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Monitoring and Evaluation of Cyanobacteria in Lake Champlain

Summer 2003

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MONITORING AND EVALUATION OF CYANOBACTERIA IN LAKE CHAMPLAIN

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Report to

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EXECUTIVE SUMMARY

In 2003, monitoring for potential toxin-producing cyanobacteria continued on Lake Champlain with the following specific objectives:

- Continue monitoring cyanobacteria in the greater Burlington area and at the Long-Term Water Quality and Biological Monitoring Project sites. If possible, expand monitoring for cyanobacteria to several sites routinely sampled by the Vermont Lay Monitoring program.
- Monitor selected sites on Missisquoi Bay, in coordination with the Province of Quebec.
- Continue screening for the presence of toxins when potential toxin-producing species are observed in plankton samples.
- Continue to refine and test a tiered cyanobacteria monitoring and public alert system framework, incorporating data and knowledge gained during 2002.
- Develop a coordinated communication network among state and provincial agencies in Vermont, New York and Quebec to facilitate the exchange of information about current BGA conditions and the potential for human exposure to toxins, and to develop a lakewide standard for reporting this information.

Collections of net and whole water plankton began in June in most locations, and continued through October. Sample sites encompassed all of Lake Champlain, but a special effort was made in Missisquoi Bay and St. Albans Bay, areas known to have problems with toxic blooms in the past. Lay monitors in the Vermont Lay Monitoring Program and volunteers living around Missisquoi Bay were recruited to collect samples in shoreline locations where algae accumulated.

In 2003, potential toxin-producing cyanobacteria species remained a common part of Lake Champlain's plankton. As in the past two years, highest abundances were found in Missisquoi Bay and St. Albans Bay, where total phosphorus and total nitrogen concentrations were also highest. In 2003, anatoxin-a was detectable only on one date in mid-August, when trace levels were measured in one sample from Missisquoi Bay and one sample from St. Albans Bay. Microcystins were common in samples collected from both bays from July through October 2003, but concentrations exceeding the World Health Organization guideline of 1µg/L were only seen in Missisquoi Bay. These high concentrations were found in shoreline algal accumulations sampled in mid-August.

Our prototype monitoring and alert framework worked well to focus toxin analyses in those areas where dense populations of potential toxin-producing species of cyanobacteria were present. As in past years, there was a high degree of spatial variability in toxin concentrations, and all high toxin concentrations were found in dense surface accumulations of algae or in scums. The lay monitors were particularly valuable in extending our sampling effort to include these shoreline problem areas.

The rapid development of the bloom in Missisquoi Bay again in 2003 reinforced the need for frequent interagency communication. Although the e-mail notification system worked well, there remains a significant amount of confusion about risk areas and the extent of the hazard when a bloom develops.

INTRODUCTION

In 1999, cyanobacteria, also known as blue-green algae (BGA), bloomed in parts of Lake Champlain and may have produced toxins potentially harmful to human health. During the summer of 2000, a collaborative effort involving the University of Vermont (UVM), the NRCS Watershed Science Institute, the Vermont Department of Health (VT DOH), the Vermont Department of Environmental Conservation (VT DEC), SUNY-ESF in Syracuse (SUNY), Wright State University, the Florida Department of Health and the Maine Department of Marine Resources documented the regular presence of toxin-producing blue-green algae in lake, as well as trace amounts of cyanotoxin on several occasions.

In the summer of 2001, UVM, VT DOH and SUNY continued the collaborative effort, concentrating on the larger Burlington Bay area. Plankton communities in the vicinity of two drinking water facilities (the Champlain Water District and the Burlington Municipal Water Treatment Plant) and two public beaches (North Beach in Burlington and Red Rocks Beach in South Burlington) were monitored over the growing season. While BGA were noted in the study area during 2001, and toxins were detected in concentrated plankton samples; environmental conditions in Burlington Bay did not support extensive blooms. Such blooms occurred in other areas of Lake Champlain, including Missisquoi Bay, St. Albans Bay, and the Inland Sea. Although the potential for human exposure to toxins may be greater in the Burlington Bay area because of the large municipal water systems and the beaches, the environmental conditions are not currently conducive to massive blooms that could release large amounts of toxins into the water.

In 2002, monitoring continued in the Burlington area, and was expanded to include the 12 stations routinely sampled as part of the Vermont and New York Long-Term Water Quality and Biological Monitoring program, as well as several locations in St. Albans Bay and selected samples from Missisquoi Bay. A tiered alert system prototype was tested during the summer. Burlington Bay again had low densities of BGA in 2002, while St. Albans Bay and especially Missisquoi Bay had high densities of BGA by mid-July.

In 2003, the monitoring effort continued in Burlington Bay, St. Albans Bay and at the Long-Term Monitoring sites. Monitoring was expanded to include several additional sites in Missisquoi Bay, a site near the Crown Point Bridge in the southern portion of the lake, and a number of locations sampled by volunteers in the South Lake and in the Missisquoi Bay area. These additional locations were monitored with the prototype tiered alert system, and provided more data for refinement and improvement of this monitoring framework.

The Specific Objectives of the Monitoring Program in 2003 were to:

- Continue monitoring cyanobacteria in the greater Burlington area and at the Long-Term Water Quality and Biological Monitoring Project sites. If possible, expand monitoring for cyanobacteria to several sites routinely sampled by the Vermont Lay Monitoring program.
- Monitor selected sites on Missisquoi Bay, in coordination with the Province of Quebec.

- Continue screening for the presence of toxins when potential toxin-producing species are observed in plankton samples.
- Continue to refine and test a tiered cyanobacteria monitoring and public alert system framework, incorporating data and knowledge gained during 2002.
- Develop a coordinated communication network among state and provincial agencies in Vermont, New York and Quebec to facilitate the exchange of information about current BGA conditions and the potential for human exposure to toxins, and to develop a lakewide standard for reporting this information.

The range of monitoring sites provided the opportunity to test the performance of the prototype tiered alert system in areas with a variety of algae bloom conditions. In Missisquoi Bay and St. Albans Bay, high algal densities routinely develop; in contrast, high algal densities are not common in the Burlington Bay area. To be useful in Lake Champlain, the tiered alert system must be able to detect and monitor potentially toxic cyanobacteria populations among sites with very different algal densities.

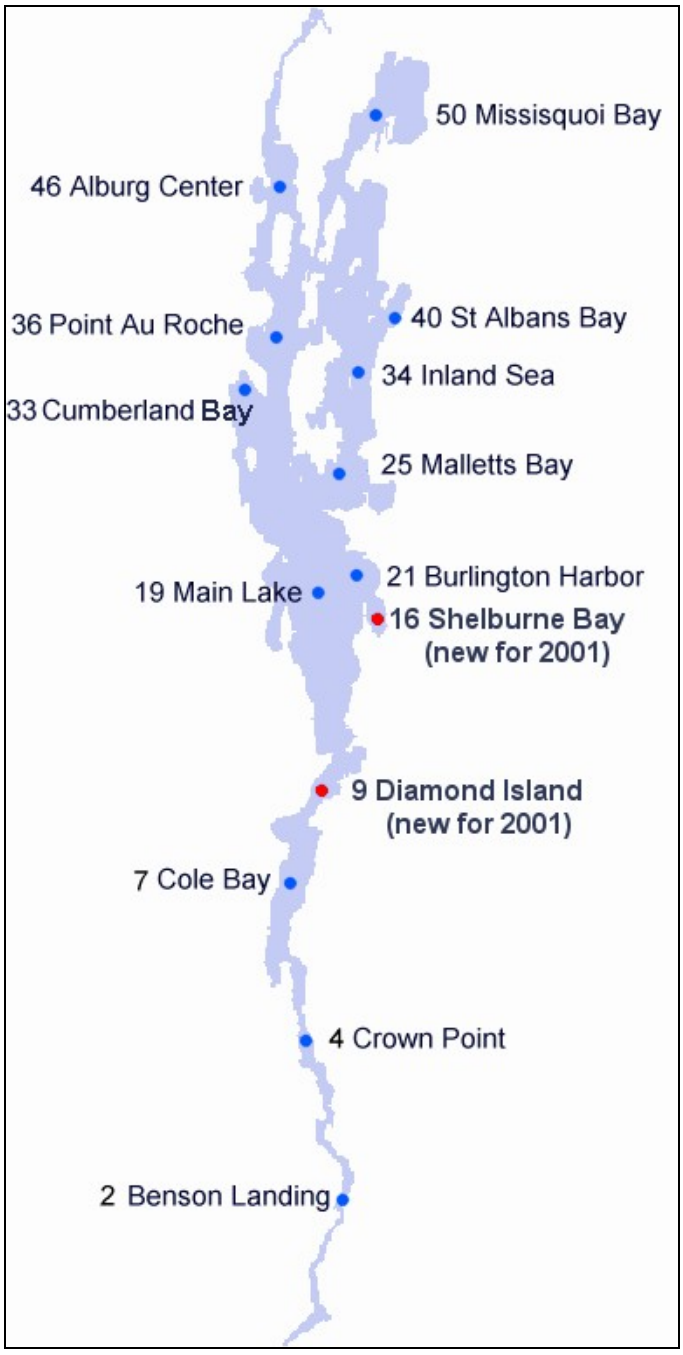
METHODS

Field Collection

To survey plankton populations lakewide, we established partnerships with the VT DEC staff and the VT Lay Monitoring Program. VT DEC staff collected plankton samples from the 14 Long-Term Monitoring Program sites during their routine collections (Figure 1). Lay monitors collected plankton samples during routine collections at additional sites, primarily in the southern sections of Lake Champlain. Working with the Lake Champlain Committee, we also recruited volunteers to sample shoreline locations in Missisqui and Maquam Bays (Figure 2). We also sampled sites in Burlington Bay, where two large water supply systems draw their water and where the highest population density of basin residents live.

Frequency. Monitoring for the presence of BGA began in April 2003 on Burlington Bay and in June 2003 at the VT DEC sites, Crown Point bridge, St. Albans Bay, and Missisquoi Bay. Sampling continued through October at all these locations. Lay monitors at all sites began sampling in early July and continued through August or September. The VT DEC sites and Vermont lay monitoring program sites were sampled approximately biweekly regardless of bloom conditions, as dictated by the state's regular program activities. Frequency of sample collection in Burlington Bay, Missisquoi Bay, St. Albans Bay, and at the Crown Point bridge was bi-weekly or weekly, as determined following the proposed tiered alert system framework (Table 1). This framework, based on recommendations in Chorus and Bartram (1999) calls for less frequent sampling initially, then weekly sampling once bloom conditions appear. The lay monitors in Missisquoi Bay sampled weekly from July through August. In Burlington Bay, cyanobacteria levels remained low throughout the season, and we remained at a bi-weekly sampling interval for the entire period. In Missisquoi and St. Albans Bay, algal densities were much higher, and weekly sampling was initiated in early July and continued until September, when cell densities indicated the decline of the bloom.

Figure 1. Location of the Lake Champlain Long-Term Biomonitoring Project Stations.



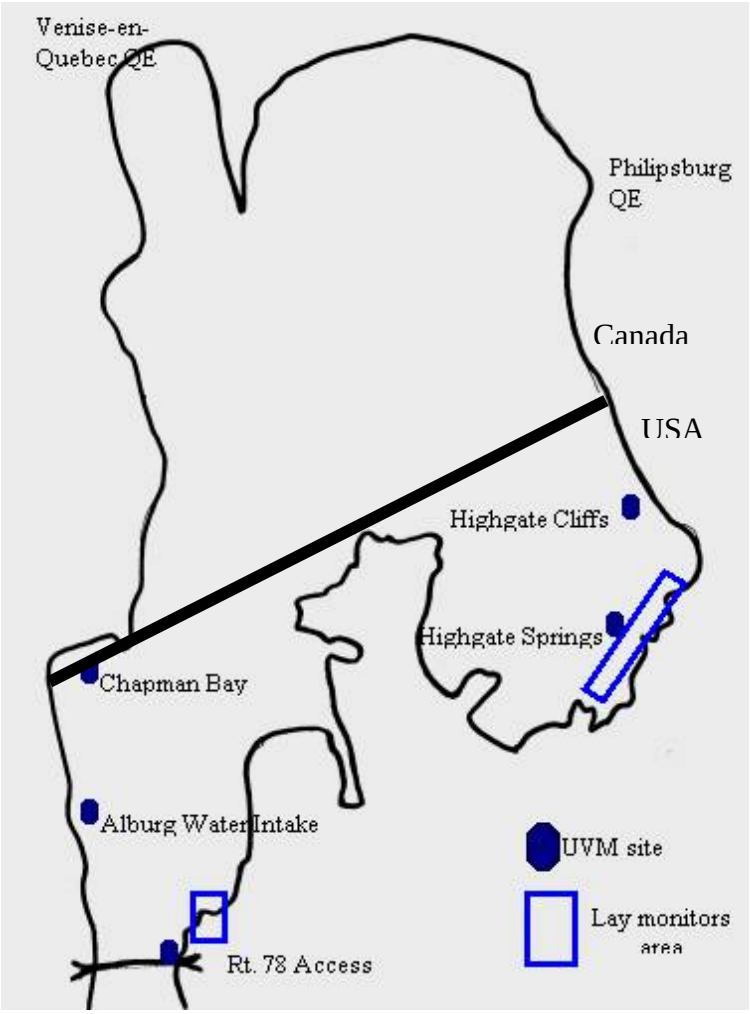


Figure 2. Sampling locations in Missisquoi Bay, 2003.

Figure 3. Sampling locations in Burlington Bay, 2003.

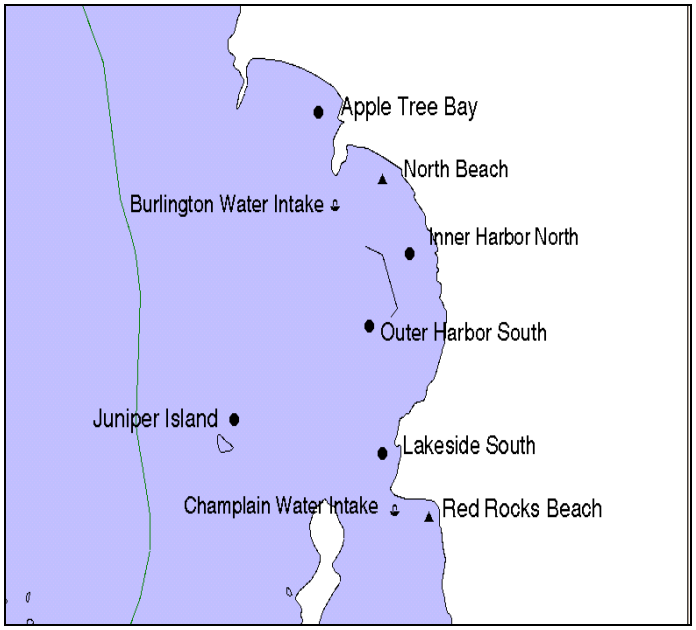


Table 1. Outline of our prototype tiered sampling and alert framework.

Qualitative sampling	
Frequency:	Monthly
Collect:	Vertical plankton tows (63 µm net, upper 3 m) Screened within 48 hours
Conclusions:	If potential toxin-producing taxa observed, proceed to *Quantitative sampling*
Quantitative sampling	
Frequency:	2/month
Collect:	Vertical plankton tow (63 µm net, upper 3m) Full enumeration within 48 hours
Conclusions:	If BGA reaches densities reach 2000 cells/mL, proceed to V*igilance level*
Vigilance level	
Frequency:	1/wk at mid-day
Collect:	Vertical plankton tow (63 µm net, upper 3m) Full enumeration within 48 hours
Conclusions:	If BGA exceed 4,000 cells/mL with greater than 80% of natural units BGA, proceed to *Alert Level 1* Return to *Quantitative sampling* if densities fall below 2,000 BGA cells/mL Notify public health officials that BGA are abundant and blooms could form
Alert Level 1	
Frequency:	1/wk at mid-day (or more frequently as needed)
Collect:	Whole water phytoplankton samples Whole water chlorophyll *a* Whole water toxin samples
Conclusions:	If microcystin concentration exceeds 1µg/L, proceed to *Alert Level 2* Notify public health officials of potential risks to humans and animals
Alert Level 2	
Frequency:	1/wk at mid-day (or more frequently as weather conditions dictate)
Collect:	As for alert level 1
Conclusions:	Return to *Alert Level 1* if microcystin concentration drops below 1 µg/L Notify public health officials that significant risk to humans and animals exists. Public Health Advisories should be issued by appropriate agencies.

Analytical Parameters. The following types of samples were collected in Burlington Bay, St. Albans Bay and Missisquoi Bay during 2003:

- whole water and net plankton
- whole water for total nitrogen
- whole water for total phosphorus
- whole water for chlorophyll *a*
- whole water and plankton for toxins (the analysis of this parameter began when microscopic analysis indicated potential toxin-producing taxa were present)

At the VT DEC sites, only net plankton samples were collected for this project; however, total nitrogen, total phosphorus, and chlorophyll samples were collected as part of the Long-term Biomonitoring Project. In St. Albans Bay and at the Crown Point bridge, only whole water plankton and toxin samples were collected.

In Burlington Bay, temperature, conductivity and oxygen were measured using a Seabird profiler from 0.5 m below the surface to 0.5 m above the bottom. YSI portable units were used in St. Albans Bay and at the Long-term Biomonitoring Project sites. Secchi depths were measured at all locations in Burlington Bay, St. Albans Bay, and at the Long-term Biomonitoring Project sites.

Sample Collection. Net plankton, net chlorophyll and net toxin samples were obtained using a 63μm Wisconsin net. A single 3m tow was collected, placed in a cooler, and transported back to the laboratory where it was subdivided for the analyses. The total volume collected for each composite was recorded.

Total nitrogen, phosphorus, whole water chlorophyll, and whole water plankton samples were collected by surface grab sampling. Two replicates were collected for each parameter.

Preservation and storage. Nalgene bottles were used for all samples. Nutrient and toxin containers were cleaned with 20% hydrochloric acid solution prior to use. Nitrogen samples were preserved with sulfuric acid to a pH less than 2. Total phosphorus samples were frozen until analysis. Plankton samples were preserved with 1% Lugols iodine solution and stored in the dark until analysis. Chlorophyll samples were filtered and frozen for analysis within 24 hours. Lake water samples for toxin analysis were preserved in one of three ways: filtered and frozen upon return to the lab, filtered and shipped for analysis at SUNY within 24 hours, or shipped as whole water samples for analysis at SUNY within 24 hours. Water treatment facility raw and finish water samples were extracted within 48 hours and shipped for analysis.

Sample Analysis

Chlorophyll. All samples were thoroughly mixed and then filtered onto 1.2 μm glass fiber filters (Whatman 934-AH) under low pressure. After sufficient material was filtered to leave a visible green layer, filters were placed in clean 15mL plastic centrifuge tubes and frozen. For chlorophyll extraction, 8mL of 95% ethanol was added to each tube, all tubes were placed in an 80°C water bath for 8 minutes, covered in foil, and placed in a refrigerator overnight. After

extraction, the samples were brought to room temperature, shaken to homogenize the extract, and centrifuged at 3000 rpm for 10 minutes. Non-acidified and acidified extract absorbance was measured at 665 and 750 nm. Chlorophyll concentrations in the net plankton samples were extrapolated to reflect actual chlorophyll concentrations in the original lake water. About 10% of the samples were run in duplicate.

Net plankton. Net plankton were analyzed either as qualitative or quantitative samples. Initial samples were evaluated qualitatively, noting and recording the taxa present. Once potentially toxic cyanobacteria were identified in the samples, evaluation became quantitative; individual algal units in the samples were identified and enumerated, and densities calculated for each taxon.

An aliquot of well-mixed sample was placed in a Sedgewick Rafter cell and allowed to settle for 5 minutes. Cells were examined at 100X with phase contrast using an inverted Olympus IX70 microscope. For qualitative samples, the entire chamber was scanned and algal taxa present were recorded. For quantitative samples, algal units were identified and enumerated. Counting continued until 100 cells of the most abundant unit had been observed or 10 fields had been examined. Algal units were categorized by size (single cells, fragments of colonies or filaments, small, medium, or large colonies or filaments). The enumerated natural units were multiplied by a cell factor to estimate cell densities (Table 2). Cell densities were extrapolated to reflect plankton populations in the original lake water.

Table 2. Cell factors used to estimate field densities of colonial algae.

Taxon	Unit Category	Estimated Cells/Unit	Cell Factor
Anabaena spp., Aulocoseira, Fragilaria	fragment	1 – 20	10
	small	20 – 100	60
	medium	100 – 1000	500
	large	>1000	1000
Microcystis, Coelosphaerium	small	<100	50
	medium	100 - 1000	500
	large	>1000	1000
Gloetrichia spp.	fragment	single trichome	20
	small	quarter of a colony	2500
	medium	half of a colony	5000
	large	entire colony	10,000
Aphanizomenon spp.	fragment	single trichome	measured
	small	small flake	200
	medium	medium flake	500
	large	large flake	1000

Whole water plankton. Whole water plankton were examined using Ütermohl settling chambers. Aliquots of well-mixed samples were allowed to settle for a minimum of 4 days, then counted using an Olympus IX70 inverted microscope with phase contrast at 400x. Counting continued until 100 individuals of the most abundant taxa had been observed or 100 fields had been evaluated. Natural units and cell densities were determined as described above.

Phosphorus. Total phosphorus samples were thawed and mixed thoroughly. A 50mL aliquot was digested using ammonium persulfate (APHA 1995) and analyzed following Quikchem™ Method 10-115-01-1-F using a Lachet Quikchem™ 8000 Series Flow Injection Analyzer.

Total Nitrogen. Total nitrogen samples were analyzed using persulfate digestion (APHA 1995) following Quikchem™ Method 10-107-06-2-H using a Lachet Quikchem™ 8000 Series Flow Injection Analyzer.

Toxin Sample Preparation. To prepare net plankton for analysis, a well-mixed aliquot of plankton concentrate was filtered onto Whatman 934-AH glass fiber filters. Filters for analysis of toxins by high pressure liquid chromatography (HPLC), and protein phosphatase inhibition assay (PPIA) at SUNY were placed on ice and shipped by overnight carrier. Filters for enyzme-linked immunosorbant assay (ELISA) analysis by the VT DOH were placed on ice and delivered to their laboratory in Burlington within 24 hours. Filters for ELISA assay by UVM were placed in 7mL glass vials with Teflon-lined caps with 4 mL of 50% methanol, shaken well and stored at –40°C until analysis.

Whole water samples for analysis by HPLC and PPIA at SUNY were kept cold and sent off by overnight carrier within 24 hours.

Microcystin (s) by ELISA. Toxin samples in 50% methanol were thawed, shaken and re-frozen three times before beginning analysis. Extracted samples were diluted with deionized water until methanol represented less than 5% of the total volume, following recommendations to improve the accuracy of the method (Metcalf et al. 2000). Microcystin plate kits were purchased from Envirologix Inc. (Portland ME). UVM and VT DOH used kits from the same production lot. Analyses at VT DOH were used as a QA/QC check.

Samples were run in duplicate following manufacturer's instructions on a KC Jr. plate reader (Biotek Instruments), utilizing standards provided in the kit. Mean values were used to determine the toxin concentration of each pair of samples. Samples exceeding the range recommended by the kit were diluted and re-analyzed. Samples below the range were also re-analyzed using manufacturer recommended dilution procedures for the standards. Laboratory blanks were run with each sample batch using deionized water.

Microcystin (s) by PPIA. PPIA analysis followed a modification of Carmichael and An (1999). Microcystin LR standards (0.06 – 1000 µg/L) were prepared fresh from a 40 µg/L stock in 50% acidified methanol. The protein phosphatase 1, catalytic subunit Roche, was used at a working concentration of 0.1mU/200 µL. All assays were done in 96 well plates in a 37°C incubator. Readings at 405nm were taken every 5 minutes for 60 minutes using an E-max plate reader.

Anatoxin-a by HPLC. At SUNY, algal material was freeze-dried and then extracted with acidified methanol. Solid phase extraction cartridges were eluted with 100% methanol. Samples were analyzed in a Zorbax ACE C18 column with C-18 Phenomenex guard disk following James et al. (1997). Several duplicate samples were analyzed at Wright State University by Dr. Wayne Carmichael, using the same procedures, as a QA/QC check.

RESULTS

Cyanobacteria and Toxins at the Monitoring Sites

A total of 84 samples were collected at the Long-term Monitoring Program sites over the summer season. Approximately 43% of these samples were analyzed by qualitative scanning, looking only for the presence of cyanobacteria. The remaining 57% of the samples were analyzed quantitatively, enumerating the cyanobacteria present. More than 300 samples were collected by UVM staff and our lay monitors. Most of these were analyzed quantitatively

The alert status reached and the maximum density of potentially toxic cyanobacteria cells at each site monitored are listed in Table 3. *Aphanizomenon* spp., *Microcystis* spp. and *Anabaena flos-aquae* were all widely distributed at sites across Lake Champlain.

Table 3. Summary of Plankton Sample Status at Cyanobacteria Monitoring Stations in 2003.

Long-term Monitoring Sites (VT DEC)

Station (south to north)	Monitoring Status	Date Achieved	Cyanobacteria Present	Maximum Density of Potentially Toxic Cells/mL
2. Benson Landing	Quantitative	Sept 10	*Anabaena*	40
4. Crown Point	Quantitative	Aug 8	*Microcystis, Anabaena*	310
7. Cole Bay	Quantitative	Aug 4	*Aphanizomenon, Anabaena, Microcystis*	780
9. Diamond Island	Quantitative	Aug 4	*Aphanizomenon, Anabaena, Microcystis*	120
16. Shelburne Bay	Quantitative	July 18	*Anabaena, Microcystis*	875
19. Main Lake	Quantitative	July 18	*Aphanizomenon, Microcystis, Anabaena*	1280
21. Burlington Harbor	Quantitative	July 18	*Anabaena, Aphanizomenon, Microcystis*	1690
25. Malletts Bay	Quantitative	July 10	*Microcystis, Anabaena*	90
33. Cumberland Bay	Quantitative	Aug 5	*Microcystis, Anabaena, Aphanizomenon*	70
34. Inland Sea	Quantitative	July 25	*Aphanizomenon*	410
36. Point Au Roche	Quantitative	July 9	*Microcystis, Anabaena*	800
40. St. Albans Bay	Alert 1	Oct 21	*Aphanizomenon*	27,000
46. Alburg Center	Quantitative	Aug 7	*Aphanizomenon, Microcystis, Anabaena*	120
50. Missisquoi Bay	Vigilance	July 22	*Microcystis, Anabaena*	3760

UVM monitoring stations – Missisquoi Bay, St. Albans Bay, and the Champlain Bridge

Location	Monitoring Status	Date Achieved	Highest Microcystin (µg/L) Observed	Cyanobacteria Present	Maximum Density of Potentially Toxic Cells/mL (net plankton)
Chapman Bay	Alert 1, 2	August 5	1.8 (Aug 26 wwp)	*Anabaena, Microcystis*	14,300 (Aug 5)
Rt. 78 Access	Alert 1, 2	July 21	23.9 (Aug 26 shoreline)	*Microcystis, Anabaena*	17,100 (Aug 19)
Highgate Cliffs	Alert 1, 2	July 14	8.6 (Aug 26 wwp)	*Microcystis, Anabaena, Aphanizomenon*	26,300 (Aug 5)
Highgate Springs	Alert 1	July 29	1.5 (Aug 26)	*Microcystis, Anabaena*	19,500 (Aug 5)
St. Albans Bay	Alert 1	August 9	0.5 (Aug 26)	*Microcystis, Anabaena, Aphanizomenon*	32,508 (Aug 26)
Champlain Bridge	Quantitative	August 3	Not measured	*Microcystis, Anabaena*	1,489 (Aug 20)

Missisquoi Bay Area Lay Monitoring Samples – Whole water samples, analyzed by Sedgewick-Rafter cell following net sample protocol.

Location	Monitoring Status	Date Achieved	Highest Microcystin (µg/L) Observed	Cyanobacteria Present	Maximum Density of Potentially Toxic Cells/mL
Pete's Point	Alert 1	July 14	0.37 (Aug 18)	*Anabaena, Microcystis*	69,000 (July 14)
Highgate (east shore)	Alert 1	July 28	1.6 (Sept 18)	*Anabaena, Microcystis*	46,890 (Sept 8)
Lime Kiln Point (east shore near Highgate)	Alert 1, 2	July 14	16.8 (Aug 18)	*Anabaena, Microcystis*	1,030,400 (Aug 18)
Camp Randolph	Alert 1, 2	Sept 8	>10 (Aug 18)*	*Microcystis*	38,400 (Sept 8)
Maquam Bay	Alert 1	July 14	0.17 (July 14)	*Microcystis*	23,350 (July 14)

* exact sample quantification not possible due to errors during storage

Burlington Bay – UVM monitoring stations

Location	Monitoring Status	Date Achieved	Microcystin (µg/L) (tested only on Sept 10)	Cyanobacteria Present on Sept 10	Maximum Density Potentially Toxic Cells/mL (net plankton)
Red Rocks Beach	Alert 1	Oct 21	0.042 (ww)	*Anabaena, Aphanizomenon*	10,400 (Oct 21) *Aphanizomenon*
Champlain Water	Alert 1	Sept 2	.083 (wwp)	*Anabaena, Aphanizomenon, Microcystis*	12,900 (Oct 21) *Aphanizomenon*

North Beach	Alert 1	Oct 21	.029 (ww)	*Aphanizomenon, Microcystis, Anabaena*	16,600 (Oct 21) *Aphanizomenon*
Burlington Water	Alert 1	Oct 21	.010 (wwp)	*Anabaena, Microcystis, Aphanizomenon*	14,900 (Oct 21) *Aphanizomenon*

Lake Champlain Lay Monitors (VT DEC): whole water samples, collected biweekly, July – August

Location	Monitoring Status	Date Achieved	Cyanobacteria Present	Maximum Density Potentially Toxic Cells/mL
Larabee's Point	Alert 1	Aug 15	*Anabaena*	112,800 (Aug 18)
Thompson Point	Alert 1	Jul 31	*Anabaena, Aphanizomenon*	22,300 (Jul 31)
Button Bay	Alert 1	Aug 5	*Aphanizomenon, Microcystis, Anabaena*	4100 (Aug 5)
St. Albans Bay	Alert 1	Aug 2	*Aphanizomenon, Microcystis, Anabaena*	143,500 (Aug 2)
Point Au Fer	Quantitative	Aug 13	*Anabaena*	1630 (Aug 13)

At the Long-term Biomonitoring sites, cyanobacteria densities did not reach the Alert Level at any site except Station 40, in St. Albans Bay. Station 50, in Missisquoi Bay, reached the Vigilence Level, and all other sites saw cyanobacteria densities no higher than the Quantitative Analysis Level.

At the UVM Sites, Alert Level was reached in mid-July in Missisquoi Bay and in early August in St. Albans Bay. At the lay monitoring sites, all of which were located along the shoreline, Alert Level was reached in mid-July in most locations in Missisquoi Bay, and in late July or August at all other sites except Point Au Fer.

The Burlington Bay sites did not reach Alert Level until the fall. The Champlain Water District intake site reached Alert Level briefly on September 2, and four sites in Burlington Bay reached Alert Level again on October 21, our last sampling date.

The highest concentrations of microcystins were found in Missisquoi Bay (Table 4). Several sites in the bay showed concentrations above 1 µg/L, the level of human health concern, on many dates in July and August. No other sites in Lake Champlain showed microcystin concentrations above 1 µg/L in 2003.

Trace amounts of anatoxin were detected in St. Albans Bay and Missisquoi Bay on one date in mid-August in 2003. No other sites or dates showed measurable concentrations of anatoxin.

Table 4. Number of samples tested and maximum concentrations of microcystin measured at cyanobacteria monitoring sites in 2003

Lake Section	Collected by	Location	Number of Samples Tested	Maximum Microcystin Concentration, µg/L
Missisquoi Bay	Lay Monitors	Highgate Shipyard	6	1.26
		Lime Kiln Point	8	16.87
		Maquam Bay	8	0.18
		Pete's Point	5	0.38
		Randolph	4	0.37
		Soft Beach- Highgate Public Beach	1	1.67
		Swamp- Highgate Springs	1	0.24
		Tyler Place Boatdock	8	0.31
	UVM	Alburg Springs	20	0.78
		Border Buoy, west side	1	0.20
		Chapman Bay	55	1.35
		Over Alburg Springs Water Intake	2	23.10
		Highgate Cliffs	83	8.60
		Highgate Springs	49	1.53
		Rock River Bay	8	0.44
		Rte 78 Access- offshore	72	0.59
		Rte 78 Access- shore	3	23.91
St. Albans Bay	UVM	St. Albans Boatlaunch	34	0.46
Other sites in Lake Champlain	Lay Monitor	2 mi N of Larrabee's Point	2	1.38
		Button Bay Broad Lake	1	0.07
		Thompson's Point	1	0.12
	UVM	Over the Burlington Water intake	4	0.01
		Over the Champlain Water intake	4	0.08
		North Beach	4	0.01
		Red Rocks Beach	4	0.03
Total Number of Samples Tested			388	

Different patterns of bloom development and persistence were observed at the sites monitored in Missisquoi Bay. Figure 5 presents the alert status over the summer season at the Rte. 78 Boatlaunch site. At this location, samples were collected at both our off-shore site (Figure 2), and along the shoreline in the visible cyanobacteria scums when these scums were present. Alert Level 1 was reached on July 22, and cell counts remained high through September. Alert Level 2, achieved when microcystin concentrations exceed the human health threshold of 1 µg/L, was

reached in the shoreline samples on August 20 and 28. On all three dates when shoreline samples were collected, the cell densities in these samples were higher than the offshore samples.

At Highgate Cliffs (Figure 6), on the east side of the bay near the Canadian border, Alert Level 1 was reached on July 14, one week earlier than at the Rte. 78 site. Cell counts remained high at this site for the remainder of the summer. Alert Level 2 was achieved on August 27. In contrast, at Chapman Bay (Figure 7), on the west of the bay, Alert Level 1 was not reached until August 5, and Alert Level 2 on September 9. At this site, and at the Highgate Springs site (Figure 8), the date when microcystin rose above levels of human health concern (Alert Level 2) did not correspond with the date when highest cell densities were achieved.

The samples collected by VT DEC at Station 50 in Missisquoi Bay never showed the bloom conditions observed at the sites regularly sampled by UVM (Figure 9). Unfortunately, samples were not collected on the same dates by both groups, so strict comparisions of the spatial variability in the bay are not possible. However, on August 5, UVM sampled five sites in the bay, and on August 7, VT DEC sampled station 50. The weather did not change significantly over this period (National Weather Service and Vermont Monitoring Cooperative, unpublished data), and yet the algae densities were dramatically different. Cell counts at the UVM stations were an order of magnitude or more above the counts at Station 50.

Figure 5. Alert status at the Rte 78 Boatlaunch over the summer 2003. Shoreline samples were collected on the same day as the samples at the regular monitoring location, but surface accumulations were targeted.

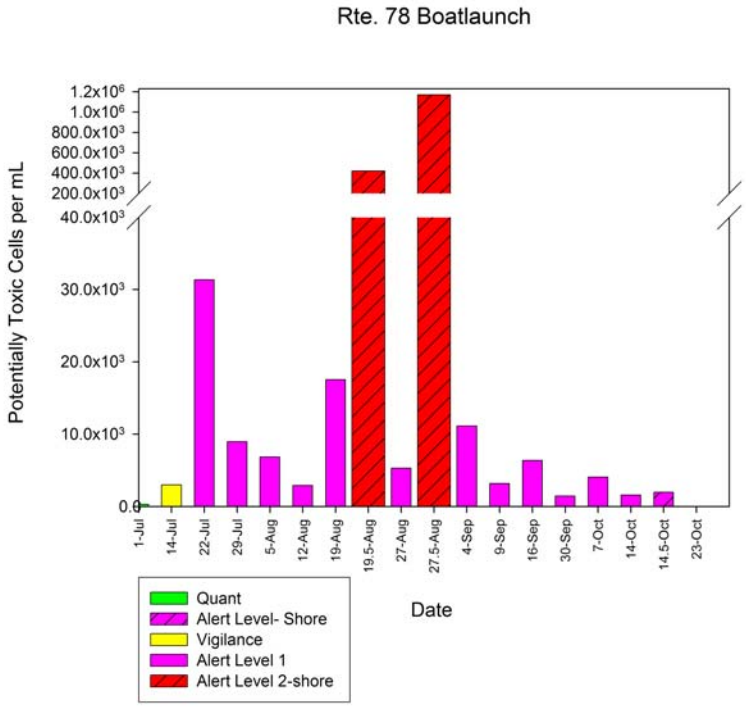


Figure 6. Alert status at the Highgate Cliffs site over the summer 2003.

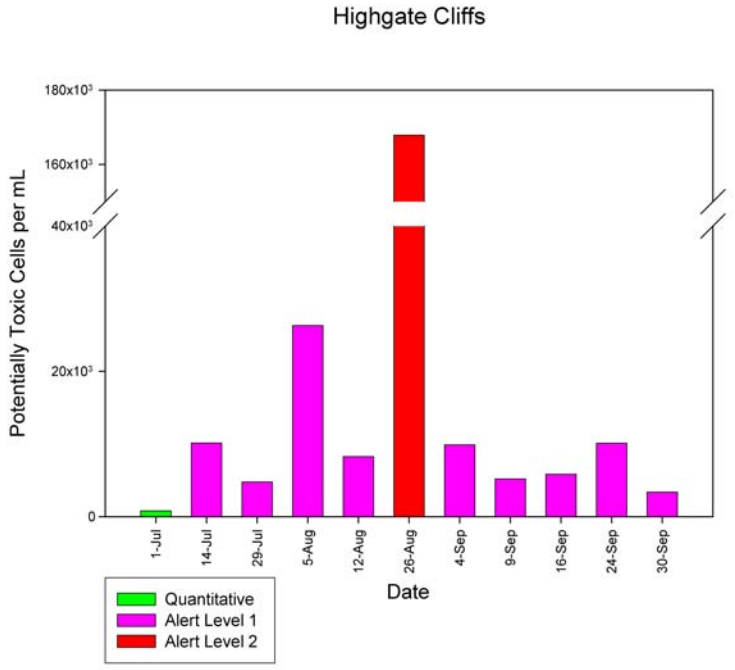


Figure 7. Alert status at the Chapman Bay site over the summer 2003.

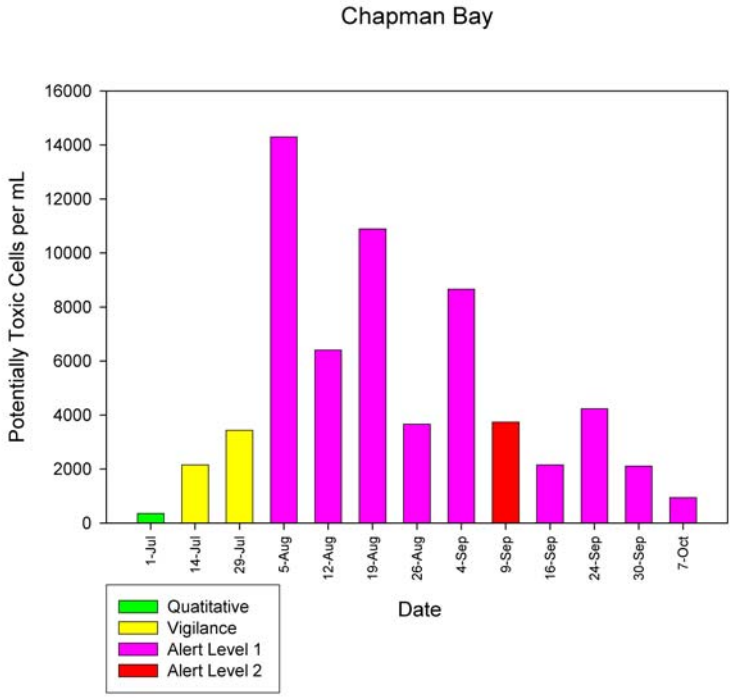


Figure 8. Alert status at the Highgate Springs site over the summer 2003.

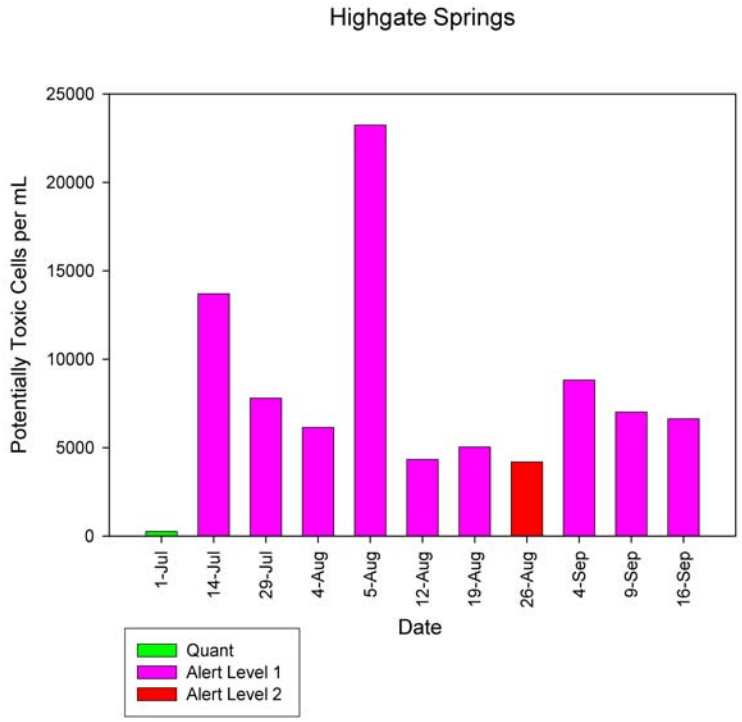
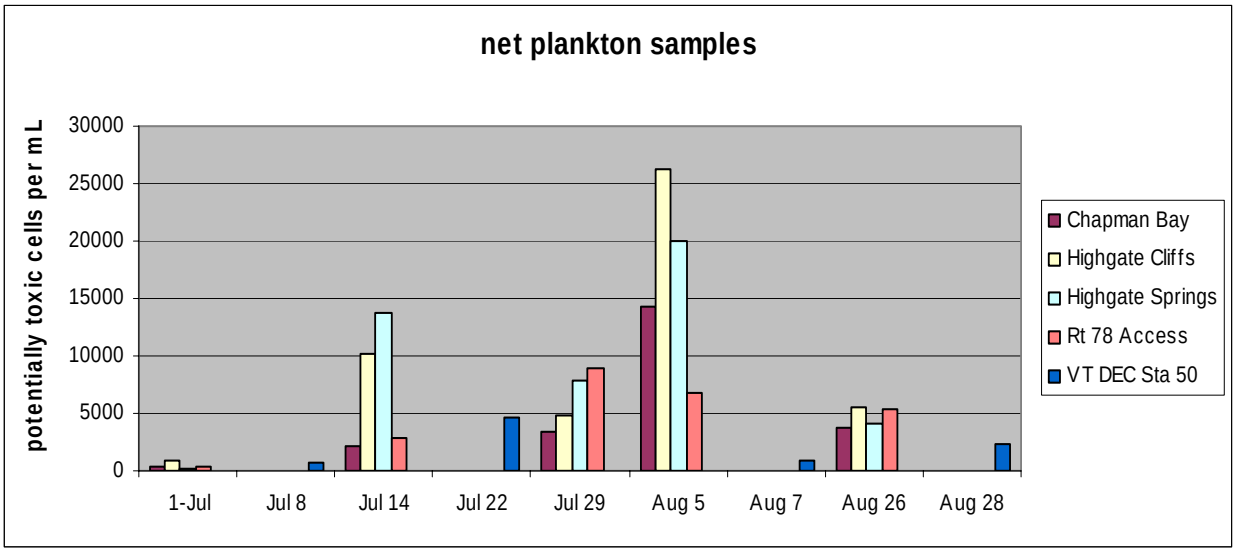
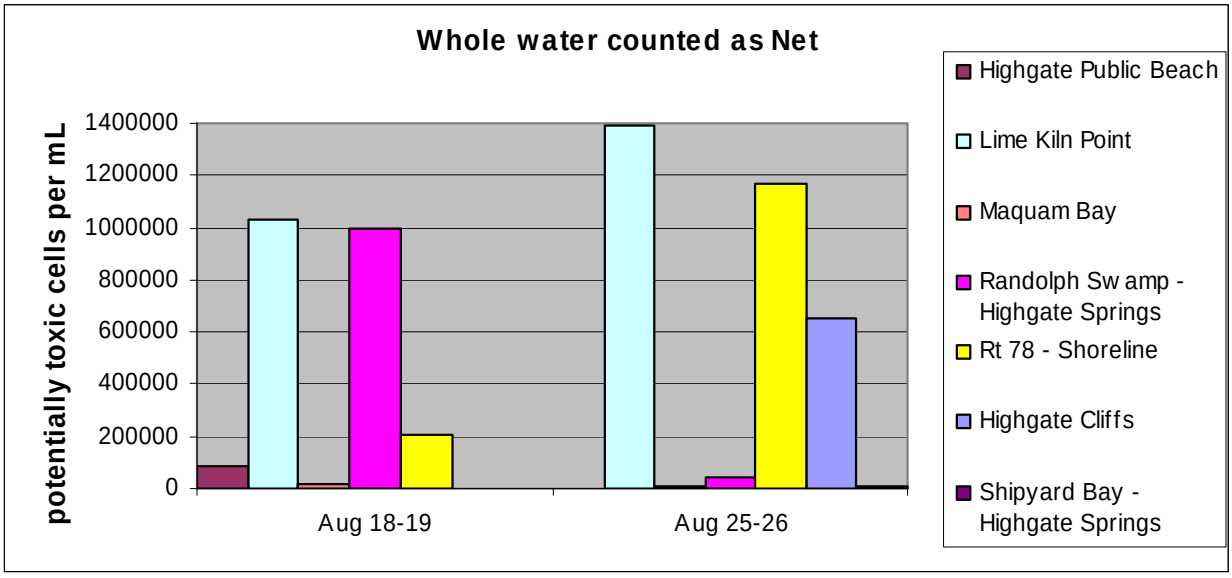


Figure 9. Cyanobacteria densities in net plankton samples collected at Station 50 and at the regular UVM sites in Missisquoi Bay.



There was tremendous spatial variability in the cell densities seen in the shoreline samples collected from Missisquoi Bay. Two example dates are presented in Figure 10. These samples were collected in shallow water, specifically targeting areas where algal densities were high or scum was accumulating. Because they were collected with a different protocol than the boat-based samples, strict comparisons are not possible, but it is clear that these shoreline scum areas represent potential problem areas. Cell densities in these samples were in the 100,000 to 1,000,000 cells per mL range, one to two orders of magnitude greater than the offshore sites.

Figure 10. Cell densities at sites in shoreline sampling sites in Missisquoi Bay in August 2003.



Summary of Cyanobacteria and Toxin Patterns in 2003

As in prior years, potential toxin-producing species of cyanobacteria frequently dominated the plankton, especially in July, August and September (Table 5). The most common potential toxin-producers included *Anabaena* spp., *Aphanizomenon flos-aquae*, and *Microcystis* spp. In Missisquoi Bay, *Microcystis* spp. were present in 94% of the samples, far exceeding the dominance seen in other parts of the lake. In general, lowest frequency of occurrence of potential toxin producing cyanobacteria was in the South Lake.

Table 5. Frequency of occurrence of cyanobacteria taxa in samples collected from Lake Champlain.

Taxon	Frequency of Occurrence 2003 - Percent			
	Main Lake	South Lake	Missisquoi Bay	Northeastern Bays
Anabaena flos-aquae	83	29	57	53
Anabaena spp	51	50	43	58
Microcystis aeruginosa	47	43	94	56
Coelosphaerium spp.	34	29	4	44
Gloeotrichia spp.	1	0	5	9
Aphanizomenon flos-aquae	73	43	22	49
Samples Analyzed	102	14	175	45

Both anatoxin-a and microcystins were detected in samples collected in 2003, but anatoxin was much less common in 2003 than in previous years (Rosen et al. 2001, Watzin et al. 2002, Watzin et al. 2003). There was a wide range in microcystin concentrations, but in 2003, concentrations were generally low and well below the current guidelines available for the protection of human health at all locations except those in Missisquoi Bay. Samples collected from the shoreline sampling sites had the highest cyanobacteria cell densities and the highest toxin concentration in 2003, reinforcing the pattern seen in 2002 (Watzin et al. 2003).

Nutrients at the Cyanobacteria Monitoring Sites

Concentrations of total phosphorus (TP) and total nitrogen (TN) were averaged by date for monitoring sites in Burlington Bay, St. Albans Bay and Missisquoi Bay. Mean concentrations of both nutrients were almost always highest in Missisquoi Bay, intermediate in St. Albans Bay, and lowest in Burlington Bay (Figures 11 and 12).

TP concentrations in Burlington Bay were generally low and averaged about 10 µg/L throughout the summer (Figure 11) Total phosphorus concentrations in St. Albans and Missisquoi Bay were much higher than those Burlington Bay. In Missisquoi Bay, highest concentrations were found in late summer and fall, with three dates measuring above 100 µg/L.

Mean concentrations of TN (Figure 12) showed a similar pattern, with highest concentrations again found in Misissquoi Bay. Concentrations in the bay were also highly variable, especially in late summer and fall.

Figure 11. Mean total phosphorus concentrations (± one standard error) in Burlington Bay, Missisquoi Bay and St. Albans Bay, 2003.

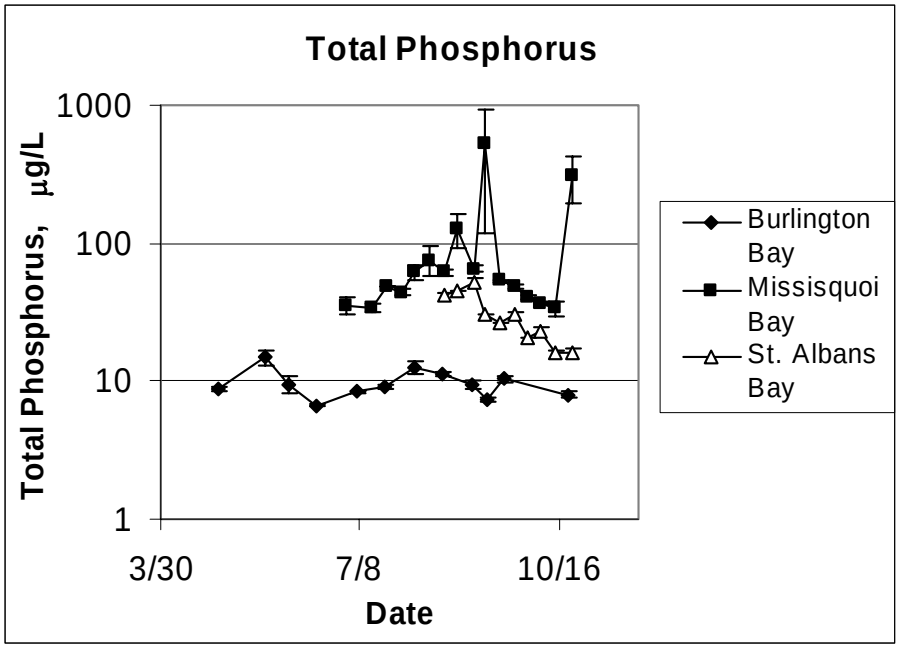
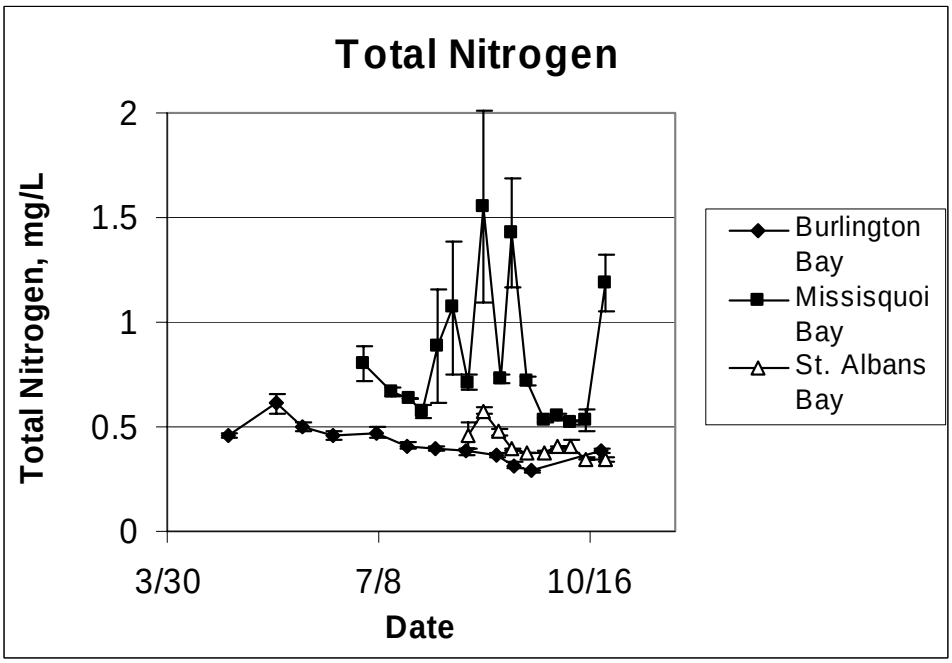


Figure 12. Mean total nitrogen concentrations (± one standard error) in Burlington Bay, Missisquoi Bay and St. Albans Bay, 2003.



Coordination

A coordination meeting was held with state, provincial, and other interested environmental management and public health officials from New York, Vermont and Quebec on June 9, 2003. Participants were briefed on the monitoring and alert framework and the jurisdictions exchanged information about how public health advisories might be issued by each agency. Agency personnel were invited to submit e-mail addresses for a distribution list for regular information sharing over the summer season.

Beginning in early July, weekly e-mail updates on monitoring results were distributed to these officials and to other professionals with an interest in bloom conditions and public health. The e-mail contained information about sampling sites, potentially toxic cell densities, and toxin concentrations.

DISCUSSION AND CONCLUSIONS

Patterns of Cyanobacteria and Toxin Distribution in Lake Champlain

Cyanobacteria were common in Lake Champlain in 2003, as they have been in previous years. High densities of cyanobacteria and other algae are known to be correlated with high concentrations of nutrients (Paerl et al. 2001), and cell densities were positively associated with both total phosphorus and total nitrogen concentrations in the lake. Missisquoi Bay, with the highest nutrient concentrations had the highest cyanobacteria densities. Burlington Bay, with much lower concentrations of phosphorus and nitrogen, had the lowest cell densities, and St. Albans Bay, with intermediate nutrient concentrations, had mid-range cell densities.

Cyanobacteria prefer warmer water temperatures and tend to form surface blooms or scums in protected areas, when winds are calm (Dokulil and Teubner, 2000; Paerl et al., 2001). Consistent with this, we saw highest cyanobacteria cell densities in protected areas, on hot days in July and August. Winds then accumulate scums along the shoreline in the predominant direction of air motion.

Because of the tendency of cyanobacteria to accumulate along the shoreline, the samples collected by the lay monitors became especially important. Highest toxin concentrations were found in the algal accumulations and scum areas they sampled. The goal of the cyanobacteria monitoring program is to protect human health. Because many people who recreate on the lake do so from the shoreline, the risks associated with these sites must be assessed. The regular, boat-based sampling conducted as part of the Long-term Biomonitoring Program cannot represent conditions in these locations, and even the UVM boat-based samples, while capturing a larger range of conditions, did not fully capture conditions seen at the shoreline, where scums accumulated.

Although highest concentrations of microcystin were found in samples collected from visible surface and shoreline accumulations in Missisquoi Bay, the samples with the highest cell densities were not necessarily the samples that showed the highest toxin concentrations (Figures

5-8, Appendix C). This pattern was similar to that seen in previous years (Watzin et al. 2002, 2003). Analysis of samples with high cell densities for both microcystins and anatoxin showed that many samples had no detectable toxin or very low concentrations even when potentially toxic taxa were abundant.

Effectiveness of the Prototype Monitoring and Alert Framework

The proposed tiered alert system was effective at identifying locations where potentially toxic algal populations were developing in a timely manner. In order to ensure that we did not miss the initiation of a bloom, we began sampling on a biweekly basis as soon as meteorological conditions favored bloom development, and this should be written into the method given how quickly populations can increase when conditions are favorable. To maintain efficiency, we also continued to make our cell counts using net sample protocols at Alert Level 1. In this way, we avoided the delay of settling whole water samples for cell counts and were able to provide data to the public health agencies in a timely manner.

The higher trigger of 2000 cells to move from Quantitative monitoring to the Vigilance Level worked well. Once reaching the Vigilance Level, the bloom in Missisquoi Bay developed very rapidly. Although the trigger at 4000 cells per mL to move from Vigilance to Alert Level does not represent a large increase in a developing bloom, we are concerned that if this trigger is increased significantly, we might miss the beginnings of toxin production. In Missisquoi Bay, microcystins were present at levels approaching or exceeding the 1 µg/L advisory level soon after bloom development. For example, at both Highgate Springs and in Chapman Bay, microcystin concentrations exceeded the 1 µg/L advisory level on one date when cell densities were approximately 4000/mL (Figures 7 and 8). As additional data are collected, we may have a better feel for the minimum cell density associated with toxin production. This density would represent the most efficient trigger for the Alert Level.

In all locations, high cell counts did not always indicate high toxin concentration, but high toxin concentrations were never found when cell counts were low. Therefore, initiating analyses for toxin only after cell densities reach the Alert level trigger seems appropriate. Although few studies have explored the variability in microcystin concentration over the course of a bloom, several studies have noted highest microcystin concentrations occur in high-density shoreline scums (Fastner et al. 1999, Chorus 2001, WHO 2003), as our data also show.

The Alert Level 2 trigger of 1 µg/L microcystin was suggested by the World Health Organization (WHO) based on health data related to chronic exposure to microcystin by consuming contaminated drinking water (WHO 1998, Chorus and Bartrum 1999). Although there are several drinking water plants that draw water from shallow water areas in northern Lake Champlain (Rosen et al. 2001), the primary use of the tiered alert system is currently to alert recreational users to potential hazards.

In late 2003, the WHO released a new set of guidelines for safe recreational water environments (WHO 2003). In this report the WHO suggests three levels of concern for recreational exposure to microcystins, as outlined in Table 6.

The WHO recommends these cell density levels for all cyanotoxins, but specifically outlines the concerns for microcystins. These are estimated in the exposure concentrations listed in Table 6. The WHO suggests that on-site risk advisories be posted at the low guidance level, and that swimming and other water contact activities be prohibited at the high guidance level, at least in the vicinity of the scums. The report acknowledges the patchy nature and variable cell densities in scums, but notes the potential for acute health risks at this level.

Table 6. WHO (2003) guidelines for safe practice in managing recreational waters

Guidance Level	Cyanobacteria	Basis for Concern (microcystins)
Relatively low probability of adverse health effects	20,000 potentially toxic cell/mL, 10 µg chl a/L	Assumes short-term exposure to microcystins at 2-10 µg/L
Moderate probability of adverse health effects	100,000 potentially toxic cells/mL, 50 µg chl a/L	Assumes short-term exposure to microcystins at or below about 20 µg/L
High probability of adverse health effects	Scum formation (thousands to millions of potentially toxic cells/mL	Assumes short-term exposure to microcystins that could be as high as 5 mg/L or more

The patchy nature of the cyanobacteria bloom and the corresponding spatial variability in toxin concentrations was readily apparent in Lake Champlain. In Missisquoi Bay, the concentration of microcystins in samples from nearby sites can vary by several orders of magnitude (Appendix C, Watzin et al. 2003). Because it is impossible to test all locations where algae may be accumulating, and recreationists are likely exposed to a variety of conditions while on the water, prudence is warranted. The WHO (2003) also advocates this approach, noting the need for very frequent monitoring and aggressive public information campaigns.

In 2003, anatoxin concentrations were very low. In prior years, higher concentrations have been observed and dog deaths from anatoxin exposure have occurred (Rosen 2001, Watzin et al. 2002). Anatoxin-producing species such as *Anabaena* spp. have remained common in Lake Champlain, and therefore, the addition of a more rapid anatoxin screening method to the protocols would be valuable.

Coordination

The rapid development of the bloom in Missisquoi Bay again in 2003 reinforced the need for frequent interagency communication. Public health officials in Quebec Province once again closed beaches and water facilities along the northern shores of Missisquoi Bay before the problem became acute in Vermont. Because public health advisories were only released later in the season in Vermont, there was general confusion about the hazards and what appropriate behavior might be on the United States side of the border. A more proactive public education and advisory approach would help with this situation. Clear information about the risks to both people and their pets should be issued on a regular basis once the bloom begins. Recreational

users of areas such as Missisquoi and St. Albans Bays would benefit from posted materials at beaches and other public access sites. Because weather conditions can greatly affect the distribution and intensity of the bloom in different areas, warning people to avoid visible accumulations of algae, especially shoreline scums, seems most appropriate. Because recreationists sometimes travel around the lake, widely publicized advisories, beyond the immediate area of the bloom, also seem wise.

General Recommendations

Evaluation of the tiered alert system should continue in 2004. Our data and those elsewhere in the literature (Fastner et al. 1999, Chorus 2001) suggest that the highest concentrations of toxin are likely to occur in the dense shoreline accumulations of algae. These areas are also where recreational users of the lake are most likely to be exposed to the toxins. Therefore, it seems important that any monitoring program sample in these shoreline locations, not just out in the open water, where most monitoring programs tend to focus. Appropriately trained lay monitors can greatly enhance the sampling capability, and might be utilized where volunteers can be recruited.

Because weather conditions influence where greatest algal densities occur, and these locations can change rapidly, it is extremely difficult to promptly identify areas of greatest risk. Essentially, this places the burden of deciding when and where to recreate in waters subject to cyanobacteria blooms on the recreational user, and suggests that educational materials should be available through multiple venues in order to help swimmers and others make informed decisions. While newspaper and radio announcements reach a broad audience, additional materials, such as permanent postings at recreational accesses and fact sheets distributed via websites and public health offices, would provide recreational users with a tangible way to determine whether the algal accumulations they encounter should be avoided.

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Appendix A. Results of Screening of Qualitative Samples Collected in Lake Champlain, 2003.

Date	Location	BGA?	Microcystis	Aphanizomenon	Oscillatoria	Anabaena	Coelosphaerium
28-Apr-03	Burlington Water Bay	no					
	Champlain Water Bay	yes	x				x
	North Beach	no					
	Noth Beach	yes					x
	Red Rocks Beach	no					
20-May-03	Burlington Water Bay	no					
	Champlain Water Bay	no					
	North Beach	yes					x
	Red Rocks Beach	no					
2-Jun-03	Champlain Water Bay	yes		x			
	North Beach	no					
	Red Rocks Beach	no					
	Sta 02	yes		x			
	Sta 04	yes		x			
3-Jun-03	Sta 34	no					
	Sta 40	yes		x			
4-Jun-03	Sta 33	no					
	Sta 36	yes		x			
5-Jun-03	Stax6	no					
	Stax9	no					
	Sta 21	no					
6-Jun-03	Sta 25	yes				x	x
10-Jun-03	Sta 06	no					
	Sta 07	no					
12-Jun-03	Sta 46	yes	x				
13-Jun-03	Sta 34	no					
	Sta 40	yes	x				
16-Jun-03	Burlington Water Bay	yes					x
	Champlain Water Bay	yes				x	
	North Beach	yes					x
	Red Rocks	yes				x	x
	Sta 02	yes		x			x
	Sta 04	no					
17-Jun-03	Sta 33	yes				x	
	Sta 36	yes	x				
18-Jun-03	Stax6	yes					x
	Stax9	no					
	Sta 21	yes				x	x
19-Jun-03	Sta 25	yes				x	x
23-Jun-03	Sta 07	no					
	Sta 09	no					
24-Jun-03	Sta 46	no					
25-Jun-03	Sta 40	yes	x			x	
26-Jun-03	Sta 33	yes					x
	Sta 36	yes	x			x	
7-Jul-03	Sta 09	yes				x	
8-Jul-03	Champlain Bridge	yes		x		x	
	Sta 46	yes	x			x	

9-Jul-03	Sta 33	yes					x	x
10-Jul-03	Sta 34	yes			x		x	x
11-Jul-03	Indian Brook Reservoir	yes				x		
14-Jul-03	Highgate Springs Shipyard	yes		x				
15-Jul-03	St. Albans- Lay Monitor	yes		x				
16-Jul-03	Sta 04	yes		x	x		x	
21-Jul-03	Champlain Bridge	yes			x			
28-Jul-03	Camp Randolph Swamp	yes		x				
	North of Larrabees Pt	no						
29-Jul-03	Button Bay shore	yes					x	
30-Jul-03	Ch#19 Point Au Fer	no						
4-Aug-03	Thompsons Pt	yes					x	
Grand Total			73	11	11	1	16	15

Appendix B. Counts of Algae in Quantitative Samples Collected from Lake Champlain in 2003.

Date	Location	Rep	Sample Type	Collection Source	Diatoms	Greens	Chryso-phytes	Cyano-bacteria	Dino-flagellates	Potential Toxin Producers	Total
12-Jun-03	VT DEC Sta 50	1	net	VT DEC	192.78	0.00	0.71	0.00	0.00	180.31	373.80
24-Jun-03	VT DEC Sta 50	1	net	VT DEC	4.76	0.29	0.00	0.00	0.00	53.42	58.47
1-Jul-03	Chapman Bay	1	net	UVM	8.33	15.70	4.39	0.00	0.00	570.18	598.60
		2	net	UVM	63.54	24.44	2.28	3.34	0.08	151.82	245.50
	Highgate Cliffs	1	net	UVM	5.53	84.03	0.00	5.67	0.00	680.63	775.86
		2	net	UVM	2.55	44.30	0.00	0.00	0.00	929.55	976.41
	Highgate Springs	1	net	UVM	0.73	73.04	0.00	0.00	0.07	316.99	390.83
		2	net	UVM	2.78	49.51	0.00	0.00	0.00	198.21	250.51
	Maquam Bay	1	net	UVM	2.04	4.34	0.52	2.61	1.36	107.73	118.60
		2	net	UVM	0.43	2.19	0.00	0.00	2.13	152.43	157.17
	Province Pt. Buoy	1	net	UVM	12.52	63.00	0.00	0.00	0.00	172.99	248.51
	Rt. 78 Access	1	net	UVM	71.53	105.21	21.57	0.00	0.00	417.51	615.83
		2	net	UVM	38.94	35.98	4.21	0.00	0.00	182.19	261.32
7-Jul-03	Burlington Water Bay	1	net	UVM	273.44	0.00	408.03	0.00	0.00	10.60	692.07
		2	net	UVM	137.82	18.19	639.49	0.00	0.00	0.00	795.50
	Champlain Water Bay	1	net	UVM	102.93	0.00	988.21	0.00	0.00	241.62	1332.76
		2	net	UVM	39.51	0.00	793.12	0.00	0.57	11.45	844.66
	North Beach	1	net	UVM	391.28	0.00	1200.91	0.00	0.00	317.63	1985.13
	Red Rocks Beach	1	net	UVM	92.41	7.47	1681.73	0.00	0.00	13.59	1795.21
		2	net	UVM	255.77	0.00	3203.21	0.00	0.00	48.72	3507.69
8-Jul-03	VT DEC Sta 50	1	net	VT DEC	106.12	74.01	0.08	3.95	0.00	645.24	829.40
9-Jul-03	VT DEC Sta 36	1	net	VT DEC	153.44	2.28	75.73	0.00	0.21	88.18	319.85
10-Jul-03	VT DEC Sta 40	1	net	VT DEC	120.90	31.80	0.00	1327.24	4.99	362.69	1847.63
14-Jul-03	Chapman Bay	1	net	UVM	155.77	85.38	0.00	0.00	0.00	2048.08	2289.23
		2	net	UVM	107.31	46.50	0.00	0.00	0.00	2253.46	2407.27
	Highgate Cliffs	1	net	UVM	775.64	166.88	0.00	0.00	0.00	9742.52	10685.04
		2	net	UVM	1414.87	268.67	0.00	0.00	0.00	10547.95	12231.49
	Highgate Springs	1	net	UVM	1308.46	586.38	0.00	0.00	0.00	12309.23	14204.08
		2	net	UVM	1650.77	170.77	2.85	0.00	0.00	15084.62	16909.00
	Lime Kiln Point	1	water[1]	Lay monitor	1127.82	2462.41	0.00	0.00	0.00	17951.13	21541.35
	Maquam Bay - Swanton Beach	1	water[1]	Lay monitor	878.93	21.97	0.00	1098.66	0.00	24170.51	26170.07
	Rt. 78 Access	1	net	UVM	160.68	57.44	0.00	0.00	0.00	4000.00	4218.12
		2	net	UVM	141.06	77.42	0.00	0.00	0.00	2001.13	2219.62
	VT DEC Sta 25	1	net	VT DEC	49.47	2.69	4.63	5.39	0.22	4.85	67.25

18-Jul-03	VT DEC Sta 16	1	net	VT DEC	746.90	0.00	0.00	0.00	0.14	42.85	789.89
	VT DEC Sta 19	1	net	VT DEC	686.68	0.00	1.64	0.00	0.00	63.05	751.37
	VT DEC Sta 21	1	net	VT DEC	756.68	0.00	2.02	0.00	0.00	103.24	861.94
21-Jul-03	Burlington Water Bay	1	net	UVM	168.84	0.00	2.15	0.00	0.14	219.38	390.52
		2	net	UVM	192.93	0.00	1.24	0.00	0.17	174.41	368.74
	Champlain Water Bay	1	net	UVM	541.54	0.11	0.00	0.00	0.22	269.91	811.77
		2	net	UVM	433.23	0.00	2.36	47.23	0.28	269.23	752.33
	North Beach	1	net	UVM	264.52	0.00	4.59	0.00	0.23	316.60	585.94
		2	net	UVM	159.69	5.47	0.00	0.00	0.00	112.04	277.20
	Red Rocks Beach	1	net	UVM	364.31	0.00	0.00	0.00	0.00	20.19	384.50
		2	net	UVM	196.84	0.00	3.80	0.00	0.14	46.34	247.12
22-Jul-03	Rock River Access	1	water[1]	UVM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		2	water[1]	UVM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Rt. 78 Access	1	water[1]	UVM	834.59	0.00	0.00	180.45	0.00	28195.49	29210.53
		2	water[1]	UVM	751.88	827.07	0.00	0.00	0.00	34511.28	36090.23
	VT DEC Sta 46	1	net	VT DEC	576.32	0.00	0.00	0.00	0.08	0.76	577.15
	VT DEC Sta 50	1	net	VT DEC	494.00	33.33	0.00	0.00	0.00	4653.33	5180.67
25-Jul-03	VT DEC Sta 34	1	net	VT DEC	1055.80	0.00	0.00	128.04	17.03	113.56	1314.43
	VT DEC Sta 40	1	net	VT DEC	590.35	268.75	0.00	1277.41	1.43	280.70	2418.64
			water[1]	VT DEC	534.32	17.00	0.00	1141.45	0.88	7.68	1701.32
28-Jul-03	Lime Kiln Point	1	water[1]	Lay monitor	97.47	808.97	0.00	0.00	9.75	11403.51	12319.69
	Maquam Bay - Swanton Beach	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	1900.00	1900.00
	Shipyard Bay - Highgate Springs	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	9868.42	9868.42
29-Jul-03	Chapman Bay	1	net	UVM	323.08	5.74	0.00	358.97	0.00	4846.15	5533.95
		2	net	UVM	238.92	0.00	0.00	0.00	0.39	2025.51	2264.82
	Highgate Cliffs	1	net	UVM	149.32	24.89	0.00	0.00	0.00	5813.57	5987.78
		2	net	UVM	179.49	22.44	0.00	0.00	0.00	3742.31	3944.23
	Highgate Springs	1	net	UVM	415.96	99.04	0.00	0.00	0.66	8728.59	9244.25
		2	net	UVM	399.49	35.04	0.00	0.00	0.00	6861.37	7295.90
	Missisquoi Bay Border Buoy	1	water[1]	UVM	657.89	0.00	0.00	657.89	0.00	61578.95	62894.74
	Rt. 78 Access	1	net	UVM	624.62	74.36	0.00	0.00	0.00	10975.38	11674.36
		2	net	UVM	633.46	0.00	0.00	0.00	0.00	6921.15	7554.62
31-Jul-03	St. Albans Bay - Ch#17	1	water[1]	Lay monitor	419.41	764.80	0.00	411.18	0.00	3782.89	5378.29
	Thompson's Pt	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	6085.53	6085.53
1-Aug-03	Oakledge	1	net	UVM	574.38	0.00	0.00	0.00	0.00	16929.23	17503.62
2-Aug-03	St. Albans Bay - near Lazy Lady	1	water[1]	Lay monitor	75.19	18796.99	0.00	1127819.55	0.00	143157.89	1289849.62
3-Aug-03	Champlain Bridge	2	net	UVM	678.08	0.00	0.00	1240.38	38.04	520.96	2477.46
4-Aug-03	Burlington Water Bay	1	net	UVM	89.08	0.01	0.77	0.46	0.09	5.98	96.39
		2	net	UVM	363.01	0.15	11.01	0.07	0.44	54.30	428.98
	Champlain Water Bay	1	net	UVM	193.04	3.84	14.97	3.84	0.77	8.44	224.89

		2	net	UVM	719.16	0.00	18.07	10.63	0.96	8.50	757.32
	Highgate Springs - Swamp	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	6140.35	6140.35
	Lime Kiln Point	1	water[1]	Lay monitor	272.23	0.00	0.00	0.00	9.07	13883.85	14165.15
	Maquam Bay - Swanton Beach	1	water[1]	Lay monitor	730.00	120.00	0.00	150.00	2.00	1530.00	2532.00
	North Beach	1	net	UVM	0.00	0.00	0.00	0.00	0.00	5.74	5.74
		2	net	UVM	109.52	0.22	7.15	5.45	0.16	66.71	189.21
	Red Rocks Beach	1	net	UVM	509.91	0.00	10.32	0.00	0.60	38.71	559.55
		2	net	UVM	289.02	0.00	16.83	0.08	0.48	93.75	400.16
	Shipyard Bay - Highgate Springs	1	water[1]	Lay monitor	13.16	0.00	0.00	0.00	0.00	18421.05	18434.21
	Sta 7	1	net	VT DEC	840.38	268.33	3.69	0.00	2.95	129.01	1244.36
	Sta 9	1	net	VT DEC	234.14	58.01	2.78	0.00	4.45	118.91	418.29
5-Aug-03	2 miles north of Larabee's Pt	1	water[1]	Lay monitor	623.27	0.00	0.00	2908.59	0.00	0.00	3531.86
	Button Bay broad lake	1	water[1]	Lay monitor	586.12	0.00	0.00	0.00	0.00	4186.60	4772.73
	Chapman Bay	1	net	UVM	1183.03	87.74	0.00	0.00	0.00	18516.92	19787.69
		2	net	UVM	732.54	0.00	0.00	0.00	0.00	10086.67	10819.21
	Highgate Cliffs	1	net	UVM	2036.67	0.00	0.00	0.00	6.67	32166.67	34210.00
		2	net	UVM	783.00	0.00	0.00	16730.77	0.00	20456.15	37969.92
	Highgate Springs	1	net	UVM	335.30	0.00	0.00	8299.60	3.32	23238.87	31877.09
	Rt. 78 Access	1	net	UVM	962.00	0.00	0.00	0.00	0.00	5720.00	6682.00
		2	net	UVM	926.82	0.00	0.00	0.00	0.00	7963.59	8890.41
	Sta 33	1	net	VT DEC	208.27	0.00	0.00	0.00	0.00	73.08	281.35
	Sta 36	1	net	VT DEC	201.59	0.00	1.05	86.45	1.01	0.04	290.15
6-Aug-03	Sta 16	1	net	VT DEC	105.58	0.00	7.82	0.00	0.78	875.90	990.08
	Sta 19	1	net	VT DEC	290.69	0.00	0.00	0.00	0.00	88.70	379.38
	Sta 21	1	net	VT DEC	174.69	0.00	1.71	0.00	0.51	7.13	184.05
7-Aug-03	Carry Bay	1	net	VT DEC	3251.50	26.34	0.00	0.00	0.00	1599.98	4877.83
	Sta 46	1	net	VT DEC	186.57	3.66	0.00	0.00	0.12	119.15	309.50
	Sta 50	1	net	VT DEC	225.68	30.27	0.00	0.00	0.00	919.80	1175.75
8-Aug-03	VT DEC Sta 04	1	net	VT DEC	82.24	6.75	1.58	0.00	0.32	5.27	96.15
9-Aug-03	St. Albans Bay - boatlaunch	1	water[1]	UVM	1578.95	144.74	0.00	657.89	52.63	33500.00	35934.21
10-Aug-03	Thompson's Pt	1	water[1]	Lay monitor	2539.47	78.95	0.00	0.00	52.63	1065.79	3736.84
11-Aug-03	Button Bay broad lake	1	water[1]	Lay monitor	11578.95	0.00	0.00	0.00	0.00	1964.91	13543.86
	Lime Kiln Point	1	water[1]	Lay monitor	389.86	29.24	0.00	0.00	0.00	10818.71	11237.82
	Maquam Bay - Swanton Beach	1	water[1]	Lay monitor	0.00	250.00	0.00	0.00	0.00	657.89	907.89
	Pete's Point	1	water[1]	Lay monitor	0.00	657.89	0.00	0.00	0.00	3947.37	4605.26
	Randolph - Swamp	1	water[1]	Lay monitor	0.00	169.17	0.00	0.00	18.80	939.85	1127.82
	Shipyard Bay - Highgate Springs	1	water[1]	Lay monitor	708.50	394.74	0.00	0.00	10.12	1619.43	2732.79
12-Aug-03	Chapman Bay	1	net	UVM	1499.15	109.44	3.11	18653.85	0.00	6448.01	26713.55
		2	net	UVM	296.15	7.18	0.00	13461.54	0.00	6353.85	20118.72
	Highgate Cliffs	1	net	UVM	1212.92	30.77	0.00	0.00	0.00	6910.77	8154.46

		2	net	UVM	1664.71	0.00	0.00	0.00	0.93	9620.19	11285.83
	Highgate Springs	1	net	UVM	1120.24	66.56	0.00	7564.10	0.76	4395.50	13147.17
		2	net	UVM	634.17	4.17	0.00	10416.67	0.00	4275.00	15330.00
	off Missisquoi NWR	1	water[1]	UVM	657.89	0.00	0.00	227302.63	0.00	34046.05	262006.58
	Rt. 78 Access	1	net	UVM	856.50	0.00	0.00	0.00	0.00	4200.00	5056.50
		2	net	UVM	848.94	0.00	0.00	0.00	0.00	1600.96	2449.90
	near Chapman Bay	1	water[1]	UVM	131.58	0.00	0.00	367105.26	0.00	18552.63	385789.47
	VT DEC Sta 25	1	net	VT DEC	56.33	0.76	0.00	7.59	0.46	95.65	160.78
13-Aug-03	Point au Fer (Ch#19)	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	1631.58	1631.58
	VT DEC Sta 34	1	net	VT DEC	25.61	0.00	0.00	279.35	1.86	270.51	577.33
	VT DEC Sta 40	1	net	VT DEC	750.26	0.00	0.00	97.44	3.90	3270.92	4122.51
14-Aug-03	St. Albans Bay - boatlaunch	1	water[1]	UVM	0.00	65.79	0.00	657.89	26.32	26328.95	27078.95
	VT DEC Sta 09	1	net	VT DEC	162.82	3.26	0.00	0.00	13.84	118.04	297.96
15-Aug-03	2 miles north of Larabee's Pt	1	water[1]	Lay monitor	0.00	6666.67	0.00	0.00	0.00	416266.67	422933.33
	vt dec Sta 33	1	net	VT DEC	375.10	1.55	0.43	2.15	0.34	73.00	452.57
	VT DEC Sta 36	1	net	VT DEC	17.95	129.23	0.00	358.97	0.72	804.10	1310.97
18-Aug-03	2 miles north of Larabee's Pt	1	water[1]	Lay monitor	48000.00	1600.00	0.00	0.00	0.00	112800.00	162400.00
	Burlington Water Bay	1	net	UVM	1189.37	0.00	0.00	16.24	1.95	101.66	1309.21
		2	net	UVM	207.42	0.65	0.00	0.00	0.97	384.46	593.49
	Champlain Water Bay	1	net	UVM	1027.17	0.00	0.00	20.09	20.49	1032.79	2100.54
		2	net	UVM	356.13	0.00	0.00	0.00	14.70	242.93	613.76
	Lime Kiln Point	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	1030400.00	1030400.00
	Maquam Bay - shore	1	water[1]	Lay monitor	0.00	0.00	0.00	140.35	0.00	14736.84	14877.19
	North Beach	1	net	UVM	1176.75	0.56	0.22	49.47	1.42	212.28	1440.70
		2	net	UVM	232.84	6.97	6.97	465.67	2.32	307.20	1021.97
	Pete's Point	1	water[1]	Lay monitor	48000.00	4800.00	0.00	0.00	0.00	354666.67	407466.67
	Randolph	1	water[1]	Lay monitor	200.00	84800.00	0.00	0.00	0.00	1988000.00	2073000.00
	Randolph - Swamp	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	2368.42	2368.42
	Red Rocks Beach	1	net	UVM	340.00	20.00	0.00	38.46	22.69	722.69	1143.85
		2	net	UVM	1045.03	225.87	0.00	162.18	52.19	982.81	2468.08
	Soft Beach-Highgate Public Beach	1	water[1]	Lay monitor	1605.26	105.26	0.00	0.00	26.32	87105.26	88842.11
	Thompson's Pt	1	water[1]	Lay monitor	26.32	0.00	0.00	0.00	210.53	157.89	394.74
19-Aug-03	Chapman Bay	1	net	UVM	1245.53	17.03	0.00	0.00	0.53	10896.41	12159.50
	Highgate Springs	1	net	UVM	993.13	23.15	0.00	0.00	0.83	4068.46	5085.58
		2	net	UVM	481.34	0.00	0.00	1914.84	4.51	5999.82	8400.49
	Point au Fer (Ch#19)	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	934.21	934.21
	Rt. 78 Access	1	net	UVM	1753.62	65.38	0.00	0.00	9.15	17562.31	19390.46
	Rt. 78 Access - shoreline	1	water[1]	UVM	0.00	0.00	0.00	40056000.00	0.00	420000.00	40476000.00
	Rt. 78 Access - shoreline QA	1	water[1]	UVM	18000.00	32600.00	0.00	8952000.00	0.00	0.00	9002600.00
20-Aug-03	Button Bay Shoreline	1	water[1]	Lay monitor	0.00	0.00	0.00	657.89	0.00	1473.68	2131.58

	Champlain Bridge	1	net	UVM	302.31	139.96	0.00	0.00	2.80	1489.15	1934.21
		2	net	UVM	252.36	85.26	0.00	596.79	0.57	750.26	1685.24
21-Aug-03	Sta 16	1	net	VT DEC	1194.73	0.00	0.00	0.00	4.01	517.28	1716.03
	Sta 19	1	net	VT DEC	996.91	0.51	0.00	0.00	2.06	236.16	1235.64
	Sta 21	1	net	VT DEC	761.08	0.17	0.61	4.35	0.17	181.53	947.91
25-Aug-03	Lime Kiln Point	1	water[1]	Lay monitor	12000.00	0.00	0.00	0.00	0.00	1399236.84	1411368.42
	Maquam Bay	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	7894.74	7894.74
	Pete's Point	1	water[1]	Lay monitor	0.00	877.19	0.00	0.00	0.00	69122.81	70000.00
	Randolph - Swamp	1	water[1]	Lay monitor	1052.63	0.00	0.00	0.00	0.00	46140.35	47192.98
	Shipyard Bay - Highgate Springs	1	water[1]	Lay monitor	8.22	633.22	0.00	411.18	0.00	12088.82	13141.45
	Sta 4	1	net	VT DEC	167.31	0.00	0.00	0.00	1.12	312.31	480.73
26-Aug-03	Chapman Bay	1	net	UVM	196.58	0.00	0.00	0.00	0.00	3136.75	3333.33
		2	net	UVM	220.00	0.00	0.00	0.00	0.00	4192.22	4412.22
	Highgate Cliffs	1	net	UVM	232.37	0.00	0.00	30.98	4.65	6707.80	6975.80
		2	net	UVM	336.54	0.00	0.00	67.31	6.73	9914.42	10513.46
			water[1]	UVM	0.00	0.00	0.00	0.00	0.00	654736.84	654736.84
	Highgate Springs	1	net	UVM	123.33	0.00	0.00	0.00	0.00	3662.05	3785.38
		2	net	UVM	223.08	0.00	0.00	0.00	2.48	4697.01	4922.56
	Rt. 78 Access	1	net	UVM	288.65	0.00	0.00	0.00	0.00	5484.42	5773.08
		2	net	UVM	274.04	11.54	0.00	72.12	0.00	5120.19	5477.88
	Rt. 78 Access - shoreline	1	water[1]	UVM	0.00	0.00	0.00	0.00	0.00	1170666.67	1170666.67
	St. Albans Bay - boatlaunch	2	water[1]	UVM	87.72	526.32	0.00	9210.53	0.00	9517.54	19342.11
28-Aug-03	Sta 50	1	net	VT DEC	206.13	0.00	0.00	0.00	0.38	2350.43	2556.94
1-Sep-03	Shipyard Bay - Highgate Springs	1	water[1]	Lay monitor	4486.84	0.00	0.00	0.00	0.00	23815.79	28302.63
2-Sep-03	Burlington Water Bay	1	net	UVM	2165.54	0.00	0.00	4358.97	5.23	1914.03	8443.77
		2	net	UVM	1571.19	0.00	0.00	0.00	1.56	1711.90	3284.65
	Champlain Water Bay	1	net	UVM	3818.76	0.00	0.00	391.03	3.91	3871.15	8084.85
		2	net	UVM	2675.88	0.00	0.00	484.62	7.27	4895.42	8063.19
	North Beach	1	net	UVM	1390.77	0.00	0.00	25.64	0.51	3450.77	4867.69
		2	net	UVM	1224.15	0.00	0.00	257.37	3.74	1617.70	3102.97
	Red Rocks Beach	1	net	UVM	5107.69	0.00	3.21	320.51	5.77	1176.92	6614.10
		2	net	UVM	782.73	0.00	0.00	30.13	5.42	1071.96	1890.24
3-Sep-03	Champlain Bridge	1	net	UVM	59.44	1.85	0.00	18.47	0.22	39.68	119.66
		2	net	UVM	79.87	2.80	0.00	0.00	0.17	165.51	248.35
	St. Albans Bay - boatlaunch	1	water[1]	UVM	5889.72	0.00	0.00	626.57	37.59	9310.78	15864.66
		2	water[1]	UVM	3157.89	0.00	0.00	657.89	52.63	17236.84	21105.26
4-Sep-03	Chapman Bay	1	net	UVM	1533.73	0.00	0.00	0.00	1.42	10683.59	12218.74
		2	net	UVM	1246.15	0.00	0.00	0.00	0.00	6635.77	7881.92
	Highgate Cliffs	2	net	UVM	3384.31	0.00	0.00	0.00	0.00	9886.15	13270.46
	Highgate Springs	1	net	UVM	2479.87	0.00	0.00	0.00	0.00	8815.51	11295.38

	Rt. 78 Access	1	net	UVM	4918.81	81.41	0.00	0.00	0.00	11967.31	16967.53
		2	net	UVM	2501.48	0.00	0.00	0.00	0.00	10296.92	12798.40
5-Sep-03	Sta 34	1	net	VT DEC	0.00	0.00	0.00	30.13	0.00	3.62	33.74
	Sta 40	1	net	VT DEC	5915.90	0.00	0.00	0.00	1.44	1486.15	7403.49
8-Sep-03	Randolph - Swamp	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	38421.05	38421.05
	Shipyard Bay - Highgate Springs	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	46842.11	46842.11
9-Sep-03	Alburg	1	net	UVM	9888.31	0.00	0.00	0.00	0.00	22876.00	32764.31
		2	net	UVM	6852.23	0.00	0.00	0.00	0.00	33485.38	46631.15
	Chapman Bay	1	net	UVM	1884.81	0.00	0.00	31.73	0.00	4119.29	6035.83
		2	net	UVM	1837.50	0.00	0.00	0.00	0.00	3367.50	5205.00
	Highgate Cliffs	1	net	UVM	1567.50	13.33	0.00	0.00	0.00	4775.83	6356.67
		2	net	UVM	2237.31	2.42	0.00	403.85	0.00	5645.77	8289.35
	Highgate Springs	1	net	UVM	1668.59	0.00	0.00	0.00	0.88	7008.08	8677.54
	Rt. 78 Access	1	net	UVM	3192.82	0.00	0.00	0.00	0.00	3181.54	6374.36
	St. Albans Bay - boatlaunch	1	water[1]	UVM	4789.47	0.00	0.00	0.00	13.16	1855.26	6657.89
		2	water[1]	UVM	10776.94	0.00	0.00	0.00	0.00	5375.94	16152.88
	Sta 07	1	net	VT DEC	566.35	0.00	0.00	29.81	7.15	779.77	1383.08
10-Sep-03	Burlington Water Bay	2	net	UVM	278.95	0.00	0.00	55.13	2.76	648.31	985.14
	Champlain Water Bay	1	net	UVM	9.44	27.52	0.00	0.00	0.00	476.51	513.47
		2	net	UVM	82.87	0.00	0.00	64.74	5.83	1173.15	1326.60
	North Beach	2	net	UVM	73.92	0.00	0.00	0.00	0.00	525.81	599.73
	Red Rocks Beach	2	net	UVM	43.46	0.00	7.24	0.00	1.45	110.10	162.26
	Sta 33	1	net	VT DEC	0.00	0.00	0.00	0.00	2.41	38.56	40.97
	Sta 36	1	net	VT DEC	311.19	0.00	3.04	304.49	1.22	2.44	622.37
11-Sep-03	Sta 02	1	net	VT DEC	123.14	0.00	10.87	0.00	0.00	43.46	177.47
	Sta 04	1	net	VT DEC	0.00	0.00	0.00	0.00	1.22	30.45	31.67
15-Sep-03	Randolph - Swamp	1	water[1]	Lay monitor	16460.53	2368.42	0.00	0.00	0.00	9868.42	28697.37
	Shipyard Bay - Highgate Springs	1	water[1]	Lay monitor	2644.74	0.00	0.00	0.00	0.00	9868.42	12513.16
16-Sep-03	Alburg	1	net	UVM	720.19	102.88	0.00	0.00	0.00	5189.50	6012.58
		2	net	UVM	843.65	0.00	0.00	0.00	0.00	5498.15	6341.81
	Chapman Bay	1	net	UVM	413.33	0.00	0.00	0.00	0.00	1645.38	2058.72
		2	net	UVM	200.51	0.00	0.00	0.00	0.00	2660.72	2861.23
	Highgate Cliffs	1	net	UVM	148.15	0.00	0.00	0.00	1.22	5387.18	5536.55
		2	net	UVM	122.44	0.00	0.00	0.00	0.00	6317.69	6440.13
	Highgate Springs	1	net	UVM	1.18	141.54	0.00	0.00	0.00	10666.10	10808.82
		2	net	UVM	296.65	0.00	0.00	0.00	2.96	9199.53	9500.31
	Maquam Bay	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	657.89	657.89
	Rt. 78 Access	1	net	UVM	2388.46	0.00	0.00	0.00	2.21	7373.27	9763.94
		2	net	UVM	3606.73	0.00	0.00	0.00	0.00	5398.46	9005.19
	St. Albans Bay - boatlaunch	1	water[1]	UVM	3289.47	0.00	0.00	0.00	0.00	9947.37	13236.84

		2	water[1]	UVM	4342.11	0.00	0.00	0.00	0.00	5894.74	10236.84
17-Sep-03	Sta 16	1	net	VT DEC	0.00	0.00	0.00	36.54	0.00	414.35	450.88
	Sta 19	1	net	VT DEC	10.26	0.00	0.00	0.00	0.00	1282.05	1292.31
	Sta 21	1	net	VT DEC	3.10	0.00	0.00	0.00	0.00	1693.22	1696.33
18-Sep-03	Burlington Water Bay	1	net	UVM	34.00	25.91	9.73	358.47	1.54	475.43	905.08
		2	net	UVM	21.70	29.40	13.30	210.02	1.26	866.40	1142.09
	Champlain Water Bay	1	net	UVM	0.00	0.00	2.76	0.00	2.21	465.28	470.24
		2	net	UVM	12.50	2.92	4.17	20.83	2.50	395.83	438.75
	North Beach	1	net	UVM	13.52	3.02	7.28	218.45	1.14	452.83	696.25
		2	net	UVM	21.12	10.83	4.51	361.00	1.99	603.59	1003.03
	Red Rocks Beach	1	net	UVM	7.87	10.37	3.54	177.23	0.52	212.76	412.30
		2	net	UVM	30.33	0.00	2.66	26.60	3.19	101.09	163.87
	Sta 25	1	net	VT DEC	3.06	0.00	0.00	24.25	0.44	30.55	58.30
22-Sep-03	Maquam Bay	1	water[1]	Lay monitor	0.00	0.00	0.00	0.00	0.00	1447.37	1447.37
	Randolph - Swamp	1	water[1]	Lay monitor	26.32	0.00	0.00	0.00	0.00	2763.16	2789.47
	Shipyard Bay - Highgate Springs	1	water[1]	Lay monitor	2644.74	5526.32	0.00	0.00	0.00	25000.00	33171.05
24-Sep-03	Chapman Bay	1	net	UVM	12.23	1.32	0.00	0.00	0.00	8474.17	8494.69
	Highgate Cliffs	1	net	UVM	28.15	0.00	0.00	0.00	0.00	10103.50	10131.64
	St. Albans Bay - boatlaunch	1	net	UVM	284.21	189.47	0.00	4210.53	0.00	5368.42	10052.63
			water[1]	UVM	970.96	127.04	0.00	2268.60	0.00	11306.72	14673.32
30-Sep-03	Chapman Bay	2	net	UVM	1.24	0.00	0.00	0.00	0.00	2104.44	2105.68
	Highgate Cliffs	1	net	UVM	111.67	0.00	0.00	0.00	0.00	3377.00	3488.66
	Rt. 78 Access	1	net	UVM	175.38	73.08	0.00	0.00	0.00	584.62	833.08
		2	net	UVM	1.60	0.00	0.00	0.00	0.00	2319.21	2320.81
	St. Albans Bay - boatlaunch	2	water[1]	UVM	2119.11	13.85	0.00	0.00	0.00	7894.74	10027.70
7-Oct-03	Chapman Bay	1	net	UVM	0.69	0.00	0.00	0.00	0.00	1097.44	1098.12
		2	net	UVM	0.00	0.00	0.00	0.00	0.00	790.56	790.56
	Rt. 78 Access	2	net	UVM	1272.94	0.00	0.00	0.00	0.00	4054.53	5327.47
	St. Albans Bay - boatlaunch	1	water[1]	UVM	92.11	0.00	0.00	0.00	0.00	2723.68	2815.79
		2	water[1]	UVM	131.58	0.00	0.00	0.00	13.16	2513.16	2657.89
11-Oct-03	Burlington Waterfront Dog Park	1	water[1]	UVM	263.16	0.00	0.00	0.00	0.00	90263.16	90526.32
		2	water[1]	UVM	736.84	0.00	0.00	0.00	0.00	56052.63	56789.47
14-Oct-03	Rt. 78 Access	2	water[1]	UVM	105.26	0.00	0.00	0.00	0.00	1578.95	1684.21
	Rt. 78 Access - shoreline	1	water[1]	UVM	684.21	0.00	0.00	0.00	0.00	1973.68	2657.89
	St. Albans Bay - boatlaunch	1	water[1]	UVM	26.32	0.00	65.79	0.00	0.00	0.00	92.11
		2	water[1]	UVM	26.32	13.16	0.00	0.00	0.00	0.00	39.47
	Tyler Place	1	water[1]	UVM	92.11	131.58	13.16	0.00	0.00	0.00	236.84
		2	water[1]	UVM	52.63	0.00	13.16	0.00	0.00	657.89	723.68
21-Oct-03	Burlington Water Bay	1	net	UVM	107.23	51.51	15.77	0.00	0.00	440.49	615.00
		2	net	UVM	50.00	0.00	1.00	0.00	0.00	312.00	363.00

	Champlain Water Bay	1	net	UVM	65.05	0.00	16.54	0.00	0.00	274.54	356.13
		2	net	UVM	77.00	0.00	0.00	0.00	0.00	331.69	408.69
	North Beach	1	net	UVM	39.95	0.00	0.00	0.00	0.00	480.44	520.38
		2	net	UVM	61.35	0.00	0.00	0.00	0.00	325.69	387.04
	Red Rocks Beach	1	net	UVM	62.31	0.00	17.31	0.00	0.00	357.69	437.31
		2	net	UVM	79.62	0.00	0.00	0.00	0.00	116.54	196.15
	Sta 40	1	net	VT DEC	34.80	20.27	0.00	114.71	0.76	86.03	256.57
23-Oct-03	Rt. 78 Access - shoreline	1	net	UVM	9600.00	0.00	0.00	0.00	0.00	0.00	9600.00
		2	water[1]	UVM	4400.00	0.00	0.00	0.00	0.00	0.00	4400.00
	St. Albans Bay - boatlaunch	1	water[1]	UVM	197.37	0.00	0.00	0.00	0.00	0.00	197.37
		2	water[1]	UVM	171.05	0.00	0.00	0.00	0.00	0.00	171.05
	Tyler Place	1	water[1]	UVM	22800.00	200.00	0.00	0.00	0.00	2400.00	25400.00
		2	net	UVM	368.42	0.00	0.00	0.00	0.00	131.58	500.00
26-Aug-26	St. Albans Bay - boatlaunch	1	water[1]	UVM	164.47	197.37	0.00	4531.25	0.00	27615.13	32508.22

[1]Whole water sample counted by net protocol.

Appendix C. Results of Toxin Analyses for Samples Collected from Lake Champlain, 2003.

					Microcystin by ELISA			Microcystin by PPIA		Anatoxin-a
Collection Dates	Sample Locations	Rep	Net, Plankton or Whole Water	Run by	Toxin Conc. In Lake Water, ug/L	Analysis Date	Sample %CV (if greater than ~15%)	Mean Toxin Conc. In Lake Water, ug/L	SD	Toxin Conc. In Lake Water, ug/L
14-Jul-03	Chapman Bay	1	net	UVM	0.005	7/16/2003				
14-Jul-03	Chapman Bay	2	net	UVM	0.005	7/16/2003				
14-Jul-03	Highgate Cliffs	1	net	UVM	0.012	7/16/2003				
14-Jul-03	Highgate Cliffs	dup	net	UVM	0.087	7/16/2003				
14-Jul-03	Highgate Cliffs	2	net	UVM	0.035	7/16/2003				
14-Jul-03	Highgate Cliffs	dup	net	UVM	0.034	7/16/2003				
29-Jul-03	Highgate Cliffs	1	net	UVM	0.082	2/25/2004	17			
29-Jul-03	Highgate Cliffs	2	net	UVM	0.079	2/25/2004	30			
5-Aug-03	Highgate Cliffs	1	net	UVM	0.071	2/25/2004				
5-Aug-03	Highgate Cliffs	2	net	UVM	0.035	2/25/2004				
12-Aug-03	Highgate Cliffs	1	net	UVM	0.067	2/25/2004				
12-Aug-03	Highgate Cliffs	dup	net	UVM	0.082	2/25/2004				
12-Aug-03	Highgate Cliffs	2	net	UVM	0.074	2/25/2004				
19-Aug-03	Highgate Cliffs	1	net	UVM	0.097	2/25/2004				
19-Aug-03	Highgate Cliffs	2	net	UVM	0.068	2/25/2004				
26-Aug-03	Highgate Cliffs	1	net	UVM	0.349	2/25/2004	25			
26-Aug-03	Highgate Cliffs	2	net	UVM	0.176	2/25/2004				
4-Sep-03	Highgate Cliffs	1	net	UVM	0.491	2/25/2004	27			
4-Sep-03	Highgate Cliffs	2	net	UVM	0.287	2/25/2004				
9-Sep-03	Highgate Cliffs	1	net	UVM	0.331	2/25/2004	57			
9-Sep-03	Highgate Cliffs	2	net	UVM	0.149	2/25/2004	19			
17-Sep-03	Highgate Cliffs	1	net	UVM	0.106	2/25/2004				
17-Sep-03	Highgate Cliffs	2	net	UVM	0.153	2/25/2004				
24-Sep-03	Highgate Cliffs	1	net	UVM	0.097	2/25/2004	109.5			
24-Sep-03	Highgate Cliffs	2	net	UVM	0.196	2/25/2004				
30-Sep-03	Highgate Cliffs	1	net	UVM	0.114	2/25/2004	23			
30-Sep-03	Highgate Cliffs	2	net	UVM	0.103	2/25/2004				
7-Oct-03	Highgate Cliffs	1	net	UVM	0.117	2/25/2004				
7-Oct-03	Highgate Cliffs	2	net	UVM	0.118	2/25/2004				
14-Jul-03	Rock River	1	net	UVM	0.097	7/16/2003				
14-Jul-03	Rock River	1	net	UVM	0.059	7/16/2003				

14-Jul-03	Rock River	2	net	UVM	0.442	7/16/2003			
14-Jul-03	Rte 78 Access	1	net	UVM	0.006	7/16/2003			
14-Jul-03	Rte 78 Access	2	net	UVM	0.007	7/16/2003			
9-Sep-03	Alburg	1	ww	UVM	0.115	9/10/2003			
9-Sep-03	Alburg	2	ww	UVM	<0.05	9/10/2003			
17-Sep-03	Alburg	1	ww	UVM	0.078	9/18/2003			
17-Sep-03	Alburg	3	ww	Wright State					nd
17-Sep-03	Alburg	2	ww	UVM	0.059	9/18/2003			
17-Sep-03	Alburg	4	ww	Wright State					nd
24-Sep-03	Alburg	1	ww	UVM	0.059	9/25/2003			
24-Sep-03	Alburg	2	ww	UVM	0.11	9/25/2003			
30-Sep-03	Alburg	1	ww	UVM	0.056	10/1/2003	25		
30-Sep-03	Alburg	2	ww	UVM	0.069	10/1/2003			
7-Oct-03	Alburg	1	ww	UVM	<0.05	10/8/2003	40		
7-Oct-03	Alburg	2	ww	UVM	<0.05	10/8/2003			
10-Sep-03	Burlington Water Bay	1	ww	UVM	<0.05	9/10/2003	131		
10-Sep-03	Burlington Water Bay	2	ww	UVM	<0.05	9/10/2003	21		
10-Sep-03	Champlain Water Bay	1	ww	UVM	<0.05	9/10/2003	111		
10-Sep-03	Champlain Water Bay	2	ww	UVM	<0.05	9/10/2003			
1-Jul-03	Chapman Bay	1	ww	UVM	<0.05	7/2/2003			
1-Jul-03	Chapman Bay	2	ww	UVM	<0.05	7/2/2003			
14-Jul-03	Chapman Bay	1	ww	UVM	<0.05	7/15/2003			
14-Jul-03	Chapman Bay	dup	ww	UVM	0.050	7/15/2003			
14-Jul-03	Chapman Bay	2	ww	UVM	<0.05	7/15/2003			
29-Jul-03	Chapman Bay	1	ww	UVM	<0.05	7/30/2003	31		
29-Jul-03	Chapman Bay	2	ww	UVM	<0.05	7/30/2003	43		
5-Aug-03	Chapman Bay	1	ww	UVM	0.054	8/6/2003			
5-Aug-03	Chapman Bay	2	ww	UVM	0.069	8/6/2003	40		
12-Aug-03	Chapman Bay	1	ww	UVM	<0.05	8/13/2003			
12-Aug-03	Chapman Bay	2	ww	UVM	<0.05	8/13/2003			
12-Aug-03	Chapman Bay	dup	ww	UVM	0.055	8/13/2003			
19-Aug-03	Chapman Bay	1	ww	UVM	0.053	8/20/2003			
19-Aug-03	Chapman Bay	2	ww	UVM	0.07	8/20/2003			
26-Aug-03	Chapman Bay	1	ww	UVM	0.312	8/27/2003			
26-Aug-03	Chapman Bay	2	ww	UVM	0.084	8/27/2003	31		
4-Sep-03	Chapman Bay	1	ww	UVM	0.126	9/5/2003	27		
4-Sep-03	Chapman Bay	2	ww	UVM	0.099	9/5/2003			
9-Sep-03	Chapman Bay	1	ww	UVM	0.089	9/10/2003			
9-Sep-03	Chapman Bay	2	ww	UVM	0.078	9/10/2003	20		
17-Sep-03	Chapman Bay	1	ww	UVM	0.061	9/18/2003			

17-Sep-03	Chapman Bay	2	ww	UVM	0.055	9/18/2003	25		
24-Sep-03	Chapman Bay	1	ww	UVM	<0.05	9/25/2003	22		
24-Sep-03	Chapman Bay	2	ww	UVM	0.053	9/25/2003	75		
30-Sep-03	Chapman Bay	1	ww	UVM	<0.05	10/1/2003	38		
30-Sep-03	Chapman Bay	2	ww	UVM	<0.05	10/1/2003	20		
7-Oct-03	Chapman Bay	1	ww	UVM	0.052	10/8/2003	24		
7-Oct-03	Chapman Bay	2	ww	UVM	<0.05	10/8/2003	45		
1-Jul-03	Highgate Cliffs	1	ww	UVM	<0.05	7/2/2003			
1-Jul-03	Highgate Cliffs	2	ww	UVM	0.061	7/2/2003			
14-Jul-03	Highgate Cliffs	1	ww	UVM	0.106	7/15/2003			
14-Jul-03	Highgate Cliffs	2	ww	UVM	0.108	7/15/2003			
14-Jul-03	Highgate Cliffs	dup	ww	UVM	0.091	7/15/2003			
29-Jul-03	Highgate Cliffs	1	ww	UVM	0.056	7/30/2003			
29-Jul-03	Highgate Cliffs	dup	ww	UVM	0.073	7/30/2003			
29-Jul-03	Highgate Cliffs	2	ww	UVM	<0.05	7/30/2003			
5-Aug-03	Highgate Cliffs	1	ww	UVM	0.084	8/6/2003			
5-Aug-03	Highgate Cliffs	2	ww	UVM	0.074	8/6/2003			
5-Aug-03	Highgate Cliffs	dup	ww	UVM	0.066	8/6/2003	32		
12-Aug-03	Highgate Cliffs	1	ww	UVM	<0.05	8/13/2003	58		
12-Aug-03	Highgate Cliffs	2	ww	UVM	0.055	8/13/2003			
19-Aug-03	Highgate Cliffs	1	ww	UVM	<0.05	8/20/2003	17		
19-Aug-03	Highgate Cliffs	2	ww	UVM	<0.05	8/20/2003	52		
26-Aug-03	Highgate Cliffs	1	ww	UVM	0.16	8/27/2003	40		
26-Aug-03	Highgate Cliffs	2	ww	UVM	0.067	8/27/2003			
26-Aug-03	Highgate Cliffs	dup	ww	UVM	0.12	8/27/2003			
9-Sep-03	Highgate Cliffs	1	ww	UVM	0.086	9/10/2003			
9-Sep-03	Highgate Cliffs	2	ww	UVM	0.061	9/10/2003	27		
17-Sep-03	Highgate Cliffs	1	ww	UVM	0.059	9/18/2003	20		
17-Sep-03	Highgate Cliffs	2	ww	UVM	0.06	9/18/2003			
24-Sep-03	Highgate Cliffs	1	ww	UVM	0.082	9/25/2003	80		
24-Sep-03	Highgate Cliffs	2	ww	UVM	0.085	9/25/2003			
30-Sep-03	Highgate Cliffs	1	ww	UVM	0.061	10/1/2003	22		
30-Sep-03	Highgate Cliffs	2	ww	UVM	<0.05	10/1/2003			
7-Oct-03	Highgate Cliffs	1	ww	UVM	0.068	10/8/2003			
7-Oct-03	Highgate Cliffs	2	ww	UVM	0.051	10/8/2003			
1-Jul-03	Highgate Springs	1	ww	UVM	<0.05	7/2/2003			
1-Jul-03	Highgate Springs	2	ww	UVM	0.062	7/2/2003			
5-Aug-03	Highgate Springs	1	ww	UVM	0.076	8/6/2003			
5-Aug-03	Highgate Springs	2	ww	UVM	0.063	8/6/2003			
5-Aug-03	Highgate Springs	dup	ww	UVM	0.061	8/6/2003			
12-Aug-03	Highgate Springs	1	ww	UVM	<0.05	8/13/2003			

12-Aug-03	Highgate Springs	2	ww	UVM	0.053	8/13/2003	
12-Aug-03	Highgate Springs	dup	ww	UVM	<0.05	8/13/2003	34
19-Aug-03	Highgate Springs	1	ww	UVM	<0.05	8/20/2003	
19-Aug-03	Highgate Springs	2	ww	UVM	0.062	8/20/2003	24
19-Aug-03	Highgate Springs	dup	ww	UVM	<0.05	8/20/2003	31
26-Aug-03	Highgate Springs	1	ww	UVM	0.168	8/27/2003	
26-Aug-03	Highgate Springs	2	ww	UVM	0.092	8/27/2003	
4-Sep-03	Highgate Springs	1	ww	UVM	0.078	9/5/2003	
4-Sep-03	Highgate Springs	2	ww	UVM	0.076	9/5/2003	
4-Sep-03	Highgate Springs	dup	ww	UVM	0.078	9/5/2003	
9-Sep-03	Highgate Springs	1	ww	UVM	0.065	9/10/2003	28
9-Sep-03	Highgate Springs	2	ww	UVM	0.06	9/10/2003	37
17-Sep-03	Highgate Springs	1	ww	UVM	<0.05	9/18/2003	52
17-Sep-03	Highgate Springs	2	ww	UVM	0.059	9/18/2003	25
24-Sep-03	Highgate Springs	1	ww	UVM	0.057	9/25/2003	21
24-Sep-03	Highgate Springs	2	ww	UVM	0.085	9/25/2003	69
30-Sep-03	Highgate Springs	1	ww	UVM	<0.05	10/1/2003	23
30-Sep-03	Highgate Springs	2	ww	UVM	0.053	10/1/2003	
7-Oct-03	Highgate Springs	1	ww	UVM	0.056	10/8/2003	
7-Oct-03	Highgate Springs	2	ww	UVM	0.056	10/8/2003	
1-Jul-03	Maquam Bay	1	ww	UVM	<0.05	7/2/2003	
1-Jul-03	Maquam Bay	2	ww	UVM	<0.05	7/2/2003	
12-Aug-03	near Chapman Bay	1	ww	UVM	<0.05	8/13/2003	
10-Sep-03	North Beach	1	ww	UVM	<0.05	9/10/2003	52
10-Sep-03	North Beach	2	ww	UVM	<0.05	9/10/2003	
12-Aug-03	off of refuge	1	ww	UVM	<0.05	8/13/2003	19
10-Sep-03	Red Rocks	1	ww	UVM	<0.05	9/10/2003	54
10-Sep-03	Red Rocks	2	ww	UVM	<0.05	9/10/2003	118
14-Jul-03	Rock River	1	ww	UVM	0.087	7/15/2003	
14-Jul-03	Rock River	2	ww	UVM	0.076	7/15/2003	
14-Jul-03	Rock River	dup	ww	UVM	0.109	7/15/2003	
22-Jul-03	Rock River	1	ww	UVM	<0.05	7/23/2003	
22-Jul-03	Rock River	2	ww	UVM	<0.05	7/23/2003	27
1-Jul-03	Rte 78 Access	1	ww	UVM	<0.05	7/2/2003	
1-Jul-03	Rte 78 Access	2	ww	UVM	<0.05	7/2/2003	
14-Jul-03	Rte 78 Access	1	ww	UVM	<0.05	7/15/2003	
14-Jul-03	Rte 78 Access	dup	ww	UVM	<0.05	7/15/2003	
14-Jul-03	Rte 78 Access	2	ww	UVM	<0.05	7/15/2003	
22-Jul-03	Rte 78 Access	1	ww	UVM	<0.05	7/23/2003	
22-Jul-03	Rte 78 Access	2	ww	UVM	<0.05	7/23/2003	
29-Jul-03	Rte 78 Access	1	ww	UVM	<0.05	7/30/2003	

29-Jul-03	Rte 78 Access	2	ww	UVM	<0.05	7/30/2003	
29-Jul-03	Rte 78 Access	dup	ww	UVM	<0.05	7/30/2003	50
5-Aug-03	Rte 78 Access	1	ww	UVM	<0.05	8/6/2003	
5-Aug-03	Rte 78 Access	2	ww	UVM	0.050	8/6/2003	
5-Aug-03	Rte 78 Access	dup	ww	UVM	<0.05	8/6/2003	
12-Aug-03	Rte 78 Access	1	ww	UVM	<0.05	8/13/2003	
12-Aug-03	Rte 78 Access	2	ww	UVM	<0.05	8/13/2003	19
19-Aug-03	Rte 78 Access	1	ww	UVM	<0.05	8/20/2003	40
19-Aug-03	Rte 78 Access	2	ww	UVM	<0.05	8/20/2003	54
19-Aug-03	Rte 78 Access	dup	ww	UVM	0.053	8/20/2003	38
26-Aug-03	Rte 78 Access	1	ww	UVM	0.084	8/27/2003	
26-Aug-03	Rte 78 Access	2	ww	UVM	0.101	8/27/2003	30
4-Sep-03	Rte 78 Access	1	ww	UVM	0.096	9/5/2003	24
4-Sep-03	Rte 78 Access	2	ww	UVM	0.099	9/5/2003	
4-Sep-03	Rte 78 Access	dup	ww	UVM	0.101	9/5/2003	
9-Sep-03	Rte 78 Access	1	ww	UVM	0.073	9/10/2003	
9-Sep-03	Rte 78 Access	2	ww	UVM	<0.05	9/10/2003	
17-Sep-03	Rte 78 Access	1	ww	UVM	0.086	9/18/2003	
17-Sep-03	Rte 78 Access	2	ww	UVM	0.062	9/18/2003	
24-Sep-03	Rte 78 Access	1	ww	UVM	0.093	9/25/2003	
24-Sep-03	Rte 78 Access	2	ww	UVM	0.059	9/25/2003	
30-Sep-03	Rte 78 Access	1	ww	UVM	<0.05	10/1/2003	
30-Sep-03	Rte 78 Access	2	ww	UVM	<0.05	10/1/2003	
7-Oct-03	Rte 78 Access	1	ww	UVM	<0.05	10/8/2003	
7-Oct-03	Rte 78 Access	2	ww	UVM	0.051	10/8/2003	
14-Oct-03	Rte 78 Access	1	ww	UVM	0.082	10/15/2003	28
14-Oct-03	Rte 78 Access	2	ww	UVM	0.077	10/15/2003	25
23-Oct-03	Rte 78 Access	1	ww	UVM	0.511	10/24/2003	
23-Oct-03	Rte 78 Access	2	ww	UVM	0.443	10/24/2003	32
26-Aug-03	Rte 78 Access- shore	1	ww	UVM	0.067	8/27/2003	
19-Aug-03	St. Albans Boatlaunch	1	ww	UVM	<0.05	8/20/2003	28
19-Aug-03	St. Albans Boatlaunch	2	ww	UVM	0.057	8/20/2003	24
26-Aug-03	St. Albans Boatlaunch	1	ww	UVM	0.077	8/27/2003	
26-Aug-03	St. Albans Boatlaunch	2	ww	UVM	0.084	8/27/2003	31
9-Sep-03	St. Albans Boatlaunch	1	ww	UVM	<0.05	9/10/2003	
9-Sep-03	St. Albans Boatlaunch	2	ww	UVM	0.084	9/10/2003	
16-Sep-03	St. Albans Boatlaunch	1	ww	UVM	0.056	9/18/2003	
16-Sep-03	St. Albans Boatlaunch	2	ww	UVM	0.058	9/18/2003	43
24-Sep-03	St. Albans Boatlaunch	1	ww	UVM	0.066	9/25/2003	28
24-Sep-03	St. Albans Boatlaunch	2	ww	UVM	0.099	9/25/2003	30
30-Sep-03	St. Albans Boatlaunch	1	ww	UVM	0.053	10/1/2003	

30-Sep-03	St. Albans Boatlaunch	2	ww	UVM	<0.05	10/1/2003	
7-Oct-03	St. Albans Boatlaunch	1	ww	UVM	0.054	10/8/2003	
7-Oct-03	St. Albans Boatlaunch	2	ww	UVM	<0.05	10/8/2003	
14-Oct-03	St. Albans Boatlaunch	1	ww	UVM	<0.05	10/15/2003	26
14-Oct-03	St. Albans Boatlaunch	2	ww	UVM	0.054	10/15/2003	
23-Oct-03	St. Albans Boatlaunch	1	ww	UVM	0.29	10/24/2003	38
23-Oct-03	St. Albans Boatlaunch	2	ww	UVM	0.296	10/24/2003	
14-Oct-03	Tyler Place Boatdock	1	ww	UVM	0.073	10/15/2003	40
14-Oct-03	Tyler Place Boatdock	2	ww	UVM	0.077	10/15/2003	
23-Oct-03	Tyler Place Boatdock	1	ww	UVM	0.306	10/24/2003	
23-Oct-03	Tyler Place Boatdock	2	ww	UVM	0.22	10/24/2003	20
15-Aug-03	2 mi N of Larrabee's Point	1	wwp	UVM	0.532	11/7/2003	
18-Aug-03	2 mi N of Larrabee's Point	1	wwp	UVM	1.380	11/7/2003	21
9-Sep-03	Alburg	1	wwp	UVM	0.781	9/10/2003	
9-Sep-03	Alburg	2	wwp	UVM	0.765	9/10/2003	
17-Sep-03	Alburg	1	wwp	UVM	0.179	9/18/2003	
17-Sep-03	Alburg	2	wwp	UVM	0.302	9/18/2003	47.7
17-Sep-03	Alburg	dup	wwp	UVM	0.109	9/18/2003	
24-Sep-03	Alburg	1	wwp	UVM	0.163	9/25/2003	29
24-Sep-03	Alburg	2	wwp	UVM	0.180	9/25/2003	
30-Sep-03	Alburg	1	wwp	UVM	0.108	11/14/2003	20
7-Oct-03	Alburg	1	wwp	UVM	0.024	11/14/2003	
7-Oct-03	Alburg	2	wwp	UVM	0.036	11/14/2003	
29-Jul-03	Border Buoy	1	wwp	UVM	0.199	7/30/2003	
10-Sep-03	Burlington Water Bay	1	wwp	UVM	0.009	9/11/2003	
10-Sep-03	Burlington Water Bay	2	wwp	UVM	0.010	9/11/2003	31
5-Aug-03	Button Bay Broad Lake	1	wwp	UVM	0.073	11/7/2003	
10-Sep-03	Champlain Water Bay	1	wwp	UVM	0.040	9/11/2003	59
10-Sep-03	Champlain Water Bay	2	wwp	UVM	0.083	9/11/2003	23
1-Jul-03	Chapman Bay	1	wwp	UVM	0.006	7/30/2003	
1-Jul-03	Chapman Bay	2	wwp	UVM	0.002	7/30/2003	27
14-Jul-03	Chapman Bay	1	wwp	UVM	0.018	7/16/2003	
14-Jul-03	Chapman Bay	2	wwp	UVM	0.017	7/16/2003	
29-Jul-03	Chapman Bay	1	wwp	UVM	0.017	7/30/2003	
29-Jul-03	Chapman Bay	2	wwp	UVM	0.037	7/30/2003	
5-Aug-03	Chapman Bay	1	wwp	UVM	0.047	8/7/2003	
5-Aug-03	Chapman Bay	2	wwp	UVM	0.067	8/7/2003	
12-Aug-03	Chapman Bay	1	wwp	UVM	0.126	8/13/2003	46
12-Aug-03	Chapman Bay	2	wwp	UVM	0.119	8/13/2003	36
12-Aug-03	Chapman Bay	dup	wwp	UVM	0.162	8/13/2003	20
19-Aug-03	Chapman Bay	1	wwp	UVM	0.198	8/20/2003	30

19-Aug-03	Chapman Bay		wwp	SUNY-ESF				0.329*	0.091	nd
19-Aug-03	Chapman Bay	2	wwp	UVM	0.132	8/20/2003				
26-Aug-03	Chapman Bay	1	wwp	VTDOH	1.880	12/1/2003				
26-Aug-03	Chapman Bay	2	wwp	UVM	0.499	2/25/2004				
26-Aug-03	Chapman Bay	2	wwp	VTDOH	0.730	12/1/2003				
4-Sep-03	Chapman Bay	1	wwp	UVM	0.687	9/8/2003	40			
4-Sep-03	Chapman Bay	1	wwp	VTDOH	0.400	12/1/2003				
4-Sep-03	Chapman Bay	2	wwp	UVM	0.626	9/8/2003				
9-Sep-03	Chapman Bay	1	wwp	UVM	1.114	9/10/2003				
9-Sep-03	Chapman Bay	2	wwp	UVM	1.353	9/10/2003				
17-Sep-03	Chapman Bay	1	wwp	UVM	0.240	9/18/2003	32			
17-Sep-03	Chapman Bay	2	wwp	UVM	0.319	9/18/2003				
24-Sep-03	Chapman Bay	1	wwp	UVM	0.095	9/25/2003	61			
24-Sep-03	Chapman Bay	2	wwp	UVM	0.164	9/25/2003	17			
30-Sep-03	Chapman Bay	2	wwp	UVM	0.123	11/14/2003	43			
7-Oct-03	Chapman Bay	1	wwp	UVM	0.041	11/14/2003	26			
7-Oct-03	Chapman Bay	2	wwp	UVM	0.041	11/14/2003				
9-Sep-03	grab Alburg	1	wwp	UVM	21.897	9/10/2003				
9-Sep-03	grab Alburg	dup	wwp	UVM	23.097	9/10/2003				
1-Jul-03	Highgate Cliffs	1	wwp	UVM	0.009	7/30/2003				
1-Jul-03	Highgate Cliffs	2	wwp	UVM	0.043	7/30/2003	27			
29-Jul-03	Highgate Cliffs	1	wwp	UVM	0.189	7/30/2003				
29-Jul-03	Highgate Cliffs	dup	wwp	UVM	0.159	7/30/2003				
29-Jul-03	Highgate Cliffs	2	wwp	UVM	0.119	7/30/2003				
5-Aug-03	Highgate Cliffs	1	wwp	UVM	0.387	8/7/2003				
5-Aug-03	Highgate Cliffs	2	wwp	UVM	0.406	8/7/2003				
5-Aug-03	Highgate Cliffs	dup	wwp	UVM	0.483	8/7/2003				
12-Aug-03	Highgate Cliffs	1	wwp	UVM	0.336	8/13/2003	30			
12-Aug-03	Highgate Cliffs	2	wwp	UVM	0.409	8/13/2003				
12-Aug-03	Highgate Cliffs	dup	wwp	UVM	0.445	8/13/2003				
19-Aug-03	Highgate Cliffs	1	wwp	UVM	0.336	8/20/2003	21			
19-Aug-03	Highgate Cliffs		wwp	SUNY-ESF				0.335*	0.092	nd
19-Aug-03	Highgate Cliffs	2	wwp	UVM	0.337	8/20/2003				
19-Aug-03	Highgate Cliffs		wwp	SUNY-ESF				0.395	0.074	nd
26-Aug-03	Highgate Cliffs	1	wwp	UVM	1.079	2/25/2004				
26-Aug-03	Highgate Cliffs	1	wwp	VTDOH	1.510	12/1/2003				
26-Aug-03	Highgate Cliffs	2	wwp	UVM	8.602	8/27/2003	32			
26-Aug-03	Highgate Cliffs	2	wwp	VTDOH	7.950	12/1/2003				
26-Aug-03	Highgate Cliffs		wwp	SUNY-ESF				17.628	0.203	nd
26-Aug-03	Highgate Cliffs		wwp	SUNY-ESF				2.273	0.092	nd
4-Sep-03	Highgate Cliffs	1	wwp	UVM	0.817	9/8/2003				

4-Sep-03	Highgate Cliffs	1	wwp	VTDOH	0.620	12/1/2003				
4-Sep-03	Highgate Cliffs	2	wwp	UVM	0.672	9/8/2003				
9-Sep-03	Highgate Cliffs	1	wwp	UVM	0.544	9/10/2003	30			
9-Sep-03	Highgate Cliffs	2	wwp	UVM	0.283	9/10/2003	48			
16-Sep-03	Highgate Cliffs		wwp	SUNY-ESF				0.517	0.045	nd
17-Sep-03	Highgate Cliffs	1	wwp	UVM	0.143	9/18/2003	31			
17-Sep-03	Highgate Cliffs	dup	wwp	UVM	0.194	9/18/2003	21			
17-Sep-03	Highgate Cliffs	2	wwp	UVM	0.237	9/18/2003				
24-Sep-03	Highgate Cliffs	1	wwp	UVM	0.265	9/25/2003				
24-Sep-03	Highgate Cliffs		wwp	SUNY-ESF				0.489	0.076	nd
24-Sep-03	Highgate Cliffs	2	wwp	UVM	0.384	9/25/2003	41			
30-Sep-03	Highgate Cliffs	1	wwp	UVM	0.672	2/9/2004				
30-Sep-03	Highgate Cliffs	2	wwp	UVM	0.189	11/14/2003				
7-Oct-03	Highgate Cliffs		wwp	SUNY-ESF				0.263	0.038	nd
7-Oct-03	Highgate Cliffs	1	wwp	UVM	0.115	11/14/2003				
7-Oct-03	Highgate Cliffs	2	wwp	UVM	0.149	11/14/2003				
18-Aug-03	Highgate Public Beach		wwp	SUNY-ESF				3.967	0.24	nd
9-Sep-03	Highgate Shipyard	1	wwp	UVM	1.262	9/10/2003				
29-Jul-03	Highgate Springs	1	wwp	UVM	0.157	7/30/2003				
5-Aug-03	Highgate Springs	1	wwp	UVM	0.359	8/7/2003				
5-Aug-03	Highgate Springs	2	wwp	UVM	0.396	8/7/2003				
5-Aug-03	Highgate Springs	dup	wwp	UVM	0.454	8/7/2003				
12-Aug-03	Highgate Springs	1	wwp	UVM	0.184	8/13/2003	50			
12-Aug-03	Highgate Springs	2	wwp	UVM	0.228	8/13/2003				
19-Aug-03	Highgate Springs	1	wwp	UVM	0.389	8/20/2003	19			
19-Aug-03	Highgate Springs		wwp	SUNY-ESF				0.910*	0.512	nd
19-Aug-03	Highgate Springs	2	wwp	UVM	0.377	8/20/2003				
19-Aug-03	Highgate Springs	dup	wwp	UVM	0.370	8/20/2003				
26-Aug-03	Highgate Springs	1	wwp	UVM	0.374	2/25/2004				
26-Aug-03	Highgate Springs	1	wwp	VTDOH	0.720	12/1/2003				
26-Aug-03	Highgate Springs	2	wwp	VTDOH	1.090	12/1/2003				
26-Aug-03	Highgate Springs	2	wwp	UVM	1.535	2/9/2004	30			
26-Aug-03	Highgate Springs		wwp	SUNY-ESF				1.154*	0.698	nd
26-Aug-03	Highgate Springs		wwp	SUNY-ESF				1.814*	1.259	nd
4-Sep-03	Highgate Springs	1	wwp	UVM	0.481	9/8/2003	20			
4-Sep-03	Highgate Springs	2	wwp	UVM	0.452	9/8/2003	21			
4-Sep-03	Highgate Springs	2	wwp	VTDOH	0.420	12/1/2003				
4-Sep-03	Highgate Springs	dup	wwp	UVM	0.401	9/8/2003				
9-Sep-03	Highgate Springs	1	wwp	UVM	0.155	9/10/2003	28			
9-Sep-03	Highgate Springs	2	wwp	UVM	0.161	9/10/2003	33			
16-Sep-03	Highgate Springs		wwp	SUNY-ESF				0.526	0.068	nd

17-Sep-03	Highgate Springs	1	wwp	UVM	0.263	9/18/2003	19				
17-Sep-03	Highgate Springs	2	wwp	UVM	0.353	9/18/2003					
17-Sep-03	Highgate Springs	dup	wwp	UVM	0.205	9/18/2003					
24-Sep-03	Highgate Springs	1	wwp	UVM	0.096	9/25/2003					
24-Sep-03	Highgate Springs	2	wwp	UVM	0.101	9/25/2003	21				
7-Oct-03	Highgate Springs		wwp	SUNY-ESF				0.171		nd	
7-Oct-03	Highgate Springs	1	wwp	UVM	0.089	11/14/2003					
7-Oct-03	Highgate Springs	2	wwp	UVM	0.132	11/14/2003					
2-Jul-03	Lime Kiln Point	1	wwp	UVM	0.326	11/7/2003					
14-Jul-03	Lime Kiln Point	1	wwp	UVM	0.598	11/7/2003	32				
28-Jul-03	Lime Kiln Point		wwp	SUNY-ESF				1.681*	2.622	nd	
4-Aug-03	Lime Kiln Point	1	wwp	UVM	0.470	11/7/2003	28				
11-Aug-03	Lime Kiln Point	1	wwp	UVM	0.471	11/7/2003					
18-Aug-03	Lime Kiln Point	1	wwp	UVM	16.870	11/7/2003					
18-Aug-03	Lime Kiln Point		wwp	SUNY-ESF				15.271	0.317	0.109	0.001
3-Sep-03	Lime Kiln Point	1	wwp	UVM	3.663	11/7/2003	18				
3-Sep-03	Lime Kiln Point	1	wwp	UVM	3.657	2/9/2004	24				
3-Sep-03	Lime Kiln Point	dup	wwp	UVM	3.286	11/7/2003	26				
14-Jul-03	Maquam Bay- Swanton	1	wwp	UVM	0.175	11/7/2003					
18-Aug-03	Maquam Bay- Swanton	1	wwp	UVM	0.049	8/20/2003					
19-Aug-03	Maquam Bay- Swanton	1	wwp	UVM	0.049	8/20/2003	40				
25-Aug-03	Maquam Bay- Swanton	1	wwp	UVM	0.033	8/27/2003	24				
4-Aug-03	Maquam Shore	1	wwp	UVM	0.022	8/7/2003					
11-Aug-03	Maquam Shore	1	wwp	UVM	0.110	8/13/2003					
10-Sep-03	North Beach	1	wwp	UVM	0.007	9/11/2003					
10-Sep-03	North Beach	2	wwp	UVM	0.006	9/11/2003					
14-Jul-03	Pete's Point	1	wwp	UVM	0.185	11/7/2003					
4-Aug-03	Pete's Point	1	wwp	UVM	0.034	8/7/2003					
11-Aug-03	Pete's Point	1	wwp	UVM	0.038	8/13/2003					
18-Aug-03	Pete's Point	1	wwp	UVM	0.376	11/7/2003					
25-Aug-03	Pete's Point	1	wwp	UVM	0.321	8/27/2003	40				
14-Jul-03	Randolph Dock Highgate Springs	1	wwp	UVM	0.202	11/7/2003					
25-Aug-03	Randolph Dock Swamp	1	wwp	UVM	0.222	11/7/2003					
25-Aug-03	Randolph Dock Swamp	dup	wwp	UVM	0.324	11/7/2003					
18-Aug-03	Randolph Swamp		wwp	SUNY-ESF				13.59	0.966	nd	
9-Sep-03	Randolph Swamp	1	wwp	UVM	0.366	9/10/2003					
10-Sep-03	Red Rocks	1	wwp	UVM	0.018	9/11/2003	33				
10-Sep-03	Red Rocks	2	wwp	UVM	0.034	9/11/2003	24				
12-Aug-03	Rt. 78 Access		wwp	SUNY-ESF				0.15		nd	
19-Aug-03	Rt. 78 Access		wwp	SUNY-ESF				0.239		nd	

26-Aug-03	Rt. 78 Access		wwp	SUNY-ESF				0.441*	0.162	nd
19-Aug-03	Rt. 78 Access Scum		wwp	SUNY-ESF				22.687*	6.269	nd
1-Jul-03	Rte 78 Access	1	wwp	UVM	0.005	7/30/2003	45			
1-Jul-03	Rte 78 Access	2	wwp	UVM	0.006	7/30/2003				
14-Jul-03	Rte 78 Access	1	wwp	UVM	0.016	7/16/2003				
14-Jul-03	Rte 78 Access	dup	wwp	UVM	0.009	7/16/2003				
14-Jul-03	Rte 78 Access	2	wwp	UVM	0.022	7/16/2003				
29-Jul-03	Rte 78 Access	1	wwp	UVM	0.094	7/30/2003				
29-Jul-03	Rte 78 Access	2	wwp	UVM	0.086	7/30/2003				
29-Jul-03	Rte 78 Access	dup	wwp	UVM	0.087	7/30/2003				
5-Aug-03	Rte 78 Access	1	wwp	UVM	0.032	8/7/2003				
5-Aug-03	Rte 78 Access	2	wwp	UVM	0.033	8/7/2003				
12-Aug-03	Rte 78 Access	1	wwp	UVM	0.051	8/13/2003				
12-Aug-03	Rte 78 Access	2	wwp	UVM	0.055	8/13/2003				
19-Aug-03	Rte 78 Access	1	wwp	UVM	0.129	8/20/2003				
19-Aug-03	Rte 78 Access	2	wwp	UVM	0.249	8/20/2003				
26-Aug-03	Rte 78 Access	1	wwp	UVM	0.594	8/27/2003				
26-Aug-03	Rte 78 Access	1	wwp	VTDOH	0.370	12/1/2003				
26-Aug-03	Rte 78 Access	2	wwp	UVM	0.498	8/27/2003				
26-Aug-03	Rte 78 Access	2	wwp	VTDOH	0.450	12/1/2003				
4-Sep-03	Rte 78 Access	1	wwp	UVM	0.507	9/8/2003				
4-Sep-03	Rte 78 Access	1	wwp	VTDOH	0.570	12/1/2003				
4-Sep-03	Rte 78 Access	2	wwp	UVM	0.546	9/8/2003				
4-Sep-03	Rte 78 Access	dup	wwp	UVM	0.572	9/8/2003				
9-Sep-03	Rte 78 Access	1	wwp	UVM	0.166	9/10/2003	57			
9-Sep-03	Rte 78 Access	2	wwp	UVM	0.080	9/10/2003	27			
17-Sep-03	Rte 78 Access	1	wwp	UVM	0.186	9/18/2003				
17-Sep-03	Rte 78 Access	2	wwp	UVM	0.107	9/18/2003	54			
17-Sep-03	Rte 78 Access	dup	wwp	UVM	0.098	9/18/2003	24			
24-Sep-03	Rte 78 Access	1	wwp	UVM	0.098	9/25/2003				
24-Sep-03	Rte 78 Access	2	wwp	UVM	0.149	9/25/2003				
30-Sep-03	Rte 78 Access	2	wwp	UVM	0.121	11/14/2003	40			
7-Oct-03	Rte 78 Access	1	wwp	UVM	0.051	11/14/2003				
7-Oct-03	Rte 78 Access	2	wwp	UVM	0.041	11/14/2003				
14-Oct-03	Rte 78 Access	1	wwp	UVM	0.023	10/15/2003	28			
14-Oct-03	Rte 78 Access	2	wwp	UVM	0.030	10/15/2003	25			
23-Oct-03	Rte 78 Access	1	wwp	UVM	0.003	10/24/2003				
23-Oct-03	Rte 78 Access	2	wwp	UVM	0.004	10/24/2003	32			
26-Aug-03	Rte 78 Access- shore		wwp	UVM	23.910	2/9/2004	41			
19-Aug-03	Scum- Rte 78 Access	1	wwp	UVM	6.188	8/20/2003				
28-Jul-03	Shipyard- Highgate Springs	1	wwp	UVM	0.198	11/7/2003				

4-Aug-03	Shipyard- Highgate Springs	1	wwp	UVM	0.163	11/7/2003	33				
11-Aug-03	Shipyard- Highgate Springs	1	wwp	UVM	0.322	11/7/2003					
25-Aug-03	Shipyard- Highgate Springs	1	wwp	UVM	0.332	11/7/2003					
25-Aug-03	Shipyard- Highgate Springs	dup	wwp	UVM	0.327	11/7/2003					
18-Aug-03	Soft Beach- Highgate Public Beach	1	wwp	UVM	1.673	11/7/2003					
19-Aug-03	St. Albans Boat Launch		wwp	SUNY-ESF				0.18		0.077	0.003
19-Aug-03	St. Albans Boat Launch		wwp	SUNY-ESF				0.213	0.005	nd	
26-Aug-03	St. Albans Boat Launch		wwp	SUNY-ESF				0.492	0.052	nd	
26-Aug-03	St. Albans Boat Launch		wwp	SUNY-ESF				0.525	0.087	nd	
24-Sep-03	St. Albans Boat Launch		wwp	SUNY-ESF				0.2		nd	
19-Aug-03	St. Albans Boatlaunch	1	wwp	UVM	0.033	8/20/2003	27				
19-Aug-03	St. Albans Boatlaunch	2	wwp	UVM	0.053	8/20/2003	19				
26-Aug-03	St. Albans Boatlaunch	1	wwp	UVM	0.461	8/27/2003	25				
26-Aug-03	St. Albans Boatlaunch	1	wwp	VTDOH	0.360	12/1/2003					
26-Aug-03	St. Albans Boatlaunch	2	wwp	UVM	0.333	8/27/2003					
26-Aug-03	St. Albans Boatlaunch	2	wwp	VTDOH	0.250	12/1/2003					
9-Sep-03	St. Albans Boatlaunch	1	wwp	UVM	0.031	2/9/2004	23				
9-Sep-03	St. Albans Boatlaunch	2	wwp	UVM	0.040	2/9/2004					
16-Sep-03	St. Albans Boatlaunch	1	wwp	UVM	0.042	9/18/2003					
16-Sep-03	St. Albans Boatlaunch	2	wwp	UVM	0.026	9/18/2003					
24-Sep-03	St. Albans Boatlaunch	1	wwp	UVM	0.053	9/25/2003	16				
24-Sep-03	St. Albans Boatlaunch	2	wwp	UVM	0.064	9/25/2003					
7-Oct-03	St. Albans Boatlaunch	1	wwp	UVM	0.013	11/14/2003					
7-Oct-03	St. Albans Boatlaunch	2	wwp	UVM	0.016	11/14/2003	18				
14-Oct-03	St. Albans Boatlaunch	1	wwp	UVM	0.006	10/15/2003	26				
14-Oct-03	St. Albans Boatlaunch	2	wwp	UVM	0.008	10/15/2003					
23-Oct-03	St. Albans Boatlaunch	1	wwp	UVM	<0.16	10/24/2003					
23-Oct-03	St. Albans Boatlaunch	2	wwp	UVM	<0.16	10/24/2003					
4-Aug-03	Swamp- Highgate Springs	1	wwp	UVM	0.240	11/7/2003					
31-Jul-03	Thompson's Point	1	wwp	UVM	0.117	11/7/2003	23				
31-Jul-03	Thompson's Point		wwp	SUNY-ESF				0.541*	0.204	nd	
14-Oct-03	Tyler Place Boatdock	1	wwp	UVM	0.036	10/15/2003	40				
14-Oct-03	Tyler Place Boatdock	2	wwp	UVM	0.034	10/15/2003					
23-Oct-03	Tyler Place Boatdock	1	wwp	UVM	0.002	10/24/2003					
23-Oct-03	Tyler Place Boatdock	2	wwp	UVM	0.002	10/24/2003	20				
12-Aug-03	Chapman Bay			SUNY-ESF				0.397*	0.216	nd	
12-Aug-03	Highgate Cliffs			SUNY-ESF				1.047*	1.446	nd	
12-Aug-03	Highgate Springs			SUNY-ESF				0.361*	0.102	nd	

Appendix D. Chlorophyll and Nutrient Concentrations in Samples Collected from Lake Champlain, 2003.

Date	Location	Time of Sampling	Rep	Whole Water Chl, µg/L	Net Chl, µg/L	Total P, µg/L	Soluble Reactive Phosphorus, µg/L	Total N, mg/L
4/28/2003	Burlington Water Bay	12:30	1	NA	NA	9.30	0.51	0.44
			2	NA	NA	9.00	0.36	0.45
	Champlain Water Bay	11:05	1	NA	NA	9.79	0.36	0.45
			2	NA	NA	8.41	0.22	0.50
	North Beach	12:40	1	NA	NA	8.05	0.43	0.47
			2	NA	NA	7.52	0.65	0.50
	Red Rocks Beach	10:55	1	NA	NA	8.95	0.22	0.44
			2	NA	NA	9.84	0.65	0.44
5/21/2003	Burlington Water Bay		2	NA	NA	18.16	1.63	0.69
	Champlain Water Bay		2	NA	NA	11.67	3.15	0.62
	Red Rocks Beach		1	NA	NA	14.65	7.56	0.52
6/2/2003	Burlington Water Bay		1	NA	NA	5.93	0.72	0.58
			2	NA	NA	5.23	0.88	0.47
	Champlain Water Bay		1	NA	NA	15.39	1.05	0.54
			2	NA	NA	8.91	0.05	0.60
	North Beach		1	NA	NA	7.68	0.55	0.48
			2	NA	NA	7.89	0.38	0.42
	Red Rocks Beach		1	NA	NA	13.12	0.55	0.48
			2	NA	NA	11.54	1.05	0.45
6/16/2003	Burlington Water Bay	12:00	1	NA	NA	6.82	0.33	0.45
			2	NA	NA	7.18	1.71	0.40
	Champlain Water Bay	11:40	1	NA	NA	6.46	1.71	0.54
			2	NA	NA	6.20	1.53	0.44
	North Beach	10:32	1	NA	NA	6.46	0.50	0.43
			2	NA	NA	6.82	0.84	0.46
	Red Rocks Beach	11:30	1	NA	NA	6.46	1.02	0.42
			2	NA	NA	6.64	0.16	0.56
7/1/2003	Chapman Bay	13:20	1	3.25	NA	27.41	7.02	0.77
			2	2.75	NA	28.80	6.94	0.78
	Highgate Cliffs	14:25	1	0.00	NA	46.76	20.33	1.04
			2	4.96	NA	46.57	20.66	0.96
	Highgate Springs	14:40	1	4.07	NA	57.31	21.17	1.03
			2	4.07	NA	56.76	21.09	1.16
	Maquam Bay	12:30	1	1.65	NA	11.76	0.83	0.35

			2	1.02	NA	12.50	0.83	0.36
	Rt. 78 Access	15:30	1	10.12	NA	34.17	7.95	0.77
			2	8.85	NA	33.80	8.12	0.82
7/7/2003	Burlington Water Bay	11:08	1	NA	NA	9.04	0.62	0.44
			2	NA	NA	8.24	0.45	0.48
	Champlain Water Bay	12:37	1	NA	NA	7.78	0.45	0.40
			2	NA	NA	8.78	1.31	0.59
	North Beach	11:00	1	NA	NA	17.20	1.41	0.93
	Red Rocks Beach	12:27	1	NA	NA	8.60	0.28	0.48
			2	NA	NA	7.69	0.62	0.45
7/14/2003	Chapman Bay	13:05	1	6.23	1.48	33.80	8.65	0.73
			2	4.12	1.29	34.91	9.65	0.75
	Highgate Cliffs	13:25	2	16.27	6.23	41.57	4.74	0.65
	Highgate Springs	14:00	1	10.31	5.89	23.61	1.82	0.66
			2	19.16	7.16	41.20	1.82	0.59
	Rt 78 Access	13:00	2	3.67	1.21	32.69	6.49	0.68
	Rt. 78 Access	13:00	1	6.42	1.46	32.13	6.82	0.64
7/21/2003	Burlington Water Bay	10:05	1	NA	NA	8.13	5.15	0.39
			2	NA	NA	8.22	-0.18	0.42
	Champlain Bridge	11:00	1	NA	NA	26.49	3.32	0.38
			2	NA	NA	25.76	4.15	0.37
	Champlain Water Bay	11:15	1	NA	NA	11.04	-0.27	0.41
			2	NA	NA	8.67	-0.02	0.50
	North Beach	10:00	1	NA	NA	9.76	-0.35	0.38
			2	NA	NA	7.95	-0.18	0.42
	Red Rocks Beach	11:00	1	NA	NA	9.22	-0.02	0.36
			2	NA	NA	9.76	0.15	0.41
7/22/2003	Rt. 78 Access	10:30	1	19.48	NA	49.15	3.82	0.64
			2	14.15	NA	49.15	4.65	0.64
7/29/2003	Chapman Bay	11:20	1	5.76	2.70	45.56	8.25	0.48
	Highgate Cliffs	12:15	1	4.35	4.29	37.84	4.08	0.52
			2	6.42	5.26	36.96	4.08	0.49
	Highgate Springs	12:30	1	20.17	4.47	40.47	4.25	0.54
			2	14.21	4.58	41.70	4.42	0.60
				NA	NA	41.70	4.42	0.60
	Rt. 78 Access	11:40	1	7.79	lost	54.33	14.08	0.74
			2	13.29	lost	52.05	13.75	0.59
8/3/2003	Champlain Bridge	17:00	1	NA	NA	41.54	11.63	0.44
			2	NA	NA	43.65	11.27	0.35
8/4/2003	Burlington Water Bay	10:52	1	NA	NA	8.35	0.02	0.40

			2	NA	NA	8.44	0.20	0.41
	Champlain Water Bay	12:00	1	NA	NA	11.39	1.80	0.39
			2	NA	NA	11.04	0.02	0.40
	North Beach	10:40	1	NA	NA	14.02	1.89	0.46
			2	NA	NA	19.12	1.98	0.39
	Red Rocks	11:45	1	NA	NA	11.78	0.38	0.38
			2	NA	NA	15.99	0.73	0.34
8/5/2003	Chapman Bay	10:05	1	7.64	2.39	46.09	10.80	0.65
			2	11.46	2.12	48.30	10.71	0.49
	Highgate Cliffs	10:25	1	10.69	3.48	64.37	10.88	0.69
			2	-14.51	2.12	62.93	10.20	0.81
	Highgate Springs	10:30	1	20.62	7.45	103.46	7.66	0.72
			2	58.82	5.82	78.65	7.66	2.76
	Rte 78 Access	10:55	1	3.82	2.26	44.66	9.36	0.47
			2	6.11	1.48	44.95	9.95	0.51
8/12/2003	Chapman Bay	10:55	1	108.46	7.20	81.89	0.26	3.19
			2	135.20	5.06	197.68	0.78	1.49
	Highgate Cliffs	11:15	1	29.79	3.95	52.77	6.81	0.58
			2	27.50	4.16	53.82	6.81	0.73
	Highgate Springs	11:30	1	28.26	5.37	62.60	3.19	0.70
			2	19.10	4.51	55.54	3.10	0.67
	Rt. 78 Access	11:55	1	9.17	2.61	67.16	3.79	0.57
			2	7.45	0.20	33.40	3.71	0.62
8/18/2003	Burlington Water Bay	10:25	1	NA	NA	10.51	0.57	0.34
			2	NA	NA	10.68	0.66	0.35
	Champlain Water Bay	11:30	1	NA	NA	11.74	1.09	0.44
			2	NA	NA	11.91	1.09	0.35
	North Beach	10:15	1	NA	NA	10.25	0.40	0.39
			2	NA	NA	9.28	0.40	0.33
	Red Rocks Beach	11:20	1	NA	NA	12.61	1.09	0.46
			2	NA	NA	13.14	0.91	0.39
8/19/2003	Chapman Bay	10:55	1	40.79	3.66	61.53	1.95	0.82
			2	52.70	5.95	64.86	2.64	0.73
	Highgate Cliffs	11:15	1	23.49	6.11	53.11	7.64	0.52
			2	26.93	3.71	54.51	6.43	0.58
	Highgate Springs	11:25	1	53.62	12.45	76.26	2.12	0.66
			2	55.00	5.70	72.05	3.50	0.81
	Rt. 78 Access	10:40	1	56.52	13.32	55.91	0.40	0.77
			2	47.66	9.11	55.30	1.60	0.81
	St. Albans Boat Launch	12:30	1	21.77		42.95	1.26	0.52

			2	23.49		41.35	1.09	0.40
8/20/2003	Champlain Bridge	10:55	1	NA	NA	0.00	10.74	0.35
			2	NA	NA	39.86	9.88	0.35
8/26/2003	Chapman Bay	10:20	1	112.28	3.93	93.12	1.78	0.96
			2	73.33	10.03	105.40	1.20	0.00
	Highgate Cliffs	10:40	1	85.55	12.03	380.18	3.03	3.10
			2	83.26	10.33	122.25	4.37	3.72
	Highgate Springs	10:55	1	55.76	5.87	82.60	6.28	0.89
			2	45.07	10.39	84.35	6.37	0.63
	Rt. 78 Access	11:15	1	58.05	6.27	80.14	1.53	0.80
			2	45.07	8.26	74.53	1.37	0.76
	St. Albans Boat Launch	12:15	2	16.04	NA	44.35	1.70	0.56
9/2/2003	Burlington Water Bay	10:45	1	NA	NA	11.34	0.22	0.40
			2	NA	NA	10.99	0.22	0.36
	Champlain Water Bay	11:45	1	NA	NA	11.48	0.22	0.35
			2	NA	NA	9.78	0.05	0.34
	North Beach	10:33	1	NA	NA	7.21	0.05	0.37
			2	NA	NA	7.40	0.05	0.36
	Red Rocks Beach	11:40	1	NA	NA	9.17	0.22	0.31
			2	NA	NA	8.34	0.73	0.42
9/3/2003	Champlain Bridge	10:35	1	NA	NA	42.64	27.51	0.40
			2	NA	NA	44.42	27.85	0.36
	St. Albans Boat Launch	14:00	1	9.17	NA	55.33	1.61	0.46
			2	14.89	NA	49.42	1.75	0.49
9/4/2003	Chapman Bay	10:50	1	34.37	12.36	65.76	1.78	0.81
			2	21.20	8.18	64.48	1.95	0.67
	Highgate Cliffs	11:20	1	34.37	14.39	72.58	11.02	0.79
			2	34.95	16.03	83.06	11.27	0.75
	Highgate Springs	11:30	1	28.64	11.26	57.10	6.19	0.74
			2	14.32	8.83	65.45	5.85	0.76
	Rt. 78 Access	12:00	1	32.65	14.18	59.07	1.44	0.65
			2	31.51	9.03	56.04	2.12	0.64
9/9/2003	Alburg	11:05	1	382.68	10.98	4569.30	0.91	1.11
			2	77.91	28.60	331.49	1.09	3.24
	Chapman Bay	11:20	1	16.80	7.31	57.07	1.43	1.23
			2	19.86	7.09	127.11	1.95	1.41
	Highgate Cliffs	11:35	1	47.36	6.87	231.40	11.83	4.63
			2	34.75	7.96	206.93	6.43	1.48
	Highgate Springs	11:45	1	15.28	6.17	53.22	4.02	0.65
			2	14.51	2.25	56.05	4.02	0.60

	Rt. 78 Access	12:25	1	15.28	10.08	53.50	2.29	0.65
			2	28.26	10.22	54.92	1.95	0.71
	St. Albans Boat Launch	8:45	1	14.32	NA	30.44	0.91	0.39
			2	14.32	NA	30.34	1.09	0.40
9/10/2003	Burlington Water Bay	13:10	1	3.21	0.65	7.96	0.83	0.30
			2	3.21	0.73	6.43	0.91	0.32
	Champlain Water Bay	13:30	1	4.12	0.73	7.13	0.91	0.26
			2	4.12	0.77	7.71	0.74	0.43
	North Beach	12:55	1	1.83	0.31	7.10	1.43	0.30
			2	2.75	0.27	7.33	1.43	0.34
	Red Rocks	13:40	1	4.58	0.36	7.50	0.91	0.31
			2	5.96	0.41	8.01	0.91	0.27
9/16/2003	Alburg	11:15	1	18.33	4.83	58.36	2.63	0.80
			2	18.33	7.50	55.21	2.13	0.64
	Chapman Bay	12:00	1	25.21	4.46	54.83	2.47	0.80
			2	19.10	4.15	45.75	1.88	0.71
	Highgate Cliffs	11:55	1	24.44	12.55	58.56	3.63	0.63
			2	24.44	11.53	56.10	3.30	0.73
	Highgate Springs	12:05	2	28.64	12.68	56.67	1.97	0.77
			1	26.73	15.24	42.45	2.97	0.76
	Rt. 78 Access	14:40	2	16.04	10.28	50.36	2.47	0.76
			1	16.80	7.85	53.57	1.88	0.63
	St. Albans Bay	9:15	1	5.96	NA	25.77	0.30	0.38
			2	5.04	NA	26.69	0.30	0.37
9/17/2003	Champlain Bridge	11:00	1	NA	NA	48.50	15.13	0.33
			2	NA	NA	46.93	18.97	0.44
9/18/2003	Burlington Water Bay	10:40	1	NA	NA	9.99	0.63	0.31
			2	NA	NA	11.63	0.47	0.29
	Champlain Water Bay	11:45	1	NA	NA	12.28	0.47	0.28
			2	NA	NA	10.65	0.30	0.29
	North Beach	10:30	1	NA	NA	12.28	0.30	0.29
			2	NA	NA	8.10	0.80	0.28
	Red Rocks Beach	11:35	1	NA	NA	10.28	0.72	0.27
			2	NA	NA	7.94	0.63	0.30
9/24/2003	Alburg	10:30		13.75	4.43	48.20	2.04	0.55
				14.32	3.90	45.57	3.57	0.56
	Chapman Bay	10:40		9.74	4.46	48.20	2.72	0.48
				16.33	3.50	46.00	2.72	0.53
	Highgate Cliffs	11:00		18.33	13.59	57.63	4.25	0.56
				23.49	12.16	55.66	3.91	0.62

	Highgate Springs	11:15		11.46	9.66	45.86	3.31	0.53
				15.47	7.88	47.32	3.23	0.51
	Rt. 78 Access	11:50		11.46	4.30	43.82	3.40	0.49
					5.96	39.44	3.91	0.49
	St. Albans Boatlaunch	13:45		9.17	NA	31.10	1.36	0.37
				13.18	NA	28.90	1.36	0.39
9/30/2003	Alburg	10:35	1	6.87	2.77	36.77	4.22	0.51
			2	6.87	2.84	37.86	4.38	0.44
	Chapman Bay	10:45	1	7.45	3.31	38.58	3.88	0.49
			2	10.88	2.50	42.76	3.72	0.56
	Highgate Cliffs	11:10	1	18.33	6.77	48.19	5.05	0.59
			2	10.31	4.12	50.77	4.30	0.60
	Highgate Springs	11:20	1	37.81	1.16	46.56	3.22	0.62
			2	13.75	3.92	35.49	3.55	0.63
	Rt 78 Access	11:45	1	6.30	4.68	36.39	4.88	0.55
			2	8.02	4.97	35.95	5.05	0.48
	St. Albans Boat Launch	12:00	1	8.59	NA	20.98	0.88	0.40
			2	4.58	NA	20.85	1.05	0.41
10/7/2003	Alburg	11:15	1	5.16	0.61	33.41	4.81	0.56
			2	4.30	0.54	34.47	4.14	0.56
	Chapman Bay	11:30	2	5.16	2.73	34.35	4.81	0.47
	Highgate Cliffs	11:55	1	6.87	3.21	40.08	2.53	0.54
			2	9.17	2.42	38.17	2.78	0.54
	Highgate Springs	12:05	2	6.30	1.12	39.21	3.97	0.50
	Rt 78	12:30	1	8.02	4.06	38.88	4.47	0.52
	Rte 78	12:30	2	3.44	10.71	36.28	4.47	0.50
	St. Albans Boat Launch	13:15	1	14.32	NA	19.87	1.76	0.47
			2	10.88	NA	24.24	1.59	0.38
				NA	NA	24.24	1.59	0.38
10/14/2003	Rte 78 Access	11:00	1	5.73	NA	25.81	3.78	0.61
	St. Albans Boatlaunch	11:30	1	1.15	NA	16.58	1.12	0.35
			2	2.29	NA	15.44	1.28	0.34
	Tyler Place Boatdock	10:30	1	5.16	NA	39.29	3.28	0.54
			2	3.44	NA	37.02	1.95	0.44
10/21/2003	Burlington Water Bay	10:30	1	NA	NA	5.99	1.42	0.34
	Champlain Water Bay	11:40	1	NA	NA	8.21	0.66	0.38
			2	NA	NA	7.98	0.41	0.45
	North Beach	10:20	1	NA	NA	8.79	1.59	0.40
			2	NA	NA	7.95	1.76	0.38
	Red Rocks Beach	11:30	1	NA	NA	9.72	1.08	0.38

			2	NA	NA	7.26	1.08	0.37
10/23/2003	Rte 78 Access	10:40	1	45.83	NA	200.79	3.54	1.00
			2	29.79	NA	185.88	4.77	1.11
	St. Albans Boatlaunch	11:10	1	5.96	NA	14.93	0.74	0.35
			2	5.50	NA	17.06	1.26	0.33
	Tyler Place	10:15	2	77.91	NA	534.12	16.00	1.45
8/26/2026	St. Albans Boat Launch	12:15	1	23.68	NA	45.75	1.70	0.59