Road Salt Application and its Effects on Sodium and Chloride Ion Concentrations in an Urban Stream
Patroon Creek, Albany, NY

A thesis presented to the Faculty

of the University at Albany, State University of New York

in partial fulfillment of the requirements

for the degree of

Master of Science

College of Arts & Sciences

Department of Earth and Atmospheric Sciences

Elizabeth K. Erickson
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Abstract

The application of road salt in an urban watershed leads to increased sodium and chloride concentrations in surface water and groundwater, which can adversely affect aquatic ecosystems, and may have consequences for soil cation exchange. This study focuses on the spatial and temporal variations in sodium and chloride concentrations in Patroon Creek, Albany County, New York, a tributary of the Hudson River. For two years, weekly surface water samples were gathered from 7 sites along Patroon Creek for major ion concentrations as measured by ion chromatography. Additionally, a USGS gage on Patroon Creek measures specific conductivity, water temperature, stage, and discharge in 15 minute intervals. Sodium and chloride concentrations in the creek are highest at all sampling sites in winter months, and near large parking lots and areas with high road density. However, concentrations remain elevated throughout the year with respect to natural background levels. Mean chloride concentration is 224 ppm (n = 644). Sodium and chloride in the creek water are a result of halite road salt application in the watershed, which is evidenced by the rapid rise in sodium and chloride concentrations in the creek during winter storm events, and the high correlation between sodium and chloride in the water (sodium to chloride ratio in mEq = 0.94:1, $R^2 = 0.95$, n = 578). Roughly one-third of the 37 km^2 watershed is covered by impervious surfaces, suggesting that much of the road salt applied to the watershed is washed directly into Patroon Creek. This study attempts to create a mass-balance of inputs and outputs of halite salt to and from the Patroon Creek Watershed system. Inputs of sodium and chloride include road salt application, groundwater baseflow input, and input from precipitation. Outputs include discharge of salt by Patroon Creek to the Hudson River, output from a combined sewage overflow system, and loss to groundwater recharge. The budget does not balance perfectly; there seems to be a net gain of salt to the system.

Acknowledgements

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1. Introduction

The urbanization of a stream's watershed affects its hydrology, geomorphology, and chemistry (Paul and Meyer, 2001). Urbanization also affects algae, fish, and invertebrates living in the stream. Increasing the amount of impervious surface cover in the watershed increases the amount of surface runoff, which increases the amount of chemicals and contaminants reaching the stream (Paul and Meyer, 2001). Urban streams face many contamination issues from both point and non-point sources. While the Clean Water Act, The National Environmental Policy Act (NEPA) and the Resource Conservation and Recovery Act (RCRA) have been successful at protecting streams and rivers from point sources of pollution, nonpoint sources of pollution remain a source of concern (Kendall, 2004). Some examples of nonpoint source pollution affecting urban watersheds include oil, hydrocarbons, lawn fertilizers and pesticides, bacteria, viruses, heavy metals, and deicing chemicals.

Deicing chemicals are a major source of contamination to urban watersheds in colder regions of the United States. These chemicals have been used in the United States since the 1930's. Beginning in the 1940's and 1950's, there was a growing dependence on automobiles for commerce and commuting. Many states adopted a "bare pavement" policy, meaning people could count on roads to be free of ice and snow. Around this time, suburban areas began to grow, which meant longer commutes, faster driving speeds, and therefore greater use of deicing chemicals (USEPA, 1999).

Today, the most commonly used deicing road salts are sodium chloride (NaCl), calcium chloride ($CaCl_2$), magnesium chloride ($MgCl_2$), and potassium chloride (KCl). Sodium chloride is the most common, because it is the most effective for maintaining the

safest roads in the most economical way (USEPA, 1999). All of these road salts are highly soluble in water, with magnesium chloride being the most soluble. Dissolved in surface water, the dominant aqueous species are the ions sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), and chloride (Cl^-). Sodium chloride road salt may contain impurities, most commonly calcium, potassium, bromine, vanadium, magnesium, and fluorine, due to their presence in natural salts (Mayer et al., 1999).

Sodium chloride (halite) road salt is present in surface waters as the ions sodium and chloride. In most cases, chloride is not a dominant anion in natural surface waters. Chloride concentrations in surface waters are directly correlated with the quantity of road salt used, because all road salts contain chloride (Foos, 2003). Also, the chloride ion behaves conservatively; it is highly soluble and mobile, and does not volatilize or precipitate out of solution easily. It does not readily adsorb to particulates, nor is it taken up in biological processes. Its concentration is only affected by physical processes such as evaporation and dilution (Mayer, et al., 1999).

Long-term studies have shown a definite increase in sodium and chloride concentrations in surface waters where road salt is applied to watersheds. For example, Godwin and others (2003) showed that sodium and chloride ion concentrations increased by 130 and 243% respectively between 1952 and 1998 in the Mohawk River of New York. Concentrations of other ions remained the same or decreased in some cases.

Road salt's harmful effects on the environment were first noted in the 1950's when New England's salt-intolerant sugar maples showed signs of damage, and drinking water sources became contaminated by salt (USEPA, 1999). Road salt use became widespread in the 1960's because it was readily available, and was the most effective and

inexpensive way to clear the roads (USEPA, 1999), even though adverse effects had been previously noted. According to Mayer and others (1999), by the 1970's the U.S. EPA had stated that large quantities of road salt may have adverse environmental effects. Road salt is also on the Priority Substances List (PSL2) of the Canadian Environmental Protection Act (CEPA), which lists chemicals with adverse effects to human health.

This thesis focuses on the effects of road salt on surface water quality in Patroon Creek in Albany, New York. Patroon Creek lies along major highways and railroad tracks with relatively small riparian buffer zones to protect it, resulting in road salt being washed directly into the creek via overland flow and through open drains which carry the stormwater.

1a. Objectives

The objectives of this study are:

a. To describe the physical hydrology of Patroon Creek.

b. To characterize spatial and temporal trends in concentrations of major ions in the surface water of Patroon Creek.

c. To test whether elevated levels of sodium and chloride in the stream are due to road salt application in the watershed.

d. As part of that test, to calculate the inputs and outputs of sodium and chloride to the system from a mass-balance approach.

2. Study Area and Methods

2a. Description of Study Area

2a1. Size and Location of Patroon Creek Watershed

Patroon Creek is located in the city of Albany and the town of Colonie, New York, in the Northeastern United States. The USGS stream gage on the creek is located at 42°40'17"N, 73°43'22"W. Patroon Creek flows 11 km generally WNW to ESE, from the Pine Bush Natural Area (300 ft. elevation) to the Hudson River in downtown Albany (sea level; Figure 1). The creek drains a 37 km^2 watershed.

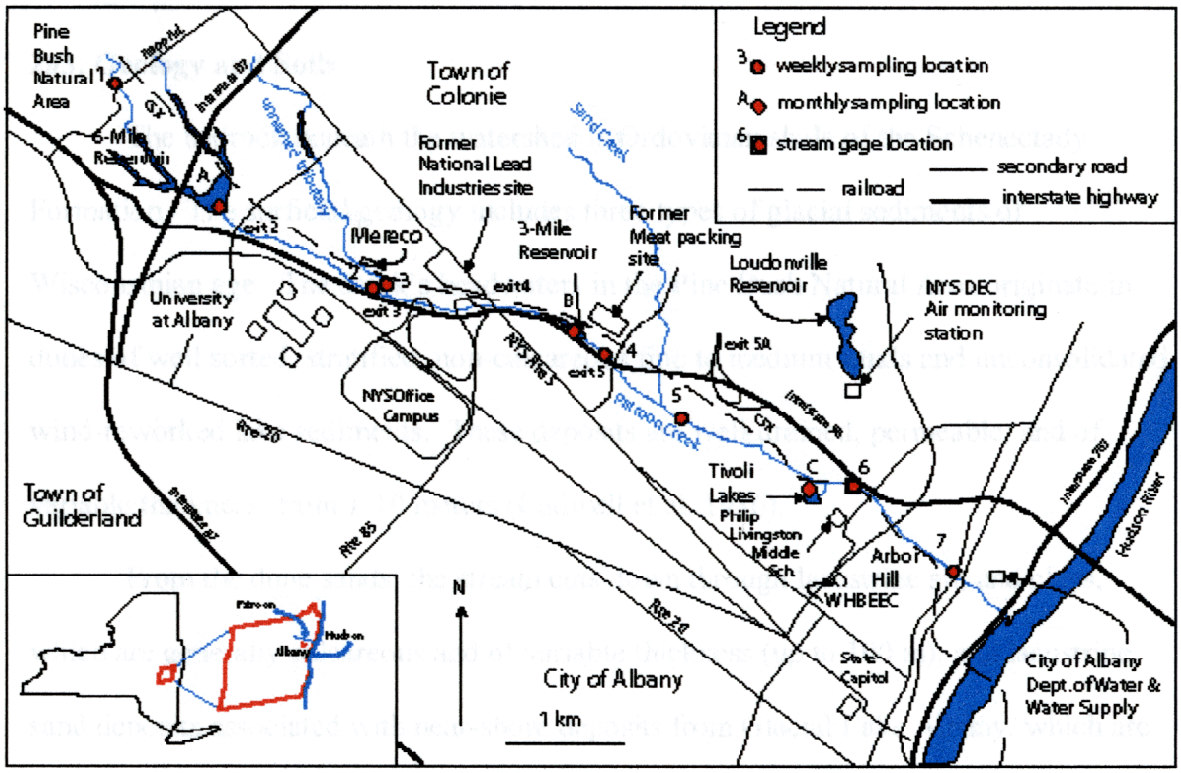

Figure 1, Map of Patroon Creek in Albany, New York. Weekly sampling locations are shown as red dots.

2a2. Description of Channel, Tributaries, and Reservoirs

Patroon Creek has two major tributaries, Sand Creek and an unnamed tributary referred to as the "North Branch" in this paper (Figure 1). There are 2 reservoirs along the creek's length. Six Mile Reservoir, or Rensselaer Lake, is located near the headwaters, and three mile reservoir is located adjacent to the west-bound lane of I-90 between exits 5 and 4 (Figure 1). The bed of Patroon Creek is mainly fine silts and sands, with very little rocky substrate or vegetation. Many of its banks are eroded into steep cutbanks. About one-third of the creek's length is in man-made channels and underground culverts.

2a3. Geology and Soils

The bedrock beneath the watershed is Ordovician shale of the Schenectady Formation. The surficial geology includes three types of glacial sediments of Wisconsinian age. The creek's headwaters in the Pine Bush Natural Area originate in dunes of well sorted, stratified, non-calcareous fine to medium sands and unconsolidated wind-reworked lake sediments. These deposits are well-drained, permeable, and of variable thickness, from 1-10 meters (Cadwell et al.,1986).

From the dune sands, the stream cuts down through lacustrine silt and clays, which are generally calcareous and of variable thickness (up to 100 m), and lacustrine sand deposits associated with near-shore deposits from Glacial Lake Albany, which are well-sorted, stratified, generally made of quartz sand, and of variable thickness, from 2-20 m. At its mouth, the creek cuts through recent flood plain deposits of the Hudson River (Cadwell et al., 1986).

According to the USEPA, some soils around Patroon Creek are classified as Urban Land – Ur, nearly level to sloping areas where impervious surfaces cover more than 85 % of the land [in that particular area]. This includes areas with miscellaneous fill, with few areas that retained their natural soil characteristics after disturbance. Some soils in undeveloped areas south of the Conrail railroad tracks are classified as Udipsamments – Ud, nearly level to very steep areas of disturbed sandy soils that are deep and well drained (USEPA, 2003).

2a4. Hydrology

Prior to this study, there had not been a gage on Patroon Creek since the early 1980's. The only data available for this earlier time period are Peak Streamflow for the water years 1979 through 1983. These data are summarized below:

Table I, Peak streamflow for the water years 1979 through 1983 in liters per second as measured at the USGS gage on Patroon Creek (USGS 01359133 "Patroon Cr at Northern Blvd at Albany NY"). Data from USGS at water.usgs.gov.

Water year	Date	Peak Streamflow (L/s)
1979	2/24/1979	9770
1980	10/3/1979	11186
1981	2/20/1981	9912
1982	8/9/1982	12744
1983	9/21/1983	17558

2a5. Land Use History

Along with the Normans Kill, Patroon Creek is one of two remaining above-ground creeks in the Albany area. Patroon Creek has been an important part of Albany history and was used since the seventeenth century for saw mills, and up until 1920 as a city drinking water source. The creek flows through underground culverts for about one-third of its length, as it has since the late 19th century. In the 1960's, the creek was significantly rerouted for the construction of Interstate 90. Patroon Creek now flows adjacent to Interstate 90 and Amtrak/Conrail tracks for much of its 11 km course.

Along its course, the creek is dammed by two reservoirs, and flows through three remnant semi-natural areas. The 223 acre section of the Albany Pine Bush Preserve surrounding Six Mile Reservoir (or Rensselaer Lake) protects the pine barrens ecology of the area. There is a wetland directly upstream from Three Mile Reservoir. Patroon Creek also flows through the Tivoli Preserve near the Arbor Hill neighborhood, where the USGS stream gage is located. The preserve encompasses 33 hectares of wetlands, ponds, hills, and fields, and is home to over 50 species of birds. The mouth of Patroon Creek where it enters the Hudson River is located in the Corning Preserve, a 200 acre park with bike paths, walking trails, picnic areas, and boat launches.

Thirty-two to thirty-eight percent of the surface area of the Patroon Creek watershed is impermeable surfaces, including highways, streets, parking lots, and building rooftops (Audette, 2004). The following table shows different types of impervious surfaces. See also Figure 2, a digital orthoimage which shows these impervious surfaces.

Table II, percentage of different types of impervious surfaces within the 37 km^2 Patroon Creek Watershed. Ranges are given in some cases because of uncertainty (data from Audette, 2004).

Categories	Area (km2)	% of watershed
Parking Lots	4.09	11
Highways/Interstates	0.87	2
Two and four lane roads	2.60	7
Rooftops	3.89 - 6.11	13 -19
Total Impervious Surfaces	**12.92**	**32 - 38**

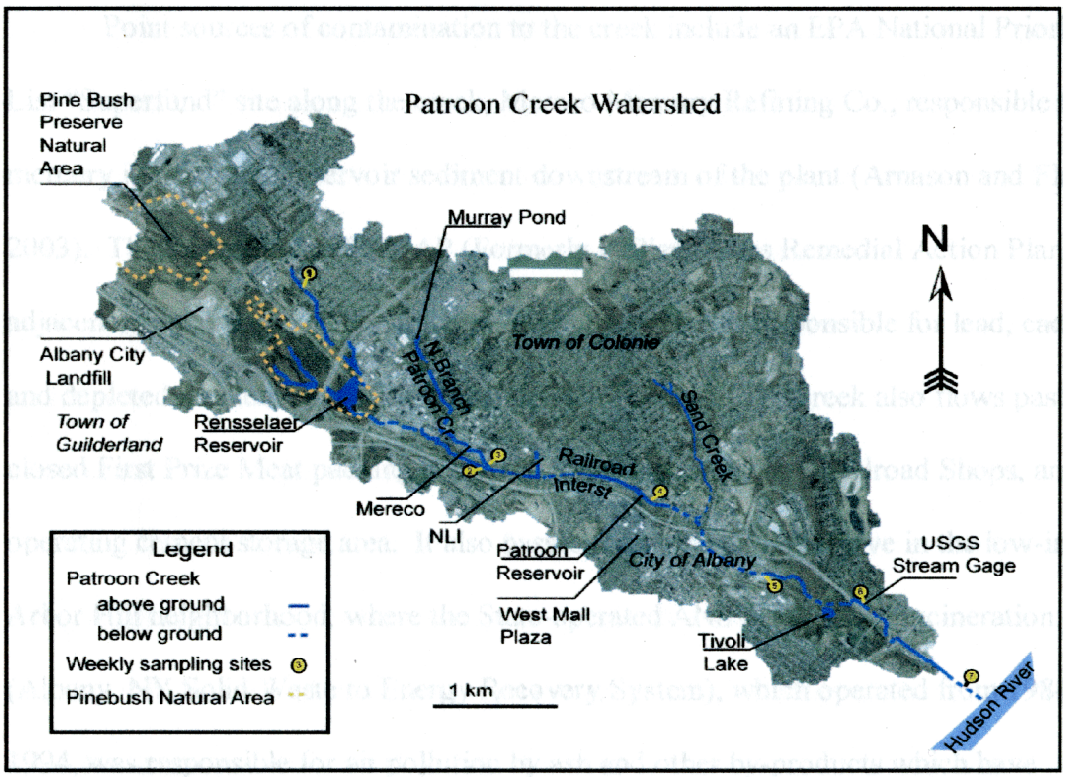

Figure 2, Digital orthoimage of the Patroon Creek Watershed illustrating impervious surfaces within the watershed (compiled by B. Fletcher and J. Arnason, watershed boundaries established by Todd Fobozzi of the Capital District Regional Planning Commission).

2a6. Contamination Issues Facing Patroon Creek

Since the early twentieth century, Patroon Creek has been polluted by urban runoff, erosion of surfaces within the watershed, heavy metals and other chemicals from industry, illegal dumping, and sewage. It has many of the contamination issues facing a typical urban stream. The creek is classified as moderately to severely impacted based on benthic macroinvertebrate indices (Audette, 2004, Bode et al., 1993). It has heavy metal contamination from mercury, lead, cadmium, and depleted uranium. It is also polluted by coliform bacteria from known sewage leakages and other unknown sources. Patroon Creek is classified by the New York State Department of Environmental Conservation as a Class C water body (NYSDEC).

Point sources of contamination to the creek include an EPA National Priorities List "Superfund" site along the creek, Mereco Mercury Refining Co., responsible for mercury in creek and reservoir sediment downstream of the plant (Arnason and Fletcher, 2003). There is also one FUSRAP (Formerly Utilized Sites Remedial Action Plan) site adjacent to a tributary, National Lead Industries, which is responsible for lead, cadmium, and depleted uranium in the creek sediments (Figure 1). The creek also flows past the closed First Prize Meat packing plant, the former West Albany Railroad Shops, and an operating cement storage area. It also passes through Tivoli Preserve in the low-income Arbor Hill neighborhood, where the State-operated ANSWERS trash incineration plant (Albany, NY Solid Waste to Energy Recovery System), which operated from 1984 to 1994, was responsible for air pollution by ash and other by-products which have contaminated the soils of Tivoli Preserve (Times Union, www.timesunion.com/communities/ahej).

2b. Methods

Water samples were collected weekly by faculty, students, and trained volunteers from the University at Albany and the W. Haywood Burns Environmental Education Center from June 2002 to November 2003, and biweekly from December 2003 until June 2004. Samples were collected from 7 sites along the 11 km creek, from the mouth to the headwaters (Figure 1). Samples were collected in 250 ml plastic Nalgene bottles using a metal "grabber" at the water's surface near the center of the channel, on Tuesday mornings, between 7 am and 12 pm. They were placed in a cooler with a frozen icepack until they could be refrigerated. Samples for bacterial analysis were collected in sterile 125 mL plastic Nalgene bottles containing 0.1 ml $N_2S_2O_3 \cdot 5H_20$ and analyzed by the Albany County Water Department. Field water temperature and dissolved oxygen concentrations were measured at each site using a hand-held dissolved oxygen meter (YSI Incorporated, 550DO). The meter was calibrated before each measurement in water-saturated air, and measurements were corrected for salinity and altitude.

Sample aliquots were filtered using plastic syringes and a 45 μm filter into 25 mL plastic scintillation vials with screw-top lids for ion chromatography. The pH of the remainder of the sample was measured and later corrected for field temperature (ThermoOrion pH meter model 420). Prior to measurement, the pH meter was calibrated using buffer solutions of pH 4, 7, and 10. Alkalinity was measured on a subset of the samples using a Hach digital titrator and digital titration cartridge with 1.6 N H_2SO_4, magnetic stirring plate, and pH meter. Samples are diluted and digitally titrated to a pH of 4.5, since this has been shown to be the correct endpoint for Patroon Creek's waters

(Drever, 1997). The number of digits used to bring the solution to this endpoint is then extrapolated to ppm calcium carbonate.

In the laboratory, U.S. EPA method 300.1, "Determination of inorganic anions in drinking water by ion chromatography (USEPA, 1997)," was used for anions, and a similar method was used for cations. 0.5 ml aliquots of the filtered samples were diluted to 5 ml with deionized water (18.3 MΩ-cm), in Dionex Poly-Vial 5 ml vials and plain caps, and analyzed on a Dionex ion chromatograph (DX-120 for anions, ICS-90 for cations, AS-40 automated sampler, Chromeleon software on Dell PC). The ion chromatograph was calibrated with standard solutions of known concentrations. The ion chromatograph measured concentrations of the cations lithium, sodium, ammonium, potassium, magnesium, and calcium, and the anions fluoride, chloride, nitrate, phosphate, and sulfate.

To test the average composition of road salt used in the watershed, a saturated solution of road salt from the Colonie Highway Department was analyzed by the ion chromatograph. Since the solubility of sodium chloride is 35.7 g NaCl/100 ml water at room temperature (25°C), this concentration was used. 89.25 g of the salt mixture was added to 250 mL of water. This brine was then diluted down to a thousandth of its concentration so it would not exceed the ion chromatograph's analytical limits.

Data measured electronically at the USGS gage station on Patroon Creek in Tivoli Preserve were compared to water samples taken from the stream at the same location. The gage measures water temperature (°C), stage (ft.), discharge (cfs), and specific conductivity (μS/cm) every 15 minutes.

2c. Quality Control and Assurance

Ionic concentrations of the water were reported only if they were determined to be accurate, precise, and above the minimum reportable quantity for the method used. Accuracy was determined by analyzing standards with known ionic concentrations, a 5 anion standard and 6 cation standard from the Dionex corporation, and a 5 ion standard created in the laboratory. Analyses of the 5 ion standard are shown in Appendix V. Samples were also fortified with standard solutions to measure analyte recovery. The formula for determining the percent recovery of the standard solution for a sample containing 4.0 mL deionized water, 0.5 mL sample, and 0.5 mL standard solution was:

$$\%\text{Recovery} = 100([LFM]-[sample])/[std]$$

Where [LFM] is the concentration of the ion in the laboratory fortified matrix, [sample] is the concentration of the ion in the unfortified sample, and [std] is the concentration of the ion in the standard solution.

Analytical precision was determined by use of duplicate samples and was reported as percent relative standard deviation (% RSD):

$$\%RSD = 100\sigma/\bar{x}$$

Where σ is the standard deviation of the sample and its duplicate, and $\bar{x}$ is the average of the sample and its duplicate.

The minimum detection limit (MDL) was set as 3 times the standard deviation of ionic concentrations in 18.3 MΩ-cm deionized water laboratory blanks as analyzed by the ion chromatograph, and the minimum reportable quantity (MRL) was set as 10 times the standard deviation. These numbers were different for each batch of samples analyzed. Appendix IV shows all analyses of deionized water.

Temperature measurements made with hand-held instruments in the field were equal, within 1% relative standard deviation, to those measured electronically by the USGS gage on Patroon Creek (Figure 3).

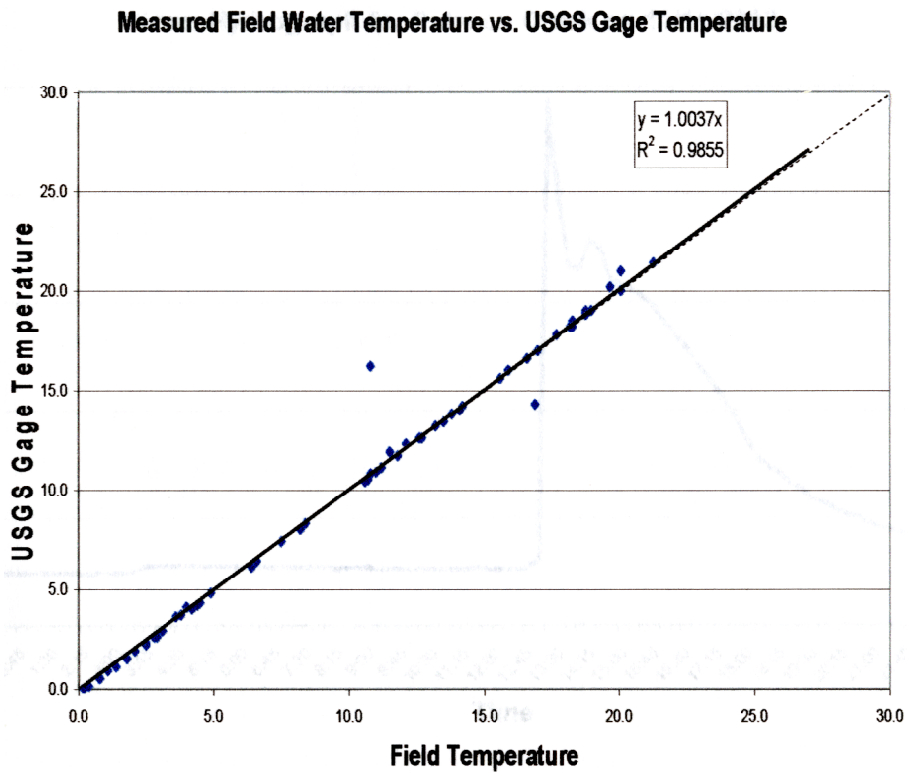

Figure 3, Field temperature (°C) as measured with a YSI dissolved oxygen meter on Tuesdays on Patroon Creek at the USGS gaging station, versus temperature (°C) measured electronically by the USGS. Slope is essentially 1, as is the R^2 value. The two outliers are due to unexplained measurement errors. n=59.

3. Results

3a. Hydrology Results

According to Likens and Bormann (1995, 15), "because of the vital role of water as a transporting agent, chemical solvent, and catalyst, quantitative data on hydrology are of paramount importance in understanding the biogeochemistry of an ecosystem."

Figure 4 is a storm hydrograph for Patroon Creek for November 11, 2002, using data from the USGS gage. Note steep rising limb and more gradual falling limb, typical of a watershed covered by impervious surfaces.

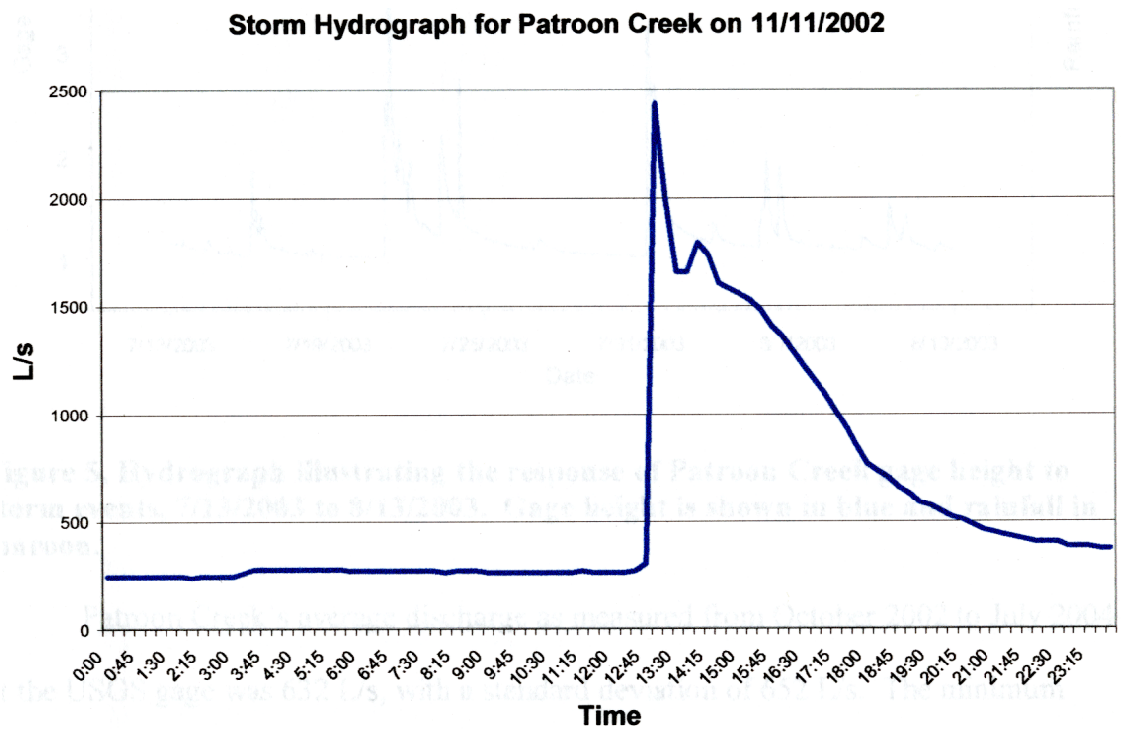

Figure 4, Storm hydrograph for Patroon Creek on 11/11/2002. The x-axis is time of day (military), and the y-axis is discharge in liters per second.

Figure 5 below is a hydrograph for one summer month for Patroon Creek, illustrating the creek's rapid response to storm events.

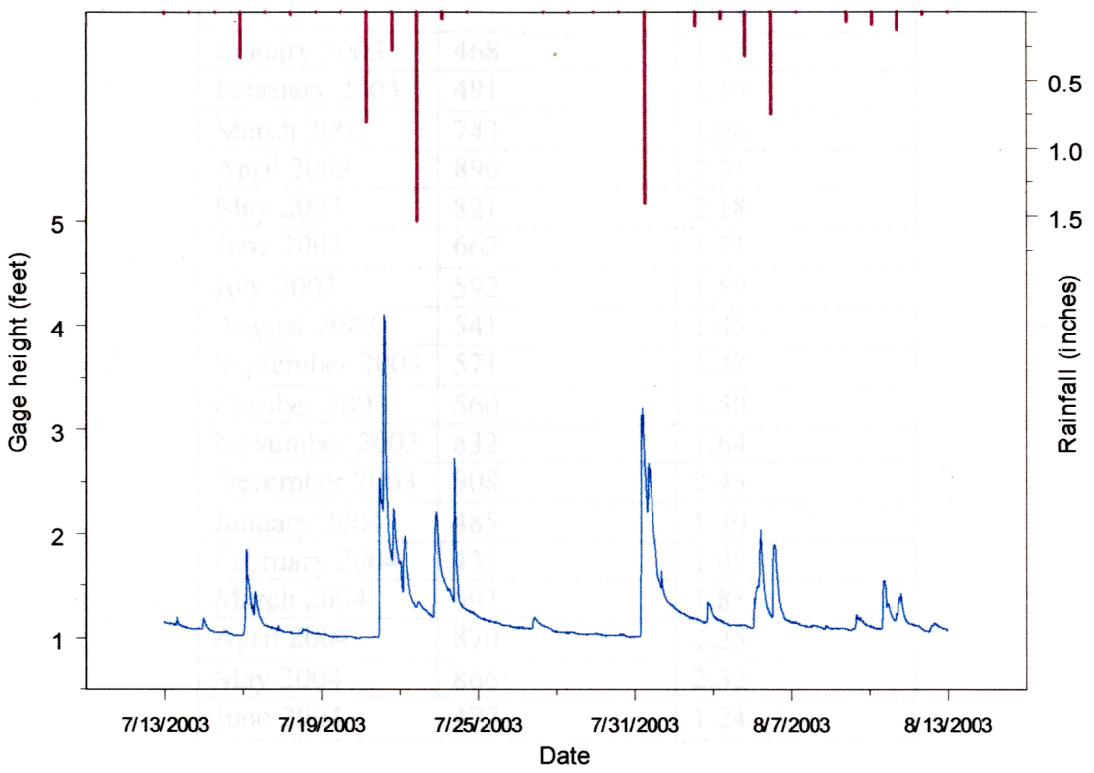

Figure 5, Hydrograph illustrating the response of Patroon Creek gage height to storm events, 7/13/2003 to 8/13/2003. Gage height is shown in blue and rainfall in maroon.

Patroon Creek's average discharge as measured from October 2002 to July 2004 at the USGS gage was 632 L/s, with a standard deviation of 652 L/s. The minimum discharge recorded was 199 L/s on October 14, 2003, and the maximum discharge was 15,231 L/s on July 21, 2003. Table I shows maximum discharge for the water years 1979-1983. Table III shows average monthly discharge and total monthly discharge for the period of this study since the USGS gage has been operational. Baseflow is around 350 L/s, a visual estimate from the stream's hydrographs (Appendix I).

Table III, Average Monthly Discharge and Monthly Total Discharge for Patroon Creek, January 2003 to June 2004

Month	Average Discharge (L/s)	Total Discharge (L x 10^9)
January 2003	468	1.23
February 2003	491	1.19
March 2003	743	1.98
April 2003	890	2.31
May 2003	821	2.18
June 2003	662	1.71
July 2003	592	1.59
August 2003	541	1.45
September 2003	571	1.48
October 2003	560	1.50
November 2003	632	1.64
December 2003	908	2.43
January 2004	485	1.30
February 2004	432	1.08
March 2004	693	1.85
April 2004	870	2.25
May 2004	866	2.32
June 2004	477	1.24

From January 2003 to June 2004, peak streamflow is during the spring snowmelt months, but there is a second peak in late autumn (Figure 6). Likens and Bormann (1995) attribute similar increases in streamflow in Northeastern forested watersheds to a lack of transpiration as vegetation dies. Of course, the record for Patroon Creek is very short, so it is unknown whether this is the reason for the autumn peak. Streamflow is lowest in winter, because much of the precipitation is trapped in snowpack (Likens and Bormann, 1995).

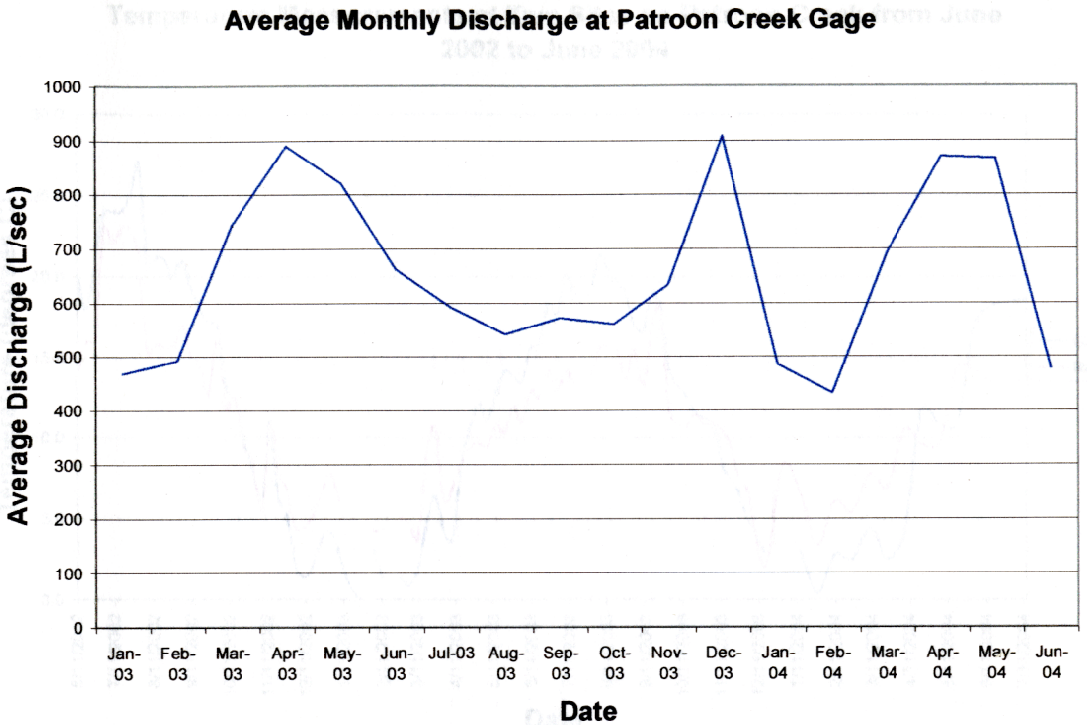

Figure 6, Average monthly discharge (liters per second) at the USGS gage on Patroon Creek, from January 2003 to June 2004.

Temperature fluctuations in Patroon Creek are shown in Figure 7 below. Temperatures at Site 1 are less variable than those at Site 6. Temperatures from each site for all sampling dates are available in Appendix VI. Temperatures range from -0.3°C to 28°C, and may fluctuate by a few degrees per day.

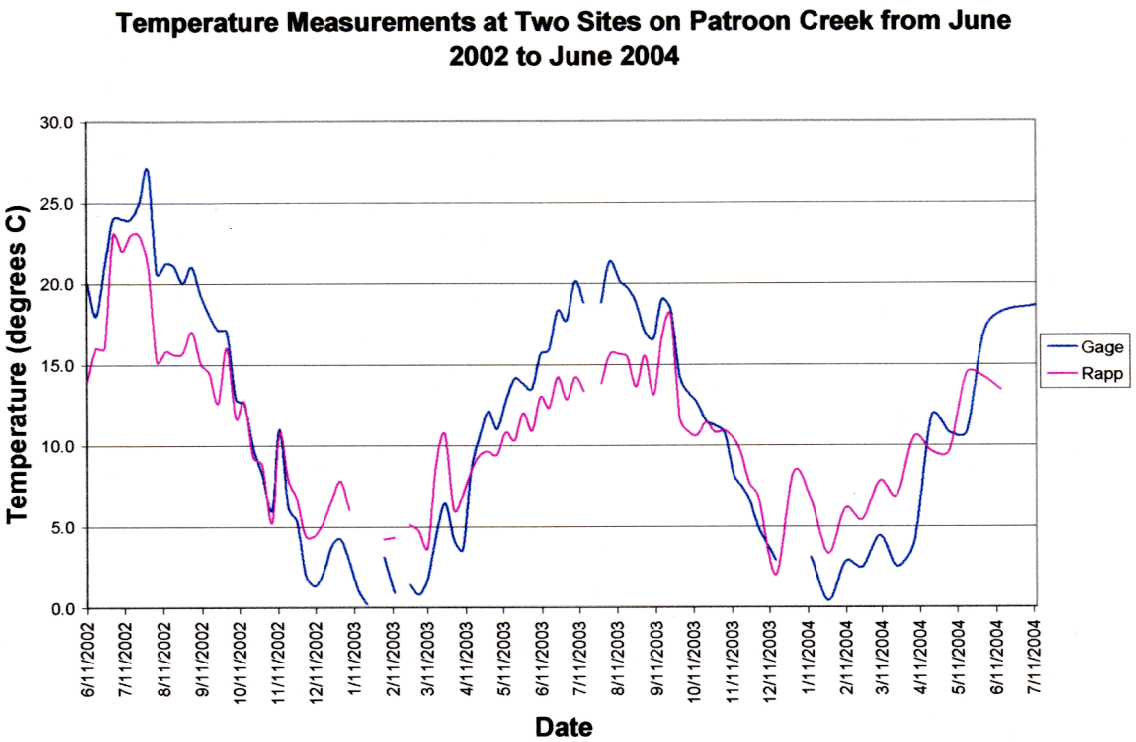

Figure 7, Temperature measurements at Site 6 (USGS Gage Station) and Site 1 (Rapp Rd.) on Patroon Creek from June 2002 to June 2004. Data gaps are from dates when sampling sites were not accessible due to weather conditions.

Figures 8 and 9 below illustrate variations in water temperature, specific conductivity, and discharge as measured by the USGS gage.

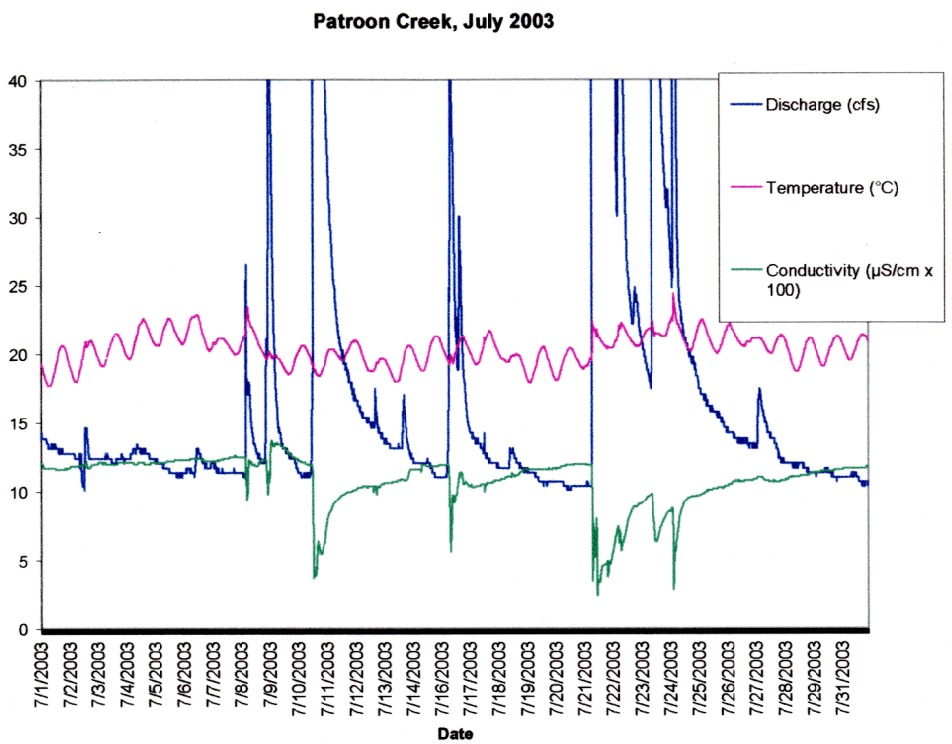

Figure 8, Water temperature, specific conductivity, and discharge measurements for the month of July, 2003.

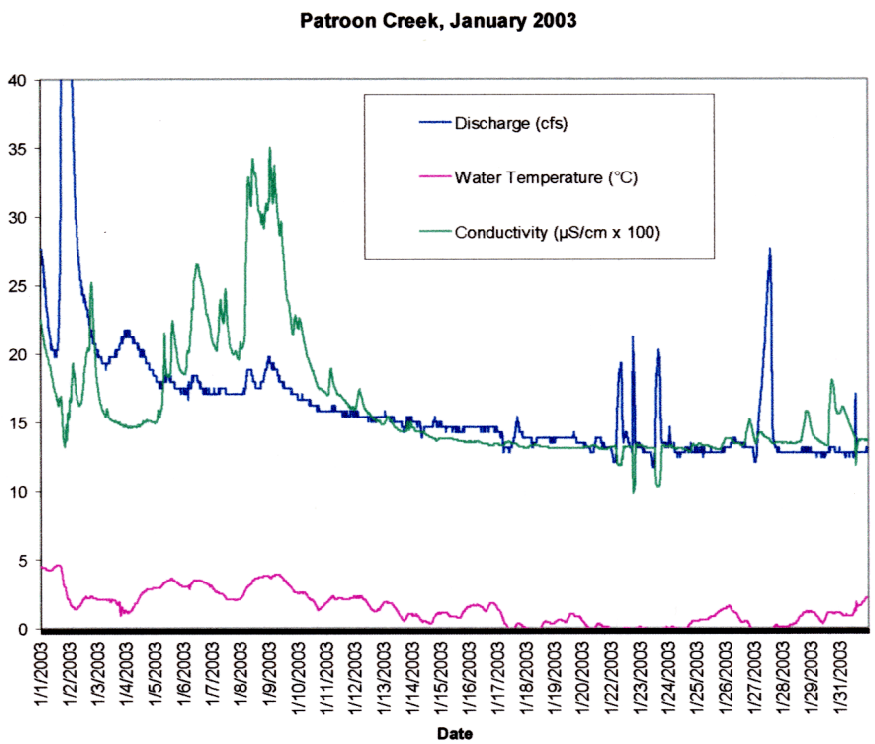

Figure 9, Water temperature, specific conductivity, and discharge measurements for the month of January, 2003.

Groundwater was not studied for this project, but Dineen and Hanson (1983) state that there is a deep aquifer underlying the region between impermeable lake clays and till deposits under artesian pressure, which may indicate that it is recharged from higher altitude areas in the Pine Bush, and a more shallow unconfined aquifer in the glacial deposits of Lake Albany, which ranges from 1.5 to 45 meters in thickness and is parallel to the land surface.

3b. Geochemistry results

3b1. General trends in ionic concentrations

Ionic concentrations from each sampling date and sampling site are available in Appendix VI. The following table shows the average concentrations, with standard

deviation, from June 2002 to June 2004, of all anions measured (n/d means non-detected).

Table IV, statistical summary of anions in Patroon Creek at all sampling sites from June 2002 to June 2004.

	Fluoride (ppm)	Chloride (ppm)	Nitrate (ppm)	Phosphate (ppm)	Sulfate (ppm)
Minimum	n/d	3.58	n/d	n/d	n/d
1st quartile	n/d	165	n/d	n/d	25.6
Mean	0.16	224	1.61	0.01	31.7
Median	0.04	203	1.41	n/d	32.1
3rd quartile	0.09	247	2.75	n/d	38.0
Maximum	5.50	1400	7.58	1.40	51.7
Std. Deviation	0.51	120	1.47	0.09	8.91
n	587	592	591	482	591

The following table shows average concentrations, with standard deviation, from June 2002 to June 2004, of all cations measured.

Table V, statistical summary of cations in Patroon Creek at all sampling sites from June 2002 to June 2004.

	Sodium (ppm)	Ammonium (ppm)	Potassium (ppm)	Magnesium (ppm)	Calcium (ppm)
Minimum	4.00	n/d	0.82	1.19	15.6
1st quartile	106	n/d	2.95	14.4	76.1
Mean	137	1.03	4.31	16.0	83.5
Median	127	n/d	3.46	16.6	88.4
3rd quartile	152	1.48	4.61	18.3	96.7
Maximum	787	7.52	42.2	23.1	116
Std. Deviation	71.0	1.61	3.50	3.67	20.8
n	589	527	591	591	591

Patroon Creek's water chemistry varies both spatially and temporally. Table VI shows this spatial variation, with arithmetic mean concentrations in ppm (ave), standard deviation (s.d.) and percent relative standard deviation (%RSD), from June 2002 to June 2004.

Table VI, spatial variation in ions at the 7 different sampling sites on Patroon Creek. Data shown is from June 2002 to June 2004.

		fluoride			chloride			nitrate			phosphate			sulfate		
Site	n	ave	s.d	%RSD	ave	s.d	%RSD	ave	s.d	%RSD	ave	s.d	%RSD	ave	s.d	%RSD
1	87	0.18	0.54	292	127	47.4	37	0.50	0.54	107	0.01	0.07	479	38.4	8.46	21
2	93	0.14	0.44	306	201	47.8	23	2.29	1.83	79	0.01	0.10	711	24.8	6.89	27
3	83	0.20	0.54	264	311	212	68	1.22	1.15	94	0.00	0.02	824	31.4	9.76	31
4	93	0.18	0.61	330	234	80.8	34	1.64	1.23	74	0.00	0.02	818	27.6	6.76	24
5	93	0.17	0.47	271	224	75.7	33	1.92	1.46	75	0.03	0.19	615	30.6	6.61	21
6	87	0.11	0.36	313	235	107	45	1.95	1.47	75	0.01	0.04	830	33.4	7.44	22
7	93	0.14	0.61	424	232	100	43	1.78	1.59	89	0.01	0.05	836	34.6	8.91	25

		sodium			ammonium			potassium			magnesium			calcium		
Site	n	ave	s.d.	%RSD	ave	s.d.	%RSD	ave	s.d.	%RSD	ave	s.d.	%RSD	ave	s.d.	%RSD
1	87	74.3	25.8	34	0.75	0.63	85	3.93	5.04	128	16.3	3.57	21	95.4	23.5	24
2	93	132	29.5	22	1.36	1.94	142	4.66	3.10	66	14.5	2.80	19	74.6	17.8	23
3	83	189	123	65	0.58	1.33	230	3.62	1.72	47	14.1	3.82	27	80.6	24.0	29
4	93	148	50.3	33	1.39	1.83	131	4.10	1.83	44	14.5	2.52	17	77.1	18.8	24
5	93	137	47.8	34	1.04	1.77	170	4.55	3.12	68	16.3	2.74	16	82.6	16.1	19
6	87	140	59.0	41	0.95	1.57	164	4.60	4.51	97	17.5	3.22	18	86.7	16.0	18
7	93	13	59.8	43	1.13	1.66	146	4.77	3.58	75	18.5	3.94	21	87.7	18.6	21

The locations of these sites are shown in Figure 1. The ionic chemistry of the water at Site 1 is very different from that of Site 3, which drains the North Branch of the creek. Figure 10 is a Piper diagram which shows this spatial variation in the creek's ionic chemistry. Waters from Site 1, Rapp Road, are shown in light blue. All other sites fall on a mixing line between the calcium- bicarbonate-type waters of Site 1 and the chloride-sodium type waters of Site 3, North Branch, shown in Orange. Water from site 1 can be

categorized as a more calcium and bicarbonate-type water, whereas further downstream as more road salt is added, the water approaches a sodium and chloride-type water (Appendix III).

The geochemistry of the water is also very different temporally, with much higher concentrations of sodium and chloride in the winter and spring months than in the summer and autumn. Figure 11 is another Piper Diagram, showing data from only Site 3 in order to highlight just the seasonal variation. There is a mixing line between calcium and bicarbonate-type waters, and sodium and chloride-type waters, with the winter values falling in the latter facies. Appendix III is a blank Piper Diagram illustrating the different hydrochemical facies, which may be used as a key for understanding Figures 10 and 11.

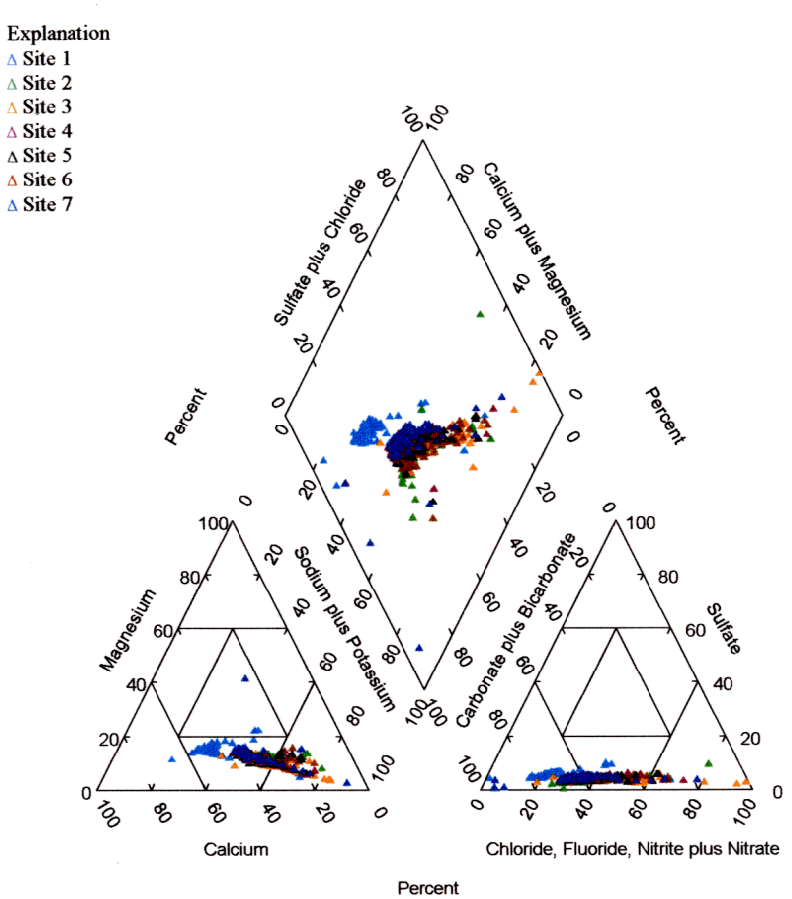

Figure 10, Piper Diagram illustrating spatial differences in surface water ionic chemistry for Patroon Creek. Site 1, Rapp Road, shown in light blue, is the furthest upstream, and Site 7, Erie Boulevard, shown in dark blue, is the furthest downstream. Site 3, North Branch, shown in orange, has the highest concentrations of sodium and chloride. n=644.

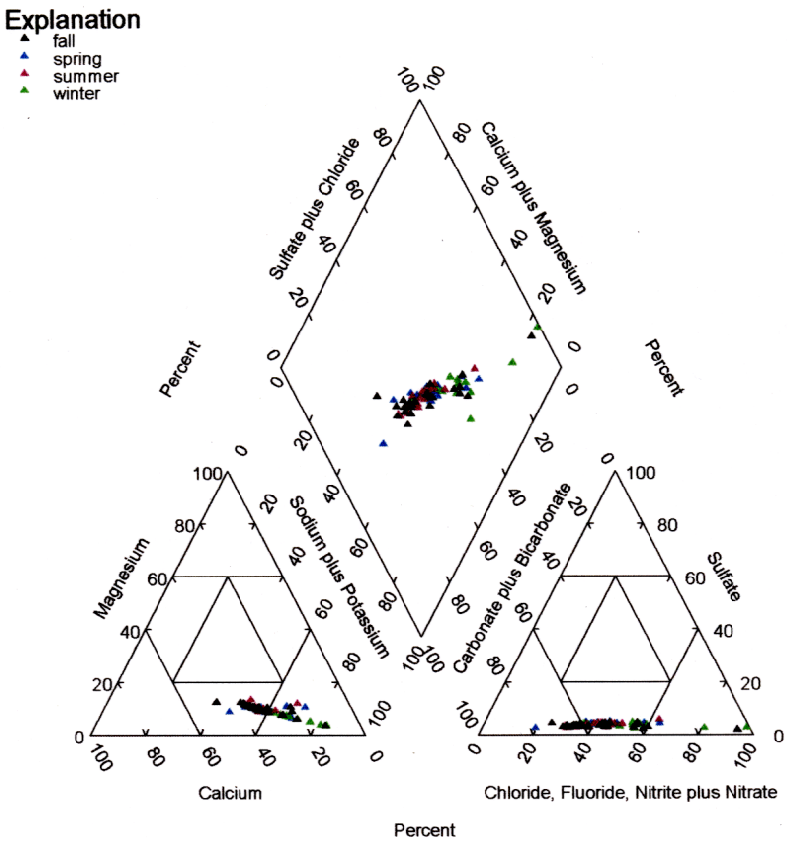

Figure 11, Piper Diagram illustrating the seasonal differences in surface water ionic chemistry for Patroon Creek. Only data from Site 3 (n = 94), the North Branch, is shown, in order to remove any spatial effect.

Geochemical modeling using PHREEQC indicates that Patroon Creek's water is saturated with respect to aragonite, calcite, and dolomite, and undersaturated with respect to anhydrite, carbon dioxide, gypsum, oxygen, and halite. This was true for different sampling sites at different times throughout the year.

3b2. Trends in Sodium and Chloride concentrations

The most striking seasonal and temporal variations in water chemistry are seen in sodium and chloride concentrations. Sodium and Chloride concentrations are highest in the winter and spring months, but remain elevated throughout the entire year. Concentrations increase from sampling sites upstream to those downstream. Figure 12 illustrates both the seasonal and spatial variations in concentrations in Patroon Creek.

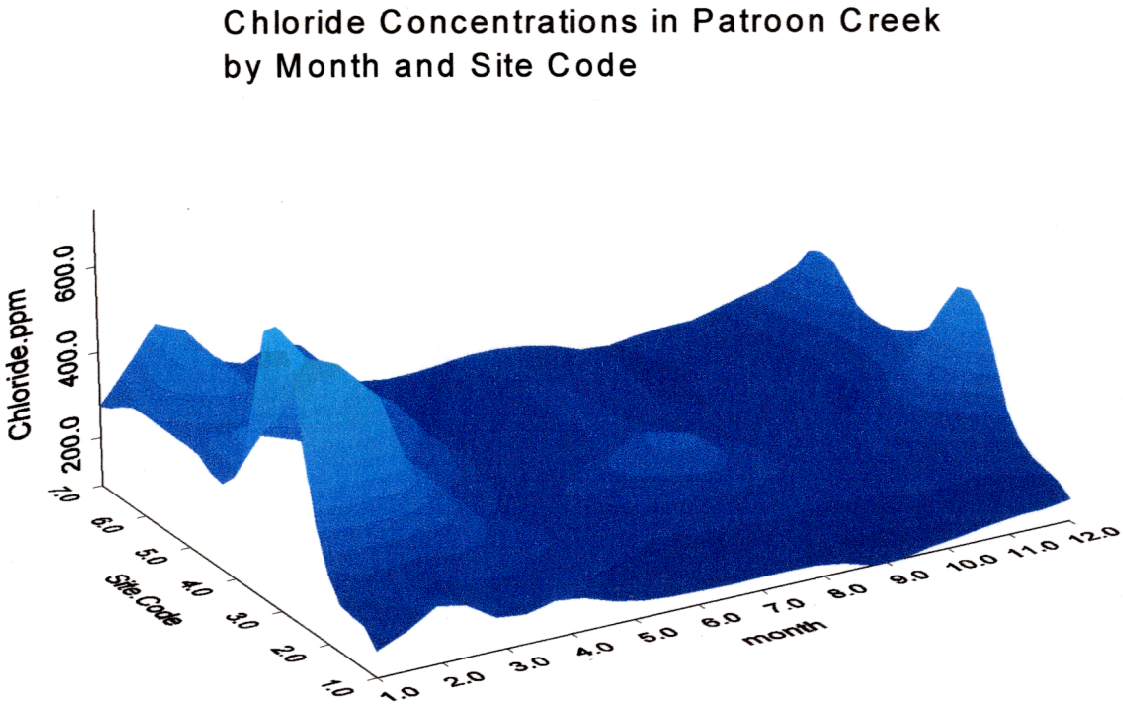

Figure 12, Three-dimensional surface representing chloride concentrations in Patroon Creek by both month and sampling site code along the stream. The x-axis is month of the year, with "1" being January, and "12" being December. The y-axis is sampling site along the stream, from 1 at Rapp Road, the headwaters of the creek, to 7, Erie Boulevard, at the mouth of the creek at the Hudson. Site 3 is the North Branch of the Creek, which has the highest Chloride Concentrations. The z-axis is chloride concentration in ppm. n=643.

Figure 13 shows data from only Site 3, in order to remove the spatial variation component and show only seasonal variation in chloride concentrations. Site 3 has the highest concentrations of sodium and chloride. This seasonal variation can also be seen in Figure 11, the Piper Diagram of the North Branch's chemistry.

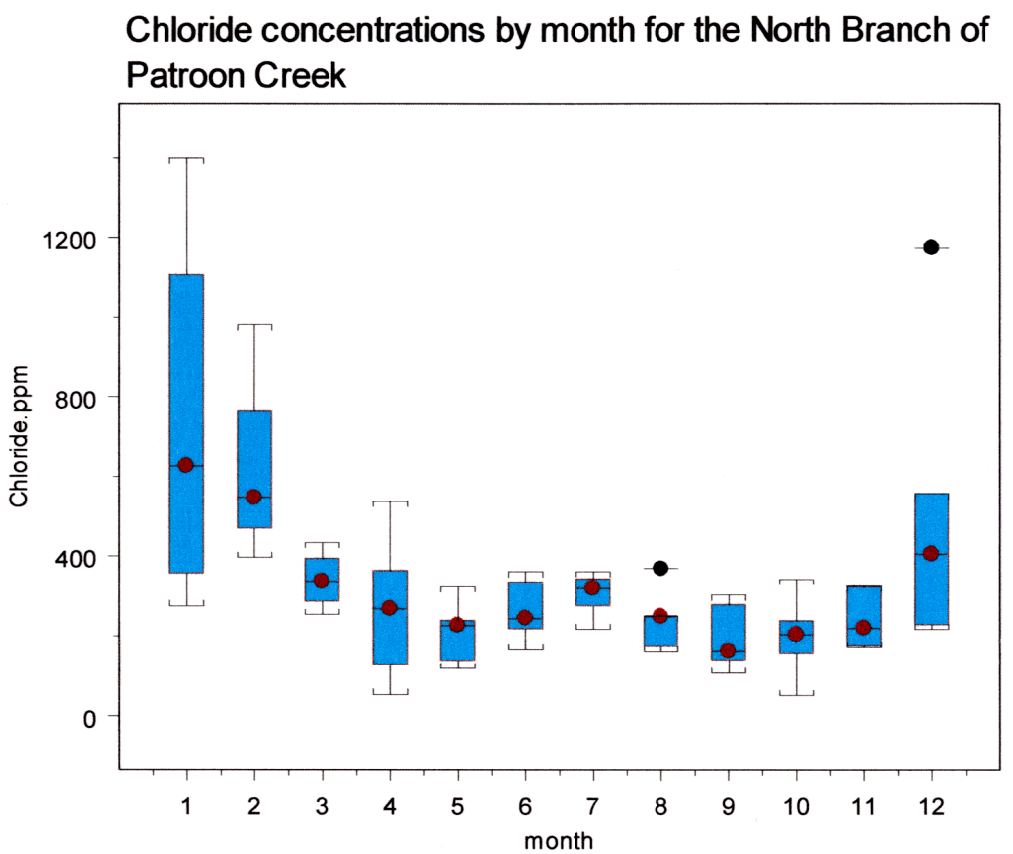

Figure 13, Box and whisker plot of chloride concentration as a function of month of the year for site 3 (North Branch) on Patroon Creek from June 2002 to June 2004. Red dots are means, with the boxes' borders representing the 25th and 75th percentiles. Whiskers are 99 percent of values, with outliers shown as black dots. On the x-axis, month 1 is January, and month 12 is December. Chloride concentration is shown in ppm on the y-axis. n=94.

Figure 14 below shows the spatial variation in chloride concentrations in Patroon Creek, with data from all sampling sites for both winters over the course of the 2 year

study. Data from only the winters is shown in order to remove any seasonal variation. This spatial variation can also be seen in Figure 10, the piper diagram illustrating Patroon Creek's geochemistry at different sampling sites.

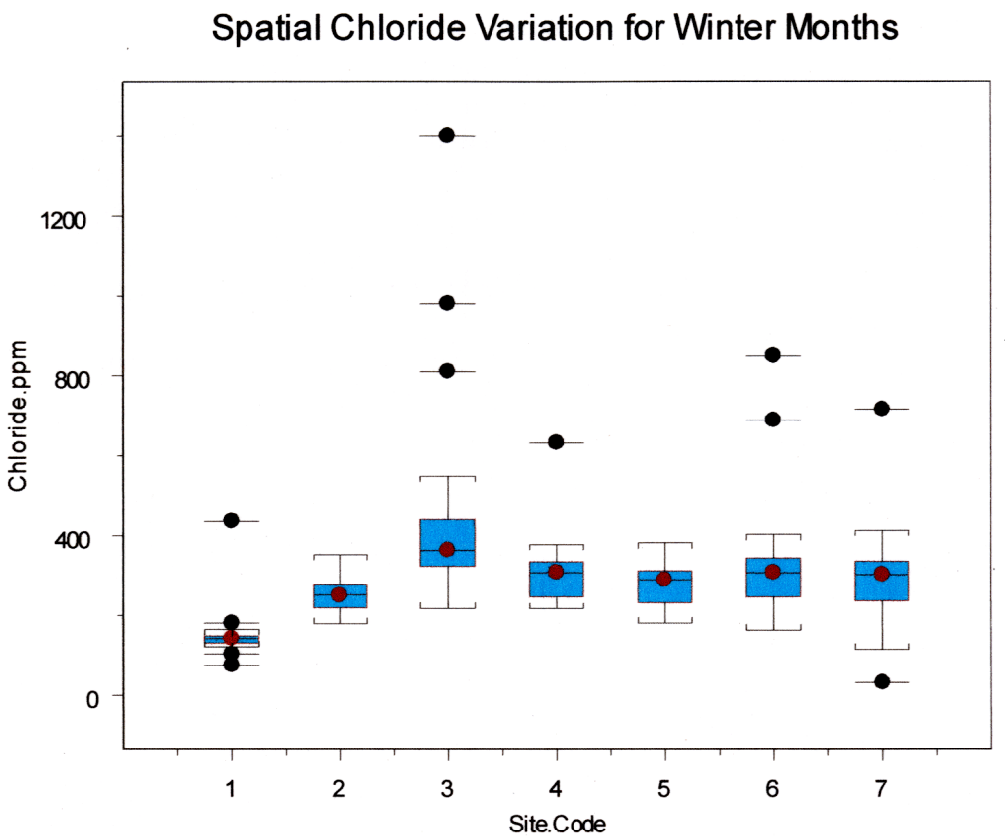

Figure 14, Box and whisker plot showing chloride concentrations at different sites along the creek during the winter months, from the headwaters at Site 1 to Site 7 near the mouth of the creek. Site 3 is the North Branch, which has the highest chloride concentrations. n=124.

The most likely source for the elevated sodium and chloride concentrations in the winter months in Patroon Creek is from the application of halite road salt to roads in the watershed. The ratio of the sodium ion to the chloride ion concentration in Patroon Creek in milliequivalents (mEq) is very close to 1 (Sodium (mEq) = 0.9311 x Chloride (mEq),

Figure 15). The slope of sodium as a function of chloride is slightly less than 1, possibly because other salts besides sodium chloride are used, which contain chloride but not sodium, and possibly because the sodium is preferentially retained in soils.

A sample of road salt from the Colonie Highway Department was shown to be halite. The exact composition of the salt analyzed on the ion chromatograph was $(Na_{0.99550}, K_{0.00001}, Mg_{0.00300}, Ca_{0.00300})Cl_{0.96000}$. It has been suggested that another possible source of chloride to Patroon Creek could be sewage and septic leakage, since there have been spills and burst pipes along near the creek in the past year. However, there was no correlation between chloride concentration and bacteria counts, which does not support this hypothesis (Figure 16).

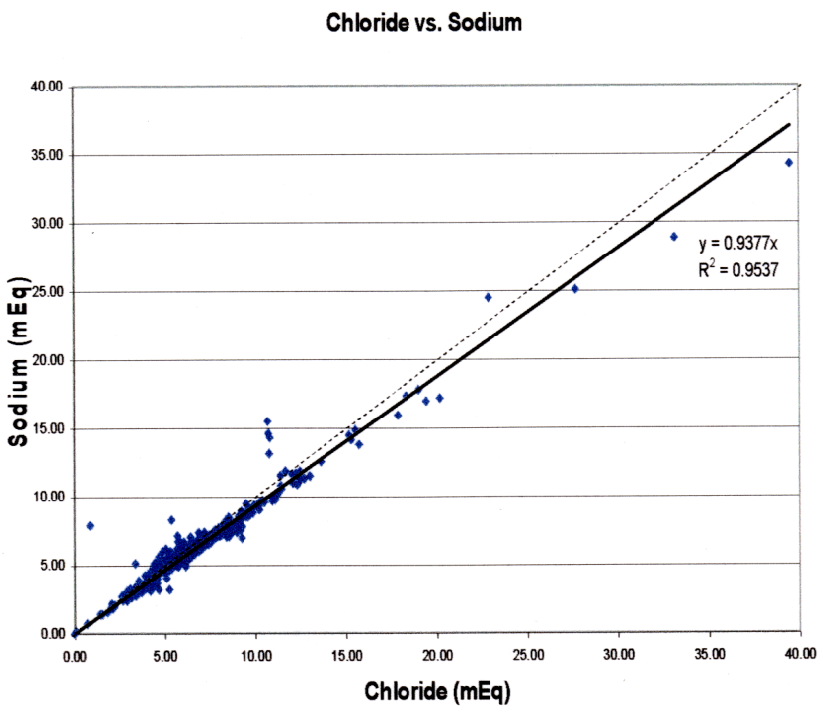

Figure 15, Relationship between the chloride concentration and sodium ion concentration in Patroon Creek in milliequivalents (mEq). The slope of the linear trend line and correlation coefficient are shown in the upper right corner. The dashed line has a slope of 1 as a point of reference. n=578.

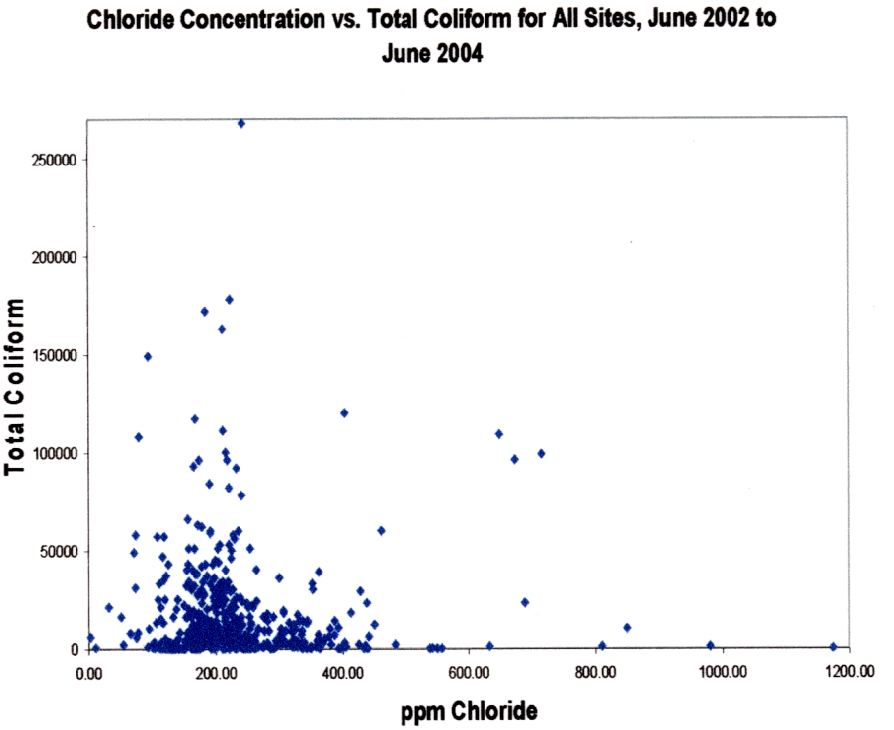

Figure 16, Scatterplot of relationship between chloride concentrations and total coliform in Patroon Creek (n=559)

4. Budget for Sodium and Chloride, Results and Discussion

To characterize the behavior of road salt within the Patroon Creek watershed system, a budget of inputs and outputs was created for sodium and chloride. Over the course of one year, inputs should balance with outputs (if all possible inputs and outputs have been identified). The water year June 1, 2003 to May 31, 2004 was chosen, since estimates of road salt inputs were for the entire winter. A June to May water year has been used by other researchers, because foliage is established in early June in the northeast, thereby making it a natural stopping point in the life cycle of plants in a watershed (Likens and Bormann, 1995). Figure 17 is a flowchart of estimated inputs and outputs of sodium and chloride to the watershed. Methods for calculating these will be explained further in the following sections.

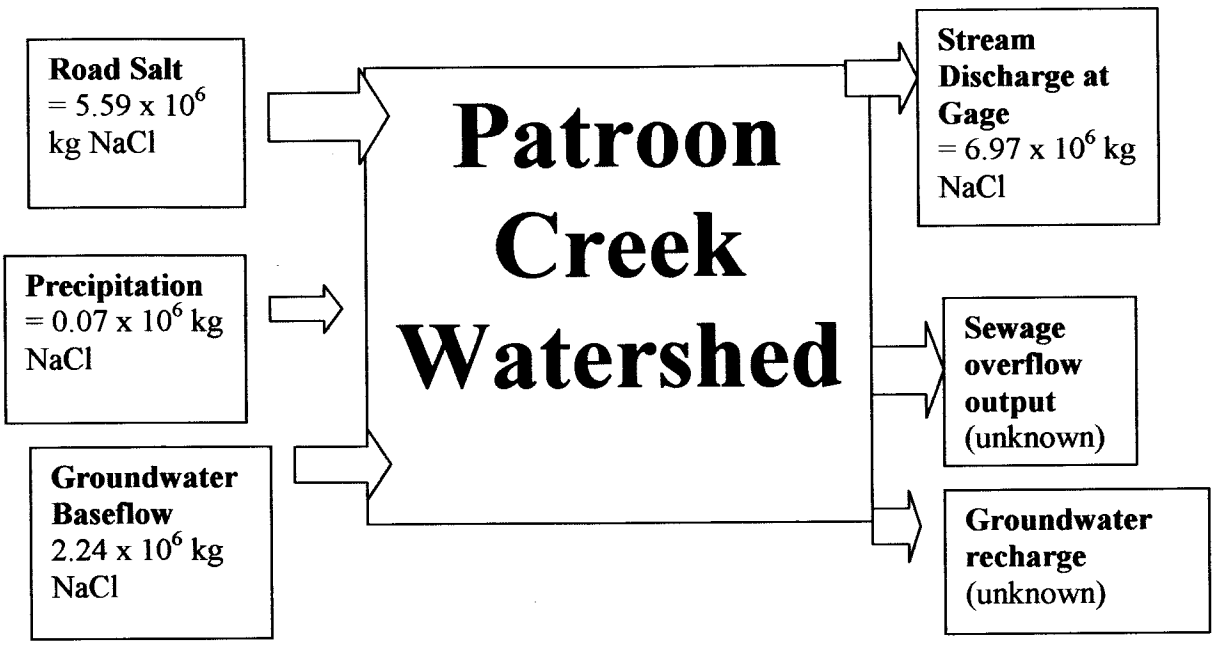

Figure 17, Flow chart illustrating inputs and outputs of sodium and chloride in the Patroon Creek watershed. Arrows flowing into Patroon Creek are inputs and arrows flowing out are outputs. Numeric values represent fluxes of sodium chloride.

4a. Inputs

4a1. Input from Sodium Chloride Road Salt Application

To estimate salt application on the watershed by the two municipalities within the watershed, Albany and Colonie, members of their respective highway departments were contacted. The watershed was divided into two parts and ArcGIS software to measure the area of each part. This smaller area within the watershed was a certain fraction of the area of the whole town. This smaller area was multiplied by the amount of salt used per square kilometer for each town. See Table VII below.

Table VII, Amount of road salt (NaCl) applied by the cities of Colonie and Albany for the winter of 2003 to 2004.

Town	Total Area of town (km^2)	Town's area within watershed (km^2)	Total salt usage for entire town (kg)	Salt usage per km^2 (kg)	Salt applied to watershed (kg), Winter 2003-2004
Colonie, NY	150	24.11	1.36×10^7	9.1×10^4	2.2×10^6
Albany, NY	57	12.88	9.1×10^6	1.58×10^5	2.0×10^6

Therefore total salt applied on city streets in Colonie and Albany was estimated as 4.2×10^6 kg for Winter 2003-2004. However, estimates of salt usage by the towns varies greatly from year to year. For example, for the Winter of 2003 to 2004, Colonie used 15,000 tons of road salt. In past years they have used anywhere from 12,000 to 18,000 tons (Ron Langdon, Personal Communication, 2004).

Estimates from the New York State Department of Transportation were used to calculate inputs of salt directly from Interstates 90 and 87. The average per lane-mile salt usage for the past 10 years in Albany is 1.3×10^4 kg per lane mile per year. This number was applied to Interstate 90 and Interstate 87, which combined total 56.64 lane-miles in the watershed. Total highway length was 9.44 miles multiplied by 6 lanes (estimated using ArcGIS). Total salt applied to highways within the watershed was estimated as 0.74×10^6 kg per year.

Private parking lots, which are very dense especially along Route 5/Central Avenue in Colonie, were a more difficult contribution to estimate. Parking lots make up 11% of the watershed, or 4.09 km^2 in total (Audette, 2004). Since each parking lot owner

uses a different private contractor to plow and salt their property, it would be prohibitively difficult to obtain estimates of salt application to the different lots. Estimates of salt usage per square kilometer (1.59×10^5 kg/km^2) from the Albany Highway Department were used, but these are a very conservative estimate since they are for a much less densely-paved area. They are meant to represent a minimum amount of salt used. This number was then applied to all parking lots in the area as an average using ArcGIS (4.09 km^2), which equals 0.65×10^6 kg.

Therefore total salt application on the watershed is conservatively estimated at 4.2×10^6 kg from city highway departments, 0.74×10^6 kg from the interstates, and a minimum of 0.65×10^6 kg from private parking lot contractors, a total of 5.59×10^6 kg.

4a2. Input from Precipitation

To determine the input of sodium and chloride deposited on the watershed directly by precipitation, data from the websites of the National Atmospheric Deposition Program (NADP) and the National Climatic Data Center (NCDC) were used. Table VIII shows data from the NADP.

Table VIII, Average sodium and chloride concentrations in precipitation from 2001 to 2002. Data is from the two NADP data collection stations located nearest Albany, NY.

Site Location	Distance from Albany	Average Sodium Concentration (2001-2002)	Average Chloride Concentration (2001-2002)
Ulster County, NY	160 km	0.52 ppm	0.12 ppm
Bennington, VT	60 km	0.46 ppm	0.10 ppm
Average		**0.49 ppm**	**0.11 ppm**

In an average year, Albany receives approximately 116 cm of precipitation, as measured at the Albany International Airport (NCDC). For the 37 km^2 watershed, average total precipitation falling in one year is approximately 4.3×10^{10} L. This number was then multiplied by the average concentrations of sodium and chloride in Albany's precipitation, to estimate total contribution to the budget from precipitation. Total sodium ion from rainfall was estimated as 2.1×10^4 kg, and total chloride as 4.8×10^4 kg, for a total contribution of salt from precipitation of 6.9×10^4 kg, which equals only about 1% of the total amount of sodium chloride contributed by road salting, a negligible contribution to the inputs.

4a3. Groundwater Input

Since not much is known about how groundwater contributes to the system, a very rough and very conservative estimate of groundwater input was made. It was based on sodium and chloride concentrations in a groundwater proxy, and estimated volume of base flow contribution to the stream.

Patroon Creek's baseflow was estimated at around 350 liters per second, a visual estimate from hydrographs (Appendix I). Average concentrations of sodium and chloride from Site 1, Rapp Road, were used as a groundwater proxy. Site 1 is upstream of any major roads, and the water here varies less in temperature than the other sites throughout the year, suggesting that much of it is groundwater-derived (Figure 7).

The Rapp Road site is also upstream of the two major reservoirs along the creek and has the lowest concentrations of sodium and chloride of the seven monitoring sites. Average sodium concentration over two years at Rapp Road was 74.7 mg/L, and average chloride concentration was 128 mg/L. These averages were multiplied by the baseflow

input of 350 liters per second, or 1.1×10^{10} liters per year, to estimate how much sodium and chloride were input to the stream by groundwater. Total sodium input was estimated as 0.825×10^{6} kg/yr, and total chloride input as 1.4×10^{6} kg/yr, meaning the total input of sodium and chloride from groundwater sources was 2.24×10^{6} kg. Data from the groundwater wells monitoring the Mereco Superfund Site from December, 2001 and March and April, 2002 show that sodium concentrations of groundwater ranged from 67 to 271 ppm. Chloride concentrations were not measured (USEPA, 2003).

4b. Outputs

4b1. Discharge at USGS Gage

To estimate discharge of sodium chloride at the USGS gage, an empirical relationship was established between specific conductivity from the USGS gage and sodium and chloride concentration from weekly measurements from the same site. Using a simple linear best fit, the relationships between specific conductivity and concentrations of the sodium and chloride ions (ppm) for Patroon Creek are:

$$[Cl^-] = 0.2192\lambda$$

$$[Na^+] = 0.1285\lambda$$

Where $[Cl^-]$ is chloride ion concentration in ppm, $[Na^+]$ is sodium ion concentration in ppm, and λ is specific conductivity in $\mu S/cm$. The graphs used to derive these functions are shown below, in Figures 18 and 19.

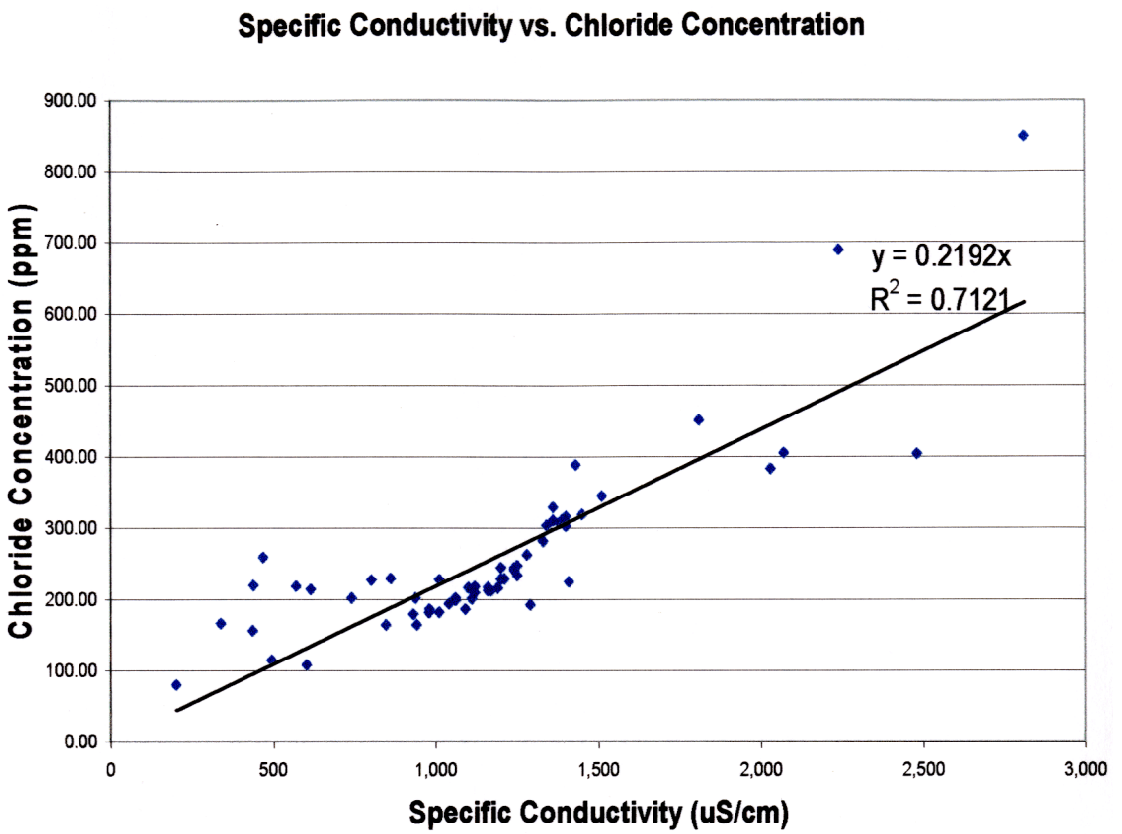

Figure 18, Chloride concentration (ppm) as a function of specific conductivity for Patroon Creek. Slope and correlation coefficient are shown in upper right corner (n=60).

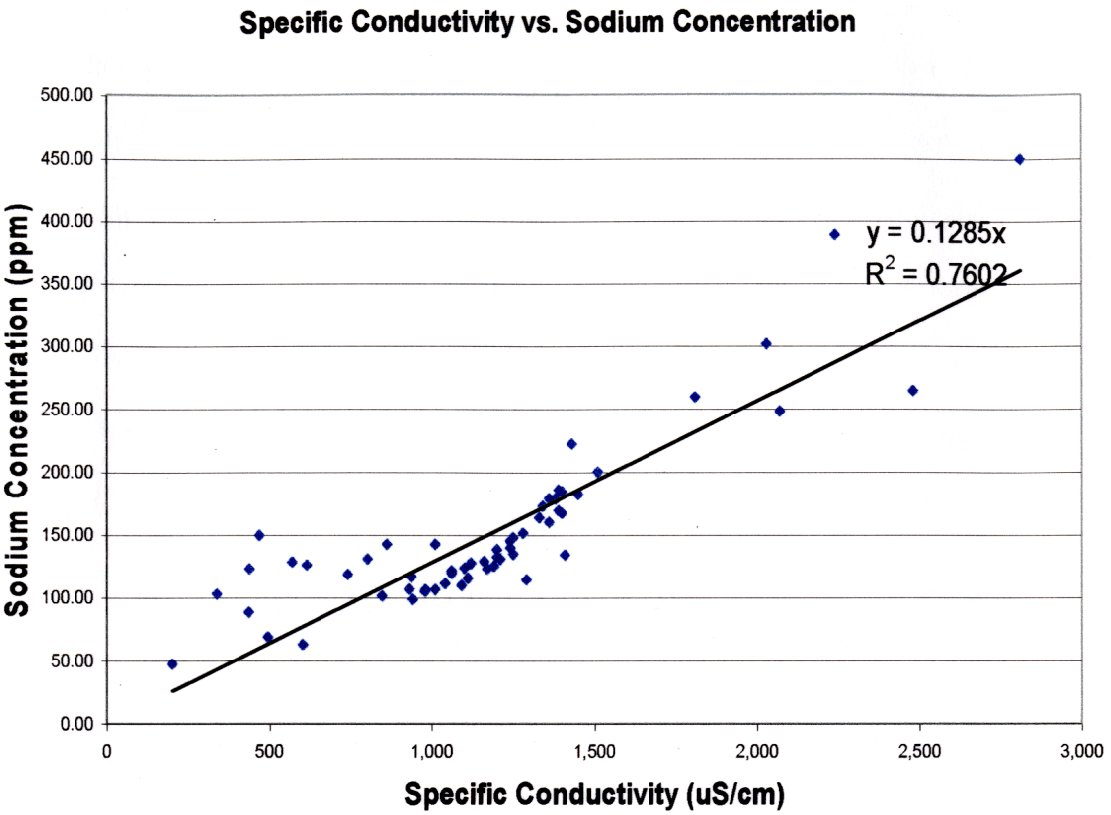

Figure 19, Sodium concentration (ppm) as a function of specific conductivity (µS/cm) for Patroon Creek. Slope and correlation coefficient are shown in upper right corner (n=60).

Although it is apparent from Figures 18 and 19 that there is not a perfect linear relationship between ion concentrations and specific conductivity, a linear relationship is assumed for the intents and purposes of creating this budget. From this relationship, sodium and chloride ion concentrations were estimated for each 15 minute interval over the course of one year, from June 1, 2003 to May 31, 2004. These concentrations were multiplied by the discharge for each 15 minute interval to estimate the total mass of sodium and chloride ions flowing past the gage over the course of 15 minutes. All totals in 15 minute intervals were summed to estimate the total mass of sodium and chloride flowing past the gage in one year. This estimate was 6.97×10^6 kg per year. Figure 21

below illustrates the mass of sodium and chloride flowing past the USGS gage each month that the gage was operational. Familiar peaks and troughs are seen, as more sodium and chloride are discharged in the winter and spring snowmelt months than at other times during the year. Of course, this is a product of both sodium and chloride concentrations, and volume of water discharged. Average discharge was shown in Figure 6 above, and average concentrations of sodium and chloride as derived from the specific conductivity function are shown in Figure 20 below. Figure 21 can be thought of as a product of these other two figures.

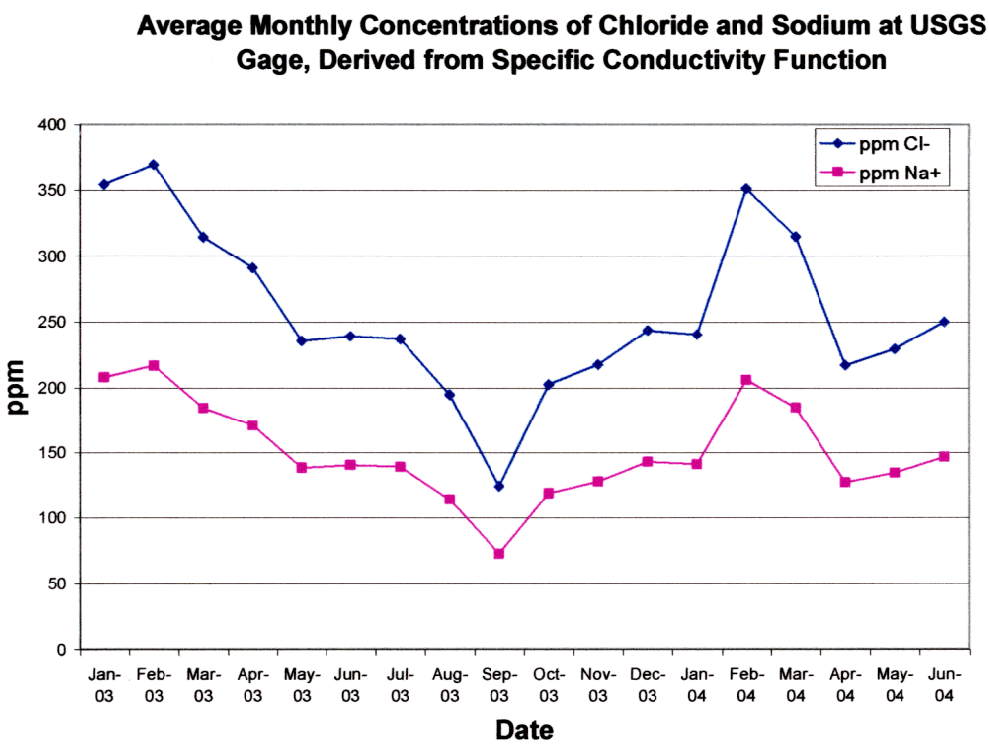

Figure 20, Average monthly sodium and chloride concentrations at the USGS gage station on Patroon Creek, as estimated from specific conductivity.

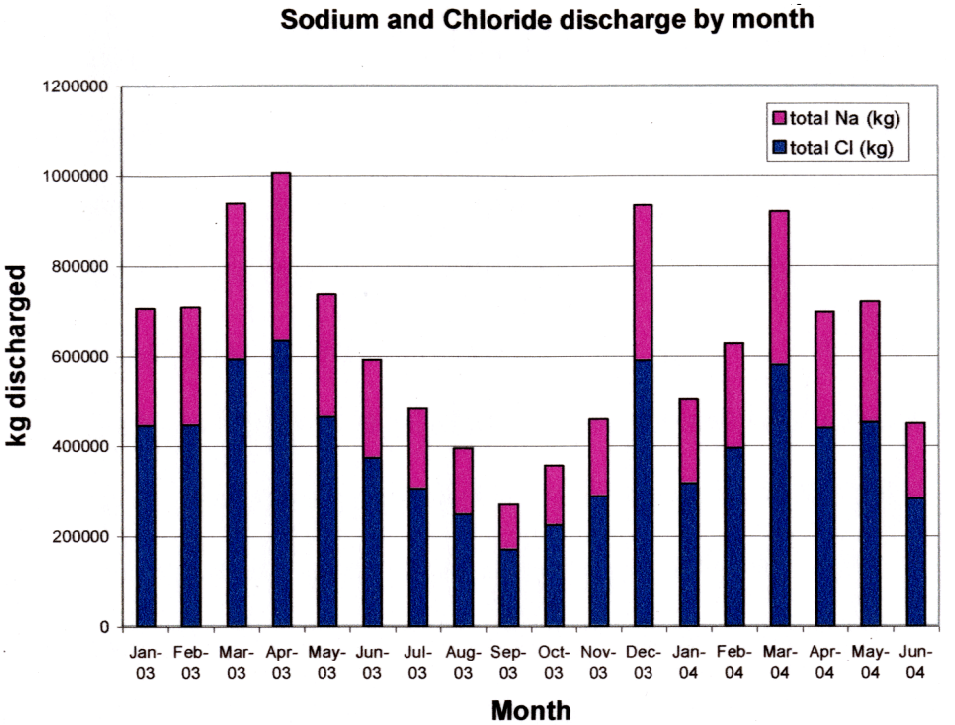

Figure 21, Total mass of sodium and chloride discharged each month at the USGS gage station on Patroon Creek, as derived from specific conductivity function and total volume of discharged water.

4b2. Combined Sewage Overflow System Output

Total discharge of water at the gage from June 1, 2003 to May 31, 2004 was 2.1 x 10^{10} L. Average annual precipitation over the Patroon Creek watershed is 4.3 x 10^{10} L, so only about half of the precipitation falling on the watershed is flowing out of the watershed past the gaging station. The rest of this water is lost to evaporation, evapotranspiration, and to diversion into a combined sewage overflow system.

The streets of Albany are on a combined sewer system, and depending on the area of Albany, runoff from winter storms can potentially go to a sewage treatment facility. However, all runoff from Interstate 90 is diverted directly into Patroon Creek, and it is

not connected to the sewage system. The Sewer Department claims that it is not possible to estimate the discharge from the roads which is diverted to the sewage system, nor is the chemistry of this water measured. Depending on the severity of the storm event, in some cases the overflow bypasses the treatment facility altogether and is diverted directly into the Hudson (Tim Murphy, personal communication, 2004).

4b3. Groundwater Output

Until recently it was widely believed that most sodium chloride applied to a watershed was mobilized in surface runoff and discharged out of streams, and so its impact on groundwater was believed to be minimal. However, recent studies in Toronto have shown that only about 45% of salt applied to watersheds exits the system via overland flow (Howard, 1998). Since the groundwater system in the Patroon Creek watershed is poorly understood, the assumption is made that water from the watershed must also be recharged to the groundwater at certain times of the year, carrying sodium and chloride with it. Since groundwater watersheds and surface watersheds do not always overlap perfectly, especially in watersheds altered by man-made drainages, this is a source of output of sodium and chloride from the system. This was not studied, so groundwater output of sodium and chloride is unknown.

4c. Discussion of Data Gaps in a Sodium Chloride Budget

In addition to storage by groundwater, the soils of the watershed may also act as a reservoir for these ions. It is hypothesized that sodium and chloride are retained in the soils throughout the year, which would explain high concentrations of these ions even in the summer months when no road salt is added to the watershed. In urban Toronto watersheds, researchers have found unusually elevated chloride levels in the unsaturated

zone directly above the water table (Howard, 1998). Further investigation is needed to understand the Patroon Creek watershed soils as a reservoir for these ions.

Estimated Inputs of Sodium Chloride to Patroon Creek total 7.9×10^6 kg, and outputs total 6.97×10^6 kg, a net gain to the creek of 0.93×10^6 kg, for the water year June 1, 2003 to May 31, 2004. Creating a budget of sodium and chloride inputs and outputs was complicated by many factors. Several assumptions had to be made. It was assumed that road salt was spread evenly over entire towns and the watershed, disregarding road density, because per lane mile estimates of usage per year were not available, the only feasible method for estimating salt application on the watershed was to scale down entire city estimates to the size of the watershed. Staff from both Albany and Colonie knew only roughly how much road salt was used over the entire city area. Imprecise estimates of road salt application made the calculation of inputs very difficult. Trucks in Colonie and Albany do not yet have automatic spreading technology, which would keep track of how much salt was spread for each storm event. This is something the cities will acquire in the near future.

Also, parking lots are maintained by private contractors. Estimates of salt application rates per unit area for the city of Albany were used to estimate the minimum amount of salt used on Parking lots. This is not precise because the estimates from the cities included all land area, not just paved areas. Parking lot application amounts must be much higher than estimated here, probably by orders of magnitude.

The estimate of per lane-mile per year interstate highway salt usage from the Department of Transportation was based on an average for the past 10 years. Since the budget created was for just one of those years, the calculation may be imprecise,

depending whether there was more or less than average salt applied this past winter. If more data could be gathered from Patroon Creek over many years, a more accurate estimate could be made, using average data. The assumption here is that the winter of 2003-2004 was an "average" winter.

5. Discussion

5a. Contrasting an Urban and a Forested Watershed

It is useful to compare and contrast the very urbanized Patroon Creek watershed with a natural, fairly undisturbed watershed in a similar climate. The Hubbard Brook Experimental Forest in New Hampshire is representative of a forested Northeastern watershed. Hubbard Brook flows west to east over the course of 13 km and has many smaller tributaries. Since the 1950's the U.S. Forest Service has monitored the watershed to better understand the workings of a natural watershed (Likens and Bormann, 1995).

The water of Hubbard Brook maintains a fairly constant daily temperature, with daily fluctuations of no more than a few degrees. Its temperature range for the year is from 0° C to 18° C. The stream is shaded by vegetation from June to October (Likens and Bormann, 1995). Temperature in Patroon Creek ranges from -0.3°C to 28°C, and fluctuates a few degrees on a daily basis (Figure 7). According to Paul and Meyer (2001), urbanization and the removal of riparian vegetation for shade can have a strong effect on a stream's temperature, with cooler winter extremes and warmer summer extremes than in a forested stream.

The stream bed of Hubbard Brook is covered by organic debris, fine sand, gravel, cobbles, and small boulders, with waterfalls and pools created by the buildup of the organic debris (Likens and Bormann, 1995). Patroon Creek's bed is mainly fine sands and silts. In fact, when biology students from the University at Albany tried to sample Patroon Creek for various biotic indices, they could not find proper substrate and rocks where invertebrates can live, and had to install artificial multiplates (Audette, 2004).

At Hubbard Brook, stream chemistry fluctuates very little throughout the seasons and over the course of many years. Calcium and sulfate dominate the system, with sodium, magnesium and aluminum being important cations. Ionic strength of the water is 0.2 mEq/L. Below, in Table IX, annual average concentrations of ions in Hubbard Brook, New Hampshire (Likens and Bormann, 1995) are contrasted with annual averages from Patroon Creek.

Table IX, average concentrations of ions in streamwater from the Hubbard Brook Experimental Forest in New Hampshire and Patroon Creek in Albany, New York.

Ion of interest	**Hubbard Brook average concentration, ppm 1963 - 1974**	**Patroon Creek average concentration, ppm 6/2002-6/2004**
Ca^{+}	1.65 ± 0.06	83.5 ± 20.8
Mg^{+2}	0.38 ± 0.01	16.0 ±3.67
K^{+}	0.23 ± 0.01	4.31 ± 3.50
Na^{+}	0.88 ± 0.02	137 ± 71.0
NH_4^{+}	0.04 ± 0.01	1.04 ± 1.61
SO_4^{-2}	6.23 ± 0.11	31.7 ± 8.92
NO_3^{-}	1.93 ± 0.31	1.61 ± 1.47
Cl^{-}	0.54 ± 0.02	224 ± 120
PO_4^{-3}	0.002	0.01 ± 0.09

In Hubbard Brook, stream water chemistry is a two-component mixture of rainwater and groundwater. Hubbard Brook shows remarkable chemical stability and chemical controls inherent to undisturbed forested ecosystems (Likens and Bormann, 1995). In contrast, Patroon Creek's chemistry is a multi-component mixture of precipitation, groundwater, road salts, and other constituents from urban overland flow.

In forested landscapes, much of the precipitation falling onto a watershed is intercepted by leaves and branches of trees, and then by organic litter, which minimizes erosion and absorbs much of the kinetic energy of the falling water. Also, evapotranspiration reduces the volume of liquid water in an ecosystem, meaning less precipitation is exiting the watershed as stream discharge (Likens and Bormann, 1995).

At Hubbard Brook, stream chemistry is highly predictable, based solely on streamflow rates. Precipitation, atmospheric inputs, and weathering are the major sources of ions to the stream. For Patroon Creek, stream chemistry is highly variable both spatially and temporally. Concentrations of the chloride ion and sodium ion are predictable based on season, since their input follows a logical weather pattern. They are somewhat predictable spatially, as the areas further downstream are more highly concentrated in these ions, and areas directly draining large parking lots are also concentrated.

While much is known about the biogeochemistry of forested watersheds, scientists understand very little about urban ones. Urban streams are often channelized and moved to culverts to divert flows around roads, highways, buildings, and developments and prevent flooding of certain areas. Culverts and concrete channels along urban streams also cause streams to bypass riparian zones which can no longer act filters to keep contaminants and excess water from passing into the stream (Groffman, et al., 2003). Urban watersheds are covered with impermeable surfaces like parking lots, roads, and buildings. Instead of percolating slowly into the ground, water falling on the watershed often becomes overland flow and flows directly into streams and rivers with no filtration by soil percolation. The hydrographs of urban streams show steep rising

limbs, meaning stage increases extremely rapidly after storm events, and this increases the potential for flooding (Paul and Meyer, 2001; Figures 4 and 5, Appendix I). This then can lead to channel incision and erosion. Indeed, this erosion can be seen in the steep cutbanks and stream sedimentation along Patroon Creek. This downcutting is especially common where land use is established and stable, where no new sediment is available to replace sediment that is eroded away by high flows (Groffman, et al., 2003). Stream incision may reduce groundwater levels in riparian areas, which may then lead to a lowering of groundwater levels, which in turn affects soil, plants, and microbial processes. For instance, it could lead to drought-like conditions in former wetlands (Groffman, et al., 2003).

Since there is so much development in urban watersheds, there are many potential sources for point and non-point contamination. Industrial chemicals, highway pollution, lawn fertilizers, and septic systems all contribute to the contamination of urban watersheds and streams.

Urban watersheds are also difficult to map and delineate. Watersheds are normally delineated and mapped based on topographic gradients. In an urban watershed, these boundaries are not as clear-cut. In many cases, water is diverted by pipes and culverts away from its natural course, into other watersheds or into sewage treatment systems. Manmade topographic changes alter the natural flows of water, and streams are diverted away from their natural course. In the case of Patroon Creek, some drains divert water out of the watershed to the Hudson, meaning that the boundaries of the watershed should exclude these smaller areas within the larger Patroon Creek watershed.

5b. Trends in Sodium and Chloride Concentrations in Patroon Creek

The concentrations of sodium and chloride ions in Patroon Creek vary seasonally and spatially. Seasonally, concentrations are highest in the winter and spring snowmelt months throughout the creek (Figures 12 and 13). Although much of the road salt applied to the watershed is washed directly to the creek, some road salt remains trapped in snowpack until the spring snowmelt, at which time it is released into Patroon Creek.

Spatially, as water moves downstream from Site 1, the concentrations of sodium and chloride get progressively higher. At Site 1, the creek's chemistry is a calcium-bicarbonate-type water, representative of more natural surface water chemistry. At site 3, North Branch, especially in winter and spring, the water's chemistry moves to a sodium-chloride-type composition, as more sodium and chloride are added to the water (Figure 10).

Site 3 has the highest salt concentrations. It is along the North Branch tributary of the creek, and drains a large area of parking lots, a mall, shopping centers, busy roads, and industry located near the intersection of Route 5 and Interstate 87 (Figure 1). After the concentrations at Site 3 are diluted by joining the main branch of Patroon Creek, concentrations are lower downstream, but still higher than at Site 1.

Although concentrations of sodium and chloride in Patroon Creek are highest in winter and spring, they remain elevated throughout the year with respect to local background concentrations, with their lowest point in the summer.

Trends seen in Patroon Creek were similar to those seen in a study at Cuyahoga Falls, Ohio (Foos, 2003). A study of springs and seeps near major roadways yielded Piper Diagrams with a similar mixing line to the ones seen in Figures 10 and 11. This

study also found halite road salt to be the source of elevated sodium and chloride ions in water, due to an excellent correlation (r^2=0.995) between sodium and chloride levels and a molar ratio of sodium to chloride of 1:1, similar to that of Figure 15 of this paper.

According to Scott (1981), there are a few factors which correlate to the amount of salt entering stream water. The first factor is the length and type of road system draining into the stream. Scott states that it is logical to assume that the more roads within the watershed, the greater the amount of salt reaching the stream. In the case of Patroon Creek, there is a highway adjacent to the stream and about one-third of the watershed is covered by impermeable surfaces. Increasing urbanization and impervious surfaces within the watershed would also lead to more salt reaching the stream.

The second factor Scott lists is the topography and drainage pattern of the watershed. Steep gradients mean the salts reach the stream more quickly. In the case of Patroon Creek, the gradient is only 300 feet of elevation change for the entire course of the stream. Since the gradient is not very steep, this would mean that salts were retained in the watershed for a longer period of time than if the gradient were steeper.

The third factor is the amount of salt applied prior to thaw periods, and the duration of temperatures above freezing. Unfortunately, it was not possible to break down the salt application by storm events, so the effect of weather events on salt concentrations in the stream was not studied.

5c. Mechanisms by Which Road Salt Enters the Stream Water

Most road salt enters the stream in the winter and spring snowmelt months. But how does it enter the stream? Does it enter the stream as a sodium chloride solid, or as ions dissolved in water? One possibility is that as temperature rises, snow and ice melt

from the roads and carry sodium and chloride into the stream as dissolved ions. Figure 9 supports this hypothesis, because specific conductivity (which can be used to estimate sodium and chloride concentrations), water temperature, and discharge all seem to be correlated in the winter months. The stream is very close to major highways and parking lots, so as it is plowed off of these surfaces it may enter the stream directly as a solid. Salt could also be made airborne by vehicle tires and plowing equipment and deposited in the stream as an aerosol. Data for daily air temperature and daily precipitation types and amounts would help explain how sodium and chloride ions from road salt physically enter the stream.

5d. Elevated Sodium and Chloride in the Summer Months

It is unknown why sodium and chloride concentrations remain elevated throughout the year in the stream. It would seem that concentrations would dip down to much lower levels in the summer months. Figure 8 shows that in the summer months, discharge and specific conductivity are negatively correlated; sodium and chloride concentrations in the stream are diluted by the addition of stormwater. This would suggest that sodium and chloride are not trapped on surfaces within the watershed and then washed into the stream by summer storms. Sodium and chloride must be coming from some source other than the land surface. Perhaps sodium is retained in the system by soil cation exchange. However, this does not explain the retention of chloride, which behaves conservatively. Further investigation is needed to characterize the year-round retention of sodium and chloride in the watershed.

5e. Adverse Effects of Road Salt Contamination

There is only limited data on chloride concentrations in urban lakes and streams. However, data collected by Mayer and others (1999) on road salt concentrations in Canadian surface waters suggest that small ponds and small streams draining urban areas are most sensitive to impacts from road salts. Road salt added to natural waters may increase toxicity and transport of heavy metals through complexation with chloride.

Sodium chloride road salt is well-known for damaging vegetation, weakening concrete structures, and corroding vehicles (Howard and Beck, 1993). Road salt application may also cause "salt burn," or bare strips with no vegetation along the sides of roads. These bare areas of soil with high salt content can lead to invasion by maritime plants which can better tolerate salty soils (Scott and Davison, 1982).

Road salt contamination may also adversely affect aquatic life. In 1988, the United States Environmental Protection Agency (USEPA) established its ambient water quality criteria for chloride. They state that freshwater aquatic organisms are not "affected unacceptably" if dissolved chloride, when associated with sodium, does not exceed 230 mg/L more than once every three years, and if one-hour average concentrations do not exceed 860 mg/L more than once every three years (USEPA, 1988).

Fish researchers have noted the effects of chloride since the 1930's. Fresh water fish tolerate an osmotic pressure of the external water only equal to that of their blood. Chloride associated with sodium is less toxic to aquatic organisms than chloride associated with calcium, magnesium, or potassium. Invertebrates are thought to be more sensitive than vertebrates to chloride (USEPA, 1988).

The following table shows LC_{50}'s for chloride for select aquatic organisms (LC_{50} is the concentration that is lethal to fifty percent of the test subjects). In some cases, ranges are given because the results are for more than one species or life stage.

Table X, Common aquatic organisms and their LC_{50}'s for Chloride (adapted from USEPA, 1988).

Aquatic Organism	LC_{50} for Chloride (mg/L)
Snails	450 – 2,540
Fingernail Clams	160 – 1,655
Daphnia	171 – 3,583
Goldfish	8,388 – 9,455
Fathead Minnow	6,570
Bluegill	965- 8616
Isopod	2,950
Caddisfly	4,039
Mosquito Larva	6,222
Midge	1,434 – 4,900
Eel	10,900 – 13,085
Rainbow Trout	3,336 – 6,743

Even if they are not directly affected biologically by the addition of sodium and chloride to surface water, changes in dissolved salt concentrations alter the density of water, and this has important implications for lake stratification and turnovers (Mayer et al., 1999). This could alter the organisms' natural habitat.

5f. Alternatives to Road Salt

Research on alternatives to road salts began in the 1960's. Alternatives include both chemical and physical snow and ice-removal methods. One chemical alternative is calcium magnesium acetate, or CMA, which is limestone treated with acetic acid. It is less toxic than sodium chloride, but can cost ten to twenty times as much as road salt, and larger quantities must be used for the same effect (USEPA, 1999). Studies of potassium carbonate as an alternative on a large scale in Vienna showed that the excess potassium it added to soils negatively affected plants' uptake of other vital ions (Sieghardt et al., 1998).

A chemical method tested in Scandinavia is pre-treatment of roads with liquid salt prior to storm events, in order to lower the freezing point of precipitation and prevent a bond between ice and pavement (USEPA, 1999). This pre-treatment method reduces the cost of snow maintenance, but has not been used in the U.S. due to the public's perception of imprecise weather prediction and wasted chemicals. Improvements in weather prediction may make this a more viable option in the future (USEPA, 1999).

Mechanical or structural methods include pavement heating, pavement coating, mobile thermal deicing equipment, snow fences, and improved plow technology. Pavement heating and coating operational costs are fifteen to thirty times more than the cost of road salting. Mobile thermal deicing equipment has been deemed impractical.

Snow fences prevent drifting of snow into roads, and if properly designed and constructed, may cost municipalities up to one hundred times less than plowing. In the past, snow fences have been poorly-designed and implemented. Plows use more energy than is necessary to displace snow and use outdated technology. Improved blade designs

and cutting edges are being developed to make plowing a more efficient option (USEPA, 1999).

The use of sodium chloride is currently the most cost-effective and practical method for clearing roads of ice and snow. It costs an average of 17 to 30 dollars per ton across the U.S. and Canada. Most alternative deicers cost between 200 to 700 dollars per ton (USEPA, 1999). Snow removal in 33 snow-belt states accounts for 16.2% of all highway maintenance costs, and 3.6% of total highway expenses. It is estimated that the U.S. uses 8 million tons of salt per year, and 5% of that amount, or 400,000 tons, is lost to improper storage of salt in uncovered stockpiles. This is a loss of 12 million dollars worth of salt per year (USEPA, 1999). The U.S. and Canada spend about 2 billion dollars per year on snow and ice removal, and there is little data collected on alternative methods to salting and plowing. Improvements in technology can cut the amount of road salt used. Road weather information systems, including meteorological sensors, pavement sensors, and better weather forecasting will soon be able to reduce the amount of road salt needed and cut costs.

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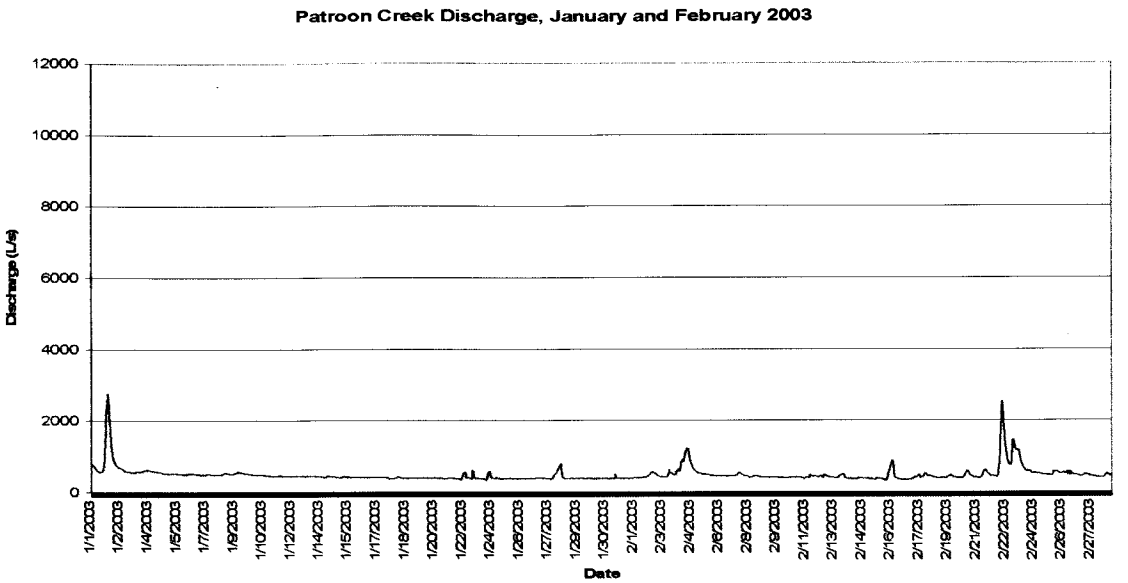
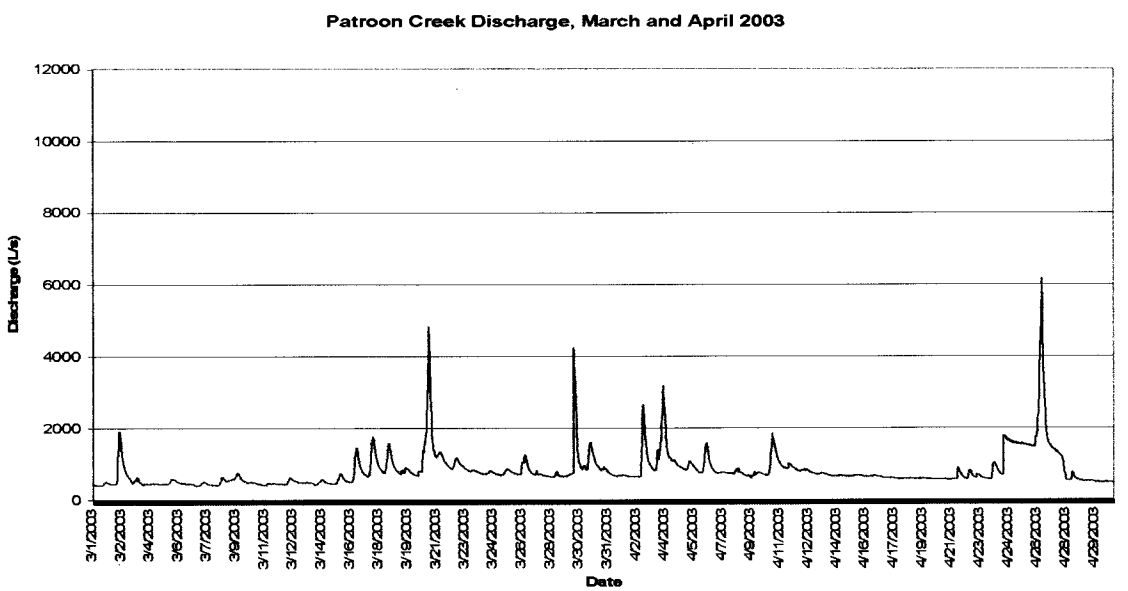
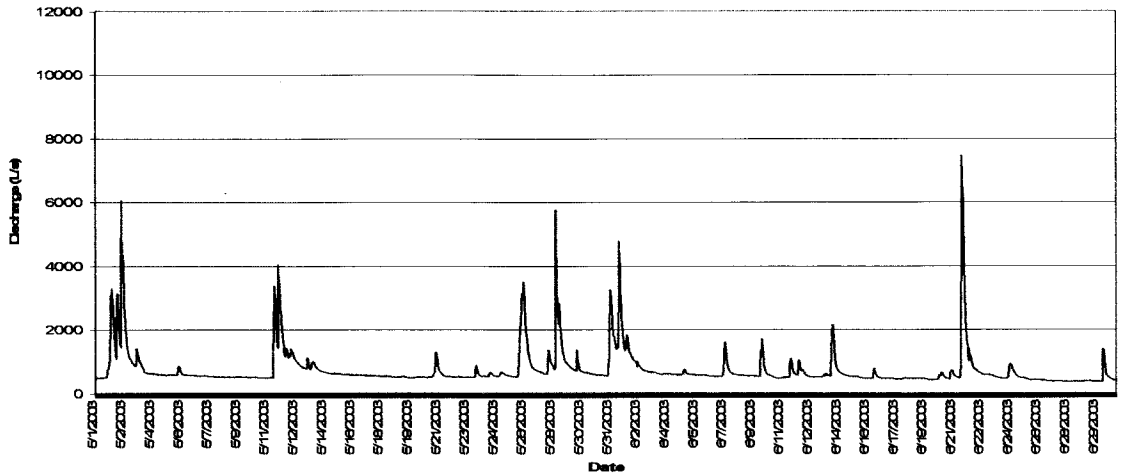
Appendix I: Hydrographs for Patroon Creek from January, 2003 to June, 2004. Each hydrograph is 2 months of time, with date on the x-axis and discharge in liters per second on the y-axis .

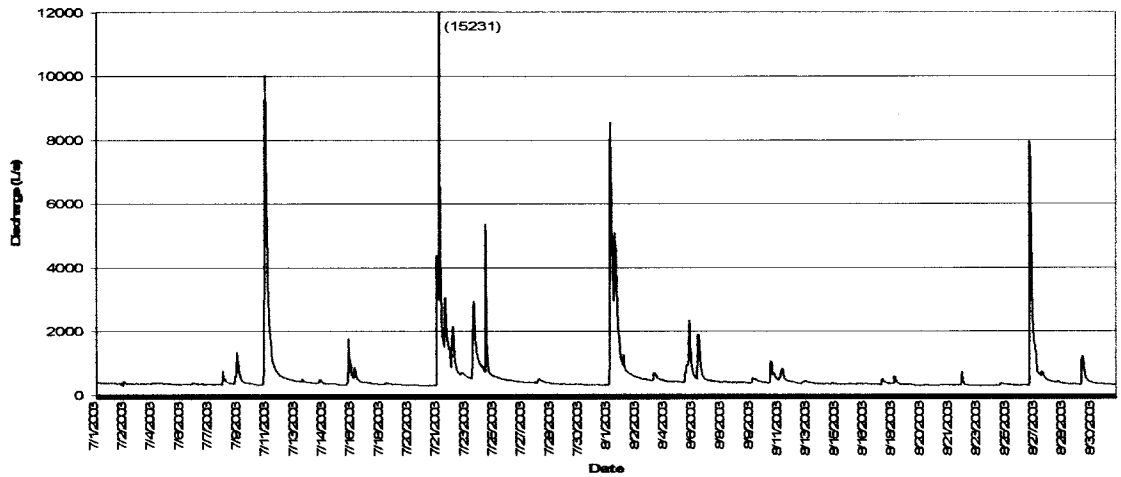




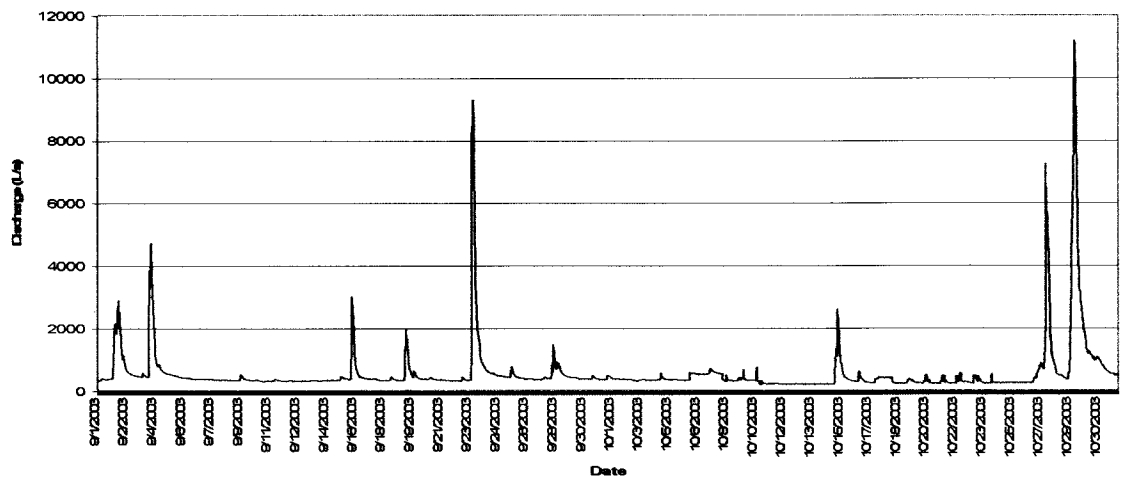
Patroon Creek Discharge, May and June 2003



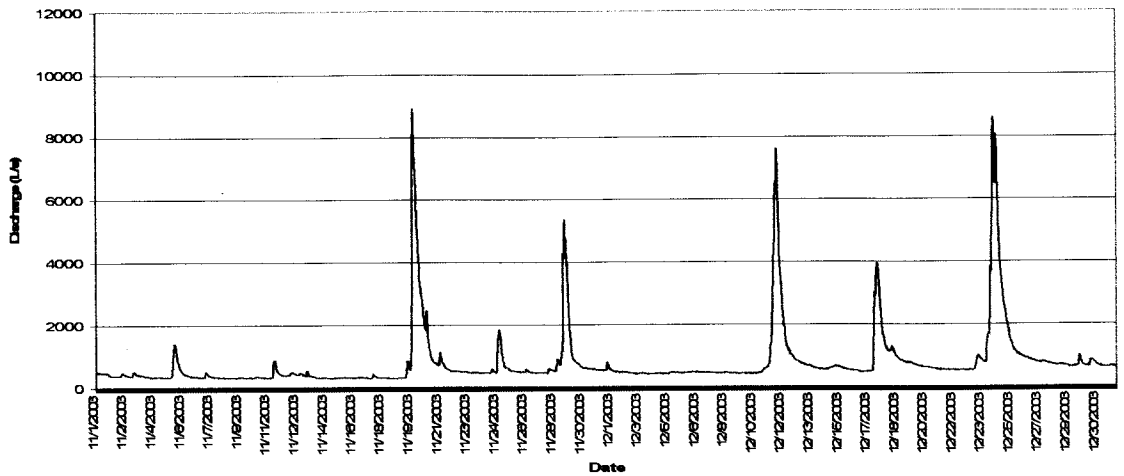
Patroon Creek Discharge, July and August 2003



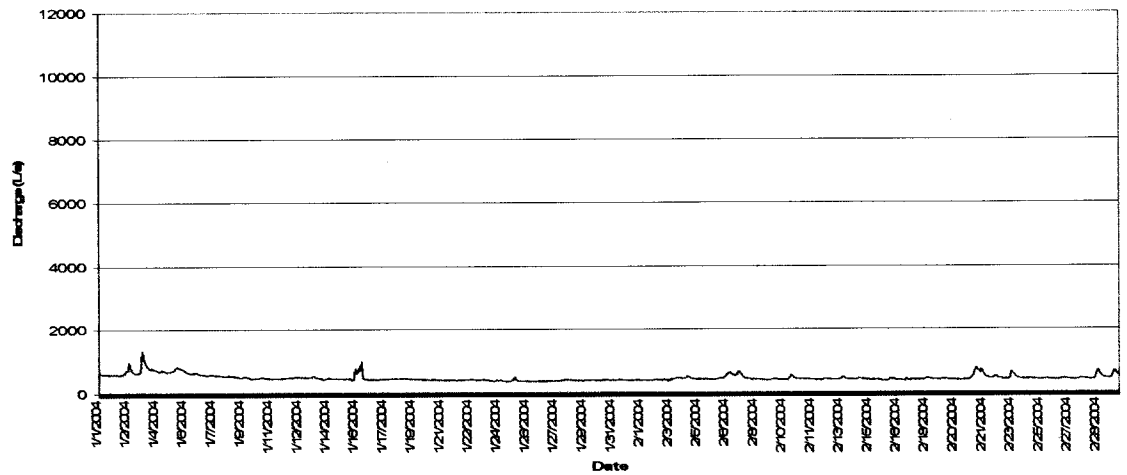
Patroon Creek Discharge, September and October 2003



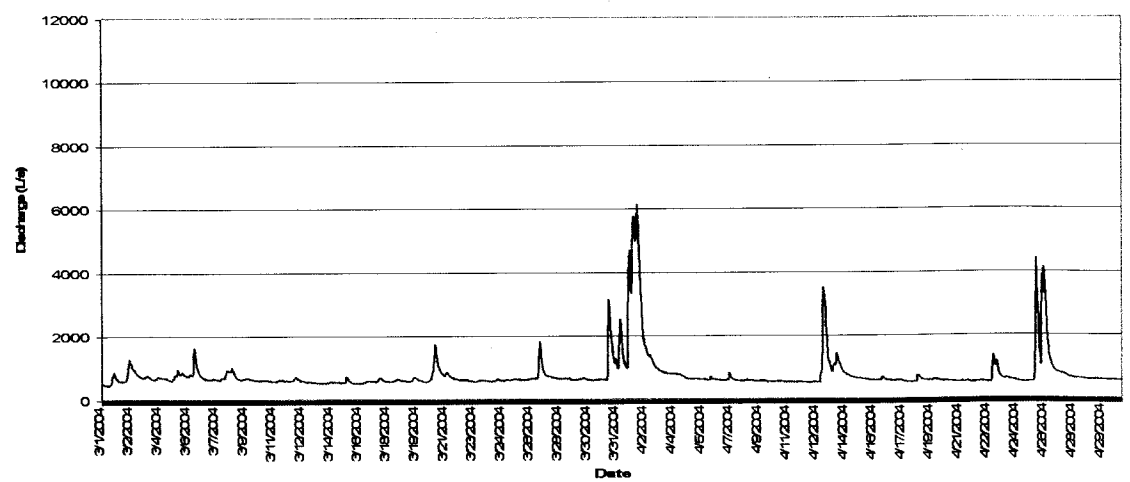
Patroon Creek Discharge, November and December 2003

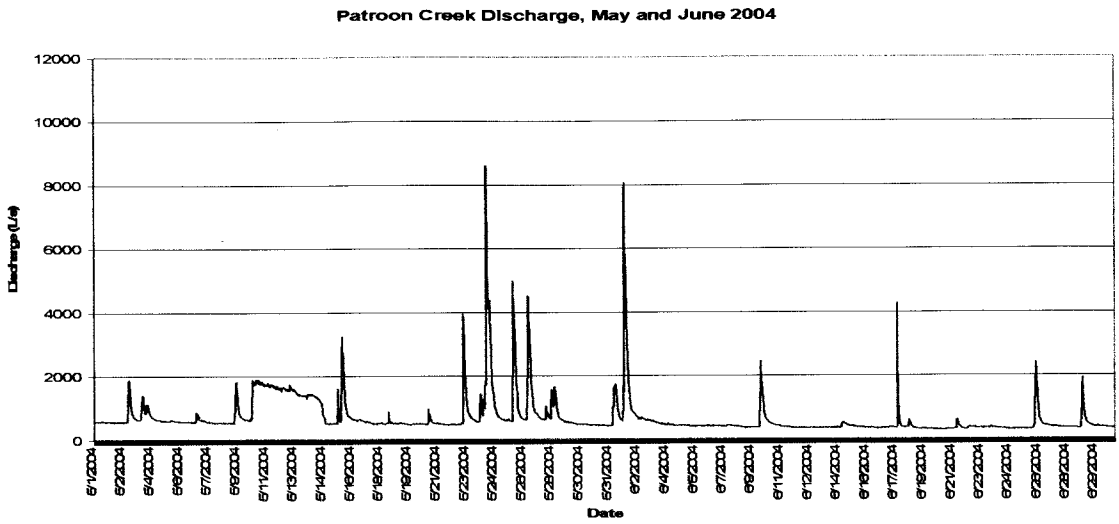


Patroon Creek Discharge, January and February 2004



Patroon Creek Discharge, March and April 2004

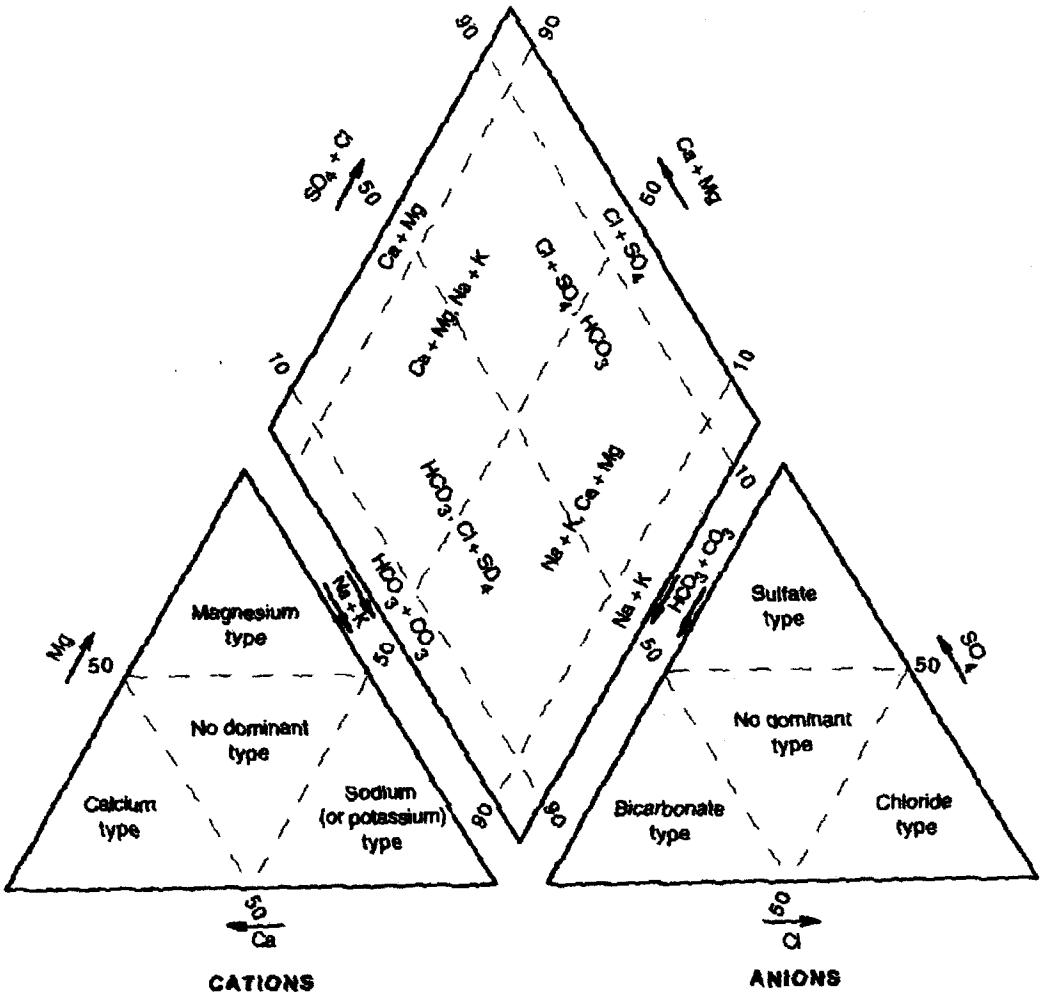



Patroon Creek Discharge, May and June 2004
12000
10000
8000
6000
4000
2000
0
Discharge (L/s)
Date

Appendix II, Correlation matrix for concentrations (ppm) of all ions investigated from June 2002 to June 2004. Values are Pearson's Correlation Coefficient (R).

	Fluoride	Nitrate	Chloride	Phosphate	Sulfate	Sodium	Ammonium	Potassium	Magnesium	Calcium
Fluoride	1	0.08	-0.01	-0.01	-0.01	-0.01	0.01	0.12	0.02	0.03
Nitrate		1	0.18	0.09	0.06	0.18	0.27	0.23	0.13	0.04
Chloride			1	-0.01	0.35	0.98	0.43	0.18	0.20	0.25
Phosphate				1	0.02	-0.02	0.01	-0.01	0.05	0.06
Sulfate					1	0.29	0.30	0.12	0.62	0.70
Sodium						1	0.43	0.12	0.21	0.25
Ammonium							1	0.39	0.10	0.17
Potassium								1	0.21	0.18
Magnesium									1	0.84
Calcium										1

Appendix III is a Piper Diagram showing hydrochemical facies based on percent total equivalents of each ion (from Drever, 1997, 411)



Appendix IV, Analysis of deionized water by ion chromatography. Concentrations are in ppm.

Sampling date	lithium	sodium	ammonium	potassium	magnesium	calcium	fluoride	chloride	nitrate	phosphate	sulfate
7/13/2004	0	0.004	0.002	0.006	0.001	0.023	0	0	0	0	0
	0	0.025	0	0.011	0	0.089	0	0.023	0	0	0
	0	0.013	0.002	0.011	0.004	0.043	0	0.021	0	0	0
	0	0.009	0.018	0.016	0	0.033	0	0.016	0	0	0
6/15/2004	0	0	0	0.008	0	0.06	0	0	0	0	0
	0	0.029	0.001	0.01	0	0.05	0	0	0	0	0
	0	0.008	0.002	0.009	0.002	0.018	0	0	0	0	0
	0	0.02	0.002	0.011	0	0.043	0	0	0	0	0
	0	0.033	0	0.009	0	0.047	0	0	0	0	0
6/1/2004	0	0.013	0	0	0	0.07	0	0	0	0.233	0
	0	0.031	0.001	0.011	0	0.042	0	0	0	0	0
	0	0.02	0	0.006	0.003	0.038	0	0	0	0	0
	0	0.019	0	0.008	0.002	0.038	0	0	0	0	0
5/18/2004	0	0.002	0.006	0.01	0	0.026	0	0.067	0.163	0	0
	0	0.022	0	0.008	0	0.019	0	0	0	0	0
	5E-04	0.076	0.003	0.024	0.006	0.197	0	0.09	0	0	0
	0	0.012	0	0.009	0.002	0.016	0	0	0	0	0
5/4/2004	0	0.008	0.005	0.01	0	0.016	0	0.088	0.047	0	0
	0	0.008	0.002	0.005	0	0.014	0	0.031	0	0	0
	0	0.123	0.005	0.143	0.004	0.037	0	0.171	0	0	0
	0	0.017	0	0.011	0	0.027	0	0	0	0	0
4/20/2004	0	0.012	0	0.012	0	0.104	0	0	0	0	0
	0	0.027	0.002	0.009	0.003	0.055	0	0	0	0	0
	0	0.01	0.002	0.005	0.004	0.025	0	0	0	0	0
	0	0.02	0	0.006	0.006	0.072	0	0	0	0	0
4/6/2004	0	0.033	0.002	0.008	0.009	0.019	0.185	0	0	0	0
	0	0.008	0	0.003	0	0	0.193	0	0	0	0
	0	0.006	0.002	0.006	0	0.01	0.187	0	0	0	0
	0	0.01	0	0.008	0.002	0.013	0.191	0	0	0	0
3/23/2004	0	0	0	0	0	0	0	0	0	0	0
	0	0.007	0	0.003	0.003	0.016	0	0	0	0	0
	6E-04	0.016	0.005	0.02	0.014	0.023	0	0	0	0	0
	0.002	0.011	0.008	0.016	0.012	0.038	0	0	0	0	0
3/9/2004	0	0.032	0.002	0.014	0.009	0.031	0	0	0	0	0
	0	0.03	0.002	0.032	0.006	0.029	0	0	0	0	0
	0	0.026	0.002	0.023	0.006	0.023	0	0	0	0	0
	7E-04	0.015	0.006	0.015	0.009	0.026	0	0	0	0	0
2/24/2004	0	0.034	0	0.046	0.005	0.025	0	0	0	0	0
	3E-04	0.033	0.003	0.039	0.007	0.033	0	0	0	0	0
	0.003	0.028	0.026	0.052	0.021	0.055	0	0	0	0	0
	0	0.057	0.003	0.085	0.008	0.052	0	0	0	0	0
2/10/2004	0	0.041	0.004	0.022	0	0.015	0	0	0	0	0
	0	0.261	0.003	0.322	0.007	0.061	0	0.171	0	0	0
	0	0.023	0.004	0.012	0	0	0	0	0	0	0
	0	0.158	0.005	0.242	0	0.037	0	0.112	0	0	0

Sampling date	lithium	sodium	ammonium	potassium	magnesium	calcium	fluoride	chloride	nitrate	phosphate	sulfate
	0	0.005	0	0.009	0	0	0	0	0	0	0
	0	0.008	0	0.003	0	0	0	0	0	0	0
1/13/2004	0	0.028	0.003	0.038	0.004	0.039	0.085	0.038	0	0.347	0.088
	0	0.047	0.004	0.073	0.004	0.049	0	0	0.15	0	0
	0	0.165	0.005	0.196	0.007	0.055	0	0	0	0	0
	1E-03	0.125	0.022	0.191	0	0.053	0	0.189	0	0	0
	0	0.038	0.004	0.051	0	0.03	0	0	0	0	0
12/16/2003	0	4E-04	0	5E-04	2E-04	0	0	0.049	0.096	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0.002	0.042	0.013	0.047	0.01	0.025	0	0	0	0	0
	0	0.008	0.003	0.006	0.003	0.02	0	0	0	0	0
12/2/2003	0	0	0	0	0	0	0.029	0.052	0	0	0.095
	0	0.002	0	0	0	0	0	0	0	0	0
	7E-04	0.009	0.004	0.005	9E-04	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
11/25/2003	9E-05	0	0	6E-04	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.004	0	0.006	0	0	0	0	0	0	0
	0	0.004	0	0	0	0.004	0	0	0	0	0
11/18/2003	0	0.007	0	0.008	0	0.001	0	0	0	0	0
	0	0.027	0	0.034	0	0	0	0	0	0	0
	5E-04	0.043	0.004	0.055	0	0.039	0	0	0	0	0
	0	0.012	0.001	0.023	0	0.001	0	0	0	0	0
11/12/2003	0	0.055	0.002	0.057	0.003	0.028	0.014	0.042	0.02	0.053	0.043
	0	0.027	0.004	0.02	0	0.019	0.014	0.031	0.01	0.013	0.021
	0.004	0.046	0.027	0.068	0.028	0.079	0.007	0.045	0.028	0.039	0.007
	0	0.023	0.013	0.017	0	0	0.012	0.004	0.054	0.068	0.016
11/5/2003	0	0.01	0	0.016	0	0	0	0	0	0	0
	0	0.021	0	0.03	0	0.007	0	0	0	0	0
	0	0.017	0.002	0.026	0	0.012	0	0	0	0	0
	5E-04	0.01	0	0.013	0	0	0	0	0	0	0
10/28/2003	0	0.008	0	0.007	0	0	0	0	0	0	0
	0	0.004	0	0.003	0	0	0	0	0	0	0
	0.001	0.027	0.007	0.029	0.007	0.013	0	0	0	0	0
	0	0.009	0.002	0.011	0	0	0	0	0	0	0
10/21/2003	0	0.019	0	0.026	0	0.03	0	0	0	0	0
	0	0.002	0	0	0	0	0	0	0	0	0
	0	0.02	0.003	0.02	0.004	0.037	0	0	0	0	0
	0	0.028	0.005	0.036	0.005	0.042	0	0	0	0	0
10/14/2003	0	0.02	0.003	0.018	0.002	0	0	0.017	0	0	0
	9E-04	0.028	0.007	0.024	0.009	0.027	0	0.02	0	0	0
	0	0.011	0.003	0.01	0	0	0	0.017	0	0	0
10/7/2003	0	0.01	0	0.009	0	0	0	0	0	0	0
	0	0.022	0.002	0.016	0	0	0	0	0	0	0
	0	0.015	0.002	0.011	0	0.016	0	0	0	0	0
	0	0.023	0.002	0.022	0.004	0.03	0	0	0	0	0
9/30/2003	0	0.005	0.002	0.006	0	0	0	0	0	0	0

Sampling date	lithium	sodium	ammonium	potassium	magnesium	calcium	fluoride	chloride	nitrate	phosphate	sulfate
	0	0.007	0.002	0.007	0	0.028	0	0	0	0	0
	0	0.01	0.003	0.012	0	0.023	0	0	0	0	0
	0	0.003	0	0	0	0.019	0	0	0	0	0
	0	0.011	0.003	0.012	0	0.015	0	0	0	0	0
	0	0.015	0	0.014	0.002	0.028	0	0	0	0	0
9/16/2003	0	0.097	0	0.168	0	0.041	0	0	0	0	0
	0	0.003	0.002	0.004	0	0	0	0	0	0	0
	0	0.008	0.002	0.006	0.001	0.013	0	0	0	0	0
	0	0.053	0	0.007	0.011	0.065	0	0	0	0	0
9/9/2003	0	0.032	0	0.003	0	0.034	0	0	0	0	0
	0	0.006	0	0.008	0	0.007	0	0	0	0	0
	0	0.009	0.003	0.03	0	0.011	0	0.097	0	0	0
	0	0.048	0.002	0.04	0.004	0.025	0	0	0	0	0
9/2/2003	0	0.017	0.016	0.014	0.002	0.014	0	0.015	0	0	0
	8E-04	0.029	0.008	0.017	0.007	0.029	0	0.02	0	0	0
	0	0.057	0.003	0.024	0.002	0.017	0	0.019	0	0	0
8/23/2004	0	0.005	0.005	0.004	0.003	0.018	0	0.037	0	0	0
	0.002	0.011	0.011	0.018	0.016	0.046	0	0.93	0	0	0
	0	0.035	0.004	0.023	0	0.015	0	0.021	0	0	0
8/19/2003	0	0.005	0.002	0.003	0.002	0.009	0	0.009	0	0	0
	0	0.006	0.002	0.006	0.004	0.026	0	0.01	0	0	0
	0	0.005	0.002	0.003	0.002	0.021	0	0.014	0	0	0
8/13/2003	0	0.003	0.003	0.005	0.004	0.008	0	0.002	0.007	0	0.004
	0	0.005	0.002	0.003	0.002	0.006	0.001	8E-04	0.008	0	0
	0	0.005	0.004	0.003	0.002	0.012	0	0.006	0	0	0
8/5/2003	0	0.012	0.005	0.009	0.003	0.088	0.002	0.052	0.005	0	0.007
	0	0.075	0.005	0.082	0.003	0.056	0.007	0.068	0	0	0.011
	0	0.012	0.004	0.006	0	0.046	0	0.032	0.054	0	0
7/29/2003	0	0.017	0.002	0.005	0.002	0.05	0	0.014	0	0	0
	0	0.014	0.002	0.009	0.003	0.025	0	0.009	0	0	0
	0	0.011	0.003	0.004	0	0	0	0.014	0	0	0
7/15/2003	0	0.066	0.003	0.091	0.006	0.022	0.005	0.073	0.006	0.012	0
	0	0.006	0.003	0.004	0.004	0.018	0	0.012	0	0	0
7/8/2003	0	0.138	0.003	0.134	0.005	0.028	0.047	0.086	0	0	0
	0	0.021	0.005	0.023	0.005	0.027	0	0.012	0	0	0
7/1/2003	0	0.031	0	0.038	0.001	0.015	0	0.035	0	0	0
	0	0.021	0.004	0.012	0	0.014	0	0.01	0	0	0
6/24/2003	0	0	0	0	0.004	0	0.002	0.031	0.014	0.009	0.009
	0	0.012	0.002	0.006	0	0.01	0	0.006	0	0	0
6/17/2003	0	0.01	0.003	0.008	0.004	0.021	0	0.008	0	0	0
	0	0.005	0.003	0.003	0	0.018	0	0.011	0	0	0
6/10/2003	0	0.084	0.003	0.092	0.004	0.027	0.014	0.067	0	0	0
	0	0.006	0.006	0.007	0.006	0.031	0	0.032	0	0	0
6/3/2003	0	0.031	0	0.051	0.003	0.02	0	0.062	0	0	0
	0	0.031	0.002	0.042	0.009	0.04	0	0.053	0	0	0
5/27/2003	0	0.013	0	0.007	0	0.01	0	0	0	0	0
	0	0.015	0	0.018	0	0.016	0	0	0	0	0
	0	0.013	0.003	0.013	0.004	0.012	0	0	0	0	0
	0	0.012	0.002	0.007	0.002	0.015	0	0	0	0	0

Sampling date	lithium	sodium	ammonium	potassium	magnesium	calcium	fluoride	chloride	nitrate	phosphate	sulfate
	0	0.009	0.002	0.002	0	0.016	0	0	0	0	0
5/13/2003	0	0.006	0.002	0.003	0.002	0.013	0	0	0	0	0
	8E-04	0.01	0.005	0.012	0.009	0.037	0	0.029	0	0	0
	0	0.006	0.028	0.004	0	0.014	0	0.004	0	0	0
4/29/2003	0	0	0	0	0	0.009	0.002	0.003	0.005	0.02	0.006
	5E-04	0.016	0.006	0.009	0.009	0.039	0	0.038	0	0	0
4/22/2003	0	0.012	0.09	0.048	0.01	0.059	0	0.014	0	0	0.127
	0	0.016	0.008	0.021	0.007	0.032	0	0.042	0	0	0
4/15/2003	0	0.005	0.002	0.005	9E-04	0.014	0	0.013	0	0	0
	0	0.008	0.005	0.002	0.009	0	0	0.005	0	0	0
4/8/2003	0	0.01	0	0.006	0.002	0.031	0	0.002	0.006	0	0
	0	0.018	0.005	0.006	0.003	0.029	0	0.022	0	0	0
4/1/2003	0	0.015	0.008	0.014	0.002	0.027	0	0	0	0	0
	0	0.028	0.016	0.026	0	0.033	0	0.031	0	0	0
	0	0.033	0.002	0.029	0.004	0.041	0	0.045	0	0	0
	0	0.022	0.001	0.012	0	0.021	0	0.016	0	0	0
3/25/2003	0	0.003	0.003	0.003	0.002	0.012	6E-04	0.004	0.02	0.003	0.001
	8E-04	0.007	0	0.031	0.01	0.031	0.007	0.03	0	0	0
3/18/2003	0	0.025	0.004	0.022	0	0.011	0	0.01	0	0	0
	0	0.051	0.003	0.048	0.009	0.086	0	0.045	0	0	0
3/11/2003	0	0.006	0.003	0	0	0.019	0	0	0	0	0
	0	0.098	0.005	0.093	0.005	0.04	0.017	0.07	0	0	0
	0	0.01	0.006	0.002	0.005	0.057	0	0.005	0	0	0
2/25/2003	0	0	0	0	0	0	0	0	0	0	0
	0	0.022	0.005	0.011	0.003	0.034	0	0.015	0	0	0
	0	0.022	0.013	0.032	0	0.043	0	0.016	0	0	0
	0	0.021	0.003	0.032	0	0.065	0	0.017	0	0	0
	4E-04	0.016	0.006	0.012	0	0.112	0	0.012	0	0	0
2/11/2003	0	0.016	0	0.012	0.001	0.015	6E-04	0.007	0.007	0.021	0
	0	0.058	0.007	0.035	0.007	0.054	0	0.029	0	0	0

Appendix V, Analysis of 5 ion standard by ion chromatography. Concentrations are in ppm. Average and standard deviation of analysis and nominal value for the standard are shown at the bottom of the chart.

Sampling Date	Sodium	Potassium	Chloride	Nitrate	Sulfate
6/15/2004	123	103	190	18	95
	124	103	194	17	98
6/1/2004	127	105	193	18	97
	125	104	194	17	97
5/18/2004	123	102	203	17	97
	125	104	197	19	99
5/4/2004	124	103	203	19	97
	126	104	198	19	99
4/20/2004	124	103	183	17	90
	124	103	187	17	94
4/6/2004	126	105	198	18	101
	131	109	204	18	103
3/23/2004	125	106	205	18	97
2/24/2004	125	104	200	18	102
2/10/2004	132	111	200	15	101
	133	111	202	15	102
1/27/2004	131	109	196	16	98
	129	107	197	15	99
1/13/2004	131	109	180	14	91
	130	108	190	13	96
12/16/2003	129	109	188	18	94
	130	108	195	18	98
11/25/2003	127	107	194	18	98
	130	108	200	18	101
11/18/2003	130	107	191	17	97
	129	107	195	16	99
11/12/2003	126	104	204	19	105
11/5/2003	129	107	197	18	99
	130	108	200	17	101
10/28/2003	130	109	195	17	97
	131	108	200	16	101
10/21/2003	131	110	200	16	100
10/14/2003	125	104	194	19	99
10/7/2003	132	110	199	15	100
	133	111	204	16	102
9/30/2003	131	109	197	15	99
	132	110	202	15	102
9/23/2003	124	105	197	18	100
	127	106	199	18	100
9/16/2003	130	108	201	17	100
	131	109	201	15	102

Sampling Date	Sodium	Potassium	Chloride	Nitrate	Sulfate
9/16/2003	126	105	202	19	102
8/26/2003	121	100	191	18	96
8/19/2003	120	100	190	18	97
8/5/2003	122	101	194	19	98
7/29/2003	121	100	194	18	98
7/8/2003	124	103	192	18	97
7/1/2003	123	102	193	18	97
6/24/2003	122	101	188	18	96
6/17/2003	121	100	191	17	96
5/20/2003	122	101	192	18	97
5/13/2003	123	102	191	18	96
5/6/2003	121	101	190	18	97
	120	100	189	18	94
4/22/2003	122	101	194	18	98
4/15/2003	122	101	189	18	97
4/8/2003	125	104	192	18	98
4/1/2003	122	101	189	18	95
3/25/2003	123	103	190	17	96
3/18/2003	126	104	190	18	96
3/11/2003	123	103	203	19	107
2/11/2003	122	102	189	18	95
n	**64**	**64**	**64**	**64**	**64**
nominal value	**123**	**104**	**200**	**20**	**100**
mean	**126**	**105**	**195**	**17**	**98**
standard deviation	**3.77**	**3.26**	**5.87**	**1.36**	**2.96**
%RSD	**2.99**	**3.11**	**3.00**	**7.88**	**3.01**

Appendix VI, File of all field data and ion chromatography analysis data for Patroon Creek from June 2002 to June 2004. Blank rows show missing data, where the sample was not collected due to weather conditions or not analyzed. Key to column headings is as follows:

Field DO mg/L:	Dissolved oxygen (mg/L) measured with hand-held D.O. meter in the field.
Field Temp °C:	Temperature measured with hand-held D.O. meter in the field
Lab pH:	pH of sample as measured in the laboratory
Lab Temp °C:	Temperature of sample as measured with laboratory pH meter when pH is measured in the laboratory
Fluoride ppm:	Concentration of fluoride ion in ppm measured by ion Chromatograph. Values of "0.00" mean the sample was non-detected, or below the machine's analytical limits
Alkalinity ppm CaCO3:	Alkalinity in ppm calcium carbonate measured by digital titration of the sample. A value of "N" means the sample was not measured. Only a subset of samples were titrated for alkalinity each week.
Total Coliform:	Total coliform count measured by Albany Water Department
Ecoli:	Total e-coli count
HPC:	Heterotrophic platelet count
Gage Height (ft):	Gage height in feet measured electronically by USGS gage
Water Temp (°C):	Water temperature measured electronically by USGS gage
Specific Conductivity (µS/cm):	Specific conductivity in microsiemens per centimeter measured by USGS gage
Date and time Of measurements:	Exact time when field sample was taken from Site 6 (USGS gage station), so that field measurements can be correlated with electronic measurements from the USGS gage

Site	Date	Field DO mg/L	Field Temp °C	Lab pH	Lab Temp °C	Fluoride ppm	Chloride ppm	Nitrate ppm	Phosphate ppm	Sulfate ppm
Rapp Rd.	6/11/2002	7.90	14.0	7.69	18.0	2.30	101.50	0.90	0.00	35.30
Main Br.	6/11/2002	6.00	22.0	7.92	18.3	0.10	159.90	2.70	0.00	20.40
North Br.	6/11/2002	7.40	19.0	7.60	19.7	2.20	243.70	2.00	0.00	27.60
Tobin	6/11/2002	7.60	20.0	7.65	17.9	0.20	180.00	2.60	0.00	24.60
Cement Plant	6/11/2002	7.90	19.0	7.76	20.7	0.80	179.70	2.90	0.00	28.50
Gage	6/11/2002	9.00	20.0	7.97	22.0	0.10	180.30	2.60	0.00	30.70
Erie Blvd.	6/11/2002	8.70	23.0	8.04	22.3	0.20	185.60	2.90	0.00	32.60
Rapp Rd.	6/18/2002	7.90	16.0	7.71	20.1	3.10	101.40	0.70	0.00	33.80
Main Br.	6/18/2002	5.60	20.0	8.07	19.7	2.00	153.80	2.70	0.00	20.10
North Br.	6/18/2002	7.90	18.0	7.72	18.9	1.30	167.30	1.10	0.00	23.00
Tobin	6/18/2002	8.00	18.0	7.75	18.5	1.50	150.80	2.20	0.00	20.70
Cement Plant	6/18/2002	7.80	17.0	7.71	18.1	2.40	161.80	2.50	0.00	25.70
Gage	6/18/2002	9.00	18.0	7.89	17.3	0.30	155.80	2.40	0.00	27.90
Erie Blvd.	6/18/2002	8.80	18.0	7.85	17.9	0.20	166.20	2.70	0.00	29.20
Rapp Rd.	6/25/2002	8.00	16.0	7.83	24.0	0.10	110.00	0.70	0.00	36.90
Main Br.	6/25/2002	7.10	23.0	7.94	24.0	0.20	165.90	2.40	0.00	20.70
North Br.	6/25/2002	6.90	20.0	7.78	23.7	0.00	185.20	2.20	0.00	26.50
Tobin	6/25/2002	7.30	22.0	7.79	23.6	0.10	161.10	2.60	0.00	22.30
Cement Plant	6/25/2002	7.50	21.0	7.80	23.4	2.90	164.80	2.80	0.00	23.10
Gage	6/25/2002	8.50	21.0	8.02	23.5	0.20	167.80	2.60	0.00	29.00
Erie Blvd.	6/25/2002	8.30	21.0	8.10	23.6	0.20	174.20	2.80	0.00	30.70
Rapp Rd.	7/2/2002		23.0	7.76	23.1	2.10	109.50	0.80	0.00	36.60
Main Br.	7/2/2002	8.90	27.0	7.97	23.5	0.20	165.40	2.50	0.00	20.20
North Br.	7/2/2002	8.20	24.0	7.74	23.3	3.10	256.20	2.42	0.00	28.70
Tobin	7/2/2002		25.0	7.75	22.9	0.20	186.80	2.30	0.00	23.90
Cement Plant	7/2/2002	7.30	23.0	7.75	22.8	0.30	186.10	2.60	0.00	27.10
Gage	7/2/2002	8.40	24.0	7.94	23.0	0.30	185.50	2.60	0.00	29.60
Erie Blvd.	7/2/2002	8.00	25.0	7.99	23.1	0.20	191.80	2.80	0.00	31.50
Rapp Rd.	7/9/2002	7.30	22.0	7.77	20.6	1.80	114.30	0.70	0.00	37.90
Main Br.	7/9/2002	2.70	25.0	8.00	20.5	0.30	168.30	1.40	0.00	20.60
North Br.	7/9/2002	7.50	24.0	7.94	20.5	1.40	342.90	1.20	0.00	34.90
Tobin	7/9/2002	7.20	24.0	7.79	20.2	0.20	223.50	1.70	0.00	26.70
Cement Plant	7/9/2002	6.90	24.0	7.79	20.3	0.10	212.60	2.10	0.00	30.30
Gage	7/9/2002	8.10	24.0	8.05	20.2	0.20	214.00	2.10	0.00	32.60
Erie Blvd.	7/9/2002	8.00	24.0	8.09	20.3	0.20	212.90	2.30	0.00	32.80
Rapp Rd.	7/16/2002	8.20	23.0	7.73	23.3	1.30	109.70	0.70	0.00	36.30
Main Br.	7/16/2002	8.80	23.0	7.98	23.4	0.30	175.00	0.30	0.00	20.20
North Br.	7/16/2002	7.30	23.0	7.90	23.3	1.60	320.40	1.40	0.00	33.40
Tobin	7/16/2002	7.10	23.0	7.79	23.3	4.70	264.80	1.70	0.00	27.00
Cement Plant	7/16/2002	7.50	25.0	7.80	22.9	0.20	221.60	1.90	1.40	29.40
Gage	7/16/2002	8.80	24.0	7.93	22.9	0.20	210.00	2.80	0.00	31.00
Erie Blvd.	7/16/2002	8.20	19.0	8.02	23.0	0.10	210.80	2.00	0.00	32.90
Rapp Rd.	7/23/2002	7.50	23.0	7.44	24.1	0.10	103.30	0.60	0.00	34.30
Main Br.	7/23/2002	4.50	27.0	7.43	24.7	0.20	168.50	1.90	0.00	19.10
North Br.	7/23/2002	6.90	27.0	7.65	24.7	0.20	301.90	1.50	0.00	29.90
Tobin	7/23/2002	6.90	27.0	7.65	24.2	0.10	202.50	1.60	0.00	23.20
Cement Plant	7/23/2002	7.10	25.0	7.69	23.2	0.20	196.60	1.80	0.00	26.00
Gage	7/23/2002	8.10	25.0	7.94	22.2	0.10	192.70	1.80	0.00	27.60
Erie Blvd.	7/23/2002	7.90	25.0	8.05	22.0	0.20	196.20	1.80	0.00	29.30
Rapp Rd.	7/30/2002	7.60	21.0	7.93	21.5					
Main Br.	7/30/2002	4.10	26.0	8.04	21.3					
North Br.	7/30/2002	7.20	26.0	7.98	21.4					
Tobin	7/30/2002	6.90	26.0	7.95	21.4	0.20	227.80	1.30	0.00	24.30
Cement Plant	7/30/2002	6.60	25.0	7.93	21.3	0.10	206.90	1.40	0.00	26.20
Gage	7/30/2002	8.30	27.0	8.04	20.7	0.10	206.90	1.80	0.00	28.10
Erie Blvd.	7/30/2002	7.70	26.0	7.92	20.3	0.20	206.60	1.80	0.00	30.30
Rapp Rd.	8/6/2002	8.71	15.2	7.98	16.6	0.08	102.47	0.06	0.00	33.85
Main Br.	8/6/2002	4.73	23.0	8.20	16.3	0.00	188.52	0.09	0.00	19.38
North Br.	8/6/2002	7.41	20.5	7.92	16.9	0.00	251.89	1.65	0.00	28.28
Tobin	8/6/2002	7.28	21.9	7.89	15.9	0.00	207.92	1.49	0.00	23.51
Cement Plant	8/6/2002	7.06	20.7	7.99	14.9	0.08	198.06	2.09	0.00	26.90
Gage	8/6/2002	8.61	20.6	8.11	13.3	0.19	196.58	1.77	0.00	28.84
Erie Blvd.	8/6/2002	8.25	20.0	7.92	11.6	0.09	199.88	1.96	0.00	30.76
Rapp Rd.	8/13/2002	8.91	15.8	7.82	21.7	0.07	104.66	0.04	0.00	35.78
Main Br.	8/13/2002	0.83	24.2	8.56	21.7	0.00	190.85	0.00	0.00	18.57
North Br.	8/13/2002	7.93	21.3	8.05	22.0	0.08	368.18	1.29	0.00	32.46
Tobin	8/13/2002	7.80	23.0	8.03	21.8	0.07	243.73	1.10	0.00	24.44
Cement Plant	8/13/2002	7.30	20.9	7.81	21.7	0.08	223.52	1.61	0.00	27.64
Gage	8/13/2002	8.98	21.2	8.08	21.6	0.08	218.91	1.62	0.00	29.18
Erie Blvd.	8/13/2002	8.45	21.6	8.24	22.3	0.08	221.46	1.78	0.00	31.41
Rapp Rd.	8/20/2002	8.25	15.6	7.77	23.0	0.06	100.87	0.44	0.00	32.81
Main Br.	8/20/2002	1.87	23.2	8.20	23.3	0.08	179.69	2.07	0.00	18.00
North Br.	8/20/2002	6.87	20.5	7.84	23.1		163.81	1.46	0.00	21.21
Tobin	8/20/2002	6.96	22.4	7.89	23.1	0.15	155.75	0.74	0.00	18.43
Cement Plant	8/20/2002	6.68	21.1	7.98	23.2	0.07	158.31	1.37	0.00	22.69
Gage	8/20/2002	8.05	21.0	8.11	22.5	0.08	153.82	1.67	0.00	24.01
Erie Blvd.	8/20/2002	8.00	21.1	8.14	22.6	0.09	164.28	2.04	0.00	26.92
Rapp Rd.	8/27/2002	8.41	15.7	7.74	15.9	0.07	101.19	0.54	0.00	32.58
Main Br.	8/27/2002			7.88	15.4	0.07	187.85	1.10	0.00	19.34
North Br.	8/27/2002	6.53	22.1	7.86	15.9	0.06	175.35	0.92	0.00	18.94
Tobin	8/27/2002	7.74	22.4	7.95	15.4	0.06	179.95	1.31	0.00	20.76
Cement Plant	8/27/2002	7.41	20.8	7.88	15.4	0.17	171.29	1.60	0.00	23.68
Gage	8/27/2002	8.83	20.0	8.07	15.9	0.07	172.78	1.84	0.00	25.54
Erie Blvd.	8/27/2002	8.37	20.0	8.12	15.6	0.11	177.67	2.02	0.00	27.43
Rapp Rd.	9/3/2002	7.60	17.0	7.58	19.7	0.15	105.73	0.61	0.00	34.28
Main Br.	9/3/2002	7.20	21.0	7.78	17.8	0.11	213.89	1.15	0.00	22.26
North Br.	9/3/2002	7.60	19.0	7.70	19.3	0.06	202.72	1.10	0.00	22.86
Tobin	9/3/2002	7.90	21.0	7.75	19.2	0.06	184.91	1.36	0.00	20.70
Cement Plant	9/3/2002	7.70	19.0	7.70	18.8	0.06	184.18	1.61	0.00	24.43
Gage	9/3/2002	8.60	21.0	7.97	18.8	0.07	179.76	1.57	0.00	26.38
Erie Blvd.	9/3/2002	7.70	24.0	7.99	16.8	0.09	174.59	1.61	0.00	26.07
Rapp Rd.	9/10/2002	8.97	15.1	7.76	19.5	0.07	104.68	0.51	0.51	34.34
Main Br.	9/10/2002	3.48	22.1	8.47	19.7	0.09	202.40	0.72	0.00	18.13
North Br.	9/10/2002	8.25	19.4	7.91	19.5	0.07	284.41	1.34	0.00	30.40
Tobin	9/10/2002	8.49	20.3	7.94	18.8	0.08	227.50	1.28	0.00	23.63
Cement Plant	9/10/2002	7.94	19.0	7.83	18.2	0.06	207.50	1.67	0.00	27.04
Gage	9/10/2002	9.22	19.3	7.99	19.4	0.09	203.18	1.63	0.00	28.85
Erie Blvd.	9/10/2002	8.60	19.6	8.13	18.9	0.10	204.01	1.93	0.00	31.23
Rapp Rd.	9/17/2002	9.31	14.4	7.85	12.5	0.10	94.22	0.52	0.00	31.41
Main Br.	9/17/2002	7.04	20.1	8.18	12.7	0.17	156.95	2.26	0.00	17.34
North Br.	9/17/2002	8.58	17.6	7.98	12.9	0.12	126.20	0.93	0.00	17.56
Tobin	9/17/2002	8.90	18.7	8.05	12.3	0.06	154.01	1.00	0.00	17.31
Cement Plant	9/17/2002	8.15	17.9	7.85	12.3	0.07	156.93	1.38	0.00	20.36
Gage	9/17/2002	9.39	18.0	8.19	11.6	0.07	155.13	1.26	0.00	21.90
Erie Blvd.	9/17/2002	8.60	17.8	8.19	11.3	0.07	156.62	1.33	0.00	22.31
Rapp Rd.	9/24/2002	9.27	12.6	8.00	12.5	0.07	101.84	0.00	0.00	32.95
Main Br.	9/24/2002	6.03	18.5	8.35	12.1	0.06	165.80	0.00	0.00	17.00
North Br.	9/24/2002	8.33	16.0	7.92	13.4	0.06	144.05	0.00	0.00	19.84
Tobin	9/24/2002	8.62	17.8	8.10	12.6	0.07	156.37	1.70	0.00	17.78
Cement Plant	9/24/2002	8.26	16.9	7.96	12.9	0.20	158.04	1.92	0.00	21.69
Gage	9/24/2002	9.91	17.1	8.20	11.8	0.06	161.11	1.92	0.00	23.72
Erie Blvd.	9/24/2002	9.10	17.6	8.55	10.5	0.10	168.85	0.00	0.00	25.56

Site	Date	Field DO mg/L	Field Temp °C	Lab pH	Lab Temp °C	Fluoride ppm	Chloride ppm	Nitrate ppm	Phosphate ppm	Sulfate ppm
Rapp Rd.	10/1/2002	6.50	16.0	7.89	16.9	0.09	108.59	0.43	0.00	34.09
Main Br.	10/1/2002	5.00	18.0	8.06	14.8	0.06	187.67	2.12	0.00	17.44
North Br.	10/1/2002	6.90	18.0	7.87	15.2	0.06	220.55	1.12	0.00	24.19
Tobin	10/1/2002	6.20	19.0	8.01	16.0	0.07	197.72	2.00	0.00	20.89
Cement Plant	10/1/2002	7.40	18.0	7.97	15.1	0.07	198.41	2.11	0.00	20.92
Gage	10/1/2002	9.00	17.0	8.06	15.4	0.24	189.85	1.76	0.00	26.94
Erie Blvd.	10/1/2002	8.60	18.0	8.26	13.9	0.07	193.16	2.06	0.00	28.02
Rapp Rd.	10/8/2002	8.86	11.7	7.82	18.3	0.00	11.54	0.45	0.00	35.23
Main Br.	10/8/2002	8.37	14.4	8.06	18.4	0.09	211.66	2.24	0.00	18.70
North Br.	10/8/2002	9.12	12.9	7.95	18.0	0.33	331.78	1.13	0.00	31.58
Tobin	10/8/2002	9.36	13.6	7.86	17.9	0.00	234.06	1.95	0.00	23.80
Cement Plant	10/8/2002	9.22	12.8	8.01	17.4	0.07	216.09	1.81	0.00	27.48
Gage	10/8/2002	10.23	12.9	8.18	17.7	0.08	209.81	1.99	0.00	28.45
Erie Blvd.	10/8/2002	9.95	13.1	8.23	17.4	0.08	211.96	2.06	0.00	31.43
Rapp Rd.	10/15/2002	10.30	12.7	7.67	15.4	0.07	103.57	0.38	0.00	33.50
Main Br.	10/15/2002	10.75	13.2	7.80	15.9	0.00	192.43	0.00	0.00	17.19
North Br.	10/15/2002	10.09	10.6	7.76	16.2	0.06	129.84	0.00	0.00	19.03
Tobin	10/15/2002	10.23	11.0	7.70	16.1	0.06	172.41	0.00	0.00	18.65
Cement Plant	10/15/2002	9.71	10.4	7.87	15.2	0.06	172.24	0.00	0.00	22.24
Gage	10/15/2002	8.31	12.6	8.13	14.8	0.07	106.46	0.00	0.00	18.52
Erie Blvd.	10/15/2002	10.02	8.8	8.20	16.1	0.07	118.30	0.00	0.00	20.99
Rapp Rd.	10/22/2002	9.85	9.3	7.71	17.6	0.11	103.50	0.67	0.00	32.78
Main Br.	10/22/2002	12.31	8.2	7.69	17.5	0.07	174.72	2.63	0.00	16.15
North Br.	10/22/2002	11.00	8.5	7.67	17.7	0.00	167.44	1.05	0.00	21.40
Tobin	10/22/2002	11.10	8.8	7.71	17.7	0.49	167.91	1.90	0.00	19.40
Cement Plant	10/22/2002	10.56	8.0	7.77	17.0	0.09	168.08	2.15	0.00	23.64
Gage	10/22/2002	9.12	9.9	7.89	16.4	0.09	169.40	2.21	0.00	26.59
Erie Blvd.	10/22/2002	9.85	9.3	7.90	17.6	0.18	176.46	2.70	0.00	28.62
Rapp Rd.	10/29/2002	10.31	8.8	7.71	13.5	0.08	116.69	0.35	0.00	35.38
Main Br.	10/29/2002	9.87	8.3	7.72	13.4	0.00	179.72	3.02	0.00	17.03
North Br.	10/29/2002	9.90	7.6	7.79	12.0	0.06	158.44	0.83	0.00	22.87
Tobin	10/29/2002	10.32	8.2	7.77	12.7	0.06	172.84	2.74	0.00	19.52
Cement Plant	10/29/2002	10.21	8.3	7.85	12.2	0.17	177.49	2.81	0.00	23.94
Gage	10/29/2002	11.42	8.2	7.95	12.3	0.10	175.36	2.62	0.00	26.56
Erie Blvd.	10/29/2002	12.51	8.4	8.09	12.6	0.28	193.55	2.63	0.00	28.84
Rapp Rd.	11/6/2002	11.66	5.2	7.45	15.5	0.12	201.96	0.67	0.00	10.71
Main Br.	11/6/2002	9.54	6.8	7.69	15.4	0.07	182.44	3.16	0.00	16.67
North Br.	11/6/2002	11.54	5.9	7.58	15.9	1.10	173.71	1.13	0.00	16.36
Tobin	11/6/2002	12.02	6.1	7.55	15.7	1.51	177.81	1.83	0.00	16.64
Cement Plant	11/6/2002	11.73	6.1	7.54	14.8	0.00	161.91	1.53	0.00	16.39
Gage	11/6/2002	13.76	6.0	7.59	14.2	0.23	136.41	1.35	0.00	17.42
Erie Blvd.	11/6/2002	11.72	6.2	7.73	14.8	0.23	119.15	1.37	0.00	16.69
Rapp Rd.	11/12/2002	8.47	10.8	7.55	16.6	0.08	100.83	0.22	0.00	32.07
Main Br.	11/12/2002	8.35	9.4	7.71	16.4	0.07	177.78	3.33	0.00	18.05
North Br.	11/12/2002	8.09	11.8	7.56	16.4	0.00	196.46	0.68	0.00	22.53
Tobin	11/12/2002	9.86	10.5	7.58	16.4	0.07	181.81	1.75	0.00	20.38
Cement Plant	11/12/2002	9.65	10.9	7.65	15.7	0.08	178.38	1.83	0.00	23.76
Gage	11/12/2002	11.00	11.0	7.74	15.3	0.07	177.43	0.00	0.00	26.47
Erie Blvd.	11/12/2002	9.38	11.2	7.90	12.8	0.08	178.37	0.00	0.00	27.69
Rapp Rd.	11/19/2002	10.06	7.9	7.56	21.5	0.00	93.16	0.40	0.00	26.52
Main Br.	11/19/2002	10.97	8.0	7.64	21.6	0.26	168.68	3.30	0.00	18.10
North Br.	11/19/2002	11.13	5.7	7.64	21.6	1.36	327.26	0.80	0.00	18.23
Tobin	11/19/2002	11.57	6.2	7.65	21.6	1.47	211.83	2.47	0.00	20.22
Cement Plant	11/19/2002	11.44	6.4	7.56	21.5	0.22	216.23	2.47	0.00	23.77
Gage	11/19/2002	12.32	6.2	7.75	21.6	0.18	214.26	2.41	0.00	27.76
Erie Blvd.	11/19/2002	7.35	6.8	7.89	21.7	0.09	225.07	2.55	0.00	29.62
Rapp Rd.	11/26/2002	10.13	6.7	7.57	20.4	0.06	116.00	0.46	0.00	34.66
Main Br.	11/26/2002	13.46	6.1	7.92	19.5	1.05	190.06	3.19	0.00	19.39
North Br.	11/26/2002	10.94	6.5	7.67	19.4	0.06	265.07	1.23	0.00	24.90
Tobin	11/26/2002	11.74	6.0	7.72	20.2	0.07	220.00	2.70	0.00	23.06
Cement Plant	11/26/2002	11.39	6.1	7.70	19.4	0.07	229.38	2.81	0.00	28.09
Gage	11/26/2002	12.42	5.3	7.85	19.8	0.09	237.20	2.97	0.00	31.44
Erie Blvd.	11/26/2002	11.91	6.7	7.96	19.4	0.10	249.90	2.93	0.00	33.15
Rapp Rd.	12/3/2002	10.77	4.4	7.65	16.1	0.22	113.14	0.67	0.00	34.22
Main Br.	12/3/2002	13.34	1.1	7.77	16.9	2.81	202.80	3.37	0.00	20.71
North Br.	12/3/2002	12.25	2.5	7.92	15.4	0.25	482.79	1.40	0.00	33.70
Tobin	12/5/2002	13.30	1.7	7.96	14.7	0.09	403.26	2.56	0.00	25.87
Cement Plant	12/5/2002	13.32	2.0	7.87	15.2	0.23	359.29	2.75	0.00	29.05
Gage	12/5/2002	12.01	2.0	7.91	15.7	0.07	372.21	2.36	0.00	31.03
Erie Blvd.	12/5/2002	13.74	2.2	8.06	14.5	0.06	387.76	2.42	0.00	32.64
Rapp Rd.	12/10/2002	10.89	4.4	7.70	11.4		122.66	0.51	0.00	35.53
Main Br.	12/10/2002	12.21	1.5	8.18	9.2	0.25	218.77	3.56	0.00	21.42
North Br.	12/10/2002	13.10	2.3	8.01	8.3	0.08	557.48	1.40	0.00	37.91
Tobin	12/10/2002	14.21	1.3	7.96	9.0		303.42	2.87	0.00	26.97
Cement Plant	12/10/2002	13.85	1.5	7.85	10.2	0.07	264.52	2.75	0.00	28.99
Gage	12/10/2002	14.51	1.3	8.03	9.7	0.11	252.63	2.56	0.00	30.14
Erie Blvd.	12/10/2002	15.28	1.3	8.13	10.9	0.08	251.47	2.58	0.00	31.19
Rapp Rd.	12/17/2002	10.92	5.2	7.44	18.0	0.24	197.18	0.72	0.00	34.86
Main Br.	12/17/2002	11.95	2.7	7.80	17.1	0.22	227.39	3.37	0.00	23.27
North Br.	12/17/2002	11.37	3.5	7.73	18.1	0.15	1175.06	1.16	0.00	31.23
Tobin	12/17/2002	13.12	2.3	7.81	17.0	0.06	438.72	2.68	0.00	26.71
Cement Plant	12/17/2002	12.48	2.3	7.80	17.3	0.09	428.43	2.65	0.00	29.21
Gage	12/17/2002	14.05	2.1	7.96	16.7	0.08	450.35	2.75	0.00	32.95
Erie Blvd.	12/17/2002	14.27	2.2	8.10	16.9	0.06	461.28	2.81	0.00	33.71
Rapp Rd.	12/24/2002	10.37	6.6	7.19	13.3	0.07	121.15	0.74	0.00	36.14
Main Br.	12/24/2002	12.21	3.7	7.50	11.2	0.06	247.78	3.29	0.00	24.58
North Br.	12/24/2002	12.22	4.8	7.68	12.0	0.19	405.52	1.26	0.00	34.02
Tobin	12/24/2002	13.18	3.6	7.80	13.2	0.15	332.02	2.94	0.00	29.07
Cement Plant	12/24/2002	12.76	3.9	7.88	12.3	0.09	304.95	2.86	0.00	31.77
Gage	12/24/2002	13.83	3.8	7.82	14.2	0.07	307.26	2.86	0.00	36.04
Erie Blvd.	12/24/2002	15.12	4.1	7.93	14.2		303.56	2.85	0.00	36.02
Rapp Rd.	12/31/2002	10.18	7.8	7.25	16.7					
Main Br.	12/31/2002	12.45	4.5	7.39	15.9					
North Br.	12/31/2002	12.54	5.5	7.59	17.2					
Tobin	12/31/2002	13.40	4.1	7.51	16.8					
Cement Plant	12/31/2002	12.77	4.4	7.49	17.2					
Gage	12/31/2002	13.48	4.2	7.88	17.1		850.00			
Erie Blvd.	12/31/2002	12.50	4.5	7.77	17.0					
Rapp Rd.	1/7/2003	10.86	6.0	7.24	16.3	0.00	181.09	0.67	0.00	46.22
Main Br.	1/7/2003	13.23	2.3	7.58	14.2	0.06	273.84	4.12	0.00	33.36
North Br.	1/7/2003	12.27	4.3	7.75	15.7	0.00	1400.00	1.59	0.00	50.33
Tobin	1/7/2003	13.53	2.7	7.77	15.5	0.19	378.79	3.30	0.00	39.10
Cement Plant	1/7/2003	13.12	2.7	7.67	15.5	0.26	382.75	6.58	0.00	43.68
Gage	1/7/2003	14.00	2.8	7.87	14.6	0.10	382.16	3.55	0.00	45.80
Erie Blvd.	1/7/2003	15.90	2.7	7.95	15.0	0.08	380.63	3.70	0.00	49.35
Rapp Rd.	1/14/2003									
Main Br.	1/14/2003									
North Br.	1/14/2003									
Tobin	1/14/2003	15.00	1.3	7.70	8.9	0.00	321.88	3.75	0.00	37.00
Cement Plant	1/14/2003	14.83	1.2	7.69	9.5	1.10	300.51	3.68	0.00	42.09
Gage	1/14/2003	15.61	1.1	7.86	8.9	0.08	318.26	3.91	0.00	45.27
Erie Blvd.	1/14/2003	14.90	1.0	8.07	9.9	0.08	321.50	3.90	0.00	47.61
Rapp Rd.	1/21/2003	12.21	2.8	7.59	14.5	0.07	125.26	0.77	0.00	48.38

Site	Date	Field DO mg/L	Field Temp °C	Lab pH	Lab Temp °C	Fluoride ppm	Chloride ppm	Nitrate ppm	Phosphate ppm	Sulfate ppm
Main Br.	1/21/2003	13.59	0.7	7.88	14.5	0.00	259.18	4.75	0.00	35.38
North Br.	1/21/2003	15.13	1.2	7.94	14.9	0.07	439.74	1.98	0.00	50.18
Tobin	1/21/2003	15.02	0.4	7.84	14.5	0.08	308.12	3.90	0.00	41.05
Cement Plant	1/21/2003	14.50	0.6	7.80	15.4	0.07	281.94	3.79	0.00	44.30
Gage	1/21/2003	15.70	0.2	7.92	15.1	0.08	281.34	4.06	0.00	47.61
Erie Blvd.	1/21/2003	14.75	0.3	8.04	15.6	0.08	284.18	3.84	0.00	49.50
Rapp Rd.	1/28/2003									
Main Br.	1/28/2003									
North Br.	1/28/2003									
Tobin	1/28/2003									
Cement Plant	1/28/2003									
Gage	1/28/2003									
Erie Blvd.	1/28/2003									
Rapp Rd.	2/4/2003	11.53	4.2	7.27	19.1	0.07	436.30	3.51	0.00	30.73
Main Br.	2/4/2003									
North Br.	2/4/2003	11.75	4.2	7.52	19.0	0.07	961.20	2.20	0.00	40.10
Tobin	2/4/2003	12.80	3.4	7.58	18.1	0.07	633.47	3.80	0.00	40.20
Cement Plant	2/4/2003									
Gage	2/4/2003	13.25	3.1	7.49	17.5	0.08	688.91	3.86	0.00	40.33
Erie Blvd.	2/4/2003	12.50	3.6	7.58	18.9	0.10	715.88	3.93	0.00	43.02
Rapp Rd.	2/12/2003	10.75	4.3	7.65	17.4					
Main Br.	2/12/2003	12.76	2.1	7.84	17.0					
North Br.	2/12/2003	14.86	2.8	8.06	16.8					
Tobin	2/12/2003	14.26	0.9	7.87	16.9					
Cement Plant	2/12/2003	13.75	0.9	7.83	17.3					
Gage	2/12/2003	14.84	0.9	8.03	17.6					
Erie Blvd.	2/12/2003	14.07	1.2	8.08	17.5					
Rapp Rd.	2/18/2003									
Main Br.	2/18/2003									
North Br.	2/18/2003									
Tobin	2/18/2003									
Cement Plant	2/18/2003									
Gage	2/18/2003									
Erie Blvd.	2/18/2003									
Rapp Rd.	2/25/2003	10.86	5.1	7.76	12.0	0.00	149.86	0.50	0.00	41.99
Main Br.	2/25/2003	12.16	2.8	8.11	10.4	0.00	291.72	3.84	0.00	32.07
North Br.	2/25/2003	13.12	3.5	8.03	10.5	0.00	397.18	1.34	0.00	35.52
Tobin	2/25/2003	13.98	1.7	7.97	11.1	0.00	320.54	3.29	0.00	32.66
Cement Plant	2/25/2003	13.70	1.5	7.91	11.5	0.00	318.55	3.04	0.00	35.49
Gage	2/25/2003	14.11	1.4	8.04	12.1	0.00	302.20	3.49	0.00	38.26
Erie Blvd.	2/25/2003	14.98	1.5	8.15	13.3	0.00	325.81	3.33	0.00	40.16
Rapp Rd.	3/4/2003	10.66	4.7	7.75	8.2	0.00	148.96	0.00	0.00	43.13
Main Br.	3/4/2003	12.34	2.4	8.21	8.6	0.00	293.17	3.46	0.00	30.84
North Br.	3/4/2003	13.48	2.9	8.07	9.0	0.00	393.45	1.39	0.00	36.38
Tobin	3/4/2003	14.09	0.8	7.94	9.9	0.00	285.15	2.54	0.00	30.46
Cement Plant	3/4/2003	13.60	0.7	7.91	9.9	0.00	297.82	3.07	0.00	37.37
Gage	3/4/2003	14.92	0.8	8.01	10.7	0.00	326.30	3.15	0.00	39.48
Erie Blvd.	3/4/2003	15.01	0.2	8.15	11.1	0.00	302.90	2.96	0.00	41.00
Rapp Rd.	3/11/2003	12.73	3.7	7.73	10.0	0.10	165.52	0.73	0.00	47.22
Main Br.	3/11/2003	13.38	3.9	7.98	10.5	0.07	289.58	4.60	0.00	34.55
North Br.	3/11/2003	13.19	4.0	8.03	11.3	0.07	349.60	3.20	0.00	38.07
Tobin	3/11/2003	12.83	1.6	7.98	11.8	0.07	339.68	3.53	0.00	39.14
Cement Plant	3/11/2003									
Gage	3/11/2003	12.86	1.8	8.24	12.1	0.07	308.87	3.55	0.00	46.41
Erie Blvd.	3/11/2003	10.17	1.5	8.28	13.3	0.07	329.13	4.16	0.00	48.19
Rapp Rd.	3/18/2003	9.54	8.8	7.66	17.2	0.00	162.24	0.94	0.00	40.68
Main Br.	3/18/2003	12.74	4.9	7.92	15.7	0.23	260.37	3.59	0.00	31.20
North Br.	3/18/2003	12.07	7.3	7.97	16.8	0.00	434.19	1.01	0.00	32.35
Tobin	3/18/2003	13.07	4.9	7.76	17.8	0.00	335.46	3.06	0.00	34.22
Cement Plant	3/18/2003	12.47	4.6	7.76	17.3	0.05	328.00	3.41	0.00	38.31
Gage	3/18/2003	13.72	4.5	7.90	16.9	0.00	310.49	3.01	0.00	42.94
Erie Blvd.	3/18/2003	12.97	4.6	8.04	17.7	5.50	336.87	3.62	0.00	45.69
Rapp Rd.	3/25/2003	9.48	10.7	7.75	18.1	0.06	151.33	1.49	0.17	44.11
Main Br.	3/25/2003	12.65	7.1	7.98	18.0	0.06	220.45	3.67	0.00	28.90
North Br.	3/25/2003	12.81	7.9	8.01	18.8	0.29	286.46	3.23	0.00	33.03
Tobin	3/25/2003	12.47	6.7	7.88	19.2	0.29	163.90	2.01	0.00	19.62
Cement Plant	3/25/2003	12.12	6.3	7.83	19.9	0.06	276.62	3.65	0.00	39.19
Gage	3/25/2003	12.76	6.4	8.05	20.1	0.06	261.82	4.23	0.00	43.93
Erie Blvd.	3/25/2003	77.81	6.4	8.17	20.7	0.06	267.57	4.02	0.00	44.42
Rapp Rd.	4/1/2003	9.43	6.0	7.73	17.7	0.06	155.64	1.00	0.00	44.95
Main Br.	4/1/2003	10.44	4.6	7.86	17.1	0.00	150.95	2.57	0.15	16.58
North Br.	4/1/2003	9.68	4.8	7.88	17.0	0.07	54.52	0.42	0.00	7.41
Tobin	4/1/2003	9.88	4.5	7.80	17.6	0.00	196.93	2.88	0.00	25.71
Cement Plant	4/1/2003	10.56	4.3	7.87	16.7	0.44	220.93	3.80	0.00	30.05
Gage	4/1/2003	11.82	4.2	7.96	17.9	0.06	244.20	4.54	0.00	41.44
Erie Blvd.	4/1/2003	9.73	4.0	8.11	18.1	0.07	249.59	4.00	0.00	42.99
Rapp Rd.	4/8/2003	10.29	6.9	7.72	16.0	0.00	250.16	1.29	0.00	46.07
Main Br.	4/8/2003	12.10	3.8	7.98	16.7	0.00	426.03	0.00	0.00	28.97
North Br.	4/8/2003	11.98	4.9	8.02	15.2	0.00	537.83	2.79	0.00	45.20
Tobin	4/8/2003	12.87	3.7	7.93	15.6	0.00	441.48	0.00	0.00	38.04
Cement Plant	4/8/2003	12.27	3.8	7.84	16.0	0.00	649.64	0.00	0.00	41.78
Gage	4/8/2003	12.87	3.6	7.98	16.8	0.00	404.42	0.00	0.00	27.11
Erie Blvd.	4/8/2003	12.45	3.4	8.10	16.3	0.00	674.00	0.00	0.00	46.93
Rapp Rd.	4/15/2003	10.06	8.4	7.70	20.6	0.07	151.91	1.41	0.00	44.52
Main Br.	4/15/2003	8.97	8.2	7.83	20.3	0.00	121.21	2.13	0.00	13.76
North Br.	4/15/2003	9.28	8.6	7.81	20.1	0.02	267.42	3.83	0.00	24.58
Tobin	4/15/2003	9.47	9.2	7.73	21.1	0.00	298.18	3.13	0.00	26.71
Cement Plant	4/15/2003	10.16	8.5	7.78	20.9	0.04	306.67	4.04	0.00	38.90
Gage	4/15/2003	11.41	8.4	7.92	21.1	0.03	223.95	2.55	0.00	28.74
Erie Blvd.	4/15/2003	11.31	8.9	8.03	20.0	0.05	344.36	4.04	0.00	47.53
Rapp Rd.	4/22/2003	9.40	9.4	7.55	19.7	0.00	140.93	1.46	0.00	40.13
Main Br.	4/22/2003	9.47	11.1	7.71	18.4	0.00	170.98	3.32	0.00	18.82
North Br.	4/22/2003	8.02	11.2	7.78	18.5	0.00	128.89	1.91	0.00	13.13
Tobin	4/22/2003	4.67	11.1	7.74	18.5	0.00	224.21	2.95	0.00	23.93
Cement Plant	4/22/2003	9.60	10.6	7.76	18.7	0.00	291.32	3.96	0.00	35.68
Gage	4/22/2003	10.50	10.6	7.93	19.1	0.05	315.73	3.51	0.00	45.35
Erie Blvd.	4/22/2003	9.72	10.9	8.05	19.7	0.00	133.87	1.63	0.00	10.35
Rapp Rd.	4/28/2003	11.64	9.6	7.81	7.8	0.00	141.95	0.00	0.00	45.08
Main Br.	4/28/2003	10.48	14.3	8.42	7.9	0.00	233.42	0.00	0.00	33.65
North Br.	4/28/2003	10.75	13.8	8.10	9.3	0.00	155.86	0.00	0.00	17.80
Tobin	4/28/2003	10.11	13.1	8.04	10.1	0.00	254.98	0.00	0.00	32.48
Cement Plant	4/28/2003	10.30	12.2	7.98	12.7	0.00	221.37	0.00	0.00	31.94
Gage	4/28/2003	11.39	12.1	8.15	12.4	0.00	191.75	0.00	0.00	29.33
Erie Blvd.	4/28/2003	10.84	12.1	8.22	13.4	0.00	259.44	0.00	0.00	43.46
Rapp Rd.	5/6/2003	8.96	9.4	7.70	8.1	0.00	112.01	0.80	0.00	33.43
Main Br.	5/6/2003	6.73	12.8	8.01	8.7	0.00	193.15	3.95	0.00	26.33
North Br.	5/6/2003	7.17	12.3	7.95	9.0	0.00	233.94	4.33	0.00	33.13
Tobin	5/6/2003	9.24	11.8	7.88	8.4	0.00	171.65	2.62	0.00	22.63
Cement Plant	5/6/2003	9.27	11.1	7.87	8.4	0.00	195.56	2.83	0.00	28.91
Gage	5/6/2003	10.67	11.0	7.98	9.8	0.00	216.34	3.49	0.00	36.84
Erie Blvd.	5/6/2003	9.79	11.0	7.99	10.4	0.00	223.01	3.61	0.00	39.44
Rapp Rd.	5/13/2003	9.50	10.8	7.71	12.8	0.00	129.26	1.01	0.00	41.47
Main Br.	5/13/2003	7.82	14.2	8.03	13.4	0.00	186.43	3.60	0.00	30.78

Site	Date	Field DO mg/L	Field Temp °C	Lab pH	Lab Temp °C	Fluoride ppm	Chloride ppm	Nitrate ppm	Phosphate ppm	Sulfate ppm
North Br.	5/13/2003	8.85	12.8	7.74	14.1	0.00	119.47	1.98	0.00	21.30
Tobin	5/13/2003	9.49	13.3	7.84	13.3	0.00	171.79	2.86	0.00	29.54
Cement Plant	5/13/2003	9.44	12.8	7.82	14.1	0.00	180.39	3.19	0.00	32.28
Gage	5/13/2003	10.29	12.7	8.01	14.1	0.08	180.91	3.30	0.00	35.33
Erie Blvd.	5/13/2003	10.23	12.6	8.13	14.3	0.08	186.74	3.29	0.00	36.24
Rapp Rd.	5/20/2003	9.70	10.3	7.85	7.3	0.06	138.73	0.88	0.00	45.66
Main Br.	5/20/2003	4.48	15.8	7.84	9.2	0.07	196.39	4.42	0.00	30.97
North Br.	5/20/2003	5.58	15.3	7.75	9.7	0.06	238.00	3.47	0.00	34.09
Tobin	5/20/2003	8.85	15.1	7.90	7.6	0.06	246.20	2.75	0.00	35.59
Cement Plant	5/20/2003	8.68	14.2	7.83	9.2	0.07	256.78	3.32	0.00	38.49
Gage	5/20/2003	9.77	14.1	8.01	9.3	0.08	243.24	3.56	0.00	42.70
Erie Blvd.	5/20/2003	7.76	14.0	8.10	9.2	0.10	242.95	3.67	0.00	42.61
Rapp Rd.	5/27/2003	9.33	12.0	7.62	17.2	0.00	132.68	0.00	0.00	45.09
Main Br.	5/27/2003	8.18	16.0	7.81	17.9	0.00	196.25	0.00	0.00	33.07
North Br.	5/27/2003	8.75	13.9	7.71	16.6	0.00	139.01	0.00	0.00	23.21
Tobin	5/27/2003	9.14	14.9	7.82	16.9	0.00	183.68	0.00	0.00	30.71
Cement Plant	5/27/2003	9.50	14.1	7.81	15.7	0.00	187.46	5.28	0.00	33.10
Gage	5/27/2003	10.41	13.8	8.02	17.1	0.00	185.83	4.76	0.00	36.23
Erie Blvd.	5/27/2003	9.88	14.4	8.11	17.1	0.00	190.26	0.00	0.00	36.43
Rapp Rd.	6/3/2003	9.88	10.9	7.70	12.7	0.03	130.80	1.12	0.00	43.06
Main Br.	6/3/2003	6.60	15.5	7.80	13.3	0.03	166.15	3.84	0.00	29.38
North Br.	6/3/2003	8.62	13.1	7.79	11.3	0.04	226.68	1.87	0.00	33.11
Tobin	6/3/2003	9.02	14.3	7.82	13.8	0.04	179.38	2.73	0.00	31.34
Cement Plant	6/3/2003	9.02	13.6	7.85	13.0	0.05	182.39	3.13	0.00	33.06
Gage	6/3/2003	10.30	13.5	8.00	13.8	0.05	181.24	3.42	0.00	36.52
Erie Blvd.	6/3/2003	9.63	13.4	8.19	12.5	0.06	189.06	3.24	0.00	38.16
Rapp Rd.	6/10/2003	9.66	13.0	7.61	19.5	0.00	131.32	1.13	0.00	44.27
Main Br.	6/10/2003	6.41	18.8	8.27	19.4	0.00	171.84	3.26	0.00	28.46
North Br.	6/10/2003	8.26	16.0	7.83	19.5	0.00	261.27	2.00	0.00	36.89
Tobin	6/10/2003	8.76	16.7	7.89	20.0	0.00	204.69	2.50	0.00	31.92
Cement Plant	6/10/2003	8.86	15.6	7.83	19.5	0.00	209.95	2.79	0.00	33.73
Gage	6/10/2003	10.26	15.6	7.99	19.3	0.00	211.47	2.72	0.00	36.18
Erie Blvd.	6/10/2003	9.70	16.5	8.14	19.6	0.00	215.67	3.10	0.00	36.82
Rapp Rd.	6/17/2003	9.90	12.3	7.90	11.6	0.05	131.89	0.87	0.00	44.22
Main Br.	6/17/2003	7.65	18.6	8.09	9.4	0.05	191.99	4.29	0.00	29.66
North Br.	6/17/2003	8.90	15.6	7.98	10.6	0.05	361.72	2.09	0.00	42.38
Tobin	6/17/2003	9.12	17.0	8.04	10.3	0.05	234.49	2.96	0.00	33.92
Cement Plant	6/17/2003	8.55	16.1	8.01	14.2	0.04	227.11	3.06	0.00	36.63
Gage	6/17/2003	10.10	15.9	8.20	13.8	0.04	227.81	2.79	0.00	38.81
Erie Blvd.	6/17/2003	9.33	15.8	8.17	14.6	0.05	237.03	3.76	0.00	40.28
Rapp Rd.	6/24/2003	9.22	14.2	7.82	15.4	0.00	126.07	0.76	0.21	43.36
Main Br.	6/24/2003	7.38	22.0	8.13	14.0	0.00	174.78	3.51	0.00	27.74
North Br.	6/24/2003	8.19	18.1	7.99	13.2	0.00	216.95	1.64	0.00	30.31
Tobin	6/24/2003	8.29	20.1	8.02	14.3	0.00	95.44	1.35	0.00	13.15
Cement Plant	6/24/2003	8.47	18.5	8.03	14.5	0.02	184.66	3.20	0.00	32.18
Gage	6/24/2003	9.50	18.3	8.23	14.4	0.00	186.92	3.12	0.00	34.55
Erie Blvd.	6/24/2003	9.00	18.1	8.36	15.5	0.00	204.68	0.00	0.00	38.31
Rapp Rd.	7/1/2003	9.42	12.8	7.98	22.6	0.06	130.54	0.87	0.00	45.24
Main Br.	7/1/2003	4.81	20.9	8.03	22.4	0.00	218.87	4.79	0.00	32.91
North Br.	7/1/2003	7.18	17.5	8.06	22.6	0.06	275.88	2.12	0.00	41.10
Tobin	7/1/2003	7.93	19.2	8.02	22.6	0.12	223.63	2.84	0.00	33.34
Cement Plant	7/1/2003	8.07	17.7	8.03	22.4	0.06	211.96	2.81	0.00	35.58
Gage	7/1/2003	9.41	17.7	8.23	22.3	0.07	211.52	2.95	0.00	37.51
Erie Blvd.	7/1/2003	6.54	17.5	8.33	22.4	0.09	224.68	3.37	0.00	40.60
Rapp Rd.	7/8/2003	8.59	14.2	7.82	22.8	0.00	130.71	0.90	0.00	44.88
Main Br.	7/8/2003	5.01	23.8	7.94	22.7	0.00	196.06	2.89	0.00	29.38
North Br.	7/8/2003	7.02	19.3	8.05	22.8	0.00	362.45	1.89	0.00	45.67
Tobin	7/8/2003	7.40	21.7	7.84	23.3	0.00	246.57	2.69	0.00	34.66
Cement Plant	7/8/2003	7.74	20.1	7.92	22.8	0.21	233.27	3.21	0.00	36.59
Gage	7/8/2003	8.63	20.1	8.15	23.3	0.00	232.95	3.19	0.00	38.63
Erie Blvd.	7/8/2003	8.99	19.9	8.24	23.0	0.00	236.87	3.37	0.00	41.07
Rapp Rd.	7/15/2003	10.17	13.3	7.99	10.1	0.24	130.61	1.28	0.00	45.24
Main Br.	7/15/2003	4.29	21.2	8.07	9.2	0.05	187.40	2.48	0.00	28.97
North Br.	7/15/2003	5.75	20.2	8.10	11.6	0.04	217.07	2.39	0.00	31.33
Tobin	7/15/2003	8.89	20.0	8.12	10.8	0.04	216.59	2.23	0.00	30.75
Cement Plant	7/15/2003	8.40	18.9	8.10	12.6	0.04	214.99	2.45	0.00	34.27
Gage	7/15/2003	10.09	18.8	8.32	13.8	0.05	215.49	2.48	0.00	36.76
Erie Blvd.	7/15/2003	9.53	18.6	8.39	14.0	0.00	231.93	0.00	0.00	40.14
Rapp Rd.	7/29/2003	9.59	13.8	7.81	22.5	0.05	133.27	0.79	0.00	46.10
Main Br.	7/29/2003	5.91	23.6	7.86	23.2	0.05	162.23	2.24	0.00	25.14
North Br.	7/29/2003	8.71	19.1	8.03	22.9	0.04	336.78	1.87	0.00	40.38
Tobin	7/29/2003									
Cement Plant	7/29/2003	8.89	18.9	7.94	22.5	0.06	201.09	2.59	0.00	33.46
Gage	7/29/2003	10.09	18.8	8.17	22.7	0.05	200.24	2.39	0.00	32.79
Erie Blvd.	7/29/2003	8.46	18.7	8.26	22.9	0.06	208.43	2.45	0.00	37.81
Rapp Rd.	8/5/2003	8.69	15.6	7.58	12.9	0.00	120.63	0.81	0.00	34.40
Main Br.	8/5/2003	7.45	20.8	8.20	13.5	0.00	168.49	2.88	0.00	23.73
North Br.	8/5/2003	5.15	24.8	7.84	14.5	0.00	249.29	2.25	0.00	34.91
Tobin	8/5/2003	8.06	22.9	7.89	14.0	0.00	194.24	2.34	0.00	27.34
Cement Plant	8/5/2003	8.04	21.4	7.93	14.1	0.00	196.06	2.82	0.00	31.62
Gage	8/5/2003	8.70	21.3	8.15	14.3	0.00	193.22	2.95	0.00	33.44
Erie Blvd.	8/5/2003	8.40	21.2	8.26	14.9	0.09	200.12	3.41	0.00	36.46
Rapp Rd.	8/13/2003	8.78	15.6	7.85	18.6	0.00	127.54	0.06	0.00	43.33
Main Br.	8/13/2003	7.34	20.7	8.16	18.1	0.00	171.58	2.76	0.00	23.61
North Br.	8/13/2003	5.86	24.7	7.95	18.4	0.00	247.19	1.62	0.00	34.03
Tobin	8/13/2003	8.11	22.7	7.91	18.1	0.00	202.99	2.31	0.00	27.94
Cement Plant	8/13/2003	8.17	21.1	7.94	19.1	0.00	201.72	2.55	0.00	31.58
Gage	8/13/2003	9.57	20.1	8.19	19.4	0.00	201.25	3.03	0.00	34.00
Erie Blvd.	8/13/2003	8.70	20.9	8.29	20.1	0.00	203.58	3.05	0.00	35.80
Rapp Rd.	8/19/2003	9.06	15.4	7.87	13.3	0.09	130.40	0.84	0.00	44.84
Main Br.	8/19/2003									
North Br.	8/19/2003									
Tobin	8/19/2003	8.04	22.0	8.10	12.4	0.09	230.57	2.14	0.00	30.88
Cement Plant	8/19/2003	6.82	20.2	8.04	13.2	0.09	217.42	2.42	0.00	33.55
Gage	8/19/2003	8.48	19.7	8.11	13.3	0.11	228.99	2.01	0.00	30.51
Erie Blvd.	8/19/2003	3.73	20.1	8.39	14.6	0.11	224.14	2.62	0.00	38.49
Rapp Rd.	8/26/2003	9.26	13.6	7.70	20.1	0.11	131.64	1.02	0.00	44.85
Main Br.	8/26/2003									
North Br.	8/26/2003									
Tobin	8/26/2003	7.87	19.8	8.04	20.9	0.06	242.78	2.14	0.00	32.23
Cement Plant	8/26/2003	7.38	18.8	8.06	21.3	0.10	235.69	2.58	0.00	35.23
Gage	8/26/2003	9.01	18.8	8.25	21.6	0.11	226.74	2.68	0.00	36.67
Erie Blvd.	8/26/2003	7.78	18.7	8.31	21.8	0.13	230.19	3.02	0.00	38.47
Rapp Rd.	9/2/2003	8.97	15.5	7.72	19.5	0.04	26.69	0.00	0.00	10.75
Main Br.	9/2/2003									
North Br.	9/2/2003					0.08	279.28	1.62	0.00	36.54
Tobin	9/2/2003	9.45	17.4	7.87	19.8	0.06	130.95	1.15	0.00	16.97
Cement Plant	9/2/2003	9.18	17.1	7.87	19.8	0.07	116.95	1.12	0.00	16.62
Gage	9/2/2003	9.96	17.0	7.99	19.6	0.03	107.98	1.15	0.00	16.06
Erie Blvd.	9/2/2003	9.32	17.2	8.12	19.8	0.06	101.42	1.11	0.00	16.03
Rapp Rd.	9/9/2003	9.05	13.1	7.84	19.5	0.00	134.28	0.00	0.00	42.63
Main Br.	9/9/2003	6.00	18.9	8.02	20.3	0.00	198.49	0.00	0.00	27.44
North Br.	9/9/2003	8.56	16.3	8.01	20.1	0.00	303.63	0.00	0.00	36.31

Site	Date	Field DO mg/L	Field Temp °C	Lab pH	Lab Temp °C	Fluoride ppm	Chloride ppm	Nitrate ppm	Phosphate ppm	Sulfate ppm
Tobin	9/9/2003	8.55	17.4	8.02	19.4	0.00	225.38	0.00	0.00	31.65
Cement Plant	9/9/2003	7.39	16.7	8.02	19.5	0.00	218.88	0.00	0.00	35.32
Gage	9/9/2003	9.71	16.6	8.23	19.0	0.00	218.95	0.00	0.00	37.90
Erie Blvd.	9/9/2003	8.84	16.5	8.30	19.8	0.00	223.83	0.00	0.00	40.36
Rapp Rd.	9/16/2003	8.13	16.7	7.62	19.2	0.00	65.50	0.00	0.00	24.13
Main Br.	9/16/2003	5.16	21.0	8.13	20.2	0.00	175.74	0.00	0.00	23.73
North Br.	9/16/2003	7.96	19.1	7.86	19.3	0.00	140.72	0.00	0.00	18.14
Tobin	9/16/2003	8.54	19.5	7.94	19.2	0.00	192.16	0.00	0.00	19.51
Cement Plant	9/16/2003	8.35	19.1	7.92	17.1	0.00	176.51	0.00	0.00	22.94
Gage	9/16/2003	9.12	19.0	8.07	19.9	0.00	165.85	0.00	0.00	22.65
Erie Blvd.	9/16/2003	8.80	19.0	8.20	20.3	0.00	168.50	0.00	0.00	23.28
Rapp Rd.	9/23/2003	9.04	18.0	7.54	10.0	0.00	3.58	0.00	0.00	0.00
Main Br.	9/23/2003	6.27	18.5	7.85	10.2	0.00	73.59	0.00	0.00	9.86
North Br.	9/23/2003	8.95	17.4	7.75	10.2	0.00	106.28	0.00	0.00	11.94
Tobin	9/23/2003	8.69	18.4	7.82	10.5	0.00	111.83	0.00	0.00	12.80
Cement Plant	9/23/2003	8.77	19.2	7.84	13.1	0.00	71.44	0.00	0.00	11.27
Gage	9/23/2003	9.78	18.3	7.73	11.8	0.00	78.76	0.00	0.00	14.21
Erie Blvd.	9/23/2003	9.53	18.4	7.91	13.8	0.00	74.25	0.00	0.00	14.13
Rapp Rd.	9/30/2003	9.17	11.6	7.81	12.1	0.00	127.82	0.00	0.00	43.97
Main Br.	9/30/2003	7.08	16.2	7.99	12.1	0.00	197.33	0.00	0.00	24.75
North Br.	9/30/2003	8.27	13.8	7.96	12.4	0.00	162.66	0.00	0.00	20.77
Tobin	9/30/2003	8.87	14.7	7.99	12.0	0.00	203.36	0.00	0.00	27.96
Cement Plant	9/30/2003	8.60	14.4	7.98	11.4	0.00	202.02	0.00	0.00	32.07
Gage	9/30/2003	9.87	14.2	8.18	11.7	0.00	201.24	0.00	0.00	34.18
Erie Blvd.	9/30/2003	8.63	14.2	8.27	12.9	0.00	206.16	0.00	0.00	37.00
Rapp Rd.	10/7/2003	9.57	10.8	7.90	17.6	0.00	134.87	0.00	0.00	46.03
Main Br.	10/7/2003	8.24	12.8	8.10	17.6	0.00	214.05	0.00	0.00	25.51
North Br.	10/7/2003	10.97	10.6	8.02	17.2	0.00	343.40	0.00	0.00	43.08
Tobin	10/7/2003	9.82	11.4	8.02	16.2	0.00	241.24	0.00	0.00	31.69
Cement Plant	10/7/2003	10.23	11.0	8.00	17.3	0.00	230.46	0.00	0.00	34.86
Gage	10/7/2003	10.65	13.2	8.10	18.2	0.00	155.42	0.00	0.00	26.94
Erie Blvd.	10/7/2003	10.47	12.9	8.16	18.9	0.00	162.02	0.00	0.00	29.28
Rapp Rd.	10/14/2003	9.43	10.6	7.72	21.7	0.06	130.85	0.84	0.00	45.07
Main Br.	10/14/2003	4.63	13.6	7.96	21.7	0.08	225.52	2.01	0.00	29.84
North Br.	10/14/2003	8.13	13.4	8.48	22.7	0.08	203.52	4.48	0.00	25.30
Tobin	10/14/2003	9.51	12.9	7.98	22.6	0.11	226.85	2.04	0.00	30.40
Cement Plant	10/14/2003	9.36	12.6	7.96	22.3	0.13	215.28	2.38	0.00	34.02
Gage	10/14/2003	10.94	12.6	8.14	22.2	0.10	214.00	2.87	0.00	36.28
Erie Blvd.	10/14/2003	9.80	12.6	8.19	23.0	0.10	217.85	2.95	0.00	38.36
Rapp Rd.	10/21/2003	9.26	11.4	7.73	18.3	0.00	134.97	0.00	0.00	46.61
Main Br.	10/21/2003	7.27	12.4	7.79	20.2	0.00	211.88	0.00	0.00	26.32
North Br.	10/21/2003	7.14	11.7	7.79	19.2	0.00	239.12	0.00	0.00	32.05
Tobin	10/21/2003	10.14	11.0	7.90	19.4	0.00	241.94	0.00	0.00	32.01
Cement Plant	10/21/2003	9.92	11.1	7.91	18.8	0.00	227.40	0.00	0.00	34.63
Gage	10/21/2003	11.46	11.5	8.10	19.3	0.00	218.20	0.00	0.00	36.56
Erie Blvd.	10/21/2003	10.98	11.3	8.19	20.4	0.00	226.61	0.00	0.00	39.52
Rapp Rd.	10/28/2003	9.80	10.8	7.71	20.0	0.00	103.16	0.00	0.00	35.09
Main Br.	10/28/2003	8.57	10.7	8.21	20.2	0.00	185.55	0.00	0.00	23.11
North Br.	10/28/2003	7.14	11.5	7.78	21.3	0.00	51.36	0.00	0.00	12.18
Tobin	10/28/2003	10.14	11.0	7.86	20.9	0.00	120.75	0.00	0.00	19.15
Cement Plant	10/28/2003	9.92	11.0	7.44	20.3	0.00	122.30	0.00	0.00	22.12
Gage	10/28/2003	11.46	11.2	7.93	20.2	0.00	114.02	0.00	0.00	23.31
Erie Blvd.	10/28/2003	10.99	11.3	8.06	21.2	0.00	114.01	0.00	0.00	24.91
Rapp Rd.	11/5/2003	9.18	10.9	7.72	23.2	0.00	128.59	0.00	0.00	44.68
Main Br.	11/5/2003	7.66	10.7	7.93	22.7	0.00	177.17	4.90	0.00	25.50
North Br.	11/5/2003									
Tobin	11/5/2003	10.34	10.8	7.89	23.1	0.00	200.98	0.00	0.00	29.43
Cement Plant	11/5/2003	10.59	10.7	7.86	23.2	0.00	197.86	0.00	0.00	33.98
Gage	11/5/2003	11.63	10.7	8.11	22.9	2.86	201.42	4.76	0.00	37.10
Erie Blvd.	11/5/2003	11.68	11.3	8.22	23.2	0.00	198.52	0.00	0.00	39.36
Rapp Rd.	11/12/2003	9.06	10.4	7.62	12.3	0.04	130.63	0.70	0.15	43.88
Main Br.	11/12/2003	8.77	8.6	7.97	12.4	0.06	188.60	3.14	0.80	28.34
North Br.	11/12/2003	10.41	8.0	7.92	13.0	0.05	323.72	0.98	0.15	44.56
Tobin	11/12/2003	11.06	8.1	7.96	12.5	0.06	225.31	3.41	0.15	31.55
Cement Plant	11/12/2003	10.83	8.2	7.98	12.0	0.10	216.64	3.48	0.60	36.62
Gage	11/12/2003	12.33	8.2	8.12	12.3	0.13	215.87	2.58	0.35	38.40
Erie Blvd.	11/12/2003	11.47	8.3	8.29	12.7	0.08	222.52	6.97	0.38	40.76
Rapp Rd.	11/18/2003	9.13	9.5	7.62	8.2	0.00	127.71	0.00	0.00	44.41
Main Br.	11/18/2003	8.96	6.7	7.97	8.0	0.00	187.29	0.00	0.00	27.89
North Br.	11/18/2003	10.92	6.9	7.97	8.2	0.00	219.47	0.00	0.00	32.80
Tobin	11/18/2003	11.31	7.1	7.96	8.5	0.00	221.36	0.00	0.00	33.29
Cement Plant	11/18/2003	10.58	7.5	8.02	8.9	0.00	210.44	0.00	0.00	35.70
Gage	11/18/2003	12.15	7.5	8.14	9.5	0.00	209.07	0.00	0.00	38.22
Erie Blvd.	11/18/2003	10.22	7.8	8.20	10.4	0.00	211.49	0.00	0.00	40.53
Rapp Rd.	11/25/2003	8.75	7.6	7.58	15.5	0.00	103.12	0.00	0.00	35.50
Main Br.	11/25/2003	9.06	6.4	8.06	15.0	0.00	177.09	0.00	0.00	27.09
North Br.	11/25/2003	10.59	6.1	7.99	15.1	0.00	176.98	0.00	0.00	26.16
Tobin	11/25/2003	11.56	6.6	8.01	14.8	0.00	182.49	0.00	0.00	25.46
Cement Plant	11/25/2003	11.18	6.7	7.94	15.0	0.00	173.55	0.00	0.00	28.35
Gage	11/25/2003	12.31	6.6	7.93	15.6	0.00	163.82	0.00	0.00	29.31
Erie Blvd.	11/25/2003	11.91	5.7	8.12	16.0	0.00	163.08	0.00	0.00	30.95
Rapp Rd.	12/2/2003	9.90	6.8	7.74	14.9	0.00	132.74	0.00	0.00	44.32
Main Br.	12/2/2003	10.37	4.5	8.16	14.2	0.00	174.23	5.31	0.00	27.40
North Br.	12/2/2003	11.64	4.1	8.07	14.1	0.00	216.74	0.00	0.00	30.40
Tobin	12/2/2003	11.76	4.6	8.08	14.5	0.00	213.26	0.00	0.00	30.44
Cement Plant	12/2/2003	11.45	4.9	8.06	14.7	0.00	138.49	0.00	0.00	26.49
Gage	12/2/2003	12.60	4.9	8.22	15.2	0.00	178.92	4.91	0.00	36.93
Erie Blvd.	12/2/2003	9.63	5.2	8.08	15.2	0.00	77.81	0.00	0.00	15.84
Rapp Rd.	12/16/2003	9.47	2.0	7.95	8.4	0.00	136.28	0.00	0.00	43.08
Main Br.	12/16/2003	10.11	3.3	8.50	8.6	0.00	187.50	0.00	0.00	28.32
North Br.	12/16/2003	10.61	4.9	8.17	8.5	0.00	336.50	0.00	0.00	39.17
Tobin	12/16/2003									
Cement Plant	12/16/2003									
Gage	12/16/2003	13.42	2.9	8.25	7.8	0.00	227.46	0.00	0.00	38.05
Erie Blvd.	12/16/2003	13.30	2.0	8.32	8.8	0.00	117.38	0.00	0.00	20.35
Rapp Rd.	12/30/2003	9.17	8.3	7.83	7.1	0.00	135.73	0.00	0.00	41.39
Main Br.	12/30/2003	10.05	4.6	8.22	5.9	0.00	201.22	0.00	0.00	0.00
North Br.	12/30/2003	10.45	5.2	8.07	6.8	0.00	229.18	0.00	0.00	31.34
Tobin	12/30/2003	11.59	5.8	8.07	7.4	0.00	230.93	0.00	0.00	29.80
Cement Plant	12/30/2003	8.60	5.1	8.04	7.8	0.00	232.47	0.00	0.00	33.65
Gage	12/30/2003									
Erie Blvd.	12/30/2003	10.49	5.5	8.27	8.2	0.00	236.46	0.00	0.00	35.50
Rapp Rd.	1/13/2004	10.51	6.7	7.85	8.5	0.00	145.98	0.00	0.00	39.03
Main Br.	1/13/2004	11.20	3.4	8.12	7.3	0.00	214.67	0.00	0.00	30.83
North Br.	1/13/2004	11.96	4.7	8.10	8.6	0.00	811.12	0.00	0.00	43.27
Tobin	1/13/2004									
Cement Plant	1/13/2004									
Gage	1/13/2004	14.22	3.1	8.20	8.7					
Erie Blvd.	1/13/2004	13.87	2.8	8.33	7.5					
Rapp Rd.	1/27/2004	10.72	3.3	7.77	3.8	0.00	133.73	0.00	0.00	45.37
Main Br.	1/27/2004	11.20	0.9	8.10	3.6	0.00	235.92	0.00	0.00	37.11
North Br.	1/27/2004	13.75	0.6	7.99	3.9	0.00	275.74	0.00	0.00	40.90
Tobin	1/27/2004	13.42	0.8	8.10	3.6	0.00	276.19	0.00	0.00	40.95

Site	Date	Field DO mg/L	Field Temp °C	Lab pH	Lab Temp °C	Fluoride ppm	Chloride ppm	Nitrate ppm	Phosphate ppm	Sulfate ppm
Cement Plan	1/27/2004									
Gage	1/27/2004	14.77	0.4	8.22	3.3	0.00	246.79	0.00	0.00	43.48
Erie Blvd.	1/27/2004	13.25	0.6	8.26	2.2	0.00	256.31	0.00	0.00	46.66
Rapp Rd.	2/10/2004	10.09	6.1	8.08	8.7	0.00	147.85	0.00	0.00	47.14
Main Br.	2/10/2004	11.25	2.7	8.12	8.2	0.00	253.23	0.00	0.00	37.97
North Br.	2/10/2004	13.01	3.5	8.14	8.5	0.00	549.85	0.00	0.00	47.60
Tobin	2/10/2004									
Cement Plan	2/10/2004									
Gage	2/10/2004	13.89	2.8	8.26	8.8	0.00	311.07	0.00	0.00	43.55
Erie Blvd.	2/10/2004	13.63	2.7	8.31	8.0	0.00	322.98	0.00	0.00	46.63
Rapp Rd.	2/24/2004	10.07	5.4	7.73	7.2	0.00	142.81	0.00	0.00	46.55
Main Br.	2/24/2004	10.85	2.8	8.19	8.7	0.00	281.35	7.28	0.00	38.11
North Br.	2/24/2004	12.83	4.3	8.16	9.1	0.00	542.07	0.00	0.00	45.44
Tobin	2/24/2004									
Cement Plan	2/24/2004									
Gage	2/24/2004	13.43	2.5	8.15	9.2	0.00	387.76	0.00	0.00	44.60
Erie Blvd.	2/24/2004			8.22	9.9	0.00	393.84	0.00	0.00	45.45
Rapp Rd.	3/9/2004	9.54	7.8	7.69	6.9	0.00	148.50	0.00	0.00	44.61
Main Br.	3/9/2004	10.47	4.9	7.94	7.7	0.00	352.33	0.00	0.00	36.50
North Br.	3/9/2004	11.78	4.7	8.47	8.3	0.00	253.93	4.68	0.00	33.59
Tobin	3/9/2004	12.05	4.6	8.15	9.1	0.00	353.13	0.00	0.00	36.85
Cement Plan	3/9/2004	11.25	4.5	7.95	9.4	0.00	336.07	0.00	0.00	39.56
Gage	3/9/2004	12.79	4.4	8.10	9.2	0.00	344.43	0.00	0.00	42.61
Erie Blvd.	3/9/2004	11.81	4.5	8.17	9.4	0.00	362.62	0.00	0.00	44.74
Rapp Rd.	3/23/2004	10.10	6.9	7.79	6.9	0.00	141.34	0.07	0.00	45.65
Main Br.	3/23/2004	11.82	5.4	8.39	6.7	0.00	258.83	4.05	0.00	33.89
North Br.	3/23/2004	12.35	2.2	8.11	7.0	0.00	323.19	0.03	0.00	37.38
Tobin	3/23/2004	12.85	2.9	8.11	6.9	0.00	323.59	0.11	0.00	37.47
Cement Plan	3/23/2004	12.59	2.4	8.02	8.4	0.00	304.96	0.19	0.00	39.65
Gage	3/23/2004	13.45	2.5	8.19	9.6	0.00	303.41	0.00	0.00	43.13
Erie Blvd.	3/23/2004	12.95	2.6	8.30	9.5	0.00	310.06	0.13	0.00	45.32
Rapp Rd.	4/6/2004	n/a	n/a	7.79	6.4	1.70	150.47	0.00	0.00	44.15
Main Br.	4/6/2004	n/a	8.0	8.13	6.3	1.88	234.31	3.99	0.00	30.40
North Br.	4/6/2004	n/a	8.0	8.12	7.2	1.70	383.63	0.00	0.00	51.69
Tobin	4/6/2004	n/a	5.0	8.06	8.8	1.74	262.17	0.00	0.00	36.51
Cement Plan	4/6/2004	n/a	6.0	8.01	10.0	1.69	256.54	0.00	0.00	37.90
Gage	4/6/2004	n/a	4.0	8.14	10.5	1.78	258.57	0.00	0.00	42.31
Erie Blvd.	4/6/2004	n/a	5.0	8.23	11.4	1.71	263.14	0.00	0.00	43.61
Rapp Rd.	4/20/2004	9.55	10.5	7.83	20.9	0.00	131.61	0.10	0.00	40.81
Main Br.	4/20/2004	10.81	12.8	8.35	20.5	0.00	220.30	3.86	0.00	29.65
North Br.	4/20/2004	9.94	13.2	7.82	19.9	0.00	350.39	0.00	0.00	45.68
Tobin	4/20/2004	9.71	11.7	8.09	19.5	0.00	254.12	0.37	0.00	33.05
Cement Plan	4/20/2004	9.80	11.9	8.06	20.5	0.00	235.14	1.39	0.00	32.06
Gage	4/20/2004	11.43	11.8	8.27	19.9	0.00	240.96	0.94	0.00	38.47
Erie Blvd.	4/20/2004	10.32	12.0	8.31	20.2	0.00	115.17	0.34	0.00	16.98
Rapp Rd.	5/4/2004	9.06	9.6	8.08	8.3	0.00	103.31	0.00	0.00	33.54
Main Br.	5/4/2004	8.24	13.7	8.27	7.5	0.00	218.24	3.70	0.00	31.13
North Br.	5/4/2004	9.42	9.6	8.03	9.8	0.00	218.18	1.14	0.00	29.11
Tobin	5/4/2004	9.68	11.7	8.04	9.1	0.00	217.25	1.28	0.00	29.22
Cement Plan	5/4/2004	9.42	10.9	7.90	11.1	0.00	204.74	0.00	0.00	30.02
Gage	5/4/2004	10.51	10.8	8.09	11.8	0.00	198.10	0.00	0.00	32.25
Erie Blvd.	5/4/2004	10.15	10.6	7.98	12.7	0.00	200.56	0.00	0.00	33.44
Rapp Rd.	5/18/2004	9.06	9.6	8.08	8.3	0.00	134.43	0.00	0.00	42.38
Main Br.	5/18/2004	8.24	13.7	8.27	7.5	0.00	221.74	3.49	0.00	31.28
North Br.	5/18/2004	9.42	9.6	8.03	9.9	0.00	323.29	0.00	0.00	43.21
Tobin	5/18/2004	9.68	11.7	8.04	9.1	0.00	246.95	0.00	0.00	35.22
Cement Plan	5/18/2004	9.42	10.9	7.90	11.1	0.00	231.88	0.00	0.00	36.22
Gage	5/18/2004	10.51	10.8	8.09	11.8	0.00	228.49	0.00	0.00	38.71
Erie Blvd.	5/18/2004	10.15	10.6	7.98	12.7	0.00	227.51	0.00	0.00	40.20
Rapp Rd.	6/1/2004	9.12	14.4	7.77	18.2	0.00	75.28	0.00	0.00	18.81
Main Br.	6/1/2004	9.94	14.4	7.93	17.3	0.00	182.74	1.00	0.00	23.62
North Br.	6/1/2004	8.90	14.6	7.99	17.7	0.00	335.37	0.00	0.00	35.43
Tobin	6/1/2004	8.91	15.0	7.99	17.6	0.00	217.53	0.95	0.00	23.10
Cement Plan	6/1/2004	8.30	14.7	7.92	17.7	0.00	181.67	0.13	0.00	20.12
Gage	6/1/2004	7.08	16.9	8.09	17.5	0.00	163.89	0.00	0.00	23.49
Erie Blvd.	6/1/2004	8.31	12.4	8.15	17.4	0.00	157.85	0.00	0.00	20.57
Rapp Rd.	6/15/2004	8.60	14.2	8.03	20.9	0.00	131.88	0.00	0.00	42.06
Main Br.	6/15/2004	4.75	21.7	8.26	21.2	0.00	179.52	0.00	0.00	26.13
North Br.	6/15/2004	7.66	19.3	8.15	21.1	0.00	357.71	0.00	0.00	40.48
Tobin	6/15/2004	7.55	19.9	8.10	20.9	0.00	221.17	0.00	0.00	30.80
Cement Plan	6/15/2004	6.51	18.4	8.07	20.8	0.00	219.12	0.00	0.00	32.34
Gage	6/15/2004	8.72	18.2	8.24	20.8	0.00	217.44	0.00	0.00	33.84
Erie Blvd.	6/15/2004	7.21	18.0	8.34	20.7	0.00	222.16	0.00	0.00	37.34

Site	Date	Sodium ppm	Ammonium ppm	Potassium ppm	Magnesium ppm	Calcium ppm	Alkalinity ppm $CaCO_3$		Total Coliform	E.coli	HPC	Gage ht. (ft)	Water Temp (°C)	Spec. cond. (µS/cm)	Date and time of measurements
Rapp Rd.	6/11/2002	67.32	0.00	3.11	17.51	110.09	N								
Main Br.	6/11/2002	118.16	0.00	3.65	14.13	69.41	N								
North Br.	6/11/2002	159.44	0.00	3.33	15.01	87.46	N								
Tobin	6/11/2002	125.99	0.00	3.51	15.03	76.26	N								
Cement Plant	6/11/2002	120.21	0.00	3.76	17.50	88.48	N								
Gage	6/11/2002	118.34	0.00	3.99	19.03	91.78	N								
Erie Blvd.	6/11/2002	118.26	0.00	3.72	20.49	93.06	N								
Rapp Rd.	6/18/2002	63.75	0.00	2.43	17.09	101.30	N		600	1	850				
Main Br.	6/18/2002	105.94	2.80	3.54	13.43	68.22	N		3000	2000	1290				
North Br.	6/18/2002	109.32	0.00	2.34	11.25	67.72	N		51000	1	5530				
Tobin	6/18/2002	105.75	0.00	3.55	13.68	73.77	N		22000	3000	4470				
Cement Plant	6/18/2002	104.09	0.00	3.57	15.88	81.53	N		17000	3000	4390				
Gage	6/18/2002	98.77	0.00	3.31	16.76	82.24	N		8000	1	2950				
Erie Blvd.	6/18/2002	103.22	0.00	11.98	18.26	96.06	N		32000	3000	4040				
Rapp Rd.	6/25/2002	71.36	0.00	3.53	18.67	95.45	N		1000	200	1060				
Main Br.	6/25/2002	112.15	0.00	4.86	15.30	75.12	N		2000	1	3360				
North Br.	6/25/2002	121.99	0.00	3.48	13.34	77.19	N		9000	1	3330				
Tobin	6/25/2002	109.97	0.00	4.73	14.37	75.14	N		7000	1000	5460				
Cement Plant	6/25/2002	109.29	0.00	4.36	17.07	85.36	N		12000	2000	4500				
Gage	6/25/2002	107.33	0.00	4.58	18.36	88.23	N		11000	1	3360				
Erie Blvd.	6/25/2002	110.55	0.00	5.47	19.83	91.44	N		96000	13000	10040				
Rapp Rd.	7/2/2002	74.45	0.00	3.17	19.00	76.36	N		25000	200	1150				
Main Br.	7/2/2002	116.06	0.00	4.72	15.63	77.54	N		12000	1	3470				
North Br.	7/2/2002	168.02	0.00	4.16	16.13	93.73	N		13000	1	2770				
Tobin	7/2/2002	128.16	0.00	4.56	16.32	96.37	N		8000	1	5220				
Cement Plant	7/2/2002	122.49	0.00	4.66	18.40	93.14	N		15000	2000	4740				
Gage	7/2/2002	120.83	0.00	4.41	19.96	96.41	N		8000	1	3560				
Erie Blvd.	7/2/2002	123.18	0.00	4.85	21.42	99.17	N		59000	5000	6100				
Rapp Rd.	7/9/2002	71.93	0.00	3.44	18.52	100.99	N		3000	200	870				
Main Br.	7/9/2002	128.79	0.00	3.48	15.06	75.72	N		117000	6000	24900				
North Br.	7/9/2002	203.45	0.00	3.39	18.42	99.33	N		13000	1	1740				
Tobin	7/9/2002	144.28	0.00	5.13	16.88	85.81	N		19000	1	11640				
Cement Plant	7/9/2002	130.85	0.00	3.98	19.01	96.33	N		18000	1000	3960				
Gage	7/9/2002	127.54	0.00	4.42	20.44	98.26	N		14000	1000	6100				
Erie Blvd.	7/9/2002	128.91	0.00	5.43	21.81	98.85	N		1000	1	100				
Rapp Rd.	7/16/2002	69.68	0.00	2.56	18.46	81.88	N		800	1	1830				
Main Br.	7/16/2002	137.63	0.00	3.58	15.52	75.48	N		2000	1000	6360				
North Br.	7/16/2002	0.00	0.00	0.00	0.00	0.00	N		1000	1	1550				
Tobin	7/16/2002	169.45	0.00	3.97	17.13	91.93	N		1	1	70				
Cement Plant	7/16/2002	138.96	0.00	3.82	19.08	96.29	N		1	1	100				
Gage	7/16/2002	129.51	0.00	3.86	20.72	99.89	N		4000	1000	4590				
Erie Blvd.	7/16/2002	130.75	0.00	4.05	22.34	100.25	N		22000	2000	4640				
Rapp Rd.	7/23/2002	70.41	0.00	2.56	18.79	89.56	N		900	400	560				
Main Br.	7/23/2002	125.66	0.00	3.89	16.03	71.44	N		1	1	5050				
North Br.	7/23/2002	194.96	0.00	4.05	17.73	102.50	N		7000	1	1970				
Tobin	7/23/2002	142.60	0.00	3.84	16.71	84.03	N		3000	1	5230				
Cement Plant	7/23/2002	130.58	0.00	3.82	19.02	91.62	N		26000	3000	6720				
Gage	7/23/2002	126.56	0.00	4.64	20.23	93.54	N		5000	1	3590				
Erie Blvd.	7/23/2002	127.12	0.00	4.06	21.70	95.21	N		30000	4000	2840				
Rapp Rd.	7/30/2002					0.00	N		1700	1	1060				
Main Br.	7/30/2002					0.00	N		1000	1	16800				
North Br.	7/30/2002					0.00	N		2000	1	2690				
Tobin	7/30/2002	161.36	0.00	3.92	17.53	90.97	N		58000	1000	35200				
Cement Plant	7/30/2002	154.85	0.00	3.79	16.80	87.39	N		53000	5000	31750				
Gage	7/30/2002	135.53	0.00	4.12	21.27	96.24	N		30000	4000	17400				
Erie Blvd.	7/30/2002	138.00	0.00	5.07	19.56	96.43	N		33000	6000	6160				
Rapp Rd.	8/6/2002	67.73	0.00	2.54	18.24	88.39	N		1200	200	1250				
Main Br.	8/6/2002	137.88	0.00	4.25	16.91	65.43	N		2000	1	8160				
North Br.	8/6/2002	180.72	0.00	3.57	18.35	90.57	N		1		1390				
Tobin	8/6/2002	146.01	0.00	4.34	16.25	73.94	N		26000	1000	11640				
Cement Plant	8/6/2002	131.26	0.00	5.35	18.90	85.33	N		36000	2000	10640				
Gage	8/6/2002	126.28	0.00	4.94	20.35	88.38	N		21000	1	8480				
Erie Blvd.	8/6/2002	127.58	0.00	4.56	21.75	90.52	N		45000	7000	7480				
Rapp Rd.	8/13/2002	67.08	0.00	2.73	18.55	87.58	N		2400	300	510				
Main Br.	8/13/2002	190.58	0.00	3.64	16.32	65.37	N		84000	4000	56900				
North Br.	8/13/2002	223.38	0.00	3.46	18.65	107.34	N		3000	1	1550				
Tobin	8/13/2002	169.12	0.00	3.53	16.86	84.07	N		268000	14000	68200				
Cement Plant	8/13/2002	146.98	0.00	3.56	19.58	92.81	N		178000	9000	48400				
Gage	8/13/2002	142.64	0.00	3.67	20.95	94.86	N		96000	10000	44200				
Erie Blvd.	8/13/2002	140.53	0.00	3.70	22.66	96.93	N		82000	3000	32700				
Rapp Rd.	8/20/2002	66.70	0.00	2.80	17.98	111.38	N		1100	100	3000				
Main Br.	8/20/2002	141.52	0.00	7.80	15.75	62.74	N		9000	1	41000				
North Br.	8/20/2002	111.35	0.00	2.80	12.33	69.35	N		11000	1	26000				
Tobin	8/20/2002	114.58	2.49	4.36	13.56	61.90	N		8000	1	188000				
Cement Plant	8/20/2002	109.82	2.19	4.31	16.61	75.37	N		34000	4000	102000				
Gage	8/20/2002	103.55	0.00	4.75	18.18	77.72	N		16000	1000	67000				
Erie Blvd.	8/20/2002	109.01	0.00	6.33	19.69	81.71	N		40000	4000	54000				
Rapp Rd.	8/27/2002	67.00	0.00	6.92	18.18	111.06	N		2000	200	2000				
Main Br.	8/27/2002	126.89	0.00	10.19	16.41	74.87	N		5000	1	5000				
North Br.	8/27/2002	120.20	0.00	4.65	16.45	72.35	N								
Tobin	8/27/2002	125.27	0.00	4.80	15.58	76.85	N								
Cement Plant	8/27/2002	112.82	0.00	4.75	18.03	84.88	N		38000	130000	9000				
Gage	8/27/2002	111.69	0.00	5.25	19.61	88.23	N		16000	2000	8000				
Erie Blvd.	8/27/2002	112.32	0.00	4.88	20.93	90.21	N		17000	5000	110000				
Rapp Rd.	9/3/2002	69.93	0.00	4.31	18.76	115.45	N		1600	200	1630				
Main Br.	9/3/2002	149.99	0.00	4.83	19.78	69.88	N		7000	1000	1410				
North Br.	9/3/2002	137.73	0.00	3.89	13.94	79.03	N		6000	1	910				
Tobin	9/3/2002	125.40	0.00	4.32	15.97	80.17	N		4000	1	1070				
Cement Plant	9/3/2002	117.99	0.00	9.41	18.71	89.35	N		43000	8000	2000				
Gage	9/3/2002	107.93	0.00	3.89	18.15	82.80	N		8000	1	2470				
Erie Blvd.	9/3/2002	109.96	0.00	3.99	19.70	85.36	N		7000	1	1090				
Rapp Rd.	9/10/2002	67.79	0.00	2.81	19.62	112.99	N		1700	100	690				
Main Br.	9/10/2002	163.94	0.00	21.93	15.90	65.81	N		11000	1	20560				
North Br.	9/10/2002	186.58	0.00	3.95	17.89	100.67	N		4000	1	19100				
Tobin	9/10/2002	148.17	0.00	5.47	17.07	87.82	N		8000	1	9660				
Cement Plant	9/10/2002	129.68	0.00	4.35	19.91	95.58	N		31000	2000	13350				
Gage	9/10/2002	126.88	0.00	4.41	21.58	98.14	N		11000	4000	8550				
Erie Blvd.	9/10/2002	124.94	0.00	4.26	23.07	99.72	N		51000	8000	8500				
Rapp Rd.	9/17/2002	63.20	0.00	3.93	17.01	105.75	N		149000	500	16250				
Main Br.	9/17/2002	118.41	0.00	5.38	14.41	64.39	N		7000	2000	11700				
North Br.	9/17/2002	88.17	0.00	2.57	10.53	58.23	N		43000	2000	8250				
Tobin	9/17/2002	110.55	0.00	5.11	13.42	63.17	N		32000	3000	18300				
Cement Plant	9/17/2002	108.55	0.00	5.89	15.48	72.14	N		43000	3000	19650				
Gage	9/17/2002	105.64	0.00	4.83	16.42	73.91	N		40000	1000	19350				
Erie Blvd.	9/17/2002	105.00	0.00	4.27	17.30	75.10	N		66000	10000	18150				
Rapp Rd.	9/24/2002	69.67	0.00	3.96	18.63	94.97	N		1900	300	17000				
Main Br.	9/24/2002	128.83	0.00	6.87	15.16	69.10	N		5000	1	171000				
North Br.	9/24/2002	99.36	0.00	4.96	12.31	67.02	N		9000	1	89000				
Tobin	9/24/2002	112.02	0.00	4.51	14.12	69.32	N		3000	1	270000				
Cement Plant	9/24/2002	106.66	0.00	5.40	16.83	79.70	N		51000	15000	301000				
Gage	9/24/2002	106.88	0.00	4.48	18.51	83.26	N		10000	2000	149000				
Erie Blvd.	9/24/2002	110.07	0.00	6.54	19.41	84.04	N		1	1	1000				

Site	Date	Sodium ppm	Ammonium ppm	Potassium ppm	Magnesium ppm	Calcium ppm	Alkalinity ppm $CaCO_3$		Total Coliform	E.coli	HPC	Gage ht. (ft)	Water Temp (°C)	Spec. cond. (µS/cm)	Date and time of measurements
Rapp Rd.	10/1/2002	64.93	0.00	5.19	16.76	98.48	N		1700	200	2000				
Main Br.	10/1/2002	133.81	0.00	6.99	15.08	69.89	N		9000	1	61000				
North Br.	10/1/2002	137.14	0.00	3.27	14.15	79.47	N		6000	1	5000				
Tobin	10/1/2002	128.12	0.00	4.29	15.36	77.64	N		7000	1000	40000				
Cement Plant	10/1/2002	129.71	0.00	4.35	15.37	77.50	N		11000	2000	51000				
Gage	10/1/2002	117.68	0.00	5.13	19.43	89.02	N		9000	1000	18000				
Erie Blvd.	10/1/2002	114.58	0.00	7.36	20.99	91.61	N		14000	1000	17000				
Rapp Rd.	10/8/2002	67.18	0.00	3.79	18.61	100.40	N		500	100	300				
Main Br.	10/8/2002	130.81	0.00	7.08	16.69	78.30	N		1		7300				
North Br.	10/8/2002	197.10	0.00	3.93	18.05	101.56	N		2000	1000	2600				
Tobin	10/8/2002	142.96	0.00	4.37	17.39	88.41	N		2000	1	7700				
Cement Plant	10/8/2002	127.37	0.00	4.21	19.96	95.58	N		18000	4000	10100				
Gage	10/8/2002	123.71	0.00	3.82	21.34	97.74	N		5000	1	5700				
Erie Blvd.	10/8/2002	121.79	0.00	5.00	22.89	99.44	N		30000	8000	5200				
Rapp Rd.	10/15/2002	63.81	0.00	2.98	17.42	106.57	N		2000	400	700				
Main Br.	10/15/2002	123.95	0.00	5.41	15.41	73.63	N		6000	1	900				
North Br.	10/15/2002	94.00	0.00	3.33	11.47	60.91	N		3000	1	400				
Tobin	10/15/2002	111.46	0.00	3.86	14.55	73.13	N		28000	3000	800				
Cement Plant	10/15/2002	105.89	0.00	4.96	16.95	81.69	N		63000	3000	1000				
Gage	10/15/2002	86.85	0.00	2.96	11.55	58.90	N		13000	1	500				
Erie Blvd.	10/15/2002	72.58	0.00	5.01	13.33	63.46	N		13000	2000	500				
Rapp Rd.	10/22/2002	66.33	0.00	4.21	17.56	109.55	N		400	100	200				
Main Br.	10/22/2002	119.41	0.00	4.59	14.61	73.02	N		1		1900				
North Br.	10/22/2002	112.95	0.00	4.01	12.50	70.01	N		1		1100				
Tobin	10/22/2002	113.44	0.00	4.94	14.31	76.15	N		7000	1000	1700				
Cement Plant	10/22/2002	106.52	0.00	5.01	17.01	85.53	N		9000	1000	13700				
Gage	10/22/2002	107.83	0.00	5.09	18.84	90.50	N		8000	1	3600				
Erie Blvd.	10/22/2002	111.14	0.00	7.45	19.96	91.25	N		1000	1	100				
Rapp Rd.	10/29/2002	68.13	0.00	8.63	18.23	102.58	N		600	200	500				
Main Br.	10/29/2002	114.58	0.00	5.00	14.16	70.92	N		1000	1	1700				
North Br.	10/29/2002	98.62	0.00	3.28	12.70	67.61	N		2000	1	4000				
Tobin	10/29/2002	109.92	0.00	4.43	14.26	73.60	N		5000	1000	4300				
Cement Plant	10/29/2002	106.05	0.00	6.06	16.75	82.39	N		2000	1000	6700				
Gage	10/29/2002	104.64	0.00	5.01	18.19	85.70	N		9000	1000	5500				
Erie Blvd.	10/29/2002	114.85	0.00	6.31	19.60	88.20	N		1		100				
Rapp Rd.	11/6/2002	127.87	0.00	4.02	5.54	36.48	N		3300	100	9150				
Main Br.	11/6/2002	116.88	0.00	5.81	13.07	67.65	N		6000	1	3340				
North Br.	11/6/2002	110.54	0.00	1.51	7.48	31.65	N		18000	1	10000				
Tobin	11/6/2002	113.47	0.00	6.36	9.96	57.14	N		30000	1000	11650				
Cement Plant	11/6/2002	101.50	0.00	4.86	9.83	54.69	N		30000	2000	10700				
Gage	11/6/2002	97.41	0.00	4.23	10.26	54.15	N		20000	1000	12000				
Erie Blvd.	11/6/2002	77.04	0.00	3.47	9.66	50.05	N		35000	2000	10650				
Rapp Rd.	11/12/2002	66.93	0.00	4.01	17.18	107.53	N		700	100	3200				
Main Br.	11/12/2002	123.63	0.00	6.44	14.85	76.90	N		1000	1	1500				
North Br.	11/12/2002	126.42	0.00	3.62	12.25	70.75	N		37000	1000	33800				
Tobin	11/12/2002	124.72	0.00	5.13	13.65	76.83	N		28000	1	26100				
Cement Plant	11/12/2002	116.38	0.00	6.77	16.05	84.13	N		42000	1000	21400				
Gage	11/12/2002	115.60	0.00	4.36	17.62	98.07	N		28000	1000	14900				
Erie Blvd.	11/12/2002	109.25	0.00	4.85	17.81	84.14	N		23000	6000	12800				
Rapp Rd.	11/19/2002	61.56	0.00	2.48	13.67	87.84	N		900	1	3300				
Main Br.	11/19/2002	109.93	2.06	5.67	13.54	70.87	N		6000	1	5500				
North Br.	11/19/2002	204.76	0.00	5.53	8.95	55.43	N		2000	1	12500				
Tobin	11/19/2002	137.24	3.10	5.68	12.14	68.22	N		163000	70000	31500				
Cement Plant	11/19/2002	135.05	2.89	4.40	13.84	74.54	N		100000	50000	23500				
Gage	11/19/2002	133.44	0.00	4.86	15.50	78.62	N		25000	7000	11600				
Erie Blvd.	11/19/2002	139.99	0.00	4.20	16.07	79.95	N		50000	13000	16400				
Rapp Rd.	11/26/2002	71.78	0.00	4.66	17.10	109.57	N		600	100	2200				
Main Br.	11/26/2002	128.32	0.00	5.52	13.77	74.24	N		2000	1	500				
North Br.	11/26/2002	162.91	0.00	3.31	12.73	75.56	N		24000	1	8700				
Tobin	11/26/2002	138.04	0.00	4.95	14.40	79.99	N		34000	3000	6200				
Cement Plant	11/26/2002	136.81	0.00	4.67	16.81	88.71	N		24000	1000	5500				
Gage	11/26/2002	140.21	0.00	4.94	18.22	92.41	N		9000	1	3900				
Erie Blvd.	11/26/2002	145.98	0.00	4.79	19.29	93.89	N		23000	2000	6400				
Rapp Rd.	12/3/2002	71.05	0.00	3.40	17.09	107.06	N		300	1	400				
Main Br.	12/3/2002	131.99	2.99	9.83	14.45	75.71	N		1000	1000	400				
North Br.	12/3/2002	288.29	0.00	5.29	17.01	103.21	N		2000	1	1000				
Tobin	12/3/2002	241.80	0.00	4.91	15.15	87.90	N		3000	1	2500				
Cement Plant	12/3/2002	213.76	0.00	4.61	17.24	93.28	N		4000	1000	3500				
Gage	12/5/2002	220.22	0.00	4.42	18.50	95.54	N		5000	1	1200				
Erie Blvd.	12/5/2002	227.41	0.00	4.80	19.85	98.32	N		14000	2000	5400				
Rapp Rd.	12/10/2002	75.27	0.00	3.46	17.73	110.60	N		200	1	700				
Main Br.	12/10/2002	145.81	2.53	5.24	15.16	80.94	N		4000	1	800				
North Br.	12/10/2002	316.73	0.00	4.65	18.77	111.12	N		1		600				
Tobin	12/10/2002	183.17	3.13	5.20	16.33	90.74	N		5000	3000	1700				
Cement Plant	12/10/2002	164.94	2.80	4.90	18.49	96.24	N		40000	4000	5900				
Gage	12/10/2002	156.37	0.00	4.81	19.31	96.16	N		6000	2000	1300				
Erie Blvd.	12/10/2002	151.90	0.00	5.14	20.52	96.65	N		21000	1000	2900				
Rapp Rd.	12/17/2002	120.37	0.00	4.76	17.41	113.65	N		100	1	400				
Main Br.	12/17/2002	149.27	3.13	4.96	15.55	86.11	N		13000	1	2200				
North Br.	12/17/2002	663.66	0.00	4.72	14.32	89.18	N		1		11400				
Tobin	12/17/2002	285.37	4.04	4.77	15.67	90.44	N		23000	3000	5800				
Cement Plant	12/17/2002	252.26	6.47	5.38	17.37	93.36	N		29000	9000	7100				
Gage	12/17/2002	259.73	0.00	5.60	19.13	99.12	N		12000	5000	2700	1.15	1.9	1,810	12/17/02 9:45 AM
Erie Blvd.	12/17/2002	263.87	0.00	5.10	20.23	100.28	N		60000	38000	37400				
Rapp Rd.	12/24/2002	76.22	0.00	2.37	18.35	116.06	N		1		300				
Main Br.	12/24/2002	155.53	2.98	3.95	16.44	91.85	N		2000	1	800				
North Br.	12/24/2002	242.74	0.00	4.36	17.27	101.93	N		1000	1000	2100				
Tobin	12/24/2002	201.53	3.16	7.77	16.78	96.87	N		14000	5000	2500				
Cement Plant	12/24/2002	180.47	0.00	4.92	18.86	101.56	N		9000	4000	2800				
Gage	12/24/2002	179.05	0.00	6.32	20.79	106.51	N		18000	6000	1400	1.12	3.7	1,380	12/24/02 10:00 AM
Erie Blvd.	12/24/2002	177.31	0.00	4.60	21.48	105.23	N		4000	2000	2700				
Rapp Rd.	12/31/2002						N		100	1	900				
Main Br.	12/31/2002						N		1000	1	1200				
North Br.	12/31/2002						N		1		700				
Tobin	12/31/2002						N		2000	1	2400				
Cement Plant	12/31/2002						N		21000	7000	6800				
Gage	12/31/2002	450.00					N		10000	1	3400	1.19	4.0	2,810	12/31/02 10:45 AM
Erie Blvd.	12/31/2002						N		81000	35000	11500				
Rapp Rd.	1/7/2003	93.03	0.00	3.35	16.60	106.19	N								
Main Br.	1/7/2003	161.40	5.62	4.78	16.06	89.30	N		1000	1	100				
North Br.	1/7/2003	787.32	0.00	5.91	16.10	100.68	N								
Tobin	1/7/2003	356.07	7.02	4.23	15.98	92.46	N		6000	22000	500				
Cement Plant	1/7/2003	328.59	6.12	5.79	18.13	99.17	N								
Gage	1/7/2003	301.89	5.41	6.13	18.81	98.25	N		2000	1000	600	1.18	2.8	2,030	1/7/03 10:30 AM
Erie Blvd.	1/7/2003	335.37	6.21	4.40	20.27	102.06	N		10000	4000	2300				
Rapp Rd.	1/14/2003						N								
Main Br.	1/14/2003						N								
North Br.	1/14/2003						N								
Tobin	1/14/2003	196.58	4.24	4.40	16.49	93.78	N		8000	3000	1300				
Cement Plant	1/14/2003	174.63	3.85	5.25	18.34	97.72	N		36000	9000	3100				
Gage	1/14/2003	182.13	3.47	4.85	19.36	99.51	N		3000	2000	1600	1.14	0.9	1,450	1/14/03 11:15 AM
Erie Blvd.	1/14/2003	181.54	3.44	4.82	20.77	102.08	N		21000	13000	2600				
Rapp Rd.	1/21/2003	73.85	1.34	4.23	17.70	96.65	N		300	1	300				

Site	Date	Sodium ppm	Ammonium ppm	Potassium ppm	Magnesium ppm	Calcium ppm	Alkalinity ppm $CaCO_3$		Total Coliform	E.coli	HPC	Gage ht. (ft)	Water Temp (°C)	Spec. cond. (µS/cm)	Date and time of measurements
Main Br.	1/21/2003	161.52	6.04	4.22	16.56	93.06	N		3000	1	400				
North Br.	1/21/2003	255.05	0.00	3.66	17.89	105.60	N		1		600				
Tobin	1/21/2003	184.68	4.02	4.11	17.77	100.85	N		4000	1	600				
Cement Plan	1/21/2003	165.06	4.51	4.34	19.42	104.21	N		14000	1000	1900				
Gage	1/21/2003	163.71	4.84	4.04	20.86	106.37	N		3000	2000	800	1.07	0.0	1330	1/21/03 9:30 AM
Erie Blvd.	1/21/2003	166.22	4.42	4.61	22.83	108.64	N		9000	5000	3800				
Rapp Rd.	1/28/2003						N								
Main Br.	1/28/2003						N								
North Br.	1/28/2003						N								
Tobin	1/28/2003						N								
Cement Plan	1/28/2003						N								
Gage	1/28/2003						N								
Erie Blvd.	1/28/2003						N								
Rapp Rd.	2/4/2003	249.83	3.26	5.60	8.15	70.95	N		1400	200	7500				
Main Br.	2/4/2003						N								
North Br.	2/4/2003	576.81	6.91	6.15	13.41	88.93	N		1000	1000	3100				
Tobin	2/4/2003	365.57	6.61	8.41	15.45	92.84	N		1000	1	3200				
Cement Plan	2/4/2003						N								
Gage	2/4/2003	389.23	5.59	5.98	14.78	93.66	N		23000	4000	8100	1.44	2.9	2240	2/4/03 8:45 AM
Erie Blvd.	2/4/2003	394.00	5.79	10.41	16.05	87.42	N		99000	24000	15100				
Rapp Rd.	2/12/2003						N								
Main Br.	2/12/2003						N								
North Br.	2/12/2003						N								
Tobin	2/12/2003						N								
Cement Plan	2/12/2003						N								
Gage	2/12/2003						N					1.11	0.7	1380	2/12/03 10:05 AM
Erie Blvd.	2/12/2003						N								
Rapp Rd.	2/18/2003						N								
Main Br.	2/18/2003						N								
North Br.	2/18/2003						N								
Tobin	2/18/2003						N								
Cement Plan	2/18/2003						N								
Gage	2/18/2003						N								
Erie Blvd.	2/18/2003						N								
Rapp Rd.	2/25/2003	72.88	1.40	19.23	17.09	96.77	N		1		300				
Main Br.	2/25/2003	172.27	7.24	16.71	17.30	94.07	N		1		300				
North Br.	2/25/2003	253.60	0.00	9.21	13.81	82.28	N		1		500				
Tobin	2/25/2003	187.08	6.01	10.77	16.41	91.72	N		4000	1	300				
Cement Plan	2/25/2003	169.78	4.93	26.25	17.47	92.91	N		9000	3000	1000				
Gage	2/25/2003	167.40	4.56	9.86	18.72	95.09	N		3000	1	2500	1.17	1.1	1400	2/25/03 10:20 AM
Erie Blvd.	2/25/2003	173.13	4.58	21.02	20.04	98.21	N		10000	4000	1200				
Rapp Rd.	3/4/2003	71.42	1.45	17.75	17.45	98.26	N		1		200				
Main Br.	3/4/2003	176.59	6.76	9.73	16.51	90.15	N		1000	1	400				
North Br.	3/4/2003	227.96	0.00	8.57	13.96	83.40	N		1		1500				
Tobin	3/4/2003	163.35	4.96	5.85	14.45	81.16	N		1000	1	900				
Cement Plan	3/4/2003	162.07	4.66	11.10	18.08	94.73	N		4000	1000	700				
Gage	3/4/2003	160.02	4.39	42.22	19.32	96.76	N		1000	1	1000	1.15	0.5	1360	3/4/03 10:10 AM
Erie Blvd.	3/4/2003	162.57	4.11	8.52	20.27	98.00	N		10000	6000	2200				
Rapp Rd.	3/11/2003	73.63	1.48	35.89	17.51	108.40	N		1		60				
Main Br.	3/11/2003	166.34	5.83	11.55	16.85	91.73	N		1		80				
North Br.	3/11/2003	201.88	5.47	11.42	16.69	93.33	N		1		30				
Tobin	3/11/2003	196.01	5.18	7.70	17.08	94.73	N		3000	1000	260				
Cement Plan	3/11/2003						N								
Gage	3/11/2003	169.39	3.87	6.14	20.77	101.68	N		5000	3000	420	1.16	1.5	1390	3/11/03 11:11 AM
Erie Blvd.	3/11/2003	179.36	3.92	10.54	21.46	103.41	N		17000	3000	1640				
Rapp Rd.	3/18/2003	84.30	1.80	20.98	15.56	99.92	N		100	1	100				
Main Br.	3/18/2003	161.23	5.86	9.40	15.44	85.65	N		5000	1	150				
North Br.	3/18/2003	268.70	0.00	9.62	11.64	71.81	N		1		8400				
Tobin	3/18/2003	200.83	4.79	14.16	14.70	85.54	N		3000	1000	4000				
Cement Plan	3/18/2003	191.86	3.91	12.09	16.51	91.05	N		4000	1000	8900				
Gage	3/18/2003	178.80	3.84	12.06	17.67	91.83	N		2000	2000	4200	1.36	4.3	1380	3/18/03 9:18 AM
Erie Blvd.	3/18/2003	199.92	3.92	27.28	18.92	95.72	N		14000	5000	6000				
Rapp Rd.	3/25/2003	82.58	1.84	9.67	16.54	106.67	N		1		100				
Main Br.	3/25/2003	136.95	5.30	8.62	13.87	76.09	N		2000	1	900				
North Br.	3/25/2003	179.10	5.16	4.91	14.36	82.07	N		1		900				
Tobin	3/25/2003	99.99	2.48	4.75	8.54	39.26	N		1		500				
Cement Plan	3/25/2003	160.56	3.63	9.90	16.50	89.85	N		9000	1	1700				
Gage	3/25/2003	151.46	3.34	7.98	17.78	93.16	N		1		700	1.33	6.1	1290	3/25/03 10:20 AM
Erie Blvd.	3/25/2003	152.90	3.57	7.66	18.82	94.66	N		10000	1000	1100				
Rapp Rd.	4/1/2003	79.54	1.72	17.08	16.56	105.64	N		2000	1	800				
Main Br.	4/1/2003	89.43	2.63	5.87	9.20	18.17	N		4000	1	1340				
North Br.	4/1/2003	32.40	1.26	2.36	3.29	28.62	N		2000	1	870				
Tobin	4/1/2003	121.27	3.16	5.18	11.91	39.07	N		3000	1	1900				
Cement Plan	4/1/2003	129.40	2.70	11.71	14.22	39.67	N		4000	1	840				
Gage	4/1/2003	138.28	3.22	12.06	17.16	89.73	N		2000	1	910	1.3	4.0	1200	4/1/03 7:23 AM
Erie Blvd.	4/1/2003	141.56	2.74	8.15	17.99	92.10	N		6000	1	1210				
Rapp Rd.	4/8/2003	151.61	2.49	2.53	17.01	108.20	N		4000	1	310				
Main Br.	4/8/2003	267.22	6.02	3.49	13.77	39.77	N		2000	1	880				
North Br.	4/8/2003	332.17	0.00	3.41	15.66	98.80	N		1		500				
Tobin	4/8/2003	271.54	5.41	3.43	15.08	90.17	N		6000	2000	1090				
Cement Plan	4/8/2003	398.02	7.52	3.99	16.78	95.29	N		109000	54000	6440				
Gage	4/8/2003	248.23	4.73	2.51	11.63	47.27	N		120000	36000	10900	1.39	3.6	2070	4/8/03 9:30 AM
Erie Blvd.	4/8/2003	408.31	7.13	3.95	19.86	103.54	N		96000	33000	12040				
Rapp Rd.	4/15/2003	84.52	1.64	2.70	16.56	105.22	N		1		230				
Main Br.	4/15/2003	72.84	1.54	1.63	6.68	29.24	N		5000	1	270				
North Br.	4/15/2003	164.62	0.00	2.83	12.28	33.28	N		1000	1	240				
Tobin	4/15/2003	184.20	0.00	2.83	12.35	32.78	N		2000	1	630				
Cement Plan	4/15/2003	184.15	0.00	3.42	15.85	45.51	N		19000	3000	2380				
Gage	4/15/2003	134.05	0.00	2.44	12.85	41.65	N		11000	2000	1270	1.31	8.3	1409	4/15/03 6:57 AM
Erie Blvd.	4/15/2003	201.22	0.00	3.47	19.73	99.71		237.50	13000	1000	1200				
Rapp Rd.	4/22/2003	77.59	0.98	2.02	15.66	46.54		237.05	1200	1000	2550				
Main Br.	4/22/2003	103.56	1.31	2.16	9.56	24.12		208.75	1		1520				
North Br.	4/22/2003	75.28	1.02	1.51	6.45	23.29		211.80	1000	1	1180				
Tobin	4/22/2003	137.75	0.00	2.29	10.58	36.23		219.45	10000	1000	1790				
Cement Plan	4/22/2003	172.49	0.00	3.30	15.95	42.40		219.55	16000	1	4060				
Gage	4/22/2003	184.30	0.00	3.41	18.77	99.38		226.65	13000	2000	1490	1.34	10.4	1400	4/22/03 7:19 AM
Erie Blvd.	4/22/2003	74.00	0.00	2.36	8.76	16.84		234.10	16000	1000	1470				
Rapp Rd.	4/29/2003	78.58	1.08	2.12	17.08	93.36		254.00	5000	1	640				
Main Br.	4/29/2003	152.49	0.00	3.33	15.17	85.21		235.00	92000	1	3250				
North Br.	4/29/2003	96.76	0.00	1.56	7.04	41.72	N		5000	1	2710				
Tobin	4/29/2003	160.18	0.00	3.19	14.83	54.37	N		51000	1000	3510				
Cement Plan	4/29/2003	134.60	0.00	3.19	14.76	51.97	N		53000	1	3330				
Gage	4/29/2003	114.16	0.00	2.60	13.99	38.56	N		33000	1000	2200	1.21	12.3	1290	4/29/2003 9:41
Erie Blvd.	4/29/2003	152.86	0.00	3.37	19.48	87.32	N		21000	1000	3410				
Rapp Rd.	5/6/2003	60.35	0.77	1.88	13.50	54.29	N		600	4000	1600				
Main Br.	5/6/2003	125.22	0.00	3.06	13.11	46.81	N		5000		2120				
North Br.	5/6/2003	149.28	0.00	3.19	14.42	76.48	N		6000		1630				
Tobin	5/6/2003	106.35	0.00	2.38	10.76	31.41	N		6000	1000	4030				
Cement Plan	5/6/2003	117.36	0.00	3.50	13.59	48.07	N		5000	1000	2800				
Gage	5/6/2003	128.68	0.00	3.20	16.31	63.47	N		4000	1000	2950	1.26	10.9	1160	5/6/03 7:54 AM
Erie Blvd.	5/6/2003	132.07	0.00	3.14	17.26	87.27	N		21000	9000	3410				
Rapp Rd.	5/13/2003	72.23	1.09	2.34	15.82	101.07	N		300	1	3800				
Main Br.	5/13/2003	73.71	0.85	3.50	7.40	47.58	N		8000	1	8800				

Site	Date	Sodium ppm	Ammonium ppm	Potassium ppm	Magnesium ppm	Calcium ppm	Alkalinity ppm $CaCO_3$	Total Coliform	E.coli	HPC	Gage ht. (ft)	Water Temp (°C)	Spec. cond. (µS/cm)	Date and time of measurements
North Br.	5/13/2003	117.79	0.00	2.98	13.56	78.50	N	57000	1000	65800				
Tobin	5/13/2003	106.14	1.28	2.84	12.24	72.48	N	27000	1	26100				
Cement Plant	5/13/2003	108.19	0.00	3.09	13.78	77.88	N	34000	3000	18800				
Gage	5/13/2003	105.04	0.00	2.96	14.68	78.69	N	15000	1	2700	1.4	12.6	979	5/13/03 9:15 AM
Erie Blvd.	5/13/2003	107.82	0.00	2.99	15.22	79.73	N	20000	1000	9100				
Rapp Rd.	5/20/2003	75.23	1.16	2.08	17.20	100.45	N	500	200	100				
Main Br.	5/20/2003	125.36	0.00	2.97	14.22	79.93	N	2000	1000	12500				
North Br.	5/20/2003	148.18	0.00	3.23	15.30	86.71	N	1000	1	9500				
Tobin	5/20/2003	150.07	0.00	3.01	15.64	87.91	N	1		5800				
Cement Plant	5/20/2003	139.73	0.00	3.44	17.14	91.45	N	6000	1000	5300				
Gage	5/20/2003	139.62	2.51	3.41	19.32	97.86	N	1		3800	1.2	14.0	1240	5/20/03 7:02 AM
Erie Blvd.	5/20/2003	139.55	0.00	3.41	19.97	96.99	N	3000	1	2600				
Rapp Rd.	5/27/2003	71.87	0.88	2.02	17.08	107.09	N							
Main Br.	5/27/2003	118.93	0.00	3.25	15.04	82.91	N							
North Br.	5/27/2003	83.73	1.02	2.04	9.03	55.33	N							
Tobin	5/27/2003	110.11	1.34	2.84	13.39	76.88	N							
Cement Plant	5/27/2003	109.22	0.00	3.07	14.73	80.76	N							
Gage	5/27/2003	108.49	0.00	3.02	16.15	82.94	N				1.33	13.8	980	5/27/03 10:15 AM
Erie Blvd.	5/27/2003	108.25	1.21	2.97	16.60	82.86	N							
Rapp Rd.	6/3/2003	72.01	1.00	2.12	16.10	101.26	N	500	1					
Main Br.	6/3/2003	102.94	0.00	2.80	13.59	77.24	N	2000	1					
North Br.	6/3/2003	138.70	0.00	2.43	12.73	77.74	N	8000	1000					
Tobin	6/3/2003	110.78	0.00	2.73	13.39	78.44	N	7000						
Cement Plant	6/3/2003	108.41	0.00	2.94	14.74	81.23	N	6000						
Gage	6/3/2003	106.51	0.00	3.12	16.20	84.57	N	13000			1.31	13.4	1010	6/3/03 7:09 AM
Erie Blvd.	6/3/2003	109.88	0.00	3.04	17.28	96.38	N	12000						
Rapp Rd.	6/10/2003	73.15	1.05	2.03	17.12	107.32	N	1000	1	3100				
Main Br.	6/10/2003	116.85	0.00	2.89	13.86	75.77	N	3000	1	13800				
North Br.	6/10/2003	163.20	0.00	2.93	14.25	88.48	N	2000	1	9000				
Tobin	6/10/2003	130.84	1.63	2.83	13.90	81.10	N	32000	1000	21300				
Cement Plant	6/10/2003	129.98	0.00	3.21	15.40	85.14	N	26000	1	20200				
Gage	6/10/2003	128.89	0.00	3.11	16.85	87.57	N	23000	1000	30300	1.22	15.6	1160	6/10/03 9:55 AM
Erie Blvd.	6/10/2003	128.72	2.54	3.17	17.39	87.49	N	40000	13000	20200				
Rapp Rd.	6/17/2003	71.13	0.84	1.91	17.00	99.89	N	500	1	1000				
Main Br.	6/17/2003	118.67	0.00	3.09	14.83	79.25	N	3000	1	4600				
North Br.	6/17/2003	214.16	0.00	3.12	16.72	100.71	N	7000	1	4000				
Tobin	6/17/2003	144.20	0.00	3.05	15.90	87.04	N	5000	1000	7200				
Cement Plant	6/17/2003	134.05	0.00	3.05	16.82	90.29	N	8000	1	6500				
Gage	6/17/2003	132.13	0.00	3.07	18.27	93.47	N	11000	3000	6100	1.17	16.0	1200	6/17/03 9:21 AM
Erie Blvd.	6/17/2003	136.38	0.00	3.12	19.53	95.58	N	14000	2000	7300				
Rapp Rd.	6/24/2003	70.82	1.15	2.05	16.62	106.18	N	200	1	2000				
Main Br.	6/24/2003	110.89	0.00	3.10	14.33	77.45	N	1000	1000	5800				
North Br.	6/24/2003	136.33	0.00	2.53	12.53	75.18	N	5000	2000	2200				
Tobin	6/24/2003	55.55	0.73	1.55	7.15	15.64	N	10000	1	3700				
Cement Plant	6/24/2003	111.00	0.00	3.18	15.76	83.07	N	172000	12000	3000				
Gage	6/24/2003	109.87	0.00	3.31	17.26	86.64	N	14000	1000	1700	1.18	18.5	1090	6/24/03 10:03 AM
Erie Blvd.	6/24/2003	118.71	1.29	3.51	19.90	95.49	N	44000	6000	4700				
Rapp Rd.	7/1/2003	72.04	1.08	2.08	17.69	109.43	243.90	1000	300	1800				
Main Br.	7/1/2003	112.72	0.00	2.85	15.04	80.50	N	11000	1000	7500				
North Br.	7/1/2003	169.11	0.00	2.80	16.38	93.51	N	16000	2000	14100				
Tobin	7/1/2003	131.77	0.00	3.13	15.19	84.43	200.00	29000	1000	8900				
Cement Plant	7/1/2003	126.17	0.00	3.17	17.17	89.63	N	28000	1000	9500				
Gage	7/1/2003	122.94	0.00	3.18	18.47	91.94	N	34000	1	9100	1.09	17.8	1170	7/1/03 9:06 AM
Erie Blvd.	7/1/2003	127.58	0.00	2.77	19.68	94.17	211.90	46000	26000	10900				
Rapp Rd.	7/8/2003	70.98	0.85	1.99	17.45	107.63	256.10	1100	100	1000				
Main Br.	7/8/2003	124.74	0.00	3.09	15.56	79.84	N	43000	1	14900				
North Br.	7/8/2003	217.74	0.00	3.34	17.84	105.86	N	4000	1000	2200				
Tobin	7/8/2003	150.85	0.00	4.24	16.53	90.00	225.00	7000		5600				
Cement Plant	7/8/2003	136.84	0.00	3.36	18.11	93.20	N	15000	100	5100				
Gage	7/8/2003	134.56	0.00	3.24	19.68	96.46	N	26000	1	4600	1.03	20.0	1250	7/8/03 8:45 AM
Erie Blvd.	7/8/2003	135.75	0.00	3.52	20.94	98.08	210.85			5500				
Rapp Rd.	7/15/2003	70.51	0.84	1.97	17.24	101.30	264.45	1200	1	2500				
Main Br.	7/15/2003	117.69	0.00	2.96	15.20	79.50	N	6000	1	13400				
North Br.	7/15/2003	134.68	0.00	3.10	15.28	82.45	N	2000	1	9500				
Tobin	7/15/2003	133.79	0.00	3.06	14.86	82.04	205.70	12000	1	9400				
Cement Plant	7/15/2003	126.68	0.00	3.17	16.85	86.53	N	15000	1000	6900				
Gage	7/15/2003	124.99	0.00	3.33	18.10	89.86	N	16000	1	7200	1.09	18.8	1190	7/15/03 7:29 AM
Erie Blvd.	7/15/2003	136.25	0.98	3.20	21.10	99.81	218.10	10000	1	6500				
Rapp Rd.	7/29/2003	70.80	0.92	1.97	17.03	107.20	N							
Main Br.	7/29/2003	100.59	0.00	2.60	12.71	67.40	N							
North Br.	7/29/2003	196.72	0.00	2.98	15.81	99.14	N							
Tobin	7/29/2003						N							
Cement Plant	7/29/2003	115.17	0.00	3.02	15.96	83.05	N							
Gage	7/29/2003	115.46	0.00	2.97	15.46	81.37	N				1.05	19.0	1110	7/29/03 10:04 AM
Erie Blvd.	7/29/2003	114.62	1.47	3.13	18.85	88.36	N							
Rapp Rd.	8/5/2003	63.09	1.03	3.02	15.38	34.57	250.70	1800	2000	2700				
Main Br.	8/5/2003	109.36	0.00	2.73	12.31	64.46	N	4000	1	13000				
North Br.	8/5/2003	150.91	0.00	2.68	13.55	81.97	N	3000	1	8200				
Tobin	8/5/2003	119.44	0.00	2.84	13.38	73.90	190.00	6000	1000	8500				
Cement Plant	8/5/2003	114.43	0.00	3.24	15.35	80.17	N	12000	1000	5200				
Gage	8/5/2003	111.37	0.00	3.07	16.67	82.73	N	9000	2000	7700	1.12	21.4	1040	8/5/03 9:51 AM
Erie Blvd.	8/5/2003	114.84	0.00	4.29	18.09	85.25	215.65	28000	18000	8600				
Rapp Rd.	8/13/2003	88.77	1.03	2.10	16.81	104.42	266.25	2400	3000	4300				
Main Br.	8/13/2003	109.00	0.00	2.77	13.13	65.82	N	4000	1	15600				
North Br.	8/13/2003	151.09	0.00	2.58	13.45	80.78	N	3000	1	22400				
Tobin	8/13/2003	124.72	0.00	2.93	13.59	74.72	189.25	9000	1000	29300				
Cement Plant	8/13/2003	118.63	0.00	3.98	15.71	81.36	N	12000	2000	21000				
Gage	8/13/2003	118.76	0.00	3.21	17.10	84.34	N	14000	1000	14800	1.09	21.0	937	8/13/03 10:00 AM
Erie Blvd.	8/13/2003	112.45	1.06	2.91	17.63	82.92	202.50	22000	2000	14800				
Rapp Rd.	8/19/2003	70.14	0.00	2.05	17.12	105.80	236.65	2600	1	1000				
Main Br.	8/19/2003						N							
North Br.	8/19/2003						N							
Tobin	8/19/2003	143.59	0.00	3.06	14.56	81.94	216.25	21000	1	114000				
Cement Plant	8/19/2003	129.12	0.00	2.98	16.58	86.02	N	17000	2000	46800				
Gage	8/19/2003	142.50	0.00	3.03	14.75	82.18	N	16000	2000	101400	1.03	20.2	961	8/19/03 10:00 AM
Erie Blvd.	8/19/2003	129.18	0.00	3.12	19.52	90.76	222.75	10000	2000	27800				
Rapp Rd.	8/26/2003	69.45	0.98	2.10	17.27	106.13	247.25	900	300	1500				
Main Br.	8/26/2003						N							
North Br.	8/26/2003						N							
Tobin	8/26/2003	154.93	0.00	3.30	15.85	84.47	230.65	12000	4000	27500				
Cement Plant	8/26/2003	133.87	2.29	4.20	17.85	98.47	N	3000	1000	22000				
Gage	8/26/2003	130.71	0.00	3.26	18.64	89.79	N	6000	3000	19600	1.01	18.9	802	8/26/03 9:42 AM
Erie Blvd.	8/26/2003	129.87	0.00	3.12	20.26	92.30	235.00	8000	2000	15100				
Rapp Rd.	9/2/2003	16.69	0.00	0.62	4.31	30.76	91.25							
Main Br.	9/2/2003						N							
North Br.	9/2/2003	168.26	0.00	3.01	14.76	87.72	N							
Tobin	9/2/2003	80.30	0.00	1.92	7.24	46.01	141.90							
Cement Plant	9/2/2003	69.52	0.00	2.04	7.15	44.29	N							
Gage	9/2/2003	62.90	0.00	1.93	6.95	41.71	N				1.74	17.0	603	9/2/03 9:35 AM
Erie Blvd.	9/2/2003	59.00	0.00	1.94	7.01	40.88	116.65							
Rapp Rd.	9/8/2003	71.61	0.82	2.08	17.74	41.55	211.25	1200	1000	700				
Main Br.	9/8/2003	120.05	0.00	3.44	15.25	80.06	N	9000	1	16700				
North Br.	9/8/2003	178.34	0.00	3.82	16.03	42.54	N	2000	1	4000				

Site	Date	Sodium ppm	Ammonium ppm	Potassium ppm	Magnesium ppm	Calcium ppm		Alkalinity ppm $CaCO_3$	Total Coliform	E.coli	HPC	Gage ht. (ft)	Water Temp (°C)	Spec. cond. (µS/cm)	Date and time of measurements
Tobin	9/8/2003	137.96	0.00	3.33	15.67	86.41	N		17000	1000	15000				
Cement Plant	9/8/2003	126.46	0.00	3.38	17.80	91.48	N		10000	2000	15900				
Gage	9/9/2003	123.04	0.00	3.23	19.37	94.23	N		7000	1	10200	1.04	16.6	439	9/9/03 9:02 AM
Erie Blvd.	9/9/2003	124.39	1.24	3.51	21.12	97.02		222.15	10000	5000	9300				
Rapp Rd.	9/16/2003	36.02	0.37	1.47	9.24	59.63		139.00	7800	1600	29400				
Main Br.	9/16/2003	116.59	0.00	3.22	13.90	71.16	N		15000	1000	28300				
North Br.	9/16/2003	88.17	0.00	1.86	7.01	46.59			25000	1	29200				
Tobin	9/16/2003	116.72	1.81	3.45	9.96	31.11		151.65	60000	6000	35600				
Cement Plant	9/16/2003	111.59	0.00	2.87	10.11	61.76	N		62000	15000	45200				
Gage	9/16/2003	102.86	0.00	2.89	9.96	59.34	N		93000	13000	39800	1.42	19.0	339	9/16/03 9:40 AM
Erie Blvd.	9/16/2003	104.63	0.00	3.15	10.55	59.75		148.30	38000	7000	40800				
Rapp Rd.	9/23/2003	3.86	0.04	1.29	1.19	12.00		46.15	5900	5400	43000				
Main Br.	9/23/2003	49.90	0.00	2.20	5.33	32.13	N		31000	5000	72200				
North Br.	9/23/2003	65.19	0.71	2.02	5.42	18.91	N		57000	13000	78400				
Tobin	9/23/2003	67.15	0.66	2.13	5.53	24.22		114.00	33000	10000	63600				
Cement Plant	9/23/2003	42.77	0.37	2.14	4.36	29.06	N		49000	5000	73200				
Gage	9/23/2003	47.24	0.53	2.08	5.50	33.30	N		108000	20000	96400	3.17	18.2	202	9/23/03 9:43 AM
Erie Blvd.	9/23/2003	44.15	0.49	2.74	5.46	31.75		82.85	58000	45000	119500				
Rapp Rd.	9/30/2003	72.56	0.84	2.55	17.98	87.42		230.50	3100	1	4400				
Main Br.	9/30/2003	127.86	0.00	3.50	15.10	79.36	N		10000	1	19000				
North Br.	9/30/2003	100.75	0.92	1.68	9.13	45.91	N		17000	1	16700				
Tobin	9/30/2003	128.92	1.34	3.21	14.89	82.73		192.80	23000	3000	38100				
Cement Plant	9/30/2003	122.15	1.38	5.18	17.32	88.63	N		18000	3000	24600				
Gage	9/30/2003	118.57	1.18	3.73	18.76	91.61	N		10000	1000	18400	1.07	14.2	741	9/30/03 8:50 AM
Erie Blvd.	9/30/2003	121.10	1.22	4.97	20.25	94.25		209.09	23000	12000	20400				
Rapp Rd.	10/7/2003	76.44	0.91	2.28	18.36	92.38		257.50	1300	100	900				
Main Br.	10/7/2003	139.55	0.00	3.49	16.08	84.16	N		5000	1	6200				
North Br.	10/7/2003	208.83	1.84	3.17	18.05	105.94	N		1		1400				
Tobin	10/7/2003	149.50	3.10	3.60	16.19	90.77		228.15	78000	22000	33600				
Cement Plant	10/7/2003	137.12	0.00	3.86	18.67	94.07	N		56000	16000	20900				
Gage	10/7/2003	88.58	1.36	2.61	13.67	70.69	N		16000	1000	6800	1.22	13.2	437	10/7/03 9:50 AM
Erie Blvd.	10/7/2003	91.86	1.62	2.84	15.06	74.05		147.08	16000	7000	8800				
Rapp Rd.	10/14/2003	72.23	0.89	2.13	17.89	110.33		241.67	200	1000	4300				
Main Br.	10/14/2003	145.68	1.89	3.54	16.68	89.12	N		22000	2000	400				
North Br.	10/14/2003	153.91	0.00	3.31	15.35	81.22		263.46	6000	2000	8800				
Tobin	10/14/2003	146.35	1.47	3.41	16.67	89.69		228.75	20000	2000	46000				
Cement Plant	10/14/2003	130.98	1.50	3.37	19.00	94.81	N		25000	1000	16700				
Gage	10/14/2003	125.85	1.36	3.33	20.39	96.51	N		25000	1	14800	0.88	12.6	615	10/14/03 10:08 AM
Erie Blvd.	10/14/2003	126.31	1.73	3.34	21.77	98.03		236.92	33000	10000	8500				
Rapp Rd.	10/21/2003	75.97	0.85	2.70	18.67	88.92		233.33	300	1	2300				
Main Br.	10/21/2003	139.10	0.00	3.56	16.28	86.20	N		111000	1	26300				
North Br.	10/21/2003	151.13	0.00	3.83	16.88	92.54	N		26000	1000	7900				
Tobin	10/21/2003	153.52	0.00	3.98	16.78	92.57		157.50	24000	4000	11200				
Cement Plant	10/21/2003	135.86	1.34	3.55	18.83	96.38	N		30000	6000	10000				
Gage	10/21/2003	128.34	1.18	3.58	19.40	96.35	N		31000	7000	7300	1	11.9	570	10/21/03 9:25 AM
Erie Blvd.	10/21/2003	132.10	1.31	3.44	21.96	99.95		204.58	13000	5000	6700				
Rapp Rd.	10/28/2003	57.51	0.57	2.94	14.58	93.53		209.23	confluent	growth	6400				
Main Br.	10/28/2003	111.58	0.86	3.50	12.86	73.19	N		19000	3000	12700				
North Br.	10/28/2003	32.12	0.00	1.72	5.46	34.97	N		16000	4000	31000				
Tobin	10/28/2003	75.95	0.63	2.50	9.69	57.07		137.31	25000	1000	28700				
Cement Plant	10/28/2003	74.70	0.00	2.75	10.96	62.41	N		37000	2000	23600				
Gage	10/28/2003	68.79	0.00	3.00	11.12	60.48	N		15000	2000	31500	1.22	11.1	495	10/28/03 8:20 AM
Erie Blvd.	10/28/2003	68.16	0.00	2.78	11.52	59.55		130.71	21000	4000	26500				
Rapp Rd.	11/5/2003	72.61	0.74	2.33	17.35	106.48		250.00	1		12000				
Main Br.	11/5/2003	117.06	1.05	3.48	13.80	75.51	N		9000	1	5000				
North Br.	11/5/2003						N								
Tobin	11/5/2003	128.53	1.11	3.66	14.62	84.95		191.43	8000	1	9000				
Cement Plant	11/5/2003	121.45	0.00	4.03	16.91	90.04	N		6000	3000	7300				
Gage	11/5/2003	121.60	0.94	10.24	16.50	96.23	N		5000	1	5400	0.94	10.5	1060	11/5/03 10:10 AM
Erie Blvd.	11/5/2003	118.15	1.83	3.51	19.99	95.58		218.64	12000	5000	4400				
Rapp Rd.	11/12/2003	70.44	0.84	2.13	16.91	106.64		254.09	1		1900				
Main Br.	11/12/2003	117.06	2.30	3.72	14.16	79.28	N		2000	1	1900				
North Br.	11/12/2003	187.25	2.20	4.03	16.19	100.66		268.57	1000	1	2200				
Tobin	11/12/2003	136.86	0.00	3.75	15.04	86.58	N		4000	1	4700				
Cement Plant	11/12/2003	124.52	1.72	3.61	17.22	90.45	N		8000	1000	2300				
Gage	11/12/2003	123.81	0.00	3.81	18.11	92.63	N		4000	1	4300	0.98	8.0	1100	11/12/03 9:50 AM
Erie Blvd.	11/12/2003	125.81	2.78	5.11	19.62	94.76		243.33	8000	5000	4500				
Rapp Rd.	11/18/2003	73.37	0.72	2.15	17.86	106.80		247.69	1		400				
Main Br.	11/18/2003	125.88	1.06	3.45	15.40	84.57	N		5000	1	1500				
North Br.	11/18/2003	143.36	1.16	3.43	16.31	92.65		195.00	6000	1	3500				
Tobin	11/18/2003	143.96	1.23	3.81	16.23	91.49	N		5000	1	3200				
Cement Plant	11/18/2003	130.21	1.21	3.72	17.66	94.53	N		6000	3000	1900				
Gage	11/18/2003	127.08	0.00	3.61	19.17	97.06	N		7000	1000	500	0.9	7.4	1120	11/18/03 8:56 AM
Erie Blvd.	11/18/2003	126.67	1.14	3.55	20.94	99.28		260.00	8000	3000	3900				
Rapp Rd.	11/25/2003	56.66	0.63	1.72	13.86	88.93		195.45	500	1	1200				
Main Br.	11/25/2003	116.23	1.34	3.40	14.26	79.28	N		5000	1	1600				
North Br.	11/25/2003	115.79	0.95	2.83	11.60	68.88		166.25	12000	1	3500				
Tobin	11/25/2003	118.68	0.92	2.69	11.85	47.43	N		8000	1	4200				
Cement Plant	11/25/2003	108.63	0.78	2.82	12.83	73.20	N		13000	1	5700				
Gage	11/25/2003	101.32	0.75	2.87	13.13	72.95	N		4000	1	5000	1.14	6.4	946	11/25/03 9:06 AM
Erie Blvd.	11/25/2003	99.89	0.87	2.74	13.82	73.12		154.50	17000	1000	6200				
Rapp Rd.	12/2/2003	75.55	0.86	2.01	17.43	110.11		242.66	300	1	600				
Main Br.	12/2/2003	114.23	1.29	3.22	14.06	80.16	N		1		600				
North Br.	12/2/2003	136.78	1.41	3.16	14.35	82.01	N		2000	1	2000				
Tobin	12/2/2003	137.35	1.45	3.08	14.45	82.42		175.00	3000	1	2200				
Cement Plant	12/2/2003	83.00	0.83	2.34	12.53	57.45	N		4000	1000	1800				
Gage	12/2/2003	106.96	1.11	3.28	17.29	89.62	N		12000	1	1400	1.02	4.8	931	12/2/03 9:09 AM
Erie Blvd.	12/2/2003	44.24	0.50	1.36	7.96	31.43		206.11	8000	4000	1600				
Rapp Rd.	12/16/2003	80.20	0.94	2.19	18.16	114.25		246.50	100	100	800				
Main Br.	12/16/2003	132.65	1.96	3.22	14.85	83.21	N		3000	1000	1000				
North Br.	12/16/2003	217.52	1.83	2.91	16.13	98.64		188.65	1		900				
Tobin	12/16/2003						N								
Cement Plant	12/16/2003						N								
Gage	12/16/2003	142.43	1.84	3.53	18.44	96.27	N		4000	1000	1900	1.05	2.6	1010	12/16/03 10:05 AM
Erie Blvd.	12/16/2003	72.79	0.85	1.72	9.98	48.95		188.65	47000	22000	2800				
Rapp Rd.	12/30/2003	80.69	1.01	2.17	16.65	106.69		230.00	1100	1	1100				
Main Br.	12/30/2003	141.55	2.13	3.31	13.88	82.14	N		2000	1	900				
North Br.	12/30/2003	154.44	1.84	3.60	15.41	91.57	N		2000	1	900				
Tobin	12/30/2003	154.57	1.88	4.00	15.27	90.83		196.36	1		500				
Cement Plant	12/30/2003	153.75	1.88	3.65	15.28	90.39	N		1		200				
Gage	12/30/2003						N								
Erie Blvd.	12/30/2003	150.98	1.57	4.15	18.56	94.27		187.22	60000	8000	6100				
Rapp Rd.	1/13/2004	92.83	1.04	2.72	18.33	114.32		182.50	1		800				
Main Br.	1/13/2004	152.77	2.54	5.84	16.40	93.09	N		1		500				
North Br.	1/13/2004	563.24	0.00	4.31	18.19	112.76		231.00	1000	1	300				
Tobin	1/13/2004						N								
Cement Plant	1/13/2004						N								
Gage	1/13/2004						N		1000	1	1	1.04	2.9	2480	1/13/04 8:30 AM
Erie Blvd.	1/13/2004							183.57	18000	2000	1700				
Rapp Rd.	1/27/2004	76.71	0.80	2.05	18.34	112.70		216.66	1		100				
Main Br.	1/27/2004	151.68	2.54	3.39	18.11	102.18	N		2000	1	900				
North Br.	1/27/2004	173.15	2.09	3.29	18.28	104.81	N		1000	1	600				
Tobin	1/27/2004	173.29	2.15	3.53	18.26	104.63		223.46	2000	1000	300				

Site	Date	Sodium ppm	Ammonium ppm	Potassium ppm	Magnesium ppm	Calcium ppm	Alkalinity ppm $CaCO_3$		Total Coliform	E.coli	HPC	Gage ht. (ft)	Water Temp (°C)	Spec. cond. (µS/cm)	Date and time of measurements
Cement Plant	1/27/2004							N							
Gage	1/27/2004	147.69	1.61	3.12	20.89	106.07		N	5000	3000	300	0.96	0.1	1250	1/27/04 9:03 AM
Erie Blvd.	1/27/2004	151.50	1.57	3.34	22.62	109.46	202.83		12000	1000	800				
Rapp Rd.	2/10/2004	87.27	0.82	2.60	18.50	114.17	228.50		100	100	300				
Main Br.	2/10/2004	160.12	2.94	3.72	18.79	104.62		N	3000	1	300				
North Br.	2/10/2004	341.02	0.00	4.30	18.69	111.40	188.50		1		400				
Tobin	2/10/2004							N							
Cement Plant	2/10/2004							N							
Gage	2/10/2004	185.89	2.13	3.42	20.95	105.38		N	2000	1	600	0.99	2.6	1390	2/10/04 8:50 AM
Erie Blvd.	2/10/2004	191.05	2.32	7.18	22.10	106.13	210.91		12000	3000	1300				
Rapp Rd.	2/24/2004	77.81	0.95	2.30	17.60	108.78	184.23		40	10	136				
Main Br.	2/24/2004	176.30	3.27	4.02	18.00	100.03		N	17500	1	672				
North Br.	2/24/2004	324.98	0.00	3.43	16.84	100.34	172.92		200	100	277				
Tobin	2/24/2004														
Cement Plant	2/24/2004														
Gage	2/24/2004	222.23	2.66	3.38	20.33	102.96		N	6800	2600	259	1	2.3	1430	2/24/04 9:00 AM
Erie Blvd.	2/24/2004	224.52	2.62	3.79	21.65	105.08	174.23		10500	4000	294				
Rapp Rd.	3/9/2004	83.84	1.02	2.31	17.11	108.42	105.00		400	200	500				
Main Br.	3/9/2004	214.51	2.98	3.43	16.05	94.12		N	33000	1	1000				
North Br.	3/9/2004	162.14	3.01	3.48	15.97	90.94	199.17		10000	1	400				
Tobin	3/9/2004	214.89	2.82	3.47	16.09	94.45		N	30000	1	700				
Cement Plant	3/9/2004	197.59	2.53	3.47	17.74	97.29		N	9000	1	1900				
Gage	3/9/2004	196.76	2.41	3.58	19.18	99.55		N	14000	2000	400	1.12	4.2	1510	3/9/04 9:05 AM
Erie Blvd.	3/9/2004	207.24	2.40	3.61	20.45	102.09	180.00		39000	21000	2000				
Rapp Rd.	3/23/2004	79.66	1.17	2.08	17.91	111.82	197.00		200	100	400				
Main Br.	3/23/2004	161.84	2.32	3.25	16.56	93.99		N	22000	1	1600				
North Br.	3/23/2004	192.88	2.22	2.96	16.69	96.54	160.45		5000	1	500				
Tobin	3/23/2004	193.18	2.39	3.23	16.67	96.18		N	5000	1	300				
Cement Plant	3/23/2004	177.28	2.09	3.31	18.55	99.90		N	5000	1	300				
Gage	3/23/2004	172.97	1.97	3.44	20.01	101.80		N	3000	1000	500	1.08	2.2	1340	3/23/04 9:18 AM
Erie Blvd.	3/23/2004	173.93	2.05	3.33	21.60	104.78	169.71		9000	1000	1500				
Rapp Rd.	4/6/2004	85.52	0.94	2.03	17.12	108.93	220.63		100	1	300				
Main Br.	4/6/2004	146.55	1.99	3.21	14.89	84.51		N	3000	1	200				
North Br.	4/6/2004	220.56	0.00	3.02	19.05	107.30	235.36		1		600				
Tobin	4/6/2004	158.02	2.11	3.20	15.83	91.77		N	4000	1	200				
Cement Plant	4/6/2004	149.49	1.84	3.26	17.23	93.37		N	5000	1000	300				
Gage	4/6/2004	149.53	2.07	3.64	19.14	98.78		N	1000	1	300	1.07	4.1	469	4/6/04 8:50 AM
Erie Blvd.	4/6/2004	150.01	1.63	3.30	20.47	100.34	207.27		7000	2000	300				
Rapp Rd.	4/20/2004	77.19	0.91	2.01	17.34	107.91	209.09		200	1	400				
Main Br.	4/20/2004	144.30	0.00	2.97	15.53	86.15		N	5000	1	200				
North Br.	4/20/2004	218.46	0.00	3.22	17.75	102.55	216.00		1000	1	800				
Tobin	4/20/2004	160.07	2.02	3.20	16.35	93.95		N	16000	4000	400				
Cement Plant	4/20/2004	143.76	0.00	3.37	17.24	92.05		N	11000	4000	900				
Gage	4/20/2004	145.15	0.00	3.84	19.26	96.56		N	16000	4000	1000	1.05	11.7	1240	4/20/04 8:40 AM
Erie Blvd.	4/20/2004	66.52	0.00	1.49	9.45	33.97	237.50		14000	4000	2800				
Rapp Rd.	5/4/2004	55.25	0.00	1.76	13.14	82.95			3200	1	1600				
Main Br.	5/4/2004	135.60	0.00	3.11	15.43	85.61			3700	400	2500				
North Br.	5/4/2004	135.30	0.00	2.77	13.11	76.90			10900	400	5900				
Tobin	5/4/2004	134.88	0.00	2.97	13.04	76.11			9300	500	6300				
Cement Plant	5/4/2004	122.74	0.00	2.85	13.73	77.59			11000	1	3600				
Gage	5/4/2004	119.45	0.00	2.95	14.76	78.17			24000	1	3800	1.14	10.8	1060	5/4/04 9:07 AM
Erie Blvd.	5/4/2004	119.21	0.00	2.85	15.93	79.78			24000	2000	2600				
Rapp Rd.	5/18/2004	72.27	0.00	2.02	17.32	107.68	259.28		800	1	300				
Main Br.	5/18/2004	141.14	0.00	3.29	16.07	95.48		N	9000	1	8700				
North Br.	5/18/2004	190.03	0.00	3.09	17.89	102.84	196.50		2000	1	2900				
Tobin	5/18/2004	149.36	2.16	3.19	16.44	90.94		N	6000	1000	2400				
Cement Plant	5/18/2004	134.14	0.00	3.11	17.75	92.54		N	9000	3000	2700				
Gage	5/18/2004	130.70	0.00	3.15	19.35	95.22		N	6000	1000	2100	1.01	16.2	1210	5/18/04 9:01 AM
Erie Blvd.	5/18/2004	129.83	0.00	3.06	20.41	95.12	224.29		9000	5000	2000				
Rapp Rd.	6/1/2004	41.93	0.51	1.57	10.05	65.27	155.07		5600	400	12100				
Main Br.	6/1/2004	111.07	1.37	2.95	14.14	76.74		N	6000	1000	1200				
North Br.	6/1/2004	201.82	0.00	3.00	14.98	95.17	187.86		7000	1	5200				
Tobin	6/1/2004	133.82	1.55	2.52	11.60	71.34		N	12000	2000	19800				
Cement Plant	6/1/2004	112.02	0.00	2.33	11.07	65.32		N	27000	5000	19800				
Gage	6/1/2004	98.67	0.00	2.44	11.51	63.50		N	12000	2000	18700	1.17	14.3	941	6/1/04 8:30 AM
Erie Blvd.	6/1/2004	94.70	0.00	2.85	12.04	63.59	150.83		20000	5000	21600				
Rapp Rd.	6/15/2004	73.63	0.92	2.25	17.27	108.72	253.46		500	1000	500				
Main Br.	6/15/2004	119.74	0.00	2.85	14.37	73.75		N	6000	1	7200				
North Br.	6/15/2004	215.50	0.00	4.83	17.54	105.21	196.88		1000	1000	5700				
Tobin	6/15/2004	140.88	0.00	2.95	15.53	84.24		N	3000	1	6800				
Cement Plant	6/15/2004	130.94	1.25	3.16	17.02	88.70		N	12000	2000	3600				
Gage	6/15/2004	127.58	0.00	3.00	18.71	91.72		N	10000	3000	4900	0.95	18.2	1120	6/15/04 9:06 AM
Erie Blvd.	6/15/2004	129.25	0.00	3.01	20.10	93.15	213.66		30000	26000	6800				