WATER QUALITY IN THE LAPLATTE WATERSHED

- **An introduction to water quality science**
- **Research results, 2004 – ’10**
- **Recommended actions**

LaPlatte Watershed Partnership
CONTACT: Marty Illick, (802) 425-2002
martylewiscreek@gmavt.net

With support from State of Vermont’s LaRosa Volunteer Water Quality Monitoring Analytical Partnerships Program, Champlain Water District, Town of Shelburne

2011

Introduction

The LaPlatte watershed and Shelburne Bay are beautiful, natural aquatic communities that provide important wildlife habitat and have high recreational value. The watershed includes approximately one hundred and seventy four miles of river channel and tributaries that drain a fifty-three square mile area mainly in Hinesburg, Charlotte and Shelburne before discharging into Shelburne Bay.

The Mouth of the LaPlatte River

Clean water in the LaPlatte watershed and Shelburne Bay is important for several reasons:

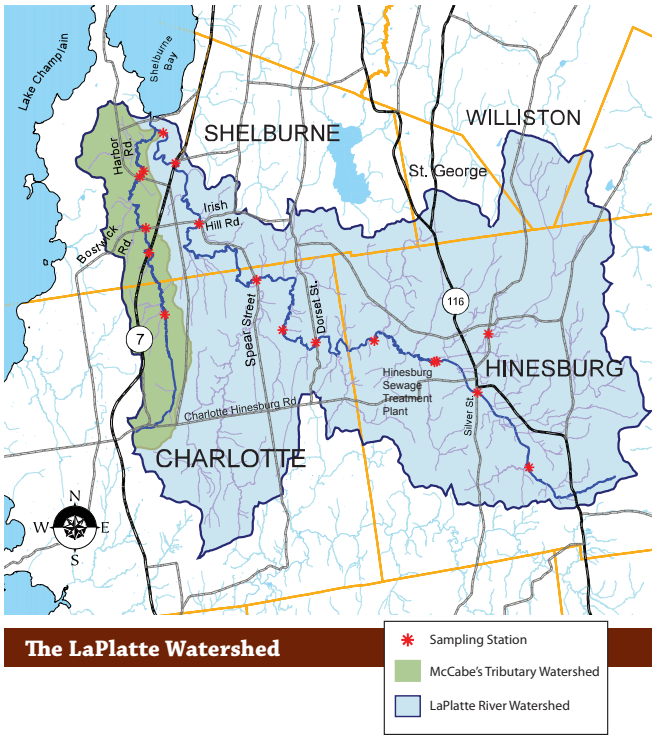
- To support thriving diverse aquatic and terrestrial communities in the watershed.
- To minimize nuisance algal blooms and aquatic weed populations, including invasive plants such as European frogbit.
- For the people who live in and use the watershed and the Bay for fishing, swimming and boating.
- As a source of drinking water for 68,000 customers in Burlington and surrounding towns.

Sediment and nutrient loads from stream bank erosion and agricultural and urban runoff enter the rivers and streams that discharge to Shelburne Bay. Concentrations often exceed limits set or proposed by the State of Vermont to protect stream life and esthetic quality. Some of these streams are listed by the State as impaired. The LaPlatte River is the major tributary entering Shelburne Bay and the largest source of the Bay's nutrients. In recent years, phosphorus concentrations in the Bay have often exceeded the limits set by the state to protect water quality.

The State of Vermont has established Water Quality Standards that are designed to provide a yardstick against which to:

- Evaluate water quality in rivers, streams and lakes.
- Identify areas that need mitigation or protective action.

LaPlatte Watershed Partnership volunteers have been monitoring water quality in the LaPlatte River and its tributaries since 2004. Today, we know there is significant degradation of water quality in the River and Bay. This report summarizes the results of our water quality monitoring and research on the LaPlatte River and its major tributary, McCabe's Brook, through 2010.



The LaPlatte Watershed

The LaPlatte Watershed Partnership expects to continue monitoring the health of the LaPlatte watershed for

many years, building on results to date and learning from the work of long-running watershed organizations such as the Lewis Creek Association. Accordingly, this report also includes our recommendations for future monitoring and research. This is designed to improve our understanding of key factors impacting the health of the watershed and Shelburne Bay and, hopefully, to measure future improvements in water quality.

Improving water quality in the LaPlatte River and McCabe's Brook watersheds requires action at two levels:

- By individual homeowners and watershed citizens.
- By the town governments of Charlotte, Shelburne and Hinesburg.

This report includes calls to action for both groups.

Vermont Water Quality Standards

The Vermont Water Quality Standards were established in 1999. These standards were based on water quality requirements for both human use and aquatic life, and were developed for both lakes and rivers. Together with biological assessments, they provide a basis for measuring and evaluating water quality and for identifying impaired, threatened and pristine waters. The standards for streams currently include turbidity, nitrate and *Escherichia coli (E. coli)*. In addition, total phosphorus and total nitrogen criteria have been proposed to protect aquatic life in streams.

The standards also stipulate that total phosphorus and nitrogen loadings from streams to lakes shall be limited so that they will not help accelerate eutrophication or stimulate the growth of aquatic biota in ways that prevent the full range of uses of Vermont's lakes and rivers. The current Vermont Water Quality Standards for open waters like Lake Champlain include total phosphorus.

Water Quality Measurements

The LaPlatte Watershed Partnership has focused primarily on monitoring of four key water quality indicators: suspended sediment, phosphorus, nitrogen and *E. coli*.

Suspended Sediment

Suspended sediment in Vermont streams is measured as solids or turbidity. The Vermont Water Quality Standard is 25 nephelometric turbidity units (NTUs) in class B streams, like the LaPlatte, designated for warm water fish. Suspended sediment is important in streams and lakes because it:

- Limits visibility in water which can be hazardous to swimmers and boaters.
- Limits photosynthesis by reducing light penetration in surface waters.

Analyzing Water Samples

- Settles to the bottom of streams and lakes, and damages habitat for aquatic animals and breeding areas for fish.
- Acts as a vehicle for the transport of phosphorus to and within streams, and subsequently to Shelburne Bay and Lake Champlain, especially in watersheds where fertilizer has been applied to fields.

Phosphorus

Phosphorus is an essential plant nutrient which can also stimulate growth of nuisance aquatic plants and algae in streams and lakes. It is generally considered to be the major nutrient limiting or stimulating the growth of algae and aquatic plants in Lake Champlain. Reducing the load of phosphorus discharged into Lake Champlain from its tributaries – including the LaPlatte River and McCabe's Brook - will slow the rate of algae growth and entrophication in the lake..

Phosphorus in Vermont streams and lakes is generally measured as total phosphorus. The Vermont Water Quality Standard is 0.014 mg/l as phosphorus in the open waters of Lake Champlain and Shelburne Bay. The proposed in-stream standard is 0.044 mg/l as phosphorus as measured during low flow stream conditions.

Nitrogen

Nitrogen, like phosphorus, is an essential plant nutrient and, either alone or together with phosphorus, can limit or stimulate algal and plant growth in streams and lakes. So, to protect the LaPlatte River system and Lake Champlain, it is important to limit nitrogen loading in the LaPlatte watershed.

Nitrogen in Vermont streams is generally measured as nitrate and as total nitrogen. The Vermont Water Quality Standard for nitrate is 5mg/l as nitrogen. The proposed standard for total nitrogen is 0.75 mg/l as nitrogen.

Taking Water Samples in McCabe's Brook

Escherichia coli

E.coli is generally a harmless bacterium found normally in the intestinal tracts of warm-blooded animals. It is not generally found in the natural environment. Its presence in the environment is, therefore, considered an indicator for possible fecal contamination and presence of other intestinal organisms capable of causing intestinal disease. When *E. coli* counts are shown to exceed the Vermont Water Quality Standard, beaches are closed to protect human health.

E. coli in Vermont streams is measured as the most probable number (MPN) of *E. coli* bacteria in 100 ml. of water. The Vermont standard for *E. coli* is no greater than 77 organisms/100 ml.

Summary of Monitoring Results, 2004 – ’10

Water quality samples were taken monthly, with occasional exceptions, starting in May or June and ending in October or November, at sampling stations on the LaPlatte River and McCabe’s Brook:

- **LaPlatte River**. Sampling stations at Yacht Haven Drive, Shelburne Road, Falls Road, Spear Street, Carpenter Road, Dorset Street, Leavenworth Road, Below Hinesburg Sewage Treatment Plant, Above Hinesburg Sewage Treatment Plant and Silver Street.
- **McCabe’s Brook**. Sampling stations at Harbor Road, Bostwick Road, Route Seven, Teddy Bear Access and Lime Kiln Road.

Program volunteers also sampled Mud Hollow Brook in Charlotte and Patrick Brook in Hinesburg on several occasions.

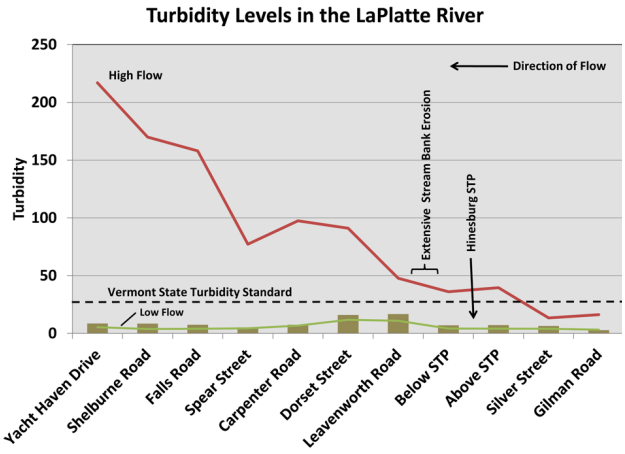
Suspended Sediment & Turbidity

Turbidity levels increase in the LaPlatte River between the Hinesburg sewage treatment plant (STP) outfall and Leavenworth Road as a result of stream bank erosion after which they decrease downstream. Levels generally fall below the Vermont standard, but can exceed it greatly when it rains.

LaPlatte River

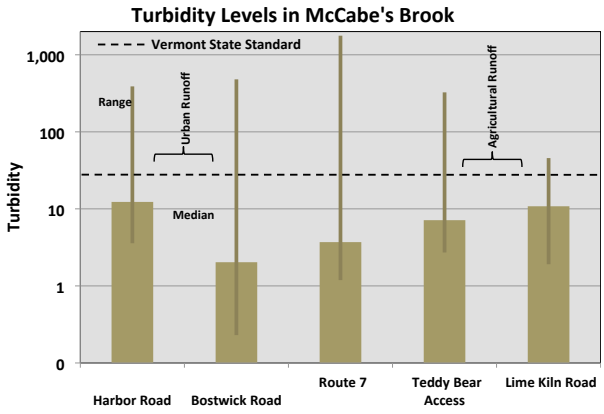
Sediment loads in the LaPlatte River:

- Constitute the main source of phosphorus in the river and its discharge into Shelburne Bay.
- Are generally low during low flows, but still influence phosphorus concentrations where stream bank erosion is prevalent.
- Increase greatly when flows increase and rise continuously to very high levels during periods of high flow.



McCabe’s Brook

McCabe’s Brook is listed under Part C of the State of Vermont’s list of priority surface waters outside the scope of section 303(d) of the Clean Water Act. This identifies McCabe’s Brook as in need of further assessment based on elevated turbidity affecting aquatic life.



- Turbidity levels exceed the Vermont standard in about 15% of all samples from Lime Kiln Road to Harbor Road. Sources appear to be erosion, bank failures and runoff from cultivated fields.
- The greatest increases in turbidity levels occur between Bostwick Road and Harbor Road where Vermont standards are exceeded in nearly half the samples analyzed. The most likely sources are drainage from the School Street neighborhood and Shelburne Village.
- Suspended sediment loadings can reach very high levels during high flows.

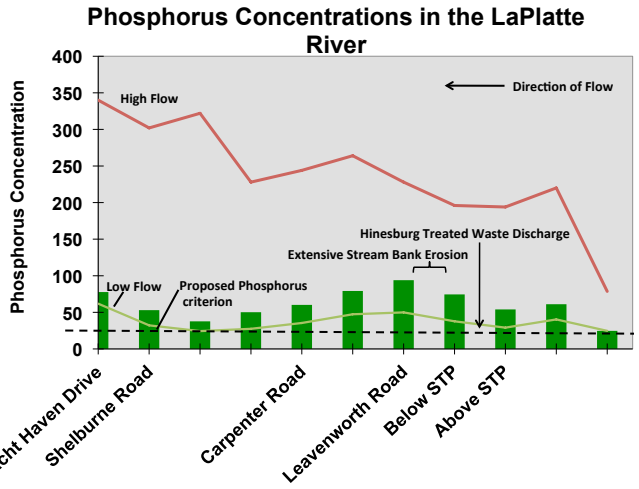
Phosphorus

Phosphorus concentrations in the LaPlatte River tend to mirror turbidity levels. Sources include the Hinesburg sewage treatment plant outfall, but much more important, stream bank erosion and agricultural runoff, especially during high flows. The bulk of phosphorus entering Shelburne Bay and Lake Champlain occurs during rain events where high flows and high phosphorus concentrations caused by agricultural runoff and stream bank erosion act together to cause high loadings. Phosphorus concentrations in Shelburne Bay in recent years frequently exceed the Vermont Water Quality Standard of 0.014 mg/l.

LaPlatte River

Total phosphorus concentrations in the LaPlatte River are heavily influenced by sediment loadings and:

- Consistently exceed proposed criterion at most locations throughout the river.
- Reach their highest levels where stream bank erosion occurs and where urban runoff impacts the lower reaches.
- Rise continuously and to very high levels during periods of high runoff.

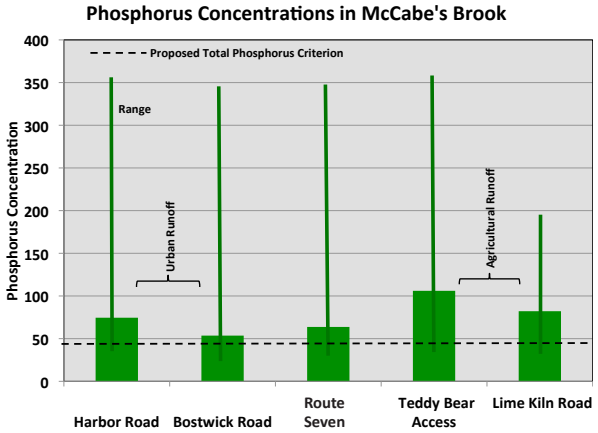


Total phosphorus levels in Mud Hollow were analyzed in 2008 and exceed the proposed state criterion at all times.

McCabe's Brook

Total phosphorus concentrations in McCabe's Brook are heavily influenced by sediment loadings and:

- Exceed the proposed Vermont criterion for Class B warm water streams in most samples.
- Reach very high levels during rain events.
- Appear to reflect changing patterns of cropping in three fields that drain into in upstream reaches between Lime Kiln Road and Vermont Teddy Bear.
- Are influenced by stream bank erosion in downstream reaches.
- Increase between Bostwick and Harbor Roads where the stream flows through wetlands and receives storm water runoff from Shelburne's central town area.

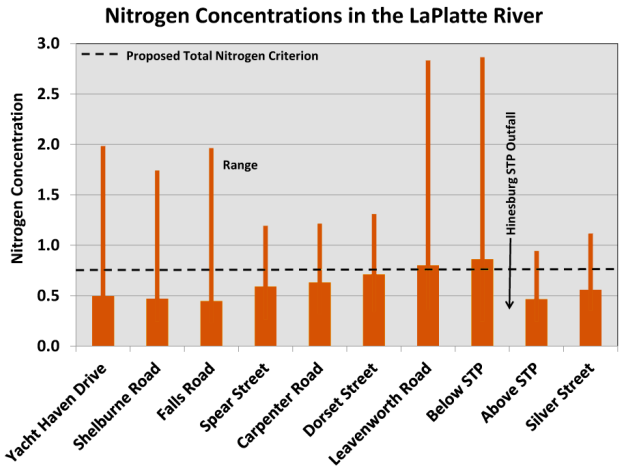


Nitrogen

Nitrogen concentrations are generally low in the LaPlatte watershed and decrease at downstream locations as a result of dilution.

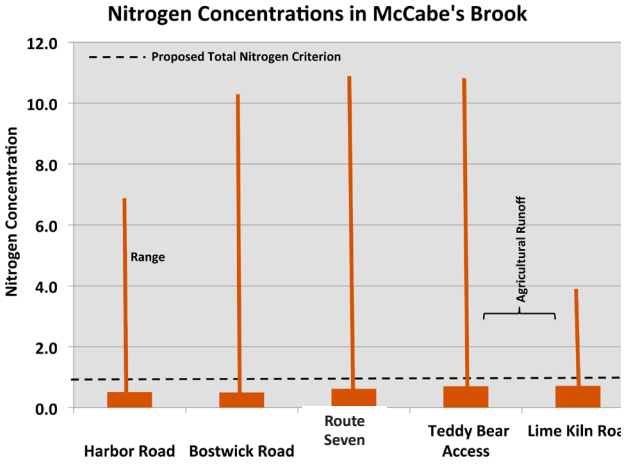
LaPlatte River

- Total nitrogen concentrations often exceed the proposed Vermont standard below the Hinesburg sewage treatment plant.
- Concentrations fall below the proposed standard downstream from Dorset Street.
- Total nitrogen concentrations in Mud Hollow Brook were tested in 2008 and consistently exceeded the proposed State criterion.



McCabe's Brook

- During rain events, total nitrogen and nitrate concentrations may far exceed the Vermont standards in McCabe's Brook as a result of agricultural runoff.
- Median total nitrogen concentrations tend to remain slightly below the proposed Vermont State criterion.
- Total nitrogen concentrations exceed proposed standards at times, however, and very high total nitrate concentrations, far exceeding the proposed Vermont state criterion, have been observed downstream from agricultural fields.
- Consistently low ratios of nitrogen to phosphorus concentrations indicate that phosphorus is present in excess.

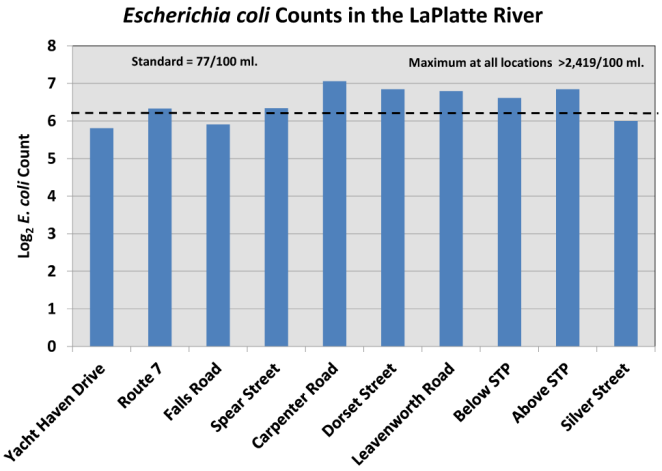


E. coli

Escherichia coli counts are often high throughout the LaPlatte watershed and generally exceed the Vermont standard. Counts are highest following rains.

LaPlatte River

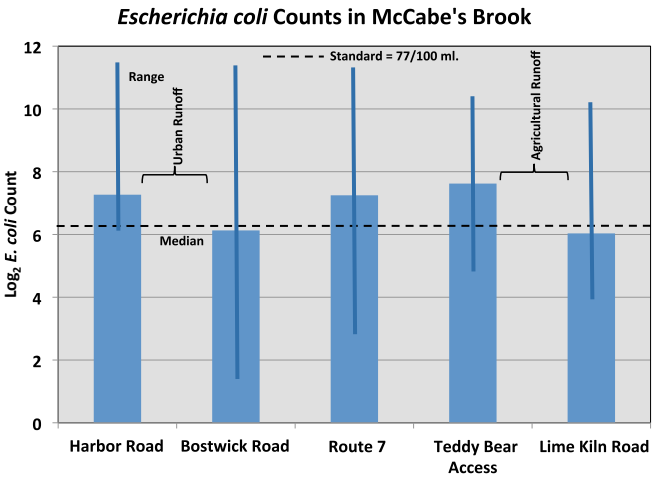
- *E. coli* counts exceed the State standards most of the time where influenced by urban runoff and waste discharges.
- Based largely on these data, the State has designated as bacteriologically impaired the LaPlatte River from its mouth upstream to the Hinesburg sewage treatment plant outfall and a three-mile reach of its tributary, Mud Hollow Brook. The State has established a bacterial Total Maximum Daily Load for the impaired reaches. This determines the reduction in *E. coli* counts that will be necessary to meet water quality standards.



- Agricultural operations and the general lack of riparian buffers are likely sources of bacterial contamination.
- On-site septic systems and storm water runoff from developed areas are other potential sources.

McCabe's Brook

- *E. coli* counts tend to exceed State standards and to increase where farm and urban runoff and treated sewage enter the stream.



Nutrient and Sediment Loadings

In 2010, staff gages were installed at five locations: three on the LaPlatte River and two on McCabe's Brook. Flow measurements at these gages will help determine nutrient and sediment loadings and the locations of major sources that impact loadings discharged to Shelburne Bay. First year results confirmed the value of flow data as a tool to place pollutant sources into perspective; they also helped clarify needs for future volunteer training.

Episodic Events

High sediment and nutrient loadings from streams discharging into Shelburne Bay are generally associated with the high runoff and high flows that occur during and after rain storms. Two events on July 10, 2007 (following several days of rain) and August 4, 2010 (during heavy rains) illustrate the potential dramatic impact of such events in McCabe's Brook.

High Embankment Collapse, McCabe's Brook

On August 4, 2010, sediment and phosphorus concentrations were exceptionally high at the Route Seven sampling station located downstream from two massive bank failures. Collapse and sloughing of such embankments is common over a stretch of McCabe's Brook both upstream and downstream from Route Seven. This event illustrates the role of stream bank collapse and erosion on sediment loadings which settle downstream and damage habitat.

The improved water quality generally observed at Bostwick Road is likely the result of filtering of the water as it flows through gravel and sand deposits.

The reach of McCabe's Brook extending from Lime Kiln Road to the Vermont Teddy Bear access road receives drainage from agricultural lands. In general, during years when fields are cultivated, phosphorus

Storm Water Drain

concentrations increase over this reach of the stream. When fields are not under cultivation, phosphorus concentrations decrease.

During a rain storm on July 10, 2007, phosphorus concentrations increased to extremely high levels driven by an exceptional increase in the concentration of particulate phosphorus. There was also a simultaneous increase in the total nitrogen concentration to extremely high levels, far exceeding Vermont State standards, driven largely by an increase in the nitrate concentration. This striking impact was observed at all downstream stations. This event illustrates:

- The impact of agricultural practices on stream water quality.
- The impact of agricultural practices on nutrient loadings to the lake.
- The need to implement best management practices on agricultural lands.

Next Steps for Town Officials and Watershed Residents

The research results presented here make the case for improving water quality in the LaPlatte watershed. The goal is to create a healthy aquatic environment in the watershed and Shelburne Bay. Reaching this goal will require changes in town policies and practices as well as coordinated action among town governments. It will also require changes in the way Shelburne, Charlotte and Hinesburg residents manage their yards, gardens, farms and forests. These changes are designed to prevent nutrients, soil and pollutants from entering the LaPlatte River and its tributaries.

Presentation to Shelburne Selectboard

For Town Officials

The LaPlatte Watershed Partnership recommends that town ordinances, plans and policies be changed to incorporate best watershed management practices based on corridor plans as described in some detail in "LaPlatte River Corridor Plans, LWP 2006-2011," http://www.lewiscreek.org/laplatte-watershed-studies and summarized here.

Storm Water Management

Conventional storm water systems transport nutrients and pollutants from urban roads, parking lots, yards and gardens to streams and rivers. They should be replaced with grass-lined channels, known as swales, wherever possible. Swales provide important benefits to streams because they:

- Remove nutrients and pollutants.
- Recharge groundwater.
- Slow down and also reduce stream loads when it rains.
- Increase stream levels and flows during droughts.

The LaPlatte Watershed Partnership recommends that town governments:

Cattle Don't Belong in Rivers

- Inventory and evaluate all private and public storm water systems and create the legal and financial capacity that is needed to upgrade all systems.
- Require low impact development in priority sub-watersheds. These developments will produce minimal increase in storm water hydrologic and pollutant loadings over predevelopment conditions.
- Disconnect impervious surfaces and all storm water outflows from storm drains and waterways.
- Create buffers along roadside ditches.
- Manage roadside ditching and drainage to ensure stability beyond town rights-of-way.

Road Maintenance

The design and maintenance of roads, culverts and ditches has a major impact on the amounts of runoff, sediment and chemicals that are carried into streams and rivers. It also impacts flow rates, stream bank erosion and fish movement.

Storm Water Drain

We recommend that town governments:

- Establish and apply protective road standards that are designed to improve water quality.
- Minimize salt use on roads. Salt concentrations in our local streams are generally highest in the early summer. Although salt levels do not yet threaten stream life in our towns, they have done so elsewhere. Prevention is important.
- Maintain grass or stone-lined roadside ditches along all town roads.
- Upgrade roads, bridges and culverts near streams to provide for fluvial geomorphic compatibility and aquatic organism passage.
- Establish schedules for roadside ditch maintenance that allow for rapid re-vegetation. The goal is to minimize the potential for erosion from bare soil.
- Use coarser gravels for road sanding, reduce overall sand applications and emphasize slow speeds for safe winter travel.
- Use sediment trapping structures and other practices to prevent roadside ditches from discharging directly into waterways.

Stream Buffers

Natural buffers along stream banks play a key role in improving water quality. The cultivated fields, lawns, roads and parking lots that border streams, rivers and Lake Champlain do nothing to reduce pollution and the run off that causes nuisance algal blooms and increased growth of aquatic weeds. The alternatives are wide buffer zones, planted in trees, shrubs and perennial grasses, from which pets and livestock are excluded. These natural buffers have many benefits because they:

- Absorb run-off of nutrients and other chemicals.
- Keep stream temperatures lower.
- Trap sediment and reduce erosion during times of heavy rainfall and flooding.
- Provide wildlife habitat and corridors.

Land Use Practices

Our research has confirmed the impact that land use practices have on water quality in the LaPlatte watershed. Nutrients in fertilizers reach waterways and nourish nuisance algal growth in the LaPlatte and the Lake. Both problems are exacerbated by soil erosion. Toxic chemicals accumulate through the food chain, harm aquatic life and can render fish unsuitable for human consumption. We recommend:

- Minimizing fertilizer applications and the use of weed and pest control chemicals to reduce concentrations of these substances in storm water runoff.
- Stabilizing stream banks and flood plains by planting trees and shrubs. Their root systems strengthen stream banks and floodplains, help trap sediment during flooding and provide shade which reduces stream temperatures.
- Taking a forest inventory and making forest conservation and protection a priority.
- Completing a soils inventory and setting priorities to protect and conserve soils with high infiltration capacity.
- Allowing streams to regain their natural channel dimensions, slope and planform.
- Reduce the rate of development in areas where there is no sanitary sewer access and where soils are not well suited for septic disposal.

For Watershed Citizens

Improving water quality in the LaPlatte watershed requires action from Shelburne, Charlotte and Hinesburg town governments. Individual actions are essential as well.

Lawns, Gardens and Septic Systems

Run off from lawns and gardens travels to roadside ditches and waterways. These areas can be managed to reduce run-off and to minimize the amounts of harmful materials entering waterways.

- Cut lawns no shorter than three inches.
- Minimize use of lawn fertilizers and focus on building healthy soil.
- Replace chemical fertilizers and pesticides with organic products to maintain soil fertility and control weeds and insect pests.
- Reduce lawn areas and save on maintenance by planting trees, shrubs and ground covers.
- Use new, more-advanced on-site septic technologies.

Agricultural Land

Cultivated fields lose nutrients and soil to erosion and run-off. These problems can be mitigated in several ways:

- Create buffers planted to perennial grasses, trees and shrubs between agricultural fields and waterways.
- Favor perennial crops and pastures whenever possible.
- Use cover crops and green manures in rotation to build soil fertility and avoid exposing bare soil for extended periods of time.

Streambank Erosion, Upper LaPlatte River

Driveways, Private Roads and Parking Lots

These impervious surfaces are maintained by homeowners, condominium associations and other organizations. They should be managed in ways that prevent run-off from entering waterways. Examples include:

- Maintain grass-lined ditches along driveways and private roads.
- Divert drainage from driveways and ditches to permeable surfaces such as lawns, fields and forests.
- Disconnect drainage pipes from direct discharge into town road ditches and streams.
- Consider replacing paved parking lots with porous materials (such as pervious concrete, gravelpure or porous asphalt) to minimize run-off and retain rainwater onsite.
- Minimize salt use during the winter.

Program Support

Laboratory support has been provided through the State of Vermont's LaRosa Volunteer Water Quality Monitoring Analytical Partnerships program. The Champlain Water District provided support for the analysis of particle size. The Town of Shelburne provided financial support for laboratory supplies, establishment of flow gaging stations, data analysis and review and public education under special environmental projects. Quality assurance under the monitoring program is carried out following the protocols contained in the State's EPA approved Vermont General Quality Assurance Project Plan for Volunteer, Educational and Local Community Monitoring and Reporting.

Volunteers have given 2,000 hours and collected more than 7,000 water samples since 2004. The Laplatte Watershed Partnership recognizes and thanks all of them: Lucy Blanton, Lisa Godfrey, Walter Gundel, Bill Hoadley, Bob Hyams, Matt Mainer, Pat Mainer, Ray Mainer, Susan Moegenburg, Andrea Morgante, Hans Puck, Judy Puck, John Quinney, Ed Sengle, Anna Speidel, Jon Trefry.

Recommendations for Additional Research, Training and Outreach

The LaPlatte Watershed Partnership can undertake monitoring and research to assess progress in protecting the resources of the LaPlatte watershed, supporting implementation of best management practices, and planning and informing the public about water quality and related issues in the watershed.

Based on results to date, The LaPlatte Watershed Partnership recommends that future monitoring and research includes these activities:

Research

- Conduct additional research to identify sources of suspended sediments in the reaches between Lime Kiln Road and Vermont Teddy Bear, and between Bostwick and Harbor Roads.
- Investigate Accepted Agricultural Practices (AAPs) and Best Management Practices (BMPs) for agricultural fields
- Recommend improved practices in order to reduce discharge of nutrients from agricultural fields to McCabe's Brook
- Continue monitoring of turbidity and total suspended solids because of their importance to aquatic life, aesthetic quality and phosphorus loadings in the LaPlatte River and Shelburne Bay.
- Use total suspended solids data and the results of fluvial geomorphic studies to recommend ways to mitigate erosion.
- Continue flow studies to better understand relationships between total and dissolved phosphorus, turbidity, total suspended solids and particle size.
- Working with USDA, NRCS, and other agencies to assess the extent of agricultural waste application through improved nutrient management planning.
- Renew and extend E. coli monitoring and research to pinpoint sources and assess improvements.

Taking Water Samples in McCabe's Brook

Volunteer Training

- Continue to improve quality control procedures with volunteers and program coordinators.
- Enlist volunteers to read staff gages on a daily basis and to measure rainfall.

Outreach and Action

- Develop the capacity to respond to and act on exceptional results in a timely manner.
- Use results of geomorphic and water quality studies, along with floodplain reconnaissance, to help formulate land management policies and to draft land use and basin plans.
- Use research results to improve planning by Regional Planning Commissions and towns.

LaPlatte Watershed Partnership Resources

The research summarized here has been more fully described in several reports prepared for the Water Quality Section of the Vermont Department of Environmental Conservation and the Town of Shelburne:

- Water Quality Supplement LaPlatte River: 2010 Data and Pilot Flow Study.
- Water Quality Supplement McCabe's Brook Watershed: 2010 Data in Context and Pilot Flow Study.
- Water Quality Supplement: LaPlatte Watershed 2008

In addition, the LaPlatte Watershed Partnership has published several studies that address water quality in the LaPlatte. These include:

- LaPlatte Corridor Plans for the towns of Hinesburg, Shelburne and Charlotte.
- The LaPlatte Storm Water Report (with Town Maps).
- The LaPlatte River Watershed Culvert Study.
- LaPlatte Management Alternatives for Hinesburg Village.

These studies are all available on the Lewis Creek Association web site: www.lewiscreek.org.