Basin 5

Upper Lake Champlain
Direct Drainage Assessment Report

December 2003

Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division

Contents

What is Basin 5 ?

Basin 5 is one of four "basins" that are atypical basins or planning units in Vermont. Basin 5 consists of a number of subwatersheds that drain directly to northern Lake Champlain. Basin 5 drainages are found in Grand Isle, Franklin, and Chittenden counties.

Waterbodies 05-01 and 05-02 are the Rock River watershed and Pike River watershed respectively in Vermont. These watersheds drain into Missisquoi Bay at the very northern end of Lake Champlain. Waterbodies 05-03, 05-04, and 05-05 consist of streams and brooks draining the islands of Alburg, Isle LaMotte, North Hero, and Grand Isle. Waterbody 05-06 includes the creeks that drain the land area between Hog Island and Hathaway Point and that flow into the upper Northeast Arm of Lake Champlain. Waterbody 05-07 are the streams and their watersheds that go into St. Albans Bay: Stevens Brook, Jewett Brook, Rugg Brook, and Mill River among others. Waterbody 05-08 are the brooks that flow into the lower part of the Northeast Arm south of St. Albans Bay. Waterbody 05-09 are those streams that flow into Malletts Bay and waterbody 05-10 are the streams that flow into Burlington Bay. Waterbody 05-11 includes the streams and the watersheds which drain to Shelburne Bay such as the LaPlatte River and its tributaries, Munroe Brook, Bartlett Brook, and Potash Brook. Waterbody 05-12 consists of small creeks draining the land between the tip of Shelburne Point and Thompson's Point. In each of these twelve waterbodies, there are also lakes and ponds and/or segments of Lake Champlain.

For basin planning (versus basin assessment) organizational purposes, Basin 5 or the Northern Lake Champlain Basin has been divided into four areas. The Pike River and Rock River will not be included in the Northern Lake Champlain basin plan but will be addressed during the Missisquoi River planning process. For basin planning purposes, the rest of Basin 5 has been divided into the St. Albans Bay drainage, the Malletts Bay drainage, the Burlington and Shelburne Bays drainage, and the drainage from the islands. Note, however, that the Rock and Pike watersheds are part of this Basin 5 assessment report.

For assessment purposes, Basin 5 or the Northern Lake Champlain drainage has been divided into seven areas for discussion of the conditions of the waters. The seven areas are: Shelburne Bay watershed, Burlington Bay watershed, Malletts Bay watershed, St. Albans Bay watershed, Rock and Pike Rivers watershed, Lake Champlain Islands, and Lake Champlain itself.

Unlike most basins in Vermont, the forest land cover type is only about 37% of the Basin 5 area. Agricultural land accounts for a substantial portion of the landscape with over 35% of the land area in this use. Developed land including transportation infrastructure occupies a relatively large percentage of the basin at approximately 13½ %. Surface waters comprise over 7½ % of the basin area. Wetlands account for approximately 6½ % of the area. The acres and percent of the basin area for each land use or cover type are given in Table 1.

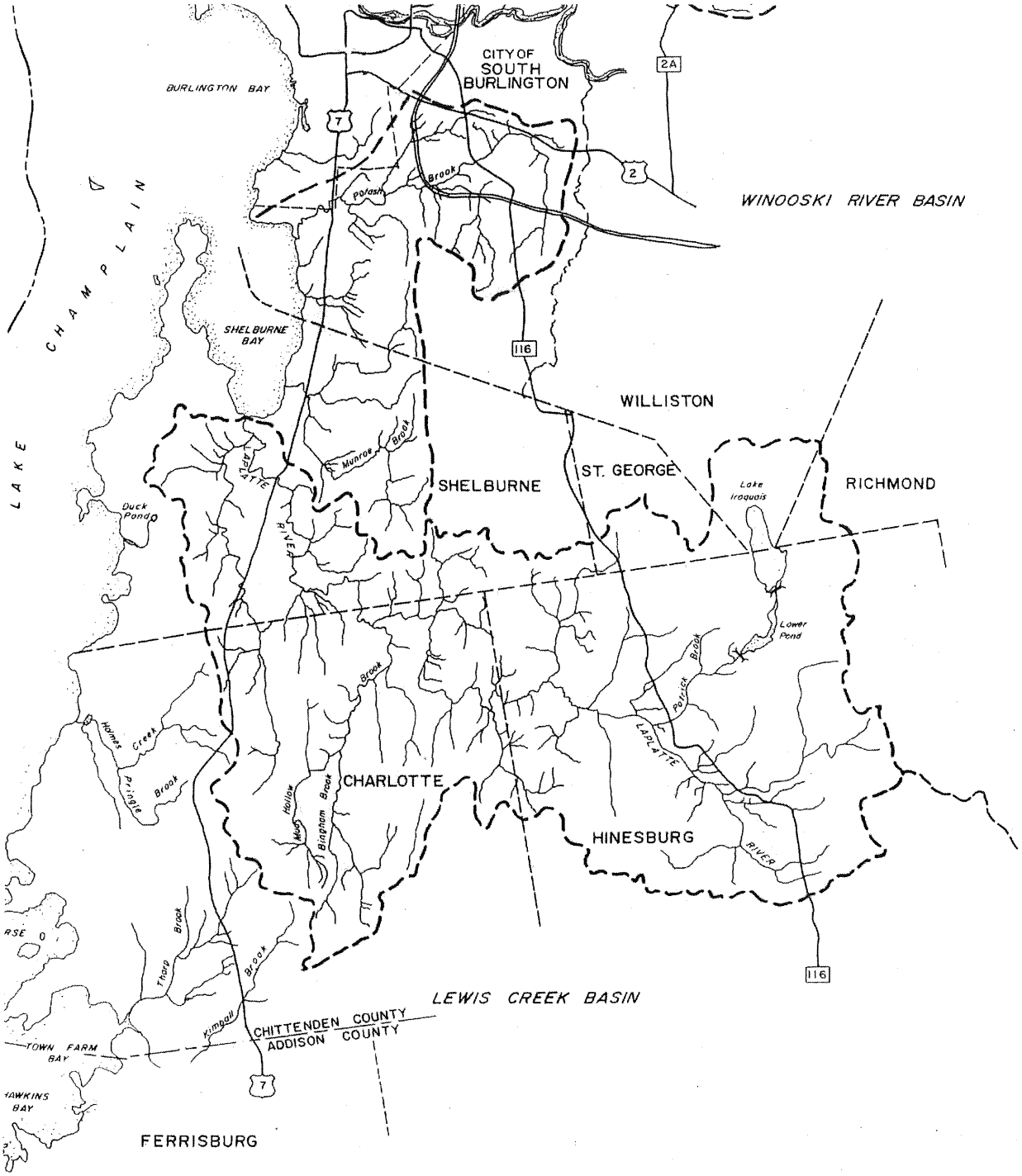
Table 1. Land Use and Land Cover in Basin 5

Land Use	Acres	% of total
Forested	94,478	36.6
Agriculture	91,555	35.4
Surface Water	19,593	7.6
Developed Land	18,950	7.3
Wetlands	16,622	6.4
Transportation	16,161	6.3
Old Field & Barren	975	0.4
Total:	258,336	100.0

1 Vermont Land Cover Classification Project, 1997 (based on satellite photographs from 1991 - 1993).

2 Developed land = residential, commercial, industrial but not transportation infrastructure, which is listed separately

Shelburne Bay Watershed



Streams and Lakes - Shelburne Bay Watershed

LaPlatte River and tributary streams

The LaPlatte River watershed is located in Chittenden County and is 57.4 square miles or 36,740 acres in size. The LaPlatte River mainstem is about 15 miles long and flows through the towns of Hinesburg, Charlotte and Shelburne emptying into Shelburne Bay. The towns of Williston, Richmond, and St. George are partially in the LaPlatte watershed. The major tributaries to the LaPlatte River are Patrick Brook, Mud Hollow Brook, and McCabes Brook. A U.S. Geological Survey (USGS) gaging station is located on the LaPlatte River at Shelburne Falls approximately two miles above the mouth.

The lower few miles of the LaPlatte River flow through land that has been largely protected by the town of Shelburne and The Nature Conservancy. In Shelburne, near Falls Road is a 115-acre natural area owned by the town that includes the river and its floodplain area for about ¾ of a mile. Downstream of this section and to Shelburne Bay, The Nature Conservancy owns about 211 acres of floodplain forest/marsh complex surrounding the LaPlatte River.

The LaPlatte River historically has had a relatively high concentration of phosphorus in its waters reaching Shelburne Bay. Through the 1980s, many agricultural best management practices were implemented in the LaPlatte River watershed in a concerted effort to improve the water quality conditions in Shelburne Bay. When implementation of projects through the ten-year United States Department of Agriculture (USDA) PL566 program was complete, there was 80% of watershed cropland, 68% of watershed livestock, 57% of barnyards, and 58% of milkhouses with Best Management Practices (BMP) in place. More recently, the Hinesburg and Shelburne Conservation Commissions have worked with the Vermont DEC to survey existing riparian buffers and have established new buffers on several miles of the river.

In the 1991 hydrologic base year, the phosphorus load and mean concentrations measured near the mouth of the LaPlatte River as part of the Lake Champlain Diagnostic-Feasibility Study were 11.8 metric tons of phosphorus per year (mt/yr) and 0.173 milligrams of phosphorus per liter respectively. Since that base measurement, phosphorus loads from the LaPlatte have generally declined: in 1993-1994, the load was 6.8 mt/yr; in 1995-1996, the load was 8.9 mt/yr; in 1997-1998, the load was 8.6 mt/yr; and in 1999-2000, the load was 5.1 mt/yr. Variations in phosphorus loads are strongly influenced by hyrdologic conditions (i.e., wet and dry years). However, the phosphorus reductions in the LaPlatte River were statistically significant even when hydrologic variations are taken into account.

The Hinesburg municipal WWTF discharges to the LaPlatte River and Shelburne WWTF #2 discharges to McCabes Brook. There used to be problems at the Hinesburg WWTF that were due to the waste from the cheese plant (Saputo is the current owner). Cheese plant waste is now pre-treated adequately before being added to the Hinesburg WWTF. The Shelburne WWTF also has no current problems. Phosphorus removal was added to Hinesburg in 1992 and to the Shelburne WWTF in 2002 helping to reduce nutrient enrichment problems in the waterways below each plant.

The macroinvertebrate community on the LaPlatte at rivermile 5.8 in 1998 was in good condition. The fish community was sampled on the LaPlatte at rivermile 5.8 in 1990 and 1995 and was assessed as very good and excellent respectively. The fish community was sampled on McCabes Brook, a tributary to the lower LaPlatte, in 1991 and 1999, but specific criteria have not yet been developed for this low gradient-soft bottom stream type. More sampling needs to occur on this brook as well as on the LaPlatte itself.

Patrick Brook, which is the outlet brook from Lower Pond, has been altered by land development, channelization, and streambank erosion. The brook has been largely diverted for use at the cheese plant. Mud Hollow Brook has been described as affected due largely to nutrient enrichment, sediments and thermal modifications from some agricultural activities, streambank erosion, and loss of riparian vegetation. Herbaceous or wooded buffers line the brook on a number of stretches and its condition is likely improved. Sampling is needed on this stream.

Munroe Brook

Munroe Brook and its fairly extensive system of tributaries are mainly within the town of Shelburne although one main tributary originates in South Burlington. The brook empties into the southeastern corner of Shelburne Bay.

Macroinvertebrate sampling on Munroe Brook at rivermile 0.4 in 1991 and 1999 found the bug community in poor health. The fish community also showed poor health at this site during the same year. In 2002, on Munroe Brook, the macroinvertebrate community was fair at rivermile 2.8 and on the North Tributary, the community was fair-poor at rivermile 0.8. Munroe Brook is impaired due to urban stormwater runoff and its many pollutants and from altered hydrology due to the developed areas. A watershed-specific stormwater general permit was issued for this watershed in June 2002. However, the "watershed improvement permit" was appealed and the Water Resources Board ruled against the permit. Stormwater projects in this watershed need to get an individual permit and propose stormwater offsets now as part of their permit application. There are at least twenty-three permitted stormwater discharges to Munroe Brook and its tributaries.

Bartlett Brook

The headwaters of Bartlett Brook begin west of Spear Street in South Burlington and flow generally westward. There are two forks of Bartlett Brook: the North Fork and the South Fork. The watershed of this brook is heavily developed and the impacts on the brook are from urban runoff.

Macroinvertebrate community sampling on Bartlett Brook found an assessment of poor at rivermile 0.2 in 1993, fair-poor in 1999 and poor in 2002; at rivermile 0.4, poor in 2002; and fair-poor at rivermile 0.7 in 1994. The fish community sampling produced an assessment of fair at rivermile 0.2 in 2001 and fair at rivermile 0.4 in 2002.

Bartlett Brook has numerous stormwater discharges most having had expired permits. A watershed-specific stormwater general permit was also issued for this watershed in June 2002 and the situation is the same as for Munroe Brook described above. There are at least twenty-five permitted stormwater discharges to Bartlett Brook and its tributaries. In 2002, the Vermont DEC, the City of South Burlington and the Champlain Water District

completed a stormwater treatment system and a natural stream restoration project in the brook's watershed.

Potash Brook

Potash Brook originates in the eastern part of the city of South Burlington and meanders north and then west emptying into Lake Champlain at the northern end of Shelburne Bay. The watershed is 7.5 square miles in area. The brook flows largely through suburban and urban areas and has been relocated and culverted due to the interstate and other roads. There are at least eighty-five permitted stormwater discharges to this small brook.

Biological monitoring in Potash Brook found the following results: a macroinvertebrate community assessment at rivermile 0.7 of poor in 1993 and 2001; at rivermile 1.0 of poor in 1993 and 2001; at rivermile 1.8 of good-fair in 1994 and fair in 1997; and at rivermile 4.3 of poor in 2001. Two Potash Brook tributaries were sampled also. Potash Brook trib 3 sampled at rivermile 0.3 was poor in 1994 and 2001. Potash Brook trib 7 sampled at rivermile 0.1 was fair in 1994 and poor in 2001. Fish sampling in 2001 at rivermiles 0.7 and 1.9 on Potash Brook resulted in an assessment of good for the fish community at both locations.

Intensive monitoring occurred in the Potash Brook watershed as part of development of the Potash Brook Watershed Restoration Plan (see references). There were twelve water quality monitoring stations established and some type of sampling occurred at each site over the course of nine months. The monitoring parameters included biomonitoring, baseflow water quality measures (pH, total suspended solids, alkalinity, total dissolved phosphorus and seven others), event-based water samples, sediment assessment, water temperature, geomorphology, and bank stability.

Lake Iroquois

From 1982 to 1985, Vermont DEC conducted a Diagnostic/Feasibility Study on 243-acre Lake Iroquois, which indicated that diffuse nonpoint source pollution was having an impact on the water quality and threatened to continue to degrade that quality. Vermont DEC plant surveys had revealed elevated algae levels and dense nuisance plant growth and Vermont DEC had received many public complaints regarding water quality up to that time. Lake Iroquois is a Class B water.

A 1991 aquatic plant survey showed little change in the native plant growth in Lake Iroquois. The survey revealed a new small infestation of Eurasian watermilfoil along the east shore. A few small patches of scattered watermilfoil growth were present.

From 1992 to 1993, Vermont DEC implemented the Lake Iroquois Watershed Project. The primary goal of the project was to reduce phosphorus loading to the lake through erosion control. The project coordinator conducted site surveys and designed erosion control measures for 38 identified problem sites. Some of the measures included: planting vegetative buffer strips along eroded shoreline and streambanks, regrading roads, replacing culverts, digging out ditches and lining them with stone riprap, and replacing stone or grass lined swales to better accommodate stormwater and spring peak water flows. The "Entering the Lake Iroquois Watershed" signs on roads in the vicinity of the lake were erected during this project to increase public awareness.

During the period 1993-1998, citizens and Vermont DEC continued to monitor the quality of waters in Lake Iroquois and conduct plant surveys. More recently, the lake has been monitored for *E. coli* bacteria in conjunction with the VT Department of Health's Town Health Officer Program. A one-day beach closure was ordered by the Town on 8/11/2002 due to a single violation of the 77 *E. coli* /100ml standard. No violations have been reported to Vermont DEC since that time.

The conditions in Lake Iroquois have begun to improve of late. Vermont DEC's citizen-based Lay Monitoring Program has produced annual Secchi disk transparency data since 1979. The Vermont DEC Spring Phosphorus Program has produced annual data on Lake Iroquois since 1977. These data indicate a significant decline in spring total phosphorus after 1995. The total phosphorus median from 1977 to 1995 is 29 ug/l, while the median for 1996-2002 is 22 ug/l (a statistically significant difference). The resumption of supplemental Lay Monitoring beginning 2003 was recommended. The mean alkalinity of the lake is 45 mg/l as CaCo3, based on 7 years of monitoring, which is more than sufficient to preclude acidification due to acid precipitation.

Lower Pond (locally known as Sunset Lake)
Lower Pond is a Class B water, and Vermont DEC's initial indications regarding the quality of this pond were not encouraging. In 1987, the town clerk and fish and wildlife wardens indicated that the lake was degraded due to algae growth and Eurasian watermilfoil. Follow-up visits up to 1995 corroborated the findings regarding Eurasian watermilfoil, and routine monitoring continued sporadically until 2002.

In 2002, the pond was visited and comprehensively reassessed under the Lake Assessment Program. Sampling results from that visit and others indicate that the pond is eutrophic. The spring phosphorus concentration is 21 ug/l based on six years of sample visits. The summer phosphorus concentrations measured during the 2002 visit were consistent with the springtime mean (average for 2002 visit = 19.5 ug/l). The alkalinity was 49 mg/l as CaCo3, which is more than sufficient to preclude acidification due to acid precipitation. Some limited algal growth was noted on the lake bottom and in a small number of localized shoreline areas, although no openwater algae blooms were apparent. A sediment quality assessment showed the presence of a deepwater aquatic community that did not appear limited by water quality.

Notably, the Eurasian watermilfoil infestation was very sparse, and had declined significantly from densities noted during prior visits. Residents expressed satisfaction with this and also indicated that water levels are occasionally manipulated by Iroquois Manufacturing, who owns the dam at the outlet of the lake. Residents also indicated that fishing is good in this pond. The shoreline of Lower Pond is moderately developed. There is a long-existing modular home development at the lake's south end, and there are 55 dwellings total along the lakeshore. No immediate evidence of failing septic systems was noted, although the DEC biologists did remove some refuse from shallow water portions of the lake. Also, there was no evidence of widespread shoreline erosion noted, although very small erosive areas existed where residents commonly access the lake (e.g., access trails). Significant stretches of undisturbed shoreline also still exist, which is uncommon for a lake so proximal to the Burlington area. There is a wetland at the lake's north end. Watershed land use is 35% residential with the remainder largely forested.

Assessment Summary of Shelburne Bay Streams and Lakes

IMPAIRED MILES/ACRES
Potash Brook: 5.2 - from lake upstream - impairments to aquatic biota/habitat, aesthetics, and secondary contact due to high sediment & turbidity, thermal & habitat modifications, metals and toxics from land and highway development, urban stormwater runoff, streambank erosion.

Bartlett Brook: 0.7 - from mouth at the lake upstream to rm 0.7 - aquatic biota/habitat, aesthetics impaired due to sediments and other components of stormwater runoff and other habitat alterations from parking lots and other impervious surfaces.

Munroe Brook: 2.8 - from mouth at the lake upstream to rm 2.8 and North Tributary: 0.8 - mouth upstream to rm 0.8 - aquatic biota/habitat impaired due to urban runoff/stormwater, erosion.

LaPlatte River: 10.5 - lake to Hinesburg - swimming impaired due to pathogens from agricultural runoff.

ALTERED MILES/ACRES
Lake Iroquois: 46 acres - aesthetics, aquatic life, swimming, and secondary contact uses are considered altered due to the continually burgeoning population of Eurasian watermilfoil. These uses are considered stressed due to nutrients and algal growth, although the data discussed above indicates an improvement to water quality.

STRESSED MILES/ACRES
LaPlatte River: 10.5 - lake to Hinesburg - aquatic habitat, aesthetics, secondary contact recreation stressed due to turbidity, sediment, thermal and habitat modifications from land development, agricultural and urban runoff, loss of riparian vegetation, channelization, and streambank erosion.

Patrick Brook: 2.0 miles - from LaPlatte River to Lower Pond - aquatic biota/habitat and aesthetics stressed due to sedimentation and habitat alterations from land development, channelization, and streambank erosion.

Lower Pond: 58 acres - aquatic life, swimming, and secondary contact uses for Lower Pond are considered stressed, due to the potential for re-growth of what was once a dense and problematic Eurasian watermilfoil infestation.

Housing and Population Growth in Shelburne Bay Watershed Towns

Most of the towns of Shelburne, Charlotte, and Hinesburg are in the Shelburne Bay watershed and thus the housing and population growth rates of these communities have an effect on the waters of this drainage area. All three towns have experienced very large growth rates in both population and housing since 1960 (U.S. Census Bureau). The biggest jump in population occurred from 1960 to 1970 when Shelburne's population more than doubled! The following decades, however, continued with the rapid addition of people and their need for housing. Population grew from 34% to 52% depending on the town from 1970 to 1980 while housing units grew 46 to 68% (an addition of 1341 housing units in the three towns over this ten year period). From 1980 to 1990, population grew from 17% to 41% and housing units were added at a rate of 27% to 45% (1379 housing units added to the landscape). From 1990 to 2000, population grew 13% to 18% and housing units grew 13% to 17% (768 new housing units overall). The population and housing numbers and growth rates of these and other Basin 5 towns are in tables in Appendix B.

Wetlands of Shelburne Bay Watershed

The LaPlatte River Marsh is a 400-acre floodplain-marsh wetland complex. The complex includes deep rush marsh, deep shrub swamp, cattail marsh, floodplain forest, and low-gradient stream. The wetland is very productive as it is underlain by limestone. The wetland system extends from Shelburne Bay south in two legs, one along McCabes Brook to the west of Shelburne Museum and one along the LaPlatte east of Shelburne Village.

The Mud Hollow Brook wetland is a 120-acre open water, shrub swamp, and forested wetland complex that has been beaver influenced for many years. This wetland is diverse and representative of an ecosystem that was once much more common in the Champlain Valley.

Burlington Bay Watershed

Streams - Burlington Bay Watershed

Englesby Brook

Englesby Brook is a very developed watershed of about 600 acres in the south end of Burlington. The stream rises in a series of manmade ponds near the UVM campus and flows into Lake Champlain at Oakledge Park.

Englesby Brook experiences frequent bankfull flooding as a result of stormwater runoff. This flooding accelerates erosion of the lower stream channel, which is a highly erodible Munson soil type. Channel cutting has lowered the channel up to 10 feet in several places. However, extremely low flow or no base flow in sections of the brook are an issue in dry seasons.

The riparian corridor of Englesby Brook varies in width from 10 to 100 meters. Habitat has been lost where the stream has been piped under the Burlington Golf Course fairways and from Pine Street to the lake where the dissected banks have been covered with fill. Between Pine Street and South Prospect Street, the corridor remains intact.

The water quality impairment is severe in the stream due to stormwater runoff. Aquatic biota and habitat, contact recreation, secondary contact recreation, and aethetics are uses that are not supported in this stream due to sediment, nutrients, pathogens, metals, and habitat alteration from this runoff. A watershed-specific stormwater general permit was issued for this watershed in June 2002 and the situation is the same as for Munroe Brook described above.

Macroinvertebrate sampling on Englesby Brook showed the following results: at rivermile 0.6 in 1995, 1996, and 1997, the community was in poor condition; and at rivermile 1.3 in 1998, the community was in poor condition. Low macroinvertebrate density and richness were issues. While fish assemblages at rivermile 0.1 were rated as very good in 1994 and 1998, the community was in poor condition upstream at rivermile 0.6 in 1994, 1998, and again in 2001.

The City of Burlington Department of Public Works collects and analyzes *E. coli* data in Englesby Brook. The numbers found are very high on almost every sampling occasion over the three years reviewed (1999, 2000, 2001).

There has been much other sampling on Englesby Brook by the USGS and by a collaborative including the University of Vermont (UVM), Vermont Agency of Agriculture, Food and Markets (AAF&M) and the Vermont DEC. The USGS has installed a concrete weir near the mouth of Englesby Brook to measure the brook's discharge. In addition, two instruments are in the brook to monitor water quality: a meter provides hourly pH, dissolved oxygen, temperature, conductivity, and turbidity data and an automated sampler collects water samples for analysis of nitrogen, phosphorus, and sediment at certain water levels or stages in the weir pool.

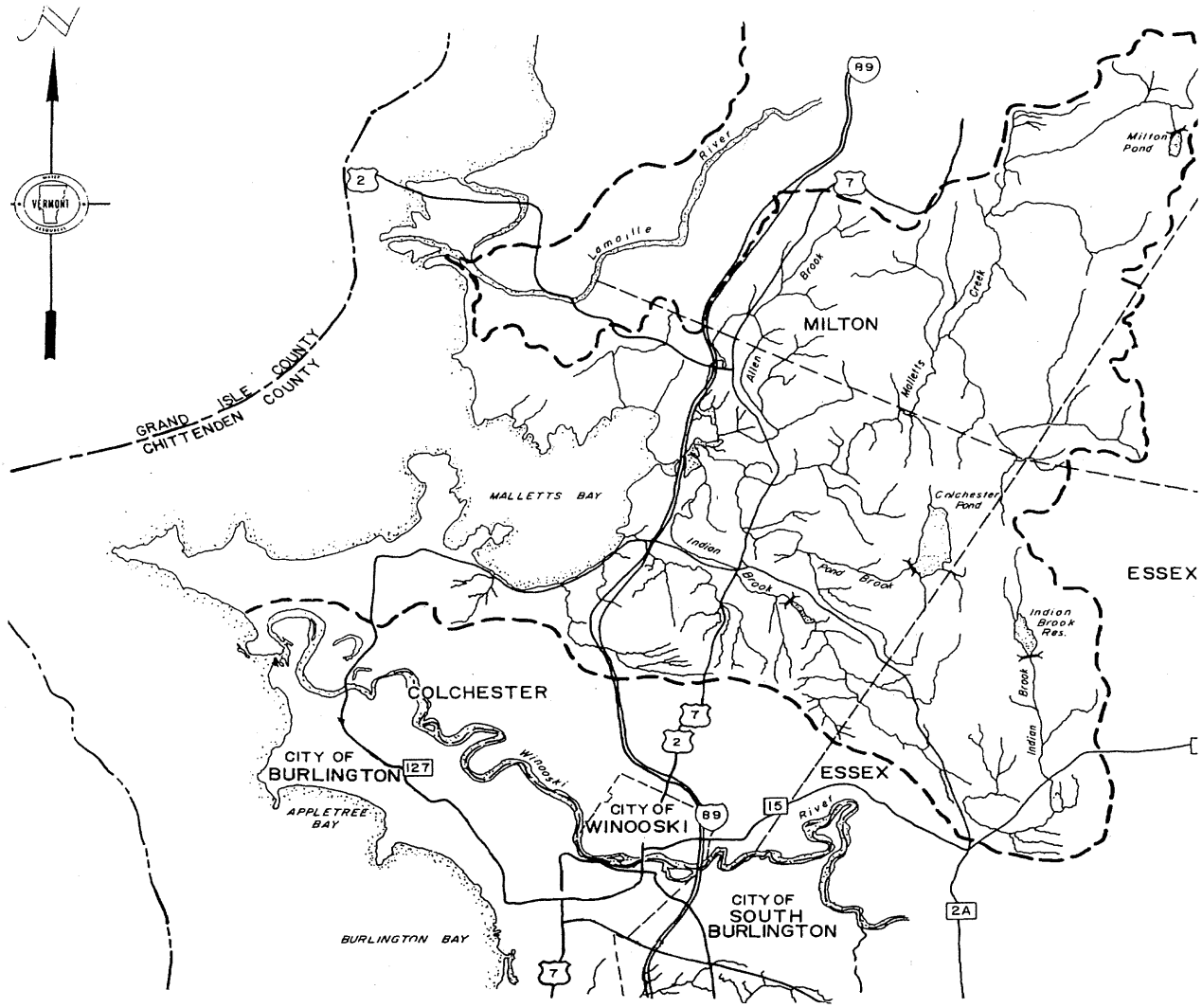
The UVM, Vermont AAF&M, and Vermont DEC partnership also sampled Englesby Brook at three sites along with six storm drain sites and runoff from a residential site to look at pesticide concentrations and risks. In 2000, a total of 22 samples from the 10 sites were analyzed. Five of the ten target compounds were not detected in any of the samples. The other five compounds were detected at least twice each during the study. Diazinon was detected at two locations on Englesby Brook during one sampling event.

A watershed restoration plan was completed for Englesby Brook in 2001. Through the Pine Street Barge Canal Settlement, funds have been provided to the City of Burlington to implement the plan. Work with the Burlington Country Club in the upper watershed has resulted in more water getting to the stream during low flows. Three stormwater retrofits are ready to go to construction at other locations in the watershed as of this writing.

Assessment Summary of Burlington Bay Streams

IMPAIRED MILES
Englesby Brook: 1.5 - from mouth upstream - aquatic biota/habitat, contact recreation, secondary contact recreation, and aesthetics impaired due to pathogens, nutrients, metals, habitat alteration, sediment from urban runoff. Blanchard Beach at the mouth of Englesby Brook is permanently closed.

Malletts Bay Watershed



Streams and Lakes - Malletts Bay Watershed

Allen Brook

The headwaters of Allen Brook are in Milton west of Cobble Hill. The brook flows westerly and then southerly through the subdivisions of Milton along Route 7. After the brook crosses into the town of Colchester, it flows southeasterly for about a mile before curving sharply and going under Route 7 and into Malletts Creek Marsh.

Allen Brook was sampled for macroinvertebrates at rivermile 1.3 in October 1998. A final community assessment was not given because a series of beaver dams complicates the interpretation too much. Additional sampling is needed at this site: this has been a reference site but now land development and runoff are serious threats to the brook and aquatic community. There are at least seven permitted stormwater discharges to Allen Brook or its tributaries.

A stream walk was done on a short section of Allen Brook in July 1999 upstream from Coonhill Road in Colchester. The entire stretch was deep, slow-moving and meandering. The water was turbid. In the one-fifth of a mile walked, there were two beaver dams ponding the water behind them on the main channel of the brook. The riparian zone included much alder and box elder.

Malletts Creek

Malletts Creek originates in the northeastern portion of Milton at Milton Pond. It flows generally west towards the town core of Milton. A small stream joins Malletts Creek from the north as the creek turns and flows in a southerly direction parallelling East Road in Milton. It continues winding generally south to the Milton-Colchester town line. In the southeastern portion of Milton, the creek flows through a large wetland complex, which has been recognized as an important wetland and is described below. In Colchester, the creek meanders in an overall southwesterly direction and near the mouth, it is part of another large wetland complex.

There are at least six permitted stormwater discharges to Malletts Creek or its tributaries.

Macroinvertebrates were sampled on Malletts Creek at rivermile 2.4 in October 1999 and the community assessment was very good. Fish population sampling, however, at rivermile 3.5 also in October 1999 found a poor fish community. There were many tolerant species and the richness of the community was not as expected. Other sites upstream of this fish site need to be sampled as well to determine if the sampling results are representative of this stream type.

A streamwalk was done on Malletts Creek in July 1999 upstream from Route 7 for about two-thirds of a mile. For most of the stretch, the creek was fairly deep, muddy, slow, and meandering. Several beaver dams were seen.

Pond Brook
Pond Brook originates at Colchester Pond and has a generally westerly flow through Colchester until it passes under Route 7. At that point, it begins a generally northerly flow into the large Malletts Creek Marsh and then Malletts Bay.

Pond Brook was sampled at rivermile 1.4 and 1.5 in October 1999 and the macro-invertebrate community was assessed as fair at both locations. Additional sampling is needed there. Earlier assessments had Pond Brook only partially supporting contact recreation because of failed septic systems. The problem came from a failing package treatment system (vs. failed individual systems) at Breezy Acres Mobile Home Park. The mobile home park has been hooked up to an extended sewer line that goes to the Airport Parkway WWTF in South Burlington since 1999 and so the partial support status for swimming on Pond Brook has been removed.

Indian Brook
Indian Brook rises in the hills around Colchester Pond and Indian Brook Reservoir. The brook was dammed to create the reservoir for a public water supply in the late 1800s. From the reservoir, the brook flows south to Essex Junction and then makes a wide sweep in the village and heads northwesterly to Colchester. It continues northwesterly in Colchester to Mill Pond dammed for a sawmill that once operated there and then on also to Malletts Creek Marsh adjacent to Malletts Bay.

Indian Brook is impaired for 4 miles from rivermile 5.8 to rivermile 9.8 due to sedimentation, nutrient enrichment, and temperature from land development, urban runoff, highway maintenance, and loss of riparian vegetation.

Macroinvertebrate data from sites on Indian Brook collected in 1993, 1995, and 1996 are the basis for the impairment of the aquatic biota/habitat use. At rivermile 5.8 in 1993, the community assessment was poor; and in 1999, it was fair. At rivermile 8.5 in 1993, the assessment was poor. At rivermile 9.5, the community assessment in 1995 was good but the next year (1996), it was only fair. At rivermile 9.8 in 1993, it was poor. Rivermile 5.8 is located below the Suzie Wilson Road bridge. Rivermile 9.8 is located below the Route 15 crossing near Lang Farm.

Data collected on the fish community after 1992 has yielded assessments of good, fair, and very good at rivermile 5.8. In 1996 and 2002, the fish community was found in very good and good health at rivermile 8.5 respectively. At rivermile 9.5, the assessments were fair in 1995 and good in 2002.

In 1995, the Indian Brook watershed was about 6% impervious surface and about 60% of the land was mixed forest or agricultural land. It is projected that land will be converted such that only 40% is undeveloped forest and agriculture as a subregional growth center gets developed. The stream corridor in Essex Junction is degraded. There are at least seventeen stormwater discharges to Indian Brook or its tributaries. A watershed-specific stormwater general permit was issued for this watershed in June 2002 and the situation is the same as for Munroe Brook described above.

The SB Collins site on Route 7 (Colchester Variety - formerly Village Beverage) is the source of petroleum-contaminated groundwater into Indian Brook. A remediation system, which targets the source of the polluted groundwater versus the sump and storm sewer discharges, has been in place since early 2000 but has been shut down recently (spring 2003) because it was not effective. Very high levels of benzene, toluene, napthalene, and other compounds (for example, 1580 ppb benzene sampled on 12/5/02 compared to 5 ppb Vermont Groundwater Enforcement Standard) are still found in the sump effluent that is sampled. The Indian Brook water samples had elevated levels of the compounds during one of the last seven sampling events at the first downstream site.

The Essex landfill, which was capped in 1992, is near Indian Brook. Groundwater and surface water monitoring have occurred twice annually at this site since May 1993. Four surface water sites are sampled - two on a tributary to Indian Brook and two on Indian Brook. The results have found arsenic above one of two standards for "protection of human health" at tributary site WQ-2 for six of the last nine sampling events. Benzene was above the standard for protection of human health-consumption of water and organisms also for six of the last nine sampling events. Diethyl ether, MTBE, and tetrahydrofuran were above the detection level frequently in the last seven sampling events. There are no Vermont standards for these three compounds currently.

Colchester Pond

Colchester Pond is a Class A(2) emergency backup water supply for the Colchester. It has not been used as a primary water source since 1974. In August 1989, the first VTDEC assessment indicated that the pond was experiencing a severe algal bloom with reduced oxygen concentrations in the lake's hypolimnion (deep waters). The suspected sources included the active farmland bordering the south and west shore and inlet streams. A white milky scum was observed at the inlet coves. A year earlier, a Vermont Department of Fish & Wildlife fisheries biologist noted no problems on the pond, and informed Vermont DEC that it had excellent pike and bass fishing based on angler surveys.

During the 1990s, the pond's entire shoreline was purchased and conserved by the Winooski Valley Park District. Routine monitoring of the pond continued in conjunction with Vermont DEC's Spring Phosphorus Program.

The lake was comprehensively reassessed on May 25, 2000. The alkalinity of 37.8 mg/l as CaCO3 indicated no likelihood of acid sensitivity. No oxygen depletion was found in the hypolimnion. Some areas of periphyton were seen, although these were limited in extent. Areas in which algae was observed during the 1989 visit did not show similar conditions in 2000. The overall aquatic plant cover was scattered to common (<50% plant cover in all cases).

No complaints have been received regarding algae or plants in several years. The spring total phosphorus average of 35 μg/l as P places this lake in the eutrophic category. No upward or downward trend is apparent in the spring phosphorus data. The nutrient accumulation apparent in the relatively elevated spring phosphorus concentrations is likely historical and attributable to prior farming activities. The Winooski Valley Park District initiated citizen monitoring under the Lay Monitoring Program in 2001. Their results as of

this writing confirm the eutrophic status. Given the land ownership changes and conservation in the 1990s, and the relative lack of recent observations or complaints regarding poor water quality, it is apparent that the pond is in a stable condition. The pond supports a population of a rare plant species, *Elodea nuttallii*. Recently, the pond was reported by Vermont Outdoors Magazine to be a premier northern pike fishery.

Indian Brook Reservoir

This is an unused Class A(2) water supply reservoir for Essex Town. Vermont DEC's assessment information on this waterbody is considerable and dates to 1988 at which time no problems were noted by town officials and a Vermont Department of Fish & Wildlife fisheries biologist. A 1989 DEC assessment indicated that the majority of the reservoir was characterized by a rocky shoreline with sparse plant growth. Some plant growth and some algae was seen in the inlet cove on the west shore.

In 1996, a comprehensive summer sampling program was performed by the University of Vermont. These data, in concert with prior and more recent Vermont DEC Spring Phosphorus Program data, establish that the reservoir is mesotrophic. Dissolved oxygen depletion has been observed in the reservoir's hypolimnion during winter and DEC data indicates low (but not critically so) dissolved oxygen during the summer. UVM information suggests that during 1997, no blue-green algae bloom developed.

In 1999, Eurasian watermilfoil was positively identified in the waterbody. A survey by DEC indicated that approximately 1 acre was heavily infested, with vigorous plants very abundantly distributed along the east shore, from the main point north to the north end of the reservoir. The Town of Essex subsequently commissioned a study to develop a management strategy for Eurasian watermilfoil. This study was performed by Aquatic Control Technology Inc. That survey work concluded that 5.2 acres were infested with abundantly or very abundantly distributed milfoil in near to total monoculture. The study recommended a five-year management strategy which included an herbicide treatment in year one, followed by handpulling/bottom barrier methods in years two-five, with follow-up monitoring annually.

In 2002, the lake was assessed for macroinvertebrates in four habitat zones as precursor to the potential herbicide treatment. Very limited milfoil was observed during that survey, and some areas of the rare plant, *Elodea nuttallii,* were seen. Results of the biological assessment are pending as of this writing.

This reservoir presently sees consistent swimming, fishing, and non-motorized boating use. Parking areas and certain nearshore areas have relatively compacted soils, but the lake itself is in good condition. An access fee is charged by theTown of Essex. Owing to the milfoil population decline, a pending permit application for herbicide use was placed on hold by the Town of Essex.

Suzanne Levine, Professor of Limnology at the University of Vermont, provided the Vermont DEC with data regarding the quality of the reservoir. These measurements indicate that the mean chlorophyll-a for 1997, 1998, and 1999 was 4.5, 3.2, and 6.1 ppb respectively. The mean phosphorus for 1997 and 1999 was 3.7 and 8.8 ppb respectively. These values collectively indicate meso-oligotrophic conditions.

The mean spring total phosphorus from Vermont DEC monitoring programs is 21 ug/l based on eight years of measurements. Phosphorous concentrations appear to be declining, but the trend is not statistically significant. Three years of alkalinity measurements indicate no threat due to acidification (mean alkalinity is 56.1 mg/l as CaCO3).

Indian Brook Pond
No data exists describing the water quality of this small waterbody. Existing data previously indicated that this was a 16-acre pond. A recent review of digital aerial ortho-phototography indicates that this is a small riverine wetland, with approximately 1 acre of open water.

Milton Pond
In 1991, when Milton Pond was first assessed, it was an active Class A water supply for the Town of Milton. Milton Pond was found at the time to be "very scenic and unspoiled." Large boulders and ledges lined its shores, and the shoreline was entirely undeveloped, save a set of powerlines that cross over the lake. The small watershed was forested. The undisturbed nature of this pond was found to be "very unusual" for the Champlain Valley. In 1993, the Town of Milton discontinued its use of the water as a public supply entirely.

By 1998, when the next assessment took place, the lake and lands surrounding it had been placed into conservation management, and there had been no changes to the character of the shoreline or watershed.

In 1998, and again in 2000, the pond was sampled as part of a large study of mercury in Vermont and New Hampshire lakes. The sediments assayed for total mercury showed concentrations above the low effects range criteria (sediment mercury average = 0.244 ug/g dryweight, ER-L criteria = 0.15 ug/g d.w.). Such concentrations, however are consistent with overall Vermont-wide averages. The concentrations of mercury in yellow perch tissues was very low relative to statewide averages.

Milton Pond remains classified as a Class A(2) water supply reservoir for Milton. During the spring of 2003, the University of Vermont Field Naturalist Program was charged with developing a management plan for the pond and surrounding lands. Given discontinuation of the pond as a public water supply and the pond's unique undeveloped character, a reclassification of the pond to B(1) during the water management typing process for Basin 5 should be considered.

Assessment Summary of Malletts Bay Streams and Ponds

IMPAIRED MILES/ACRES
Indian Brook: 4.0 miles - from rivermile 5.8 to 9.8 - aquatic biota/habitat and aesthetics impaired due to sedimentation, nutrient enrichment, and temperature from land development, urban runoff, highway maintenance and runoff, and loss of riparian vegetation. Also highly contaminated sump effluent and stormwater discharge (benzene, MTBE, napthalene, others) to Indian Brook from the former Village Beverage site approximately 2.5 miles upstream from mouth of brook and arsenic and benzene in the tributary to Indian Brook below the Essex landfill.

Crooked Creek and Smith Hollow Stream: 5.7 miles - upstream from mouth at Mallett's Bay - contact recreation impaired due to bacteria from urban/suburban runoff, beaver, and failed septic systems.

STRESSED MILES/ACRES
Colchester Pond: 186 acres - aesthetics, aquatic life, secondary contact, and swimming uses are presently considered stressed due to the potential for algal blooms, scattered shoreline periphyton, and hypolimnetic oxygen depletion. Thirty-three of these acres are also stressed by the potential for Eurasian watermilfoil infestation due to Colchester Pond's proximity to other milfoil-infested waters.

Indian Brook Reservoir: 23 acres - aesthetics, aquatic life, swimming, and secondary contact are considered stressed due to the presence of Eurasian watermilfoil.

Housing and Population Growth in Malletts Bay Watershed Towns

The housing and population growth in the three towns that largely comprise the Malletts Bay watershed has been very high over the past four decades as it has been in other parts of the basin (U.S. Census Bureau). The population of Colchester, Milton, and Essex taken together almost doubled from 24,222 people in 1970 to 45,091 people in 2000. The housing unit growth was even greater going from 7,553 housing units in the three towns in 1970 to 17,402 housing units in 2000.

Wetlands of the Malletts Bay Watershed

Malletts Creek Marsh is a large, diverse, and important wetland complex to the east of Malletts Bay. The major streams of the Malletts Bay watershed, Allen Brook, Malletts Creek, Pond Brook, and Indian Brook, all flow into this 425-acre wetland complex. Interstate 89 crosses the western portion of this wetland area. The community types of this complex include deep rush marsh, floodplain forest, and red maple swamp. There is a rare and state-threatened plant species and a rare sedge in the wetland and there are historical records for two other rare plant species. The marsh portion is the site for two significant fish – the very rare back-nosed shiner and the very rare and state-endangered northern brook lamprey.

Indian Brook Corridor is identified as an important wetland in the Malletts Bay watershed as well. The corridor is a riverine system with shrub and emergent communities on the floodplains. Indian Brook flows through a highly developed area and the corridor is highly important for wildlife travel and habitat.

At the upper end of Malletts Creek in the southeastern section of Milton, there is the Mallett Creek Wetland Complex or Marrs Hollow Marsh. This 600-acre wetland complex consists of shallow and deep water emergent marsh with maple-ash and hardwood-cedar swamps. The hydrology and integrity of this wetland has been severely compromised by the railroad, roads, and residential development. Beaver have also had a role in changing the wetland by flooding portions with their dams.

Lower Northeast Arm Direct Watershed

Streams and Lakes – Lower Northeast Arm Direct

Stonebridge Brook

Macroinvertebrate sampling in 1997 at the mouth of Stonebridge Brook found the community in fair condition - a low EPT, relatively high BI and a community dominated by Hydropsychid caddis. The metrics indicate that nutrient enrichment probably from agricultural sources is the source of the impairment. In 1999, the macroinvertebrate community assessment was improved over the 1997 findings and was at the "good-fair" line.

A St. Michaels College biologist sampled fish at the mouth of Stonebridge Brook in 1991 and a Vermont DEC biologist sampled fish about 200 meters up from the mouth in 1997. Both came up with "very good" IBIs (39 and 37 respectively). Both samples were in areas that become inundated by high spring lake levels. The community that was first sampled was indicative of tributary mouths of Champlain - high to moderate densities and very high species richness. The second sample was done in a moderate gradient area and the fish assemblage reflected more of a riverine environment. The only metric indicating a potential problem was density, which was low for this stream type. Neither biologist has sampled upstream but that would be good data to get. The areas upstream may be affected by the grazing and loss of riparian vegetation that occurs there.

Long Pond

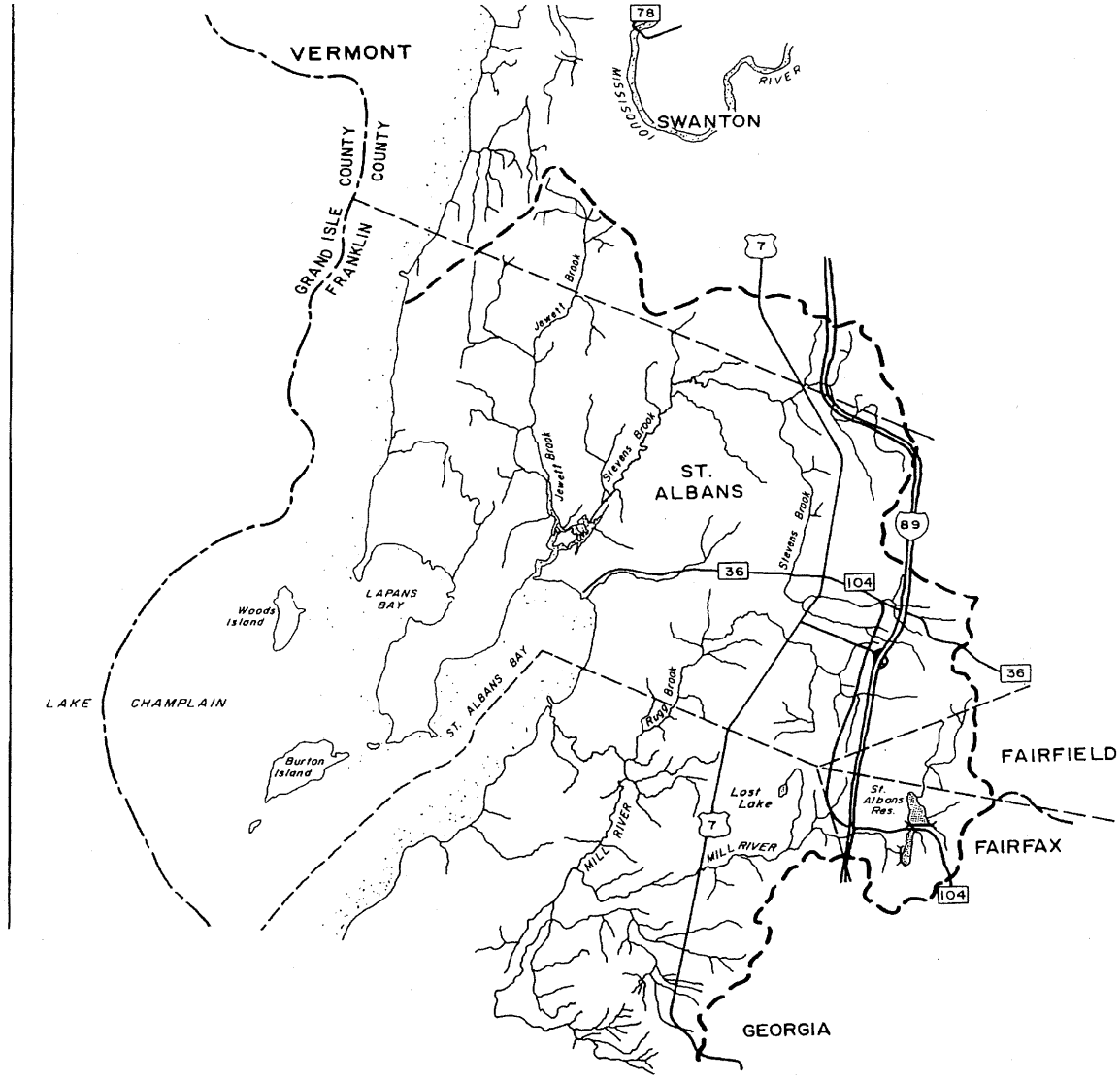
This 47-acre moderately eutrophic pond in Milton sees little public access. Several uses (aesthetics, aquatic life, secondary contact, and swimming) are considered stressed due to occasional algae blooms, and in localized areas due to native plant growth. There is no record of public complaint regarding this lake over the past several years. The pond is also considered threatened by potential infestation of Eurasian watermilfoil.

Assessment Summary of Lower Northeast Arm Direct Watershed

IMPAIRED MILES/ACRES
Stonebridge Brook: 2.0 - aquatic habitat/biota, water clarity, and contact recreation (swimming) are not fully supported due to sedimentation, turbidity, and nutrient enrichment primarily from agricultural land uses and loss of riparian vegetation.

STRESSED MILES/ACRES
Long Pond: 47 acres – aesthetics, aquatic life, secondary contact recreation, and swimming stressed due to occasional algae blooms and in localized areas, heavy plant growth.

St. Albans Bay Watershed



Streams and Lakes - St. Albans Bay Watershed

The St. Albans Bay Rural Clean Water Program (RCWP) was a ten year effort to reduce agricultural phosphorus loading to the bay through best management practices on key watershed farms. Continuous phosphorus and other monitoring occurred at the mouths of Jewett Brook, Stevens Brook, Rugg Brook and Mill River throughout the ten years. At the end of the project, 61 of 102 watershed farms had signed contracts to implement best management practices (BMPs). The contracts covered 74% of the critical acres, 79% of the animal units, and 80% of total manure phosphorus loads.

Jewett Brook
Jewett Brook originates in Swanton and flows in a southerly direction through the town of St. Albans meeting the Stevens Brook watershed contribution in a large wetland complex at the northern end of St. Albans Bay.

In 1992, Jewett Brook was sampled at rivermile 3.2 and the macroinvertebrate community was poor. No more recent data is available.

The mouth of Jewett Brook was sampled annually from 1981 through 1990 as part of the St. Albans Bay RCWP monitoring. Mean values for a number of water quality parameters were compared pre- and post- BMP implementation. For example, total suspended solids (TSS) increased significantly, total phosphorus (TP) increased significantly, and fecal coliform (FC) decreased significantly following BMP implementation on Jewett Brook.

A stream walk was done on 2400 feet of Jewett Brook upstream from Route 38 in August 1999. The entire stretch is through pasture land "without any significant riparian zone or fencing to exclude cows from the stream." At the time of the site visit, water was not flowing in the channel - the streambed was alternately dry and standing pools of water. Where there was water, there was dense aquatic plant growth and filamentous algae.

Mill River
The Mill River originates at the impounded St. Albans Reservoir and flows west under Interstate 89 then southwesterly passing under Route 7. About a mile and a half west of Route 7, the river flows abruptly north turning west again towards Lake Champlain after Rugg Brook enters. It flows through a lakeside floodplain forest community west of Georgia Shore Road before entering St. Albans Bay of Lake Champlain.

Nutrient samples collected four times in the summer of 1999 on the Mill River had the following TP results: on 6/24 - .037 mg/l (low flow); on 7/7 - .204 mg/l (following rain); on 8/4 - .048 mg/l (low flow); and on 9/9 - .112 mg/l (following rain).

The fish assemblage at rivermile 0.7 clearly failed to meet Class B criteria in 1992 and 1998. The 1998 sample indicated severe impact with only three species being recorded where six to ten would have been expected under reference or minimal impact conditions. Rivermile 8.7 was sampled for fish in 2002 and received a poor assessment.

At rivermile 0.7 on the Mill River, the macroinvertebrate community was in fair condition in July and September 1990 but in poor condition in September 1991 due to nonpoint sources including agriculture. In 1998 at rivermile 0.7 on the Mill River, the macroinvertebrate community health and integrity was good; in 1999, also at rivermile 0.7, it was fair-poor; and in 2002, it was fair. At mile 8.7 in 2002, the macroinvertebrate community was assessed as good.

The mouth of Mill River was sampled annually from 1981 through 1990 as part of the St. Albans Bay RCWP monitoring. Mean values for a number of water quality parameters were compared pre- and post- BMP implementation. For example, turbidity decreased significantly, TSS decreased significantly, TP increased significantly, and FC decreased significantly following BMP implementation on Mill River.

The stretch of river between Georgia Shore Road and the confluence of Rugg Brook was walked and surveyed in July 1999 by two Vermont DEC Water Quality Division summer employees and a local watershed activist. About 2.5 miles of the Mill River was walked on two different days. Observations from an old trail in Georgia downstream to Georgia Shore Road included numerous sections of eroding or slumping streambank but mostly on outside bends of the river; a section of stream bermed with cobble, gravel, and concrete; and stretches with dense algae cover. The town of Georgia has received a grant to do a Phase I Geomorphic Assessment of all the streams in town and so more information about the condition of the Mill River will be forthcoming.

Rugg Brook

Rugg Brook's headwaters originate from east of Interstate 89 and from the south between St. Albans Hill and Bellevue Hill. The two main branches of this brook flow together near Clyde Allen Drive in St. Albans. The brook flows northwest through suburban and urban areas then west along Nason Street in St. Albans City. It then flows southwest through primarily agricultural land until it joins the Mill River.

In 1999, at rivermile 0.5 on Rugg Brook the macroinvertebrate community health and integrity was poor. In 2002, at rivermile 4.4, the macroinvertebrate community was also assessed as poor. In 1999 and 2000 at rivermile 4.3, the fish community was poor in Rugg Brook. There are at least twenty-two permitted stormwater discharges to Rugg Brook and its tributaries.

The mouth of Rugg Brook was sampled annually from 1981 through 1990 as part of the St. Albans Bay RCWP monitoring. Mean values for a number of water quality parameters were compared pre- and post-BMP implementation. For example, turbidity decreased significantly, TSS decreased significantly, TP increased significantly, and FC decreased significantly post-BMP implementation on Rugg Brook.

A stream walk was also done on Rugg Brook in July 1999. About a half-mile stretch from Mill River Road down to the mouth was walked and the instream conditions, streambank and riparian zone status, and the adjacent land uses were all described. In this stretch, the brook flows largely through pasture land that has scattered streamside willows. Cows have access to the stream. The brook varies from cobble-boulder riffle-pool stretches to

muddy and sandy slow-winder sections. The stream appears highly enriched with the riffles containing up to 100% filamentous algae cover.

The Stevens Brook and Rugg Brook were part of a watershed study done by Dubois & King Inc. for the Northwest Regional Planning Commission in partnership with the City of St. Albans, the Town of St. Albans and the Town of Georgia. These partners are concerned about water quality and flooding problems in these two streams and their watersheds and the results of the investigation by Dubois & King Inc. are the beginning of an effort to address these issues.

Stevens Brook

The headwaters of Stevens Brook originate along the ridgeline east of Interstate 89. Several intermittent tributaries from the western slopes of this ridge join the main channel of Stevens Brook. Grice Brook, an intermittent stream, also drains this ridgeline and flows west to join Stevens Brook in St. Albans City.

West of the interstate, Stevens Brook is shown as a perennial brook on the USGS topographic maps. It flows first west through the southern part of St. Albans City and then turns north after the floodwater diversion structure that was built in the late 1970s. This diversion structure shunts floodwaters from Stevens Brook into Rugg Brook at certain flows to reduce flooding between Lower Weldon Street and Lower Newton Street where the floodplain was built upon.

Stevens Brook flows north along the western side of St. Albans City past the Central Vermont Railroad lands and facilities and then under Lower Newton Road and out of St. Albans City. Throughout its course through St. Albans City, the brook is very much confined or encroached upon with riprap or concrete walls in place of banks in some stretches and lawns and organic fill adjacent to the stream in other locations.

Once out of the city, the brook continues north past the St. Albans WWTF. The brook flows in a northerly direction still after the wastewater treatment plant but through more rural and agricultural land than previously. Near Jewett Road, the Stevens Brook begins a westerly flow and then after approximately a mile, the stream turns south and continues in a southwesterly direction for approximately three miles until it reaches the large wetland complex at the confluence of Stevens and Jewett Brooks.

In 1992, three sites were sampled for macroinvertebrates on Stevens Brook. At rivermile 3.2, the assessment was fair and at rivermiles 6.6 and 6.7, the assessments were poor. In 1993, at rivermile 4.2 on the Stevens Brook (just below the Central Vermont RR bridge), there was non-support of aquatic biota due to sand embeddedness and toxic impacts. In 1998 at rivermile 4.2 on Stevens Brook, the macroinvertebrate community health and integrity was again poor and at rivermile 9.0, it was also poor. There are at least twenty-five permitted stormwater discharges to the Stevens Brook and its tributaries.

The fish community was sampled at rivermile 3.2 in 1992 and was assessed as poor. At rivermile 4.2, it was poor in 1992 and 1999. At rivermile 6.6, it was also poor in 1992.

The mouth of Stevens Brook was sampled annually from 1981 through 1990 as part of the St. Albans Bay RCWP monitoring. Mean values for a number of water quality parameters were compared pre- and post-BMP implementation. For example, turbidity decreased significantly, TSS decreased significantly, TP decreased significantly (in contrast to the other tributaries and more as expected) and FC decreased significantly following BMP implementation on Stevens Brook.

Remediation is underway at the Central Vermont Railway hazardous waste site in St. Albans City near Stevens Brook. Track pans have been put in place to prevent current leaching to the brook and a pump and treat system has been installed to deal with the contamination that occurred over a number of years earlier. The contaminant plume is now thought to be much smaller than the original estimate. The consultant for the Central Vermont Railway prepares a quarterly report of activities at the site, which discusses the volume and type of contaminant recovered on the site as well as operation details for the remediation system.

The former St. Albans Gas & Light Property was used for gas manufacturing from the 1870s until the 1950s and so decades of contamination occurred at this site. Numerous environmental investigations have been conducted on the property including sampling of soils on the site at various depths, groundwater sampling, and surface water and stream sediment sampling. The latest sampling occurred as a final expanded site inspection done for EPA Region I by Weston Solution of Wilmington, Mass. The Weston investigation found: "one VOC, acetone, was detected in the sediment samples collected from Stevens Brook at concentrations greater than or equal to three times the appropriate reference sample (SD-06) concentration or greater than or equal to the reference sample's sample quantitation limit (SQL); eight SVOCs were detected in the sediment samples collected from Stevens Brook at concentrations greater than or equal to three times the appropriate reference sample (SD-06) concentration or greater than or equal to the reference sample's SQL"; "four inorganic analytes [cadmium, cyanide, barium, zinc] were detected in sediment samples collected from Stevens Brook at concentrations greater than or equal to three times the appropriate reference sample (SD-06 and SD-07) concentration or greater than or equal to the reference sample's sample detection limit (SDL)."

The St. Albans Department of Public Works yard on Aldis Street is also a hazardous waste site (96-2036) adjacent to Stevens Brook. Groundwater and surface water sampling has occurred first quarterly and, in the last two years (2002 & 2003), annually since 1996. Three sites have been sampled on Stevens Brook. In the 2002 sampling, the midstream surface water sample had trace petroleum product contamination and the downstream and upstream samples had no detectable contamination. In the 2003 sampling, all three surface water sites had detectable petroleum contamination although the midstream sample had the highest concentration (23.2 ug/l MTBE, 25.3 ug/l toluene, 47.7 ug/l total xylenes among others). Groundwater modeling indicates that the MTBE and BTEX plumes are slowly migrating towards Stevens Brook. Annual monitoring will continue.

Lost Pond (Georgia)

Lost Pond is a unique waterbody for this part of the state in that it is not developed and meets the wilderness-like 9 rating of Vermont DEC Lakes Classification System. There are only eight other lakes in Vermont that meet the wilderness-like 9 rating and 38% of

those are impaired or threatened due to their vulnerability to acid precipitation. Lost Pond has a high buffering capacity with an alkalinity of 24.1 mg/l, so its water quality is not severely degraded by atmospheric deposition. Vermont DEC staff saw evidence of a diversity of aquatic life during the October 2003 field visit including a number of Eastern Floater mussel shells scattered around apparently the result of river otters consuming them. Canada geese were using the pond during their migration.

North and South St. Albans Reservoirs (Fairfax)
These are actively-used drinking water supply reservoirs for the City of St. Albans. They are posted against public access. The reservoirs were subject to a joint DEC Water Quality Division / Water Supply Division project during 2002 to measure reservoir chemical conditions and determine the effects thereof on in-plant treatment problems encountered by operators. Both lakes were sampled weekly for multiple parameters including multiprobe profiles, phosphorus, nitrogen, chlorophyll-a, and other parameters.

For North St. Albans Reservoir, a strong deepwater oxygen depletion was evident, and the lake had a mean summer total phosphorus concentration of 26.4 ug/l, indicating eutrophic status. During 2002, chlorophyll-a concentrations became elevated (up to 20 ug/l) until mid-summer, at which time they declined precipitously in conjunction with water replenishment into the reservoir using water from the adjacent South St. Albans Reservoir. These reservoirs are linked by a piping system.

Watershed land use phosphorus export modeling indicates that a small amount of sediment phosphorus resuspension is necessary to account for in-lake concentrations. This means that if nutrient control is determined to be necessary in the reservoir, in-lake restoration techniques (e.g., chemical treatments) may be necessary. Water level fluctuations associated with drinking water treatment practices yielded a peak drawdown of one meter during 2002. Macroinvertebrate assessments indicate that this reservoir scores 70% of the maximum possible score for "small, well-buffered lakes" as assessed using DEC's trial lake biological criteria. This may represent more than a moderate deviation from reference conditions (median score = 87%) for lakes of this type, which would indicate some level of impairment to the benthic community. Impacts are limited to rocky-littoral and macrophyte-bed communities, which represent approximately 7 acres. Following Vermont DEC protocols for assessing biological impairment, this system will be visited a second time to verify the impairment. It is thus appropriately listed as stressed in need of follow-up assessment. This lake has received historical copper-sulfate treatments to control algae blooms, resulting in copper concentrations in sediments (mean of two samples = 105 ppm) that are elevated above NOAA sediment criteria threshold effects guidelines (>34 ppm).

For South St. Albans Reservoir, a strong oxygen depletion was also evident and the lake displayed a mean summer total phosphorus concentration of 14 ug/l (mesotrophic). Watershed land use phosphorus export modeling indicated that watershed sources were sufficient to account for in-lake concentrations. Chlorophyll-a concentrations became elevated (up to 20 ug/l) through the late summer, until lake turnover. Water from this reservoir is piped to the north reservoir as needed to replenish water in that reservoir. Accordingly, water level fluctuations are significant, with a peak drawdown of two meters within a two-week period during refilling of the north reservoir. The reservoir's shallow

northern embayment, partially exposed by drawdowns, also receives phosphorus-rich filter backwash from the treatment facility, which may provide a significant source of additional phosphorus to the reservoir. This reservoir receives an unquantifiable contribution of water from Silver Lake (Georgia) via a piping system. Macroinvertebrate assessments indicate that this reservoir scores 80% of the maximum possible score for "small, well-buffered lakes" as assessed using Vermont DEC's trial lake biological criteria, which is not more than a moderate change from reference conditions (median score = 87%) for lakes of this type.

In-plant data collected during the 2002 study suggested the existence of water treatment problems with turbidity spiking in finished water. Reservoir data indicated the spikes were attributable to turbidity influencing the entire water column during peak stratification. These turbidity spikes could be addressed in the plant, however, meaning that the turbidity did not impair drinking water supply use.

Assessment Summary of St. Albans Bay Streams and Lakes

IMPAIRED MILES
Jewett Brook: 3.5 miles - upstream from mouth - aquatic biota/habitat, contact and non-contact recreation, aesthetics impaired due to nutrient and organic enrichment, turbidity, sedimentation, algae, and pathogens due to agricultural runoff, cattle access to stream, and loss of riparian vegetation.

Stevens Brook: 5.8 miles - upstream from St. Albans Bay (to a point about a mile below CV Railway) - aquatic biota/habitat, contact recreation and aesthetics impaired due to turbidity, organic and nutrient enrichment, algae and thermal changes from agricultural impacts, eroding banks.

Stevens Brook: 1.0 mile - directly below Central Vermont Railway - aquatic biota/habitat, aesthetics, contact and non-contact recreation, agricultural and drinking water supply impaired due to an oil seep from improperly managed/stored/transferred fuel oil.

Stevens Brook: 2.5 miles - above Central Vermont Railway (above rm 6.8 Pearl Street) - aquatic biota/habitat, aesthetics, contact recreation impaired due to sedimentation and turbidity, organics and metals, trash and habitat alterations from urban runoff, contained and channelized stream, CSOs, loss of riparian vegetation, land development, road construction and repair, and dredging.

Mill River: 1.8 miles - mouth upstream to Rugg Brook confluence - non-support of aesthetics and aquatic biota/habitat due to sedimentation, turbidity, physical alterations and nutrient enrichment from agricultural activities, streambank erosion, channel instability and manipulation.

Rugg Brook: 4.3 miles - upstream from the mouth (at Mill River) - aquatic biota/habitat, contact recreation (swimming), and aesthetics due to sedimentation, turbidity, nutrients, pathogens, and thermal modifications from urban/suburban runoff, loss of riparian vegetation, land development, agricultural land runoff, cattle with access to brook.

Rugg Brook: 0.4 - from rm 4.3 (Crosby Street) upstream to Route 7 - aquatic biota/habitat and aesthetics impaired due to sediments, flow changes from urban/suburban runoff, physical alterations of channel, loss of riparian vegetation, land development.

STRESSED MILES/ACRES
Mill River: 3.0 - upper 3 miles - aquatic biota/habitat stressed due to hydrological changes, sediments from erosion.

Rugg Brook: 1.1 - upstream from Route 7 (see above) - aquatic habitat stressed due to flow changes, physical habitat alterations from land development, suburban runoff.

North and South St. Albans Reservoirs: 12 acres - North Reservoir (seven acres) and South Reservoir (five acres) are stressed for aquatic life uses due to the proximity of a Eurasian watermilfoil infested water. Aquatic life use in the seven acres of the North Reservoir are also stressed by an unknown cause.

Wetlands of the St. Albans Bay Watershed

The largest wetland in the St. Albans Bay watershed is Black Creek Marsh, which is at the north end of St. Albans Bay where Jewett and Stevens Brooks converge. This 360-acre wetland complex includes deep rush and cattail marshes and deciduous forested wetland. In a 1988 survey of the area, both the rare spiny softshell turtle and the uncommon map turtles were found. Approximately 80% of the wetland is part of the Black Creek Wildlife Management Area with the rest in private ownership.

Another large and important wetland complex in this watershed is the so-called Newton Road wetland. This 240-acre forested wetland is both northeast and southwest of Newton Road right outside of St. Albans City. Residential development and human activity in and adjacent to the wetland threatens its integrity, health, and functions.

The Mill River Mouth floodplain forest and wetland complex was identified in two state publications as an important area: *The Vermont Advanced Wetlands Planning and Protection Project Report: Lake Champlain Basin*, 1997 and *Floodplain Forests of Vermont: Some Sites of Ecological Significance*, July 1998. The complex consists of silver maple floodplain forest with a 70-foot canopy and groundcover of ferns. Also part of the complex and south of Mill River is a patchwork of shrub swamp and deep rush marsh communities. Lakeward of the floodplain forest is a series of deep rush marsh communities. Thirty-four acres of this wetland complex have been donated to a conservation organization by the local landowner.

Housing and Population Growth in St. Albans Bay Watershed Towns

The housing and population growth of St. Albans Town, St. Albans City and Georgia, the towns predominantly in the St. Albans Bay watershed, have increased at varying rates over the last 30 years (U.S. Census Bureau). Georgia's housing and population grew substantially from 638 housing units in 1970 to 1654 housing units in 2000 and 1711 people in 1970 to 4375 people in 2000. St. Albans City housing increased less rapidly and grew from 2809 housing units in 1970 to 3376 in 2000. Its population actually declined overall in that time period with 8082 people in 1970 and 7650 in 2000. St. Albans Town, however, grew each decade with housing units going from 1319 in 1970 to 2257 in 2000 and the number of people going from 3270 in 1970 to 5324 in 2000.

Rock and Pike Rivers Watershed

Rock River Watershed

Rock River

The Rock River originates at the outlet of a large, linear wetland system east of Rice Hill in Highgate and Franklin. It flows north for a little over a mile through forested and agricultural land then turns abruptly westward, flows around a wooded knoll, and begins a general southwesterly flow to Bullis Pond. The dominant land use in this area is agriculture with pasture, hay, and corn all represented. Below the culvert under the road that brings the river out of Bullis Pond, the river drops abruptly in elevation falling over rock and boulder. It then winds northwesterly north of Browns Corner for about a mile and then turns and winds back southwesterly into the town of Highgate. Through this stretch the river is in a small valley amidst extensive flat fields of hay, corn, and pasture. About one-half mile past the mouth of Steele Brook, the river begins a meandering northerly flow for over six miles to the Canadian border. Below Rollo Road, the river is now in a much higher, steep and narrow valley. In Canada, it continues northwesterly and then curves and heads southwesterly back into the United States. Not far south of the border, the river flows through a large floodplain forest and then into Missisquoi Bay.

Macroinvertebrate sampling on the Rock River found the community health/integrity at rivermile 7.9 (below Tart Road about 300 feet) to be poor in 1999 and 2000; poor at rivermile 9.4 (below Route 207) in 1999; fair at rivermile 14.8 (below Bruso Road) in 1999 and 2000; and good at rivermile 19.0 (below East Highgate Road) in 1999. Fish sampling on the Rock River in August 2002 at rivermile 5.4 found a fish community in fair condition.

Vermont DEC Water Quality Division staff conducted windshield surveys, streamwalks, and a canoe trip on most of the Rock River in the summers of 1999 or 2000. The prevalence of corn, pasture, and hay was noted during these field investigations as well as the lack of riverside vegetation on a number of stretches. Turbid water was observed by staff in both summers as well as algae growth on the substrate (75%-100% coverage).

The Rock River had the highest concentration of phosphorus of the tributaries to Lake Champlain that were sampled as part of the Lake Champlain diagnostic/feasibility study in the 1991 hydrologic base year. The mean total phosphorus concentration was 0.419 mg/liter at the Rock sampling station (almost twice as high as the next highest tributary mean phosphorus concentration of 0.236 mg/l). The total load of phosphorus that year was estimated at 28.9 metric tons from the Rock River.

Bullis Pond (Franklin)

Vermont DEC has no data regarding this 11-acre pond. An evaluation using aerial digital orthophotographs indicates that this is a shallow impoundment of the upper Rock River. The largest part of the pond is directly adjacent to a farming operation and is within several yards of a manure pit. Very little buffering exists between the agricultural operation and the water. Provided that the farmer/landowner is operating within current Agricultural Accepted Management Practice regulations, these waters are presumed to comply with water quality standards.

Proper Pond
Vermont DEC has no historical information on this pond. The aerial digital orthophotograph shows a small openwater area within a larger (~20 acre) area of wetland margin.

Cutler Pond
This 25-acre lake was first visited by Vermont DEC in 1979 as part of an "Inaccessible Lakes Study." It was reported that the pond was surrounded by marsh habitat, that it is very difficult to access, and that it provided good waterfowl habitat. Agricultural fields in the basin drained directly to the pond.

Vermont DEC visited the pond again in 1992. Exceptionally thick muck was noted throughout the lake. A nearby farmer said that the muck was measured to be 15 feet thick without finding a solid bottom. The water was found to be so shallow that the flocculant-muck made canoeing difficult to impossible around the perimeter of the pond. The aquatic plant growth was limited, presumably due to soft muck. The source of these muds was then presumed to be sedimentation from nearby farm fields, and possibly from past land clearings.

Recently, Vermont DEC re-evaluated the pond using aerial digital orthophotographs. The pond remains relatively undisturbed. Nearby agricultural land is separated from the pond by significant buffers. The tributary stream draining from the south shows clear and obvious signs of historical channelization that was done to drain agricultural lands to the pond's south. Vermont DEC's stream geomorphology experts indicate that the layout of the tributary stream in relation to the pond is such that once completed, the channelization might have produced very significant sediment delivery to the lake. Historic stream alteration is thus a possible source of the muds observed in the lake. Insufficient current field data are available to comprehensively reassess this pond, which merits attention during the next Basin 5 assessment cycle.

Assessment Summary of Rock River Watershed

IMPAIRED MILES
Rock River: 3.6 miles - from mouth to Vermont/Quebec border - aquatic biota/habitat, aesthetics impaired due to nutrients, turbidity, sedimentation, likely temperature from agricultural land uses (pasture with no fencing, other), loss of riparian vegetation.

Rock River: 13.0 miles - upstream from Vermont/Quebec border - aquatic biota/habitat, and aesthetics are impaired from nutrient enrichment, sedimentation, turbidity, likely temperature due to agricultural activities and loss of riparian vegetation.

Saxe Brook: 1.0 mile – from mouth upstream - aquatic biota/habitat, aesthetics, and contact recreation are impaired due to nutrient enrichment, likely temperatures from agricultural activities and loss of riparian vegetation.

STRESSED ACRES
Youngman Brook: 1.8 - mouth to rm 1.8 - aquatic biota stressed but stressor unknown.

Cutler Pond: 25 acres - aquatic life, aesthetics, secondary contact, and swimming uses are stressed due to potential infestation by Eurasian water milfoil.

Bullis Pond: 11 acres – aquatic life, aesthetics, secondary contact recreation are stressed due to plant and algae growth.

Wetlands of the Rock River Watershed

The largest wetland system in the Rock River watershed is the floodplain forest, shrub swamp, cattail marsh and deep rush marsh complex surrounding the lower Rock River. This 520-acre, diverse wetland is valuable for wildlife: it is excellent nesting habitat for ducks during high water in the spring and it is inhabited by the uncommon map turtle.

A second large and important wetland in the watershed is a wetland complex surrounding Cutler Pond in Highgate. The system includes forested wetland, shrub swamp, emergent wetlands, and open water. Green ash, white cedar, and larch dominate the northern forested wetland. Historically, the stream draining this wetland was channelized, likely for agricultural purposes.

Pike River Watershed

Pike River

The Pike River originates in the hills of Berkshire, Vermont then flows southerly for approximately 4 miles to the confluence of Mineral Brook before meandering around to the west then flowing northerly and into Quebec. In Quebec, the Pike River makes a large arc northeasterly and then southerly into Missisquoi Bay in Canada. About 85% of the Pike River watershed is in Quebec. The outlet stream from Lake Carmi and its watershed join the Pike River about a mile south of the Quebec/Vermont border.

Macroinvertebrate sampling on the Pike River at rivermile 2.0 in September 1999 found the community health/integrity to be good. Windshield surveys done on the Pike River in July 1999 and July 2000 found variable buffers along the river from no buffer where there is pasture or hayfield right next to the streambank to narrow bands of shrubs and small trees providing a little canopy coverage to wider forested riparian zones. Alders and herbaceous plant species along the top of the riverbank were commonly noted. The Pike River meanders through a shrub and emergent wetland complex from above Mineral Brook Road to West Berkshire. Pasture, corn, hay, and some old field are dominant land uses in other sections of the riparian corridor. High percentages of instream algae coverage were noted frequently.

Lake Carmi

This large (1,402-acre) and heavily used lake has a long history of documented water quality problems, and has been the subject of several studies and water quality improvement initiatives. As a result of these efforts, the quality of the lake water is improving, although these gains are being offset to some degree by increases in Eurasian watermilfoil growth. A chronological summary of relevant information follows:

1980s: Many public complaints were received and an aquatic plant harvesting program was initiated. The lake was experiencing excessive plant and algae growth and reduced water clarity and fish kills were common. The U.S. Soil Conservation Service assisted several large farms in the Carmi watershed with installation of manure management structures to reduce nutrient runoff into the lake.

1990-1994: Routine Eurasian watermilfoil surveys suggested relatively light infestation densities. Public comments and calls regarding poor water quality were common.

1994-2000: DEC initiated an intensive water quality sampling effort to determine the source of the excess phosphorus that having an impact on the lake. A late 1994 comprehensive assessment underscored several problematic situations, including erosion and algal scums.

Results of the DEC studies, released in 1995 and again in 1996, indicated that high phosphorus concentrations were most likely external (watershed) in source. Internal sediment phosphorus release, if occurring, was limited to short-term episodes. Comprehensive biological assessment indicated that phytoplankton and macroinvertebrate

community integrity had been adversely affected. The water level of the lake was fluctuated annually, adding stress to the aquatic community.

The Lake Carmi Campers Association and subsequently the Franklin Watershed Committee, with technical and financial support from DEC, initiated several projects to improve water quality by controlling erosion from farms, roads, and shoreline property.

In 1997, a revised statewide fish consumption advisory was issued by the Vermont Department of Health regarding mercury in walleye. Lake Carmi, however, was identified as an exception. Mercury does not bioaccumulate very rapidly in the tissues of Lake Carmi fish. A more recent study of mercury contamination statewide explains that this is due to the eutrophic nature of Lake Carmi.

The Vermont Department of Forests, Parks and Recreation annually monitors the quality of the water at the State Park beach by measuring *E. coli* indicator bacteria. Violations of the Water Quality Standard for *E. coli* were noted during the period 1994-1997.

In 1999, DEC conducted a paleolimnological investigation of the lake focusing on mercury and elemental sediment composition. The sedimentation history indicated that mercury concentrations are declining. The surficial mercury concentration in Lake Carmi (0.12 ug/g d.w.) is below NOAA ER-L sediment criteria (0.15 ug/g d.w.). The sediment core also indicated that the rate that sediment is deposited in the deepwater is higher than that of any other lake similarly studied in Vermont. The elemental composition of the sediments indicates that the material falling to the lake sediments has become increasingly dominated by algal production in the lake over time, indicating that eutrophication has proceeded at an accelerated pace in this lake.

In 2000, a moderate fish kill was observed on the lake by residents. A Department of Fish & Wildlife fisheries biologist attributed the kill to normal post-spawning stress. In 2002, the lake was written up in Vermont Outdoors Magazine as a premier northern pike fishery.

A turnaround in lake water quality, which initially began in response to the installation of manure management structures and continued with the watershed work conducted by the Campers Association and the Franklin Watershed Committee, was clear and obvious by 2002. The lake is now clearly improving based on the Lay Monitoring Porgram data record. From 1983 to 2001, Secchi disk transparency improved by 0.05 meter per year, total phosphorus summer averages declined 0.61 ug/l/yr, and chlorophyll-a concentrations declined by approximately 1 ug/l/yr. All of these trends are statistically significant. These data and recent resident opinions collectively suggest a real improvement in the quality of Lake Carmi, which has been corroborated by Franklin Watershed Committee members. They indicate that lake water clarity is improving, and further state that milfoil densities are increasing in direct response. If these trends continue, this lake should be proposed for de-listing from Vermont's 303(d) Impaired Waters List where it is listed due to excess phosphorus concentrations. Unfortunately, the problem of eutrophication may be replaced by one of Eurasian watermilfoil management.

A 2003 review of bacterial monitoring at Lake Carmi State Park indicated that since 1998, 21 of 204 *E. coli* samples were in excess of Vermont's standard of 77 *E. coli* /100ml. In

2002, exceedances occurred on 3 of 15 sampling days. Retest of these events yielded results well below the standard in every case.

Little Pond (Franklin)
This is a relatively remote 95-acre pond that Vermont DEC visited in 1992 and again in 2002. It is highly tannic, has an undisturbed shoreline and watershed, and is surrounded by large areas of wetland. There is no established public access. This is a wilderness-like lake as determined by Vermont DEC's Lake Protection Classification System.

In 2002, the lake was sampled for total phosphorus (27 ug/l), total nitrogen (0.79 mg/l), and physico-chemical measurements (oxygen, temperature). Dissolved oxygen depression was evident throughout the shallow water column (3.67 mg/l DO at 1 meter, <1 mg/l at 2 meter) attributable to the wetland character of the lake. The pH (5.98 s.u.), conductivity (average of 39 us/cm3), and alkalinity (6.9 mg/l as CaCO3) were all low, indicating that this is an acid sensitive lake. Vermont DEC's assessment threshold for acid sensitive lakes is an alkalinity of 12.5 mg/l. The lake sediments are comprised of decomposing macrophyte material reflecting primary production in the lake. Land uses in the watershed are having minimal impact on the lake. This lake may have experienced historic nutrient inputs due to prior farming, but the present state is undisturbed. Due to its proximity to a large Eurasian watermilfoil population on Lake Carmi, uses on the lake are considered stressed owing to the potential for infestation.

Assessment Summary Pike River Watershed

IMPAIRED MILES/ACRES
Lake Carmi: 1,402 acres – aesthetics, secondary contact recreation and swimming uses are impaired due to elevated phosphorus concentrations and associated effects. Aquatic life in a subset of 700 acres is impaired due to low dissolved oxygen; a manifestation of the elevated total phosphorus.

STRESSED MILES/ACRES
Alder Run: 1.0 mile and Marsh Brook: 2.5 miles – aquatic habitat, contact recreation and aesthetics stressed due to nutrient and organic enrichment, pathogens, sedimentation and turbidity, and thermal changes primarily from agricultural sources.

Pike River: 8.5 miles - upstream from Vermont/Quebec border - aquatic habitat, contact recreation and aesthetics stressed due to nutrient and organic enrichment, pathogens, sedimentation and turbidity, and thermal changes primarily from agricultural sources.

Lake Carmi: 140 acres – aquatic life, aesthetics, secondary contact recreation and swimming uses are stressed due to Eurasian watermilfoil infestation and water level fluctuations.

Lake Carmi: 10 acres – swimming use stressed due to occasional exceedances of *E. coli* standard.

Little Pond: 95 acres - aquatic life uses stressed due to acid sensitivity and potential for Eurasian watermilfoil infestation.

The Lake Champlain Islands

Streams- Lake Champlain Islands

The streams and creeks of the Lake Champlain Islands are small and often associated with wetlands. In Alburg, the two named streams are Mud Creek and Sucker Brook. Mud Creek is often not distinguishable as a creek but it is part of a rich wetland with diverse habitat for much wildlife. Emergent plants, floating plants, alders and other shrubs, frogs, various ducks, and great blue herons have been observed from the road crossings or access points of this creek. The wetland is briefly described below. Sucker Brook is an intermittent stream that flows into Isle La Motte Passage.

North Hero has a stream that is shown as perennial on the USGS map although it too is part of a wetland system and not very distinguishable as a stream where it has been observed. North Hero has a number of intermittent streams and numerous wetlands throughout the town.

South Hero Creek flows north as part of another large wetland complex into Keeler Bay in South Hero. The "creek" where observed is more a stretch of open water with little to no sign of flow and no distinct banks similar to other island creeks and streams. Large, well-tended farm fields east of Lake View Road border the forested land on the western edge of the wetland but it is not clear whether runoff from the fields can get to the wetland system.

Wetlands of the Lake Champlain Islands

The town of Alburg has nine wetland areas that were identified as "priority wetlands" during the Vermont Advanced Wetlands Planning and Protection Project. Priority wetlands are defined as "wetlands with high functional significance and with moderate to high threats of future degradation." The largest of these nine priority wetlands in Alburg, Mud Creek Marsh and Swamp, is a 1500-acre wetland complex that includes softwood and hardwood swamps, shrub swamps, emergent wetlands and shallow open water areas. These wetlands border Mud Creek from its origin in Quebec south to Ransoms Bay. 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, and map turtles among others. Part of this wetland complex is owned by the Vermont Department of Fish and Wildlife as Mud Creek State Waterfowl Area. Three hundred thirty-three acres of this wetland are identified as a lake in Vermont DEC's Lakes and Ponds Inventory database.

The South Alburg Swamp and associated sand beach 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.

Kelly Bay wetland is a 400-acre deep rush marsh wetland with small areas of floodplain also located in Alburg. It has a high plant diversity and is a high quality wetland for waterfowl and furbearers. Bluff Point wetland, which is a 209-acre lakeside emergent marsh, is also an important wetland for waterfowl and fish in Alburg.

The town of Isle La Motte has three wetland communities that were identified during the advanced wetlands planning project. The largest of these at 357 acres is called "The Marsh" and is located just south of Isle la Motte village. This wetland is actually a combination of marsh on its eastern end along Jordan Bay and hardwood swamp on the western side. Some special features of this wetland complex are a population of showy lady's slippers, an uncommon plant otherwise unknown from Grand Isle County, and accumulations of marl in some of the pools also unusual in Grand Isle County wetlands.

There are seven priority wetlands that were identified in the town of North Hero. The largest of the seven is Holiday Point Swamp, which has probably seen the least hydrological disturbance of the forested wetlands on the islands and has an unusual assemblage of plants for a Vermont swamp. This wetland lies along the shore of Allen Bay and has several unnamed streams flowing through it to the Bay.

The town of Grand Isle has eight priority wetlands identified through the advanced planning project. The largest of these wetlands is the 280-acre Pearl Swamp located in the interior of Grand Isle. This forested wetland is important because of its size and diversity. Two other primarily maple-ash swamps are also priority wetlands in town and five of the priority wetlands are marshes bordering the bays on Lake Champlain in Grand Isle.

Six priority wetlands are described for the town of South Hero. The largest is Station Marsh at 290 acres and it is an emergent wetland with small areas of forested wetland at the edges and at the south end. The common moorhen, pied-bill grebe, and sora are all part of this marsh community.

Due to the proximity of numerous Eurasian watermilfoil populations in Lake Champlain, all wetland areas in the Lake Champlain Islands are at risk of infestation.

Lake Champlain Waters by Lake Segment

Burlington Bay

Burlington Bay (2,532 acres) serves as the hub of lake activities for the City of Burlington and surrounding areas. Burlington Bay sees very high use. This includes many thousands of swimmer-days per year at beaches maintained for public use by the City of Burlington, and a very high level of boating and fishing use. From an economic standpoint, Burlington Bay is vitally important to the regional and statewide economy.

The quality of waters in openwater areas, as measured via a wide variety of monitoring efforts, meets Vermont Water Quality Standards, although occasional blooms of algae and cyanobacteria (blue-green algae) can have an impact on uses during short-term episodes in the summer, largely in nearshore areas. Occasional exceedances of the *E. coli* criterion of 77 *E. coli*/100ml at North Beach have resulted in a low number of beach closures (typically one or two days per summer, associated with rain events). Blanchard Beach is subject to a long-term closure. Sediment quality as documented by sediment chemistry analyses is poor and the degree to which this impairs aquatic life uses is unclear and the subject of current study. Burlington Bay and its urban tributaries are subject to research and monitoring projects being carried out by the University of Vermont and by citizens groups. Other problems include fish-tissue contamination (PCBs and mercury) which impairs fish consumption use, and zebra mussel and Eurasian watermilfoil infestations, which alter several uses.

Several efforts are underway to improve the quality of this lake segment by addressing issues both in Burlington and lakewide. 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. Fish tissue contamination by mercury is a national-level problem which is being addressed by implementation of regional and national emissions controls, and locally by reduction and elimination of mercury-bearing products. Control of zebra mussels in this lake segment is impractical given the current state of knowledge concerning these organisms. Other major pollution prevention and remediation strategies already implemented include capping of the Pine Street Barge Canal site and upgrades to the Burlington Main wastewater treatment facility. There are several known stormwater discharges to areas draining directly to Burlington Bay.

Generalized problems pertaining to the entirety of Lake Champlain are being addressed by strategies contained in the Lake Champlain Management Conference's *Opportunities for Action*, the pollution prevention and cleanup plan for Lake Champlain. In aggregate, these actions will reduce nutrient, sediment, and toxic contaminant releases to the lake.

Summary for Burlington Bay:

IMPAIRED ACRES:

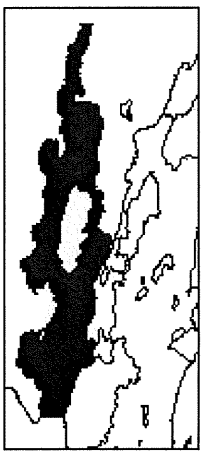
2,532 acres by PCBs in lake trout and mercury in walleye, due to 0 meal consumption advisories for a segment of the population issued by Vermont Department of Health. Fish consumption use impaired.

9 acres by the long-term closure of Blanchard Beach due to violations of the VT *E. coli* criterion. Swimming use impaired.

ALTERED ACRES:
253 acres by zebra mussel infestation, which causes changes to aquatic biota due to benthic colonization and littoral water filtration; reductions in enjoyment of swimming due to the likelihood of being cut by mussels while swimming; and increased costs for public drinking water supply facilities due to maintenance of intake pipes. Aquatic life, swimming, drinking water uses altered.

253 acres due to moderately dense Eurasian milfoil infestation. Aesthetics, aquatic life, secondary contact, and swimming uses altered.

Isle LaMotte



This is a major (26,202-acre) segment of Lake Champlain bordering the State of NY. This segment supports a high degree of boating, swimming, and fishing use. Fish consumption use in this segment is impaired due to elevated concentrations of PCBs in lake trout and mercury in walleye. Aquatic life and swimming uses are impaired on a subset of 5,240 acres (presumed littoral acreage of this largely shallow lake segment) due to zebra mussel infestation and Eurasian watermilfoil. Zebra mussels also alter drinking water use and Eurasian watermilfoil alters secondary contact and aesthetics uses.

Several efforts are underway to improve the quality of this lake segment by addressing these impairments. 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. Fish tissue contamination by mercury is a national-level problem which is being addressed by implementation of regional and national emissions controls, and in Vermont by reduction and elimination of mercury-bearing products. Control of zebra mussels in this lake segment is impractical given the current state of knowledge concerning these organisms.

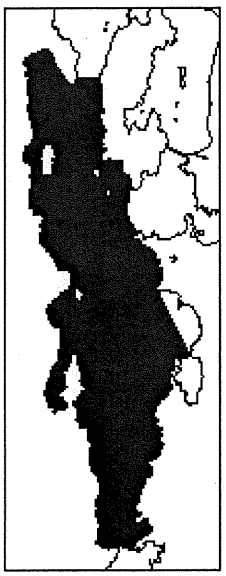
Generalized problems pertaining to the entirety of Lake Champlain are being addressed by strategies contained in the Lake Champlain Management Conference's *Opportunities for Action*, the pollution prevention and cleanup plan for Lake Champlain. In aggregate, these actions will reduce nutrient, sediment, and toxic contaminant releases to the lake.

Summary for Isle LaMotte:
IMPAIRED ACRES: 26,202 acres by PCBs in lake trout and mercury in walleye due to 0 meals consumption advisories for a segment of the population issued by Vermont Department of Health. Fish consumption use impaired.

ALTERED ACRES: 5,240 acres by zebra mussel infestation, which causes changes to aquatic biota due to benthic colonization and littoral water filtration and reductions in enjoyment of swimming due to the likelihood of being cut by mussels while swimming. Aquatic life and swimming uses altered.

STRESSED ACRES: 5,240 acres due to increasing Eurasian milfoil densities, particularly in the northern end of this lake segment. Aesthetics, aquatic life, secondary contact recreation, and swimming uses stressed.

Main Lake



This is the largest segment of Lake Champlain (42,010 acres), which borders the State of NY. This segment supports a high degree of boating, swimming, and fishing uses. Swimming use and aesthetics in this segment are impaired due to elevated phosphorus concentrations based on a long-term record of water quality monitoring. The water quality criterion for this segment is 10 μg/l total phosphorus. The current long-term annual median total phosphorus concentration, based on the Lake Champlain lakewide monitoring program, is 11 μg/l. The current long-term summer mean based on six Lay Monitoring Program stations is 16.3 μg/l total phosphorus. Fish consumption use in this segment is impaired due to elevated concentrations of PCBs in lake trout, and mercury in walleye. Aquatic life and swimming uses are altered on a subset of 4,201 acres (presumed littoral acreage of this deep lake segment) due to zebra mussel and Eurasian watermilfoil infestations Eurasian watermilfoil also alters secondary contact and aesthetic uses. Swimming uses for approximately 200 acres near the mouth of the Winooski River are stressed due to *E. coli* contamination.

Several efforts are underway to improve the quality of this lake segment by addressing these impairments. Elevated phosphorus concentrations are being addressed via the Lake Champlain TMDL for phosphorus. 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. Fish tissue contamination by mercury is a national-level problem which is being addressed by regional and national emissions controls, and in Vermont by reduction and elimination of mercury-bearing products. Control of zebra mussels in this lake segment is impractical given the current state of knowledge concerning these organisms. Control of Eurasian milfoil is partially achievable in localized areas using a variety of management techniques. The extent of the *E. coli* contamination continues to be under evaluation.

Generalized problems pertaining to the entirety of Lake Champlain are being addressed by strategies contained in the Lake Champlain Management Conference's *Opportunities for Action*, the pollution prevention and cleanup plan for Lake Champlain. In aggregate, these actions will reduce nutrient, sediment, and toxic contaminant releases to the lake.

***Summary for the Main Lake*:**
IMPAIRED ACRES:
42,010 acres by elevated phosphorus concentrations in excess of acceptable levels promulgated by the Vermont Water Quality Standards. Swimming and aesthetics uses impaired.

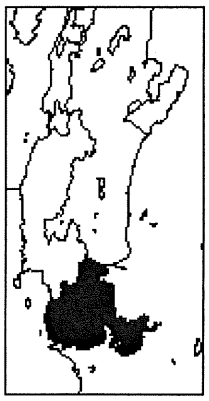
42,010 acres by PCBs in lake trout and mercury in walleye, due to 0 meals consumption advisories for a segment of the population issued by the Vermont Department of Health. Fish consumption use impaired.

ALTERED ACRES:
4201 acres by zebra mussel infestation, which causes changes to aquatic biota due to benthic colonization and littoral water filtration, reductions in enjoyment of swimming due to the likelihood of being cut by mussels while swimming, and increased costs for public drinking water supply facilities. Aquatic life, drinking water, and swimming uses altered.

4,201 acres due to Eurasian milfoil infestations. Aesthetics, aquatic life, secondary contact recreation, and swimming uses altered.

STRESSED ACRES:
200 acres due to exceedances of the Water Quality Standard for *E. coli* at the Winooski River mouth. Swimming use stressed.

Malletts Bay
This 13,388-acre segment of Lake Champlain supports a very high degree of use. Fish consumption use in this segment is impaired due to elevated concentrations of PCBs in lake trout, and mercury in walleye. Aquatic life and swimming uses are altered on a subset of 1,339 acres due to zebra mussel infestation and Eurasian milfoil infestations (Eurasian milfoil also alters secondary contact and aesthetic uses). Zebra mussel infestations alter drinking water uses. Approximately 10 acres at the Bayside Park are stressed for swimming due to *E. coli* contamination.



Several efforts are underway to improve the quality of this lake segment by addressing these impairments. 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. Fish tissue contamination by mercury is a national-level problem which is being addressed by implementation of regional and national emissions controls, and in Vermont by reduction and elimination of mercury-bearing products. Control of zebra mussels in this lake segment is impractical given the current state of knowledge concerning these organisms. Control of Eurasian milfoil is partially achievable in localized areas using a variety of management techniques. The source of the *E. coli* contamination at Bayside Park continues to be under evaluation. In 2001, USEPA sponsored a study to use DNA tracking to identify sources of the *E. coli* bacteria, which found that of the 50% of the bacteria that could be attributed to any source, the majority was of bacteria was derived from avian

sources. It is anticipated that implementation of strategies contained in the Lake Champlain Management Conference's *Opportunities for Action*, the pollution prevention and cleanup plan for Lake Champlain will address this pollution source to a certain extent.

Generalized problems pertaining to the entirety of Lake Champlain are also being addressed by strategies contained in the Lake Champlain Management Conference's *Opportunities for Action*, the pollution prevention and cleanup plan for Lake Champlain. In aggregate, these actions will reduce nutrient, sediment, and toxic contaminant releases to the lake.

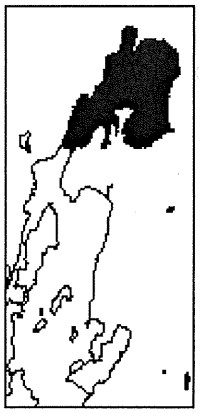
Summary for Malletts Bay:
IMPAIRED ACRES:
13,388 acres by PCBs in lake trout and mercury in walleye, due to limited consumption advisories issued by Vermont Department of Health. Fish consumption use impaired.

ALTERED ACRES:
1,339 acres by zebra mussel infestation, which causes changes to aquatic biota due to benthic colonization and littoral water filtration, reductions in enjoyment of swimming due to the likelihood of being cut by mussels while swimming, and increased costs for public drinking water supply facilities. Aquatic life and swimming uses impaired.

1,339 acres due to Eurasian milfoil infestations. Aesthetics, aquatic life, secondary contact, and swimming uses impaired.

STRESSED ACRES:
Ten acres due to repeating exceedances of the Water Quality Standard for *E. coli*. and subsequent closures at Bayside Park Municipal Beach. Swimming use impaired.

Missisquoi Bay



This 7,998 acre segment of Lake Champlain supports a very high degree of boating and fishing uses. While swimming is known to occur with some frequency, there can be no question that elevated phosphorus and sediment loads from the Pike, Rock, and Missisquoi Rivers impair swimming uses in the Bay. The current long-term annual median total phosphorus concentration, as measured by the Lake Champlain lakewide monitoring program, is 42 μg/l (the criterion is 24 μg/l). The University of Vermont routinely monitors these waters for the presence of cyanotoxins, and blue-green algae blooms, which are detected frequently. Fish consumption use in this segment is impaired due to elevated concentrations of mercury in walleye, based on up-to-date (2000) fish tissue data. Aquatic life and swimming uses are altered on a subset of 1,600 acres due to zebra mussel infestation and to Eurasian milfoil infestations (Eurasian milfoil also impairs secondary contact and aesthetic uses). There is a nearby infestation of water chestnut (*Trapa natans*) in Quebec (South River, tributary to the Richelieu River), and introduction of water chestnut to Missisquoi Bay would have severe impacts to shallow areas where the plant became established.

Several efforts are underway to improve the quality of this lake segment by addressing these impairments. The Lake Champlain phosphorus TMDL and associated VT-Quebec Agreement on Phosphorus establishes target point and non-point load reductions to attain the phosphorus standard in this segment. Cyanobacterial and other algal blooms are anticipated to abate with reductions in phosphorus loading. Fish tissue contamination by mercury is a national-level problem which is being addressed by implementation of regional and national emissions controls, and in Vermont by reduction and elimination of mercury-bearing products. Control of Eurasian milfoil is partially achievable in localized areas using a variety of management techniques.

Generalized problems pertaining to the entirety of Lake Champlain are being addressed by strategies contained in the Lake Champlain Management Conference's *Opportunities for Action*, the pollution prevention and cleanup plan for Lake Champlain. In aggregate, these actions will reduce nutrient, sediment, and toxic contaminant releases to the lake.

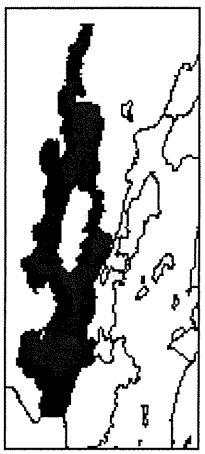
Summary for Missisquoi Bay:
IMPAIRED ACRES:
7,998 acres impaired by elevated phosphorus concentrations in excess of acceptable levels promulgated by the Vermont Water Quality Standards. Excess phosphorus results in severe cyanobacteria and other algae blooms. Swimming and aesthetics uses are impaired.

7998 acres due to mercury in walleye, because of 0 meals consumption advisories for a segment of the population issued by Vermont Department of Health. Fish consumption use impaired.

ALTERED ACRES:
1600 acres by zebra mussel infestation, which causes changes to aquatic biota due to benthic colonization and littoral water filtration, and reductions in enjoyment of swimming due to the likelihood of being cut by mussels while swimming. Aquatic life and swimming uses altered.

1,600 acres due to Eurasian milfoil infestations. Aesthetics, aquatic life, secondary contact, and swimming uses altered. These acres are also stressed due to the potential for introduction of water chestnut.

Northeast Arm
This is a major (58,184 acre) segment of Lake. Swimming use and aesthetics in this segment are impaired due to elevated phosphorus concentrations based on a long-term record of water quality monitoring. The water quality criterion for this segment is 14 μg/l total phosphorus. The current long-term annual phosphorus median measured by the Lake Champlain lakewide monitoring program is 15 μg/l. The current long-term summer mean based on six Lay Monitoring Program stations is 21.9 μg/l. This latter value mean includes stations from several embayments of higher trophic status than the large openwater sections of the Northeast Arm. The Carry and Pelot's Bay regions of the Alburg Passage are two such



examples, which have poor water quality as evidenced by State and citizen monitoring efforts and hydrodynamic studies. Fish consumption use in this segment is impaired due to elevated concentrations of PCBs in lake trout and mercury in walleye. Aquatic life and swimming uses are altered on a subset of 1,162 acres due to Eurasian milfoil and zebra mussel infestation. Six acres are stressed for swimming in the vicinity of Knight Point, Grand Isle, due to occasional exceedances of Vermont's *E. coli* criterion and ensuing beach closures.

Several efforts are underway to improve the quality of this lake segment by addressing these impairments. Elevated phosphorus concentrations are being addressed via the Lake Champlain TMDL for phosphorus. 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. Fish tissue contamination by mercury is a national-level problem which is being addressed by implementation of regional and national emissions controls, and locally by reduction and elimination of mercury-bearing products. Control of zebra mussels in this lake segment is impractical given the current state of knowledge concerning these organisms. Control of Eurasian milfoil is partially achievable in localized areas using a variety of management techniques.

Generalized problems pertaining to the entirety of Lake Champlain are being addressed by strategies contained in the Lake Champlain Management Conference's *Opportunities for Action*, the pollution prevention and cleanup plan for Lake Champlain. In aggregate, these actions will reduce nutrient, sediment, and toxic contaminant releases to the lake.

Summary for the Northeast Arm:
IMPAIRED ACRES:
58,184 acres due to mean phosphorus concentration which exceeds criterion in VT Water Quality Standards - aesthetics and swimming uses impaired.

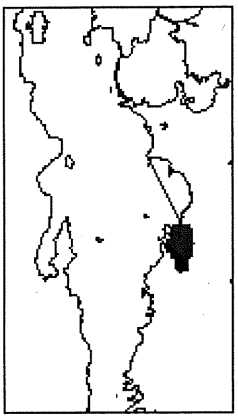
58,184 acres by PCBs in lake trout and Hg in walleye, due to 0 meals consumption advisories for a segment of the population issued by Vermont Department of Health. Fish consumption use impaired.

ALTERED ACRES:
1,162 acres due to increasing Eurasian milfoil densities, particularly in the northern end of this lake segment. Aesthetics, aquatic life, secondary contact, and swimming uses altered.

STRESSED ACRES:
1,162 acres by potentially increasing zebra mussel infestation, which causes changes to aquatic biota due to benthic colonization and littoral water filtration, reductions in enjoyment of swimming due to the likelihood of being cut by mussels while swimming, and increased costs for public drinking water supply facilities. Aquatic life, drinking water, and swimming uses stressed.

6 acres due to exceedances of the Water Quality Standard for *E. coli* and subsequent closures at Knight Point State Park. Swimming use stressed.

Shelburne Bay



This 2,249-acre embayment of Lake Champlain supports a high degree of boating, swimming, and fishing use. Swimming use and aesthetics in this segment are impaired due to elevated phosphorus concentrations based on a long-term record of water quality monitoring. The water quality criterion for total phosphorus for this segment is 14 μg/l. The current two-year annual total phosphorus median based on the Lake Champlain lakewide monitoring program is 11 μg/l. The current long-term summer mean based on one Lay Monitoring Program station is 18 μg/l total phosphorus. Fish consumption use in this segment is impaired due to elevated concentrations of PCBs in lake trout and mercury in walleye. Aquatic life and swimming uses are altered on a subset of 448 acres due to Eurasian milfoil and zebra mussel infestation. Six acres are stressed for swimming in the vicinity of Red Rocks Park, due to exceedances of Vermont's *E. coli* criterion and ensuing beach closures.

Several efforts are underway to improve the quality of this lake segment by addressing these impairments. Elevated phosphorus concentrations are being addressed via the Lake Champlain TMDL for phosphorus. Fish tissue contamination due to PCBs is being addressed by remediation 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. Fish tissue contamination by mercury is a national-level problem which is being addressed by implementation of regional and national emissions controls, and locally by reduction and elimination of mercury-bearing products. Control of zebra mussels in this lake segment is impractical given the current state of knowledge concerning these organisms. Control of Eurasian milfoil is partially achievable in localized areas using a variety of management techniques.

E. coli contamination is attributable to wildlife sources in the East Woods area of the Potash Brook watershed, as well as stormwater discharges to Potash Brook. The City of South Burlington has developed a Watershed Improvement Plan for Potash Brook. A new citizen group has joined with the Champlain Water District to monitor water quality in tributaries to Shelburne Bay.

Generalized problems pertaining to the entirety of Lake Champlain are being addressed by strategies contained in the Lake Champlain Management Conference's *Opportunities for Action*, the pollution prevention and cleanup plan for Lake Champlain. In aggregate, these actions will reduce nutrient, sediment, and toxic contaminant releases to the lake.

Summary:

IMPAIRED ACRES:

2,249 acres due to mean total phosphorus concentration which exceeds criterion in VT Water Quality Standards. Aesthetics and swimming uses impaired.

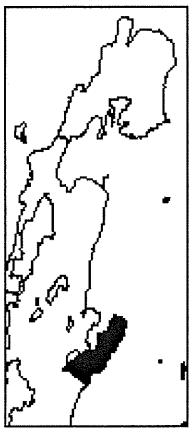
2,249 acres by PCBs in lake trout and mercury in walleye, due to 0 meals consumption advisories for a segment of the population issued by Vermont Department of Health. Fish consumption use impaired.

448 acres by zebra mussel infestation which causes changes to aquatic biota due to benthic colonization and littoral water filtration; reductions in enjoyment of swimming due to the likelihood of being cut by mussels while swimming; and increased costs for public drinking water supply facilities due to maintenance of intake pipes. Aquatic life, drinking water, and swimming uses altered.

448 acres due to Eurasian milfoil infestation. Aesthetics, aquatic life, secondary contact, and swimming uses altered.

STRESSED ACRES:
6 acres due to occasional exceedances of the Water Quality Standard for *E. coli* and subsequent closures at Red Rocks Park. Swimming use stressed.

St. Albans Bay



This 2,499-acre embayment of Lake Champlain is wholly contained within Vermont. This segment supports a high degree of boating and fishing use. Swimming use and aesthetics in this segment are impaired due to elevated phosphorus concentrations and associated algal blooms. The water quality criterion for this segment is 17 μg/l. The long-term median annual total phosphorus concentration measured by the Lake Champlain lakewide monitoring program is 24 μg/l. The current long-term summer mean based on one Lay Monitoring Program station is 37 μg/l. A significant increasing trend in phosphorus concentrations has been detected by both monitoring programs. Fish consumption use in this segment is impaired due to elevated concentrations of mercury in walleye. Several uses are altered due to Eurasian milfoil, and the potential for increases in zebra mussel infestation densities also stress these uses. Complaints regarding water quality in this segment of the lake are common.

Several efforts are underway to improve the quality of this lake segment by addressing these impairments. A Watershed Plan for the Stevens and Rugg Brooks has been developed by the City of St. Albans and the Northwest Regional Planning Commission. Elevated phosphorus concentrations are being addressed via the Lake Champlain TMDL for phosphorus. A new volunteer-based watershed group, in cooperation with VTDEC and the University of Vermont, is carrying out a water quality monitoring program for tributaries to the bay, with the goal of developing a new model describing nutrient loadings associated with various land-use categories. The University of Vermont also routinely monitors St. Albans Bay for the presence of cyanotoxins. Tissue contamination by mercury is a national-level problem which is being addressed by implementation of regional and national emissions controls, and locally by reduction and elimination of mercury-bearing products. Control of zebra mussels in this lake segment is impractical given the current state of knowledge concerning these organisms. Control of Eurasian milfoil is partially achievable in localized areas using a variety of management techniques, and local citizens are investigating suitable approaches for the Bay.

Summary for St. Albans Bay:

IMPAIRED ACRES: 2,499 acres due to mean phosphorus concentration which exceeds criterion in VT Water Quality Standards - aesthetics and swimming uses impaired.

2,499 acres by Hg in walleye, due to 0 meal consumption advisories for a segment of the population issued by Vermont Department of Health. Fish consumption use impaired.

ALTERED ACRES: 500 acres due to Eurasian milfoil densities. Aesthetics, aquatic life, secondary contact, and swimming uses altered.

STRESSED ACRES: 500 acres by zebra mussel infestation, which threatens changes to aquatic biota due to benthic colonization and littoral water filtration and reductions in enjoyment of swimming due to the likelihood of being cut by mussels while swimming. Aquatic life and swimming uses stressed.

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5) Long-Term Water Quality and Biological Monitoring Project for Lake Champlain: Cummulative Report of Project Years 1992 – 2002, February 2003. Vermont Department of Environmental Coinservation, Water Quality Division, Waterbury, VT and the New York State Department of Environmental Conservation Region 5, Ray Brook, NY.

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8) State of Vermont Year 2002 List of Waters: Part A - List of Impaired Surface Waters, July 2002. Prepared for EPA by Vermont Department of Environmental Conservation Water Quality Division, Waterbury, VT.

9) Urban Nonpoint Pollution Source Assessment of the Greater Burlington Area, December 1997. James Pease, Vermont Department of Environmental Conservation for the Lake Champlain Basin Program

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11) Vermont Advanced Wetlands Planning and Protection Project Report: Lake Champlain Basin, 1997. Vermont Agency of Natural Resources, Department of Environmental Conservation.

12) Waterfalls, Cascades and Gorges of Vermont, 1985. Jerry Jenkins & Peter Zika for the Vermont Department of Environmental Conservation and Department of Forests, Parks and Recreation.

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Appendix A: Macroinvertebrate & Fish Stream Sampling Sites in Basin 5

Table A.1. Macroinvertebrate River Sample Sites in Basin 5 for 1993 - 2002

WBID	River/stream	Town	Date	Rivermile	Assessment
VT05-01	Rock River	Highgate	9/27/1999	7.9	poor
VT05-01	Rock River	Highgate	10/11/2000	7.9	poor
VT05-01	Rock River	Highgate	9/29/1999	9.4	poor
VT05-01	Rock River	Franklin	9/29/1999	14.8	fair
VT05-01	Rock River	Franklin	10/11/2000	14.8	fair
VT05-01	Rock River	Franklin	9/29/1999	19.0	good-vg
VT05-01	Saxe Brook	Highgate	10/21/1999	0.4	fair
VT05-02	Pike River	Berkshire	9/27/1999	2.0	good
VT05-07	Stevens Brook	St. Albans Town	10/18/1993	4.2	fair
VT05-07	Stevens Brook	St. Albans Town	10/20/1998	4.2	fair
VT05-07	Stevens Brook	St. Albans City	10/20/1998	9.0	fair-poor
VT05-07	Mill River	Georgia	10/20/1998	0.7	good
VT05-07	Mill River	Georgia	10/21/1999	0.7	fair
VT05-07	Mill River	Georgia	10/15/2002	0.7	fair
VT05-07	Mill River	Georgia	10/15/2002	8.7	good
VT05-07	Rugg Brook	Georgia	10/21/1999	0.5	fair
VT05-07	Rugg Brook	St. Albans City	10/15/2002	4.4	poor
VT05-08	Stone Bridge Brook	Milton	10/8/1997	0.2	fair
VT05-08	Stone Bridge Brook	Milton	10/12/1999	0.2	good
VT05-09	Indian Brook	Essex	10/12/1999	5.8	fair
VT05-09	Indian Brook	Essex	9/30/1993	8.5	poor
VT05-09	Indian Brook	Essex	10/08/2002	8.5	fair-poor
VT05-09	Indian Brook	Essex	10/08/2002	9.0	good-fair
VT05-09	Indian Brook	Essex	10/12/1995	9.5	excellent
VT05-09	Indian Brook	Essex	10/1/1996	9.5	fair-good

VT05-09	Indian Brook	Essex	10/08/2002	9.5	fair
VT05-09	Indian Brook	Essex	9/30/1993	9.8	poor
VT05-09	Allen Brook	Colchester	10/20/1998	1.3	
VT05-09	Malletts Creek	Colchester	10/12/1999	2.4	very good
VT05-09	Pond Brook	Colchester	10/12/1999	1.4	fair
VT05-09	Pond Brook	Colchester	10/12/1999	1.5	fair
VT05-10	Englesby Brook	Burlington	10/28/1994	0.6	poor
VT05-10	Englesby Brook	Burlington	10/12/1995	0.6	poor
VT05-10	Englesby Brook	Burlington	10/1/1996	0.6	poor
VT05-10	Englesby Brook	Burlington	9/22/1997	0.6	poor
VT05-10	Englesby Brook	Burlington	9/30/1993	1.3	poor
VT05-10	Englesby Brook	Burlington	10/20/1998	1.3	poor
VT05-11	Potash Brook	South Burlington	9/30/1993	0.7	poor
VT05-11	Potash Brook	South Burlington	10/10/2001	0.7	poor
VT05-11	Potash Brook	South Burlington	9/30/1993	1.0	fair-poor
VT05-11	Potash Brook	South Burlington	10/5/2001	1.0	poor
VT05-11	Potash Brook	South Burlington	10/13/1994	1.8	good
VT05-11	Potash Brook	South Burlington	9/22/1997	1.8	fair
VT05-11	Potash Brook-trib3	South Burlington	10/13/1994	0.3	poor
VT05-11	Potash Brook-trib 7	South Burlington	10/13/1994	0.1	fair
VT05-11	Bartlett Brook	South Burlington	9/30/1993	0.2	poor
VT05-11	Bartlett Brook	South Burlington	10/12/1999	0.2	poor
VT05-11	Bartlett Brook	South Burlington	10/13/1994	0.7	poor
VT05-11	LaPlatte River	Charlotte	10/20/1998	5.8	v. good
VT05-11	Munroe Brook	Shelburne	10/12/1999	0.4	poor
VT05-11	Munroe Brook	Shelburne	10/10/2002	2.8	fair
VT05-11	Munroe Brook North Tributary	Shelburne	10/10/2002	0.8	fair-poor

Table A.2. Fish Stream Sample Sites in Basin 5 for 1993 - 2002

WBID	River/Stream	Date	Rivermile	Assessment
VT05-01	Rock River	8/5/2002	5.9	fair
VT05-02	Marsh Brook	9/29/1999	0.4	poor
VT05-04	Potash Brook	10/17/2001	1.9	good
VT05-07	Rugg Brook	10/6/1999	4.3	poor
VT05-07	Rugg Brook	10/4/2000	4.3	poor
VT05-07	Stevens Brook	10/14/1993	3.2	poor
VT05-07	Stevens Brook	10/6/1999	4.2	poor
VT05-07	Stevens Brook	10/1/2003	4.7	poor
VT05-07	Stevens Brook	10/1/2003	6.6	poor
VT05-07	Mill River	10/22/1998	0.7	poor
VT05-07	Mill River	8/6/2002	8.7	poor
VT05-08	Stone Bridge Brook	10/8/1997	0.2	very good
VT05-09	Indian Brook	10/14/2003	3.1	fair
VT05-09	Indian Brook	9/30/1993	5.8	good
VT05-09	Indian Brook	9/23/1994	5.8	fair
VT05-09	Indian Brook	10/13/1999	5.8	good
VT05-09	Indian Brook	10/2/2003	5.8	fair
VT05-09	Indian Brook	7/17/1996	8.5	very good
VT05-09	Indian Brook	10/8/2002	8.5	good
VT05-09	Indian Brook	10/12/1995	9.5	fair
VT05-09	Indian Brook	10/8/2002	9.5	good
VT05-09	Malletts Creek	10/7/1999	3.5	poor
VT05-10	Englesby Brook	6/10/1994	0.1	very good
VT05-10	Engelsby Brook	8/26/1998	0.1	very good
VT05-10	Englesby Brook	9/30/2002	0.5	poor
VT05-10	Englesby Brook	6/10/1994	0.6	poor
VT05-10	Englesby Brook	9/10/1998	0.6	poor
VT05-11	Bartlett Brook	9/13/1993	0.2	good
VT05-11	Bartlett Brook	8/29/1994	0.2	fair
VT05-11	Bartlett Brook	8/14/1995	0.2	good
VT05-11	Bartlett Brook	9/20/2001	0.2	fair
VT05-11	Bartlett Brook	10/9/2003	0.2	poor
VT05-11	Bartlett Brook	9/30/2002	0.3	fair
VT05-11	Bartlett Brook	10/12/1995	0.4	poor
VT05-11	Bartlett Brook	9/30/2002	0.4	fair
VT05-11	Bartlett Brook	10/9/2003	0.4	poor
VT05-11	Potash Brook	10/17/2001	0.7	good
VT05-11	Potash Brook	10/9/2003	0.7	good
VT05-11	Potash Brook	9/24/1993	1.0	good
VT05-11	Potash Brook	8/26/1994	1.3	good
VT05-11	Potash Brook	10/9/2003	1.8	good
VT05-11	Potash Brook-Trib 3	8/24/1994	0.3	poor
VT05-11	Munroe Brook	10/15/1999	0.4	poor
VT05-11	LaPlatte River	7/26/1995	5.8	excellent

Appendix B: Population and Housing Unit Growth in Basin 5

Table B.1. Population and Population Growth in Basin 5 Towns

Town	1970 Pop	1980 Pop	1990 Pop	2000 Pop	1970-1980	1980 - 1990	1990 - 2000
Hinesburg	1775	2690	3780	4340	52%	41%	15%
Charlotte	1802	2561	3148	3569	42%	23%	13%
Shelburne	3728	5000	5871	6944	34%	17%	18%
Essex	10,951	14,392	16,498	18,626	31%	15%	13%
Burlington	38,633	37,712	39,127	39,824	- 2%	4%	2%
So Burlington	10,032	10,679	12,809	14,879	6%	20%	16%
Colchester	8776	12,629	14,731	16,986	44%	17%	15%
Milton	4495	6829	8404	9479	52%	23%	13%
Georgia	1711	2818	3753	4375	65%	33%	17%
St. Albans City	8082	7308	7339	7650	-10%	4%	4%
St. Albans Town	3270	3555	4606	5324	9%	30%	16%
Swanton	4622	5141	5636	6203	11%	10%	10%
Highgate	1936	2493	3020	3397	29%	21%	12%
Franklin	821	1006	1068	1268	23%	6%	19%
Berkshire	931	1116	1190	1388	20%	7%	17%
Alburg	1271	1352	1362	1952	6%	1%	43%
Isle La Motte	262	393	408	488	50%	4%	20%
North Hero	364	442	502	810	21%	14%	61%
Grand Isle	809	1238	1642	1955	53%	33%	19%
South Hero	868	1188	1404	1696	37%	18%	21%

Table B.2. Housing Units and Housing Unit Growth in Basin 5 Towns

Town	H.U.s 1970	H.U.s 1980	H.U.s 1990	H.U.s 2000	H.U.s 1970-80	H.U.s 1980-90	H.U.s 1990-2000
Hinesburg	610	1025	1487	1693	68%	45%	14%
Charlotte	714	1043	1329	1500	46%	27%	13%
Shelburne	1122	1719	2350	2741	53%	37%	17%
Essex	3053	4826	6310	7170	58%	31%	14%
Burlington	12,025	13,763	15,480	16,398	14%	12%	6%
So Burlington	2879	3972	5437	6496	38%	37%	19%
Colchester	3088	4566	5922	6727	48%	30%	14%
Milton	1412	2321	3009	3505	64%	30%	16%
Georgia	638	1053	1397	1654	65%	33%	18%
St. Albans City	2809	3077	3241	3376	10%	5%	4%
St. Albans Town	1319	1662	2115	2257	26%	27%	7%
Swanton	1674	2167	2423	2689	29%	12%	11%
Highgate	748	926	1247	1375	24%	35%	10%
Franklin	497	627	677	736	26%	8%	9%
Berkshire	296	419	474	550	42%	13%	16%
Alburg	743	943	1086	1259	27%	15%	16%
Isle La Motte	239	324	371	415	36%	15%	12%
North Hero	607	734	743	906	21%	1%	22%
Grand Isle	458	723	977	1047	58%	35%	7%
South Hero	571	832	958	1036	46%	15%	8%

Appendix C: Stormwater Discharges in Basin 5

Table C1: Stormwater Discharges in Shelburne Bay Watershed: LaPlatte River and Tribs

Permit #	Permittee	# Dschgs	Receiving Water
3034-9010	Giroux Brothers Subdivision	2	Patrick Brook
3281-9010	Lyman Meadows Condominiums	1	Patrick Brook
3203-9010	Gardenside Townhouse Association	2	Trib LaPlatte River
1-0717	Bay Colony Estates	1	LaPlatte River
1-0722	Peter Holmberg	1	Mud Hollow Brook
1-0852	Rice Lumber Co	2	LaPlatte River
1-0905	Northern Vermont Financial Corp	3	LaPlatte River
1-0984	J & H Sheehan	2	Trib Mud Hollow Brook
1-0985	Peter Holmberg	4	McCabes Brook
1-1057	Natures Way Real Estate Trust	1	Trib LaPlatte River
1-1079	Hinesburg Elementary School	1	LaPlatte River
1-1161	Chittenden South Supervisory District	1	McCabes Brook
1-1291	Vt Agency of Transportation	3	LaPlatte River
1-1579	Shelburne Family Housing	2	LaPlatte R & McCabes
2-1149	Retrovest Associates Inc	2	Trib LaPlatte River
2-1173	D & M Wade	1	LaPlatte River

Table C2: Stormwater Discharges in Shelburne Bay Watershed: Munroe Brook

Permit #	Permittee	# Dschgs	Receiving Water
1-0732	Green Mountain Development Group	5	Munroe Brook
1-0779	Charles Hubgard	3	Munroe Brook
1-0852	Rice Lumber Co	1	Munroe Brook
1-1291	Vt Agency of Transportation	6	Munroe Brook
1-1390	Jack Dubrul	1	Trib Munroe Brook
1-1400	Pizzagalli Properties LLC	2	Trib Munroe Brook
1-1534	Sterling Construction, Boulder Hill	5	Munroe Brook

Table C3: Stormwater Discharges in Shelburne Bay Watershed: Bartlett Brook

Permit #	Permittee	# Dschgs	Receiving Water
1-0492	Heritage Automotive Group	2	North Brook
1-0512	IDX Systems Corporation	1	Trib Bartlett Brook
1-0523	C & C Enterprise	1	Bartlett Brook
1-0665	Harbor View Community Care Ctr	4	Bartlett Brook
1-0734	Champ Car Care Center	2	South Fork Bartlett Brook
1-0818	Green Mtn Power Corp	1	North Brook
1-0853	Advanced Animations	1	Bartlett Brook
1-0935	Dennis Blodgett	1	North Brook
1-1134	Richard A Knight Sr	1	South Fork Bartlett Brook
1-1155	L & M Partnership	2	Trib Bartlett Brook

1-1220	John Larkin	1	Bartlett Brook
1-1291	VT Agency of Transportation	4	Bartlett Brook
1-1372	Lark Inns Inc	1	Bartlett Brook
1-1404	John Larkin	2	Bartlett Brook
1-1502	Shearer Chevrolet Inc	1	Bartlett Brook

Table C.4. Stormwater Discharges in Shelburne Bay Watershed: Potash Brook

Permit No.	Permittee	# Dschgs	Receiving Water
2-0167	Morvan, Morvan & Merek	1	Potash Brook
2-0228	Vt Gas System Inc	3	Trib Potash Brook
2-0619	City of South Burlington	1	Potash Brook
2-0619	City of South Burlington	3	Trib Potash Brook
2-0940	The Lane Press	1	Trib Potash Brook
1-0242	Veve Associates	1	Potash Brook
1-0464	LDB Inc.	8	Trib Potash Brook
1-0471	Osgood & Hart	1	Potash Brook
1-0503	University Mall Realty Trust	5	Trib Potash Brook
1-0526	Palco Ltd	2	Potash Brook
1-0538	Pomerleau Real Estate Corp	4	Trib Potash Brook
1-0618	Orchard Lake Rd Properties	3	Potash Brook
1-0647	Southsett Partnership	3	Trib Potash Brook
1-0661	South Meadows Housing Assoc	1	Potash Brook
1-0969	So Burlington Insurance Partshp	1	Potash Brook
1-0998	Wright & Morissey Inc	1	Potash Brook
1-1000	Adelphia Cable Communications	1	Potash Brook
1-1013	CPA Partnership	1	Potash Brook
1-1015	John Larkin	1	Potash Brook
1-1020	Palmer & Myers	1	Potash Brook
1-1033	City of South Burlington	3	Potash Brook
1-1117	Dorset Land Co	2	Trib Potash Brook
1-1155	L & M Partnership	1	Trib Potash Brook
1-1214	Hannaford Brothers Co	2	Potash Brook
1-1241	Jam Golf LLC	3	Trib Potash Brook
1-1254	Technology Park Associates	1	Potash Brook
1-1269	Summer Ice Joint Venture	4	Potash Brook
1-1270	City of Burlington	2	Trib Potash Brook
1-1290	CPA Partnership	2	Potash Brook
1-1337	The Lane Press Inc	3	Potash Brook wetlands
1-1438	David M. Farrell	1	Potash Brook
1-1452	Wright/Morrissey Realty Corp	1	Potash Brook
1-1520	O'Brien Home Farm	3	Potash Brook
1-1582	City of South Burlington - Kennedy Dr	14	Potash Brook

Table C5: Stormwater Discharges in Malletts Bay Watershed

Permit #	Permittee	# Dschgs	Receiving Water
2-0269	New England Development Assoc	1	Indian Brook
1-0480	So. Burlington Realty Co	1	Indian Brook
1-0771	Champlain Valley Exposition Inc	2	Indian Brook
1-0756	Sheppard Construction	1	Trib Indian Brook
1-0787	Cynosure Inc	1	Allen Brook
1-0809	D & L Demers	2	Trib Pond Brook
1-0906	Bean Family Restaurant	1	Trib Malletts Creek
1-0911	Milton Centre	1	Trib Malletts Creek
1-1036	Rodney Reynolds	2	Allen Brook
1-1039	Hauke Building Supply Inc	4	Trib Malletts Creek
1-1186	Woodlands II LTD Partnership	2	Trib Indian Brook
1-1278	VT Agency of Administration	1	Trib Allen Brook
1-1319	Church of Latter Day Saints	2	Indian Brook
1-1339	Chimney Corners Corp	3	Allen Brook
1-1346	The Miller Group	1	Trib Indian Brook
1-1371	Links@Lang Farm LLC	1	Trib Indian Brook
1-1381	Retrovest Associates Inc	2	Trib Indian Brook
1-1427	Sheppard, Brogna, Gardner	3	Trib Indian Brook
1-1409	Champlain Valley Expostion	1	Indian Brook
1-1530	Demers Industrial Park	5	Trib Pond Brook

Table C6: Stormwater Discharges in St. Albans Bay Watershed: Rugg Brook

Permit #	Permittee	# Dschgs	Receiving Water
1-0977	Ben & Jerry's Manufacturing Plant	3	Trib Rugg Brook
1-0438	Bourbeau and Lebel	2	Trib Rugg Brook
1-0577	CC Construction	1	Rugg Brook
1-0691	Donald Merchant	1	Rugg Brook
1-0795	K,W. St. Albans LP	1	Rugg Brook
1-0908	Northwestern Developers	1	Rugg Brook
1-0930	Church of the Rock	2	Rugg Brook
1-1011	Lapierre	2	Rugg Brook
1-1268	Franklin County Industrial Dev	1	Rugg Brook
1-1322	Franklin County Industrial Dev	1	Trib Rugg Brook
1-1349	Earlyn Church	1	Rugg Brook
1-1408	Pizzagalli Properties LLC	1	Rugg Brook
1-1428	Ingleside Equity Group	1	Trib Rugg Brook
1-1442	Ingleside Equity Group	1	Trib Rugg Brook
1-1563	Pineview Estates	1	Trib Rugg Brook
2-1168	Scanlon	2	Rugg Brook

Table C7: Stormwater Discharges in St. Albans Bay Watershed: Stevens Brook

Permit #	Permittee	# Dschgs	Receiving Water
1-0484	Montcalm	3	Trib Stevens Brook
1-0506	Mahoney & Desranleau	1	Stevens Brook
1-0671	Poquette Construction	1	Stevens Brook
1-0681	Northwestern Medical Center	2	Stevens Brook
1-0702	City of St. Albans	1	Stevens Brook
1-0952	Meadow Crossing Subdivision	2	Stevens Brook
1-1065	V & A Rich	1	Stevens Brook
1-1105	Franklin Park West	2	Trib Stevens Brook
1-1140	Northwest Medical Center	1	Stevens Brook
1-1159	WalMart Stores	1	Stevens Brook
1-1185	Ruth Hungerford Trust	1	Stevens Brook
1-1194	Grice Brook Development Corp	2	Grice Brook
1-1199	Petro-Canada USA	1	Trib Stevens Brook
1-1206	St. Albans School District	1	Stevens Brook
1-1264	James Warner	1	Stevens Brook
1-1434	Mark Lareau	1	Stevens Brook
1-1465	Philip Gerbode	1	Trib Stevens Brook
1-1477	Northwestern Medical Center	2	Stevens Brook

* The stormwater permits in these tables are from the former stormwater database and are not up-to-date. The tables will be updated as time allows and so noted in this appendix.

Appendix D: Dams in Basin 5

Table D.1. Dams in Basin 5

Dam Name and ID #	Stream	Town	Status	Use *	Built	Re-con+
Charlotte-1 (46.01)	Holmes Creek	Charlotte	Unknown			
Lake Iroquois (97.01)	Patrick Brook	Hinesburg	In service	OR	1870	
Lower Pond (97.02)	Patrick Brook	Hinesburg	In service	OR	1867	
Iroquois Mfg Mill Pond (Upper) (97.03)	Patrick Brook	Hinesburg	Unknown			
Cemetary Pond (97.04)	Patrick Brook	Hinesburg	Unknown			
Iroquois Mfg Mill Pond (Lower) (97.08)	Patrick Brook	Hinesburg	Unknown			
Hinesburg-9 (97.09)	Patrick Brook	Hinesburg	Unknown			
Twitchell (97.05)	LaPlatte R. trib	Hinesburg	Unknown			
Colchester Pond (51.01)	Pond Brook	Colchester	In service	R	1965	
Milton Pond (128.04)	Malletts Creek trib	Milton	In service	S	1900	1963
Mill Pond (51.02)	Indian Brook	Colchester	Not in use	R	1900	
Indian Brook Reservoir (69.01)	Indian Brook	Essex	In service	R	1957	
Stone Bridge Pond (79.01)	Stone Bridge Brook	Georgia	Unknown			
St. Albans North Reservoir (70.01)	Mill River	Fairfax	In service	S	1895	1995
St. Albans South Reservoir (70.02)	Mill River	Fairfax	In service	S	1910	
Lake Carmi (78.01)	Pike River trib	Franklin	In service	R	1970	
West Berkshire (19.01)	Pike River	Berkshire	Breached			
Bullis Pond (78.02)	Rock River	Franklin	Not in use	O	1843	
Mud Creek (3.01)	Mud Creek	Alburg	In service	R	1957	
Lynch (144.01)	Abenaki Bay trib	North Hero	Unknown		1969	

*H = hydroelectric, R = recreation, C = flood control, S= water supply, O = other

+ date re-constructed