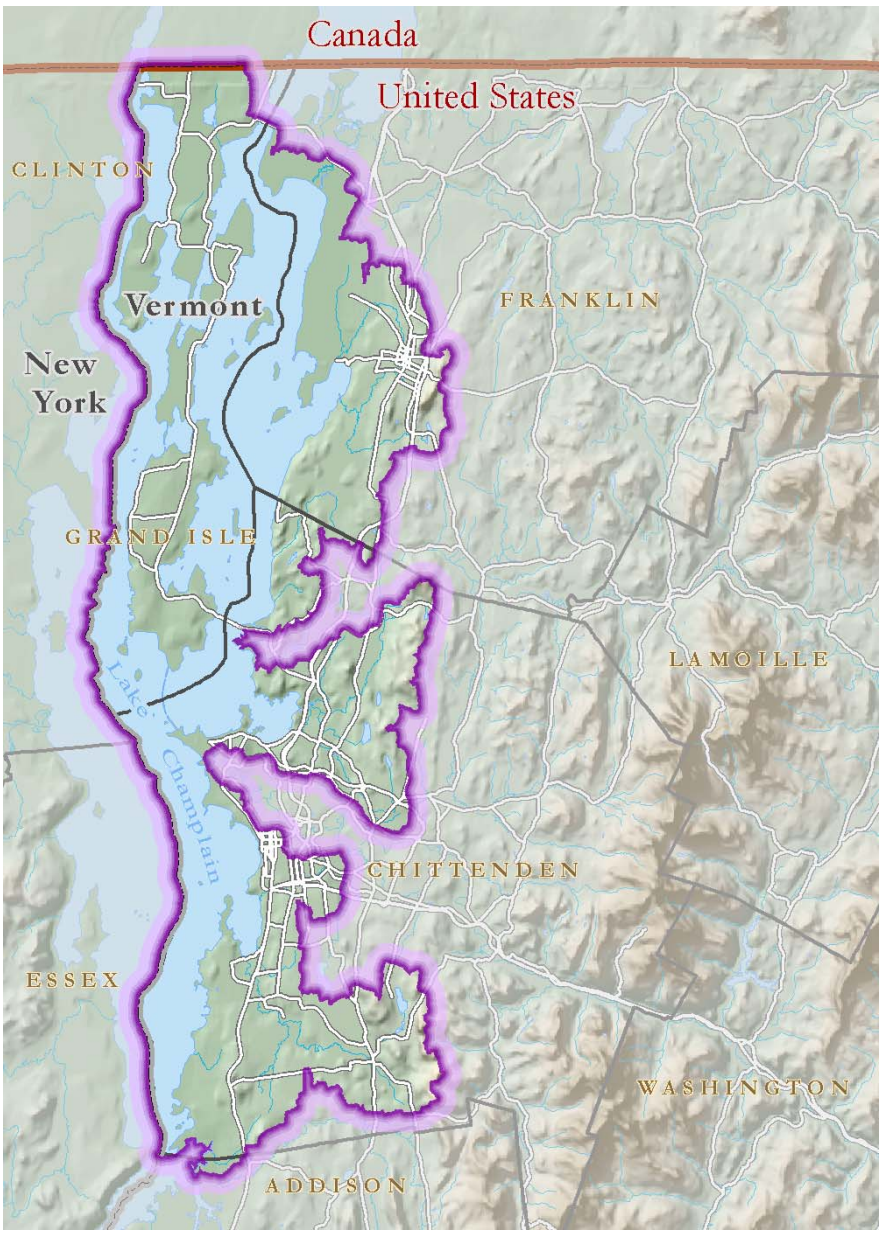
Vermont Agency of Natural Resources

# DRAFT INTERIM FINAL
# WATER QUALITY MANAGEMENT PLAN
# For the
# NORTHERN LAKE CHAMPLAIN DIRECT DRAINAGES

October, 2008



THE WATER QUALITY PLAN FOR THE NORTHERN LAKE CHAMPLAIN DIRECT DRAINAGES (BASIN 5) WAS PREPARED IN ACCORDANCE WITH 10 V.S.A. § 1253(d), THE VERMONT WATER QUALITY STANDARDS, THE FEDERAL CLEAN WATER ACT AND 40 CFR 130.6.

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October, 2008

Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division
Waterbury, Vermont 05671-0408

# Table of Contents

**List of Figures** ..... **5**

**List of Tables** ..... **5**

**List of Maps** ..... **5**

**Glossary** ..... **7**

**Chapter 1. Introduction** ..... **14**

1.1 The Purpose of the Basin Plan and the Basin Planning Process ..... 14
1.2 Planning at the Watershed Level ..... 15
1.3 Plan Development as a Collaborative Process ..... 15
1.4 Watershed Council and Watershed Plan Development ..... 15

**Chapter 2. Description of the Basin** ..... **17**

2.1 Physical Characteristics ..... 17
2.2 Water-based Resources ..... 19

**Chapter 3. Water Quality in the Basin** ..... **22**

3.1 Water Quality Assessment ..... 22
Phosphorus ..... 22
Sediment ..... 23
Pathogens ..... 23
Mercury ..... 23
PCBs ..... 24
Aquatic Invasive Species ..... 24
3.2 Community Concerns ..... 24

**Chapter 4. Addressing Local Water Quality Concerns** ..... **26**

4.1 Leveraging resources within a community ..... 26
4.2 Protecting River Corridors: A case study for the LaPlatte River Watershed ..... 26
4.3 Addressing Urban Stormwater Runoff: A case study for Burlington and Malletts Bay watersheds ..... 34
4.4 Reducing algal blooms: A case study in St. Albans Bay and the Alburgh Passage ..... 42
4.5 Agriculture and Water Quality: A case study for St. Albans Bay Watershed ..... 51
4.6 Addressing Aquatic Nuisance Species Problems in the Islands ..... 54
4.7 Protecting Drinking Water Supplies ..... 57

**Chapter 5. Addressing Water Quality Problems in Specific Waterbodies** ..... **63**

5.1 Introduction ..... 63
5.2 Addressing Water Quality Problems: Strategies for Surface Waters ..... 64
5.3 Addressing Water Quality Problems: Strategies for Lake Champlain ..... 66
5.4 Impaired Waters ..... 68
5.5 Strategies for Waters in Need of Further Assessment ..... 71
5.6 Strategies for Waters altered by Aquatic Nuisance Species ..... 72

**Chapter 6. Establishing Management Goals for Surface Waters** ..... **76**

6.1 Water Management Typing and Classification ..... 76
6.2 Outstanding Resource Waters. ..... 77
6.3 Warm Water and Cold Water Designations ..... 78
6.4 Existing Uses ..... 78

**Chapter 7. Summary and Implementation of the Basin Plan ..... 81**

7.1 Evaluation of the Planning Process ..... 81
7.2 Progress Reporting ..... 81

**References ..... 82**

**Acronyms ..... 84**

# List of Figures

Figure 1 Seventeen planning basins in Vermont ..... 14
Figure 2. Annual visitor use at St. Albans Bay State Park, now Bayside Park, 1964-1974. (Source: St. Albans Bay Rural Clean Water Program) ..... 42
Figure 3. Long-term average phosphorus levels (mg/L) in northern Lake Champlain are highest in St. Albans Bay and in and around Missisquoi Bay (Vermont Lay Monitoring Program data, 1979-2004) .. 43
Figure 4. Current Sources of Phosphorus Loading to St. Albans Bay (Lake Champlain Phosphorus TMDL) ..... 51

# List of Tables

Table 1. Subbasins in Basin 5 and their associated streams, towns and lake segments. ..... 19
Table 2. The community's water quality concerns in Basin 5 and the corresponding ANR water quality assessment of predominant pollutants. ..... 25
Table 3. Total Allocation of the high flow (Q0.3%) percent reductions in Basin 5 stormwater TMDLs and the relative portion allocated to the Load Allocation. ..... 35
Table 4. Impaired waters listed by subbasin to Lake Champlain (DEC 2007a) and actions. ..... 69
Table 5. Waters in need of further assessment in basin 5 listed by subbasin (DEC 2007). The subbasin, in bold font, is not in need of further assessment unless a possible pollutant is listed. ..... 71
Table 6. Status of Aquatic nuisance species in Basin 5 (DEC 2007). ..... 72
Table 7. Examples of Agency of Natural Resources supported Basin 5 projects 2002-2008 ..... 74
Table 8. Determination of existing uses of flowing waters for boating in Basin 5(RM is river mileage measured from the river terminus). ..... 79
Table 9. Determination of existing uses of flowing waters for fishing in Basin 5. ..... 80
Table 10. Determination of existing uses of waters for public surface water supplies in Basin 5. ..... 80

# List of Maps

Map 1. Northern section of Basin 5……...12
Map 2. Southern section of Basin 5……...13

# List of Appendices

Found in *Appendices and Statutory Indexes for the Northern Lake Champlain Basin Program*[1]

Appendix A: List of plans relevant to the Basin 5 planning process

Appendix B: The Department of Environmental Conservation's Public Process in the Basin 5

Appendix C: Agriculture's Role in Water Quality Protection in Basin 5

Appendix D: Relevant Grant and Funding Sources Covering the Basin 5

Appendix E: Regulatory and Non-regulatory Programs Applicable to Protecting and Restoring Waters within the Basin 5

Appendix F: Draft Vermont Anti-Degradation Implementation
Existing Use Determination

[1] Appendices can be found at http://www.anr.state.vt.us/dec/waterq/planning/htm/pl_northernlcb.htm or by contacting the Water Quality Division, Building 10 North, 103 South Main St., Waterbury, VT

# Glossary

**10 V.S.A., Chapter 47** - Title 10 of the Vermont Statutes Annotated, Chapter 47, Water Pollution Control, which is Vermont's basic water pollution control legislation.

**Accepted Agricultural Practices (AAP)** - land management practices adopted by the Secretary of Agriculture, Food and Markets in accordance with applicable State law.

**Acceptable Management Practices for Logging (AMP)** - developed and adopted as rules to Vermont's water quality statutes and became effective on August 15, 1987. The AMP's are intended and designed to prevent any mud, petroleum products and woody debris (logging slash) from entering waters of the state. They are scientifically proven methods for loggers and landowners to follow for maintaining water quality and minimizing erosion.

**Aggradation** - a progressive buildup or raising of the channel bed and floodplain due to sediment deposition. The geologic process by which streambeds are raised in elevation and floodplains are formed. Aggradation indicates that stream discharge and/or bed-load characteristics are changing. Opposite of degradation.

**Aquatic biota** - all organisms that, as part of their natural life cycle, live in or on waters.

**Basin** - one of seventeen planning units in Vermont. Some basins include only one major watershed after which it is named such as the White River Basin. Other Basins include two or major watersheds such as Basin 11 including the West, Williams and Saxtons Rivers.

**Best Management Practices (BMP)** - a practice or combination of practices that may be necessary, in addition to any applicable Accepted Agricultural or Silvicultural Practices, to prevent or reduce pollution from NPS pollution to a level consistent with State regulations and statutes. Regulatory authorities and practitioners generally establish these methods as the best manner of operation. BMPs may not be established for all industries or in Agency regulations, but are often listed by professional associations and regulatory agencies as the best manner of operation for a particular industry practice.

**Biological Monitoring** - surveys of the macroinvertebrate and fish communities of lakes, wetlands, rivers, and streams in order to evaluate the biological health, or biological integrity, of the resource surveyed.

**Classification** - a method of designating the waters of the State into categories with more or less stringent standards above a minimum standard as described in the Vermont Water Quality Standards.

**Designated use** - any value or use, whether presently occurring or not, that is specified in the management objectives for each class of water as set forth in §§ 3-02 (A), 3-03(A), and 3-04(A) of the Vermont Water Quality Standards.

**Dissolved Oxygen** - the concentration of free molecular oxygen dissolved in water.

**Existing use** - a use that has actually occurred on or after November 28, 1975, in or on waters, whether or not the use is included in the standard for classification of the waters, and whether or not the use is presently occurring.

**Fluvial erosion hazard** (FEH)- refers to the endangerment of human investments and public safety resulting from land use choices and expectations that conflict with the dynamic and oftentimes catastrophic physical adjustments of stream channel and flood plain dimensions, elevations, locations and longitudinal slope, in response to rainfall/runoff events and sometimes ice jams (contrast with flood inundation hazard).

**Fluvial geomorphic equilibrium** - the condition in which the physically dynamic nature of fluvial systems is freely expressed over time in response to the range of watershed inputs and climatologic conditions, and as influenced by topographic, geologic, and existing human imposed boundary conditions.

**Fluvial geomorphology** - a science that seeks to explain the physical interrelationships of flowing water and sediment in varying land forms.

**Impaired water** - a water that has documentation and data to show: a violation of one or more criteria in the Vermont Water Quality Standards, or conditions that cause lack of full support for any given designated use for the water's class or management type.

**Impervious** - a surface that does not allow water or other liquids to penetrate through.

**Low Impact Development** - a set of innovative stormwater management techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source through small, cost-effective landscape features located at the lot level. These include practices such as raingardens, bioretention facilities, dry wells, filter/buffer strips, grassed swales, and rain barrels.

**Macroinvertebrate** - animals without backbones and large enough to see with the naked eye.

**Nonpoint source pollution** - waste that reaches waters in a diffuse manner from any source other than a point source including, but not limited to, overland runoff from construction sites, or as a result of agricultural or silvicultural activities.

**Phosphorus** - phosphorus is a nutrient which is generally the limiting nutrient in aquatic systems in the northeast. Because of this the amount of phosphorus available in aquatic systems determines the extent of aquatic plant and algae growth.

**Point source** - any discernable, confined and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which either a pollutant or waste is or may be discharged.

**Reference condition** - the range of chemical, physical, and biological characteristics of waters minimally affected by human influences. In the context of an evaluation of biological indices, or where

necessary to perform other evaluations of water quality, the reference condition establishes attainable chemical, physical, and biological conditions for specific water body types against which the condition of waters of similar water body type is evaluated.

**Riparian** - located on the banks of a stream or other body of water.

**Riparian Buffer Zone - t**he width of land adjacent to lakes or streams between the top of the bank or top of slope or mean water level and the edge of other land uses. Riparian buffer zones are typically undisturbed areas, consisting of trees, shrubs, groundcover plants, duff layer, and a naturally vegetated uneven ground surface, that protect the waterbody and the adjacent riparian corridor ecosystem from the impact of these land uses.

**Runoff** - water that flows over the ground and reaches a stream as a result of rainfall or snowmelt.

**Sedimentation** - the sinking of soil, sand, silt, algae, and other particles and their deposition frequently on the bottom of rivers, streams, lakes, ponds, or wetlands.

**Source Protection Area (SPA)** – A public water source protection area meaning a surface or subsurface area from or through which contaminants are reasonably likely to reach a public water system source. Defined in **10 V.S.A., Chapter 21.**

**Surface Waters** - surface waters are waters that flow above the level of the ground in streams and in lakes and ponds.

**Total maximum daily load (TMDL)** - the calculation of the maximum amount of a pollutant that a waterbody can receive on a daily basis and still meet Vermont Water Quality Standards.

**Turbidity** - the capacity of materials suspended in water to scatter light usually measured in Nephelometric Turbidity Units (NTU). Highly turbid waters appear dark and "muddy."

**Type / Typing** - a category of water management requirements based on both the existing water quality and reasonably attainable and desired water quality management goals. Through the basin planning process all Class B waters must be allocated into one or more Water Management Types (B1, B2, B3) pursuant to § 3-06 of the Vermont Water Quality Standards.

**Water Quality Standards** - the minimum or maximum limits specified for certain water quality parameters at specific locations for the purpose of managing waters to support their designated uses. In Vermont, Water Quality Standards include both Water Classification Orders and the Regulations Governing Water Classification and Control of Quality.

**Waters** - all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs, wetlands and all bodies of surface waters, artificial or natural, which are contained within, flow through or border upon the State or any portion of it.

**Watershed** - all the land within which water drains to a common waterbody (river, stream, lake, pond or wetland.

# Executive Summary

The water quality management plan for the Northern Lake Champlain Direct Drainages (Basin 5 Plan) provides a description of the basin and steps to restore and protect the basin's surface waters. The basin includes the northern section of Lake Champlain, beginning at the Ferrisburgh and Charlotte town line and ending at the Canadian border, and all Vermont surface waters that drain directly into this section of the Lake (Maps 1 and 2). The Basin 5 Lake sections also receive waters from watersheds outside the basin, including the Missisquoi, Winooski and the Lamoille river watersheds. The Agency of Natural Resources is developing water quality management plans for these watersheds that will provide additional remediation steps for improving water quality in Lake Champlain.

Surface waters in Basin 5 support swimming, fishing, and boating. In addition the waters provide drinking water and are appreciated for the wildlife habitat and plant communities they support. For the majority of surface waters, water quality is sufficient to protect these uses. The majority of the water quality problems in the basin that impair, stress or threaten uses include algal blooms, high levels of pathogens or turbidity in the water, high levels of mercury and PCBs, and aquatic nuisance species. Pollutants or processes most responsible for the first three conditions include agricultural and urban runoff, and eroding river channels due to a lack of equilibrium in the river system.

The plan describes existing State and federal programs that are presently in place to address identified water quality problems. In addition, the plan includes strategies to develop or improve upon the collaborative efforts of the Agency with other partners to improve water quality. The collaborative efforts have been developed over the last five years during discussions with the Agency, community members, other state and federal groups, and non-profit organizations. Implementation of Chapter 4 strategies will support the following collaborative efforts:

- The Agency will continue to provide technical and financial assistance to the LaPlatte Watershed Partnership in its efforts to protect the LaPlatte River corridor through assessment and project implementation. Projects will continue to include: geomorphic assessments, water quality monitoring, tree planting, floodplain restoration, and education programs for the public and municipal officers.

- A multitude of partners will assist the Agency in the control of stormwater runoff in Burlington and Malletts Bay watersheds through community education and installation of innovative stormwater treatment systems. Efforts will be part of existing stormwater control permitting programs or provide supplemental stormwater treatment. Improving the recreational opportunities in these embayments will also be supported by helping communities understand and reduce pathogen loads in stormwater.

- The Agency will be aided by community efforts to reduce algal blooms in the Northeast Arm and St. Albans Bay of Lake Champlain. Efforts will continue to include education to increase public awareness about lake friendly lawn care, stormwater infrastructure improvements, and the investigation and implementation of innovative approaches to addressing water quality problems.

- The agricultural community, including the Franklin and Grand Isle County-based Farmers Watershed Alliance, will continue to participate in phosphorus and sediment reduction efforts with assistance from the agricultural resource agencies and the community.

- The Agency will continue to assist local shoreline associations and municipalities in the Lake Champlain Islands in their efforts to reduce aquatic nuisance species populations.

- Water supply operators and municipalities within the basin will continue to assist in the protection of their water supplies to control treatment costs. Using education, support from local watershed groups and other collaborative efforts with agencies and organizations, they will maintain the water quality necessary for supplying safe drinking while minimizing costs.

The rest of the plan includes strategies for impaired waters and waters of concern in Chapter 5. Management goals are discussed in Chapter 6, including the determination of existing uses.

Over the next five years, the Agency will focus its efforts in these areas in collaboration with the community and other state or federal agencies to improve and restore waters in this Basin.

Map 1. Northern section of Basin 5

http://www.anr.state.vt.us/dec/waterq/planning/docs/pl_Map1Basin%205-Impaired%20Waters%20(north).pdf

Map 2. Southern section of Basin 5

http://www.anr.state.vt.us/dec/waterq/planning/docs/pl_Map2Basin%205-Impaired%20Waters%20(south).pdf

# Chapter 1. Introduction

## 1.1 The Purpose of the Basin Plan and the Basin Planning Process

The water quality management plan for the Northern Lake Champlain Direct (Basin 5 plan) includes strategies to restore and protect surface waters in the basin. This water quality management plan covers the broad section of Lake Champlain north to the Canadian border, and the small rivers and streams in Vermont that drain directly to the Lake along with the ponds and wetlands in their watersheds (see Map 1 and 2). In conjunction with the Agency of Natural Resources' basin plans for the large rivers in Lake Champlain's watershed, including the Winooski, Lamoille and Missisquoi, and other water quality improvement plans for the Lake (see Appendix A) this plan is also part of a collaborative effort to improve the health of the entire Lake. Implementation of the strategies will help to ensure that swimming, boating, aquatic habitat and the surface waters' other values and beneficial uses can co-exist with economic development, recreational activities and other surrounding land uses.

The majority of the plan's strategies are the result of a basin planning process that sought community involvement to identify and build upon existing interest and resources in the basin to protect and improve water quality. The remaining strategies describe the Agency's existing programs and efforts to have all surface waters meet the Vermont Water Quality Standards. In addition to guiding the Agency in its work, individuals and groups will be able to use the plan's strategies to find resources and opportunities to collaborate with others. The plan also includes revisions to the State's management goals for surface waters, including the determination of existing uses.

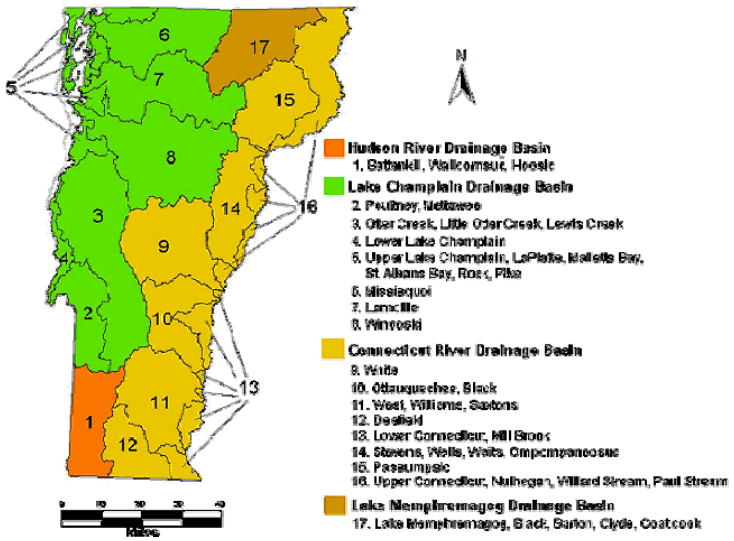


**Figure 1 Seventeen planning basins in Vermont**

## 1.2 Planning at the Watershed Level

A watershed, or basin, is a distinct land area that drains into a particular waterbody either through channelized flow or surface runoff. Preparing a water quality management plan at a watershed level allows for the consideration of all contributing sources of surface water runoff to the waterbody.

The Agency has conducted water quality assessment and improvement efforts at a watershed level since the 1970s. The state is divided into 17 planning basins for this purpose, with each basin including one or more major river watersheds (Figure 1). The Agency is responsible for preparing basin plans for each of the 17 major basins and updating them every five years after the plan is adopted.

## 1.3 Plan Development as a Collaborative Process

Planning through a collaborative process with communities in the basin, local, State, and federal governments, and private organizations is an effective method for addressing nonpoint source pollution. Nonpoint source pollution (NPS) is the predominant water quality problem in Vermont. In contrast to a point source - polluted discharge piped from one source - nonpoint source pollution originates from dispersed and varied activities and is carried to a waterbody by surface and ground runoff. Examples of these activities include agricultural cropping, lawn and garden care, and construction.

Reducing nonpoint source pollution requires the participation of many different sectors of the community to identify strategies that the community can and will use to address all of the pollutant sources. As many as 65 volunteer-based groups in the state are already working collaboratively with community members and resource agencies to identify and implement water quality-related strategies within their own watersheds.

The Agency's basin planning program recognizes and works to advance collaborative efforts within the community. The planning process begins by documenting community-voiced problems and solutions; then provides a venue for the exchange of information among resource agencies, groups, and individual citizens to facilitate collaborative ventures. Finally, the process helps direct existing resources towards the priorities of active groups within the communities. Opening the basin planning process to the entire community also serves to increase public awareness of opportunities to promote and preserve water quality in the basin.

## 1.4 Watershed Council and Watershed Plan Development

In the spring of 2001, the Agency sent out an open invitation to the community within Basin 5 to participate in the development of a water quality management plan. The community members that came together as a watershed council represented a diverse mix of stakeholders from within the basin. They included farmers, foresters, business owners, municipal officials, anglers, local watershed and lakeshore organizations, environmental groups, teachers, and regional planners. The DEC watershed coordinator worked with the watershed council to complete the following steps, over a three-year period (see Appendix B):

- Identification of public concerns;
- Development of strategies; and
- Identification of resources and funding to implement strategies.

The DEC watershed coordinator also worked with local watershed groups and other partners to implement strategies as resources and interest allowed.

Council meetings and membership were continually open to the public and many participants attended meetings based on their particular interests. Once the council identified the public concerns, the coordinator scheduled meetings that addressed each of the concerns, including river instability, aquatic nuisance species control, adequate protection of drinking water supplies, reducing excessive algal blooms through reduction of urban runoff, and the agricultural community's role.

At each of the meetings, technical advisors, usually employees of state or federal organizations, presented background information for each concern, and provided the council and watershed coordinator with information necessary to develop strategies. Chapter 4 includes the strategies along with available resources and funding for implementation.

In addition to attending council meetings, many council members took on a variety of roles including:

- Encouraging constituents' participation and conducting outreach and education to inform constituents about known watershed issues;
- Identifying water resources issues (assets and problems), related community needs and interests, resources and potential solutions;
- Identifying immediate or ongoing water quality improvement projects to be undertaken during the planning process; and
- Guiding the plan through review, revision, and approval process.

# Chapter 2. Description of the Basin

## 2.1 Physical Characteristics

In Vermont, land use is the primary determinant of how a watershed will affect the receiving waters. Other physical characteristics that influence water quality include the watershed's soils, geology and topography as well as the character and condition of the waterbodies, themselves. The following descriptions of the basin's physical characteristics provide background to subsequent sections. The complete picture of the watershed's effect on water quality also includes the level of the communities' awareness of water quality and land use practices, which will be addressed in Chapter 4. The bays and shores of Basin 5 are also influenced by watersheds outside of this basin and associated Agency basin plans should be referenced to completely understand impacts to all the lake segments in the basin.

**Land use**
A forested landscape is the best protector of water quality. In Basin 5, only about 37 percent of the land is forested. This is in contrast to other communities in Vermont, most of which have a higher percentage of forest cover. Historically, the basin has been heavily farmed and agricultural land still accounts for a substantial portion of the landscape with approximately 35% of the land area in this use.

Overall, the landscape in the northern half of the basin (Grand Isle and Franklin counties) is predominantly agricultural, whereas the southern end of the basin around the LaPlatte River watershed is predominantly forested. In between are the urbanized communities of Burlington, South Burlington, Colchester, Milton, Essex Junction and Shelburne.

**Soils**
The genesis of the soils in the majority of the basin is tied to the expansion and recession of the Champlain Sea (present day Lake Champlain) at the end of the last ice age. The expansion of the sea over the Champlain lowlands resulted in valley bottom sediments, productive soils that are sorted by water. Examples include clays that were left in areas of deep water and sandy silts deposited by rivers where the sea was stable for a time. Clays predominate in areas like St. Albans and Charlotte and sand-predominated soils make up much of the soils in Colchester, Milton, and Burlington. The exceptions are the hills at the eastern edges of the basin. Although the hills only reach an elevation of about 1700 feet, they were beyond the furthest encroachment of the sea. The soils here are influenced by an upland till or carbonate rock.

The size of the soil particles helps to define potential water quality problems in an area. The finer sediments, such as clays, have a greater capacity to capture and hold pollutants than silt and sand do. However, the pollutants only affect water quality when water erodes and carries soil particles to waterbodies or leaches pollutants out of soil. Larger particles, like sand, erode easier and are therefore more likely to wash into a surface water. The presence of finer sediments, like the clays and silts, in the water column become a water quality problem in itself by increasing turbidity.

The character of the till (sediment picked up and deposited by the glacial) also has an effect on water quality. The carbonate rocks that make up the till increase the buffering capacity of the soil. The result

has been that surface waters in the basin are buffered from the full impact of acidic rainfall that has had adverse impacts in other areas in Vermont.

**Limnological features of northern Lake Champlain**

Each of the basin's watersheds drains into a different section of Lake Champlain, which itself has geologically distinct subbasins. Each represents a somewhat different set of limnological conditions. Conditions such as depth and volume of a lake section would affect the dilution of incoming pollutants and temperature. The following description is taken from the Lake Champlain Research Consortium's web page:

"The Missisquoi Bay flows south into the Inland Sea, also known as the Northeast Arm. This rather large section of Lake Champlain lays to the east of the Champlain Islands (South Hero, North Hero, and Isle LaMotte). Although fringed by some warm, shallow bays, much of the Inland Sea is fairly deep (over 30 m), cool, and relatively clear. South of the Inland Sea lies Malletts Bay - a rather small basin with restricted exchange with the rest of the lake due to a highway causeway on its north side (US Route 2) and a former railroad causeway on its west side. Over 80% of the volume of the entire lake is contained within the Main Lake, also known as the Broad Lake. This section runs from Crown Point north to Rouses Point, where the lake flows into the Richeleau River on its way to the St. Lawrence River and, eventually, the Atlantic Ocean. The Main Lake is quite deep, with much of it over 60 m and a few locations over 120 m in depth. Much of the Main Lake is clear and cold." (Lake Champlain Research Consortium 2008).

**Fluvial Geomorphology**

Climate change, geologic events, and major storms affect the flow of water, sediment and debris and they in turn change the shape of river channels. Natural adjustments in river channel and floodplain geometry occur continually in dynamic equilibrium. Chanel and floodplain adjustments, however, have been greatly magnified during the past two centuries in Vermont by human-imposed changes to the depth and slope of rivers in association with intensive watershed and riparian land uses. Human-imposed changes include: deforestation; clearing debris from channels; channelizing streams to make room for early settlements and roads; mills, dams and diversions; gravel removal; and encroachments, stormwater and urbanization.

Five years of assessment of all Vermont streams by the Agency's River Management Program has found that 75 percent of Vermont field-assessed reaches (stream sections) are undergoing stream channel evolution processes. A stream in this situation lacks access to its floodplains during high frequency floods. The evolution process includes the widening and aggrading of incised streams and results in the development of new floodplains along the rivers. Recent major storm events have energized these channelized stream systems with inputs of water and sediment and, in so doing, have accelerated the process. The physical adjustment process of streams is most commonly observed as stream bank erosion. Erosion results in the meander changes that occur as the channel slope and energy gradient adjust in equilibrium with watershed inputs.

The currently incised streams and the ongoing adjustment process have impacted water quality in the streams by increasing pollutant loads associated with sediment erosion, including turbidity. In turn, aquatic habitat has declined due to the increase in sedimentation and absence of riparian vegetation. Geomorphic assessments for streams in Basin 5 have identified similar conditions. Data for specific

streams in Basin 5 are available on the DEC-WQD River Management sections' Stream Geomorphic Assessment viewer[2]

**Five Subbasins in Basin 5**

In this plan, Basin 5 has been divided into five subbasins: St. Albans, Malletts, Burlington and Shelburne Bays, and the Champlain Islands. The watersheds, their significant streams and adjacent lake sections are identified in Table 1. The Pike and Rock Rivers and the Missisquoi Bay are also basin 5 waters; however, they have been addressed in the Missisquoi River planning process[3]

**Table 1. Subbasins in Basin 5 and their associated streams, towns and lake segments.**

| Subbasin | Contributing Streams and Ponds | Towns | Adjacent Lake Segment |
|---|---|---|---|
| St. Albans Bay | Jewett, Ruggs, Stevens Brook, and Mill River; and St. Albans Reservoirs | St. Albans city and town, Georgia | Northeast Arm |
| Malletts Bay | Malletts Creek, Indian Brook, Crooked Creek and Milton Pond and Indian Brook Pond | Colchester, Milton, Essex Junction | Main Lake, Northeast Arm |
| Burlington Bay | Englesby Brook | Burlington | Main Lake |
| Shelburne Bay (and shoreline south) | Potash, Munroe, Bartlett, Thorpe and Kimball Brooks, LaPlatte River, and Lake Iroquois | Shelburne, Charlotte, Hinesburg, South Burlington | Main Lake |
| Champlain Islands and shoreline of lake | Stonebridge Creek | Islands, Georgia, Milton | Northeast Arm, Main Lake |

## 2.2 Water-based Resources

The rivers, lakes, ponds and wetlands in the basin support aquatic life and habitat and provide recreational opportunities through their fisheries, swimming beaches, boating runs, and aesthetics. In addition, these surface waters provide drinking water and irrigation supplies. The fundamental purpose of protecting water quality in Vermont is to enhance these and other beneficial uses and values of the water.

### Boating

The basin's lakes, especially Lake Champlain, are heavily used for motorized and non-motorized boating. Within the Lake, the sheltered bays, e.g., Malletts Bay, Shelburne Bay and Town Farm Bay, are valuable for boat moorings. The excessive growth associated with the aquatic invasive plants in the basin can hinder some boating activity, especially in shallow waters. The LaPlatte River and Malletts Creek can be canoed during high water, but many of the other streams in the basin are too small for significant boating activity.

### Swimming

People take advantage of an abundance of public swimming beaches in state parks and municipal properties along Lake Champlain and Lake Iroquois. The majority of the rivers and streams in the basin are only deep enough for wading, although a few informal swimming holes exist in the larger rivers like

[2] http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_sgav_user_manual.pdf
[3] see http://www.anr.state.vt.us/dec/waterq/planning/htm/pl_missisquoi.htm

the LaPlatte. The most serious threats to swimming in the basin are aquatic invasive species populations and the potential for pathogens after rain events.

## Fish Habitat and Fisheries

The basin is home to a diversity of fish species, many of which support popular recreational fisheries. Lake Champlain is a warm water fishery with the exception of portions of the lake where depths are more than 25 feet at Low Lake Level (93 feet NGVD) from June 1, through September 30. These areas support a cold water fishery. Fishery habitats in the streams range from high velocity riffles with cobble substrate such as in the upper LaPlatte River, to slow moving pools with sand substrate, such as in Indian Brook, to seasonally flooded wetlands adjacent to Lake Champlain. The wetlands with lake influenced hydrology are spawning habitat for yellow perch, brown bull head, pumpkinseed, bowfin, largemouth bass, black crappie, carp, mudminnow and longnose gar. In addition, spring high water levels inundate upland meadows as well as wetlands, providing additional spawning habitat for fish. Prime spawning habitat for northern pike lies above 98.5 feet (the average annual high is 99.7 feet); however, it is the additional spawning habitat created during the infrequent years with spring lake levels rising above 100 feet that support the abundant population of northern pike (ANR 1978). The high lake levels allow northern pike to swim through flooded fields to spawn on grasses, where eggs and small fry will benefit from the warm temperatures of the shallow water. Carmans Marsh in Swanton is an excellent example of this environment. Vermont and New York state biologists and the U.S. Fish and Wildlife Service, as part of the Lake Champlain Fish and Wildlife Management Cooperative, are currently in the process of developing a long-range plan to manage fish populations in Lake Champlain (Fisheries Technical Committee 2008).

## Irrigation

Surface waters are also used to irrigate farmland. The 2002 Census of Agriculture includes thirty-four farms irrigating 246 acres of farmland in Franklin County (partially within the basin) and 16 farms irrigating 84 acres of farmland in Grand Isle County (completely within the basin).

## Drinking Water Supplies

Lake Champlain is the source water for the two largest public water suppliers in the state. The Champlain Water District, the largest supplier, serves more than 65,000 customers and major corporate entities surrounding the Burlington area. The second largest water supplier, the City of Burlington, meets the water supply needs of its population. In addition, North and South St. Albans Reservoirs (Fairfax) are active drinking water supply reservoirs for the City of St. Albans. This reservoir receives an unquantifiable contribution of water from Silver Lake in Georgia (Lamoille River Watershed) via a piping system. The surface waters in the basin also provide drinking water to numerous private residences and businesses.

## Significant Natural Communities and Rare, Threatened, and Endangered Species

Waterbodies in the basin that fit this category include the wetlands along the shoreline of Lake Champlain. The wetlands have evolved around and depend upon the natural fluctuations of the Lake for their existence and ability to support wildlife and fish. The largest of these wetlands are often situated on the deltas of sediment dropped at river mouths. Black Creek Marsh, located at the north end of St. Albans Bay where Jewett and Stevens Brooks converge, is one example. This 360-acre wetland complex

includes deep rush and cattail marshes and deciduous forested wetland. In a 1988 survey of the area, both the state threatened spiny softshell turtle and the uncommon map turtles were found. Similar wetland complexes are found at the mouth of the Mill River, LaPlatte River, and Malletts Creek.

The clay sediments and low elevation of the Lake Champlain Islands helped create the 33 wetland complexes identified as "priority wetlands" during the Vermont Advanced Wetlands Planning and Protection Project. The largest one, Alburgh's Mud Creek and Swamp, is a 1500-acre wetland complex that includes softwood and hardwood swamps, shrub swamps, emergent wetlands and shallow open water areas. A number of rare or threatened plants and animals inhabit portions of this wetland complex including nodding trillium, matted spikerush, least bitterns, black-crowned night herons, map turtles, blue-spotted salamander, spiny softshell, sora, pied-billed grebe, black tern, and common moorhen.

The South Alburgh Swamp and associated sand beach at the Alburgh Dunes is considered "one of Vermont's premier natural areas" by the Advanced Wetland Planning and Protection Project. The swamp consists of a number of wetland types including red maple-green ash swamp, the unusual tamarack-red maple swamp, small areas of white cedar swamp, and a black spruce swamp with open bog, a boreal community out-of-place in the moderate climate of the Champlain Valley. At the southern end of this large and diverse swamp community is a long stretch of sand beach and dunes. More information on the wetlands in the basin is contained in *The DEC Basin 5 Assessment Report (2003).*

# Chapter 3. Water Quality in the Basin

## 3.1 Water Quality Assessment

The Agency of Natural Resources (Agency) is responsible for maintaining or improving water quality in surface waters in accordance with the Vermont Water Quality Standards. Water quality is determined using biological, physical, and chemical criteria. The Agency, through the Department of Environmental Conservation (DEC), collects water quality data throughout the state to identify impairments based on the standards. Vermont DEC Biomonitoring and Aquatic Studies Section provide much of the data used in the assessment of monitored river miles. The Vermont DEC Lakes and Ponds Management and Protection Section provide much of the data used in the assessment of monitored lake acres. The *DEC Basin 5 Assessment Report (2003)* is a compilation of the monitoring data and includes assessments of each waterbody.

The specific waterbodies that do not meet the Vermont Water Quality Standards are listed and discussed in Chapter 5 along with strategies for remediation. The strategies focus on addressing nonpoint source pollution, the main source of pollution in the basin. The point sources, e.g., wastewater treatment plants or industrial discharges, are addressed through permit processes that are described in Appendix E.

The predominant pollutants in the basin include phosphorus, sediment, pathogens, Mercury, PCBs and aquatic invasive species. General descriptions of the pollutants and their effects on aquatic biota, recreation and other beneficial uses follow.

### Phosphorus

Phosphorus is a nutrient that is naturally limited in the environment. High levels of nutrients cause aquatic plants, especially algae, to grow in much greater densities than the aquatic ecosystem can normally support. In excessive amounts, algae can impair recreational uses, aesthetic enjoyment, the taste of drinking water, and the biological community. In some cases, algal blooms can produce toxins that harm animals and people.

While no specific data on phosphorus sources exist for Basin 5, results from Lake Champlain studies are relevant. In Lake Champlain, nonpoint source runoff from agricultural and developed landscapes provides the most significant source of phosphorus. Developed land provides the greater percentage of the load to the lake, despite the fact that agriculture land cover is greater. A recent land use study of the Lake Champlain watershed estimated that the 8% of urban or developed land cover provided 53% of phosphorus entering the Lake. Agricultural land use provides 39% (Troy et al. 2007).

Point sources generally contribute a small percentage of phosphorus to waterbodies. In Lake Champlain, point sources, mainly from waste water treatment plants, are responsible for less than 10% of the phosphorus load (Lake Champlain Basin Program 2008).

The sources of phosphorus from agricultural runoff include fertilizers, animal manure, milkhouse wastewater, and crop residues. Urban sources of phosphorus include fertilizer, pet waste, eroded soils, atmospheric deposition, sludge, and septic systems. The increased quantity of stormwater due to the

imperviousness of an urban area also increases the phosphorus load from urban areas. The increased volumes are responsible for increased erosion, especially along river channels. The eroded soil, which contains phosphorus, becomes an additional pollutant. In addition, the erosion of rivers going through the channel evolution process in both agricultural and developed areas can also release a significant amount of phosphorus.

## Sediment

Sediment is fine particulate matter originating from soils. The accumulation of sediment on the bottom of a waterbody results in sedimentation, while the suspension of sediment in the water column causes turbidity. Sediment can fill the crevices between pebbles that would otherwise create habitat for aquatic biota and for fish spawning. Turbidity also degrades the habitat for aquatic biota, reducing visibility for predators as one example. Sources of sediment include the erosion of open soils and river channels described in the section on phosphorus.

## Pathogens

Pathogens are any disease-causing organism, including bacteria, viruses, and protozoa. The pathogens that are of concern in Vermont surface waters are those that come from fecal matter of humans and other warm-blooded animals. These pathogens cause gastrointestinal problems and become a more serious health risk to people who have weakened immune systems. Surface waters containing fecal matter pose a risk to human health when ingested through drinking water or inadvertent ingestion through contact recreation.

In surface waters, the most likely source of human fecal matter or sewage is a malfunctioning wastewater treatment plant or septic system. Sources of animal fecal matter are highest in urban and agricultural areas. Wildlife that resides in the water, such as beaver and waterfowl, can also contribute pathogens.

The primary indicator of fecal matter in freshwater is the bacteria, *Escherichia coli* (*E. coli*). The bacteria are often present in the intestinal tract of warm-blooded animals and can survive after it leaves its host, making it an ideal indicator. Although most strains of *E. coli* are harmless, specific concentrations in water can be equated to a level of risk for developing an illness from a water-borne pathogen. Vermont's water quality standard for *E. coli* bacteria for Class B waters is 77 *E. coli*/100 ml in a single sample, equating to a risk level of less than 0.1 illnesses per 1000 swimmers. Vermont's standard is the most stringent in the nation and is often exceeded due to natural conditions.

## Mercury

Mercury contamination is ubiquitous in Vermont's still waters. Mercury is a naturally occurring metal used in a wide variety of applications ranging from the production of household bleach to the mining of gold. Mercury is released into the environment either directly to water via waste systems, or much more commonly, directly to the atmosphere. It is this atmospheric pathway that is largely responsible for mercury contamination in Vermont. The combustion of coal for energy production and incineration of municipal and medical wastes produces the majority of mercury deposited onto the watersheds of the northeastern US and Eastern Canada. Some mercury also enters the aquatic environment from direct wastewater discharges. Through the processes of biomagnification, minute concentrations of the toxic methyl-form of mercury are passed up food chains, increasing to levels that pose a significant threat to those organisms that feed at the top of the aquatic food web. Organisms that are at risk of methyl-

mercury exposure include top-level carnivorous fish such as walleye, as well as fish eating birds such as eagles and loons. Humans who consume large quantities of fish are also at risk.

The Vermont Department of Health has general advisories for women of childbearing age and children younger than 6 years to limit consumption of fish. In addition, the department also identifies specific waterbodies where eating resident fish carries a greater level of risk because of elevated mercury concentrations in fish tissue. In Lake Champlain for example, children and women of childbearing age are advised not to eat any walleye or meals of lake trout 25 inches or greater.

### PCBs

In the past, poly-chlorinated biphenyls or PCBs were used for a variety of chemical processes including the production of plastics like PVC piping. PCBs were also a component in the dielectric fluid used in transformers, capacitors and other heat transfer systems. The manufacture of PCBs was stopped in the US in 1977 and any remaining PCB transformers in Burlington were decommissioned by the late 1980s. Presently, stores of PCBs exist in landfills nationwide.

PCBs can escape into the environment either by waste incineration or via landfill leachate. PCBs do not readily breakdown in the environment and like mercury, PCBs also bioaccumulate, increasing in concentration with each step up the food chain. To date, testing performed by the Water Quality Division, in concert with the Vermont Department of Fish and Wildlife, has uncovered PCB contamination only in the tissues of large lake trout from Lake Champlain. PCBs are known by USEPA to be carcinogenic to animals, and are considered likely human carcinogens as well. The Vermont Department of Health recommends that people limit their intake of large trout based on PCB concentrations. Based on a considerable remediation initiative undertaken by the New York State Department of Environmental Conservation, PCB concentrations in Lake Champlain lake trout are expected to decline in the coming years.

### Aquatic Invasive Species

Many aquatic invasive species can seriously hinder the recreational use of a waterbody, out-compete beneficial native plants and animals, and otherwise alter the natural environment. Aquatic invasive species that infest Basin 5 include Eurasian watermilfoil (*Myriophyllum spicatum* L.), zebra mussels (*Dreissena polymorpha),* water chestnut (*Trapa natans* L.), European frog-bit (*Hydrocharis morsus-ranae*), curly leaf pondweed (*Potamogeton crispus),* white perch (*Morone americana*) and alewife (*Alosa pseudoharengus*). In addition, a number of other problematic exotic species (e.g. hydrilla, *Hydrilla verticillata* and didymo or rock snot,(*Didymosphenia geminata*) are at the basin's doorstep. Hydrilla has not entered Vermont yet, however, didymo has. Currently, didymo is present in the Connecticut, White, Battenkill and Mad Rivers, but has not yet been documented in Basin 5.

## 3.2 Community Concerns

The Agency uses scientific means to identify water quality problems, including the analysis of macroinvertebrate communities, water chemistry, and river geomorphology. In contrast, laypeople in the community often rely on a sensory-related approach, for example, the smell or the look of the water or shoreline, which is then related to people's ability to use the water. Despite the differing approaches, the

predominant pollutants identified by the Agency in Basin 5 cause the same problems identified by the community (see Table 2 and descriptions of pollutants in Section 3.1).

While a scientifically based assessment of water quality is necessary for an effective permitting and regulatory process, a community's assessment is often better for attracting people's interest. In the basin planning process (Appendix B), the Basin 5 watershed council and the Agency were able to engage the community in the basin planning discussion by inviting them to discuss water quality concerns relevant to the community. This helps minimize use of unfamiliar terms associated with a scientific assessment. The benefit to the Agency's planning process is that, in addition to the work the Agency can do on its own, it has also gained the interest, energy and expertise of the community to further water quality improvement efforts.

**Table 2. The community's water quality concerns in Basin 5 and the corresponding ANR water quality assessment of predominant pollutants.**

| Community Concerns | Corresponding pollutants identified by ANR as impacting water quality in Basin 5 |
|---|---|
| River instability | Phosphorus, Sediment |
| Urban stormwater runoff | Phosphorus, Sediment, Pathogens |
| Aquatic nuisance species (ANS) | ANS |
| Inadequate protection of drinking water supplies | Phosphorus, Sediment, Pathogens, ANS |
| Excessive algal blooms | Phosphorus, Sediment |
| Agricultural impacts | Phosphorus, Sediment, Pathogens |

The strategies in the next two chapters address community concerns in the basin as well as Agency identified pollutants.

# Chapter 4. Addressing Local Water Quality Concerns

## 4.1 Leveraging resources within a community

Basin 5 consists of smaller watersheds or subbasins, each with its own demographics, land use patterns and history. The differences among the subbasins result in varying intensities of water quality problems, community priorities for water resource protection, as well as community perspectives on the appropriate balance between the environment and development.

To simplify this diverse basin planning process, the choice was made to focus primarily on one predominant water quality problem of concern to community members within each subbasin; however, each of the issues is relevant throughout the basin. The following five sections include case studies of how collaborative efforts by the Agency and others in the community are addressing a water quality concern in the LaPlatte River Watershed, Burlington and Malletts Bays, the Islands and the St. Albans Bay. The associated strategies are applicable to all areas of Basin 5 unless otherwise indicated. An additional concern, the protection of drinking water supplies, covers the entire basin and was developed with the Lake Champlain Coalition of Municipal Water Suppliers.

Agency staff facilitated the identification of public concerns and development of strategies during watershed council meetings and additional meetings with individuals, community groups, and local, state, federal, and nonprofit staff. The collaborative process should help leverage existing resources (see Appendix D for funding sources). In addition, the strategies will assist the Agency in prioritizing its efforts within the basin. In most cases, the strategies will apply to similar water quality problems in all subbasins. Chapter 5, Table 4 lists community and Agency identified water quality problems in each subbasin.

## 4.2 Protecting River Corridors: A case study for the LaPlatte River Watershed

Rivers are too often treated as static during community planning efforts resulting in the loss of flood attenuation areas or confinement of channels over time as development continues[4]. The DEC-WQD River Management Program supports the development of river corridor plans by communities. This is an effort to manage toward, protect, and restore the fluvial geomorphic equilibrium conditions of rivers by resolving conflicts between human investments and river dynamics in the most economically and ecologically sustainable manner. In the end, the plan should also achieve the objectives of:

- fluvial erosion hazard mitigation;
- sediment and nutrient load reduction; and
- aquatic and riparian habitat protection and restoration.

[4] For more information on rivers, see Section 2.1 of this plan and http://www.anr.state.vt.us/dec//waterq/rivers/htm/rv_restoration.htm

**LaPlatte River Watershed Case Study**

The health of the LaPlatte River watershed has been a focal point for community members for decades. From Lake Iroquois to the LaPlatte River floodplains in Shelburne, groups have educated community members, conserved lands, managed aquatic nuisance species and planted riparian buffers. Recently, groups and individuals from the communities within the watershed have joined to form the LaPlatte Watershed Partnership (Partnership)[5]. The Partnership's goal is to protect the river corridor and its wildlife habitat and to keep its waters clean not only for the biota that the river supports but also for the protection of its receiving waters, Shelburne Bay.

To understand the current condition and pollutant sources, the Partnership has initiated both water quality monitoring and stream geomorphic assessment[6]. The Agency of Natural Resources (Agency) has provided grants and technical support to support the Partnership in its work; however, the group's commitment of time and energy has brought about its successes. Members have coordinated projects including writing and receiving grants to hire project consultants. In the case of the water quality monitoring program, one member took on the responsibility of developing and implementing the program and analyzing data. Community members have also recognized the importance of the river's watershed in river protection efforts. To this end, they received a grant to quantify impervious surfaces within the watershed. The results are available to towns to help them identify areas close to reaching a percentage of impervious cover that is likely to result in an impact to a receiving waterbody. In addition, the Hinesburg Land Trust was instrumental in the conservation of 600 wetland and forested acres and five miles of stream in the LaPlatt River headwaters (Bissonette Farm) with help of the Agency and other funders. The project will also include the restoration of wetland to further enhance the LaPlatte river corridor.

The group has recognized that providing information to a community must be followed by discussions that lead to actions. To that end, the group's plan also includes the following goal:

> "To help the public better understand some of the complex issues related to the quality of water in Lake Champlain and guide community decision makers to promote policies that enhance and protect the water quality of the LaPlatte River and other tributaries that feed into Shelburne Bay."

One of the most pressing concerns of the Partnership is the impact each of the rural communities will have on the river as they continue to grow. Hinesburg especially has seen a rapid rate of development compared to other towns in the county. A Hinesburg Land Trust board member worries, "The incremental but cumulative effect of this development will put additional burdens on a river system that has already been highly degraded." The information on water quality, geomorphology and the extent of impervious surface that the group has collected could provide the community with the basis for writing new zoning, purchasing lands or assisting in the implementation of existing plans and ordinances.

One very effective tool may be the river corridor plans that the Partnership is helping to develop with assistance from the Agency. A river corridor protection plan incorporates the geomorphic assessment work and the results of public discussions to develop strategies. The plan is developed to ensure that future development or land use change provides an adequate river corridor width, riparian buffer to provide boundary conditions, bank protection, shade, and other ecological benefits, culvert or bridge

[5] The Lewis Creek Association serves as the umbrella group for the LWP.
[6] Results are located at http://www.lewiscreek.org/LaPlatte.htm

openings and flood-plain access. The plan will also be used to facilitate the development of town plans, and zoning and ordinances that protect the river corridor. The process in Hinesburg could become an example of how towns can incorporate watershed protection into plans for growth.

The Agency will also continue to encourage and enable local government to play a more effective role in managing land use decisions in river corridors. The incentives could include the following:

- Establish comprehensive, coordinated, State and local water quality, economic development, and hazard mitigation planning;
- Strengthen state technical and administrative support for community land use and development planning and review, and hazard plan implementation;
- Create economic incentives for river corridor protection initiatives by local government; and;
- Increase emphasis on land conservation activities in river corridors.

In addition, the Agency will also help communities to protect resources within the watershed that enhance or protect water quality and the river corridor. Efforts may encourage the protection of forests and wetlands to reduce stormwater runoff to streams.

The following strategies will help protect or enhance the basin's river corridors by supporting existing efforts and facilitating the development of new projects. While tailored for the LaPlatte River, the strategies for managing river corridors are applicable to most of the basin. This is especially true where sediment from streambank erosion has added to the phosphorus load in Lake Champlain. The strategies for assisting with new development are particularly relevant to the basin north of Burlington, where the rate of development has accelerated in what was once a predominantly agricultural landscape.

**GOALS:**

- **PROTECT RIVER CORRIDORS.**
- **IMPROVE AND PROTECT FORESTS AND TREES, WILDLIFE HABITAT AND NATURAL COMMUNITIES ASSOCIATED WITH RIVER CORRIDORS.**

| GENERAL APPROACH /OBJECTIVES |
|---|
| **1. Assess the condition of river corridors and watershed** |
| **2. Protect and enhance the river corridor to restore natural stability and wildlife habitat.** |

**OBJECTIVE 1. Assess condition of the river corridors and watershed**

Many of the rivers in the LaPlatte watershed were assessed by the LWP during the basin planning process. The geomorphic assessments provide information to help protect and restore the river corridor. In general, the LaPlatte has a naturally high sensitivity rating, indicating that it is prone to channel adjustment given any change in the hydrologic or sediment regime. Most reaches of the LaPlatte (with the exception of the few reaches stabilized by bedrock) are in a state of disequilibrium, meaning that there is an imbalance between the sediment and hydrologic load. Historically, many reaches of the river

were straightened, dredged, and bermed for agricultural and flood control purposes. This channel manipulation has lead to channel incision, and consequent widening of the channel (through eroding of the banks) due to the increased power of the flow. The increased sediment load from eroding banks has caused many reaches to actively aggrade as this excess sediment is sorted by the river and formed into a new floodplain at a lower elevation than the historically accessed floodplain. The process by which a channel becomes incised, widens, and eventually forms a new floodplain is called channel evolution. In addition, the increased sediment makes its way to Shelburne Bay, adversely affecting water quality in the Bay (see sediment in Chapter 3).

In general, the upper reaches of the LaPlatte (Hinesburg area) are in earlier stages of evolution meaning that a new floodplain is not well developed, whereas the lower reaches of the LaPlatte (Charlotte and Shelburne) are closer to achieving an equilibrium state.

River corridor plans have been completed for the entire LaPlatte main stem, and suggested projects to enhance stream geomorphic condition are primarily focused on obtaining river corridor easements to allow for channel evolution, restoring riparian buffers with native vegetation, and replacing undersized culverts to allow for passage of sediment.

Protecting and increasing the wetland and forest cover within the entire watershed also plays a role in protecting the stability of a river corridor and water quality. In addition, protecting natural communities and association wildlife increase the ecosystem values of the river corridor.

**STRATEGIES FOR OBJECTIVE 1.:**

1. Continue to conduct DEC Phase 1 (remote sensing) geomorphology assessments. The Phase 1 assessment results provide baseline scientific data needed to assist communities in various river corridor protection and management goals. Prioritize subwatersheds that are slated for town centers or other growth centers and watersheds that have valuable natural areas.
   Lead agencies/organizations: LWP and other watershed groups, RPCs
   Partners: DEC, towns
   Potential funding sources: C&C, LCBP, 604(b) and 319 funding
   Time frame: Ongoing[7]

2. Continue to complete Phase 2 geomorphic assessments and bridge and culvert assessments. Stream reaches that are impaired, reaches vulnerable to fluvial and erosion flooding hazards areas proposed for development and waterways exhibiting reference reach qualities should be first priorities for this assessment.
   Lead agencies/organizations: LWP and other watershed groups, RPCs
   Partner(s): DEC, towns
   Potential Funding Sources: C&C, LCBP, and Vermont Watershed grants
   Time frame: Ongoing

3. Evaluate the effect of dams on stream channel stability, fisheries and wildlife habitat. Also evaluate for historical significance. Develop a plan for removing or protecting the dam and implementing measures to enhance fisheries and wildlife habitat (*The 2003 DEC Basin 5 Assessment* includes a list of dams.)

[7] Ongoing means that projects were begun during the basin planning process and implementation continues

Lead agencies/organizations: DEC, DFW
Partners: Historic preservation, municipalities
Potential funding source(s): C&C, Vermont Watershed grants
Time frame: 2012

4. Conduct and map inventories of natural communities, perform assessment of tree and forest cover using existing tools such as LEAF-OUT analysis and Forest land Evaluation and Site Assessment (FLESA) program. Assessing natural communities and forest cover helps in their protection and management. Preserving these landcovers will enhance the ecological value of the river corridors and protect water quality.
   Lead agency: FPR DEC, LWP and other watershed groups[8]
   Partners:, DFW, FPR, RPCs, The Nature Conservancy, VLCT
   Potential funding sources: C&C, Vermont Watershed Grants, 319 grants
   Time frame: 2012

5. Monitor water quality and stream channel conditions to assist communities and the Agency in better understanding resources and threats.
   Lead agencies/organizations: DEC, LWP and other watershed groups
   Partners: Municipalities, UVM
   Potential funding sources: DEC lab services
   Time frame: Ongoing

6. Protect and restore state priority wetland restoration sites (see Map and *http://www.vtfpr.org/wprp/index.cfm*) Wetlands play an important role in water quality protection, flood storage and wildlife habitat.
   Lead agencies/organizations: DEC, DFW, LWP and other watershed groups
   Partners: Municipalities, The Nature Conservancy, USFWS
   Potential funding sources: C&C, Partners for F&W, WHIP,
   Time frame: Ongoing

**OBJECTIVE 2. PROTECT AND ENHANCE THE RIVER CORRIDOR TO RESTORE NATURAL STABILITY AND WILDLIFE HABITAT:**

**STRATEGIES:**

7. Assist communities with the development and implementation of river corridor management plans that include fluvial erosion hazard plans and mapping as part of pre-disaster mitigation efforts. Use the DEC River Corridor Management Alternatives Analysis to determine if and what type of restoration approach to use for reaches undergoing adjustment processes (DEC, 2006)**.**
   Lead agencies/organizations: DEC, RPCs
   Partner(s): LWP and other watershed groups, municipalities
   Potential Funding Sources: C&C, PDM funds, FEMA
   Time frame: Ongoing

8. Protect reaches of streams that are stable and functioning well ecologically. These are reaches that are least disturbed and where the geomorphic condition of rivers, vegetated corridors and

[8] A list of currently active Watershed and Lake Associations that are community based can be found at: http://www.anr.state.vt.us/cleanandclear/orgs/index.cfm.

floodplain forests that provide natural boundary conditions and floodplain access are relatively intact. Specific strategies might include: protective language in town plans and the establishment of town zoning regulations, floodway setbacks, public acquisition, and acquiring conservation easements.

Lead agencies/organizations: ANR, LWP and other watershed groups,
Partner(s): RPCs, USFWS, VLCT, and municipalities
Potential Funding Sources: C&C, WHIP, CREP, and Partners for F&W, VRC, Vermont Landowner Incentive Program, Vermont Wetland Protection and Restoration Program
Time frame: Ongoing

9. Establish and enhance vegetated riparian buffers along watershed streams. Prioritize sections of buffer that connect existing high quality riparian buffer to ensure long-term natural stream stability, especially where they offer known or potential wildlife travel corridors and/or protect important aquatic habitats.

   Lead agencies/organizations: AAFM, DEC, LWP and other watershed groups
   Partner(s): RPCs, municipalities, NRCS, USFWS
   Potential Funding Sources: C&C, WHIP, CREP, and Partners for F&W
   Time frame: Ongoing

10. Offer information and technical support to selectboards and municipal planners on planning, zoning and regulatory opportunities that protect or enhance river corridors, including their watersheds and water quality of surface waters. Examples include:
    a. Review zoning regulations from each town to develop a report on how they do or do not protect river corridors and their watersheds. Present the report to each planning commission in the watershed.
    b. Prepare model ordinances that towns can use to protect water quality and work with individual towns in drafting water quality protective language specific to their conditions and policies.
    c. Encourage appropriate development patterns by identifying and mapping river corridors.
    d. Prepare educational material for four specific audiences: regional plan language, town governance, landowners, and NGOs. Chittenden County RPC would provide education outreach for local planning.

    Lead agencies/organizations: DHCA, VLCT, DFW Conservation Assistance Project, Urban and Community Forestry Program, County Foresters
    Partners: DEC, FPR, LWP, RPCs, watershed groups
    Potential funding sources: C&C, 604(b) grants, LCBP
    Time frame: Ongoing

11. Encourage and support citizen-based efforts to protect river corridors: enhanced economic incentives and education to landowners. Educate the community, including schoolchildren.

    Lead agencies/organizations: DEC, AAFM, US Fish and Wildlife Service
    Partners: CWD, LWP and other watershed groups, municipalities
    Potential funding sources: C&C, LCBP, USFW and NRCS programs
    Time frame: Ongoing

12. Encourage farmers to apply for enrollment in the Conservation Reserve Enhanced Program (CREP) and other buffer protection programs.

    Lead agency/organization: AAFM
    Partners: DEC, NRCS, UVM Extension, watershed groups
    Potential funding source(s): C&C

Time frame: Ongoing

13. Assist town highway managers and crews to protect streams and lakes through road improvements. Provide technical assistance and education on road maintenance and repair and water quality, aquatic habitat and stream stability concerns. Assist them in developing applications for grant programs.

    Towns can also adopt road and bridge standards consistent with those recommended by the Agency of Transportation in the Handbook for Local Officials to help reduce erosion and sedimentation (VTrans 2007). These standards include minimum requirements for seeding and mulching ditches, installing stone lined ditches and roadway and culvert standards. By adopting these standards the town match on class 2 projects is reduced from 30% to 20% and the town can receive increased disaster relief to rebuild roads up to adopted standards not just current road conditions. Another important policy for towns to adopt is a highway access policy. Poorly designed driveways are a common cause of flood damage to road systems and contribute a disproportionate amount of sediment to surface waters in Vermont.

    Work with all municipalities in the watershed to adopt and actively implement the following programs or standards:

    A. To ensure that adequate erosion control measures implemented during road maintenance - Town road and bridge standards consistent with or exceeding those listed under Town Roads & Bridges Standards, Handbook for Local Officials, VTrans 2004.

    B. To ensure adequate culvert size to reduce road washout during intense storms - Driveway/highway access (curb cut) construction ordinances meeting the standards outlined in the Highway Access Policy and Program Guidance and Model Ordinance, VT Local Roads Program, May 1997.

    Lead agencies/organizations: VTrans, DEC, Better Backroads Program
    Partners: DFW, town road crews and commissions, conservation commissions, and selectboards, watershed groups
    Potential funding sources: Increased state match for class 2 road projects and reimbursement for disaster relief, BBR, Stormwater mitigation funds
    Time frame: Ongoing

14. Continue prioritizing in-stream and corridor management restoration projects within sub-watersheds based on a river corridor protection plan. When opportunities or a crisis make a river restoration project necessary in an area that has not been surveyed, a geomorphic analysis-based approach should be used. The projects should focus on areas in the headwaters where they can do the most good and they are the least apt to be disturbed by land practices. Where possible, consideration should be given to allowing the river to adjust until the river achieves natural stream stability.

    Lead agencies/organizations(s): DEC, RPCs, NRCS, LWP and other watershed groups
    Potential funding sources: C&C
    Time frame: Ongoing

15. Protect riparian and aquatic habitats during forest logging operations by encouraging the use of best practices including wooden portable skidder bridges for temporary stream crossings.

Workshops are offered for loggers, forest landowners and private consulting foresters that address protection of water quality and stream habitats during timber harvesting operations.

Lead agencies/organizations: USDA Forest Service State & Private Forestry
Partners: VT Dept. of Forests, Parks and Recreation, RC&D, NRCD, High school vocational programs
Potential Funding Sources: C&C, 319 grants, USDA Forest Service Redesign grants; USDA Forest Service Wood Education Resource Center grants
Time Frame: ongoing

## 4.3 Addressing Urban Stormwater Runoff: A case study for Burlington and Malletts Bay watersheds

Urban stormwater runoff occurs when precipitation collects and then runs off impervious surfaces, often directly into streams, rather than infiltrating into the soil. The increase in the quantity of stormwater runoff leads to the degredation of the physical and biological conditions in the stream: increased quantity, increases velocity of stream flows, causing erosion of the stream channel, and leading to the eventual destabilization of the channel as well as sedimentation of the stream bed. The reduced infiltration of stormwater can also lower ground water levels. As a result, streams that depend on ground water to maintain a base flow during dry months can experience periods of no flow in highly impervious watersheds.

Stormwater in urban areas also carries a significant load of pollutants to receiving water bodies. Concentrated activity in urban areas loads stormwater with fertilizers, road salt, animal feces, pesticides, oils, heavy metals, and decaying organic matter. With very little pervious area for stormwater infiltration, these pollutants reach and adversely impact aquatic habitat. The end result of unmanaged stormwater can include the erosion of valuable property, degraded or destroyed aquatic life and wildlife habitats, algal blooms and pathogen contaminated beaches and water supplies. Treating stormwater to reduce flows and pollutants requires both a regulatory and non-regulatory approach, with local communities playing a role in encouraging residential landowners to take voluntary actions.

**Case Study: Burlington and Malletts Bays**

Encompassed by the cities of Burlington and South Burlington, Burlington Bay watershed includes the largest urban center in Vermont. The Malletts Bay watershed is highly urbanized as well with four smaller urban centers: Colchester, Essex, Essex Junction and Milton. The resulting high concentration of impervious surface and land use activities in these watersheds has led to water quality problems.

In these two watersheds, excessive stormwater from the impervious surfaces has impaired the tributaries to the Bays. In addition, the shorelines of the Bays are impacted by stormwater-related pollutants because of their close proximity to stormwater discharge points. Moderate rain events usually result in high *E. coli* levels at stormwater discharge points, including the mouths of streams, while the heaviest rain and snow melt events carry the majority of the Bays' annual phosphorus and sediment loads (Medalie 2007). This pattern holds true for most urbanized watersheds.

The management of stormwater and pollutant sources has been, and will continue to be, the most important tool for cleaning up these bays. Much of the management will be dictated by regulatory processes, but voluntary efforts will play an important role as well. The Basin 5 planning meetings elicited public comments that ranged from frustration over the inadequacies of existing stormwater treatment structures to the recognition that the stormwater problem can be improved if individuals increase their sense of personal responsibility. The discussion and the strategies in this section are also particularly relevant to other subbasins that include urban areas such as St. Albans and Shelburne Bays.

## The Role of Stormwater Regulations

In the late 1970s, the Agency of Natural Resources (Agency) first began requiring the treatment of stormwater when developments created new impervious surfaces above a specified threshold. Initially, the primary goal of stormwater treatment was to reduce flooding. Over time, the impact of stormwater on water quality and other water-related factors has been recognized and stormwater regulations have evolved to address these concerns. Appendix E describes all current stormwater-related regulations.

The Agency's most recent stormwater treatment standards, adopted in 2002, now address water quality, channel protection, groundwater recharge, overbank flood protection and extreme flood control. The standards require treatment of storms ranging from the smallest, most frequent storm events that are beneficial for groundwater discharge, to the largest, very infrequent storm events that can cause catastrophic damage.

Although stormwater management in recent developments is improving, the cumulative impacts of stormwater from older and subjurisdictional developments have resulted in the impairment of seven streams in the basin (Table **3**).

Act 140, passed by the General Assembly in 2004, requires that the Agency develop a TMDL and a water quality remediation plan for each stormwater impaired water by January 15, 2010. Together, the TMDL and remediation plan are an EPA-approved watershed restoration plan that attempts to limit and allocate discharge loads among the various dischargers to impaired waters to assure attainment with water quality standards. The Agency has developed a Total Maximum Daily Load for each of these streams[9].

Table 3 shows that in order to meet the high flow target set forth in the TMDL, a percentage of the high flow reductions required will need to come from unregulated sources of stormwater. For example, within the watershed of Munroe Brook, 21% of the reductions in stormwater volume will have to come from unregulated sources. The Agency's TMDL recognizes that voluntary efforts within the community will be necessary to address sources that do not require a stormwater permit. Educational efforts will be an important tool for encouraging voluntary efforts. The TMDL implementation process for stormwater-impaired waters is discussed in Section 5.2.

Table 3. Total Allocation of the high flow (Q0.3%) percent reductions in Basin 5 stormwater TMDLs and the relative portion allocated to the Load Allocation.

| **Watershed** | **Total Allocation (% ) – stormwater volume at high flow that needs to be reduced** | **Load Allocation (%) - total reduction that is allocated to unregulated stormwater** |
|---|---|---|
| Englesby Brook | 34.3 | 0 |
| Potash Brook | 17.9 | 8 |
| Munroe Brook | 6.6 | 21 |
| Indian Brook | 1.4 | 7 |
| Bartlett Brook | 33.8 | 2 |
| Rugg Brook | 22.6 | 29 |
| Stevens Brook | 27.3 | 11 |

[9] For a map of the streams and their TMDL see http://www.anr.state.vt.us/dec//waterq/stormwater/htm/sw_impaired.htm

## Encouraging Improved Stormwater Treatment Through Education

Education by a multitude of groups in the basin has also played an important role in addressing stormwater. To date, most of the educational efforts to reduce stormwater impacts have focused on encouraging individuals or entities to reduce polluting activities. Watershed groups, conservation commissions, non profits, schools and towns have all played a role in these efforts. More recently efforts have focused on reducing the quantity of stormwater through infiltration practices such as rain gardens and barrels.

Educational efforts have ranged from providing factsheets and presentations to developing full fledged campaigns. In addition to encouraging behavior change through instructions, projects have also included demonstrations. Examples of demonstrations for a residential landowner include installation of rain gardens on a neighbor's lawn. For a developer or municipality, it may be the use of an improved stormwater treatment technique, like an infiltration basin. These demonstration projects, in addition to other education projects in the Burlington and Malletts Bay watersheds are described below:

### *Agency of Natural Resources Watershed Restoration Projects*

With federal funding assistance and State matching funds, a number of large scale watershed restoration projects have been initiated. Examples include the Farrell Street retrofit which treats stormwater from existing development in the Potash Brook watershed (2007). Additional projects are planned for Indian Brook, Potash Brook and Monroe Brook. Many of these projects help the municipalities investigate the use of alternative practices, including many that focus on infiltrating stormwater to reduce the adverse effects of detaining and releasing stormwater.

### *Englesby Brook Watershed Restoration Project*

In May 2001, the City of Burlington, with help from the Center for Watershed Protection and other stakeholders, completed a restoration plan for the one-acre Englesby Brook watershed. Using federal grants, the city implemented stormwater mitigation projects including the expansion of a pond at a country club and development of a stormwater wetland to help mitigate peak flows and reduce sediment loads. The improvements were followed by the reopening of a recreational beach near the brook's confluence with the lake that had been closed for years due to high levels of bacteria.

### *Low Impact Development (LID) practices*

Both towns and local watershed groups have been involved in promoting Low Impact Development (LID) practices. These practices closely replicate the natural hydrology by allowing water to soak into the ground in a variety of places. Examples include depressed gardens that receive runoff directly from a roof or driveway, rain barrels below house gutters, the protection of forested area and the addition of compost to soil to increase its moisture holding capacity.

In contrast to LID, traditional stormwater detention ponds collect all stormwater from a development and discharge it to one point. Focusing on infiltration can improve stormwater treatment by reducing pollutant loads and the scouring of stream channels. In addition, LID treatments can be tucked into an existing development needing to improve stormwater treatment without having to find space for a stormwater detention pond.

Work with towns in the basin has begun to introduce LID concepts into the local planning and development review process. The Agency of Natural Resources, UVM Sea Grant Program, and Vermont League of Cities and Towns have all provided assistance. Projects include presentations to towns, including an April 2008 LID conference for towns and engineers, LID demonstrations, and creating a model LID stormwater management ordinance.

***Rain Garden and Rain Barrel Project***

Low Impact Development can be encouraged on the residential level as well. Efforts to educate residents in the basin about the benefits of infiltrating their roof runoff using rain garden began in summer 2005 with the installation of four residential rain gardens in South Burlington. The demonstration project was a collaborative effort involving South Burlington, the Agency of Natural Resources, UVM Master Gardener Program, and the Winooski Natural Resources Conservation District (WNRCD). The groups along with UVM Sea Grant Program have continued educational efforts since then with presentations and additional demonstration gardens throughout the basin and the county. The WNRCD has also coordinated the development of a Vermont Rain Garden Manual with the above partners and others. Most recently, the WNRCD and ANR have helped schools to decorate and distribute rain barrels that capture roof runoff.

***Lake Friendly Lawn Care***

Many non-profits and for-profit based organizations within the community have programs to promote the use of lake friendly lawn and garden practices. In December 2003, a group began to meet as the Vermont Green Lawn Coalition to help leverage existing resources. In the Burlington and Malletts Bay watersheds, the group organized the Green Lawn Expo in the spring of 2005 and 2006 with support from Gardener's Supply, and participated in the Vermont Flower Show in 2007. Efforts are now coordinated through the Lake Champlain Basin Program where a "Don't P on Your Lawn" brochure, describing lake friendly lawn care, has been produced and distributed by the coalition and a website has been developed (Lawntolake.org). In addition to the Agency, others participating in the coalition include the Lake Champlain Basin Program, Lake Champlain Committee; UVM Extension and UVM Sea Grant Program, the Vermont Agency of Agriculture, Food and Markets (AAFM) and Cornell Cooperative Extension. Additional efforts have included television, radio and newspaper interviews, community presentations and a television public service announcement aired by AAFM, community presentations, and Master Gardener outreach.

***Redesigning the American Neighborhood (RAN) project***

The goal of this project was to quantify the balances among environmental, economic, and social costs and benefits for alternative stormwater management techniques at whole-watershed, neighborhood, and individual house scale in a typical New England landscape and climate. This is an alternative to centralized, engineered facilities, to treat stormwater. This project is a collaborative effort with the University of Vermont, the City of South Burlington and the WNRCD. This project worked directly with two South Burlington developments in the upper Potash Brook watershed: Butler Farms and Oak Creek Village. Community members have had the opportunity to learn about stormwater best management practices (BMPs) and to participate in design charrettes to help develop the various stormwater treatment scenarios that are most appropriate aesthetically, ecologically, and economically for their neighborhoods. The project's internet site is http://www.uvm.edu/~ran/public_resources/potash/toolbox/toolbox.html.

***Regional Stormwater Education Program (RSEP)***

The urban and suburban communities within Basin 5 have developed education and outreach plans for reducing impacts from water quality and quantity from urban stormwater. The plan is part of the State's Stormwater Program for Municipal Separate Storm Sewer Systems (MS4) permit under Phase 2 of the Federal CWA 1987 amendments. In Chittenden County, nine municipalities and three other entities have formed the Chittenden County Regional Stormwater Education Program (RSEP) to cooperatively conduct Public Education and Outreach efforts to comply with Minimum Measure #1 of their permits.

Administered by the Chittenden County Regional Planning Commission, its members include: the Towns of Colchester, Essex, Milton, Shelburne, Williston; the Cities of Burlington, South Burlington and Winooski; the Village of Essex Junction; the Burlington International Airport; the University of Vermont; and the Vermont Agency of Transportation. The RSEP was first formed in 2003 through a Memo of Understanding (MOU) and recently completed its first 5 years of a comprehensive education campaign. All 12 entities have signed onto a similar MOU committing towards another 5-year cooperative effort through early March 2013.

The RSEP uses a combination of television, radio, print, and a program web site[10], as well as educational events, to raise awareness and encourage positive behavior change in Chittenden County residents to address stormwater problems. A fall 2007 survey of residents from the nine communities indicated the following gains:

- an increased knowledge of stormwater and where it flows;
- an increase in reported disposal of pet waste; and
- an increase in the knowledge of the negative impacts of certain household behaviors.

The following strategies are applicable to the entire basin. Implementation will support existing efforts to address stormwater and facilitate the development of new projects by the Agency, the community and others.

**GOALS:**

- **INCREASE THE USE OF RESIDENTIAL PRACTICES THAT PROTECT WATER QUALITY.**
- **INCREASE THE INFILTRATION OF STORMWATER FLOWS IN CONJUNCTION WITH THE TRADITIONAL DETENTION METHODS USED TO TREAT STORMWATER.**
- **PROTECT HUMAN HEALTH BY IDENTIFYING AND CONTROLLING SOURCES OF WATER-BORNE PATHOGENS.**

| GENERAL APPROACH /OBJECTIVES |
|---|
| **1. Educate the community and provide incentives for implementing urban stormwater best management practices.** |
| **2. Develop and promote *E. coli* monitoring and control programs for recreational waters (boating and swimming).** |

[10] www.smartwaterways.org

**OBJECTIVE 1. Educate the community and provide incentives for implementing urban stormwater best management practices (BMP).**

**STRATEGIES:**

1. Provide residential BMP education that is effective in helping the community adopt the practices. Provide incentives and identify barriers to behavior change. Incentives to continued use of a behavior may include celebrating successful community efforts. Demonstration sites showing the use of rain barrels or other practices helps to provide additional information about installation or effectiveness.
   Lead agencies/organizations: DEC, RSEP, FPR
   Partners: LCBP, RPC, RSEP, UVM, Watershed associations, Lake Champlain International, Inc.
   Potential funding sources: LCBP, 319
   Time frame: Ongoing

2. Collect data that is specific to a community regarding its impact to water quality to help design effective educational programs, e.g., survey the community about water quality awareness, collect soil sample data to educate people about need for phosphorus application to lawns.
   Lead agencies/organizations: DEC, RSEP, UVM Sea Grant
   Partner(s): watershed groups
   Potential funding sources: LCBP, 319, RSEP
   Time frame: Ongoing

3. Encourage landscaping that encourages infiltration of stormwater and reduces export of pollutants such as fertilizer and pesticides. Examples include installation of rain gardens, lake friendly lawn care, protection and enhancement of forest cover.
   Lead agencies/organizations: DEC, NRCD, UVM Sea Grant; FPR
   Partner(s): Municipalities
   Potential funding sources: LCBP, 319
   Time frame: Ongoing

4. Collaborate with the MS4 entities (see background information) that plan to fully implement their stormwater management programs by 2008. The programs include a collaborative effort by the MS4 entities in the implementation of Minimum Control Measure 1 (Public Education and Outreach) through the Regional Stormwater Education Program (RSEP).
   Lead agencies/organizations: RSEP, DEC
   Partners: RPC, watershed associations
   Potential funding sources: No funds specificed
   Time frame: Ongoing

5. The potential effects of new development involving less than one acre are not addressed under the State's stormwater program. With residential and other small-scale development increasing, towns are encouraged to adopt local stormwater standards to ensure that this incremental development occurs in ways that help to maintain water quality
   Lead agencies/organizations: CCRPC, VLCT
   Partner(s): Municipalities
   Potential funding sources: C&C
   Time frame: Ongoing

6. Encourage land use development practices that minimize pollution from stormwater runoff, including the reduction of stormwater volume and soil erosion. Development should employ innovative approaches to avoid adverse stormwater impacts, such as construction management practices and low-impact development practices.
   Lead agencies/organizations: CCRPC, DEC
   Partners: CAV, VLCT
   Potential funding sources: C&C
   Time frame: Ongoing

7. Assist municipalities in developing a digital dataset of stormwater infrastructure and permit data. This project will enhance municipal and State efforts to understand and mitigate the adverse effects of stormwater runoff on water quality and quantity.
   Lead agency/organization: DEC
   Partners: RPCs, municipalities
   Potential funding sources: 319 and 604b
   Time frame: Ongoing

8. Due to the highly erodible nature of sandy soils, discharging stormwater into sandy slopes can result in erosion that threatens infrastructure on adjoining land and downstream water quality. Fixing the existing erosion can be very expensive with costs range from $20,000 to $100,000. Reducing stormwater volumes is a plausible approach in a watershed that can easily infiltrate surface water. In addition, work with landowners, public works directors where applicable to fix areas where public or private infrastructure and water quality is most threatened in the watershed.
   Lead agency/organization: DEC
   Partners: municipalities, FPR, municipalities, VYCC
   Potential funding sources: 319, Stormwater Mitigation Funds
   Time frame: 2012

**OBJECTIVE 2 DEVELOP AND PROMOTE E. COLI MONITORING AND CONTROL PROGRAMS IN RECREATIONAL WATERS.**

**STRATEGIES:**

9. Many towns and state parks monitor for *E. coli* levels at public swimming areas to identify health risks associated with water-borne pathogens. Assist in the development of water quality monitoring plans at public swimming areas that help to identify pathogen sources and trends for predicting high E. coli levels.
   Lead agencies/organizations: DEC, Municipalities, FPR
   Partners: VDH, watershed associations
   Potential funding sources: 319, Vermont Watershed Funds
   Time frame: 2012

10. Promote the use of the DEC Water Quality Divisions, “Citizen’s Guide to Bacterial Monitoring in Vermont Waters.”
    Lead agency/organization: DEC
    Partners: Municipalities, VHD
    Potential funding sources: Vermont Watershed Funds, 319
    Time frame: Ongoing

11. Provide educational information on reducing pathogen sources to communities in watersheds of recreational waters with high *E. coli* levels. Include educating shoreline owners about how to avoid attracting large flocks of seagulls, geese and other birds that can add pathogens to swimming areas.

    Lead agencies/organizations: DEC, DFW
    Partners: VDH
    Potential funding sources: LCBP, Vermont Watershed Funds.
    Time frame: 2012

12. Identify public beaches where water quality monitoring indicates low *E. coli* levels and help develop a plan to protect existing water quality.

    Lead agency/organization: DEC
    Partners: FPR, municipalities, watershed groups
    Potential funding sources: no funds specified
    Time frame: 2012

## 4.4 Reducing algal blooms: A case study in St. Albans Bay and the Alburgh Passage

High phosphorus levels are responsible for algal blooms in Lake Champlain. Phosphorus levels are predominantly determined by land use with developed and agricultural activity providing the vast majority of the phosphorus to the Lake. High levels of phosphorus in lake sediments from historic loading can also provide phosphorus to the water column. Section 3.2 provides additional information about phosphorus. Innovative approaches as well as the standard best management practices are required to address the problem. A collaborative effort among community members, the Agency and other resource agency facilitates the development and implementation of innovative approaches.

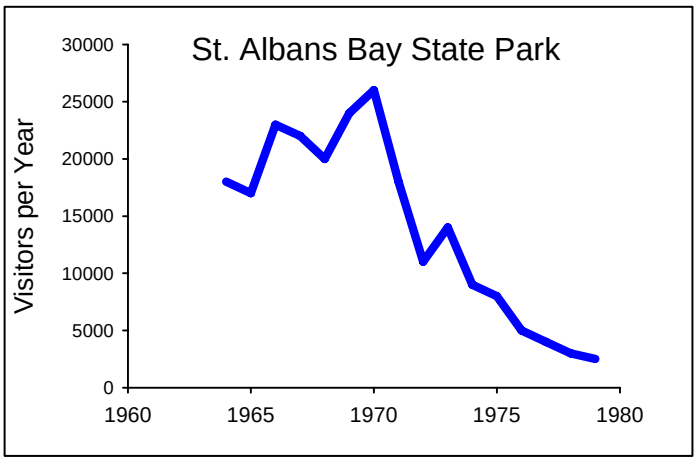


Figure 2. Annual visitor use at St. Albans Bay State Park, now Bayside Park, 1964-1974. (Source: St. Albans Bay Rural Clean Water Program).

**Case study: St. Albans Bay and the Alburgh Passage**

In northern Lake Champlain, the frequency of algal blooms in the St. Albans Bay and the Alburgh Passage are second only to those in the Missisquoi Bay. Since 2000, weekly monitoring during the recreational season has revealed toxic blue-green algae is also present at a higher frequency than most other areas of the Lake. The most dramatic result of the degraded water quality has been a decrease in the waters' recreational value. The poor water quality is best indicated in St. Albans Bay by the declining use of Bayside Park (Figure 2) as well as the diminished value of shoreline property. A 1984 study showed a 20% decrease compared to the value of similar properties located outside of the Bay.

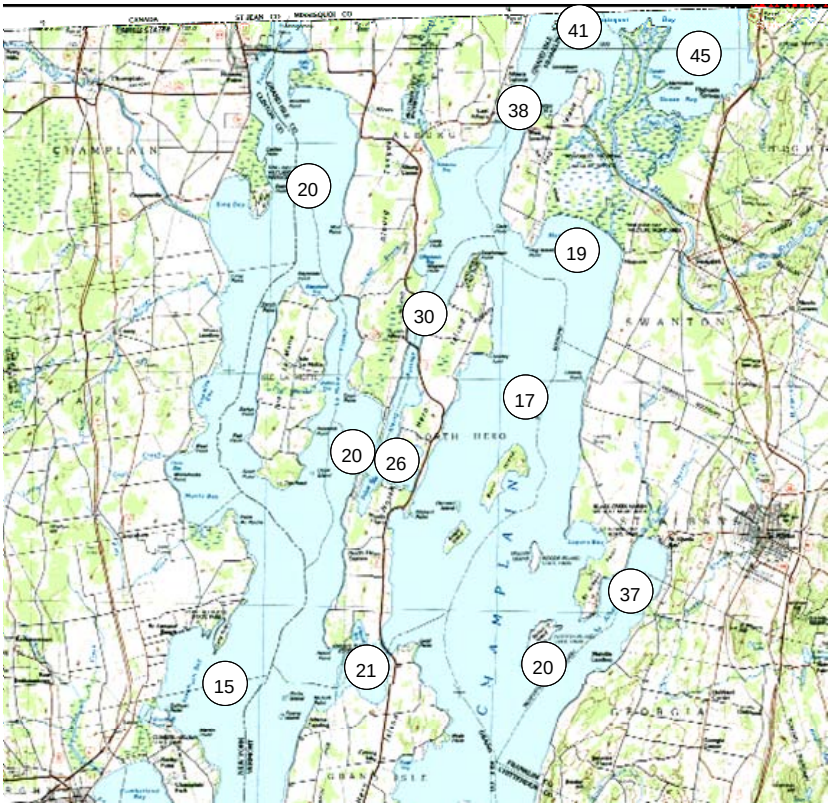


Figure 3. Long-term average phosphorus levels (mg/L) in northern Lake Champlain are highest in St. Albans Bay and in and around Missisquoi Bay (Vermont Lay Monitoring Program data, 1979-2004)

The algal blooms are fed by an over abundance of phosphorus in the water and the chronic blooms are symptomatic of the fact that the Bay and the Passage have the lake's highest phosphorus levels, second only again to the Missisquoi Bay (Figure 3). The high phosphorus levels in the Alburgh Passage can be largely attributed to transport from the Missisquoi Bay. The high percentage of agricultural and developed land compared to forested land in the St. Albans Bay and Missisquoi Bay watersheds help to explain the extraordinarily high loads of phosphorus. In addition, historic contributions of phosphorus to St. Albans Bay, now stored in the lake sediments, add to the present-day phosphorus levels in the water column. Although external loads to the St. Albans Bay have decreased over the last 20 years, internal loading of phosphorus from Bay sediments to the water column has significantly delayed recovery (Druschel et al. 2005).

Reducing the phosphorus concentrations in St. Albans Bay requires the reduction of both the internal loading from the Bay sediments and the external loading from the watershed. Reducing phosphorus concentrations from the Alburgh Passage will require addressing the phosphorus loading to Missisquoi Bay, which empties into the passage, and will be addressed in the Agency's Missisquoi River watershed plan. An additional strategy of removing the Carry Bay causeway to dilute the Passage water with cleaner water from the west side of the causeway will be discussed later in this section.

The Agency funded a study that assessed the different options for reducing the internal load to St. Albans Bay (ENSR Corporation 2007). Treating the Bay's sediments with alum was found to be the most feasible solution if it were combined with efforts to reduce external loading from the watershed; otherwise, the sediments could eventually receive enough new phosphorus to re-activate the internal loading.

**External loading: Identifying sources through modeling**

Three recent models identify nonpoint sources from agricultural and urban land use as the most significant contributors to the external phosphorus load. The Agency derived an estimate using land use and land cover data (ca. 1993) with a phosphorus export modeling analysis identifying agricultural land at 73% and urban land at 18%. The most significant point source, wastewater, (St. Albans City and Northwest Correctional Facility, 1996-2002 average loads) was a relatively small portion (7%) of the total load (Hegman et al. 1999, VTANR 2003).

In 2007, a dynamic landscape simulation model of diffuse phosphorus transport processes in the St. Albans Bay watershed was developed (Gaddis 2007). The model incorporated water quality, soil phosphorus, and stream sediment phosphorus data specific to the Bay's watershed. The results of the model by Gaddis are similar to first model (Hegman et al. 1999); however, the finer level of detail afforded by the Gaddis model provided additional information:

- Almost half of the agricultural surface runoff originates from soluble phosphorus leaching off soil particles during spring runoff and large storms.
- Road and sand washoff in the developed landscape provides 12%.
- Direct discharge to streams from farmsteads represents a significant load to streams (15%) of which the majority comes from barnyard manure runoff and silage leachate.
- The Stevens Brook watershed, including St. Albans city, accounts for 35% of the phosphorus load.
- Both the watershed and the city account for more load than their relative area in the watershed.
- The clay soils, found primarily in the Jewett Brook and lower Stevens Brook subwatersheds, appear to provide larger phosphorus loads than other soil types.
- 42% of the phosphorus load is transported during storm and post-storm events.
- 27% is transported during the spring runoff event each year.
- Although none of the models is able to calculate the amount of phosphorus loading from eroding stream banks, it is still considered to be a significant source by the Agency and Gaddis.

An updated land use and phosphorus modeling analysis conducted by the University of Vermont (Troy et al. 2007), based on more recent land use and land cover data (2001) than the Hegman study, increased the phosphorus contribution from developed land in St. Albans Bay to 55%, while agricultural land was estimated to contribute 44%. The results emphasize the need to look at developed land as closely as agricultural land for phosphorus reduction opportunities.

**Developing strategies to address nonpoint source pollution**

The earliest model, (Hegeman et al. 1999) guided the Agency's initial response to St. Albans Bay's high phosphorus loading in the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL)[11]. The

[11] http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp_phosphorus.htm

TMDL includes a list of recommended actions that need to be taken to reduce the phosphorus load enough to achieve Vermont water quality standards. The actions include best management practices (BMP) for all land uses, including road maintenance, crop management, stormwater treatment and protection of stream corridors (see also Section 5.3). The severity of the problem and extent of sources have resulted in a significant contribution of resources from the State through the Clean and Clear Action Plan to support the implementation of projects supported by the TMDL, including an alum treatment study for the Bay. Other contributing partners to projects in the St. Albans watershed include the University of Vermont, Lake Champlain Basin Program, Lake Champlain Committee, the St. Albans Area Watershed Association and the Northwest Regional Planning Commission[12].

Most of the projects were implemented before the release of the studies by Gaddis and Troy. Subsequent work could benefit from the additional information provided by the studies.

**Center for Clean and Clear**

While developing the Basin 5 Plan, there was a call from watershed stakeholders for a new level of state agency focus on the issues in northern Lake Champlain. In 2007, the Secretaries of ANR and AAFM created the Center for Clean and Clean (CCC). The Center's mission is to oversee implementation of the Clean and Clear Action Plan, with an initial focus on Northern Lake Champlain and its watershed. The Northern Lake Champlain watershed includes all of the Misssiquoi Bay watershed (Missisquoi, Rock, and Pike River watersheds), the St. Albans Bay watershed (Stevens, Jewitt and Rugg Brook and Mill River watersheds), and the Lake Champlain Islands. The Center's director reports to the two agency secretaries, thereby fostering further coordination between the agencies' programs.

The CCC has developed an implementation workplan that describes in greater detail the approaches that ANR and AAFM will take toward water quality improvement. That workplan follows from the ideas, information, and community involvement used to develop this plan. It also covers parts of the Northern Lake Champlain Direct basin plan that are relevant to St. Albans Bay and the Lake Champlain Islands.

The CCC will guide and coordinate state agency work in the Vermont portion of the Northern Lake Champlain watershed. Successful approaches and lessons learned in this watershed will be applied elsewhere in the Lake Champlain watershed and statewide.

**Examples of collaborative projects with the Agency**

The Agency also helped community members develop strategies and implement projects during the basin planning process. The strategies in this plan have and will be implemented using a collaborative approach between professional organizations, including the Agency and the community. The ability of the community in St. Albans to work collaboratively has also resulted in the implementation of innovative projects such as permeable sidewalks and the use of iron slag to absorb phosphorus.

The following are examples of projects supported during the basin planning process (additional projects can be found in Table 7):

- The Northwest Regional Planning Commission has facilitated the development of the *Watershed Study Report Stevens Brook & Rugg Brook* with community members and the Agency. The

[12] For a list of projects supported by Clean and Clear funds see Table X and http://www.anr.state.vt.us/cleanandclear/projects/

planning commission is helping the community to implement these strategies and others with the help of an EPA pass-through grant procured through U.S. Senator Leahy's Office. The projects have included the installation of the first permeable sidewalk in Franklin County and trials of iron slag to absorb phosphorus from stormwater.

- A survey conducted by the St. Albans Area Watershed Association and partners indicates that their first educational effort to reduce lawn fertilizer application by homeowners was successful. Partners included the Agency, a Bellows Free Academy science class, the Master Gardener's program, UVM Sea Grant Program and a UVM PhD candidate. Educational efforts are continuing with the Agency including a phosphorus-free fertilizer rebate program and a lawn sign campaign.

- In cooperation with the Agency and the University of Vermont, the St. Albans Area Watershed Association also carried out a water quality monitoring program on tributaries to the Bay, with the goal of developing Gaddis' model that described nutrient loadings associated with various land use categories and compared the effectiveness of different practices on improving water quality. UVM graduate students used the model results to help facilitate discussions with a group of St. Albans Bay community members and the Agency to develop a set of community supported practices. By collecting information from the agricultural and the urban community, the discussion also provided an opportunity for different sectors of the community to describe their role in water quality protection.
- Strategies 4-7 under Objective 1 incorporate the results of the UVM supported discussion.

**Monitoring water quality improvements**
All of the above mentioned projects will help reduce the phosphorus load from the watershed into St. Albans Bay. The Agency and the Lake Champlain Basin Program will measure improvements through water quality monitoring and the attainment of predetermined indicators. Long-term water quality monitoring programs are in place to document changes in phosphorus levels and algal densities, and these results will serve as the ultimate indicator of success in reducing phosphorus in Lake Champlain. In addition, the Agency and the Lake Champlain Basin Program are developing phosphorus reduction indicators that will also help to measure the amount of work completed towards phosphorus reduction.

**Immediate relief from algal blooms**
Despite planned and completed efforts, it is not reasonable to expect these activities will result in immediate reductions in tributary phosphorus loadings or lake phosphorus concentrations in the St. Albans Bay or the Alburgh Passage. These changes may require decades, depending on how long it takes watershed and internal lake processes to readjust to better management and to purge the accumulated reservoir of phosphorus in soils and sediments.

A community supported solution that may have an immediate affect in the Missisquoi Bay and Alburgh includes the removal of the Missisquoi Bay causeway. The International Joint Commission's review supported the available scientific studies which predict only a 1% reduction in phosphorus concentration in Missisquoi Bay if the causeway is removed. The Commission also recognized that the public support for removing the causeway is so strong that it has become a distraction from the work needed to stem phosphorus inputs from the watershed, and for this reason recommended causeway removal. Local

residents feel that even 1% improvement is worth the cost of removal. In 2007, 100 m of the eastern end of the causeway was removed.

The Northern Lake Champlain Advisory Committee, a citizen group, is advocating for the removal of the Carry Bay causeway. The abandoned railroad causeway runs between North Hero and Alburgh and is owned by the Vermont Department of Forests, Parks, and Recreation. A study that modeled the hydrodynamics and water quality effects of the removal of the Carry Bay causeway indicates that the causeway interrupts the flow of clean water from the western side of the Lake Champlain Islands into the nutrient-rich water in Carry Bay and northeastward through the Alburgh Passage (Binkerd Environmental, Inc. 2004). The study predicted that removal of the Carry Bay causeway would reduce summer phosphorus concentrations in Carry Bay and the Alburgh Passage region by 1-10%, on average. The majority of the phosphorus load in the Passage and Carry Bay originates in the Missisquoi River watershed and the group contends that the removal of the Missisquoi Bay causeway would release even more phosphorus into the Alburgh Passage and Carry Bay. They have requested that the Carry Bay causeway removal occur in conjunction with or before the Missisquoi Bay causeway (personal communications: David Borthwick-Leslie).

The Agency has initiated the planning process for the removal of both the Missisquoi Bay and Carry Bay causeways. The risks and benefits of removing all or some of the causeways will be assessed as part of the planning process. Considerations will include recreation opportunities, wildlife habitat and the protection of water quality. Some of the analyses will occur during state and federal regulatory reviews.

The St. Albans Area Watershed Association has also requested innovative efforts to bring immediate relief to the Bay. The Agency has initiated two efforts with help from the association and others:

- Feasibility study for the control of internal phosphorus loading in St Albans Bay. The first part of the feasibility study, including findings and recommendations was delivered in June 2007 [13]

- Agency study [14] to show the effectiveness of SolarBee (TM) water circulators in reducing algae blooms at the northern end of St. Albans Bay during 2007. The study found no evidence that the SolarBees reduced algal concentrations, improved water clarity, or inhibited blue-green algae in St. Albans Bay. The treatment goal of producing an approximately 100-acre zone of clear, low-algae water at the northern end of St. Albans Bay was not achieved by the SolarBee deployment.

The following strategies were developed during the basin planning process and will help address the algal blooms by supporting existing efforts and facilitating the development of new projects by the Agency, the community and others. In addition the basin planning strategies to address external phosphorus loading in the St. Albans area include all those regarding stream corridor protection in Section 4.2, the urban stormwater treatment in Section 4.3 and the agricultural section in Section 4.5.

[13] ENSR Corporation 2007 http://www.anr.state.vt.us/cleanandclear/StAlbansBay-FinalReport-Phase1.pdf

[14] http://www.anr.state.vt.us/cleanandclear/SolarBee%20Report%20Final.pdf

**GOALS: REDUCE THE CONCENTRATION OF PHOSPHORUS IN ST. ALBANS BAY AND THE ALBURGH PASSAGE TO MEET WATER QUALITY STANDARDS.**

| GENERAL APPROACH /OBJECTIVES |
|---|
| 1. **Provide education and incentives to communities and individuals to implement practices that reduce the amount of phosphorus entering the watershed and its waterbodies.** |
| 2. **Develop and measure indicators that will gauge progress towards water quality improvement.** |
| 3. **Identify and implement solutions that will result in immediate relief from algal blooms while maintaining adequate resources to address phosphorus load reductions to the lake.** |

**Objective 1. Provide education and incentives to communities and individuals to implement practices that reduce the amount of phosphorus entering the watershed and its waterbodies.**

**STRATEGIES:**

1. Support strategies for reducing phosphorus found in the Clean and Clear Action plan, Clean and Clear Work Plan and the *Watershed Study Report Stevens Brook & Rugg Brook* (NWRPC 2003). Assist communities in identifying specific projects and funding and assist in developing additional strategies as needed.
   Lead agencies/organizations: ANR, municipalities, RPC, watershed volunteers
   Potential funding sources: C&C, LCBP, 319 and 604b
   Time frame: Ongoing[15]

2. Research the benefits of using steel slag barriers to reduce phosphorus concentrations in surface runoff. Attention should be focused on corn fields with clay soils where Gaddis' model has suggested that soluble phosphorus leaching off soil particles contributes a significant amount to the phosphorus load[16]
   Potential partners: AAFM, ANR, UVM
   Potential funding sources: 319, LCBP
   Time frame: Ongoing

[15]Ongoing project were begun during the basin planning process and implementation continues.

[16] The following four strategies are the outcome of the community meetings to discuss modeling results developed by Erica Gaddis, see narrative. They are recommendations by the community group and do not necessarily have a lead agency organization at this time.

3. Decrease the amount of road sand reaching waterways: Improved road sand sweepers could be purchased and utilized by all municipalities to maximize the recovery of road sand following winter months. Sweeping should occur as early in the season as possible. A source of road sand with lower phosphorus concentrations could be investigated.
   Potential Partners: ANR, Municipalities, RPC, Watershed associations
   Potential funding sources: 319, Stormwater mitigation funds
   Time frame: 2012

4. Treatment of farmstead runoff should be prioritized whenever possible. All technologies employed in treating runoff should account for both dissolved and particulate phosphorus.
   Potential Partners: AAFM, ANR, NRCS
   Potential funding sources: EQUIP
   Time frame: 2012

5. Efforts to implement phosphorus reduction interventions should be targeted first to Stevens and Jewett Brook subwatersheds.
   Potential Partners: AAFM, ANR, Watershed associations
   Potential funding sources: no funding source specified
   Time frame: 2012

**Objective 2. Develop and measure indicators that will gauge progress towards water quality improvement.**

**STRATEGIES:**

6. Continue to support the long-term phosphorus monitoring project for Lake Champlain.
   Lead agency/organization: DEC
   Partners: LCBP, UVM
   Potential funding sources: LCBP
   Time frame: 2012

7. Continue to support the development of a set of phosphorus reduction indicators for Lake Champlain. Track indicators and provide the public with an annual report based on the indicators.
   Lead agency/organization: DEC,
   Partners: LCBP, UVM, USDA, LAKE CHAMPLAIN COMMITTEE
   Potential funding sources: No funds specified
   Time frame: 2012

**Objective 3. Identify and implement solutions that will result in immediate relief from algal blooms while maintaining adequate resources to address phosphorus load reductions to the lake.**

**STRATEGIES:**

8. Continue to investigate most appropriate method for addressing internal loading of phosphorus to St. Albans Bay. Pursue permits and funding to implement a feasible treatment option. Treatment effectiveness and longevity will depend on making reductions in watershed phosphorus loads.

    Lead agency/organization: ANR
    Partners: SAAWA and other watershed groups
    Potential funding sources: C&C, federal sources
    Time frame: Ongoing

9. Assist in the reviews needed to receive permits to remove the Missisquoi and Carry Bay causeways, including development of additional study, permitting, and appropriate public comment periods. The Agency's review will look at any negative effects that may accrue to the larger lake ecosystem as a result of the removal of one or both causeways.

    Lead agency/organization: ANR
    Potential funding sources: No funding specified
    Time frame: Ongoing

## 4.5 Agriculture and Water Quality: A case study for St. Albans Bay Watershed

Agricultural landuse in the St. Albans Bay Watershed, as in the entire Basin 5, contributes a significant source of phosphorus (see Figure 4). Agriculture's role in water quality protection throughout Basin 5 is described in Appendix C.

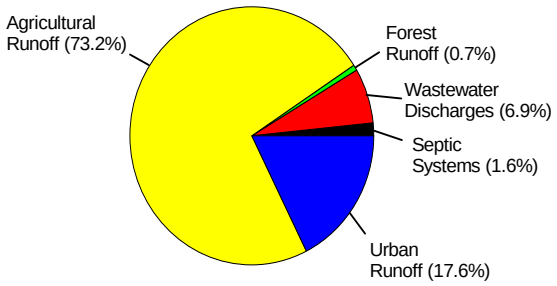


Figure 4. Current Sources of Phosphorus Loading to St. Albans Bay (Lake Champlain Phosphorus TMDL)

**Case study: St. Albans Bay Watershed**

During basin planning meetings with St. Albans Bay watershed farmers (see Appendix B), many expressed pride in their efforts to protect water quality and described having put significant resources to that end. Their consensus appeared to be that they desired acknowledgement of the agricultural community's efforts and that significant pollution loads exist from sources other than agriculture. They were also willing to continue to implement new practices that would protect water quality, but they wanted to receive enough information to make their own decisions or provide input towards new policies. The farmer's experience and expertise is valuable and could be used to increase the effectiveness of proposed practices. Participants pointed to previous misguided efforts by farm agencies to improve crop production, but that have now been identified as harming the environment. The efforts include the push to use super phosphate fertilizer for decades that resulted in phosphorus laden soils. A significant portion of the phosphorus load from agricultural lands may be derived from those soils, both as eroded soil and the leached phosphorus from soil particles (Gaddis 2007). In addition, the tile draining that farm agencies financed is now being blamed for draining many wetland acres. The other point that was often mentioned was the need to compensate farmers for their efforts, especially if the community saw the open landscape as an important aesthetic.

Since those discussions, members of the agricultural community have worked to provide the rest of the community with a better understanding of all the sources of water quality problems, including extensive newspaper reporting and development of an educational project to promote lake friendly lawn care. Discussions within the agricultural community including farm agency staff have also taken place in the Bay and in Franklin County on how best to provide information to farmers and increased compensation for expenses related to improving water quality. Participants outlined their preferred approach for involvement of the agricultural community in water quality improvement efforts. The suggested approaches that follow apply to all areas of the basin unless specifically noted otherwise. Additional

agricultural strategies are found in Opportunities for Action by the Lake Champlain Management Conference (Lake Champlain Basin Program 2005) and the Lake Champlain Phosphorus TMDL (see Chapter 5.2). The Agency of Agriculture, Food and Markets has included their strategies in Appendix C.

**Goals:**

- **Reduce the amount of phosphorus imported into the watershed.**
- **Reduce the erosion of soil and runoff of manure and nutrients into waterways.**

| GENERAL APPROACH /OBJECTIVES |
|---|
| **1. Provide farmers with information to help them make decisions about how to best reduce pollutants in farm runoff.** |
| **2. Obtain funding and other support to assist the farmers in implementing BMPs.** |
| **3. Acknowledge the agricultural community's commitment to improved water quality.** |
| **4. Invest in new technologies and practices that reduce phosphorus loading.** |

**Objective 1. Provide farmers with information to help them make decisions about how to best reduce pollutants in farm runoff.**

**STRATEGIES:**

1. Provide outreach and technical assistance to farmers to assist them in evaluating their own farming practices with regard to water quality protection, nutrient management programs and sustainability.

   Lead agency/organization: UVM Extension
   Partners: AAFM, LCBP, NRCS, UVM
   Potential funding sources: funding sources not specified
   Time frame: Ongoing

2. Assist farmers in protecting public surface water supplies. Provide information about the general location of intake pipes, source water protection areas and activities that adversely affect the quality of raw water at the intake of water supply facilities.

   Lead agencies/organizations: LCCWS, NeRWA
   Partners: AAFM, NRCS
   Potential funding sources: Funding sources not specified
   Time frame: 2012

3. Provide the growing equine industry with best management practice information.
   Lead agency/organization: AAFM
   Partners: AAFM, DEC, UVM, private equine groups
   Potential funding sources: LCBP, 319
   Time frame: Ongoing

**Objective 2. Obtain funding or support to assist the farmers in implementing BMPs.**

4. Work with volunteer-based groups in the community to obtain funding from local and State funding sources (e.g., Lake Champlain Basin Program, Waterwheel Foundation) to buy and plant trees, subsidize nutrient management programs, address eroding river banks and provide other necessary assistance.
   Lead agency/organization: DEC, Watershed groups
   Partners: AAFM, LCBP, UVM
   Potential funding sources: LCBP, USFW Partners for F&W, WHIP, Waterwheel Foundation,
   Time frame: 2012

5. Provide information about best culvert or bridge size on farm roads to reduce erosion and achieve or protect streambank stability. The Agency of Natural Resource's bridge and culvert assessments take into account the amount of water and sediment that needs to pass through in order to maintain the stability of the streambanks.
   Lead agency/organization: DEC
   Partners: Watershed groups
   Potential funding sources: BBR, C&C
   Time frame: Ongoing

**Objective 3. Acknowledge the agricultural community's commitment to improved water quality.**

6. Educate non-agricultural community about the agricultural community's efforts and successes regarding the protection and improvement of water quality.
   Lead agencies/organizations: ANR, community groups
   Partners: AAFM, ANR
   Potential funding sources: Funding sources not specified
   Time frame: Ongoing

7. Assist in the identification of farms to be considered for water quality protection awards, such as the one administered by the Lake Champlain Basin Program.
   Lead agencies/organizations: ANR, community groups
   Partners: NRCD
   Potential funding sources: Funding sources not specified
   Time frame: 2012

**Objective 4. Invest in new technologies and practices that reduce phosphorus loading.**

8. Obtain input from members of the agricultural community about any proposed legislation that supports new technologies for agriculture to gain their perspective and knowledge.
   Lead agency/organization: Farmer's Watershed Alliance
   Partners: AAFM, legislators
   Potential funding sources: Funding sources not specified
   Time frame: 2012

## 4.6 Addressing Aquatic Nuisance Species Problems in the Islands

Acres of beds of nonnative species such as Eurasian watermilfoil and zebra are now found along many shorelines. These aquatic invasive species (AIS) have reached beyond their historic range and threaten the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters. As an example in Basin 5, recreational opportunities can be severely limited by the thick, motor entangling growth characteristics of Eurasian watermilfoil.

Eurasian watermilfoil is the most prevalent aquatic invasive species in Basin 5. It has been in Lake Champlain since the 1960s and reproduces easily and quickly through plant fragments that loosen and re-colonize when they are disturbed. Despite various management efforts and the assumption that milfoil had populated all the areas where favorable conditions exist, milfoil populations have continued to expand in this section of the lake during the past six years.

The change in conditions that has allowed milfoil populations to expand recently is improvements to water clarity due to growing populations of zebra mussels. Mussels filter out particles, such as algae, that block the light. This light is now more available to submerged aquatic plants, enabling them to grow more quickly. For more about zebra mussels, refer to Section 4.7.

The Agency of Natural Resources' strategies for addressing aquatic invasive species (AIS) are included in the *Lake Champlain Basin ANS Management Plan* (2005). The goals of the plan are to limit introduction of new species and limit the range of existing populations. The Agency's assessment work, to identify new or expanding populations, is identified in Table 6 of this plan. Existing populations of AIS, or nuisance populations of native species (ANS) are managed through a collaborative effort between the state and shoreline owners.

**Case Study: The Lake Champlain Islands**

The number of complaints from citizens and visual surveys by the Agency indicate that populations of AIS are too large and widespread for the Agency to manage with its existing resources. In addition, preventing the spread of AIS is complicated by the fact that people who visit the lake may not be aware of the problems associated with AIS or how easy it is to spread the problem (small fragments or larval stages.) Shoreline owners in the Champlain Islands and others have managed local AIS populations while still protecting native species with financial and technical assistance from the Agency and the Lake Champlain Basin Program. In addition, community members have helped to educate others. To effectively manage AIS in Vermont's surface waters, partnerships between the Agency and citizens is essential, as well as assistance from other resource groups like the Nature Conservancy and the Lake Champlain Basin Program.

During the basin planning process, a group of shoreline owners from the Champlain Islands and others interested in addressing Eurasian watermilfoil and other aquatic invasive or nuisance plants met to discuss strategies to improve collaborative management efforts.

**GOAL:**

- **Manage existing populations of aquatic invasive and nuisance species**
- **Prevent the spread and introduction of new invasive species.**

| GENERAL APPROACH /OBJECTIVES |
| --- |
| **1. Develop and maintain community-led management efforts.** |

**OBJECTIVE 1. DEVELOP COMMUNITY-LED MANAGEMENT EFFORTS**

**STRATEGIES:**

1. Continue to keep an inventory of waters that contain AIS species in and adjacent to Vermont. In addition, encourage community members to become certified DEC Vermont Invasive Patrollers (VIPs), to help survey lake shoreline for new invasive incursions. Inventories of aquatic invasive species (AIS) help groups understand the proximity of new AIS species to their waters as well as the extent of existing ANS problem. The results of inventories can be used to help prevent the spread of new AIS to uninfested waters.
   Lead agency/organization: DEC
   Partners: Lake and watershed associations, Lake Champlain Basin Program,
   The Nature Conservancy,
   Potential funding sources: Funding sources not specified
   Time frame: Ongoing

2. Prevent the spread of ANS by educating residents and visitors. During fishing tournaments provide information in registration materials and at boat access areas. Attract attention by offering coffee and a map of good fishing spots, train marina staff to check boats for ANS and provide materials. Encourage volunteers from sports organizations to provide education.
   Lead agencies/organizations: DEC, DFW, lake and watershed association
   Partners: Chambers of commerce, FPR, Lake Champlain International, Inc.
   Potential funding sources: LCBP, Vermont Watershed Grants
   Time frame: 2012

3. Help groups identify the most appropriate tool to manage AIS: develop a publication that outlines a step-by-step process to identify the problem, find the most appropriate management methods, complete permit applications and find resources. Disseminate the information over a variety of easily accessible venues: the web, the phone book, other ANR departments, in brochures at lake festivals, on signs at public boat accesses and in public service announcements on TV and the radio.
   Lead agency/organization: DEC
   Partners: lake and watershed association

Potential funding sources: Funds not specified
Time frame: Ongoing

4. Encourage regional planning commissions (RPC) and local chambers of commerce to assist local groups in their efforts to receive town support for their management projects. Educating towns would be a first step, especially with regard to the impact of AIS on a recreation driven economy. The RPC could encourage shoreline towns to add goals into town plans about preventing or managing AIS.
   Lead agency/organization: DEC
   Partners: chambers of commerce, RPC, lake and watershed association
   Potential funding sources: 604b
   Time frame: 2012

5. Motivate people and towns to address AIS problems as a group: link problem to economic impacts; help them understand the potential for AIS to become a problem if not already there; organize AIS tours of infested lakes; encourage existing groups to present their efforts to town boards, set up forums, write articles or letters to the editor to a local paper, ask for a monthly column in a local paper about water quality issues.
   Lead agency/organization: lake and watershed association
   Partner: DEC,
   Potential funding sources: Vermont Watershed Grants
   Time frame: 2012

6. Assist groups in finding liability insurance for innovative mechanical control equipment at a reasonable cost.
   Lead agency/organization: DEC
   Partner: Municipalities, VLCT
   Potential funding sources: State and federal programs
   Time frame: 2012

7. Assist groups with ideas for proper disposal of harvested AIS. Agricultural operations can often use the harvested plants. Distribute guidelines for AIS transport and disposal to reduce the chance of spread to uninfested waterbodies.
   Lead agency/organization: DEC, DFW
   Partners: watershed and lake groups
   Potential funding sources: Funding not specified
   Time frame: Ongoing

## 4.7 Protecting Drinking Water Supplies

Strategies for protecting public drinking water supplies in Basin 5 were developed with the Lake Champlain Coalition of Municipal Water Suppliers (LCCWS) as part of the basin planning process.

Lake Champlain is the source water for the State's two largest public water suppliers as well as smaller water suppliers (see section 2.2). Although all public water supplies are treated, a water quality management plan such as this basin plan is the first tier of protection for the water supply's source protection area. A clean water source for water supplies allow for more effective treatment, reducing treatment costs as well as health risks to the public.

Criteria in the Vermont Water Quality Standards for surface waters that are used to measure the safety or usability of surface water bodies as sources for drinking water include *E. coli*, turbidity and the presence of toxic substances. The additional standards regulating the treatment of water before it reaches the tap are based in the federal Safe Drinking Water Act (SDWA). The protection of the water supply to maintain or meet Vermont water quality standards for surface waters allows water suppliers to meet SDWA goals at a reasonable cost.

The following strategies address the main concerns for water suppliers, including the aquatic invasive species, zebra mussels; algae; pathogens; solids and toxins.

**GOALS:**

- **Continue to provide safe drinking water at a reasonable cost.**
- **Maintain the public's confidence in their public water supply.**

| GENERAL APPROACH /OBJECTIVES |
|---|
| **1. Maintain high quality source water by supporting pollutant reduction efforts.** |
| **2. Predict problems before they occur to allow facilities to respond with appropriate treatment measures.** |
| **3. Educate customers.** |

### WATER QUALITY PROBLEMS AND STRATEGIES

#### Zebra Mussels

Zebra mussels are an aquatic invasive species that have become well established in the south, central, and northwest sections of Lake Champlain since their introduction in 1996. The small mussel produces large populations that densely colonize around any structure, including water intake pipes. They can also enter water supply systems as juveniles (veligers) and cause problems. Although no method exists to

eliminate or reduce zebra mussel populations in the lake, technology is available to avoid encrusted water intake pipes.

The Department of Environmental Conservation is developing techniques to monitor adult zebra mussel populations in addition to the juveniles that are presently monitored. This effort will help towards identifying appropriate lake depths for intake pipes to avoid zebra mussel colonization.

**STRATEGIES:**

1. Continue discussions between water suppliers and researchers to prepare water suppliers for new zebra mussel settlement trends and to help water suppliers prepare for the appearance of the Quagga mussel, an aquatic invasive species present in the Great Lakes. The Quagga mussel will result in problems similar to those created by the zebra mussels but at greater depths.
   Lead agency/organization: DEC
   Partners: LCBP
   Potential funding sources: fund source not specified
   Time frame: Ongoing

2. Members of the Lake Champlain Coalition of Municipal Water Suppliers will continue to share information with the group on the latest technologies to reduce zebra mussel colonization around intake pipes.
   Lead agency/organization: LCCWS
   Potential funding sources: water district resources,
   Time frame: Ongoing

**Algae – General**

The following Basin 5 segments exceed the phosphorus levels set by the Vermont Water Quality Standards: Northeast Arm, Main Lake, St. Albans Bay, and Shelburne Bay. The high levels result in excessive algal growth during certain parts of the year, which can alter the taste of water. When the algae die, their mass adds to the organic matter in the water, which must be removed from drinking water at an increased cost.

**STRATEGIES**:

Most of the phosphorus entering the lake is attached to or washed from soils. Section 4.2 and 4.3 address sediment issues in rural and urban landscapes, including strategies to reduce erosion. Control of sediment will help manage phosphorus levels. An additional strategy follows:

3. Encourage discussion and implementation of innovative ideas for addressing water quality problems in Basin 5 among water suppliers, technical staff and researchers. The water suppliers would like to discuss the feasibility of removing phosphorus in stormwater or soils by binding it to the alum in drinking water treatment residuals. Possible uses include: augmenting manure or incorporating into a stormwater treatment system. Excessive alum or its plausible transformation to the heavy metal, aluminum, may have adverse effects on aquatic biota or soil fertility. Levels would be controlled to assure acceptable levels of aluminum are maintained. The LCCWS will

implement full scale demonstration projects based upon the completed literature review and pilot study.

Lead agency/organization: LCCWS
Partners: ANR, AAFM
Potential funding sources: water district
Time frame: 2012

## Blue-green Algae

Blue-green algae can produce toxins that may pose health risks when ingested. Blue-green algae blooms are fed like other algae by high concentration of nutrients in the water. Weather can influence the intensity and duration of the blooms. In Lake Champlain, blooms are most common in late July or early August through September

***Lake Champlain Monitoring Program***

During the summer of 1999, the death of two dogs was attributed to blue-green algae poisoning after ingesting large amounts of algae in a bloom adjacent to Lake Champlain's Juniper Island. Since then the UVM Rubenstein Lab, the Lake Champlain Committee and DEC have conducted summer monitoring for blue-green algae and their toxins, throughout the lake. Monitoring sites include the VT and NY DEC long term monitoring stations supported under the Lake Champlain Basin Program and additional sites monitored by UVM in Missisquoi Bay, St. Albans Bay, and Burlington Bay. In 2005, Lake Champlain Committee launched a citizen volunteer monitoring program with about 15 sites in the north lake. They have expanded the program to other areas in the lake and have continued to monitor through 2008. The VT Department of Health (VDH) has established a maximum contaminant level for a blue-green algal toxin (microcystin) in drinking water (1 ppb) and an exposure level for swimming (6 ppb).

Water quality testing programs in Lake Champlain show that, to date, microcystin levels in the finished (distributed) water from public water supplies are below detection. Private water users that draw their water directly from the lake are responsible for testing their own waters, which should be done in the vicinity of their intake during bloom conditions. Visible surface accumulations or scums of blue-green algae pose the greatest risks.

The public can obtain information about blue-green algae in the lake from a webpage (http://healthvermont.gov/enviro/bg_algae/bgalgae.aspx) created by the Vermont Department of Health (VDH). The site provides information on cell densities, toxin concentrations, health alert postings and contact information. The data on blue-green algal status will be updated on a weekly basis. The webpage will incorporate data collected by the Rubenstein Laboratory at UVM, lay monitors, and the DEC Lake Champlain monitoring group. It is designed to be a central location for current information on algae in Lake Champlain and an educational resource for people who wish to learn more about cyanobacteria.

The VDH has also held informational meetings. The public can obtain analysis of water samples for microcystin toxin through the VDH (free for public beaches and water supplies, small fee for general public).

***Current Programs Addressing Problem***
Strategies in "Opportunities for Action" (LCBP 2003) have already helped support research efforts to understand blue-green algae in Lake Champlain and education and outreach to the public and water suppliers. The following blue-green algae related projects have begun:

- Research to develop and implement a monitoring and public alert system for Lake Champlain (Lake Champlain Basin Program, UVM).
- Research to understand bloom dynamics and improve monitoring efforts (NOAA MERHAB program, SUNY ESF, UVM, and SUNY Plattsburgh).
- Research to determine whether or not herbicide use in the Missisquoi watershed may be contributing to bloom development (Lake Champlain Basin Program, Clarkson University, SUNY Plattsburgh).

The following additional strategies will help meet the goals mentioned at the beginning of this section.

**STRATEGIES:**

**4.** Continue to implement the blue-green algae monitoring program to learn about the extent of blue-green algae and microcystin concentrations within drinking source protection areas.
Lead agencies/organizations: DEC, Lake Champlain Committee, Rubenstein Lab
Partner: LCCWS
Potential funding sources: Funding sources not specified
Time frame: Ongoing

**5.** Encourage research that will help predict blooms. Water suppliers are willing to provide their support to grant applications.
Lead agency/organization: LCBP, Rubenstein Lab,
Partners: LCCWS
Potential funding sources: Funding sources not specified
Time frame: Ongoing

**6.** Continue to update the existing VT-DEC Water Supply Division Practice for response to algal cell alert levels in the vicinity of water supplies. Continue to coordinate with LCBP, Rubenstein Center, VDH and others.
Lead agency/organization: DEC-WSD, VDH
Partner: Rubenstein Center, LCCWS
Potential funding sources: Funding sources not specified
Time frame: Ongoing

**7.** Develop enhanced monitoring and treatment strategies for response to long term presence of alert levels of microcystin in raw water., Investigate feasibility and need at treatment plants.
Lead agency/organization: LCCWS
Partner: DEC
Potential funding sources: Funding sources not specified
Time frame: 2012

8. Educate public about actual health risks. Distribute information through water suppliers' mailings. The public needs to be reassured that water from public water suppliers is safe and that continued monitoring will ensure continued safety.

   Lead agency/organization: LCCWS
   Partners: VRWA
   Potential funding sources: Funding sources not specified
   Time frame: 2012

**Pathogens and Solids**

Grandfathered septic systems along shorelines could potentially be contributing pathogens to water supplies. In addition, livestock manure washed into surface waters can also contain pathogens. Present monitoring at the intake pipes indicate that pathogens levels are well below the state water quality standards; however, the water suppliers' practice is to treat water based on the assumption that pathogens may be present. Strategies addressing urban and agricultural runoff in sections 4.3 through 4.5 will help to reduce pathogens in surface waters.

Solids, including sediment, can lead to the clogging of the filtration barrier in water treatment facilities. Clogged filters increase costs to treating water and reduce the effectiveness of the treatment process. In addition, solids that do get through the filtration barrier carry pathogens and nitrates that are more difficult to remove than if separated from the solids. Reducing erosion in the watershed will lead to a reduction of sediment in surface waters. See strategies in section 4.2 to address erosion within stream channels, section 4.3 and 4.4 to address erosion in urban areas and section 4.5 to address erosion in agricultural areas. In addition, the following strategies will also address the problems of sediment in water supplies.

**STRATEGIES:**

9. Provide information to customers about importance of maintaining septic systems, especially those that are on the lakeshore and close to intake pipes.

   Lead agency/organization: LCCWS
   Partner: VRWA
   Potential funding sources: Vermont Watershed Grants
   Time frame: 2012

10. Support studies that could increase water suppliers' ability to predict turbidity spikes in their intake water, and therefore be better prepared to take protective actions within the facility to ensure consistent treatment and disinfection of the water supply. This could include additional studies on the lake's hydrodynamics and the relationship between river flows and turbidity levels in the lake.

    Lead agency/organization: LCCWS
    Partners: DEC, LCBP
    Potential funding sources: Funding source not specified
    Time frame: Ongoing

**11.** Encourage the public to participate in watershed protection activities as a way to protect their water supply. Water suppliers could provide tours of water treatment plants, include information in mailings, participate in collaborative efforts to educate people.

Lead agency/organization: LCCWS
Partners: DEC, LCBP, UVM
Potential funding sources: Funding source not specified
Time frame: 2012

**12.** Address localized shoreline erosion near water intake pipes by working directly with landowners. The following strategies are recommended:

Determine the impact of eroding shorelines on sediment levels around intake pipes.

(1) Identify sediment as a problem around an intake pipe.
(2) Identify shorelines that could be a source of sediment to water supplies.
(3) Provide owners of these shorelines with list of resources available to help stabilize shoreline (include The Shoreline Stabilization Handbook developed collaboratively through the Northwest Regional Planning Commission).

Lead agencies/organizations: LCCWS, VRWA
Partners: DEC, RPC,
Potential funding sources: Vermont Watershed Grants, 319 and 604b funding
Time frame: Ongoing

**13.** Address erosion of agricultural fields near water intake pipes by working directly with landowners and Natural Resources Conservation Service (NRCS). New York agricultural fields have the potential to adversely impact water quality around intake pipes in the narrow sections of the lake. Inform farmers and the NRCS about the proximity of intake pipe to agricultural fields or barnyards. Recipients of federal EQIP funds must protect source protection areas from agricultural runoff.

Lead agencies/organizations: LCCWS, VRWA
Partners: DEC, NRCS
Potential funding sources: USDA, AAFM
Time frame: 2012

**Toxins**

Water suppliers routinely monitor for about 200 regulated contaminants, such as volatile organic compounds and inorganics. The location of intake pipes in deep water keeps these contaminants at low to nondetectable levels.

**STRATEGIES:**

**14.** Work with the DEC Water Supply Division to locate potential sources of toxins during the source protection planning process and work with DEC to contain.

Lead agencies/organizations: LCCWS, DEC –Water Supply Division
Partners: Municipalities
Potential funding sources: Funding source not specified
Time frame: 2012

# Chapter 5. Addressing Water Quality Problems in Specific Waterbodies

**Goal:**
**RESTORE ALL IMPAIRED WATER TO MEET VERMONT WATER QUALITY STANDARDS AND IMPROVE THE MANAGEMENT OF ALL WATERS OF CONCERN BEFORE THEY BECOME IMPAIRED.**

## 5.1 Introduction

The Agency of Natural Resources (Agency) is responsible for maintaining the quality of surface waters in accordance with the Vermont Water Quality Standards (VTWQS). Water quality is determined using biological, physical, and chemical criteria. The Agency, through the Department of Environmental Conservation, monitors surface waters for conformance with numeric and narrative water quality criteria to document violations and determine use attainment. In addition, the Agency also establishes lists of waters that do not conform to the VTWQS as prescribed under State and federal regulations.

**Listing Waters**
In Basin 5, the Agency maintains the following three lists of surface waters in accordance with the DEC *2006 Vermont Surface Water Assessment Methodology Including Vermont Listing Methodology*: Impaired waters (Table 4); Waters in need of further assessment (Table 5) and; Waters impacted by an aquatic nuisance species (Table 6).

**Impaired Waters**
Under EPA guidance and federal regulations, impaired waters must be identified by the State and reported under Section 303(d) of the Clean Water Act. The waterbodies in Table 4 are designated as impaired based on data that show them to be out of compliance with VWQS due to one or more pollutants. All impaired waterbodies are identified in the *Vermont 2006 303(d) List of Waters* and are scheduled for the development of a TMDL (Total Maximum Daily Load) pollution source control plan. These control plans identify the pollution sources, determine a numeric target to be reached for each pollutant to bring the waterbody into compliance with the VTWQS, allocate the load of each pollutant to meet that numeric target, and develop a monitoring plan to determine when compliance has been achieved and the waterbody is no longer impaired.

If the waterbody is identified as impaired but has specific regulatory measures in place that are likely to bring it into compliance with water quality standards, it is not required to be reported as needing a TMDL under Section 303(d). The Barge Canal in Burlington is the only impaired waterbody in Basin 5 that falls into this category. All other impaired waterbodies where no legal remedies exist must be listed and scheduled for Total Maximum Daily Load development[17]. Table 4 lists the completed TMDLs as well as remediation actions supported by the Agency.

[17] For more about the state's TMDL program, see: http://www.anr.state.vt.us/dec/waterq/planning/htm/pl_tmdl.htm

**Waters in Need of Further Assessment**
If a violation of the VWQS is suspected in a waterbody, but not yet substantiated, the Agency lists the waterbody as in need of further assessment (*Vermont 2006 List of Priority Surface Waters Outside the Scope of the Clean Water Act Section 303(d), Part C.*) Table 5 includes all waters in the basin in need of further assessment. The Agency has and will continue to gather more data on waters needing further assessment, as well as support remediation actions.

**Altered Waters**
The Agency also lists waters that are impacted by non-pollutants, and in the case of Basin 5, the list includes waters that are impacted by the aquatic invasive species, Eurasian watermilfoil and zebra mussels (Table 6). The waters are listed in Part E of the State's *2006 Priority Surface Waters List Outside the Scope of the Clean Water Act Section 303(d).* Waters appearing in Part E are assessed as "altered." They represent situations to be given priority for management where aquatic habitat and/or other designated uses have been altered to the extent that one or more designated uses are not supported due to the presence of exotic aquatic species.

**Addressing Water Quality Problems**
The remainder of this section includes Agency strategies to remediate or provide further assessment of waterbodies identified on the three lists (Tables 4-6). Many of the strategies are voluntary collaborative actions with many different partners in the basin. See Table 7 for examples of Agency-supported projects during the basin planning process. Voluntary efforts may be sufficient to correct the impairment, achieve VWQS, and make it possible to remove the water from the 303(d) list before the TMDL is developed. Voluntary efforts are also expected to be part of many of the TMDL implementation plans.

Section 5.2 describes the Agency's strategies for addressing specific sources of water quality problems. Section 5.3 addresses water quality problems specific to Lake Champlain. Sections 5.4 though 5.6 provide specific strategies for the waterbodies on each of the three list, including references to the previous two sections.

## 5.2 Addressing Water Quality Problems: Strategies for Surface Waters

In addition to the regulatory programs described in Appendix E, the following strategies apply to all surface waters impaired by the specified pollutant source, see Table 7 for specific projects:

### A. Agricultural Runoff

- NRCS offers whole farm assessments to farms in the watershed, see Appendices C and E for specific programs that would address runoff problems
- AAFM will review farms in the watershed and assist farmers with the implementation of BMPs in additions to strategies in Appendix C.
- ANR and partners will continue to implement the Lake Champlain Phosphorus TMDL

**B. Fluvial Geomorphic Instability**

- ANR DEC will assist in the development of Phase 1 and 2 fluvial geomorphic assessment and river corridor plans and support the recommendations of the plans.

**C. Stormwater**

- ANR will continue to assist in efforts to educate the community about residential BMP.
- ANR, including FPR programs, will offer training to municipalities in methods to address stormwater impacts at developed sites. Examples of methods include using filter strips, tree pits, swales, wooded wetlands, and bioretention and bioinfiltration facilities.
- ANR will look for ways to assess and increase tree canopy cover across the landscape including in existing forested areas, riparian areas, and developed and developing areas.

**D. Stormwater TMDLs**

Act 140, passed by the General Assembly in 2004, requires that ANR develop a TMDL or water quality remediation plan for stormwater impaired surface water by January 15, 2010. DEC has developed hydrology based TMDLs for Potash, Bartlett and Englesby Brooks, which have been approved by EPA. Approval for TMDLs for Munroe, Stevens and Rugg Brooks is expected by the end of 2008. Although TMDLs are not required to include implementation plans, these TMDLs include a brief description of DEC's current thinking on a general implementation approach. Vermont is authorized to implement both a federally-authorized NPDES permit program for stormwater discharges from construction activities, industrial activities and municipal discharges under the MS4 program and a state-authorized permitting program for stormwater discharges from impervious surfaces equal to or greater than one acre. This duel permitting authority provides Vermont with powerful tools for requiring the implementation of stormwater treatment and control practices necessary to meet the cleanup targets in this TMDL.

The Agency anticipates that it will utilize a phased, adaptive management approach to implementing these TMDLs. The first prong of implementation will most likely involve the issuance of a watershed-wide general permit. Stormwater treatment and control measures would be required in the first-round watershed-wide general permit. The permit would also include a coordinated and cost-effective monitoring program to gather necessary information to determine the extent to which the general permit provides for the attainment of the VTWQS and to determine the appropriate conditions or limitations for subsequent permits. Such a monitoring program might include ambient monitoring, receiving water assessment, discharge monitoring (as needed), or a combination of monitoring procedures designed to gather the necessary information. Based on this information, the permit would be amended, as needed, through the implementation of more widespread and/or more stringent treatment and controls or other best management practices as necessary to meet the water quality targets in the TMDL. This phased, adaptive management approach is a cyclical process in which a TMDL implementation plan is periodically assessed for its achievement of water quality standards and adjustments to the plan are made as necessary.

The second prong of the implementation plan includes NPDES permits issued by the Agency for construction activities, industrial activities and municipal discharges under the MS4 permitting program. These permits contain conditions for implementation of appropriate best management practices that will assist in the attainment of the VTWQS.

## 5.3 Addressing Water Quality Problems: Strategies for Lake Champlain

In addition to the regulatory programs described in Appendix E, the following strategies apply to sections of Lake Champlain:

### E. Mercury

The high concentration of Mercury in Lake Champlain walleye has resulted in the listing of Lake Champlain and the mouth of the LaPlatte as impaired for mercury. The Vermont Department of Health has issued a zero meals consumption of walleye advisory for a segment of the population. Vermont is a national leader in efforts to reduce mercury contamination from sources in-state, contributes to the implementation of regional mercury controls and research initiatives, and actively pushes for meaningful national-level controls on mercury emissions. Under a 2005 Vermont law (10 V.S.A. Chapter 164), and in coordination with the Vermont Advisory Committee on Mercury Pollution, the Agency is implementing pollution reduction and prevention from numerous source sectors within the waste stream, while identifying remaining unaddressed mercury sources and mechanisms for their control. Vermont is also in compliance with the Northwest Regional Mercury TMDL. More information about these efforts is available at www.mercvt.org.

### F. PCBs

The high concentration of PCBs in lake trout has resulted in the need for the Vermont Department of Health to issue a zero meals consumption advisory for a segment of the population. Fish tissue contamination due to PCBs is being addressed by remediation of a known site of PCB contamination in Plattsburgh, NY (Wilcox Dock), as well as by nationwide controls on the emissions of PCBs from combustion sources. The New York State Department of Environmental Conservation has conducted fish-tissue monitoring to determine if the clean-up in Plattsburgh was sufficient to reduce PCB levels in fish tissue. Vermont DEC efforts to monitor fish PCBs have been hampered by the lack of resource availability.

### G. Phosphorus

In addition to increasing the frequency of algal blooms, the high levels of phosphorus are also responsible for a summer time decline in oxygen levels over the last 15 years in the Northeast Arm. The decline is the result of the abnormally high use of oxygen during the decomposition of the algae that has settled on the lake bottom. The deepest section of the Northeast Arm (north of Keeler Bay and 135 feet below the surface) now has oxygen levels of 3 or 4 parts per million, half of what is required by fish living in that habitat, such as land locked salmon and brown trout.

Essentially all point wastewater discharges in the Vermont portion of the Lake Champlain Basin are meeting their discharge permit limits for phosphorus, with the exception of two aerated lagoon plants (Waterbury, Proctor) that are outside of Basin 5. The major thrust to reduce the remaining phosphorus in the lake now needs to come from nonpoint sources.

Phosphorus loading from the lake’s major tributaries exceeds the allowable amounts in almost every case. In Lake Champlain, the Northeast Arm, Missisquoi Bay and St. Albans Bay are not meeting their phosphorus standards (Figure 4.) and the remaining segments are “fair” where standards are not met

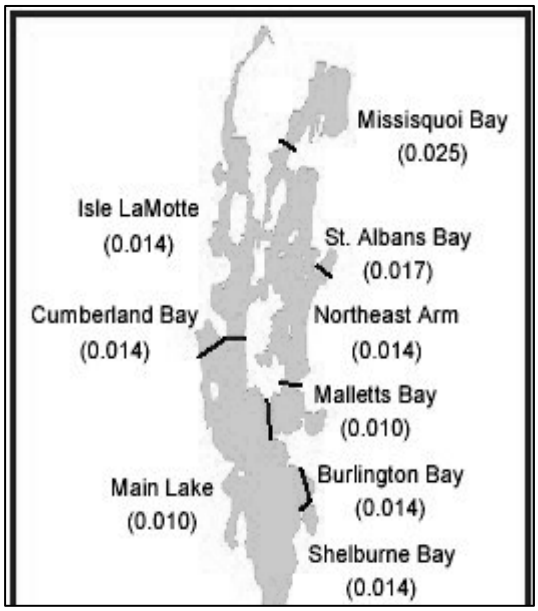


Figure 5. Phosphorus concentration criteria (mg/l) in the Vermont Water Quality Standards for lake segments in Basin 5

consistently (Lake Champlain Basin Program 2008). Most areas of the lake have seen no statistically significant change in phosphorus concentrations since 1990, although phosphorus levels are increasing in Malletts Bay, St. Albans Bay and the Northeast Arm. Phosphorus loads have been decreasing in three of the 18 monitored rivers, including the LaPlatte River, but are increasing in two others (Lake Champlain Basin Program 2008).

In conjunction with appropriate sections of Opportunities for Action, the Lake Champlain Phosphorus TMDL is the Agency's plan to address the high phosphorus concentrations in the lake. The plan includes actions to reduce phosphorus loading from land use activities and wastewater treatment plants[18]. The clean up is expected to take about 20 years and will require continual efforts: However, relying solely on existing point and nonpoint source phosphorus reduction programs will not be sufficient to achieve the ultimate 20-year phosphorus loading targets, at least for some lake segment watersheds. Current programs will need to be sustained and enhanced, and new approaches will need to be developed and implemented.

In this basin plan, specific strategies to implement the TMDL within Basin 5 are listed under specific community concerns including river corridor protection, urban runoff abatement and reducing phosphorus concentrations in St. Albans Bay. The Missisquoi River Basin Plan will include additional strategies to reduce phosphorus loading to the Missisquoi Bay.

The TMDL strategies are presently receiving funding under the Clean and Clear Initiative. The funded strategies include:

- Operate a Best Management Practice Cost Share Program statewide to assist farmers in implementing structural and animal practices on their farms to contain wastes and eliminate runoff of phosphorus and other water pollutants.

- Expand the Conservation Reserve Enhancement Program statewide to create conservation easements on farms along streams for buffer implementation.

- Initiate an Integrated Crop Management Program statewide to help farmers implement comprehensive nutrient management plans to ensure wastes are being utilized to optimize the production of crops and protect water quality.

- Offer Alternative Manure Management Technology Grants statewide to help develop technologies to reduce odors, separate liquids from solids, clean the liquid fractions, and extract nutrients so that manure wastes can be applied to farmland at proper agronomic rates for both nitrogen and phosphorus.

[18] http://www.anr.state.vt.us/dec/waterq/lakes/docs/lp_lctmdl-report.pdf

- Provide technical assistance by Agricultural Resource Specialists to help farmers statewide with best management practices, riparian buffer conservation, nutrient management, and compliance with Accepted Agricultural Practices, basin planning, and other technical needs. Assist farmers in implementation.

- Staff a statewide Agricultural Water Quality Regulatory Program that will expand the permitting process for large farms to include farms with more than 200 milking cows.

- Support the Vermont Department of Environmental Conservation River Management Program to promote stream stability and reduce phosphorus loading from stream bank and stream channel erosion in the Lake Champlain Basin through a comprehensive program of assessment, protection, management, restoration, and education.

- Enhance the Vermont Better Backroads Program throughout the Lake Champlain Basin with staffing for technical assistance and increased funding for erosion control grants to towns.

- Prevent and control erosion of sediment and phosphorus at construction sites statewide by maintaining staffing at the Vermont Department of Environmental Conservation for training and education, inter-agency coordination, permit review, and compliance assistance.

- Offer technical assistance to towns in the Lake Champlain Basin seeking to provide better water quality protection through local ordinances and other municipal actions.

- Protect and/or restore riparian wetlands.

- Develop and implement water quality remediation plans for 17 stormwater-impaired watersheds in the state, including 14 in the Lake Champlain Basin.

- Develop estimates of phosphorus loadings and the reductions expected from various management activities. There has been sampling and an estimation of loading in this basin, especially for St. Albans Bay and the LaPlatte River watersheds and there is strong public desire to have some modeling to maximize efficiency of efforts to reduce phosphorus loading.

- Supplement the water quality monitoring programs supported through the Lake Champlain Basin Program to track progress in achieving lake water quality criteria and watershed phosphorus loading targets.

## 5.4 Impaired Waters

Table 4 lists the impaired waterbodies in Basin 5 and Table 4 includes strategies to remediate specific waterbodies. Table 7 includes completed remediation projects or further assessments for the listed waterbodies.

**Table 4. Impaired waters listed by subbasin to Lake Champlain (DEC 2007a) and actions.**

| **Waterbody** (The subbasin is in bold font). | **Impairment** | **Source of impairment** | **Completed or Proposed Actions (numbers indicate section where action is described.) See also Table 7.** |
|---|---|---|---|
| **ST. ALBANS BAY** | Mercury, PCBs, Phosphorus, | | • 5.3<br>• 4.4 (phosphorus) |
| RUGG BROOK, River mile (rm) 3.1 (Crosby St) upstream 1.6 miles | Stormwater | Stormwater runoff, | • 5.2 B: Phase 1 and 2 geomorphic assessments (Phase 1 and 2) completed; Floodplain restoration and tree planting projects completed. Continue to conduct river restoration projects based on geomorphic assessment.<br>• 5.2 C: Continue to support educational efforts to encourage BMP on residential lots (see 4.3)<br>• 5.2 D Draft TMDL<br>• 4.4 |
| RUGG BROOK, from mouth to approx. 3.1 miles upstream | *E. coli*, undefined | Agricultural runoff | • 5.2 A<br>• 5.2 B: Phase 1 and 2 completed; floodplain restoration and tree planting projects completed. Continue to conduct river restoration projects based on geomorphic assessment.<br>• 4.4 |
| JEWETT BROOK (3.5 miles) | Sediment, nutrients, *E. coli* | Agricultural runoff | • 5.2 A<br>• 5.2 B: Phase 1 completed<br>• 4.4 |
| MILL RIVER, from St. Albans Bay to 1.8 miles upstream | Sediment, nutrients, *E. coli* | Agricultural runoff, streambank erosion | • 5.2 A<br>• 5.2 B: Phase 2 completed<br>• 4.4 |
| STEVENS BROOK, rm 6.8 (pearl st) to rm 9.3 | Stormwater | Stormwater runoff, erosion/sedimentation, morphological instability | • 5.2 B: Phase 2 to Rte 104<br>• 5.2 C and D: Draft TMDL<br>• 4.4 |
| STEVENS BROOK, approx. 1 mile below Central Vermont rail yard upstream to yard | Sediment, oil, grease, hydrocarbons | Sediment, soil & water contamination from fuel spills & management | • Remediation of hazardous waste sites is underway. |
| STEVENS BROOK, mouth upstream 6.8 miles | Sediment, nutrients, *E. coli* | Agricultural runoff; morphological instability | • 5.2 A<br>• 5.2 B: Phase 2 to Route 104 completed<br>• 4.4 |
| **NORTHEAST ARM (East side of Islands)** | Phosphorus | | • 5.3 G |
| STONEBRIDGE BROOK, from mouth upstream 2 miles | Undefined | Agricultural runoff, land development | • 5.2 A<br>• 5.2 B Phase 2 completed |
| **MALLETTS BAY** | Mercury, PCBs, | | • 5.3 |
| Direct smaller drainages to inner Malletts Bay | *E. coli* | Urban runoff, failed/failing septic systems; includes Smith Hollow Brook & Crooked Creek | • 5.2 B and 5.2 C<br>• Support Colchester Water Quality Management plan<br>• Colchester IDDE[19] plan has shown no illicit discharges, continue with monitoring<br>• Colchester will continue to study *E. coli* sources |
| INDIAN BROOK, rm 5.8 (Suzie Wilson Rd) to rm 9.8 | Stormwater | Stormwater runoff, land development, erosion | • 5.2 B: Phase 2 is complete<br>• 5.2 C and D: TMDL complete |

[19] Illicit Discharge, Detection and Elimination

| **Waterbody** (The subbasin is in bold font). | **Impairment** | **Source of impairment** | **Completed or Proposed Actions (numbers indicate section where action is described.) See also Table 7.** |
|---|---|---|---|
| | | | • Support efforts of Essex Waterways Assn. and municipality, including zoning changes<br>• Essex Jct. IDDE plan has shown no illicit discharges. |
| **MAIN SECTION** | Mercury, PCBs, Phosphorus | | • 5.3 |
| **BURLINGTON BAY** | Mercury, PCB | | • 5.3 |
| ENGLESBY BROOK, mouth to rm 1.3 | Stormwater, *E. coli* | Stormwater runoff, Blanchard Beach closure | • 5.2 B: Phase 1 and 2 completed<br>• 5.2 C and D: TMDL complete<br>• Support strategies in the Englesby Brook report |
| [20]BURLINGTON BAY - LAKE CHAMPLAIN - Pine Street Barge Canal | Priority and nonpriority metal, oils and organics, grease, PCBs | Contamination from coal tar in sediments of Pine St. barge canal | • The Pine Street Barge Canal Coordinating Council oversaw implementation of the May 1998 Cleanup Plan (Superfund site). Cleanup Plan was reviewed and approved by EPA. Personnel from DEC's Hazardous Materials Division participate with and serve on the Council.<br>• No future actions planned. |
| **SHELBURNE BAY Lake Champlain** | Mercury, PCB, Phosphorus | | • 5.3 |
| LAPLATTE RIVER 10.5 miles from Hinesburg to mouth | Fecal coliform | Agricultural runoff | • 5.2 A<br>• 5.2 B: river corridor plan completed<br>• Support LaPlatte Watershed Partnership water quality monitoring program<br>• DEC will look at changes in the river by comparing current macroinvertibrate and fish communities at the sites sampled during the 10-year study in the 1980s on the LaPlatte River |
| MUD HOLLOW BROOK From mouth to 3 miles upstream | Fecal coliform | Agricultural runoff, streambank erosion | • 5.2 A<br>• 5.2 B: Phase 2 completed |
| MUNROE BROOK from mouth 2.8 miles upstream | Stormwater | Stormwater runoff, erosion, land development | • 5.2 B Phase 2 completed<br>• 5.2 C and D: TMDL completed<br>• Completed plan based on Munroe Brook TMDL |
| POTASH BROOK From mouth 5.2 miles upstream | *E. coli* | Beach closures (Red Rocks) | • 5.2 B: Phase 2 completed<br>• 5.2 C and D: TMDL completed<br>• Support the Potash Brook Watershed Restoration Plan South Burlington, Vermont , FINAL REPORT, January 2003 |
| BARTLETT BROOK, mouth to rm 0.7 | Stormwater | Stormwater runoff, land development, erosion | • 5.2 B: Phase 1 and 2 completed<br>• 5.2 C and D: TMDL complete |

[20] The Barge Canal is an impaired water that does not need a TMDL because other pollution control required by local, state or federal authority are expected to address all water-pollutant combinations and the Water Quality Standards are expected to be attained in a reasonable period of time.

## 5.5 Strategies for Waters in Need of Further Assessment

The waterbodies listed in Table 5 were identified as needing further assessment to determine if an impairment existed (DEC 2007). Table 5 also includes activities that have been recently completed or are planned to address the assessment needs. Table 7 lists completed remediation projects or additional assessments completed for the listed waterbodies.

**Table 5. Waters in need of further assessment in basin 5 listed by subbasin (DEC 2007).**

| Water Segment Name/Description | Possible Pollutant | Potential Source | Assessment Status and Proposed or Completed Action (number indicates section where action is described). See also Table 7. |
|---|---|---|---|
| **ST. ALBANS BAY**[21] | | | |
| MILL RIVER, 3.5 miles in upper reaches | Sediment, nutrient & Organic enrichment, *E.coli* | Agricultural & urban runoff, streambank erosion | • 5.2 A<br>• 5.2 B Phase 2 completed |
| ST. ALBANS RESERVOIR, north (Fairfax) | Unknown | Macroinvertebrate assessment indicates potential biological impairment. Copper in sediments above NOAA threshold effects value | • Work with Vermont Rural Water Association to collect additional data and work on remediation plan. |
| **MALLETTS BAY - Lake Champlain (Colchester)** | | | |
| INDIAN BROOK from lake upstream 10 miles to Butlers Corners (Rt 15) | *E. coli* | Possible failed septic systems (threat) | • Review Essex Junction illicit discharge survey |
| INDIAN BROOK, from 3.1 miles to 5.8 miles upstream | Sediment, toxics, metals | Potential impacts from landfill leachate, developed areas | • 5.2Phase 2 completed<br>• Review Colchester's illicit discharge survey. |
| MALLETTS CREEK, mouth upstream 3.5 miles | Sediment, nutrient & organic enrichment, metals, *E. coli* | Land development, erosion/sedimentation, urban runoff | • 5.2 C<br>• Review Colchester's illicit discharge survey. |
| **Burlington Bay** | | | |
| Direct drainages to Burlington Bay | Sediment, nutrients & organic enrichment, metals, toxics, *E. coli* | Land development; erosion/sedimentation; urban runoff | • 5.2 C: Pursue strategies to increase implementation of residential BMPs<br>• IDDE by Burlington ongoing. |
| **MAIN SECTION - Lake Champlain (South Hero)** | *E. coli* | Elevated *E. coli* levels off Colchester Pt near mouth of Winooski River | • Review Colchester water quality data annually. |

[21] The subbasin, in bold font, is not in need of further assessment unless a possible pollutant is listed.

## 5.6 Strategies for Waters altered by Aquatic Nuisance Species

The Agency's strategies for addressing aquatic nuisance species (ANS) are included in the *Lake Champlain Basin ANS Management Plan (2005)*. The goals of the plan include:

I. Prevent new introductions of ANS into waters of the Lake Champlain Basin;
II. Limit the spread of established populations of ANS into uninfested waters of the Lake Champlain Basin; and
III. Abate harmful ecological, socioeconomic, and public health and safety impacts resulting from infestations of ANS within the Lake Champlain Basin.

In addition, Section 4.6 of this basin plan also provides guidance for enhancing the collaborative efforts between the Agency and communities to manage ANS populations.

Table 6 outlines the Agency's ANS survey work, including the presently expanding zebra mussel population and work with the aquatic milfoil weevil, which to date indicates that this native weevil may contribute to a reduction in the amount of Eurasion watermilfoil growth under certain conditions.

**Table 6. Status of Aquatic nuisance species in Basin 5 (DEC 2007).**

| Waterbodies | Aquatic nuisance species present and status | Action |
|---|---|---|
| MISSISQUOI BAY-Lake Champlain (Alburgh) | Zebra Mussel Infestation - Adult Zebra Mussels found at bridge (1998). Adults found north of bridge, west of Missisquoi River (2004-2005) | |
| | Eurasian Watermilfoil Infestation | Weevils present in Lake Champlain |
| NORTHEAST ARM-Lake Champlain (Swanton) | Eurasian Watermilfoil Infestation | Weevils present in Lake Champlain: Weevils introduced into Pelots Bay in 1999 and 2000 |
| | Zebra Mussel Infestation - Adult Zebra Mussels expanding rapidly | |
| ISLE LAMOTTE-Lake Champlain (Alburgh) | Zebra Mussel Infestation - nearly all suitable substrate covered; expanding onto soft substrate; native mussels mostly extirpated | |
| | Eurasian Watermilfoil Infestation in some near shore areas | Weevils present in Lake Champlain |
| ST. ALBANS BAY-Lake Champlain (St. Albans) | Eurasian Watermilfoil Infestation | Mechanical harvesting in past and recently in 2005. Weevils present in Lake Champlain |
| | Zebra Mussel Infestation - Adult Zebra Mussels expanding rapidly | |
| MALLETTS BAY-Lake Champlain (Colchester) | Eurasian Watermilfoil Infestation | Weevils present in Lake Champlain |
| | Zebra Mussel Infestation - Native Mussels Impacted in outer Malletts Bay | |

| Waterbodies | Aquatic nuisance species present and status | Action |
|---|---|---|
| BURLINGTON BAY-Lake Champlain (Burlington) | Zebra Mussel Infestation - Zebra Mussels on General Butler boat wreck; nearly all suitable substrate covered; expanding onto soft substrate; native mussels mostly extirpated | |
| | Eurasian Watermilfoil Infestation in some near shore areas | Weevils present in Lake Champlain |
| MAIN SECTION-Lake Champlain (South Hero) | Eurasian Watermilfoil Infestation in some near shore areas | Weevils present in Lake Champlain |
| | Zebra Mussel Infestation - nearly all suitable substrate covered; expanding onto soft substrate; native mussels mostly extirpated | |
| SHELBURNE BAY-Lake Champlain (Shelburne) | Zebra Mussel Infestation - nearly all suitable substrate covered; expanding onto soft substrate; native mussels mostly extirpated | |
| | Eurasian Watermilfoil Infestation | Weevils present in Lake Champlain |
| LAKE IROQUOIS (Hinesburg) | Locally abundant Eurasian watermilfoil growth | Weevils present, weevil augmentation (1996-2005) |

**Table 7. Examples of Agency of Natural Resources supported Basin 5 projects 2002-2008**

| Waterbody | Date | Project Title | Cost | Funding | Lead | Partners |
|---|---|---|---|---|---|---|
| Alburgh Passage | 2007 | Pelot Pt Rd stabilization | $7,000 | BBR[22] | Northern Vt. RC&D | |
| | 2007 | Pelots Bay ANS removal (3 yrs) | $38,653 | ANS, VWP | Pelots Bay Assocn. | |
| Bartlett Brook | | Installed 306 brushrolls | | 319 | | VYCC |
| | | Geo. Assess., intial project ID | | C&C | | |
| Basin 5 | 2004 | Green Lawn Expo | $600 | C&C | | UVM |
| | Ongoin | Assist towns in wq enhancement - | | C&C | Vt. League of Cities & Towns | CCRPC |
| Burlington Bay | 2009 | College St. Outfall upgrade | $250,000 | ACOE/ | Burlington | |
| Direct drainages | 2008 | Charlotte Geomorphic Assessment | $20,000 | C&C | LWP | |
| Englesby Brook | | Geo. Assess, project ID | | C&C | | |
| | 2008 | Installed check dams | | 319 | | VYCC |
| Indian Brook | | Map erosion, stormwater discharges, | | 604b | CCRPC | |
| | 2003 | Erosion control on trails | | 319 | Essex | VYCC |
| | 2005 | Canyon Rd erosion | $222,548 | MSM | Colchester | |
| | 2009 | Geo. Assess., corridor plan, FEH | | C&C | CCRPC | |
| | 2009 | Jetter-vactor truck | $350,000 | SAFETEA | Essex Jct. | |
| Jewett Brook | | Geomorphic Assessment Phase I | | C&C | Lake Champlain Committee | SAAWA |
| Lake Champlain | 2003 | Chittenden Cty stormwater citizens | $17,000 | 319 | Lake Champlain Committee | |
| | 2004 | Shore Acres Drive Project | $74,917 | BBR,Town | Northern Vt. RC&D | Colchester |
| | 2004 | Lakeview Dr Project | $12,435 | BBR,Town | Northern Vt. RC&D | N. Hero |
| | 2005 | Beacon St Storm Sewer Project | $20,854 | BBR | Northern Vt. RC&D | S. Burling. |
| | 2005 | modeling stormwater impaired | $30,755 | 319 | UVM | |
| | 2005 | West Shore Rd Project | $10,083 | BBR, Town | Isle La Motte | NVRC&D |
| | 2006 | Lake Shore Road Project | $9,978 | BBR | Northern Vt RC&D | VYCC |
| | 2006 | Landscaping for WQ presentation | $250 | C&C | | VAPH |
| | 2007 | South End Rd Project | $11,535 | BBR,Town | Northern Vt. RC&D | N. Hero |
| | 2008 | Rain Barrel distribution project | $3,000 | C&C | Winooski NRCD | |
| | 2008 | Shoreline stabilization manual, | $5,000 | 319, VWP | NWRPC | |
| | 2008 | Rain Garden Contest | $5,968 | VWP | UVM Sea Grant | WNRCD |
| | Ongoin | "Don't P on Your Lawn" Campaign | | LCBP, C&C | LCBP,LCC,DEC,AAFM,UVM | Sea Grant |
| LaPlatte River | 2003 | 3000 ft buffer plantings, tree | | 319 | | VYCC |
| | 2006 | Tree planting along buffer | $1,000 | VWP | Hinesburg Conservation | |
| | 2006 | Geo. Assess., partial corridor plan, | $35,000 | VWP, C&C | LaPlatte Watershed | Lewis Crk |
| | 2007 | Hinesburg bioretention basin | $10,000 | C&C | Town of Hinesburg | |
| | Ongoin | Bissonette Farm Wetland | $270,000 | VEDA, C&C | Hinesburg Land Trust | Trust for PL |
| | Ongoin | Water quality monitoring | | LaRosa | LaPlatte Watershed | |
| Malletts Bay | 2004 | Erosion control on trails | | 319 | DFPR | VYCC |
| | 2007 | mapped stormwater infrastructure, | | 604b | CCRPC | |
| | 2007 | Vacuum street sweeper | $174,202 | Stage 03 | Colchester | |
| McCabe Brook | 2007 | Salt-sand storage shed | $133,500 | SAFETEA | Shelburne | |
| Mill River | 2008 | Geo. Assess.,project | | C&C | NWRPC | USFW |
| | Ongoin | Buffer planting | | C&C | | |

[22] Most of the funding programs are described in Appendix D and in the agricultural section of Appendix E.

| Waterbody | Date | Project Title | Cost | Funding | Lead | Partners |
|---|---|---|---|---|---|---|
| Munroe Brook | | Geo. Assess.,draft FEH map | | C&C | | |
| Northeast Arm | 2003 | Stormwater infrastructure mapping | $2,300 | 319 | CCRPC | |
| Pond Brook | | Geomorphic assessment - Phase I | | C&C | | |
| Potash Brook | | Geo. Assess., partial corridor plan | | C&C | | |
| | | Map stormwater infrastructure | | 604b | CCRPC | |
| | 2002 | "Pesticides in Our Water" campaign | $635 | VWP | S. Burlington Naturl Resrce | |
| | 2003 | Pesticide reduction awareness | $9,000 | 319 | Voice of Potash Brook | |
| | 2005 | South Burlington Rain Gardens | $36,650 | 319 | City of South Burlington | WNRCD |
| | 2006 | Rain garden demonstration project | | Donations | Winooski NRCD | UVM |
| | 2006 | Airport Parkway Drainage Repair | $7,000 | BBR,City | Northern Vt RC&D | S. Burling. |
| | 2007 | Stormwater pond, stream clean up | | 319 | South Burlington | VYCC |
| | 2007 | Vacuum street sweeper | $174,202 | MSM | South Burlington | |
| Rugg Brook | 2006 | Nason Street buffer planting | $2,000 | USFW | St. Albans Area Watershed | |
| | 2007 | Floodplain restoration project | $150,000 | 319 | Town of St. Albans | SAAWA |
| | Ongoin | Fencing & buffer at the alpaca farm | | | | |
| St. Albans Bay | | Inventory, catalog stormwater permits | | 604b | NWRPC | |
| | 2002 | Water quality forum | $200 | VWP | St. Albans Area Watershed | |
| | 2005 | WQ monitoring Stevens, Rugg | $55,700 | LaRosa, | St. Albans Area Watershed | |
| | 2006 | Lake friendly lawn care education | $6,590 | LCBP | St. Albans Area Watershed | Sea Grant |
| | 2006 | hydrology, nutrient transport model | | | UVM Gund Institute | St. Albans |
| | 2007 | Solarbee trial | $14,725 | ANS | St. Albans Area Watershd | |
| | 2008 | Study:Control of Internal P Loading | $75,000 | C&C | St. Albans Area Watershed | SAAWA |
| | 2008 | Taylor Park Pervious Pavement | $10,000 | C&C | NRCD | St. Albans |
| | 2008 | Storm sewer map, illicit discharges | | 319 | NWRPC | St. Albans |
| | 2008 | LID demonstration projects | | 319 | UVM Sea Grant | |
| | 2009 | Don't Fertilize in Spring Campaign | $680 | VWP | St. Albans Area Watershed | |
| | 2009 | Watershed signs | $2,973 | VWP | St. Albans Area Watershed | |
| | Ongoin | Mechanical ANS harvesting (4 yrs) | $50,635 | ANS | St. Albans Area Watershed | |
| Stevens Brook | 2004 | Floodplain enhancement | $4,500 | 319 | St. Albans City | |
| | 2006 | Houghton Park buffer planting | $1,500 | USFW, | St. Albans Area Watershed | SAAWA |
| | 2006 | City riparian planting | $200 | USFW | St. Albans Area Watershed | USFWS |
| | 2007 | Optical Brightener Survey | $2,600 | C&C | St. Albans Area Watershed | St. Albans |
| | 2008 | Lawn care demonstration project | $150 | EPA pass | DEC | SAAWA |
| | 2008 | Road-side Rain Gardens | | BBR | Northern Vt RC&D | UVM Sea |
| Stevens, Rugg | | Geomorphic. Assessment, Project ID | | C&C, EPA | Lake Champlain Committee | SAAWA |
| Stevens,Rugg,Mi | 2009 | FEH discussions | | C&C | NWRPC | |
| Stonebridge Brk | 2009 | Geo. Assess.,corridor map,FEH | | C&C | NWRPC | |
| Thorp Brook | 2005 | Natural Communities Mapping | $3,200 | VWP | Charlotte Conservation | |
| Thorp,Kimball | Ongoin | Water quality monitoring | | LaRosa | Thorp Brook Watershed | |

# Chapter 6. Establishing Management Goals for Surface Waters

**GOAL: ESTABLISH MANAGEMENT GOALS WITHIN THE BASIN THAT PROTECT BOTH THE BENEFICIAL USES AND VALUES OF SURFACE WATERS AND MEET THE NEEDS OF THE COMMUNITY.**

The protection or improvement of water quality and water-related uses can also occur by establishing specific management goals for particular bodies or stretches of water. The management goals describe the values and uses of the surface water that are to be protected or achieved through appropriate management. Management goals can be established through the following processes which are further described below:

- Classification of waters and designation of water management types.
- Designation of waters as Outstanding Resource Waters.
- Designation of waters as warm and cold water fisheries.
- Designation of existing uses.

The Agency of Natural Resources (Agency) is responsible for designating existing uses on a case by case basis or through basin planning and the Vermont Water Resources Panel is responsible for adopting the other designations by rule. Once the Agency or the Panel establishes a management goal, the Agency manages state lands and issues permits to achieve all management goals established for the associated surface water. Before the Agency recommends, or the Panel establishes management goals through a classification or designation of surface waters as a rule, input from the public on any proposal is required and considered. The public is also able to present a proposal for establishing management goals for the Panel to consider at any time.

When the public develops proposals regarding management goals, the increased community awareness can lead to protection of uses and values by the community and individuals.

## 6.1 Water Management Typing and Classification

Since the 1960s, Vermont has had a classification system for waters that establishes management goals. Setting water quality management goals is the responsibility of the Vermont Water Resources Panel. These goals describe the values and uses of surface waters that are to be protected or restored through appropriate management practices. The Agency works to implement activities that restore, maintain or protect the management goals. The current classification system includes three classes: A(1), A(2), and B.

Presently, in all basins across Vermont waters above 2,500 feet in elevation are classified A(1) by Vermont statute. In addition the Water Resources Panel or members of the public can petition that high quality waters with significant ecological value below 2500 feet be classified as A(1) based upon the public interest. The management objective for A(1) waters is to maintain their natural condition. No A(1) waters exist in Basin 5.

Waters used as public water supplies are classified A(2). In Basin 5 the following waters and all the waters within its watershed unless otherwise stated are A(2):

- Milton Pond, Milton: No longer used as a water supply.
- Indian Brook Reservoir, Essex Town: No longer used as a water supply
- Colchester Pond, Village of Colchester water supply: The Pond has not been used as a water supply since 1974, but is reserved for emergency use.
- Two reservoirs which drain to the Mill River and all waters within their watersheds in the Towns of Fairfax, St. Albans, and Fairfield: Presently used as the City of St. Albans water supply.

All the remaining waters in Basin 5 are Class B waters.

As part of the Water Quality Standards revisions in 2000, the system was changed to allow Class B waters be divided into three management types: B1, B2 and B3. This change was made to furnish a greater level of protection to existing higher quality waters and to recognize attainable uses that could be supported by improvements to existing water quality. A simplification of the designations would be to say that the spectrum from B3 to B2 to B1 is described as representing "good," "better" and "best" aquatic conditions.

The revised Water Quality Standards require that all basin plans place Class B waters into one of the three water management types. However, the Vermont Legislature passed bill H154 in 2007 that only allowed the adoption of basin plans for Basin 11 and Basin 14 without water management typing proposals. Plan adoption needs to occur before July 1, 2008. These two plans must be revised within two years of adoption with proposed water management types or an alternative method of protecting water quality in high quality waters.

The Basin 5 plan does not contain any water management typing (WMT) recommendations for any Class B waters. Once an agreed upon process for WMT or for an alternative to WMT is developed by the Water Resources Panel, this plan will be revised accordingly.

Once the Vermont Water Resources Panel adopts the water management type designations for specific waters, it is the responsibility of the Agency, individuals and all levels of government to work to achieve or maintain the level of water quality specified by the designations.

## 6.2 Outstanding Resource Waters.

In 1987, the Vermont Legislature passed Act 67, "An Act Relating to Establishing a Comprehensive State Rivers Policy." A part of the law provides protection to rivers and streams that have "exceptional natural, cultural, recreational or scenic values" through the designation of Outstanding Resource Waters (ORW). ORW designation identifies waters that have exceptional natural, recreational, cultural, or scenic values. Depending on the values for which designation is sought, ORW designation may protect exceptional waters through the permits for stream alteration, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects and other activities.

Basin 5 has no ORW designations and the Basin 5 plan does not contain any recommendations for ORW designations.

## 6.3 Warm Water and Cold Water Designations

In addition to the foregoing classifications and designations, the following list of waters are designated for management as Warm Water Habitat by the Vermont Water Quality Standards. This designation specifies a lower minimum dissolved oxygen concentration than waters in the remainder of the basin which are designated as Cold Water Habitat (Water Resources Board 2008):

(a) All streams, creeks and brooks lying with Grand Isle County.
(b) Lake Carmi, Franklin
(c) Lake Champlain, between the Ferrisburgh-Charlotte town boundary and the Canadian boundary, where depths are less than 25 feet at Low Lake Level (93 feet NGVD) - June 1, through September 30, only.
(d) Cutler Pond, Highgate
(e) Holmes Creek, Charlotte
(f) Indian Brook, Colchester from Vermont Routes 2 & 7 to its confluence with Lake Champlain
(g) Lake Iroquois, Hinesburg/Williston
(h) LaPlatte River from its confluence with Patrick Brook in Hinesburg extending downstream to the Spear Street extension bridge in Charlotte annually from the period June 1 through September 30 only.
(i) Long Pond, Milton
(j) Lower Lake, (Lake Sunset), Hinesburg
(k) Malletts Creek, Colchester, from Vermont Routes 2 & 7 to its confluence with Lake Champlain
(l) Milton Pond, Milton
(m) Mud Creek Pond, Alburgh A-3
(n) Murr (Monroe) Brook, Shelburne
(o) Rock River from the Canadian boundary to its confluence with Lake Champlain
(p) Round Pond, Milton
(q) St. Albans Reservoir (N), Fairfax
(r) Stevens Brook, St. Albans

The Basin 5 plan contains no recommendations for changing any of these warm water or cold water designations.

## 6.4 Existing Uses

All surface waters in Vermont are managed to support uses valued by the public including drinking water supplies, swimming, boating, and fishing. The degree of protection afforded to these uses is based on the management type or class of the water. In particular surface waters, however, some uses are protected specifically if the Agency identifies them as existing uses under the anti-degradation policy of the Vermont Water Quality Standards (VWQS). The Agency identifies and determines the presence of existing uses of particular waters either during the basin planning process or on a case by case basis during application reviews for state or federal permits. The VWQS define an existing use as

*"a use which has actually occurred on or after November 28, 1975, in or on waters, whether or not the use is included in the standard for classification of the waters, and whether or not the use is presently occurring."*

The following factors can be considered by the Agency when identifying the presence of existing uses (VWQS § 1- 03(b)).

- Aquatic biota and wildlife that use or are present in the waters;
- Habitat that supports existing aquatic biota, wildlife or plant life;
- The use of waters for recreation or fishing;
- The use of waters for water supply or commercial activity that depends directly on the preservation of an existing high level of water quality; and
- With regard to the factors considered under the first two bullets above, evidence of the use's ecological significance in the functioning of the ecosystem or evidence of the use's rarity.

During the Basin 5 planning process, the Agency collected sufficient information to document and determine the presence of existing uses for fishing and boating on flowing waters. The Agency did not find sufficient information to document swimming as an existing use on any of the flowing waters in the basin. All surface waters used as public drinking water supplies were also identified. Appendix F includes the process used to identify existing uses. The Agency presumes that all lakes and ponds in the basin have existing uses of fishing, contact recreation and boating. This simplified assumption is being used because of the well-known and extensive use of these types of waters for these activities based upon their intrinsic qualities and, to avoid the production and presentation of exhaustive lists of all of these waterbodies across Basin 5. This presumption may be rebutted on a case-by-case basis during the Agency's consideration of a permit application, which might be deemed to affect these types of uses.

The following lists are not intended to represent an exhaustive list of all existing uses, but merely an identification of well-known existing uses having public access. Additional existing uses of contact recreation, boating and fishing on/in flowing waters and additional public drinking water supplies may be identified during the Agency's consideration of a permit application or in the future during subsequent basin planning efforts.

**Table 8. Determination of existing uses of flowing waters for boating in Basin 5(RM is river mileage measured from the river terminus).**

| Waterbody | Town | Basis for determining the presence of an existing use |
|---|---|---|
| LaPlatte River<br>Mouth to RM 1 | Shelburne | Lake Champlain Land Trust Shelburne River Park canoe and kayak launch at RM 1. Majority of riparian buffer is part of a Nature Conservancy Preserve |

**Table 9. Determination of existing uses of flowing waters for fishing in Basin 5.**

| Waterbody | Town | Basis for determining the presence of an existing use |
|---|---|---|
| Mud Creek - Lake Champlain to the dam in Alburgh (just upstream of Route 78 bridge). | Alburgh | General state fishing regulations pertaining to Lake Champlain apply. Parking at Fish and Wildlife Mud Creek Wildlife Management Areaoff Rte. 78.. |
| Mill River - Lake Champlain to the falls in Georgia (just upstream of Georgia Shore Rd bridge). | Georgia | General state fishing regulations pertaining to Lake Champlain apply. Town of Georgia parking lot at Georgia Shore Road bridge provides access to area with conservation easement. |
| Malletts Creek to the first falls upstream of Roosevelt Highway (US 2 and US 7) in Colchester. | Colchester | General state fishing regulations pertaining to Lake Champlain apply. During spring high water, the stretch can be canoed (personal communications, Bernie Pientka, DFW fisheries biologist). |
| LaPlatte River to the falls in Shelburne (under Falls Road bridge | Shelburne | General fishing regulations pertaining to Lake Champlain apply. State Fish and Wildlife access ramps located at mouth of LaPlatte. Falls can be reached by boat from the Lake Champlain Land Trust Shelburne River Park canoe and kayak launch at RM 1 |

**Table 10. Determination of existing uses of waters for public surface water supplies in Basin 5.**

| Waterbody | Town | Basis for determining the presence of an existing use |
|---|---|---|
| Colchester Pond | Colchester | Classified at an A(2) (Water Resources Panel 2006) |
| St. Albans Reservoir North | Fairfield | Water source for one or more community water supplies regulated by the Water Supply Division |
| Northeast Arm - Lake Champlain | N/A | Same as above |
| Main Lake – Lake Champlain | N/A | Same as above |
| Malletts Bay – Lake Champlain | N/A | Same as above |
| Burlington Bay | N/A | Same as above |
| Shelburne Bay | N/A | Same as above |

# Chapter 7. Summary and Implementation of the Basin Plan

Many State and federal agencies, private organizations, and community groups have been involved in developing the strategies in this basin plan. The next step is implementation of the strategies by these groups and others.

The collaborative process of identifying concerns and strategies ensures that participating groups will be engaged in implementing the Basin 5 Plan. Because the basin planning initiative included extensive discussions with the community and resource agencies, the actions of some of the potential key players, such as local conservation commissions and natural resource conservation districts, correspond with the strategies. For other potential partners, the plan will provide ideas, opportunities and the rationale to leverage funding for implementation projects. Implementation then needs only a small catalyst to start the process or a guiding hand to keep it progressing. For some strategies, the Vermont DEC will facilitate the implementation process by setting up meetings and providing technical support. Implementation of other strategies will require the resources and energy of other community groups using the plan as a guide.

The success of the basin plan is not to be limited to the implementation of the strategies in the plan. The basin planning process has also developed a vast network of groups working together to meet common goals. The strength of the network will help leverage existing funds and support from other organizations. If the process has been successful, the next basin planning process will begin with the existing partnerships intact. In addition, a number of projects were completed with community partners during the planning process.

## 7.1 Evaluation of the Planning Process

No planning process is complete without feedback on the elements of the plan. Periodically the basin's watershed council and their partners and collaborators will review the process and examine accomplishments in planning and implementation. Topics to be considered include the adequacy of the process set forth by the State and its partners, the progress of the basin planning process, reactions of the public to the process, and the adequacy of resources to conduct planning and implementation.

## 7.2 Progress Reporting

The watershed councils and partners will annually address the accomplishments made toward achieving the basin plan goals and the goals of the VT ANR's *Watershed Planning Initiative*. This will include an analysis of the number of strategies successfully completed from the basin plan on a yearly basis. In addition, each year strategies scheduled to be completed will be reviewed by the watershed councils, DEC and key players to ensure efforts are moving forward and to identify and address any obstacles which may prevent implementation. In addition, longer range strategies will be reviewed to make sure progress is being made and to identify intermediate actions which may be necessary. This review process will keep community partners engaged and allow for accountability in achieving the goals laid out in this basin plan.

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# Acronyms

| | |
|---|---|
| 319 | Federal section 319 grants for NPS pollution abatement |
| 604b | Federal section 604b pass through funds for regional planning commissions |
| AAFM | Vermont Agency of Agriculture Food and Markets |
| AAP | Acceptable Agricultural Practices |
| AIS | Aquatic Invasive Species |
| AMP | Acceptable Management Practices |
| ANR | Vermont Agency of Natural Resources |
| ANS | Aquatic Nuisance Species Program |
| BASS | Biological Assessment Studies Section |
| BBR | Better Back Roads Program |
| BMP | Best Management Practices |
| CCC | ANR Center for Clean and Clear |
| C&C | Clean and Clear funds distributed through the Center for Clean and Clear |
| CREP | Conservation Reserve Enhancement Program |
| DEC | Vermont Department of Environmental Conservation |
| DFPR | Vermont Department of Forest Parks and Recreation |
| DFW | Vermont Department of Fish and Wildlife |
| DHCA | Vermont Department of Housing and Community Affairs |
| DOH | Vermont Department of Health |
| EPA | Environmental Protection Agency |
| EQIP | Environmental Quality Incentives Program |
| FEH | Fluvial Erosion Hazard |
| FEMA | Federal Emergency Management Agency |
| FERC | Federal Energy Regulatory Commission |
| HMGP | Hazard Mitigation Grant Program |
| IDDE | Illicit discharge and detection elimination plan |
| LCBP | Lake Champlain Basin Program |
| LaRosa | LaRosa Analytical Partnership Program |
| LCCWS | Lake Champlain Coalition of Municipal Water Suppliers |
| LMP | Lay Monitoring Program |
| LWP | LaPlatte Watershed Partnership |
| NFIP | National Flood Insurance Program |
| NPS | Nonpoint Source Pollution |
| NRCS | Natural Resources Conservation Service |
| NRCD | Natural Resources Conservation District |
| ORW | Outstanding Resource Water |
| Partners for F&W | USFWS Partners for Fish and Wildlife Program |
| PDM | Pre-disaster Mitigation Funds |
| RC&D | Resource Conservation and Development |
| RMP | River Management Program (Agency of Natural Resources) |
| RPC | Regional Planning Commission |
| RSEP | Regional Stormwater Education Program |
| **SAAWA** | St. Albans Area Watershed Association |
| SUNY | State University of New York |

TMDL Total Maximum Daily Load
USFW United States Fish and Wildlife Service
UVM Ext University of Vermont Extension
VDH Vermont Department of Health
VHCB Vermont Housing and Conservation Board
VLCT Vermont League of Cities and Towns
VTrans Vermont Agency of Transportation
VRC Vermont River Conservancy
VRWA Vermont Rural Water Agency
VWQS Vermont Water Quality Standards
VYCC Vermont Youth Conservation Corps
WHIP Wildlife Habitat Enhancement Program
WMA Wildlife Management Area
WQD Water Quality Division