Prepared in cooperation with the
New York State Department of Environmental Conservation and the
U.S. Environmental Protection Agency

Ground-Water Quality in Western New York, 2006

Open-File Report 2008–1140

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

Cover. The American Falls viewed from the Niagara River at Niagara Falls, New York (photo by H.J. Zajd, Jr., 2007).

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DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
Mark D. Myers, Director

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Conversion Factors, Datum, and Abbreviations

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
square mile (mi^2)	2.590	square kilometer (km^2)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32$$

Vertical coordinate information is referenced to National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Abbreviations

AMCL	Alternative maximum contaminant level
CFU/ml	Colony forming units per milliliter
CIAT	2-chloro-4-isopropylamino-6-amino-s-triazine (also called deethylatrazine)
ESA	Ethanesulfonic acid
GWSI	Ground-Water Site Inventory
HA	Health Advisory for drinking water
HPC	Heterotrophic plate count
MCL	Maximum contaminant level
MTBE	Methyl-tert-butyl ether
NWQL	USGS National Water Quality Laboratory
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OA	Oxanilic acid
OGRL	USGS Organic Geochemistry Research Laboratory
SMCL	Secondary maximum contaminant level
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	Volatile organic compound

Other abbreviations in this report:

micrometer	µm
micrograms per liter	µg/L
milligrams per liter	mg/L
microsiemens per centimeter	µS/cm
platinum-cobalt units	Pt-Co units
picocuries per liter	pCi/L

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Abstract

Water samples were collected from 7 production wells and 26 private residential wells in western New York from August through December 2006 and analyzed to characterize the chemical quality of ground water. Wells at 15 of the sites were screened in sand and gravel aquifers, and 18 were finished in bedrock aquifers. The wells were selected to represent areas of greatest ground-water use and to provide a geographical sampling from the 5,340-square-mile study area. Samples were analyzed for 5 physical properties and 219 constituents that included nutrients, major inorganic ions, trace elements, radionuclides, pesticides, volatile organic compounds (VOC), phenolic compounds, organic carbon, and bacteria.

Results indicate that ground water used for drinking supply is generally of acceptable quality, although concentrations of some constituents or bacteria exceeded at least one drinking-water standard at 27 of the 33 wells. The cations that were detected in the highest concentrations were calcium, magnesium, and sodium; anions that were detected in the highest concentrations were bicarbonate, chloride, and sulfate. The predominant nutrients were nitrate and ammonia; nitrate concentrations were higher in samples from sand and gravel aquifers than in samples from bedrock. The trace elements barium, boron, copper, lithium, nickel, and strontium were detected in every sample; the trace elements with the highest concentrations were barium, boron, iron, lithium, manganese, and strontium. Eighteen pesticides, including 9 pesticide degradates, were detected in water from 14 of the 33 wells, but none of the concentrations exceeded State or Federal Maximum Contaminant Levels (MCLs). Fourteen volatile organic compounds were detected in water from 12 of the 33 wells, but none of the concentrations exceeded MCLs.

Eight chemical analytes and three types of bacteria were detected in concentrations that exceeded Federal and State drinking-water standards, which are typically identical. Sulfate concentrations exceeded the U.S. Environmental Protection Agency (USEPA) Secondary Maximum Contaminant Level (SMCL) of 250 milligrams per liter (mg/L) in three samples, and chloride concentrations exceeded the SMCL of 250 mg/L in two samples. Sodium concentrations exceeded the USEPA Drinking Water Health Advisory of 60 mg/L in nine samples. Iron concentrations exceeded the SMCL of 300 μg/L (micrograms per liter) in 14 filtered samples, and manganese exceeded the USEPA SMCL of 50 μg/L in 15 filtered samples, as well as the New York State MCL of 300 μg/L in 1 filtered sample. Arsenic exceeded the USEPA MCL of 10 μg/L in two samples, aluminum exceeded the SMCL for aluminum of 50 μg/L in one sample, and lead exceeded the MCL of 15 μg/L in one sample. Radon-222 exceeded the proposed USEPA MCL of 300 picocuries per liter in 24 samples. Any detection of coliform bacteria indicates a violation of New York State health regulations; total coliform was detected in 12 samples, and *Escherichia coli* was detected in 2 samples. The plate counts for heterotrophic bacteria exceeded the MCL (500 colony-forming units per milliliter) in four samples.

Introduction

Water samples were collected from 7 production wells and 26 private residential wells in the 9 westernmost counties of New York from August through December 2006 and analyzed to characterize the chemical quality of ground water in the 5,340-mi^2 study area. All 33 wells were within 3 river or lake basins (fig. 1); 16 were in the Lake Erie and Niagara River Basin, 7 were in the western Lake Ontario Basin, which lies between the Niagara River and the Genesee River Basins, and 10 were in the Allegheny River Basin. Fifteen of the wells were screened in sand and gravel aquifers, and 18 were completed in bedrock aquifers.

Many studies of ground-water quality in New York have included parts of the study area, such as Crain (1966), La Sala (1968), Frimpter (1974), Moore and Staubitz (1984), Erie County (1985), Koszalka and others (1985), and Anderson and others (2000). These studies provide much useful information, but a comprehensive and current assessment of the ground-water quality throughout the entire area is needed.

Section 305(b) of the Federal Clean Water Act Amendments of 1977 (U.S. Environmental Protection Agency, 1997) requires all States to implement a comprehensive water-quality-monitoring program for surface-water and ground-water

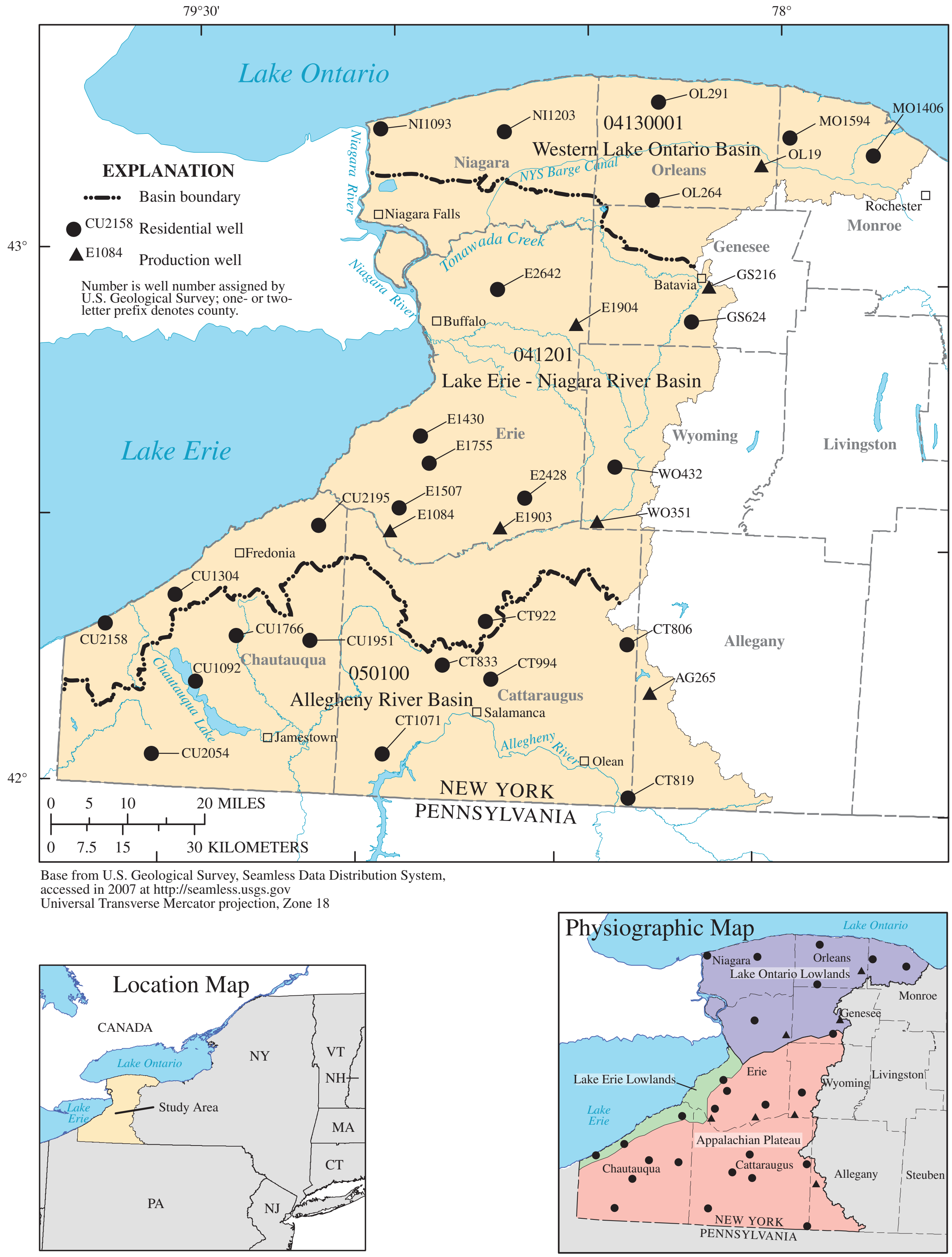


Figure 1. Pertinent geographic features of study area in western New York, and locations of the 33 wells sampled in 2006. (Well data are given in table A1 at end of report.)

resources. In 2001, the U.S. Geological Survey (USGS), in cooperation with the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (USEPA), began an assessment of ground-water quality in major river basins throughout the State, as specified in Section 305(b). To date (2008), ground-water-quality studies have been completed in the Chemung River Basin (Hetcher-Aguila, 2004), the Lake Champlain Basin (Nystrom, 2006), the upper Susquehanna River Basin (Hetcher-Aguila and Eckhardt, 2006), the Delaware River Basin (Nystrom, 2007a), the St. Lawrence River Basin (Nystrom, 2007b), the Genesee River Basin (Eckhardt and others, 2007), and the Mohawk River Basin (Nystrom, 2008). In 2006, a study of the westernmost region of New York was completed and is the subject of this report.

Purpose and Scope

This report presents the results of the 2006 ground-water study in western New York. It first describes the study area and the sampling methods, then presents results of the water-quality analyses. Summary statistics (number of samples exceeding Federal or State drinking-water standards) and the minimum, median, and maximum concentrations of all analytes in surficial and bedrock aquifers are given in tables 1–4; detailed analytical results are given in Appendix tables A1–A9 (at end of report). Analytical results for selected constituents are compared with Federal and State drinking-water standards, which are typically identical. The standards include Maximum Contaminant Levels (MCLs), Secondary Maximum Contaminant Levels (SMCLs), and Health Advisories (HAs) established by the USEPA (2002; 2004; and 2006) and the New York State Department of Health (NYSDOH) (2006). MCLs specify the highest level of a contaminant that is allowed in drinking water; they are based on human health criteria and are legally enforceable by Federal and State authorities. SMCLs are non-enforceable guidelines based on cosmetic and aesthetic criteria, such as taste and odor. HAs are estimates of acceptable drinking water levels for contaminants that can effect human health; they are non-enforceable standards that provide technical guidance for water use.

Study Area

The study area includes all of Chautauqua, Erie, and Niagara Counties and most of Cattaraugus and Orleans Counties; it also includes the western parts of Allegany, Genesee, Monroe, and Wyoming Counties (fig. 1). It encompasses parts of the Lake Erie and Niagara River Basin, the western Lake Ontario Basin (between the Niagara River and the Genesee River Basins), and the Allegheny River Basin (fig. 1, table 1). The parts of these drainage basins that lie outside New York's boundaries were not included in this study.

Physiography, Land Use, and Precipitation

The central, southern, and eastern parts of the study area lie within the Appalachian Plateau physiographic province (fig. 1, table A1); the northern part lies in the Lake Ontario Lowlands province, and the western part lies in the Lake Erie Lowlands province. Forest and pasture dominate the uplands and narrow valleys of the southern and eastern parts of the study area; cultivation of row crops, apples, and grapes is common in the Lake Erie and Lake Ontario Lowlands; and row-crop, forage-crop, and dairy farming is concentrated in a band of fertile soils between Buffalo and Rochester (fig. 2). The Buffalo and Niagara Falls metropolitan area lies near the outlet of Lake Erie and extends northward along the Niagara River. The study

Table 1. Area and population of the western New York study area, by drainage basin[1].

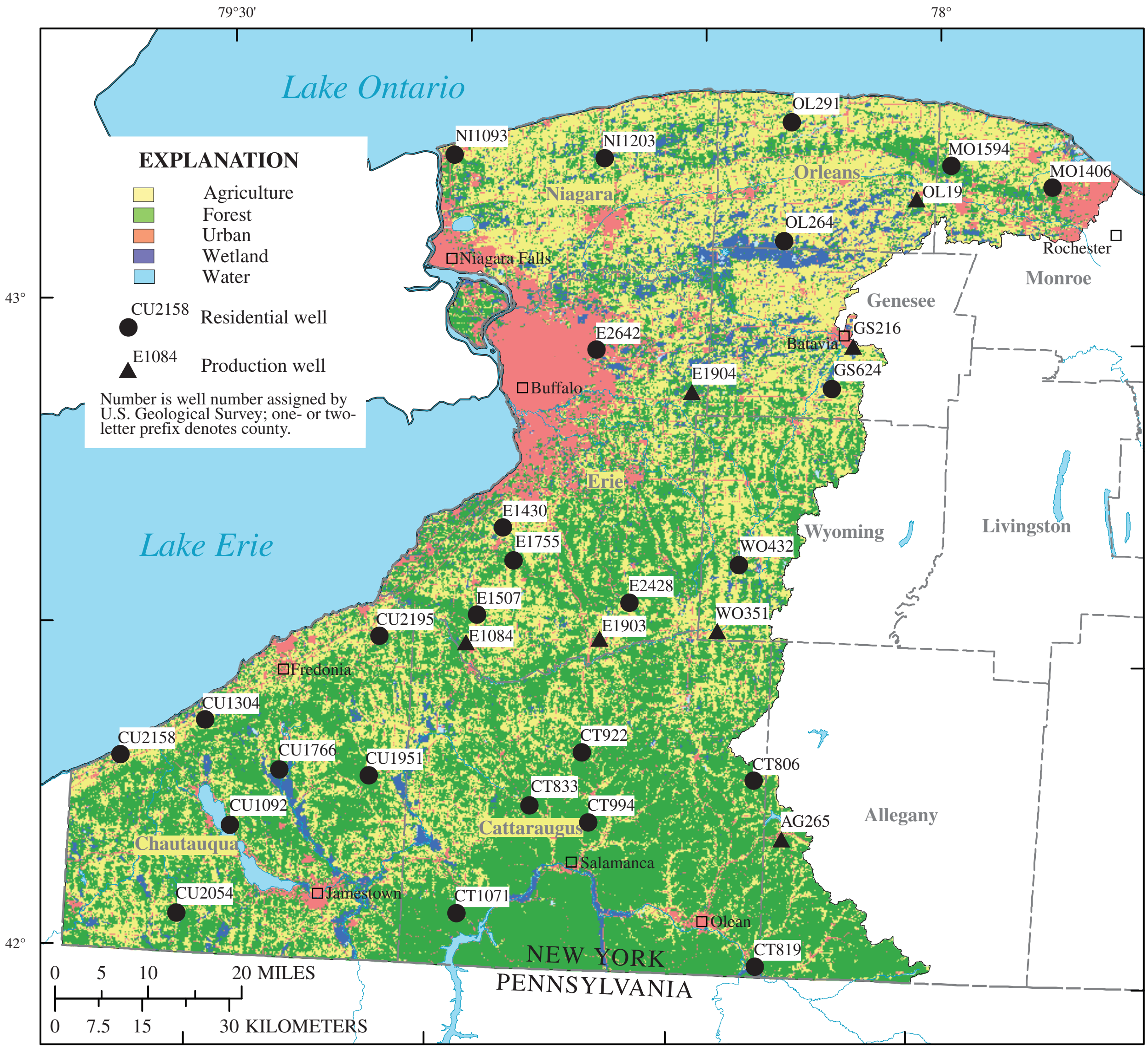
[Locations are shown in fig. 1]

Drainage basin	Hydrologic unit code	Area (square miles)	Population[2]
Lake Erie and Niagara River	041201	2,378	1,239,000
Lake Ontario, west of Genesee River[3]	04130001	1,035	568,000
Allegheny River	050100	1,927	159,000

[1] Data represent the part of basin that lies in New York State.

[2] 2000 Census (U.S. Department of Commerce, 2000).

[3] Basin area excludes Genesee River Basin.



Base from U.S. Geological Survey, Seamless Data Distribution System, accessed in 2007 at http://seamless.usgs.gov
Universal Transverse Mercator projection, Zone 18

Land use from National Land Cover Data 1992, Resolution 1 arc-second (approx. 30m)

Figure 2. Land use in western New York study area and locations of the 33 wells sampled in 2006. (Well data are given in table A1.)

area contains several small lakes, such as Chautauqua Lake, and is crossed by the New York State Barge (Erie) Canal, which traverses the State from Albany to Buffalo.

Land-surface elevations range from about 250 ft at Lake Ontario and 320 ft at Lake Erie to about 2,500 ft in the eastern and southern uplands. The climate is humid, and air temperatures are moderated by Lake Ontario and Lake Erie. Precipitation ranges from about 50 in/yr in the southwestern area near Jamestown (fig. 1) to about 30 in/yr along the Lake Ontario shore; mean annual precipitation is about 40 in. About 15 percent of the annual precipitation infiltrates the land surface and recharges the sand and gravel and bedrock aquifers (Randall, 2001).

Glacial Deposits

Glacially derived deposits are generally present throughout New York, except in an area around Salamanca in southern Cattaraugus County that was not covered by glacial ice (fig. 3), where a thin layer of colluvium is formed from weathered bedrock. Glaciers scoured the hills and valleys of New York and left a thin mantle of till on top of the bedrock in upland areas and morainal deposits of fine-grained, poorly sorted material that formed valley plugs and low ridges. During the subsequent period of deglaciation, meltwater streams deposited thick layers of stratified drift (fluvial sand and gravel) in front of the glaciers and on top, beneath, and alongside them, to form deposits that are seen today as outwash plains, eskers, kettles, kames, and kame terraces. Glacial meltwaters also deposited fine particles in proglacial lakes, where they settled to form poorly permeable deposits of lacustrine clay, silt, and fine sand. Recent alluvium covers some of the glacial deposits and forms today's flood plains along the larger streams and rivers and on the terraces along the lake shores. The glacial deposits within the study area are described in detail by Fairchild (1928), Coates (1966), Gilbert and Kammerer (1971), Frimpter (1974; 1986), Miller and Staubitz (1985), Cadwell and Muller (1986), Miller (1988), Yager and others (1997), and Randall (2001).

Bedrock

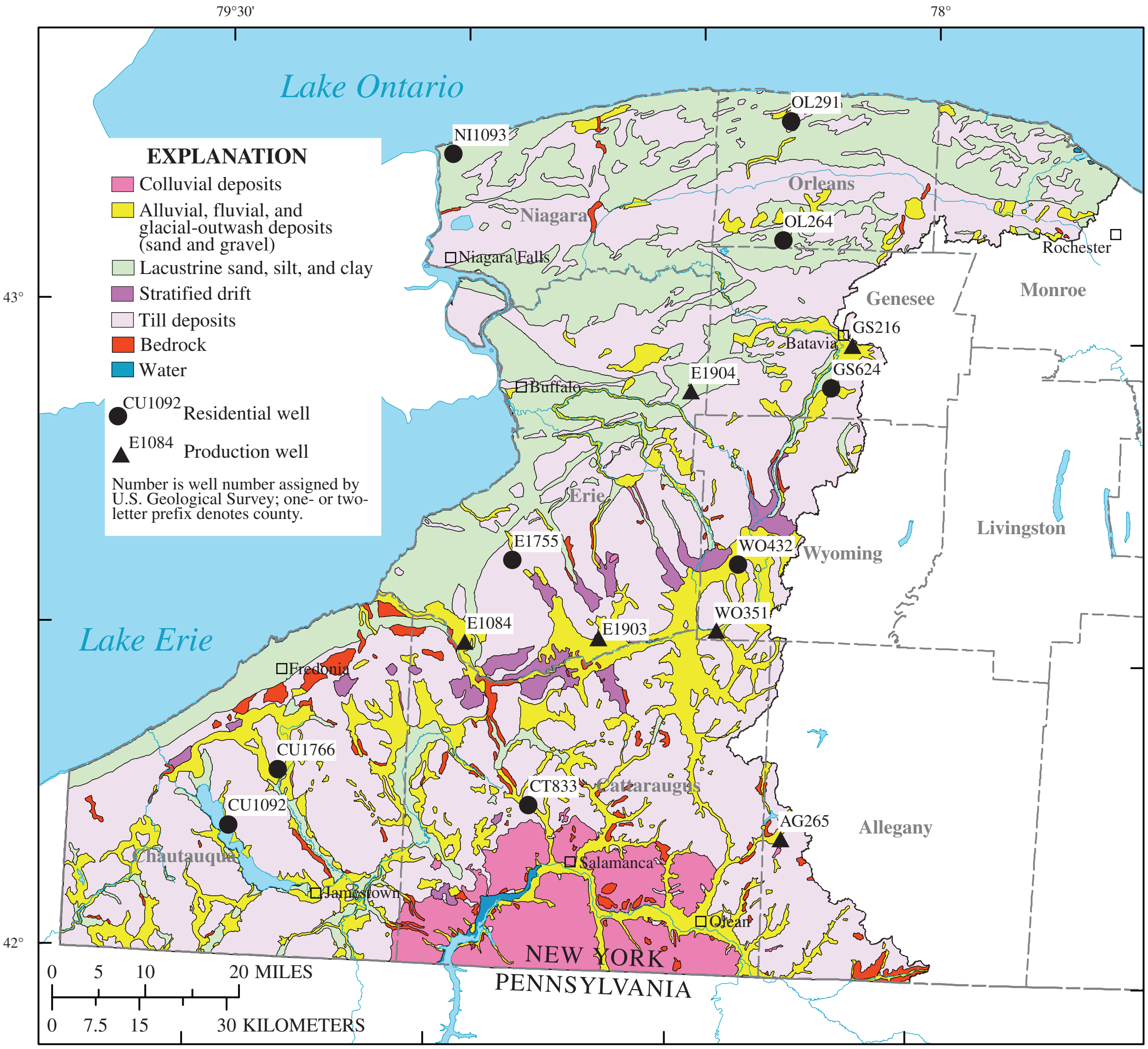
The bedrock aquifers in the study area (fig. 4) consist of relatively flat-lying, interbedded sedimentary units of shale, siltstone, sandstone, limestone, and dolostone of Ordovician, Silurian, and Devonian age (Broughton and others, 1962; Johnston, 1964; Staubitz and Miller, 1987; Brett and others, 1995; Kappel and Miller, 1996). Two bands of carbonate-rock aquifers—limestones and dolostones—extend from Buffalo to Batavia and from Niagara Falls to Rochester; interbedded shale, dolostone, and evaporites crop out in the area between the carbonate-rock aquifers.

Population and Water Supply

The southern and eastern parts of the study area are predominantly rural, although they contain several small cities (Batavia, Fredonia, Jamestown, and Olean) (fig. 1) and many small villages and hamlets. Most of the developed, urban area is in the cities of Buffalo and Niagara Falls, their suburbs in Erie and Niagara Counties, and in part of the Rochester metropolitan area in Monroe County (fig. 2). Total population of the study area in 2000 was about 1,966,000, about half of which lives in the Buffalo and Niagara Falls area (U.S. Department of Commerce, 2000). Production wells provide water to about 40,000 people in the villages, towns, and cities within the study area (New York State Department of Health, 2005).

The largest water suppliers are the Erie County Water Authority and the Niagara Falls Water Authority, which provide the residents of these areas with water from Lake Erie and the Niagara River, respectively. The Monroe County Water Authority provides residents in Monroe, eastern Orleans, and northeastern Genesee Counties with water from Lake Ontario. Many of the rural communities and residents in areas that lie beyond these water-system service areas rely on ground water from bedrock or from surficial deposits of sand and gravel. Some community systems in areas where surficial aquifers are thin or absent use surface water from small reservoirs or lakes; others obtain water from bedrock wells. Most rural homeowners that live beyond the service areas of community water systems have private wells that tap surficial deposits or bedrock.

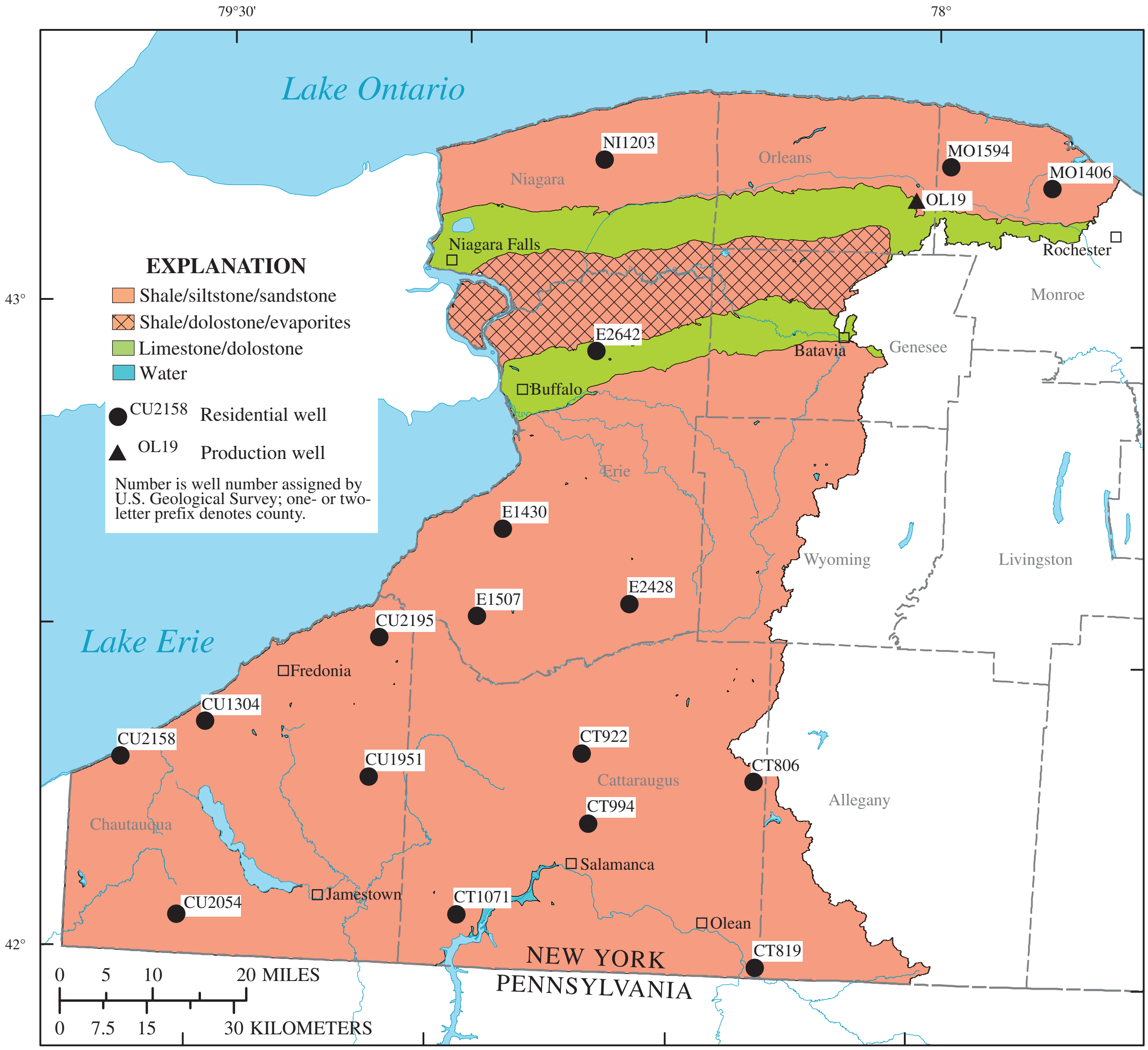
The most productive aquifers within the study area are the glacial and alluvial deposits of sand and gravel (fig. 3). Frimpter (1974) estimated that sand and gravel aquifers in the Allegheny River valley can yield more than 220 Mgal/d. Deltaic sand and gravel deposits that are tapped for water supply at Jamestown may potentially yield 10 Mgal/d (Crain, 1966), and outwash deposits at Batavia yield as much as 1.4 Mgal/d (Cosner, 1984). Till deposits are typically thin and relatively impermeable and yield little water to wells. Clay beds yield little or no water to wells but may overlie productive sand and gravel aquifers. Bedrock aquifers (fig. 4) are used for water supply where sand and gravel aquifers are absent, typically in upland areas. The bedrock aquifers in the study area may yield water of poorer chemical quality than the surficial aquifers; for example, the carbonate-rock aquifers typically yield very hard water, whereas shale bedrock aquifers along the shores of Lake Erie and Lake Ontario Lowlands often yield salty water at depths greater than 50 ft (Frimpter, 1974; La Sala, 1968).



Base from U.S. Geological Survey, Seamless Data Distribution System, accessed in 2007 at http://seamless.usgs.gov
Universal Transverse Mercator projection, Zone 18

Surficial Geology from New York State Museum, 1:250,000

Figure 3. Surficial geology of western New York study area and locations of the 15 wells screened in sand and gravel aquifers that were sampled in 2006. (Well data are given in table A1.)



Base from U.S. Geological Survey, Seamless Data Distribution System, accessed in 2007 at http://seamless.usgs.gov
Universal Transverse Mercator projection, Zone 18

Bedrock Geology from New York State Museum, 1:250,000

Figure 4. Generalized bedrock geology of western New York study area and locations of the 18 wells completed in bedrock that were sampled in 2006. (Well data are given in table A1.)

Methods

A total of 33 wells were selected for sample collection—15 were finished in sand and gravel aquifers (fig. 3), and 18 were finished in bedrock aquifers (fig. 4). The 15 wells that tap sand and gravel consisted of 6 production wells and 9 private residential wells; the 18 bedrock wells consisted of 1 production well and 17 private residential wells. Sampling was done from August through December 2006. The water samples were analyzed for 5 physical properties and 219 constituents, including 4 types of bacteria. Three samples—two field blanks and one replicate sample—were collected for quality assurance (QA) and quality control (QC), as required for the Federal 305(b) program.

Site Selection

The wells were identified through (1) the USGS Ground-Water Site Inventory (GWSI) database, (2) the NYSDEC Water-Well Reporting Program, and (3) information from State and county health departments. The Water-Well Reporting Program was implemented in 2000 to collect information about newly drilled wells throughout New York from licensed well drillers; the resulting database provides useful information for ground-water studies. A letter requesting permission to sample the water was sent to owners of residential wells that were identified as potential sampling sites; the letter described the project and included a questionnaire asking the location of the well, the most convenient times for sampling, any safety concerns around the well, and other information.

Production wells were identified through the NYSDOH and by local officials from the Allegany, Erie, Genesee, Niagara, and Wyoming County Departments of Health and water managers of villages and cities throughout the study area. The water managers were sent a project description and a questionnaire similar to those sent to residential well owners. Well owners who responded favorably were contacted by telephone to clarify information about the wells and to arrange sampling dates.

Most of the wells finished in sand and gravel (fig. 3) were in valleys and ranged from 15 to 185 ft deep (table A1). All the production wells that tap sand and gravel have slotted screens, whereas most residential wells that tap sand and gravel simply have an open-bottomed steel casing. The bedrock wells (fig. 4) were generally in upland terrains and ranged from 27 to 210 ft deep (table A1); these wells typically have steel casing set into open boreholes in competent rock.

Site selection did not target specific municipalities, industries, or agricultural practices; rather, sampling sites were selected to represent areas of greatest ground-water use and to obtain a geographical representation of the study area and its aquifers (figs. 2–4). Site selection included wells in each of four predominant land-use categories—agriculture, urban, forest, and wetland. The land-use classification was done through satellite-image analysis of the predominant land uses within a half-mile radius of each well (fig. 2). Most were surrounded by a predominant land use that represented more than 50 percent of the radial area surrounding the well; the other wells were surrounded by a combination of land uses.

Shallow wells that tap sand and gravel aquifers are susceptible to contamination by several types of compounds, including volatile organic compounds (VOCs), pesticides, deicing chemicals, and nutrients from nearby highways and industrial, agricultural, and residential areas. The movement of these contaminants to the water table through the soils and surficial sand and gravel can be relatively rapid. Bedrock wells that tap sandstone and shale aquifers in rural upland areas are generally less susceptible to contamination from industrial and urban sources, which are mainly in the valleys; but bedrock wells in lowland areas underlain by carbonate rock (limestone and dolostone) may be vulnerable to contamination from surface runoff because infiltration rates and ground-water flow can be relatively rapid through solution features in the rock. Agricultural land that surrounds wells may be a potential source of contamination from fertilizers, pesticides, and fecal waste from livestock; lawns and septic systems are also a potential source of these contaminants. In addition to human contaminants, the aquifers contain naturally derived elements that may diminish water quality, such as sodium, chloride, sulfate, iron, manganese, and trace elements such as arsenic; some also may contain hydrogen sulfide, methane, and radon gases from deep-lying sources.

Sampling Methods

Water samples were analyzed for the physical properties and constituents listed in Appendix tables A2–A9 (at end of report). The categories are as follows: physical properties (table A3), inorganic constituents (table A4), nutrients and total organic carbon (table A5), trace elements and radon-222 (table A6), and VOCs and phenols (table A8). Samples were collected from every well for these analyses and were processed by methods described in the USGS manual for the collection of water-quality data (U.S. Geological Survey, 2006). Additionally, pesticide samples were collected for pesticide analyses (table A7) and processed by the methods of Shelton (1994) and Sandstrom and others (2001). These samples were analyzed at the USGS National Water Quality Laboratory (NWQL) and the USGS Kansas Organic Geochemistry Research Laboratory (OGRL) for 134 pesticides and pesticide degradates through methods described by Zaugg and others (1995), Furlong and others (2001), Meyer and others (1993), and Lee and Strahan (2003). The analytical method devised by Zaugg and others (1995) was developed in cooperation with the USEPA and allows detection of the nation's most commonly used pesticides. Samples for bacteria analyses (table A9) were processed in accordance with NYSDOH guidelines.

Sampling was done at all sites as follows: the well pump was turned on (many of the production wells were already running) and allowed to run until at least five casing-volumes of well water had passed the sampling point. A raw-water tap between the well and the pressure tank was opened, and the water was allowed to flush for several minutes. During this time, a general visual evaluation of the area surrounding the well was conducted to identify potential sources of contamination that could affect the well water. Samples were collected from the raw-water tap to avoid all water-treatment systems and to ensure that the water collected was representative of the water in the aquifer. A Teflon discharge line was then connected to the tap, and samples were analyzed with a multiprobe meter for physical properties (temperature, specific conductance, dissolved-oxygen concentration, and pH). After the measurements of these properties had stabilized, a second Teflon discharge line was connected to the first with a stainless-steel quick-connect fitting and was directed into a sample-collection chamber mounted upon a plastic box; this chamber was used to minimize sample exposure to dust and other potential sources of contamination. Bottles were filled within the chamber according to standard USGS field methods (U.S. Geological Survey, 2006).

The analyses for physical properties, most trace elements and metals, acid-neutralizing capacity, organic carbon, radon-222, VOCs, and phenols were done on unfiltered water samples to obtain total whole-water concentrations. Dissolved concentrations of nutrients, major inorganic constituents, three metals, and pesticides were obtained from filtered samples. Concentrations of iron and manganese in unfiltered samples were compared with those in filtered samples to obtain the difference between the total and dissolved concentrations (table A6). Sulfuric acid was added to the samples collected for phenol analysis, hydrochloric acid was added to samples collected for total organic carbon and VOC analyses, and nitric acid was added to some of the samples collected for trace-element analyses to prevent sample degradation. Samples collected for dissolved inorganic-compound analyses were filtered through a 0.45-micrometer (µm) cellulose capsule filter that was attached to the Teflon discharge line inside the sample-collection chamber; samples for pesticide analysis were filtered through a 0.7-µm furnace-baked glass-fiber plate filter.

All Teflon discharge lines were cleaned in the laboratory before each sampling day and in the field between each sample collection. New bags were used at each sampling site. Samples for radon analysis were obtained through an in-line septum chamber with a disposable syringe to avoid atmospheric contamination. Samples for bacterial analysis were collected in sterile containers provided by the bacteriological laboratory; the connection of the sampling tube to the well tap was not sterilized.

The samples were stored on ice in coolers and delivered directly, or shipped by overnight delivery, to one of four laboratories: (1) the USGS NWQL in Denver, Colo., for analysis for inorganic major ions, nutrients, inorganic trace elements and radon-222, some pesticides, and VOCs (U.S. Geological Survey, 2007); (2) the USGS Kansas OGRL in Lawrence, Kans., for other pesticides; (3) a New York State-certified private laboratory in Waverly, N.Y., for total organic carbon and phenolic compounds; and (4) a laboratory in Lackawanna, N.Y., approved by New York State for bacteria analysis.

Ground-Water Quality

The 33 ground-water samples collected during this study were analyzed for 5 physical properties and 219 constituents. Most (137) of the 215 chemical constituents were not detected in any sample (table A2). The concentrations of the 78 detected chemical constituents are listed in tables A4–A8, and the results for 4 types of bacteria are listed in table A9. The quality of the sampled ground water was generally acceptable, except where concentrations of certain constituents exceeded recommended MCLs, SMCLs, or HAs set by the U.S. Environmental Protection Agency (2006) and the New York State Department of Health (2006).

The QA/QC field blanks contained no constituent in concentrations above the laboratory reporting levels; this indicates that no contamination had occurred through the sampling or analytical procedures. The results of the two QA/QC replicate samples indicated that variability in sample results met the precision requirements of the study. The analytes with the largest percent differences between concentration in a ground-water sample and that in the replicate sample were acid-neutralizing capacity, residue on evaporation, and low-concentration trace elements (concentrations near the reporting level for the elements).

Physical Properties

The pH of the samples (table A3) ranged from 6.4 to 8.2; pH of 1 of the 33 samples was outside the accepted SMCL range of 6.5 to 8.5 (U.S. Environmental Protection Agency, 2006). Specific conductance of the samples ranged from 171 to 5,500 µS/cm. Dissolved-oxygen concentrations ranged from less than 0.3 mg/L at four wells to 6.7 mg/L. None of the samples had a water color that exceeded the SMCL of 15 platinum-cobalt units. The odor of hydrogen sulfide gas was noted by field personnel in water from 10 of the 33 wells.

Inorganic Major Ions

Water from the wells was generally a calcium-bicarbonate type, although water from three wells—CT 994, CU 1304, and CU 1766 (fig. 1)—was a sodium-bicarbonate type; water from two wells (CU 2158 and E 2642) was a calcium-sulfate type; water from two wells (AG 265 and MO 1594) was a calcium-chloride type; and water from one well (NI 1203) was a sodium-chloride type (Hem, 1985). The cations that were detected in the highest concentrations were calcium, magnesium, and sodium (tables 2 and A4). Calcium concentrations ranged from 6.04 to 197 mg/L, and magnesium concentrations ranged from 1.46 to 57.4 mg/L. Calcium and magnesium contribute to water hardness, and 18 of the 33 wells yielded water with hardness greater than 180 mg/L, which is classified as "very hard" (Hem, 1985). Sodium concentrations ranged from 2.87 to 929 mg/L, and nine samples exceeded the USEPA Health Advisory, which recommends that sodium concentrations in drinking water not exceed 60 mg/L to minimize the taste. This HA for sodium is not federally enforceable but is intended as a guideline for consumers (U.S. Environmental Protection Agency, 2002; 2006).

The anions that were detected in the highest concentrations were bicarbonate (alkalinity), chloride, and sulfate (tables 2 and A4). Bicarbonate concentrations ranged from 90 to 486 mg/L (as $CaCO_3$), chloride concentrations ranged from 0.78 to 1,590 mg/L, and sulfate concentrations ranged from less than 0.18 to 371 mg/L. The chloride SMCL of 250 mg/L was exceeded in two samples, and the sulfate SMCL of 250 mg/L was exceeded in three samples.

Table 2. Summary statistics for concentrations of major ions in sand and gravel aquifers and bedrock aquifers in western New York, 2006.

[Concentrations are in milligrams per liter. All samples represent filtered water; No., number; --, not applicable; <, less than]

	Constituent	Drinking-water standard	No. of samples exceeding standard	Sand and gravel (15 samples)			Bedrock (18 samples)		
				Minimum	Median	Maximum	Minimum	Median	Maximum
Cations	Calcium	--	--	12.2	91.2	150	6.04	49.1	197
Cations	Magnesium	--	--	2.72	19.4	57.4	1.46	13.6	47.1
Cations	Potassium	--	--	0.81	1.9	4.2	0.73	1.9	26.1
Cations	Sodium	60[a]	9	3.82	35.3	75.5	2.87	35.3	929
Anions	Bicarbonate	--	--	109	299	390	90	240	486
Anions	Chloride	250[b]	2	10.8	38.6	140	.78	43.1	1,590
Anions	Fluoride	2.2[b]	0	< .1	.1	.69	.11	.3	.77
Anions	Sulfate	250[b,c]	3	< .18	30.9	136	1.09	24.0	371
	Hardness, mg/L as $CaCO_3$			42	320	500	21	180	680
	Alkalinity, mg/L as $CaCO_3$			89	245	320	74	197	398
	Residue on evaporation, mg/L			203	403	652	100	315	3,250

[a] USEPA Drinking Water Advisory Taste Threshold.

[b] NYSDOH Maximum Contaminant Level.

[c] USEPA Secondary Maximum Contaminant Level.

Nutrients and Organic Carbon

Nitrate and ammonia were the predominant nutrients in the ground-water samples (table A5); nitrite and organic nitrogen concentrations were negligible in most samples. Nitrate plus nitrite concentrations ranged from less than 0.06 (the analytical detection limit) to 6.92 mg/L as nitrogen (N), and ammonia concentrations ranged from less than 0.01 to 3 mg/L as N. The nitrate MCL of 10 mg/L (as N) was not exceeded in any sample, and the concentrations in 20 of the 33 samples were below the detection limit (less than 0.06 mg/L). Of the samples in which nitrate was detected, those from wells finished in sand and gravel had a higher median nitrate concentration (2.40 mg/L) than those from wells finished in bedrock (0.18 mg/L). Orthophosphate was detected in 30 of the 33 samples, but concentrations were typically low; the maximum concentration was 0.109 mg/L (as phosphorus). Total organic carbon was detected in 10 of the 33 samples; concentrations ranged from less than 1.0 mg/L (the analytical detection limit) to 3.6 mg/L.

Table 3. Summary statistics for concentrations of nutrients and organic carbon in sand and gravel aquifers and bedrock aquifers in western New York, 2006.

[All samples represent filtered water except as noted; No., number; -- not applicable; <, less than; N, nitrogen; P, phosphorus]

Constituent	Drinking-wter standard	No. of samples exceeding limit	Sand and gravel (15 samples)			Bedrock (18 samples)		
			Minimum	Median	Maximum	Minimum	Median	Maximum
Ammonia plus organic N, mg/L as N	--	--	< 0.1	0.14	3.1	< 0.1	0.30	2.8
Ammonia, mg/L as N	--	--	<0.02	0.054	3.00	< 0.01	0.076	2.61
Nitrate plus nitrite, mg/L as N	10 [a,b]	0	<0.06	< 0.06	6.92	< 0.06	< 0.06	2.33
Nitrite, mg/L as N	1[a,b]	0	< 0.002	< 0.002	0.208	< 0.002	< 0.002	0.006
Orthophosphate, mg/L as P	--	--	< 0.006	0.006	0.109	< 0.006	0.007	0.026
Total organic carbon, unfiltered, mg/L	--	--	< 1.0	< 1.0	1.8	< 1.0	< 1.0	3.6

[a] USEPA Drinking Water Advisory Taste Threshold.

[b] NYSDOH Maximum Contaminant Level.

Trace Elements and Radon-222

The most commonly detected trace elements were barium, boron, copper, lithium, nickel, and strontium, all of which were detected in every sample (tables 4 and A6). The elements detected in the highest concentrations were barium, boron, iron, lithium, manganese, and strontium. Barium concentrations ranged from 21.7 to 1,660 µg/L, but the MCL for barium (2,000 µg/L) was not exceeded. Boron concentrations ranged from 12 to 2,430 µg/L, but MCLs have not been established for boron. Iron was detected in 29 of the 33 filtered samples at concentrations ranging from 3 to 3,220 µg/L, and the SMCL for iron (300 µg/L) was exceeded in 14 samples. Lithium concentrations ranged from 1.2 to 917 µg/L, but MCLs have not been established for lithium. Manganese was detected in 29 of the 33 filtered samples at concentrations ranging from 0.5 to 696 µg/L; the Federal SMCL for manganese (50 µg/L) was exceeded in 15 samples, and the New York State MCL (300 µg/L) was exceeded in 1 sample. Strontium concentrations ranged from 48.5 to 10,600 µg/L, but MCLs have not been established for strontium.

Aluminum was detected in 21 of the 33 samples, and the SMCL (50 µg/L) was exceeded in 1 sample. Arsenic was detected in 32 samples, and the MCL (10 µg/L) was exceeded in 2 samples. Lead was detected in 31 samples, and the MCL (15 µg/L) was exceeded once.

Table 4. Summary statistics for concentrations of trace elements and radon-222 in sand and gravel aquifers and bedrock aquifers in western New York, 2006.

[All concentrations are in micrograms per liter except as noted. All samples unfiltered except as noted. pCi/L, picocuries per liter; No., number; -- not applicable; <, less than; E, estimated]

Constituent	Drinking-water standard	No. of samples exceeding standard	Sand and gravel (15 samples)			Bedrock (18 samples)		
			Minimum	Median	Maximum	Minimum	Median	Maximum
Aluminum	50[c]	1	<2	<2	30	<2	2	85
Antimony	6[a,b]	0	<0.2	<0.2	0.5	<0 .2	<0.2	3.8
Arsenic	10[a]	2	<.12	.60	111	E .06	.77	20.9
Barium	2,000[a,b]	0	33.4	153	817	21.7	120	1,660
Beryllium	4[a,b]	0	<.06	<.06	<.06	<.06	<.06	0.52
Boron, filtered	--	--	12	32	365	13	156	2,430
Cadmium	5[a,b]	0	<.02	<.02	.05	<.09	<.04	4.02
Chromium	100[a,b]	0	<.6	<.6	2.1	<.04	.105	1.8
Cobalt	--	--	E .027	.189	.478	<.04	.118	2.85
Copper	1,000[c]	0	E .6	2.2	49.9	E .4	2.85	441
Iron, filtered	300[b,c]	14	<6	28	3,220	<6	276	1,580
Iron	300[b,c]	16	E 4	187	2,870	<6	301	1,620
Lead	15[d]	1	<.6	.17	15.3	<.06	.46	4.48
Lithium	--	--	1.2	6.2	58.4	2.2	27.1	917
Manganese, filtered	50[c]–300[b]	15 - 1	<.6	22.7	152	<.6	54.2	696
Manganese	50[c]–300[b]	16 - 1	<.6	22.2	146	<.6	53.3	625
Molybdenum	--	--	<.2	1.1	8	E .1	.45	14.7
Nickel	--	--	.31	.86	2.52	.21	.44	8.66
Selenium	50[a,b]	0	<.08	<.08	.8	<.08	<.08	1.6
Silver	100[a,b]	0	<.02	<.02	.06	<.02	<.16	2.23
Strontium	--	--	90.2	237	976	48.5	320	10,600
Thallium	--	--	<.18	<.18	<.18	<.18	<.18	.45
Zinc	5,000[b,c]	0	<2	7.0	196	E 1	7	100
Radon-222, pCi/L	300[e]	24	40	500	1,200	70	510	2,160
Uranium	30[a]	0	<.012	.152	347	<.012	.113	6.45

[a] USEPA Maximum Contaminant Level.

[b] NYSDOH Maximum Contaminant Level.

[c] USEPA Secondary Maximum Contaminant Level.

[d] USEPA Treatment Technique.

[e] USEPA Proposed Maximum Contaminant Level.

Uranium was detected in 26 samples, but none exceeded the MCL of 30 µg/L. The MCLs for antimony (6 µg/L), beryllium (4 µg/L), cadmium (5 µg/L), chromium (100 µg/L), selenium (50 µg/L), and silver (100 µg/L) and the SMCLs for copper (1,000 µg/L) and zinc (5,000 µg/L) were not exceeded in any sample. Mercury was not detected in any sample (table A2).

Radon-222 was detected in every sample (table A6), and concentrations ranged from 40 to 2,160 pCi/L. The proposed MCL of 300 pCi/L for radon-222 in drinking water was exceeded in 24 samples, but the proposed AMCL of 4,000 pCi/L was not exceeded. The AMCL is the proposed allowable concentration of radon in raw-water samples where programs have been implemented to address the health risks of radon in indoor air, but none of the 33 well sites sampled in this study had such implementation. The proposed MCL and AMCL for radon are under review and have not been adopted (U.S. Environmental Protection Agency, 2004; 2006).

Pesticides

Eighteen pesticides (including 9 pesticide degradates) were detected in water from 14 of the 33 wells (table A7), but none of the concentrations exceeded MCLs. Eight of the samples containing pesticides were from sand and gravel aquifers, and six were from bedrock aquifers. Caffeine, which is not a pesticide and can be an indicator of human wastes, is included in table A7 because it is measured as part of the pesticide analyses and was detected at a trace level in one sample. The pesticide compounds that were detected most frequently were herbicide degradation products— CIAT (2-chloro-4-isopropylamino-6-amino-*s*-triazine, also called deethylatrazine, a degradation product of atrazine), alachlor ESA (a degradation product of alachlor), and metolachlor ESA and OA (degradation products of metolachlor). CIAT was detected in six samples; the maximum concentration was 0.019 µg/L. Metolachlor and siduron were detected in three samples; their maximum concentrations were 0.400 µg/L and 0.01 µg/L, respectively. Atrazine was detected in two samples; the maximum concentration was 0.104 µg/L. Alachlor was detected in one sample, at a concentration of 1.03 µg/L. No Federal MCLs currently have been established for pesticide degradation products, and no pesticide concentration exceeded the New York State MCL of 50 µg/L. These trace-level detections of pesticides are similar to those reported by Eckhardt and others (2001), Phillips and others (1999), and Eckhardt and Stackelberg (1995) from studies of pesticides in ground water throughout New York State.

Volatile Organic Compounds and Phenolic Compounds

Fourteen VOCs were detected in 12 samples (table A8), but none of the concentrations exceeded MCLs. Phenolic compounds, which are semivolatile, were detected in one sample at a concentration of 8 µg/L. Toluene was detected in four samples; the maximum concentration was 0.9 µg/L. Trichloromethane was detected in three samples, and tribromomethane and dibromochloromethane were each detected in one sample; these compounds are called trihalomethanes and are typically formed as disinfection by-products that result from chlorination of water. Xylene compounds were detected in three samples; the maximum concentration was 29.8 µg/L for the *meta* plus *para* isomers. Methyl *tert*-butyl ether (MTBE), a gasoline additive that can infiltrate into ground water from leaking fuel tanks, was detected in two samples; the maximum concentration was 1.3 µg/L. The New York State MCL for MTBE is 10 µg/L, which was not exceeded. No Federal MCL has been established for MTBE, although the USEPA has suggested a limit of 20 to 40 µg/L on the basis of taste and odor of drinking water (U.S. Environmental Protection Agency, 2006).

Bacteria

All samples were analyzed for total coliform, fecal coliform, *Escherichia coli (E. coli)*, and heterotrophic bacteria. Total coliform was detected in 12 samples, and *E. coli* in 2 samples (table A9). These bacteria were detected in four samples from sand and gravel aquifers and in nine samples from bedrock aquifers; eight of these samples were from private residential wells, and one was from a production well (E 1084, fig. 1), which taps a sand and gravel aquifer. Any detection of these bacteria is considered a violation of New York State health regulations, and well owners were notified of positive results upon receipt of laboratory results. The raw-water samples collected in this study were collected prior to disinfection treatments, and most production wells have chlorination systems that eliminate potential contamination by bacteria before the water is distributed to consumers; however, private residential wells generally lack a chlorination system.

Heterotrophic plate counts (HPCs) ranged from less than 2 to greater than 738 colony-forming units per milliliter (CFU/mL). The USEPA MCL for HPC is 500 CFU/mL, and four samples exceeded this limit.

Summary

In 2001, the USGS, in cooperation with the NYSDEC and the USEPA, began an assessment of ground-water quality in river basins throughout New York State. As a part of this assessment, water samples were collected from 33 production wells and private residential wells throughout western New York from August through December 2006 and were analyzed for 5 physical properties and 219 constituents that included inorganic major ions, nutrients, organic carbon, trace elements, radon-222, VOCs, phenolic compounds, pesticides, and bacteria. The quality of the sampled ground water was generally acceptable, except where concentrations of certain constituents exceeded recommended MCLs, SMCLs, or HAs set by the USEPA and NYSDOH. Of the 78 constituents that were detected, 8 exceeded Federal and State MCLs, SMCLs, or HAs at specific wells; 3 types of bacteria also were detected in concentrations that exceeded MCLs at some wells.

The cations that were detected in the highest concentrations were calcium, magnesium, and sodium; the anions that were detected in the highest concentrations were bicarbonate, chloride, and sulfate. The predominant nutrients were nitrate and ammonia; no sample exceeded the MCL (10 mg/L as N) for nitrate. The HA for sodium in drinking water (60 mg/L) was exceeded in 9 of the 33 samples; the sulfate SMCL (250 mg/L) was exceeded in 3 samples; and the chloride SMCL (250 mg/L) was exceeded in 2 samples.

The trace elements detected in the highest concentrations were barium, boron, iron, lithium, manganese, and strontium, but of these, only dissolved iron, manganese, and aluminum concentrations exceeded SMCLs. Iron was detected in 29 of the 33 filtered samples at concentrations ranging from 3 to 3,220 µg/L, and the SMCL for iron (300 µg/L) was exceeded in 14 samples. Manganese was detected in 29 filtered samples at concentrations ranging from 0.5 to 696 µg/L; the USEPA SMCL for manganese (50 µg/L) was exceeded in 15 samples, and the New York State MCL (300 µg/L) was exceeded in 1 sample. Aluminum was detected in 21 samples, and the SMCL (50 µg/L) was exceeded once. Arsenic was detected in 32 samples, and the MCL for arsenic (10 µg/L) was exceeded in 2 samples. Lead was detected in 32 samples, and the MCL (15 µg/L) was exceeded once. Radon-222 was detected in every sample; the proposed Federal MCL for radon-222 in drinking water (300 pCi/L) was exceeded in 24 samples, but the proposed AMCL (4,000 pCi/L) was not exceeded in any sample.

Eighteen pesticides, including 9 pesticide degradates, were detected in water from 14 of the 33 wells; most of the concentrations were at or near the detection limits, and no concentration exceeded an MCL. Eight of the samples containing pesticides were from sand and gravel aquifers, and six were from bedrock aquifers. Caffeine was detected at a trace level in one sample. Fourteen VOCs were detected in 12 samples, but no concentration exceeded an MCL. Any detection of total coliform or fecal coliform bacteria is considered a violation of New York State MCLs; in this study, total coliform was detected in 12 samples, and *E. coli* was detected in 2 samples. Heterotrophic plate counts exceeded the MCL of 500 CFU/mL in four samples.

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Appendix

Table A1. Information on wells sampled in western New York study area, 2006.

[Well locations are shown in figure 1. --, information not available]

Well number[1]	Date sampled	Basin name[2]	Well type[3]	Well depth, feet below land surface	Casing depth, feet below land surface	Physiographic province
			Sand and gravel wells			
AG 265	10/17/2006	A	P	70	--	Appalachian Plateau
CT 833	8/16/2006	A	R	85	85	Appalachian Plateau
CU 1092	8/15/2006	A	R	185	185	Appalachian Plateau
CU 1766	8/16/2006	A	R	80	80	Appalachian Plateau
E 1084	12/13/2006	E	P	28	--	Appalachian Plateau
E 1903	11/8/2006	E	P	177	141	Appalachian Plateau
E 1904	12/13/2006	E	P	45	45	Lake Ontario Lowland
E 1755	8/23/2006	E	R	23	23	Appalachian Plateau
GS 216	10/26/2006	E	P	69	56	Lake Ontario Lowland
GS 624	11/8/2006	E	R	65	64	Appalachian Plateau
NI 1093	12/12/2006	O	R	15	15	Lake Ontario Lowland
OL 264	10/4/2006	O	R	32	32	Lake Ontario Lowland
OL 291	11/7/2006	O	R	37	37	Lake Ontario Lowland
WO 351	10/25/2006	E	P	36	36	Appalachian Plateau
WO 432	10/29/2006	E	R	27	27	Appalachian Plateau
			Bedrock wells			
CT 806	8/30/2006	A	R	70	48	Appalachian Plateau
CT 819	8/23/2006	A	R	210	184	Appalachian Plateau
CT 922	8/22/2006	A	R	170	73	Appalachian Plateau
CT 994	9/14/2006	A	R	113	85	Appalachian Plateau
CT 1071	9/14/2006	A	R	88	74	Appalachian Plateau
CU 1304	8/29/2006	E	R	45	33	Lake Erie Lowland
CU 1951	8/30/2006	A	R	124	20	Appalachian Plateau
CU 2054	9/13/2006	A	R	80	56	Appalachian Plateau
CU 2158	10/11/2006	E	R	55	15	Lake Erie Lowland
CU 2195	10/26/2006	E	R	50	15	Lake Erie Lowland
E 1430	10/5/2006	E	R	80	46	Lake Erie Lowland
E 1507	10/18/2006	E	R	50	12	Appalachian Plateau
E 2428	10/18/2006	E	R	143	40	Appalachian Plateau
E 2642	10/5/2006	E	R	160	20	Lake Ontario Lowland
MO 1406	9/20/2006	O	R	41	23	Lake Ontario Lowland
MO 1594	9/19/2006	O	R	27	15	Lake Ontario Lowland
NI 1203	9/20/2006	O	R	74	18	Lake Ontario Lowland
OL 19	10/24/2006	O	P	32	--	Lake Ontario Lowland

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

[2] A, Allegheny River; E, Lake Erie and Niagara River; O, Western Lake Ontario.

[3] P, Production well; R, Residential well.

Table A2. Compounds for which ground-water samples from western New York were analyzed but not detected, 2006.

USGS parameter code	Constituent	Laboratory reporting level, micrograms per liter (µg/L)
	Trace elements in unfiltered water	
71900	Mercury	0.190 - 0.200
	Pesticides in filtered water	
50470	2,4-D methyl ester	0.016
39732	2,4-D	0.04
82660	2,6-Diethylaniline	0.006
50355	2-Hydroxy-4-isopropyl-amino-6-ethyl-amino-s-triazine	0.032 - 0.080
49260	Acetochlor	0.006
61029	Acetochlor ethanesulfonic acid	0.02
61030	Acetochlor oxanilic acid	0.02
62847	Acetochlor sulfynilacetic acid	0.02
49315	Acifluorfen	0.028 - 0.060
62849	Alachlor ethanesulfonic acid second amide	0.02
61031	Alachlor oxanilic acid	0.02
63781	Alachlor second amide	0.02
62848	Alachlor sulfynilacetic acid	0.02
49313	Aldicarb sulfone	0.02 - 0.08
49314	Aldicarb sulfoxide	0.040 - 0.100
49312	Aldicarb	0.04 - 0.15
34253	*alpha*-HCH	0.005
82686	Azinphos-methyl	0.050 - 0.080
50299	Bendiocarb	0.04 - 0.08
50300	Benomyl	0.020 - 0.022
61693	Bensulfuron	0.02 - 0.06
38711	Bentazon	0.02
04029	Bromacil	0.02 - 0.04
49311	Bromoxynil	0.04 - 0.12
04028	Butylate	0.004
49310	Carbaryl	0.02
82680	Carbaryl	0.041 - 0.060
49309	Carbofuran	0.016 - 0.060
82674	Carbofuran	0.020
61188	Chloramben methyl ester	0.02 - 0.10
50306	Chlorimuron	0.032 - 0.080
04039	Chlorodiamino-s-triazine	0.04 - 0.12
38933	Chlorpyrifos	0.005
82687	*cis*-Permethrin	0.006 - 0.010

Table A2. Compounds for which ground-water samples from western New York were analyzed but not detected, 2006.—Continued

USGS parameter code	Constituent	Laboratory reporting level, micrograms per liter (µg/L)
	Pesticides in filtered water	
49305	Clopyralid	0.06 - 0.07
04041	Cyanazine	0.018
04031	Cycloate	0.01 - 0.06
49304	Dacthal monoacid	0.02 - 0.03
82682	DCPA	0.003
63778	Dechloroacetochlor	0.02
63777	Dechloroalachlor	0.02
63779	Dechlorodimethenamid	0.02
63780	Dechlorometolachlor	0.02
62170	Desulfinyl fipronil	0.012
39572	Diazinon	0.005 - 0.026
38442	Dicamba	0.04 - 0.08
49302	Dichlorprop	0.03 - 0.04
39381	Dieldrin	0.009
61951	Dimethenamid ethanesulfonic acid	0.02
62482	Dimethenamid oxanilic acid	0.02
61588	Dimethenamid	0.02
49301	Dinoseb	0.04
04033	Diphenamid	0.01 - 0.04
82677	Disulfoton	0.02
49300	Diuron	0.02 - 0.04
82668	EPTC	0.004
82663	Ethalfluralin	0.009
82672	Ethoprop	0.012
49297	Fenuron	0.04 - 0.10
62169	Desulfinylfipronil amide	0.029
62167	Fipronil sulfide	0.013
62168	Fipronil sulfone	0.024
62166	Fipronil	0.016
61952	Flufenacet ethanesulfonic acid	0.02
62483	Flufenacet oxanilic acid	0.02
62481	Flufenacet	0.02
61694	Flumetsulam	0.04 - 0.06
38811	Fluometuron	0.02 - 0.04
04095	Fonofos	0.005 - 0.006
63784	Hydroxyacetochlor	0.02
63785	Hydroxymetolachlor	0.02
64045	Hydroxydimethenamid	0.02

Table A2. Compounds for which ground-water samples from western New York were analyzed but not detected, 2006.—Continued

USGS parameter code	Constituent	Laboratory reporting level, micrograms per liter (µg/L)
	Pesticides in filtered water	
50356	Imazaquin	0.04
50407	Imazepyr	0.04
61695	Imidacloprid	0.020 - 0.060
39341	Lindane	0.004
38482	MCPA	0.06 - 0.07
38487	MCPB	0.10 - 0.20
50359	Metalaxyl	0.03 - 0.04
38501	Methiocarb	0.034 - 0.040
49296	Methomyl	0.060 - 0.070
82667	Methyl parathion	0.015
82630	Metribuzin	0.028
61697	Metsulfuron	0.07 - 0.14
82671	Molinate	0.003
61692	*N*-(4-Chlorophenyl)-*N*´-methylurea	0.04 - 0.06
82684	Napropamide	0.007 0.018
49294	Neburon	0.01 - 0.02
50364	Nicosulfuron	0.04 - 0.10
49293	Norflurazon	0.02 - 0.04
49292	Oryzalin	0.02 - 0.04
38866	Oxamyl	0.04 - 0.05
34653	*p,p*´-DDE	0.003
39542	Parathion	0.010
82669	Pebulate	0.004
82683	Pendimethalin	0.022
82664	Phorate	0.011 - 0.055
49291	Picloram	0.03 - 0.12
04037	Prometon	0.01
82676	Propyzamide	0.004
62766	Propachlor ethanesulfonic acid	0.05
62767	Propachlor oxanilic acid	0.02
82679	Propanil	0.011
82685	Propargite	0.02
49236	Propham	0.030 - 0.060
50471	Propiconazole	0.01 - 0.060
38538	Propoxur	0.008 - 0.040
50337	Sulfometuron	0.060 - 0.090
82670	Tebuthiuron	0.026 - 0.040
82665	Terbacil	0.034 - 0.040

Table A2. Compounds for which ground-water samples from western New York were analyzed but not detected, 2006.—Continued

USGS parameter code	Constituent	Laboratory reporting level, micrograms per liter (µg/L)
	Pesticides in filtered water	
04032	Terbacil	0.026 - 0.040
82675	Terbufos	0.01 - 0.02
82681	Thiobencarb	0.010
82678	Triallate	0.006
49235	Triclopyr	0.03 - 0.04
82661	Trifluralin	0.006 - 0.009
	Volatile organic compounds, in unfiltered water	
77652	1,1,2-Trichloro-1,2,2-trifluoroethane	0.1
34501	1,1-Dichloroethene	0.1
34536	1,2-Dichlorobenzene	0.1
32103	1,2-Dichloroethane	0.2
34541	1,2-Dichloropropane	0.1
34566	1,3-Dichlorobenzene	0.1
34571	1,4-Dichlorobenzene	0.1
34030	Benzene	0.1
32101	Bromodichloromethane	0.1
34301	Chlorobenzene	0.1
77093	*cis*-1,2-Dichloroethene	0.1
81576	Diethyl ether	0.2
81577	Diisopropyl ether	0.2
50005	Methyl *tert*-pentyl ether	0.2
77128	Styrene	0.1 - 0.3
50004	*tert*-Butyl ethyl ether	0.1
32102	Tetrachloromethane	0.2
34546	*trans*-1,2-Dichloroethene	0.1
34488	Trichlorofluoromethane	0.2
39175	Vinyl Choride	0.2

Table A3. Physical properties of ground-water samples from western New York study area, 2006.

[Well locations are shown in figure 1. mg/L, milligrams per liter; <, less than; µS/cm, microsiemens per centimeter at 25°C; (00080), National Water Information System (NWIS) parameter code; --, no data]

Well number [1]	Water color, filtered, platinum cobalt units (00080)	Dissolved-oxygen concentration, field, mg/L (00300)	pH, field, standard units (00400)	Specific conductance, field, µS/cm (00095)	Water temperature, degrees Celsius (00010)
Sand and gravel wells					
AG 265	5	3.0	6.4	495	12.7
CT 833	< 1	6.3	7.4	369	9.6
CU 1092	12	< 0.3	7.5	740	19.7
CU 1766	12	< 0.3	7.6	317	11.0
E 1084	2	4.7	7.2	808	12.5
E 1903	5	0.4	7.3	830	11.3
E 1904	2	0.5	7.0	1,040	13.6
E 1755	5	< 0.3	7.0	370	13.2
GS 216	2	2.1	7.2	1,100	12.6
GS 624	8	0.4	7.5	575	13.6
NI 1093	5	5.4	7.6	1,060	14.3
OL 264	2	0.6	7.4	655	15.8
OL 291	2	0.4	7.3	1,040	12.5
WO 351	2	2.6	7.5	465	12.1
WO 432	2	6.7	7.2	653	10.2
Bedrock wells					
CT 806	8	--	7.4	383	10.8
CT 819	10	0.5	7.3	333	14.7
CT 922	2	3.2	7.7	171	15.1
CT 994	8	0.4	8.2	531	17.7
CT 1071	8	0.7	7.6	480	11.2
CU 1304	8	--	8.0	603	14.1
CU 1951	2	--	7.5	464	12.6
CU 2054	10	0.4	7.3	303	13.0
CU 2158	2	3.5	7.0	1,260	16.7
CU 2195	2	3.3	7.1	576	13.2
E 1430	2	0.5	7.4	1,030	12.9
E 1507	8	0.6	7.4	461	16.0
E 2428	5	0.5	7.4	350	13.4
E 2642	5	--	7.2	1,370	11.9
MO 1406	5	0.7	7.4	851	17.7
MO 1594	5	< 0.3	7.1	1,850	17.3
NI 1203	2	1.1	7.5	5,500	14.4
OL 19	2	1.0	7.1	765	12.3

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A4. Concentrations of inorganic constituents in ground-water samples from western New York study area, 2006.

[Well locations are shown in figure 1. mg/L, milligrams per liter; (00900), USGS National Water Information System (NWIS) parameter code. **Bold** values exceed one or more drinking-water standard]

Well number [1]	Hardness, filtered, mg/L as $CaCO_3$ (00900)	Calcium, filtered, mg/L (00915)	Magnesium, filtered, mg/L (00925)	Potassium, filtered, mg/L (00935)	Sodium, filtered, mg/L (00930)	Acid-neutralizing capacity,[2] unfiltered, mg/L as $CaCO_3$ (90410)	Alkalinity,[2] filtered, mg/L as $CaCO_3$ (29801)
Sand and gravel wells							
AG 265	140	41.8	8.21	1.91	38.6	89	89
CT 833	160	53.7	7.15	0.81	8.99	152	151
CU 1092	180	44.5	17.7	1.85	**75.5**	296	298
CU 1766	42	12.2	2.72	1.89	**63.4**	139	140
E 1084	320	97.3	19.4	1.73	37.7	269	268
E 1903	420	122	28.7	1.30	16.0	259	259
E 1904	480	150	25.4	3.28	33.6	299	299
E 1755	100	29.5	7.60	2.04	36.1	160	161
GS 216	400	110	29.6	3.99	**74.4**	319	318
GS 624	320	91.5	22.7	0.87	3.82	246	245
NI 1093	450	113	41.0	1.59	51.4	274	264
OL 264	330	76.0	33.1	4.15	7.25	163	162
OL 291	500	105	57.4	3.70	35.3	320	320
WO 351	200	63.1	10.9	1.55	18.2	176	176
WO 432	300	91.2	18.3	2.51	19.1	238	238
Bedrock wells							
CT 806	180	49.4	13.1	1.48	10.2	174	175
CT 819	130	33.5	10.1	1.41	23.9	165	165
CT 922	82	25.9	4.30	0.73	2.87	74	74
CT 994	21	6.04	1.46	1.36	**109**	197	197
CT 1071	140	38.0	10.0	1.79	51.2	197	199
CU 1304	110	30.6	6.95	2.08	**78.6**	150	150
CU 1951	110	34.8	6.69	1.61	43.7	157	158
CU 2054	150	38.7	12.0	2.34	5.53	154	154
CU 2158	680	197	45.1	1.91	21.9	349	347
CU 2195	240	61.0	21.7	3.23	19.9	196	197
E 1430	340	101	21.1	1.75	**82.0**	231	232
E 1507	180	48.8	14.1	1.38	26.9	209	209
E 2428	160	44.8	12.2	1.51	5.67	143	143
E 2642	660	188	47.1	4.43	52.5	256	255
MO 1406	250	52.4	28.7	12.8	**82.2**	286	286
MO 1594	580	173	35.3	9.74	**166**	398	398
NI 1203	510	155	28.7	26.1	**929**	196	196
OL 19	380	108	25.6	2.34	17.7	285	284

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

[2] Fixed-endpoint titration at pH 4.5.

[3] Calculated from alkalinity.

Table A4. Concentrations of inorganic constituents in ground-water samples from western New York study area, 2006.—Continued

[Well locations are shown in figure 1. mg/L, milligrams per liter; (29805), USGS National Water Information System (NWIS) parameter code; <, less than; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery. **Bold** values exceed one or more drinking-water standard]

Well number [1]	Bicarbonate,[3] filtered, mg/L as $CaCO_3$ (29805)	Chloride, filtered, mg/L (00940)	Fluoride, filtered, mg/L (00950)	Silica, filtered, mg/L (00955)	Sulfate, filtered, mg/L (00945)	Residue on evaporation, at 180° Celsius, filtered, mg/L (70300)
Sand and gravel wells						
AG 265	109	88.0	E 0.08	6.31	12.9	272
CT 833	184	19.3	< 0.10	8.14	11.7	203
CU 1092	364	56.6	0.41	5.96	< 0.18	403
CU 1766	171	37.4	0.57	8.88	1.69	225
E 1084	327	71.3	E 0.09	10.1	30.9	456
E 1903	316	37.9	< 0.10	11.8	136	534
E 1904	365	79.9	0.10	9.67	135	629
E 1755	196	15.3	0.30	14.8	14.6	211
GS 216	388	140	0.14	8.96	43.6	612
GS 624	299	10.8	E 0.07	14.5	60.8	362
NI 1093	322	91.7	0.15	16.2	120	650
OL 264	198	26.6	0.69	9.99	121	403
OL 291	390	85.9	0.22	19.5	130	652
WO 351	215	29.9	E 0.09	6.75	17.7	258
WO 432	290	38.6	E 0.07	7.25	25.4	366
Bedrock wells						
CT 806	214	3.91	0.13	10.5	26.8	223
CT 819	201	2.61	0.22	11.6	15.0	196
CT 922	90	0.78	0.12	7.63	17.4	100
CT 994	240	50.1	0.61	8.04	5.60	312
CT 1071	243	28.3	0.29	12.5	23.5	298
CU 1304	183	103	0.29	9.55	1.09	328
CU 1951	193	44.6	0.29	9.29	5.33	251
CU 2054	188	0.96	0.27	16.1	9.30	187
CU 2158	423	22.2	0.17	11.0	**345**	922
CU 2195	240	61.8	0.39	16.8	8.36	317
E 1430	283	141	0.16	15.2	81.0	615
E 1507	255	10.1	0.33	12.3	24.4	259
E 2428	174	20.2	0.28	15.1	7.59	195
E 2642	311	93.6	0.73	6.58	**371**	952
MO 1406	349	78.7	0.28	13.8	54.4	490
MO 1594	486	**340**	0.17	8.05	87.0	1,070
NI 1203	239	**1,590**	0.77	8.41	**271**	3,250
OL 19	346	41.5	0.11	11.8	63.3	462

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A5. Concentrations of nutrients and total organic carbon in ground-water samples from western New York study area, 2006.

[Well locations are shown in figure 1. mg/L, milligrams per liter; N, nitrogen; P, phosphorus; <, less than; (00623), National Water Information System (NWIS) parameter code; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery]

Well number [1]	Ammonia plus organic nitrogen, filtered, mg/L as N (00623)	Ammonia, filtered, mg/L as N (00608)	Nitrate plus nitrite, filtered, mg/L as N (00631)	Nitrite, filtered, mg/L as N (00613)	Orthophosphate, filtered, mg/L as P (00671)	Total organic carbon, unfiltered, mg/L (00680)
			Sand and gravel wells			
AG 265	E 0.06	< 0.020	2.40	< 0.002	0.012	< 1.0
CT 833	< 0.10	E 0.006	1.45	< 0.002	0.007	< 1.0
CU 1092	3.1	3.00	< 0.06	< 0.002	0.109	1.8
CU 1766	0.46	0.465	< 0.06	< 0.002	0.008	< 1.0
E 1084	E 0.07	E 0.010	4.58	< 0.002	E 0.004	< 1.0
E 1903	E 0.10	0.055	< 0.06	< 0.002	0.006	< 1.0
E 1904	0.23	0.154	< 0.06	< 0.002	E 0.005	1.0
E 1755	0.59	0.536	< 0.06	< 0.002	0.021	< 1.0
GS 216	E 0.06	E 0.013	0.72	< 0.002	E 0.003	< 1.0
GS 624	E 0.10	0.054	< 0.06	< 0.002	0.009	< 1.0
NI 1093	0.34	E 0.019	< 0.06	< 0.002	E 0.004	< 1.0
OL 264	0.19	0.074	2.59	0.208	< 0.006	< 1.0
OL 291	0.17	0.078	< 0.06	< 0.002	E 0.005	1.3
WO 351	< 0.10	< 0.020	1.38	< 0.002	0.006	< 1.0
WO 432	E 0.07	< 0.020	6.92	< 0.002	E 0.003	< 1.0
			Bedrock wells			
CT 806	< 0.10	0.015	< 0.06	< 0.002	E 0.004	< 1.0
CT 819	E 0.09	0.078	< 0.06	E 0.001	0.026	< 1.0
CT 922	E 0.05	< 0.010	0.24	< 0.002	0.007	< 1.0
CT 994	0.32	0.242	< 0.06	< 0.002	0.013	< 1.0
CT 1071	0.32	0.302	< 0.06	< 0.002	0.009	< 1.0
CU 1304	0.46	0.344	< 0.06	< 0.002	E 0.005	< 1.0
CU 1951	0.11	0.058	E 0.04	0.005	E 0.005	< 1.0
CU 2054	E 0.07	0.042	< 0.06	< 0.002	0.011	< 1.0
CU 2158	0.25	0.073	0.12	< 0.002	< 0.006	< 1.0
CU 2195	0.27	0.057	0.96	0.005	0.009	1.1
E 1430	0.81	0.684	< 0.06	< 0.002	0.009	1.1
E 1507	0.53	0.411	< 0.06	< 0.002	0.007	< 1.0
E 2428	0.43	0.355	< 0.06	< 0.002	0.006	< 1.0
E 2642	0.61	< 0.020	< 0.06	E 0.001	< 0.006	1.6
MO 1406	0.83	0.727	< 0.06	< 0.002	0.008	2.4
MO 1594	0.16	0.018	E 0.04	0.006	E 0.005	3.6
NI 1203	2.8	2.61	< 0.06	E 0.002	E 0.006	1.5
OL 19	E 0.09	E 0.016	2.33	< 0.002	0.006	1.2

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A6. Concentrations of trace elements and radon-222 in ground-water samples from western New York study area, 2006.

[Well locations are shown in figure 1. µg/L, micrograms per liter; (01105), USGS National Water Information System (NWIS) parameter code; <, less than; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery. **Bold** values exceed one or more drinking-water standard]

Well number [1]	Aluminum, unfiltered, µg/L (01105)	Antimony, unfiltered, µg/L (01097)	Arsenic, unfiltered, µg/L (01002)	Barium, unfiltered, µg/L (01007)	Beryllium, unfiltered, µg/L (01012)	Boron, filtered, µg/L (01020)	Cadmium, unfiltered, µg/L (01027)	Chromium, unfiltered, µg/L (01034)
				Sand and gravel wells				
AG 265	< 2	E 0.1	2.2	124	< 0.06	32	0.02	< 0.60
CT 833	E 1	< 0.2	0.32	236	< 0.06	12	< 0.04	0.22
CU 1092	5	< 0.2	**111**	817	< 0.06	222	< 0.04	0.12
CU 1766	2	< 0.2	< 0.12	412	< 0.06	365	< 0.04	0.14
E 1084	< 2	< 0.2	0.42	175	< 0.06	32	< 0.02	1.1
E 1903	E 2	< 0.2	0.24	48.1	< 0.06	52	< 0.02	< 0.60
E 1904	< 2	< 0.2	0.41	153	< 0.06	71	E 0.01	< 0.60
E 1755	30	< 0.2	E 0.08	294	< 0.06	172	< 0.04	0.17
GS 216	< 2	< 0.2	1.3	178	< 0.06	55	E 0.01	E 0.40
GS 624	3	< 0.2	E 0.19	184	< 0.06	15	0.02	< 0.60
NI 1093	2	E 0.2	1.7	33.4	< 0.06	20	< 0.02	2.1
OL 264	E 2	0.5	0.60	94.5	< 0.06	22	0.05	< 0.60
OL 291	< 2	< 0.2	4.2	79.2	< 0.06	92	E 0.02	< 0.60
WO 351	E 1	< 0.2	3.2	93.2	< 0.06	26	< 0.02	< 0.60
WO 432	< 2	< 0.2	1.1	99.1	< 0.06	18	< 0.02	< 0.60
				Bedrock wells				
CT 806	11	< 0.2	0.31	21.7	< 0.06	50	< 0.04	0.11
CT 819	< 2	< 0.2	3.6	84.1	< 0.06	106	< 0.04	0.13
CT 922	E 2	< 0.2	0.42	36.0	< 0.06	13	< 0.04	0.13
CT 994	E 1	< 0.2	E 0.06	276	< 0.06	292	< 0.04	0.10
CT 1071	E 2	< 0.2	0.79	56.2	< 0.06	185	< 0.04	0.15
CU 1304	E 1	< 0.2	0.75	1,660	< 0.06	157	< 0.04	0.12
CU 1951	5	< 0.2	0.97	1,410	< 0.06	182	< 0.04	0.08
CU 2054	E 2	< 0.2	0.93	128	< 0.06	38	< 0.04	0.41
CU 2158	**85**	3.8	3.5	22.6	0.52	51	4.02	1.8
CU 2195	29	< 0.2	0.47	873	< 0.06	154	< 0.02	< 0.60
E 1430	< 2	< 0.2	0.48	120	< 0.06	197	< 0.02	< 0.60
E 1507	7	< 0.2	0.34	607	< 0.06	120	< 0.02	< 0.60
E 2428	E 1	< 0.2	E 0.17	325	< 0.06	58	< 0.02	< 0.60
E 2642	< 2	0.2	0.83	31.3	< 0.06	385	< 0.09	0.99
MO 1406	< 2	< 0.2	**20.9**	105	< 0.06	375	0.08	< 0.04
MO 1594	3	< 0.2	0.53	334	< 0.06	298	0.32	< 0.04
NI 1203	<6	< 0.6	1.2	100	< 0.18	2,430	0.94	< 0.12
OL 19	< 2	< 0.2	2.2	119	< 0.06	35	< 0.02	E .38

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A6. Concentrations of trace elements and radon-222 in ground-water samples from western New York study area, 2006.—Continued

[Well locations are shown in figure 1. µg/L, micrograms per liter; (01037), USGS National Water Information System (NWIS) parameter code; <, less than; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; **Bold** values exceed one or more drinking-water standard]

Well number [1]	Cobalt, unfiltered, µg/L (01037)	Copper, unfiltered, µg/L (01042)	Iron, filtered, µg/L (01046)	Iron, unfiltered, µg/L (01045)	Lead, unfiltered, µg/L (01051)	Lithium, unfiltered, µg/L (01132)	Manganese, filtered, µg/L (01056)	Manganese, unfiltered, µg/L (01055)	Molybdenum, unfiltered, µg/L (01062)
Sand and gravel wells									
AG 265	0.121	31.4	28	187	1.64	1.2	**57.5**	**67.1**	0.1
CT 833	0.103	E 0.6	E 5	E 4	0.53	3.3	< 0.6	< 0.6	< 0.2
CU 1092	0.149	1.6	**3,220**	**2,870**	0.07	2.3	**65.2**	**57.1**	2.8
CU 1766	E 0.027	1.1	10	12	0.09	23.2	20.5	18.2	< 0.2
E 1084	0.234	1.8	E 6	11	0.17	5.4	2.2	2.2	1.1
E 1903	0.245	1.5	**1,630**	**1,540**	E 0.04	8.5	**136**	**133**	1.9
E 1904	0.369	E 1.0	**888**	**806**	< 0.06	28.5	**107**	**107**	2.6
E 1755	0.083	11.1	**471**	**644**	2.65	58.4	**152**	**146**	< 0.2
GS 216	0.226	1.9	< 6	E 4	0.07	10.2	E 0.5	E 0.4	1.6
GS 624	0.182	12.4	**775**	**716**	0.07	6.2	22.7	22.2	1.5
NI 1093	0.478	49.9	< 6	**458**	15.3	17.7	45.0	**50.7**	0.8
OL 264	0.277	5.5	109	122	1.77	5.5	18.9	20.0	8.0
OL 291	0.333	2.5	**2,570**	**2,570**	0.45	30.9	**64.5**	**62.6**	4.5
WO 351	0.118	2.2	E 3	27	0.33	2.9	< 0.6	< 0.6	0.4
WO 432	0.189	5.4	< 6	E 4	E 0.05	2.1	< 0.6	< 0.6	0.1
Bedrock wells									
CT 806	0.171	3.3	**1,510**	**1,620**	0.67	13.3	**696**	**625**	0.6
CT 819	0.062	E 0.5	**1,360**	**1,390**	E 0.04	15.7	**188**	**182**	E 0.2
CT 922	0.044	E 0.4	< 6	< 6	0.07	4.1	< 0.6	< 0.6	0.5
CT 994	< 0.040	2.6	219	215	0.08	31.8	14.2	13.1	0.8
CT 1071	0.081	3.1	**346**	**359**	0.91	22.4	**88.3**	**83.2**	0.4
CU 1304	0.097	1.2	**363**	**527**	1.01	41.3	**83.2**	**74.5**	1.8
CU 1951	0.091	5.0	6	12	1.17	13.9	22.0	19.9	E 0.1
CU 2054	0.124	1.3	**1,580**	**1,440**	0.56	17.7	**394**	**388**	0.3
CU 2158	2.85	2.6	30	154	4.48	2.2	13.9	35.4	1.6
CU 2195	0.112	6.9	E 6	47	0.35	125	13.9	14.8	0.2
E 1430	0.189	E 0.9	44	57	< 0.06	133	38.3	40.6	0.1
E 1507	0.101	7.6	262	**317**	1.14	32.0	**67.1**	**64.6**	0.4
E 2428	0.083	E 0.6	128	146	1.15	11.8	**68.2**	**65.7**	0.6
E 2642	0.459	441	23	269	0.36	52.7	14.9	16.3	0.4
MO 1406	0.165	1.8	**966**	**867**	0.09	64.2	**65.0**	**62.5**	7.1
MO 1594	0.375	12.1	**938**	**1,330**	1.98	78.9	43.3	44.1	2.7
NI 1203	0.250	5.2	290	285	0.32	917	**157**	**155**	14.7
OL 19	0.227	6.6	**304**	**316**	0.12	7.4	28.0	27.7	0.4

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A6. Concentrations of trace elements and radon-222 in ground-water samples from western New York study area, 2006.—Continued

[Well locations are shown in figure 1. µg/L, micrograms per liter; (01067), USGS National Water Information System (NWIS) parameter code; <, less than; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery. **Bold** values exceed one or more drinking-water standard]

Well number [1]	Nickel, unfiltered, µg/L (01067)	Selenium, unfiltered, µg/L (01147)	Silver, unfiltered, µg/L (01077)	Strontium, unfiltered, µg/L (01082)	Thallium, unfiltered, µg/L (01059)	Radon-222, unfiltered, picocuries per liter (pCi/L) (82303)	Uranium, (natural), unfiltered, µg/L (28011)	Zinc, unfiltered, µg/L (01092)
Sand and gravel wells								
AG 265	1.16	E 0.07	0.06	94.1	< 0.18	1,200	0.017	196
CT 833	0.53	< 0.08	< 0.16	90.2	< 0.18	780	0.083	< 2
CU 1092	0.83	< 0.08	< 0.16	976	< 0.18	770	< 0.012	31
CU 1766	0.32	< 0.08	< 0.16	163	< 0.18	670	< 0.012	E 2
E 1084	2.15	0.16	< 0.02	145	< 0.18	500	0.618	3
E 1903	0.86	< 0.08	< 0.02	237	< 0.18	190	0.074	39
E 1904	2.52	0.54	< 0.02	631	< 0.18	170	0.473	16
E 1755	0.39	< 0.08	< 0.16	246	< 0.18	430	< 0.012	3
GS 216	0.87	0.80	< 0.02	364	< 0.18	470	0.837	7
GS 624	0.75	< 0.08	< 0.02	191	< 0.18	160	0.016	13
NI 1093	2.33	E 0.06	0.02	244	< 0.18	40	0.842	30
OL 264	1.42	E 0.05	< 0.02	370	< 0.18	500	2.80	25
OL 291	0.96	< 0.08	< 0.02	693	< 0.18	1,140	3.47	2
WO 351	0.31	0.23	< 0.02	111	< 0.18	680	0.170	3
WO 432	0.56	0.18	< 0.02	115	< 0.18	590	0.152	E 2
Bedrock wells								
CT 806	0.62	< 0.08	< 0.16	124	< 0.18	1,010	0.179	32
CT 819	0.27	< 0.08	< 0.16	278	< 0.18	1,700	0.332	E 1
CT 922	0.21	E 0.04	< 0.16	48.5	< 0.18	1,570	0.107	8
CT 994	0.27	< 0.08	< 0.16	103	< 0.18	230	< 0.012	3
CT 1071	0.37	< 0.08	< 0.16	470	< 0.18	140	0.020	15
CU 1304	0.37	< 0.08	< 0.16	314	< 0.18	390	0.013	E 1
CU 1951	0.33	< 0.08	< 0.16	251	< 0.18	940	0.119	4
CU 2054	0.41	< 0.08	< 0.16	220	< 0.18	580	0.093	E 2
CU 2158	0.81	1.6	2.23	60.6	0.45	480	1.27	62
CU 2195	0.45	E 0.06	< 0.02	550	< 0.18	70	0.018	32
E 1430	1.15	< 0.08	< 0.02	1,090	< 0.18	170	< 0.012	E 1
E 1507	0.43	E 0.04	< 0.02	346	< 0.18	400	< 0.012	2
E 2428	0.21	< 0.08	< 0.02	325	< 0.18	410	< 0.012	E 2
E 2642	8.66	0.08	E 0.01	10,600	< 0.18	190	0.272	180
MO 1406	1.54	< 0.08	< 0.16	1,580	< 0.18	1,420	0.423	9
MO 1594	1.24	0.10	< 0.16	1,920	< 0.18	2,080	6.45	8
NI 1203	2.06	< 0.24	< 0.48	4,900	< 0.54	2,160	0.160	14
OL 19	0.66	0.27	< 0.02	189	< 0.18	540	0.720	6

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU,Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A7. Concentrations of pesticides and caffeine detected in ground-water samples from western New York study area, 2006.

[Well locations are shown in figure 1. µg/L, micrograms per liter; <, less than; (04040), USGS National Water Information System (NWIS) parameter code; CEAT, 2-Chloro-6-ethylamino-4-amino-s-triazine; CIAT, 2-Chloro-4-isopropylamino-6-amino-s-triazine; ESA, ethanesulfanic acid; OA, oxanilic acid; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery]

Well number [1]	CIAT, filtered, µg/L (04040)	CEAT, filtered, µg/L (04038)	2-[(2-Ethyl-6-methylphenyl) amino]2-oxo-ESA, filtered, µg/L (62850)	Acetochlor 3rd amide, filtered, µg/L (63782)	Alachlor ESA, filtered, µg/L (50009)	Alachlor, filtered, µg/L (46342)	Atrazine, filtered, µg/L (39632)	Benfluralin, filtered, µg/L (82673)	Caffeine, filtered, µg/L (50305)
Sand and gravel wells									
AG 265	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
CT 833	E 0.004	E 0.01	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
CU 1092	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
CU 1766	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	E 0.008
E 1084	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
E 1903	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
E 1904	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
E 1755	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
GS 216	E 0.005	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
GS 624	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
NI 1093	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
OL 264	E 0.009	< 0.08	0.40	< 0.02	0.08	< 0.005	< 0.007	< 0.006	< 0.040
OL 291	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
WO 351	E 0.005	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
WO 432	E 0.006	< 0.08	< 0.02	< 0.02	0.07	< 0.005	< 0.007	< 0.006	< 0.040
Bedrock wells									
CT 806	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
CT 819	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
CT 922	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
CT 994	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
CT 1071	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	E 0.001	< 0.018
CU 1304	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
CU 1951	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
CU 2054	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	E 0.001	< 0.018
CU 2158	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
CU 2195	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
E 1430	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
E 1507	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
E 2428	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
E 2642	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.006	< 0.040
MO 1406	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
MO 1594	< 0.014	< 0.08	< 0.02	< 0.02	< 0.02	< 0.005	< 0.007	< 0.010	< 0.018
NI 1203	< 0.014	< 0.08	< 0.02	0.10	< 0.02	1.03	0.104	< 0.010	< 0.018
OL 19	E 0.019	< 0.08	< 0.02	< 0.02	0.08	< 0.005	0.026	< 0.006	< 0.040

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Table A7. Concentrations of pesticides and caffeine detected in ground-water samples from western New York study area, 2006.—Continued

[Well locations are shown in figure 1. µg/L, micrograms per liter; <, less than; (49308), USGS National Water Information System (NWIS) parameter code; CEAT, 2-Chloro-6-ethylamino-4-amino-s-triazine; CIAT, 2-Chloro-4-isopropylamino-6-amino-s-triazine; ESA, ethanesulfanic acid; OA, oxanilic acid; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery]

Well number[1]	3-Hydroxy carbofuran, filtered, µg/L (49308)	Hydroxy alachlor, filtered, µg/L (63783)	Linuron, filtered, µg/L (82666)	Malathion, filtered, µg/L (39532)	Metolchlor ESA, filtered, µg/L (61043)	Metolchlor OA, filtered, µg/L (61044)	Metolachlor, filtered, µg/L (39415)	Propachlor, filtered, µg/L (04024)	Siduron, filtered, µg/L (38548)	Simazine, filtered, µg/L (04035)
Sand and gravel wells										
AG 265	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
CT 833	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CU 1092	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CU 1766	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
E 1084	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	E 0.01	< 0.006
E 1903	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
E 1904	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	E 0.01	< 0.006
E 1755	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
GS 216	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
GS 624	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
NI 1093	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	E 0.01	< 0.006
OL 264	< 0.020	< 0.02	< 0.060	0.046	2.81	1.88	< 0.010	< 0.010	< 0.04	< 0.006
OL 291	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
WO 351	< 0.020	< 0.02	< 0.060	< 0.016	0.08	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
WO 432	< 0.020	< 0.02	< 0.060	< 0.016	0.54	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
Bedrock wells										
CT 806	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CT 819	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CT 922	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CT 994	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	E 0.001	< 0.010	< 0.02	< 0.005
CT 1071	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CU 1304	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CU 1951	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CU 2054	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
CU 2158	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
CU 2195	E 0.003	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
E 1430	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
E 1507	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
E 2428	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
E 2642	< 0.020	< 0.02	< 0.060	< 0.016	< 0.02	< 0.02	< 0.010	< 0.010	< 0.04	< 0.006
MO 1406	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
MO 1594	< 0.008	< 0.02	< 0.035	< 0.027	< 0.02	< 0.02	< 0.006	< 0.010	< 0.02	< 0.005
NI 1203	< 0.008	0.07	E 0.017	< 0.027	< 0.02	< 0.02	0.400	0.111	< 0.02	0.015
OL 19	< 0.020	< 0.02	< 0.060	< 0.016	0.32	0.06	E 0.002	< 0.010	< 0.04	< 0.006

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A8. Concentrations of volatile organic compounds and phenolic compounds in ground-water samples from western New York study area, 2006.

[Well locations are shown in figure 1. µg/L, micrograms per liter; <, less than; (32730), USGS National Water Information System parameter code; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery]

Well number[1]	Phenolic compounds, total recoverable, unfiltered, µg/L (32730)	1,1,1-Trichloro-ethane, unfiltered, µg/L (34506)	1,1-Dichloro-ethane, unfiltered, µg/L (34496)	Dibromo-chloro-methane, unfiltered, µg/L (32105)	Tribromo-methane, unfiltered, µg/L (32104)	Trichloro-methane, unfiltered, µg/L (32106)	Dichloro-difluoro-methane, unfiltered, µg/L (34668)	Dichloro-methane, unfiltered, µg/L (34423)
Sand and gravel wells								
AG 265	< 4	< 0.1	< 0.1	E 0.1	< 0.2	< .1	< 0.2	< 0.2
CT 833	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
CU 1092	< 4	< 0.1	< 0.1	< 0.2	< 0.2	0.7	< 0.2	0.2
CU 1766	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
E 1084	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
E 1903	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
E 1904	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
E 1755	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
GS 216	< 4	0.6	0.1	< 0.2	< 0.2	0.3	< 0.2	< 0.2
GS 624	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
NI 1093	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
OL 264	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
OL 291	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
WO 351	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
WO 432	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
Bedrock wells								
CT 806	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
CT 819	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
CT 922	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
CT 994	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
CT 1071	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
CU 1304	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
CU 1951	< 4	< 0.1	< 0.1	< 0.2	< 0.2	0.3	< 0.2	< 0.2
CU 2054	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
CU 2158	< 4	< 0.1	< 0.1	< 0.2	0.2	< .1	< 0.2	< 0.2
CU 2195	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
E 1430	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
E 1507	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
E 2428	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
E 2642	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
MO 1406	8	< 0.1	< 0.1	< 0.2	< 0.2	< .1	E 0.1	< 0.2
MO 1594	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
NI 1203	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2
OL 19	< 4	< 0.1	< 0.1	< 0.2	< 0.2	< .1	< 0.2	< 0.2

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A8. Concentrations of volatile organic compounds and total phenols in ground-water samples from western New York study area, 2006.—Continued

[Well locations are shown in figure 1. µg/L, micrograms per liter; <, less than; (34371), USGS National Water Information System parameter code; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery]

Well number[1]	Ethyl-benzene, unfiltered, µg/L (34371)	*m + p* Xylene, unfiltered, µg/L (85795)	*o*-Xylene, unfiltered, µg/L (77135)	Methyl *tert*-butyl ether, unfiltered, µg/L (78032)	Tetrachloro-ethene, unfiltered, µg/L (34475)	Trichloro-ethene, unfiltered, µg/L (39180)
Sand and gravel wells						
AG 265	< 0.1	< 0.2	< 0.1	< 0.2	0.2	< 0.1
CT 833	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CU 1092	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CU 1766	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
E 1084	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
E 1903	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
E 1904	< 0.1	< 0.2	< 0.1	1.3	< 0.1	< 0.1
E 1755	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
GS 216	< 0.1	< 0.2	< 0.1	< 0.2	0.4	0.3
GS 624	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
NI 1093	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
OL 264	7.6	29.8	5.4	< 0.2	< 0.1	< 0.1
OL 291	< 0.1	< 0.2	< 0.1	0.3	< 0.1	< 0.1
WO 351	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
WO 432	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
Bedrock wells						
CT 806	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CT 819	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CT 922	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CT 994	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CT 1071	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CU 1304	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CU 1951	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CU 2054	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
CU 2158	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	0.2
CU 2195	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
E 1430	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
E 1507	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
E 2428	< 0.1	E 0.2	< 0.1	< 0.2	< 0.1	< 0.1
E 2642	1.8	7.4	2.2	< 0.2	< 0.1	< 0.1
MO 1406	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
MO 1594	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
NI 1203	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1
OL 19	< 0.1	< 0.2	< 0.1	< 0.2	< 0.1	< 0.1

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

Table A9. Concentrations of bacteria in unfiltered ground-water samples from western New York study area, 2006.

[Well locations are shown in figure 1. mL, milliliter; <, less than; > greater than; CFU per mL, colony-forming units per milliliter; (61213), National Water Information System (NWIS) parameter code. **Bold** values exceed one or more drinking-water standard]

Well number[1]	Total coliform colonies per 100 mL (61213)	Fecal coliform colonies per 100 mL (61215)	*Escherichia coli,* colonies per 100 mL (31691)	Heterotrophic plate count, CFUs per mL (31692)
		Sand and gravel wells		
AG 265	< 1	< 1	< 1	< 2
CT 833	< 1	< 1	< 1	2
CU 1092	< 1	< 1	< 1	< 2
CU 1766	**1**	< 1	< 1	8
E 1084	**6**	< 1	< 1	6
E 1903	< 1	< 1	< 1	17
E 1904	< 1	< 1	< 1	19
E 1755	< 1	< 1	< 1	**> 738**
GS 216	< 1	< 1	< 1	2
GS 624	< 1	< 1	< 1	10
NI 1093	**173**	< 1	3	38
OL 264	**12**	< 1	< 1	**> 738**
OL 291	< 1	< 1	< 1	< 2
WO 351	< 1	< 1	< 1	10
WO 432	< 1	< 1	< 1	3
		Bedrock wells		
CT 806	< 1	< 1	**4**	11
CT 819	< 1	< 1	< 1	15
CT 922	< 1	< 1	< 1	8
CT 994	**7**	< 1	< 1	22
CT 1071	**2**	< 1	< 1	79
CU 1304	< 1	< 1	< 1	83
CU 1951	< 1	< 1	< 1	18
CU 2054	**99**	< 1	< 1	45
CU 2158	**23**	< 1	< 1	**680**
CU 2195	**228**	< 1	< 1	**> 738**
E 1430	3	< 1	< 1	65
E 1507	< 1	< 1	< 1	264
E 2428	< 1	< 1	< 1	25
E 2642	< 1	< 1	< 1	16
MO 1406	**179**	< 1	< 1	84
MO 1594	**48**	< 1	< 1	74
NI 1203	< 1	< 1	< 1	9
OL 19	< 1	< 1	< 1	3

[1] Two-letter prefix denotes county: AG, Allegany; CT, Cattaraugus; CU, Chatauqua; E, Erie; GS, Genesee; MO, Monroe; NI, Niagara; OL, Orleans; WO, Wyoming; number is local well-identification number assigned by U.S. Geological Survey.

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Eckhardt, Reddy, and Tamulonis—Ground-Water Quality in Western New York, 2006—Open-File Report 2008–1140