2005

Water Resources of Monroe County, New York, Water Years 2000-02 Atmospheric Deposition, Ground Water, Streamflow, Trends in Water Quality, and Chemical Loads in Streams

Donald A. Sherwood

USGS
science for a changing world

Maggie Brooks
County Executive

In cooperation with
MONROE COUNTY DEPARTMENT OF HEALTH

Water Resources of Monroe County, New York, Water Years 2000-02

Atmospheric Deposition, Ground Water, Streamflow, Trends in Water Quality, and Chemical Loads in Streams




Scientific Investigations Report 2005-5107

U.S. Department of the Interior
U.S. Geological Survey

This page has been left blank intentionally.

Water Resources of Monroe County, New York, Water Years 2000-02

Atmospheric Deposition, Ground Water, Streamflow, Trends in Water Quality, and Chemical Loads in Streams

By Donald A. Sherwood

In cooperation with
MONROE COUNTY DEPARTMENT OF HEALTH

Scientific Investigations Report 2005-5107

U.S. Department of the Interior
Gale A. Norton, Secretary

U.S. Geological Survey
P. Patrick Leahy, Acting Director

U.S. Geological Survey, Reston, Virginia: 2006
Version 1.0

For product and ordering information:
World Wide Web: http://www.usgs.gov/pubprod
Telephone: 1-888-ASK-USGS

For more information on the USGS--the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment:
World Wide Web: http://www.usgs.gov
Telephone: 1-888-ASK-USGS

Suggested citation:
Sherwood, D.A., 2005, Water resources of Monroe County, New York, water years 2000-02—atmospheric deposition, ground water, streamflow, trends in water quality, and chemical loads in streams: U.S. Geological Scientific Investigations Report 2005-5107, 55 p..

Contents

Figures

Tables

Conversion Factors, and Datum

Multiply	By	To Obtain
	Length	
inch (in)	25.40	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
square mile (mi^2)	2.590	square kilometer
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
inch per year (in/yr)	25.4	millimeter per year
million gallons per day (Mgal/d)	3.785	cubic meters per day
gallons per minute (gal/min)	0.06309	liter per second
gallons per second (gal/s)	0.0010515	liter per second
	Volume	
cubic feet (ft^3)	0.02832	cubic meters
	Temperature	
degrees Fahrenheit (°F)	°C = 5/9 (°F-32)	degrees Celsius
	Specific Conductance	
	microsiemens per centimeter at 25° Celsius (mS/cm)	
	Equivalent Concentration Terms	
	milligrams per liter (mg/L) = parts per million	
	micrograms per liter (mg/L) = parts per billion	
	Load	
Tons per day (ton/d)	907.1	kilograms per day
Pounds per square mile (lb/mi^2)	0.175	kilograms per square kilometer
Tons per square mile (ton/mi^2)	0.350	metric tons per square kilometer

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).
Horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27).

Water Resources of Monroe County, New York, Water Years 2000-02

Atmospheric Deposition, Ground Water, Streamflow, Trends in Water Quality, and Chemical Loads in Streams

By Donald A. Sherwood

Abstract

This report, the fifth in a series that presents analyses of the hydrologic data collected in Monroe County since 1984, interprets data from four surface-water-monitoring sites in the Irondequoit Creek basin (Irondequoit Creek at Railroad Mills, East Branch Allen Creek at Pittsford, Allen Creek near Rochester, and Irondequoit Creek above Blossom Road); and from three sites on tributaries to the Genesee River (Oatka Creek at Garbutt, Honeoye Creek at Honeoye Falls, and Black Creek at Churchville) and from the Genesee River at Charlotte Docks. It also interprets data from a site on Northrup Creek, which provides information on nutrient loads delivered to Long Pond, a small eutrophic embayment of Lake Ontario. The report also includes water-level and water-quality data from nine observation wells in Ellison Park, and atmospheric-deposition data from a collection site at Mendon Ponds.

Atmospheric Deposition: Average annual precipitation for 2000-02 was 33.11 in., 0.94 in. below normal. Average annual loads of some chemical constituents in atmospheric deposition for 2000-02 differed considerably from those for the previous period of record. Loads of all nutrients except ammonia decreased by amounts ranging from 28 percent (ammonia + organic nitrogen and phosphorus) to 2 percent (nitrite + nitrate), whereas ammonia loads an increased by 8 percent. Loads of dissolved sodium and total zinc in atmospheric deposition increased by 56 percent, and 54, percent respectively, over the previous period of record. Average annual loads of other constituents showed decreases ranging from 41 percent (dissolved magnesium) to 17 percent (dissolved chloride).

Loads of all nutrients deposited in the Irondequoit Creek basin from atmospheric sources during 2000-02 greatly exceeded those transported by Irondequoit Creek. The ammonia load deposited in the basin was 165 times the load transported at Blossom Road (the most downstream site); the ammonia + organic nitrogen load was 2.8 times greater, orthophosphate 9.7 times greater, total phosphorus 1.2 times greater, and the nitrite + nitrate load was 1.6 times greater. Average yields of dissolved chloride and dissolved sulfate from atmosphoric sources were much less than those transported by streamflow at Blossom Road—chloride was about 1.5 percent and sulfate about 9.1 percent of the amount transported by Irondequoit Creek.

Ground water: Ground-water-levels and water quality data were collected from 9 observation wells in Ellison Park in Monroe County. All wells except Mo 2 and Mo 659 are in the flood plain of Irondequoit Creek. Water levels indicate frequent reversals in direction of lateral flow toward or away from Irondequoit Creek, and all wells except Mo2 and Mo 659 respond to water level fluctuations in the Creek. Trend tests on water levels for the period of record indicate a slight upward trend in water levels at all nine wells, two of which (Mo 3 and Mo 667) were statistically significant.

Concentrations of ammonia and ammonia + organic nitrogen showed a general decrease for the current period of record. Total phosphorus concentrations showed an increase at four wells and a decrease at four wells.

Water quality data showed that the highest median concentrations of nutrients continues to occur in Mo 667 and the highest median concentrations of common ions was at Mo 664.

Streamflow: Statistical analysis of long-term (greater than 15 years) streamflow records for unregulated streams in Monroe County indicated that annual mean flows for water years (A water year is the 12-month period from October 1 through September 30 of the following year.) 2000-02 generally were in the normal range (75th to 25th percentile), although Allen Creek continued to show a significant downward trend in mean monthly streamflow during the 1984-2002 water years.

Chemical Concentration in Streams: Concentrations of several constituents in streams of the Irondequoit Creek basin showed statistically significant ($\alpha = 0.05$) trends from the beginning of their period of record through 2002. Three of the four Irondequoit Creek sites (Allen Creek, Blossom Road, and Railroad Mills) showed downward trends in ammonia (4.6 to 12.0 percent per year) and ammonia + organic nitrogen

(2.8 to 5.3 percent per year). Allen Creek showed downward trends in nitrite + nitrate and total phosphorus (both 1.2 percent per year), and Irondequoit Creek above Blossom Road showed an upward trend in orthophosphate (1.8 percent per year). Three Irondequoit Creek sites showed upward trends in dissolved chloride: Railroad Mills (4.8 percent per year), Allen Creek, and Blossom Road (both 1.9 percent per year). Allen Creek showed a downward trend in sulfate of 0.98 percent per year, whereas Blossom Road showed a downward trend in suspended solids of 4.0 percent per year. Volatile suspended solids showed an upward trend of 3.2 percent per year at Allen Creek and a downward trend of 2.2 percent per year at Blossom Road.

Northrup Creek in western Monroe County, showed significant downward trends in concentrations of volatile suspended solids (2.5 percent per year), total phosphorus (5.3 percent per year), and orthophosphate (9.9 percent per year). The Genesee River at Charlotte Docks showed downward trends in volatile suspended solids (2.1 percent per year) and ammonia + organic nitrogen (4.5 percent per year). Oatka Creek at Garbutt showed an upward trend of 21.4 percent per year in turbidity.

Chemical Loads in Streams: Mean annual yields (pounds or tons per square mile) of many constituents at the Irondequoit Creek sites were lower than those in previous reporting periods. Suspended solids and nitrite + nitrate yields were lower at three of the sites, and yields of volatile suspended solids, ammonia, and total phosphorus were lower at two of the sites. East Branch Allen Creek showed lower yields for five of the nine constituents for 2000-02, than for previous reporting periods. The decreased yields at East Branch Allen Creek are likely due to the Jefferson Road stormflow-detention basin and the much lower than normal runoff for the 2000-02 period

Introduction

Irondequoit Bay, near the city of Rochester, N.Y. (fig. 1), has been eutrophic (overly enriched with nutrients) for several decades as a result of sewage, sediment, and nutrients transported by Irondequoit Creek. The discharge of sewage to Irondequoit Creek was diverted to the Monroe County wastewater- treatment facility along the shore of Lake Ontario in 1979, but Irondequoit Creek continues to transport loads of sediment and nutrients to the bay.

Since 1980, the U.S. Geological Survey (USGS) has conducted a program, in cooperation with the Monroe County Health Department (MCHD) and the Monroe County Environmental Health Laboratory (MCEHL), to collect and analyze water-resources data from several sites in Monroe County, particularly the Irondequoit Creek basin (fig. 2). Data are analyzed to help identify sources of contamination, estimate the annual loads of selected constituents at selected sites, detect trends in concentration of these constituents in the county's streams and rivers, and assess the effectiveness of current water-resource- management practices. A similar monitoring effort began in 1990 on Northrup Creek near North Greece (fig. 1), the main tributary to Long Pond, a small, highly eutrophic embayment (Makarewicz and others, 1990) in western Monroe County along the southern edge of Lake Ontario.

Results of a USGS study in 1980-81 (Kappel and others, 1986), of nonpoint-source contamination from selected sites representing specific land uses in the Irondequoit Creek basin as part of the National Urban Runoff Program (NURP), provided a basis for comparison of changes in the nutrient and chemical loads of Irondequoit Creek. In 1993, the USGS, in cooperation with the Monroe County Health Department, began a long-term program to analyze and interpret hydrologic data collected at those sites and in western Monroe County to detect temporal trends in the concentrations of selected constituents in streamflow and ground water.

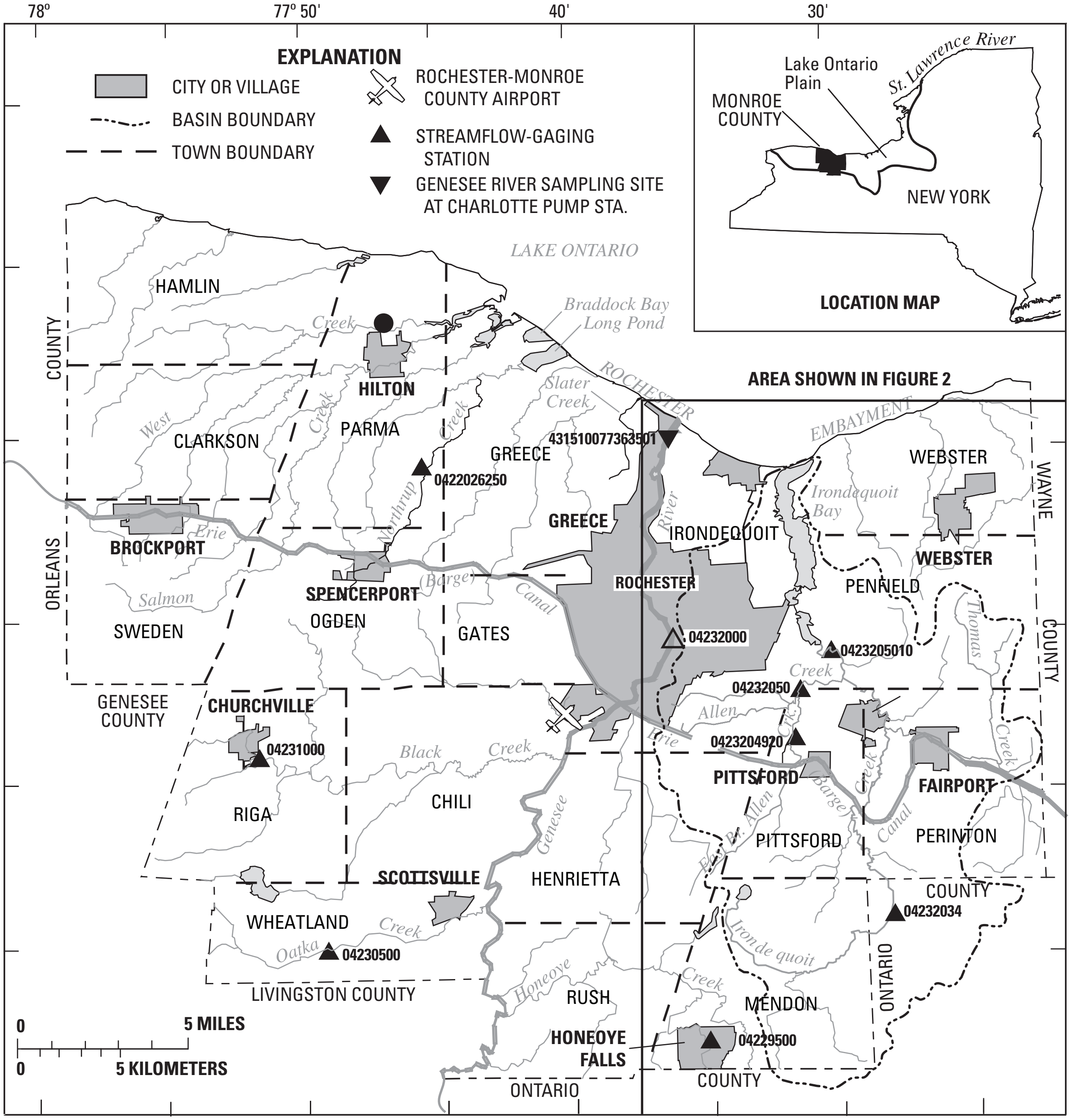
Evaluation of trends in chemical concentrations and loads transported by streams entails consideration of factors such as (1) changes in quantity and chemical quality of atmospheric deposition, a major source of nutrients to streams; (2) annual and seasonal variability of streamflow; (3) annual variability in the snowpack and spring runoff (the annual snowmelt period accounts for 50 to 75 percent of the annual chemical load transported by streamflow); (4) annual and seasonal variability in storm intensity (most of the annual load after the spring snowmelt period comes from storm washoff); and (5) effects of ground- water discharge to streams on the concentrations of selected constituents of streamflow, such as chloride from road-deicing salts.

Objectives of the long-term study are to:

1. Investigate trends in atmospheric deposition, streamflow, and water quality in Monroe County.
2. Analyze data on chemical quality of ground water in Irondequoit Creek basin and relate results to surface-water data through statistical analyses.
3. Investigate trends in ground-water, surface-water and atmospheric-deposition quality in the Irondequoit Creek basin; and
4. Document changes in loads of selected chemical constituents transported by the streams and rivers of Monroe County.

Results of the statistical analysis of hydrologic data collected during water years 1984-88[1] are presented in Johnston and Sherwood (1996), those for water years 1989-93 are given in Sherwood (1999), those for water years 1994-96 are given in Sherwood (2000), and those for water years 1997-99 are given in Sherwood (2004).

1. Water year: the 12-month period from October 1 through September 30 of the following year. Thus, the water year ending on September 30, 1996, is the 1996 water year. All years referenced in this report are water years.



Base from U.S. Geological Survey
Digital Line Graph, 1:100,000

Streamflow-gaging stations

0422026250	Northrup Creek at North Greece
04229500	Honeoye Creek at Honeoye Falls
04230500	Oatka Creek at Garbutt
04231000	Black Creek at Churchville
04232000	Genesee River at Rochester
04232034	Irondequoit Creek at Railroad Mills
0423204920	East Branch Allen Creek at Pittsford
04232050	Allen Creek near Rochester
0423205010	Irondequoit Creek above Blossom Road

Water quality site

431510077363501 Genessee River at Charlotte Pump Station

Figure 1. Principal geographic features of Monroe County, N.Y. and locations of streamflow-gaging stations in study area. (from Sherwood, 2000, fig. 1.)

Purpose and Scope

This report describes the hydrologic conditions within Monroe County and the Irondequoit Creek basin during water years 2000-02 and

1. describes the methods of data analysis and the statistical methods used for trend analyses and estimation of constituent loads.
2. provides an analysis of precipitation volume and chemical quality of bulk atmospheric deposition during 2000-02, for comparison with data from the four previous periods (1984-88, 1989-93, 1994-96, 1997-99),
3. analyzes fluctuations in ground-water levels in northern Ellison Park,
4. examines the vertical distribution of chemical concentrations in ground water at paired wells.
5. relates streamflow in Monroe County during 2000-02 to historical records and to streamflow during the four previous report periods,
6. examines water-quality trends in Monroe County streams and relates the chemical concentrations in 2000-02 to those of the previous four report periods,
7. presents loads and yields of selected constituents transported by the monitored streams.

Monthly and annual loads of selected constituents at the four Irondequoit basin sites, and four sites in western Monroe County are presented in the appendix of this report.

Study Area

Monroe County encompasses 673 mi^2 in the Lake Ontario Plain region of western New York (fig. 1) (Heffner and Goodman, 1973). Rochester, the county seat and largest city, is in the northern part of the county.

Surface Water

The Genesee River, which flows northward through Rochester into Lake Ontario, is the largest in Monroe County and has a drainage area of 2,480 mi^2 at its mouth (Wagner and Dixson, 1985). Black Creek at Churchville, Oatka Creek at Garbutt, and Honeoye Creek at Honeoye Falls in western Monroe County range in drainage area size from 130 mi^2 to 200 mi^2 and flow into the Genesee River. Other streams west of the Genesee River have drainage basins range from less than 5 mi^2 to about 88 mi2 and flow northeastward into Lake Ontario or to one of the many bays of the western part of the Rochester Embayment. Streams east of the Genesee River have drainage basins that range from less than 0.2 mi^2 to nearly 24 mi^2 and flow north or northwestward into Lake Ontario and the Irondequoit Creek basin (169 mi^2).

Irondequoit Creek drains into Lake Ontario through Irondequoit Bay (fig. 2). The drainage basin of the creek is mostly in eastern Monroe County and includes the east side of the city of Rochester and parts of Ontario and Wayne Counties to the south and east. Northrup Creek (fig. 1), drains 23.5 mi^2 in western Monroe County, and flows into Long Pond, a small embayment on the southern edge of Lake Ontario. A more complete description of the Irondequoit Creek basin by Kappel and others (1986), describes stormwater and sanitary-sewer systems, drinking-water supplies, surficial geology, and climate. The glacial history and geohydrology of the Irondequoit Creek valley are discussed in Kappel and Young (1989).

The Erie (Barge) Canal flows generally southeastward through the middle of the county and receives a small amount of flow from the headwater areas of some of the streams described above, as well as from some storm sewers in areas such as the villages of Pittsford and Fairport and from one tributary in Pittsford (fig. 1). Diversion structures at several points along the canal allow water from the canal to augment the flow of these small streams during low-flow conditions. The canal intersects the Genesee River 11.8 mi upstream from the river's mouth. Water diverted by the canal from Lake Erie is discharged into the Genesee River from the west; a smaller amount is then diverted from the Genesee River easterward into the canal.

A bulk precipitation collector collects water-quality data at Mendon Ponds County Park on the southwest side of the Irondequoit Creek drainage basin (fig. 2). Ground-water data is collected from nine observation wells along Irondequoit Creek in Ellison Park (fig. 2).

Population and Land Use

The population of Monroe County according to the 2000 United States census was 735,343, an increase of about 3 percent since 1991. The greatest increases occurred in the towns of Clarkson (34.4 percent) and Mendon (22.3 percent). The towns of Henrietta, Mendon, Penfield, Perinton, Pittsford, and Webster showed population increases ranging from 7.1 percent to 22.3 percent. Two towns decreased in population—Irondequoit (2.4 percent), and Sweden (3.3 percent) as did the village of East Rochester (4.1percent),

Land-use data for this report were compiled from the real property tax rolls by the Monroe County Department of Planning. The primary land-use categories in Monroe County are residential (average 37.1 percent) and agricultural (average 22.4 percent)(Monroe County Department of Planning, written commun., 2004). Three towns in western Monroe County—Wheatland, Riga, and Hamlin had the greatest percentage of agricultural land—59.9 percent, 58.1 percent, and 51.9 percent, respectively. Towns with the greatest percentage of residential land are Irondequoit (64.3 percent), Webster (47.8 percent), and Perinton (46.4 percent). Vacant land accounted for 17.8 percent of land in Monroe County; the percentages ranging from 5.8 percent in the village of East Rochester to 36.1 percent in the town of Clarkson. Other types of land use in Monroe County represent less than 4.4 percent of the total (table 1).

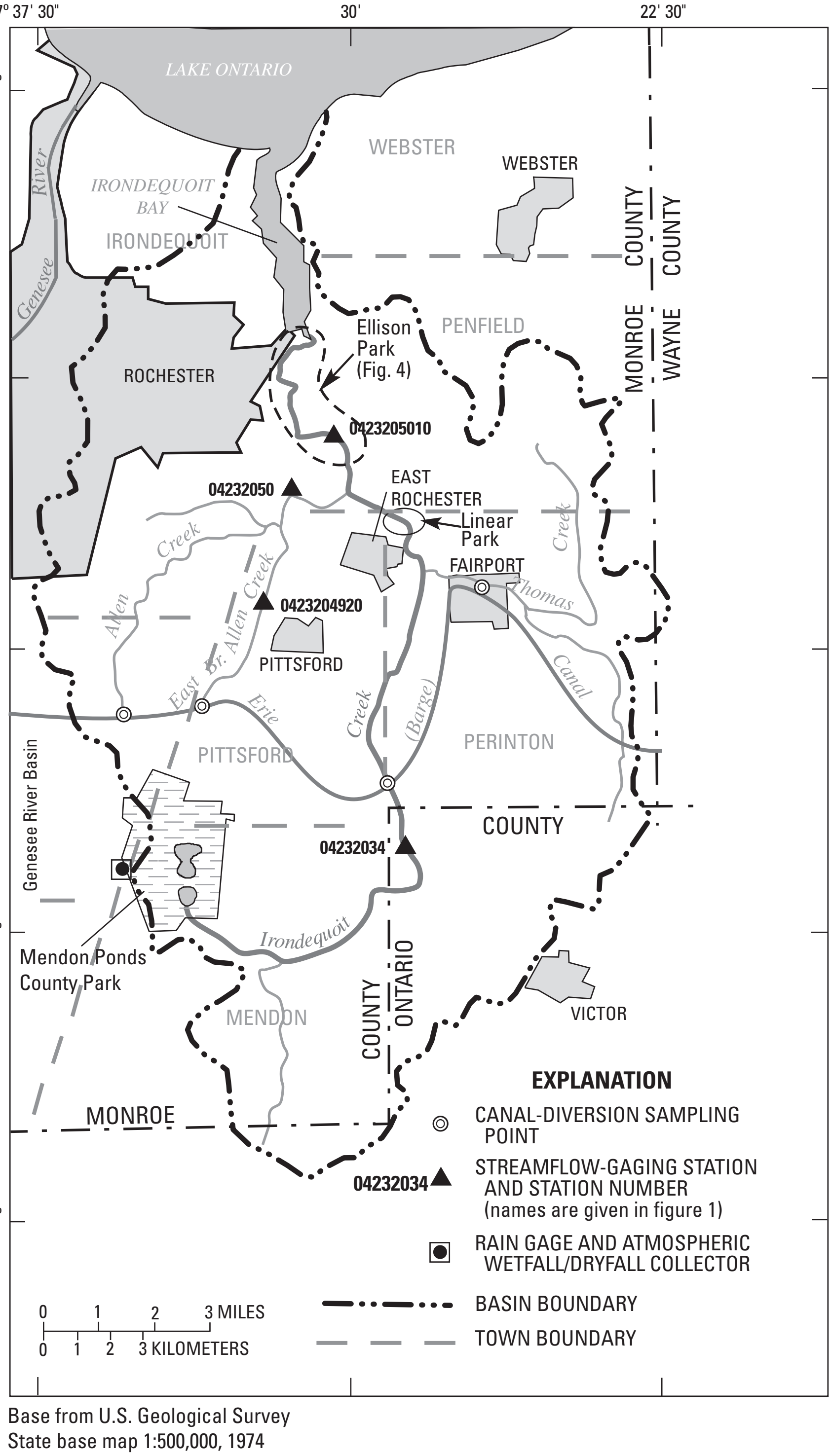


Figure 2. Locations of streamflow-gaging stations, canal-diversion sites, and atmospheric deposition collection sites within the Irondequoit Creek basin, Monroe County, N.Y. (Locations shown in fig. 1. Modified from Sherwood, 2000, fig. 2.)

Table 1. Land-use statistics for towns of Monroe County, N.Y., for 2002, as percentage of total area.
[Locations are shown in fig.1]

Town	Land-use category								
	Agri-cultural	Resi-dential	Vacant land	Com-mercial	Recreation and entertain-ment	Com-munity services	Industrial	Public services	Wild, forested, conserva-tion lands, and public parks
Brighton	1.8	42.6	20.4	12.5	3.0	12.6	0.5	2.8	3.7
Chili	32.9	25.2	18.8	3.9	2.1	3.6	1.8	3.6	8.2
Clarkson	23.7	33.6	36.1	1.6	3.3	.6	.0	.9	.1
E.Roch	.0	42.7	4.5	21.6	4.8	11.3	9.4	5.9	.0
Gates	.4	41.8	17.8	11.6	6.1	7.5	11.2	2.5	1.0
Greece	7.9	43.8	17.0	6.6	2.3	5.2	3.1	3.4	10.7
Hamlin	51.9	27.0	15.4	1.3	.9	.6	.2	.1	2.8
Henrietta	10.5	30.9	27.0	10.6	4.3	12.1	2.2	2.2	.2
Irondequoit	.3	64.3	13.5	8.8	1.3	9.6	.1	1.1	1.1
Mendon	26.3	41.9	18.1	.7	1.4	.8	1.2	.2	9.5
Ogden	36.2	32.1	21.2	1.6	1.4	1.9	2.1	1.0	2.5
Parma	37.4	33.7	19.6	3.2	2.8	1.5	1.5	.2	.1
Penfield	20.8	44.4	16.2	4.3	4.5	2.2	1.5	1.2	4.9
Perinton	15.9	46.4	16.4	4.7	3.5	4.5	2.5	2.1	3.9
Pittsford	20.2	41.9	15.5	2.7	5.9	7.2	.8	1.4	4.3
Riga	58.1	20.2	12.2	.5	.6	1.0	.1	3.4	4.0
Rochester	.0	34.6	7.0	16.2	12.9	9.5	8.4	8.6	2.8
Rush	43.8	25.6	12.7	.5	3.8	10.6	.9	.7	1.4
Sweden	16.2	38.8	28.6	3.8	1.0	2.6	2.3	3.5	3.3
Webster	6.9	47.8	25.6	4.5	2.4	3.1	5.8	.7	3.3
Wheatland	59.9	18.9	11.2	.7	.7	4.6	2.2	.9	.8
Average	22.4	37.1	17.8	5.8	3.3	5.4	2.8	2.2	3.3

Agricultural land in the Irondequoit Creek basin has shown a modest decrease over the past 10 years, while residential land has increased slightly. In general, the towns with the greatest increases in residential land also had the greatest increases in population growth (table 2). Towns in western Monroe County with the greater amounts of agricultural land also showed higher percentages of population growth, suggesting a higher rate of conversion of agricultural and vacant land to residential land.

Table 2. Population and land-use changes in selected Monroe County towns within the Irondequoit Creek basin Monroe County, N.Y. calendar years 1992-2002.
[All values are in percent. Locations are shown in fig. 2. Data from the Monroe County Department of Planning]

Town	Percent Change since 1992			
	Agri-cultural	Resi-dential	Vacant	1990-2000 popula-tion
Henrietta	-0.2	1.0	-1.2	7.3
Irondequoit	.2	.9	-1.3	-2.4
Mendon	-1.4	4.5	-.1	22.3
Penfield	-.4	3.6	1.0	14.6
Perinton	-1.9	2.1	.5	7.1
Pittsford	-1.0	.1	1.2	11.1
Mendon	-1.1	2.2	.5	19.9

Atmospheric Deposition

Records of precipitation volume collected at the Rochester-Monroe County Airport (fig. 1) and published by the National Oceanic and Atmospheric Administration (NOAA) (1983, 2000-02) were used with chemical-deposition data from Mendon Ponds County Park, near the southwestern edge of the Irondequoit basin (fig. 2), for computation of constituent loads from atmospheric deposition within the Irondequoit Creek basin. The Mendon Ponds site was selected to represent deposition that is unaffected by urban emissions.

Atmospheric samples from Mendon Ponds County Park were analyzed for common ions, nutrients, and lead, and for physical characteristics such as pH and specific conductance.

The chemical composition of rainfall is highly variable, not only from place to place, but from storm to storm in a single area and within individual storm systems as well. The conditions that usually produce rain—a mixing of air masses of differing properties and origins—promote a high degree of vertical and horizontal variation. Although sampling and analysis of atmospheric deposition can provide relatively accurate estimates of the amounts of each constituent that reach the land surface, the effect of these inputs on the loads transported by streams is uncertain because of the interactions of chemicals with the land surface before they enter the streams.

Precipitation Volume

Precipitation amounts are obtained from The National Weather Service at the Rochester-Monroe County Airport (Fig. 1). Monthly total, annual total, and average monthly precipitation values for water years 2000-02 are shown in table 3, which includes "normal" values (mean values calculated from 1971- 2000 records). Average annual rainfall for the 3-year period 2000-02 was 33.11 in. (0.94 in. below normal). Six months of greater-than-normal precipitation during water year 2000 resulted in a total annual precipitation of 38.85 in. (4.80 in. above normal), whereas seventeen months of below normal precipitation for water years 2001 and 2002 resulted in below normal totals for those years—4.75 in. and 2.84 in., respectively.

Chemical Yields

Atmospheric deposition is a major source of nutrients, especially nitrogen, to the Irondequoit Creek basin. The yields (pounds or tons per square mile) of all nutrients from atmospheric sources for 2000- 02 (table 4) were greater than the yields transported by Irondequoit Creek at its downstream end at Blossom Road, indicating that the watershed is a sink for nutrients from atmospheric deposition. The ammonia+organic nitrogen yield from atmospheric deposition

Table 3. Monthly and annual total precipitation, with 3-year average monthly and normal monthly values, at Rochester-Monroe County Airport, N.Y., water years 2000-02.

[All values are in inches. Location is shown in fig. 1.]

Water year	Month												Annual total
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	
2000	2.12	2.86	2.06	2.98	1.97	2.04	4.35	4.70	4.47	3.66	4.11	3.53	38.85
2001	1.36	2.19	2.47	1.95	2.26	4.13	1.19	2.66	1.84	1.80	4.30	3.15	29.30
2002	2.28	1.90	1.72	2.97	1.61	2.09	3.44	5.87	4.29	1.59	0.84	2.61	31.21
3-year average	1.92	2.32	2.08	2.63	1.95	2.75	2.99	4.41	3.53	2.35	3.08	3.10	33.11
Normal*	2.60	2.84	2.73	2.34	2.11	2.58	2.75	2.82	3.36	2.93	3.54	3.45	34.05

*Normal values are based on the average monthly or annual totals for 1971-2000.

Table 4. Annual yields of selected constituents in bulk atmospheric deposition at Mendon Ponds County Park, Monroe County, N.Y., and transported by Irondequoit Creek at Blossom Road, water years 2000-02.

[Yields are in pounds per square mile; dashes indicate no data. Location is shown in fig. 1.]

Water year	Calcium, dissolved 00915	Magnesium, dissolved 00925	Sodium, dissolved 00930	Potassium, dissoslved 00935	Sulfate, dissolved 00945	Chloride, dissolved 00940	Ammonia plus organic nitrogen, total 00625	Nitrite plus nitrate, total 00630	Ammonia, dissolved 00608	Phosphorus, total 00665	Orthophosphate, dissolved 00671	Zinc, total recoverable 01092
2000	2,371	247	2,580	883	33,213	5,628	3,549	3,574	2,446	255	107	437
2001	2,095	653	2,404	1,850	15,200	4,147	5,060	2,569	3,671	630	477	346
2002	2,113	497	1,074	778	9,093	2,501	2,819	2,159	1,810	195	114	286
2000-02 avg.	2,193	466	2,019	1,170	19,169	4,092	3,809	2,767	2,642	360	233	356
1997-99 avg.	3,732	754	2,089	2,891	18,324	5,080	7,647	3,043	4,718	584	196	339
1984-99 avg.	3,358	796	1,298	1,622	26,612	4,944	5,310*	2,821*	2,454	502*	264	231*
Percent difference 2000-02 avg. 1984-99 avg.	-35	-41	+56	-28	-28	-17	-28	-2	+8	-28	-12	+54
Blossom Rd 2000-02 avg.	--	--	--	--	210,000	272,000	1,380	1,780	16	300	24	--

* Averages averages were calculated with less than 16 years of data

was 2.8 times the ammonia+organic nitrogen yield at Blossom Road, nitrite + nitrate was 1.6 times greater, and total phosphorus was 1.2 times greater. Ammonia, a component of reduced nitrogen (ammonia+organic nitrogen), and orthophosphate, a component of total phosphorus, are forms of nutrients that are readily available for plant uptake and most susceptible to consumption by plant growth. The ammonia yield from atmospheric deposition was 165 times the ammonia yield at Blossom Road and the orthophosphate yield was 9.7 times greater.

Annual yield (load per unit area) from atmospheric sources was calculated from the following formula:

Yield = *CP* x conversion factor,

where: *C* = concentration, in milligrams per liter; and

P = precipitation (annual), in inches.

The concentration C is obtained from the laboratory analysis of monthly bulk-deposition samples. The conversion factor transforms the results to the desired units of yield, in mass per unit area—pounds or tons per square mile. The yield is then multiplied by drainage area to obtain load. This computation assumes that the precipitation recorded at the rain gage fell uniformly over the entire area represented by that particular gage, which is not usually the case; therefore, the calculated chemical load may be subject to some degree of error. The annual yields of selected constituents from atmospheric sources to the Irondequoit Creek basin are given in table 4.

The most abundant chemical in precipitation in Monroe County is dissolved sulfate, with an average annual yield of 19,200 lb/mi^2 for water years 2000-02, a 28-percent decrease over the long-term (1984- 99) average. Orthophosphate and zinc are the least abundant. Nearly all constituents showed similar or lower average yields for water years 2000-02 than for 1997-99 (table 4); the only exceptions were sulfate and orthophosphate, with slightly greater yields for 2000-02. These decreased yields were likely the result of the low annual precipitation during water year 2001, which caused the average precipitation for 2000-02 to be about 5 in. less than the average annual precipitation for 1997-99. Average annual yields of most constituents were also less than the long-term averages (1984-99), the only exceptions were dissolved sodium, ammonia, and zinc.

Annual yields of atmospheric ammonia for water years 2000-02 showed a substantial decrease after a 5 year (1995-99) increase; Annual loads ranged from a high of 5,821 lb/mi^2 for 1999 high to 1,810 lb/ mi^2 for water year 2002 (fig. 3). The average annual load of atmospheric ammonia for 2000-02 was 2,642 lb/mi^2, only slightly higher than the long term (1984-99) average of 2,454 lb/mi^2. The reasons for these variations in annual yield, are unknown, although year-to-year variations in the application of fertilizers and livestock manure, major sources of atmospheric ammonia, may account for part of the annual differences in yield.

Ground Water

Ground-water-levels and water-quality data were collected from nine observation wells between Blossom Road and a point just north of Browncroft Boulevard within Ellison Park, (fig. 4). Water levels were measured MONTHLY and recorded to the nearest 0.01 ft. Water samples were collected twice yearly during 2000-02 from all wells and analyzed by MCEHL for specific conductance, pH, hardness, and concentrations of common ions, nutrients, metals, and dissolved solids. All wells except Mo 659 are finished in the upper (unconfined) part of the aquifer (table 5). Three sets of

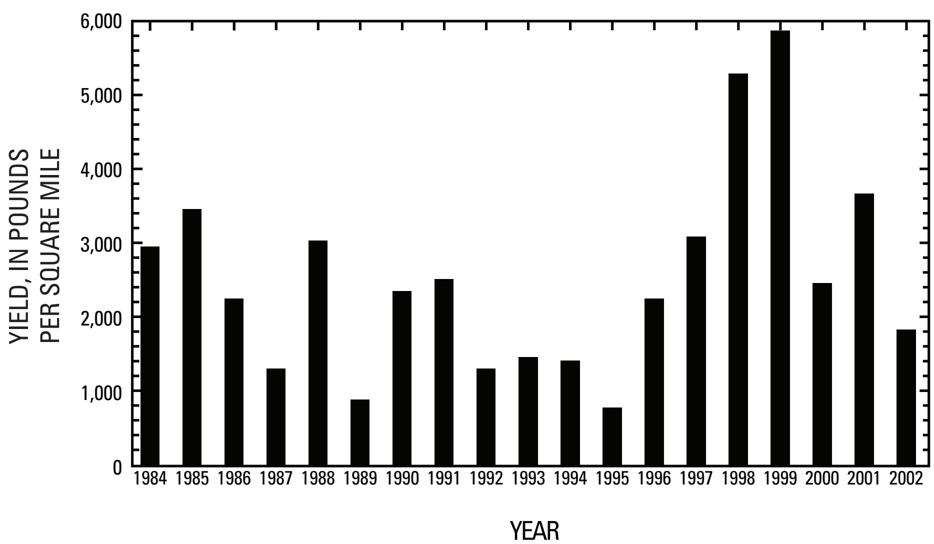


Figure 3. Annual yield of ammonia from bulk atmospheric deposition at Mendon Ponds County Park, Monroe County, N.Y. (Location shown in fig. 2.)

paired wells—Mo 663 and Mo 664, on the upper south slope of the buried Pinnacle Hills moraine (fig. 4), Mo 665 and Mo 666, on top of the moraine, and Mo 667 and Mo 668 on the upper north slope of the moraine—provide information on water-level and water-quality differences with depth.

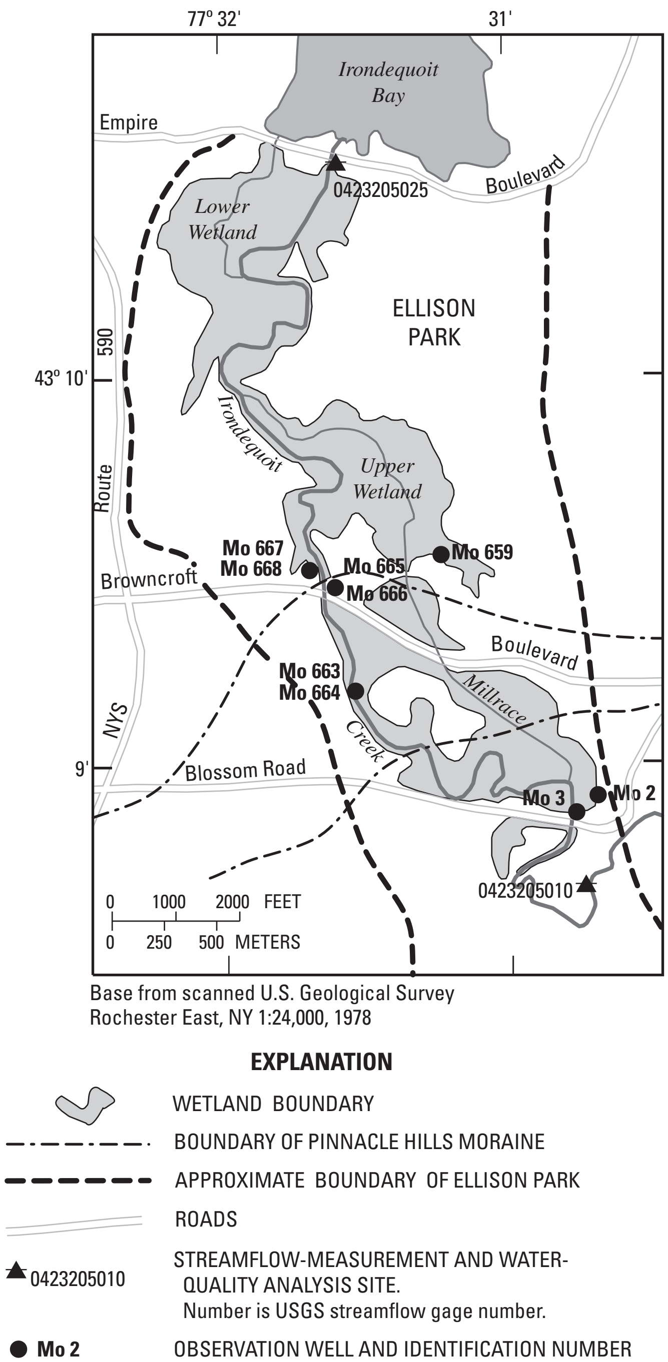


Figure 4. Locations of observation wells in Ellison Park, Monroe County, N.Y. (Modified from Coon, 1996, fig. 2).

Table 5. Completion data on wells in Ellison Park , Monroe County, N.Y.

[LS, land surface; ft, feet. Locations shown in fig. 4.]

Well no.	Instal-lation date	LS datum (ft above sea level)	Depth (ft below LS)	Screen interval (ft below LS)	Aquifer type[1]	Principal aquifer[2]
Mo 2	9/84	252.60	45	41-45	U	S & G
Mo 3	9/84	253.20	16	13.5-16	U	A
Mo 659	12/86	266.58	215	80-90 160-170	C	S & G
Mo 663	9/88	251.16	10	7.5-10	U	A
Mo 664	9/88	251.18	27	22-27	U	A
Mo 665	9/88	254.14	17	12-17	U	A
Mo 666	9/88	254.14	27	22-27	U	A
Mo 667	9/88	255.38	15	10-15	U	A
Mo 668	9/88	255.32	36	31-36	U	A

[1] U, unconfined; C, confined
[2] S & G, sand and gravel; A, alluvium

Water Levels

Recharge to the sand and gravel aquifers in the glaciated northeastern United States occurs either by direct infiltration of precipitation and surface water, or by underflow from the upgradient aquifer system. Recharge rates are usually highest during the spring snowmelt period and are lowest during midsummer, when evapotranspiration is greatest (fig. 5). Recharge also can occur during fall, when evapotranspiration decreases. Water-level data from the Ellison Park wells indicate frequent reversals in direction of lateral flow toward or away from Irondequoit Creek, as well as vertically within the aquifer.

All wells except Mo 2 and Mo 659 are within the flood plain of Irondequoit Creek (fig. 4) and, thus, respond to water-level fluctuations in the creek. The Ellison Park wetland is usually a ground-water discharge point; although high stages in Irondequoit Creek may cause temporary streambank storage (recharge). Mean annual water levels in well Mo 3, on the east bank of Irondequoit Creek, averaged 2.28 ft lower than in Mo 2, near the east wall of the valley and upgradient from Mo 3. Water levels in Mo 2 during 1985-2002 ranged from 1.77 ft below land surface to 1.25 ft above, and those in Mo 3 ranged from 4.17 ft below land surface to 2.03 ft above. With few exceptions, mean monthly water levels at all wells during 2000-02 were within the monthly extremes for the period of record (fig. 6). Mean monthly water levels for the month of June exceeded the maximum monthly value at five of the nine wells—Mo 3, Mo 663, Mo 665, Mo 666, and Mo 667. At Mo 667, the 2000-02 mean monthly value for April was greater than the long-term monthly maximum. The 2000-2002 mean monthly values for the month of February were close to, or equaled the monthly maximum at Mo 663, Mo 664, Mo 665, Mo 666, Mo 667, and Mo 668 (fig. 6). Water levels at all wells, including Mo 659, which is screened in a confined

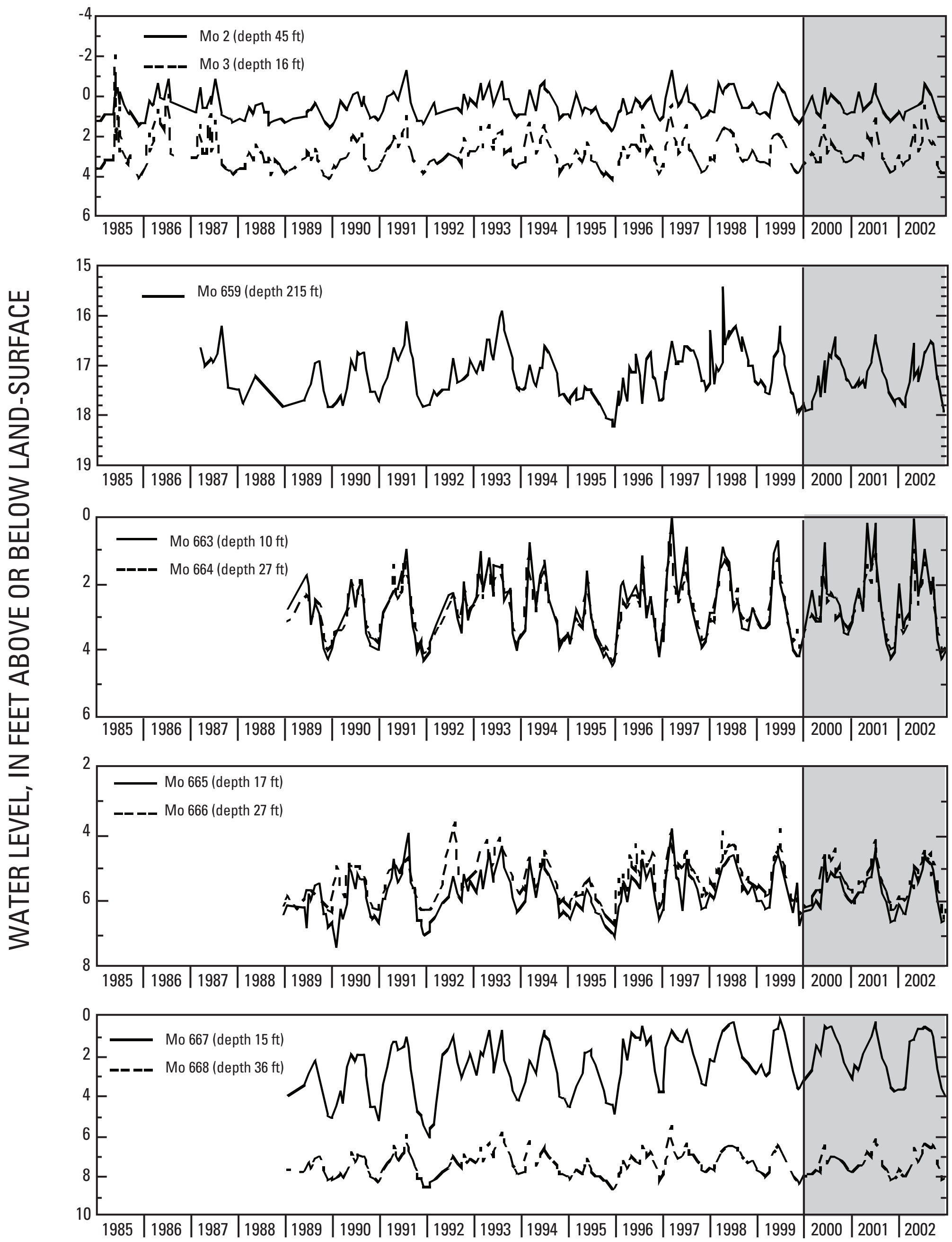


Figure 5. Hydrographs showing water levels in Ellison Park wells, for period fo record through 2002. (Locations are shown in fig. 4.)

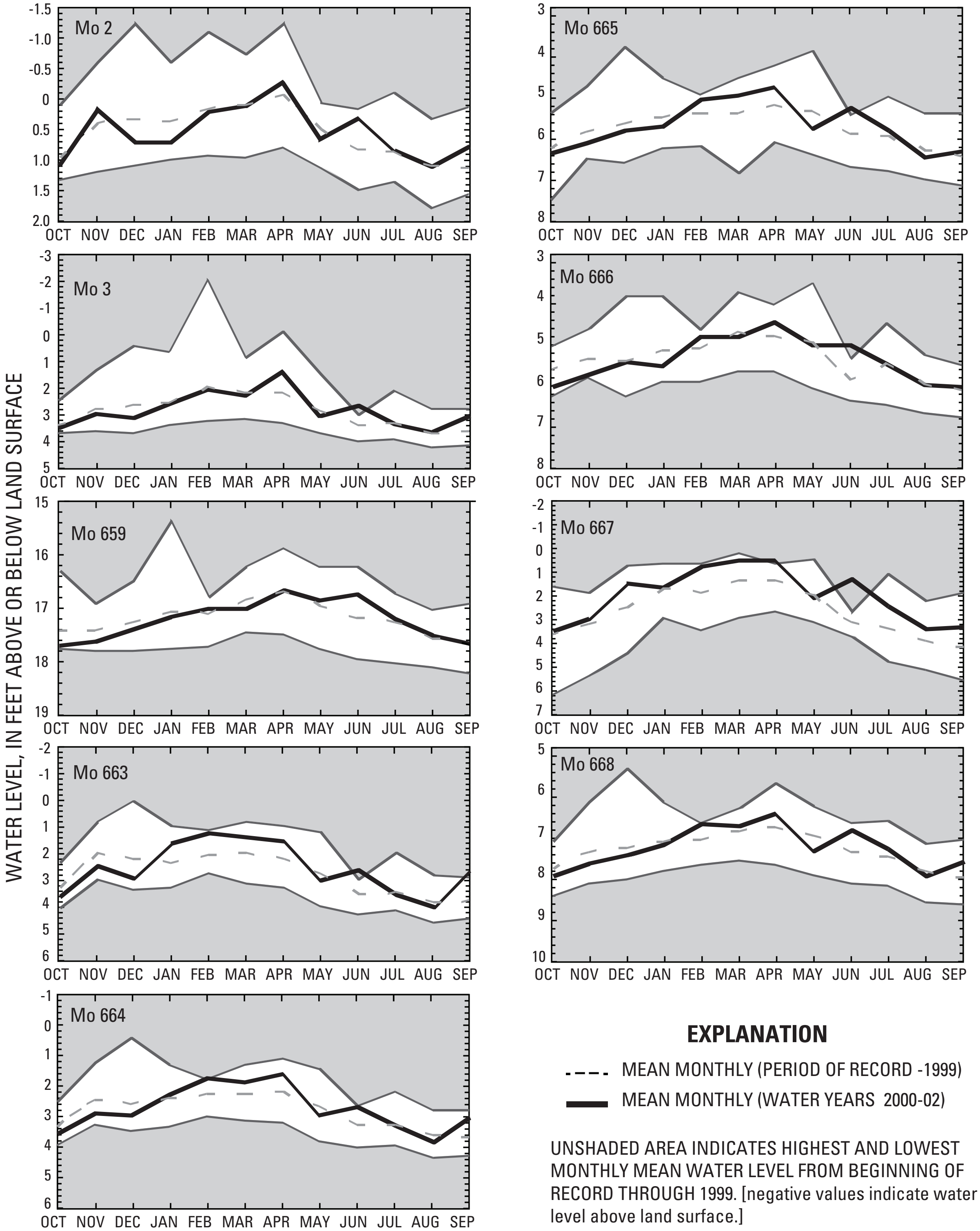


Figure 6. Mean monthly water levels at Ellison Park wells in Monroe County, N.Y.,2000-02, with mean monthly, maximum and minimum water levels for period of record through 1999. (Locations are shown in fig. 4.)

aquifer, showed similar seasonal fluctuations and response to recharge.

Water-level records from the beginning of the period of record through 2002 were tested for trends using the seasonal Kendall test (Hirsch and others, 1982), described further on. All wells showed a slight upward trend two of which—at Mo 3 and Mo 667— were statistically significant at $\alpha = 0.05$ (table 6).

Chemical Concentrations

Comparison of water-quality data among wells can indicate local differences in water quality within a given aquifer, ground-water movement to or from a stream, and possible sources of contamination and the degree of mixing. Water-quality data also can be used to estimate temporal trends in ground-water quality at a given site. Factors that affect ground-water quality are well depth and location, rate and direction of ground-water flow (vertical and horizontal), type of aquifer material, availability of dissolved oxygen, and precipitation amount and intensity.

The Oneway Analysis of Variance (ANOVA), combined with Tukey's multiple-comparison test, was used to identify statistically significant areal differences in mean concentration of selected constituents among wells, as well as differences in constituent concentration with depth at the paired wells. ANOVA is a statistical test used to determine the significance of overall differences in the means of groups of data, but it does not specify which groups are different from the others. Tukey's multiple comparison test is often used in conjunction with ANOVA to indicate which of the groups are significantly different from the others, and whether the difference is positive or negative. The tests were performed on ranked data because water-quality data do not generally have a normal distribution, and ranking of the data minimize the influence of outliers.

Spatial Variability

Median concentrations of ammonia and ammonia + organic nitrogen show a general decrease from the period of record, while the total phosphorus median for 2000-02 generally showed an increase at four wells and a decrease at four wells (fig. 7). The highest median concentrations of nutrients continue to occur in water samples from well Mo 667, the shallower (15 ft) of a well pair finished in the historic Irondequoit Creek flood-plain sediment (fig. 4). This area underwent considerable disturbance during the construction of a sewer project in the 1970's and fill and foreign material remaining on the surface may still be affecting the water chemistry at this location (Young, 1993). High concentrations of ammonia and ammonia + organic nitrogen were also detected at wells Mo 666 and Mo 668; Mo 668 is the deeper (36 ft) of the well pair Mo 667-668, and Mo 666 is near Mo 667. Median concentrations of ammonia and ammonia + organic nitrogen were lower for all three wells for the 2000-02 period than those for the previous period of record.

Since 1997, the median concentration of nitrite + nitrate in well Mo 663 has increased sharply from 0.05 mg/L before 1997 to 2.70 mg/L after, with a corresponding decrease in median concentration of ammonia from 0.80 mg/L to 0.08 mg/L. The conversion of ammonia to nitrate indicates that oxygen is being introduced into the ground-water system from some source. Recent changes in the vicinity of Mo 663 that could contribute increased oxygenation; proximity to artesian wells, roadway repairs, home construction, collapse of the hill going up Blossom Road upgradient of the well, and construction of a pond in the recharge area. Despite it's closeness to Irondequoit Creek, the high nitrite + nitrate values at Mo 663 do not seem to correlate with high flows or excessively high nitrite + nitrate concentrations in the creek.

Table 6. Descriptive statistics and trends of water levels in Ellison Park wells, Monroe County, N.Y., for the period of record through 2002.

[Values are in feet above (-) or below land surface except as noted. *p*, significance of trend. <, less than, **Bold type** indicates trend is statistically significant at $\alpha = 0.05$. Well locations are shown in fig. 4.]

		Descriptive Statistics						Trend		
Well no.	Period of Record	Max	Min	Mean	25th percentile	50th percentile (median)	75th percentile	Units per year	Percent per year	*p*
Mo 2	1985-2002	-1.25	1.77	0.51	0.96	0.60	0.11	0.02	3.3	0.060
Mo 3	**1985-2002**	**-2.03**	**4.17**	**2.79**	**3.41**	**3.00**	**2.35**	**.02**	**.60**	**.044**
Mo 659	1987-2002	15.40	18.21	17.17	17.55	17.25	16.85	.01	.03	.330
Mo 663	1989-2002	.00	4.53	2.75	3.53	2.80	2.12	.02	.83	.186
Mo 664	1989-2002	.42	4.35	2.80	3.41	2.95	2.29	.02	.61	.284
Mo 665	1989-2002	3.90	7.48	5.79	6.32	5.82	5.31	.02	.43	.142
Mo 666	1989-2002	3.66	6.75	5.42	5.92	5.48	4.98	.01	.21	.474
Mo 667	**1989-2002**	**.20**	**6.06**	**2.46**	**3.47**	**2.37**	**1.27**	**.12**	**4.9**	**<.001**
Mo 668	1989-2002	5.49	8.65	7.40	7.85	7.40	6.97	.02	.27	.165

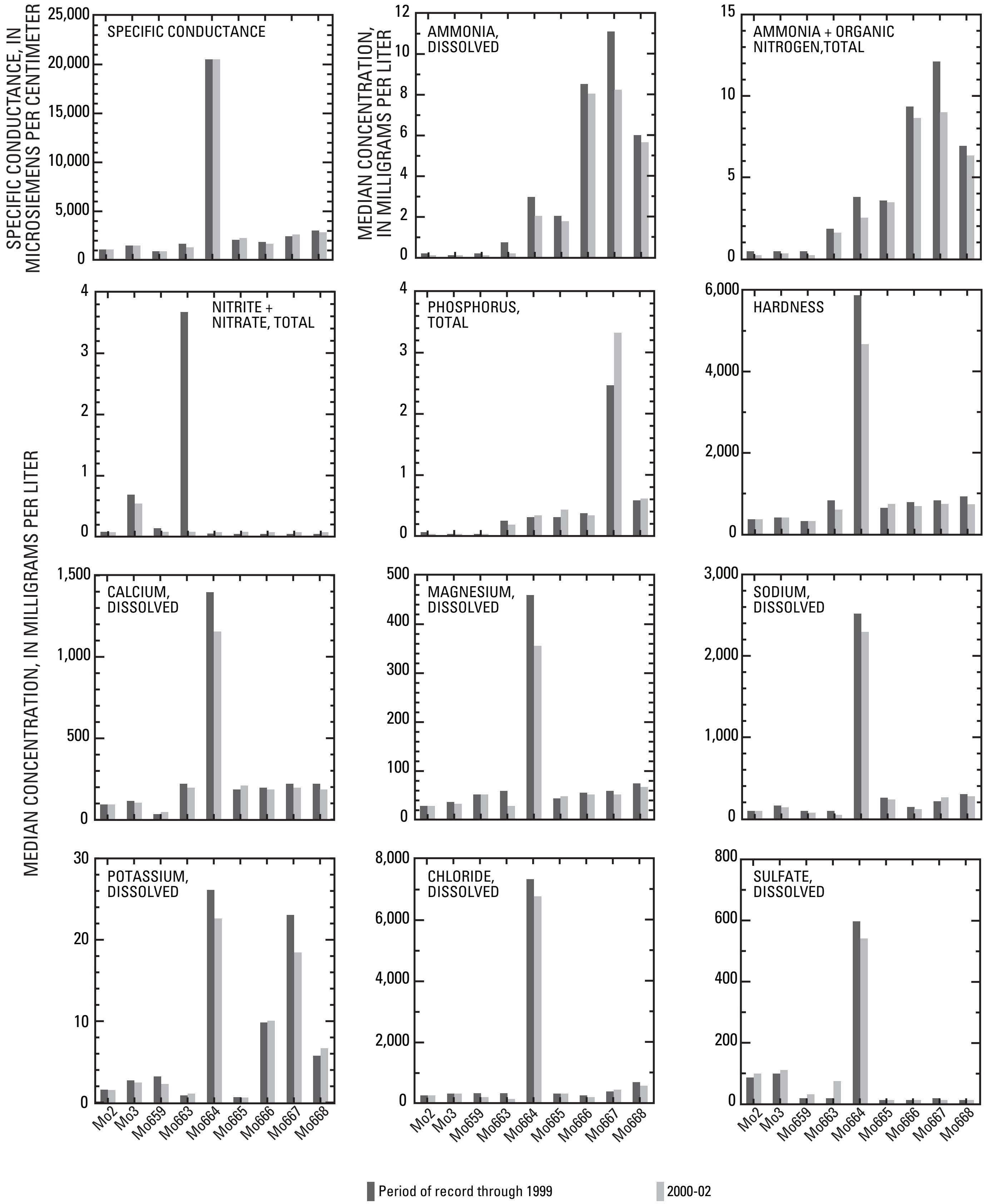


Figure 7. Median concentrations of selected constituents in Ellison Park wells, Monroe County, N.Y., for period of record through 1999 and for 2000-02. (Locations are shown in fig. 4.)

Median 2000-02 concentrations of nitrite + nitrate for all other wells were at or below the detection limit of 0.05 mg/L. The median concentration of total phosphorus for 2000-02 at Mo 667 (3.4 mg/L) was considerably higher than at any of the other wells, and also was higher than the median for the previous period of record.

Median concentrations of common ions were higher at well Mo 664 than any of the other wells. Mo 664 is at the upstream edge of the buried Pinnacle Hills moraine and is subject to an upward flow from a pool of dense, mineralized (chloride brine) water that has collected at the base of the moraine (Young, 1993). Median 2000-02 concentrations of common ions at Mo 664 were slightly lower than for the previous period of record, however. Median concentrations of ions in this well are relatively consistent, but fluctuate slightly with changes in the level of the saltwater/freshwater interface.

Median concentrations of most constituents in the shallow wells of each well pair were generally significantly lower than those in the deep well of a well pair. Generally, the lower concentrations were detected in the shallow wells. Well Mo 664, the deep well at well pair 663-664, showed higher concentrations of all constituents except ammonia + organic nitrogen, total phosphorus, and specific conductance, none of which showed any change with depth, and nitrite + nitrate, which showed higher concentrations in the shallow well (Mo 663). Again, the significantly higher concentrations of common ions in the deep well (Mo 664) are attributed to the upwelling of mineralized water from the base of the Pinnacle Hills moraine. Well pair Mo 665-666 had fewer significant differences in concentration with depth; specific conductance, hardness, and sodium values were greater in the shallow well (Mo 665), whereas ammonia, ammonia + organic nitrogen, and potassium values were greater in the deep well, and turbidity, nitrite + nitrate, total phosphorus, chloride, and sulfate showed no difference with depth. Well pair Mo 667-668, showed significantly higher median concentrations of turbidity, ammonia, ammonia + organic nitrogen, total phosphorus, and potassium in the shallow well (Mo 667), than in the deep well, whereas median concentrations of magnesium were greater in the deep well. Specific conductance, nitrite + nitrate, hardness, sodium, chloride, and sulfate showed no significant differences with depth (table 7).

Table 7. Statistically significantly differences in median concentration of selected constituents in paired wells, in Ellison Park, Monroe County, N. Y., water years 2000-02.

[D, mean concentration for deep well is significantly higher than for shallow well; S, mean for shallow well is significantly higher than for deep well; nd, no significant difference. Locations are shown in fig. 4.]

Constituent or Property	Well Pair (upper number represents shallow well)			
	Mo 663 Mo 664	Mo 665 Mo 666	Mo 667 Mo 668	Mo 3 Mo 2
Turbidity	D	nd	S	D
Specific Conductance	D	S	nd	S
Ammonia, dissolved	D	D	S	nd
Ammonia + organic nitrogen, total	nd	D	S	nd
Nitrite + nitrate, total	S	nd	nd	S
Phosphorus, total	nd	nd	S	D
Hardness	D	nd	nd	S
Magnesium, dissolved	D	nd	D	S
Sodium, dissolved	D	S	nd	S
Potassium, dissolved	D	D	S	S
Chloride, dissolved	D	nd	nd	S
Sulfate, dissolved	D	nd	nd	S

Temporal Trends

Trends in chemical constituent concentrations in Ellison Park wells were examined through use of the Kendall slope estimator, a nonparametric test that does not account for seasonality in the data. The Kendall slope estimator incorporates the Mann-Kendall test to determine the statistical significance of the trend.

A total of 86 significant trends in concentration were detected among all wells and constituents; approximately two-thirds (71 percent) of these trends were downward (table 8). Six of the nine wells showed statistically significant trends in concentration for 10 or more of the constituents measured in each well. Mo 666, showed the least number of trends (five constituents), whereas Wells Mo 3 and Mo 668 showed trends in 12 of the 15 constituents (9 downward at Mo 3 and 10 downward at Mo 668). All wells except Mo 659 and Mo 665 showed more downward trends than upward trends. Nitrite + nitrate, in contrast to the previous period of record, showed trends at the greatest number of wells (nine); upward at four wells and downward at five wells. Sodium and magnesium showed trends at eight wells—seven of the trends in sodium, and six of the trends in magnesium were downward. The constituent with the fewest number of trends was total phosphorus—an upward trend at two wells and a downward trend at one well. Dissolved oxygen was omitted from the analysis because it was measured in only three wells. The common ions as a group showed more trends than any other constituent, and most of these were downward (table 8).

Surface Water

Streamflow and water-quality data were collected at four sites in the Irondequoit Creek basin, one site on the Genesee River, and four other sites in western Monroe County. The Genesee River data were collected at the Charlotte Pump

Table 8. Statistically significant (α = 0.05) trends in concentrations of selected constituents at Ellison Park wells, Monroe County, N.Y., period of record through 2002.

[↓, downward trend;↑, upward trend; →, no trend. Dashes indicate insufficient data for trend test. Locations are shown in fig. 3]

Constituent or property	Mo 2 (1986-2002)	Mo 3 (1986-2002)	Mo 659 (1991-2002)	Mo 663 (1991-2002)	Mo 664 (1991-2002)	Mo 665 (1991-2002)	Mo 666 (1993-2002)	Mo 667 (1991-2002)	Mo 668 (1991-2002)	Total no. trends	Up-ward	Down-ward
Turbidity	→	↓	↑	↓	↓	→	→	→	↓	5	1	4
Specific conductance	→	↓	→	↓	→	↑	↓	→	↓	5	1	4
Oxygen, dissolved	--	--	↓	--	→	--	--	--	--	1	0	1
Ammonia, dissolved	↓	↑	→	↓	↓	→	→	↓	↓	6	1	5
Ammonia + organic nitrogen, total	↓	↓	↓	↓	↓	→	→	↓	→	6	0	6
Nitrite + nitrate, total	↑	↑	↓	↑	↑	↓	↓	↓	↓	9	4	5
Phosphorus, total	→	↓	→	→	→	↑	→	→	↑	3	2	1
Orthophosphate, dissolved	→	→	→	↑	↑	→	↑	↑	↑	5	5	0
Hardness	→	↓	↑	↓	↓	↑	→	↓	↓	7	2	5
Calcium, dissolved	→	↓	↑	→	↓	↑	→	↓	↓	6	2	4
Magnesium, dissolved	→	↓	↑	↓	↓	↑	↓	↓	↓	8	2	6
Sodium, dissolved	↓	→	↓	↓	↓	↓	↓	↑	↓	8	1	7
Potassium, dissolved	↓	↓	↓	→	↓	→	→	↓	→	5	0	5
Chloride, dissolved	↓	↓	→	↓	↓	→	→	→	↓	5	0	5
Sulfate, dissolved	↑	↑	↑	↑	→	↓	→	↓	↓	7	4	3
Dissolved solids	--	--	--	--	--	--	--	--	--			
Total number of trends	7	12	10	11	11	8	5	10	12	86		
Upward trends	2	3	5	3	2	5	1	2	2		25	
Downward trends	5	9	5	8	9	3	4	8	10			61

station, downstream from the flow-monitoring site. The streamflow and chemical-concentration data were used to test for trends in concentration and to estimate annual loads of constituents transported by the streams.

Temporal Trends in Streamflow

Upward or downward trends in streamflow can influence trends in the concentration of chemical constituents. Streamflow variability results from changes in climatic conditions and can affect many water quality properties; variability can also produce a significant bias in the trends of constituent concentrations. Concentration-to-discharge relations and trends in streamflow form an important basis for the interpretation of water-quality trends. For example, runoff (overland flow from rainfall or snowmelt) can wash chemical constituents into nearby streams, increasing the concentration of suspended constituents from nonpoint sources; it also can dilute the concentrations of some dissolved constituents. Therefore, any observed trend in constituent concentration could be due, at least in part, to a concurrent trend in streamflow.

Monthly mean streamflow data from four Irondequoit Creek basin sites and from Northrup Creek, and Oatka Creek at Garbutt were tested for trends using the Seasonal Kendall Trend Test. Trends in streamflow were considered statistically significant if the level of significance (p value) was equal to or less than 0.05. Only those parts of the streamflow record for which water-quality data were available were tested for trends.

Two sites, both in the Irondequoit Creek basin, showed significant downward trends in streamflow. These were Irondequoit Creek at Railroad Mills which showed a downward trend of 1.72 percent per year (table 9); and Allen Creek which showed a downward trend of 1.24 percent per year, similar to the trend noted at this site for 1997-99. The downward trend at Railroad Mills also was similar to that for 1997- 99 but which was not statistically significant (Sherwood, 2004). Monthly mean flows for Irondequoit Creek at Blossom Road, Allen Creek, and Black Creek at Churchville are summarized in the following paragraphs and in figures 8 (period of record) and 9 (2000-02).

Irondequoit Creek above Blossom Road

This site has the second longest period of record (22 years) in the Irondequoit Creek basin (1981- 2002); the longest record (43 years) is for Allen Creek near Rochester (1960-2002). Mean monthly flows for the 2000-02 water years at Blossom Road (fig. 8A) were within the normal range for that site except for 2 months (November and January) when the mean monthly flows were slightly below normal and one month (June) when the mean monthly flow was slightly above normal. The normal range is defined as between the 25th percentile (flows exceeded 75 percent of the time) and

Table 9. Statistical summary and results of trend tests for streamflow at Northrup Creek, Oatka Creek at Garbutt, and four sites in Irondequoit Creek basin, Monroe County, N.Y., for period of sampling record through 2002.

[*p*, significance of trend. Mean, median, 25th, 75th percentiles, and trend units are in cubic feet per second. **Bold type** indicates trend is statistically significant at $\alpha = 0.05$.]

Site	Period of trend test	Descriptive statistics					Trend results				
		no. of samples	Mean	25th percentile	Median	75th percentile	no. of seasons	no. of samples	Units per year	Percent per year	*p*
Northrup Creek	1989-2002	156	13.4	6.05	10.5	18.0	12	156	0.244	1.82	0.066
Railroad Mills	**1992-2002**	**132**	**37.4**	**19.9**	**28.7**	**49.4**	**12**	**132**	**-.644**	**-1.72**	**.050**
East Branch Allen	1991-2002	144	8.56	3.72	6.13	12.1	12	144	-.014	-.164	.565
Allen Creek	**1984-2002**	**228**	**28.6**	**14.5**	**21.8**	**37.7**	**12**	**228**	**-.355**	**-1.24**	**.002**
Blossom Road.	1984-2002	228	130	68.2	99.0	173	12	228	-.710	-.546	.132
Oatka Creek	1998-2002	60	203	42.8	124	321	12	60	-2.59	-1.28	.832

the 75th percentile (flows exceeded 25 percent of the time). The slightly higher mean for the month of June was a result of greater than normal rainfall for that month during the 2000 and 2002 water years. Monthly mean flow for the 2000 water year was below normal for November and at or above normal for April through September. Precipitation for all of those months was above normal, and resulted in above normal precipitation for the year. Monthly mean flows for the 2001 (fig. 9A) water year were within the normal range, except for March, which slightly exceeded normal, and July and August, which were below normal. Flows for the months of November through January, April, May, July, August, and September 2001 were below the median. Monthly mean flows for water year 2002 were below normal for October through January, March, August, and September, and greater than normal for May and June.

Allen Creek near Rochester

The Allen Creek drainage basin is primarily moderate- to high-density residential land with some commercial areas, and therefore, is not representative of the rest of the Irondequoit Creek basin. Flows in Allen Creek are generally more variable than elsewhere because the large amounts of impervious surfaces in the drainage area cause a rapid response to rainfall and large amounts of runoff. Mean monthly flows for the 2000-02 water years were below normal for the months of October, November, August, and September, and below the median for December, January, March, and July (fig. 8B). Monthly mean flows for the 2000 water year (fig. 9B) were below normal for the months of October and November and above normal for April through July. Flows for the 2001 water year were below normal for November, May, and August, and well below normal for June and July. March was the only month in 2001 to exceed normal. Flows during water year 2002 were also outside the normal range—October, November, January, July, August, and September were all below normal; May was the only month above normal.

Black Creek at Churchville

The drainage basin for Black Creek at Churchville (fig. 1) is typical of many of the primarily agricultural watersheds in western Monroe County, has a 57-year period of record that has been used to relate long-term flow conditions in drainage basins west of the Genesee River. Mean monthly flows for water years 2000-02 (fig. 8C) like those at Blossom Road and Allen Creek were within the normal range except those for the months of May and June, which were slightly above normal. Monthly mean flows during water year 2000, (fig. 9C) were slightly below normal for November, December, and March, and above normal from April through September. Monthly mean flow for water year 2001 was within the normal range for all months except July through September, which was below normal. Monthly mean flows for the 2002 water year were below normal for November, March, August, and September, and above normal for February, May, and June.

Water Quality

Measurement of physical parameters such as water temperature and specific conductance, and chemical constituents such as nutrients and common ions are important in assessing water quality. Concentrations and estimated loads of constituents in streams can highlight differences in water quality from basin to basin and through trend analysis, whether conditions are improving or deteriorating.

Water Temperature

Water temperature is one of the most important factors when assessing water quality. It affects many of the physical properties of water, the rate of chemical reactions, and the level of activity of all organisms in the aquatic environment. Water temperature also affects the electrical conductivity of water, the solubility of constituents, and the growth and death rates of microorganisms, which are important to the biological process of waste decomposition.

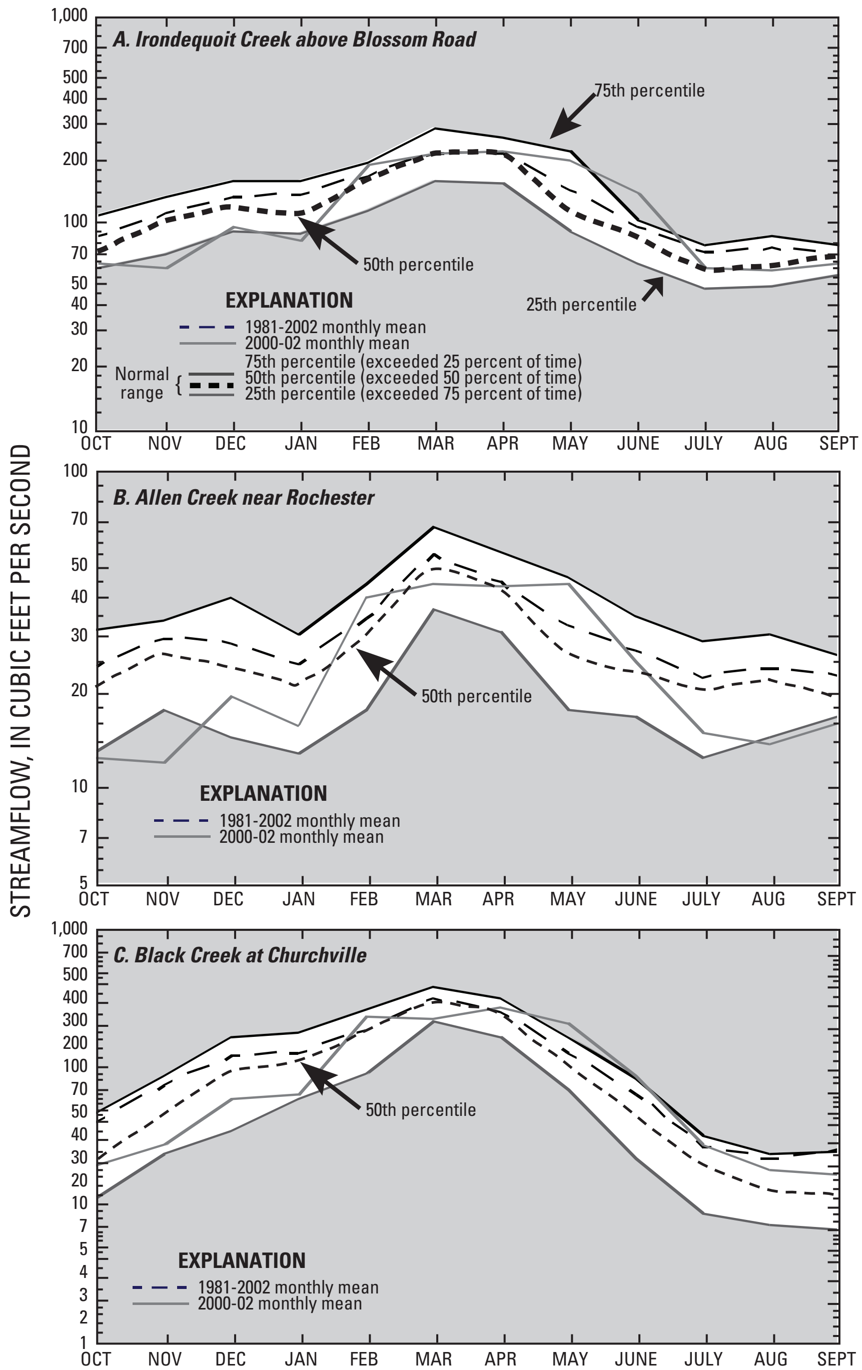


Figure 8. Mean monthly flow at three sites in Monroe County, N. Y., for period of record and water years 2000-02, in relation to normal range (between the 25th and 75th percentile) for period of record: *A*. Irondequoit Creek above Blossom Road. *B*. Allen Creek at Rochester, and *C*. Black Creek at Churchville. (Locations are shown in fig. 1.)

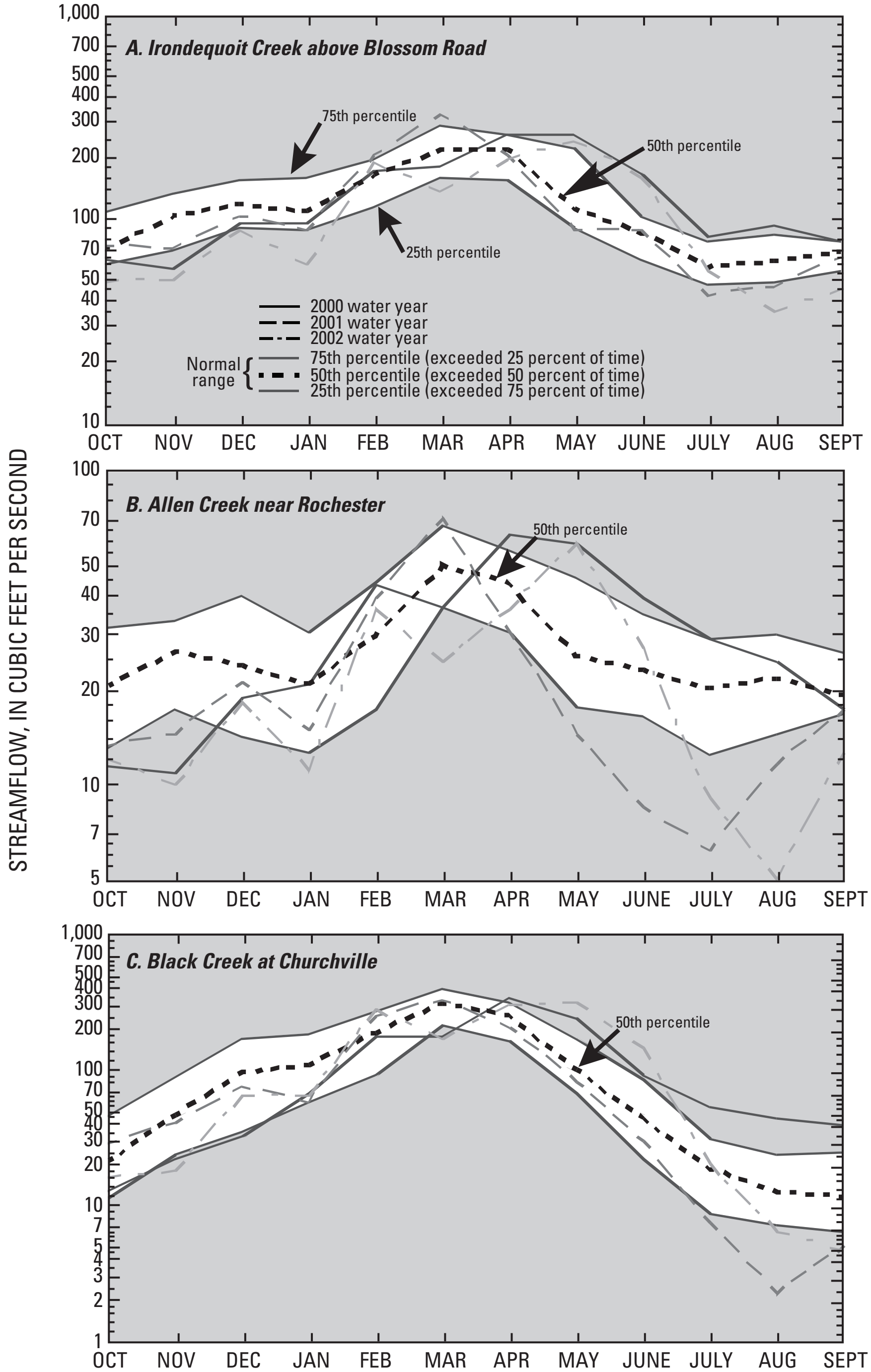


Figure 9. Monthly mean flow at three sites in Monroe County, N. Y., water years 2000, 2001, and 2002, in relation to normal range (flows between the 25th and 75th percentile) for period of record: *A*. Irondequoit Creek above Blossom Road. *B*. Allen Creek at Rochester, and *C*. Black Creek at Churchville. (Locations are shown in fig. 1.)

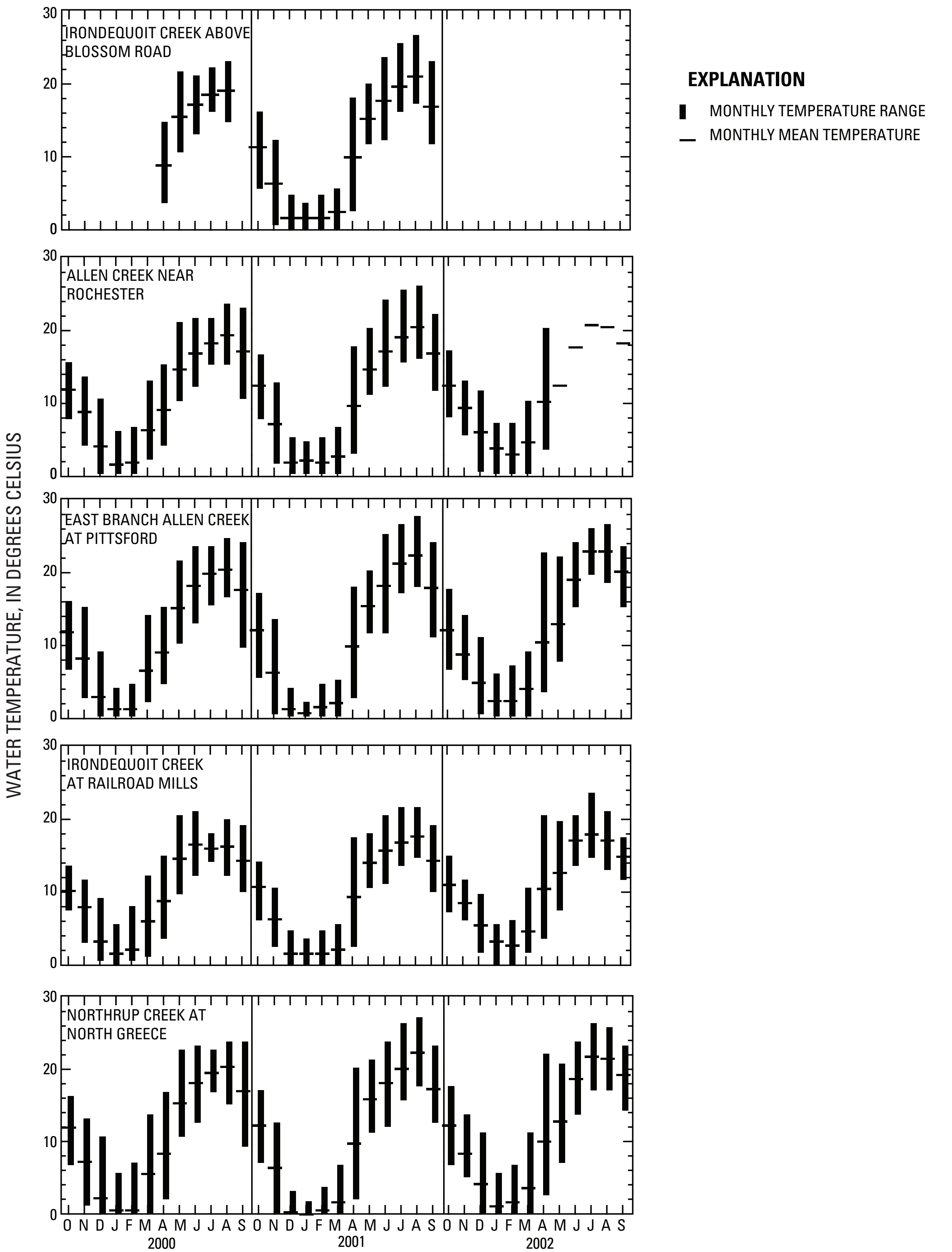


Figure 10. Monthly water temperature range and monthly mean water temperature at four Irondequoit Creek basin sites and Northrup Creek, water years 2000-02. (Locations are shown in fig. 1.)

Temperature records have been collected at the four Irondequoit Creek basin sites and Northrup Creek since 1994. Temperatures are recorded at a single point in the stream cross section and stream reach and, therefore, may not be representative of stream temperatures any distance away from the point of collection. Several factors affect the temperature of stream water as it flows down the channel; these include ground-water contribution, precipitation, the amount of solar radiation reaching the stream, and the temperature of tributaries entering the stream. The New York State Department of Environmental Conservation (NYSDEC) threshold for discharges to trout streams specifies, that no discharge will exceed 21.1°C (70° F) and no discharge from June through September will increase stream temperature by more than 1.1°C (2° F) above predischarge temperature.

Maximum recorded daily water temperatures during 2000-02 exceeded 22° C on many days during the summer months at the Irondequoit basin sites, but daily mean temperatures for those days generally did not exceed the 22° C limit (table 10, fig. 10). None of the minimum daily temperatures were above 22° C.

Erie (Barge) Canal Diversions

Water from the Erie (Barge) canal is used to supplement flow in some streams north of the canal (fig. 1) during the canal navigation season, from about April 15 to about November 15. Water is diverted from the canal through siphons to maintain minimum flows in the streams during low-flow periods for dilution of sewage-treatment-plant discharges, for irrigation, and to help maintain canal-pool elevation. The Monroe County Environmental Health Laboratory (MCEHL) has been sampling these diversions since 1986 at Allen Creek, East Branch Allen Creek, the Cartersville waste channel, which diverts water from the canal to Irondequoit Creek, and at the Fairport waste channel, which diverts water from the canal to Irondequoit Creek through Thomas Creek (fig. 2). Samples are collected at Allen Creek and East Branch Allen Creek, immediately upstream from the siphon, from the siphon, and immediately downstream from the siphon. The East Branch Allen Creek canal siphon is 1.1 mi upstream from the monitoring site on East Branch Allen Creek, and the Allen Creek siphon is 4.6 mi upstream of the monitoring site on Allen Creek. Cartersville and Fairport samples are collected directly from the waste channels. Median concentrations of constituents at the Allen Creek and East Branch Allen Creek sites for the period of record are plotted in figure 11. Median concentrations of constituents from sites above the siphon, from the siphon and below the siphon for the period- of-record through 2002 (table 11) were similar to those noted for the period- of - record through 1999 (Sherwood, 2004). The relation among concentrations upstream from the siphon, from the siphon, and below the siphon (fig. 11) were also similar to those given in the previous report. Concentrations of suspended material, such as turbidity, suspended solids, and volatile suspended solids, were higher in water from the siphon than above the siphon and generally resulted in elevated median concentrations below the siphon. Median concentrations of nutrients above, from, and below the siphons were mixed: ammonia and nitrite + nitrate showed higher concentrations in water from the siphon, and high concentrations below the siphon, whereas ammonia + organic nitrogen showed higher concentrations in water above the siphon than from and below the siphon. This result suggests dilution of organic nitrogen. Median concentrations of chloride were appreciably higher in samples collected above the siphon than from the siphon or below, indicating a dilution of the upstream chloride concentrations by water from the canal. Median concentrations of sulfate were highest in samples from the siphon, an indication that canal water is increasing the sulfate concentrations at these diversions.

Instantaneous nutrient loads—obtained by multiplying concentration by the corresponding flow and by a conversion factor that converts milligrams per liter and cubic feet per second to tons per day—were calculated for three sampling points at the East Branch Allen Creek and Allen Creek sites —upstream from the canal siphon, the canal siphon, and the point downstream from the siphon (table 12; fig. 12). Median concentrations of some nutrients (fig. 11) such as ammonia + organic nitrogen, total phosphorus, and orthophosphate, in discharge from the canal at East Branch Allen Creek and Allen Creek were the same as, or lower than, in water upstream from the siphon, but median loads of these constituents were greater than those upstream from the siphon (fig. 12) because water from the canal is the main component of flow in the stream at that point. Thus, the diversion from the canal is the main contributor of nutrients to the reaches of East Branch Allen Creek and Allen Creek below the siphons for periods of base flow during the navigation season.

Median concentrations of constituents at the Fairport and the Cartersville waste channels are included in table 11. Unlike East Branch Allen Creek and Allen Creek, the canal diversions through the Cartersville and Fairport waste channel sites to Irondequoit Creek have no sampling sites immediately upstream or downstream from the diversions by which to assess the relative effect of canal water on chemical concentrations in Irondequoit Creek.

During 2001, Monroe County also began collecting water samples at the canal diversion in western Monroe County at Spencerport (fig. 1) which diverts water from the canal into Northrup Creek. Four sampling sites are associated with this diversion—Northrup Creek above the Spencerport waste channel (diversion), the waste channel, Northrup Creek below the waste channel and above the sewage-treatment plant, and Northrup Creek at Townline Road, which is downstream from the Spencerport sewage- treatment-plant outflow. These samples are collected during the canal navigation season, as at Allen Creek and East Branch Allen Creek. Median concentrations of turbidity, suspended solids, and sulfate in Northrup Creek (fig. 13), were significantly higher at sampling sites downstream from the diversion than at the upstream site, whereas median concentrations of all nutrients (except

Table 10. Monthly maximum, minimum, and mean water temperatures at the four Irondequoit Creek basin sites and Northrup Creek, Monroe County, N.Y., water years 2000-02 and period of record

[All values are in degrees Celsius; dashes indicate no data. Locations are shown in fig. 1.]

Month	Irondequoit Creek above Blossom Road			Allen Creek			East Branch Allen Creek			Irondequoit Creek at Railroad Mills			Northrup Creek		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
2000 Water Year															
Oct 1999	--	--	--	15.5	7.5	11.7	16.0	6.5	11.8	13.5	7.5	10.3	16.0	6.5	11.8
Nov 1999	--	--	--	13.5	4.0	8.7	15.0	2.5	8.1	11.5	3.0	8.0	13.0	1.0	7.2
Dec 1999	--	--	--	10.5	.0	4.0	9.0	.0	3.0	9.0	0.5	3.3	10.5	.0	2.1
Jan 2000	--	--	--	6.0	.0	1.5	4.0	.0	1.2	5.5	.0	1.6	5.5	.0	.6
Feb 2000	--	--	--	6.5	.0	1.8	4.5	.0	1.3	8.0	.5	2.1	7.0	.0	.6
Mar 2000	--	--	--	13.0	2.0	6.3	14.0	2.0	6.4	12.0	1.0	6.0	13.5	.0	5.4
Apr 2000	14.5	3.5	8.8	15.0	4.0	90.	15.0	4.5	8.9	15.0	3.5	8.7	16.5	2.0	8.3
May 2000	21.5	10.5	15.4	21.0	10.0	14.5	21.5	10.0	15.0	20.5	9.5	14.6	22.5	10.5	15.2
Jun 2000	21.0	13.0	17.2	21.5	12.0	16.9	23.5	13.0	18.3	21.0	12.0	16.5	23.0	12.5	18.0
Jul 2000	22.0	16.0	18.5	21.5	15.0	18.3	23.5	15.5	19.9	18.0	14.0	16.0	22.5	16.5	19.5
Aug 2000	23.0	14.5	19.1	23.5	15.0	19.3	24.5	16.5	20.5	20.0	12.0	16.4	23.5	15.0	20.2
Sept 2000	--	--	--	23.0	10.5	17.1	24.0	9.5	17.7	19.0	10.0	14.4	23.5	9.0	17.0
2001 Water Year															
Oct 2000	16.0	5.5	11.2	16.5	7.5	12.3	17	5.5	12.0	14.0	6.0	10.7	17.0	7.0	12.3
Nov 2000	12.0	.5	6.2	12.5	1.5	7.1	13.5	0.5	6.2	10.5	2.5	6.4	12.5	.0	6.4
Dec 2000	4.5	.0	1.4	5.0	.0	1.8	4.0	.0	1.2	4.5	.0	1.6	3.0	.0	.3
Jan 2001	3.5	.0	1.4	4.5	.0	2.0	2.0	.0	.8	3.5	.0	1.7	1.5	.0	.1
Feb 2001	4.5	.0	1.6	5.0	.0	1.9	4.5	.0	1.6	4.5	.0	1.6	3.5	.0	.6
Mar 2001	5.5	.0	2.4	6.5	.0	2.6	5.0	.0	2.2	5.5	.0	2.2	6.5	.0	1.5
Apr 2001	18.0	2.5	9.9	17.5	3.0	9.6	18.0	2.5	9.9	17.5	2.5	9.4	20.0	2.0	9.8
May 2001	20.0	11.5	15.2	20.0	11.0	14.7	20.0	11.5	15.5	18.0	10.5	14.0	21.0	11.0	15.9
Jun 2001	23.5	12.0	17.7	24.0	12.0	17.1	25.0	11.5	18.1	20.5	11.0	15.6	23.5	12.0	18.1
Jul 2001	25.5	16.0	19.5	25.5	15.5	19.1	26.5	17.0	21.1	21.5	13.5	16.9	26.0	15.5	20.1
Aug 2001	26.5	17.0	21.0	26.0	16.0	20.4	27.5	18.0	22.4	21.5	14.5	17.6	27.0	17.5	22.1
Sept 2001	23.0	11.5	16.9	22.0	11.5	16.8	24.0	11.0	18.0	19.0	10.0	14.4	23.0	12.5	17.2
2002 Water Year															
Oct 2001	--	--	--	17.0	8.0	12.4	17.5	6.5	12.0	15.0	7.0	11.1	17.5	6.5	12.3
Nov 2001	--	--	--	13.0	5.5	9.2	14.0	5.0	8.7	11.5	6.0	8.5	13.5	5.0	8.4
Dec 2001	--	--	--	11.5	0.5	5.9	110.	.5	4.9	9.5	1.5	5.4	11.0	.0	4.1
Jan 2002	--	--	--	7.0	.0	3.6	6.0	.0	2.4	5.5	.0	3.2	5.5	.0	1.2
Feb 2002	--	--	--	7.0	.0	3.0	7.0	.0	2.4	6.0	.0	2.7	6.5	.0	1.7
Mar 2002	--	--	--	10.0	.0	4.5	9.0	.0	3.9	10.5	1.5	4.6	11.0	.0	3.5
Apr 2002	--	--	--	20.0	3.5	10.0	22.5	3.5	10.4	20.5	3.5	10.4	22.0	2.5	10.1
May 2002	--	--	--	--	--	12.4	22.0	7.5	12.9	19.5	7.5	12.6	20.5	7.0	12.7
Jun 2002	--	--	--	--	--	17.6	24.0	15.0	18.9	20.5	13.5	17.1	23.5	13.5	18.7
Jul 2002	--	--	--	--	--	20.6	26.0	19.5	23.0	23.5	14.5	18.0	26.0	17.0	21.7
Aug 2002	--	--	--	--	--	20.4	26.5	18.5	22.9	21.0	13.0	17.0	25.5	17.0	21.3
Sept 2002	--	--	--	--	--	18.3	23.5	15.0	20.0	17.5	11.5	14.9	23.0	14.0	19.2

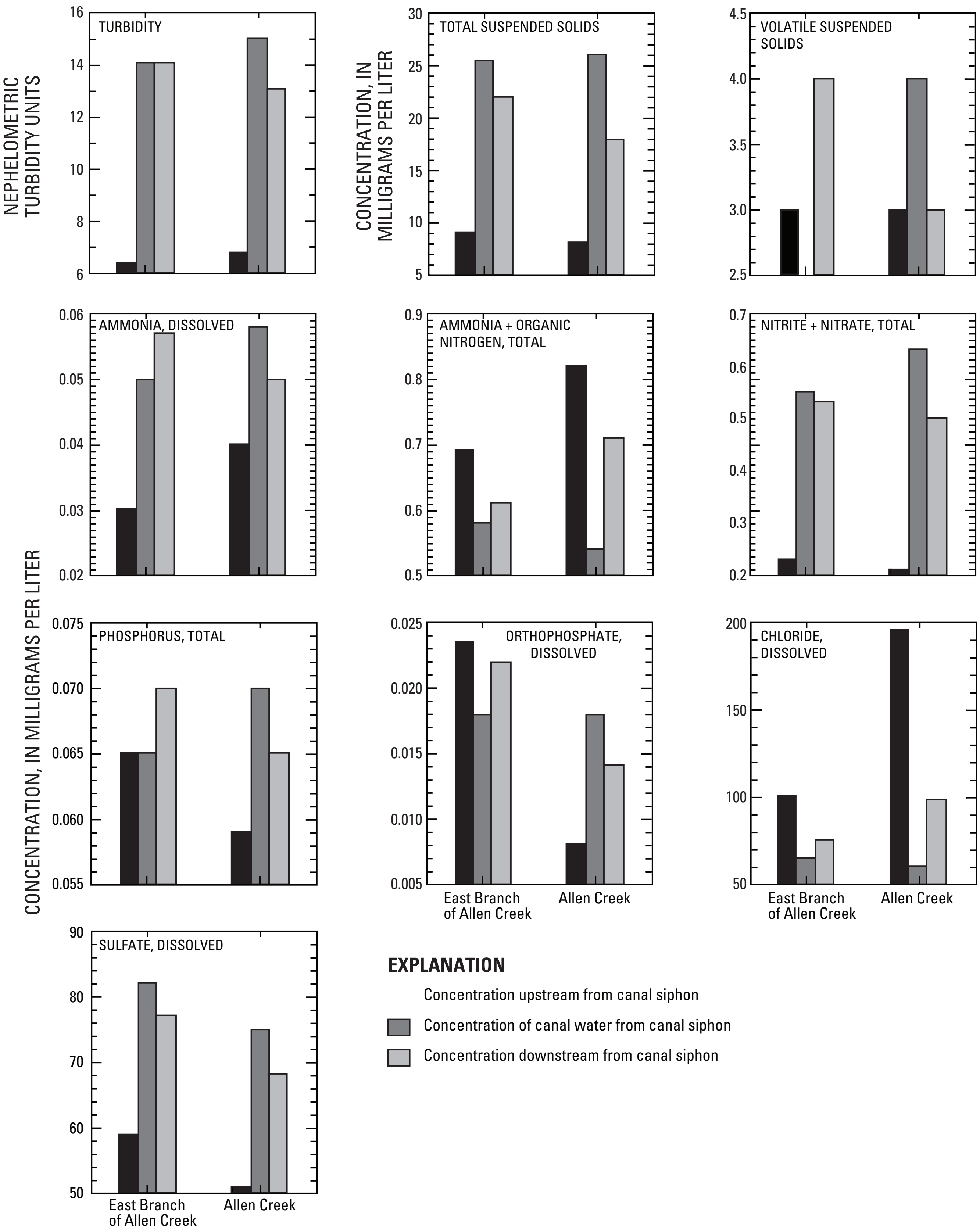


Figure 11. Median concentrations of selected constituents at Erie (Barge) Canal diversions at Allen Creek and East Branch Allen Creek, Monroe County, N. Y., for period of record through 2002. (Locations are shown in fig. 2.)

Table 11. Median concentrations of selected constituents at Erie (Barge) Canal diversions on East Branch Allen Creek, Allen Creek, Irondequoit Creek, and Northrup Creek, Monroe County, N.Y., period of record through 2002.

[Units are milligrams per liter unless otherwise noted. NTU, nephelometric turbidity units. Locations are shown in fig. 2.]

Site	Turbidity (NTU) 00076	Total suspended solids 00530	Volatile suspended solids 00535	Ammonia as N, dissolved	Ammonia + organic nitrogen as N, total 00625	Nitrite + nitrate as N, total 00630	Phosphorus as P, total 00665	Ortho-phosphate as P, dissolved 00671	Chloride, dissolved 00940	Sulfate, dissolved 00945
East Branch Allen Creek canal sites										
above siphon	6.4	9	3	0.03	0.69	0.23	0.065	0.024	101	59
from the siphon	14	26	4	.05	.58	.55	.065	.018	64	82
below siphon	14	22	4	.06	.61	.53	.070	.022	76	77
Allen Creek canal sites										
above siphon	6.8	8	3	.04	.82	.21	.059	.008	195	51
from the siphon	15	26	4	.06	.54	.63	.070	.018	60	75
below siphon	13	18	3	.05	.71	.50	.065	.014	98	68
Irondequoit Creek canal sites										
Cartersville waste	13	20	3	.03	.47	.66	.065	.026	54	81
Fairport waste	6.4	9	3	.05	.47	.56	.060	.020	57	82
Northrup Creek sites										
above Spencerport	3.8	3	2	.07	.57	1.10	.085	.041	168	46
Spencerport waste	8.5	11	2	.04	.36	.67	.066	.036	36	60
below waste	6.2	10	2	.06	.36	.78	.068	.042	51	58
Townline Road	6.0	10	2	.90	1.45	1.32	.190	.127	63	60

Table 12. Median values of instantaneous flow and loads of nutrients at Erie (Barge) Canal diversions on East Branch Allen Creek, Allen Creek, and Northrup Creek, Monroe County, N.Y. for period of record through 2002.

[Units are pounds unless otherwise noted. Locations are shown in fig. 1.]

Site	Discharge (cubic feet per second)	Ammonia as N, dissolved 00608	Ammonia + organic nitrogen as N, total 00625	Nitrite + nitrate as N, total 00630	Phosphorus as P, total 00665	Orthophosphate as P, dissolved 00671
East Branch Allen Creek canal sites						
above siphon	0.62	0.155	2.16	1.54	0.235	0.052
from the siphon	2.4	.662	5.30	6.62	.771	.297
below siphon	2.7	.778	7.89	8.77	1.09	.362
Allen Creek canal sites						
above siphon	1.1	.189	3.62	1.14	.347	.043
from the siphon	1.8	.310	3.89	5.83	.589	.140
below siphon	2.9	.648	7.98	7.13	1.04	.176
Northrup Creek sites						
above Spencerport	.80	.378	2.25	5.10	.371	.177
Spencerport waste	4.2	1.08	8.42	16.5	1.62	.864
below waste	5.6	1.73	11.0	21.2	2.13	1.15
Townline Road	6.2	32.4	51.4	54.7	6.53	4.44

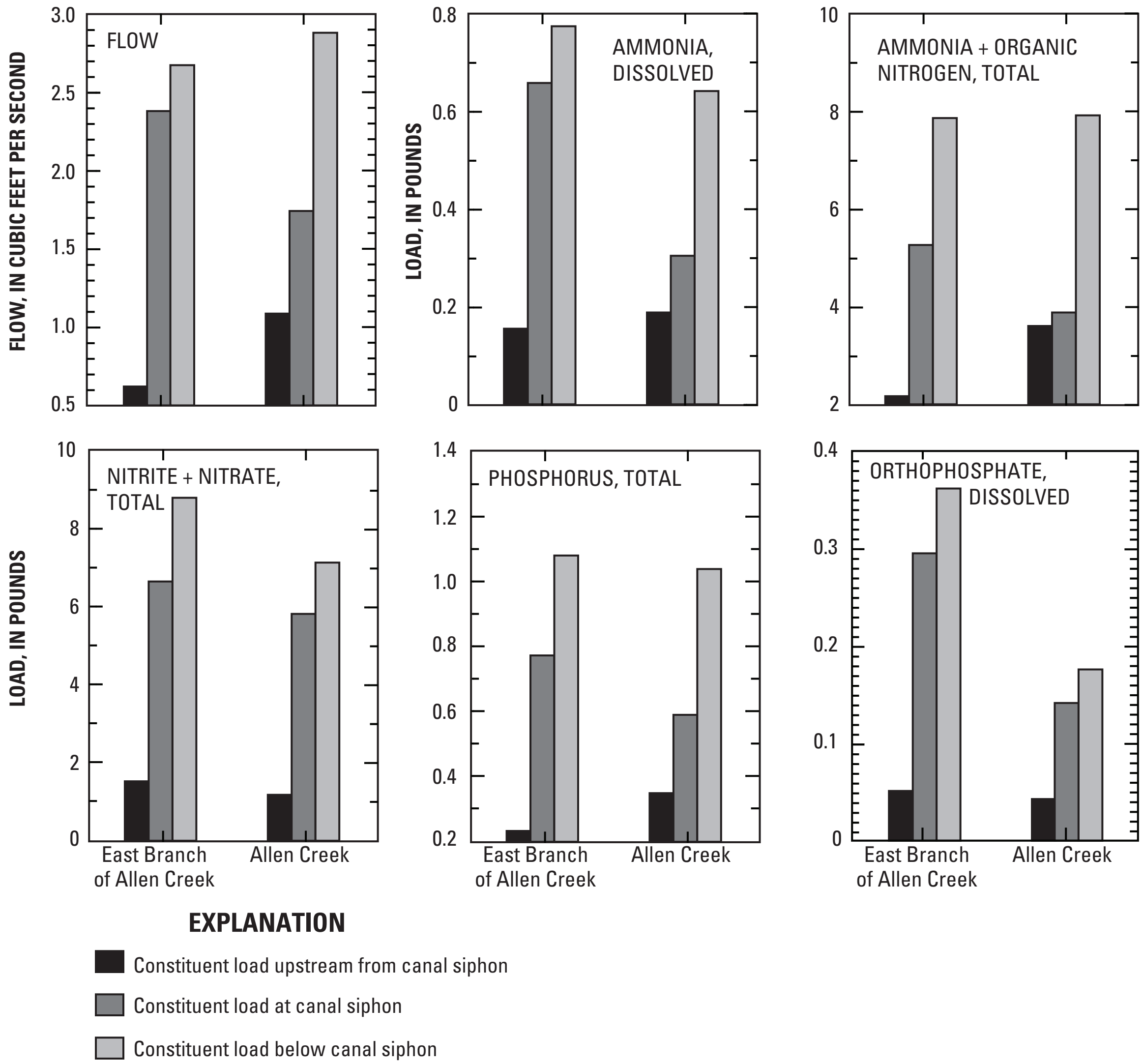


Figure 12. Median instantaneous flow values and loads of nutrients at Erie (Barge) Canal diversions at Allen Creek, East Branch Allen Creek, and Northrup Creek, Monroe County, N.Y., for period of record through 2002. (Locations are shown in fig. 2.)

orthophosphate) were lower at sites downstream from the waste channel than sites above it as a result of dilution by flow diverted from the canal (table 11). The highest median concentrations of nutrients were at the site at Townline Road (fig. 14) as a result of the sewage-treatment-plant discharge to the stream. The median concentration of chloride (168 mg/L) at Northrup Creek was significantly higher at the upstream site than at any of the downstream sites, again a result of dilution by flows from the canal. The primary source of sulfate entering Northrup Creek seems to be the canal, however.

Instantaneous nutrient loads (table 12) were significantly greater at the Townline Road site, below the sewage-treatment plant, than at the three sites that are upstream from the plant. As at the Allen Creek and East Branch Allen Creek sites, median concentrations of nutrients above the waste channel greatly exceeded those within or just below it, whereas nutrient loads were the opposite—those within or just below the waste channel were greater than those upstream—because water from the canal is the main component of flow at that point. The significant increase in nutrient load between Northrup Creek below the waste channel and the load at Townline Road, is a result of discharge from the Spencerport waste- treatment plant.

Chemical Concentrations

Streamflow is measured at all sites at which water-quality data were collected, except for the Genesee River at the Charlotte Pump station. Streamflow values associated with those samples were obtained from records for the Genesee

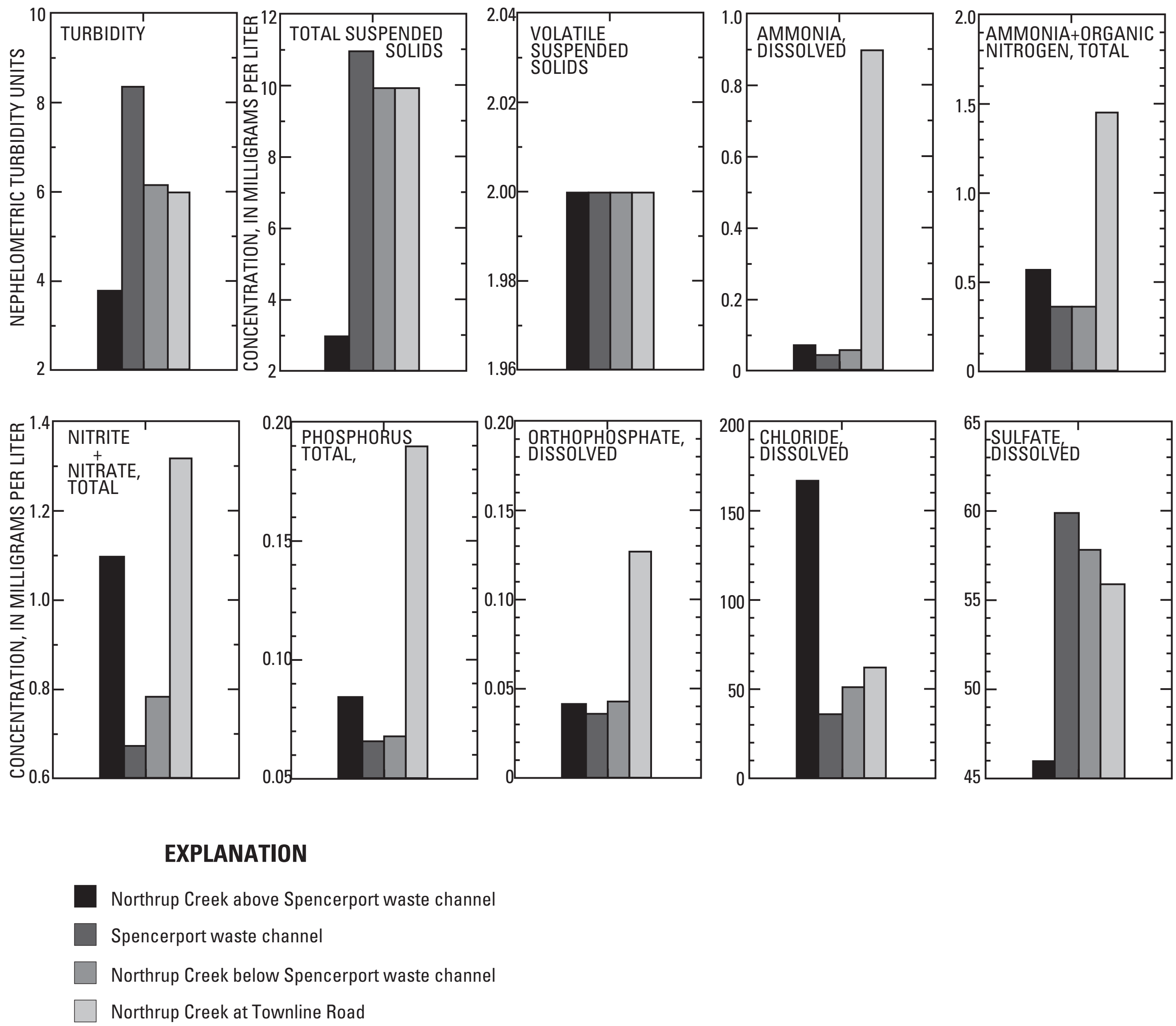


Figure 13. Median concentrations of selected constituents at Erie (Barge) Canal diversions on Northrup Creek, Monroe County, N.Y., for water years 2000-02. (Locations are shown in fig. 2.)

River at Rochester (04232000), about 6 mi upstream. Samples collected by the automatic sampler at the upstream sites in the Irondequoit Creek basin and Northrup Creek were combined in the laboratory into one 2- to 4 -day composite sample each quarter to produce a sample representing base-flow conditions, and were composited for shorter time periods over high flow events to produce about two high-flow samples per month. Base-flow samples from all other sites were combined into 2- to 4 -day composite samples to produce 1 to 2 base-flow samples per month, and those collected during high flows were combined into 1 or 2 composite samples that spanned the duration of the high flow. Samples were analyzed for physical properties and for concentrations of nutrient species and common ions. For purposes of statistical evaluation, these composite samples are treated as discrete samples. Median constituent concentrations for water years 2000-02 are shown in table 13. The median is often used as a measure of central tendency rather than the mean because it is not influenced by extreme values, as is the mean.

Spatial Variability

The primary cause of chemical differences among streams, or between reaches of the same stream, is differences in land use; precipitation intensity or frequency, atmospheric borne constituents deposited either as rain or stored in the snow pack, also can affect the variability of storm water quality, but generally to a lesser extent. For example, median concentrations of chloride were considerably lower

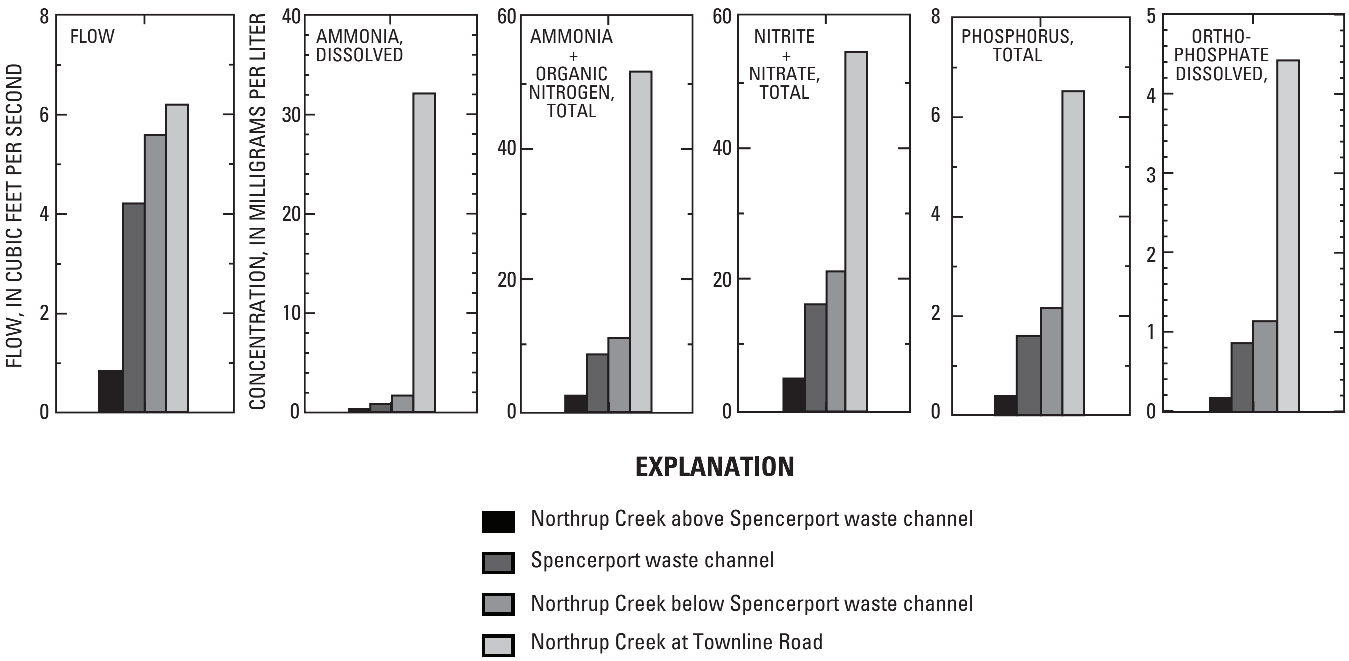


Figure 14. Median flow values and median nutrient loads at Erie (Barge) Canal diversions on Northrup Creek, Monroe County, N.Y., for water years 2000-02. (Locations are shown in fig. 2.)

Table 13. Median concentrations of selected constituents at four Irondequoit Creek basin sites and four western Monroe County sites, Monroe County, N.Y., water years 2000-02.

[Units are milligrams per liter unless otherwise noted. NTU, nephelometric turbidity units. Locations are shown in fig. 1.]

Site	Turbidity (NTU) 00076	Total suspended solids 00530	Volatile suspended solids 00535	Ammonia as N, dissolved 00608	Ammonia + organic nitrogen as N, total 00625	Nitrite + nitrate as N, total 00630	Phosphorus as P, total 00665	Ortho-phosphate as P, dissolved 00671	Chloride, dissolved 00940	Sulfate, dissolved 00945
Irondequoit Creek basin sites										
Irondequoit Creek at Railroad Mills	14	110	20	0.01	0.48	1.1	0.055	0.008	94	183
East Branch Allen Creek at Pittsford	16	80	13	.03	.70	.98	.090	.016	146	79
Allen Creek near Rochester	14	95	16	.02	.66	.88	.085	.016	187	64
Irondequoit Creek at Blossom Road	11	81	12	.01	.50	.96	.091	.014	141	154
Western Monroe County sites										
Northrup Creek at North Greece	18	88	17	.05	.92	1.8	.20	.078	105	54
Honeoye Creek at Honeoye Falls	7.3	51	7.0	.01	.42	.14	.043	.008	41	27
Oatka Creek at Garbutt	4.0	9.0	3.0	.01	.40	1.8	.034	.008	56	237
Black Creek at Churchville	4.8	38	10	.03	.65	1.3	.050	.014	64	245

Table 14. Results of Tukey's Multiple Comparison Test (MCT) showing statistically significant (α = 0.05) differences in mean concentrations of selected constituents among Irondequoit Creek basin sites and western Monroe County sites, Monroe County, N.Y., water years 2000-02.

[Diss., dissolved. H indicates value for boldface site is significantly higher; L indicates value for boldface site is significantly lower; ND; no significant difference. Locations are shown in fig. 1.]

Site	Turbid-ity 00076	Total sus-pended solids 00530	Volatile sus-pended solids 00535	Ammonia, diss. 00608	Ammonia + organic nitrogen, total 00625	Nitrite + nitrate, total. 00630	Phos-phorus, total 00665	Ortho-phos-phate, diss. 00671	Chloride, diss. 00940	Sulfate, diss. 00945
Irondequoit Creek above Blossom Road in relation to:										
Irondequoit Creek at Railroad Mills	ND	ND	L	ND	ND	L	H	H	H	L
East Branch Allen Creek at Pittsford	L	ND	ND	L	L	ND	L	ND	ND	H
Allen Creek near Rochester	ND	ND	ND	L	L	ND	ND	ND	L	H
Northrup Creek at North Greece	L	ND	L	L	L	L	L	L	H	H
Black Creek at Churchville	H	ND	ND	L	L	L	H	ND	H	L
Oatka Creek at Garbutt	H	H	H	L	H	L	H	H	H	L
Honeoye Creek at Honeoye Falls	H	H	ND	L	H	H	H	H	H	H
Irondequoit Creek at Railroad Mills in relation to:										
East Branch Allen Creek at Pittsford	ND	ND	ND	L	L	ND	L	L	L	H
Allen Creek near Rochester	ND	ND	ND	L	L	H	L	L	L	H
Northrup Creek at North Greece	ND	ND	ND	L	L	L	L	L	ND	H
Black Creek at Churchville	H	H	H	L	L	L	ND	L	H	H
Oatka Creek at Garbutt	H	H	H	L	H	L	H	ND	H	H
Honeoye Creek at Honeoye Falls	H	H	H	L	H	H	H	ND	H	H
Northrup Creek at North Greece in relation to:										
East Branch Allen Creek at Pittsford	ND	ND	ND	H	H	H	H	H	L	L
Allen Creek near Rochester	ND	ND	ND	H	H	H	H	H	L	ND
Black Creek at Churchville	H	H	ND	H	H	H	H	H	H	L
Oatka Creek at Garbutt	H	H	H	H	H	ND	H	H	H	L
Honeoye Creek at Honeoye Falls	H	ND	H	H	H	H	H	H	H	H
East Branch Allen Creek at Pittsford in relation to:										
Allen Creek near Rochester	ND	ND	ND	H	ND	ND	ND	ND	ND	H
Black Creek at Churchville	H	ND	ND	ND	ND	L	H	ND	H	L
Oatka Creek at Garbutt	H	H	H	H	H	ND	H	H	H	L
Honeoye Creek at Honeoye Falls	H	H	H	H	H	H	H	H	H	H
Allen Creek near Rochester in relation to:										
Black Creek at Churchville	H	H	ND	L	ND	ND	H	ND	H	L
Oatka Creek at Garbutt	H	H	H	L	H	L	H	H	H	L
Honeoye Creek at Honeoye Falls	H	ND	H	H	H	H	H	H	H	H
Black Creek at Churchville in relation to:										
Oatka Creek at Garbutt	ND	H	H	H	H	L	H	H	H	ND
Honeoye Creek at Honeoye Falls	L	ND	ND	H	H	H	ND	H	H	H
Oatka Creek at Garbutt in relation to:										
Honeoye Creek at Honeoye Falls	L	L	L	H	ND	H	H	ND	H	H

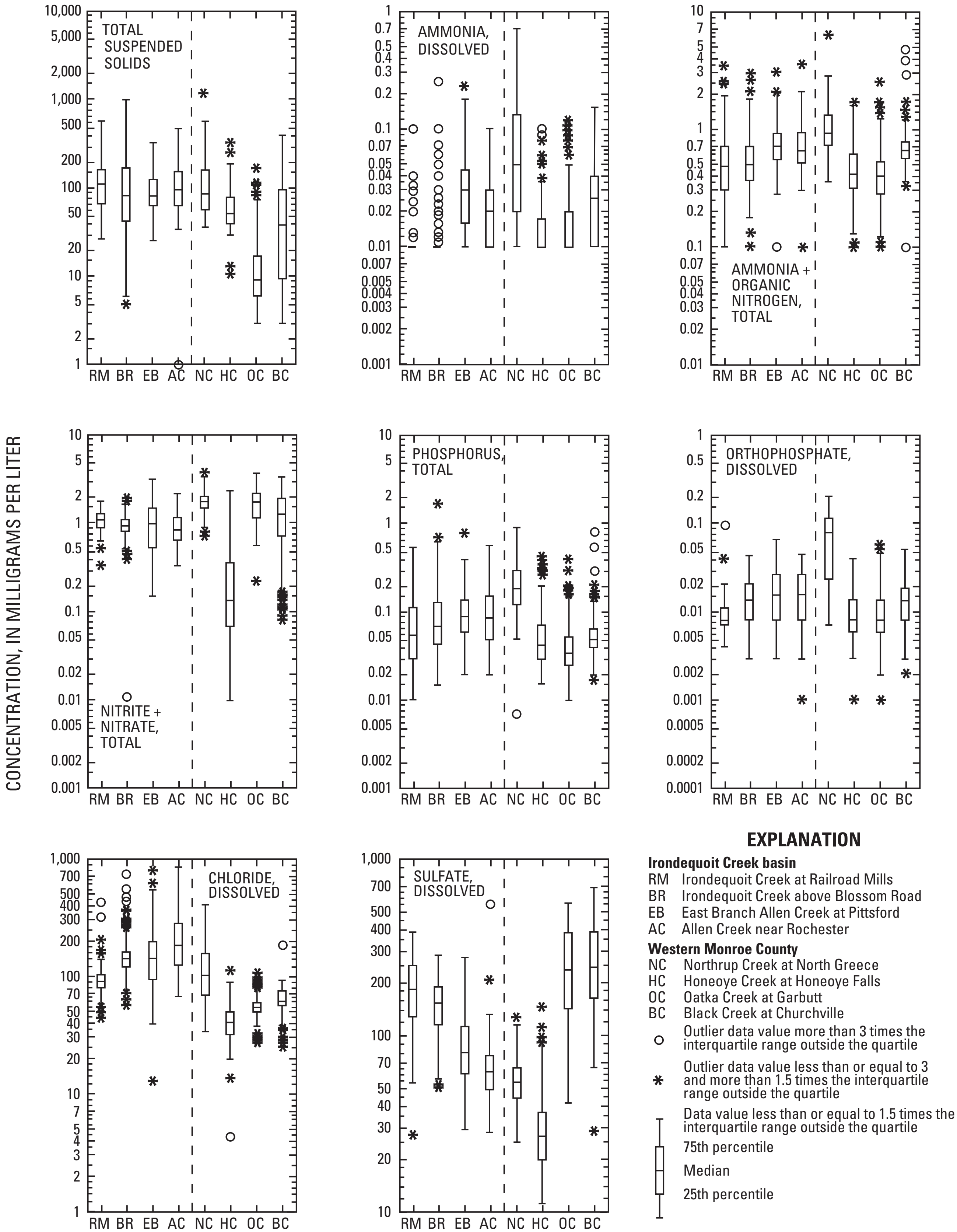


Figure 15. Ranges in concentration of selected constituents at four Irondequoit Creek basin sites and four sites in western Monroe County, N.Y., water years 2000-02. (Locations are shown in fig. 1.)

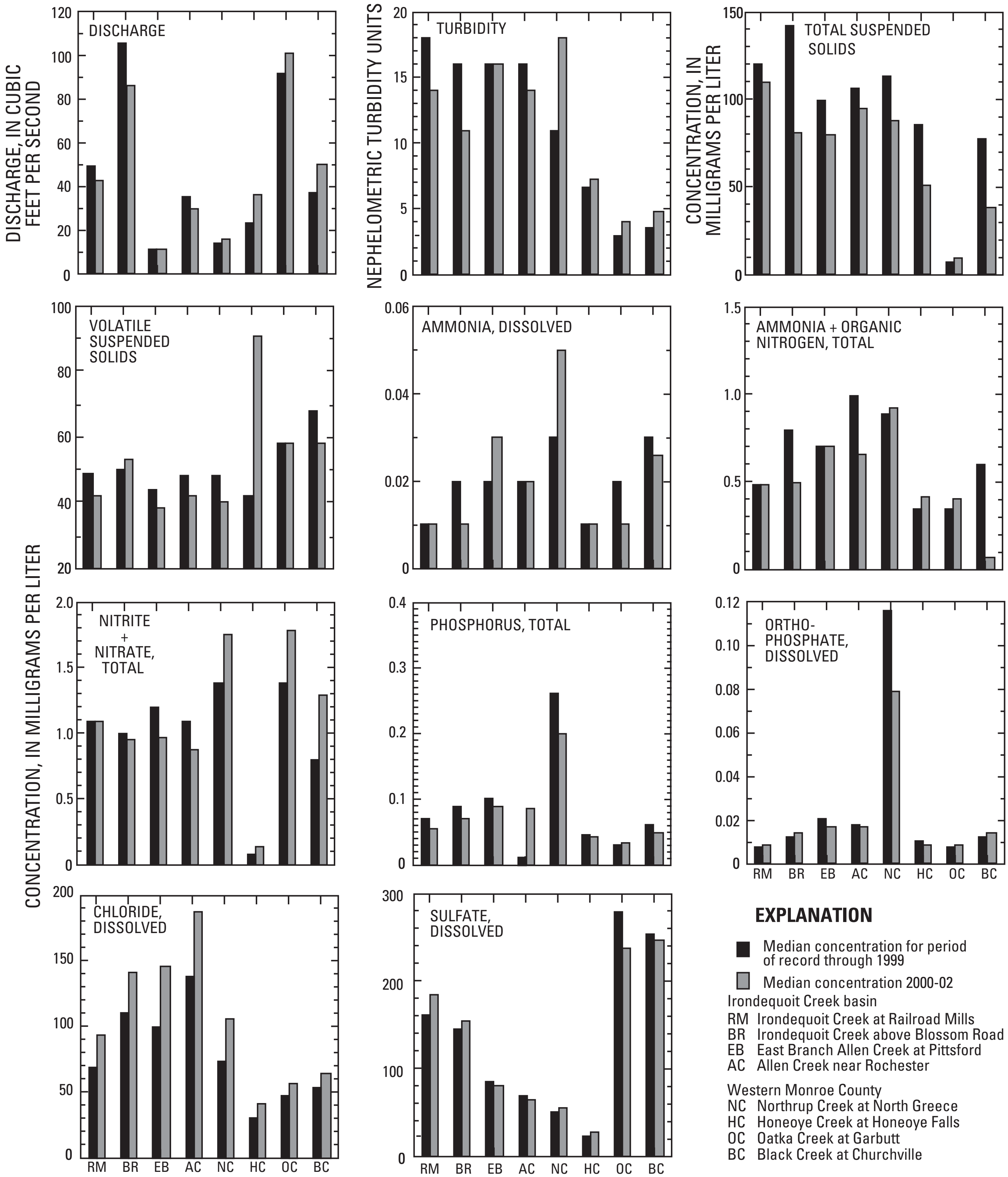


Figure 16. Median concentration of constituents at Irondequoit Creek basin sites and four sites in western, Monroe County, N. Y., for period of record through 1999 and for 2000-02. (Locations are shown in fig. 1.)

at sites representing agricultural subbasins than at sites in predominantly urban areas.

The median and range of concentration for selected constituents at the Irondequoit Creek basin sites and the sites west of the Genesee River were compared using boxplots (fig. 15) and Tukey's MCT (multiple comparison test) on ranks of the concentration data to identify significant ($\alpha = 0.05$) differences among sites; results are summarized in table 14. The Wilcoxon rank-sum test (a statistical test to determine whether two sets of observations come from the same distribution) was used to detect statistically significant ($\alpha = 0.05$) differences in mean concentration between the period of record data (through 1999) and the 2000-02 data. This is a nonparametric test performed on ranks of the data to determine if there are statistically significant differences in the means of the two populations (period of record and 2000-02) (table 15). The sites with the fewest number (5) of constituents showing significant differences between the two periods were Irondequoit Creek at Railroad Mills, Honeoye Creek, and Black Creek. Blossom Road showed a significant difference for all constituents.

Irondequoit Creek Basin Sites

Median concentration of some constituents differed among streams (table 14), as well as between the two time periods (table 15).

Nutrients: Irondequoit Creek at Railroad Mills had the lowest 2000-02 median concentrations of all nutrients except nitrite + nitrate which were the highest (1.1 mg/L). Median concentrations of nutrients at Allen Creek were similar to those at East Branch Allen Creek. Nutrients generally show a seasonal pattern, particularly those with a particulate component (fig. 17). Concentrations of ammonia + organic nitrogen and, to some extent, total phosphorus are higher during spring and summer than during the fall and winter; whereas nitrite + nitrate concentrations are elevated during winter and subside during the summer. Dissolved nutrients, such as ammonia and orthophosphate, showed opposite seasonal variation; concentrations of ammonia were highest during the late fall and winter, whereas concentrations of orthophosphate generally decreased during that period (fig. 17). Median concentrations of total suspended solids, turbidity, nitrite + nitrate, and ammonia + organic nitrogen, for 2000-02 were the same as or lower than for the previous preceding of record. Median concentrations of chloride at all Irondequoit sites for 2000-02 were higher than for the preceding period of record.

Median phosphorus concentrations were higher in the Irondequoit basin sites than at all western Monroe County sites except Northrup Creek. The agricultural basins in western Monroe County had lower median concentrations of ammonia + organic nitrogen than the Irondequoit Creek basin, and except for Honeoye Creek, higher median concentrations of nitrite + nitrate. Median concentrations of nutrients at the Irondequoit Creek basin sites were similar to, or slightly higher than those for the 1997- 99 period. The constituents with the greatest number of significant differences among sites were ammonia (26), total phosphorus (24), and ammonia + organic nitrogen (23) (table 14).

Chloride and Sulfate: The primary source of chloride in Monroe County is the road salt spread on highways during the winter. Concentrations are highest during the winter and lowest during the summer. Median concentrations of chloride for 2000-02 exceeded those for the preceding study period (1997-99) at all Irondequoit Creek basin sites at all Irondequoit Basin sites (fig. 16), indicating an increased

Table 15. Statistically significant differences between mean concentrations of selected constituents for the period of record through 1999 and those for 2000-02 at Irondequoit Creek basin sites and western Monroe County sites, Monroe County, N.Y.

[L, mean for 2000-02 is significantly lower than that for pre-1999 period; H, mean value for 2000-02 is significantly higher than that for pre-1999 period; ND, no significant difference. Locations are shown in fig. 1.]

	Irondequoit Creek basin				Western Monroe County			
Constituent or property	Blossom Road	Allen Creek	East Branch Allen Creek	Railroad Mills	Northrup Creek	Honeoye Creek	Oatka Creek	Black Creek
Discharge	L	ND	ND	ND	H	ND	ND	ND
Turbidity	L	ND	ND	ND	H	ND	H	H
Total suspended solids	L	ND	ND	ND	ND	ND	H	ND
Volatile suspended solids	H	L	L	ND	L	ND	ND	ND
Ammonia, dissolved	L	L	H	L	ND	ND	L	ND
Ammonia + organic nitrogen, total	L	L	H	ND	ND	H	H	H
Nitrite + nitrate, total	L	L	L	ND	H	H	H	H
Phosphorus, total	L	ND	L	L	L	ND	ND	L
Orthophosphate, dissolved	H	ND	L	H	L	L	ND	ND
Chloride, dissolved	H	H	H	H	H	H	H	H
Sulfate, dissolved	H	L	L	H	H	H	ND	ND
Total significant differences	11	6	8	5	8	5	6	5

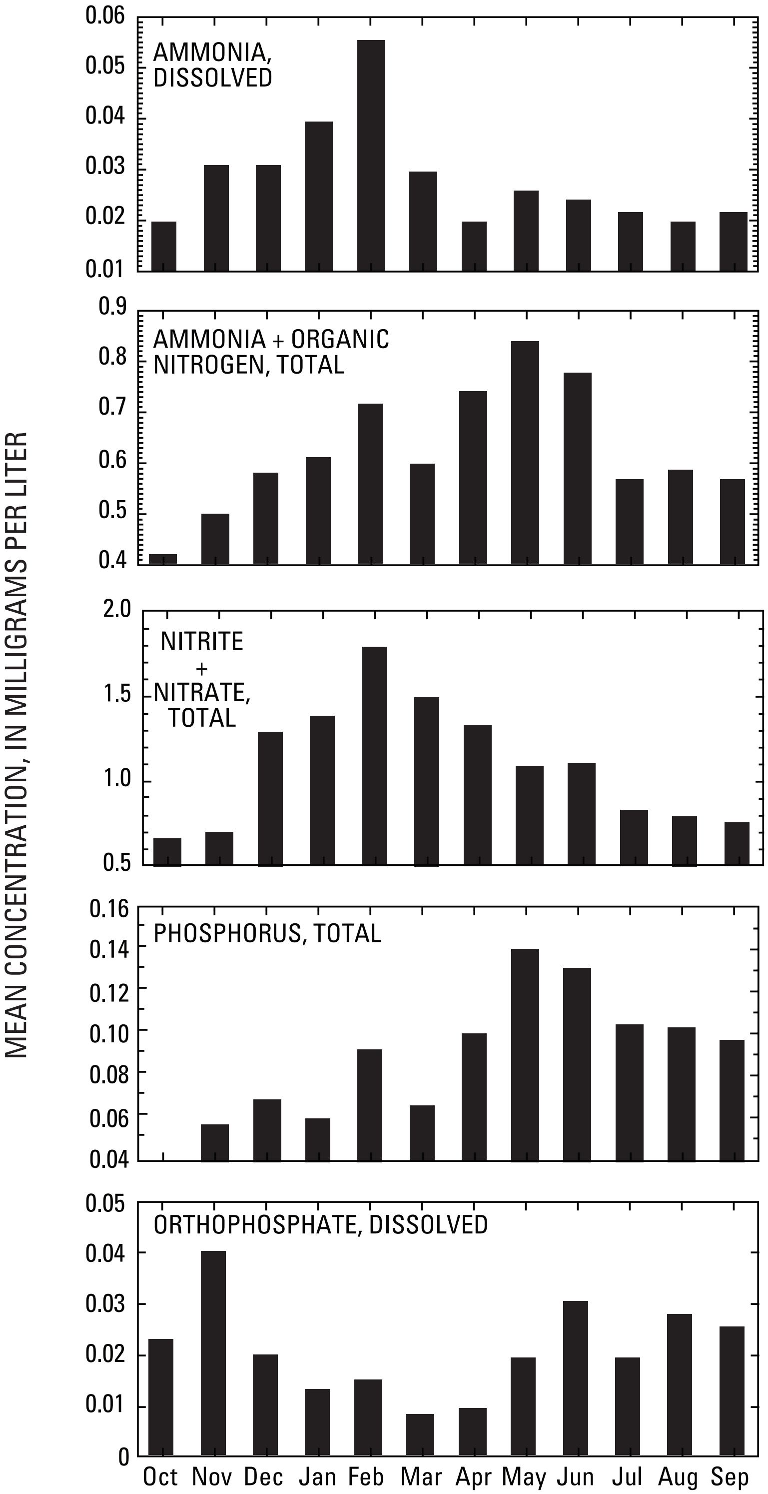


Figure 17. Composite monthly mean concentration of nutrients at four sites in the Irondequoit Creek basin and four sites in western Monroe County N.Y. water years 2000-02 illustrating seasonal distribution of constituent concentrations.

usage of road salt. The highest median concentration (187 mg/L) occurred at Allen Creek, which historically has had the highest chloride concentrations. The higher chloride concentrations in the Irondequoit Creek basin than at western Monroe County sites are due to the greater degree of urbanization of the basin and the greater road density. The application rates and amounts of road salt applied to the roads of Monroe County towns are shown in table 16.

The high concentrations of sulfate at the four monitoring sites in the Irondequoit Creek basin result from the dissolution of sulfate from local glacial deposits and from shale bedrock that underlies much of the area (Young, 1993), and to a lesser extent, atmospheric deposition from industrial sources. Median concentrations of sulfate for 2000-02 were similar to those for the period-of-record through 1999. Median concentrations of sulfate in the Irondequoit Creek basin ranged from 64 mg/L at Allen Creek to 183 mg/L at Railroad Mills. Median concentrations of chloride and sulfate showed many significant differences among sites (table 15).

Suspended Solids: Suspended solids originate as sediment eroded from stream channels and exposesd soils and, thus, are highly correlated with streamflow. Because of differing analytical methods, total-suspended solids data are generally not comparable to suspended-sediment data and should not be used interchangeably (Gray and others, 2000). All Irondequoit Creek basin sites showed lower median concentrations of suspended solids for 2000-02 than for the previous period of record; the greatest decrease in median concentration (142 mg/L to 81 mg/L) was at Blossom Road.

The general decrease in median concentration of total suspended solids for 2000-02 could be due to several factors; such as the stabilization of a length of streambank along Irondequoit Creek in Linear Park; the timing, magnitude, and intensity of precipitation events; and (or) the increased use of stormwater detention basins during construction of new housing developments. In addition, many of the months during 2000-02 with the greatest amounts of precipitation were months when vegetation would have been established, thus, inhibiting the erosion of sediment to streams.

Western Monroe County Sites

Nutrients: The Northrup Creek site, just downstream from the village of Spencerport sewage- treatment plant, had the highest median concentrations of all nutrients, especially phosphorus (0.20 mg/ L) of all sites in western Monroe County (table 13, fig. 16). Median concentrations of ammonia + organic nitrogen at all sites except Black Creek for 2000-02 exceeded those of the previous period of record; Black Creek showed a substantial decrease (0.65 mg/L to 0.06 mg/L) (fig. 16). Nitrite + nitrate concentrations increased at all western Monroe

Table 16. Application rates and amounts of road salt applied to roads of towns in Monroe County, N.Y., water years 2000-02. (data from Monroe County Department of Transportation).

Town	Lane miles	Treated lane miles	Total tons material	Tons per lane mile
Irondequoit Creek Basin				
Pittsford	156	154	5,152	33.5
Henrietta	281	275	8,205	29.8
Irondequoit	285	285	10,450	36.7
Brighton	241	241	8,830	36.6
Penfield	231	226	8,867	39.2
E. Rochester	8.5	8.5	186	21.9
Perinton	210	210	6,548	31.2
Mendon	236	224	6,671	29.8
Webster	311	307	6,549	21.3
Western Monroe County				
Greece	540	538	21,111	39.2
Clarkson	112	73	2,092	28.7
Parma	272	237	6,314	26.6
Gates	147	147	3,579	24.3
Ogden	235	223	4,963	22.3
Sweden	210	167	4,490	26.9
Hamlin	209	160	3,383	21.1
Wheatland	194	176	3,278	18.6
Rush	165	147	2,458	16.7
Riga	185	150	2,465	16.4

County sites whereas those in the Irondequoit Creek basin decreased or stayed the same. Median concentrations of total phosphorus and orthophosphate decreased at Northrup Creek and Honeoye Creek but increased slightly at Oatka Creek and Black Creek. The agricultural subbasins in western Monroe County had lower median concentrations of ammonia + organic nitrogen than the Irondequoit Creek basins and, except for Honeoye Creek, had higher median concentrations of nitrite + nitrate. The median nitrite + nitrate concentration for 2000-02 were considerably higher than those for the preceding period of record at all sites: the median 2000-02 concentrations of all other nutrients at all sites were either similar to, or only slightly greater, than those for the previous period of record.

Chloride and Sulfate: Median concentrations of chloride increased slightly at all sites in western Monroe County after 1999 and ranged from 41 mg/L at Honeoye Creek to 105 mg/L at Northrup Creek. The higher chloride concentrations in the Irondequoit basin are due to the more urban nature of the basin and the greater road density in the Irondequoit basin than in western Monroe County. Except for Northrup Creek (105 mg/L), median chloride concentrations at the western Monroe County basin sites were much lower (41-64 mg/L) than at the Irondequoit Creek basin sites (94-187 mg/L). The lower chloride concentrations at the western monroe County sites are due to the less urbanization and lower road density in this area than in the Irondequoit Creek basin.

The two western Monroe County sites with the lowest concentrations of sulfate — Northrup Creek and Honeoye Creek— showed a slight increase in median concentration for 2000-02 over the previous period of record, while those with the highest concentrations showed slight decreases. Median concentrations of sulfate ranged from 27 mg/L at Honeoye Creek to 245 mg/L at Black Creek.

Suspended Solids: All sites except Oatka Creek at Garbutt showed a decrease in median concentrations of total suspended solids for 2000-02 over the 1997-99 period. Oatka Creek had the lowest concentrations of suspended solids but showed a slight increase for 2000-02. Median 2000-02 concentrations for the four western Monroe County sites ranged from 9 mg/L at Garbutt to 88 mg/L at Northrup Creek. Concentrations were lower than at the Irondequoit Creek sites except Northrup Creek where median concentrations were similar to those in the Irondequoit Creek basin.

Temporal trends

The Irondequoit Creek basin has undergone rapid development over the past few decades, during which agricultural land has been converted to residential development. That process has slowed in some towns in recent years, however. One way to assess the effect of development on surface-water quality within a basin is through statistical trend analysis of chemical constituent concentrations in streams.

A trend, as defined in this report, is a monotonic (overall) change in concentration of a given constituent at a specific sampling site over a specified time period. Trends, regardless of magnitude, were considered statistically significant at $p \leq 0.05$, where p is the probability that an apparent trend resulted from chance arrangement of the data, rather than an actual change in the trend of the data values. A USGS software program called ESTREND (EStimate TREND, Shertz and others, 1991) was used to determine magnitude and direction of trends in constituent concentration. Statistical and graphical techniques are incorporated in ESTREND to overcome some of the common problems inherent in the application of conventional trend tests to water-quality data. ESTREND is based on the Seasonal Kendall test (Hirsch and others, 1982), a nonparametric test that ignores the magnitude of the data and instead uses the ranks of the data. This method is used for constituents where less than 5 percent of the data are below the detection limit. The seasonal Kendall test (Hirsch and others, 1982) is a seasonally adjusted, nonparametric test that compares all possible seasonal pairs of data values and counts the number of times that the later value is higher (positive difference) or lower (negative difference) than the earlier one. Thus, where the seasons are defined as monthly, each October value is compared with every other October value, and each November value is compared to every other November value, etc. An equal number of positive and negative differences would indicate the absence of a trend.

Trends for constituents for which more than 5 percent of the values censored (below the detection limit) are usually tested by either the Seasonal Kendall test for censored data, or the TOBIT test, which is applied when a number of values are at or below one or more detection limits.

An estimate of the rate of change in the trend slope for the period analyzed was computed according to Sen (1968). The trend slope, expressed as the change in original units (such as milligrams per liter) per year, was computed as the median of all pairwise comparisons (each paired difference is divided by the number of years separating the pair of observations). If more than 10 percent of the data were censored, the magnitude of the trend slope was likely to be inaccurate, and the trend was not reported (Lanfear and Alexander, 1990).

Constituent concentrations typically reflect seasonal variations in biochemical or hydrologic processes or in human activities. The seasonal Kendall test accounts for these seasonal differences by allowing comparisons only for the same season of different years. Variability in constituent concentrations resulting from short-term variations in streamflow can be minimized in trend analysis through regression of concentration as a function of flow by use of a LOWESS (locally weighted scatterplot smoothing) procedure (Cleveland, 1979). The LOWESS procedure is a robust method of fitting a smoothed line to bivariate data. The degree of distance weighting is controlled by adjusting the magnitude of the smoothing factor (*f*). The smoothing factor ranges from 0 (an exact match of the data points) to 1 (a straight line through the data). A smoothing factor of 0.5 is generally used for water- quality data (and was used for this analysis) because it tends to give a good fit to the data without masking the essential features of the relation or producing abrupt changes in slope. This regression produces a residual (flow-adjusted concentration) that is then used in the trend test. Occasionally, this flow adjustment is unsuccessful; if so, the trend is reported as a trend in unadjusted concentrations. The techniques used for addressing the effects of seasonal concentration variation, streamflow variation, missing values, and censored data on trend analysis are discussed in detail in Johnston and Sherwood (1996) and Sherwood (1999).

Generally, trend tests produce more reliable results when at least 5 years of data are available (Hirsch and others, 1982). Because the reports in this series represent 3-year periods of data collection, the trend analyses are updated for the entire period of record to include the most recent 3 years of data (2000-02).

Irondequoit Creek Basin Sites

Ten constituents were tested for temporal trends (table 17); results varied by site and constituent. The five nutrients that were tested were ammonia, ammonia + organic nitrogen, nitrite + nitrate, total phosphorus, and orthophosphate; the other five constituents tested for trends were dissolved chloride, dissolved sulfate, turbidity, total suspended solids, and volatile suspended solids. Generally, trends in constituent concentrations were similar to those noted in the 1997-99 report (Sherwood, 2004).

Nitrogen and phosphorus: Ammonia and ammonia + organic nitrogen showed significant downward trends at three of the four Irondequoit Creek basin sites—from 4.6 percent per year at Allen Creek to 12.0 percent per year at Railroad Mills for ammonia, and from 2.8 percent per year at Railroad Mills to 5.3 percent per year at Blossom Road for ammonia + organic nitrogen. Ammonia also showed an upward trend of 3.1 percent per year at East Branch Allen Creek. No trend was noted for ammonia + organic nitrogen at East Branch Allen Creek. Allen Creek also showed downward trends in nitrite + nitrate and total phosphorus of 1.2 percent per year each. Blossom Road showed an upward trend of 1.8 percent per year in orthophosphate (table 17).

Dissolved chloride and dissolved sulfate: Trends in chloride are likely to vary among the study periods and are a function of the rate of road salt application during the winter and the amount of impervious area in the drainage basin. Upward trends in dissolved chloride ranged from 1.9 percent per year at Allen Creek and Blossom Road to 4.8 percent per year at Railroad Mills. Sulfate enters the Irondequoit Creek basin primarily from atmospheric deposition (table 4) and, to a lesser extent, from the dissolution of sulfate-bearing rocks. The only site to currently exhibit a trend in dissolved sulfate was Allen Creek (downward at 0.98 percent per year).

Suspended solids and turbidity: None of the Irondequoit Creek basin sites showed a trend in turbidity, and only Blossom Road showed a trend in suspended solids—a downward trend of 4.0 percent per year. Allen Creek showed an upward trend (3.2 percent per year) and Blossom Road a downward trend (2.2 percent per year) in volatile suspended solids (table 17).

Western Monroe County Sites

Trend analysis of concentrations in Northrup Creek, Genesee River at Charlotte Docks, and Oatka Creek at Garbutt was based on samples collected by the Monroe County Environmental Health Laboratory at Northrup Creek near North Greece and at the Charlotte pump station, 1.6 mi downstream of the discontinued National Stream Quality Accounting Network (NASQAN) site 04232006 on the Genesee River, and at the Oatka Creek streamflow-monitoring site at Garbutt. Streamflow data associated with the Genesee River samples were derived from the USGS streamflow-gaging station about 6 mi upstream from the sampling site.

Northrup Creek showed three statistically significant downward trends—volatile suspended solids (2.5 percent per year), total phosphorus (5.3 percent per year), and orthophosphate (9.9 percent per year (table 18). The continued downward trends in nutrients, particularly phosphorus, are a result of the improved phosphorus removal capabilities of the

Table 17. Statistical summary and results of trend tests for selected constituents at four sites in Irondequoit Creek basin, Monroe County, N.Y., period of record through 2002.

[Dashes indicate greater than 10-percent censoring. n, number of samples for period of record; Q1, 25th percentile; Q3, 75th percentile; n(s), number of seasons used in trend test; n(t), number of samples used in trend analysis; *p*, significance of trend. Units are in milligrams per liter unless otherwise noted. **Bold type** indicates trend is statistically significant at $\alpha = 0.05$. **DN**, downward trend; **UP**, upward trend; **NO**, no trend. All tests were performed on flow-adjusted concentrations. Locations are shown in fig. 1.]

		Descriptive statistics					Trend results					
Constituent and site	Period of record	n	Mean	Q1	Median	Q3	n(s)	n(t)	Percent per year	*p*	Current Trend	Previous Trend
NUTRIENTS												
Ammonia as N, dissolved												
Railroad Mills	**1992-2002**	**378**	**0.016**	**0.01**	**0.01**	**0.01**	**--**	**305**	-12.0	**<0.001**	**DN**	**--**
East Branch Allen Creek	**1991-2002**	**447**	**.035**	**.01**	**.02**	**.04**	**--**	**371**	3.1	**.002**	**UP**	**--**
Allen Creek	**1984-2002**	**1039**	**.036**	**.01**	**.02**	**.04**	**--**	**921**	-4.6	**<.001**	**DN**	**--**
Blossom Road	**1984-2002**	**3193**	**.040**	**.01**	**.01**	**.03**	**--**	**2900**	-9.5	**<.001**	**DN**	**--**
Ammonia + organic nitrogen as N, total												
Railroad Mills	**1992-2002**	**368**	**.591**	**.33**	**.48**	**.70**	**12**	**89**	-2.8	**.017**	**DN**	**NO**
East Branch Allen Creek	1991-2002	440	.763	.53	.70	.91	12	104	-1.8	.366	NO	DN
Allen Creek	**1984-2002**	**1038**	**1.02**	**.69**	**.96**	**1.20**	**12**	**180**	-4.1	**<.001**	**DN**	**DN**
Blossom Road	**1984-2002**	**3140**	**.91**	**.55**	**.78**	**1.10**	**12**	**225**	-5.3	**.001**	**DN**	**DN**
Nitrate + nitrate as N, total												
Railroad Mills	1992-2002	386	1.10	.91	1.10	1.30	12	93	.00	.982	NO	NO
East Branch Allen Creek	1991-2002	455	1.20	.56	1.02	1.70	12	109	-2.5	.201	NO	DN
Allen Creek	**1984-2002**	**1066**	**1.11**	**.78**	**1.06**	**1.40**	**12**	**186**	-1.2	**.004**	**DN**	**DN**
Blossom Road	1984-2002	3148	1.07	.82	1.00	1.30	12	224	-.39	.455	NO	NO
Phosphorus as P, total												
Railroad Mills	1992-2002	614	.113	.04	.07	.14	12	117	-3.0	.230	NO	NO
East Branch Allen Creek	1991-2002	737	.136	.07	.10	.16	12	135	-.62	.536	NO	NO
Allen Creek	**1984-2002**	**1426**	**.132**	**.06**	**.10**	**.16**	**12**	**211**	-1.2	**.020**	**DN**	**NO**
Blossom Road	1984-2002	3238	.145	.05	.09	.16	12	224	-.99	.372	NO	NO
Orthoophosphate as P, dissolved												
Railroad Mills	1992-2002	612	.009	.01	.01	.01	12	118	3.9	.076	NO	UP
East Branch Allen Creek	1991-2002	736	.024	.01	.02	.03	12	135	.06	1.000	NO	NO
Allen Creek	1984-2002	1428	.019	.01	.02	.03	12	211	1.1	.172	NO	NO
Blossom Road	**1984-2002**	**3310**	**.014**	**.01**	**.01**	**.02**	**12**	**224**	1.8	**.032**	**UP**	**NO**

Table 17. Statistical summary and results of trend tests for selected constituents at four Irondequoit Creek basin sites, Monroe County, N.Y., period of record through 2002 (continued)

Constituent and site	Period of record	Descriptive statistics					Trend results				Cur- rent Trend	Previ ous Trend
		n	Mean	Q1	Median	Q3	n(s)	n(t)	Percent per year	p		
OTHER CONSTITUENTS												
Chloride, dissolved												
Railroad Mills	**1992-2002**	**615**	**78**	**62**	**73**	**88**	**12**	**119**	**4.8**	**<0.001**	**UP**	**UP**
East Branch Allen Creek	1991-2002	738	138	77	107	169	12	135	1.8	.113	NO	NO
Allen Creek	**1984-2002**	**1432**	**188**	**106**	**143**	**219**	**12**	**212**	**1.9**	**.011**	**UP**	**UP**
Blossom Road	**1984-2002**	**3208**	**127**	**97**	**112**	**139**	**12**	**224**	**1.9**	**<.001**	**UP**	**UP**
Sulfalte, dissolved												
Railroad Mills	1992-2002	606	178	124	161	227	12	119	.15	.695	NO	NO
East Branch Allen Creek	1991-2002	732	93	60	82	120	12	134	-.65	.612	NO	NO
Allen Creek	**1984-2002**	**1342**	**71**	**53**	**67**	**86**	**12**	**211**	**-.98**	**.045**	**DN**	**DN**
Blossom Road	1984-2002	3117	152	110	146	180	12	224	-.11	.615	NO	DN
Turbidity, NTU												
Railroad Mills	1992-2002	616	36	6.5	17	39	12	118	-3.1	.239	NO	NO
East Branch Allen Creek	1991-2002	736	28	7.4	16	31	12	135	.20	.969	NO	NO
Allen Creek	1984-2002	1061	25	6.0	16	31	12	182	-2.3	.280	NO	NO
Blossom Road	1984-2002	2590	32	5.7	15	32	12	190	-3.6	.190	NO	NO
Total suspended solids												
Railroad Mills	1992-2002	197	176	74	117	202	6	49	1.8	.572	NO	UP
East Branch Allen Creek	1991-2002	209	126	62	92	149	12	82	-2.4	.246	NO	NO
Allen Creek	1984-2002	413	139	63	105	181	12	138	.79	.631	NO	NO
Blossom Road	**1984-2002**	**1015**	**221**	**79**	**137**	**253**	**12**	**194**	**-4.0**	**.012**	**DN**	**DN**
Volatile suspended solids												
Railroad Mills	1992-2002	197	24	12	18	28	--	167	3.4	.130	NO	NO
East Branch Allen Creek	1991-2002	208	19	10	15	21	--	173	-1.9	.156	NO	NO
Allen Creek	**1984-2002**	**413**	**19**	**10**	**16**	**24**	**--**	**365**	**3.2**	**.015**	**UP**	**NO**
Blossom Road	**1984-2002**	**1009**	**27**	**11**	**18**	**30**	**--**	**932**	**-2.2**	**.003**	**DN**	**NO**

Table 18. Statistical summary and results of trend tests for selected constituents at three western Monroe County sites, Monroe County, N.Y., period of record through 2002.

[Dashes indicate greater than 10-percent censoring. n, number of samples for period of record. Q1; 25th percentile; Q3, 75th percentile; n(s), number of seasons used in trend test; n(t), number of samples used in trend analysis; *p*, significance of trend. Units are in milligrams per liter unless otherwise noted. **Bold type** indicates trend is statistically significant at $\alpha = 0.05$. **DN**, downward trend; **UP**, upward trend; **NO**, no trend. All tests were performed on flow-adjusted concentrations. Locations are shown in fig. 1.]

	Descriptive statistics					Trend results					
Site and Constituent	n	Mean	Q1	Median	Q3	n(s)	n(t)	Percent per year	*p*	Current Trend	Previous trend
Northrup Creek 1989-2002											
Turbidity, NTU	923	24	5.3	12	28	12	137	3.1	0.126	NO	NO
Total suspended solids	226	159	71	111	180	6	53	-2.0	.617	NO	NO
Volatile suspended solids	**225**	**23**	**11**	**17**	**25**	**--**	**201**	**-2.5**	**.046**	**DN**	**NO**
Ammonia as N, dissolved	918	.12	.02	.04	.14	--	807	.45	.762	NO	NO
Ammonia + organic nitrogen as N, total	926	1.01	.72	.89	1.2	12	137	-2.0	.217	NO	DN
Nitrite + nitrate as N, total	921	1.56	1.2	1.4	1.8	12	125	.95	.443	NO	NO
Phosphorus as P, total	**920**	**.35**	**.15**	**.25**	**.48**	**12**	**126**	**-5.3**	**.013**	**DN**	**DN**
Orthophosphate as P, dissolved	**925**	**.19**	**.05**	**.11**	**.21**	**12**	**126**	**-9.9**	**.005**	**DN**	**DN**
Chloride, dissolved	930	89	58	77	109	12	137	2.1	.094	NO	NO
Sulfate, dissolved	929	53	42	50	61	12	137	1.6	.054	NO	UP
Genesee River 1990-2002											
Turbidity, NTU	2518	33	5.9	13	35	12	156	3.3	.098	NO	NO
Total suspended solids	644	135	65	101	173	6	61	1.9	.563	NO	NO
Volatile suspended solids	**636**	**11**	**6.0**	**9.0**	**12**	**--**	**597**	**-2.1**	**.002**	**DN**	**NO**
Ammonia as N, dissolved	2476	.13	.07	.11	.16	12	156	-1.4	.293	NO	NO
Ammonia + organic nitrogen as N, total	**2486**	**.66**	**.48**	**.60**	**.76**	**12**	**156**	**-4.5**	**.003**	**DN**	**DN**
Nitrite + nitrate, as N, total	2505	1.04	.74	.95	1.2	12	156	.30	.653	NO	NO
Phosphorus as P, total	2508	.09	.05	.07	.10	12	156	1.4	.184	NO	UP
Orthophosphate as P, dissolved	2514	.02	.01	.02	.03	12	156	3.3	.073	NO	UP
Chloride, dissolved	2517	60	40	51	70	12	156	-4.0	.058	NO	DN
Sulfate, dissolved	2509	73	50	73	92	12	156	.25	.672	NO	NO
Oatka Creek 1996-2002											
Turbidity, NTU	**618**	**7.4**	**2.2**	**3.5**	**6.1**	**12**	**62**	**21.4**	**.022**	**UP**	**--**
Total suspended solids	446	16	6.0	8.0	15	--	--	--	--	--	--
Volatile suspended solids	442	4.9	3.0	3.0	6.0	--	--	--	--	--	--
Ammonia as N, dissolved	620	.02	.01	.01	.02	--	--	--	--	--	--
Ammonia + organic nitrogen as N, total	619	.41	.27	.37	.50	12	62	9.2	.148	NO	--
Nitrite + nitrate, as N, total	620	1.66	1.2	1.6	2.1	12	62	5.2	.203	NO	--
Phosphorus as P, total	619	.05	.02	.03	.05	12	62	3.6	.477	NO	--
Orthophosphate as P, dissolved	616	.01	.01	.01	.01	12	62	1.7	.248	NO	--
Chloride, dissolved	619	52	47	52	58	12	62	6.7	.054	NO	--
Sulfate, dissolved	619	265	141	245	396	12	62	.96	.380	NO	--

Table 19. Equation parameter estimates showing linear dependence of concentration on flow (β_1) and magnitude (β_3), in percent per year, of estimated trends in loads for selected constituents, and R^2 values for concentrations and loads at four sites in the Irondequoit Creek basin, four sites in western Monroe County, and the Genesee River, Monroe County, N.Y., 2000-02.

[**Bold type** indicates figure is statistically significant at $\alpha = 0.05$. Negative value for parameter β_1 indicates dilution effect; positive or negative value for parameter β_3 indicates upward or downward trend, respectively. Conc, concentration. Dashes indicate no/insufficient data. Locations are shown in fig. 1.]

Site	Equation 1 parameter [1]	Constituent: Total suspended solids 00530	Volatile suspended solids 00535	Ammonia as N, dissolved 00608	Ammonia + organic nitrogen as N, total 00625	Nitrite + nitrate as N, total 00630	Phosphorus as P, total 00665	Orthophosphate as P, dissolved 00671	Chloride, dissolved 00940	Sulfate, dissolved 00945
Irondequoit Creek at Railroad Mills	β_1	-0.223	-0.165	0.128	**0.857**	**- 0.087**	**0.941**	**0.207**	**- 0.153**	**- 0.340**
	β_3	**-30.3**	-13.4	15.7	8.66	**4.96**	4.06	**-7.87**	**7.79**	**4.27**
	R^2 Conc	57.5	33.4	17.5	37.4	53.1	30.6	59.0	61.5	84.0
	R^2 Load	68.2	63.1	54.4	82.4	95.5	70.7	92.0	96.9	82.8
East Branch Allen Creek near Pittsford	β_1	**-.143**	-.104	.099	**.184**	**.213**	**.404**	**.373**	**- .166**	**- .302**
	β_3	-7.04	-3.29	9.52	4.85	**-7.54**	**9.26**	-0.44	-1.70	**-8.76**
	R^2 Conc	53.1	38.3	37.3	28.8	69.6	48.3	75.8	66.6	67.8
	R^2 Load	90.1	91.6	75.6	91.3	94.1	89.0	90.6	90.7	87.1
Allen Creek near Rochester	β_1	-.139	-.169	.085	**.148**	.034	**.379**	**.180**	**- .156**	**- .177**
	β_3	**-38.3**	-21.4	**-15.9**	3.83	**-5.46**	3.76	-2.93	2.14	-0.23
	R^2 Conc	30.6	28.0	40.6	22.9	59.4	30.6	69.6	78.8	54.1
	R^2 Load	66.2	76.2	78.8	89.5	95.8	81.8	89.6	95.3	94.2
Irondequoit Creek above Blossom Road	β_1	**0.795**	**.503**	**.509**	**.605**	- .015	**1.16**	**.239**	**- .169**	**- .314**
	β_3	-5.72	3.55	**-16.7**	4.95	-1.28	**-1.84**	**-2.87**	**2.33**	**2.12**
	R^2 Conc	34.8	29.3	14.1	48.2	61.1	60.0	66.5	72.8	84.6
	R^2 Load	69.3	68.8	58.2	89.1	96.7	86.7	89.3	95.6	92.3
Northrup Creek near North Greece	β_1	.180	.110	**.197**	**.153**	**- .201**	**.146**	**- .102**	**- .132**	**- .192**
	β_3	**-32.2**	**-21.9**	**- 15.3**	.50	**6.84**	-6.07	1.58	**-8.36**	.40
	R^2 Conc	48.8	39.7	71.4	47.3	54.0	29.9	82.8	85.4	67.2
	R^2 Load	86.8	87.9	84.2	91.3	94.3	75.9	84.9	96.3	94.3
Genesee River at Charlotte Pump station	β_1	**1.41**	**1.11**	**- .320**	**.106**	**.062**	**.671**	**.143**	**- .205**	**- .271**
	β_3	-6.69	-6.70	**20.5**	**5.47**	**6.82**	**9.86**	**4.30**	**5.28**	**4.24**
	R^2 Conc	55.9	50.6	45.4	17.4	72.7	67.2	42.6	51.4	70.3
	R^2 Load	83.9	84.3	64.2	90.8	97.7	94.6	88.4	94.7	93.4
Black Creek at Churchville	β_1	--	--	**-.128**	**.108**	**.306**	**.143**	**.210**	**- .126**	**- .242**
	β_3	--	--	**-10.7**	1.40	-4.23	-3.67	**-10.4**	**8.49**	**3.04**
	R^2 Conc	--	--	41.1	29.4	82.4	43.1	53.7	74.2	85.9
	R^2 Load	--	--	77.4	97.5	97.3	94.8	93.3	99.3	96.2
Oatka Creek at Garbutt	β_1	**.786**	**.544**	**.481**	**.575**	**.178**	**.636**	**.927**	**- .112**	**- .417**
	β_3	3.52	-6.08	**-20.4**	4.11	**16.1**	5.16	**-5.14**	**4.17**	1.35
	R^2 Conc	43.9	31.6	38.3	53.4	86.8	46.2	62.1	37.4	92.8
	R^2 Load	84.1	82.2	81.0	93.0	98.9	91.0	92.9	98.3	91.0
Honeoye Creek at Honeoye Falls	β_1	--	--	**- .192**	**.083**	**.321**	**.158**	**.062**	**- .144**	**- .098**
	β_3	--	--	**24.7**	**10.1**	.89	**13.7**	4.84	**5.77**	**-7.49**
	R^2 Conc	--	--	46.0	37.3	68.9	45.3	59.9	64.3	60.0
	R^2 Load	--	--	91.1	97.4	95.6	96.5	96.2	99.3	98.1

[1] β_1 estimates were retransformed from log units as $(e^{\beta 1} - 1)$; β_3 estimates were retransformed from log units as $100\,(e^{\beta 3} - 1)$.

wastewater-treatment plant upstream from the sampling site which were implemented in August 1995 (Sherwood, 1999).

The Genesee River showed only two significant trends; volatile suspended solids and ammonia + organic nitrogen showed downward trends of 2.1 percent per year and 4.5 percent per year, respectively. Trends noted for the Genesee River in this report should not be compared with trends published in reports prior to 1994, however, because those previously reported trends were based on data collected at a different sampling location (the discontinued NASQAN site), at different sampling frequencies, and by different sampling methods. This report represents the first period that Oatka Creek has had sufficient record length (greater than 5 years) to make trend analysis possible. Turbidity at this site showed an upward trend of 21.4 percent per year. Data on suspended solids, volatile suspended solids, and ammonia at this site were insufficient for trend analysis.

Chemical Loads and Yields

Chemical load calculations provide an estimate of the amount (mass per unit of time) of a given constituent moving past a given point (gaging station) or into a receiving body of water. Chemical loads presented in this report were calculated by the ESTIMATOR program (Cohn and others, 1992), which uses multivariate linear regression to develop a quantitative relation between periodic constituent concentrations and daily streamflows. The regression is used to estimate daily concentrations, which are then used with daily streamflow values to estimate daily constituent loads. ESTIMATOR uses a minimum-variance unbiased estimator (MVUE) procedure to correct for log-retransformation bias (Cohn and others, 1989); it also uses an adjusted maximum-likelihood estimator (AMLE) of the moments of lognormal populations to estimate values for censored data.

The ESTIMATOR program estimates constituent concentration from equation 1, in which streamflow, time, and seasonal indicators (sine and cosine transformations of time) serve as explanatory variables to remove the effects of seasonality in the data. The program then computes daily loads (eq. 2), applies the MVUE bias correction to those daily estimates, and finally sums those estimates to obtain monthly and annual totals.

$$\ln[C] = \beta_0 + \beta_1 \ln[Q/\tilde{Q}] + \beta_2\{\ln[Q/\tilde{Q}]\}^2 + \beta_3[T/\tilde{T}] + \beta_4[T/\tilde{T}]^2 + \beta_5 \sin[2\pi T] + \beta_6 \cos[2\pi T] + \varepsilon \quad (1)$$

where:

C = constituent concentration, in milligrams per liter,

Q = discharge at time of sample collection, in cubic feet per second,

T = time, in years,

ε = error (assumed to be independent and normally distributed with a mean and variance of zero),

ß's = parameters of the equation that must be estimated from the data, and,

Q, T = centering variables that simplify the numerical work and have no effect on the load estimates.

The corresponding load L is given by

$$L = KQ\exp(\beta_0 + \beta_1 \ln[Q/\tilde{Q}] + \beta_2\{\ln[Q/\tilde{Q}]\}^2 + \beta_3[T/\tilde{T}] + \beta_4[T/\tilde{T}]^2 + \beta_5 \sin[2\pi T] + \beta_6 \cos[2\pi T] + \varepsilon) \quad (2)$$

where:

K = conversion factor,

Q = daily mean discharge, in cubic feet per second, and all other variables are as defined for equation 1.

The precision of the estimated loads can be described in terms of a confidence interval that is based on the estimated mean and the standard error of prediction. At the 95-percent confidence interval ($\alpha = 0.05$), the confidence limits are the estimated load ± 1.96 times the standard error of prediction. The value 1.96 is from a statistical table for a Student's t-distribution at the $\alpha/2$ quantile with a large number of samples (more than 250). If, for example, the monthly load estimated for chloride was 145 tons, and the standard error of prediction was 12 tons, the approximate 95-percent confidence limits would be:

145 ± (1.96 x 12) = 121.5 to 168.5 tons.

The wider the confidence limits, the greater the uncertainty and, hence, the less reliable the load estimates. A more detailed explanation of the MVUE method is given in Cohn and others (1992).

Knowledge of trends in the loads of chemical constituents carried by streams and their tributaries is important in assessing the effectiveness of management practices already in use and in evaluating the effect of land-use changes within the basin on downstream bodies of water. Some of the parameter estimates (coefficients) for the terms of the equation used to calculate concentrations (eq. 1) can be directly related to basin characteristics or to physical process. For example, β_1, which corresponds to the linear dependence of concentration on streamflow, may depend on the source of the constituent— negative values indicate a dilution effect, suggesting point sources; near-zero values imply no effect from dilution, as is characteristic of some dissolved constituents; and positive values are generally indicative of sediment-related nonpoint sources. The value of β_3 corresponds to the magnitude of the log-linear component of the upward or downward time trends in constituent load. R^2 (coefficient of variation) of the concentration is the amount of variability explained by the equation for the logarithm of concentration, and R^2 of the load is the amount of variability explained by the equation for the logarithm of load. The dependence of concentration on flow (β_1), the direction and magnitude of trends in loads ($ß_3$), and coefficients of variation (R^2) for concentration and load are summarized in table 19.

Four sites—East Branch Allen Creek, Irondequoit Creek above Blossom Road, Genesee River, and Oatka Creek—showed statistically significant flow-related coefficients ($ß_1$ values) for total suspended solids and volatile suspended solids for water years 2000-02 (table 19). The relatively large $ß_1$ coefficients for these constituents at three of these sites (Blossom Road, Genesee River, and Oatka Creek) indicate a positive dependence on flow and, thus, a nonpoint source for these constituents. The $ß_1$ coefficients for dissolved chloride and dissolved sulfate at all sites indicate a significant negative dependence on flow, which implies a strong probability of point sources for these constituents. The negative dependence on flow for chloride however, is most likely a result of dilution, particularly during the warm months, since chloride and sulfate are associated with increased runoff. The $ß_1$ coefficients for phosphorus and orthophosphate, except for orthophosphate at Northrup Creek, indicate to varying degrees a positive dependence on streamflow, which suggests either a nonpoint source or a mixture of contributions from point and nonpoint sources for these nutrients. The $ß_1$ value for orthophosphate at Northrup Creek indicates a combination of sources with a strong input from a point source. $ß_1$ values for the nitrogen species indicate a mix of point and nonpoint sources for these nutrients at the study sites. $ß_1$ values for ammonia and ammonia + organic nitrogen appear to be dependent on flow at Blossom Road and Oatka Creek, and at Railroad Mills for ammonia + organic nitrogen. $ß_1$ values for nitrite + nitrate seem to indicate a mixture of point and non point sources at all sites.

Total suspended solids and volatile suspended solids showed few statistically significant trends at the seven sites from which data was sufficient for analysis. Those trends are all large—the negative trends range from -38.3 percent per year for suspended solids at Allen Creek to -21.9 percent per year for volatile suspended solids at Northrup Creek. Significant trends for chloride and sulfate were mixed; with some sites showing upward trends and some showing downward trends. None, however, were very large; the values ranged from a downward trend of 8.76 percent per year for sulfate at East Branch Allen Creek to an upward trend of 8.49 percent per year for chloride at Black Creek. The significant trends for nutrients also were mixed, upward at some sites, and downward at others. Ammonia showed the largest trends, which ranged from -20.4 percent per year at Blossom Road to +24.7 percent per year at Honeoye Creek. The Genesee River was the only site to show significant trends (all upward) for all nutrients.

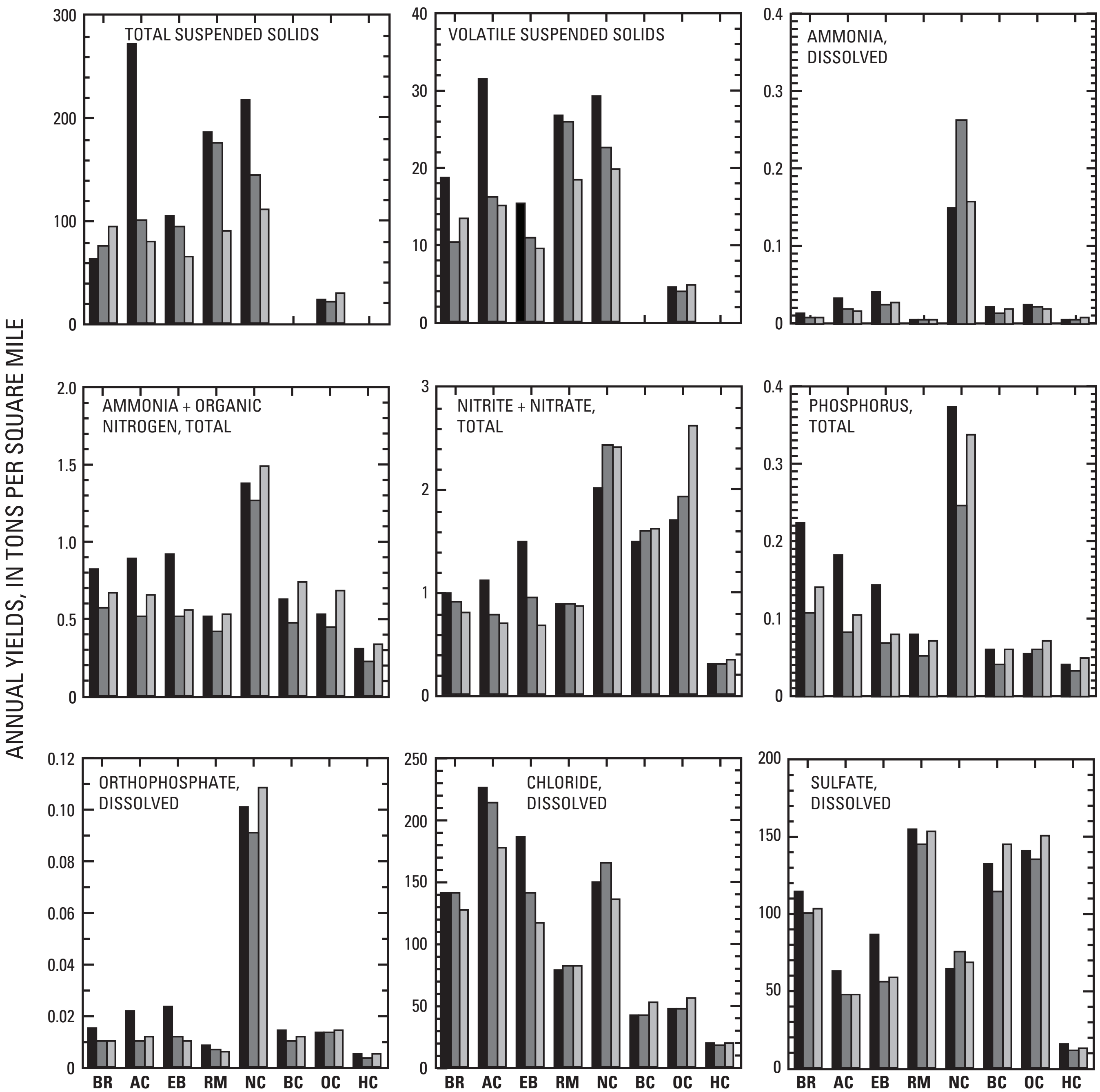
The loads of most constituents generally are greatest during the spring (February through May), when snowmelt and spring rains cause high runoff. The constituents that were analyzed for total concentration (suspended and dissolved), such as ammonia + organic nitrogen, nitrite + nitrate, and total phosphorus, had the greatest loads at these times. The dissolved constituents, such as orthophosphate, ammonia, chloride, and sulfate, vary with flow to a far lesser degree and, generally are diluted by high flows; although the large volumes of flow during spring are usually enough to produce large loads of these constituents, despite dilution.

Irondequoit Creek Basin Sites

Total annual chemical loads entering Irondequoit Bay from the Irondequoit Creek basin are estimated by multiplying the calculated loads for Irondequoit Creek at

Table 20. Annual loads (A) and percentage (B) of selected constituents transported by Irondequoit Creek to Irondequoit wetlands, Monroe County, N.Y., water years 2000-02, and percentage of total annual load transported from February through May.

	Constituent									
Water year or period	Total Suspended solids 00530	Volatile suspended solids 00535	Ammonia, dissolved 00608	Ammonia + organic nitrogen, total 00625	Nitrite + nitrate, total 00630	Phosphorus, total 00665	Orthophosphate, dissolved 00971	Chloride dissolved 00940	Sulfate dissolved 00945	Annual runoff (inches)
A. Annual loads (multiplied by 1.10 to account for drainage area between Empire Boulevard and mouth of the creek)										
2000	13,600	1,780	6.67	118	150	24.7	2.99	23,800	18,300	13.92
2001	7,300	1,080	3.02	93.0	140	14.8	1.91	23,700	15,700	11.84
2002	8,100	1,380	1.38	96.0	108	16.0	1.70	19,100	14,600	11.24
2000-02 (Mean)	9,700	1,410	3.69	102	133	18.5	2.20	22,200	16,200	12.33
1984-99 (Mean)	25,400	3,210	5.62	145	172	23.7	2.34	18,900	17,600	12.86
B. Percentage of total annual loads transported from February through May (spring snowmelt and runoff period)										
2000	54	51	43	54	54	52	31	54	40	54
2001	59	55	47	58	59	54	36	59	44	59
2002	60	57	46	57	57	56	37	56	43	58
2000-02 (Mean)	58	54	45	56	57	54	35	56	42	57
1984-99 (Mean)	50	46	47	49	52	46	32	50	40	44



EXPLANATION

2000 2001 2002

Irondequoit Creek basin		**Western Monroe County**	
BR	Irondequoit Creek above Blossom Road	NC	Northrup Creek at North Greece
AC	Allen Creek near Rochester	BC	Black Creek at Churchville
EB	East Branch Allen Creek at Pittsford	OC	Oatka Creek at Garbutt
RM	Irondequoit Creek at Railroad Mills	HC	Honeoye Creek at Honeoye Falls

Figure 18. Annual yield of selected constituents at four sites in the Irondequoit Creek basin and four sites in western Monroe County Monroe County, N. Y., water years 2000-02. (Locations are shown in fig. 1.)

Table 21. Mean annual yield of selected constituents at the four Irondequoit Creek basin sites and the four western Monroe County sites, Monroe County, N. Y., for indicated water years.
[All values are in tons per square mile, unless otherwise noted. Dashes indicate no/insufficient data: Locations are shown in fig.1.]

Water year	Total suspended solids 00530	Volatile suspended solids 00535	Ammonia, dissolved 00608	Ammonia + organic nitrogen, total 00625	Nitrite + nitrate, total 00630	Phos-phorus, total 00665	Ortho-phosphate, dissolved 00671	Chloride, dissolved 00940	Sulfate, dissolved 00945	Runoff, in inches
Irondequoit Creek above Blossom Road										
1984-88	170	19.0	0.038	1.13	1.15	0.138	0.015	99.7	112	12.67
1989-93	277	35.1	.030	1.18	1.09	.240	.010	115	111	13.88
1994-96	143	17.7	.013	.64	.91	.140	.011	114	106	11.54
1997-99	250	21.7	.017	.61	1.00	.220	.013	123	109	13.27
2000-02	**77.2**	**14.1**	**.008**	**.69**	**.89**	**.150**	**.012**	**136**	**105**	**12.33**
Allen Creek										
1984-88	143	17.4	.044	1.26	1.30	.146	.021	161	72.1	13.86
1989-93	117	19.0	.040	1.06	1.14	.140	.020	173	60.4	13.64
1994-96	142	17.9	.018	.67	.91	.110	.018	178	51.4	11.12
1997-99	132	16.4	.020	.60	1.04	.160	.023	173	49.8	13.26
2000-02	**150**	**20.8**	**.023**	**.68**	**.85**	**.123**	**.015**	**205**	**51.5**	**11.34**
East Branch Allen Creek										
1991-93	199	28.5	.050	1.34	2.45	.260	.030	136	102	19.62
1994-96	164	21.3	.042	1.05	1.71	.170	.033	143	97.0	15.84
1997-99	112	16.3	.027	.55	1.42	.160	.027	121	67.1	17.45
2000-02	**88.2**	**11.9**	**.030**	**.66**	**1.03**	**.097**	**.015**	**148**	**65.8**	**10.77**
Irondequoit Creek at Railroad Mills										
1992-93	124	16.9	.010	.62	.73	.100	.010	42.3	124	15.68
1994-96	173	20.3	.010	.55	.99	.100	.007	62.8	255	12.02
1997-99	190	23.2	.017	.49	1.08	.123	.010	76.9	154	13.77
2000-02	**150**	**23.6**	**.004**	**.48**	**.88**	**.068**	**.007**	**80.2**	**150**	**11.17**
Northrup Creek										
1990-93	240	30.8	.160	1.37	1.55	.380	.180	84.1	48.3	15.09
1994-96	246	29.6	.210	1.05	1.57	.320	.130	107	54.6	14.22
1997-99	159	20.5	.207	1.10	1.82	.290	.090	121	66.8	18.54
2000-02	**157**	**23.8**	**.190**	**1.37**	**2.26**	**.319**	**.100**	**150**	**68.8**	**15.93**
Black Creek										
1999	--	--	.014	.37	1.03	.041	.012	27.0	91.0	--
2000-02	**--**	**--**	**.017**	**.62**	**1.56**	**.053**	**.012**	**45.0**	**129**	**11.03**
Oatka Creek										
1998-99	48.0	9.6	.038	.58	1.94	.026	.001	44.3	116	--
2000-02	**24.3**	**4.3**	**.021**	**.55**	**2.06**	**.062**	**.014**	**49.6**	**141**	**12.90**
Honeoye Creek										
1999	--	--	.004	.14	.20	.026	.004	12.3	8.54	--
2000-02	**--**	**--**	**.005**	**.28**	**.31**	**.041**	**.004**	**18.8**	**12.5**	**6.75**

Table 22. Annual constituent loads with associated error and annual yield, for Genesee River at Charlotte Pump Station, Monroe County, N.Y., water years 2000-02.

Constituent	2000		2001		2002		Yield		
	Load	Error	Load	Error	Load	Error	2000	2001	2002
Total suspended solids	266	56.5	212	41.4	191	37.0	108	85.9	77.4
Volatile suspended solids	18.6	3.86	15.8	3.10	13.8	2.72	7.54	6.40	5.59
Ammonia as N, dissolved	.199	.024	.188	.022	.279	.033	.081	.076	.113
Ammonia + organic nitrogen as N, total	1.67	.15	1.25	.11	1.74	.151	.677	.507	.705
Nitrite + nitrate as N, total	2.82	.14	2.63	.12	3.08	.143	1.14	1.07	1.25
Phosphorus as P, total	.31	.031	.22	.020	.34	.031	.126	.089	.138
Orthophosphate as P, dissolved	.051	.005	.035	.003	.052	.005	.021	.014	.021
Chloride, dissolved	110	5.82	99.3	5.04	117	6.01	44.6	40.2	47.4
Sulfate, dissolved	143	6.70	117	5.32	147	6.85	58.0	47.4	59.6

Empire Boulevard by 1.10 (Coon, 2000) to account for the additional drainage area between Empire Boulevard and the bay. Previous reports in this series (through 1993) based constituent-load estimates on those calculated for Irondequoit Creek at Blossom Road, multiplied by 1.17 to account for the intervening area between the gaging station and the mouth of the creek. Those calculations provided a reasonably accurate estimate of the loads of some, but not all constituents entering the bay. The intervening area calculation tended to overestimate loads of particulate constituents such as total suspended solids, volatile suspended solids, total phosphorus, and ammonia + organic nitrogen, and to underestimate the loads of certain dissolved constituents, such as ammonia and orthophosphate. The overestimation of particulate-constituent loads results from the settling of these constitutents in the wetland between Blossom Road and Empire Boulevard, and the underestimation of ammonia and orthophosphate results from the conversion of nitrogen and phosphorus to these constituents within the wetland. The loads of chloride and sulfate estimated from the Empire Boulevard data were consistent with those estimated previously from the Blossom Road data because these constituents are little changed by chemical or biological activity in the wetland. Residence times of constituents in Irondequoit Bay range from several months to several years (Bubeck and Burton, 1989); thus, a minor change in load of some of the conservative constituents could have a major effect on water quality of the bay because those constituents tend to accumulate in the sediments of the bay, where they are subject to resuspension and release when these sediments are disturbed.

Annual loads of constituents transported to Irondequoit Bay by Irondequoit Creek were generally consistent with annual runoff (table 20A)—the greatest annual loads occurred during 2000, when the runoff was highest (13.92 in.) although the percentage of loads carried during the spring snowmelt and runoff period that year was lower than during the 2001-02 water years because much of the high runoff occurred outside the usual high-runoff period. Percentages of each constituent transported during the high-flow period were fairly consistent over the 3-year period, however (table 20B).

Mean annual 2000-02 yields at the four Irondequoit Creek basin sites (table 21) generally were comparable to those of previous report periods and from site to site, although the yields of some constituents were lower than in previous periods because of the generally lower runoff. Mean annual yields of all constituents at East Branch Allen Creek have remained low since the installation of the Jefferson Road stormflow-detention basin, 1.1 mi upstream from the monitoring site during the summer of 1995. The stormwater stored in the detention basin during high flows is released slowly to East Branch Allen Creek and is used for irrigation downstream during the summer. Detention basins have been shown to reduce concentrations of contaminants contained in storm runoff (Zarriello and Sherwood, 1992 and Sherwood, 2001).

Yields of chloride for 2000-02 at all Irondequoit Creek sites were higher than for any previous report period, despite the generally lower runoff in 2000-02. The high yields probably reflect an increased use of road salt during the winter months in an effort to maintain bare road surfaces. Chloride loads transported by Irondequoit Creek at Blossom Road for 2000-02 (57,842 tons, see appendix), closely match the amount of road salt applied to the roads throughout the Irondequoit Creek basin (61,458 tons, table 14) during that period.

Western Monroe County Sites

Mean annual yields of nutrients at Northrup Creek for water years 2000-02 were higher than at any of the other western Monroe County sites. Yields of nitrite + nitrate have shown a steady increase since data collection began, whereas yields of orthophosphate have generally declined, and yields of other nutrients have remained nearly constant. The lower mean annual yield of orthophosphate for 2000-02 than for previous periods is a continued indication of the improved phosphorus treatment that was implemented at the Spencerport sewage-treatment plant in the summer of 1995. The apparent lack of more improvement for total phosphorus yields is a result of the increased daily mean streamflows for the years after phosphorus control. Total phosphorus, which adheres to suspended particulate matter, generally shows a positive correlation with streamflow. The relatively high nutrient yields in Northrup Creek than in the Irondequoit Creek basin are derived primarily from sewage-treatment-plant discharge upstream from the sampling site and, to a lesser extent, from agricultural runoff and fertilizers, as well as from the New York State Barge Canal, septic systems, and atmospheric deposition. Mean annual 2000- 02 yields of total suspended solids and volatile suspended solids for Northrup Creek (157 ton/mi^2 and 23.8 ton/mi^2 , respectively) were about the same as for the 1997-99 period and considerably lower than for the two previous periods (table 21). Mean annual 2000-02 yields of chloride and sulfate for Northrup Creek were higher than for the three previous periods as a result of the greater runoff during that period. Mean annual yields of chloride at Black Creek, Oatka Creek, and Honeoye Falls were much lower than those at Northrup Creek and about the same as those in the Genesee River (table 22). The high chloride yields at Northrup Creek, like the high nutrient yields, may be result of discharge from the Spencerport sewage-treatment plant.

Annual loads of constituents in the Genesee River (table 22) were estimated from streamflow data collected at the Genesee River gaging station at Rochester (04232000) and concentration data collected at the Charlotte pump station, about 5 mi downstream (fig 1). Yields for all constituents were within the range of those noted for the other sites in Monroe County. Loads and yields of suspended and volatile solids for water year 2000-02 were consistent with those noted for the 1999 water year, but were considerably lower than those for 1997-98. Annual mean flow for the Genesee River for the 2000-02 period was 2,396 ft^3/s, which is 15 percent below the long-term annual mean of 2,800 ft^3/s.

Summary and Conclusions

Many years of systematic collection of hydrologic data in Monroe County have provided a foundation for a comprehensive assessment of the county's water resources. Long-term records of precipitation and unregulated streamflow provide the basis for determining the normality of much shorter periods of record, such as the 2000-02 water-year period analyzed in this report. In 1993, the U. S. Geological Survey in cooperation with the Monroe County Health Department, began a long-term program to analyze and interpret hydrologic data collected at selected sites in Monroe County. This report, is one of a series of reports representing three years (2000-02) of data collection.

Precipitation records collected by the National Weather Service at Rochester indicate that average annual rainfall for 2000-02 was 33.11 in., 0.94 in. below normal. Precipitation for 2000 was 4.8 in. above normal, whereas that for 2001 and 2002 was below normal (4.75 in. and 2.84 in. respectively). Several months of higher-than-normal precipitation during the spring and summer contributed to the above- normal total for 2000. Annual yields of chemicals deposited on the Irondequoit Creek basin from atmospheric sources during 2000-02 were generally lower than during the previous (1984-99) report periods; decreases ranged from 2 percent for nitrite + nitrate to 41 percent for dissolved magnesium. Constituents that showed increases over the period-of-record means were dissolved sodium (56 percent), zinc (54 percent), and ammonia (8 percent). Loads of all nutrients deposited in the Irondequoit Creek basin from atmospheric sources during 2000-02 greatly exceeded those transported by Irondequoit Creek. The ammonia load deposited in the basin was 165 times the load transported at Blossom Road (the most downstream site); the ammonia + organic nitrogen load was 2.8 times greater, orthophosphate 9.7 times greater, total phosphorus 1.2 times greater and the nitrite + nitrate load was 1.6 times greater. Average yields of dissolved chloride and dissolved sulfate from atmospheric sources were much less than those transported by streamflow at Blossom Road—chloride was about 1.5 percent and sulfate about 9.1 percent of the amount deposited

Water-level data from observation wells in Ellison Park indicate frequent reversals in direction of lateral flow toward or away from Irondequoit Creek, as well as vertically within the sand and gravel aquifer. Trend analysis of water levels in Ellison Park wells for the period of record through 2002 showed upward trends of 0.6 percent per year at well Mo 3 (finished in the lower confined part of the aquifer), and 4.9 percent per year at Mo 667 (finished in the upper unconfined part of the aquifer).

Trend analysis of chemical constituent concentrations in Ellison Park wells showed a total of 86 statistically significant trends. The wells with the highest number of significant trends were Mo 3 and Mo 668; each showed a total of 12 trends, of which 9 and 10 respectively, were downward. All wells except Mo 659 and Mo 665 showed more downward than upward trends. Nitrite + nitrate was the constituent with the greatest number of trends—upward in four wells, and downward in five wells. Total phosphorus was the constituent with the least number of trends—upward in two wells and downward in 1 well. Common ions were the constituents that showed the greatest number of trends among wells, and nutrients showed the fewest.

The 2000-02 mean monthly streamflows for the four monitored streams in the Irondequoit Creek basin were generally within the normal range (25th to 75th percentile), except for November, which was below the 25th percentile, and April and May which were near or above the 75th percentile. Flows of Black Creek at Churchville indicate that streamflow at the four monitored sites in western Monroe County was within the normal range (25th to 75th percentile) for all months except May. Trend analysis of the monthly mean flows at four Irondequoit Creek basin sites, at Northrup

Creek, and at Oatka Creek at Garbutt indicated downward trends at Allen Creek (1.24 percent per year) and Irondequoit Creek at Railroad Mills (1.72 percent per year) for the period during which water-quality data have been collected at these sites.

Streamflow temperatures in the Irondequoit Creek basin were typical of the large, low-gradient streams in New York. Maximum daily temperatures during 2000-02 exceeded 22.0° C on many days during the summer at all sites, but daily mean temperatures for those days generally were lower than 22.0° C, and those at Railroad Mills never exceeded that limit. No minimum temperatures at any of the sites exceeded 22.0° C.

Some differences in median concentration of constituents were noted among the Irondequoit Creek sites as well as between time periods. Among the nutrients, nitrite + nitrate showed the greatest range in concentration, from 0.88 mg/L at Allen Creek to 1.1 mg/L at Irondequoit Creek at Railroad Mills. The highest median concentration of ammonia + organic nitrogen (0.70 mg/L) was at East Branch Allen Creek, and the lowest (0.48 mg/L) was at Railroad Mills. Median concentrations of total phosphorus ranged from 0.055 mg/L to 0.091 mg/L, whereas those for orthophosphate ranged from 0.008 mg/L to 0.016 mg/L. The highest median concentration of chloride (187 mg/L) occurred at Allen Creek, and the highest median concentration of sulfate (183 mg/L) was at Irondequoit Creek at Railroad Mills. Median concentrations of these constituents for 2000-02, were higher than for previous reporting periods and showed statistically significant differences among most of the sites. Median concentrations of total suspended solids were highest at Railroad Mills (110 mg/L) and Allen Creek (95 mg/L). Median concentrations of total phosphorus and orthophosphate in Northrup Creek were higher than those found at the Irondequoit Creek basin sites and other western Monroe County sites, but lower than during previous reporting periods because of the improved removal of phosphorus upstream at Spencerport. Median concentrations of ammonia, ammonia + organic nitrogen and nitrite + nitrite increased slightly at Northrup Creek.

Period-of-record trends for constituents at sites in the Irondequoit Creek basin differed from site to site and in magnitude and direction. Ammonia showed statistically significant downward trends in concentration at three of the four Irondequoit Creek basin sites—Railroad Mills, Blossom Road, and Allen Creek showed downward trends ranging from 12.0 percent per year to 4.6 percent per year, respectively, and an upward trend of 3.1 percent per year at East Branch Allen Creek. Ammonia + organic nitrogen showed statistically significant downward trends at three of the four Irondequoit sites, ranging from 5.3 percent per year at Blossom Road to 2.8 percent per year at Railroad Mills.

Dissolved chloride showed upward trends at three of the Irondequoit Creek basin sites ranging from 1.9 percent per year at Allen Creek and Blossom Road to 4.8 percent per year at Railroad Mills. Dissolved sulfate showed a downward trend of 0.98 percent per year at Allen Creek.

Northrup Creek showed statistically significant downward trends in total phosphorus (5.3 percent per year), orthophosphate (9.9 percent per year), and volatile suspended solids (2.5 percent per year). The Genesee River showed downward trends in ammonia + organic nitrogen (4.5 percent per year) and volatile suspended solids (2.1 percent per year). Oatka Creek at Garbutt showed no statistically significant trends in any of the constituents.

Loads of chemical constituents transported to Irondequoit Bay during 2000-02 were generally smaller than those for 1997-99. Total suspended solids were transported at the rate of 9,700 ton/yr, nearly 15 percent (1,410 tons) of which volatile suspended solids. Nutrient transport to the bay averaged 102 ton/yr for ammonia + organic nitrogen, 133 ton/yr for nitrite + nitrate, 3.69 ton/yr for ammonia, 18.5 ton/ yr for total phosphorus, and 2.20 ton/yr for orthophosphate. Dissolved chloride transported to the bay averaged 22,200 ton/yr, and sulfate transported averaged 16,200 ton/yr.

Mean annual yields of all constituents for the four Irondequoit Creek basin sites were lower than, or within the range of previous reporting periods, except for chloride which increased at all sites. Yields of ammonia + organic nitrogen (0.48 to 0.69 tons/mi^2) and nitrite + nitrate (0.85 to 1.03 tons/mi^2) were fairly uniform through out the basin. Allen Creek had the highest mean annual yield of chloride (205 tons/mi^2) and with Irondequoit Creek at Railroad Mills the highest yield of suspended solids (150 tons/ mi^2). Irondequoit Creek at Railroad Mills had the highest yield of sulfate (150 tons/mi^2). Northrup Creek had the highest yields of all nutrients among the western Monroe County sites and the Irondequoit basin sites. Mean annual yield of chloride (150 tons/mi^2) at Northrup Creek was higher than at any of the other western Monroe County sites, but was within the range found in the Irondequoit basin. The high yields of nutrients at Northrup Creek are a result of the discharge from an upstream wastewater-treatment plant and, to a lesser extent, agricultural runoff. The yields of all constituents except ammonia, ammonia + organic nitrogen, and chloride at East Branch Allen Creek continued to decrease as a result of the Jefferson Road stormwater-detention basin. Annual yields of constituents in the Genesee River were within the range of those found at Northrup Creek and the Irondequoit basin sites.

Streamwater quality during 2000-02 was generally similar to that of the previous periods of record, but with some differences. Dissolved chloride showed a significant increase in median concentration over the previous period of record at all sites. Northrup Creek continued to have the highest concentrations of all nutrients and median concentrations of the nitrogen species for 2000-02 increased, whereas those for phosphorus continued to decline.

Review of the 2000-02 data revealed some differences in water quality from basin to basin. Northrup Creek had the highest concentrations of nutrients, whereas Irondequoit Creek at Railroad Mills, with the exception of nitrite +

nitrate, had the lowest. Irondequoit Creek at Railroad Mills, which is largely agricultural, had the lowest concentrations of chloride and the highest concentrations of sulfate. Allen Creek, the most urbanized of the subbasins, had the highest concentrations of chloride. Northrup Creek had the highest nutrient yields of any of the sites, but these yields are attributable to sewage-treatment plant releases.

Water-quality management practices and improved treatment, or diversion, of sewage-treatment plant effluent, continue to decrease the median concentration of some constituents (particularly nutrients) in surface water throughout Monroe County. The 2000-02 loads of most constituents delivered to Irondequoit Bay were greater than during previous reporting periods because the flows were greater, but the concentrations of those constituents during 2000-02 were lower than before.

Acknowledgments

Special thanks are extended to the personnel of MCEHL for assistance in the collection, analysis, and verification of the data presented herein, and in particular, to Charles Knauf for his suggestions and guidance in preparing this report. Thanks are also extended to Tongyan Li of the Monroe County Planning Department for supplying the land-use statistics for Monroe County and to Karen Paris-Tuori of the Monroe County Department of Health and Tim Frelier of the Monroe County Department of Transportation for supplying the statistics on road salt usage.

References Cited

Bubeck, R.C. and Burton, R.S., 1989, Changes in chloride concentrations, mixing patterns, and stratification characteristics of Irondequoit Bay, Monroe County, New York, after decreased use of road-deicing salts, 1974-84: U.S. Geological Survey Water-Resources Investigations Report 87-4223, 52 p.

Cleveland, W.S., 1979, Robust locally weighted regression and smoothing scatterplots: Journal of the American Statistical Association, v. 74, p. 829-836.

Cohn, T.A., DeLong, L.L, Gilroy, E.J., Hirsch, R.M., and Wells, D. K., 1989, Estimating constituent loads: Water Resources Research, v. 25, no. 5, p. 937-942.

Cohn, T.A., Caulder, D.L., Gilroy, E.J., Zynjuk, L.D., and Summers, R. M., 1992, The validity of a simple statistical model for estimating fluvial constituent loads—an empirical study involving nutrient loads entering Chesapeake Bay: Water Resources Research, v. 28, no. 9, p. 2353-2363.

Coon, W.F., 1996, Hydrology, sedimentology, and biology of Ellison Park wetland at the mouth of Irondequoit Creek near Rochester, New York: U.S. Geological Survey Water-Resources Investigations Report 96-4269, 41 p.

Coon, W.F., 2000, Effects of a cattail wetland on water quality of Irondequoit Creek near Rochester, New York: U.S. Geological Survey Water-Resources Investigations Report 00-4032, 74 p.

Gray, J.R., Glysson, G.D., Turcios, L.M., and Schwarz, G.E., 2000, Comparability of suspended- sediment concentration and total suspended solids data: U.S. Geological Survey Water-Resources Investigations Report 00-4191, 13 p.

Heffner, R.L., and Goodman, S.D., 1973, Soil survey of Monroe County, New York: U.S. Department of Agriculture, 172 p.

Hirsch, R.M., Slack, J.R., and Smith, R.A., 1982, Techniques of trend analysis for monthly water quality data: Water Resources Research, v. 18, no. 1, p. 107-121.

Johnston, W.H., and Sherwood, D.A., 1996, Water resources of Monroe County, New York, water years 1984-88, with emphasis on water quality in the Irondequoit Creek basin, part 2: U.S. Geological Survey Water-Resources Investigations Report 96-4054, 84 p.

Kappel, W.M., Yager, R.M., and Zarriello, P.J., 1986, Quantity and quality of urban storm runoff in the Irondequoit Creek basin near Rochester, New York, Part 2—Quality of storm runoff and atmospheric deposition, rainfall-runoff-quality modeling, and potential of wetlands for sediment and nutrient retention: U.S. Geological Survey Water-Resources Investigations Report 85-4113, 93 p.

Kappel, W.M. and Young, R.A., 1989, Glacial history and geohydrology of the Irondequoit Creek valley, Monroe County, New York: U.S. Geological Survey Water-Resources Investigations Report 88-4145, 34 p.

Lanfear, K.J. and Alexander, R.B., 1990, Methodology to derive water-quality trends for use by the national water summary program of the U. S. Geological Survey: U.S. Geological Survey Open-File Report 90-359, 10 p.

Makarewicz, J.C., Lewis, T.W., Brooks, Anna, and others, 1990, Chemical analysis and nutrient loading of Salmon Creek, Otis Creek, Black Creek, Spencerport Sewage Treatment Plant, precipitation falling in Western Monroe County, with a discussion on the trophic status of Long Pond and stress stream analysis of Northrup Creek and Buttonwood Creeks: Brockport, N.Y., State University of New York at Brockport, unpublished report, 120 p.

Monroe County Water Quality Planning Bureau, 2001, The effects of road salt on water quality in Monroe County (draft report): Monroe County Water Quality Planning Bureau, 15 p.

National Oceanic and Atmospheric Administration, 1983-2002, Climatological data annual summary, New York: Asheville, N.C., National Climatic Data Center, no. 13, v. 106-108 [issued annually].

Schertz, T.L., Alexander, R.B., and Ohe, D.J., 1991, The computer program Estimate Trend (ESTREND)—a system for the detection of trends in water-quality data: U.S. Geological Survey Water-Resources Investigations Report 91-4040, 63 p.

Sen, P.K., 1968, Estimates of the regression coefficient based on Kendall's tau: Journal of the American Statistical Association, v. 63, p. 1379-1389.

Sherwood, D.A., 1999, Water Resources of Monroe County, New York, Water Years 1989-93, with emphasis on water quality in the Irondequoit Creek basin, part 2: U.S. Geological Survey Water-Resources Investigations Report 99-4084, 50 p..

Sherwood, D.A., 1999, Phosphorus loads entering Long Pond, a small embayment of Lake Ontario near Rochester, Monroe County, New York: U.S. Geological Survey Fact Sheet FS-128-99, 4 p.

Sherwood, D.A., 2001, Water Resources of Monroe County New York, Water Years 1994-96, with emphasis on water quality in the Irondequoit Creek basin: U.S. Geological Survey Water-Resources Investigations Report 00-4201, 44 p.

Sherwood, D.A., 2001, Effects of a vegetated stormwater-detention basin on chemical quality and temperature of runoff from a small residential development in Monroe County, New York: U.S. Geological Survey Water-Resources Investigations Report 01-4099, 11 p.

Sherwood, D.A., 2004, Water Resources of Monroe County, New York, Water Years 1997-99, with emphasis on water quality in the Irondequoit Creek basin: U.S. Geological Survey Water-Resources Investigations Report 02-4221, 55 p.

Wagner, L.A., 1982, Drainage areas of New York streams by river basins—a stream gazetteer, Part 1—Data compiled as of October 1980: U.S. Geological Survey Open-File Report 81-1055, 359 p.

Yager, R.M., Zarriello, P.J., and Kappel, W.M., 1985, Geohydrology of the Irondequoit Creek basin near Rochester, New York: U.S. Geological Survey Water-Resources Investigations Report 84-4259, 6 pl.

Young, R.A., 1993, Analysis and recommendations for ground-water sampling program (1988-93), Irondequoit Creek basin, with emphasis on the Ellison Park-Browncroft Boulevard reach: Rochester, N.Y., Monroe County Health Department, unpublished report, 20 p.

Zarriello, P.J., and Sherwood, D.A., 1993, Effects of stormwater detention on the chemical quality of runoff from a small residential development, Monroe County, New York: U.S. Geological Survey Water- Resources Investigations Report 92-4003, 57 p.

Appendix

Estimated monthly chemical loads and associated error for four Irondequoit Creek basin sites and four western Monroe County sites, water years 2000-02.

Irondequoit Creek basin:

Irondequoit Creek at Railroad Mills

East Branch Allen Creek near Pittsford

Allen Creek near Rochester

Irondequoit Creek above Blossom Road

Western Monroe County:

Northrup Creek near North Greece

Oatka Creek at Garbutt

Honeoye Creek at Honeoye Falls

Black Creek at Churchville

Appendix. Monthly chemical loads and associated error for the Irondequoit Creek basin sites and Northrup Creek, Monroe County, N.Y., water years 2000-02.

[Loads and errors are in tons, Error when multiplied by 1.96 and added to or subtracted from the estimated load provides the 95-percent confidence limits of the load estimate. Dashes indicate no data. Locations are shown in fig. 1.]

	Total suspended solids 00530		Volatile suspended solids 00535		Ammonia as N, dissolved 00608		Ammonia + organic nitrogen as N, total 00625		Nitrite + nitrate as N, total 00630		Total phosphorus, as P 00665		Ortho-phosphate as P, dissolved 00671		Chloride, dissolved 00940		Sulfate, dissolved 00945	
Month	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error
Irondequoit Creek at Railroad Mills (04232034)																		
Water year 2000																		
OCT	355	206	46.5	28.8	0.009	0.004	0.46	0.10	1.16	0.07	0.08	0.02	0.012	0.001	115	6	401	27
NOV	293	172	36.6	22.8	0.011	0.005	0.55	0.13	1.23	0.07	0.08	0.02	0.012	0.001	131	7	386	27
DEC	336	125	46.8	18.7	0.019	0.007	1.28	0.28	2.20	0.12	0.17	0.05	0.020	0.002	204	9	501	32
JAN	445	173	55.3	22.9	0.014	0.006	1.41	0.34	2.81	0.16	0.20	0.07	0.020	0.002	234	11	482	32
FEB	796	275	92.9	34.8	0.011	0.007	2.29	0.61	4.02	0.24	0.32	0.13	0.028	0.003	376	18	499	31
MAR	585	199	83.7	30.5	0.009	0.004	1.54	0.26	3.51	0.16	0.16	0.04	0.023	0.002	419	16	552	30
APR	582	173	122.5	39.0	0.029	0.012	3.45	0.67	4.92	0.24	0.44	0.13	0.043	0.003	502	20	685	37
MAY	781	223	159.0	49.0	0.031	0.017	3.53	0.86	4.78	0.26	0.61	0.25	0.049	0.005	369	15	630	35
JUN	1067	337	147.2	50.1	0.011	0.006	2.50	0.62	3.69	0.20	0.45	0.17	0.043	0.004	259	11	508	29
JUL	750	257	74.3	27.3	0.003	0.002	0.64	0.12	1.88	0.10	0.12	0.03	0.019	0.002	136	6	362	22
AUG	635	184	80.6	25.0	0.005	0.003	1.30	0.26	2.33	0.13	0.25	0.07	0.029	0.002	170	8	496	31
SEP	648	187	97.3	30.1	0.008	0.003	1.13	0.25	2.05	0.10	0.21	0.06	0.024	0.002	160	7	506	30
Total	7273	2510	1042.8	378.9	0.161	0.075	20.09	4.50	34.59	1.85	3.08	1.06	0.323	0.028	3075	135	6009	364
Water year 2001																		
OCT	656	300	88.1	42.9	0.008	0.003	0.57	0.11	1.60	0.08	0.09	0.02	0.016	0.001	148	6	450	28
NOV	496	262	64.8	36.4	0.012	0.005	0.77	0.17	1.76	0.10	0.10	0.03	0.017	0.001	175	8	446	30
DEC	465	172	64.9	25.7	0.018	0.008	1.44	0.42	2.59	0.15	0.19	0.08	0.022	0.002	219	10	490	31
JAN	538	253	66.7	33.5	0.010	0.005	1.08	0.27	3.03	0.17	0.14	0.05	0.018	0.002	242	12	460	30
FEB	900	434	115.0	59.5	0.011	0.006	2.64	0.56	5.26	0.28	0.32	0.10	0.033	0.003	476	21	598	36
MAR	987	406	161.3	70.8	0.022	0.010	4.20	0.76	6.99	0.32	0.48	0.13	0.050	0.004	739	28	782	41
APR	554	194	124.4	46.6	0.022	0.008	2.97	0.52	5.03	0.24	0.33	0.08	0.037	0.003	529	21	679	37
MAY	425	165	87.6	36.3	0.010	0.004	0.81	0.14	2.49	0.12	0.11	0.03	0.017	0.001	212	9	426	25
JUN	581	264	76.8	37.1	0.005	0.002	0.44	0.08	1.82	0.09	0.07	0.02	0.013	0.001	132	6	316	19
JUL	549	245	56.8	27.1	0.003	0.002	0.33	0.06	1.49	0.08	0.06	0.02	0.012	0.001	105	5	297	19
AUG	360	164	43.5	20.9	0.003	0.002	0.28	0.05	1.24	0.07	0.06	0.02	0.010	0.001	88	4	313	20
SEP	388	149	62.1	24.7	0.006	0.003	0.60	0.19	1.43	0.08	0.11	0.05	0.013	0.001	112	5	384	23
Total	6901	3007	1011.9	461.5	0.129	0.056	16.12	3.34	34.73	1.79	2.06	0.63	0.257	0.021	3176	135	5640	338
Water year 2002																		
OCT	389	199	57.6	31.5	0.007	0.003	0.27	0.05	1.17	0.07	0.04	0.01	0.009	0.001	109	5	363	24
NOV	274	152	40.8	23.9	0.010	0.005	0.39	0.09	1.27	0.08	0.05	0.02	0.009	0.001	131	7	365	26
DEC	284	96	51.5	18.7	0.020	0.008	1.35	0.30	2.56	0.14	0.16	0.05	0.018	0.002	235	11	525	33
JAN	278	131	44.2	22.3	0.011	0.005	0.78	0.15	2.57	0.15	0.10	0.03	0.012	0.001	222	11	446	30
FEB	468	216	78.9	39.1	0.015	0.008	2.79	0.71	4.83	0.27	0.36	0.15	0.026	0.002	455	20	592	36
MAR	301	114	62.7	25.1	0.012	0.005	1.57	0.32	3.50	0.17	0.16	0.05	0.017	0.001	436	17	557	30
APR	238	71	74.9	24.1	0.028	0.012	2.82	0.58	4.19	0.21	0.32	0.10	0.026	0.002	473	20	650	37
MAY	372	110	123.3	39.3	0.053	0.025	5.36	1.20	5.79	0.31	0.84	0.31	0.047	0.004	483	21	764	44
JUN	395	128	92.8	32.6	0.017	0.008	3.12	0.68	3.86	0.21	0.49	0.16	0.033	0.003	304	14	575	35
JUL	239	84	40.2	15.0	0.005	0.003	0.77	0.16	1.77	0.10	0.13	0.04	0.014	0.001	143	7	383	26
AUG	128	60	23.7	12.0	0.005	0.003	0.37	0.08	1.19	0.07	0.08	0.02	0.008	0.001	96	5	348	26
SEP	112	57	26.1	13.9	0.008	0.004	0.46	0.12	1.10	0.07	0.08	0.03	0.008	0.001	98	5	373	27
Total	3478	1419	716.8	297.6	0.193	0.089	20.06	4.45	33.78	1.84	2.83	0.96	0.228	0.020	3184	141	5941	374

Appendix. Monthly chemical loads and associated error for the Irondequoit Creek basin sites and Northrup Creek, Monroe County, N. Y., water years 2000-02. (continued)

	Total suspended solids 00530		Volatile suspended solids 00535		Ammonia as N, dissolved 00608		Ammonia + organic nitrogen as N, total 00625		Nitrite + nitrate as N, total 00630		Total phosphorus, as P 00665		Ortho-phosphate as P, dissolved 00671		Chloride, dissolved 00940		Sulfate, dissolved 00945	
Month	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error
East Branch Allen Creek near Pittsford (0423204920)																		
Water year 2000																		
OCT	8	5	4.2	2.2	0.004	0.001	0.20	0.03	0.14	0.02	0.03	0.01	0.005	0.001	34	5	55	5
NOV	4	2	1.7	0.9	0.002	0.001	0.07	0.01	0.06	0.01	0.01	0.00	0.001	0.000	19	3	24	2
DEC	19	6	4.0	1.3	0.017	0.004	0.41	0.05	0.53	0.07	0.04	0.01	0.007	0.001	100	11	55	4
JAN	80	24	7.1	1.9	0.053	0.012	0.71	0.08	1.44	0.17	0.07	0.01	0.011	0.001	256	29	79	6
FEB	189	54	19.2	4.9	0.059	0.015	1.31	0.18	3.47	0.46	0.15	0.03	0.018	0.003	454	51	113	9
MAR	122	29	19.4	4.1	0.028	0.005	0.97	0.09	2.64	0.25	0.10	0.01	0.010	0.001	360	34	116	8
APR	159	32	29.5	5.3	0.048	0.010	1.70	0.19	2.94	0.33	0.22	0.03	0.021	0.003	262	26	114	8
MAY	223	73	29.5	8.1	0.099	0.053	2.00	0.57	1.69	0.42	0.46	0.19	0.076	0.028	128	18	75	6
JUN	87	19	12.7	2.5	0.033	0.010	0.61	0.10	0.54	0.08	0.12	0.03	0.032	0.006	66	8	56	5
JUL	40	8	6.1	1.1	0.010	0.003	0.27	0.04	0.28	0.04	0.06	0.01	0.015	0.002	34	4	42	4
AUG	39	8	5.5	1.0	0.011	0.003	0.27	0.04	0.29	0.04	0.06	0.01	0.015	0.003	30	4	42	4
SEP	31	8	5.3	1.2	0.008	0.002	0.18	0.02	0.16	0.02	0.04	0.01	0.009	0.001	27	3	36	3
Total	1001	266	144.2	34.4	0.372	0.118	8.70	1.40	14.17	1.91	1.35	0.35	0.219	0.051	1770	195	808	64
Water year 2001																		
OCT	19	6	5.7	1.5	0.006	0.001	0.17	0.02	0.13	0.02	0.03	0.00	0.008	0.001	33	4	38	3
NOV	13	4	4.4	1.2	0.007	0.002	0.23	0.04	0.21	0.04	0.03	0.01	0.008	0.002	43	6	31	3
DEC	37	10	5.3	1.2	0.026	0.008	0.49	0.08	0.62	0.10	0.06	0.02	0.014	0.003	100	12	40	3
JAN	79	30	4.2	1.4	0.028	0.007	0.26	0.03	0.55	0.07	0.03	0.00	0.005	0.001	126	15	32	3
FEB	181	70	11.8	4.1	0.054	0.012	0.70	0.08	1.94	0.22	0.08	0.01	0.013	0.002	343	36	68	5
MAR	218	59	27.6	6.7	0.045	0.010	1.40	0.17	3.35	0.37	0.18	0.03	0.020	0.003	382	36	98	7
APR	108	28	15.7	3.6	0.023	0.005	0.69	0.08	1.33	0.15	0.08	0.01	0.009	0.001	157	16	59	4
MAY	75	23	8.4	2.3	0.019	0.004	0.28	0.03	0.27	0.03	0.04	0.01	0.007	0.001	51	5	33	2
JUN	48	15	5.0	1.4	0.009	0.002	0.12	0.01	0.10	0.01	0.02	0.00	0.005	0.001	23	3	22	2
JUL	42	9	5.6	1.1	0.009	0.002	0.20	0.02	0.18	0.02	0.04	0.01	0.011	0.001	30	3	35	3
AUG	37	8	4.7	0.9	0.009	0.002	0.20	0.02	0.19	0.02	0.04	0.01	0.010	0.001	25	3	33	3
SEP	32	8	5.2	1.2	0.008	0.002	0.18	0.02	0.14	0.02	0.04	0.01	0.008	0.001	27	3	34	3
Total	890	268	103.6	26.7	0.242	0.057	4.92	0.61	9.01	1.07	0.65	0.11	0.117	0.018	1340	142	523	40
Water year 2002																		
OCT	13	4	3.6	1.1	0.003	0.001	0.08	0.01	0.05	0.01	0.01	0.00	0.003	0.000	19	2	23	2
NOV	8	3	2.5	0.7	0.003	0.001	0.09	0.01	0.06	0.01	0.01	0.00	0.002	0.000	22	3	19	2
DEC	27	6	4.0	0.8	0.019	0.005	0.36	0.05	0.40	0.05	0.04	0.01	0.007	0.001	80	9	33	3
JAN	49	16	2.8	0.8	0.016	0.004	0.15	0.02	0.24	0.03	0.01	0.00	0.002	0.000	78	9	23	2
FEB	157	54	11.3	3.4	0.069	0.023	0.90	0.15	1.84	0.28	0.11	0.03	0.014	0.003	318	38	66	5
MAR	63	13	9.6	1.8	0.013	0.002	0.41	0.04	0.82	0.08	0.04	0.01	0.003	0.000	169	16	57	4
APR	81	14	15.6	2.4	0.025	0.005	0.84	0.09	1.18	0.13	0.10	0.01	0.007	0.001	158	16	69	5
MAY	121	24	20.2	3.6	0.064	0.018	1.30	0.19	0.98	0.14	0.22	0.05	0.024	0.004	124	14	74	6
JUN	51	11	9.3	1.8	0.023	0.005	0.46	0.05	0.30	0.03	0.08	0.01	0.012	0.002	58	6	54	4
JUL	24	7	5.1	1.4	0.010	0.002	0.27	0.03	0.19	0.02	0.05	0.01	0.008	0.001	33	4	46	4
AUG	16	6	3.3	1.2	0.006	0.002	0.19	0.03	0.13	0.02	0.04	0.01	0.005	0.001	22	3	39	4
SEP	13	6	3.7	1.6	0.007	0.002	0.20	0.03	0.11	0.02	0.04	0.01	0.004	0.001	25	3	42	4
Total	623	165	90.9	20.6	0.256	0.069	5.24	0.70	6.30	0.81	0.75	0.14	0.092	0.015	1105	123	545	44

Appendix. Monthly chemical loads and associated error for the Irondequoit Creek basin sites and Northrup Creek, Monroe County, N. Y., water years 2000-02. (continued)

	Total suspended solids 00530		Volatile suspended solids 00535		Ammonia as N, dissolved 00608		Ammonia + organic nitrogen as N, total 00625		Nitrite + nitrate as N, total 00630		Total phosphorus, as P 00665		Ortho-phosphate as P, dissolved 00671		Chloride, dissolved 00940		Sulfate, dissolved 00945	
Month	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error
Allen Creek near Rochester (04232050)																		
Water year 2000																		
OCT	219	151	21.6	9.9	0.010	0.003	0.55	0.11	0.53	0.06	0.11	0.04	0.021	0.004	116	12	81	7
NOV	81	68	11.3	6.8	0.009	0.003	0.61	0.13	0.54	0.06	0.09	0.03	0.019	0.004	139	15	68	5
DEC	253	208	38.4	22.6	0.033	0.009	1.26	0.19	1.45	0.13	0.13	0.03	0.026	0.004	371	33	115	8
JAN	515	398	76.9	42.0	0.081	0.022	1.48	0.24	2.42	0.22	0.14	0.04	0.021	0.003	685	61	135	10
FEB	599	391	81.4	36.0	0.127	0.039	3.17	0.58	5.18	0.52	0.41	0.13	0.033	0.006	1445	138	225	17
MAR	530	262	66.5	22.3	0.061	0.014	2.40	0.31	4.02	0.31	0.23	0.05	0.020	0.002	1157	90	208	13
APR	1347	750	147.3	54.7	0.110	0.030	4.70	0.75	5.54	0.48	0.68	0.20	0.047	0.007	1068	91	256	17
MAY	1935	1375	210.7	98.7	0.247	0.123	5.34	1.62	4.90	0.64	1.74	1.15	0.123	0.038	705	79	221	19
JUN	1141	731	127.0	54.1	0.169	0.056	2.85	0.54	3.34	0.33	0.68	0.26	0.119	0.022	445	41	179	13
JUL	494	297	53.8	20.6	0.080	0.033	2.30	0.56	2.38	0.30	0.74	0.35	0.134	0.032	266	30	141	12
AUG	596	354	61.5	24.6	0.043	0.013	1.45	0.26	1.82	0.18	0.36	0.12	0.067	0.011	216	21	137	10
SEP	422	268	45.8	19.4	0.024	0.008	0.74	0.14	0.97	0.10	0.19	0.07	0.034	0.006	165	16	104	8
Total	8133	5254	942.2	411.5	0.995	0.352	26.86	5.43	33.10	3.35	5.51	2.46	0.664	0.140	6779	625	1870	140
Water year 2001																		
OCT	173	103	22.4	9.1	0.013	0.004	0.49	0.07	0.62	0.06	0.10	0.02	0.024	0.003	162	14	91	6
NOV	63	52	11.8	7.0	0.013	0.004	0.67	0.13	0.71	0.08	0.11	0.04	0.026	0.005	209	21	82	6
DEC	167	131	32.4	17.6	0.043	0.015	1.32	0.26	1.60	0.17	0.19	0.07	0.034	0.007	445	42	113	9
JAN	245	170	46.8	21.9	0.068	0.021	0.90	0.16	1.80	0.19	0.10	0.03	0.014	0.002	630	61	97	7
FEB	412	263	74.6	32.1	0.140	0.041	2.29	0.37	4.63	0.42	0.29	0.09	0.029	0.005	1528	133	203	14
MAR	519	264	82.0	27.9	0.120	0.031	4.96	0.76	7.12	0.60	0.77	0.22	0.050	0.007	1968	158	316	20
APR	382	214	58.0	21.9	0.044	0.010	1.80	0.24	2.64	0.21	0.21	0.05	0.017	0.002	690	55	143	9
MAY	372	297	58.2	32.0	0.046	0.012	0.85	0.13	1.19	0.11	0.12	0.03	0.017	0.002	264	22	79	5
JUN	159	119	25.9	13.4	0.029	0.008	0.47	0.07	0.64	0.06	0.08	0.02	0.019	0.003	136	12	53	4
JUL	80	48	12.3	5.0	0.014	0.004	0.35	0.05	0.44	0.04	0.07	0.02	0.019	0.003	86	8	44	3
AUG	191	119	25.5	10.5	0.017	0.005	0.65	0.12	0.78	0.08	0.15	0.05	0.029	0.005	116	11	72	6
SEP	240	156	33.3	14.3	0.020	0.007	0.79	0.17	0.90	0.10	0.22	0.09	0.035	0.007	163	17	100	8
Total	3004	1936	483.2	212.7	0.566	0.163	15.53	2.56	23.08	2.11	2.43	0.72	0.314	0.051	6398	555	1393	98
Water year 2002																		
OCT	86	52	14.7	6.1	0.009	0.002	0.46	0.07	0.51	0.05	0.09	0.02	0.020	0.003	152	13	84	6
NOV	29	24	6.9	4.0	0.007	0.002	0.48	0.09	0.45	0.05	0.07	0.02	0.016	0.003	155	15	62	5
DEC	100	72	24.0	12.3	0.027	0.008	1.17	0.19	1.29	0.12	0.14	0.04	0.025	0.004	399	35	105	7
JAN	121	83	29.6	14.1	0.036	0.009	0.71	0.10	1.19	0.10	0.07	0.01	0.009	0.001	484	42	81	6
FEB	235	167	53.6	25.4	0.109	0.044	2.60	0.56	3.90	0.43	0.36	0.16	0.030	0.007	1316	126	188	14
MAR	146	70	29.3	9.2	0.027	0.006	1.69	0.24	2.28	0.18	0.16	0.04	0.012	0.002	811	63	145	9
APR	335	177	59.5	20.8	0.040	0.010	2.72	0.40	2.86	0.24	0.31	0.08	0.021	0.003	711	58	168	11
MAY	833	575	141.7	65.9	0.149	0.050	5.64	1.11	4.49	0.46	1.16	0.45	0.094	0.018	731	69	236	18
JUN	315	214	57.1	26.4	0.065	0.018	2.23	0.36	2.01	0.19	0.39	0.11	0.065	0.010	321	28	139	10
JUL	71	45	13.1	5.7	0.012	0.003	0.69	0.11	0.60	0.06	0.12	0.03	0.025	0.004	103	9	62	5
AUG	45	36	8.2	4.6	0.004	0.001	0.34	0.06	0.28	0.03	0.06	0.02	0.011	0.002	54	5	41	3
SEP	89	77	16.1	9.3	0.009	0.004	0.81	0.22	0.57	0.08	0.20	0.10	0.024	0.006	104	13	78	8
Total	2404	1592	453.9	203.8	0.494	0.159	19.53	3.51	20.44	1.97	3.14	1.08	0.354	0.061	5341	478	1389	101

Appendix. Monthly chemical loads and associated error for the Irondequoit Creek basin sites and Northrup Creek, Monroe County, N. Y., water years 2000-02. (continued)

	Total suspended solids 00530		Volatile suspended solids 00535		Ammonia as N, dissolved 00608		Ammonia + organic nitrogen as N, total 00625		Nitrite + nitrate as N, total 00630		Total phosphorus, as P 00665		Ortho-phosphate as P, dissolved 00671		Chloride, dissolved 00940		Sulfate, dissolved 00945	
Month	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error
Irondequoit Creek above Blossom Road (0423205010)																		
Water year 2000																		
OCT	623	285	88.6	34.6	0.044	0.016	2.51	0.34	3.68	0.17	0.51	0.10	0.092	0.006	632	30	992	36
NOV	270	111	49.0	17.5	0.044	0.017	2.30	0.34	3.49	0.17	0.35	0.07	0.060	0.004	631	31	866	31
DEC	374	138	66.2	21.1	0.086	0.028	4.97	0.61	7.97	0.34	0.58	0.10	0.094	0.006	1252	56	1286	44
JAN	174	150	57.7	19.5	0.075	0.026	4.91	0.61	10.58	0.45	0.44	0.08	0.082	0.005	1728	77	1295	44
FEB	725	977	189.4	75.1	0.143	0.065	11.59	1.93	17.80	0.95	1.85	0.45	0.109	0.009	3131	169	1531	58
MAR	724	417	161.7	42.8	0.108	0.032	10.23	1.07	17.68	0.72	1.24	0.17	0.087	0.005	3313	145	1767	59
APR	1781	1470	435.2	130.9	0.248	0.086	21.61	2.72	22.80	1.01	4.49	0.84	0.167	0.010	3026	140	1897	64
MAY	1817	9425	922.4	622.2	0.512	0.347	32.30	7.58	23.83	1.50	14.64	6.22	0.423	0.044	2322	131	1822	66
JUN	921	1219	278.6	106.2	0.236	0.096	13.65	2.00	13.73	0.63	3.94	0.93	0.388	0.027	1486	69	1464	49
JUL	404	328	110.8	33.8	0.075	0.026	4.46	0.58	6.48	0.27	1.23	0.24	0.195	0.012	825	36	1008	33
AUG	611	464	155.4	45.6	0.077	0.027	5.10	0.65	7.10	0.31	1.67	0.31	0.220	0.014	861	39	1106	38
SEP	422	359	119.9	37.9	0.053	0.019	3.32	0.44	5.18	0.22	1.01	0.20	0.157	0.010	711	32	969	33
Total	8846	15343	2635.0	1187.1	1.703	0.785	116.95	18.87	140.31	6.74	31.95	9.71	2.075	0.150	19920	955	16004	556
Water year 2001																		
OCT	232	202	80.6	27.1	0.048	0.014	2.68	0.29	4.53	0.18	0.64	0.10	0.125	0.007	763	32	1012	33
NOV	113	98	49.5	16.8	0.053	0.018	2.82	0.37	4.61	0.20	0.51	0.09	0.088	0.005	813	37	939	31
DEC	149	165	67.7	24.4	0.098	0.039	5.70	0.83	9.26	0.42	0.89	0.20	0.123	0.008	1413	64	1243	41
JAN	303	127	45.8	15.7	0.058	0.020	4.12	0.52	10.72	0.46	0.40	0.08	0.079	0.005	1817	81	1171	38
FEB	1100	380	132.1	38.9	0.132	0.043	11.17	1.28	22.02	0.92	1.36	0.22	0.144	0.008	3881	172	1765	60
MAR	4406	1765	468.3	150.4	0.268	0.098	25.85	3.39	32.04	1.44	5.77	1.16	0.199	0.013	5259	242	2272	78
APR	1793	557	239.4	62.3	0.138	0.042	13.92	1.54	18.45	0.76	2.45	0.36	0.120	0.007	2718	121	1617	53
MAY	555	190	89.5	26.5	0.061	0.017	4.79	0.50	8.20	0.32	0.70	0.10	0.099	0.005	1069	45	1024	33
JUN	367	132	58.3	18.3	0.041	0.012	2.64	0.28	5.07	0.20	0.44	0.06	0.105	0.006	686	29	791	26
JUL	321	110	50.0	15.0	0.026	0.007	1.61	0.16	3.49	0.14	0.35	0.04	0.089	0.005	511	21	674	22
AUG	485	167	70.9	21.1	0.025	0.008	1.87	0.22	3.60	0.15	0.50	0.08	0.096	0.005	502	22	712	23
SEP	900	503	118.9	50.6	0.043	0.022	3.21	0.63	4.34	0.22	1.12	0.36	0.136	0.011	615	31	830	29
Total	10724	4395	1471.0	467.1	0.990	0.340	80.37	10.02	126.32	5.41	15.12	2.84	1.402	0.085	20047	897	14051	468
Water year 2002																		
OCT	288	113	52.8	18.2	0.023	0.007	1.54	0.16	3.02	0.12	0.31	0.04	0.074	0.004	567	24	803	26
NOV	159	62	36.1	12.4	0.028	0.010	1.85	0.25	3.26	0.15	0.28	0.05	0.056	0.003	628	29	775	27
DEC	272	106	57.2	19.1	0.061	0.022	4.76	0.62	7.70	0.34	0.59	0.11	0.093	0.006	1264	58	1173	40
JAN	158	62	29.6	10.5	0.026	0.008	2.35	0.24	6.94	0.28	0.16	0.02	0.045	0.002	1324	57	974	32
FEB	1268	627	157.7	62.0	0.112	0.051	12.30	1.89	19.71	0.95	1.54	0.38	0.133	0.010	3565	168	1729	60
MAR	865	341	127.2	41.0	0.053	0.019	7.77	0.95	12.95	0.54	0.88	0.17	0.059	0.003	2681	116	1505	50
APR	1972	734	286.7	87.0	0.107	0.037	15.32	1.87	16.45	0.70	2.35	0.42	0.106	0.006	2514	113	1676	56
MAY	4752	2367	609.3	234.4	0.246	0.104	27.91	4.18	20.85	0.99	6.41	1.58	0.315	0.023	2334	110	1945	66
JUN	2099	826	295.7	95.1	0.141	0.050	14.70	1.91	12.65	0.57	2.98	0.57	0.318	0.020	1513	70	1587	55
JUL	511	187	84.8	27.0	0.028	0.008	2.88	0.31	4.19	0.17	0.50	0.07	0.104	0.006	628	27	892	30
AUG	386	179	65.5	27.1	0.012	0.004	1.36	0.14	2.51	0.10	0.25	0.03	0.056	0.003	397	18	674	23
SEP	603	321	96.8	43.3	0.018	0.009	2.23	0.42	2.77	0.15	0.47	0.13	0.071	0.006	451	24	750	29
Total	13334	5924	1899.5	677.2	0.856	0.327	94.96	12.94	112.99	5.04	16.73	3.57	1.429	0.093	17865	815	14484	494

Appendix. Monthly chemical loads and associated error for the Irondequoit Creek basin sites and Northrup Creek, Monroe County, N. Y., water years 2000-02. (continued)

	Total suspended solids 00530		Volatile suspended solids 00535		Ammonia as N, dissolved 00608		Ammonia + organic nitrogen as N, total 00625		Nitrite + nitrate as N, total 00630		Total phosphorus, as P 00665		Ortho-phosphate as P, dissolved 00671		Chloride, dissolved 00940		Sulfate, dissolved 00945	
Month	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error
Northrup Creek near North Greece (0422026250)																		
Water year 2000																		
OCT	97	44	13.0	5.1	0.021	0.007	0.66	0.10	1.20	0.10	0.22	0.06	0.097	0.016	62	5	51	4
NOV	12	8	2.0	1.2	0.023	0.007	0.39	0.06	0.89	0.07	0.12	0.03	0.054	0.008	60	5	42	3
DEC	7	6	1.2	0.8	0.063	0.020	0.39	0.06	0.87	0.07	0.10	0.02	0.050	0.008	69	6	33	2
JAN	61	36	8.3	4.3	0.294	0.094	0.93	0.14	1.40	0.10	0.16	0.04	0.060	0.009	133	11	41	3
FEB	355	173	44.5	18.6	0.516	0.169	1.98	0.30	2.33	0.16	0.26	0.07	0.043	0.006	268	21	64	4
MAR	286	88	37.9	10.0	0.233	0.055	1.56	0.17	2.30	0.13	0.22	0.04	0.027	0.003	262	16	71	4
APR	570	161	71.1	16.9	0.185	0.060	2.72	0.38	3.17	0.20	0.62	0.17	0.062	0.009	275	19	98	6
MAY	482	167	63.9	18.2	0.102	0.046	2.64	0.55	3.00	0.24	1.05	0.49	0.168	0.036	169	14	85	6
JUN	167	56	26.6	7.4	0.035	0.011	1.26	0.18	1.83	0.12	0.44	0.11	0.159	0.022	92	7	58	4
JUL	40	15	7.3	2.5	0.012	0.004	0.55	0.08	1.11	0.08	0.23	0.05	0.112	0.016	50	4	38	3
AUG	53	17	8.8	2.4	0.010	0.003	0.43	0.05	0.99	0.07	0.20	0.04	0.102	0.014	36	3	32	2
SEP	66	19	10.2	2.5	0.010	0.003	0.33	0.04	0.99	0.06	0.15	0.03	0.087	0.011	29	2	31	2
Total	2196	790	294.7	89.7	1.503	0.479	13.85	2.09	20.08	1.38	3.78	1.16	1.021	0.158	1506	113	643	42
Water year 2001																		
OCT	29	11	4.9	1.7	0.012	0.003	0.29	0.03	1.09	0.07	0.10	0.02	0.066	0.009	38	3	41	3
NOV	26	17	4.8	2.7	0.072	0.020	0.78	0.09	1.87	0.11	0.17	0.04	0.087	0.011	115	8	89	5
DEC	48	25	8.0	3.5	0.291	0.083	1.28	0.16	2.28	0.14	0.23	0.05	0.103	0.013	178	12	90	5
JAN	128	72	19.8	9.6	0.610	0.180	1.44	0.19	2.48	0.17	0.20	0.04	0.079	0.011	205	16	69	4
FEB	413	229	60.9	29.0	1.108	0.366	2.91	0.42	3.97	0.26	0.35	0.10	0.075	0.012	373	27	102	6
MAR	412	138	61.4	17.6	0.411	0.103	2.71	0.31	4.22	0.23	0.38	0.08	0.046	0.005	385	23	120	6
APR	161	52	25.1	6.9	0.084	0.021	1.05	0.11	2.18	0.12	0.19	0.03	0.030	0.003	152	9	64	3
MAY	115	42	19.5	6.1	0.033	0.008	0.81	0.09	1.85	0.11	0.22	0.04	0.068	0.008	83	5	51	3
JUN	36	12	7.3	2.1	0.013	0.003	0.50	0.06	1.32	0.08	0.18	0.03	0.094	0.012	48	3	38	2
JUL	18	7	4.0	1.4	0.008	0.002	0.41	0.05	1.10	0.08	0.17	0.04	0.098	0.014	39	3	34	2
AUG	25	8	4.9	1.4	0.007	0.002	0.32	0.04	0.96	0.06	0.15	0.03	0.090	0.012	28	2	28	2
SEP	40	11	7.3	1.8	0.008	0.002	0.31	0.03	1.05	0.06	0.13	0.02	0.085	0.010	26	2	31	2
Total	1453	624	228.0	83.6	2.657	0.795	12.79	1.59	24.35	1.50	2.47	0.53	0.920	0.120	1669	114	758	44
Water year 2002																		
OCT	14	6	2.8	1.0	0.008	0.002	0.23	0.03	1.01	0.07	0.08	0.02	0.059	0.008	28	2	35	2
NOV	4	3	1.0	0.6	0.022	0.007	0.30	0.04	1.09	0.07	0.08	0.02	0.049	0.007	49	4	45	3
DEC	18	10	3.6	1.6	0.151	0.042	0.84	0.10	1.77	0.11	0.15	0.03	0.077	0.010	114	8	64	4
JAN	48	27	8.9	4.3	0.331	0.095	1.09	0.14	2.10	0.15	0.15	0.03	0.068	0.010	146	11	55	4
FEB	204	110	34.7	15.9	0.680	0.229	2.36	0.33	3.28	0.21	0.26	0.07	0.063	0.010	273	20	80	5
MAR	124	35	21.9	5.3	0.152	0.035	1.43	0.15	2.61	0.14	0.18	0.03	0.027	0.003	208	12	70	4
APR	221	64	37.0	9.1	0.109	0.031	2.17	0.26	3.10	0.18	0.39	0.08	0.051	0.006	201	13	86	5
MAY	342	105	58.9	15.1	0.097	0.033	3.79	0.59	4.15	0.28	1.17	0.37	0.230	0.040	183	14	106	7
JUN	94	24	19.4	4.1	0.026	0.007	1.52	0.18	2.15	0.13	0.44	0.09	0.175	0.022	86	6	61	4
JUL	12	6	3.0	1.3	0.006	0.002	0.52	0.07	1.08	0.08	0.20	0.05	0.109	0.016	37	3	32	2
AUG	12	7	2.8	1.4	0.004	0.001	0.37	0.05	0.86	0.06	0.17	0.04	0.093	0.014	24	2	24	2
SEP	20	9	4.1	1.6	0.005	0.002	0.34	0.05	0.91	0.06	0.14	0.03	0.087	0.012	22	2	25	2
Total	1114	405	198.0	61.4	1.592	0.485	14.97	2.01	24.12	1.55	3.41	0.86	1.089	0.159	1373	97	684	42

Appendix. Monthly chemical loads and associated error for the Irondequoit Creek basin sites and Northrup Creek, Monroe County, N.Y., water years 2000-02.(continued)

	Total suspended solids 00530		Volatile suspended solids 00535		Ammonia as N, dissolved 00608		Ammonia + organic nitrogen as N, total 00625		Nitrite + nitrate as N, total 00630		Total phosphorus, as P 00665		Ortho-phosphate as P, dissolved 00671		Chloride, dissolved 00940		Sulfate, dissolved 00945	
Month	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error
Oatka Creek at Garbutt (04230500)																		
Water year 200																		
OCT	11	3	3.2	0.9	0.016	0.004	0.48	0.05	1.58	0.06	0.04	0.01	0.012	0.001	109	4	1130	48
NOV	22	6	7.5	2.4	0.048	0.015	1.02	0.15	3.17	0.15	0.09	0.01	0.029	0.004	174	7	1335	55
DEC	74	19	22.8	6.4	0.223	0.058	3.15	0.41	9.69	0.41	0.28	0.04	0.102	0.013	364	13	1789	71
JAN	245	77	55.6	17.2	0.683	0.202	8.45	1.22	25.96	1.13	0.83	0.15	0.329	0.051	687	25	2273	93
FEB	826	392	108.4	47.3	1.021	0.449	16.20	3.45	51.43	3.38	2.18	0.59	0.518	0.116	1082	58	2480	119
MAR	344	70	86.2	18.4	0.535	0.113	13.49	1.38	61.89	2.21	1.07	0.13	0.199	0.021	1548	51	3439	130
APR	1236	317	245.5	58.5	0.920	0.226	26.87	3.14	80.61	3.13	2.65	0.39	0.409	0.050	2071	72	4225	165
MAY	956	290	193.7	49.7	0.623	0.165	18.17	2.25	47.39	1.84	1.88	0.31	0.375	0.051	1326	44	3514	134
JUN	314	78	72.0	17.4	0.252	0.061	7.04	0.83	21.11	0.81	0.71	0.10	0.178	0.022	675	22	2471	94
JUL	85	16	20.0	4.2	0.081	0.017	2.18	0.22	8.57	0.30	0.22	0.03	0.052	0.005	351	11	1780	67
AUG	111	25	23.8	5.8	0.098	0.023	3.05	0.35	10.47	0.41	0.31	0.04	0.086	0.009	398	13	1784	71
SEP	181	63	38.9	13.3	0.146	0.048	5.38	0.88	13.99	0.70	0.61	0.12	0.284	0.051	471	20	1869	80
Total	4405	1357	877.5	241.5	4.646	1.380	105.49	14.34	335.87	14.54	10.86	1.91	2.572	0.396	9257	339	28089	1127
Water year 2001																		
OCT	64	15	20.6	5.3	0.078	0.019	2.69	0.32	9.11	0.37	0.28	0.04	0.129	0.015	374	14	1808	75
NOV	41	10	16.1	4.2	0.087	0.023	1.74	0.21	7.05	0.29	0.20	0.03	0.081	0.010	312	11	1645	65
DEC	131	33	42.2	10.8	0.352	0.088	4.66	0.58	18.10	0.73	0.58	0.08	0.245	0.031	571	19	2114	81
JAN	90	19	26.2	5.9	0.291	0.061	3.48	0.37	19.80	0.74	0.41	0.05	0.148	0.015	546	17	1930	73
FEB	698	219	129.0	36.2	1.234	0.354	18.26	2.43	86.82	3.66	2.54	0.44	0.813	0.121	1666	61	3247	133
MAR	551	128	125.8	28.5	0.616	0.137	16.09	1.76	85.98	3.15	1.76	0.23	0.313	0.034	1930	64	3702	139
APR	2253	854	330.3	105.5	1.215	0.415	31.79	4.90	110.70	5.22	4.99	1.06	0.742	0.130	2498	102	4440	186
MAY	255	68	64.8	16.2	0.180	0.045	5.97	0.72	24.44	0.95	0.63	0.09	0.122	0.016	748	25	2466	97
JUN	86	17	22.6	4.9	0.070	0.015	2.12	0.22	10.09	0.37	0.23	0.03	0.048	0.005	372	12	1791	70
JUL	40	8	9.0	2.0	0.033	0.007	0.94	0.10	5.09	0.18	0.11	0.01	0.022	0.002	228	7	1435	56
AUG	23	5	4.5	1.1	0.018	0.004	0.54	0.06	2.96	0.11	0.07	0.01	0.014	0.001	153	5	1157	46
SEP	13	3	2.9	0.7	0.011	0.003	0.38	0.04	1.99	0.07	0.05	0.01	0.012	0.001	113	4	999	40
Total	4245	1379	794.1	221.4	4.184	1.169	88.66	11.71	382.14	15.83	11.84	2.08	2.689	0.382	9512	340	26735	1060
Water year 2002																		
OCT	10	2	2.9	0.7	0.011	0.002	0.36	0.04	1.98	0.07	0.05	0.01	0.013	0.001	118	4	1087	43
NOV	9	2	3.2	0.8	0.016	0.004	0.37	0.04	2.16	0.08	0.05	0.01	0.013	0.001	127	4	1125	46
DEC	73	19	21.5	5.6	0.155	0.039	2.85	0.36	12.94	0.54	0.32	0.05	0.112	0.014	399	14	1754	68
JAN	173	43	38.1	9.6	0.350	0.084	6.47	0.79	33.66	1.39	0.71	0.10	0.227	0.027	720	24	2198	85
FEB	1068	421	144.4	47.0	1.237	0.432	25.08	3.73	111.02	4.85	3.48	0.74	0.998	0.187	1843	68	3516	148
MAR	397	80	84.6	17.9	0.354	0.072	15.03	1.52	87.00	3.07	1.27	0.15	0.189	0.018	1766	57	3611	136
APR	861	193	159.4	34.8	0.436	0.099	22.88	2.47	93.90	3.49	2.05	0.27	0.256	0.028	1991	67	4027	154
MAY	2058	562	293.1	71.7	0.674	0.171	35.66	4.27	96.90	3.77	3.80	0.58	0.595	0.076	2003	70	4481	175
JUN	1085	268	161.4	39.8	0.388	0.096	21.51	2.60	58.63	2.39	2.14	0.31	0.413	0.050	1263	46	3514	144
JUL	107	21	18.5	4.1	0.052	0.012	3.05	0.32	12.51	0.47	0.26	0.03	0.043	0.004	393	13	1928	77
AUG	46	9	7.1	1.7	0.021	0.005	1.39	0.15	5.95	0.22	0.12	0.01	0.019	0.002	226	8	1439	58
SEP	24	5	3.9	1.0	0.011	0.003	0.85	0.09	3.53	0.13	0.07	0.01	0.014	0.001	152	5	1198	49
Total	5911	1626	938.0	234.8	3.704	1.018	135.50	16.38	520.18	20.49	14.31	2.26	2.892	0.411	11001	379	29879	1183

Appendix. Monthly chemical loads and associated error for the Irondequoit Creek basin sites and Northrup Creek, Monroe County, N. Y., water years 2000-02. (continued)

Month	Total suspended solids 00530		Volatile suspended solids 00535		Ammonia as N, dissolved 00608		Ammonia + organic nitrogen as N, total 00625		Nitrite + nitrate as N, total 00630		Total phosphorus, as P 00665		Ortho-phosphate as P, dissolved 00671		Chloride, dissolved 00940		Sulfate, dissolved 00945	
	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error
Honeoye Creek at Honeoye Falls (04229500)																		
Water year 2000																		
OCT	--	--	--	--	0.002	0.000	0.19	0.02	0.02	0.00	0.02	0.00	0.004	0.000	16	1	19	2
NOV	--	--	--	--	0.004	0.001	0.27	0.03	0.05	0.01	0.02	0.00	0.005	0.001	31	2	46	4
DEC	--	--	--	--	0.021	0.004	1.73	0.18	1.21	0.25	0.17	0.02	0.031	0.004	166	8	247	20
JAN	--	--	--	--	0.032	0.006	2.51	0.26	3.82	0.74	0.24	0.03	0.043	0.005	257	12	279	23
FEB	--	--	--	--	0.082	0.022	8.56	1.33	20.65	6.24	1.04	0.21	0.120	0.020	632	41	456	49
MAR	--	--	--	--	0.107	0.020	8.76	0.87	10.40	2.15	0.90	0.11	0.102	0.011	794	36	558	43
APR	--	--	--	--	0.199	0.039	15.16	1.66	10.70	2.29	2.11	0.30	0.178	0.021	901	44	681	56
MAY	--	--	--	--	0.195	0.040	13.19	1.63	6.76	1.79	2.18	0.36	0.214	0.028	557	29	403	36
JUN	--	--	--	--	0.118	0.024	7.81	0.96	3.40	0.84	1.22	0.20	0.189	0.025	295	15	204	18
JUL	--	--	--	--	0.019	0.003	0.92	0.09	0.27	0.05	0.10	0.01	0.027	0.003	55	3	39	3
AUG	--	--	--	--	0.008	0.002	0.50	0.05	0.20	0.04	0.06	0.01	0.017	0.002	33	2	25	2
SEP	--	--	--	--	0.003	0.001	0.23	0.03	0.06	0.02	0.03	0.00	0.008	0.001	19	1	14	1
Total	--	--	--	--	0.790	0.162	59.82	7.12	57.55	14.41	8.09	1.26	0.938	0.122	3755	193	2970	257
Water year 2001																		
OCT	--	--	--	--	0.012	0.002	0.89	0.09	0.19	0.03	0.12	0.01	0.028	0.003	78	4	63	5
NOV	--	--	--	--	0.012	0.002	0.56	0.05	0.13	0.02	0.07	0.01	0.015	0.001	74	3	76	6
DEC	--	--	--	--	0.035	0.007	1.61	0.19	1.57	0.37	0.20	0.03	0.039	0.005	196	10	203	17
JAN	--	--	--	--	0.031	0.005	1.14	0.12	1.91	0.40	0.12	0.02	0.024	0.003	180	8	129	10
FEB	--	--	--	--	0.098	0.019	5.18	0.59	12.94	3.26	0.62	0.10	0.094	0.012	599	29	329	28
MAR	--	--	--	--	0.189	0.037	10.15	1.11	13.00	2.75	1.34	0.19	0.138	0.016	975	47	519	43
APR	--	--	--	--	0.362	0.083	21.60	2.96	27.40	7.77	3.88	0.70	0.300	0.045	1300	75	750	74
MAY	--	--	--	--	0.034	0.006	0.78	0.08	0.15	0.03	0.09	0.01	0.012	0.001	83	4	45	4
JUN	--	--	--	--	0.014	0.002	0.27	0.03	0.04	0.01	0.03	0.00	0.006	0.001	26	1	14	1
JUL	--	--	--	--	0.002	0.000	0.04	0.00	0.01	0.00	0.00	0.00	0.001	0.000	4	0	2	0
AUG	--	--	--	--	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0	0	0	0
SEP	--	--	--	--	0.001	0.000	0.03	0.00	0.01	0.00	0.00	0.00	0.001	0.000	3	0	2	0
Total	--	--	--	--	0.790	0.164	42.26	5.22	57.36	14.65	6.47	1.07	0.658	0.087	3519	182	2133	187
Water year 2002																		
OCT	--	--	--	--	0.002	0.000	0.05	0.01	0.01	0.00	0.01	0.00	0.002	0.000	7	0	5	0
NOV	--	--	--	--	0.004	0.001	0.13	0.01	0.02	0.01	0.01	0.00	0.003	0.000	20	1	19	2
DEC	--	--	--	--	0.031	0.006	1.33	0.15	1.07	0.23	0.16	0.02	0.028	0.003	153	8	145	13
JAN	--	--	--	--	0.043	0.008	1.77	0.17	2.50	0.44	0.18	0.02	0.032	0.003	228	10	156	12
FEB	--	--	--	--	0.168	0.039	11.66	1.75	38.76	14.38	1.65	0.36	0.196	0.034	885	50	489	49
MAR	--	--	--	--	0.128	0.026	7.07	0.89	5.56	1.48	0.81	0.14	0.074	0.010	636	32	334	29
APR	--	--	--	--	0.249	0.049	14.96	1.74	9.21	2.22	2.09	0.32	0.152	0.019	881	45	511	44
MAY	--	--	--	--	0.303	0.062	18.61	2.34	7.65	2.09	3.17	0.54	0.250	0.034	656	34	388	34
JUN	--	--	--	--	0.153	0.030	9.09	1.07	2.53	0.58	1.35	0.21	0.155	0.020	299	16	175	16
JUL	--	--	--	--	0.010	0.002	0.39	0.05	0.06	0.01	0.04	0.01	0.008	0.001	21	1	13	1
AUG	--	--	--	--	0.001	0.000	0.03	0.00	0.01	0.00	0.00	0.00	0.001	0.000	2	0	2	0
SEP	--	--	--	--	0.001	0.000	0.03	0.00	0.00	0.00	0.00	0.00	0.001	0.000	2	0	2	0
Total	--	--	--	--	1.092	0.223	65.12	8.18	67.39	21.44	9.49	1.62	0.902	0.126	3792	198	2238	199

Appendix. Monthly chemical loads and associated error for the Irondequoit Creek basin sites and Northrup Creek, Monroe County, N.Y., water years 2000-02.(continued)

	Total suspended solids 00530		Volatile suspended solids 00535		Ammonia as N, dissolved 00608		Ammonia + organic nitrogen as N, total 00625		Nitrite + nitrate as N, total 00630		Total phosphorus, as P 00665		Ortho-phosphate as P, dissolved 00671		Chloride, dissolved 00940		Sulfate, dissolved 00945	
Month	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error	Load	Error
Black Creek at Churchville (04231000)																		
Water year 2000																		
OCT	--	--	--	--	0.073	0.013	0.75	0.05	0.57	0.06	0.06	0.01	0.012	0.001	72	2	558	31
NOV	--	--	--	--	0.106	0.019	1.21	0.08	1.72	0.18	0.09	0.01	0.027	0.003	122	4	866	46
DEC	--	--	--	--	0.104	0.019	1.95	0.14	4.58	0.51	0.13	0.01	0.059	0.007	190	6	982	53
JAN	--	--	--	--	0.160	0.032	4.20	0.33	13.78	1.61	0.28	0.03	0.149	0.022	358	11	1269	72
FEB	--	--	--	--	0.266	0.075	10.19	1.20	33.24	5.51	0.88	0.16	0.287	0.061	689	29	1630	114
MAR	--	--	--	--	0.225	0.039	8.89	0.56	33.58	3.13	0.58	0.05	0.130	0.014	858	23	2230	112
APR	--	--	--	--	0.345	0.068	21.68	1.64	51.44	5.51	1.75	0.20	0.274	0.038	1250	37	3063	164
MAY	--	--	--	--	0.519	0.116	20.44	1.95	33.10	4.19	2.24	0.35	0.370	0.068	856	28	2538	144
JUN	--	--	--	--	0.403	0.076	6.68	0.49	9.75	1.05	0.78	0.09	0.188	0.025	355	10	1419	75
JUL	--	--	--	--	0.195	0.041	3.77	0.33	4.36	0.57	0.44	0.06	0.148	0.024	218	7	888	51
AUG	--	--	--	--	0.092	0.018	2.81	0.21	2.77	0.31	0.27	0.03	0.088	0.011	192	6	767	44
SEP	--	--	--	--	0.090	0.020	2.38	0.20	2.41	0.31	0.22	0.03	0.052	0.007	177	6	794	49
Total	--	--	--	--	2.578	0.535	84.94	7.16	191.32	22.95	7.72	1.03	1.782	0.282	5339	170	17004	955
Water year 2001																		
OCT	--	--	--	--	0.107	0.018	1.56	0.10	1.86	0.18	0.14	0.01	0.030	0.003	157	4	894	45
NOV	--	--	--	--	0.133	0.026	2.20	0.18	4.99	0.68	0.19	0.02	0.064	0.010	221	7	1158	63
DEC	--	--	--	--	0.170	0.031	4.51	0.33	14.68	1.63	0.35	0.04	0.170	0.022	417	12	1597	83
JAN	--	--	--	--	0.115	0.019	3.07	0.19	13.19	1.23	0.22	0.02	0.104	0.011	362	10	1116	56
FEB	--	--	--	--	0.337	0.068	12.71	0.99	57.19	6.30	1.09	0.13	0.420	0.061	1100	33	2354	129
MAR	--	--	--	--	0.310	0.059	18.03	1.33	66.03	6.89	1.48	0.17	0.299	0.039	1493	44	3000	159
APR	--	--	--	--	0.177	0.033	11.20	0.79	34.96	3.68	0.84	0.09	0.128	0.016	931	27	2157	113
MAY	--	--	--	--	0.183	0.040	5.67	0.48	10.93	1.30	0.55	0.08	0.086	0.015	389	12	1271	69
JUN	--	--	--	--	0.125	0.022	1.82	0.12	2.61	0.26	0.19	0.02	0.038	0.004	151	4	650	34
JUL	--	--	--	--	0.036	0.007	0.43	0.03	0.34	0.04	0.05	0.00	0.013	0.001	44	1	221	12
AUG	--	--	--	--	0.007	0.001	0.12	0.01	0.05	0.01	0.01	0.00	0.003	0.000	15	0	79	5
SEP	--	--	--	--	0.014	0.003	0.26	0.02	0.16	0.02	0.02	0.00	0.005	0.001	31	1	168	10
Total	--	--	--	--	1.715	0.327	61.57	4.57	206.98	22.22	5.12	0.58	1.360	0.185	5311	156	14665	779
Water year 2002																		
OCT	--	--	--	--	0.062	0.013	0.88	0.07	1.04	0.15	0.08	0.01	0.016	0.002	101	3	588	35
NOV	--	--	--	--	0.063	0.011	0.90	0.06	1.47	0.17	0.07	0.01	0.019	0.002	121	3	709	37
DEC	--	--	--	--	0.136	0.025	3.95	0.28	11.19	1.21	0.27	0.03	0.119	0.015	396	12	1520	81
JAN	--	--	--	--	0.115	0.020	3.63	0.24	13.32	1.34	0.23	0.02	0.102	0.012	419	12	1244	64
FEB	--	--	--	--	0.355	0.072	15.39	1.21	56.41	6.20	1.17	0.15	0.431	0.068	1311	40	2786	154
MAR	--	--	--	--	0.168	0.029	8.88	0.58	29.80	2.82	0.53	0.05	0.097	0.011	980	27	2284	117
APR	--	--	--	--	0.248	0.048	19.34	1.42	42.08	4.43	1.33	0.15	0.180	0.024	1360	40	3088	164
MAY	--	--	--	--	0.555	0.118	28.48	2.40	37.78	4.31	2.67	0.36	0.381	0.061	1278	40	3431	191
JUN	--	--	--	--	0.487	0.094	12.17	0.91	13.94	1.55	1.19	0.13	0.229	0.029	612	19	2154	120
JUL	--	--	--	--	0.077	0.015	1.37	0.09	1.00	0.11	0.12	0.01	0.029	0.003	114	3	540	30
AUG	--	--	--	--	0.017	0.003	0.41	0.03	0.16	0.02	0.03	0.00	0.007	0.001	42	1	217	12
SEP	--	--	--	--	0.014	0.003	0.28	0.02	0.10	0.01	0.02	0.00	0.003	0.000	31	1	193	12
Total	--	--	--	--	2.296	0.451	95.66	7.32	208.31	22.34	7.69	0.92	1.614	0.229	6766	201	18755	1017

For additional information write to:
New York Water Science Center
U.S. Geological Survey
30 Brown Road
Ithaca, NY 14850

Information requests:
(518) 285-5602
or visit our website at:
http://ny.water.usgs.gov

USGS Sherwood

Water Resources of Monroe County, New York, Water Years 2000-02 Atmospheric Deposition, Ground Water, Streamflow, Trends in Water Quality, and Chemical Loads in Streams

SIR 2005-5107