In cooperation with the
Delaware Department of Natural Resources and Environmental Control
and the
Delaware Geological Survey

Occurrence and Distribution of Selected Contaminants in Public Drinking-Water Supplies in the Surficial Aquifer in Delaware

Open-File Report 01-327

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

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

Occurrence and Distribution of Selected Contaminants in Public Drinking-Water Supplies in the Surficial Aquifer in Delaware

By Matthew J. Ferrari

Open-File Report 01-327

In cooperation with the
Delaware Department of Natural Resources and Environmental Control
and the
Delaware Geological Survey

Baltimore, Maryland
2002

U.S. Department of the Interior
GALE A. NORTON, Secretary

U.S. Geological Survey
Charles G. Groat, Director

For additional information contact:

District Chief
U.S. Geological Survey
8987 Yellow Brick Road
Baltimore, MD 21237

Copies may be purchased from:

U.S. Geological Survey
Branch of Information Services
Box 25286
Denver, CO 80225-0286

CONTENTS

Abstract 1
Introduction 2
Purpose and scope 2
Acknowledgments 2
Methods of study 2
Sampling network design 2
Sampling collection and analysis 4
Quality-control sampling 5
Age dating 5
Occurrence and distribution of selected contaminants in public drinking-water supplies in the surficial aquifer 6
Pesticides and metabolites 6
Volatile organic compounds 9
Inorganic compounds 12
Radium and radon 14
Summary 15
References cited 15
Appendixes 18

Figures

1-2. Maps showing:
1. Location of sampled public-supply wells screened in the unconfined aquifer in Delaware 3
2. Location of selection cells and public-supply wells screened in the unconfined aquifer in Delaware 3

3. Map showing pesticide and metabolite detections at each sampling location of public-supply wells screened in the unconfined aquifer in Delaware 6

4. Graph showing pesticides and metabolites detected in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware 7

5. Boxplot showing concentrations of selected pesticides and associated metabolites in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware 8

6. Map showing volatile organic compound detections at each sampling location of public-supply wells screened in the unconfined aquifer in Delaware 9

7. Graph showing volatile organic compounds detected in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware 10

8-9. Maps showing:
8. Location of detections above the U.S. Environmental Protection Agency Primary or Secondary Maximum Contaminant Levels for major ions and nutrients in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware 12

9. Location of public-supply wells in Delaware screened in the unconfined aquifer and sampled for radiochemistry 14

Tables

1. Well construction data for sampled public-supply wells screened in the unconfined aquifer in Delaware and modeled ages of ground-water samples....4

2. Pesticides and metabolites measured in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware....7

3. Summary statistics for pesticides and metabolites detected in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware, and comparisons to U.S. Environmental Protection Agency Primary Maximum Contaminant Levels and Health Advisories....8

4. Volatile organic compounds measured in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware....10

5. Summary statistics for volatile organic compounds detected in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware, and comparisons to U.S. Environmental Protection Agency Primary Maximum Contaminant Levels and Health Advisories....11

6. Summary statistics for selected field parameters, major ions, and nutrients for ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware, and comparisons to U.S. Environmental Protection Agency Primary and Secondary Maximum Contaminant Levels....13

7. Radiochemical activities for ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware and comparisons to U.S. Environmental Protection Agency Primary Maximum Contaminant Levels....14

Appendixes

A. Hydrologic data for the Delaware Source Water Assessment Program unconfined aquifer well network—Site information, well construction data, and modeled ages of ground-water samples....19

B. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Field parameters....20

C. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Major inorganic compounds....22

D. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Nutrients....24

E. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Pesticides....26

F. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Pesticide metabolites....32

G. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Volatile organic compounds....34

H. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Radium and radon....46

Appendixes—Continued

I. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Age dating:
Ia. Sulfur hexafluoride data. 48
Ib. Dissolved gas data. 50

J. Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data:
Ja. Major inorganic compounds 52
Jb. Nutrients 53
Jc. Pesticides. 54
Jd. Pesticide metabolites. 57
Je. Volatile organic compounds 58
Jf. Radionuclides 62

Conversion Factors, Vertical Datum, and Abbreviations

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
	Volume	
gallon (gal)	3.785	liter (L)
	Flow rate	
gallon per minute (gal/min)	0.06309	liter per second (L/s)
	Pressure	
atmosphere, standard (atm)	101.3	kilopascal (kPa)
atmosphere, standard (atm)	760	millimeter of mercury (mm Hg)
	Mass	
pound, avoirdupois (lb)	0.4536	kilogram (kg)
ounce, avoirdupois (oz)	28.35	gram (g)
	Radioactivity	
picocurie per liter (pCi/L)	0.037	becquerel per liter (Bq/L)

Temperature in degrees Fahrenheit (°F) and degrees Celsius (°C) may be converted using the following equations:

$$°F = (1.8 \times °C) + 32$$

$$°C = (°F - 32) / 1.8$$

Vertical datum: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Altitude, as used in this report, refers to distance above or below sea level.

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L). Micrograms per liter is a unit expressing the concentrations of chemical constituents in solution as weight (micrograms) of solute per unit volume (liter) of water. For concentrations less than 7,000,000 µg/L, the numerical value is the same as for concentrations in parts per billion.

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

Maximum Contaminant Level (MCL): An enforcable, health-based drinking-water regulation established by the U.S. Environmental Protection Agency.

Method Detection Limit (MDL): The minimum concentration of a substance that can be identified, measured, and reported with a 99-percent confidence that the analyte concentration is greater than zero; determined from analysis of a sample in a given matrix containing analyte. For additional information, see Oblinger Childress and others, 1999.

Foreword

The U.S. Geological Survey (USGS) is committed to serve the Nation with accurate and timely scientific information that helps enhance and protect the overall quality of life, and facilitates effective management of water, biological, energy, and mineral resources. Information on the quality of the Nation's water resources is of critical interest to the USGS because it is so integrally linked to the long-term availability of water that is clean and safe for drinking and recreation and that is suitable for industry, irrigation, and habitat for fish and wildlife. Escalating population growth and increasing demands for the multiple water uses make water availability, now measured in terms of quantity *and* quality, even more critical to the long-term sustainability of our communities and ecosystems.

The USGS implemented the National Water-Quality Assessment (NAWQA) Program to support national, regional, and local information needs and decisions related to water-quality management and policy. Shaped by and coordinated with ongoing efforts of other Federal, State, and local agencies, the NAWQA Program is designed to answer: What is the condition of our Nation's streams and ground water? How are the conditions changing over time? How do natural features and human activities affect the quality of streams and ground water, and where are those effects most pronounced? By combining information on water chemistry, physical characteristics, stream habitat, and aquatic life, the NAWQA Program aims to provide science-based insights for current and emerging water issues. NAWQA results can contribute to informed decisions that result in practical and effective water-resource management and strategies that protect and restore water quality.

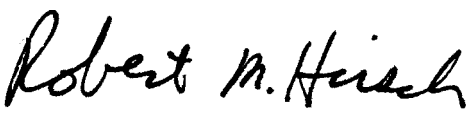
Since 1991, the NAWQA Program has implemented interdisciplinary assessments in more than 50 of the Nation's most important river basins and aquifers, referred to as Study Units. Collectively, these Study Units account for more than 60 percent of the overall water use and population served by public water supply, and are representative of the Nation's major hydrologic landscapes, priority ecological resources, and agricultural, urban, and natural sources of contamination.

Each assessment is guided by a nationally consistent study design and methods of sampling and analysis. The assessments thereby build local knowledge about water-quality issues and trends in a particular stream or aquifer while providing an understanding of how and why water quality varies regionally and nationally. The consistent, multi-scale approach helps to determine if certain types of water-quality issues are isolated or pervasive, and allows direct comparisons of how human activities and natural processes affect water quality and ecological health in the Nation's diverse geographic and environmental settings. Comprehensive assessments on pesticides, nutrients, volatile organic compounds, trace metals, and aquatic ecology are developed at the national scale through comparative analysis of the Study-Unit findings.

The USGS places high value on the communication and dissemination of credible, timely, and relevant science so that the most recent and available knowledge about water resources can be applied in management and policy decisions. We hope this NAWQA publication will provide you the needed insights and information to meet your needs, and thereby foster increased awareness and involvement in the protection and restoration of our Nation's waters.

The NAWQA Program recognizes that a national assessment by a single program cannot address all water-resource issues of interest. External coordination at all levels is critical for a fully integrated understanding of watersheds and for cost-effective management, regulation, and conservation of our Nation's water resources. The Program, therefore, depends extensively on the advice, cooperation, and information from other Federal, State, interstate, Tribal, and local agencies, non-government organizations, industry, academia, and other stakeholder groups. The assistance and suggestions of all are greatly appreciated.

Robert M. Hirsch



Associate Director for Water

Occurrence and Distribution of Selected Contaminants in Public Drinking-Water Supplies in the Surficial Aquifer in Delaware

By Matthew J. Ferrari

Abstract

Water samples were collected from August through November 2000 from 30 randomly selected public drinking-water supply wells screened in the unconfined aquifer in Delaware, and analyzed to assess the occurrence and distribution of selected pesticide compounds, volatile organic compounds, major inorganic ions, and nutrients. Water from a subset of 10 wells was sampled and analyzed for radium and radon. The average age of ground water entering the well screens in all the wells was determined to be generally less than 20 years.

Low concentrations of pesticide compounds and volatile organic compounds were detected throughout the State of Delaware, with several compounds often detected in each water sample. Pesticide and metabolite (pesticide degradation products) concentrations were generally less than 1 microgram per liter, and were detected in samples from 27 of 30 wells. Of the 45 pesticides and 13 metabolites analyzed, 19 compounds (13 pesticides and 6 metabolites) were detected in at least 1 of the 30 samples. Desethylatrazine, alachlor ethane sulfonic acid, metolachlor ethane sulfonic acid, metolachlor, and atrazine were the most frequently detected pesticide compounds, and were present in at least half the samples. None of the pesticide detections was above the U.S. Environmental Protection Agency's Primary Maximum Contaminant Levels or Health Advisories. Volatile organic compounds also were present at low concentrations (generally less than 1 microgram per liter) in samples from all 30 wells. Of the 85 volatile organic compounds analyzed, 34 compounds were detected in at least 1 of the 30 samples. Chloroform, tetrachloroethene, and methyl *tert*-butyl ether were the most frequently detected volatile organic compounds, and were found in at least half the samples. None of the volatile organic compound detections was above U.S. Environmental Protection Agency's Primary Maximum Contaminant Levels or Health Advisories.

A few samples contained compounds with concentrations above the U.S. Environmental Protection Agency's Primary Maximum Contaminant Levels or Secondary Maximum Contaminant Levels for inorganic compounds and radionuclides. One sample out of 30 contained a concentration of nitrite plus nitrate above the U.S. Environmental Protection Agency's Primary Maximum Contaminant Level of 10 milligrams per liter as nitrogen. Iron and manganese concentrations above the U.S. Environmental Protection Agency's Secondary Maximum Contaminant Levels were found in 7 of 30 ground-water samples, most of them from Sussex County. In the 10 wells sampled for radionuclides, only one sample had detectable levels of radium-224 and -226, and another sample contained detectable levels of radium-228; both of these samples also had detectable gross-alpha and gross-beta activities. None of these activities were above the U.S. Environmental Protection Agency's Primary Maximum Contaminant Levels or Secondary Maximum Contaminant Levels. Radon was detected in all 10 samples, but was above the current U.S. Environmental Protection Agency's proposed Primary Maximum Contaminant Level of 300 picocuries per liter in only one sample.

Introduction

The surficial Coastal Plain aquifer system is an important drinking-water source for public and domestic use in Delaware. Almost 400 public drinking-water supply wells are screened in unconfined parts of the surficial aquifer system. The aquifer system is comprised primarily of sands and gravels of fluvial and marginal marine origin. Since it is largely unconfined, it is susceptible to contamination from applications or spills of chemicals on or near the land surface. The primary land uses surrounding these relatively shallow public-supply wells in the Coastal Plain of Delaware include agriculture, and urban and suburban areas associated with small towns and communities. Health officials and water-resource managers are concerned about the overall quality of this drinking-water resource. Of particular concern are the occurrence and distribution of pesticides commonly used for agriculture and weed or insect control in developed areas and along roads, organic compounds associated with fuels and industrial uses, nutrients from agricultural or domestic use, and radon and radium from natural sources in ground water in the surficial aquifer.

This project was partially funded under a cooperative agreement between the Delaware Geological Survey (DGS) and the U.S. Geological Survey (USGS), in support of the Delaware Department of Natural Resources and Environmental Control (DNREC) and the U.S. Environmental Protection Agency (USEPA) Source Water Assessment and Protection Program. The remaining funding was supplied by the USGS National Water-Quality Assessment (NAWQA) Program Delmarva Peninsula Study Unit.

Purpose and Scope

The purpose of this report is to present data from ground-water samples collected from 30 randomly selected public drinking-water supply wells in the surficial aquifer in Delaware (fig. 1). Samples were collected from August through November 2000. The wells were selected using a database of public water-supply wells developed by the DNREC Water Supply Section (Steven Smailer, Delaware Department of Natural Resources and Environmental Control, written commun., 2000). Ground-water quality data included in this study were major ions, nutrients, pesticides, volatile organic compounds, selected radionuclides, and age dating. Results of preliminary analysis of selected pesticide and metabolite (pesticide degradation products) data, and data from a subset of 10 wells analyzed for radium and radon also are presented. Complete tables of site information and analytical results are included as Appendixes at the end of the report.

Acknowledgments

The author would like to thank John Barndt, Steven Smailer, and other personnel at the Delaware Department of Natural Resources and Environmental Control Water Supply Section for their help and cooperation, and for providing the database of public-supply wells. Anita Beckel of the Delaware Division of Public Health, Office of Drinking Water, provided assistance and access to their files. John Talley of the Delaware Geological Survey provided a technical review for this report and Scott Strohmeier assisted with well numbering. Additional thanks are extended to all well owners and water managers who allowed access to their property to sample these wells. Deborah Bringman, Julie Matlaga, Mark Nardi, and other U.S. Geological Survey personnel provided office and field technical support for this project; Lisa Olsen provided information on the sources and chemical properties of the volatile organic compounds; Michael Wieczorek produced the Geographic Information System (GIS) coverages; and the Publications Staff provided editing, graphics, and layout for this report.

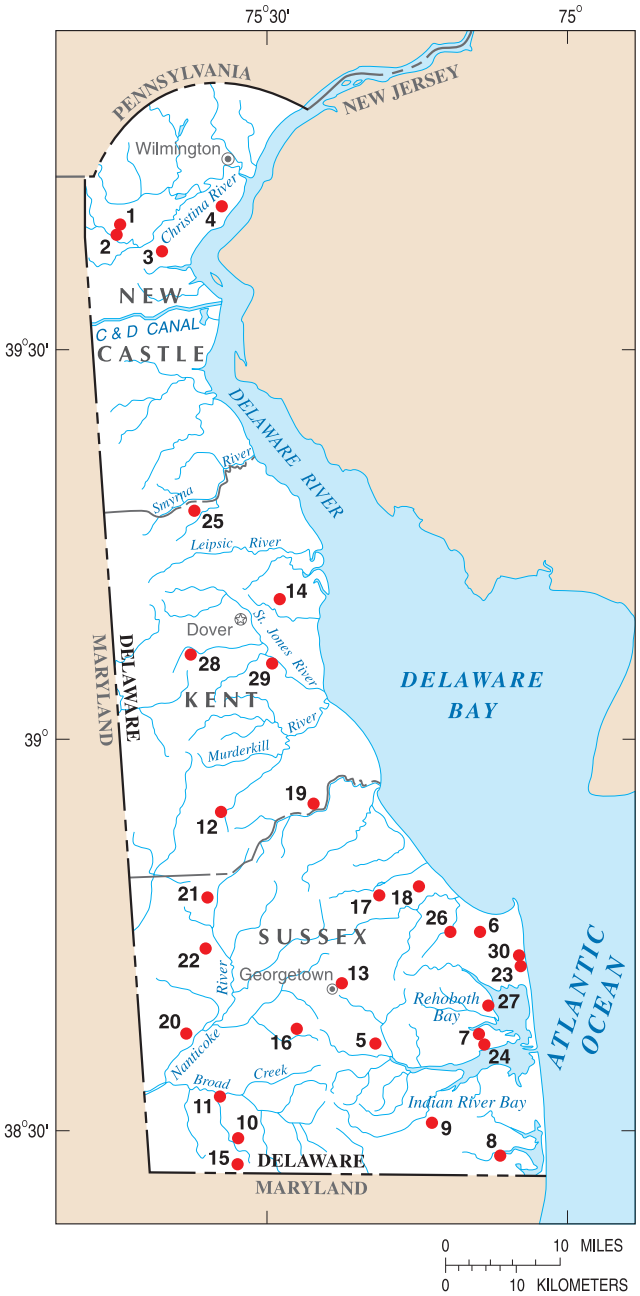
Methods of Study

The sampling design for this study was developed to obtain information on the spatial occurrence and distribution of selected chemicals in the unconfined aquifer in the Delaware Coastal Plain. Water samples collected for this purpose were obtained using trace-level protocols (Wilde and others, 1998), and analyzed for major ions, nutrients, pesticides, volatile organic compounds, selected radionuclides, and age dating.

Sampling Network Design

The goal of the network design was to obtain a 30-well random sample from a total population of 372 public drinking-water supply wells identified as screened in the unconfined aquifer in the Delaware Coastal Plain (fig. 2). Because most of the candidate wells were located in Sussex County, a cell-based selection technique (Scott, 1990) was used to provide some data from the northern two-thirds of the State. Attempts to create 30 relatively contiguous, equal area cells containing at least 3 candidate sites (one primary and two alternates) were unsuccessful due to the spatial bias of the target population. Therefore, randomly located grids of smaller cells were iteratively overlain on the target population until at least 24 cells contained the necessary 3 candidate wells (see figure 2). The first successful grid contained 27 cells with the required 3 sites. One primary and two alternate sites were randomly selected from within each of these 27 cells; sites 28, 29, and 30 (and the corresponding alternates) were randomly selected from the entire set of remaining wells.

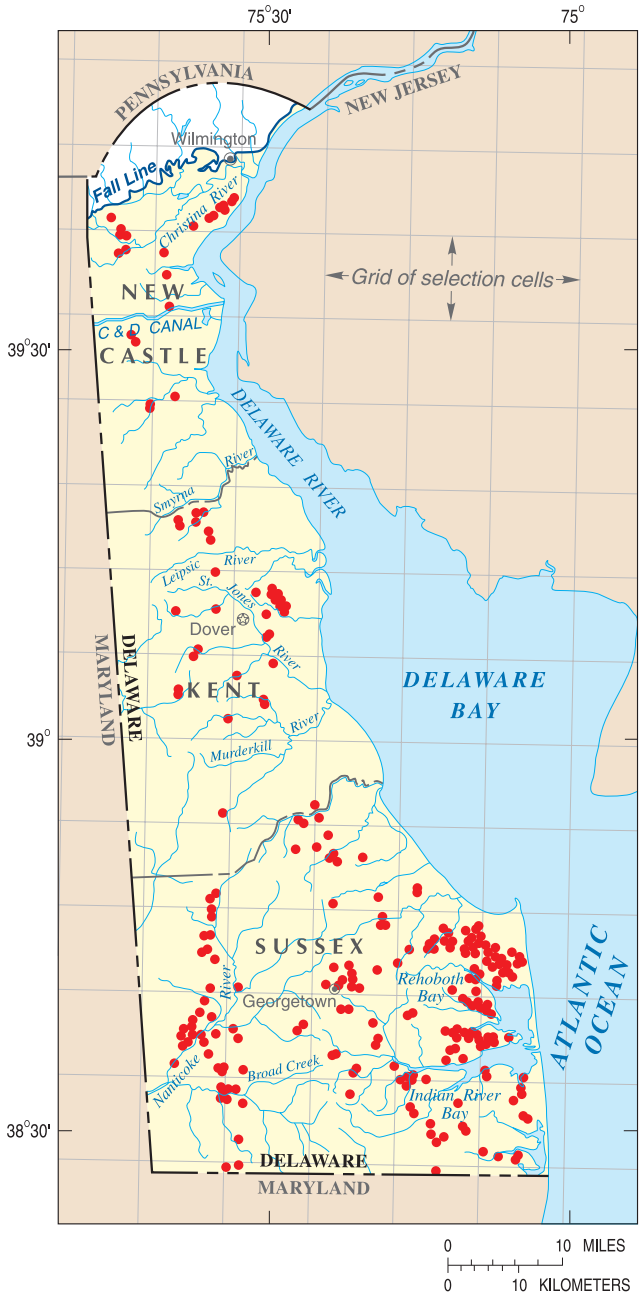
Well-construction and geologic information was reviewed for each candidate well site. Each well was then located in the field and evaluated for inclusion in the sampling network. Primary sites were checked for accessibility, construction integrity, and identification verification. Several wells could not be positively identified or were no longer in use and had to be excluded; other wells had to be excluded due to problems with the plumbing or accessibility. Alternate sites were included, as necessary, in the order of their original selection within each cell. Where both the primary and alternate sites were unusable, additional alternates were



EXPLANATION

2 SAMPLED PUBLIC-SUPPLY WELL SCREENED IN THE UNCONFINED AQUIFER AND SITE IDENTIFICATION NUMBER (Refer to site numbers in Table 1.)

Figure 1. Location of sampled public-supply wells screened in the unconfined aquifer in Delaware.



EXPLANATION

PUBLIC-SUPPLY WELL SCREENED IN THE UNCONFINED AQUIFER

DELAWARE COASTAL PLAIN

GRID OF SELECTION CELLS

Figure 2. Location of selection cells and public-supply wells screened in the unconfined aquifer in Delaware.

Table 1. *Well construction data for sampled public-supply wells screened in the unconfined aquifer in Delaware and modeled ages of ground-water samples*

[USGS, U.S. Geological Survey; DGS, Delaware Geological Survey; DNREC, Delaware Department of Natural Resources and Environmental Control]

Site[1] Number	USGS Site Identification Number	DGS Local Well Number	DNREC Permit Number	Year Well Constructed	Casing Material	Depth of Well (feet)	Diameter of Well (inches)	Depth to Top of Screen (feet)	Depth to Bottom of Screen (feet)	Average modeled ground-water sample age (years)
1	393928075440202	Db11-27	10004	1956	Steel	66	10	41	62	8.5
2	393916075440802	Db11-28	10003	1956	Unknown	62	10	31	62	7.0
3	393739075394202	Dc31-15	10434	1960	Unknown	76	17	52	76	7.5
4	394060075334601	Cd52-15	10045	1953	Steel	74	17	58	74	6.0
5	383705075192801	Forest Hills 1	10700	Unknown	Steel	110	4	Unknown	110	Unknown
6	384526075091601	Ni51-32	55833	1984	Plastic	139	16	85	135	21.0
7	383736075092801	Pi31-02	49713	1982	Steel	70	8	55	70	15.5
8	382830075073601	Ri23-04	106344	1995	Plastic	82	6	70	80	20.0
9	383101075141101	Frankford 2	10342	1934	Unknown	85	8	69	81	23.0
10	383000075326001	Qd52-09	78054	1989	Plastic	70	4	60	70	Unknown
11	383311075344401	Qd21-12	35239	1975	Steel	100	12	70	100	18.5
12	385448075341801	Md11-04	65911	1986	Unknown	70	10	50	70	11.0
13	384139075230101	Georgetown 1	10325	1948	Unknown	120	Unknown	Unknown	120	19.5
14	391060075282801	Ie42-03	85022	1991	Steel	70	16	49	64	12.0
15	382805075330301	Rd22-01	66041	1986	Plastic	60	2	52	60	15.0
16	383815075271001	Pe23-185	72060	1987	Plastic	120	4	100	110	18.5
17	384819075190101	Ng21-03	71704	1987	Plastic	111	4	91	111	20.5
18	384856075151101	Ng25-04	7993	1994	Plastic	139	8	99	139	18.5
19	385522075251802	Le55-09	31756	1974	Steel	91	10	71	91	18.0
20	383801075375701	Pc33-44	10369	1962	Unknown	105	Unknown	82	97	12.5
21	384818075354101	Nc25-37	72714	1988	Steel	63	12	40	63	15.0
22	384428075355701	Oc15-11	10319	1955	Unknown	119	12	100	119	13.0
23	384322075051101	Oi25-18	93955	1993	Plastic	38	4	23	38	9.0
24	383649075090801	Pot Nets 1	10651	1962	Unknown	85	6	Unknown	85	24.5
25	391747075364202	Hc34-03	10068	1948	Steel	100	10	80	95	13.0
26	384530075121101	Nh53-01	30657	1974	Steel	110	4	100	110	17.0
27	383947075083401	Pi12-08	32247	1974	Plastic	55	4	45	55	12.0
28	390652075370701	Jc43-05	82964	1990	Plastic	70	4	60	70	17.0
29	390619075290901	Je41-08	10735	1955	Unknown	40	4	Unknown	40	9.5
30	384326075050801	Oi25-19	93496	1992	Unknown	37	4	27	37	9.0

[1] *Source: DNREC Public Water-Supply Well database. Refer to figure 1 for site locations and identification numbers.*

randomly selected from the remaining candidates in the appropriate cell or the entire study area, if that was not possible. A summary of construction information for the sampled wells is shown in table 1.

Sample Collection and Analysis

Water samples were collected from the raw sample tap prior to any treatment at 30 shallow public-supply wells in Delaware and analyzed for various physical parameters and chemical analytes. Samples were collected using trace-level protocols (Koterba and others, 1995; Wilde and others, 1998) and analyzed for the following constituents: pH, dissolved oxygen, specific conductance, alkalinity, major inorganic ions, nutrients (nitrogen and phosphorus compounds), 45 pesticides, 13 pesticide metabolites, 85 volatile organic compounds, and age dating. In addition, 23 samples were analyzed for an additional herbicide (glyphosate), and 10 samples were analyzed for radium and radon. Analyses

for most of these constituents were conducted at the USGS National Water-Quality Laboratory (NWQL) in Denver, Colorado, using established procedures (Fishman, 1993; Zaugg and others, 1995; Connor and others, 1998). Analyses for pesticide metabolites were performed at the USGS Organic Geochemistry Laboratory in Lawrence, Kansas, and analyses for age dating were performed at the USGS Chlorofluorocarbon Laboratory in Reston, Virginia. Analysis methods for pesticide metabolites are described in Lee and others (2001); methods using chlorofluorocarbons and sulfur hexafluoride for age dating of ground water are described in Plummer and Busenberg (1999), Plummer and Friedman (1999), and Busenberg and Plummer (2000).

Comparisons between concentrations or activities of selected constituents and USEPA Primary Maximum Contaminant Levels (PMCLs), Secondary Maximum Contaminant Levels (SMCLs), and Health Advisories (HAs) (U.S. Environmental Protection Agency, 2000, 2001) were made. These standards and guidelines cover public drinking water as supplied to consumers, and are not applied to raw-water samples, which were collected for this study. Consequently, comparisons are for informational purposes only and should not be interpreted as evidence of compliance or non-compliance with Federal regulations.

Quality-Control Sampling

Field blanks, replicates, and spikes were collected to determine uncertainty and variability in the data as described in the NAWQA protocols (Koterba and others, 1995). Eleven samples were collected and analyzed for quality-control and quality-assurance purposes—three field blanks, six replicates, one spike, and one spike replicate. Not all chemical constituents were analyzed in each sample, but particular suites of chemicals were targeted. For example, only one blank for major ions was collected, but three blanks for volatile organic compounds (VOCs) were collected, since the reporting levels for VOCs are several orders of magnitude lower than the reporting levels for major ions. Quality-control data are presented in Appendix J.

Field blanks are used to estimate the reliability of concentrations reported at, near, or below analytical detection limits. Generally, concentrations in the field blanks were lower than the reporting limits for most constituents. The most notable exception was metolachlor, which was detected in both of the field blanks collected for pesticide analysis. This may be indicative of contamination caused by field equipment or in the laboratory, as other recent studies have also identified metolachlor in field blanks (Scott Ator, U.S. Geological Survey, oral commun., 2001). Since some of the environmental samples contained metolachlor at concentrations below those detected in the field blanks, these data need to be interpreted with caution.

Replicate samples are used to assess the sources of variability caused by short-term environmental fluctuations or laboratory procedures (Koterba and others, 1995). Most of the replicate samples are consistent with the environmental samples, indicating proper sample handling, processing, and analysis procedures. The three exceptions were isopropylbenzene, metolachlor, and toluene. In each case, one out of three replicates had concentrations that were not consistent with the concentrations reported in the associated environmental sample. In all three cases, however, one of the samples had a reported concentration estimated to be lower than the reporting limit, whereas the associated environmental or replicate sample did not have a detectable concentration of the constituent in question. In addition, the reporting levels for the non-detects were higher than the estimated concentrations in the associated environmental or replicate samples. Since the reported concentrations were lower than the non-detection reporting levels, these replicate samples are considered to be consistent.

Spikes are samples fortified with a known quantity of selected pesticides to assess recovery bias and variability (Koterba and others, 1995). Generally, mean recoveries in spiked samples are similar to or higher than values published in Zaugg and others (1995). This may be indicative of improvements in the analytical methods for compounds where the spike recovery is higher than the published value.

Age Dating

Ground-water ages, as determined from sulfur hexafluoride concentrations (SF_6), were generally less than 20 years (table 1, Appendix I). Since most of the sampled wells are screened over relatively large intervals—up to 40 ft (feet)—these model ages should be considered as the average age of all the individual flow paths intercepted by each well. The SF_6 model ages listed in table 1 were calculated by averaging the model ages determined from two samples collected from each well. In one instance, there was a wide discrepancy in the two ages. In this case, the younger age was chosen as being the more reliable age, based on the ages from wells of similar depth and because the older age is near the upper limit of the dating method, possibly indicating loss of SF_6 from an improperly sealed sample bottle.

Dissolved-gas analyses also were performed on samples from each well as part of the age-dating analysis to determine the average recharge temperature of the water in the aquifer. These data are included in Appendix I.

Ground-water ages can be assigned using SF_6 because its accumulation in the atmosphere over the past 40 years has been determined, its solubility in water is known, and its concentration in air and water is high enough to be accurately measured (Plummer and Friedman, 1999). By relating the measured concentrations of SF_6 in ground-water samples to known historical atmospheric concentrations and to calculated concentrations expected in water in equilibrium with air, the date of introduction of the SF_6 into the water can determined. Since transport and chemical processes can affect the concentration of SF_6 or other chemical tracers, ages determined by these methods are usually qualified by the terms "model" or "apparent" (Plummer and Friedman, 1999).

Occurrence and Distribution of Selected Contaminants in Public Drinking-Water Supplies in the Surficial Aquifer

Water-quality data from ground-water samples collected from public-supply wells screened in the unconfined aquifer in Delaware are presented in this section. The water-quality data are grouped according to the type of chemicals: pesticides and metabolites, VOCs, major inorganic compounds, and radium and radon.

Pesticides and Metabolites

The spatial distribution of pesticide and metabolite detections across the State is shown in figure 3. Of the 45 pesticide and 13 metabolites analyzed, 19 compounds (13 pesticides and 6 metabolites) were detected in at least 1 of the 30 samples (table 2, fig. 4). Concentrations of pesticides and metabolites generally were less than 1 µg/L (microgram per liter), and in no case were concentrations higher than any current PMCL or HA (table 3). Of the 30 wells sampled, 24 had multiple pesticide detections (fig. 3), and only 3 wells (Ng25-04, Pe23-185, and Pi12-08) had no detectable concentrations of any analyzed pesticide or metabolite (see Appendixes E and F).

Desethylatrazine, alachlor ESA, metolachlor ESA, metolachlor, and atrazine, the most frequently detected compounds, were present above reporting limits in at least half of the samples (fig. 4). The metabolites desethylatrazine, alachlor ESA, and metolachlor ESA were detected more frequently than their parent pesticides, atrazine, alachlor, and metolachlor, respectively. In addition, concentrations of these metabolites were generally higher than the concentrations of the parent pesticides (fig. 5). USEPA PMCLs, SMCLs, or HAs have not been established for metabolites (U.S. Environmental Protection Agency, 2000, 2001).

An estimated 1.28 million lbs (pounds) of pesticides are used annually for agricultural purposes in Delaware (Gianessi and Marcelli, 2000). Non-agricultural applications of pesticides are difficult to quantify, but the USEPA estimates that nationwide, agricultural applications accounted for 79 percent of the total pesticide usage in 1997 (Aspelin and Grube, 1999). Metolachlor and atrazine are the most widely applied agricultural pesticides in Delaware, with estimated applications in 1997 of 450,000 and 191,000 lbs per year, respectively (Gianessi and Marcelli, 2000). These were also the two most frequently detected pesticides in this study (fig. 4). Reported agricultural usage of metolachlor is for weed control mainly on corn (241,000 lbs) and soybeans (174,000 lbs), whereas atrazine is used exclusively on corn (Gianessi and Marcelli, 2000). Neither of these pesticides was among the most widely used in non-agricultural settings in 1995 and 1996 (Aspelin and Grube, 1999).

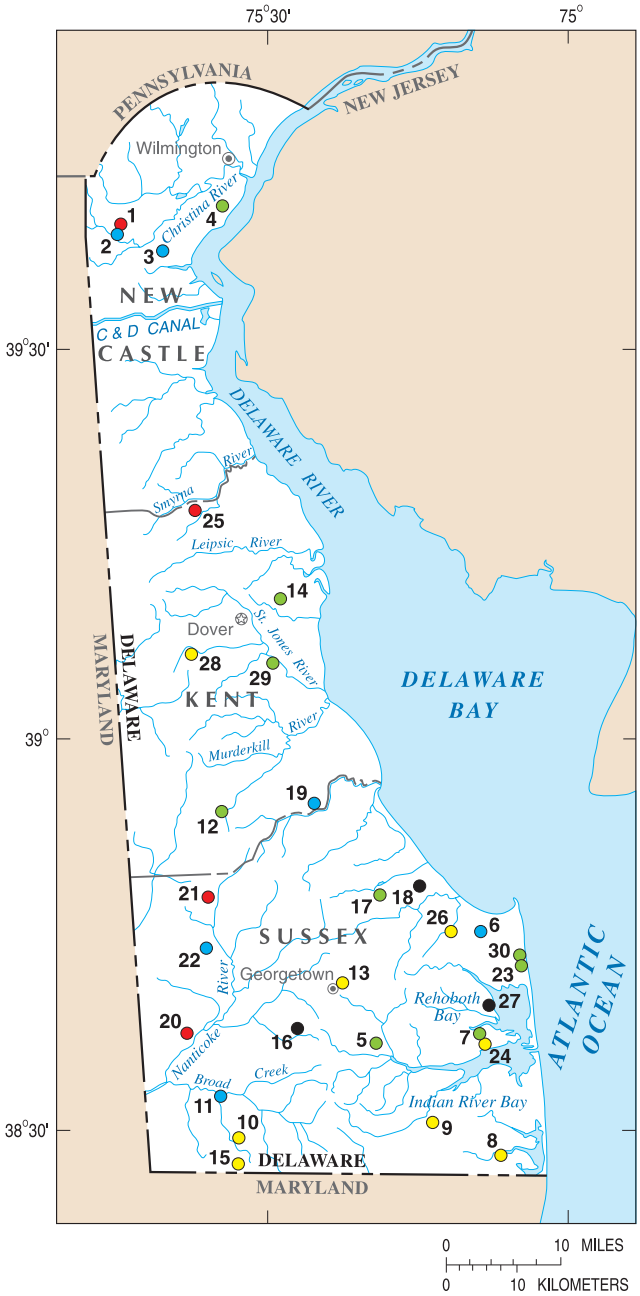


Figure 3. Pesticide and metabolite detections at each sampling location of public-supply wells screened in the unconfined aquifer in Delaware.

Table 2. *Pesticides and metabolites measured in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware*

[*Italicized* compounds are degradation products of pesticides; **Red** compounds were detected; ESA, ethane sulfonic acid; OXA, oxanilic acid]

Acetochlor	*Dimethenamid ESA*	Parathion
Acetochlor ESA	*Dimethenamid OXA*	Parathion-methyl
Acetochlor OXA	Disulfoton	**Pebulate**
Alachlor	**Eptam**	Pendimethalin
Alachlor ESA	Ethalfluralin	*cis*-Permethrin
Alachlor OXA	Ethoprophos	Phorate
Atrazine	*Flufenacet ESA*	**Prometon**
Azinphos-methyl	*Flufenacet OXA*	Propachlor
Benfluralin	Fonofos	Propanil
Butylate	Glyphosate	Propargite
Carbaryl	alpha-HCH	Propyzamide
Carbofuran	**Lindane**	**Simazine**
Chlorpyrifos	Linuron	**Tebuthiuron**
Cyanazine	Malathion	Terbacil
Dacthal	**Metolachlor**	Terbufos
p,p'-DDE	***Metolachlor ESA***	Thiobencarb
Desethylatrazine	***Metolachlor OXA***	Triallate
Diazinon	Metribuzin	Trifluralin
Dieldrin	Molinate	
2,6-Diethylanaline	Napropamide	

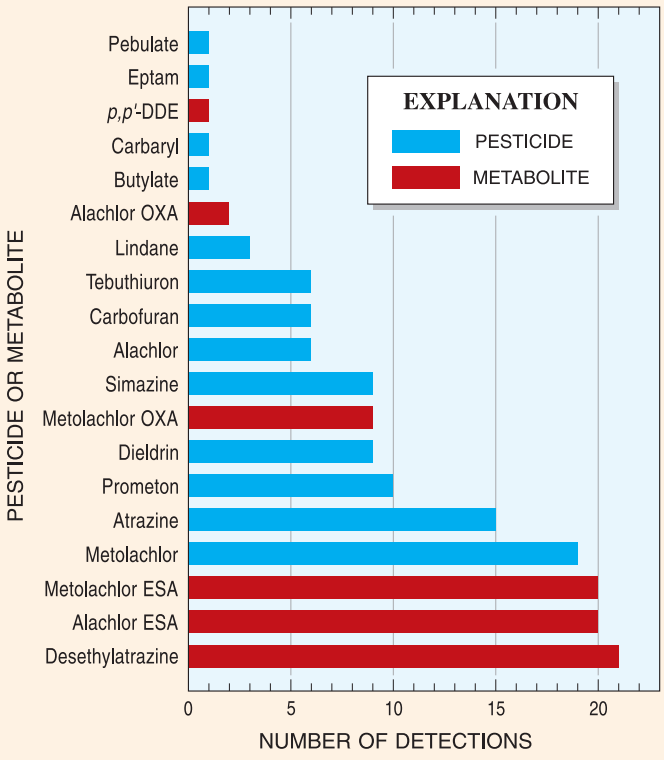


Figure 4. Pesticides and metabolites detected in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware.

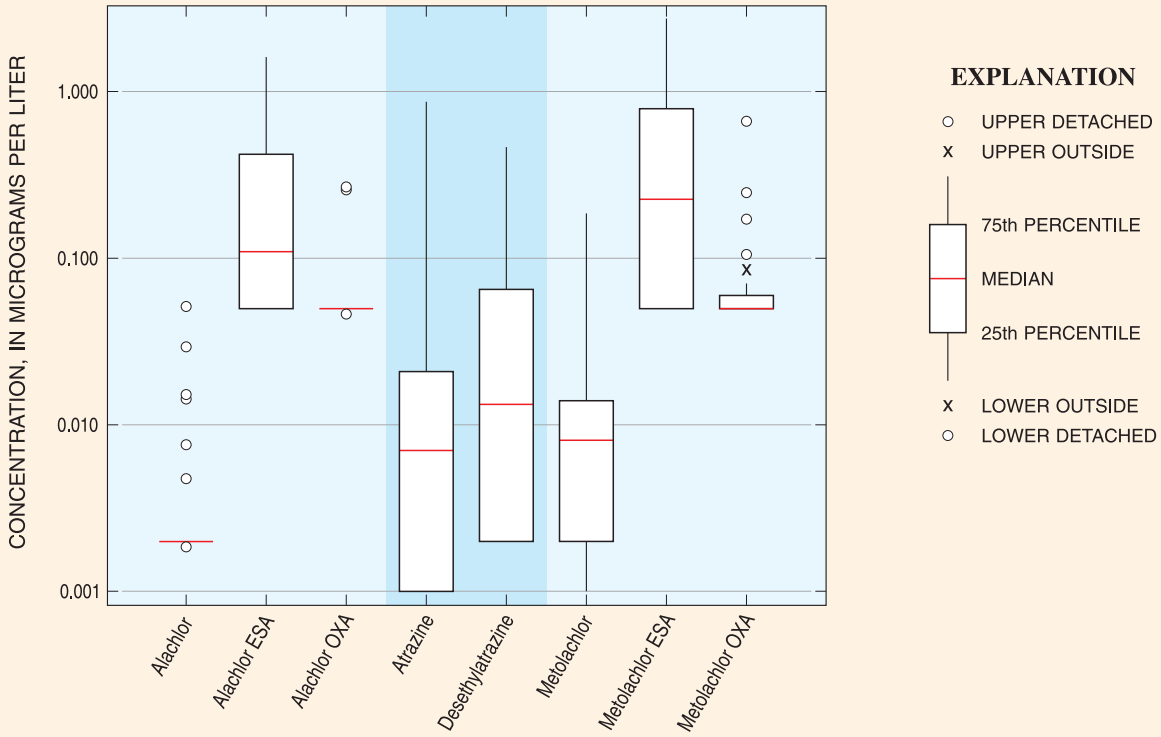


Figure 5. Concentrations of selected pesticides and associated metabolites in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware.

Table 3. *Summary statistics for pesticides and metabolites detected in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware, and comparisons to U.S. Environmental Protection Agency Primary Maximum Contaminant Levels and Health Advisories*

[*Italicized* compounds are degradation products of pesticides; <, less than; ---, not applicable; E, estimated value; nsg, no standard or guideline established; PMCL, Primary Maximum Contaminant Level; HA, Health Advisory; all concentrations are in micrograms per liter.]

Compound	Number of Detections	SUMMARY STATISTICS			PRIMARY MAXIMUM CONTAMINANT LEVEL[1]		HEALTH ADVISORIES[2]			
							Child[3]		Adult[4]	
		Minimum	Median	Maximum	PMCL	Number above PMCL	HA	Number above HA	HA	Number above HA
Alachlor	6	<0.002	<0.002	0.054	2	0	100	0	nsg	---
Alachlor ESA	20	<0.05	0.11	1.6	nsg	---	nsg	---	nsg	---
Alachlor OXA	2	<0.05	<0.05	0.28	nsg	---	nsg	---	nsg	---
Atrazine	15	<0.001	0.007	0.862	3	0	nsg	---	200	0
Butylate	1	<0.002	<0.002	0.01	nsg	---	2,000	0	400	0
Carbaryl	1	<0.003	<0.003	0.041	nsg	---	1,000	0	700	0
Carbofuran	6	<0.003	<0.003	E0.17	40	0	50	0	40	0
p,p'-DDE	1	E0.001	<0.006	<0.006	nsg	---	nsg	---	nsg	---
Desethylatrazine	21	<0.002	E0.014	E0.46	nsg	---	nsg	---	nsg	---
Dieldrin	9	<0.001	<0.003	0.106	nsg	---	0.5	0	nsg	---
Eptam	1	<0.002	<0.002	0.018	nsg	---	1,000	0	0.2	0
Lindane	3	E0.002	<0.004	0.009	0.2	0	2,000	0	100	0
Metolachlor	19	E0.001	<0.009	0.185	nsg	---	nsg	---	nsg	---
Metolachlor ESA	20	<0.05	0.23	2.92	nsg	---	nsg	---	nsg	---
Metolachlor OXA	9	<0.05	0.05	0.70	nsg	---	nsg	---	nsg	---
Pebulate	1	<0.002	<0.004	0.004	nsg	---	nsg	---	nsg	---
Prometon	10	E0.003	<0.018	0.149	nsg	---	200	0	100	0
Simazine	9	E0.004	<0.011	0.019	4	0	500	0	4	0
Tebuthiuron	6	E0.007	<0.01	0.39	nsg	---	3,000	0	500	0

[1] *U.S. Environmental Protection Agency, 2001*

[2] *U.S. Environmental Protection Agency, 2000*

[3] *The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to ten days of exposure for a 10-kilogram (22-pound) child.*

[4] *The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure.*

Volatile Organic Compounds

All wells had at least one VOC detection and most wells (28 out of 30) had two or more VOC detections (fig. 6). Four wells had ten or more VOC detections. Of the 85 VOCs analyzed, 34 compounds were detected in at least 1 of the 30 samples (table 4). Chloroform, tetrachloroethylene, and methyl *tert*-butyl ether (MTBE) were the most frequently detected compounds, and were detected in at least half of the samples (fig. 7). Many of the VOC detections were near, and in some cases, below the laboratory reporting level (table 5, Appendix G).

Possible sources of these VOC detections include chemical manufacturing, industrial processes (solvents, degreasers, dry cleaning), gasoline or other petroleum-based fuels, by-products of the chlorination of drinking water, or agricultural applications (used as either pesticides or solvents for pesticides). It is also possible that some of these detections, especially at low levels, are due to laboratory or sampling contamination. Chloroform, which was detected in samples from 28 out of 30 wells, is used in some industrial and manufacturing processes (production of chlorofluorocarbon-22 and vinyl chloride, an industrial solvent), but it is often produced during the chlorination of drinking water, as are several other VOCs that were detected in some samples (bromodichloromethane, bromoform, chloromethane, dibromochloromethane, and dichloromethane). Tetrachloroethene, detected in 20 of 27 samples, also is used in some industrial and manufacturing processes (production of chlorofluorocarbon-113, metal degreasing), but it is widely used in dry cleaning. None of the detections for chloroform or tetrachloroethene exceeded 4 µg/L and the median concentrations for each were about 0.1 µg/L (table 5). MTBE, detected in 17 out of 30 samples, is widely used as an additive in reformulated gasoline, and several other VOCs also are associated with gasoline or other petroleum-based fuels (benzene, ethyl *tert*-butyl ether, methyl *tert*-pentyl ether, and toluene).

None of the VOC detections were above the USEPA PMCLs or HAs (table 5). As with pesticides, PMCLs, SMCLs, or HAs have not been established for many of the VOCs detected. In addition, except for the PMCL for total trihalomethanes, no standard or guideline has been established for combinations of compounds. The USEPA has not established a PMCL for MTBE, but has placed it on the drinking water Contaminant Candidate List for further evaluation to determine whether regulation is necessary. As an interim measure, the USEPA has issued a Consumer Acceptability Advisory, which recommends control levels to prevent adverse taste and odor (U.S. Environmental Protection Agency, 2000). These levels (40 µg/L for taste and 20 µg/L for odor) also will provide protection against any potential adverse health effects, but are not legally enforceable (U.S. Environmental Protection Agency, 1997). None of the MTBE concentrations in this study were above these taste and odor levels.

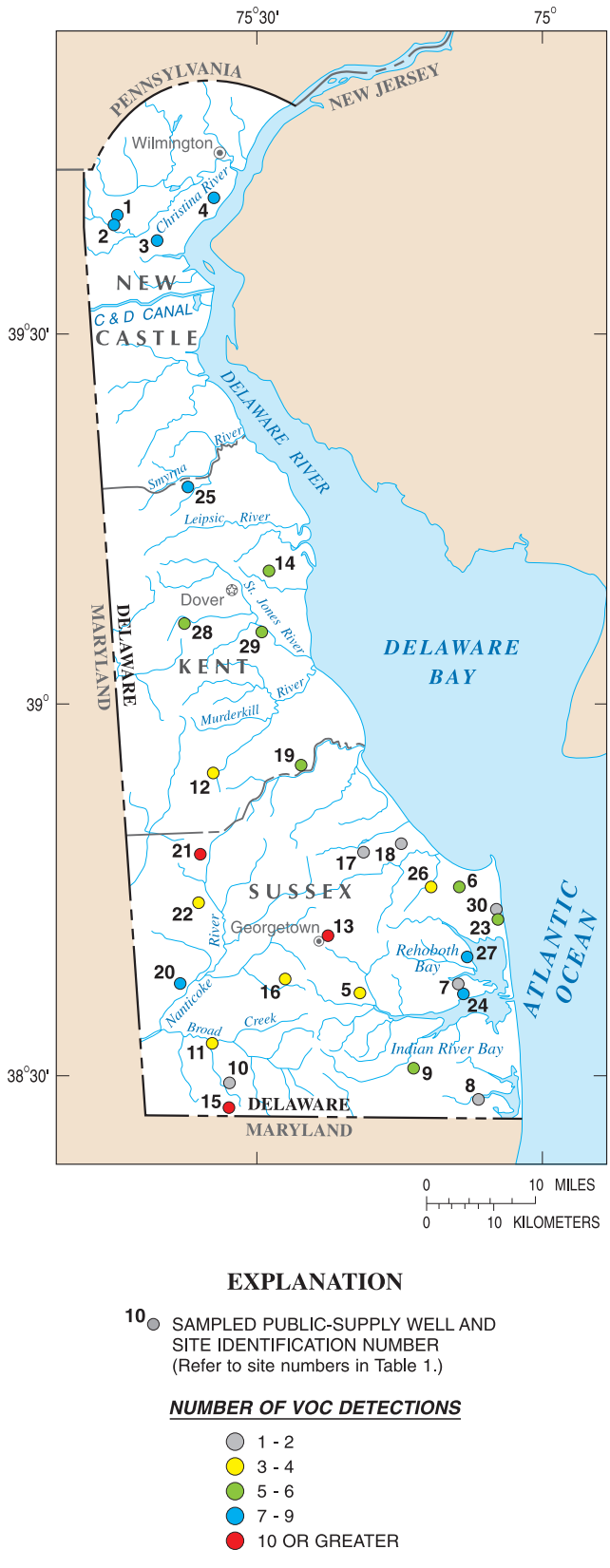


Figure 6. Volatile organic compound (VOC) detections at each sampling location of public-supply wells screened in the unconfined aquifer in Delaware.

Table 4. *Volatile organic compounds measured in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware*

[**Red** compounds were detected.]

Acetone	3-Chloropropene	**Dichloromethane**	Methyl acrylate	1,2,3,5-Tetramethylbenzene
Acrylonitrile	2-Chlorotoluene	**1,2-Dichloropropane**	Methyl acrylonitrile	1,2,3-Trichlorobenzene
Benzene	4-Chlorotoluene	1,3-Dichloropropane	**Methyl *tert*-butyl ether (MTBE)**	1,2,4-Trichlorobenzene
Bromobenzene	**Dibromochloromethane**	2,2-Dichloropropane	Methyl butyl ketone	**1,1,1-Trichloroethane**
Bromochloromethane	1,2-Dibromo-3-chloropropane	1,1-Dichloropropene	Methyl ethyl ketone	1,1,2-Trichloroethane
Bromodichloromethane	1,2-Dibromoethane	*cis*-1,3-Dichloropropene	Methyl iodide	**Trichloroethene**
Bromoform	Dibromomethane	*trans*-1,3-Dichloropropene	Methyl isobutyl ketone	**Trichlorofluoromethane**
Bromomethane	**1,2-Dichlorobenzene**	Diethyl ether	Methyl methacrylate	1,2,3-Trichloropropane
n-Butylbenzene	1,3-Dichlorobenzene	**Diisopropyl ether**	**Methyl *tert*-pentyl ether**	**1,1,2-Trichlorotrifluoroethane**
***sec*-Butylbenzene**	**1,4-Dichlorobenzene**	Ethylbenzene	Naphthalene	1,2,3-Trimethylbenzene
***tert*-Butylbenzene**	*trans*-1,4-Dichloro-2-butene	**Ethyl *tert*-butyl ether**	*n*-Propylbenzene	1,2,4-Trimethylbenzene
Carbon disulfide	**Dichlorodifluoromethane**	Ethyl methacrylate	Styrene	1,3,5-Trimethylbenzene
Carbon tetrachloride	**1,1-Dichloroethane**	*o*-Ethyl toluene	1,1,1,2-Tetrachloroethane	**Toluene**
Chlorobenzene	**1,2-Dichloroethane**	Hexachlorobutadiene	1,1,2,2-Tetrachloroethane	Vinyl bromide
Chloroethane	**1,1-Dichloroethene**	Hexachloroethane	**Tetrachloroethene**	Vinyl chloride
Chloroform	***cis*-1,2-Dichloroethene**	**Isopropylbenzene**	**Tetrahydofuran**	*m*- and *p*-Xylene
Chloromethane	*trans*-1,2-Dichloroethylene	***p*-Isopropyltoluene**	1,2,3,4-Tetramethylbenzene	*o*-Xylene

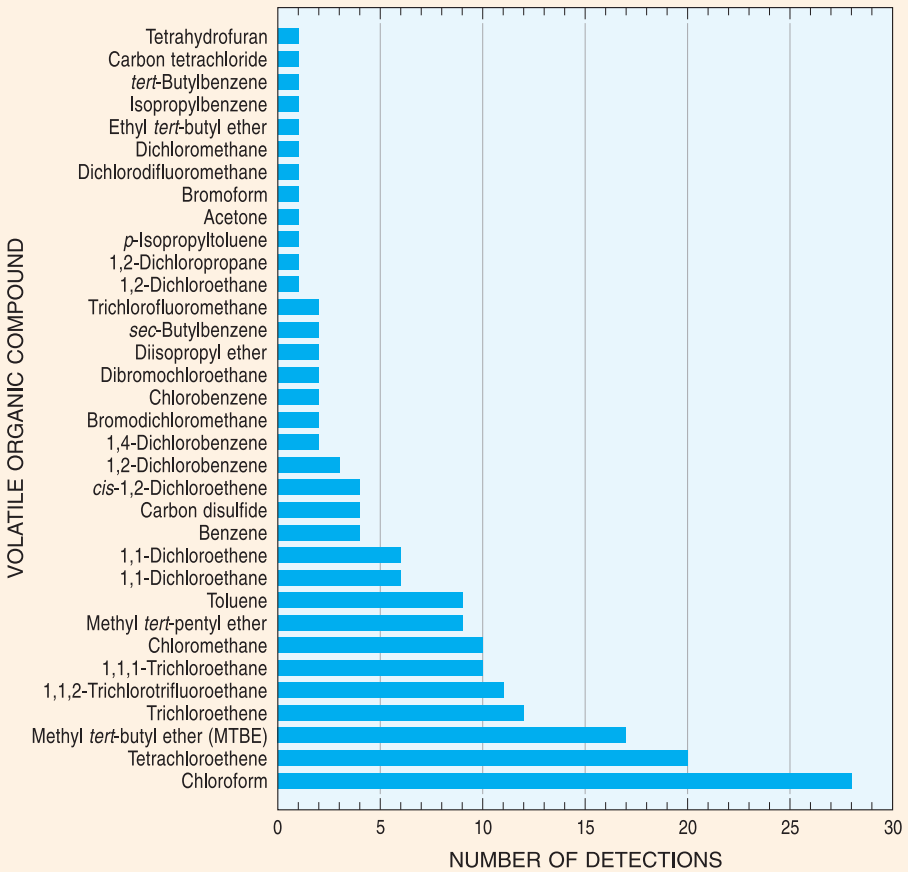


Figure 7. Volatile organic compounds detected in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware.

Table 5. *Summary statistics for volatile organic compounds detected in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware, and comparisons to U.S. Environmental Protection Agency Primary Maximum Contaminant Levels and Health Advisories*

[E, estimated value; <, less than; ---, not applicable; nsg, no standard or guideline established; M, detection verified but not quantified; PMCL, Primary Maximum Contaminant Level; HA, Health Advisory; all concentrations are in micrograms per liter.]

Compound	Number of Detections	SUMMARY STATISTICS			PRIMARY MAXIMUM CONTAMINANT LEVEL[1]		HEALTH ADVISORIES[2]			
							Child[3]		Adult[4]	
		Minimum	Median	Maximum	PMCL	Number above PMCL	HA	Number above HA	HA	Number above HA
Acetone	1	E6	<7	<7	nsg	---	nsg	---	nsg	---
Benzene	4	E0.01	<0.04	0.29	5	0	200	0	nsg	---
Bromodichloromethane	2	<0.05	<0.05	0.23	nsg[5]	---	nsg	---	nsg	---
Bromoform	1	E0.05	<0.06	<0.06	nsg[5]	---	nsg	---	nsg	---
sec-Butylbenzene	2	E0.01	<0.03	0.24	nsg	---	nsg	---	nsg	---
tert-Butylbenzene	1	E0.04	<0.06	<0.06	nsg	---	nsg	---	nsg	---
Carbon disulfide	4	E0.02	<0.07	<0.07	nsg	---	nsg	---	nsg	---
Carbon tetrachloride	1	E0.03	<0.06	<0.06	5	0	200	0	nsg	---
Chlorobenzene	2	<0.03	<0.03	0.49	100	0	nsg	---	nsg	---
Chloroform	28	E0.01	0.12	3.85	nsg[5]	---	4,000	0	nsg	---
Chloromethane	10	M	0.35	0.5	nsg	---	400	0	nsg	---
Dibromochloromethane	2	E0.1	<0.2	<0.2	nsg[5]	---	6,000	0	60	0
1,2-Dichlorobenzene	3	E0.03	<0.05	1.47	600	0	9,000	0	600	0
1,4-Dichlorobenzene	2	E0.02	<0.05	0.51	75	0	9,000	0	600	0
Dichlorodifluoromethane	1	<0.3	<0.3	E1.6	nsg	---	40,000	0	1,000	0
1,1-Dichloroethane	6	E0.02	<0.07	0.15	nsg	---	nsg	---	nsg	---
1,2-Dichloroethane	1	<0.1	<0.1	0.1	5	0	700	0	nsg	---
1,1-Dichloroethene	6	E0.01	<0.04	0.5	7	---	1,000	0	7	0
cis-1,2-Dichloroethene	4	E0.02	<0.04	0.08	70	0	1,000	0	70	0
Dichloromethane	1	M	<0.4	<0.4	5	0	2,000	0	nsg	---
1,2-Dichloropropane	1	<0.03	0.07	E0.07	5	0	90	0	nsg	---
Diisopropyl ether	2	E0.1	<0.1	0.5	nsg	---	nsg	---	nsg	---
Ethyl *tert*-butyl ether	1	<0.05	<0.05	0.36	nsg	---	nsg	---	nsg	---
Isopropylbenzene	1	E0.01	<0.03	<0.03	nsg	---	11,000	0	nsg	---
p-Isopropyltoluene	1	E0.01	<0.07	<0.07	nsg	---	nsg	---	nsg	---
Methyl *tert*-butyl ether (MTBE)	17	M	0.2	12	nsg	---	nsg	---	nsg	---
Methyl *tert*-pentyl ether	9	M	<0.1	0.4	nsg	---	nsg	---	nsg	---
Tetrachloroethene	20	M	0.1	1.9	5	0	2,000	0	10	0
Tetrahydrofuran	1	<2	<2	10	nsg	---	nsg	---	nsg	---
1,1,1-Trichloroethane	10	E0.01	<0.03	2.44	200	0	40,000	0	200	0
Trichloroethene	12	E0.01	<0.04	0.81	5	0	nsg	---	nsg	---
Trichlorofluoromethane	2	E0.01	<0.09	0.15	nsg	---	nsg	---	nsg	---
1,1,2-Trichlorotrifluoromethane	11	E0.02	<0.06	0.23	nsg	---	nsg	---	nsg	---
Toluene	9	E0.01	<0.05	0.05	nsg	---	nsg	---	nsg	---
Total trihalomethanes[6] (THM)		0.17	0.28	4.21	100	0	nsg	---	nsg	---

[1] *U.S. Environmental Protection Agency, 2001*

[2] *U.S. Environmental Protection Agency, 2000*

[3] *The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to ten days of exposure for a 10-kilogram (22-pound) child.*

[4] *The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure.*

[5] *Included in the PMCL for total trihalomethanes.*

[6] *Totals were calculated using one-half the value for any THM (bromodichloromethane, bromoform, chloroform, and dibromochloromethane) reported as a "less than" value.*

Inorganic Compounds

Field parameters, major ions, and nutrient data are summarized in table 6 and listed completely in Appendixes B and C. Most of these substances do not adversely affect human health and consequently, PMCLs or HAs have not been established for many of them (table 6). Drinking-water standards have been established for the nitrogen species nitrate and nitrite, at a PMCL of 10 mg/L (milligrams per liter) for nitrite plus nitrate ($NO_2 + NO_3$) and 1 mg/L for nitrite (U.S. Environmental Protection Agency, 2001). Only 1 sample out of 30 had a concentration of $NO_2 + NO_3$ above 10 mg/L (fig. 8), although the median concentration of $NO_2 + NO_3$ in the wells sampled was 5.2 mg/L as nitrogen.

SMCLs, non-enforceable standards that cover aesthetic effects (such as taste or odor) or cosmetic effects (such as tooth or skin coloration), have been established for seven of the analyzed compounds (U.S. Environmental Protection Agency, 2000). Compounds detected above their SMCLs include the chemical measure pH, which was more acidic than the SMCL in 29 out of 30 samples (table 6), and iron and manganese, which more frequently had concentrations above their SMCLs in Sussex and southern Kent counties (6 out of 22 samples) than in New Castle and northern Kent Counties (1 out of 8 samples) (fig. 8).

Major ions are chemical elements and molecules that have gained or lost one or more electrons when dissolved in water (although a few compounds like silica remain uncharged) and are found in most natural waters. Concentrations of some of these substances can be increased through human activities, such as an increase in chloride concentrations due to applications of road salt. Nutrients are nitrogen- or phosphorus-containing compounds that are necessary for plant growth, but they also contribute to eutrophication of surface-water bodies; some, such as nitrate, may have human-health effects. Although these compounds occur naturally, concentrations in ground or surface water can be increased through human activities, such as fertilizer and manure applications, sewage and septic effluent, or atmospheric deposition from the burning of coal and petroleum products.

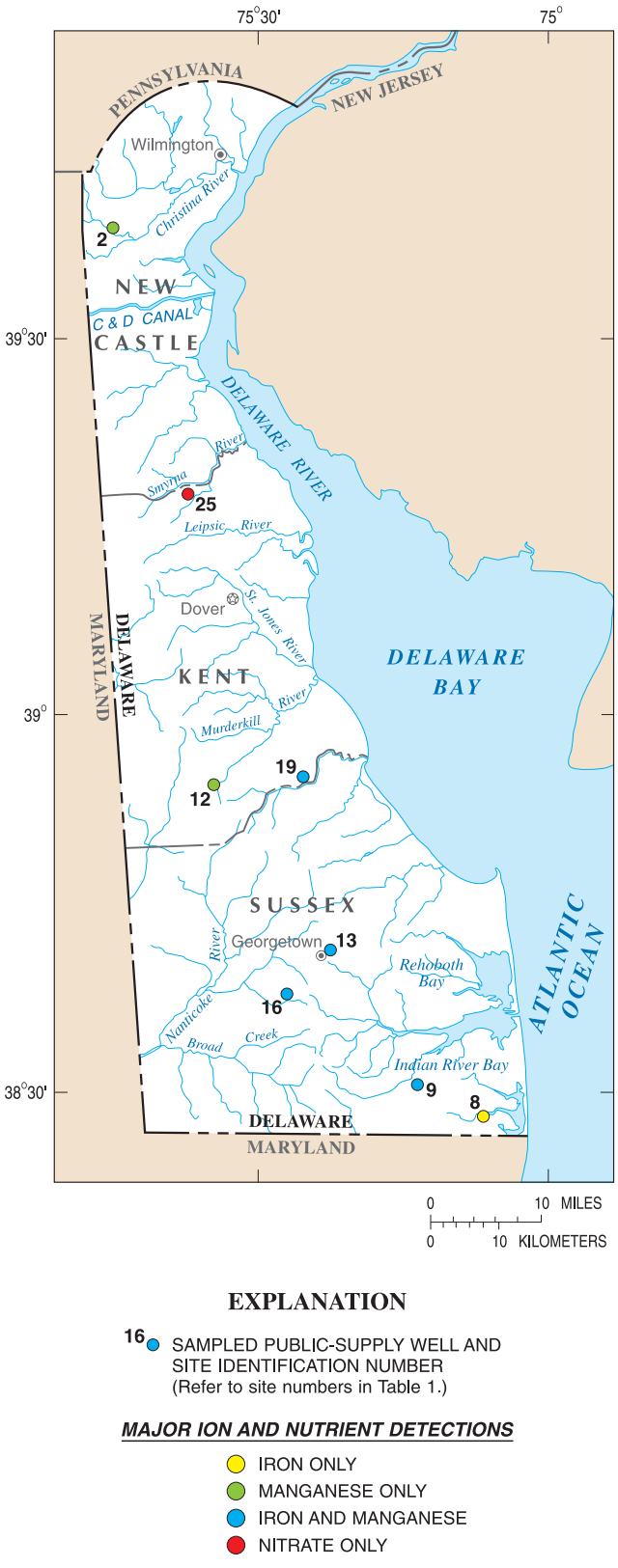


Figure 8. Location of detections above the U.S. Environmental Protection Agency Primary or Secondary Maximum Contaminant Levels of major ions and nutrients in ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware.

Table 6. *Summary statistics for selected field parameters, major ions, and nutrients for ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware, and comparisons to U.S. Environmental Protection Agency Primary and Secondary Maximum Contaminant Levels*

[PMCL, Primary Maximum Contaminant Level; SMCL, Secondary Maximum Contaminant Level; ---, not applicable; <, less than; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; E, estimated value; nsg, no standard or guideline established]

Constituent	Units	SUMMARY STATISTICS			PMCL[1]	Number above PMCL	SMCL[2]	Number above SMCL
		Minimum	Median	Maximum				
Field parameters								
pH	pH units	4.5	5.4	6.9	nsg	---	6.5-8.5	29
Specific conductance	µS/cm	63	149	389	nsg	---	nsg	---
Dissolved oxygen	mg/L	0.1	4.6	10.0	nsg	---	nsg	---
Major ions								
Calcium	mg/L	2.0	8.05	19.2	nsg	---	nsg	---
Bromide	mg/L	<0.01	0.05	0.12	nsg	---	nsg	---
Chloride	mg/L	4.6	18.3	60.8	nsg	---	250	0
Fluoride	mg/L	E0.01	<0.01	<0.02	4	0	2	0
Iron	mg/L	<0.01	E0.01	10.1	nsg	---	0.3	5
Magnesium	mg/L	0.73	3.91	12.4	nsg	---	nsg	---
Manganese	mg/L	<0.002	0.011	0.33	nsg	---	0.05	6
Potassium	mg/L	1.0	2.2	16.5	nsg	---	nsg	---
Silica	mg/L	9.4	17.7	39.2	nsg	---	nsg	---
Sodium	mg/L	5.3	11.7	25.9	nsg	---	nsg	---
Sulfate	mg/L	E0.2	13.8	44.4	nsg	---	250	0
Total dissolved solids	mg/L	56	116	221	nsg	---	500	0
Nutrients								
Nitrite plus nitrate	mg/L	<0.05	5.2	11.3	10	1	nsg	---
Nitrite	mg/L	<0.01	<0.01	0.024	1	0	nsg	---
Ammonia	mg/L	<0.02	<0.02	0.17	nsg	---	nsg	---
Total phosphorus	mg/L	E0.002	<0.008	2.1	nsg	---	nsg	---

[1] *U.S. Environmental Protection Agency, 2001*
[2] *U.S. Environmental Protection Agency, 2000*

Radium and Radon

Radium and radon are naturally occurring radioactive elements that have been detected adjacent to Delaware in ground water from aquifers in Maryland (Bolton, 2000) and New Jersey (Szabo and dePaul, 1998); radon also has been detected in southern New Castle County, Delaware (Bachman and Ferrari, 1995). Since similar aquifer settings are present in Delaware, 10 wells were chosen for sampling for radium isotopes (radium-224, radium-226, and radium-228), radon-222, gross-alpha activity, and gross-beta activity. Four of the 10 wells selected were in New Castle County (fig. 9), which most likely has the same aquifer characteristics as the areas in Maryland and New Jersey where radium was found. The other wells selected were in mainly agricultural areas, since there is an apparent relation of radium concentration to agricultural land use in New Jersey (Szabo and DePaul, 1998). Only one sample had detectable levels of radium-224 and -226; another sample contained detectable levels of radium-228 (table 7, Appendix H). Both of these samples also had detectable gross-alpha and gross-beta activities, as did several other samples. None of these concentrations or activities were above current standards (U.S. Environmental Protection Agency, 2001). Radon was detected in all 10 samples, but was above the proposed PMCL of 300 pCi/L (picocuries per liter) in only one sample.

Table 7. *Radiochemical activities for ground-water samples from public-supply wells screened in the unconfined aquifer in Delaware, and comparisons to U.S. Environmental Protection Agency Primary Maximum Contaminant Levels*

[All activities in picocuries per liter (pCi/L); <, less than; ---, no data; na, not applicable]

DGS local well number	Gross alpha	Gross beta	Radium-224	Radium-226	Radium-228	Radon-222
Db11-27	<3.00	<4.00	<1.00	<1.00	<1.00	246
Db11-28	<3.00	<4.00	<1.00	<1.00	<1.00	222
Dc31-15	<3.00	<4.00	<1.00	<1.00	<1.00	260
Cd52-15	1.72	1.19	<1.00	<1.00	<1.00	192
Forest Hills 1	1.05	---	<1.00	<1.00	<1.00	220
Qd52-09	---	0.41	<1.00	<1.00	<1.00	221
Pe23-185	<3.00	<4.00	<1.00	<1.00	<1.00	79
Pc33-44	10.55	7.6	1.94	1.29	---	155
Pot Nets 1	<3.00	<4.00	<1.00	<1.00	<1.00	343
Hc34-03	5.11	6.73	<1.00	<1.00	1.13	167
Primary Maximum Contaminant Level	15[1]	na	na	5[2,3]	5[2,3]	300[1,4]

[1] *U.S. Environmental Protection Agency, 2001*
[2] *U.S. Environmental Protection Agency, 2000*
[3] *PMCL for combined radium-226 and radium-228.*
[4] *PMCL currently under review.*

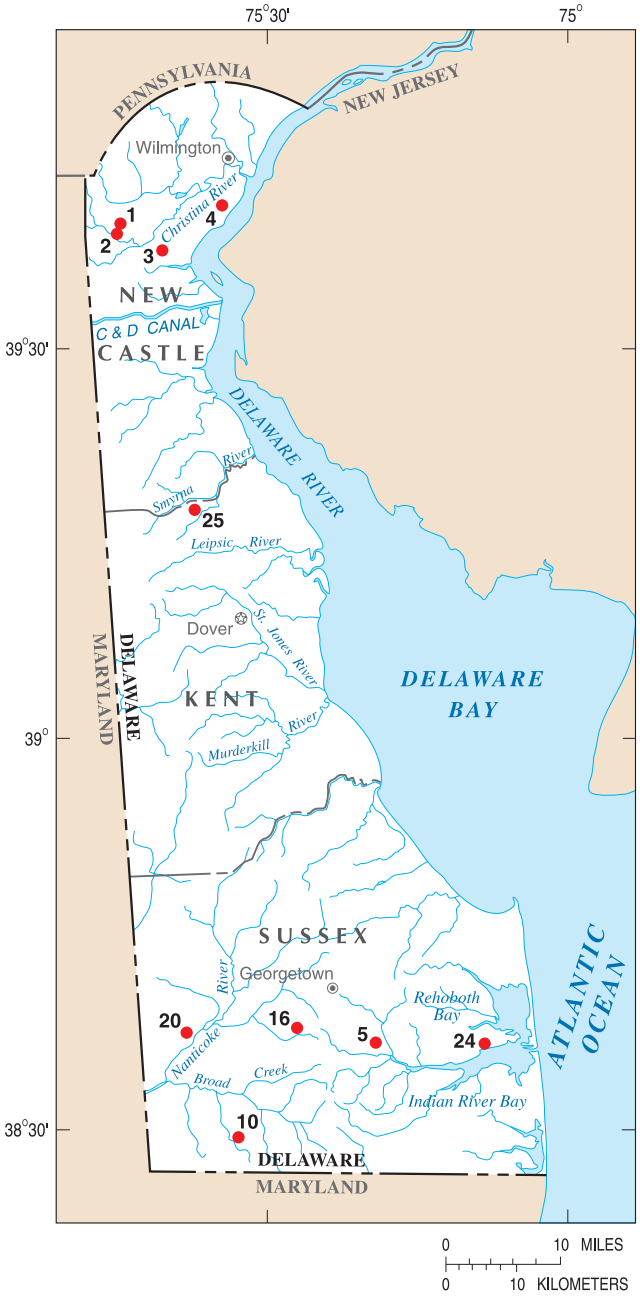


Figure 9. Location of public-supply wells in Delaware screened in the unconfined aquifer and sampled for radiochemistry.

Summary

This report presents ground-water quality data collected by the U.S. Geological Survey from August 2000 through November 2000 from public-supply wells screened in the unconfined aquifer in Delaware. This report also includes a description of the network design, sampling methods, and quality-assurance data analysis. Ground-water samples were collected from sample taps on 30 public-supply wells and analyzed for field parameters, major inorganic constituents, nutrients, pesticides, pesticide metabolites, volatile organic compounds, and age dating. Ground-water samples also were collected from 10 of the 30 wells and analyzed for radium and radon. Summary statistics and graphical analyses for selected constituents also are presented. Comparisons between ground-water quality data and U.S. Environmental Protection Agency Primary Maximum Contaminant Levels, Secondary Contaminant Levels, and Health Advisories also are presented, but these comparisons are for informational purposes only and should not be interpreted as evidence of compliance or non-compliance with Federal regulations.

At least one pesticide or metabolite was detected in ground-water samples from 27 of 30 wells, although concentrations were generally less than 1 microgram per liter. Of the 45 pesticides and 13 metabolites analyzed, 13 pesticides and 6 metabolites were detected in samples from at least 1 of the 30 wells. Desethylatrazine, alachlor ethane sulfonic acid, metolachlor ethane sulfonic acid, metolachlor, and atrazine were present in at least half the samples. None of the pesticides detected were present in concentrations above the U.S. Environmental Protection Agency Primary Maximum Contaminant Levels or Health Advisories.

Volatile organic compounds were detected in ground-water samples from all 30 wells, at concentrations that were generally less than 1 microgram per liter, however. Of the 85 volatile organic compounds analyzed, 34 compounds were detected in samples from at least 1 of the 30 wells. Chloroform, tetrachloroethene and methyl *tert*-butyl ether were present in at least half of the samples. None of the volatile organic compounds detected were present in concentrations above the U.S. Environmental Protection Agency Primary Maximum Contaminant Levels or Health Advisories.

Several samples contained inorganic compounds or radionuclides with concentrations above the U.S. Environmental Protection Agency Primary Maximum Contaminant Levels or Secondary Maximum Contaminant Levels. A nitrite-plus-nitrate concentration above the Primary Maximum Contaminant Level of 10 milligrams per liter was found in 1 sample out of 30. Iron and manganese concentrations above their respective Secondary Maximum Contaminant Levels were found in 7 out of 30 samples. Of the 10 ground-water samples analyzed for selected radionuclides, only 1 sample had detectable levels of radium-224 and -226, and another sample contained detectable levels of radium-228. Radon was detected in all 10 samples, but was present in concentrations above the proposed Primary Maximum Contaminant Level of 300 picocuries per liter in only 1 sample.

References Cited

Aspelin, A.L., and Grube, A.H., 1999, Pesticides industry sales and usage–1996 and 1997 market estimates: U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, 733–R–99–001, 39 p., accessed June 28, 2001, on the World Wide Web at URL *http://www.epa.gov/oppbead1/pestsales/97pestsales/97pestsales.pdf*

Bachman, L.J., and Ferrari, M.J., 1995, Quality and geochemistry of ground water in southern New Castle County, Delaware: Delaware Geological Survey Report of Investigations No. 52, 31 p.

Bolton, D.W., 2000, Occurrence and distribution of radium, gross alpha-particle activity, and gross beta-particle activity in ground water in the Magothy Formation and Potomac Group aquifers, upper Chesapeake Bay area, Maryland: Maryland Geological Survey Report of Investigations No. 70, 97 p.

Busenberg, Eurybiades, and Plummer, L.N., 2000, Dating young ground water with sulfur hexafluoride: Natural and anthropogenic sources of sulfur hexafluoride: Water Resources Research, v. 36 (10), p. 3,011–3,030.

Connor, B.F., Rose, D.L., Noriega, M.C., Murtagh, L.K., and Abney, S.R., 1998, Methods of analysis by the U.S. Geological Survey National Water-Quality Laboratory—Determination of 86 volatile organic compounds in water by gas chromatography/mass spectrometry, including detections less than reporting limits: U.S. Geological Survey Open-File Report 97–829, 78 p.

Fishman, M.J., 1993, Methods of analysis by the U.S. Geological Survey National Water-Quality Laboratory—Determination of inorganic and organic constituents in water and fluvial sediments: U.S. Geological Survey Open-File Report 93–125, 217 p.

Gianessi, L.P., and Marcelli, M.B., 2000, Pesticide use in U.S. crop production: 1997 National summary report: National Center for Food and Agricultural Policy, accessed June 26, 2000, on the World Wide Web at URL *http://www.ncfap.org/ncfap/index.html*

Koterba, M.T., Wilde, F.D., and Lapham, W.W., 1995, Ground-water data-collection protocols and procedures for the National Water-Quality Assessment Program: Collection and documentation of water-quality samples and related data: U.S. Geological Survey Open-File Report 95–399, 113 p.

Lee, E.A., Kish, J.L., Zimmerman, L.R., and Thurman, E.M., 2001, Methods of analysis by the U.S. Geological Survey Organic Geochemistry Research Group—Update and additions to the determination of chloroacetanilide herbicide degradation compounds in water using high-performance liquid chromatography/mass spectrometry: U.S. Geological Survey Open-File Report 01–10, accessed June 14, 2001, on the World Wide Web at URL *http://ks.water.usgs.gov/Kansas/pubs/reports/ofr.01-10.html*

Oblinger Childress, C.J., Foreman, W.T., Connor, B.F., and Maloney, T.J, 1999, New reporting procedures based on long-term method detection levels and some considerations for interpretations of water-quality data provided by the U.S. Geological Survey National Water-Quality Laboratory: U.S. Geological Survey Open-File Report 99–193, accessed August 30, 2001, on the World Wide Web at URL *http://water.usgs.gov/owq/OFR_99–193/ofr99_193.pdf*

Plummer, L.N., and Busenberg, Eurybiades, 1999, Chlorofluorocarbons: Tools for dating and tracing young groundwater *in* Cook, P., and Herczeg, A., eds, environmental tracers in subsurface hydrology: Boston, Massachusetts, Kluwer Academic Publishers, Chapter 15, p. 441–478, accessed June 14, 2001, on the World Wide Web at URL *http://water.usgs.gov/lab/cfc/background/Chapter.html*

Plummer, L.N., and Friedman, L.C., 1999, Tracing and dating young ground water: U.S. Geological Survey Fact Sheet FS-134–99, 4 p.

Scott, J.C., 1990, Computerized stratified random site-selection approaches for design of a ground-water-quality sampling network: U.S. Geological Survey Water-Resources Investigations Report 90–4101,109 p.

Szabo Z., and dePaul, V., 1998, Radium-226 and radium-228 in shallow ground water, southern New Jersey: U.S. Geological Survey Fact Sheet FS-062-98, 6 p.

U.S. Environmental Protection Agency, 1997, Drinking water advisory: Consumer acceptability advice and health effects analysis on methyl tertiary-butyl ether (MtBE): Office of Water, EPA–822–F–97–009, accessed June 15, 2001, on the World Wide Web at URL *http://www.epa.gov/OST/drinking/mtbe.html*

_____ **2000**, Drinking-water standards and health advisories: Office of Water, EPA 822–B–00–001, accessed May 23, 2001, on the World Wide Web at URL *http://www.epa.gov/ost/drinking/standards/dwstandards.pdf*

_____ **2001**, National Primary Drinking-Water Standards: U.S. Environmental Protection Agency, Office of Water, EPA 816–F–01–007, accessed May 23, 2001 on the World Wide Web at URL *http://www.epa.gov/safewater/consumer/mcl.pdf)*

Wilde, F.D., Radtke, D.B., Gibs, J., and Iwatsubo, R.T., eds., 1998, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, [variously paged.]

Zaugg, S.D., Sandstrom, M.W., Smith, S.G., and Fehlberg, K.M., 1995, Methods of analysis by the U.S. Geological Survey National Water-Quality Laboratory—determination of pesticides in water by C-18 solid-phase extraction and capillary-column gas chromatography/mass spectrometry with selective-ion monitoring: U.S. Geological Survey Open-File Report 95–181, 60 p.

Appendixes A Through J Follow

Appendix A. *Hydrologic data for the Delaware Source Water Assessment Program unconfined aquifer well network—Site information, well construction data, and modeled ages of ground-water samples*

[DGS, Delaware Geological Survey; USGS, U.S. Geological Survey; DNREC, Delaware Department of Natural Resources and Environmental Control; S, steel; P, plastic; U, unknown]

DGS local well number	USGS site identification number	DNREC permit number	Date well constructed	Casing material	Depth of well (feet)	Diameter of well (inches)	Depth to top of screen (feet)	Depth to bottom of screen (feet)	Elevation above land surface datum (feet)	Average modeled ground-water sample age (years)
Db11-27	393928075440202	10004	1956	S	66	10	41	62	20	8.5
Db11-28	393916075440802	10003	1956	U	62	10	31	62	20	7.0
Dc31-15	393739075394202	10434	1960	U	76	17	52	76	20	7.5
Cd52-15	394060075334601	10045	1953	S	74	17	58	74	15	6.0
Forest Hills 1	383705075192801	10700	U	S	110	4	U	110	10	U
Ni51-32	384526075091601	55833	1984	P	139	16	85	135	5	21.0
Pi31-02	383736075092801	49713	1982	S	70	8	55	70	5	15.5
Ri23-04	382830075073601	106344	1995	P	82	6	70	80	5	20.0
Frankford 2	383101075141101	10342	1934	U	85	8	69	81	10	23.0
Qd52-09	383000075326001	78054	1989	P	70	4	60	70	10	U
Qd21-12	383311075344401	35239	1975	S	100	12	70	100	5	18.5
Md11-04	385448075341801	65911	1986	U	70	10	50	70	15	11.0
Georgetown 1	384139075230101	10325	1948	U	120	U	U	120	15	19.5
Ie42-03	391060075282801	85022	1991	S	70	16	49	64	5	12.0
Rd22-01	382805075330301	66041	1986	P	60	2	52	60	15	15.0
Pe23-185	383815075271001	72060	1987	P	120	4	100	110	10	18.5
Ng21-03	384819075190101	71704	1987	P	111	4	91	111	10	20.5
Ng25-04	384856075151101	97993	1994	P	139	8	99	139	5	18.5
Le55-09	385522075251802	31756	1974	S	91	10	71	91	10	18.0
Pc33-44	383801075375701	10369	1962	U	105	U	82	97	10	12.5
Nc25-37	384818075354101	72714	1988	S	63	12	40	63	15	15.0
Oc15-11	384428075355701	10319	1955	U	119	12	100	119	15	13.0
Oi25-18	384322075051101	93955	1993	P	38	4	23	38	5	9.0
Pot Nets 1	383649075090801	10651	1962	U	85	6	U	85	5	24.5
Hc34-03	391747075364202	10068	1948	S	100	10	80	95	20	13.0
Nh53-01	384530075121101	30657	1974	S	110	4	100	110	10	17.0
Pi12-08	383947075083401	32247	1974	P	55	4	45	55	5	12.0
Jc43-05	390652075370701	82964	1990	P	70	4	60	70	20	17.0
Je41-08	390619075290901	10735	1955	U	40	4	U	40	5	9.5
Oi25-19	384326075050801	93496	1992	U	37	4	27	37	5	9.0

Appendix B. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Field parameters*

[DGS, Delaware Geological Survey; USGS, U.S. Geological Survey; mm Hg, millimeters mercury; mg/L milligrams per liter; %, percent; µS/cm, microsiemens per centimeter; °C, degrees Celsius; gal/min, gallons per minute; min, minute; –, no data]

DGS local well number	USGS site identification number	Sample date	Sample time	Air pressure (mm Hg)	Dissolved oxygen (mg/L)	Dissolved oxygen (% of saturation)	pH, field units	pH, laboratory units
Db11-27	393928075440202	08/07/2000	1000	768	6.7	67	5.4	5.6
Db11-27	393928075440202	09/27/2000	1109	766	6.3	62	5.3	–
Db11-28	393916075440802	08/07/2000	1500	768	4.5	46	5.3	5.6
Db11-28	393916075440802	09/27/2000	1005	766	3.3	33	5.4	–
Dc31-15	393739075394202	08/08/2000	1000	769	7.8	75	5.5	5.8
Dc31-15	393739075394202	09/27/2000	1312	766	6.7	65	5.3	–
Cd52-15	394060075334601	08/08/2000	1400	769	4.5	45	5.6	5.7
Cd52-15	394060075334601	09/27/2000	1448	766	6.8	67	5.6	–
Forest Hills 1	383705075192801	08/16/2000	1130	768	6.2	60	5.4	5.7
Forest Hills 1	383705075192801	10/12/2000	1100	777	5.3	51	5.5	–
Ni51-32	384526075091601	08/17/2000	1100	773	4.7	46	5.5	5.6
Pi31-02	383736075092801	08/17/2000	1500	773	8.1	78	5.3	5.5
Ri23-04	382830075073601	08/21/2000	1100	778	0.1	1	5.9	6.0
Frankford 2	383101075141101	08/21/2000	1500	778	0.1	1	5.4	5.8
Qd52-09	383000075326001	08/22/2000	1000	778	10.0	97	5.7	5.9
Qd52-09	383000075326001	10/12/2000	0900	778	3.4	32	5.4	–
Qd21-12	383311075344401	08/22/2000	1400	778	9.8	96	5.6	5.7
Md11-04	385448075341801	08/23/2000	1000	774	5.7	57	5.6	5.6
Georgetown 1	384139075230101	08/23/2000	1400	774	0.1	1	5.1	5.2
Ie42-03	391060075282801	08/29/2000	0900	773	4.7	55	6.9	5.6
Rd22-01	382805075330301	08/31/2000	0930	772	0.2	2	5.4	5.9
Pe23-185	383815075271001	09/05/2000	1130	774	0.1	1	5.9	6.2
Ng21-03	384819075190101	09/06/2000	0830	779	7.5	74	5.1	5.4
Ng25-04	384856075151101	09/06/2000	1200	779	0.9	9	5.4	5.8
Le55-09	385522075251802	09/07/2000	0900	779	0.5	5	5.7	5.6
Pc33-44	383801075375701	09/12/2000	0930	772	6.8	68	4.5	4.8
Nc25-37	384818075354101	09/12/2000	1300	772	3.5	36	5.0	5.4
Oc15-11	384428075355701	09/13/2000	0900	768	6.1	61	5.3	5.7
Oi25-18	384322075051101	09/13/2000	1300	768	3.3	33	5.5	5.8
Pot Nets 1	383649075090801	10/11/2000	1000	774	5.1	49	5.4	5.8
Hc34-03	391747075364202	10/16/2000	1200	772	4.5	44	5.3	5.7
Nh53-01	384530075121101	10/24/2000	1000	781	3.2	30	5.0	5.4
Pi12-08	383947075083401	10/24/2000	1300	780	6.3	60	5.7	5.9
Jc43-05	390652075370701	10/26/2000	1000	776	4.0	38	5.3	5.5
Je41-08	390619075290901	10/26/2000	1300	777	5.8	56	5.0	5.3
Oi25-19	384326075050801	11/01/2000	1000	764	3.3	32	5.5	5.6

Specific conductance, field (µS/cm)	Specific conductance, laboratory (µS/cm)	Air temperature (°C)	Water temperature (°C)	Alkalinity (mg/L as $CaCO_3$)	Bicarbonate (mg/L as HCO_3)	Flow rate (gal/min)	Pumping period (min)	DGS local well number
289	291	32.5	16.0	18	22	–	35	Db11-27
293	–	20.5	15.0	–	–	–	25	Db11-27
245	246	33.0	16.5	17	21	–	40	Db11-28
228	–	20.5	16.0	–	–	–	30	Db11-28
267	269	28.0	14.0	18	21	330	30	Dc31-15
262	–	19.5	14.0	–	–	–	30	Dc31-15
265	266	32.0	15.5	14	17	–	45	Cd52-15
264	–	21.0	15.0	–	–	–	35	Cd52-15
136	134	31.5	14.5	10	12	–	50	Forest Hills 1
118	–	20.5	14.5	–	–	–	28	Forest Hills 1
149	152	25.0	15.0	8	10	1,300	45	Ni51-32
140	139	23.0	14.5	5	6	220	30	Pi31-02
169	168	25.5	15.5	24	29	–	55	Ri23-04
199	196	27.0	15.5	22	26	–	45	Frankford 2
74	76	23.0	15.0	12	15	–	50	Qd52-09
51	–	15.0	14.0	–	–	–	25	Qd52-09
150	151	27.0	15.5	8	10	–	45	Qd21-12
272	270	26.0	16.0	13	16	–	30	Md11-04
389	384	27.5	16.0	23	29	–	30	Georgetown 1
214	216	–	23.5	8	9	–	30	Ie42-03
85	88	26.0	16.0	19	24	–	30	Rd22-01
64	92	17.5	17.5	41	49	–	60	Pe23-185
120	149	19.0	15.5	5	6	–	20	Ng21-03
63	94	21.0	15.0	9	11	–	25	Ng25-04
198	222	22.0	16.5	16	19	–	30	Le55-09
144	176	29.0	16.0	–	–	–	50	Pc33-44
148	204	29.0	17.5	10	12	–	40	Nc25-37
95	127	27.0	16.0	6	7	–	30	Oc15-11
190	223	24.0	16.0	22	27	–	15	Oi25-18
63	84	17.5	14.0	8	9	–	27	Pot Nets 1
176	183	22.0	15.0	15	18	–	30	Hc34-03
97	114	15.5	14.0	3	4	–	30	Nh53-01
84	156	17.0	14.0	15	18	–	60	Pi12-08
148	182	14.5	14.0	11	14	–	40	Jc43-05
100	116	18.0	15.0	6	7	–	60	Je41-08
261	219	10.5	14.5	15	19	–	30	Oi25-19

Appendix C. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Major inorganic compounds*

[DGS, Delaware Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; **E**, estimated value; <, less than; –, no data]

DGS local well number	Bromide (mg/L as Br)	Calcium (mg/L as Ca)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Iron (µg/L as Fe)	Magnesium (mg/L as Mg)	Manganese (µg/L as Mn)
Db11-27	0.05	19.2	30.6	<0.1	**E** 10	12.4	3
Db11-28	0.06	14.8	31.2	<0.1	30	9.04	327
Dc31-15	0.05	14.6	35.4	<0.1	<10	8.71	3
Cd52-15	0.05	16.1	27.9	<0.1	10	9.65	11
Forest Hills 1	0.05	8.05	11.9	<0.1	<10	2.18	4
Ni51-32	0.06	6.64	15.7	<0.1	10	3.64	7
Pi31-02	0.04	4.91	13.4	<0.1	<10	4.24	7
Ri23-04	0.05	7.49	19.4	<0.1	4,590	2.11	38
Frankford 2	0.03	6.97	31.3	<0.1	9,640	1.91	70
Qd52-09	0.02	2.95	6.6	<0.1	<10	0.73	**E** 2
Qd21-12	0.04	8.81	10.1	<0.1	20	4.04	15
Md11-04	0.08	19.2	26.5	<0.1	**E** 10	5.45	7
Georgetown 1	0.11	19.1	60.8	<0.1	2,000	6.46	150
Ie42-03	0.05	14.3	17.9	<0.1	<10	7.41	12
Rd22-01	<0.01	3.67	8.6	<0.1	10	0.84	34
Pe23-185	0.06	3.25	4.6	<0.1	10,100	0.86	171
Ng21-03	0.05	9.35	12.1	<0.1	40	3.78	8
Ng25-04	0.08	2.80	18.4	<0.1	10	0.91	<2
Le55-09	0.09	13.3	27.1	<0.1	7,420	4.43	242
Pc33-44	0.04	7.42	21.6	<0.1	30	3.78	40
Nc25-37	0.02	9.78	25	<0.1	<10	4.68	46
Oc15-11	0.03	6.18	8.7	<0.1	**E** 10	1.62	3
Oi25-18	0.08	12.8	27.8	<0.1	20	6.18	8
Pot Nets 1	0.05	1.98	10.5	<0.2	20	0.87	**E** 2
Hc34-03	0.05	10.7	18.2	<0.2	<10	5.79	59
Nh53-01	0.05	3.73	12.1	<0.2	**E** 10	1.68	17
Pi12-08	0.06	5.93	22	**E** 0.1	<10	3.41	<3
Jc43-05	0.01	11.3	16.9	<0.2	250	3.29	20
Je41-08	0.07	4.75	10.7	<0.2	<10	4.47	25
Oi25-19	0.12	8.05	30.8	<0.2	<10	7.75	<3

Potassium (mg/L as K)	Silica (mg/L as SiO_2)	Sodium (mg/L as Na)	Sulfate (mg/L as SO_4)	Dissolved residue (mg/L)	Total dissolved solids (mg/L)	Dissolved noncarbonate hardness (mg/L as $CaCO_3$)	Total hardness (mg/L as $CaCO_3$)	DGS local well number
2.4	13.5	9.1	28.4	176	163	81	99	Db11-27
2.8	13.6	11.2	20.3	153	137	57	74	Db11-28
2.8	14.1	16.3	24.0	168	151	55	72	Dc31-15
3.5	16.9	12.7	39.2	156	154	66	80	Cd52-15
1.8	21.6	9.9	**E** 0.2	115	–	19	29	Forest Hills 1
2.3	16.4	11.9	9.6	98	96	23	32	Ni51-32
2.0	16.0	10.0	2.4	98	88	25	30	Pi31-02
1.4	33.1	16.3	17.2	121	116	4	27	Ri23-04
1.6	26.1	17.7	17.4	129	126	4	25	Frankford 2
1.2	26.2	8.7	3.3	66	63	–	10	Qd52-09
2.4	18.4	9.4	12.1	104	100	30	39	Qd21-12
1.8	25.2	17.2	20.0	204	173	57	70	Md11-04
16.5	20.1	25.9	44.4	231	221	50	74	Georgetown 1
3.8	18.5	9.0	24.0	139	135	59	66	Ie42-03
1.1	39.2	10.8	2.4	79	82	–	13	Rd22-01
1.0	29.2	6.3	0.4	73	80	–	12	Pe23-185
4.6	13.0	5.3	1.7	107	92	34	39	Ng21-03
1.5	14.6	10.5	0.8	61	56	2	11	Ng25-04
2.7	20.0	12.0	41.9	144	139	36	51	Le55-09
2.8	11.4	13.3	15.5	95	–	–	34	Pc33-44
3.0	19.2	16.9	4.2	127	126	34	44	Nc25-37
2.2	19.1	11.6	<0.3	97	–	16	22	Oc15-11
1.9	9.4	15.2	22.5	120	120	35	58	Oi25-18
1.4	18.5	10.5	1.5	60	62	1	9	Pot Nets 1
4.2	15.2	9.8	17.8	117	114	36	51	Hc34-03
1.8	15.4	11.8	3.5	65	77	13	16	Nh53-01
1.6	15.6	14.9	11.0	83	99	14	29	Pi12-08
1.6	25.0	14.6	19.4	124	125	30	42	Jc43-05
2.4	13.5	5.9	5.4	66	74	25	30	Je41-08
2.2	14.1	18.1	26.7	126	122	36	52	Oi25-19

Appendix D. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Nutrients*

[DGS, Delaware Geological Survey; mg/L, milligrams per liter; <, less than; **E**, estimated value]

DGS local well number	Sample date	Ammonia (mg/L as N)	Dissolved ammonia plus organic (mg/L as N)	Total ammonia plus organic (mg/L as N)	Nitrite plus nitrate (mg/L as N)	Nitrite (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Phosphorus, total (mg/L as P)	Ortho-phosphorus (mg/L as P)
Db11-27	08/07/2000	<0.020	<0.10	<0.10	8.36	<0.010	<0.006	<0.008	<0.010
Db11-28	08/07/2000	<0.020	<0.10	**E** 0.05	5.23	<0.010	<0.006	<0.008	<0.010
Dc31-15	08/08/2000	<0.020	<0.10	<0.10	5.56	<0.010	<0.006	<0.008	<0.010
Cd52-15	08/08/2000	<0.020	<0.10	<0.10	4.40	<0.010	<0.006	<0.008	<0.010
Forest Hills 1	08/16/2000	<0.020	<0.10	<0.10	7.85	<0.010	<0.006	<0.008	<0.010
Ni51-32	08/17/2000	<0.020	<0.10	<0.10	5.54	<0.010	<0.006	<0.008	<0.010
Pi31-02	08/17/2000	<0.020	**E** 0.05	**E** 0.07	7.33	<0.010	<0.006	<0.008	<0.010
Ri23-04	08/21/2000	0.031	**E** 0.06	**E** 0.09	<0.050	<0.010	0.052	0.026	0.019
Frankford 2	08/21/2000	0.167	0.24	0.23	<0.050	<0.010	0.068	0.048	0.033
Qd52-09	08/22/2000	<0.020	<0.10	<0.10	1.28	<0.010	0.007	**E** 0.007	<0.010
Qd21-12	08/22/2000	<0.020	< 0.10	**E** 0.06	6.74	<0.010	**E** 0.003	**E** 0.004	<0.010
Md11-04	08/23/2000	<0.020	**E** 0.06	**E** 0.06	11.3	<0.010	0.008	0.009	<0.010
Georgetown 1	08/23/2000	<0.020	0.15	0.16	2.62	<0.010	<0.006	<0.008	<0.010
Ie42-03	08/29/2000	<0.020	**E** 0.05	<0.10	8.14	<0.010	0.024	0.024	0.025
Rd22-01	08/31/2000	<0.020	<0.10	<0.10	.866	0.024	**E** 0.003	<0.008	<0.010
Pe23-185	09/05/2000	0.055	**E** 0.07	**E** 0.05	<0.050	<0.010	0.009	0.009	<0.010
Ng21-03	09/06/2000	<0.020	<0.1	<0.10	8.75	<0.010	<0.006	<0.008	<0.010
Ng25-04	09/06/2000	<0.020	<0.1	<0.10	0.118	<0.010	**E** 0.003	<0.008	<0.010
Le55-09	09/07/2000	0.078	**E** 0.06	**E** 0.10	<0.050	<0.010	0.053	0.057	0.035
Pc33-44	09/12/2000	<0.020	**E** 0.07	**E** 0.10	4.96	<0.010	<0.006	<0.008	<0.010
Nc25-37	09/12/2000	<0.020	<0.10	<0.10	8.43	<0.010	<0.006	<0.008	<0.010
Oc15-11	09/13/2000	<0.020	<0.10	<0.10	8.78	<0.010	<0.006	<0.008	<0.010
Oi25-18	09/13/2000	0.047	**E** 0.08	0.10	2.35	<0.010	<0.006	<0.008	<0.010
Pot Nets 1	10/11/2000	<0.041	**E** 0.08	<0.10	2.67	<0.006	<0.006	0.004	<0.018
Hc34-03	10/16/2000	< 0.041	<0.10	<0.10	5.18	<0.006	0.013	0.016	0.037
Nh53-01	10/24/2000	<0.041	<0.10	<0.10	5.55	<0.006	<0.006	<0.004	<0.018
Pi12-08	10/24/2000	< 0.041	<0.10	<0.10	3.49	<0.006	<0.006	**E** 0.002	<0.018
Jc43-05	10/26/2000	<0.041	<0.10	<0.10	5.53	<0.006	0.060	2.10	0.325
Je41-08	10/26/2000	< 0.041	<0.10	<0.10	5.28	<0.006	<0.006	<0.004	<0.018
Oi25-19	11/01/2000	<0.041	<0.10	**E** 0.05	1.16	<0.006	**E** 0.003	0.006	<0.018

Appendix E Follows

Appendix E. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Pesticides*

[DGS, Delaware Geological Survey; **E**, estimated value; –, no data; <, less than; numbers below the chemical names are the Chemical Abstracts Service (CAS) registry numbers; all concentrations are in micrograms per liter]

DGS local well number	Sample date	Acetochlor (34256-82-1)	Alachlor (15972-60-8)	Atrazine (1912-24-9)	Azinphos-methyl (86-50-0)	Benfluralin (1861-40-1)	Butylate (2008-41-5)	Carbaryl (63-25-2)
Db11-27	08/07/2000	<0.002	0.005	0.393	<0.001	<0.002	0.01	<0.003
Db11-28	08/07/2000	<0.002	<0.002	0.224	<0.001	<0.002	<0.002	<0.003
Dc31-15	08/08/2000	<0.002	<0.002	0.122	<0.001	<0.002	<0.002	<0.003
Cd52-15	08/08/2000	<0.002	<0.002	0.021	<0.001	<0.002	<0.002	<0.003
Forest Hills 1	08/16/2000	<0.004	<0.002	**E** 0.002	<0.05	<0.01	<0.002	<0.041
Ni51-32	08/17/2000	<0.002	<0.002	0.067	<0.001	<0.002	<0.002	<0.003
Pi31-02	08/17/2000	<0.002	0.015	**E** 0.004	<0.001	<0.002	<0.002	<0.003
Ri23-04	08/21/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003
Frankford 2	08/21/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003
Qd52-09	08/22/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003
Qd21-12	08/22/2000	<0.002	0.008	0.007	<0.001	<0.002	<0.002	<0.003
Md11-04	08/23/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003
Georgetown 1	08/23/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.003	<0.003
Ie42-03	08/29/2000	<0.002	<0.002	0.024	<0.001	<0.002	<0.002	<0.003
Rd22-01	08/31/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003
Pe23-185	09/05/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003
Ng21-03	09/06/2000	<0.002	<0.002	0.862	<0.001	<0.002	<0.002	<0.003
Ng25-04	09/06/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003
Le55-09	09/07/2000	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003
Pc33-44	09/12/2000	<0.002	0.016	0.011	<0.001	<0.002	<0.002	<0.003
Nc25-37	09/12/2000	<0.002	0.054	0.007	<0.001	<0.002	<0.002	<0.003
Oc15-11	09/13/2000	<0.002	0.031	0.005	<0.001	<0.002	<0.002	<0.003
Oi25-18	09/13/2000	<0.002	<0.002	**E** 0.003	<0.001	<0.002	<0.002	<0.003
Pot Nets 1	10/11/2000	<0.004	<0.002	<0.007	<0.05	<0.01	<0.002	<0.041
Hc34-03	10/16/2000	<0.004	<0.005	0.054	<0.05	<0.01	<0.002	<0.041
Nh53-01	10/24/2000	<0.004	<0.002	<0.007	<0.05	<0.01	<0.002	<0.041
Pi12-08	10/24/2000	<0.004	<0.002	<0.007	<0.05	<0.01	<0.002	<0.041
Jc43-05	10/26/2000	<0.004	<0.002	<0.007	<0.05	<0.01	<0.002	<0.041
Je41-08	10/26/2000	<0.004	<0.002	<0.007	<0.05	<0.01	<0.002	<0.041
Oi25-19	11/01/2000	<0.004	<0.002	<0.007	<0.05	<0.01	<0.002	**E** 0.009

Carbofuran (1563-66-2)	Chlorpyrifos (2921-88-2)	Cyanazine (21725-46-2)	Dacthal (1861-32-1)	Diazinon (333-41-5)	Dieldrin (60-57-1)	Disulfoton (298-04-4)	Eptam (759-94-4)	DGS local well number
<0.003	<0.004	<0.004	<0.002	<0.002	0.081	<0.017	0.018	Db11-27
<0.003	<0.004	<0.004	<0.002	<0.002	0.065	<0.017	<0.002	Db11-28
<0.003	<0.004	<0.004	<0.002	<0.002	0.026	<0.017	<0.002	Dc31-15
<0.003	<0.004	<0.004	<0.002	<0.002	0.106	<0.017	<0.002	Cd52-15
<0.02	<0.005	<0.018	<0.003	<0.005	<0.005	<0.021	<0.002	Forest Hills 1
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Ni51-32
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Pi31-02
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Ri23-04
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Frankford 2
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Qd52-09
<0.003	<0.004	<0.004	<0.002	<0.002	<0.013	<0.017	<0.002	Qd21-12
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Md11-04
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Georgetown 1
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Ie42-03
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Rd22-01
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Pe23-185
E 0.12	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Ng21-03
<0.003	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Ng25-04
E 0.005	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Le55-09
E 0.008	<0.004	<0.004	<0.002	<0.002	0.105	<0.017	<0.002	Pc33-44
E 0.15	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Nc25-37
E 0.17	<0.004	<0.004	<0.002	<0.002	<0.001	<0.017	<0.002	Oc15-11
<0.003	<0.004	<0.004	<0.002	<0.002	0.047	<0.017	<0.002	Oi25-18
<0.02	<0.005	<0.018	<0.003	<0.005	<0.005	<0.021	<0.002	Pot Nets 1
<0.02	<0.005	<0.018	<0.003	<0.005	0.04	<0.021	<0.002	Hc34-03
<0.02	<0.005	<0.018	<0.003	<0.005	<0.005	<0.021	<0.002	Nh53-01
<0.02	<0.005	<0.018	<0.003	<0.005	<0.005	<0.021	<0.002	Pi12-08
<0.02	<0.005	<0.018	<0.003	<0.005	<0.005	<0.021	<0.002	Jc43-05
E 0.14	<0.005	<0.018	<0.003	<0.005	<0.005	<0.021	<0.002	Je41-08
<0.02	<0.005	<0.018	<0.003	<0.005	0.087	<0.021	<0.002	Oi25-19

Appendix E. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Pesticides*—Continued

DGS local well number	Sample date	Ethalfluralin (55283-68-6)	Ethoprophos (13194-48-4)	Fonofos (944-22-9)	Glyphosate (1071-83-6)	α-HCH (319-84-6)	Lindane (58-89-9)	Linuron (330-55-2)
Db11-27	08/07/2000	<0.004	<0.003	<0.003	<5	<0.002	0.009	<0.002
Db11-28	08/07/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Dc31-15	08/08/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Cd52-15	08/08/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Forest Hills 1	08/16/2000	<0.009	<0.005	<0.003	–	<0.005	<0.004	<0.035
Ni51-32	08/17/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Pi31-02	08/17/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Ri23-04	08/21/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Frankford 2	08/21/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Qd52-09	08/22/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Qd21-12	08/22/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Md11-04	08/23/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Georgetown 1	08/23/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Ie42-03	08/29/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Rd22-01	08/31/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Pe23-185	09/05/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Ng21-03	09/06/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Ng25-04	09/06/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Le55-09	09/07/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Pc33-44	09/12/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Nc25-37	09/12/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Oc15-11	09/13/2000	<0.004	<0.003	<0.003	<5	<0.002	<0.004	<0.002
Oi25-18	09/13/2000	<0.004	<0.003	<0.003	<5	<0.002	**E** 0.002	<0.002
Pot Nets 1	10/11/2000	<0.009	<0.005	<0.003	–	<0.005	<0.004	<0.035
Hc34-03	10/16/2000	<0.009	<0.005	<0.003	–	<0.005	<0.004	<0.035
Nh53-01	10/24/2000	<0.009	<0.005	<0.003	–	<0.005	<0.004	<0.035
Pi12-08	10/24/2000	<0.009	<0.005	<0.003	–	<0.005	<0.004	<0.035
Jc43-05	10/26/2000	<0.009	<0.005	<0.003	–	<0.005	<0.004	<0.035
Je41-08	10/26/2000	<0.009	<0.005	<0.003	–	<0.005	<0.004	<0.035
Oi25-19	11/01/2000	<0.009	<0.005	<0.003	–	<0.005	0.006	<0.035

Malathion (121-75-5)	Metolachlor (51218-45-2)	Metribuzin (21087-64-9)	Molinate (2212-67-1)	Napropamide (15299-99-7)	Parathion (56-38-2)	Parathion-methyl (298-00-0)	Pebulate (1114-71-2)	DGS local well number
<0.005	0.182	<0.004	<0.004	<0.003	<0.004	<0.006	0.004	Db11-27
<0.005	0.011	<0.002	<0.004	<0.003	<0.004	<0.006	<0.004	Db11-28
<0.005	0.015	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Dc31-15
<0.005	0.006	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Cd52-15
<0.027	**E** 0.003	<0.006	<0.002	<0.007	<0.007	<0.006	<0.002	Forest Hills 1
<0.005	0.033	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Ni51-32
<0.005	0.004	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Pi31-02
<0.005	<0.002	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Ri23-04
<0.005	<0.002	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Frankford 2
<0.005	<0.002	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Qd52-09
<0.005	0.054	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Qd21-12
<0.005	0.005	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Md11-04
<0.005	<0.002	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Georgetown 1
<0.005	0.014	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Ie42-03
<0.005	**E** 0.001	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Rd22-01
<0.005	<0.002	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Pe23-185
<0.005	**E** 0.003	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Ng21-03
<0.005	<0.002	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Ng25-04
<0.005	**E** 0.002	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Le55-09
<0.005	0.02	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Pc33-44
<0.005	0.012	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Nc25-37
<0.005	0.108	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Oc15-11
<0.005	**E** 0.002	<0.004	<0.004	<0.003	<0.004	<0.006	<0.004	Oi25-18
<0.027	**E** 0.001	<0.006	<0.002	<0.007	<0.007	<0.006	<0.002	Pot Nets 1
<0.027	0.185	<0.006	<0.002	<0.007	<0.007	<0.006	<0.002	Hc34-03
<0.027	<0.013	<0.006	<0.002	<0.007	<0.007	<0.006	<0.002	Nh53-01
<0.027	<0.013	<0.006	<0.002	<0.007	<0.007	<0.006	<0.002	Pi12-08
<0.027	<0.013	<0.006	<0.002	<0.007	<0.007	<0.006	<0.002	Jc43-05
<0.027	<0.013	<0.006	<0.002	<0.007	<0.007	<0.006	<0.002	Je41-08
<0.027	<0.013	<0.006	<0.002	<0.007	<0.007	<0.006	<0.002	Oi25-19

Appendix E. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Pesticides*—Continued

DGS local well number	Sample date	Pendamethalin (40487-42-1)	*cis*-Permethrin (54774-45-7)	Phorate (298-02-2)	Prometon (1610-18-0)	Propachlor (1918-16-7)	Propanil (709-98-8)	Propargite (2312-35-8)
Db11-27	08/07/2000	<0.004	<0.005	<0.002	**E** 0.007	<0.007	<0.004	<0.013
Db11-28	08/07/2000	<0.004	<0.005	<0.002	0.057	<0.007	<0.004	<0.013
Dc31-15	08/08/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Cd52-15	08/08/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Forest Hills 1	08/16/2000	<0.01	<0.006	<0.011	<0.015	<0.01	<0.011	<0.023
Ni51-32	08/17/2000	<0.004	<0.005	<0.002	**E** 0.007	<0.007	<0.004	<0.013
Pi31-02	08/17/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Ri23-04	08/21/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Frankford 2	08/21/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Qd52-09	08/22/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Qd21-12	08/22/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Md11-04	08/23/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Georgetown 1	08/23/2000	<0.004	<0.005	<0.002	**E** 0.004	<0.007	<0.004	<0.013
Ie42-03	08/29/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Rd22-01	08/31/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Pe23-185	09/05/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Ng21-03	09/06/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Ng25-04	09/06/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Le55-09	09/07/2000	<0.004	<0.005	<0.002	**E** 0.003	<0.007	<0.004	<0.013
Pc33-44	09/12/2000	<0.004	<0.005	<0.002	0.019	<0.007	<0.004	<0.013
Nc25-37	09/12/2000	<0.004	<0.005	<0.002	**E** 0.004	<0.007	<0.004	<0.013
Oc15-11	09/13/2000	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013
Oi25-18	09/13/2000	<0.004	<0.005	<0.002	0.149	<0.007	<0.004	<0.013
Pot Nets 1	10/11/2000	<0.01	<0.006	<0.011	<0.015	<0.01	<0.011	<0.023
Hc34-03	10/16/2000	<0.01	<0.006	<0.011	0.046	<0.01	<0.011	<0.023
Nh53-01	10/24/2000	<0.01	<0.006	<0.011	<0.015	<0.01	<0.011	<0.023
Pi12-08	10/24/2000	<0.01	<0.006	<0.011	<0.015	<0.01	<0.011	<0.023
Jc43-05	10/26/2000	<0.01	<0.006	<0.011	<0.015	<0.01	<0.011	<0.023
Je41-08	10/26/2000	<0.01	<0.006	<0.011	<0.015	<0.01	<0.011	<0.023
Oi25-19	11/01/2000	<0.01	<0.006	<0.011	**E** 0.006	<0.01	<0.011	<0.023

Propyzamide (23950-58-5)	Simazine (122-34-9)	Tebuthiuron (34014-18-1)	Terbacil (5902-51-2)	Terbufos (13071-79-9)	Thiobencarb (28249-77-6)	Triallate (2303-17-5)	Trifluralin (1582-09-8)	DGS local well number
<0.003	0.019	0.027	<0.007	<0.013	<0.002	<0.001	<0.002	Db11-27
<0.003	0.013	0.039	<0.007	<0.013	<0.002	<0.001	<0.002	Db11-28
<0.003	0.019	0.023	<0.007	<0.013	<0.002	<0.001	<0.002	Dc31-15
<0.003	0.014	0.026	<0.007	<0.013	<0.002	<0.001	<0.002	Cd52-15
<0.004	<0.011	<0.016	<0.034	<0.017	<0.005	<0.002	<0.009	Forest Hills 1
<0.003	**E** 0.004	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Ni51-32
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Pi31-02
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Ri23-04
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Frankford 2
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Qd52-09
<0.003	0.008	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Qd21-12
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Md11-04
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Georgetown 1
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Ie42-03
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Rd22-01
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Pe23-185
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Ng21-03
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Ng25-04
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Le55-09
<0.003	0.019	0.028	<0.007	<0.013	<0.002	<0.001	<0.002	Pc33-44
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Nc25-37
<0.003	<0.005	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Oc15-11
<0.003	0.01	<0.01	<0.007	<0.013	<0.002	<0.001	<0.002	Oi25-18
<0.004	<0.011	<0.016	<0.034	<0.017	<0.005	<0.002	<0.009	Pot Nets 1
<0.004	0.015	**E** 0.007	<0.034	<0.017	<0.005	<0.002	<0.009	Hc34-03
<0.004	<0.011	<0.016	<0.034	<0.017	<0.005	<0.002	<0.009	Nh53-01
<0.004	<0.011	<0.016	<0.034	<0.017	<0.005	<0.002	<0.009	Pi12-08
<0.004	<0.011	<0.016	<0.034	<0.017	<0.005	<0.002	<0.009	Jc43-05
<0.004	<0.011	<0.016	<0.034	<0.017	<0.005	<0.002	<0.009	Je41-08
<0.004	<0.011	<0.016	<0.034	<0.017	<0.005	<0.002	<0.009	Oi25-19

Appendix F. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Pesticide metabolites*

[DGS, Delaware Geological Survey; **E**, estimated value; –, no data; <, less than; ESA, ethane sulfonic acid; OXA, oxanilic acid; numbers below the chemical names are the Chemical Abstracts Service (CAS) registry numbers; all concentrations are in micrograms per liter]

DGS local well number	Sample date	Acetochlor ESA	Acetochlor OXA	Alachlor ESA	Alachlor OXA	*p,p´*-DDE (72-55-9)
Db11-27	08/07/2000	<0.05	<0.05	0.12	<0.05	<0.006
Db11-28	08/07/2000	<0.05	<0.05	0.1	<0.05	<0.006
Dc31-15	08/08/2000	<0.05	<0.05	0.07	<0.05	<0.006
Cd52-15	08/08/2000	<0.05	<0.05	<0.05	<0.05	<0.006
Forest Hills 1	08/16/2000	<0.05	<0.05	0.76	<0.05	<0.002
Ni51-32	08/17/2000	<0.05	<0.05	0.09	<0.05	<0.006
Pi31-02	08/17/2000	<0.05	<0.05	0.29	<0.05	<0.006
Ri23-04	08/21/2000	<0.05	<0.05	0.42	<0.05	<0.006
Frankford 2	08/21/2000	<0.05	<0.05	0.26	<0.05	<0.006
Qd52-09	08/22/2000	<0.05	<0.05	<0.05	<0.05	<0.006
Qd21-12	08/22/2000	<0.05	<0.05	0.41	<0.05	<0.006
Md11-04	08/23/2000	<0.05	<0.05	0.49	<0.05	<0.006
Georgetown 1	08/23/2000	<0.05	<0.05	<0.05	<0.05	<0.006
Ie42-03	08/29/2000	<0.05	<0.05	0.68	<0.05	<0.006
Rd22-01	08/31/2000	<0.05	<0.05	<0.05	<0.05	<0.006
Pe23-185	09/05/2000	<0.05	<0.05	<0.05	<0.05	<0.006
Ng21-03	09/06/2000	<0.05	<0.05	1.6	<0.05	<0.006
Ng25-04	09/06/2000	<0.05	<0.05	<0.05	<0.05	<0.006
Le55-09	09/07/2000	<0.05	<0.05	0.22	0.27	<0.006
Pc33-44	09/12/2000	<0.05	<0.05	0.37	<0.05	<0.006
Nc25-37	09/12/2000	<0.05	<0.05	0.75	0.28	<0.006
Oc15-11	09/13/2000	<0.05	<0.05	0.82	<0.05	<0.006
Oi25-18	09/13/2000	<0.05	<0.05	<0.05	<0.05	<0.006
Pot Nets 1	10/11/2000	<0.05	<0.05	<0.05	<0.05	**E** 0.001
Hc34-03	10/16/2000	<0.05	<0.05	0.24	<0.05	<0.002
Nh53-01	10/24/2000	<0.05	<0.05	0.09	<0.05	<0.002
Pi12-08	10/24/2000	<0.05	<0.05	<0.05	<0.05	<0.002
Jc43-05	10/26/2000	<0.05	<0.05	0.44	<0.05	<0.002
Je41-08	10/26/2000	<0.05	<0.05	0.10	<0.05	<0.002
Oi25-19	11/01/2000	<0.05	<0.05	<0.05	<0.05	<0.002

Desethylatrazine (6190-65-4)	2,6-Diethylanaline (579-66-8)	Dimethenamid ESA	Dimethenamid OXA	Flufenacet ESA	Flufenacet OXA	Metolachlor ESA	Metolachlor OXA	DGS local well number
E 0.46	<0.003	<0.05	<0.05	<0.05	<0.05	1.26	0.18	Db11-27
E 0.099	<0.003	<0.05	<0.05	<0.05	<0.05	0.13	<0.05	Db11-28
E 0.14	<0.003	<0.05	<0.05	<0.05	<0.05	0.41	<0.05	Dc31-15
E 0.008	<0.003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Cd52-15
E 0.043	<0.002	<0.05	<0.05	<0.05	<0.05	0.63	<0.05	Forest Hills 1
E 0.05	<0.003	<0.05	<0.05	<0.05	<0.05	0.74	0.11	Ni51-32
E 0.065	<0.003	<0.05	<0.05	<0.05	<0.05	1.52	<0.05	Pi31-02
<0.002	<0.003	<0.05	<0.05	<0.05	<0.05	0.96	0.26	Ri23-04
<0.002	<0.003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Frankford 2
<0.002	<0.003	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	Qd52-09
E 0.011	<0.003	<0.05	<0.05	<0.05	<0.05	1.81	0.7	Qd21-12
E 0.043	<0.003	<0.05	<0.05	<0.05	<0.05	0.14	<0.05	Md11-04
E 0.004	<0.003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Georgetown 1
E 0.079	<0.003	<0.05	<0.05	<0.05	<0.05	2.92	0.09	Ie42-03
<0.002	<0.003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Rd22-01
<0.002	<0.003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Pe23-185
E 0.22	<0.003	<0.05	<0.05	<0.05	<0.05	0.79	<0.05	Ng21-03
<0.002	<0.003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Ng25-04
<0.002	<0.003	<0.05	<0.05	<0.05	<0.05	0.87	0.06	Le55-09
E 0.016	<0.003	<0.05	<0.05	<0.05	<0.05	0.32	<0.05	Pc33-44
E 0.075	<0.003	<0.05	<0.05	<0.05	<0.05	1.34	0.07	Nc25-37
E 0.15	<0.003	<0.05	<0.05	<0.05	<0.05	0.19	<0.05	Oc15-11
E 0.002	<0.003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Oi25-18
<0.006	<0.002	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Pot Nets 1
E 0.023	<0.002	<0.05	<0.05	<0.05	<0.05	0.29	0.11	Hc34-03
E 0.017	<0.002	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Nh53-01
<0.006	<0.002	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Pi12-08
E 0.017	<0.002	<0.05	<0.05	<0.05	<0.05	0.27	<0.05	Jc43-05
E 0.009	<0.002	<0.05	<0.05	<0.05	<0.05	0.29	<0.05	Je41-08
E 0.004	<0.002	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	Oi25-19

Appendix G. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Volatile organic compounds*

[DGS, Delaware Geological Survey; <, less than; **E**, estimated value; **M**, presence of material verified but not quantified; numbers below the chemical names are the Chemical Abstracts Service (CAS) registry numbers; all concentrations are in micrograms per liter]

DGS local well number	Sample date	Acetone (67-64-1)	Acrylonitrile (107-13-1)	Benzene (71-43-2)	Bromo-benzene (108-86-1)	Bromo-chloro-methane (74-97-5)	Bromo-dichloro-methane (75-27-4)	Bromo-form (75-25-2)
Db11-27	08/07/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Db11-28	08/07/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Dc31-15	08/08/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Cd52-15	08/08/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Forest Hills 1	08/16/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Ni51-32	08/17/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Pi31-02	08/17/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Ri23-04	08/21/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Frankford 2	08/21/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Qd52-09	08/22/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Qd21-12	08/22/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Md11-04	08/23/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Georgetown 1	08/23/2000	<7	<1	**E** 0.04	<0.04	<0.04	<0.05	<0.06
Ie42-03	08/29/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Rd22-01	08/31/2000	<7	<1	**E** 0.02	<0.04	<0.04	<0.05	<0.06
Pe23-185	09/05/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Ng21-03	09/06/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Ng25-04	09/06/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Le55-09	09/07/2000	<7	<1	0.29	<0.04	<0.04	<0.05	<0.06
Pc33-44	09/12/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Nc25-37	09/12/2000	**E** 6	<1	**E** 0.01	<0.04	<0.04	0.13	**E** 0.05
Oc15-11	09/13/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Oi25-18	09/13/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Pot Nets 1	10/11/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Hc34-03	10/16/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Nh53-01	10/24/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Pi12-08	10/24/2000	<7	<1	<0.04	<0.04	<0.04	0.23	<0.06
Jc43-05	10/26/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Je41-08	10/26/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06
Oi25-19	11/01/2000	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06

Bromo-methane (74-83-9)	*n*-Butyl-benzene (104-51-8)	*sec*-Butylbenzene (135-98-8)	*tert*-Butylbenzene (98-06-6)	Carbon disulfide (75-15-0)	Carbon tetrachloride (56-23-5)	Chloro-benzene (108-90-7)	Chloro-ethane (75-00-3)	DGS local well number
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Db11-27
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Db11-28
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Dc31-15
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Cd52-15
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Forest Hills 1
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Ni51-32
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Pi31-02
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Ri23-04
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Frankford 2
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Qd52-09
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Qd21-12
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Md11-04
<0.3	<0.2	0.24	**E** 0.04	<0.07	<0.06	**E** 0.08	<0.1	Georgetown 1
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Ie42-03
<0.3	<0.2	**E** 0.01	<0.06	**E** 0.03	<0.06	0.49	<0.1	Rd22-01
<0.3	<0.2	<0.03	<0.06	**E** 0.04	<0.06	<0.03	<0.1	Pe23-185
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Ng21-03
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Ng25-04
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Le55-09
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Pc33-44
<0.3	<0.2	<0.03	<0.06	**E** 0.03	**E** 0.03	<0.03	<0.1	Nc25-37
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Oc15-11
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Oi25-18
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Pot Nets 1
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Hc34-03
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Nh53-01
<0.3	<0.2	<0.03	<0.06	**E** 0.02	<0.06	<0.03	<0.1	Pi12-08
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Jc43-05
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Je41-08
<0.3	<0.2	<0.03	<0.06	<0.07	<0.06	<0.03	<0.1	Oi25-19

Appendix G. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Volatile organic compounds*—Continued

DGS local well number	Sample date	Chloroform (67-66-3)	Chloro-methane (74-87-3)	3-Chloropropene (107-05-1)	2-Chlorotoluene (95-49-8)	4-Chlorotoluene (106-43-4)	Dibromo-chloro-methane (124-48-1)
Db11-27	08/07/2000	0.25	<0.5	<0.2	<0.04	<0.06	<0.2
Db11-28	08/07/2000	0.34	<0.5	<0.2	<0.04	<0.06	<0.2
Dc31-15	08/08/2000	0.43	<0.5	<0.2	<0.04	<0.06	<0.2
Cd52-15	08/08/2000	0.43	<0.5	<0.2	<0.04	<0.06	<0.2
Forest Hills 1	08/16/2000	0.17	<0.5	<0.2	<0.04	<0.06	<0.2
Ni51-32	08/17/2000	0.12	<0.5	<0.2	<0.04	<0.06	<0.2
Pi31-02	08/17/2000	0.29	<0.5	<0.2	<0.04	<0.06	<0.2
Ri23-04	08/21/2000	<0.05	<0.5	<0.2	<0.04	<0.06	<0.2
Frankford 2	08/21/2000	0.19	<0.5	<0.2	<0.04	<0.06	<0.2
Qd52-09	08/22/2000	0.27	<0.5	<0.2	<0.04	<0.06	<0.2
Qd21-12	08/22/2000	**E** 0.05	<0.5	<0.2	<0.04	<0.06	<0.2
Md11-04	08/23/2000	**E** 0.05	**E** 0.1	<0.2	<0.04	<0.06	<0.2
Georgetown 1	08/23/2000	<0.05	**E** 0.1	<0.2	<0.04	<0.06	<0.2
Ie42-03	08/29/2000	**E** 0.02	**M**	<0.2	<0.04	<0.06	<0.2
Rd22-01	08/31/2000	**E**0.04	**M**	<0.2	<0.04	<0.06	<0.2
Pe23-185	09/05/2000	**E** 0.04	**M**	<0.2	<0.04	<0.06	<0.2
Ng21-03	09/06/2000	**E** 0.04	<0.5	<0.2	<0.04	<0.06	<0.2
Ng25-04	09/06/2000	0.62	<0.5	<0.2	<0.04	<0.06	<0.2
Le55-09	09/07/2000	**E** 0.01	<0.5	<0.2	<0.04	<0.06	<0.2
Pc33-44	09/12/2000	0.12	**M**	<0.2	<0.04	<0.06	<0.2
Nc25-37	09/12/2000	0.54	<0.5	<0.2	<0.04	<0.06	**E** 0.1
Oc15-11	09/13/2000	**E** 0.03	**M**	<0.2	<0.04	<0.06	<0.2
Oi25-18	09/13/2000	**E** 0.09	**M**	<0.2	<0.04	<0.06	<0.2
Pot Nets 1	10/11/2000	1.02	**M**	<0.1	<0.03	<0.06	<0.2
Hc34-03	10/16/2000	0.32	<0.2	<0.1	<0.03	<0.06	<0.2
Nh53-01	10/24/2000	**E** 0.03	<0.2	<0.1	<0.03	<0.06	<0.2
Pi12-08	10/24/2000	3.85	<0.2	<0.1	<0.03	<0.06	**E** 0.1
Jc43-05	10/26/2000	**E** 0.04	**M**	<0.1	<0.03	<0.06	<0.2
Je41-08	10/26/2000	**E** 0.02	<0.2	<0.1	<0.03	<0.06	<0.2
Oi25-19	11/01/2000	0.39	<0.2	<0.1	<0.03	<0.06	<0.2

1,2-Dibromo-3-chloro-propane (96-12-8)	1,2-Dibromo-ethane (106-93-4)	Dibromo-methane (74-95-3)	1,2-Dichloro-benzene (95-501)	1,3-Dichloro-benzene (541-73-1)	1,4-Dichloro-benzene (106-46-7)	*trans*-1,4-Dichloro-2-butene (110-57-6)	Dichloro-difluoro-methane (75-71-8)	DGS local well number
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Db11-27
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Db11-28
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Dc31-15
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Cd52-15
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Forest Hills 1
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Ni51-32
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Pi31-02
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Ri23-04
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Frankford 2
<0.2	<0.04	<0.05	<0.05	<0.05	**E** 0.02	<0.7	<0.3	Qd52-09
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Qd21-12
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Md11-04
<0.2	<0.04	<0.05	**E** 0.03	<0.05	<0.05	<0.7	**E** 1.6	Georgetown 1
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Ie42-03
<0.2	<0.04	<0.05	1.47	<0.05	0.51	<0.7	<0.3	Rd22-01
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Pe23-185
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Ng21-03
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Ng25-04
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Le55-09
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Pc33-44
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Nc25-37
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Oc15-11
<0.2	<0.04	<0.05	<0.05	<0.05	<0.05	<0.7	<0.3	Oi25-18
<0.2	<0.04	<0.05	**E** 0.06	<0.03	<0.05	<0.7	<0.3	Pot Nets 1
<0.2	<0.04	<0.05	<0.03	<0.03	<0.05	<0.7	<0.3	Hc34-03
<0.2	<0.04	<0.05	<0.03	<0.03	<0.05	<0.7	<0.3	Nh53-01
<0.2	<0.04	<0.05	<0.03	<0.03	<0.05	<0.7	<0.3	Pi12-08
<0.2	<0.04	<0.05	<0.03	<0.03	<0.05	<0.7	<0.3	Jc43-05
<0.2	<0.04	<0.05	<0.03	<0.03	<0.05	<0.7	<0.3	Je41-08
<0.2	<0.04	<0.05	<0.03	<0.03	<0.05	<0.7	<0.3	Oi25-19

Appendix G. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Volatile organic compounds*—Continued

DGS local well number	Sample date	1,1-Dichloroethane (75-34-3)	1,2-Dichloroethane (107-06-2)	1,1-Dichloroethene (75-35-4)	*cis*-1,2-Dichloroethene (156-59-2)	*trans*-1,2-Dichloroethene (156-60-5)	Dichloromethane (75-09-2)	1,2-Dichloropropane (78-87-5)
Db11-27	08/07/2000	<0.07	<0.1	<0.04	**E** 0.08	<0.03	<0.4	<0.07
Db11-28	08/07/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Dc31-15	08/08/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Cd52-15	08/08/2000	<0.07	<0.1	**E** 0.05	<0.04	<0.03	<0.4	<0.07
Forest Hills 1	08/16/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Ni51-32	08/17/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Pi31-02	08/17/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Ri23-04	08/21/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Frankford 2	08/21/2000	0.13	0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Qd52-09	08/22/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Qd21-12	08/22/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	**E** 0.07
Md11-04	08/23/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Georgetown 1	08/23/2000	<0.07	<0.1	<0.04	**E** 0.06	<0.03	<0.4	<0.07
Ie42-03	08/29/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Rd22-01	08/31/2000	0.14	<0.1	**E** 0.04	<0.04	<0.03	<0.4	<0.07
Pe23-185	09/05/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Ng21-03	09/06/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Ng25-04	09/06/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Le55-09	09/07/2000	**E** 0.02	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Pc33-44	09/12/2000	<0.07	<0.1	**E** 0.06	<0.04	<0.03	<0.4	<0.07
Nc25-37	09/12/2000	**E** 0.02	<0.1	<0.04	**E** 0.02	<0.03	**M**	<0.07
Oc15-11	09/13/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Oi25-18	09/13/2000	<0.07	<0.1	<0.04	<0.04	<0.03	<0.4	<0.07
Pot Nets 1	10/11/2000	**E** 0.02	<0.1	**E** 0.01	**E** 0.02	<0.03	<0.2	<0.03
Hc34-03	10/16/2000	0.15	<0.1	0.5	<0.04	<0.03	<0.2	<0.03
Nh53-01	10/24/2000	<0.04	<0.1	<0.04	<0.04	<0.03	<0.2	<0.03
Pi12-08	10/24/2000	<0.04	<0.1	**E** 0.01	<0.04	<0.03	<0.2	<0.03
Jc43-05	10/26/2000	<0.04	<0.1	<0.04	<0.04	<0.03	<0.2	<0.03
Je41-08	10/26/2000	<0.04	<0.1	<0.04	<0.04	<0.03	<0.2	<0.03
Oi25-19	11/01/2000	<0.04	<0.1	<0.04	<0.04	<0.03	<0.2	<0.03

1,3-Dichloro-propane (142-28-9)	2,2-Dichloro-propane (594-20-7)	1,1-Dichloro-propene (563-58-6)	*cis*-1,3-Dichloro-propene (10061-01-5)	*trans*-1,3-Dichloro-propene (10061-02-6)	Diethyl ether (60-29-7)	Diisopropyl ether (108-20-3)	DGS local well number
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Db11-27
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Db11-28
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Dc31-15
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Cd52-15
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Forest Hills 1
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Ni51-32
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Pi31-02
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Ri23-04
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	0.5	Frankford 2
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Qd52-09
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Qd21-12
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Md11-04
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	**E** 0.1	Georgetown 1
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Ie42-03
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Rd22-01
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Pe23-185
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Ng21-03
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Ng25-04
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Le55-09
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Pc33-44
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Nc25-37
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Oc15-11
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Oi25-18
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Pot Nets 1
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Hc34-03
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Nh53-01
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Pi12-08
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Jc43-05
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Je41-08
<0.1	<0.05	<0.03	<0.09	<0.09	<0.2	<0.1	Oi25-19

Appendix G. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Volatile organic compounds*—Continued

DGS local well number	Sample date	Ethyl-benzene (100-41-4)	Ethyl *tert*-butyl ether (637-92-3)	Ethyl methacrylate (97-63-2)	*o*-Ethyl toluene (611-14-3)	Hexachloro-butadiene (87-68-3)	Hexachloro-ethane (67-72-1)
Db11-27	08/07/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Db11-28	08/07/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Dc31-15	08/08/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Cd52-15	08/08/2000	<0.03	0.36	,0.2	<0.06	<0.1	<0.2
Forest Hills 1	08/16/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Ni51-32	08/17/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Pi31-02	08/17/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Ri23-04	08/21/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Frankford 2	08/21/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Qd52-09	08/22/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Qd21-12	08/22/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Md11-04	08/23/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Georgetown 1	08/23/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Ie42-03	08/29/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Rd22-01	08/31/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Pe23-185	09/05/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Ng21-03	09/06/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Ng25-04	09/06/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Le55-09	09/07/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Pc33-44	09/12/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Nc25-37	09/12/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Oc15-11	09/13/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Oi25-18	09/13/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Pot Nets 1	10/11/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Hc34-03	10/16/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Nh53-01	10/24/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Pi12-08	10/24/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Jc43-05	10/26/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Je41-08	10/26/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2
Oi25-19	11/01/2000	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2

Isopropyl-benzene (98-82-8)	*p*-Isopropyl-toluene (99-87-6)	Methyl acrylate (96-33-3)	Methyl acrylonitrile (126-98-7)	Methyl *tert*-butyl ether (MTBE) (1634-04-4)	Methyl butyl ketone (591-78-6)	Methyl ethyl ketone (78-93-3)	Methyl iodide (74-88-4)	DGS local well number
<0.03	<0.07	<1	<0.6	4	<0.7	<2	<0.1	Db11-27
<0.03	<0.07	<1	<0.6	2.6	<0.7	<2	<0.1	Db11-28
<0.03	<0.07	<1	<0.6	1.5	<0.7	<2	<0.1	Dc31-15
<0.03	<0.07	<1	<0.6	12	<0.7	<2	<0.1	Cd52-15
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Forest Hills 1
<0.03	<0.07	<1	<0.6	0.4	<0.7	<2	<0.1	Ni51-32
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Pi31-02
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Ri23-04
E 0.01	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Frankford 2
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Qd52-09
<0.03	<0.07	<1	<0.6	0.7	<0.7	<2	<0.1	Qd21-12
<0.03	<0.07	<1	<0.6	0.4	<0.7	<2	<0.1	Md11-04
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Georgetown 1
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Ie42-03
<0.03	<0.07	<1	<0.6	0.4	<0.7	<2	<0.1	Rd22-01
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Pe23-185
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Ng21-03
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Ng25-04
<0.03	<0.07	<1	<0.6	0.7	<0.7	<2	<0.1	Le55-09
<0.03	<0.07	<1	<0.6	0.2	<0.7	<2	<0.1	Pc33-44
<0.03	<0.07	<1	<0.6	**M**	<0.7	<2	<0.1	Nc25-37
<0.03	**E** 0.01	<1	<0.6	<0.2	<0.7	<2	<0.1	Oc15-11
<0.03	<0.07	<1	<0.6	2.5	<0.7	<2	<0.1	Oi25-18
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Pot Nets 1
<0.03	<0.07	<1	<0.6	8.6	<0.7	<2	<0.1	Hc34-03
<0.03	<0.07	<1	<0.6	<0.2	<0.7	<2	<0.1	Nh53-01
<0.03	<0.07	<1	<0.6	1	<0.7	<2	<0.1	Pi12-08
<0.03	<0.07	<1	<0.6	0.2	<0.7	<2	<0.1	Jc43-05
<0.03	<0.07	<1	<0.6	0.2	<0.7	<2	<0.1	Je41-08
<0.03	<0.07	<1	<0.6	1.9	<0.7	<2	<0.1	Oi25-19

Appendix G. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Volatile organic compounds*—Continued

DGS local well number	Sample date	Methyl isobutyl ketone (108-10-1)	Methyl methacrylate (80-62-6)	Methyl *tert*-pentyl ether (994-05-8)	Naphthalene (91-20-3)	*n*-Propyl-benzene (103-65-1)	Styrene (100-42-5)
Db11-27	08/07/2000	<0.4	<0.3	**E** 0.1	<0.2	<0.04	<0.04
Db11-28	08/07/2000	<0.4	<0.3	**E** 0.1	<0.2	<0.04	<0.04
Dc31-15	08/08/2000	<0.4	<0.3	0.2	<0.2	<0.04	<0.04
Cd52-15	08/08/2000	<0.4	<0.3	0.4	<0.2	<0.04	<0.04
Forest Hills 1	08/16/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Ni51-32	08/17/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Pi31-02	08/17/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Ri23-04	08/21/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Frankford 2	08/21/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Qd52-09	08/22/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Qd21-12	08/22/2000	<0.4	<0.3	**M**	<0.2	<0.04	<0.04
Md11-04	08/23/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Georgetown 1	08/23/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Ie42-03	08/29/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Rd22-01	08/31/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Pe23-185	09/05/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Ng21-03	09/06/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Ng25-04	09/06/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Le55-09	09/07/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Pc33-44	09/12/2000	<0.4	<0.3	**M**	<0.2	<0.04	<0.04
Nc25-37	09/12/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Oc15-11	09/13/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Oi25-18	09/13/2000	<0.4	<0.3	0.3	<0.2	<0.04	<0.04
Pot Nets 1	10/11/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Hc34-03	10/16/2000	<0.4	<0.3	0.1	<0.2	<0.04	<0.04
Nh53-01	10/24/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Pi12-08	10/24/2000	<0.4	<0.3	**E** 0.1	<0.2	<0.04	<0.04
Jc43-05	10/26/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Je41-08	10/26/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04
Oi25-19	11/01/2000	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04

1,1,1,2-Tetra-chloro-ethane (630-20-6)	1,1,2,2-Tetra-chloro-ethane (79-34-5)	Tetra-chloro-ethene (127-18-4)	Tetra-hydro-furan (109-99-9)	1,2,3,4-Tetramethyl-benzene (488-23-3)	1,2,3,5-Tetramethyl-benzene (527-53-7)	1,2,3-Trichloro-benzene (87-61-6)	DGS local well number
<0.03	<0.09	1.1	<2	<0.2	<0.2	<0.3	Db11-27
<0.03	<0.09	0.7	<2	<0.2	<0.2	<0.3	Db11-28
<0.03	<0.09	**E** 0.1	<2	<0.2	<0.2	<0.3	Dc31-15
<0.03	<0.09	0.1	<2	<0.2	<0.2	<0.3	Cd52-15
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Forest Hills 1
<0.03	<0.09	0.2	<2	<0.2	<0.2	<0.3	Ni51-32
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Pi31-02
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Ri23-04
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Frankford 2
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Qd52-09
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Qd21-12
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Md11-04
<0.03	<0.09	1	<2	<0.2	<0.2	<0.3	Georgetown 1
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Ie42-03
<0.03	<0.09	**M**	10	<0.2	<0.2	<0.3	Rd22-01
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Pe23-185
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Ng21-03
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Ng25-04
<0.03	<0.09	1.9	<2	<0.2	<0.2	<0.3	Le55-09
<0.03	<0.09	**E** 0.1	<2	<0.2	<0.2	<0.3	Pc33-44
<0.03	<0.09	0.4	<2	<0.2	<0.2	<0.3	Nc25-37
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Oc15-11
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Oi25-18
<0.03	<0.09	**E** 0.1	<2	<0.2	<0.2	<0.3	Pot Nets 1
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Hc34-03
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Nh53-01
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Pi12-08
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Jc43-05
<0.03	<0.09	**M**	<2	<0.2	<0.2	<0.3	Je41-08
<0.03	<0.09	<0.1	<2	<0.2	<0.2	<0.3	Oi25-19

Appendix G. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Volatile organic compounds*—Continued

DGS local well number	Sample date	1,2,4-Trichloro-benzene (120-82-1)	1,1,1-Trichloro-ethane (71-55-6)	1,1,2-Trichloro-ethane (79-00-5)	Trichloro-ethene (79-01-6)	Trichloro-fluoro-methane (75-69-4)	1,2,3-Trichloro-propane (96-18-4)	1,1,2-Trichloro-trifluoro-ethane (76-13-1)
Db11-27	08/07/2000	<0.2	**E** 0.02	<0.06	0.1	<0.09	<0.2	0.18
Db11-28	08/07/2000	<0.2	**E** 0.04	<0.06	**E** 0.04	<0.09	<0.2	0.23
Dc31-15	08/08/2000	<0.2	**E** 0.04	<0.06	**E** 0.04	<0.15	<0.2	<0.06
Cd52-15	08/08/2000	<0.2	0.11	<0.06	**E** 0.03	<0.09	<0.2	**E** 0.03
Forest Hills 1	08/16/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	**E** 0.03
Ni51-32	08/17/2000	<0.2	<0.03	<0.06	**E** 0.1	<0.09	<0.2	<0.06
Pi31-02	08/17/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06
Ri23-04	08/21/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	**E** 0.02
Frankford 2	08/21/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06
Qd52-09	08/22/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06
Qd21-12	08/22/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06
Md11-04	08/23/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06
Georgetown 1	08/23/2000	<0.2	<0.03	<0.06	0.17	<0.09	<0.2	<0.06
Ie42-03	08/29/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	**E** 0.02
Rd22-01	08/31/2000	<0.2	<0.03	<0.06	**E** 0.03	<0.09	<0.2	<0.06
Pe23-185	09/05/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06
Ng21-03	09/06/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	**E** 0.04
Ng25-04	09/06/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06
Le55-09	09/07/2000	<0.2	<0.03	<0.06	0.22	<0.09	<0.2	<0.06
Pc33-44	09/12/2000	<0.2	**E** 0.03	<0.06	**E** 0.05	**E** 0.01	<0.2	0.14
Nc25-37	09/12/2000	<0.2	**E** 0.01	<0.06	<0.04	<0.09	<0.2	<0.06
Oc15-11	09/13/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06
Oi25-18	09/13/2000	<0.2	**E** 0.01	<0.06	<0.04	<0.09	<0.2	<0.06
Pot Nets 1	10/11/2000	<0.2	**E** 0.03	<0.06	**E** 0.04	<0.09	<0.2	<0.06
Hc34-03	10/16/2000	<0.2	2.44	<0.06	0.81	<0.09	<0.2	<0.06
Nh53-01	10/24/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	**E** 0.04
Pi12-08	10/24/2000	<0.2	**E** 0.09	<0.06	<0.04	<0.09	<0.2	**E** 0.02
Jc43-05	10/26/2000	<0.2	<0.03	<0.06	**E** 0.01	<0.09	<0.2	<0.06
Je41-08	10/26/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	**E** 0.02
Oi25-19	11/01/2000	<0.2	<0.03	<0.06	<0.04	<0.09	<0.2	<0.06

1,2,3-Trimethylbenzene (526-73-8)	1,2,4-Trimethylbenzene (95-63-6)	1,3,5-Trimethylbenzene (108-67-8)	Toluene (108-88-3)	Vinyl bromide (593-60-2)	Vinyl chloride (75-01-4)	*m*- and *p*-Xylene (*m*: 108-38-3) (*p*: 106-42-3)	*o*-Xylene (95-49-8)	DGS local well number
<0.1	<0.06	<0.04	**E** 0.02	<0.1	<0.1	<0.06	<0.04	Db11-27
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Db11-28
<0.1	<0.06	<0.04	**E** 0.02	<0.1	<0.1	<0.06	<0.04	Dc31-15
<0.1	<0.06	<0.04	**E** 0.02	<0.1	<0.1	<0.06	<0.04	Cd52-15
<0.1	<0.06	<0.04	**E** 0.01	<0.1	<0.1	<0.06	<0.04	Forest Hills 1
<0.1	<0.06	<0.04	**E** 0.01	<0.1	<0.1	<0.06	<0.04	Ni51-32
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Pi31-02
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Ri23-04
<0.1	<0.06	<0.04	**E** 0.02	<0.1	<0.1	<0.06	<0.04	Frankford 2
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Qd52-09
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Qd21-12
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Md11-04
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Georgetown 1
<0.1	<0.06	<0.04	**E** 0.01	<0.1	<0.1	<0.06	<0.04	Ie42-03
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Rd22-01
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Pe23-185
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Ng21-03
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Ng25-04
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Le55-09
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Pc33-44
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Nc25-37
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Oc15-11
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Oi25-18
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Pot Nets 1
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Hc34-03
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Nh53-01
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Pi12-08
<0.1	<0.06	<0.04	**E** 0.01	<0.1	<0.1	<0.06	<0.04	Jc43-05
<0.1	<0.06	<0.04	**E** 0.01	<0.1	<0.1	<0.06	<0.04	Je41-08
<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04	Oi25-19

Appendix H. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Radium and radon*

[DGS, Delaware Geological Survey; <, less than; –, no data; all activities in picocuries per liter]

DGS local well number	Sample date	Gross-alpha	Gross-alpha, 2-sigma [1]	Gross-beta	Gross-beta, 2-sigma [1]	Radium-224	Radium-224, 2-sigma [1]	Radium-226	Radium-226, 2-sigma [1]	Radium-228	Radium-228, 2-sigma [1]	Radon-222	Radon-222, 2-sigma [1]
Db11-27	08/07/2000	<3.00	2.0	<4.00	4.0	–	–	–	–	<1.00	0.41	246	24
Db11-27	09/27/2000	–	–	–	–	<1.00	0.03	<1.00	0.04	–	–	–	–
Db11-28	08/07/2000	<3.00	2.2	<4.00	3.9	–	–	–	–	<1.00	0.43	222	23
Db11-28	09/27/2000	–	–	–	–	<1.00	0.12	<1.00	0.07	–	–	–	–
Dc31-15	08/08/2000	<3.00	2.4	<4.00	3.9	–	–	–	–	<1.00	0.43	260	21
Dc31-15	09/27/2000	–	–	–	–	<1.00	0.10	<1.00	0.07	–	–	–	–
Cd52-15	08/08/2000	1.72	2.4	1.19	3.9	–	–	–	–	<1.00	0.34	192	20
Cd52-15	09/27/2000	–	–	–	–	<1.00	0.10	<1.00	0.08	–	–	–	–
Forest Hills 1	08/16/2000	1.05	2.4	–	3.9	–	–	–	–	<1.00	0.47	220	21
Forest Hills 1	10/12/2000	–	–	–	–	<1.00	0.17	<1.00	0.11	–	–	–	–
Qd52-09	08/22/2000	–	1.6	0.41	3.9	–	–	–	–	<1.00	0.34	221	18
Qd52-09	10/12/2000	–	–	–	–	<1.00	0.08	<1.00	0.07	–	–	–	–
Pe23-185	09/05/2000	<3.00	2.8	<4.00	4.1	<1.00	0.15	<1.00	0.11	<1.00	0.37	79	16
Pc33-44	09/12/2000	10.6	4.1	7.60	4.5	1.94	0.56	1.29	0.34	–	–	155	20
Pot Nets 1	10/11/2000	<3.00	2.1	<4.00	3.6	<1.00	0.07	<1.00	0.04	<1.00	0.45	343	21
Hc34-03	10/16/2000	5.11	2.9	6.73	4.2	<1.00	0.32	<1.00	0.15	1.13	0.46	167	18

[1] 2-sigma precision estimate.

Appendix I Follows

Appendix Ia. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Age dating—Sulfur hexafluoride data*

[DGS, Delaware Geological Survey; fmol/L, femtomole per liter; NOAA, National Oceanic and Atmospheric Administration; mL, milliliters; °C, degrees Celsius; cont., sample contaminated; –, no data]

DGS local well number	Sampling date	fmol/L NOAA Scale	Excess air (mL)	Recharge temperature (°C)	Recharge elevation (feet)	Model SF_6 age [1] (date)	Model SF_6 age[1] (in years)	Comments
Db11-27	08/07/2000	1.23541	2.2	14	50	1993.0	7.60	
Db11-27	08/07/2000	1.10668	2.2	14	50	1991.5	9.10	
Db11-28	08/07/2000	1.42221	2.6	12.7	50	1994.0	6.60	
Db11-28	08/07/2000	1.40387	2.6	12.7	50	1993.5	7.10	
Dc31-15	08/08/2000	1.18611	1.5	13.6	50	1993.0	7.61	
Dc31-15	08/08/2000	1.17651	1.5	13.6	50	1993.0	7.61	
Cd52-15	08/08/2000	1.28181	1.6	14.7	50	1994.5	6.11	
Cd52-15	08/08/2000	1.27629	1.6	14.7	50	1994.5	6.11	
Ni51-32	08/17/2000	0.36942	2	13.6	20	1980.5	20.13	
Ni51-32	08/17/2000	0.30233	2	13.6	20	1979.0	21.63	
Pi31-02	08/17/2000	0.57006	1.2	12.7	20	1985.0	15.63	
Pi31-02	08/17/2000	0.60131	1.2	12.7	20	1985.5	15.13	
Ri23-04	08/21/2000	0.54641	5.4	12.3	20	1981.0	19.64	CH_4 present
Ri23-04	08/21/2000	0.47307	5.4	12.3	20	1980.0	20.64	CH_4 present
Frankford 2	08/21/2000	0.22952	1.1	12.6	30	1977.5	23.14	CH_4 present
Frankford 2	08/21/2000	0.24698	1.1	12.6	30	1978.0	22.64	CH_4 present
Qd21-12	08/22/2000	0.53004	4.2	16	40	1982.5	18.14	
Qd21-12	08/22/2000	0.51417	4.2	16	40	1982.0	18.64	
Md11-04	08/23/2000	1.08939	2.6	11.4	50	1990.0	10.65	
Md11-04	08/23/2000	1.01209	2.6	11.4	50	1989.0	11.65	
Georgetown 1	08/23/2000	0.39797	2.2	13.5	30	1981.0	19.65	CH_4 present /high CO_2
Georgetown 1	08/23/2000	0.39506	2.2	13.5	30	1981.0	19.65	CH_4 present /high CO_2
Ie42-03	08/29/2000	1.02050	3.7	13.5	50	1989.0	11.66	
Ie42-03	08/29/2000	0.97452	3.7	13.5	50	1988.0	12.66	
Rd22-01	08/31/2000	9.23205	4.4	11.3	50	cont.	–	high CO_2
Rd22-01	08/31/2000	0.86559	4.4	11.3	50	1986.0	14.67	high CO_2
Rd22-01	08/31/2000	0.85201	4.5	11.3	50	1985.5	15.17	
Rd22-01	08/31/2000	0.91441	4.5	11.3	50	1986.0	14.67	
Pe23-185	09/05/2000	0.62526	4.3	8.9	50	1982.0	18.68	
Pe23-185	09/05/2000	0.11120	4.3	8.9	50	1968.0	32.68	
Ng21-03	09/06/2000	0.37004	2.9	11	50	1979.5	21.18	
Ng21-03	09/06/2000	0.45108	2.9	11	50	1981.0	19.68	
Ng25-04	09/06/2000	0.82963	3.8	6.5	50	1984.5	16.18	
Ng25-04	09/06/2000	0.50377	3.8	6.5	50	1980.0	20.68	

DGS local well number	Sampling date	fmol/L NOAA Scale	Excess air (mL)	Recharge temperature (°C)	Recharge elevation (feet)	Model SF_6 age [1] (date)	Model SF_6 age [1] (in years)	Comments
Le55-09	09/07/2000	0.41068	4.4	14.1	50	1980.0	20.69	denitrification?
Le55-09	09/07/2000	0.78396	4.4	14.1	50	1985.5	15.19	denitrification?
Pc33-44	09/12/2000	0.82633	2.1	13.5	50	1988.0	12.70	
Pc33-44	09/12/2000	0.86389	2.1	13.5	50	1988.5	12.20	
Nc25-37	09/12/2000	0.89423	5.3	12.8	50	1985.5	15.20	
Nc25-37	09/12/2000	0.89174	5.3	12.8	50	1985.5	15.20	
Oc15-11	09/13/2000	0.84243	2.3	11.7	50	1987.5	13.20	
Oc15-11	09/13/2000	0.89021	2.3	11.7	50	1988.0	12.70	
Oi25-18	09/13/2000	1.07963	1.8	14.3	50	1992.0	8.70	
Oi25-18	09/13/2000	1.03569	1.8	14.3	50	1991.5	9.20	
Pot Nets 1	10/11/2000	0.22638	1.5	11.3	50	1976.5	24.28	
Hc34-03	10/16/2000	0.81710	2.6	15.1	30	1988.0	12.79	High CO_2
Hc34-03	10/16/2000	0.84048	2.6	15.1	30	1988.0	12.79	High CO_2
Nh53-01	10/24/2000	0.64734	4.1	12.2	10	1983.5	17.32	
Nh53-01	10/24/2000	0.73661	4.1	12.2	10	1984.5	16.32	
Pi12-08	10/24/2000	0.72746	0.8	11.2	10	1987.5	13.32	
Pi12-08	10/24/2000	0.92884	0.8	11.2	10	1990.0	10.82	
Jc43-05	10/26/2000	0.71534	5	11.1	60	1983.5	17.32	denitrification?
Jc43-05	10/26/2000	0.74902	5	11.1	60	1984.0	16.82	denitrification?
Je41-08	10/26/2000	0.99569	1	15	60	1992.5	8.32	
Je41-08	10/26/2000	0.86549	1	15	60	1990.5	10.32	
Oi25-19	11/01/2000	1.13635	1.6	12.7	50	1992.0	8.84	

[1] Model dates corrected for excess air.

Appendix Ib. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Age dating—Dissolved gas data*

[DGS, Delaware Geological Survey; mg/L, milligrams per liter; atm., atmospheres]

DGS local well number	Sample date	Concentration (mg/L)					Partial pressures at field temperatures (atm.)				
		Argon (Ar)	Carbon dioxide (CO_2)	Methane (CH_4)	Nitrogen (N_2)	Oxygen (O_2)	Argon (Ar)	Carbon dioxide (CO_2)	Methane (CH_4)	Nitrogen (N_2)	Oxygen (O_2)
Db 11-27	08/07/2000	0.6676	101.852	0.0000	19.098	6.775	0.01017	0.052717	0.000000	0.9084	0.1413
Db 11-27	08/07/2000	0.6616	102.209	0.0000	18.696	6.637	0.01008	0.052902	0.000000	0.8893	0.1384
Db 11-28	08/07/2000	0.6971	125.889	0.0007	20.684	4.591	0.01070	0.065966	0.000027	0.9909	0.0965
Db 11-28	08/07/2000	0.6815	125.171	0.0000	19.757	4.341	0.01046	0.065589	0.000000	0.9465	0.0913
Dc 31-15	08/08/2000	0.6586	75.166	0.0000	18.332	8.371	0.00963	0.036539	0.000000	0.8403	0.1675
Dc 31-15	08/08/2000	0.6558	75.345	0.0000	18.248	8.258	0.00959	0.036626	0.000000	0.8365	0.1653
Cd52-15	08/08/2000	0.6508	63.347	0.0000	18.314	7.773	0.00977	0.032082	0.000000	0.8600	0.1598
Cd52-15	08/08/2000	0.6407	72.345	0.0000	17.932	7.688	0.00962	0.036639	0.000000	0.8421	0.1581
Forest Hills 1	08/16/2000	0.6953	45.197	0.0000	18.508	6.845	0.01029	0.022393	0.000000	0.8580	0.1387
Forest Hills 1	08/16/2000	0.6908	45.315	0.0000	18.127	6.787	0.01022	0.022451	0.000000	0.8404	0.1375
Ni 51-32	08/17/2000	0.6688	40.651	0.0000	19.440	4.411	0.01002	0.020523	0.000000	0.9113	0.0905
Ni 51-32	08/17/2000	0.6669	40.736	0.0000	19.342	4.019	0.00999	0.020566	0.000000	0.9067	0.0825
Pi 31-02	08/17/2000	0.6676	43.716	0.0000	18.399	8.267	0.00986	0.021591	0.000000	0.8513	0.1672
Ri23-04	08/21/2000	0.7427	67.678	0.0084	24.083	0.079	0.01115	0.034275	0.000310	1.1310	0.0016
Ri23-04	08/21/2000	0.7401	67.515	0.0085	24.051	0.083	0.01111	0.034193	0.000311	1.1295	0.0017
Frankford 2	08/21/2000	0.6670	88.460	0.2924	23.292	0.074	0.01004	0.044941	0.010750	1.0958	0.0015
Frankford 2	08/21/2000	0.6653	88.314	0.2938	23.283	0.068	0.01001	0.044866	0.010803	1.0954	0.0014
Qd 52-09	08/22/2000	0.7393	55.934	0.0000	21.191	3.310	0.01099	0.027887	0.000000	0.9860	0.0674
Qd 52-09	08/22/2000	0.7400	56.034	0.0000	21.293	3.445	0.01100	0.027937	0.000000	0.9908	0.0701
Qd 21-12	08/22/2000	0.6704	45.932	0.0000	20.157	3.493	0.01007	0.023262	0.000000	0.9466	0.0718
Qd 21-12	08/22/2000	0.6711	46.039	0.0000	20.136	3.429	0.01008	0.023316	0.000000	0.9456	0.0705
Md11-04	08/23/2000	0.7092	54.012	0.0000	20.216	4.987	0.01080	0.027956	0.000000	0.9616	0.1040
Md11-04	08/23/2000	0.7111	55.113	0.0000	20.267	4.442	0.01083	0.028526	0.000000	0.9640	0.0926
Georgetown 1	08/23/2000	0.6700	260.791	0.0330	21.977	0.113	0.01023	0.135398	0.001233	1.0472	0.0024
Georgetown 1	08/23/2000	0.6736	262.780	0.0334	22.186	0.117	0.01028	0.136431	0.001247	1.0571	0.0025
Ie42-03	08/29/2000	0.6859	39.299	0.0000	20.018	4.306	0.01045	0.020341	0.000000	0.9521	0.0898
Ie42-03	08/29/2000	0.7042	44.879	0.0000	20.945	4.024	0.01072	0.023228	0.000000	0.9962	0.0839
Rd22-01	08/31/2000	0.7343	102.602	0.0000	23.614	0.089	0.01118	0.053105	0.000000	1.1232	0.0018
Rd22-01	08/31/2000	0.7490	103.298	0.0000	24.497	0.130	0.01141	0.053465	0.000000	1.1652	0.0027

Appendix Ib. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Age dating—Dissolved gas data*—Continued

DGS local well number	Sample date	Concentration (mg/L)					Partial pressures at field temperatures (atm.)				
		Argon (Ar)	Carbon dioxide (CO_2)	Methane (CH_4)	Nitrogen (N_2)	Oxygen (O_2)	Argon (Ar)	Carbon dioxide (CO_2)	Methane (CH_4)	Nitrogen (N_2)	Oxygen (O_2)
Pe23-158	09/05/2000	0.7766	52.147	0.0584	22.772	0.127	0.01218	0.028257	0.002250	1.1123	0.0027
Pe23-158	09/05/2000	0.7757	52.018	0.0588	22.821	0.125	0.01217	0.028187	0.002268	1.1147	0.0027
Ng21-03	09/06/2000	0.7238	27.812	0.0000	20.832	7.932	0.01091	0.014174	0.000000	0.9819	0.1637
Ng21-03	09/06/2000	0.7172	28.017	0.0000	20.480	8.073	0.01081	0.014278	0.000000	0.9653	0.1666
Ng25-04	09/06/2000	0.8118	40.153	0.0008	23.406	0.687	0.01212	0.020145	0.000029	1.0931	0.0140
Ng25-04	09/06/2000	0.8111	40.384	0.0000	23.372	0.693	0.01210	0.020261	0.000000	1.0915	0.0142
Le55-09	09/07/2000	0.7050	50.053	0.0010	26.322	0.079	0.01063	0.025508	0.000038	1.2407	0.0016
Le55-09	09/07/2000	0.6925	50.342	0.0008	25.630	0.076	0.01044	0.025655	0.000031	1.2081	0.0016
Pc33-44	09/12/2000	0.6705	58.841	0.0000	20.003	6.152	0.01073	0.032855	0.000000	0.9940	0.1347
Pc33-44	09/12/2000	0.6694	58.826	0.0000	19.939	6.151	0.01071	0.032847	0.000000	0.9908	0.1347
Nc25-37	09/12/2000	0.7293	76.621	0.0000	22.105	4.061	0.01129	0.040645	0.000000	1.0665	0.0860
Nc25-37	09/12/2000	0.7359	76.012	0.0000	22.423	4.196	0.01139	0.040322	0.000000	1.0818	0.0889
Oc15-11	09/13/2000	0.6962	35.314	0.0000	19.668	6.413	0.01082	0.018847	0.000000	0.9523	0.1364
Oc15-11	09/13/2000	0.7059	34.727	0.0000	20.059	6.561	0.01097	0.018534	0.000000	0.9712	0.1396
Oi25-18	09/13/2000	0.6530	93.754	0.0000	18.359	2.767	0.00995	0.048525	0.000000	0.8732	0.0577
Oi25-18	09/13/2000	0.6534	93.197	0.0000	18.388	3.227	0.00995	0.048237	0.000000	0.8746	0.0673
Pot Nets 1	10/11/2000	0.6937	36.461	0.0000	19.177	6.062	0.01025	0.018007	0.000000	0.8873	0.1226
Pot Nets 1	10/11/2000	0.6892	36.277	0.0000	19.066	6.031	0.01018	0.017917	0.000000	0.8822	0.1220
Hc34-03	10/16/2000	0.6588	67.085	0.0000	20.499	3.087	0.00983	0.033658	0.000000	0.9574	0.0631
Hc34-03	10/16/2000	0.6523	67.357	0.0000	20.238	2.906	0.00973	0.033794	0.000000	0.9452	0.0594
Nh53-01	10/24/2000	0.7182	36.387	0.0000	21.247	3.237	0.01050	0.017688	0.000000	0.9739	0.0648
Pi12-08	10/24/2000	0.6825	20.175	0.0000	18.458	5.579	0.00998	0.009807	0.000000	0.8461	0.1116
Pi12-08	10/24/2000	0.6820	20.421	0.0000	18.513	5.504	0.00997	0.009927	0.000000	0.8486	0.1102
Nh53-01	10/24/2000	0.7257	36.441	0.0000	21.528	3.402	0.01061	0.017714	0.000000	0.9868	0.0681
Jc43-05	10/26/2000	0.7571	49.901	0.0000	25.829	5.217	0.01107	0.024258	0.000000	1.1840	0.1044
Jc43-05	10/26/2000	0.7478	49.912	0.0000	25.418	5.162	0.01093	0.024263	0.000000	1.1651	0.1033
Je41-08	10/26/2000	0.6324	92.295	0.0000	17.468	5.741	0.00944	0.046306	0.000000	0.8158	0.1173
Je41-08	10/26/2000	0.6262	92.207	0.0000	17.171	5.895	0.00935	0.046262	0.000000	0.8019	0.1205
Oi25-19	11/01/2000	0.6759	81.384	0.0000	18.871	1.463	0.00998	0.040194	0.000000	0.8732	0.0296
Oi25-19	11/01/2000	0.6696	83.166	0.0000	18.627	2.342	0.00989	0.041074	0.000000	0.8619	0.0474

Appendix Ja. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Major inorganic compounds*

[DGS, Delaware Geological Survey; USGS, U.S. Geological Survey; sample type: B, blank; R, replicate; S, spike; –, no data; mg/L, milligrams per liter; µg/L, micograms per liter; µS/cm, microsiemens per centimeter; **E**, estimated value; <, less than]

DGS local well number	USGS site identification number	Date	Sample type	Calcium (µg/L as Ca)	Magnesium (µg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Chloride (mg/L as Cl)	Sulfate (mg/L as SO_4)	Fluoride (mg/L as F)	Silica (mg/L as SiO_2)
Frankford 2	383101075141101	08/21/2000	R	–	–	–	–	–	–	–	–
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	13.6	7.03	8.6	3.7	17.8	23.8	<0.1	17.5
Ie42-03	391060075282801	08/29/2000	B	**E** 0.01	<0.01	<0.1	<0.2	<0.3	<0.3	<0.1	<0.1
Rd22-01	382805075330301	08/31/2000	R	3.62	0.84	10.4	1.2	8.6	2.4	<0.1	39.0
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–

DGS local well number	USGS site identification number	Date	Sample type	Iron (µg/L as Fe)	Manganese (µg/L as Mn)	Bromide (mg/L as Br)	pH, laboratory units	Hardness (mg/L as $CaCO_3$)	Specific conductance, laboratory (µS/cm)	Residue (mg/L)
Frankford 2	383101075141101	08/21/2000	R	–	–	–	–	–	–	–
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	<10	12	0.05	5.4	63	213	136
Ie42-03	391060075282801	08/29/2000	B	<10	<2	<0.01	6.4	- -	4	<10
Rd22-01	382805075330301	08/31/2000	R	10	32	<0.01	5.8	12	87	86
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–

Appendix Jb. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Nutrients*

[DGS, Delaware Geological Survey; USGS, U.S. Geological Survey; sample type: B, blank; R, replicate; S, spike; –-, no data; mg/L, milligrams per liter; **E**, estimated value; <, less than]

DGS local well number	USGS site identification number	Date	Sample type	Ammonia (mg/L as N)	Ammonia and organic (mg/L as N)	Ammonia plus organic (mg/L as N)	Nitrite (mg/L as N)	Nitrate (mg/L as N)	Nitrite plus nitrate (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Phosphorus, total (mg/L as P)	Ortho-phosphorus (mg/L as P)
Frankford 2	383101075141101	08/21/2000	R	–	–	–	–	–	–	–	–	–
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	0.025	**E** 0.06	<0.1	<0.01	–	8.17	0.024	0.024	0.023
Ie42-03	391060075282801	08/29/2000	B	<0.02	<0.1	<0.1	<0.01	–	<0.05	0.011	<0.008	0.013
Rd22-01	382805075330301	08/31/2000	R	<0.02	<0.1	<0.1	0.023	0.841	0.864	**E** 0.004	<0.008	<0.01
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–

Appendix Jc. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Pesticides*

[DGS, Delaware Geological Survey; USGS, U.S. Geological Survey; sample type: B, blank; R, replicate; S, spike; <, less than; **E**, estimated value; –, no data; all concentrations are in micrograms per liter]

DGS local well number	USGS site identification number	Date	Sample type	Acetochlor	Alachlor	Atrazine	Azinphos-methyl	Benfluralin	Butylate	Carbaryl	Carbofuran	Chlorpyrifos	Cyanazine
Frankford 2	383101075141101	08/21/2000	R	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003	<0.003	<0.004	<0.004
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	<0.002	<0.002	<0.023	<0.001	<0.002	<0.002	<0.003	<0.003	<0.004	<0.004
Ie42-03	391060075282801	08/29/2000	B	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003	<0.003	<0.004	<0.004
Rd22-01	382805075330301	08/31/2000	R	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002	<0.003	<0.003	<0.004	<0.004
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.004	<0.002	**E** 0.002	<0.05	<0.01	<0.002	<0.041	<0.02	<0.005	<0.018
Hc34-03	391747075364202	10/16/2000	S	0.114	0.111	0.168	**E** 0.21	0.100	0.117	**E** 0.19	**E** 0.17	0.103	0.137
Hc34-03	391747075364202	10/16/2000	S	0.111	0.109	0.166	**E** 0.21	0.098	0.117	**E** 0.19	**E** 0.16	0.102	0.135
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–

DGS local well number	USGS site identification number	Date	Sample type	Dacthal	Diazinon	Dieldrin	Disulfoton	Eptam	Ethal-fluralin	Ethoprophos	Fonofos	Glyphosate	α-HCH
Frankford 2	383101075141101	08/21/2000	R	<0.002	<0.002	<0.001	<0.017	<0.002	<0.004	<0.003	<0.003	<5	<0.002
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	<0.002	<0.002	<0.001	<0.017	<0.002	<0.004	<0.003	<0.003	<5	<0.002
Ie42-03	391060075282801	08/29/2000	B	<0.002	<0.002	<0.001	<0.017	<0.002	<0.004	<0.003	<0.003	<5	<0.002
Rd22-01	382805075330301	08/31/2000	R	<0.002	<0.002	<0.001	<0.017	<0.002	<0.004	<0.003	<0.003	<5	<0.002
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.003	<0.005	<0.0048	<0.021	<0.002	<0.009	<0.005	<0.0027	–	<0.005
Hc34-03	391747075364202	10/16/2000	S	0.112	0.109	0.152	0.075	0.118	0.102	0.109	0.098	–	0.091
Hc34-03	391747075364202	10/16/2000	S	0.110	0.102	0.153	0.078	0.119	0.102	0.107	0.097	–	0.091
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–

Appendix Jc. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Pesticides*—Continued

DGS local well number	USGS site identification number	Date	Sample type	Lindane	Linuron	Malathion	Metolachlor	Metribuzin	Molinate	Napropamide	Parathion	Parathion-methyl
Frankford 2	383101075141101	08/21/2000	R	<0.004	<0.002	<0.005	<0.002	<0.004	<0.004	<0.003	<0.004	<0.006
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	<0.004	<0.002	<0.005	0.013	<0.004	<0.004	<0.003	<0.004	<0.006
Ie42-03	391060075282801	08/29/2000	B	<0.004	<0.002	<0.005	0.012	<0.004	<0.004	<0.003	<0.004	<0.006
Rd22-01	382805075330301	08/31/2000	R	<0.004	<0.002	<0.005	<0.002	<0.004	<0.004	<0.003	<0.004	<0.006
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.004	<0.035	<0.027	0.016	<0.006	<0.002	<0.007	<0.007	<0.006
Hc34-03	391747075364202	10/16/2000	S	0.107	0.118	0.123	0.277	0.111	0.121	0.129	0.127	0.123
Hc34-03	391747075364202	10/16/2000	S	0.105	0.111	0.118	0.279	0.106	0.121	0.128	0.124	0.114
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–

DGS local well number	USGS site identification number	Date	Sample type	Pebulate	Pendamethalin	*cis*-Permethrin	Phorate	Prometon	Propachlor	Propanil	Propagarite	Propyzamide
Frankford 2	383101075141101	08/21/2000	R	<0.004	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013	<0.003
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	<0.004	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013	<0.003
Ie42-03	391060075282801	08/29/2000	B	<0.004	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013	<0.003
Rd22-01	382805075330301	08/31/2000	R	<0.004	<0.004	<0.005	<0.002	<0.018	<0.007	<0.004	<0.013	<0.003
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.002	<0.01	<0.006	<0.011	<0.015	<0.010	<0.011	<0.023	<0.004
Hc34-03	391747075364202	10/16/2000	S	0.123	0.115	0.090	0.088	0.161	0.138	0.122	0.132	0.108
Hc34-03	391747075364202	10/16/2000	S	0.121	0.114	0.091	0.090	0.157	0.134	0.144	0.138	0.107
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–

Appendix Jc. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network — Quality-control data—Pesticides*—Continued

DGS local well number	USGS site identification number	Date	Sample type	Simazine	Tebuthiuron	Terbacil	Terbufos	Thiobencarb	Triallate	Trifluralin
Frankford 2	383101075141101	08/21/2000	R	<0.005	<0.010	<0.007	<0.013	<0.002	< 0.001	<0.002
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	<0.005	<0.010	<0.007	<0.013	<0.002	< 0.001	<0.002
Ie42-03	391060075282801	08/29/2000	B	<0.005	<0.010	<0.007	<0.013	<0.002	< 0.001	<0.002
Rd22-01	382805075330301	08/31/2000	R	<0.005	<0.010	<0.007	<0.013	<0.002	< 0.001	<0.002
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.011	<0.016	<0.034	<0.017	<0.0048	<0.002	<0.009
Hc34-03	391747075364202	10/16/2000	S	0.121	0.160	**E** 0.13	0.100	0.106	0.102	0.104
Hc34-03	391747075364202	10/16/2000	S	0.118	0.149	**E** 0.12	0.102	0.104	0.099	0.102
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–

Appendix Jd. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Pesticide metabolites*

[DGS, Delaware Geological Survey; USGS, U.S. Geological Survey; sample type: B, blank; R, replicate; S, spike; <, less than; **E**, estimated value; –, no data; all concentrations are in micrograms per liter]

DGS local well number	USGS site identification number	Date	Sample type	*p,p´*-DDE	Desethylatrazine	2,6-Diethylanaline
Frankford 2	383101075141101	08/21/2000	R	<0.006	<0.002	<0.003
Md11-04	385448075341801	08/23/2000	B	–	–	–
Ie42-03	391060075282801	08/29/2000	R	<0.006	**E** 0.069	<0.003
Ie42-03	391060075282801	08/29/2000	B	<0.006	<0.002	<0.003
Rd22-01	382805075330301	08/31/2000	R	<0.006	<0.002	<0.003
Pe23-185	383815075271001	09/05/2000	R	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.002	<0.006	<0.002
Hc34-03	391747075364202	10/16/2000	S	0.072	**E** 0.11	0.113
Hc34-03	391747075364202	10/16/2000	S	0.069	**E** 0.10	0.114
Hc34-03	391747075364202	10/16/2000	R	–	–	–

Appendix Je. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Volatile organic compounds*

[DGS, Delaware Geological Survey; USGS, U.S. Geological Survey; sample type: B, blank; R, replicate; S, spike; <, less than; **E**, estimated value; –, no data; **M**, presence of material verified but not quantified; all concentrations are in micrograms per liter]

DGS local well number	USGS site identification number	Date	Sample type	Acetone	Acrylo-nitrile	Benzene	Bromo-benzene	Bromo-chloro-methane	Bromo-dichloro-methane	Bromo-form	Bromo-methane	*n*-Butyl-benzene	*sec*-Butyl-benzene
Frankford 2	383101075141101	08/21/2000	R	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06	<0.3	<0.2	<0.03
Md11-04	385448075341801	08/23/2000	B	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06	<0.3	<0.2	<0.03
Ie42-03	391060075282801	08/29/2000	R	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06	<0.3	<0.2	<0.03
Ie42-03	391060075282801	08/29/2000	B	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06	<0.3	<0.2	<0.03
Rd22-01	382805075330301	08/31/2000	R	<7	<1	**E** 0.02	<0.04	<0.04	<0.05	<0.06	<0.3	<0.2	**E** .01
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<7	<1	<0.04	<0.04	<0.04	<0.05	<0.06	<0.3	<0.2	<0.03
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–

DGS local well number	USGS site identification number	Date	Sample type	*tert*-Butyl-benzene	Carbon disulfide	Carbon tetrachloride	Chloro-benzene	Chloro-ethane	Chloro-form	Chloro-methane	3-Chloro-propene	2-Chloro-toluene	4-Chloro-toluene
Frankford 2	383101075141101	08/21/2000	R	<0.06	<0.07	<0.06	<0.03	<0.1	0.19	<0.5	<0.2	<0.04	<0.06
Md11-04	385448075341801	08/23/2000	B	<0.06	<0.07	<0.06	<0.03	<0.1	<0.05	**M**	<0.2	<0.04	<0.06
Ie42-03	391060075282801	08/29/2000	R	<0.06	<0.07	<0.06	<0.03	<0.1	**E** 0.02	**M**	<0.2	<0.04	<0.06
Ie42-03	391060075282801	08/29/2000	B	<0.06	**E** 0.03	<0.06	<0.03	<0.1	<0.05	**M**	<0.2	<0.04	<0.06
Rd22-01	382805075330301	08/31/2000	R	<0.06	**E** 0.03	<0.06	0.51	<0.1	**E** 0.04	**M**	<0.2	<0.04	<0.06
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.06	<0.07	<0.06	<0.03	<0.1	**E** 0.02	<0.2	<0.2	<0.03	<0.06
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–

Appendix Je. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Volatile organic compounds*—Continued

DGS local well number	USGS site identification number	Date	Sample type	Dibromo-chloro-methane	1,2-Dibromo-3-chloro-propane	1,2-Dibromo-ethane	Dibromo-methane	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	*trans*-1,4-Dichloro-2-butene	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane
Frankford 2	383101075141101	08/21/2000	R	<0.2	<0.2	<0.04	<0.05	<0.05	<0.054	<0.05	<0.7	<0.3	0.13	0.1
Md11-04	385448075341801	08/23/2000	B	<0.2	<0.2	<0.04	<0.05	<0.05	<0.054	<0.05	<0.7	<0.3	<0.07	<0.1
Ie42-03	391060075282801	08/29/2000	R	<0.2	<0.2	<0.04	<0.05	<0.05	<0.054	<0.05	<0.7	<0.3	<0.07	<0.1
Ie42-03	391060075282801	08/29/2000	B	<0.2	<0.2	<0.04	<0.05	<0.05	<0.054	**E** .02	<0.7	<0.3	<0.07	<0.1
Rd22-01	382805075330301	08/31/2000	R	<0.2	<0.2	<0.04	<0.05	1.55	<0.054	0.54	<0.7	<0.3	0.15	<0.1
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.2	<0.2	<0.04	<0.05	<0.031	<0.03	<0.05	<0.7	<0.3	<0.04	<0.1
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–	–

DGS local well number	USGS site identification number	Date	Sample type	1,1-Dichloro-ethene	*cis*-1,2-Dichloro-ethene	*trans*-1,2-Dichloro-ethylene	Dichloro-methane	1,2-Dichloro-propane	1,3-Dichloro-propane	2,2-Dichloro-propane	1,1-Dichloro-propene	*cis*-1,3-Dichloro-propene	*trans*-1,3-Dichloro-propene	Diethyl ether
Frankford 2	383101075141101	08/21/2000	R	<0.04	<0.04	<0.03	<0.4	<0.07	<0.1	<0.05	<0.03	<0.09	<0.09	<0.2
Md11-04	385448075341801	08/23/2000	B	<0.04	<0.04	<0.03	<0.4	<0.07	<0.1	<0.05	<0.03	<0.09	<0.09	<0.2
Ie42-03	391060075282801	08/29/2000	R	<0.04	<0.04	<0.03	<0.4	<0.07	<0.1	<0.05	<0.03	<0.09	<0.09	<0.2
Ie42-03	391060075282801	08/29/2000	B	<0.04	<0.04	<0.03	0.6	<0.07	<0.1	<0.05	<0.03	<0.09	<0.09	<0.2
Rd22-01	382805075330301	08/31/2000	R	**E** 0.03	**E** 0.01	<0.03	<0.4	<0.07	<0.1	<0.05	<0.03	<0.09	<0.09	<0.2
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.04	<0.04	<0.03	**E** 0.1	<0.03	<0.1	<0.05	<0.03	<0.09	<0.09	<0.2
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–	–

Appendix Je. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Volatile organic compounds*—Continued

DGS local well number	USGS site identification number	Date	Sample type	Diisopropyl ether	Ethyl-benzene	Ethyl *tert*-butyl ether	Ethyl meth-acrylate	*o*-Ethyl toluene	Hexa-chloro-butadiene	Hexa-chloro-ethane	Isopropyl-benzene	*p*-Isopropyl-toluene	Methyl acrylate	Methyl acrylonitrile
Frankford 2	383101075141101	08/21/2000	R	0.4	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2	**E** 0.01	<0.07	<1	<0.6
Md11-04	385448075341801	08/23/2000	B	<0.1	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2	<0.03	<0.07	<1	<0.6
Ie42-03	391060075282801	08/29/2000	R	<0.1	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2	<0.03	<0.07	<1	<0.6
Ie42-03	391060075282801	08/29/2000	B	<0.1	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2	<0.03	<0.07	<1	<0.6
Rd22-01	382805075330301	08/31/2000	R	<0.1	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2	**E** 0.01	<0.07	<1	<0.6
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.1	<0.03	<0.05	<0.2	<0.06	<0.1	<0.2	<0.03	<0.07	<1	<0.6
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–	–

DGS local well number	USGS site identification number	Date	Sample type	Methyl *tert*-butyl ether (MTBE)	Methyl butyl ketone	Methyl ethyl ketone	Methyl iodide	Methyl isobutyl ketone	Methyl methacrylate	Methyl *tert*-pentyl ether	Naphthalene	*n*-Propyl-benzene	Styrene	1,1,1,2-Tetra-chloro-ethane	1,1,2,2-Tetra-chloro-ethane
Frankford 2	383101075141101	08/21/2000	R	<0.2	<0.7	<2	<0.1	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04	<0.03	<0.09
Md11-04	385448075341801	08/23/2000	B	<0.2	<0.7	<2	<0.1	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04	<0.03	<0.09
Ie42-03	391060075282801	08/29/2000	R	<0.2	<0.7	<2	<0.1	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04	<0.03	<0.09
Ie42-03	391060075282801	08/29/2000	B	<0.2	<0.7	<2	<0.1	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04	<0.03	<0.09
Rd22-01	382805075330301	08/31/2000	R	0.4	<0.7	<2	<0.1	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04	<0.03	<0.09
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.2	<0.7	<2	<0.1	<0.4	<0.3	<0.1	<0.2	<0.04	<0.04	<0.03	<0.09
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–	–	–

Appendix Je. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Volatile organic compounds*—Continued

DGS local well number	USGS site identification number	Date	Sample type	Tetra-chloro-ethylene	Tetra-hydro-furan	1,2,3,4-Tetra-methyl-benzene	1,2,3,5-Tetra-methyl-benzene	1,2,3-Tri-chloro-benzene	1,2,4-Tri-chloro-benzene	1,1,1-Tri-chloro-ethane	1,1,2-Tri-chloro-ethane	Tri-chloro-ethene	Tri-chloro-fluoro-methane
Frankford 2	383101075141101	08/21/2000	R	<0.1	<2	<0.2	<0.2	<0.3	<0.2	<0.03	<0.06	<0.04	<0.09
Md11-04	385448075341801	08/23/2000	B	<0.1	<2	<0.2	<0.2	<0.3	<0.2	<0.03	<0.06	<0.04	<0.09
Ie42-03	391060075282801	08/29/2000	R	**M**	<2	<0.2	<0.2	<0.3	<0.2	<0.03	<0.06	<0.04	<0.09
Ie42-03	391060075282801	08/29/2000	B	**M**	<2	<0.2	<0.2	<0.3	<0.2	<0.03	<0.06	<0.04	<0.09
Rd22-01	382805075330301	08/31/2000	R	**M**	<2	<0.2	<0.2	<0.3	<0.2	<0.03	<0.06	**E** 0.02	<0.09
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.1	<2	<0.2	<0.2	<0.3	<0.2	<0.03	<0.06	<0.04	<0.09
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–

DGS local well number	USGS site identification number	Date	Sample type	1,2,3-Tri-chloro-propane	1,1,2-Tri-chloro-trifluoro-ethane	1,2,3-Tri-methyl-benzene	1,2,4-Tri-methyl-benzene	1,3,5-Tri-methyl-benzene	Toluene	Vinyl bromide	Vinyl chloride	*m*- and *p*-Xylene	*o*-Xylene
Frankford 2	383101075141101	08/21/2000	R	<0.2	<0.06	<0.1	<0.06	<0.04	**E** 0.02	<0.1	<0.1	<0.06	<0.04
Md11-04	385448075341801	08/23/2000	B	<0.2	<0.06	<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04
Ie42-03	391060075282801	08/29/2000	R	<0.2	**E** 0.02	<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04
Ie42-03	391060075282801	08/29/2000	B	<0.2	**E** 0.03	<0.1	<0.06	<0.04	**E** 0.01	<0.1	<0.1	<0.06	<0.04
Rd22-01	382805075330301	08/31/2000	R	<0.2	<0.06	<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04
Pe23-185	383815075271001	09/05/2000	R	–	–	–	–	–	–	–	–	–	–
Pot Nets 1	383649075090801	10/11/2000	R	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	B	<0.2	**E** 0.04	<0.1	<0.06	<0.04	<0.05	<0.1	<0.1	<0.06	<0.04
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	–	–	–	–	–	–	–	–	–	–

Appendix Jf. *Ground-water quality data for the Delaware Source Water Assessment Program unconfined aquifer well network—Quality-control data—Radionuclides*

[DGS, Delaware Geological Survey; USGS, U.S. Geological Survey; sample type: B, blank; R, replicate; S, spike; <, less than; –, no data; all activities are in picocuries per liter]

DGS local well number	USGS site identification	Date	Sample type	Gross-alpha	Gross-alpha, 2-sigma [1]	Gross-beta	Gross-beta, 2-sigma [1]	Radium-224	Radium-224, 2-sigma [1]	Radium-226	Radium-226, 2-sigma [1]	Radium-228	Radium-228, 2-sigma [1]	Radon-222	Radon-222, 2-sigma [1]
Frankford 2	383101075141101	08/21/2000	R	–	–	–	–	–	–	–	–	–	–	–	–
Md11-04	385448075341801	08/23/2000	B	–	–	–	–	–	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	R	–	–	–	–	–	–	–	–	–	–	–	–
Ie42-03	391060075282801	08/29/2000	B	–	–	–	–	–	–	–	–	–	–	–	–
Rd22-01	382805075330301	08/31/2000	R	–	–	–	–	–	–	–	–	–	–	–	–
Pe23-185	383815075271001	09/05/2000	R	<3.00	2.1	<4.00	4.1	<1.00	0.10	<1.00	0.12	<1.00	0.42	80.0	16
Pot Nets 1	383649075090801	10/11/2000	R	<3.00	1.8	<4.00	3.7	<1.00	0.05	<1.00	0.05	<1.00	0.39	341	21
Hc34-03	391747075364202	10/16/2000	B	<3.00	1.5	<4.00	3.8	<1.00	0.00	<1.00	0.03	<1.00	0.40	<26.0	14
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	S	–	–	–	–	–	–	–	–	–	–	–	–
Hc34-03	391747075364202	10/16/2000	R	5.83	3.1	4.61	4.1	<1.00	0.24	<1.00	0.12	1.15	0.51	–	–

[1] 2-sigma precision estimate.