitoring Program	In progress	Monitoring of the lake and its tributaries is continuing by Vermont DEC and New York State DEC with funding from the Lake Champlain Basin Program.
	Continue the Vermont Lay Monitoring Program	In progress	Monitoring of Lake Champlain and Vermont inland lakes by citizen volunteers is continuing with funding from Clean and Clear.

TMDL Action Item (2002)		Status	Comments
	Continue the operation of USGS stream flow gages in the Lake Champlain Basin	In progress	USGS is continuing to operate the network of flow gages in the Lake Champlain basin.
	Track agricultural BMP implementation	In progress	The Agency of Agriculture tracks BMP implementation by watershed in Vermont.
	Conduct BMP effectiveness monitoring studies	In progress	Before and after monitoring of the effectiveness of urban stormwater controls in Englesby Brook in Burlington is continuing with laboratory services provided by Vermont DEC. A similar study on an agricultural site on Little Otter Creek in Ferrisburg had to be discontinued when the farmer declined to follow through with planned BMP implementation.
	Update Lake Champlain Basin land use and phosphorus export analysis	Completed	A report on a Lake Champlain basin land use and phosphorus export study has been completed by the University of Vermont with Clean and Clear funding and published by the Lake Champlain Basin Program.
	Conduct research on phosphorus reductions expected from nonpoint source management actions	In progress	A draft report funded by Clean and Clear on "An Environmental Accounting System to Track Nonpoint Source Phosphorus Pollution in the Lake Champlain Basin" was completed by the University of Vermont in December 2009 and submitted for technical review to the Lake Champlain Basin Program.
Program Administration			
	Provide one staff position for general administrative support	In progress with expanded scope	An additional Information Technology staff was hired in 2006 to support Clean and Clear related work not originally anticipated in the TMDL.
Agriculture			
	Accelerate the establishment and protection of riparian buffers on agricultural land	In Progress	The CREP program has enrolled approximately 2,111 acres in the Lake Champlain basin and the momentum remains very strong for the program. Two staff were hired at VAAFM which increased the program efforts significantly, however one of those positions was lost due to rescissions. In 2007, the Vermont Agricultural Buffer Program was released to provide a harvestable filter strip and grassed waterway option to help recycle nutrients on the farm and increase the use of soil erosion reduction practices. This program has not been very successful due to the higher incentives offered by CREP. In 2010, the Agency of Agriculture hopes to amend the program language to include the ability

TMDL Action Item (2002)		Status	Comments
			to buffer ditches and intermittent streams, and to also work on reducing hydrologic connections between field drainage and river systems.
	Accelerate the establishment of nutrient, crop and pesticide management services in the Basin	In Progress	Statewide more than 134,000 acres have been enrolled in the Nutrient Management Cost-Share Program at VAAFM with the majority located in the Champlain Basin. The Farm Agronomic Practices Program has also been developed to help implement practices that compliment a nutrient management plan. In 2010 over 7,500 acres were planted into winter cover crops through the FAP program. It is evident that more funding is needed to meet the farmer demand in the coming year.
	Additional resources to conduct and target agricultural nonpoint source pollution outreach to farm operators in the Lake Champlain Basin	In Progress	VAAFM has increased staff resources in Franklin County by cooperating with USDA and VACD to obtain 3 conservation district positions, an engineer and a CREP specialist in the USDA service center. Additionally, VAAFM restructured a separate agreement with VACD to have 3 agricultural resource specialist positions focus on key watersheds, including the northern and southern portions of Lake Champlain.
	Continue LFO permitting	In Progress	The number of farms permitted has nearly doubled since the TMDL was developed, and the LFO rules were revised which included additional standards for nutrient management. Currently there are 20 LFOs statewide, 12 are in Lake Champlain Basin. Each LFO is inspected annually and most receive technical assistance visits from VAAFM staff at least once per year.
	Create a permitting program for farms between 300 and 950 animal units	In Progress	The MFO rules were completed in 2007 and official permitting begins in August 2007. Three additional staff have been hired to develop and implement this program. As of 2009, each MFO has been inspected and many have received either technical assistance or regulatory follow ups.
	Implement more non-structural BMPs in the Basin and increase funding for all BMPs, structural and non-structural	In progress and expanding	An additional engineering technician was hired at VAAFM to educate farmers on composting techniques. The FAP program has provided cost-sharing for field practices that reduce erosion. The level of cost-sharing for livestock exclusion from streams has been increased to 80% for permanent fences. Overall BMP cost-sharing has been increased from 50% up to 80% on structural practices when no other assistance is available. In 2009, the cost-share was temporarily increased to 90% to address the historically low milk prices.

TMDL Action Item (2002)		Status	Comments
	Review the AAPs	Completed	The AAPs were revised in 2006 to include new streamside setback requirements, livestock disposal practices, streambank requirements, and nutrient management practices

APPENDIX B: Stakeholder Workshop Participants

July 9th Meeting

Last Name	*First Name*	*Affiliation*
Archer	Milly	VLCT
Bartlett	Bill	
Beck	Erik	Environmental Protection Agency
Blandino	Jim	
Boudette	Linda	NVT RC +D
Britch-Valenta	Heidi	Franklin Watershed Committee
Bullett	Heather	Agency of Natural Resources
Butler	Bridget	ECHO
Campoli	Gina	VTrans
Coleman	Warren	Agency of Natural Resources
Crandall	Trafton	Env Engineer
Deen	David	CRWC
Deming	Bruce	
Dickinson	Lynn	
Digiammarino	Craig	VTrans
DiPietro	Laura	Agency of Agriculture
Dupont	Larry	
Dutcher	Daniel	VTrans
Egan	Jim	Town of Salisbury
Ehlers	James	LCI
Farnsworth	David	
Finlay	Beth Ann	
Fisher	Lori	Lake Champlain Committee
Ford	Russ	UVM
Ghebremichael	Lula	UVM
Groveman	Jon	
Gudorf	Michelle	VACD
Horn	Karen	VLCT
Howland	Bill	LCBP

Hyams	Robert	Charlotte Conservation Commission
Iarrapino	Anthony	CLF
Illick	Marty	Lewis Creek Association
Johnson	Justin	Agency of Natural Resources
Jutras	James L.	Village of Essex Junction
Kilbride	Marie	
Kost	David L	IBM
Larson	Ed	
Leech	Marty	
Libby	David	IBM
Linthilac	Crea	Non-profit
Little	John	MRBA
Mack	Robert	Farmer 734-9400
Madden	Paul	Friends of No. Lake Champlain
Manahan	Mike	MRBA
Mapes	Scott	
McCrumb	Jeannine	Agency of Natural Resources
Miskell	David	Farming Consultant
Moore	Julie	Agency of Natural Resources
Moregante	Andrea	Laplatte/Lewis Creek Assn
Murray	Sharon	
Nease	Floyd	Legislature
Phillips	Don	
Purdom	Rebecca	PMNRCB
Rapacz	Mike	CLF
Rupe	Marli	PMNRCY
Shonnard	Wally	LCRA
Smeltzer	Eric	Agency of Natural Resources
Spangler	Kristy	State Rep Colchester
Stefanek	Pam	OCNECD 388-6746
Stickney	Michaela	Agency of Natural Resources
Susslin	Beverly & Gould	St. Albans Bay Watershed

Swift	Ethan	Agency of Natural Resources
Viskup	John	
Weaver	Don	NLCAC - Chair
Webb	Kate	Legislature
Winslow	Mike	Lake Champlain Committee
Wolinsky	Eric	St Albans Watershed Assoc.
Wood	Jonathan	Agency of Natural Resources

September 24th Meeting

Last Name	*First Name*	*Affiliation*
Archer	Milly	VLCT
Bartlett	Bill	
Bates	Karen	Agency of Natural Resources
Becker	Jarrod	NVRC&D
Bothwick-Leslie	David	
Bullett	Heather	Agency of Natural Resources
Campoli	Gina	VTrans
Clifford	Jane	
DiPietro	Laura	Agency of Agriculture
Dube	Jeff	UVM
Ehlers	James	LCI
Farber	Jeff	VACD
Finlay	Beth Ann	
Fisher	Lori	Lake Champlain Committee
Gudorf	Michelle	VACD
Hoerr	Buzz	VT CAC
Horn	Karen	VLCT
Howe	Eric	LCBP
Illick	Marty	Lewis Creek Association
Larson	Ed	
Lewis	Trevor	VACD-NRCS
Linthilac	Crea	
Madden	Paul	Friends of No. Lake Champlain
Manahan	Mike	MRBA
Maroney	James	
McCrumb	Jeannine	Agency of Natural Resources
Moore	Julie	Agency of Natural Resources
Perry	Deb	NWRPC
Rapacz	Mike	CLF
Rupe	Marli	PMNRCD
Ryan	Jim	Agency of Natural Resources
Scott	Cynthia	MRBA

Smeltzer	Eric	Agency of Natural Resources
Spengler	Kristy	State Rep Colchester
Stickney	Michaela	Agency of Natural Resources
Swift	Ethan	Agency of Natural Resources
Viskup	John	
Weaver	Don	NLCAC - Chair
Winslow	Mike	Lake Champlain Committee
Wolinsky	Eric	St Albans Watershed Assoc.

APPENDIX C: Individuals and Organizations Providing Written Comments on the Draft Plan

Vermont Agency of Transportation
Mike Rapacz, Conservation Law Foundation
U.S. Environmental Protection Agency, Region 1
Jon Groveman, Vermont Natural Resources Council
Bill Bartlett
Lake Champlain Committee
Deb Perry, Northwest Regional Planning Commission
Jim Justras, Village of Essex Junction
Bryan Osborne, Town of Colchester
Chris Louras, City of Rutland
Paul Madden, Friends of Northern Lake Champlain
Karen Horn, Vermont League of Cities and Towns
Steven Eisenhauer
Eric Wolinsky, St Albans Watershed Association
Sylvia Knight
James Maroney
Shaun Fielder, Vermont Rural Water Association
Marty Illick, Lewis Creek Association

APPENDIX D. Public Hearing Attendees

December 8th (Caselton)

Laura DiPietro, Agency of Agriculture

Justin Johnson, Agency of Natural Resources

Rebecca Purdom, PMNRCB

Ethan Swift, Agency of Natural Resources

Mike Winslow, Lake Champlain Committee

Eric Howe, LCBP

Nanci McGuire, Rutland NRCD

Steve Pytlik, NRCS

Mike Winslow, Lake Champlain Committee

Bridget Bowen, RNRCD

Sylvia Harris, VACD

Ed Lewis

Terry Williams

Brian DuBois

Monica Erhart

James Maroney

Barb Woodard

Sandy Kuehn, South Group Committee

Rep. Bob Helm, Legislature

Ted Greenberg, RNRCD

Russell Reay, RNRCD

Cindy Watrous, VACD

Joanne & David Calvi

Eric Hansen, Agency of Natural Resources

Chris Smid, PMNRCD

Sarah Mittlefehldt

John Gillette

Mary Beth Dewey

Sue Sutheimer

Dave Potter

Chuck Domerice, GMC

Molly Smith, WCAX

December 14th (Burlington)

Rick Hopkins, Agency of Natural Resource

Craig DiGiammarino, Agency of Transportation

Jim Jutras, Village of Essex Junction

Jane Clifford, Green Mt Dairy

Gene Forbes, Hoyle, Tanner & Assoc

Don Phillips, Forcier Aldrich & Assoc

Bill Ryan

Trevor Lewis, VACD

Mike Kline, Agency of Natural Resources

Charlie Baker, CCRPC

Shaun Fielder, VRWA

Gina Campoli, Agency of Transportation

Nicole Grohoski, LCBP

Megan Moir, Burlington DPW

Faye Baker

Bob Leidy

Jarrod Becker, Northern Vermont RC&D

Ashley Lidman, Winooski NRCD

Silvia Knight

Marty Illick, Lewis Creek Association

Karen Horn, VLCT

David Kost, IBM

Milly Archer, VLCT

Jon Groveman, VNRC

Gary Sabourin, Agency of Natural Resources

Buzz Hoerr, Vt Citizens Advisory Committee on Lake Champlain's Future (VTCAC)

Jan Peterson, VTCAC

Lori Fisher, VTCAC

Sen. Ginny Lyons, VTCAC

Sen. Claire Ayer, VTCAC

Rep Kate Webb, VTCAC

Rep. Kristy Spengler, VTCAC

Eric Clifford, VTCAC

Larry Dupont, VTCAC

Paul Hansen, VTCAC

Ted Tyler, VTCAC

James Ehlers, VTCAC

Peter Kreisel, VTCAC

Eric Howe, LCBP

Michaela Stickney, LCBP

Crea Lintilhac

Mike Rapacz, Conservation Law Foundation

Pixley Hill

Bill Bartlett

James Maroney

Don Weaver, NLCAC

Laura DiPietro, Agency of Agriculture

Bernie Pientka, Agency of Natural Resources

David Borthwick-Leslie

Eric Smeltzer, Agency of Natural Resources

Dave Tilton, USFWS

December 15th (Swanton)

Larry & Jeanine Pratt, Pelots Bay Restoration Assn

Chris Kitonis

Ruth Wallman, Lake Champlain Islands Chamber, Northern

Steve Merrill

Patty Gale

Cynthia Scott, MRBA

Bob Johnson

Mike Manahan, MRBA

Russ Ford, MRBA

Liz Royer, VT Rural Water Assn

Pixley Hill

Maggie Triggs, Channel 15, St. Albans

Roger Rainville, Farmers Watershed Alliance

Jim Mackenzie, MRBA

Don Hill

Don Weaver, NLCAC

Ted Kissane, FNLC

Joe Poquette

Rory Martin

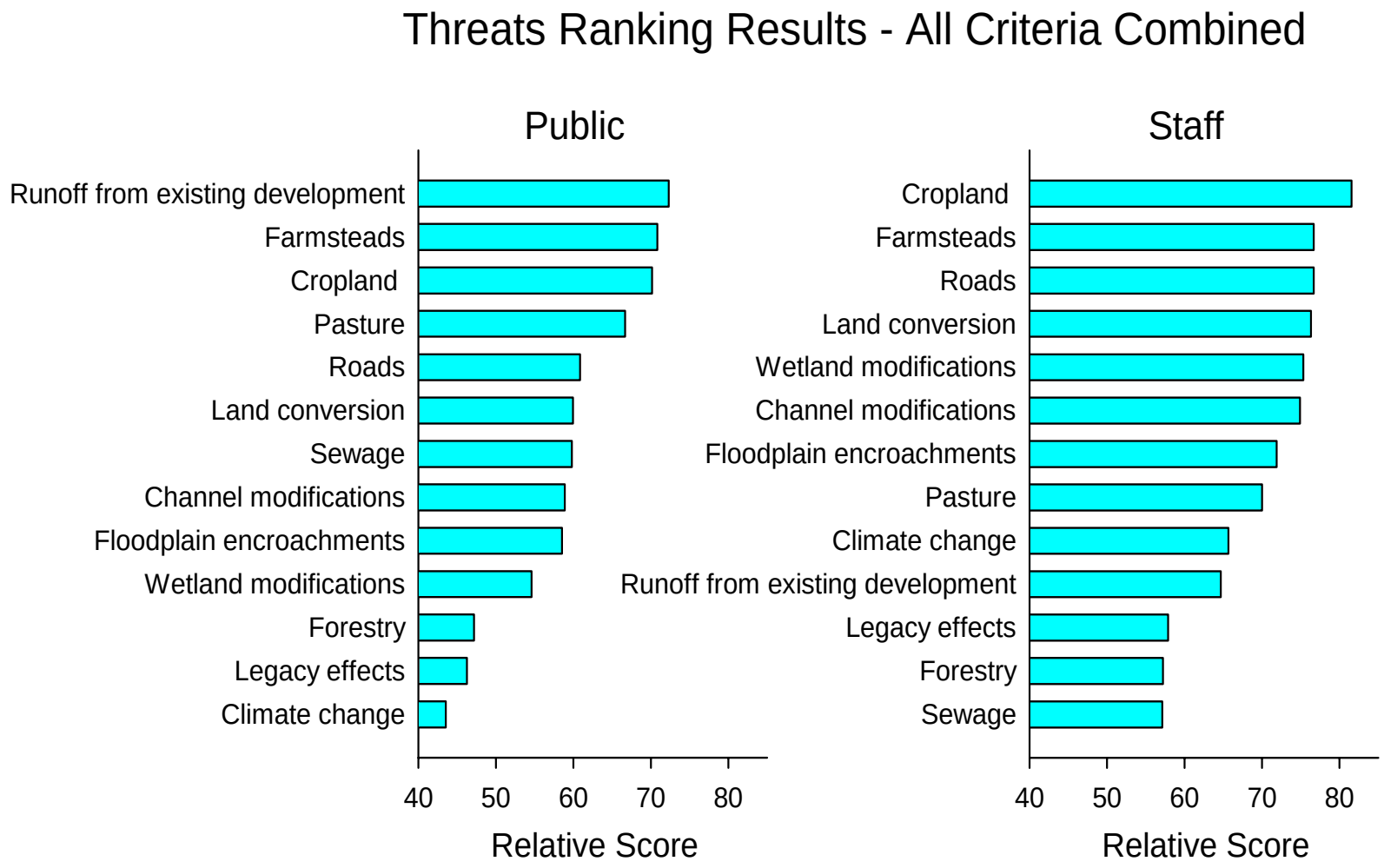
Brian Jerose

David Borthwick-Leslie

Pat Rainville, FNLC

Bill Howland, LCBP

Paul Madden, FNLC


Threats Ranking Results - All Criteria Combined
Public
Runoff from existing development
Farmsteads
Cropland
Pasture
Roads
Land conversion
Sewage
Channel modifications
Floodplain encroachments
Wetland modifications
Forestry
Legacy effects
Climate change
40
50
60
70
80
Relative Score
Staff
Cropland
Farmsteads
Roads
Land conversion
Wetland modifications
Channel modifications
Floodplain encroachments
Pasture
Climate change
Runoff from existing development
Legacy effects
Forestry
Sewage
40
50
60
70
80
Relative Score

APPENDIX F: Strategies for Improving Water Quality in Lake Champlain

Untreated/unmanaged runoff from existing development

EXPAND STATE AND MUNICIPAL PROGRAMS THAT ADDRESS STORMWATER RUNOFF FROM EXISTING DEVELOPMENT

Current Actions:

- issue and implement TMDLs for stormwater-impaired watersheds
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $150,000, for TMDL development ONLY
  - outcomes: to date, 12 of the stormwater TMDLs have been approved by EPA, including all non-mountain watersheds; water quality remediation plans will be used to address stormwater impairments in the remaining mountain watersheds
  - future needs: remediation plans and watershed permits to implement the TMDLs are under development; significant resources (in excess of $100 million) will be required to achieve full implementation
- revise the regulatory requirements contained in the MS4 permit and/or expand MS4 jurisdiction to include additional municipalities
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $25,000, for administration of current program requirements
  - outcomes: ANR staff are currently revising MS4 permit requirements and expect to release a draft permit in early 2010; ANR staff are currently evaluating whether to designate additional municipalities as MS4s
  - future needs: $150,000 (annually) may be needed to fully implement the program

Next Steps (2010 – 2016, budget permitting):

- require additional post-construction stormwater management for impervious surfaces using existing stormwater management authorities, such as state operational stormwater permits, MS4 permits, and residual designation authority
  - estimated budget: $225,000 (annually)
  - next steps: requires consideration by Vermont legislature
- establish a stormwater utility or utilities to provide funding for stormwater treatment
  - estimated budget:: $425,000 (one-time) to form and start-up the stormwater utility
  - next steps: ANR has committed $70,000 of Clean and Clear funds to develop a preliminary plan and organizational structure for a stormwater utility that would operate in some or all of the 12 stormwater impaired watersheds
- modify priority ranking system for SRF loans to give more weight to stormwater projects
  - estimated budget:: budget neutral
  - next steps: requires action by Vermont Legislature

Further Measures (beyond 2016):

- offer incentives or disincentives for reducing the phosphorus contribution of stormwater discharges
- eliminate "grandfathering" of older stormwater systems and require upgrades at permit renewal
- revise stormwater requirements for redevelopment projects
- develop an approach for addressing the cumulative impacts of stormwater runoff
- evaluate legal authorities to collect impact fees for highway access permits whose issuance results in "drain-on" to the right-of-way

Untreated/unmanaged runoff from existing development

IMPLEMENT STRATEGIC STORMWATER RETROFITS CAPABLE OF MANAGING RUNOFF FROM MULTIPLE SITES

Current Actions:

- make available cost-share for managing stormwater runoff from unregulated impervious surface
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $200,000 in FY10; $150,000 in FY09
  - outcomes: competitive grants have been made available to municipalities and other entities pursuing stormwater management projects that are NOT required by a permit or other enforceable mechanism
  - future needs: significant; total needs likely in excess of $300 million

Next Steps (2010 – 2016, budget permitting):

- develop maps of existing impervious surfaces and stormwater infrastructure to help identify and prioritize potential retrofits
  - estimated budget: $200,000 (annually) to complete surveys in 10 towns per year, done in conjunction with IDDE surveys
  - next steps: basic stormwater infrastructure mapping is currently being undertaken by a number of municipalities within the Lake Champlain basin as part of illicit discharge detection and elimination (IDDE) surveys, potential retrofits need to be identified and prioritized; other areas have yet to undertake even basic mapping
- develop strategies for "bundling" stormwater retrofits with municipal capital projects including streetscaping, transportation projects, school construction, and water and sewer line reconstruction
  - estimated budget: $25,000 (annually) for on-going coordination
  - next steps: identify critical points in municipal infrastructure planning and funding where opportunities to "green-up" are most timely; expand outreach to municipalities on the availability of Clean & Clear grants

Further Measures (beyond 2016):

- explore mechanisms for assessing impact fees (e.g., anti-degradation policy, fee-in-lieu) to fund stormwater treatment
- provide incentives, such as tax credits and cost-share, for upgrades of out-dated stormwater systems

Untreated/unmanaged runoff from existing development

INCREASE ON-SITE STORMWATER MANAGEMENT EFFORTS

Current Actions:

- more fully utilize ECHO Lake Aquarium and Science Center as an educational outreach tool
  - lead agency/organization: ECHO Lake Aquarium and Science Center
  - annual budget: $25,000 in FY10
  - outcomes: opportunity to reach the more than 130,000 visitors to ECHO each year
  - future needs: ECHO is embarking on a major construction project/renovation which provides the opportunity to implement best practices in erosion control at the construction site as a "living/working" demonstration project and to install stormwater management practices that will become interpretative exhibits in a "science park"

Next Steps (2010 – 2016, budget permitting):

- provide incentives, such as training and cost-share, for on-site stormwater management (e.g., green roofs, rain barrels, downspout disconnection, rain gardens) to individual property owners
  - estimated budget: $200,000 (annually) including at least $125,000 in small grants
  - next steps: in conjunction with the *Small Sites Guide* that ANR will release in 2010, offer training and small grants to individual property owners and homeowners associations to install on-site stormwater management practices
- develop strategies for reducing the compaction of urban soils
  - estimated budget: $100,000 (one-time)
  - next steps: based on on-going work in Washington State ("Soils for Salmon") and elsewhere, develop a suite of BMPs to preserve and improve soils in the developed landscape
- provide incentives for stormwater management in municipal right-of-ways (e.g., green streets, tree planting, pervious pavement)
  - estimated budget: $250,000 (annually)
  - next steps: develop schedule of incentive payments for "greening" planned municipal infrastructure projects to incorporate stormwater management/treatment
- encourage residential stewardship (activities and practices that can reduce the volume or quantity of runoff from individual properties or whole neighborhoods) to improve stormwater quality
  - estimated budget: $150,000 (annually)
  - next steps: evaluate programs that have been employed successfully in other watersheds to increase individual awareness and personal responsibility for water quality impacts associated with residential stormwater runoff

Further Measures (beyond 2016):

- require individual property owners to implement on-site stormwater management to the maximum extent practicable

Untreated/unmanaged runoff from existing development

CONTROL THE USE OF PHOSPHORUS FERTILIZERS AND HERBICIDES

Current Actions:

- promote the use of low-P/no-P fertilizers (e.g., incentives; "Don't P on Your Lawn" campaign)
  - lead agency/organization: numerous, including Lake Champlain Basin Program, Agency of Agriculture, Agency of Natural Resources
  - current budget: limited; materials developed between 2004 and 2006 continue to be used
  - outcomes: significant increase in the number of suppliers offering low-P or no-P fertilizer as an option for customers
  - future needs: continued financial support for the development and distribution of promotional materials

Next Steps (2010 – 2016, budget permitting):

- regulate the application of P-fertilizer by placing limits on the retail sale of P-fertilizer
  - estimated budget: $75,000, for program administration
  - next steps: requires action by Vermont legislature; Minnesota has enacted regulations that require a soil test before P-fertilizer can be purchased which could be used as a template

Further Measures (beyond 2016):

- ban, outright, residential use of P-fertilizer in the Lake Champlain basin
- quantify the effects of P-fertilizer on Lake Champlain water quality
- evaluate phosphorus contributions attributable to the use of glyphosate-based herbicides from all applications (agriculture, golf courses, landscaping, and highway, utility and railroad right of way maintenance)

Land conversion

EXPAND STATE PROGRAMS THAT ADDRESS STORMWATER RUNOFF FROM NEW DEVELOPMENT

Current Actions:

- provide training for contractors on best management practices for erosion prevention and sediment control
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $0; no funding/staff support is currently available
  - outcomes: training sessions have been conducted in cooperation with the Agency of Transportation and the International Erosion Control Association
  - future needs: $20,000 per year to support periodic training/refresher course offerings
- develop erosion and sediment control BMPs specifically for use in homeowner-scale construction projects
  - lead agency/organization: Agency of Natural Resources
  - annual budget: one-time ARRA funds used to develop materials
  - outcomes: a *Small Sites Guide* is currently under development and scheduled to be released in 2010 which, when used in conjunction with the *Low Risk Site Handbook for Erosion Prevention and Sediment Control,* provides a complete suite of homeowner scale BMPs
  - future needs: $25,000 per year to support distribution of and training on *Small Sites Guide*
- inspect at least 20% of active construction projects for compliance with erosion and sediment control
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $150,000; ANR currently dedicates roughly 2 FTEs to construction stormwater related permitting, education and outreach, and compliance assistance
  - outcomes: since the stormwater construction permit was reissued in 2006, the number of sites inspected annually have varied from less than 75 to more than 200; currently there are fewer stormwater permit writers than at any time since 2006 and ANR anticipates inspecting approximately 10% of permitted sites in FY10.
  - future needs: $150,000 (annually)
- develop an anti-degradation policy that addresses pollution from stormwater discharges
  - lead agency/organization: Agency of Natural Resources
  - annual budget: budget neutral
  - outcomes: ANR has scheduled a series of five stakeholder meetings between January and April 2010 in order to inform the development of an anti-degradation policy
  - future needs: TBD

Next Steps (2010 – 2016, budget permitting):

- establish a suite of broad-based BMPs for land conversion (forestry to agriculture, pasture to cropland, etc.)
  - estimated budget: $100,000 (one-time)
  - next steps: convene a workgroup that includes foresters, farmers, and developers to identify commonalities across different types of land conversion to serve as foundation for BMP development

Further Measures (beyond 2016):

- require a construction stormwater permit for any land conversion (forestry to agriculture, pasture to cropland, etc.)
- require no net increase in discharge volumes and pollutants over pre-development levels
- require a performance bond for large-scale construction projects, repayable at project completion provided successful completion
- require certification for contractors on best management practices
- periodically inspect post-construction stormwater management projects to ensure compliance and proper up-keep

Land conversion

INCREASE THE ABILITY OF MUNICIPALITIES TO DIRECTLY ADDRESS AND IMPROVE MANAGEMENT OF STORMWATER DURING LAND CONVERSION

Current Actions:

- promote "water quality friendly zoning" including: stream corridors and lakeshore buffers, vegetated buffer protection, low impact development practices, and small site stormwater management

  lead agency/organization: Vermont League of Cities and Towns, with financial support from the Agency of Natural Resources
  annual budget: $64,000 in FY10
  outcomes: 26 out of 136 towns in the basin have adopted the full complement of water quality protection provisions in their zoning ordinances
  future needs: progress is very slow; with an average of seven towns per year taking any action to improve water quality protection; stronger incentives (financial or regulatory) may be necessary in the near-term to ensure continued progress; expanded training and technical assistance is needed to ensure regulations are consistently implemented and enforced

Next Steps (2010 – 2016, budget permitting):

- include questions related to construction and post-construction stormwater permit requirements on all local building applications

  estimated budget: $100,000 (annually) for technical assistance and small grants to municipalities
  next steps: incentivize revisions to local building applications using small grants
- put in place driveway access ordinance to minimize sediment contributions from poorly constructed private roads and driveways

  estimated budget: $25,000 (annually) for technical assistance
  next steps: the Better Backroads program has developed a *Driveway Access Guide*, which could serve as a basis for such ordinance

Further Measures (beyond 2016):

- require that all towns in the basin have an effective, implementable LID ordinance
- encourage towns to designate growth center and adopt open space rules
- improve town ordinances to protect prime agricultural/statewide significant soils and productive forest soils

Land conversion

REVISE THE *Stormwater Management Manual* TO BETTER TARGET PHOSPHORUS POLLUTION

Current Actions:

- create specific incentives in the *Stormwater Management Manual* for low impact development, including stream corridor protection
  - lead agency/organization: Agency of Natural Resources
  - annual budget: budget neutral
  - outcomes: "credits" for low impact development and stream corridor protection are being emphasized and expanded as part of on-going revisions to the *Stormwater Management Manual*; revised manual will go to rulemaking in early 2010
  - future needs: TBD
- incorporate forest conservation and protection measures into the *Stormwater Management Manual*
  - lead agency/organization: Agency of Natural Resources
  - annual budget: budget neutral
  - outcomes: measures are being considered as part of on-going revisions to the *Stormwater Management Manual*; revised manual will go to rulemaking in early 2010
  - future needs: TBD

Next Steps (2010 – 2016, budget permitting):

- create incentives for the infiltration of stormwater to the greatest extent practicable
  - estimated budget: $300,000 (annually) for technical and financial (small grant program) assistance to interested landowners
  - next steps: stormwater infiltration is typically more difficult and expensive than retention/detention; need to develop full understanding of incremental cost and practicality of going from detention to infiltration

Further Measures (beyond 2016):

- reduce the required separation distance from seasonal high water table for stormwater infiltration practices
- evaluate the benefits of additional "polishing" steps to capture additional dissolved phosphorus (e.g. slag or other P-binding media)
- require additional water quality protections for Class A waters

Land conversion

PROMOTE LOW-IMPACT DEVELOPMENT (LID) TECHNIQUES

Current Actions:

- develop and present training materials for municipal officials and homeowners on applications of LID practices
  - lead agency/organization: Agency of Natural Resources, VLCT, Conservation Districts, Regional Planning Commissions
  - annual budget: $87,000, in FY10 of one-time 604b ARRA funds
  - outcomes: a *Small Sites Guide* has been developed, which includes information on LID practices that is specifically targeted at municipal officials and homeowners
  - future needs: $50,000 (annually) to support technical assistance and workshops demonstrating the benefits of LID approaches
- develop and present training materials for developers and engineers on applications of LID practices
  - lead agency/organization: Regional Planning Commissions
  - annual budget: $77,000 in FY10 of one-time 604b ARRA funds
  - outcomes: RPCs will identify barriers to the implementation of LID practices and propose solutions
  - future needs: financial resources to provide on-going technical assistance to towns wishing to adopt LID practices in their zoning
- develop a LID model ordinance
  - lead agency/organization: Vermont League of Cities and Towns (VLCT)
  - annual budget: $64,000, part of the work of the Water Quality Specialist at VLCT
  - outcomes: model LID ordinance was developed in 2008 and accompanied by a technical paper "Managing Stormwater through Low Impact Development Techniques." More than 1000 copies of both documents have been distributed
  - future needs: financial resources to replace the "one-time" stimulus dollars to support work beyond FY10

Next Steps (2010 – 2016, budget permitting):

- provide incentives for the use of LID practices in new and existing development
  - estimated budget: $400,000 (annually) for technical and financial (small grant program) assistance to interested landowners
  - next steps: stormwater infiltration is typically more difficult and expensive than retention/detention; need to develop full understanding of incremental cost and practicality of going from detention to infiltration

Further Measures (beyond 2016):

- develop a low impact development manual for Vermont; Michigan has an excellent example
- require LID practices for all new development
- develop a suite of stormwater control measures, including LID, that achieve no increase in stormwater hydrologic and pollutant loadings over pre-development conditions
- adopt a LID ordinance through the MS4 permit

Land conversion

USE FINANCIAL INCENTIVES TO PROTECT KEY NATURAL RESOURCES

Current Actions:

- maintain the Current Use Policy
  - lead agency/organization: numerous
  - annual budget: N/A
  - outcomes: fair taxation has encouraged the on-going production of local food and fiber, provided a buffer against urban sprawl, as well as maintained open space that allows for a wide range of ecosystem services
  - future needs: continued, targeted support for the Current Use Policy to ensure its longevity
- purchase wetland and river corridor easements in highly sensitive (erosive) and/or key attenuation areas to allow floodplain and wetland restoration and minimize conflicts between river dynamics and land use investments
  - lead agency/organization: Land Trusts, with technical and financial assistance from state and federal agencies
  - annual budget: $400,000 (for technical assistance and easement purchases)
  - outcomes: program is currently averaging six easement purchases per year, with the goal of ten river corridor easements in each of the next five years
  - future needs: modify USDA Farm Bill Programs to allow wetland and river corridor protection/restoration amendments to existing and future farm easements involving federal funds

Next Steps (2010 – 2016, budget permitting):

- establish the compatibility of land, wetland, floodplain, river corridor and lakeshore conservation in federal and state land conservation policy and programs, with the opportunity to amend existing easements
  - estimated budget: budget neutral
  - next steps: ANR staff are working with colleagues in state and federal agricultural agencies to develop a mutually agreeable approach for allowing conservation-minded farmers to participate in water quality programs
- expand the use of incentive programs (specifically CRP) for taking marginal farmland out of production and re-establishing woody vegetation
  - estimated budget: $600,000 (annually)
  - next steps: this program would be a logical extension of the CREP program, expanding the ability to pay farmers to take marginal areas -outside of riparian areas and flood chutes - out of agricultural production
- identify pockets of "natural" stormwater management in developed areas in order to protect them
  - estimated budget: $85,000 (annually)
  - next steps: use GIS and other tools to identify and prioritize sites, using a process similar to that which supported development of the *Lake Champlain Basin Wetland Restoration Plan*

Further Measures (beyond 2016):

- develop incentives for restoring/conserving undeveloped wetland, lakeshore and stream riparian areas
- develop incentives for high density living/working areas in towns
- restore on-site water resources during land conversion (agriculture to developed land)
- make additional stormwater planning assistance available to communities participating in the state growth center designation program
- develop an ecosystem services program for both forested and agricultural lands

Land conversion

IMPROVE THE UTILITY OF STATEWIDE PLANNING TO ADDRESS WATER QUALITY ISSUES

Current Actions:

- develop a state-wide water quality master plan that integrates current ANR activities which address water quality protection and remediation into basin-specific implementation plans
  - lead agency/organization: Agency of Natural Resources
  - annual budget: budget neutral
  - outcomes: currently under development
  - future needs: $50,000 (one-time) to provide town-specific outputs from the state-wide water resource plan that make it easy for municipal land use planner to incorporate science and practices
- use the state-wide water quality plan framework to more clearly link watershed/basin/river corridor plans to other land use planning initiatives
  - lead agency/organization: Agency of Natural Resources
  - annual budget: budget neutral
  - outcomes: recent formation of MAPP (monitoring, assessment and planning program) within ANR's Water Quality Division will support integration of on-going watershed, basin, and river corridor planning efforts
  - future needs: better integration of water quality programs within ANR is an important and necessary first step; next will be using ANR's integrated water quality data and priorities to support and inform the development of land use plans

Next Steps (2010 – 2016, budget permitting):

- evaluate the impacts of clustered development on water quality in rural areas
  - estimated budget: $15,000/town to evaluate and support revisions to PUD/subdivision regulations, as needed
  - next steps: start tracking land preserved as open space through PUDs and PRDs
- develop a comprehensive conservation plan for the Lake Champlain basin
  - estimated budget: $350,000 (one-time)
  - next steps: convene a workgroup that reflects the broad cross-section of interests within the Lake Champlain basin to develop a framework from a comprehensive conservation plan

Further Measures (beyond 2016):

- reinvigorate state-wide land use planning
- strengthen Vermont's growth center program to better address sprawl and water quality concerns
- support the Governor's Commission on Climate Change's target of reducing the rate of forestland conversion by 50% by 2020

Discharges from farmsteads & agricultural production areas

EXPAND FINANCIAL ASSISTANCE PROGRAMS AVAILABLE TO AGRICULTURAL PRODUCERS TO SUPPORT IMPLEMENTATION OF BEST MANAGEMENT PRACTICES

Current Actions:

- provide additional cost share, through state and/or federal programs, for projects with important water quality benefits
  - lead agency/organization: Agency of Agriculture
  - annual budget: $1.6 million allocated for the BMP Program in FY10
  - outcomes: in FY10, the Vermont legislature authorized a one-year increase in the maximum cost share available to producers – from 85% to 90% - on select projects to address water quality concerns; the Agency of Agriculture is in the process of contracting all of the FY10 funding with farmers to install structural farmstead practices that improve water quality. In FY09, 290 water quality practices were contracted.
  - future needs: the ability to provide higher cost share will expire at the end of FY10 without further action by the Vermont legislature; the program should be extended through the end of FY12 and then re-evaluated
- identify critical source areas and then target farmstead investments accordingly
  - lead agency/organization: Lake Champlain Basin Program (LCBP)
  - annual budget: $800,000 in funding has been provided to date through the International Joint Commission (IJC) to support critical source area identification within the Missisquoi watershed
  - outcomes: in early 2009, LCBP convened a series of stakeholder workshops to define criteria for evaluating "critical sources areas"; in early 2010 it is anticipated that LCBP will release a request for proposal (RFP) for contractor support to identify and rank potential critical source areas
  - future needs: current work is limited to the Missisquoi watershed, additional resources ($1-2 million) will likely be required to extend the analysis throughout the Vermont portion of the Lake Champlain basin; higher cost-share should be considered as a means to incentivize farmers to install conservation practices in critical watershed areas.

Next Steps (2010 – 2016, budget permitting):

- pursue special designation for Lake Champlain to increase cost-share available through NRCS
  - estimated budget: budget neutral, but could make more dollars available to individual farmers
  - next steps: requires action by U.S. Congress

Further Measures (beyond 2016):

- promote and provide financial support to farmers interested in moving away from liquid manure storage and handling into composting, bedded pack or other semi-solid manure management systems
- establish as clearinghouse of financial assistance programs available to producers
- create incentives for grass-based livestock operations that protect water resources and reduce the amount of imported feed

Discharges from farmsteads & agricultural production areas

EXPAND TECHNICAL ASSISTANCE PROGRAMS AVAILABLE TO ARGRICULTURAL PRODUCERS TO SUPPORT IMPLEMENTATION OF BEST MANAGEMENT PRACTICES

Current Actions:

- increase engineering services available to plan and design barnyard practices and correct water quality issues

  lead agency/organization: Agency of Agriculture

  annual budget: $650,000, total, between FY08 and FY10

  outcomes: state engineers provided 37 farms with certified engineered designs for production area structural practices such as barnyards, waste storages and waste treatment practices; in 2009 31 farms began construction on the practices and the remaining 6 farms will begin construction in 2010.

  future needs: $450,000, per year, to provide additional engineering resources to work with farmers to develop plans and cost estimates, and provide construction oversight.

Next Steps (2010 – 2016, budget permitting):

- develop farmer workgroups to disseminate information and provide feedback to regulatory agencies

  estimated budget: $12,000, to support monthly meetings (per diem and staff support)

  next steps: work with Conservation Districts to form farmer workgroups, similar to the Farmer's Watershed Alliance or farmer clubs in Quebec, in other areas of the state

Further Measures (beyond 2016):

- develop outreach and education resources dedicated to on-farm water quality issues
- conduct a comprehensive "needs survey" to clarify the scope of on-farm water quality problems; include follow-up surveys to track progress

Discharges from farmsteads & agricultural production areas

ENHANCE EFFORTS TO TARGET SMALL FARMS, INCLUDING DAIRY, HORSE AND VEGETABLE OPERATIONS

Current Actions:

- complete surveys of all small farms, using AEM (Agricultural Environmental Management) or similar, to help identify and prioritize problem areas and provide technical assistance to support implementation of low-cost/low-tech solutions

  lead agency/organization: Conservation Districts, with support from Agency of Agriculture
  annual budget: $150,000
  outcomes: by the end of FY10, AEM surveys will have been completed on 193 farms, and doing follow up assessments and drinking water testing performed on 34 of those surveyed farms.
  future needs: $75,000 (annually) to support enhanced coordination and collaboration with the New York AEM program, utilizing their robust field training and program model to provide farmers with incentives to participate in the program.

Next Steps (2010 – 2016, budget permitting):

- expand efforts specifically targeting implementation on small farms

  estimated budget: $150,000 (annually)
  next steps: completion of the small farm survey, described above under current actions, in order to understand the universe of needs and establish water quality priorities

- provide AAFM with ticket-writing capabilities for small farms

  estimated budget: budget neutral
  next steps: requires action by Vermont legislature

- expand NRCS' definition of "limited resource producers" to make more farmers eligible for 90% federal cost share

  estimated budget: budget neutral
  next steps: requires action by U.S. Congress

- make implementation of the AAPs (Accepted Agricultural Practices) inspection-based

  estimated budget: $750,000 (annually)
  next steps: requires action by the Vermont Legislature.

Discharges from farmsteads & agricultural production areas

IMPROVE MANURE STORAGE AND MANAGEMENT

Current Actions:

- establish guidelines for the locating manure piles that include criteria minimum separation from waterways
  - lead agency/organization: Agency of Agriculture
  - annual budget: budget neutral
  - outcomes: rules are in place; the AAPs, and MFO and LFO rules specify minimum separation distances from waterways for manure piles, and also from neighboring domiciles and drinking water wells
  - future needs: none identified
- provide financial and technical assistance to farmers interested in alternative manure management techniques (e.g., composting, digestion)
  - lead agency/organization: Agency of Agriculture
  - annual budget: $450,000
  - outcomes: alternative manure management monies have been used to support a variety of projects to date, including anaerobic digesters, an algae photo bio-reactor system, and manure application technology
  - future needs: technical services to support operation and routine maintenance of anaerobic digesters; with recent changes in how power derived from anaerobic digesters is charged to the farmer, combined with federal stimulus funds it is anticipated that Vermont will have more digesters per capita than any state in the nation by next year.

Next Steps (2010 – 2016, budget permitting):

- require evaluation of available manure storage and storage needs on any farm receiving a manure spreading waiver
  - estimated budget: $12.6 million (one-time) to develop NMPs on small dairy farms
  - next steps: currently when a producer requests a manure spreading waiver, an Agricultural Resource Specialist (ARS) or Agency of Agriculture field agent meets with the farmer to assess his/her immediate needs, including storage capacity. In 2010 the Agency will develop policies that triggers an enforcement process when (repeated) poor management creates the need for the waiver.
- require waste storage facility upgrades or new structures, consistent with appropriate NRCS standards, at all livestock farms where current waste storage practices are creating water quality impairments
  - estimated budget: $47.2 million (one-time) to build or upgrade waste storage facilities to meet current (2010) standards
  - next steps: complete needs assessment for all small farms

Further Measures (beyond 2016):

- promote solid manure management for small farms
- promote composting as an alternative to liquid manure management, where appropriate
- upgrade the solid waste management rules to perform nutrient management based on phosphorus recommendations on farms that take on whey, septage, or other solid waste materials

Discharges from farmsteads & agricultural production areas

IMPROVE MANAGEMENT OF HEAVY USE AREAS (BARNYARDS)

Current Actions:

- design, fund, and implement practices that direct clean water away from barnyards
  - lead agency/organization: Agency of Agriculture
  - annual budget: one of numerous practices eligible for BMP Program funding – total program budget $1.6 million in FY09
  - outcomes: 18 roof runoff diversion structures were installed in FY09
  - future needs: until recently, many of the clean water diversion practices installed did not take hydrologic flows into consideration; new practices need to consider the volume of water being diverted and design best fit projects to reduce the potential for downstream erosion
- exclude animals from all surface water in barnyards
  - lead agency/organization: Agency of Agriculture
  - annual budget: $300,000 (as part of MFO and LFO programs)
  - outcomes: all medium and large farm operations in Vermont must exclude livestock from streams in production areas
  - future needs: work with smaller farms to exclude livestock from streams in production areas
- provide adequate treatment for barnyard discharges, including silage leachate and milk house waste
  - lead agency/organization: Agency of Agriculture
  - annual budget: practices eligible for BMP Program funding – total program budget $1.6 million in FY09
  - outcomes: the BMP Program contracted for 292 practices in FY09
  - future needs: total cost to address all production area needs is estimated at $72 million

Next Steps (2010 – 2016, budget permitting):

- provide financial and/or regulatory incentives to decommission and relocate poorly sited manure pits, silage bunkers and barnyards (as opposed the current programs which only cost share treatment retrofits)
  - estimated budget: $14.4 million (one-time)
  - next steps: establish guidelines for what constitutes "poorly sited" to ensure proper use of funds; the Agency of Agriculture could begin now using BMP funds
- initiate more enforcement actions against improperly managed livestock concentration areas
  - estimated budget: $750,000 (annually)
  - next steps: expand field presences by increasing the number of agents available to make inspections

Further Measures (beyond 2016):

- create incentive payment for high quality management of farmstead
- provide incentives for farms to capture and reuse clean water
- investigate ability of new technologies, such as Biochar to treat barnyard waste and improve water quality

Discharges from farmsteads & agricultural production areas

IDENTIFY AND TARGET AGRICULTURAL OPERATIONS THAT DISPROPORTIONATELY CONTRIBUTE PHOSPHORUS

Current Actions:

- develop an inventory of all livestock operation to improve technical assistance and outreach
  - lead agency/organization: Conservation Districts, Agency of Agriculture
  - annual budget: $150,000
  - outcomes: by the end of FY10, AEM surveys will have been completed on 193 small farms, in addition to surveys of all medium and large farms have been completed as part of existing regulatory programs
  - future needs: expand effort in order to identify and complete AEM surveys for all small farms in the basin

Next Steps (2010 – 2016, budget permitting):

- provide more pro-active outreach to farms in need of conservation programs, in particular, EQIP, rather than serve only those who request assistance
  - estimated budget: budget neutral
  - next steps: expanded collaboration between the Agency of Agriculture as farms with needs are indentified
- require more detailed pre-planning for EQIP contracts
  - estimated budget: $150,000 (annually)
  - next steps: work with NRCS to increase the rigor of current pre-planning to define needs and estimate total project cost

- target any herd buy-out options that might develop to farms having the greatest water quality impacts
  - estimated budget: budget neutral
  - next steps: expand collaboration between the Agency of Agriculture and the Farm Services Agency to educate farmers with environmental issues about potential buy-out options, if any

Further Measures (beyond 2016):

- create maps of sensitive ecosystem and distribute them to landowners to facilitate stewardship
- support efforts to ensure farming is economically viable and environmentally responsible, including evaluating opportunities for diversifying Vermont agriculture

Discharges from farmsteads & agricultural production areas

EVALUATE CHANGES TO THE EXISTING REGULATORY FRAMEWORK FOR AGRICULTURE THAT COULD IMPROVE PROGRAM EFFICACY

Current Actions:

- develop a CAFO (concentrated animal feeding operation) program at the Agency of Natural Resources to address farm discharges
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $225,000
  - outcomes: an MOU has been in place since 1997 for the CAFO (LFO) regulations between ANR and AAFM; the MOU was last revised in 2007. Under this agreement AAFM manages the MFO and LFO programs in lieu of the CAFO program in Vermont; if a farm is found to have a CAFO defined discharge, then the MOU states that AAFM will notify ANR, who then initiate the process for drafting a CAFO permit
  - future needs: ANR and AAFM are currently evaluating the timing of and role that a CAFO general permit might have in Vermont's regulatory framework

Next Steps (2010 – 2016, budget permitting):

- revise the AAPs to create a mechanism for towns to zone and manage backyard livestock
  - estimated budget: $75,000 (one-time)
  - next steps: work with the legislature and special interest groups to develop language that properly defines the areas of jurisdiction

Further Measures (beyond 2016):

- require NRCS environmental review for feed storage facility (silage or grain silos) funded through FSA loans
- evaluate the effectiveness of MFO and LFO programs
- require regular updates to the AAPs
- eliminate the agricultural exemption from the ban on phosphorus-based detergents
- reassign responsibility for all agriculture-related water quality enforcement to ANR

EXPAND VOLUNTARY AND REGULATORY PROGRAMS THAT TARGET SOIL LOSS AND EROSION FROM CROPLAND

Current Actions:

- expand the Farm Agronomic Practices (FAP) program to support increased use of soil erosion control practices (e.g., cover cropping, minimized tillage) and alternative manure application techniques (e.g., soil aeration, manure injection) on annually tilled fields
  - lead agency/organization: Agency of Agriculture and NRCS
  - annual budget: $540,952 (in FY09); FAP and NMP tap a single, shared pool of funds
  - outcomes: approximately 7,000 acres were cover cropped in 2009, and many farmers were turned down for additional cover cropping/alternative crop and manure management practices due to a lack of funds.
  - future needs: $750,000 annually to support the full requests of cover cropping and alternative manure application practices, while continuing to support nutrient management development for small livestock operations
- provide incentives for reducing the number of acres of annually tilled land
  - lead agency/organization: Agency of Agriculture and NRCS
  - annual budget: $15,000
  - outcomes: very few farms have utilized the conservation crop rotation practice available through the FAP program; less than 300 acres have been enrolled each year since the programs inception in 2007
  - future needs: farmers have shown a strong interest in certain practices designed to protect soils (e.g., cover cropping); expanded technical and financial assistance could help extend this interest to other practices

Next Steps (2010 – 2016, budget permitting):

- lower tolerable soil loss "T" in the AAPs from 2T to T
  - estimated budget: budget neutral
  - next steps: requires action by the Vermont Legislature
- discourage/prohibit cultivation of annual crops in inappropriate locations
  - estimated budget: $3 million (one-time)
  - next steps: develop water quality-based criteria for evaluate annual cropland; create a robust incentive program to cover the costs of lost production on lands that will be taken out of production
- create incentive program for high quality management of cropland
  - estimated budget: $375,000 (one-time) to develop concept and run pilot program
  - next steps: provide increased financial incentives for implementing an entire suite of soil erosion control practices, coupled with on-site verification that practices are done properly

Further Measures (beyond 2016):

- require soil erosion control practices (e.g., cover cropping, minimized tillage) on all annually tilled fields
- develop designs for reinforced entrances for farm fields (similar to reinforced construction entrances)
- develop strategies to reduce subsidies for soil erosion reduction practices, such as cover cropping, without reducing utilization on sensitive fields
- expand the use of performance-based incentives to reward farmers for achieving specified environmental performance at the farm-level

Poorly managed cropland

EXPAND EFFORTS TO DEVELOP AND IMPLEMENT NUTRIENT MANAGEMENT PLANS (NMPs)

Current Actions:

- make available incentives for NMP implementation through expansion and continued support for the farm agronomic practices (FAP) program

  lead agency/organization: Agency of Agriculture
  annual budget: $540,952 (in FY09); FAP and NMP tap a single, shared pool of funds
  outcomes: approximately 7,000 acres of cover crop were planted in 2009, more than 500 acres of alternative manure applications, and 10 nutrient management plans contracted for development
  future needs: $75,000 for staff support dedicated to the administration of the farm agronomic and nutrient management programs at the Agency of Agriculture

Next Steps (2010 – 2016, budget permitting):

- ensure that small livestock farms are following waste management plans outlined in the AAPs

  estimated budget: $150,000 (annually)
  next steps: increase the number of routine AAP inspections, and integrate review of waste management plans into the process

- rewrite/restructure the AAPs to include additional nutrient management requirements for farmers who apply synthetic fertilizers on annual cropland

  estimated budget: $75,000 (annually)
  next steps: revising the AAPs requires action by the Vermont Legislature, public meetings, and passage by the LCAR.

- provide additional technical assistance resources to farmers to implement practices that enhance NMP concepts such as no-till, strip till, crop rotation, and cover cropping

  estimated budget: $150,000 (annually)
  next steps: work with the UVM extension and Southern Vermont Nutrient Management Program to expand their efforts in their respective territories.

Further Measures (beyond 2016):

- work with farmers to balance feed rations with the goal of reducing the importation of phosphorus onto Vermont farms
- develop, implement, and properly oversee/enforce use of NMPs on all farms

Poorly managed cropland

INCREASE TECHNICAL ASSISTANCE AVAILABLE TO AGRICULTURAL PRODUCERS FOR IMPROVING CROPLAND MANAGEMENT

Current Actions:

- demonstrate and encourage alternative crops and cropping systems with increased levels of residue
  - lead agency/organization: University of Vermont Extension Service
  - annual budget: $50,000
  - outcomes: successful demonstration of practices that help to reduce input costs and improve water quality
  - future needs: the continued demonstration and documentation of the performance of new practices under variable conditions

Next Steps (2010 – 2016, budget permitting):

- increase the number of extension personnel (agronomists and nutritionists) available for on-farm technical assistance, education and support
  - estimated budget: $500,000 (annually)
  - next steps: identify funding in order to build upon the successful examples offered by the "farmer clubs" that are organized in the Canadian provinces of Quebec and New Brunswick; each Farmer Club would hire an agronomist/club coordinator to provide information and guidance to the club and its members
- develop certification (licensing) program for custom operators (planting, harvesting, manure spreading, bunk-packing, etc)
  - estimated budget: $375,000 (annually)
  - next steps: form work group to design certification program; create a database to track and manage a licensing/certification program similar to the pesticide program that currently exists within the Agency of Agriculture

Further Measures (beyond 2016):

- complete economic analysis of different crop rotations to demonstrate the "true cost" of bad rotations

Poorly managed cropland

EXPAND PROGRAMS THAT ADDRESS AGRICULTURAL DRAINAGE PRACTICES (DITCHES AND TILES)

Current Actions:

- make routine inspections of tillage and/or manure application, identify those activities occurring too close to surface water and take enforcement action, when appropriate

  lead agency/organization: Agency of Agriculture
  annual budget: $375,000; such inspections are one of the many responsibilities of field agents whose salaries are reflected in this budget
  outcomes: 178 investigations were conducted during FY09, resulting in six buffer violations
  future needs: continue to investigate and address public complaints and staff concern regarding potential violations

Next Steps (2010 – 2016, budget permitting):

- provide financial incentives to achieve a minimum width (10 feet) of buffer zone along intermittent streams and ditches that pass through annual cropland

  estimated budget: $500,000 (annually)
  next steps: appropriate authorities are in place to ensure that streams are not placed in pipes and filled over where landowners wish to avoid new buffer requirements
- configure and install detention basins or other treatment for ditch/tile networks outside the stream corridor

  estimated budget: $300,000 (annually)
  next steps: subcontract with non-profit organizations to install these practices in targeted watersheds

Further Measures (beyond 2016):

- develop cost-share program and technical standards for installing and maintaining ditch and tile networks
- develop education and outreach materials that target contractors who install new drain tiles and perform ditch maintenance activities
- require permits for new drain tiles and ditch maintenance activities

Poorly managed cropland

IMPROVE THE TIMING, AMOUNT, LOCATION AND METHODS USED IN MANURE APPLICATION

Current Actions:

- use incentives to promote manure injection or immediate incorporation of manure (<24 hours) on cropland
  - lead agency/organization: Agency of Agriculture, NRCS
  - annual budget: $15,000 in FY09
  - outcomes: in FY09 alternative manure incorporation methods were used on roughly 500 acres
  - future needs: $750,000 annually to support the full requests of alternative manure application practices
- make enforcement of the winter manure spreading ban a priority
  - lead agency/organization: Agency of Agriculture
  - annual budget: budget neutral; compliance with the winter spreading ban is a priority for AAFM
  - outcomes: since January 2008, 35 technical assistance visits to work with farmers who needed spreading exemptions, and follow up assistance with each one to assure the cause for the exemption is remediated.
  - future needs: $120,000 for continued support to fund the grant agreement with the Vermont Association of Conservation Districts to perform the manure spreading exemption technical assistance

Next Steps (2010 – 2016, budget permitting):

- increase flexibility to put EQIP monies toward equipment (e.g., manure injectors, aerators)
  - estimated budget: budget neutral
  - next steps: ANR successfully applied for a CCPI grant, through NRCS, in 2009 which has made available an additional $400,000 in financial incentives for manure injection and conservation tillage practices in three counties in the Lake Champlain basin

Further Measures (beyond 2016):

- develop mapping resources to identify sensitive areas (e.g., lakeshore, steep slopes, etc.) so that information can be incorporated into nutrient management plans

Unmanaged or poorly managed pasture

IMPROVE THE MANAGEMENT OF ANIMALS IN AND AROUND SURFACE WATER FEATURES

Current Actions:

- increase the staff and resources dedicated to the CREP program
  - lead agency/organization: Agency of Agriculture
  - annual budget: $25,000
  - outcomes: in FY09, technical support on at least 15 CREP contracts in the Northern Lake Champlain watershed
  - future needs: $150,000 increase in the federal partners budgets for CREP technical support; a list of interested CREP applicants needs to be developed in order to better target outreach efforts

Next Steps (2010 – 2016, budget permitting):

- provide financial and regulatory incentives to install fencing (temporary and permanent), watering systems, and stream crossings in order to improve management of animals in and around streams and rivers
  - estimated budget: $200,000 (annually)
  - next steps: create and fund a "flex program" the expands cost-share for temporary and permanent fencing, and increases the cost-share available for watering systems and stream crossings
- require salt block, water facilities, and feeding areas be at least 50 feet away from all surface water
  - estimated budget: $75,000
  - next steps: develop a framework for grazing management plans that specifically address livestock concentration areas

Further Measures (beyond 2016):

- complete cost/benefit/animal health analysis of grazing in wetlands
- require animals to be fenced out of perennial rivers and streams

Unmanaged or poorly managed pasture

DEVELOP TOOLS TO IMPROVE PASTURE MANAGEMENT

Current Actions:

- explore alternative grazing crops
  - lead agency/organization: University of Vermont Extension Service
  - annual budget: $40,000
  - outcomes: demonstrations of strategies, using different forage species, that can be used to lengthen the grazing period and reduce imported feed
  - future needs: with the renewed interest in grazing, need technical assistance to be able to conduct farm-specific evaluations of whether or not grazing makes sense
- provide technical assistance and financial incentives for rotational grazing
  - lead agency/organization: University of Vermont Center for Sustainable Agriculture – Pasture Program
  - annual budget: $195,000
  - outcomes: in 2009, the Pasture Program provided on-farm technical assistance to over 60 farms and organized and sponsored 13 pasture walks and workshops
  - future needs: $150,000 (annually) to assist farmers in adopting and implementing grazing systems and to provide farm specific evaluations and recommendations

Next Steps (2010 – 2016, budget permitting):

- establish a buyout program for marginal pasture and/or pasture with unsuitable access
  - estimated budget: $500,000 (annually)
  - next steps: develop an inventory of parcels to target with buyout program
- increase cost-share programs (state and federal) for laneways
  - estimated budget: $200,000 (annually)
  - next steps: the current CREP program has a $1,500 cap per farm for stream-crossings and laneways that are a part of the stream crossing, it does not include laneways created by funneling livestock into paths adjacent to a stream; requires changes to the national CRP program requirements

Further Measures (beyond 2016):

- enhance technical assistance and financial incentives for rotational grazing
- develop stocking density guidelines
- develop land application assistance program for manure generated by pasture-based operations
- create specific incentives to improve management of dry cow and heifer pasture

Channel modifications

EXPAND RIAPRIAN AREA PROTECTION AND RESTORATION EFFORTS

(note: includes ideas generated in response to "Untreated/unmanaged runoff" threat)

Current Actions:

- provide financial incentives to landowners to replant/restore riparian areas
  - lead agency/organization: Conservation Districts, with technical and financial assistance from the Agency of Natural Resources
  - annual budget: $75,000
  - outcomes: Trees for Streams programs have been established in six Conservation Districts, supported by a combination of 319 and Clean and Clear funds, that provide project planning and outreach to develop riparian restoration projects identified in river corridor plans resulting in replanting 25-40 sites per year
  - future needs: $75,000 (for a total of $150,000) to have programs in each District statewide

Next Steps (2010 – 2016, budget permitting):

- develop a clear, consistent definition for stream that is used across regulatory programs and agencies
  - estimated budget: budget neutral
  - next steps: requires action by the Vermont Legislature
- provide on-going capacity for more targeted outreach to current lakeshore and streambank landowners on buffer establishment and protection consistent with river corridor and lake watershed plans
  - estimated budget: $200,000 (annually)
  - next steps: establish capacity within Conservation Districts to deliver technical assistance, from site design to restorative planting plans, to waterfront property owners

Further Measures (beyond 2016):

- institute a tax relief program for all landowners who allow all land within 100' of a streambank to be managed for riparian conservation
- establish a state-administered stream corridor protection program that provides for stream equilibrium, floodplain function, and vegetated buffers
- provide training for heavy equipment operators that will operate in riparian areas on best practices

Channel modifications

EXPAND THE SCOPE OF STATE AND FEDERAL REGULATORY PROGRAMS GOVERNING IN-STREAM ACTIVITIES

Current Actions:

- align regulatory procedures and requirements (state and federal) to better support stream and floodplain restoration
  - lead agency/organization: Agency of Natural Resources and federal regulatory agencies
  - annual budget: budget neutral
  - outcomes: greater opportunity to propose and carry out restoration projects in a timely and efficient manner, resulting in an increased number of projects per year
  - future needs: a commonly accepted definition of restoration, which does not include mitigation and enhancement and establishes standards whereby the regulatory community knows when to use expedited procedures

Next Steps (2010 – 2016, budget permitting):

- increase capacity to provide landowners and municipalities with engineering assistance in the siting and design of infrastructure near or in stream
  - estimated budget: $150,000 (annually)
  - next steps: develop a suite of accepted practices for the siting and design of infrastructure that may encroach within the river corridor; increase the number of regional stream alteration engineers to expand technical capacity to guide and/or regulate many of the watershed modifications that currently lead to severe gullying and stream instability
- eliminate the 10mi^2 drainage area threshold for issuing stream alteration permits
  - estimated budget: $150,000 (annually)
  - next steps: create a general permit for activities at different watershed size thresholds for activities that would alter hydraulics or hydrology, and better promote the cost/benefit in public and private dollars saved through avoided flood and erosion damages
- increase regulatory pressure, particularly through the Army Corps of Engineers, to prohibit on-going maintenance of ditched or otherwise manipulated streams
  - estimated budget: $200,000 (annually)
  - next steps: amend the Army Corps of Engineers General Permit to fully support efforts to manage streams toward their equilibrium state

Further Measures (beyond 2016):

- regulate all dredging and gravel mining as a stream alteration that requires a permit
- identify and prioritize dam removal projects that are important to restoring stream equilibrium

Channel modifications

PROVIDE MORE OUTREACH FOR AND OVERSIGHT OF PROJECTS INVOLVING DRAINAGE OR OTHER CHANNEL AND FLOODPLAIN MODIFICATIONS

Current Actions:

- educate landowners about the impacts of channel and floodplain modification and best practices
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $105,000
  - outcomes: regional river scientists and engineers conduct over 500 events or site visits annually, using river flumes and other visual aides, to educate landowners and municipalities about erosion hazards, the benefits of stream equilibrium, and floodplain function
  - future needs: $35,000, annually, to match funding available from FEMA to support technical assistance to landowners and municipalities in submitting development projects for floodplain encroachment review
- remove historic berms, floodplain fills, and derelict levees and allow reconnection of rivers & streams to floodplains
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $150,000
  - outcomes: two to three floodplain restoration projects per year
  - future needs: maintain current program

Next Steps (2010 – 2016, budget permitting):

- promote the use of bioengineering in locations where streambank stabilization is necessary and consistent with stream equilibrium and water quality goals
  - estimated budget: $15,000 (one-time), to develop technical guidance
  - next steps: build on existing guidance developed to support stream geomorphic assessments and establish criteria for identifying specific locations where bioengineering is appropriate

Further Measures (beyond 2016):

- establish a regulatory framework to govern ditching and ditch maintenance
- develop an enhanced hydrography dataset for the Lake Champlain basin

Floodplain and lakeshore encroachments

USE REGULATION, ZONING, AND INCENTIVES TO PREVENT CONFLICTS BETWEEN INFRASTRUCTURE AND STREAMS/RIVERS

Current Actions:

- provide technical assistance and financial incentives to encourage municipalities to adopt stream corridor protection that prevents conflicts between streams and infrastructure and provides for stream equilibrium, floodplain function, and vegetated buffers on tributaries and lakeshores

lead agency/organization:	municipalities, Agency of Natural Resources, Vermont League of Cities and Towns
current budget:	$75,000 (for technical assistance)
outcomes:	to date, eight Vermont communities have adopted fluvial erosion hazard or equivalent zoning; program goals include having ten additional communities adopt FEH zoning in each of the next five years
future needs:	an additional $150,000 per year – current program is staff limited and needs to be expanded in order to be able to increase the number of towns that can be engaged annually; state and federal grant eligibility for infrastructure development, hazard mitigation, and riparian restoration linked to municipal actions toward river corridor planning and protections

Next Steps (2010 – 2016, budget permitting):

none currently

Further Measures (beyond 2016):

- improve town ordinances in order to protect stream corridor protection that provides for stream equilibrium, vegetated buffers, and floodplain storage of stormwater, sediments and nutrients
- develop peer-to-peer "zoning teams" that visit adjacent towns to provide technical assistance on the development of water quality friendly zoning
- modify the National Flood Insurance Program to more fully support Vermont's FEH zoning program

Floodplain and lakeshore encroachments

EXPAND TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS THAT SPECIFICALLY TARGET LAKESHORE PROPERTY OWNERS

Current Actions:

- provide technical and financial assistance to shoreland property owners on best practices
  - lead agency/organization: Agency of Natural Resources
  - annual budget: currently 0.25 FTE is devoted, but it is not specifically budgeted
  - outcomes: on-going technical assistance to lake associations and lakeshore residents on bank stabilization and increasing natural vegetation on the shores
  - future needs: $175,000 to expand technical and financial assistance offerings and fully realize the program

Next Steps (2010 – 2016, budget permitting):

- strengthen/motivate/empower local lake groups to continue and expand monitor and education efforts
  - estimated budget: $100,000 (annually)
  - next steps: expand technical assistance available to support local lake groups

Further Measures (beyond 2016):

- increase compliance and enforcement activities related to shoreland encroachments
- establish requirements to manage lakeshores for riparian conservation
- encourage municipalities to restore and protect naturally vegetated lakeshores

Untreated or improperly treated sewage

FURTHER REDUCE THE PHOSPHORUS CONTRIBUTION FROM POINT SOURCES

Current Actions:

- complete illicit discharge detection and elimination (IDDE) surveys for all towns in the Lake Champlain basin
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $200,000 (annually) to complete surveys in 10 towns per year, done in conjunction with stormwater infrastructure surveys
  - outcomes: in FY09, surveys were completed for nine towns in the Lake Champlain basin
  - future needs: continue to conduct surveys, with a goal of completing ten per year; provide necessary follow-up to ensure discharges are promptly remediated
- provide technical assistance and training to wastewater operators to support optimization of plant performance
  - lead agency/organization: Vermont Rural Water Association
  - annual budget: $125,000
  - outcomes: provided on-site technical assistance and training to communities with direct discharge facilities to improve operational practices, including both treatment and collection systems; particular focus is placed on strategies to reduce phosphorus and nitrogen discharges
  - future needs: sustained annual funding

Next Steps (2010 – 2016, budget permitting):

- use incentives to encourage WWTFs to exceed phosphorus load/concentration permit requirements
  - estimated budget: $1,400,000 (annually)
  - next steps: determine rates for incentive payments that would be meaningful in the context of a municipal budget

Further Measures (beyond 2016):

- offer incentives or disincentives to wastewater treatment plants for maintaining 2006 levels of phosphorus discharged
- upgrade phosphorus removal capabilities at all WWTFs to achieve 0.2 mg/L effluent concentration
- accelerate implementation of the CSO elimination and abatement program
- develop standards for stormwater management for recently separated combined sewers
- reduce influent phosphorus concentrations at WWTFs by limiting the use of high-P cleaners
- identify and pursue opportunities to put treated wastewater into the ground, rather than surface water
- evaluate the performance of innovative "polishing" steps to reduce phosphorus concentrations in wastewater effluent

Untreated or improperly treated sewage

REPLACE OR UPGRADE FAILING AND SUB-STANDARD SEPTIC SYSTEMS

Current Actions:

- expand the use of innovative and alternative systems to improve on-site wastewater management
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $30,000
  - outcomes: approximately 150-200 advanced treatment systems are installed annually
  - future needs: continue to expand the universe of approved innovative and alternative systems in order to give homeowners with failing or sub-standard septic systems options; advanced treatment systems are critical for a small number of replacement systems each year because of the reduced size of the system fits better on small lots.

Next Steps (2010 – 2016, budget permitting):

- develop a septic pump-out program to improve drainfield function and expected septic system life
  - estimated budget: $50,000 (annually) for program administration
  - next steps: identify other jurisdictions with pump-out programs, and use as a basis for a program for Vermont
- provide technical assistance to homeowners on septic maintenance and upgrades
  - estimated budget: $75,000 (annually)
  - next steps: provide direct technical assistance to town health officers to conduct sanitary surveys in targeted areas

Further Measures (beyond 2016):

- collaborate with the Department of Housing, Community and Economic Development to promote available resources on wastewater options for small communities
- increase compliance and enforcement efforts related to implementation of DEC sub-division septic system regulations, with particular emphasis placed on sub-divisions near surface water
- pilot the use of cluster/community systems to treat wastewater
- create a one-time incentive program for corrective action on failed or substandard septic systems
- require permitting, with a 5-year inspection cycle, of all septic systems; require replacement of failing systems
- ban the land application of septage

Untreated or improperly treated sewage

IMPROVE THE ABILITY OF FINANCIAL ASSISTANCE PROGRAMS, INCLUDING THE STATE REVOLVING FUND (SRF), TO TARGET PHOSPHORUS REDUCTION PROJECTS

Current Actions:

- ensure SRF priority system ranks high infrastructure improvements to reduce phosphorus loading
  - lead agency/organization: Agency of Natural Resources
  - annual budget: budget neutral
  - outcomes: currently, phosphorus removal projects rank second only to dry weather pollution abatement projects
  - future needs: none currently
- direct more SRF funding toward cities with existing, aging sewers and away from suburban expansion into undeveloped areas
  - lead agency/organization: Agency of Natural Resources
  - annual budget: budget neutral
  - outcomes: currently, with the priority rule, SRF funding is directed toward existing infrastructure, unless there is a pollution problem that demands more immediate attention
  - future needs: none currently

Next Steps (2010 – 2016, budget permitting):

- increase Vermont's SRF allocation and capitalization in order to have more money available to lend in the medium-term
  - estimated budget: SRF capitalization requires $1 from the state for every $5 federal received
  - next steps: in FFY10, Vermont's SRF allocation will be over $13 million, or nearly double what it has been in recent years
- strengthen financial assistance programs available for septic upgrade/repair
  - estimated budget: up to $500,000 for each of two years
  - next steps: ANR is currently evaluating different program designs and administration

Further Measures (beyond 2016):

- use SRF funding for projects that promote water conservation and energy efficiency, and reward communities that maintain systems in good working order

Road construction and maintenance

EXPAND TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS TO ACCELERATE REPLACEMENT OF FAILED/UNDERSIZED CULVERTS

Current Actions:

- promote replacement culvert designs that address both stream equilibrium and aquatic organism passage
  lead agency/organization: Agency of Transportation, Agency of Natural Resources, Better Backroads Program
  annual budget: $250-500,000 for replacement of critical structures
  outcomes: 5-10 projects have been constructed each of the past five years
  future needs: assist VTrans in replacing failing culverts with appropriately sized and set structures as part of on-going and routine maintenance

Next Steps (2010 – 2016, budget permitting):

- increase engineering capacity to provide landowners and municipalities with greater technical assistance in the siting and design of culverts and road drainage infrastructure
  estimated budget: $150,000 (annually) action would be part of broader effort to increase engineering assistance available to landowners and municipalities, described under "channel modifications"
- develop and encourage the use of best practices for ditch outfall stabilization in order to dissipate energy and prevent erosion
  estimated budget: $30,000 (one-time) to develop best practices
  next steps: convene a workgroup of ANR and VTrans experts to establish best practices and management responsibilities

Further Measures (beyond 2016):

- provide financial assistance to towns to ensure the proper sizing and replacement of culverts
- identify and implement priority projects related to culverts throughout the Lake Champlain basin
- set culvert replacement modification priorities on the state, municipal and private systems through major, coordinated planning effort
- work with NRCS to develop a revolving loan fund to finance culvert replacement

Road construction and maintenance

EXPAND TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS THAT TARGET LOCAL (GRAVEL) ROADS

Current Actions:

- provide financial assistance to encourage good road maintenance practices
  - lead agency/organization: VTrans, in conjunction with the Better Backroads Program
  - annual budget: $380,000
  - outcomes: ~70 grants annually to towns for erosion control projects, on-site technical assistance and workshops
  - future needs: continued combination of state and federal funds for the program; maintained simplified grant process to enable town participation

Next Steps (2010 – 2016, budget permitting):

- establish FEMA funding guidelines to leverage greater financial support during flood recovery operations to ensure properly size structures and best practices are used
  - estimated budget: driven by flood-recovery efforts
  - next steps: work with FEMA to ensure that replacement structures achieve the best environmental outcome, rather than defaulting to "in-kind" replacement
- encourage municipalities to establish driveway and curb-cut ordinances to ensure proper drainage design (including culvert sizing)
  - estimated budget: $150,000 (annually) action would be part of broader effort to increase engineering assistance available to landowners and municipalities, described under "channel modifications"
  - next steps: review VTrans access permit program and the utility it could have as part of such an effort; consider including driveway ordinance as part of suite of road AMPs

Further Measures (beyond 2016):

- provide technical assistance to private property owners to better understand adverse effects of erosion of steep driveways and corrective action(s) that can mitigate adverse effects
- expand Local Roads Program to include more training and site visits/inspections to improve management of stormwater runoff from dirt roads

Road construction and maintenance

DEVELOP AND IMPLEMENT A SUITE OF ACCEPTED MANAGEMENT PRACTICES (AMPs) FOR ROADS THAT SPECIFICALLY ADDRESS DRAINAGE, MAINTENANCE, AND EROSION CONTROL

Current Actions:

- develop and offer best practice demonstrations for town road crews on proper ditch construction, maintenance, and erosion control

  lead agency/organization: Better Backroads and Local Roads Program, with financial support from the Agency of Transportation and the Federal Highway Administration

  annual budget: $153,000 in FY09

  outcomes: The Better Backroads program works with towns, planning commissions, nonprofits, and lake and watershed groups to correct road-related erosion problems to save towns money on road maintenance and improve water quality. Since 1997, 324 grants have been awarded to 154 towns and organizations. The Local Roads Program (http://www.vermontlocalroads.org/) hosts 70+ workshops per year, publishes quarterly newsletters, and has a "circuit rider" who provides on-site technical assistance to municipalities; the program also maintains a library of video and written resources

  future needs: continued combination of state and federal support for the programs

Next Steps (2010 – 2016, budget permitting):

- develop and implement a suite of water quality-based design standards and best management practices for road maintenance and drainage and link state transportation funding for municipalities to adherence to the standards

  estimated budget: $225,000 (annually) for workgroup facilitation, document development and publication and then program implementation; incremental cost of implementation to municipalities has not been estimated

  next steps: establish a task force that includes experts in roadway design and maintenance, as well as water quality experts, to create the suite of AMPs; VTrans has several relevant procedures/standards

Further Measures (beyond 2016):

- put in place a winter ban (akin to the manure spreading ban) for ditch cleaning
- encourage towns to use coarser gravels for road sanding, and reduce overall salt and sand applications
- use sediment trapping structures and other practices to disconnect ditches/drainages from discharging into directly waterways
- encourage municipalities to leave appropriate buffers between roadside ditches and adjacent land
- make state and local road crews responsible for managing drainage in a manner that ensures stability beyond the right-of-way
- extend municipal responsibility for the use of conservation practices to Class 4 roads and legal trails

Road construction and maintenance

USE TRANSPORTATION INFRASTRUCTURE PLANNING TO ADDRESS PHOSPHORUS POLLUTION AND STORMWATER MANAGEMENT

Current Actions:

- provide technical assistance to encourage the use of LID concepts (i.e., pervious pavement, greenways, narrower roadways) as road infrastructure is developed or significantly rehabilitated

  lead agency/organization: Agency of Natural Resources
  annual budget: $87,000 in FY10 of one-time 604b ARRA funds
  outcomes: a model subdivision ordinance, which addresses (among other things) roads widths, greenways, and pervious pavement, is under development
  future needs: permanent funding to ensure program stays intact and effective

Next Steps (2010 – 2016, budget permitting):

- adjust the Federal Highway Administration's (FHWA) definition of "allowable costs" to include more green/LID technologies

  estimated budget: budget neutral
  next steps: currently the CFR definition of allowable costs for State and local projects funded through FHWA does not include many LID concepts; this action would require support from the federal Congressional delegation

- establish allowable P-levels in road sand

  estimated budget: $50,000 (one-time)
  next steps: research in St Albans indicated that the contribution from phosphorus bound to road sand to the total load delivered to St Albans Bay was potentially significant; more work is needed to determine if this effect is localized and/or to predict the water quality impacts of road sand throughout the basin

Road construction and maintenance

ENHANCE TREATMENT OF STORMWATER RUNOFF FROM PAVED ROADS

Current Actions:

- pursue funding for additional stormwater mitigation grants for municipalities through the federal transportation bill
  - lead agency/organization: congressional delegation; Agency of Transportation; the Vermont Local Roads Program
  - annual budget: as part of the 2005 federal transportation bill, more than $6 million was made available to Vermont municipalities to reduce water pollution directly associated with public roads and road maintenance
  - outcomes: federal funds have provided essential cost share for dozens of water quality projects ranging from the purchase of maintenance equipment to the installation of gravel wetlands and other innovative treatments
  - future needs: the federal transportation bill is schedule to be reauthorized in 2010, and continued, high-level federal financial support for stormwater management from road infrastructure is essential

Next Steps (2010 – 2016, budget permitting):

- develop specific strategies in the *Stormwater Management Manual* to address stormwater runoff from roadway infrastructure
  - estimated budget: $25,000 (one-time)
  - next steps: evaluate strategies for a targeted approach for dealing with stormwater runoff from roadway infrastructure, including the role that general permit could play
- better enforce requirements for periodic maintenance of stormwater infrastructure once treatment practices are in place
  - annual budget: $75,000 (annually)
  - next steps: create position dedicated to an expanded maintenance/reporting/inspection program
- develop cost-share program for (shared) stormwater maintenance or BMP equipment
  - estimated budget: $100,000 (annually)
  - next steps: regional entities, such as regional planning commissions, develop a framework to support equipment sharing and implement a grant program to incentivize purchases

Further Measures (beyond 2016):

- create a statewide General Permit specific to stormwater from road construction projects
- expand MS4 program to include paved roadway infrastructure throughout the Lake Champlain basin

Failure to implement forest management practices

EXPAND TECHNICAL ASSISTANCE OFFERINGS TO LOGGERS

Current Actions:

- expand the *Portable Skidder Bridge Initiative,* fabricating and making available additional bridges to loggers for purchase/loan/rent
  - lead agency/organization: Agency of Natural Resources, in conjunction with Northern Vermont RC&D
  - annual budget: approximately $100,000
  - outcomes: twenty-two portable skidder bridges are currently available for loan/rent statewide; a project coordinator was hired in 2008 to provide technical assistance to loggers using the bridges
  - future needs: expanding the pool of available bridges, including several heavier-duty bridges capable of accommodating larger equipment; estimate budget - an additional $75,000
- provide AMP and portable skidder bridge workshops for loggers, landowners, and consulting foresters
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $80,000 (for technical assistance)
  - outcomes: staff within the Department of Forests, Parks & Recreation (FPR) have observed that water quality violations associated with logging operations are becoming less severe
  - future needs: continued support for outreach and education efforts targeting loggers

Next Steps (2010 – 2016, budget permitting):

- work with NRCS to continue to expand technical and financial assistance available to forest landowners through EQIP
  - estimated budget: budget neutral, drawing from existing pool of EQIP funds
  - next steps: since its inception, EQIP has been regarded as a "traditional agricultural program," therefore it is critical to increase the overall awareness of EQIP among forest landowners

Further Measures (beyond 2016):

- expand technology transfer between the Vermont Cooperative Soil Survey Partnership and forest management professionals
- promote LEAP (Logger Education to Advance Professionalism) training program for loggers

Failure to implement forest management practices

USE THE *Acceptable Management Practices* (AMPs) TO ADDRESS EROSION PREVENTION AND SEDIMENT CONTROL

Current Actions:

- expand the Watershed Forestry program
  - lead agency/organization: Agency of Natural Resources
  - annual budget: $85,000
  - outcomes: the watershed forester provides education, outreach, and technical assistance to forest landowners, loggers, forestry professionals, and the general public in regards to forestry principles and practices associated with protecting forest water quality, preventing soil erosion, and maintaining forest riparian health
  - future needs: financial and technical resources to continue to offer training and grow the skidder bridge so that resources are widely available throughout the Lake Champlain basin

Next Steps (2010 – 2016, budget permitting):

- expand the technical elements of the forestry AMPs to specifically address: operations on non-frozen ground, logging in wetlands, and the handling of hazardous materials
  - estimated budget: $50,000 (one-time)
  - next steps: Vermont's AMP manual has not been updated since it was originally published in 1987; revisions to the manual would necessarily involve input from stakeholders as well as ANR staff
- require better protection of Streamside Management Zones (SMZ) during timber harvesting operations
  - estimated budget: budget neutral, assuming done in conjunction with other updates to AMPs
  - next steps: could be considered as part of the broader updates/revisions to the AMPs described above; AMP #14 provides a good, although voluntary, framework for SMZ protection

Further Measures (beyond 2016):

- expand the informational and educational elements of the forestry AMPs to specifically address: new tools, technology, and tested field methods
- implement CGP-like permit requirements for the construction of new logging roads, skid trails, and log landings
- require notification when forest land is converted to agricultural use and have in place regulatory standards to protect water and soil resources during conversion

Failure to implement forest management practices

MAKE AVAILABLE ADDITIONAL FINANCIAL ASSISTANCE TO SUPPORT FOREST STEWARDSHIP

Current Actions:

- expand the forestry practices eligible for cost-share under EQIP to include forest trail and land closure, and improved stream crossings on forest roads

lead agency/organization: NRCS; Agency of Natural Resources

annual budget:	budget neutral; applications for expanded practices will compete with those previously eligible for EQIP funding
outcomes:	eligible forestry practice have been expanded in FFY10 to include forest trail and landing closure, and improved stream crossings on forest roads
future needs:	TBD

Next Steps (2010 – 2016, budget permitting):

- increase EQIP funding available for forest management plans

estimated budget:	projected $742,000 in FY10, up from $148,363 in FY09
next steps:	each year NRCS apportions EQIP funds into several program areas including: structural and non-structural practices for agricultural operations and forestry; allocations are developed by NRCS' EQIP subcommittee and approved by the State Conservationist – therefore, participation on the EQIP subcommittee is essential

Further Measures (beyond 2016):

- achieve no net loss of forest in the Champlain basin
- work with the U.S. Forest Service (USFS) to expand partnerships in the Lake Champlain basin
- identify forested parcels at risk for conversion through watershed assessment and analysis
- increase the amount of conserved forest land
- develop and implement strategies to curtail the rate and mitigate the effects of parcelization and forest fragmentation
- obtain additional resources from NRCS and USFS to raise the level of overall forest land management thru innovative watershed projects

Failure to implement forest management practices

IMPLEMENT STRATEGIES TO ENHANCE FOREST CANOPY AND TREE COVER IN DEVELOPED AREAS

Current Actions:

- work with communities to complete assessments of urban forest resources, adopt a local goal to increase urban tree canopy, and encourage measures to attain the established goals; focus initial efforts on communities with impaired watersheds due to stormwater runoff

  lead agency/organization: Agency of Natural Resources, with funding from U.S. Forest Service

  budget: $120,000, to date, from the U.S. Forest Service for assessment and strategy work in Burlington, St. Albans, Rutland and Montpelier

  outcomes: locally developed strategic plans to protect, enhance and increase urban tree canopy cover in target communities

  future needs: regional planning commissions taking a lead role in conducting future assessments and leading the charge in developing canopy goals and developing a strategic plan to reach them

Next Steps (2010 – 2016, budget permitting):

- establish procedures for guiding the long-term maintenance of the urban forest

  estimated budget: $25,000 (one-time)

  next steps: clearly define the link between urban forestry and water quality programs, developing the water quality message for the urban forest

- work with communities and town officials to identify priority forests, and strengthen planning and zoning strategies for forest conservation and protection areas

  estimated budget: $50,000 (annually) for technical assistance

  next steps: develop a process for determining priority forests and a program to assist communities in adopting land use planning tools to accomplish this goal

Further Measures (beyond 2016):

- encourage the adoption of local policies to plant and protect trees during development and redevelopment such as: landscaping requirements, promoting trees in stormwater treatment practices, and tree protection plans
- investigate innovative stormwater management program using trees, plantings and landscaping

Wetland modifications

EXPAND VOLUNTARY AND REGULATORY PROGRAMS TO PROTECT AND RESTORE WETLANDS

Current Actions:

- implement the *Lake Champlain Basin Wetland Restoration Plan*
  - lead agency/organization: Agency of Natural Resources
  - annual budget: more than $75,000 in grants was provided in FY10 to non-profit groups to identify and develop wetland restoration projects
  - outcomes: to date, $1 million Vermont has appropriated specifically for the implementation of the *Lake Champlain Basin Wetland Restoration Plan* which has been committed to projects that will result in the protection and/or restoration of nearly 800 acres
  - future needs: expanded capacity for project identification and development
- increase, through restoration, the total number of acres of functioning wetland in the Lake Champlain basin
  - lead agency/organization: NRCS; Agency of Natural Resources
  - annual budget: $6 million in FFY09 available through the Wetlands Reserve Program (WRP)
  - outcomes: in FFY09, 16 projects totaling almost 1000 acres were enrolled in WRP and will be restored in the next 12-24 months
  - future needs: continued availability of financial resources through NRCS

Next Steps (2010 – 2016, budget permitting):

- reduce regulatory requirements for wetland restoration projects
  - estimated budget: budget neutral
  - next steps: ANR treats wetland restoration projects as an "allowable use" and therefore does not impose state jurisdiction; similar allowances should be made under federal regulatory authorities

Further Measures (beyond 2016):

- achieve no net loss of wetlands in the Lake Champlain basin
- increase financial incentives available for protecting wetlands from conversion
- identify Class III wetlands in the Lake Champlain basin that provide water quality functions and reclassify them to Class II
- implement a public education campaign to improve awareness of the importance of wetlands

Wetland modifications

MITIGATE FOR AND RESTORE WETLANDS IMPACTED BY AGRICULTURAL OPERATIONS

Current Actions:

- broaden the conservation purposes of and annually expend all funds made available through the Wetland Reserve Program (WRP) and Farmland Protection Program (FRPP) to permanently protect and restore wetlands and stream corridors

  lead agency/organization: Natural Resources Conservation Service
  annual budget: $6 million in FFY09
  outcomes: in FFY09, 16 projects totaling almost 1000 acres were enrolled in WRP and will be restored in the next 12-24 months
  future needs: $200,000 (annually) for outreach, project development, and technical assistance, although unprecedented resources were available for wetland restoration and protection were available in FFY09 through the WRP program, attendant staff resources were not available through NRCS; in order to achieve the full promise of the funds allocated to WRP more staff resources must be made available through NRCS

Next Steps (2010 – 2016, budget permitting):

- develop an approach to allow portions of farms previously conserved under the Farmland and Rangeland Protection Project (FRPP) to be enrolled in Wetland Reserve Program (WRP) so that on-site wetlands can be restored

  estimated budget: budget neutral
  next steps: evaluate mechanisms for creating the necessary flexibility to allow conservation easements on farms that have previously been conserved for agricultural purposes; may require support from the federal congressional delegation

Further Measures (beyond 2016):

- rewrite wetland rules to no longer exempt, across the board, agricultural activities impacting wetlands from state regulation
- develop an in-lieu fee mitigation bank that is designed to meet the needs of agricultural landowners
- identify critical parcels where PC-wetlands should be restored

Wetland modifications

USE FINANCIAL INCENTIVES TO PROTECT AND RESTORE WETLANDS

Current Actions:

- establish an in-lieu fee mitigation program and make it available to developers

  lead agency/organization: Agency of Natural Resources, Army Corps of Engineers
  annual budget: anticipated $200-600,000 for mitigation
  outcomes: Ducks Unlimited has submitted a prospectus to the Corps for an in lieu fee program for Vermont
  future needs: TBD

Next Steps (2010 – 2016, budget permitting):

- relax the criteria used to determine eligibility for parcels to be enrolled in the Wetland Reserve Program (WRP)

  estimated budget: budget neutral
  next steps: the most recent Farm Bill changed the eligibility requirements for landowners interested in enrolling lands in WRP; most problematic is the newly-minted requirement that the current owner must have owned the land for a period of at least seven years prior to enrolling it in WRP – the applicability of this requirement to Vermont (and other New England states) should be reevaluated

Further Measures (beyond 2016):

- look for opportunities to access state wildlife grant monies, duck stamp monies, Pittman-Robertson monies in projects that jointly benefit wildlife and water quality
- develop technical and financial assistance programs that target the protection and restoration of "high value" wetlands on tracts that are not eligible for enrollment in WRP

Legacy effects

UNDERSTAND PAST PRACTICE IN ORDER TO INFORM FUTURE MANAGEMENT DECISIONS

Current Actions:

- remove the Missisquoi Bay and Carry Bay causeways, as appropriate
  - lead agency/organization: Agency of Natural Resources, with technical and financial support from the Army Corps of Engineers
  - annual budget: the Corps is currently drafting a project management plan for the Carry Bay project, including a budget
  - outcomes: ANR is currently working with the Army Corps on a Project Management Plan for the feasibility study of the removal of the Carry Bay Causeway
  - future needs: the State and/or non-federal partners will need to be able to pay at least 35 percent of the total cost of the project with a combination of cash and in-kind services
- complete the in-lake treatment in St Albans Bay/Black Creek Swamp, if appropriate
  - lead agency/organization: Army Corps of Engineers
  - budget: $300,000 (combined state and federal) for Phase II study
  - outcomes: ANR is currently working with the Army Corps on a Project Management Plan for the Phase II study of alternative treatments, and expects that the Phase II study will proceed in 2010
  - future needs: implementation is anticipated to cost between $500,000 and $3.5 million
- estimate the effect that nutrient dynamics (i.e., internal loads) may have on critical lake segments including, but not limited to, Missisquoi Bay
  - lead agency/organization: Lake Champlain Basin Program
  - annual budget: $125,000 was allocated in LCBP's FY09 budget
  - outcomes: LCBP appropriated funds for a preliminary study of nutrient dynamics in the Missisquoi Bay in FY09; and RFP is expected to be released shortly
  - future needs: total cost for the modeling necessary to develop a comprehensive assessment of internal loads is estimated at $450,000

Further Measures (beyond 2016):

- restore and protect river corridor and floodplain function to maximize storage of sediment and nutrients in the watershed
- provide broad-based environmental education for the public regarding the cumulative impacts that more than 200 years of intensive land use have had on the Lake Champlain basin

Failure to consider climate change in planning and design

CONSIDER THE EFFECTS CLIMATE CHANGE COULD HAVE ON STRATEGIES TO REDUCE PHOSPHORUS POLLUTION IN LAKE CHAMPLAIN

Current Actions:

- use "best available" science to factor changing hydrology patterns associated and anticipated with climate change into management strategies
  lead agency/organization: many
  future needs: continue to keep abreast of the best available science and adapt implementation efforts to account for the most current information available on the measured and predicted effects of climate change

Next Steps (2010 – 2016, budget permitting):

- utilize, when available, LCBP/EPA research on the effects of climate change on the Lake Champlain basin
  estimated budget: $75,000 (one-time)
  next steps: LCBP appropriated funds to open an investigation into the effects of climate change on Lake Champlain in FY09; and RFP is expected to be released shortly

- increase resilience of watersheds to attenuate increased volume and frequency of flooding
  next steps: expand programs designed restore and protect wetland, river corridor and floodplain function

APPENDIX G: Program Indicators for the Lake Champlain TMDL Implementation Plan

Indicator	Acceptable Level (Near-Term)	Acceptable Level (Ultimate)
Agricultural Sources		
Percent of farm inspections identifying violations of Accepted Agricultural Practices	5%	0%
Estimated percent of farms in need of BMP structures, by farm size (LFO, MFO, or SFO) and by structure type: (a) Manure storage (b) Silage leachate treatment (c) Barnyard runoff treatment (d) Milkhouse waste treatment (e) Nutrient management plan Current needs are: <u>SFOs</u> a) 50% b) 30% c) 75% d) 50% e) 65% <u>MFOs</u> a) 10% b) 37% c) 20% d) 0% e) 5% <u>LFOs</u> 0% all types (Note: A need identified for small farms does not mean that without each structure there will be uncontrolled discharges; instead it is an estimate of farms in need regardless of proximity of water resources. For MFO and LFO farms, the results do consider the proximity to water, however they are not suggesting a discharge exists, rather that the risk is increased and it is the Agency's preference that the structure is redesigned.)	SFOs: 5% for all types, by 2013 MFOs: 0% for all types, by 2013 LFOs 0% for all types (current level)	All farms: 0% for all types
Number of farms with completed Small Farm Production Area Surveys	Rock River: 40 by 2009 St Albans Bay and Hungerford Brook: 26 by 2010 Rutland County (predominately South Lake): 18 by 2010 Statewide: 193 farms by 2010	All farms in high priority watersheds surveyed on a 5-year cycle. All other farms surveyed on a 10-year cycle.
Percent of farms with silage leachate systems built to NRCS/VAAFM standard.	100% of farms receiving cost-share from the VAAFM will be built to the NRCS/VAAFM standard.	100% of new, expanded or improved silage leachate systems posing a water quality risk will be updated to the NRCS/VAAFM standard.

Indicator	Acceptable Level (Near-Term)	Acceptable Level (Ultimate)
Area of agricultural land receiving manure annually that is managed under a nutrient management plan (NMP)	200,000 acres, or 45% of the total acres in agricultural production by 2012	100% of the land with a manure production to land ratio of a minimum 4,000 gal/acre will have a NMP that meets the NRCS 590 standard. Farms under 4,000gal/acre will continue to be managed under AAP NMP requirements.
Area of annual cropland that is cover-cropped under the state program (Note: In FY 2010 approximately 7,500 acres were planted to cover crops by October 31st. A goal for FY 2011 is that 100% of the land that can be physically be planted to cover crops in the FAP program is completed by October 15.)	12,000 acres by 2012	90% of the annual crop land in identified critical source areas implement cover cropping (100% is not realistic as weather constraints cannot be predicted)
Area of agricultural land enrolled in CREP (2,313 acres currently enrolled)	2,600 acres of crop, hay, and pasture land by 2012, including at least 600 acres of annual cropland in partnership with NRCS and USFWS	Continue to enroll a minimum of 300 acres per year statewide until appropriate buffer compliance is achieved.
Area of agricultural land using alternative manure spreading methods (e.g., manure injection and/or soil aeration) (Note: In 2009 more than 13,000 acres utilized soil aeration in Northern Lake Champlain.)	15,000 acres by 2012	90% of the land in identified critical source areas utilize some form of alternative manure application management (100% is not realistic as weather constraints cannot be predicted).
Area of cropland using conservation tillage (Note: In FY 2010 more than 350 acres were enrolled, which is an increase from previous years.)	500 acres by 2012	90% of the land in identified critical source areas utilize some form of conservation tillage on annual cropland (100% is not realistic as weather constraints cannot be predicted).
Develop a new program and technical assistance effort that allows single and double strand poly-wire fencing to exclude livestock from streams.	Identify funding resources and begin program development and implementation in 2010.	By 2015 begin the process of revising the AAPs to include livestock exclusion from all lakes and streams where it is technically and financially feasible.

Indicator	Acceptable Level (Near-Term)	Acceptable Level (Ultimate)
Area of pasture and/or hay land enrolled in CREP annually	200 acres of pasture and/or hay land, with a minimum of 50,000 linear feet of fence installed each year between now and 2012	Continue to enroll a minimum of 300 acres per year statewide and 50,000 linear feet of fence until appropriate buffer compliance is achieved.
Area of pasture land using prescribed grazing systems	10,000 acres by 2012	All grazing systems include livestock exclusion from streams where technically and financially feasible, and maintain reasonable livestock stocking densities to minimize water quality impacts.
Wastewater Discharges		
Total wastewater phosphorus load, by Vermont lake segment	Less than the applicable wastewater allocation for the lake segment	Less than the applicable wastewater allocation for the lake segment
Percent of wastewater facilities meeting TMDL wasteload allocation	100% by 2012	100%
Complete implementation of remaining wastewater upgrades specified in the TMDL	Complete upgrades at Waterbury and Troy/Jay by 2012	
Number of wastewater treatment facilities in the Lake Champlain basin having an approved sewage spill prevention plan for the treatment plant and collection system	All 60 facilities by 2012	
Number of combined sewer overflows (CSOs) eliminated in the Lake Champlain basin		All 55 CSOs
Stormwater Management		
Percent of stormwater permit projects inspected annually, by permit type (construction, operational ,industrial) Requires additional staff and resources.	10% of all construction permits and 5% of all operational permits	20% of all construction permits and 10% of all operational permits
Percent of all permitted construction and operational stormwater sites in substantial compliance with their permit		100%
Stormwater management manuals including best available technologies and standards	Update the Vermont Stormwater Management Manual by 2010 to further incorporate Low Impact Development practices into technologies available to stormwater designers	Continuously update technical standards as warranted by advancement of technologies and standards
Educational materials for towns to use when reviewing building permit applications and provide assistance with developing a question related to obtaining a stormwater permit (construction and operational) on all building and zoning permit applications. Requires additional staff and resources.	Develop materials by 2012	

Indicator	Acceptable Level (Near-Term)	Acceptable Level (Ultimate)
Technical training and materials related to erosion prevention, sediment control, and post-construction stormwater management practices for projects that do not trigger state jurisdiction Requires additional staff and resources.	Create materials by 2012 and provide training in 20 towns per year thereafter	
Number of Stormwater TMDLs adopted and implemented. Requires additional staff and resources	14 adopted	14 adopted and 14 implemented (includes all stormwater impaired waters in Lake Champlain Basin
Number of Lake Champlain Basin towns with good water quality protection provisions in town plans and zoning ordinances, including incorporation of Low Impact Development standards where appropriate Requires additional staff and resources.		100%
Better Backroads		
Number of Better Backroads Program inventory and capital budget planning projects		
Cumulative number of road ditches stabilized by the Better Backroads Program since 2004		
Cumulative number of culverts stabilized by the Better Backroads Program since 2004		
Cumulative number of roadside banks stabilized by the Better Backroads Program since 2004		
Percent of Vermont towns participating in the Better Backroads Program since 1997		100%
Technical and financial assistance to municipalities to implement best management practices and construction techniques for upgrading and maintaining rural roads	Provide assistance to at least 50 municipalities	
Percent of towns following acceptable management practices on roads (dependant on funding to develop and implement these standards, currently a priority "next step" in this plan)		100%
River Management		
Percent of Vermont river miles in each stream geomorphic assessment category: I. Equilibrium II. Incised and steepening III. Incised and widening IV. Incised and depositional V. Restored equilibrium	Reduce percent of river miles in Stages II and III from current 60% to 50% by 2020	Reduce percent of river miles in Stages II and III to 30%
Floodplain restoration results: (a) Area of floodplain access actively restored (b) Area of floodplain access under passive restoration (c) Volume of sediment deposited (d) Mass of phosphorus deposited (if measurements are available)	(a) 20 acres actively restored (b) 200 acres under passive restoration	
Number of communities with completed Fluvial Erosion Hazard (FEH) maps	75 communities by 2012	100% of communities

Indicator	Acceptable Level (Near-Term)	Acceptable Level (Ultimate)
Number of communities with adopted municipal FEH ordinances	10 communities per year between now and 2012 (when significant municipal incentives are established)	100% of communities (when significant municipal incentives are established)
Number of communities with modernized FEMA maps and/or model ordinances designed to surpass floodplain protection beyond the NFIP minimum standards	5 communities per year	100% of communities
Number of river corridor easements for reaches of river identified as key sediment attenuation areas in completed geomorphic-based river corridor plans	20 reaches per year	40 reaches per year
Number of floodplain restoration projects completed annually	3 projects annually through 2012	6 projects annually
Number of river corridor easement projects with buffer vegetation reestablished	10 reaches per year through 2012	20 reaches per year
Number of encroachment removal/retrofit projects completed per year (encroachments include structures such as berms and stream crossings)	4 projects per year through 2012	10 projects per year
Wetland Restoration		
Number of landowners in the Lake Champlain Basin signed up for the USDA's Wetland Reserve Program (WRP)	60 landowners by 2012	
Area of wetland restored annually through the Wetland Reserve Program in partnership with the State of Vermont and USFWS	500 acres restored annually; 2,000 acres by 2012	
Forest Management		
Number of participants in logger education workshops annually		
Number of forestry Accepted Management Practice technical assists annually		
Portable Skidder Bridge Program indicators: (a) number of rentals/loans (b) harvested area accessed (c) lumber volume harvested using portable skidder bridges		
Number of portable skidder bridges made available to loggers for purchase/loan/rental	20 additional portable skidder bridges by 2012	