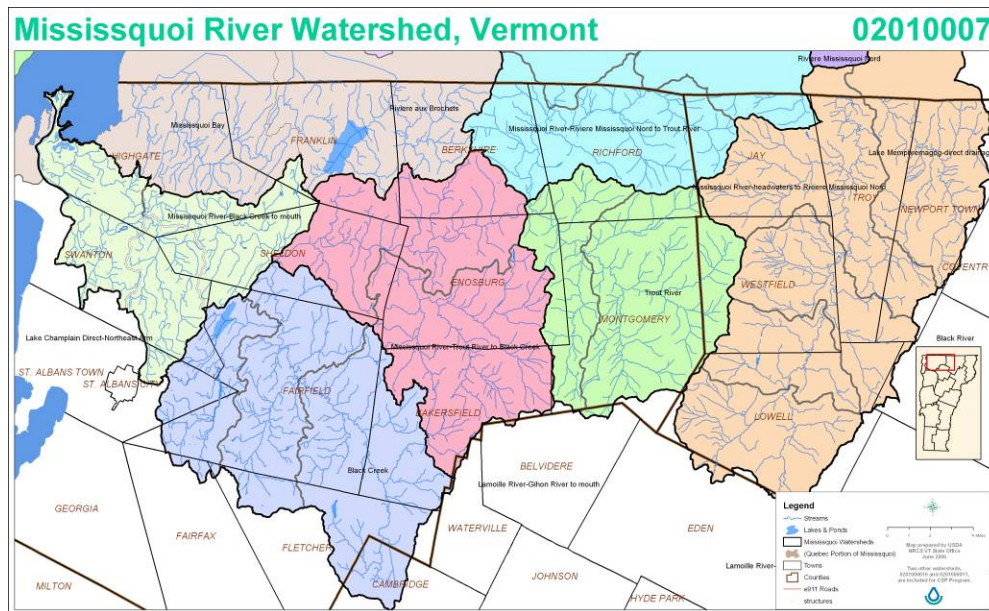


# The Missisquoi Areawide Plan

## MISSISQUOI RIVER BASIN – VERMONT: A WATERSHED APPROACH TO IMPROVING WATER QUALITY IN LAKE CHAMPLAIN



## An NRCS-Led Partnership Project to Develop Strategies for Reducing Agriculturally-Related Phosphorus Pollution in Missisquoi Bay

January 22, 2008 Draft

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# The Missisquoi Areawide Plan

## MISSISQUOI RIVER BASIN – VERMONT: A WATERSHED APPROACH TO IMPROVING WATER QUALITY IN LAKE CHAMPLAIN

### INTRODUCTION

#### **Project Background - Lake Champlain and the Missisquoi Sub-basin**

Lake Champlain is one of the largest bodies of freshwater in the world. Most of its 120 mile length and drainage basin is divided between Vermont and New York. The most northern end of the Lake extends into the province of Quebec in Canada. Due to the worsening water quality problems in Lake Champlain the Lake Champlain Special Designation Act (Public Law 101-596) was signed into law on November 16<sup>th</sup>, 1990. This Act has led to an ongoing multi-jurisdictional effort comprised of the states of New York and Vermont, and the province of Quebec to address water quality and other concerns in the Lake Basin.

Known for its scenic beauty, Lake Champlain attracts millions of tourists each year. It is also the drinking water source for over 200,000 people in Vermont and New York. Unfortunately, it is also a water body with significant water quality problems, particularly in Missisquoi Bay. This Bay is shallow and eutrophic; it experiences severe, and sometimes toxic, algae blooms that typically occur each summer. The Missisquoi Bay watershed covers about 720 square miles in Vermont. Most of it occupies an 8-digit sub-basin (02010007) under the Natural Resources Conservation Service (NRCS) Hydrologic Unit Code (HUC) system. About 20 percent of the Sub-basin lies in Canada. The Canadian portion of the Sub-basin is not considered in this report unless it is otherwise specifically mentioned.

The Missisquoi Bay Sub-basin is a very rural area located in the northwest corner of Vermont adjacent to the Canadian border. It is dominated by forests and agricultural lands which comprise 68 and 21 percent of the land cover, respectively. Urban and other built-up uses comprise only about 5 percent of the land cover in the watershed<sup>1</sup>. Due to the extent of agriculture in the watershed most of the pollutant primarily responsible for the eutrophic conditions in the Bay, specifically phosphorus (P), is from agricultural sources. An estimated 70% of the non-point phosphorus load in the Sub-basin originates from agricultural sources<sup>1</sup>.

Agriculture in the Missisquoi Sub-basin is dominated by dairy operations. The phosphorus runoff from animal waste handling facilities and land application of manure and fertilizer are the principal management concerns. Erosion resulting from cropping practices, stream channel instability, and forestry practices also contribute phosphorus-laden sediment to the

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<sup>1</sup> Troy A., Wang D. and Capen D., The Rubenstein School of Environment and Natural Resources University of Vermont, Updating the Lake Champlain Basin Land Use Data to Improve Prediction of Phosphorus Loading. LCBP Technical Report #54, 2007, 121p.



Bay. There is an extensive legacy of phosphorus applications to fields during the early history of farming in the Sub-basin. As a result, some of the alluvial soils along the stream network have accumulated phosphorus throughout the profile. Because of the intensity of agriculture in this area, many of the stream reaches in the Missisquoi Sub-basin are included on the Vermont State 303(d) list as “Impaired Waters” due to agriculture<sup>2</sup>. The Phosphorus Total Maximum Daily Load (TMDL) for Lake Champlain identifies a phosphorus reduction goal of 40 metric tons per year<sup>3</sup>. This is the largest required phosphorus reduction of any lake segment in the Lake Champlain Basin.

Led by efforts under the Lake Champlain Basin Program (LCBP) a plan was developed in 1990, “Opportunities for Action”<sup>4</sup>, that provided guidance for addressing water quality and other concerns in the Basin. More recently, Vermont Governor Jim Douglas designated a state Clean & Clear Initiative<sup>5</sup> to improve water quality. This initiative has provided additional State funds to implement targeted water quality improvement and protection programs in the Lake Champlain Basin. Since the most severe water quality problems in the Lake occur in the Missisquoi Bay and nearby St. Albans Bay, a new “Northern Waters” initiative is also underway. This “Northern Waters” effort focuses the State’s conservation efforts and funds on Missisquoi and St. Albans Bay, essentially designating these as the highest priorities for water quality remediation in the State.

This Areawide Plan consists of a series of water quality improvement strategies that target efforts to specific priority areas. They have been developed in close consultation with local stakeholders and representatives of various state and federal agencies. These strategies represent a first initial attempt to target conservation efforts in the Sub-basin. NRCS and other co-operating agencies and organizations will continue to refine priorities and targeting methods in the forthcoming years. Most of the methods and procedures developed in this plan for the Missisquoi Sub-basin could be employed in other priority watersheds in Vermont and elsewhere.

## **Scope of Project**

The Missisquoi River Sub-basin (hydrologic unit code 02010007) is large, about 862 sq. mi. (Figure 1). It spans the border between Quebec, Canada and Vermont. Eighty three percent of the Sub-basin is in Vermont. Vermont portions of the Rock and Pike River Sub-watersheds (Lake Champlain Direct Sub-basin, code 02010008), comprising about 148 square miles, will be included in the project area because these sub-watersheds also drain to Missisquoi Bay and make for a more sensible project area. The Rock and Pike River Sub-watersheds are of particular conservation concern for both partners and the NRCS due to

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<sup>2</sup> Vermont Department of Environmental Conservation, State of Vermont 2006 303(d) List of waters Water, March 1, 2007, 10p.

<sup>3</sup> Vermont Agency of Natural Resources, Department of Environmental Conservation, Lake Champlain Phosphorus TMDL, September 25, 2002, 130p.

<sup>4</sup> Lake Champlain Basin Program, Opportunities for Action Lake Champlain Management Plan, April 2003, 138p.

<sup>5</sup> Vermont Agency of Natural Resources, Center for Clean and Clear DRAFT Work Plan, August 29, 2007, 86p.

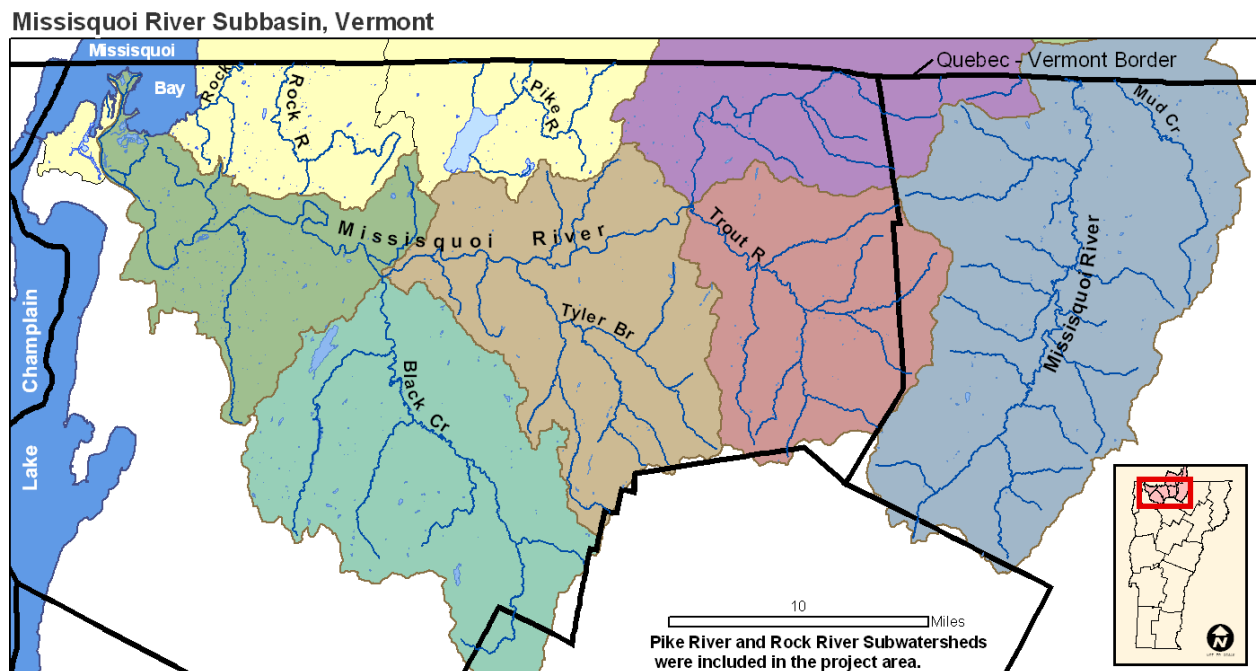
their large contributions of phosphorus to the Bay. All of these collective watersheds are referred to as the Missisquoi Sub-basin throughout this report.

### **Need for an Area-wide Plan**

Conservation measures to remediate water quality problems in Missisquoi Bay have been conducted for several decades. NRCS, the Farm Service Agency (FSA) and the Vermont Agency of Agriculture, Food and Markets (VAAFM) have targeted this area for conservation programs since the early 1980's. More recently, the State of Vermont has also undertaken efforts to reduce phosphorus discharges from point sources such as sewage treatment plants and urban stormwater outlets. To date, millions of dollars of conservation funds have been spent in the Sub-basin with as yet no observable improvement in water quality.

At this point in time no formal plan has been developed for conservation efforts in the Missisquoi Sub-basin. Conservation implementation actions are largely conducted on a first come, first served basis working primarily with farmers who apply for conservation program cost-share funds. In addition, there has been no comprehensive database, including geospatial information, to help compile, integrate, and analyze the various resource needs in the Sub-basin. The development of this comprehensive database, in conjunction with a well thought out plan, will enable the effective targeting of restoration efforts. In the future, this data will also be used to help evaluate the effectiveness and success of conservation efforts in the Missisquoi Sub-basin and direct watersheds

**Figure 1 - Map of the Missisquoi Sub-basin and Sub-watersheds.**



Annual expenditures of conservation funds in the Missisquoi Sub-basin total several million dollars. The total annual expenditures by NRCS for all of its conservation programs is estimated to be between 1 - 2 million dollars per year. The State of Vermont also has several well funded conservation programs with expenditures of less than 1 million dollars per year in the Sub-basin. In addition, the U.S. Environmental Protection Agency and the International Joint Commission, through the LCBP, expects to allocate more than \$400,000 for monitoring and phosphorus reduction in the Missisquoi Sub-basin. However, these funds appear to be insufficient when compared to the total conservation need.

In the agricultural sector alone, initial anticipated conservation systems needed for all Sub-basin farms include over 200 waste storage facilities, 185 barnyard runoff control systems, conservation crop rotation on 2,550 acres, 180 comprehensive nutrient management plans, 800 acres of filter strips, and over 300 acres of forested riparian buffer<sup>6</sup>. Based on these NRCS estimates, the total estimated implementation need in the Missisquoi Sub-basin is approximately \$30,804,500 (Table 1). Obviously, the total conservation needs far exceed the funds available to address these needs. In order to achieve significant improvements in water quality, these limited conservation funds must be spent as effectively as possible.

### **Project Objectives**

NRCS and its partners will develop tools which compile existing data with new data inventories to characterize resource problems, target land-based implementation efforts, and leverage NRCS programs with state and local partner programs. This framework will be refined throughout the project to improve its application in future priority sub-basins. The implementation phase will utilize Farm Bill programs with other available federal, state and local programs to implement targeted conservation practices that optimize environmental benefits.

This project will develop a watershed-based Area-wide plan that will reduce the Phosphorus load delivered to Missisquoi Bay. The plan is structured to inform and help partner agencies and cooperating farmers schedule their work in the Missisquoi to complement each others' efforts, addressing the most pressing resource concerns first. The Missisquoi Sub-basin is a Conservation Security Program (CSP) Priority Watershed and this plan will provide extensive information to guide CSP program delivery.

Geospatial analysis and simple hydrologic modeling are used in a watershed approach, to examine where conservation interventions are likely to have the greatest impact. This includes assessing which sub-basins and farm/field locations are the greatest pollution source areas, which stream reaches are transporting the largest amounts of sediment and phosphorus downstream, and where conservation practices, channel modifications, wetland enhancements, and other actions will have the greatest potential for phosphorus reduction.

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<sup>6</sup> USDA-NRCS, personal communication with Kathryn Hakey, 2007.

**Table 1 - Missisquoi Sub-basin, Vermont - Conservation Needs (60% participation), with Costs.**

			Completed		Obligated		Remaining	
Practice Name	Unit	Ave. Unit Cost	#	Est. Dollars FA	#	Est. Dollars FA	~#	Est. Dollars FA
Waste Storage Facility	each	70,000	19	1,330,000	41	2,870,000	205	14,350,000
Manure Transfer	each	20,000	28	560,000	37	740,000	185	3,700,000
Heavy Use Area Protection	each	40,000	12	480,000	37	1,480,000	185	7,400,000
Composting Facility	each	20,000	4	80,000	8	160,000	40	800,000
Roof runoff Structure	each	7,500	15	112,500	37	277,500	185	1,387,500
CNMP	each	500	24	12,000	36	18,000	180	90,000
Nutrient Management	acre	18	5700	102,600	9900	178,200	49500	891,000
Conservation Crop Rotation	acre	250	150	37,500	510	127,500	2550	637,500
Residue Management	acre	45	0	0	260	11,700	1300	58,500
Streambank/Shoreline Protection (bio)	linear foot	50	1100	55,000	1300	65,000	10000	500,000
Cover Crop	acre	25	225	5,625	800	20,000	4000	100,000
Riparian Forest Buffer	acre	2,500	18	45,000	28	70,000	308	770,000
Filter Strip	acre	150	50	7,500	160	24,000	800	120,000
		<b>Totals</b>		<b>2,827,725</b>		<b>6,041,900</b>		<b>30,804,500</b>

This Missisquoi Areawide Plan pulls together data collected to date and provides a newly developed framework for incorporating geomorphic and geospatial information into the VT Department of Environmental Conservation (DEC) Missisquoi Basin Plan and the Clean and Clear Work Plan. This planning framework may then be used in future Basin Plans being developed for the State's 16 other priority sub-basins. The Geographic Information System (GIS) inventories and analyses will drive and target land-based implementation efforts planned for the Sub-basin by willing partners who will leverage NRCS programs with state and local programs to optimize environmental results.

Specific objectives of the Missisquoi Areawide Plan include:

- i. Integrate existing and newly developed databases** for the Sub-basin, and collect missing information needed to identify major sources of P.
- ii. Use stream geomorphic data to highlight priority reaches**, and improve access to the

data by all partner agencies.

**iii. Describe P transport and sequestration mechanisms** within the Sub-basin, and develop a model to analyze P transport, sedimentation and delivery.

**iv. Incorporate farmer resource concerns** into the planning process and relate to target areas.

**v. Collaboratively determine conservation priorities, using GIS to analyze compiled data** to more efficiently and effectively develop solutions to address those priorities.

**vi. Develop a coordinated, spatially-enabled approach to implementation;** optimize and foster strategies by agencies, local organizations, and farmers.

The newly developed framework for incorporating geomorphic and geospatial information into the Missisquoi Bay and future watershed plans will be achieved through active collaboration. NRCS and its partners will use tools developed for this Areawide Plan which compile existing data, and develop new data inventories to characterize resource problems, target land-based implementation efforts, and leverage NRCS programs with state and local partner programs to optimize environmental results. This framework will be refined as necessary to improve its application in future priority sub-basins.

### **Project Partnerships**

NRCS provided overall management and support, as well as data collection, organization, and GIS analysis as part of this project. Funds were used to support NRCS staff, for development of a web-based planning tool by DEC, and to support graduate research work at the University of Vermont (UVM). Other partners included the Vermont DEC, Water Quality Division (VTDEC); the Franklin County and Orleans County Conservation Districts; the USDA FSA; the Lake Champlain Basin Program (LCBP); the U.S. Fish and Wildlife Service (USFWS); the Missisquoi River Basin Association; the Northwest Regional Planning Commission (NRPC); the UVM Rubenstein School of Environment and Natural Resources, the UVM Extension System; and the VAAFM.

The LCBP has been working in the Lake Champlain Basin since the initiation of the Lake Champlain Designation Act. Their efforts have focused research and implementation funds to address critical issues throughout the Basin. These ongoing efforts were coordinated with the Missisquoi Areawide Plan. Priorities identified in this plan will help further focus research and conservation efforts not only in the Missisquoi Sub-basin, but throughout the Basin as a whole.

The VTDEC has ongoing programs associated with the Missisquoi Sub-basin that will be coordinated with this area-wide plan. The VTDEC has initiated targeted water quality implementation programs through its Clean and Clear Program as well as the new Northern Waters Initiative. These efforts will benefit directly from the area-wide plan. They are also in the process of developing a watershed plan for the Missisquoi Sub-basin that has focused on developing priorities based on the input of local stakeholders.

Several ministries and organizations in the Canadian Province of Quebec are also actively

addressing agricultural runoff issues in their portion of the watershed. In addition, farmers in the Sub-basin have formed a Watershed Alliance in the past year, with the purpose of assisting their peers with technology, farm planning, and environmental goal-setting.

One project partially funded by the Missisquoi CCPI grant is the software development of a GIS web-based planning tool. The tool is designed to gather disparate records from VTDEC's Stream Geomorphic Assessment databases, summarize and deliver information within a GIS interface. It has been specifically designed for partners' planning and decision making needs. It will be used to assist with decision-making for applications in programs such as CREP, Partners for Wildlife, WHIP, EQIP, and AMA.

Another project was partially funded through the UVM Rubenstein School of Environment and Natural Resources. The CCPI funds were leveraged with UVM funds to support a full time graduate student who performed data collection and analysis of phosphorus from water samples collected during storm events at stream confluences in the Hungerford Brook Sub-watershed. Additionally, UVM provided laboratory phosphorus analysis of soil samples collected throughout the watershed. These data will be used to develop a conceptual model to better characterize P transport dynamics in Hungerford Brook Sub-watershed.

### **Anticipated Results and Benefits**

NRCS and the conservation partnership will: 1) use the newly developed framework for incorporating geomorphic and geospatial information into the Missisquoi Basin Plan to target implementation efforts; 2) prioritize and leverage NRCS programs with state and local partner programs to optimize environmental results; 3) help solve water quality problems in Missisquoi Bay and remove identified stream segments from the state's 303(d) list; and 4) establish a methodology for addressing water quality resource concerns in other, future priority watersheds in Vermont. This suite of changes will help the partnership reduce the total cost for effective conservation implementation in the project area by as much as 50%.