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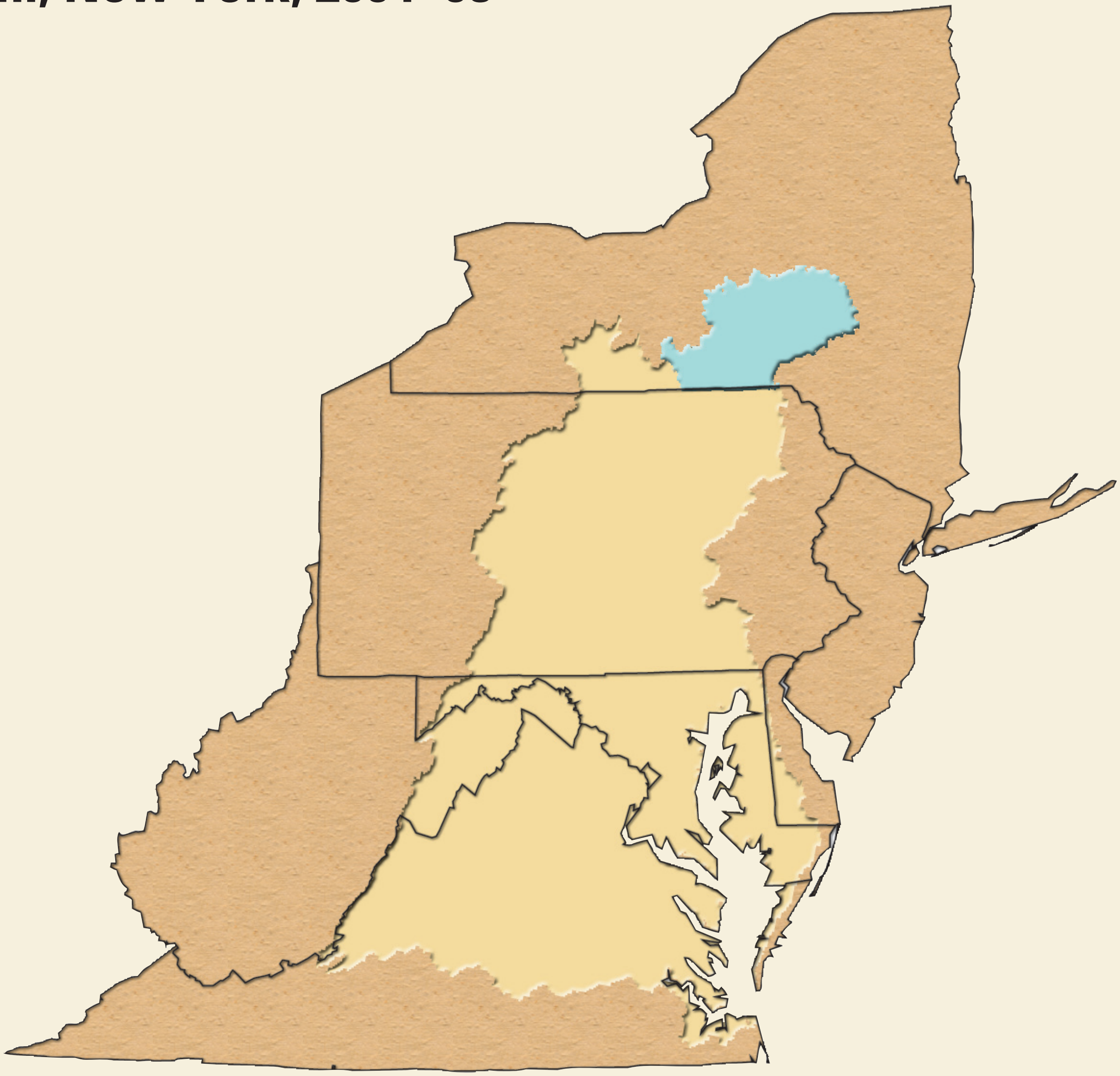
# Ground-Water Quality in the Upper Susquehanna River Basin, New York, 2004–05



Open-File Report 2006–1161

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

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By Kari K. Hetcher-Aguila and David A.V. Eckhardt

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

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# Contents

# Figures

1–2. Maps showing—

# Tables

# Conversion Factors, Abbreviations, and Datum

| Multiply | By | To obtain |
|---|---|---|
| inch (in.) | 2.54 | centimeter (cm) |
| foot (ft) | 0.3148 | meter (m) |
| mile (mi) | 1.609 | kilometer (km) |
| square mile ($mi^2$) | 2.59 | square kilometer ($km^2$) |
| inch per year (in/yr) | 2.54 | centimeter per year (cm/yr) |
| gallon (gal) | 3.785 | liter (L) |
| gallon per minute (gal/min) | 3.7854 | liter per minute (L/min) |

Temperature in degrees Celsius (ºC) may be converted to degrees Fahrenheit (ºF) as follows:

$$ºF = (1.8 \times ºC) + 32$$

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

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

**Other abbreviations used in this report**

micrometers (µm)

picocuries per liter (pCi/L)

milliliter per minute (mL/min)

Maximum Contaminant Level (MCL)

Secondary Maximum Contaminant Level (SMCL)

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## Abstract

Water samples were collected from 20 production wells and 13 private residential wells throughout the upper Susquehanna River Basin (upstream from the Pennsylvania border) during the fall of 2004 and the spring of 2005 and analyzed to describe the chemical quality of ground water in the upper basin. Wells were selected to represent areas of greatest ground-water use and highest vulnerability to contamination, and to provide a representative sampling from the entire (4,516 square-mile) upper basin. Samples were analyzed for physical properties, nutrients, inorganic constituents, metals, radionuclides, pesticides, volatile organic compounds, and bacteria.

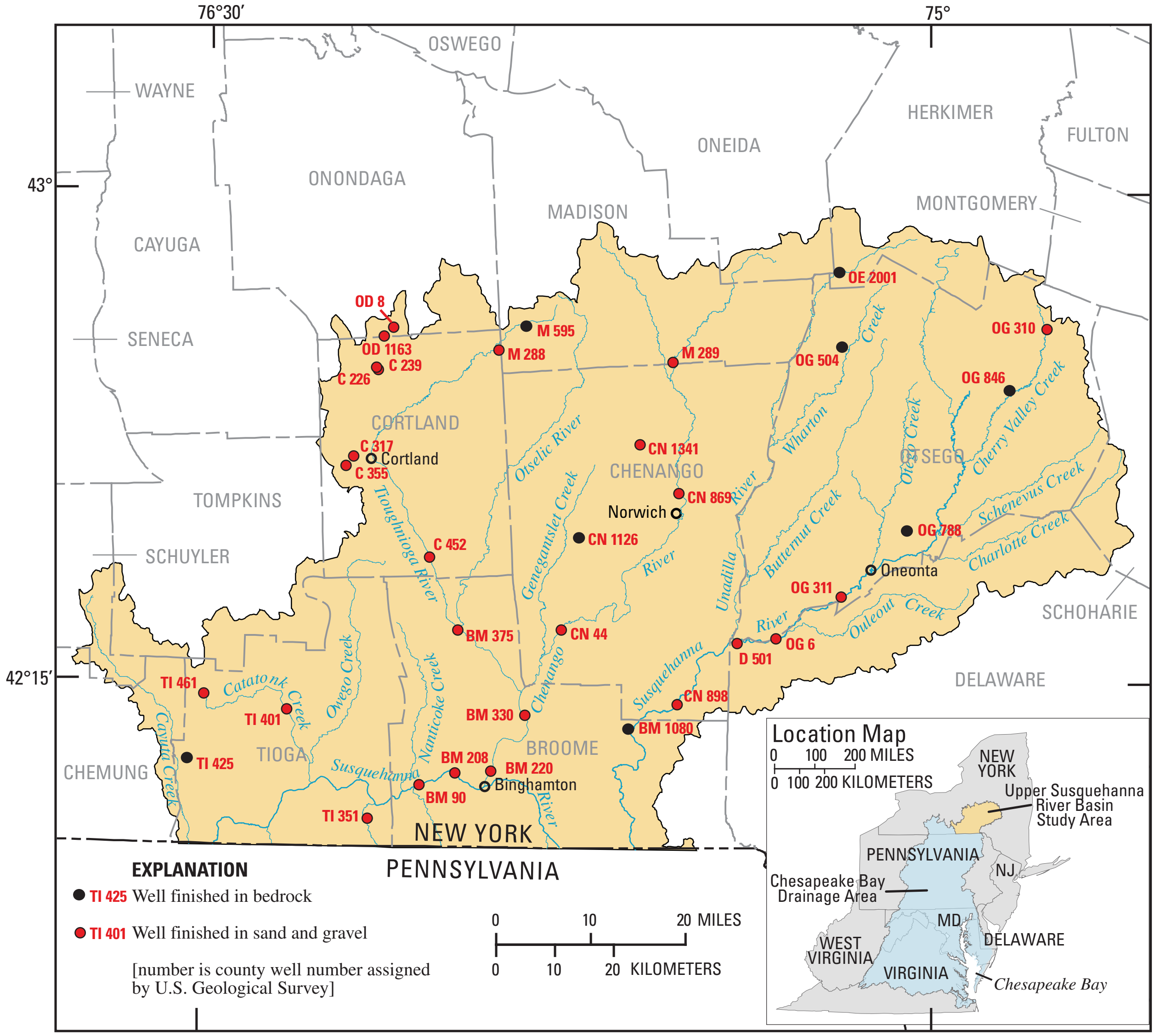
The cations that were detected in the highest concentrations were calcium, magnesium, and sodium; the anions that were detected in the greatest concentrations were bicarbonate, chloride, and sulfate. The predominant nutrient was nitrate, the concentrations of which were greater in samples from sand and gravel aquifers than in samples from bedrock. The metals barium, boron, cobalt, copper, and nickel were detected in every sample; the metals with the highest concentrations were barium, boron, iron, manganese, strontium, and lithium. The pesticide compounds detected most frequently were atrazine, deethylatrazine, alachlor ESA, and two degradation products of metolachlor (metolachlor ESA and metolachlor OA); the compounds detected in highest concentration were metolachlor ESA and OA. Volatile organic compounds were detected in 11 samples, and concentrations of 3 of these compounds exceeded 1 microgram per liter (µg/L). Methyl tert-butyl ether (MTBE), a gasollline additive, was not detected in any sample.

Several analytes were found in concentrations that exceeded Federal and New York State water-quality standards, which are typically identical. Chloride concentrations exceeded the U.S. Environmental Protection Agency (USEPA) Secondary Maximum Contaminant Level (SMCL) of 250 milligrams per liter (mg/L) in two samples, and sulfate concentrations exceeded the SMCL of 250 mg/L in one sample. Sodium concentrations exceeded the USEPA Drinking Water Advisory of 60 mg/L in six samples. Nitrate concentrations exceeded the USEPA Maximum Contaminant Level (MCL) of 10 mg/L in one sample and approached this limit (at 9.84 mg/L) in another sample. Barium concentrations exceeded the MCL of 2,000 µg/L in one sample. Iron concentrations exceeded the SMCL of 300 µg/L in five samples, and manganese concentrations exceeded the SMCL of 50 µg/L in 14 samples. Arsenic was detected in seven samples, and the MCL for arsenic (10 µg/L) was exceeded in two samples. Radon-222 exceeded the proposed MCL of 300 picocuries per liter in 24 samples. Any detection of total coliform or fecal coliform bacteria is considered a violation of New York State health regulations; in this study, total coliform was detected in six samples and fecal coliform was detected in one sample, but *Escherichia coli* (*E. coli*) was not detected in any sample.

## Introduction

The upper Susquehanna River Basin encompasses 4,516 mi$^2$ in south-central New York north of the Pennsylvania border. The main valley of the Susquehanna River trends northeast-southwest and is about 1 mi wide in most places. The Susquehanna River Basin drains most of south-central New York and half of Pennsylvania and eventually flows into Chesapeake Bay, the nation’s largest estuary (fig. 1). Concentrations of nutrients, sediment, and other constituents in Chesapeake Bay have increased over the past 50 years as a result of deforestation, growth of urban areas, poor land management, and water-treatment-plant effluent within its basin (Sprague, 2001; U.S. Environmental Protection Agency, 1988; Bell and others, 1996; Belval and others, 1995; Belval and Sprague, 1999). In 2001, Hetcher and others (2003) described the chemical quality of base flow within a part of the upper Susquehanna River Basin, but a comprehensive assessment of the quality of ground water throughout the basin has been needed.

Section 305(b) of the Federal Clean Water Act Amendments of 1977 (U.S. Environmental Protection Agency, 1997) requires all states to undertake a comprehensive water-quality monitoring program for surface-water and ground-water resources. In 2001, the U.S. Geological Survey (USGS), in cooperation with the New York State Department



Base from U.S. Geological Survey, Digital Line Graph, 1983, 1:100,000,
Universal Transverse Mercator projection, Zone 18, NAD 83

**Figure 1.** Location of upper Susquehanna River Basin in New York and of the 33 wells sampled in 2004–05. (Well data are given in table 1.)

of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (USEPA), initiated an assessment of ground-water quality in river basins throughout the State, as specified in Section 305(b). As part of this program, a ground-water-quality study was conducted in the Mohawk River Basin during 2002, the Chemung River Basin during 2003, and the Lake Champlain Basin during 2004.

As part of the cooperative program with NYSDEC, the USGS sampled ground water in the fall of 2004 and the spring of 2005 from selected aquifers within the upper Susquehanna River Basin (fig. 1) for chemical and bacteriological analysis. Sampling was done at production wells and private residential wells that tap sand and gravel aquifers and bedrock aquifers. The analytical results were compared with drinking-water standards established by the USEPA and New York State and used to define the pattern of ground-water quality throughout the study area.

## Study Area

The northernmost part of the study area is characterized by low relief and contains mostly farm land and wetlands, whereas the central and southern parts are characterized by moderate to high relief and a mixture of forested and farm land. The study area is predominantly rural, although it contains several small cities (Oneonta, Binghamton, Norwich, and Cortland [fig. 1]) and many scattered villages. Most of the developed areas are within the Susquehanna, Unadilla, Chenango, and Tioughnioga River valleys (fig. 1). Total population of the study area in 2000 was 460,000 (U.S. Bureau of Census, 2000). Community-water-supply systems provide water to more than 250,000 people in the villages, towns, and cities within the study area (U.S. Environmental Protection Agency, 2005). Most of the water-supply systems use ground water, although some use surface water from reservoirs and lakes, and others use a combination of surface water and ground water. Most rural homeowners rely on ground water for their domestic water use.

During deglaciation of the region, thick deposits of glaciofluvial sand and gravel (deposited beneath, in front of, or alongside a glacier by meltwater streams) and glaciolacustrine clay, silt, and fine sand (deposited within proglacial lakes) were left within the valleys. As a result, glacially derived landforms are found within the valleys throughout the study area; these include valley trains of outwash, kames and kame terraces, eskers, kettles, and morainal valley plugs and ridges. Recent alluvium covers some of the glacial deposits and forms the flood plains of the larger streams and rivers. The glacial and fluvial deposits within the study area are described in detail by Randall (2001), Fleisher (1977a,b; 1986), MacNish and Randall (1982), and Coates (1966).

The most productive aquifers within the study area are the glaciofluvial deposits of sand and gravel (fig. 2). The glaciolacustrine deposits of sand, silt, and clay are relatively impermeable and yield little water to wells but may confine underlying aquifers. Bedrock aquifers are tapped for water use in areas where significant thicknesses of saturated sand and gravel are not available. The bedrock aquifers are relatively flat-lying, inter-bedded sedimentary units of shale and sandstone that extend throughout most of the study area; some carbonate-rock aquifers of limestone and dolostone are present but limited to a small area in the northern part of the basin.

## Purpose and Scope

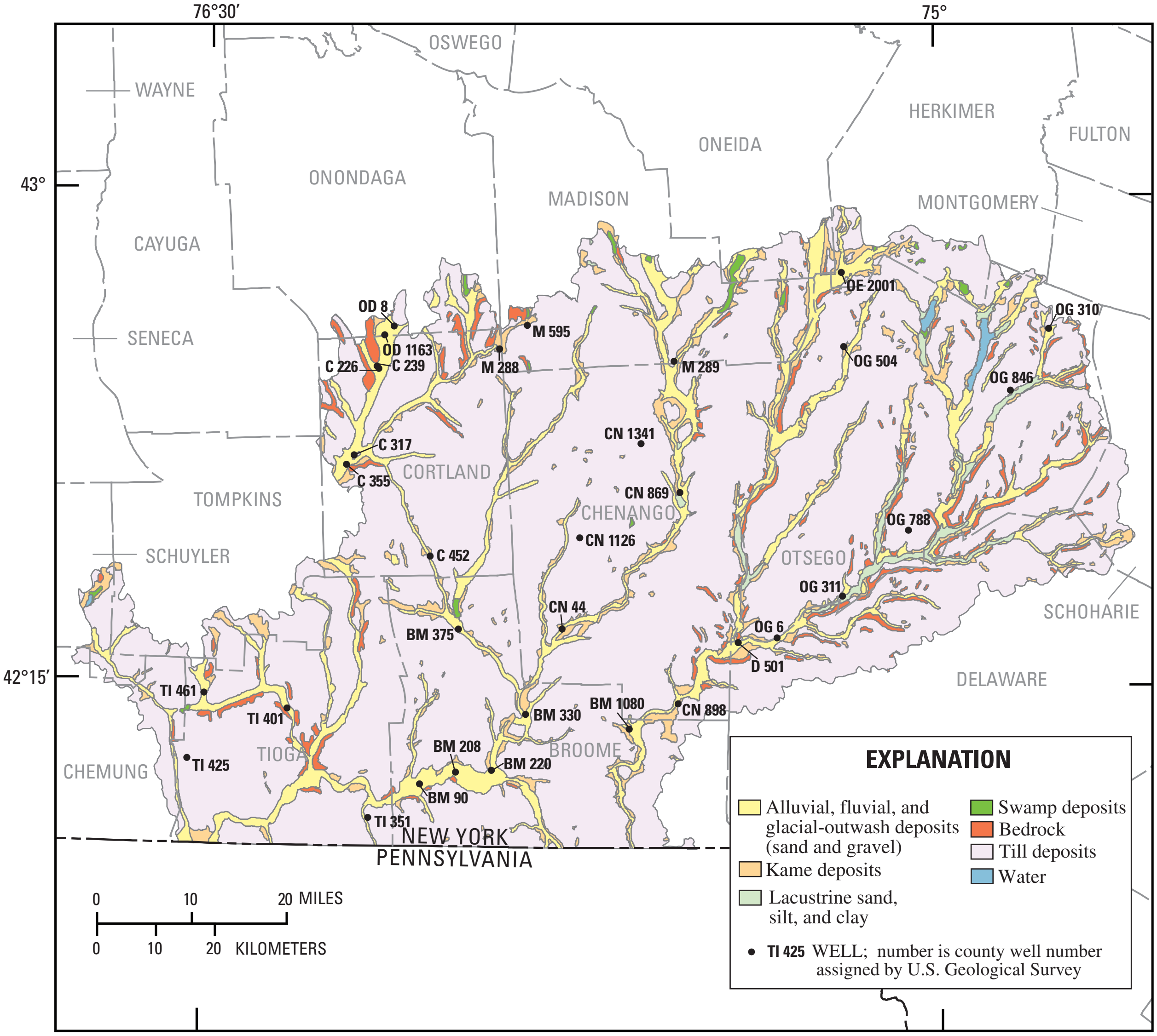
This report describes the sampling and analytical methods used for, and presents the results of, the water-quality analyses conducted on ground-water samples from 33 wells throughout the upper Susquehanna River Basin. Results are given in tables 1–8 (at end of report). Analytical results for selected constituents are compared with drinking-water standards, which include Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) established by the U.S. Environmental Protection Agency (1996; 2002; 2004; 2005) and New York State (1998a,b).

# Methods

Water samples were collected from 13 private residential wells and 20 production wells and analyzed for 202 constituents and 5 physical properties. The following paragraphs describe the criteria used to select these wells, the sampling methods used in the field, and the analytical methods. Three samples were collected for quality assurance (QA) and quality control (QC)—one field blank and two replicate samples—as required for the Federal 305(b) program.

## Site Selection

Residential wells were identified in the USGS Ground-Water Site Inventory (GWSI) database and through the NYSDEC Water-Well Reporting Program. The Water-Well Reporting Program was implemented in 2000 to collect information about newly drilled wells throughout New York from licensed well drillers and was useful in locating wells suitable for ground-water studies. A letter was sent to the owner of each well that was identified as a potential sampling site. The letter described the project, requested permission to sample the water, and included a questionnaire asking the location of the well, the most convenient times for sampling, any safety concerns around the well, and other well-related information. Well owners who did not return the questionnaire received a phone call to ask permission to sample the well water and for other information about the well. Well owners who responded favorably to the questionnaire or called



Base from U.S. Geological Survey, Digital Line Graph, 1983, 1:100,000,
Universal Transverse Mercator projection, Zone 18, NAD 83

Geology modified from Cadwell and Muller, 1986

**Figure 2.** Surficial geology of the upper Susquehanna River Basin in New York and locations of the wells sampled in 2004–05. (Well data are given in table 1.)

were contacted a week before sampling to establish the date and time.

Production wells were identified in the GWSI database and through contact with local officials (including the Cortland County and Otsego County Departments of Health) and with water managers of villages and cities throughout the basin. The water managers were sent a project description and a questionnaire similar to those sent to residential-well owners. Telephone calls were made to well owners to clarify information about the wells and to arrange sampling dates.

Site selection did not target specific municipalities, industries, or agricultural practices; rather, sample sites were selected to represent areas of greatest ground-water use and highest vulnerability to contamination, and to obtain a thorough geographical representation of the upper basin (fig. 2). Site selection included (1) wells finished in sand and gravel and wells finished in bedrock; (2) wells in the main valley of the Susquehanna, Unadilla, Chenango, and Tioughnioga Rivers, in the tributary valleys, and in the uplands surrounding the valleys; (3) wells in each of four predominant land-use categories—agriculture, forest, urban, or mixed; and (4) public-supply and residential wells.

The land-use classification was done through satellite-image analysis to describe the predominant land uses within a half-mile radius of each well. Most (20 of the 33 well sites) were surrounded by a single land use that represented more than 50 percent of well-site area; the other 13 well sites contained a combination of the three land uses (table 1). Most of the wells finished in sand and gravel were in the valleys and ranged from 25 to 233 feet deep. The bedrock wells, which were generally in the uplands, ranged from 55 to 358 feet deep. The well data, land-use data, and water-quality physical properties are given in table 1.

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 the sand and gravel can be relatively rapid. Bedrock wells in the uplands are generally less susceptible to contamination from industrial and urban sources, which are mainly in the valleys; also, water movement in the bedrock is generally slower than in sand and gravel. The agricultural areas that surround most of the upland wells are a potential source of contamination from fertilizers, animal wastes, and domestic septic systems. In addition to manmade contaminants, all aquifers contain naturally derived minerals that may adversely affect water quality, such as sodium, chloride, iron, manganese, and trace elements, and some may also contain radon gas.

Well categorization according to predominant land use within a half-mile radius of each well allows a general indication of potential types of manmade contamination; for example, water from wells surrounded mostly by agricultural land could have elevated concentrations of nutrients or pesticides, whereas water from wells surrounded by urban land (industrial, commercial, parks, or highways) might have elevated concentrations of chloride, VOCs, or pesticides. Water from wells surrounded by forested, undeveloped land, in contrast, tends to be relatively uncontaminated.

The assignment of land-use categories to a well does not always accurately denote the potential sources of contamination that may affect that well. For example, a well completed in sand and gravel adjacent to the Susquehanna River may pump river water, which may contain chemicals discharged to the river upstream from the site. Also, a well might yield water consisting of a mixture of recent precipitation and deeper water that might have entered the system tens to hundreds of years ago. Therefore, land-use descriptions at well sites provide only a general indication of the potential for contamination, and a single water-quality analysis cannot indicate whether a specific land use affects specific wells. Delineation of the flow paths and travel times of water at the sampled wells would require additional sampling and hydrogeologic analysis, which were beyond the scope of this study.

## Sampling and Analytical Methods

Water samples that were analyzed for nutrients (table 3), inorganic constituents (table 4), metals and radionuclides (table 5), and VOCs (table 7) were collected from every well and processed by methods described in the USGS manual for the collection of water-quality data (U.S. Geological Survey, 2004). In addition, pesticide samples (table 6) were collected 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 116 pesticides and pesticide degradates through methods described by Zaugg and others (1995), Meyer and others (1993), and Ferrer and others (1997). 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 8) were collected and processed in accordance with NYSDEC and New York State Department of Health (NYSDOH) regulations.

Sampling entailed the following steps: the well pump was turned on (many of the production wells were already running) and allowed to run about 20 minutes, or until at least five casing-volumes of well water had passed the sampling point. A raw-water spigot between the well and the pressure tank was opened, and the water was allowed to run for several more minutes to flush the spigot. During this time, a general visual evaluation of the area surrounding the sampling site was conducted to identify obvious potential nonpoint and point sources of contamination that could affect the well water. Samples were collected from the raw-water spigot to avoid all water-treatment systems and to ensure that the water collected was representative of the water in the aquifer.

At each sampling site, a Teflon discharge line was connected to the spigot, and samples were analyzed with a multiprobe meter for physical properties, including temperature, specific conductance, dissolved-oxygen concentration, and pH. The water was run slowly enough (100 to 250 mL/min) for the water-quality sensors to react, yet fast enough to cause the pump in the well to run continuously (this sometimes required opening other faucets to waste). Once these properties had stabilized, a second Teflon discharge line was connected to the first with a stainless-steel quick-connect fitting, and the second line was directed into a sampling-chamber bag mounted on a plastic box; this sample-collection chamber was used to minimize sample exposure to dust and other potential sources of contamination. The bottom of the sampling-chamber bag was pierced above a plastic funnel in the top of the box to allow water to run to waste for several minutes to flush the Teflon line. Bottles were filled within the chamber bag according to standard USGS field methods (U.S. Geological Survey, 2004).

Analyses for physical properties, most metals, radionuclides, and VOCs were conducted on unfiltered water samples (tables 1, 5, and 7) to obtain the whole-water concentrations. Concentrations of most nutrients, major inorganic constituents, three metals, and pesticides were obtained from filtered samples (tables 3, 4, 5, and 6). Unfiltered-water concentrations were compared with filtered concentrations to estimate the difference between the total and dissolved concentrations of some constituents. Sulfuric acid was added to some nutrient samples to prevent biologic degradation of the sample, and nitric acid was added to some metal samples to prevent constituent loss by precipitation. If a filtered sample was required for inorganic analytes, a 0.45-µm capsule filter was attached to the Teflon discharge line inside the sample chamber bag; pesticide samples were filtered in the laboratory through 0.7-µm plate filters.

All Teflon discharge lines were cleaned in the laboratory before each sampling day and in the field between each sample. New chamber 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 within the sampling chamber in sterile containers provided by the bacteriological laboratory; the connection of the sampling tube to the well tap was not sterilized.

All 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 nutrients (table 3), inorganic constituents (table 4), metals (table 5), some pesticides (table 6), and VOCs (table 7); (2) the USGS Kansas OGRL in Lawrence, Kans., for other pesticides (table 6); (3) a New York State-certified private laboratory in Newburgh, N.Y., for total organic carbon and phenolic compounds (table 3); and (4) a local laboratory in Ithaca, N.Y., approved by New York State for bacteriological analysis (table 8).

Most well sites allowed easy access to a raw-water spigot that was not affected by treatment or pressure tanks. Twelve wells had the following unusual situations: (1) Eight wells (OG 310, D 501, M 288, BM 220, C 317, M 289, C 355, and BM 330, fig. 2) had no spigot, but rather had either a tube at the top of the well, or a kitchen faucet, from which a raw-water sample could be obtained. The Teflon sampling apparatus and chamber bags could not be used at these wells; therefore, the well pump was allowed to run for several minutes to flush the tube or faucet before the bottles were rinsed and filled. An extra 3-L Teflon bottle was filled, and samples that required filtration were filtered from this bottle with a peristaltic pump and clean silicone tubing. (2) Two wells (CN 869 and BM 90, fig. 2) did not have access to a raw-water sample because phosphate was injected into the well for the sequestering of manganese. (3) One well (OE 2001) had no spigot, but raw-water samples were collected from a pipe that discharged to a farm pond. (4) One well (OD 1163) did not have access to a raw, untreated sample because the owner's water softener system interfered; therefore, the well casing was opened and the well was pumped with a peristaltic pump for 20 minutes while faucets inside the home were run to flush the well casing and cause the well pump to run. Clean silicone tubing was then used to draw water out of the well and into the sample chamber, from which samples were collected and filtered.

# Ground-Water Quality

The 33 ground-water samples collected during this study were analyzed for 202 chemical constituents. Most (127) constituents were not detected in any samples (table 2); the concentrations of the 75 constituents that were detected are listed in tables 3–8. Concentrations of several constituents exceeded recommended MCLs or SMCLs set by the U.S. Environmental Protection Agency (1996) and New York State (1998a,b).

The QA/QC field blank contained no constituent in concentrations above the laboratory reporting levels; this indicates that no constituents were affected by artificial contamination from the sampling or analytical procedures. The results of the two QA/QC replicate samples showed that variability in sample results met the precision requirements of the study. The largest percent differences between concentrations in a ground-water sample and the replicate sample were in acid-neutralizing capacity, residue on evaporation, and low-concentration metals (concentrations near or below the reporting level for the metals).

## Physical Properties

The pH of the samples (table 1) ranged from 7.1 to 9.1, and 7 of the 33 samples exceeded the accepted SMCL range of 6.5 to 8.5 (U.S. Environmental Protection Agency, 1996). Specific conductance of the samples (table 1) ranged from 245 to 2,140 µS/cm. Water temperature (table 1) ranged from 5.7 to 12.9°C. The color of two samples exceeded the SMCL of 15 (table 1).

## Nutrients

Nitrate was the predominant nutrient in the ground-water samples (table 3); the concentrations ranged from less than 0.06 (the analytical detection limit) to 10.5 mg/L as nitrogen (N). The nitrate MCL of 10 mg/L as N was exceeded in one sample and approached this limit (at 9.84 mg/L) in another sample. Samples from wells finished in sand and gravel had higher nitrate concentrations than those from wells finished in bedrock.

## Inorganic Ions

The cations that were detected in the highest concentrations were calcium, magnesium, and sodium (table 4). Calcium concentrations ranged from 13.0 to 254 mg/L, and magnesium concentrations ranged from 2.38 to 162 mg/L. Calcium and magnesium contribute to water hardness, and 32 of the 33 wells yielded water that is moderately hard to very hard (Hem, 1985). Sodium concentrations ranged from 2.5 to 275 mg/L, and six samples exceeded the USEPA Drinking Water Advisory, which recommends that sodium concentrations in drinking water not exceed 60 mg/L to minimize the taste. This recommendation is not federally enforceable but is intended as a guideline for States (U.S. Environmental Protection Agency, 2002).

The anions that were detected in the highest concentrations were bicarbonate (alkalinity), chloride, and sulfate. Alkalinity concentrations ranged from 94 to 283 mg/L (as $CaCO_3$), chloride concentrations ranged from 0.55 to 408 mg/L, and sulfate concentrations ranged from 1.0 to 1,120 mg/L (table 4). The chloride SMCL of 250 mg/L was exceeded in two samples, and the sulfate SMCL of 250 mg/L was exceeded in one sample.

## Metals and Radionuclides

The most commonly detected metals were barium, boron, cobalt, copper, lithium, nickel, strontium, and uranium, all of which were detected in every sample. The metals detected in the highest concentrations were barium, boron, iron, manganese, strontium, and lithium (table 5). Barium concentrations ranged from 6 to 2,220 µg/L, and the MCL for barium (2,000 µg/L) was exceeded in one sample (well BM 1080, which is finished in bedrock). Boron concentrations ranged from 8.5 to 1,730 µg/L; cobalt concentrations ranged from 0.066 to 1.22 µg/L; and copper concentrations ranged from 0.3 to 34.3 µg/L. MCLs for boron or cobalt have not been established. The SMCL for copper (1,000 µg/L) was not exceeded in any sample. Dissolved iron was detected in 16 filtered samples at concentrations ranging from less than 6 to 1,230 µg/L, and the SMCL for iron (300 µg/L) was exceeded in five samples. Dissolved manganese was detected in 25 filtered samples at concentrations ranging from 0.6 to 969 µg/L, and the SMCL for manganese (50 µg/L) was exceeded in 14 samples. Uranium was detected in every sample; concentrations ranged from 0.007 to 0.869 µg/L, but none exceeded the MCL of 30 µg/L. Arsenic was detected in 7 samples, and the MCL for arsenic (10 µg/L) was exceeded in 2 samples (table 5); lead was detected in 31 samples, but the MCL (15 µg/L) was not exceeded.

Radon also was detected in every sample, and concentrations ranged from 60 to 1,490 pCi/L. The proposed MCL of 300 pCi/L for radon-222 in drinking water was exceeded in 24 samples, but the proposed Alternate Maximum Contaminant Level ACML) of 4,000 pCi/L was not exceeded in any sample. The AMCL is the proposed allowable concentration of radon in a raw-water sample from a drinking-water system that has programs to address the health risks of radon in indoor air, but none of the 33 wells sampled had such a system. The proposed MCL and AMCL for radon are under review and have not been adopted (U.S. Environmental Protection Agency, 2004).

## Pesticides

Fifteen pesticides including three pesticide degradates were detected in water from 20 of the 33 wells (table 6). Most (17) of the samples containing pesticides were from sand and gravel aquifers; the other three samples were from bedrock aquifers. Caffeine, which is not a pesticide but is included in table 6 because it is measured as part of the pesticide analyses, was detected at trace levels in 22 samples. The pesticide compounds that were detected most frequently were the herbicides atrazine, deethylatrazine (a degradation product of atrazine), alachlor ESA (the ethanesulfonic acid degradate of alachlor), and metolachlor ESA and metolachlor OA (the ethanesulfonic acid and oxanilic acid degradation products of metolachlor). Atrazine was detected in five samples; the concentrations ranged from 0.003 to 0.095 µg/L and did not exceed the MCL of 3 µg/L (U.S. Environmental Protection Agency, 1996). Deethylatrazine (2-chloro-4-isopropylamino-6-amino-*s*-triazine) was detected in 11 samples at concentrations ranging from 0.003 to 0.051 µg/L. Alachlor ESA was detected in 11 samples at concentrations ranging from 0.02 to 0.16 µg/L. Metolachlor ESA was detected in 14 samples at concentrations ranging from 0.06 to 2.91 µg/L, and Metolachlor OA was detected in 7 samples at concentrations ranging from 0.02 to 0.29 µg/L. No Federal MCLs currently have been established for deethylatrazine, alachlor ESA, metolachlor ESA, or metolachlor OA, and no pesticide concentration exceeded the New York State MCL of 50 µg/L (New York State, 1998a). These findings are similar to those reported by Eckhardt and others (2001) and Phillips and others (1999) from studies of pesticides in ground water throughout New York State.

### Volatile Organic Compounds

Volatile organic compounds (VOCs) were detected in 11 samples (table 7), and none of the concentrations exceeded MCLs. The compound 1,1,1-trichloroethane was detected in five samples, and *cis*-1,2-dichloroethene and trichloroethene were detected in four samples; no MCLs have yet been established for these compounds. Methyl *tert*-butyl ether (MTBE), a gasoline additive that can infiltrate into ground water from leaking fuel tanks, was not detected in any sample. No 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, 1996).

### Bacteria

All samples were analyzed for total coliform, fecal coliform, and *Escherichia coli* (*E. coli*) (table 8). Total coliform was detected in six samples, and fecal coliform in one sample; *E. coli* was not detected in any sample. Any detection of total coliform or fecal coliform is considered a violation of New York State health regulations. Bacteria were detected in samples from sand and gravel and bedrock aquifers. Most of the production wells have chlorination systems that eliminate bacteria before the water is distributed to consumers, but private residential wells are generally not chlorinated. The results of this study indicate that some residential wells may contain high concentrations of bacteria.

## Summary

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), initiated an assessment of ground-water quality in river basins throughout the State. Water samples collected from 33 private and production wells throughout the upper Susquehanna River Basin in the fall of 2004 and the spring of 2005 were analyzed for physical properties, nutrients, inorganic constituents, metals, radionuclides, VOCs, pesticides, and bacteria. Of the 75 constituents that were detected, several exceeded Federal MCLs, SMCLs, and AMCLs.

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 nutrient was nitrate. The SMCL for chloride was exceeded in two samples; the sodium Drinking Water Advisory was exceeded in six samples; the sulfate SMCL was exceeded in one sample; and the MCL for nitrate was exceeded in one sample.

The metals detected in the highest concentrations were barium, boron, iron, manganese, strontium, and lithium. The MCL for barium was exceeded in 1 sample; the SMCL for iron was exceeded in 5 samples; and the SMCL for manganese was exceeded in 14 samples. Uranium was detected in every sample, but no detections exceeded the MCL. Arsenic was detected in 7 samples, and the MCL for arsenic (10 µg/L) was exceeded in 2 samples; lead was detected in 32 samples, but the MCL (15 µg/L) was not exceeded. Radon also was detected in every sample; the proposed MCL for radon-222 in drinking water was exceeded in 24 samples, but the proposed AMCL was not exceeded in any sample.

Of the 15 pesticides or pesticide degradates detected during this study, those detected most frequently were atrazine, deethylatrazine, alachlor ESA, metolachlor ESA, and metolachlor OA. The pesticide compounds detected at the highest concentrations were metolachlor ESA and OA. Most (17) of the samples containing pesticides were from sand and gravel aquifers; the other three samples were from bedrock aquifers. No pesticide concentrations exceeded Federal or New York State MCLs, although Federal MCLs have not been established for deethylatrazine, alachlor ESA, metolachlor ESA, or metolachlor OA.

VOCs were detected in 11 samples; most of the concentrations were at or near the detection limits, and no concentration exceeded an MCL. Bacteria were detected in water from bedrock as well as sand and gravel aquifers––total coliform was detected in six samples and fecal coliform was detected in one sample, but *E. coli* was not detected in any sample.

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# Tables 1–8

**Table 1.** Well information and physical properties of ground-water samples from selected wells in the upper Susquehanna River Basin, New York, 2004–05.

[mi, mile; mg/L, milligrams per liter; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25° C; (00080), USGS National Water Information System (NWIS) parameter code; --, lost sample; UNK, unknown; <, less than. Well locations are shown in figure 1]

| Well data | | | | | | | Water data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well number[1]** | **Type: P, production R, private residential** | **Location: U, uplands; V, valley flat** | **Aquifer: SG, sand and gravel; B, bedrock** | **Depth (feet below land surface )** | **Casing depth (feet below land surface)** | **Land-use percentages within 0.5-mi radius of well: (f, forested; u, urban; a, agricultural)** | **Sample date** | **Water color, filtered, (platinum cobalt units) (00080)** | **Dissolved-oxygen concentration, unfiltered (mg/L) (00300)** | **pH, field, unfiltered, (standard units) (00400)** | **Specific conductance, unfiltered, field (µS/cm) (00095)** | **Temperature (°C) (00010)** |
| TI 401 | R | V | SG | 59 | 59 | 51a 39f 10u | 10/06/2004 | 2 | 0.6 | 7.7 | 373 | 11.6 |
| TI 461 | R | V | SG | 39 | 39 | 76a 21f 3u | 10/07/2004 | 2 | 7.2 | 7.6 | 702 | 10.9 |
| OG 310 | P | V | SG | 32 | 26 | 71a 17u 12f | 10/12/2004 | 5 | 22.0 | 8.5 | 650 | 10.5 |
| TI 351 | R | U | SG | 37 | 37 | 75f 25a | 10/14/2004 | 5 | 3.6 | 7.7 | 298 | 11.9 |
| OE 2001 | R | V | B | 175 | 65 | 63a 21u 15f | 10/14/2004 | 2 | 2.7 | 8.2 | 2,140 | 10.1 |
| OG 504 | R | U | B | 109 | 57 | 64f 35a | 10/13/2004 | 10 | .3 | 8.6 | 307 | 9.6 |
| OG 846 | R | U | B | 230 | 34 | 51a 49f | 11/08/2004 | <1 | 3.5 | 8.8 | 455 | 9.5 |
| CN 1126 | R | U | B | 299 | 162 | 98f 2a | 11/08/2004 | <1 | 3.8 | 9.1 | 288 | 9.8 |
| CN 1341 | R | U | SG | 131 | 131 | 48f 48a 4u | 11/09/2004 | <1 | 3.9 | 8.9 | 408 | 9.4 |
| OG 788 | R | U | B | 119 | 59.5 | 58f 41a | 12/01/2004 | -- | .6 | 8.9 | 308 | 8.3 |
| OG 311 | P | V | SG | 77 | 62 | 49a 34f 13u | 11/30/2004 | <1 | 2.3 | 7.9 | 245 | 9.4 |
| D 501 | P | V | SG | 95 | 75 | 48u 31f 18a | 11/30/2004 | <1 | 5.9 | 7.9 | 392 | 11.8 |
| BM 1080 | R | V | B | 249 | 101 | 49a 32f 14u | 12/01/2004 | -- | .6 | 8.9 | 1,060 | 10.0 |
| OG 6 | P | V | SG | 108 | 90 | 17f 29u 21a | 12/14/2004 | <1 | 2.3 | 8.0 | 566 | 10.5 |
| CN 898 | P | V | SG | 133 | 123 | 44a 31f 19u | 12/15/2004 | <1 | 1.6 | 8.0 | 246 | 9.9 |
| M 288 | P | V | SG | 58 | 52 | 45a 42f 12u | 02/17/2005 | 8 | 5.8 | 8.0 | 702 | 10.0 |
| CN 869 | P | V | SG | 233 | 204 | 48u 27f 24a | 02/16/2005 | 5 | 6.3 | 8.4 | 477 | 10.1 |
| CN 44 | P | V | SG | 172 | 162 | 28a 25f 20u | 02/16/2005 | 8 | 4.0 | 8.5 | 494 | 9.4 |
| BM 208 | P | V | SG | 101 | 66 | 51u 28f 4a | 02/15/2005 | 5 | 4.9 | 7.9 | 1,030 | 11.3 |
| BM 90 | P | V | SG | 145 | UNK | 59u 14f 12a | 02/23/2005 | 25 | 7.2 | 7.6 | 969 | 11.8 |
| BM 220 | P | V | SG | 51 | 36 | 63u 21f 4a | 02/23/2005 | 8 | 7.4 | 7.4 | 1,310 | 12.9 |
| C 317 | P | V | SG | 68 | UNK | 63u 25f 12a | 03/09/2005 | 2 | 8.2 | 7.6 | 581 | 7.6 |
| BM 375 | P | V | SG | 25 | 20 | 39u 36f 23a | 03/09/2005 | 2 | 6.9 | 7.1 | 1,010 | 8.4 |
| M 595 | R | U | B | 358 | 63 | 79f 20a | 03/08/2005 | 2 | 6.5 | 8.6 | 1,330 | 8.4 |
| M 289 | P | V | SG | 130 | 100 | 53a 39f 7u | 03/08/2005 | 2 | 3.3 | 7.6 | 376 | 6.6 |
| OD 8 | P | V | SG | 79 | 66 | 74a 19u 7f | 03/02/2005 | 2 | 6.8 | 7.9 | 822 | 10.1 |
| C 355 | P | V | SG | 63 | 49 | 43u 33f 25a | 03/02/2005 | 5 | 9.2 | 8.1 | 516 | 7.1 |
| TI 425 | R | U | B | 55 | 55 | 64f 36a | 03/15/2005 | 2 | 3.9 | 7.6 | 255 | 7.2 |
| BM 330 | P | V | SG | 41 | 32 | 58f 21a 9u | 03/17/2005 | 2 | 7.2 | 7.4 | 546 | 9.7 |
| C 452 | P | V | SG | 28 | 21 | 41f 37u 22a | 03/16/2005 | 2 | 7.8 | 7.3 | 598 | 5.7 |
| OD 1163 | R | V | SG | 29 | 29 | 35f 18a 8u | 03/22/2005 | 30 | 2.1 | 8.4 | 346 | 7.9 |
| C 226 | P | V | SG | 38 | 32 | 89a 7u 3f | 03/30/2005 | 2 | 8.8 | 8.5 | 603 | 8.8 |
| C 239 | P | V | SG | 59 | 42 | 81a 11u 8f | 03/30/2005 | 2 | 5.4 | 7.6 | 411 | 7.7 |

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[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by U.S. Geological Survey.

**Table 2.** Constituents for which ground-water samples from the upper Susquehanna River Basin, New York, were analyzed but not detected.

[01012, USGS National Water Information System (NWIS) parameter code]

**Elements**
Beryllium 01012
Silver 01077
Thallium 01059
**Organic Compounds**
Acetochlor 49260
Acifluorfen 49315
Aldicarb 49312
Aldicarb sulfone 49313
Aldicarb sulfoxide 49314
Azinphos-methyl 82686
Bendiocarb 50299
Benfluralin 82673
Benomyl 50300
Bensulfuron 61693
Bentazon 38711
Benzene 34030
Bromacil 04029
Bromoxynil 49311
Butylate 04028
*tert*-Butyl ethyl ether 50004
Carbaryl 49310
Carbofuran 82674
Chlorobenzene 34301
Chlorpyrifos 38933
Cyanazine 04041
2,4-D 39732
2,4-DB 38746
2,4-D methyl ester 50470
Dacthal monoacid 49304
DCPA 82682
*p,p*'-DDE 34653
Desulfinyl fipronil 62170
Desulfinyl fipronil amide 62169
Diazinon 39572
Dibromochloromethane 32105
Dicamba 38442
1,3-Dichlorobenzene 34566
1,2-Dichlorobenzene 34536
1,4-Dichlorobenzene 34571
Dichlorodifluoromethane 34668
1,2-Dichloroethane 32103
1,1-Dichloroethene 34501
*trans*-1,2-Dichloroethene 34546
Dichloromethane 34423
Dichloroprop 49302
1,2-Dichloropropane 34541
Dieldrin 39381
2,6-Diethylaniline 82660
Diethyl ether 81576
Diisopropyl ether 81577
Dimethenamid ESA 61951
Dimethenamid OXA 62482
Dinoseb 49301
Diphenamid 04033
Disulfoton 82677
Diuron 49300
EPTC 82668
Ethalfluralin 82663
Ethoprop 82672
Ethylbenzene 34371
Fenuron 49267
Fipronil 62166
Fipronil sulfide 62167
Fipronil sulfone 62168
Flufenacet ESA 61952
Flufenacet OXA 62483
Flumetsulam 61694
Fluometuron 38811
Fonofos 04095
*alpha*-HCH 34253
3-Hydroxycarbofuran 49308
Imazaquin 50356
Imazethapyr 50407
Imidacloprid 61695
3-Ketocarbofuran 50295
Lindane 39341
Linuron 38478
Mathathion 39532
MCPA 38482
MCPB 38487
Methyl parathion 82667
Metribuzin 82630
Molinate 82671
Metalaxal 50359
Methiocarb 38501
Methomyl 49296
Methyl *tert*-butyl ether 78032
Methyl *tert*-pentyl ether 50005
Metsulfuron 61697
*N*-4-Chlorophenyl-*N*'-methylurea 61692
Napropamide 82684
Neburon 49294
Nicosulfuron 50364
Norflurazon 49293
Oryzalin 49292
Oxamyl 38866
Parathion 39542
Pebulate 82669
Pendimethalin 82683
*cis*-Permethrin 82687
Phorate 82664
Picloram 49291
Prometon 04037
Propachlor 04024
Propachlor ESA 62766
Propachlor OXA 62767
Propanil 82679
Propargite 82685
Propham 49236
Propiconazole 50471
Propoxur 38538
Propyzamide 82676
Siduron 38548
Simazine 04035
Sulfometuron 50337
Styrene 77128
Tebuthiuron 82670
Terbacil 82665
Terbufos 82675
Tetrachloromethane 32101
Thiobencarb 82681
Triallate 82678
Tribromomethane 32104
Trichlopyr 49235
Trichlorofluoromethane 34488
1,1,2-Trichloro-1,2,2-trifluoroethane 77652
Trifluralin 82661
Xylenes 81551

**Table 3.** Concentrations of nutrients, total organic carbon, and total phenols in ground-water samples from upper Susquehanna River Basin, New York, 2004–05.

[mg/L, milligrams per liter; µg/L, micrograms per liter; N, nitrogen; P, phosphorus; (00623), USGS National Water Information System (NWIS) parameter code; <, less than. Dashes (--) indicate no data. Well locations are shown in figure 1]

| Well number[1] | Ammonia plus organic nitrogen, filtered (mg/L as N) (00623) | Ammonia, filtered, (mg/L as N) (00608) | Nitrite plus nitrate, filtered, (mg/L as N) (00631) | Nitrite, filtered, (mg/L as N) (00613) | Nitrate, filtered, (mg/L as N) (00618) | Orthophosphate, filtered, (mg/L as P) (00671) | Total organic carbon, unfiltered, (mg/L) (00680) | Phenols, total recoverable, unfiltered (m g/L) (46002) |
|---|---|---|---|---|---|---|---|---|
| TI 401 | <0.10 | [2]E0.02 | <0.06 | <0.008 | <0.06 | 0.12 | <1.00 | <.0050 |
| TI 461 | E.05 | <0.04 | 9.84 | <.008 | 9.84 | <0.02 | 1.37 | 0.0080 |
| OG 310 | 0.25 | <.04 | 2.17 | <.008 | 2.17 | <.02 | 1.15 | 0.0060 |
| TI 351 | <.10 | <.04 | 1.25 | <.008 | 1.25 | <.02 | <1.00 | 0.0070 |
| OE 2001 | 1.3 | 1.30 | <.06 | <.008 | <.06 | <.02 | <1.00 | 0.0100 |
| OG 504 | <.10 | 0.06 | <.06 | <.008 | <.06 | <.02 | <1.00 | <.0050 |
| OG 846 | 0.22 | 0.16 | E.05 | E.005 | E.045 | 0.02 | <1.00 | <.0050 |
| CN 1126 | <.10 | <.04 | <.06 | <.008 | <.06 | <.02 | <1.00 | <.0050 |
| CN 1341 | 0.14 | 0.10 | <.06 | <.008 | <.06 | <.02 | <1.00 | <.0050 |
| OG 788 | 0.10 | 0.07 | <.06 | <.008 | <.06 | 0.02 | <1.00 | 0.0200 |
| OG 311 | <.10 | <.04 | 0.51 | <.008 | 0.51 | <.02 | <1.00 | 0.0160 |
| D 501 | E.05 | <.04 | 1.04 | <.008 | 1.04 | <0.02 | 1.13 | <.0050 |
| BM 1080 | 0.37 | 0.36 | <.06 | <.008 | <.06 | 0.09 | <1.00 | <.0050 |
| OG 6 | <.10 | E.02 | 3.89 | <.008 | 3.89 | <.02 | <1.00 | <.0050 |
| CN 898 | E.09 | E.04 | <.06 | <.008 | <.06 | E.01 | <1.00 | <.0050 |
| M 288 | E.08 | <.04 | 3.91 | <.008 | 3.91 | <.02 | 1.09 | <.0050 |
| CN 869 | E.07 | E.04 | <.06 | <.008 | <.06 | <.02 | <1.00 | <.0050 |
| CN 44 | <.10 | 0.05 | 2.23 | <.008 | 2.23 | <.02 | <1.00 | <.0050 |
| BM 208 | E.07 | <.04 | 1.17 | <.008 | 1.17 | <.02 | 1.23 | 0.0100 |
| BM 90 | 0.26 | 0.25 | <.06 | <.008 | <.06 | -- | 1.46 | <.0050 |
| BM 220 | E.08 | <.04 | 4.39 | <.008 | 4.39 | <.02 | 1.41 | <.0050 |
| C 317 | E.06 | <.04 | 3.30 | <.008 | 3.30 | <.02 | 1.25 | <.0050 |
| BM 375 | E.05 | <.04 | 3.36 | <.008 | 3.36 | <.02 | 1.50 | <.0050 |
| M 595 | 0.36 | 0.34 | <.06 | <.008 | <.06 | 0.02 | <1.00 | <.0050 |
| M 289 | E.09 | E.02 | <.06 | <.008 | <.06 | <.02 | <1.00 | <.0050 |
| OD 8 | E.08 | <.04 | 2.82 | <.008 | 2.82 | <.02 | 1.09 | <.0050 |
| C 355 | 0.12 | <.04 | 1.75 | <.008 | 1.75 | <.02 | <1.00 | <.0050 |
| TI 425 | <.10 | <.04 | 0.38 | E.006 | 0.37 | <.02 | <1.00 | <.0050 |
| BM 330 | <.10 | <.04 | 0.73 | <.008 | 0.73 | <.02 | <1.00 | 0.0067 |
| C 452 | E.06 | <.04 | 1.53 | <.008 | 1.53 | <.02 | 1.02 | 0.0052 |
| OD 1163 | 0.11 | 0.06 | <.06 | E.004 | <.06 | <.02 | <1.00 | 0.0052 |
| C 226 | <.10 | <.04 | 10.5 | <.008 | 10.5 | <.02 | 1.22 | <.0050 |
| C 239 | E.06 | <.04 | 3.83 | <.008 | 3.83 | <.02 | <1.00 | <.0050 |

[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by U.S. Geological Survey.

[2] fixed-endpoint (pH 4.5) titration on unfiltered samples; (mg/L as $CaCO_3$).

[3] fixed-endpoint (pH 4.5) titration on filtered samples; (mg/L as $CaCO_3$).

E, estimated value; constituent was detected in the sample but with low or inconsistent recovery.

**Table 4.** Concentrations of inorganic constituents in ground-water samples from the upper Susquehanna River Basin, New York, 2004–05.

[Concentration in milligrams per liter (mg/L) for filtered samples, unless noted; (90410), USGS National Water Information System (NWIS) parameter code; °C, degrees Celsius; <, less than. Well locations are shown in figure 1]

| Well number[1] | Acid-neutralizing capacity [2], unfiltered (90410) | Alkalinity [3], filtered (29801) | Bicarbonate [3], filtered (29805) | Calcium, filtered (00915) | Magnesium, filtered (00925) | Potassium, filtered (00935) | Sodium, filtered (00930) | Chloride, filtered (00940) | Fluoride, filtered (00950) | Silica, filtered (00955) | Sulfate, filtered (00945) | Residue on evaporation, dried at 180°C, filtered (70300) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TI 401 | 151 | 151 | 184 | 39.3 | 8.0 | 0.46 | 26.5 | 28.1 | 0.2 | 7.63 | 1.0 | 205 |
| TI 461 | 168 | 278 | 339 | 94.6 | 21.8 | 3.45 | 17.8 | 27.4 | E0.1 | 9.56 | 19.2 | 394 |
| OG 310 | 114 | 282 | 344 | 122 | 6.17 | 1.73 | 15.5 | 29.5 | E.1 | 6.64 | 12.2 | 372 |
| TI 351 | 128 | 127 | 155 | 47.5 | 7.01 | 0.48 | 8.22 | 4.89 | 0.2 | 10.2 | 19.0 | 179 |
| OE 2001 | 117 | 190 | 232 | 254 | 162 | 6.60 | 85.4 | 24.0 | 0.9 | 12.2 | 1,120 | 1,890 |
| OG 504 | 127 | 154 | 188 | 41.0 | 6.98 | 0.49 | 15.1 | 2.92 | 0.1 | 13.6 | 3.6 | 175 |
| OG 846 | 147 | 146 | 174 | 13.0 | 2.38 | 0.50 | 76.8 | 50.6 | 0.4 | 8.07 | 2.4 | 251 |
| CN 1126 | 124 | 148 | 175 | 38.6 | 9.07 | 0.87 | 12.0 | 0.55 | E0.1 | 12.9 | 7.1 | 173 |
| CN 1341 | 139 | 175 | 207 | 43.6 | 10.2 | 0.60 | 28.0 | 24.8 | E0.1 | 13.3 | 2.4 | 229 |
| OG 788 | 165 | 165 | 196 | 17.8 | 4.87 | 0.43 | 48.8 | 3.64 | 0.2 | 9.93 | 5.5 | 187 |
| OG 311 | 94 | 94 | 115 | 35.5 | 3.89 | 0.73 | 7.68 | 10.7 | E0.1 | 9.80 | 10.5 | 136 |
| D 501 | 122 | 129 | 157 | 59.7 | 4.25 | 1.02 | 12.7 | 30.5 | E0.1 | 8.46 | 16.6 | 221 |
| BM 1080 | 141 | 138 | 162 | 30.2 | 5.77 | 1.86 | 275 | 408 | 0.3 | 7.66 | 2.2 | 813 |
| OG 6 | 159 | 203 | 248 | 87.3 | 7.48 | 2.00 | 21.5 | 39.5 | E0.1 | 9.28 | 17.5 | 325 |
| CN 898 | 114 | 113 | 138 | 38.4 | 4.27 | 0.70 | 8.47 | 6.55 | 0.2 | 12.4 | 9.4 | 148 |
| M 288 | 199 | 237 | 289 | 101 | 10.7 | 1.41 | 30.9 | 60.8 | E0.1 | 8.28 | 23.8 | 394 |
| CN 869 | 147 | 147 | 179 | 57.3 | 11.6 | 1.04 | 21.7 | 43.6 | 0.1 | 10.7 | 25.9 | 260 |
| CN 44 | 177 | 177 | 216 | 71.4 | 14.5 | 0.83 | 9.77 | 31.9 | E0.1 | 9.74 | 20.9 | 274 |
| BM 208 | 228 | 231 | 282 | 107 | 18.4 | 2.03 | 83.7 | 173 | E0.1 | 8.87 | 42.6 | 586 |
| BM 90 | 258 | 258 | 315 | 126 | 19.9 | 2.00 | 53.7 | 140 | E0.1 | 11.2 | 33.9 | 546 |
| BM 220 | 283 | 283 | 345 | 114 | 20.1 | 5.00 | 136 | 222 | 0.1 | 9.17 | 32.1 | 739 |
| C 317 | 198 | 198 | 242 | 77.1 | 14.0 | 0.98 | 23.0 | 44.6 | <0.1 | 7.49 | 14.3 | 295 |
| BM 375 | 254 | 254 | 310 | 104 | 14.7 | 1.29 | 85.6 | 144 | E0.1 | 7.34 | 17.2 | 518 |
| M 595 | 188 | 197 | 240 | 32.1 | 4.83 | 0.65 | 23.4 | 297 | 0.8 | 8.40 | 3.2 | 705 |
| M 289 | 168 | 168 | 205 | 59.5 | 12.0 | 0.54 | 2.49 | 2.05 | E0.1 | 10.6 | 22.9 | 204 |
| OD 8 | 254 | 254 | 310 | 100 | 18.9 | 2.71 | 49.3 | 102 | E0.1 | 6.80 | 16.6 | 434 |
| C 355 | 184 | 184 | 224 | 62.5 | 10.7 | 1.27 | 35.2 | 45.9 | <.1 | 6.58 | 12.0 | 280 |
| TI 425 | 105 | 105 | 128 | 33.6 | 5.94 | 0.56 | 10.9 | 5.09 | 0.1 | 9.13 | 15.7 | 140 |
| BM 330 | 182 | 182 | 222 | 75.4 | 15.3 | 0.90 | 22.6 | 50.1 | E0.1 | 9.56 | 32.7 | 307 |
| C 452 | 139 | 139 | 170 | 60.4 | 9.10 | 1.97 | 50.7 | 92.1 | E0.1 | 5.33 | 12.1 | 314 |
| OD 1163 | 170 | 170 | 207 | 51.2 | 15.1 | 0.63 | 5.12 | 7.91 | E0.1 | 6.28 | 10.2 | 193 |
| C 226 | 239 | 256 | 312 | 92.1 | 24.4 | 1.01 | 7.85 | 11.1 | <0.1 | 7.57 | 16.2 | 358 |
| C 239 | 166 | 166 | 203 | 56.9 | 14.3 | 1.00 | 10.9 | 15.6 | E0.1 | 6.37 | 10.2 | 238 |

[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by U.S. Geological Survey.

[2] fixed-endpoint (pH 4.5) titration on unfiltered samples; (mg/L as $CaCO_3$).

[3] fixed-endpoint (pH 4.5) titration on filtered samples; (mg/L as $CaCO_3$).

E, estimated value; constituent was detected in the sample but with low or inconsistent recovery.

**Table 5.** Concentrations of metals and radionuclides in ground-water samples from the upper Susquehanna River Basin, New York, 2004–05.

[All values are in micrograms per liter (µg/L) except as noted; (01105), USGS National Water Information System (NWIS) parameter code; <, less than. Well locations are shown in figure 1]

| Well number[1] | Aluminum, unfiltered, recoverable (01105) | Arsenic, unfiltered recoverable (01002) | Barium, unfiltered, recoverable (01007) | Boron, filtered (01020) | Cadmium, unfiltered (01027) | Chromium, unfiltered, recoverable (01034) | Cobalt, unfiltered, recoverable (01037) | Copper, unfiltered, recoverable (01042) | Iron, filtered (01046) | Iron, unfiltered, recoverable (01045) | Lead, unfiltered, recoverable (01051) | Lithium, unfiltered, recoverable (01132) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TI 401 | 3 | 27 | 277 | 21 | <.04 | E.4 | 0.151 | 0.7 | 898 | 840 | 0.10 | 3.8 |
| TI 461 | <2 | <2 | 166 | 18 | <.04 | <.8 | 0.425 | 3.3 | <6 | <6 | 0.38 | 4.8 |
| OG 310 | [2]E1 | <2 | 137 | 28 | <.04 | <.8 | 0.385 | 11.2 | <6 | <6 | 0.38 | 4.0 |
| TI 351 | E1 | <2 | 6 | 20 | <.04 | <.8 | 0.177 | 13.3 | 12 | 210 | 0.22 | 3.0 |
| OE 2001 | E2 | <2 | 42 | 1,730 | <.04 | <.8 | 1.22 | 10.3 | 10 | 30 | <.06 | 503 |
| OG 504 | E2 | <2 | 55 | 118 | <.04 | <.8 | 0.145 | E.3 | 303 | 350 | E.05 | 14.2 |
| OG 846 | 11 | <2 | 48 | 489 | <.04 | <.8 | 0.066 | 1.8 | 6 | 50 | 0.14 | 132 |
| CN 1126 | E1 | E1 | 206 | 39 | <.04 | E.4 | 0.381 | 1.5 | 16 | 190 | 1.46 | 13.8 |
| CN 1341 | E2 | E1 | 222 | 101 | <.04 | <.8 | 0.218 | E.5 | 407 | 410 | 0.21 | 20.9 |
| OG 788 | 3 | <2 | 125 | 244 | <.04 | <.8 | 0.080 | 3.0 | 45 | 170 | 0.78 | 38.0 |
| OG 311 | E1 | <2 | 10 | 15 | <.04 | <.8 | 0.124 | 6.0 | <6 | <6 | 6.19 | 3.5 |
| D 501 | E2 | <2 | 121 | 15 | <.04 | <.8 | 0.197 | 1.6 | <6 | <6 | E.05 | 4.0 |
| BM 1080 | 35 | 19 | 2,220 | 180 | 0.42 | E.6 | 0.164 | 3.6 | <6 | 440 | 0.33 | 544 |
| OG 6 | 2 | <2 | 109 | 43 | <.04 | 1.5 | 0.481 | 1.6 | <6 | M[3] | 0.08 | 3.2 |
| CN 898 | E1 | E1 | 105 | 25 | <.04 | 2.2 | 0.193 | 1.8 | E3 | 10 | 0.09 | 5.0 |
| M 288 | <2 | <2 | 107 | 43 | <.04 | <.8 | 0.387 | 1.4 | <6 | <6 | 0.91 | 12.0 |
| CN 869 | E1 | <2 | 101 | 21 | <.04 | <.8 | 0.237 | 1.0 | 12 | 10 | 0.55 | 7.2 |
| CN 44 | 4 | <2 | 130 | 15 | <.04 | E.5 | 0.292 | 3.6 | <6 | 10 | 0.27 | 13.0 |
| BM 208 | <2 | <2 | 79 | 38 | <.04 | E.7 | 0.398 | 2.4 | <6 | M | 0.26 | 7.8 |
| BM 90 | E1 | 7 | 508 | 47 | <.04 | <.8 | 0.507 | 7.5 | 1,230 | 1,150 | E.04 | 10.8 |
| BM 220 | E1 | <2 | 99 | 70 | <.04 | E.5 | 0.560 | 3.0 | <6 | M | 0.12 | 12.9 |
| C 317 | <2 | <2 | 36 | 16 | <.04 | E.5 | 0.288 | 8.8 | E4 | <6 | E.04 | 3.5 |
| BM 375 | <2 | <2 | 61 | 31 | <.04 | <.8 | 0.354 | 2.0 | <6 | <6 | 0.07 | 1.0 |
| M 595 | 13 | <2 | 1,420 | 624 | <.04 | E.5 | 0.110 | 2.6 | <6 | 240 | 0.31 | 425 |
| M 289 | <2 | E2 | 118 | 14 | <.04 | <.8 | 0.214 | 1.9 | 55 | 70 | 0.10 | 6.2 |
| OD 8 | E1 | <2 | 115 | 28 | <.04 | E.4 | 0.444 | 2.8 | <6 | <6 | 1.04 | 4.3 |
| C 355 | E1 | <2 | 29 | 13 | <.04 | E.6 | 0.272 | 34.3 | <6 | <6 | E.05 | 3.3 |
| TI 425 | E2 | <2 | 59 | 32 | E.04 | <.8 | 0.146 | 1.5 | <6 | M | 0.19 | 4.5 |
| BM 330 | <2 | <2 | 60 | 10 | <.04 | E.4 | 0.305 | 1.9 | 16 | 40 | 0.31 | 5.7 |
| C 452 | <2 | <2 | 64 | 16 | <.04 | E.4 | 0.277 | 2.3 | <6 | <6 | 0.08 | 1.1 |
| OD 1163 | E1 | <2 | 163 | 8.5 | <.04 | <.8 | 0.292 | 1.4 | 1,130 | 5,270 | <.06 | 3.5 |
| C 226 | 6 | <2 | 171 | 17 | <.04 | E.6 | 0.434 | 2.8 | <6 | 20 | 0.18 | 3.3 |
| C 239 | E2 | <2 | 67 | 12 | <.04 | E.5 | 0.263 | 4.7 | E3 | 10 | 0.68 | 1.9 |

[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by U.S. Geological Survey.

[2] E, estimated value; constituent was detected in the sample but with low or inconsistent recovery.

[3] M, constituent was detected in the sample but was not quantified.

**Table 5.** Concentrations of metals and radionuclides in ground-water samples from the upper Susquehanna River Basin, New York, 2004–05.

[All values are in micrograms per liter (µg/L) except as noted; (01105), USGS National Water Information System (NWIS) parameter code; <, less than. Well locations are shown in figure 1]

| Well number[1] | Manganese, filtered (01056) | Manganese, unfiltered, recoverable (01055) | Mercury, unfiltered, recoverable (71900) | Molybdenum, unfiltered, recoverable (01062) | Nickel, unfiltered, recoverable (01067) | Selenium, unfiltered (01147) | Strontium, unfiltered, recoverable (01082) | Radon-222, unfiltered, (picocuries per liter) (82303) | Antimony unfiltered (01097) | Uranium (natural), unfiltered (28011) | Zinc, unfiltered, recoverable (01092) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TI 401 | 410 | 408 | <.01 | 1.6 | 0.46 | <.4 | 227 | 1,000 | <.2 | E0.007 | E1 |
| TI 461 | <.6 | <.6 | <.01 | E.2 | 1.83 | <.4 | 120 | 750 | <.2 | 0.344 | 3 |
| OG 310 | <.6 | <.6 | <.01 | 0.3 | 1.85 | 0.5 | 276 | 660 | <.2 | 0.393 | E2 |
| TI 351 | 0.8 | 1.1 | <.01 | <.2 | 1.76 | 0.5 | 44.5 | 1,290 | <.2 | 0.157 | 8 |
| OE 2001 | 16.5 | 14.8 | <.01 | 0.3 | 4.67 | 5.1 | 11,600 | 60 | <.2 | 0.386 | 4 |
| OG 504 | 138 | 134 | <.01 | 0.5 | 0.61 | E.4 | 281 | 280 | <.2 | 0.088 | 7 |
| OG 846 | 41.1 | 37.6 | <.01 | 0.2 | 0.55 | 0.8 | 322 | 110 | <.2 | 0.018 | E1 |
| CN 1126 | 134 | 110 | <.01 | 0.5 | 0.93 | <.4 | 250 | 1,490 | <.2 | 0.256 | 3 |
| CN 1341 | 148 | 129 | <.01 | E.2 | 0.78 | 0.7 | 945 | 210 | <.2 | 0.149 | 13 |
| OG 788 | 51.5 | 46.0 | E.01 | 0.3 | 0.44 | <.4 | 281 | 640 | <.2 | 0.015 | 4 |
| OG 311 | 59.4 | 52.0 | E.01 | 0.6 | 0.36 | <.4 | 134 | 630 | <.2 | 0.375 | E2 |
| D 501 | 360 | 343 | <.01 | E.1 | 0.46 | 0.5 | 93.1 | 1,050 | E.1 | 0.388 | E1 |
| BM 1080 | 190 | 159 | E.01 | 2.5 | 2.23 | 7.4 | 2,140 | 430 | <.2 | 0.042 | E2 |
| OG 6 | <.6 | <.6 | E.01 | <.2 | 1.26 | 0.5 | 117 | 1,180 | <.2 | 0.182 | E1 |
| CN 898 | 444 | 420 | <.01 | 0.5 | 0.70 | E.3 | 161 | 430 | <.2 | 0.783 | 3 |
| M 288 | 2.1 | 2.0 | <.01 | <.2 | 2.93 | <.4 | 199 | 700 | <.2 | 0.544 | 12 |
| CN 869 | 264 | 260 | <.01 | 0.4 | 0.82 | 0.5 | 381 | 180 | <.2 | 0.600 | <2 |
| CN 44 | 15.3 | 32.3 | E.01 | 0.3 | 1.00 | 0.5 | 104 | 660 | 0.2 | 0.832 | 3 |
| BM 208 | E.4 | <.6 | <.01 | 0.5 | 1.45 | 0.9 | 177 | 730 | <.2 | 0.305 | 6 |
| BM 90 | 969 | 975 | <.01 | 0.4 | 2.45 | 0.6 | 340 | 290 | <.2 | 0.869 | 19 |
| BM 220 | <.6 | <.6 | <.01 | E.1 | 2.82 | 1.2 | 215 | 560 | <.2 | 0.301 | E1 |
| C 317 | <.6 | <.6 | E.01 | E.1 | 0.84 | E.4 | 103 | 650 | <.2 | 0.212 | <2 |
| BM 375 | 0.6 | [2]E.5 | <.01 | <.2 | 1.05 | 0.6 | 127 | 840 | <.2 | 0.505 | 5 |
| M 595 | 62.1 | 59.5 | <.01 | 0.5 | 0.53 | 3.0 | 2,400 | 90 | <.2 | 0.033 | E2 |
| M 289 | 157 | 143 | <.01 | 0.5 | 0.56 | E.3 | 130 | 120 | <.2 | 0.709 | E2 |
| OD 8 | 1.1 | 0.9 | <.01 | E.2 | 3.50 | 0.9 | 478 | 480 | <.2 | 0.246 | E1 |
| C 355 | <.6 | <.6 | <.01 | <.2 | 1.98 | 0.5 | 81.4 | 640 | <.2 | 0.097 | 2 |
| TI 425 | 156 | 170 | 0.02 | 0.2 | 0.38 | <.4 | 87.7 | 1,040 | <.2 | 0.307 | 9 |
| BM 330 | E.4 | E.4 | <.01 | E.1 | 0.76 | 0.5 | 98.5 | 700 | <.2 | 0.291 | 9 |
| C 452 | 14.4 | 18.8 | E.01 | E.1 | 1.11 | 0.6 | 104 | 850 | <.2 | 0.183 | 4 |
| OD 1163 | 49.0 | 63.4 | <.01 | 0.5 | 0.80 | 0.5 | 65.9 | 60 | <.2 | 0.314 | E1 |
| C 226 | <.6 | E.3 | <.01 | <.2 | 0.84 | <.4 | 95.4 | 380 | <.2 | 0.221 | <2 |
| C 239 | <.6 | <.6 | 0.02 | <.2 | 0.70 | <.4 | 65.7 | 410 | <.2 | 0.105 | 4 |

[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by U.S. Geological Survey.

[2] E, estimated value; constituent was detected in the sample but with low or inconsistent recovery.

[3] M, constituent was detected in the sample but was not quantified.

**Table 6.** Concentrations of pesticides detected in ground-water samples from the upper Susquehanna River Basin, New York, 2004–05.

[All concentrations are in micrograms per liter (µg/L) for filtered samples. (04040), USGS National Water Information System (NWIS) parameter code. Dashes (--) indicate no data. Well locations are shown in figure 1]

| Well number[1] | 2-Chloro-4-isopropyl-amino-6-amino-*s*-triazine (04040) | 2-Chloro-6-ethyl-amino-4-amino-*s*-triazine (04038) | 2-Hydroxy-4-isopropyl-amino-6-ethylamino-*s*-triazine (50355) | Alachlor (46342) | Atrazine (39632) | Caffeine (50305) | Chloro-diamino-*s*-triazine (04039) | Metolachlor (39415) |
|---|---|---|---|---|---|---|---|---|
| TI 401 | <.006 | <.08 | <.032 | <.004 | <.007 | E.0050 | <.04 | <.013 |
| TI 461 | [2]E.007 | <.08 | <.032 | <.004 | E.006 | <.0180 | E.01 | <.013 |
| OG 310 | E.005 | <.08 | <.032 | <.004 | <.007 | E.0100 | <.04 | <.013 |
| TI 351 | <.006 | <.08 | <.032 | <.004 | <.007 | <.0180 | <.04 | <.013 |
| OE 2001 | <.006 | <.08 | <.032 | <.004 | <.007 | E.0061 | <.04 | <.013 |
| OG 504 | <.006 | <.08 | <.032 | <.004 | <.007 | E.0090 | <.04 | <.013 |
| OG 846 | <.006 | <.08 | <.032 | <.004 | <.007 | <.0180 | <.04 | <.013 |
| CN 1126 | <.006 | <.08 | <.032 | <.004 | <.007 | <.0180 | <.04 | <.013 |
| CN 1341 | <.006 | <.08 | <.032 | <.004 | <.007 | E.0084 | <.04 | <.013 |
| OG 788 | <.006 | <.08 | <.032 | <.004 | <.007 | E.0099 | <.04 | <.013 |
| OG 311 | <.006 | <.08 | <.032 | <.004 | <.007 | E.0063 | <.04 | <.013 |
| D 501 | E.004 | <.08 | <.032 | <.004 | E.005 | 0.0282 | <.04 | <.013 |
| BM 1080 | <.006 | <.08 | <.032 | <.004 | <.007 | <.0180 | <.04 | <.013 |
| OG 6 | E.003 | <.08 | <.032 | <.004 | <.007 | E.006 | <.04 | <.013 |
| CN 898 | <.006 | <.08 | <.032 | <.004 | <.007 | E.005 | <.04 | <.013 |
| M 288 | E.051 | E.01 | E.006 | 0.120 | 0.095 | E.0106 | <.04 | 0.517 |
| CN 869 | <.006 | <.08 | <.032 | <.004 | <.007 | <.0180 | <.04 | <.013 |
| CN 44 | <.006 | <.08 | <.032 | <.004 | <.007 | E.0131 | <.04 | <.013 |
| BM 208 | E.003 | <.08 | <.032 | <.004 | E.003 | E.0101 | <.04 | <.013 |
| BM 90 | <.006 | <.08 | <.032 | <.004 | <.007 | E.0118 | <.04 | <.013 |
| BM 220 | E.003 | <.08 | <.032 | <.004 | <.007 | E.0168 | <.04 | <.013 |
| C 317 | E.012 | <.08 | <.032 | <.005 | <.007 | <.020 | <.04 | <.006 |
| BM 375 | <.006 | <.08 | <.032 | <.005 | <.007 | E.004 | <.04 | <.006 |
| M 595 | <.006 | <.08 | <.032 | <.005 | <.007 | E.0069 | <.04 | <.006 |
| M 289 | <.006 | <.08 | <.032 | <.005 | <.007 | E.0088 | <.04 | <.006 |
| OD 8 | E.004 | <.08 | <.032 | <.004 | <.007 | <.0180 | <.04 | 0.131 |
| C 355 | E.013 | <.08 | <.032 | <.004 | E.006 | <.0180 | <.04 | <.013 |
| TI 425 | <.006 | <.08 | <.032 | <.005 | <.007 | E.013 | <.04 | <.006 |
| BM 330 | <.006 | <.08 | <.032 | <.005 | <.007 | E.006 | <.04 | <.006 |
| C 452 | E.005 | <.08 | <.032 | <.005 | <.007 | E.017 | <.04 | <.006 |
| OD 1163 | <.006 | <.08 | <.032 | <.005 | <.007 | <.0180 | <.04 | <.006 |
| C 226 | <.006 | <.08 | <.032 | <.005 | <.007 | E.015 | <.04 | <.006 |
| C 239 | <.006 | <.08 | <.032 | <.005 | <.007 | <.0180 | <.04 | <.006 |

[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by U.S. Geological Survey.

[2] E, estimated value; constituent was detected in the sample but with low or inconsistent recovery.

[3] M, constituent was detected in the sample but was not quantified.

**Table 6.** Concentrations of pesticides detected in ground-water samples from the upper Susquehanna River Basin, New York, 2004–05.

| Well number[1] | Dinoseb (49301) | Acetochlor ESA (61029) | Alachlor ESA (50009) | Alachlor OA (61031) | Metolachlor ESA (61043) | Metolachlor OA (61044) | Acetochlor/ Metolachlor ESA - 2nd Amide (62850) | Hydroxy-alachlor (63783) |
|---|---|---|---|---|---|---|---|---|
| TI 401 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| TI 461 | <.04 | <.02 | <.02 | <.02 | 0.78 | 0.06 | 0.06 | -- |
| OG 310 | <.04 | <.02 | <.02 | <.02 | 0.06 | <.02 | <.02 | -- |
| TI 351 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| OE 2001 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| OG 504 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| OG 846 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| CN 1126 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| CN 1341 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| OG 788 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| OG 311 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| D 501 | <.04 | <.02 | <.02 | <.02 | 0.09 | <.02 | <.02 | -- |
| BM 1080 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | -- |
| OG 6 | <.04 | <.02 | <.02 | <.02 | 0.06 | <.02 | <.02 | <.02 |
| CN 898 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 |
| M 288 | M[3] | <.02 | 0.02 | 0.16 | 0.10 | 0.12 | <.02 | 0.03 |
| CN 869 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 |
| CN 44 | <.04 | <.02 | <.02 | <.02 | 0.10 | <.02 | <.02 | <.02 |
| BM 208 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 |
| BM 90 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 |
| BM 220 | <.04 | <.02 | <.02 | <.02 | 0.15 | 0.02 | <.02 | <.02 |
| C 317 | <.04 | <.02 | 0.04 | <.02 | 2.91 | 0.03 | <.02 | <.02 |
| BM 375 | <.04 | 0.08 | 0.09 | <.02 | <.02 | <.02 | <.02 | <.02 |
| M 595 | <.04 | <.02 | 0.06 | <.02 | <.02 | <.02 | <.02 | <.02 |
| M 289 | <.04 | <.02 | 0.04 | <.02 | <.02 | <.02 | <.02 | <.02 |
| OD 8 | <.04 | <.02 | 0.07 | <.02 | 0.39 | 0.29 | <.02 | <.02 |
| C 355 | <.04 | <.02 | 0.09 | <.02 | 0.38 | <.02 | <.02 | <.02 |
| TI 425 | <.04 | <.02 | 0.04 | <.02 | 0.07 | <.02 | <.02 | <.02 |
| BM 330 | <.04 | <.02 | 0.16 | <.02 | <.02 | <.02 | <.02 | <.02 |
| C 452 | <.04 | <.02 | 0.04 | <.02 | 0.57 | 0.04 | <.02 | <.02 |
| OD 1163 | <.04 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 | <.02 |
| C 226 | <.04 | <.02 | 0.02 | <.02 | 2.46 | 0.04 | 0.05 | <.02 |
| C 239 | <.04 | <.02 | <.02 | <.02 | 1.13 | <.02 | <.02 | <.02 |

[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by U.S. Geological Survey.

[2] E, estimated value; constituent was detected in the sample but with low or inconsistent recovery.

[3] M, constituent was detected in the sample but was not quantified.

**Table 7.** Concentrations of volatile organic compounds (VOCs) in ground-water samples from the upper Susquehanna River Basin, New York, 2004–05.

[All values are in micrograms per liter (µg/L) for unfiltered samples. (34506), USGS National Water Information System (NWIS) parameter code. Well locations are shown in figure 1]

| Well number[1] | 1,1,1-Trichloro-ethane (34506) | 1,1-Dichloro-ethane (34496) | Bromo-dichloro-methane (32101) | *cis*-1,2-Dichloro-ethene (77093) | Dibromo-chloro-methane (32105) | Methyl *tert*-butyl ether (78032) | Tetrachloro-ethene (34475) | Vinyl chloride (39175) | Trichloro-ethene (39180) | Trichloro-methane (32106) | Toluene (34010) | Tetrachloro-methane (32102) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TI 401 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | 0.1 | <.2 |
| TI 461 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OG 310 | <.1 | <.1 | 0.2 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | 0.2 | <.1 | <.2 |
| TI 351 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OE 2001 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OG 504 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OG 846 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| CN 1126 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | 0.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| CN 1341 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OG 788 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OG 311 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| D 501 | <.1 | <.1 | <.1 | 1.9 | <.2 | <.2 | <.1 | <.2 | 2.0 | <.1 | <.1 | <.2 |
| BM 1080 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OG 6 | 0.7 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| CN 898 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| M 288 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| CN 869 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| CN 44 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| BM 208 | 0.9 | 0.2 | <.1 | 0.4 | <.2 | <.2 | <.1 | <.2 | 0.8 | <.1 | <.1 | <.2 |
| BM 90 | 0.1 | 1.2 | <.1 | 2.5 | <.2 | <.2 | <.1 | 0.4 | <.1 | <.1 | <.1 | <.2 |
| BM 220 | 0.2 | 0.4 | 0.1 | 0.3 | <.2 | <.2 | <.1 | <.2 | 0.6 | 0.9 | <.1 | <.2 |
| C 317 | 0.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | 0.1 | <.1 | <.1 | <.2 |
| BM 375 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| M 595 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | 0.1 | <.2 |
| M 289 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OD 8 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | 0.4 |
| C 355 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| TI 425 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| BM 330 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| C 452 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| OD 1163 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |
| C 226 | <.1 | <.1 | 0.3 | <.1 | 0.2 | <.2 | <.1 | <.2 | <.1 | 0.2 | <.1 | <.2 |
| C 239 | <.1 | <.1 | <.1 | <.1 | <.2 | <.2 | <.1 | <.2 | <.1 | <.1 | <.1 | <.2 |

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[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by U.S. Geological Survey.

**Table 8.** Concentrations of bacteria in unfiltered ground-water samples from the upper Susquehanna River Basin, New York, 2004–05.

[(31691), USGS national Water Information System (NWIS) parameter code. mL, milliliter; <, less than. Well locations are shown in figure 1]

| Well number[1] | *Escherichia coli* (colonies per 100 mL) (316910 | Fecal coliform (colonies per 100 mL) (61215) | Heterotrophic plate count (colony forming unit) | Total coliform (colonies per 100 mL) (61213) |
|---|---|---|---|---|
| TI 401 | <1 | 5 | 83 | 157 |
| TI 461 | <1 | <5 | <1 | <1 |
| OG 310 | <1 | <5 | 2 | <1 |
| TI 351 | <1 | <5 | <1 | <1 |
| OE 2001 | <1 | <5 | 1 | 1 |
| OG 504 | <1 | <5 | <1 | <1 |
| OG 846 | <1 | <5 | 248 | 39 |
| CN 1126 | <1 | <5 | <1 | <1 |
| CN 1341 | <1 | <5 | 1 | 1 |
| OG 788 | <1 | <5 | 1 | <1 |
| OG 311 | <1 | <5 | <1 | <1 |
| D 501 | <1 | <5 | <1 | <1 |
| BM 1080 | <1 | <5 | <1 | <1 |
| OG 6 | <1 | <5 | <1 | <1 |
| CN 898 | <1 | <5 | <1 | <1 |
| M 288 | <1 | <5 | 1 | <1 |
| CN 869 | <1 | <5 | <1 | <1 |
| CN 44 | <1 | <5 | 1 | <1 |
| BM 208 | <1 | <5 | <1 | <1 |
| BM 90 | <1 | <5 | <1 | <1 |
| BM 220 | <1 | <5 | <1 | <1 |
| C 317 | <1 | <5 | 2 | 1 |
| BM 375 | <1 | <5 | 2 | 18 |
| M 595 | <1 | <5 | <1 | <1 |
| M 289 | <1 | <5 | <1 | <1 |
| OD 8 | <1 | <5 | <1 | <1 |
| C 355 | <1 | <5 | <1 | <1 |
| TI 425 | <1 | <5 | 1 | <1 |
| BM 330 | <1 | <5 | <1 | <1 |
| C 452 | <1 | <5 | <1 | <1 |
| OD 1163 | <1 | <5 | <1 | <1 |
| C 226 | <1 | <5 | <1 | <1 |
| C 239 | <1 | <5 | <1 | <1 |

[1] TI, Tioga County; CN, Chenango County; C, Cortland County; OG, Onondaga County; BM, Broome County; D, Delaware County; M, Madison County; OE, Otsego County; number is local well-identification number assigned by the U.S. Geological Survey.

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