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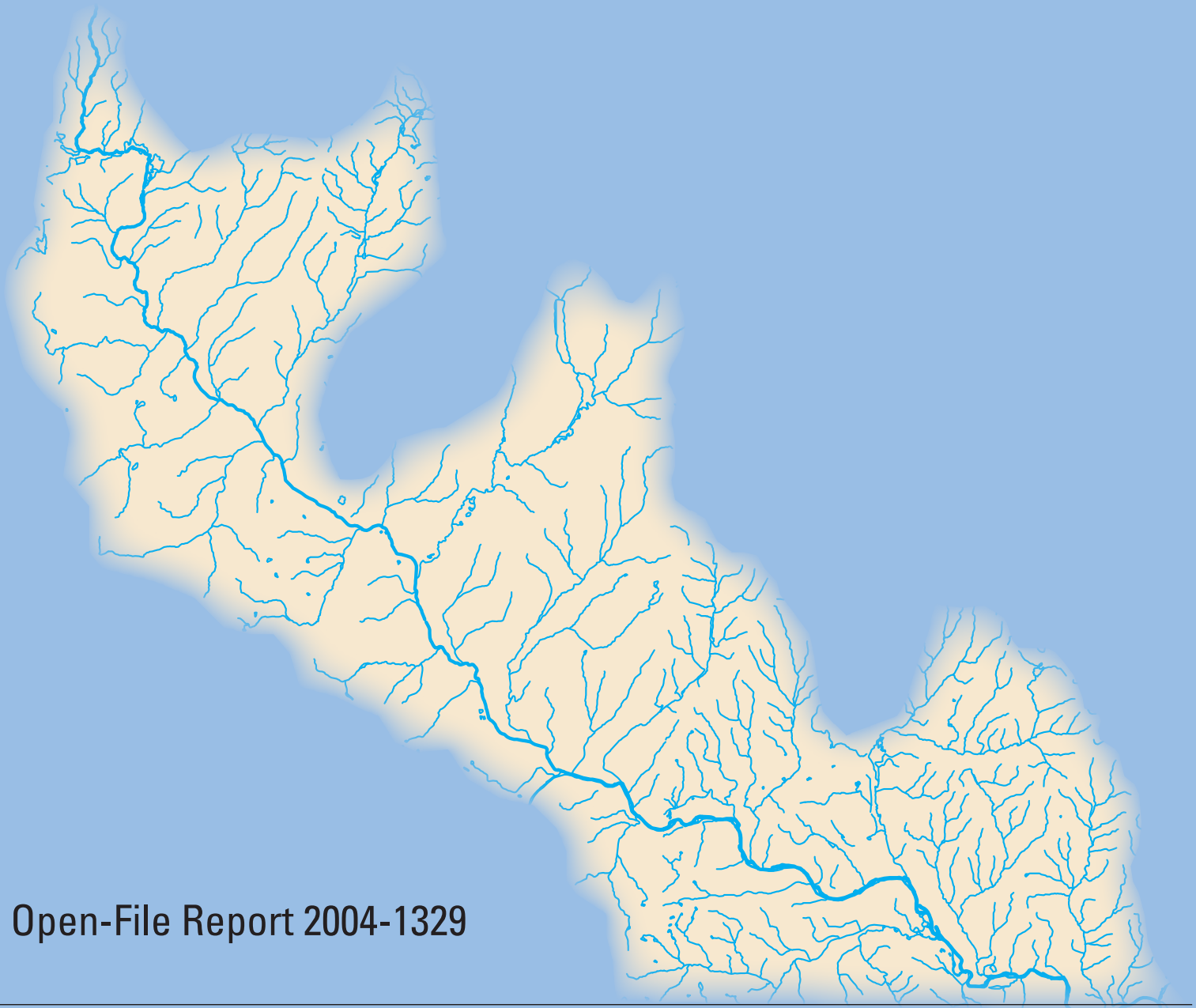
Ground-Water Quality in the Chemung River Basin, New York, 2003



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Ground-Water Quality in the Chemung River Basin, New York, 2003

By Kari Hetcher-Aguila

In cooperation with New York State Department of Environmental Conservation

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Conversion Factors and Abbreviations

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)

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

$$°F=(1.8\times°C)+32$$

Other abbreviations used in this report

micrograms per liter (µg/L)

milligrams per liter (mg/L)

picocuries per liter (pCi/L)

tritium units (TU)

microsiemens per centimeter (µS/cm)

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Abstract

Water samples were collected from 24 public-supply wells and 13 private residential wells during the summer of 2003 and analyzed to describe the chemical quality of ground water throughout the Chemung River basin, upgradient from Waverly, N.Y, on the Pennsylvania border. Wells were selected to represent areas of heaviest ground-water use and greatest vulnerability to contamination, and to obtain a geographical distribution across the 1,130 square-mile basin. Samples were analyzed for physical properties, inorganic constituents, nutrients, metals and radionuclides, pesticides, volatile organic compounds, and bacteria.

The cations that were detected in the highest concentrations were calcium and sodium; the anions that were detected in the greatest concentrations were bicarbonate, chloride, and sulfate. The predominant nutrient was nitrate. Nitrate concentrations in samples from wells finished in sand and gravel were greater than in those from wells finished in bedrock, except for one bedrock well, which had the highest nitrate concentration of any sample in this study. The most commonly detected metals were aluminum, barium, iron, manganese, and strontium. The range of tritium concentrations (0.6 to 12.5 tritium units) indicates that the water ages ranged from less than 10 years old to more than 50 years old. All but one of the 15 pesticides detected were herbicides; those detected most frequently were atrazine, deethylatrazine, and two degradation products of metolachlor (metachlor ESA and metachlor OA), which were the pesticides detected at the highest concentrations. Not every sample collected was analyzed for pesticides, and pesticides were detected only in wells finished in sand and gravel. Volatile organic compounds were detected in 15 samples, and the concentrations were at or near the analytical detection limits. Total coliform were detected in 12 samples; fecal coliform were detected in 7 samples; and *Escherichia coli* was detected in 6 samples. These bacteria were detected in water from bedrock as well as sand-and-gravel aquifers.

Federal and State water-quality standards were exceeded in several samples. Two samples exceeded the chloride U.S. Environmental Protection Agency Secondary Maximum Contaminant Level of 250 milligrams per liter. The U.S. Environmental Protection Agency Drinking Water Advisory for sodium (30 to 60 milligrams per liter) was exceeded in 11 samples. The upper limit of the Secondary Maximum Contaminant Level range for aluminum (200 micrograms per liter) was exceeded in one sample. The Maximum Contaminant Level for barium (2,000 micrograms per liter) was exceeded in one sample. The Secondary Maximum Contaminant Level for iron (300 micrograms per liter) was exceeded in 11 samples. The Secondary Maximum Contaminant Level for manganese (50 micrograms per liter) was exceeded in 20 samples. The proposed Maximum Contaminant Level for radon (300 picocuries per liter) was exceeded in 34 samples.

Introduction

Section 305(b) of the Federal Clean Water Act Amendments of 1977 (U.S. Environmental Protection Agency, 1997) requires states to undertake a comprehensive water-quality monitoring program for surface-water and ground-water resources. The New York State Department of Environmental Conservation (NYSDEC) Rotating Intensive Basin Study routinely monitors surface water to fulfill one portion of this requirement, but historically ground water has been less frequently monitored. In 2002, the U.S. Geological Survey (USGS), in cooperation with the NYSDEC, and with input from the U.S. Environmental Protection Agency (USEPA), developed a plan to sample ground water in various aquifers within the Chemung River Basin (fig. 1).

Hydrologic Setting

The Chemung River basin (1,130 mi^2) lies mostly in southwestern New York and partly in north-central Pennsylvania (fig. 1). The main valley of the Chemung River trends northwest-southeast, is about 1 mile wide in most places and empties into the Susquehanna River, south of Waverly, N.Y., in Pennsylvania.

The glacial and alluvial sediments within the Chemung River valley are as much as 500 feet thick (Miller, 1982) and form unconfined and confined aquifers that supply water to the villages and cities throughout the basin, including the cities of Elmira, Corning, and Bath (fig. 1). The main valley intersects northeast-southwest trending glaciated tributary valleys

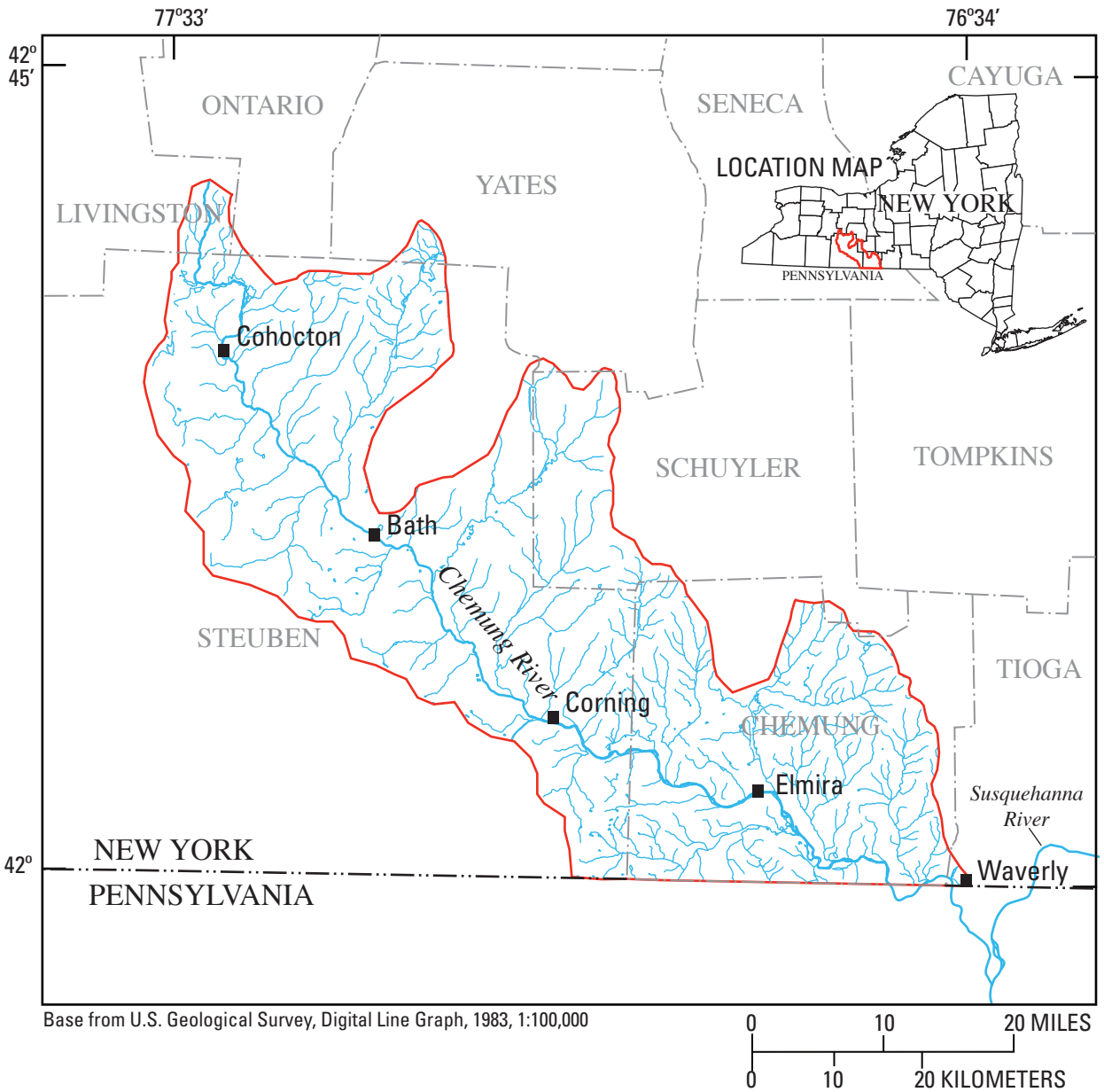

Figure 1. Principal geographic features of Chemung River basin, New York.

that are filled with Pleistocene glacial sediments (outwash, kames, lacustrine deposits, and till) and Recent deposits from the small tributaries that flow within these valleys (fig. 2). Surrounding the tributary valleys are bedrock uplands that generally consist of a thin layer of till on top of nearly flat-lying shale, siltstone, and fine-grained sandstone bedrock, and rise as high as 900 feet above the valley floor.

Objectives and Approach

In 2002, the USGS, in cooperation with the NYSDEC, began a program to evaluate ground-water quality throughout selected river basins in New York to fulfill the requirements of Section 305(b) of the Federal Clean Water Act Amendments of 1977 (U.S. Environmental Protection Agency, 1997). As part of this program, a ground-water-quality study was conducted in the Chemung River basin during the summer of 2003. The study addressed only the part of the basin that lies within New York (fig. 1). Ground-water was sampled throughout the basin from sand and gravel aquifers and bedrock aquifers for water-quality analysis to identify (1) areas with potential ground-water-contamination, (2) water-quality differences between the bedrock and the sand and gravel aquifers, and (3) water-quality differences between the main valley and the forested uplands. Sampling was done at public-supply wells and private residential wells. Analytical results from both types of wells were compared with USEPA and NYSDEC water-quality standards to depict a pattern of ground-water quality throughout the basin.

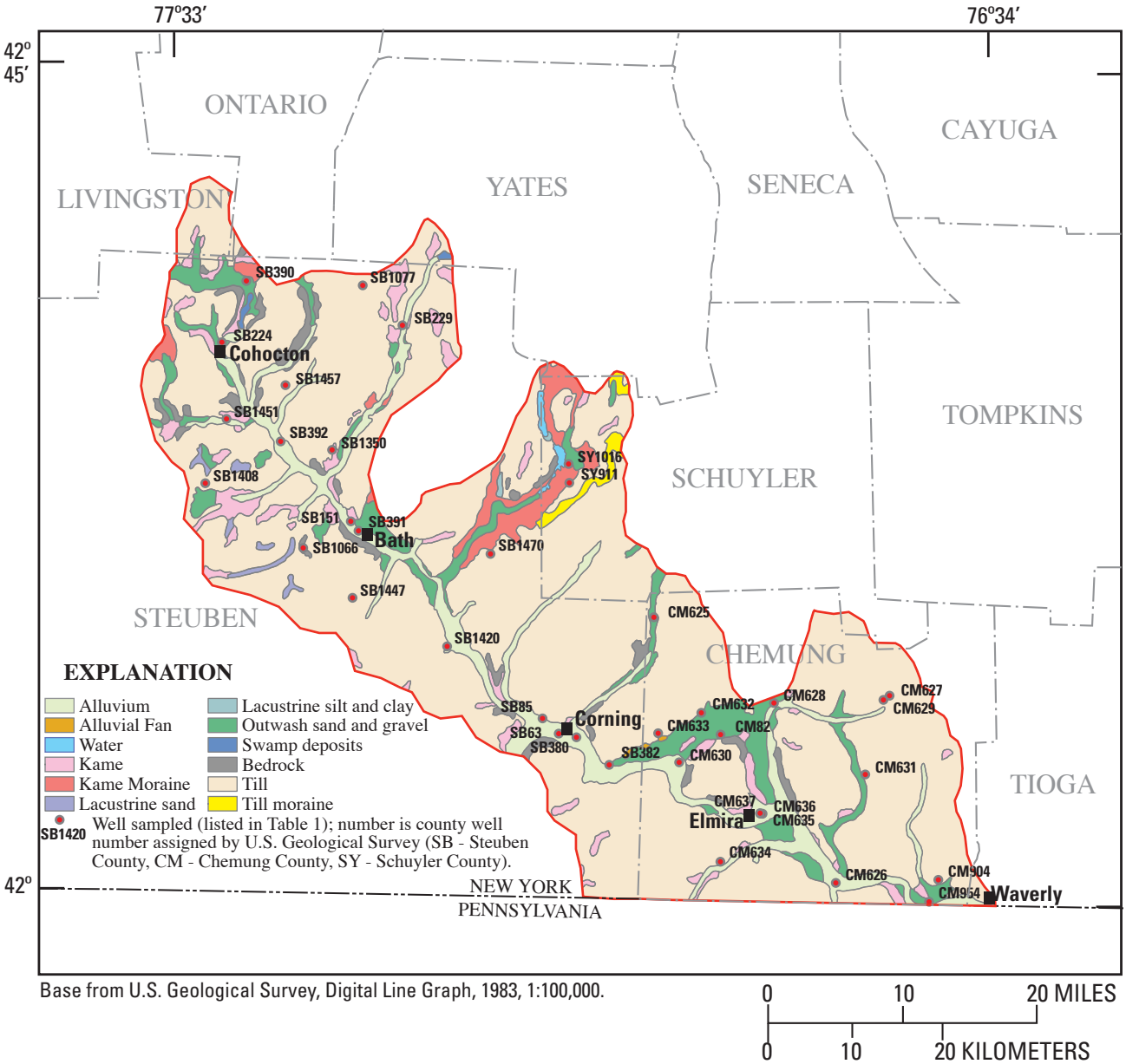

Figure 2. Surficial geology of Chemung River basin and locations of wells sampled in 2003 study (Cadwell, 1991). (Well data are given in table 1.)

This report presents the results of the water-quality analyses conducted on ground-water samples collected in 2003 from 37 wells in the Chemung River basin in New York. The samples were collected from 24 public-supply wells and 13 private residential wells. Samples were analyzed for physical properties, major inorganic constituents, nutrients, metals, radionuclides, pesticides, volatile organic compounds, and bacteria. Results of the analyses are presented in 8 tables at the end of this report. Analytical results for selected constituents are compared to the Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) established by the USEPA.

Methods

Water samples were collected from 37 wells throughout the Chemung River basin and analyzed for 209 constituents and physical parameters. This section describes the criteria used to select these 13 private residential wells and 24 public-supply wells, the sampling methods used in the field, and the analytical methods used. Any anomalous sampling procedures that were required are also described.

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 is useful in locating wells suitable for ground-water studies. Once a well was identified as a potential sampling site, a letter was sent to the owner of the well. 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 did return the questionnaire or who gave permission to sample their well during a phone call were contacted approximately one week before sampling to set up a date and time to sample their well.

Public-supply wells were identified in the GWSI database, and through contact with local officials (including the Cornell Cooperative Extension in Elmira, the Chemung and Steuben County Departments of Health, and the Chemung County Soil and Water Conservation District), and the water managers of villages and cities throughout the basin. The water managers were then sent letters containing a project description and questionnaire similar to that sent to residential-well owners. Phone calls were made to clarify any questions about the wells and to set up a date and time to sample the wells.

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 greatest vulnerability to contamination, and to obtain a thorough geographical distribution of the entire 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 Chemung River, in the tributary valleys, and in the uplands surrounding the valley; (3) wells in each of four land-use categories—predominantly agricultural, forested, urban, or mixed; and (4) public-supply and residential wells.

The land-use categories were used only to describe the wells and the area surrounding them within a half-mile radius, and can overlap. For example, a residential well finished in sand and gravel might be in either the main valley or in the uplands and may be surrounded by forest or agricultural land. Most wells finished in sand and gravel were in the valleys, however, and ranged from 30 to 110 feet deep, whereas most bedrock wells were in the uplands and ranged from 94 to 330 feet deep. Well data, land-use data, and water-quality data are given in table 1.

Shallow sand and gravel wells within the valleys are susceptible to contamination of various types including volatile organic compounds (VOCs), pesticides, deicing chemicals, and nutrients from nearby industries, highways, agriculture, and residential areas, and the movement of these contaminants to the water table is generally relatively rapid. The bedrock wells in the uplands are less susceptible to contamination from industrial and urban sources because the industries, roads, and residential areas are mainly in the valleys below, and because water generally takes longer to move from land surface into the bedrock through the surficial materials. The rural areas surrounding most upland wells are a potential source of contamination from agricultural chemicals, animal wastes, and septic systems, however, and these sources can make the upland wells more susceptible than valley-bottom wells to nutrients and pesticide contamination.

Well designation according to predominant land use within a half-mile radius of the well provides a general indication of the type of contamination that can be expected; for example, water from wells surrounded by predominantly agricultural land could have elevated concentrations of nutrients or pesticides, whereas water from wells surrounded by mixed land uses (industrial, commercial, parks, highways) might have elevated concentrations of VOCs or pesticides. Water from wells surrounded by predominantly forested, undeveloped land, in contrast, tends to be relatively uncontaminated.

The above method of assigning a land-use category to a well, although relatively easy, does not always accurately denote the land use that affects the water in the well. For example, a well completed in sand and gravel in the main valley of the Chemung River pumps water that could be affected by chemicals discharged several miles upstream. Also, a sample from a well finished in the valley aquifer might contain a mixture of relatively recent water and older water from deep within the aquifer that might have entered the system tens to hundreds of years ago. In addition, a chemical spill within a half-mile of a well might not be reflected in the water sample because it might not reach the well for many years or it could bypass the well entirely. Therefore, using land-use categories as well descriptors provides only a general indication of the potential for contamination, and it is not possible to conclude that specific land uses are affecting specific wells on the basis of a single water-quality analysis. Delineation of the actual flow paths and traveltimes of water at the wells sampled would require extensive sampling, which was beyond the scope of this study.

Sampling and Analytical Methods

Water samples analyzed for inorganic constituents (table 3), nutrients (table 4), metals and radionuclides (table 5) and VOCs (table 7) were collected from each well and processed by methods described in the USGS national field manual for the collection of water-quality data (U.S. Geological Survey, variously dated). In addition, pesticide samples (table 6) were collected and processed by the methods of Shelton (1994) and Sandstrom and others (2001) and

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), developed in cooperation with the USEPA, detects some of the most commonly used pesticides in the nation. Bacteria samples (table 8) were collected and processed in accordance with NYSDEC and New York State Department of Health (NYSDOH) regulations.

Quality-assurance samples were collected to assess the accuracy and reproducibility of the data. Blank and replicate samples were collected for at least 10 percent of the samples. Blank samples contained either inorganic-grade blank water or pesticide-grade blank water provided by the USGS Water-Quality Services Unit in Ocala, Fla.; the blank samples did not contain any constituents in concentrations above the detection limits of the analytical methods used. Concentrations in the replicate samples had no statistically significant differences.

Sampling entailed the following steps: the well pump was turned on (many of the public-supply wells were already running) and allowed to run as long as 20 minutes, or until at least five casing-volumes of well water had passed the sampling point. A spigot 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 sources and point sources of contamination that could affect the water from the well. The latitude and longitude of each well was documented with a global positioning system. Whenever possible, samples were collected from a spigot between the well and any pressure tanks or water treatment systems 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 milliliters (mL) per minute) for the sensors in the container 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. 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 sampling methods described in the USGS field manual (U.S. Geological Survey, variously dated).

Analyses for most physical parameters, most metals, radionuclides, and VOCs were conducted on unfiltered water samples (tables 1, 5, and 7) to determine the whole-water concentrations of these analytes, which best represent the natural concentrations within the aquifer. Concentrations of major inorganic constituents, most nutrients, pesticides, and 3 metals were determined from filtered samples (tables 3, 4, 5, and 6). Comparison of unfiltered concentrations to filtered concentrations are used to determine the difference between the total and dissolved concentrations of a constituent (for example, filtered and unfiltered iron concentrations in table 5). In addition, concentrations of some constituents can change if left in an unfiltered sample because of changes in temperature, pH, and degradation of the compounds through biologic processes; therefore, a filtered sample is required to determine the concentrations of these constituents in the natural aquifer (for example, pesticides can degrade into other pesticides when left in an unfiltered sample). Nitric acid was also added to some filtered and unfiltered samples to stop biologic degradation of the sample. When a filtered sample was required, a 0.45 micron capsule filter was attached to the Teflon discharge line inside the sample chamber bag; pesticide samples were filtered using a plate filter assembly.

All Teflon discharge lines were cleaned in the laboratory before each sampling day and in the field in between each sampling site. New chamber bags were used at each sampling site. Samples for radon analysis were obtained through a septum chamber with a disposable syringe in accordance with the procedures outlined in the USGS field manual (U.S. Geological Survey, variously dated). Samples for bacterial analysis were collected in sterile containers provided by a NYSDOH-approved laboratory.

All samples were stored on ice in coolers until the end of the sampling day, when each was sent to one of four laboratories: (1) the USGS National Water Quality Laboratory in Denver, Colo., to be analyzed for inorganic constituents (table 3), nutrients (table 4), metals (table 5), some pesticides (table 6), and VOCs (table 7); and (2) the Kansas Organic Geochemical Research Laboratory in Lawrence, Kans. for other pesticide analyses (table 6); (3) the USGS Isotope Laboratory in Menlo Park, Calif. for tritium analyses (table 5); or (4) a local NYSDOH-approved laboratory in Waverly, N.Y., for bacteriological analysis (table 8).

Most well sites allowed easy access to a spigot that was not preceded by treatment or pressure tanks; but five had unusual situations. (1) Wells CM 635, CM 636, and CM 637 (fig. 2) had no spigot-type sampling attachment that preceded the treatment systems, but rather had a metal tube at the top of the well from which a raw sample could be obtained. The Teflon sampling apparatus and chamber bags could not be used at these wells, but the well pump was allowed to run the appropriate length of time and the water was allowed to flush the metal tube for several minutes before the bottles were rinsed and filled. The disposable syringe was inserted into the tube to obtain the best available sample for radon analysis. (2) Well SB1077 (fig. 2) had a spigot, but the pump was not fitted with a flow regulator, and the water came out of the spigot at too high a rate for the Teflon apparatus to be attached. Therefore, the pump was allowed to run the

appropriate amount of time, and water was allowed to flush the spigot for several minutes before the bottles were rinsed and filled. The radon-sampling apparatus was attached to the spigot, however, and a sample was easily obtained. (3) At well CM 629, the well spigot was in a cellar below a mobile home in a cramped location. Most of the samples from this well were collected at the spigot, but the samples for pesticide and inorganic constituent analyses were collected from an outside spigot. (4) Wells SB 151 and SB 391 did not provide access to a raw, untreated sample because chlorination was done by injection inside the well casing. Samples were taken nevertheless, although some of the analytical results from this site do not represent a raw sample (for example, the bacteriological counts or chloride concentration in these samples are not representative of untreated water). (5) An additional sample was collected at wells SB1408 and SB1066 because the first sample indicated infiltration of surface runoff into the wells from recent heavy rains, which resulted in high turbidity and high bacteriological concentrations in the water; therefore, these wells were resampled about 2 weeks later to obtain a more representative sample. These 2 extra samples are included in the tables at the end of the report for comparison purposes.

Ground Water Quality

The 39 ground-water samples (two wells were sampled twice) collected during the summer of 2003 were analyzed for 209 constituents and physical properties; more than half (131) of the constituents were not detected in any samples (table 2); the concentrations of the 78 constituents that were detected are listed in tables 3 through 8. Concentrations of several constituents were above recommended Maximum Contaminant Levels (MCLs) or Secondary Maximum Contaminant Levels (SMCLs) of the U.S. Environmental Protection Agency (1996), the New York State Department of Environmental Conservation (1998), and the New York State Department of Health (1998).

Physical Properties

Field pH of all but one of the samples was within the accepted SMCL range (U.S. Environmental Protection Agency, 1996) of 6.5 to 8.5 (table 1); the exception exceeded this range in the field measurement but was less than 8.5 when tested at the laboratory. Specific conductance of the samples (table 1) ranged from 204 to 1,450 microsiemens per centimeter (µS/cm) in the field and from 211 to 1,420 µS/cm at the laboratory. Water temperature (table 1) ranged from 8.6 to 16.1°C. The color of seven samples exceeded the SMCL of 15 (table 1).

Inorganic Constituents

The cations that were detected in the highest concentrations were calcium and sodium; calcium values ranged from 8.6 to 105 milligrams per liter (mg/L); sodium values ranged from 4.1 to 173 mg/L (table 3), and 11 samples exceeded the USEPA Drinking Water Advisory for sodium. This Advisory recommends sodium concentrations in drinking water do not exceed 30 to 60 mg/L on the basis of 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, chloride, and sulfate; bicarbonate values ranged from 107 to 389 mg/L, chloride values ranged from 1.5 to 335 mg/L, and sulfate values ranged from 0.4 to 63.4 mg/L (table 3). Bicarbonate values were calculated from the filtered acid-neutralizing capacity (alkalinity) concentrations, which are given in mg/L $CaCO_3$, and are related to the “hardness” of the water. The chloride SMCL of 250 mg/L was exceeded in two samples, and the sulfate SMCL of 250 mg/L was not exceeded in any samples.

Nutrients

The predominant nutrient was nitrate (table 4). Nitrate concentrations ranged from 0.06 to 7.45 mg/L as N, and the nitrate MCL of 10 mg/L as N was not exceeded in any samples. Samples from wells finished in sand and gravel had higher nitrate concentrations than those from wells finished in bedrock, except in the one bedrock well that had the highest nitrate concentration of any sample in this study. This well and the house it served were recently constructed, had an on-site septic system, and previous land use had been agricultural, with heavy use of manure as fertilizer.

Metals and Radionuclides

The most commonly detected metals and radionuclides were aluminum, barium, boron, iron, manganese, strontium, radon-222, and uranium (table 5). Aluminum was detected in 34 samples and concentrations ranged from 1 to 8,090 micrograms per liter (µg/L). The upper limit of the SMCL range for aluminum (200 µg/L) was exceeded in one sample, SB1066 (table 5). Barium was detected in all 39 samples, and concentrations ranged from 37 to 7,970 µg/L. The MCL for barium (2,000 µg/L) was exceeded in one sample, SB1447, which was finished in bedrock (table 5). Iron was detected in 36 samples, and concentrations ranged from 20 to 5,980 µg/L; the SMCL for iron (300 µg/L) was exceeded in 11 samples. Manganese was detected in 37 samples, and concentrations ranged from 1 to 681 µg/L; the SMCL for manganese (50 µg/L) was exceeded in 20 samples. Uranium was detected in

every sample; concentrations ranged from 0.007 to 1.17 µg/L, but none exceeded the MCL of 30 µg/L (table 5).

Radon also was detected in every sample, and concentrations ranged from 100 to 2,580 picocuries per liter (pCi/L). The proposed MCL of 300 pCi/L for radon was exceeded in 34 samples, but the proposed ACML (Alternate Maximum Contaminant Level) of 4,000 pCi/L was not exceeded in any sample (table 5). The AMCL is the proposed allowable concentration of radon in a raw-water sample for a drinking-water system that has developed enhanced programs to address the health risks of radon in indoor air; none of the public-supply or private wells sampled had enhanced systems. The proposed MCL and AMCL for radon are still in the review process and have not been promulgated (U.S. Environmental Protection Agency, 2004).

Tritium is a hydrogen isotope that can indicate the general age of ground water. Tritium entered ground water during periods of atmospheric testing of nuclear devices that began in 1952 and peaked during the early 1960s (Clark and Fritz, 1997). Since then, tritium concentrations in precipitation and in ground water have been monitored, and the relative age of the ground water (time since it entered the ground water and stopped having contact with the atmosphere) can be estimated through a comparison of the of tritium concentration in a water sample with the recorded historical concentration in precipitation. The estimated age of a ground-water sample can reflect mixing of old and young water within an aquifer; however, the three ground-water samples with tritium values between 0 and 1 tritium units (TU) probably infiltrated into the aquifer before 1952 (table 5); samples with values between 1 and 4 TU are probably a mixture of recent (1952-2003) water with old (pre-1952); and samples with values between 5 and 15 TU probably entered the aquifer after 1995. None of the samples had values above 13 TU, but a value between 15 and 30 TU would probably indicate water that infiltrated during the 1950s and 1960s, a value above 30 TU would indicate a large component of recharge from the 1960s and 1970s.

Pesticides

Samples for pesticide analysis were not collected at every site during this study because of limited funding. Previous studies have indicated a correlation between land use and well depth and concentrations of pesticides (Eckhardt and Stackelberg, 1995; Phillips and others, 1999; Eckhardt and others, 2001); therefore, most samples for pesticide analysis were collected at wells in areas dominated by agricultural or mixed land use (parks, highways, residential developments) and from relatively shallow wells finished in sand and gravel (table 6). Three samples were collected from bedrock wells, none of which was found to contain a pesticide.

All but one of the pesticides detected in this study (table 6) are herbicides that are used to control broadleaf weeds and undesirable grasses in agricultural fields, lawns, and other areas that require control of vegetation. Metalaxyl, a fungicide used to control fungus growth in vineyards and orchards, was detected only in two samples, and the concentrations were near the analytical detection limit. The herbicides detected most frequently were atrazine, deethylatrazine, and two degradation products of metolachlor, and these were only detected in wells finished in sand and gravel. Atrazine was detected in 11 samples; the concentrations ranged from 0.007 to 0.049 µg/L and did not exceed the MCL (3 µg/L) (U.S. Environmental Protection Agency, 1996). A degradation product of atrazine—deethylatrazine (2-chloro-4-isopropylamino-6-amino-s-triazine)—was detected in 10 samples (each of which also contained atrazine); concentrations ranged from 0.006 to 0.029 µg/L. Two degradation products of metolachlor (metolachlor ESA and metolachlor OA) were detected in 13 and 6 samples, respectively, and concentrations ranged from 0.05 to 1.49 µg/L for metolachlor ESA and from 0.05 to 1.5 µg/L for metolachlor OA. No Federal MCLs currently have been established for deethylatrazine, metolachlor ESA, metolachlor OA; none of these pesticides concentrations exceeded the New York State MCLs, however (New York State Department of Environmental Conservation, 1998).

Volatile Organic Compounds

Volatile organic compounds (VOCs) were detected infrequently and at extremely low concentrations (table 7). Of the 11 VOCs detected during this study, 10 were detected in fewer than 4 samples each, and none of the concentrations exceeded MCLs. Trichloromethane was detected in 8 samples. Methyl *tert*-butyl ether (MTBE), a gasoline additive that can infiltrate into ground water from leaking gasoline-storage tanks, was detected in 2 samples at concentrations at or near the analytical detection limit. No MCL has been established for MTBE; however, 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 and fecal coliform (table 8). If a sample contained fecal coliform, it was also analyzed for *Escherichia coli* (*E. coli*). Total coliform were detected in 12 samples, fecal coliform in 7 samples, and E. coli in 6 samples. These samples were from wells finished in sand and gravel and bedrock. Most of the public-supply wells have chlorination systems that kill bacteria before the water is distributed to consumers; therefore, bacteria in the raw-water samples collected from the public-supply systems is not cause for concern. The samples from private residential wells had some of the highest concentrations of bacteria detected during this study, however; the owners of these wells were notified within 48 hours after sampling, and a full list of all the constituents for which the sample was analyzed was sent to each well owner upon completion of the project (2003).

Summary

Water samples collected from 37 private and public-supply wells during summer 2003 were analyzed to describe the chemical quality and physical properties of ground water throughout the Chemung River basin in New York. Samples were analyzed for physical properties, inorganic constituents, nutrients, metals, radionuclides, VOCs, pesticides, and bacteria. Of the 78 constituents that were detected, several exceeded Federal MCLs, SMCLs, and AMCLs.

The cations that were detected in the highest concentrations were calcium and sodium; the anions that were detected in the highest concentrations were bicarbonate, chloride, and sulfate. The predominant nutrient was nitrate. Two samples exceeded the chloride SMCL; 11 samples exceeded the sodium Drinking Water Advisory; none of the samples exceeded the MCL for nitrate.

The most commonly detected metals were aluminum, barium, iron, manganese, and strontium. The SMCL for aluminum was exceeded in one sample. The MCL for barium was exceeded in one sample; the SMCL for iron was exceeded in 11 samples; the SMCL for manganese was exceeded in 20 samples. Uranium was detected in every sample; no detections exceeded the MCL. Radon also was detected in every sample; the proposed MCL for radon was exceeded in 34 samples, but the proposed AMCL was not exceeded in any sample. The range of tritium values (0.6 to 12.5 TU) indicates that the water ranged from less than 10 years old to more than 50 years old.

All but one of the pesticides detected were herbicides; those detected most frequently were atrazine (detected in 11 samples), deethylatrazine (detected in 10 samples), metolachlor ESA (detected in 13 samples) and metolachlor OA (detected in 6 samples). Metolachlor ESA and OA were the pesticides detected at the highest concentrations. No Federal MCLs currently exist for deethylatrazine, metolachlor ESA, or metolachlor OA; the concentrations of these compounds did not exceed the New York State MCLs. Atrazine detections did not exceed Federal or New York State MCLs. Not every sample collected was analyzed for pesticides, and pesticides were detected only in wells finished in sand and gravel.

VOCs were detected in 15 samples, the concentrations were at or near the detection limits, and no sample exceeded an MCL. Bacteria were detected in water from bedrock as well as sand and gravel aquifers. Total coliform were detected in 12 samples; fecal coliform were detected in 7 samples; E. coli was detected in 6 samples.

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Table 1. Well information and physical properties of ground-water samples from selected wells in the Chemung River basin, New York, 2003.

[mi, mile; mg/L, milligrams per liter; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25° C; 00080, National Water Information System (NWIS) Parameter Code. Locations are shown shown in fig. 1.]

Well data								Water data						
Well number [1]	Date Sampled (all in 2003)	Type: P, public supply R, private residential	Location: U, uplands; V , main valley of Chemung River or trib. valley	Aquifer: SG, sand and gravel; B, bedrock	Depth (feet below land surface)	Casing Length (feet below land surface)	Dominant land use within 0.5-mi radius of well: f, forested; u, urban; a, agricultural or mixed	Water color, filtered (platinum cobalt units) 00080	Dissolved-oxygen concentration, unfiltered (mg/L) 00300	pH, field, unfiltered (standard units) 00400	pH, laboratory, unfiltered (standard units) 00403	Specific conductance, unfiltered, field (µS/cm) 00095	Specific conductance, unfiltered, laboratory (µS/cm) 90095	Tempe ature, field (°C) 00010
CM 82	07-30	P	V	SG	55	45	fu	5	8.2	8.0	7.7	1450	1420	11.0
CM 625	08-13	P	V	SG	55	45	fau	5	2.7	8.0	7.8	440	449	11.3
CM 626	07-02	P	V	SG	109.5	90	fau	2	3.0	8.2	7.5	1010	965	11.2
CM 627	08-06	P	U	SG	56	47	fa	88	2.4	7.6	7.5	601	578	9.4
CM 628	07-22	P	V	SG	72	62	fau	2	6.0	8.0	8.0	393	372	14.4
CM 629	07-23	P	U	B	94	30	fa	12	0.4	8.0	7.6	1100	1060	10.9
CM 630	07-30	P	V	SG	38.1	28	a	<1	7.9	7.6	7.5	816	782	11.2
CM 631	07-10	P	U	B	112	51	f	2	2.4	8.4	8.0	650	659	10.6
CM 632	07-30	P	V	SG	51	20	fau	2	6.4	8.0	7.9	351	339	10.7
CM 633	08-06	R	U	B	289	20	f	8	4.3	8.3	8.2	410	400	12.6
CM 634	07-31	P	V	SG	75	69	fau	2	5.8	7.9	8.0	453	446	11.7
CM 635	08-12	P	V	SG	47.3	30	u	2	5.4	7.8	7.5	419	413	16.1
CM 636	08-12	P	V	SG	53.7	37	u	5	5.3	7.5	7.4	530	524	15.3
CM 637	08-12	P	V	SG	75	55	u	<1	6.4	7.8	7.5	750	748	12.0
CM 904	07-02	R	U	B	220	85.5	fa	18	0.2	7.9	7.5	690	621	11.5
CM 954	07-08	P	V	B	333	76	fau	5	6.7	8.2	8.0	460	424	11.3
SB 63	06-25	P	V	SG	64	42	fu	<1	5.5	7.4	7.2	898	872	12.0
SB 85	07-01	P	V	SG	61	49	fu	5	4.1	8.1	7.8	709	688	11.8
SB 151	08-20	P	V	SG	65	55	fu	12	4.4	7.5	7.2	1080	1100	11.0
SB 224	07-24	P	V	SG	73	65	fau	2	6.1	8.1	7.9	850	792	10.6
SB 229	07-09	P	V	SG	96	86	fa	25	0.4	8.1	7.7	608	571	9.8
SB 380	06-25	P	V	SG	60	56	u	2	6.6	7.5	7.2	586	566	11.0
SB 382	07-01	P	V	SG	75	67	fu	2	2.6	8.3	8.0	705	680	10.1
SB 390	07-24	P	V	SG	63	53	fa	2	5.7	7.3	7.7	740	698	10.0
SB 391	08-20	P	V	SG	98	83	fu	5	3.2	8.0	7.4	540	543	9.9
SB 392	09-03	P	V	SG	52	42	fau	5	7.5	8.4	7.4	719	710	9.9
SB1066	07-23	R	U	B	181	90	f	200	7.2	7.3	7.6	204	211	13.6
SB1066	08-19	R	U	B	181	90	f	10	4.1	7.4	6.9	240	242	12.1
SB1077	07-09	R	U	B	105	37	f	2	8.3	7.8	7.7	260	286	8.6
SB1350	07-17	R	U	B	140	47.5	f	20	0.2	8.1	7.6	520	490	9.9
SB1408	07-23	R	U	SG	40	40	a	5	5.1	8.0	7.5	1280	1250	9.8
SB1408	08-14	R	U	SG	40	40	a	8	3.4	7.8	7.6	1130	1120	11.4
SB1420	07-08	R	U	B	160	60.3	f	35	4.5	7.8	7.5	650	561	11.0
SB1447	07-10	R	U	B	160	80.3	a	8	0.2	7.6	7.4	590	577	10.4
SB1451	07-16	R	U	SG	30	30	f	2	1.0	8.0	7.7	385	357	9.4
SB1457	07-16	R	U	B	120	88	fa	5	3.2	7.9	7.7	277	275	11.0
SB1470	06-26	R	U	B	278	18	fa	<1	5.4	8.4	7.5	374	371	11.2
SY 911	09-04	R	U	B	125	20	fa	5	1.4	8.3	8.0	969	884	12.8
SY1016	06-26	R	V	SG	33.5	33.5	fa	25	0.4	9.0	7.6	575	559	10.1

[1] SB, Steuben County; CM, Chemung County; SY, Schuyler County; number is local well-identification number assigned by U.S. Geological Survey.

Table 2. Constituents for which ground-water samples from the Chemung River basin, New York, were analyzed for but not detected, 2003.

Elements
Antimony 01097
Silver 01077
Thallium 01059
Organic Compounds
Acetochlor 49260
Acetochlor OA 61030
Acetochlor SAA 62847
Acifluorfen 49315
Alachlor 46342
Alachlor SAA 62848
Aldicarb 49312
Aldicarb sulfone 49313
Aldicarb sulfoxide 49314
alpha-HCH 34253
Azinphos-methyl 82686
Bendiocarb 50299
Benfluralin 82673
Benomyl 50300
Bensulfuron 61693
Bentazon 38711
Benzene 34030
Bromacil 04029
Bromoxynil 49311
Butylate 04028
Caffeine 50305
Carbaryl 49310
Carbofuran 82674
Chloramben methyl ester 61188
Chlorimuron 50306
Chlorobenzene 34301
Chlorothalonil 49306
Chlorpyrifos 38933
cis-Permethrin 82687
Clopyralid 49305
Cynazine 04041
Cycloate 04031
2,4-D 39732
2,4-DB 38746
2,4-D methyl ester 50470
Dacthal monoacid 49304
DCPA 82682
Desulfinyl fipronil 62170
Desulfinyl fipronil amide 62169
Diazinon 39572
Dicamba 38442
1,2-Dichlorobenzene 34536
1,3-Dichlorobenzene 34566
1,4-Dichlorobenzene 34571
Dichlorodifluoromethane 34668
1,2-Dichloroethane 32103
1,1-Dichloroethene 34501
Dichloromethane 34423
Dichloroprop 49302
1,2-Dichloropropane 34541
Dieldrin 39381
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 49297
Fipronil 62166
Fipronil sulfide 62167
Fipronil sulfone 62168
Flufenacet ESA 61952
Flufenacet OXA 62483
Flumetsulam 61694
Fluometuron 38811
Fonofos 04095
3-Hydroxycarbofuran 49308
Imazaquin 50356
Imidacloprid 61695
3-Ketocarbofuran 50295
Lindane 39341
Linuron 38478
Malathion 39532
MCPA 38482
MCPB 38487
Methiocarb 38501
Methomyl 49296
Methyl parathion 82667
Methyl *tert*-pentyl ether 50005
Metsulfuron 61697
Molinate 82671
m-Xylene 85795
N-(4-Chlorophenyl-N'-methylurea) 61692
Napropamide 82684
Neburon 49294
Nicosulfuron 50364
Norflurazon 49293
Oryzalin 49292
Oxamyl 38866
p,p'-DDE 34653
Parathion 39542
Pebulate 82669
Pendimethalin 82683
Phenolic compounds 32730
Phorate 82664
Picloram 49291
Pronamide 82676
Propachlor 04024
Propachlor ESA 62766
Propachlor OXA 62767
Propanil 82679
Propargite 82685
Propham 49236
Propiconazole 50471
Propoxur 38538
Siduron 38548
Simazine 04035
Sulfometuron 50337
Syrene 77128
Tebuthiuron 82670
Terbacil 82665
Terbufos 82675
tert-Butyl ethyl ether 50004
Tetrachloromethane 32102
Thiobencarb 82681
trans-1,2-Dichloroethene 34546
Triallate 82678
Trichlorofluoromethane 34488
1,1,2-Trichloro-1,2,2-trifluoromethane 77652
Triclopyr 49235
Trifuralin 82661
Vinyl chloride 39175

Table 3. Concentrations of major inorganic constitutents in ground-water samples from the Chemung River basin, New York, 2003.

[mg/L as $CaCO_3$, milligrams per liter as calcium carbonate; °C, degrees Celsius. Locations are shown in fig. 1.]

Well no.[1]	Acid-neutralizing capacity fixed-endpoint (pH 4.5) titration (mg/L as CaCO3)		Bicarbonate[2] (mg/L as HCO_3)	Concentrations in filtered samples, in milligrams per liter								Residue on evaporation, dried at 180 °C (mg/L)
	Unfiltered 90410	Filtered 29801		Calcium 00915	Magnesium 00925	Potassium 00935	Sodium 00930	Chloride 00940	Fluoride 00950	Silica 00955	Sulfate 00945	70300
CM 82	167	174	212	102	20.9	1.7	169	335	<.2	7.98	20	812
CM 625	157	157	192	56.1	11.7	1.02	20.4	47.8	<.2	8.67	8.7	271
CM 626	171	171	209	64.7	13	1.94	119	201	<.2	11.4	13.6	562
CM 627	103	102	124	46.8	9.75	0.71	54.1	118	<.2	9.81	11	357
CM 628	119	119	145	43	8.41	1.64	21.2	41.7	<.2	5.54	15	224
CM 629	170	170	207	80.1	19.8	0.86	110	235	<.2	12.3	13	642
CM 630	214	192	234	96.3	19	3.26	47.4	103	<.2	10.2	27.9	466
CM 631	151	152	185	19.2	3.94	0.88	123	117	0.3	9.95	10.1	379
CM 632	115	115	140	48	10.3	1.1	9.14	19.2	<.2	8.86	32.8	212
CM 633	198	197	240	16.2	3.36	0.58	76.9	4.4	0.2	10.6	20.7	258
CM 634	117	117	143	51.9	9.65	2.31	28.1	57.3	<.2	6.8	22.4	252
CM 635	126	126	154	50.3	10.5	2.34	25.3	44.5	<.2	6.67	19.8	241
CM 636	152	153	187	64.3	12.7	2.48	31.8	62.9	<.2	7.83	24.1	299
CM 637	182	181	221	83.8	17.1	2.11	53.3	111	<.2	9.37	30.6	426
CM 904	293	294	359	66.7	18	1.03	51.5	15.6	<.2	16	38.8	386
CM 954	154	153	187	69.8	14	1.21	7.49	26.4	<.2	15.1	46.2	272
SB 63	251	250	305	93.9	22.1	3.19	53.3	121	<.2	10.6	30.2	498
SB 85	228	228	278	83.8	18.9	1.92	31.2	70.9	<.2	12.3	35.5	431
SB 151	234	246	300	105	25.8	2.16	80.9	183	1.8	11	45.6	615
SB 224	232	238	290	71.8	18.2	4.53	72.2	98	<.2	9.44	29.7	474
SB 229	190	190	232	68.2	17.7	1.26	32.8	62	<.2	14.6	27.8	341
SB 380	153	153	187	61.1	13.8	2.33	38.7	76.6	<.2	6.66	24.4	318
SB 382	173	173	211	72.8	13.8	2.22	43.8	102	<.2	7.28	21.4	429
SB 390	193	254	310	103	24	1.62	18.3	37.6	<.2	10.7	63.4	445
SB 391	175	178	217	67.4	15.8	1.84	23.9	55.1	<.2	7.55	26	322
SB 392	183	186	227	81.7	21	1.39	25.2	74.7	<.2	9.55	52.1	413
SB1066	89	88	107	32.8	5.55	0.92	4.12	3.66	<.2	7.96	15.8	129
SB1066	110	110	134	36.3	6.3	0.96	3.94	2.37	<.2	8.49	15.6	144
SB1077	135	132	161	42.5	11	1.11	4.68	1.46	<.2	11.4	20.5	158
SB1350	231	231	282	44.9	10.3	1.16	48	6.45	0.2	9.93	45.2	309
SB1408	211	211	257	97.2	19.6	7.28	133	255	<.2	7.48	29.9	714
SB1408	215	215	262	89.6	18.8	7.18	118	223	<.2	7.69	32	670
SB1420	188	189	231	37.8	9.26	1.52	80.7	86.1	0.3	11	0.4	339
SB1447	319	319	389	83.9	12.3	2.05	37.2	10	<.2	16.3	2.4	353
SB1451	135	135	165	50.1	9.41	1.38	14.9	32.2	<.2	6.3	12.2	204
SB1457	136	125	153	34.4	7.03	0.98	20	9.67	<.2	10.1	7.5	153
SB1470	121	120	146	50.3	11.4	1.48	6.98	10.1	<.2	13.3	24.1	217
SY 911	305	307	375	8.58	1.78	0.75	173	115	1.3	7.07	2	529
SY1016	235	245	299	81.1	22.4	0.95	7.19	24.3	<.2	14.5	28.7	327

[1] SB, Steuben County; CM, Chemung County; SY, Schuyler County. Number is local well-identification number assigned by U.S. Geological Survey.

[2] Calculated from filtered acid-neutralizing capacity concentrations.

Table 4. Concentrations of nutrients in ground-water samples from the Chemung River basin, New York, 2003.
[mg/L, milligrams per liter; N, nitrogen; P, phosphorus. Locations are shown in fig. 1.]

Station name [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) 00631-00613	Orthophosphate, filtered (mg/L as N) 00671	Organic carbon, unfiltered (mg/L as N) 00680
CM 82	<.10	<.04	1.12	<.008	1.12	<.02	1.5
CM 625	<.10	[E].02	0.06	<.008	0.06	<.18	1.3
CM 626	0.16	0.17	<.06	<.008	<.06	<.02	1.2
CM 627	<.10	<.04	<.06	<.008	<.06	<.02	1.1
CM 628	[E].07	<.04	0.23	<.008	0.23	<.02	1.4
CM 629	0.27	0.23	<.06	<.008	<.06	0.04	0.8
CM 630	[E].05	<.04	5.99	<.008	5.99	<.02	1.5
CM 631	0.28	0.24	<.06	<.008	<.06	0.02	0.6
CM 632	<.10	<.04	1.03	<.008	1.03	<.02	1.8
CM 633	<.10	<.04	0.22	<.008	0.22	0.02	3.1
CM 634	<.10	<.04	0.92	<.008	0.92	<.02	1.7
CM 635	0.14	<.04	0.64	<.008	0.64	0.02	2.4
CM 636	0.2	0.09	0.96	<.008	0.96	<.02	2.3
CM 637	[E].08	<.04	2.69	<.008	2.69	<.02	2.7
CM 904	0.2	0.22	<.06	<.008	<.06	<.02	2.6
CM 954	[E].05	0.04	<.06	<.008	<.06	<.02	0.7
SB 63	<.10	<.04	1.81	<.008	1.81	<.02	1.1
SB 85	[E].07	<.04	<.06	<.008	<.06	<.02	1.3
SB 151	<.10	<.04	0.54	<.008	0.54	<.02	2.6
SB 224	[E].06	<.04	5.21	<.008	5.21	<.02	1.4
SB 229	0.14	0.08	<.06	<.008	<.06	<.02	1.2
SB 380	<.10	<.04	0.99	<.008	0.99	<.02	1.1
SB 382	[E].07	<.04	1.63	<.008	1.63	<.02	2
SB 390	[E].05	<.04	3.95	<.008	3.95	<.02	1
SB 391	<.10	<.04	1.14	<.008	1.14	<.02	5.9
SB 392	[E].06	<.04	0.58	0.013	0.567	<.02	1.4
SB1066	0.11	<.04	0.26	<.008	0.26	<.02	2.9
SB1066	<.10	<.04	0.15	<.008	0.15	<.02	1.1
SB1077	<.10	<.04	[E].03	<.008	[E].03	<.02	1
SB1350	<.10	0.08	<.06	<.008	<.06	<.02	1
SB1408	0.2	<.04	3.05	<.008	3.05	[E].01	2.4
SB1408	0.13	<.04	1.98	0.009	1.971	<.18	1.9
SB1420	0.35	0.33	<.06	<.008	<.06	0.05	1.1
SB1447	0.22	0.2	<.06	<.008	<.06	<.02	1.4
SB1451	<.10	<.04	0.63	<.008	0.63	<.02	2.7
SB1457	<.10	<.04	<.06	<.008	<.06	<.02	1.2
SB1470	0.1	<.04	7.45	<.008	7.45	<.02	1.2
SY 911	0.42	0.33	<.06	<.008	<.06	0.03	1.4
SY1016	<.10	<.04	<.06	<.008	<.06	<.02	9.3

[1] SB, Steuben County; CM, Chemung County; SY, Schuyler County. Number is local well-identification number assigned by U.S. Geological Survey.
[E] estimated value; constituent was detected in the sample below the laboratory reporting level.

Table 5. Concentrations of metals and radionuclides in ground-water samples from the Chemung River basin, New York, 2003.

[All values are in micrograms per liter except as noted. Locations are shown in fig. 1.]

Well no. [1]	Aluminum, unfiltered, recoverable 01105	Barium, unfiltered, recoverable 01007	Beryllium, unfiltered, recoverable 01012	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
SB 63	<2	278	<.06	100	<.04	<.8	m	2.1	<8	<6	m	4.6
CM 82	16	220	<.06	50	<.04	[E].6	m	1.6	<8	30	m	5.5
CM 625	[E]2	280	<.06	40	<.04	<.8	m	[E].4	317	290	m	6.8
CM 626	3	155	<.06	80	<.04	<.8	m	1.3	11	20	m	8.6
CM 627	23	900	<.06	40	<.04	<.8	m	2.5	26	1020	8	9
CM 628	4	129	<.06	20	<.04	<.8	m	1.3	<8	<6	m	1.2
CM 629	[E]1	446	<.06	210	<.04	<.8	m	1.5	316	330	m	34.3
CM 630	<2	169	<.06	50	<.04	<.8	m	0.6	<8	<6	<.06	4.4
CM 631	116	197	<.06	190	<.04	<.8	m	[E].4	<8	320	m	45.9
CM 632	[E]2	121	<.06	10	<.04	<.8	m	<.6	<8	m	<.06	4.5
CM 633	83	108	<.06	240	<.04	<.8	m	3.8	<8	140	m	32.1
CM 634	5	67	<.06	30	<.04	<.8	m	32.3	31	70	m	2.1
CM 635	3	93	<.06	50	<.04	<.8	m	13	<8	m	m	3.1
CM 636	3	134	<.06	50	<.04	<.8	m	5.4	[E]5	m	m	3.1
CM 637	[E]2	156	<.06	60	<.04	<.8	m	3.3	<8	m	m	6.8
CM 904	64	93	<.06	110	<.04	1.1	m	1	527	670	m	77.9
CM 954	[E]1	122	<.06	20	<.04	<.8	m	0.6	197	260	m	7.6
SB 85	9	426	<.06	80	<.04	<.8	m	1.1	16	30	m	7
SB 151	[E]2	215	<.06	20	<.04	<.8	m	4.5	20	30	<.06	10.1
SB 224	<2	165	<.06	30	<.04	<.8	m	3.6	<8	<6	<.06	5
SB 229	[E]1	247	<.06	40	[E].02	<.8	m	[E].5	588	530	m	11.2
SB 380	[E]2	100	<.06	290	<.04	<.8	m	2.1	<8	<6	m	3.4
SB 382	<2	147	<.06	460	<.04	<.8	m	3.3	<8	m	m	3.3
SB 390	<2	112	<.06	10	<.04	<.8	m	1.1	<8	m	m	9.6
SB 391	[E]1	151	<.06	20	<.04	<.8	m	1.7	<8	m	<.06	3.1
SB 392	[E]1	149	<.06	20	<.04	<.8	m	2.1	<8	30	m	5.1
SB1066	8090	212	0.22	20	[E].03	3.7	2	64.3	<8	5980	3	10.8
SB1066	72	169	<.06	20	<.04	<.8	m	38.1	<8	270	m	5.7
SB1077	134	81	<.06	20	<.04	<.8	m	0.9	<8	320	m	9.9
SB1350	22	110	<.06	160	<.04	[E].5	m	1.3	803	1220	m	21.7
SB1408	8	320	<.06	40	<.04	<.8	m	2.5	20	80	<.06	4.4
SB1408	4	296	<.06	40	<.04	<.8	m	2.5	13	190	m	5.2
SB1420	22	406	<.06	140	<.04	<.8	m	[E].6	1510	1530	3	25.7
SB1447	4	7970	<.06	140	<.04	<.8	m	1.4	339	320	m	26.7
SB1451	33	37	<.06	10	<.04	<.8	m	4.8	<8	100	m	2
SB1457	4	128	<.06	80	<.04	<.8	m	<.6	[E]7	50	m	8.7
SB1470	4	77	<.06	30	<.04	<.8	m	18.6	<8	m	m	11.5
SY 911	79	233	<.06	430	<.04	<.8	m	<.6	[E]6	150	m	93.9
SY1016	6	551	<.06	20	<.04	<.8	m	0.9	953	940	m	8.8

[1] SB, Steuben County; CM, Chemung County; SY, Schuyler County. Number is local well-identification number assigned by U.S. Geological Survey.

[E] estimated value; constituent was detected in the sample below the laboratory reporting level.

m constituent was detected in the sample but was not quantified.

Table 5. Concentrations of metals and radionuclides in ground-water samples from the Chemung River basin, New York, 2003 (continued).

Well no.[1]	Manganese, filtered 01056	Manganese, unfiltered, recoverable 01055	Mercury, unfiltered, recoverable 71900	Molybdenum unfiltered, recoverable 01062	Nickel, unfiltered, recoverable 01067	Selenium, unfiltered, recoverable 01147	Strontium, unfiltered, recoverable 01082	Radon-222, unfiltered, picocuries per liter 82303	Tritium, unfiltered (tritium units) 07000	Uranium (natural), unfiltered 28011	Zinc, unfiltered, recoverable 01092
SB 63	4.9	5	<.02	<.2	3	[E]0.3	145	630	9.5	0.284	3
CM 82	0.6	1	<.02	[E].1	2	<.5	142	950	10.7	0.281	3
CM 625	278	253	<.02	0.8	2	[E].4	182	570	9.4	0.301	3
CM 626	439	414	<.02	0.9	2	0.8	497	540	4.1	0.606	3
CM 627	293	504	<.02	0.2	2	1	533	390	8.8	[E].010	19
CM 628	<.4	<.22	<.02	[E].1	1	<.5	95	570	11.3	0.138	6
CM 629	383	388	<.02	0.3	2	0.8	1400	810	0.6	0.156	<2
CM 630	[E].4	m	<.02	<.2	2	[E].4	123	760	12.2	0.202	[E]1
CM 631	86.8	86	<.02	0.6	m	<.5	308	160	5.3	0.087	2
CM 632	<.4	M	<.02	[E].1	m	[E].3	87.9	580	10.0	0.205	<2
CM 633	0.8	20	<.02	0.2	m	[E].3	218	300	2.5	0.036	[E]2
CM 634	1.4	2	<.02	<.2	1	<.5	71.1	670	10.3	0.088	<2
CM 635	91.1	78.9	<.02	0.5	2	0.6	70.4	840	11.6	0.098	9
CM 636	801	681	<.02	0.7	5	0.8	88.3	740	11.0	0.146	7
CM 637	3.4	3	<.02	[E].2	3	0.9	98	750	10.0	0.22	18
CM 904	215	157	<.02	[E].1	2	<.5	674	450	m	0.03	17
CM 954	271	261	<.02	0.3	1	<.5	266	100	8.8	0.097	80
SB 85	328	317	<.02	0.3	2	<.5	175	1700	9.7	1.17	<2
SB 151	24.2	24	<.02	0.4	3	<.5	175	760	11.6	0.955	<2
SB 224	[E].4	<.22	<.02	0.3	2	<.5	95.4	760	11.3	0.29	5
SB 229	233	225	<.02	4.7	1	<.5	279	250	11.6	0.6	<2
SB 380	<.4	m	<.02	0.2	1	0.9	85.4	730	10.9	0.172	3
SB 382	<.4	m	<.02	<.2	2	[E].4	108	550	10.0	0.127	5
SB 390	1	m	<.02	1.6	3	[E].3	166	490	12.5	0.509	3
SB 391	26.2	27	<.02	0.4	2	[E].3	101	610	11.9	0.322	14
SB 392	139	137	<.02	[E].2	2	0.5	117	490	12.5	0.373	<2
SB1066	0.8	50	[E].01	[E].1	7	<.5	70.6	1010	11.0	0.311	40
SB1066	2.5	5	<.02	[E].2	1	[E].3	87.1	1580	11.0	0.36	13
SB1077	<.4	320	<.02	[E].1	1	<.5	83.3	2180	7.8	0.281	13
SB1350	469	454	<.02	0.8	1	<.5	180	1540	0.6	1.01	2
SB1408	3.9	4	<.02	[E].1	3	[E].4	120	1140	12.9	0.642	5
SB1408	7.8	36.5	<.02	[E].1	4	[E].4	111	630	13.5	0.862	22
SB1420	371	367	<.02	1.8	1	[E].5	853	520	2.5	0.029	28
SB1447	360	342	<.02	[E].1	1	<.5	897	2130	m	0.171	151
SB1451	2.1	3	<.02	[E].2	1	[E].3	65.6	1030	11.3	0.119	60
SB1457	99.5	85.1	<.02	1.6	m	<.5	115	2420	3.1	0.587	3
SB1470	4.2	5	<.02	[E].2	2	<.5	273	2580	6.3	0.102	3
SY 911	13	15	<.02	<.2	m	0.8	370		1.3	[E].007	5
SY1016	133	115	<.02	1.5	2	<.5	219	210	10.1	0.292	<2

[1] SB, Steuben County; CM, Chemung County; SY, Schuyler County. Number is local well-identification number assigned by U.S. Geological Survey.

[E] estimated value; constituent was detected in the sample below the laboratory reporting level.

m constituent was detected in the sample but was not quantified.

Table 6. Concentrations of pesticides detected in ground-water samples from the Chemung River basin, New York, 2003.

[All values are in micrograms per liter and all are from filtered samples. Dashes (--) indicate sample was not analyzed for this constituent. Well locations are shown in fig. 1.]

Well no.[1]	2-Chloro-4-isopropylamino-6-amino-s-triazine (deethylatrazine) 004040	2-Chloro-6-ethylamino-4-amino-s-triazine 04038	2-Hydroxy-4-isopropylamino-6-ethylamino-s-triazine 50355	Atrazine 39632	Chlorodiamino-s-triazine 04039	Imazethapyr 50407	Metalaxyl 50359
CM 82	<0.006	--	--	<0.007	--	--	--
CM 625	<.006	--	--	<.007	--	--	--
CM 626	<.006	<.04	<.008	<.007		<.02	<.02
CM 627	<.006	--	--	<.007	--	--	--
CM 628	[E].007	--	--	0.011	--	--	--
CM 630	[E].029	--	--	0.017	--	--	--
CM 632	<.006	--	--	<.007	--	--	--
CM 633	<.006	--	--	<.007	--	--	--
CM 634	<.006	--	--	<.007	--	--	--
CM 635	[E].013	--	--	0.034	--	--	--
CM 636	<.006	--	--	0.02	--	--	--
CM 637	<.006	--	--	<.007	--	--	--
SB 63	<.006	--	--	<.007	--	--	--
SB 85	<.006	--	--	<.007	--	--	--
SB 151	[E].006	--	--	0.008	--	--	--
SB 224	[E].013	<.04	<.008	0.03	<.01	<.02	[E].01
SB 229	<.006	<.04	<.008	<.007	<.01	m	<.02
SB 380	[E].006	--	--	0.017	--	--	--
SB 382	[E].009	m	<.008	0.007	<.01	<.02	<.02
SB 390	<.006	--	--	<.007	--	--	--
SB 391	[E].009	--	--	0.01	--	--	--
SB 392	<.006	--	--	<.007	--	--	--
SB 1408		--	--	--	--	--	--
SB 1408	[E].021	--	--	0.049	--	--	--
SB 1420	<.006	--	--	<.007	--	--	--
SB 1451	[E].008	--	--	0.009	--	--	--
SB 1470	<.006	--	--	<.007	--	--	--
SY 1016	<.006	<.04	<.008	<.007	<.01	<.02	<.02

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[E] estimated value; constituent was detected in the sample below the laboratory reporting level.

m constituent was detected in the sample but was not quantified.

Table 6. Concentrations of pesticides detected in ground-water samples from the Chemung River basin, New York, 2003 (continued).

Well no.[1]	Metolachlor 39415	Metribuzin 82630	Prometon 04037	Acetochlor ESA 61029	Alachlor ESA 50009	Alachlor OA 61031	Metolachlor ESA 61043	Metolachlor OA 61044
CM 82	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
CM 625	<.013	<.006	<.01	<0.05	0.75	<0.05	0.14	<0.05
CM 626	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
CM 627	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
CM 628	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
CM 630	<.013	<.006	<.01	<0.05	0.22	<0.05	1.49	<0.05
CM 632	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
CM 633	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
CM 634	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
CM 635	[E].009	<.006	<.01	<0.05	<0.05	<0.05	0.17	0.17
CM 636	<.013	<.006	<.01	<0.05	<0.05	<0.05	0.13	0.05
CM 637	<.013	<.006	<.01	<0.05	<0.05	<0.05	0.05	<0.05
SB 63	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
SB 85	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
SB 151	<.013	<.006	<.01	<0.05	0.5	<0.05	<0.05	<0.05
SB 224	[E].011	0.054	0.05	0.06	0.09	0.11	0.53	1.5
SB 229	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
SB 380	<.013	<.006	<.01	<0.05	<0.05	<0.05	0.15	0.05
SB 382	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
SB 390	<.013	<.006	<.01	<0.05	<0.05	<0.05	0.08	<0.05
SB 391	<.013	<.006	<.01	<0.05	<0.05	<0.05	0.23	<0.05
SB 392	<.013	<.006	<.01	<0.05	<0.05	<0.05	0.41	0.12
SB1408	--	--	--	<0.05	<0.05	<0.05	0.08	<0.05
SB1408	0.019	<.006	<.01	<0.05	<0.05	<0.05	0.16	0.11
SB1420	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
SB1451	<.013	<.006	<.01	<0.05	<0.05	<0.05	0.23	<0.05
SB1470	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05
SY1016	<.013	<.006	<.01	<0.05	<0.05	<0.05	<0.05	<0.05

[1] SB, Steuben County; CM, Chemung County; SY, Schuyler County. Number is local well-identification number assigned by U.S. Geological Survey.

[E] estimated value; constituent was detected in the sample below the laboratory reporting level.

ESA - Ethanesulfonic acid metabolite.

OA - Oxanilic acid metabolite.

Table 7. Concentrations of volatile organic compounds (VOCs) in ground-water samples from the Chemung River basin, New York, 2003.

[All values are in micrograms per liter and all are from unfiltered samples. Locations are shown in fig. 1.]

Well no.[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	Toluene 34010	Tribromo-methane 32104	Trichloro-ethene 39180	Trichloro-methane 32106
CM 82	2.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1
CM 625	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
CM 626	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
CM 627	<.1	<.1	<.1	<.1	<.2	[E].2	<.1	<.1	<.2	<.1	<.1
CM 628	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
CM 629	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
CM 630	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	0.1	<.1
CM 631	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
CM 632	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
CM 633	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
CM 634	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
CM 635	<.1	<.1	<.1	<.1	<.2	<.2	0.4	<.1	<.2	<.1	0.2
CM 636	<.1	<.1	<.1	0.2	<.2	<.2	1.7	<.1	<.2	0.2	0.3
CM 637	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	0.1
CM 904	<.1	<.1	<.1	<.1	<.2	<.2	<.1	0.3	<.2	<.1	<.1
CM 954	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB 63	0.4	<.1	<.1	<.1	<.2	<.2	1.4	<.1	<.2	0.7	<.1
SB 85	0.3	0.2	<.1	<.1	<.2	0.4	<.1	<.1	<.2	<.1	<.1
SB 151	<.1	<.1	0.2	<.1	0.2	<.2	<.1	<.1	<.2	<.1	0.8
SB 224	0.1	<.1	0.2	<.1	0.3	<.2	<.1	<.1	0.3	<.1	<.1
SB 229	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB 380	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB 382	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB 390	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB 391	<.1	<.1	0.3	<.1	0.2	<.2	<.1	<.1	<.2	<.1	0.6
SB 392	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB1066	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB1066	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB1077	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	0.1
SB1350	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB1408	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	0.1
SB1408	<.1	<.1	0.2	<.1	<.2	<.2	<.1	<.1	<.2	<.1	1.9
SB1420	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB1447	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB1451	<.1	<.1	<.1	<.1	<.2	<.2	0.1	<.1	<.2	<.1	<.1
SB1457	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SB1470	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SY 911	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1
SY1016	<.1	<.1	<.1	<.1	<.2	<.2	<.1	<.1	<.2	<.1	<.1

[1] SB, Steuben County; CM, Chemung County; SY, Schuyler County. Number is local well-identification number assigned by U.S. Geological Survey.

[E] estimated value.

Table 8. Concentrations of bacteria in ground-water samples from the Chemung River basin, New York, 2003.

Well no.[1]	*Esherichia coli* [2] (per 100mL)	Fecal coliform (colonies per 100mL)	Standard plate count (per mL)	Total coliform[2] colonies per 100mL)
CM 82	--	<5	<1	neg
CM 625	--	<5	7	neg
CM 626	--	<5	6	neg
CM 627	--	<5	<1	neg
CM 628	pos	<5	9	pos
CM 629		600	<1	neg
CM 630	neg	<5	3	pos
CM 631	--	<5	<1	neg
CM 632	--	<5	<1	neg
CM 633	--	<5	86	neg
CM 634	--	<5	2	neg
CM 635	--	<5	1	neg
CM 636	neg	<5	3	pos
CM 637	neg	<5	1	pos
CM 904	--	<5	24	neg
CM 954	--	<5	130	neg
SB 63	--	<5	<1	neg
SB 85	--	<5	<1	neg
SB 151	neg	<5	2	pos
SB 224	--	<5	<1	neg
SB 229	--	15	10	neg
SB 380	--	<5	2	neg
SB 382	--	<5	1	neg
SB 390	--	5	5	neg
SB 391	--	<5	2	neg
SB 392	--	<5	1	neg
SB1066	pos		<1	pos
SB1066	pos	20	27	pos
SB1077	--	<5	3	neg
SB1350	--	<5	1400	neg
SB1408	pos	530	680	pos
SB1408	pos	20	120	pos
SB1420	---	<5	93	neg
SB1447	neg	<5	140	pos
SB1451	--	<5	12	neg
SB1457	--	<5	17	neg
SB1470	pos	10	87	pos
SY 911	neg	<5	1900	pos
SY1016	--	<5	76	neg

[1] SB, Steuben County; CM, Chemung County; SY, Schuyler County. Number is local well-identification number assigned by U.S. Geological Survey.

[2] neg, negative result (organism not detected); pos, positive result (organism detected).

-- indicates organism was not analyzed for in sample.