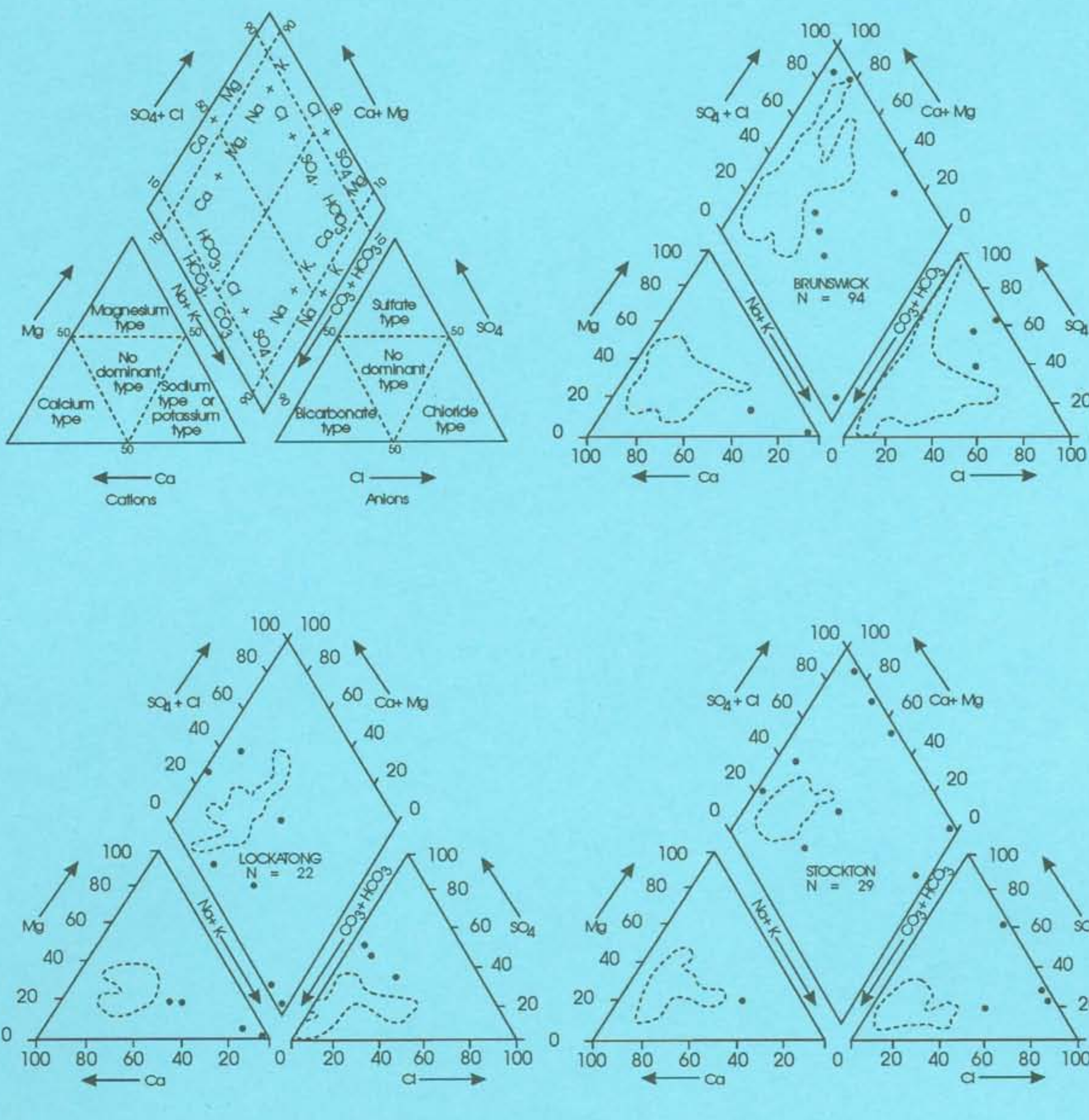
New Jersey Geological Survey
Geological Survey Report GSR 35

NATURAL GROUND-WATER QUALITY IN BEDROCK OF THE NEWARK BASIN, NEW JERSEY



N.J. Department of Environmental Protection - Division of Science and Research

STATE OF NEW JERSEY
Christine Todd Whitman, *Governor*

Department of Environmental Protection
Robert C. Shinn, Jr., *Commissioner*

Policy and Planning
Lewis Nagy, *Assistant Commissioner*

Division of Science and Research
Robert K. Tucker, Ph.D., *Director*

Geological Survey
Haig F. Kasabach, *State Geologist*

NEW JERSEY GEOLOGICAL SURVEY

The mission of the New Jersey Geological Survey is to map, research, interpret and provide scientific information regarding the state's geology and ground-water resources. This information supports the regulatory and planning functions of DEP and other governmental agencies and provides the business community and public with the information necessary to address environmental concerns and make economic decisions.

Cover illustration: Piper diagrams showing chemical types of water found in wells sampled in this investigation (see page 6).

New Jersey Geological Survey
Geological Survey Report GSR 35

Natural Ground-Water Quality in Bedrock of the Newark Basin, New Jersey

by
Michael E. Serfes

New Jersey Department of Environmental Protection
Division of Science and Research
Geological Survey
CN 427
Trenton, NJ 08625
1994

Printed on recycled paper

New Jersey Geological Survey Reports (ISSN 0741-7357) are published by the New Jersey Geological Survey, CN 427, Trenton, NJ 08625. This report may be reproduced in whole or part provided that suitable reference to the source of the copied material is provided.

Additional copies of this and other reports may be obtained from:

New Jersey Department of Environmental Protection
Maps and Publications Sales Office
Bureau of Revenue
CN 417
Trenton, NJ 08625

A price list is available by calling, (609) 777-1038.

CONTENTS

FIGURES

TABLES

NATURAL GROUND-WATER QUALITY IN BEDROCK OF THE NEWARK BASIN, NEW JERSEY

ABSTRACT

Chemical analyses of 169 water samples from 150 wells in the bedrock of the Newark Basin show water to be generally fresh, somewhat oxidizing, slightly alkaline, non-corrosive, and hard. They are predominantly calcium-magnesium-sodium bicarbonate type waters of good natural quality, but locally they may require treatment for undesirable characteristics and constituents. The most common problems are with the state-recommended secondary drinking water standards. For the sedimentary formations, the standards exceeded are manganese (26.9 percent of samples exceeded the standard), maximum hardness (20.8 percent exceeded the standard), corrosivity (31.2 percent are corrosive), total dissolved solids (13.6 percent exceeded the standard), iron (14.5 percent exceeded the standard), sodium (8.5 percent exceeded the standard), and sulfate (8.2 percent exceeded the standard). A few samples exceeded the state primary drinking water standards for gross alpha particle activity (6.5 percent exceeded the standard), radium (only ^{226}Ra measured, 3 percent exceeded the standard), and lead (only one sample, or 0.7 percent, exceeded the standard).

INTRODUCTION

The purpose of this report is to summarize data on natural ground-water quality in sedimentary bedrock formations of the Newark Basin in New Jersey (fig. 1). This information will provide natural ranges of many water-quality parameters. Uses for this data include (1) establishing baselines for assessing ground-water pollution and (2) assisting local governments, water companies, drillers and private well owners in recognizing the potential for natural water-quality problems.

Ground water is an extremely important resource for New Jersey. It provides approximately 50 percent of the state's potable water (NJDEP, 1987); of this, 80 percent is from public supplies and 20 percent from domestic wells. In addition, ground water provides base flow to streams and is intimately associated with the ecology of the state's wetlands. Within the Newark Basin, home to most of New Jersey's population, about 59 percent of the purveyor-supplied water is ground water (NJDEP, 1985). In addition, more than 71,000 domestic wells supply approximately 9 percent of the inhabitants with water.

With ground water, as with surface water, quality is an important concern. Ground-water quality is a function of (1) the composition of precipitation, (2) the conditions precipitation encounters at the land surface, (3) the residence time in the ground-water reservoir, and (4), most important, the composition and mineralogy of subsurface materials.

Undesirable constituents in ground water are not always anthropogenic in origin, and the federal and state primary and secondary drinking water standards are often exceeded under natural conditions. Defining natural ground-water quality, however, can be difficult. Many of the dissolved constituents in ground water, such as sodium and chloride from road salting, can come from widely distributed point sources as well as from natural sources. For constituents with multiple sources, the contribution from anthropogenic activities may not be distinguishable from natual background concentration. In the Newark Basin, however, manganese,

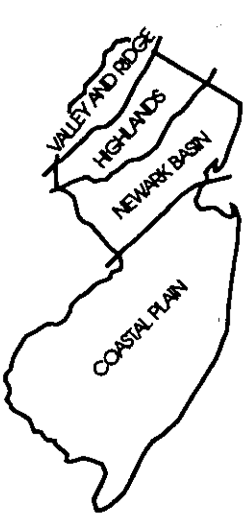


Figure 1. Physiographic regions of New Jersey.

hardness, corrosivity, total dissolved solids, iron, sulfate, sodium, and chloride in excess of secondary drinking water standards have long been recognized, at some locations, as natural (for example Kasabach, 1966; Nichols, 1968). More recently, naturally occurring radionuclides exceeding the primary drinking water standards have been recognized and investigated (Zapecza and Szabo, 1987).

Elsewhere, it is clear that human activities have degraded ground-water quality. Previous studies in Newark, New Jersey, and the adjacent urban area to the east and northeast show both naturally-occurring and induced poor ground-water quality in the fractured rocks of the Brunswick Group. Localized saltwater intrusion due to overpumping has degraded water quality, resulting in chloride concentrations as high as 1900 milligrams per liter in the area around Newark Bay (Nichols, 1968). Deep, slow moving ground water in this area commonly requires treatment for naturally high levels of dissolved solids, hardness, iron and sulfate (Carswell, 1976). Ubiquitous ground-water pollution in this area is related to extensive industrialization and urbanization.

The water quality data used in this report were obtained from two sources: (1) The Ambient Ground Water Quality Network and (2) a N.J. Department of Environmental Protection (NJDEP) and U.S. Geological Survey (USGS) study of radionuclides in ground water of the Newark basin. The Ambient Ground-Water Quality Network was established by the NJDEP and USGS to monitor the environmental quality of ground water in New Jersey. Its present focus is to determine natural ground-water quality throughout the state and examine how geologic conditions influence water quality. Each year, 22 to 26 wells are selected and sampled. In each of the state's four physiographic regions (fig. 1) samples are taken over a two-year period. Wells are sampled for major ions, nutrients, trace constituents, gross alpha activity and volatile organic compounds. The analyses presented here from the Ambient Ground Water Quality Network were collected during 1987 and 1988.

The DEP-USGS study of radionuclides was undertaken to determine the occurrence and distribution of naturally occurring radionuclides in the Newark Basin in New Jersey. Water samples were collected from 260 ground-water sites geographically distributed throughout the basin. One hundred and twenty-five samples were analyzed for major ions, trace metals, radioactive constituents, and field parameters such as pH, specific conductance and dissolved oxygen. The analyses presented here from the DEP/USGS study of radionuclides in ground water were collected between 1985 and 1987.

For both the ambient network and the study of radionuclides, wells near known pollution sites were avoided. Also, all wells from the ambient network found to contain volatile organic compounds were eliminated from the database used here. All analyses were done at the U.S. Geological Survey National Laboratory using standard methods presented in Fishman and Friedman (1985).

In total, 169 acceptable analyses were available from 150 wells; 167 samples were collected from 148 wells in sedimentary bedrock and 2 samples were collected from 2 wells in basaltic igneous rocks. Statistical summary tables in this report are based on the samples from sedimentary bedrock. Nineteen of the wells were sampled twice. Before calculating summary statistics, the analytical results from wells with two samples were averaged into one value. This was to avoid statistical bias from overrepresentation of sites sampled more than once.

Acknowledgments

The Ambient Ground-Water Quality Network is supported by a grant from the USEPA and by Department of Environmental Protection permit fees. The Department of Environmental Protection and the USGS supported the study of radionuclides in ground water. Appreciation is extended to all involved in establishing the ambient network, particularly my predecessors in the NJGS, Gail Carter, who standardized the sample collection process, and George Blyskun, project chief during much of the sample collection in the Newark Basin. I would also like to thank the samplers (Rich Fenton from the Bureau of Water Monitoring and all those from the USGS) for their dedication to this project. Special thanks go to Zoltan Szabo of the USGS for providing data he collected for the study of radionuclides in the Newark Basin and for reviewing the manuscript.

HYDROGEOLOGY

The Newark Basin (fig. 1) is a regional geologic trough bounded on the northwest by a fault. The basin was formed, filled with stream- and lake-deposited sediments, and intruded and overlain by basaltic magma between 230 and 187 million years ago. The sediments were subsequently lithified. Together with rocks in similar basins between South Carolina and Nova Scotia, they make up the Newark Supergroup. Rock units in the

Table 1. Geologic units of the New Jersey portion of the Newark Basin

Era	System	Series	Stratigraphic unit				Predominant lithology	
MESOZOIC	Jurassic	Lower Jurassic	Newark Supergroup	Brunswick Group	Boonton Formation		sandstone, siltstone, shale, conglomerate	
					Hook Mountain Basalt		basalt	
					Towaco Formation		sandstone, siltstone, shale, conglomerate	
					Preakness Basalt		basalt, intercalated sedimentary rock	
					Feltville Formation		sandstone, siltstone, shale, conglomerate, limestone	
					Orange Mountain Basalt	diabase intrusives	basalt	diabase
	Triassic	Upper Triassic			Passaic Formation		sandstone, siltstone, shale, conglomerate	
				Lockatong Formation			siltstone, mudstone, sandstone, shale	
				Stockton Formation			arkosic sandstone, siltstone, shale, conglomerate	

Newark Basin are listed in table 1 and shown geographically in figure 2. They are gently folded and generally dip at 5 to 15 degrees to the northwest. From older to younger, they are the Stockton Formation, the Lockatong Formation, and the Brunswick Group. The Brunswick Group includes four sedimentary formations dominated by red mudstone, three igneous formations consisting of basalt, and diabase intrusives (Olsen, 1980). One of the Brunswick Group sedimentary formations, the Passaic, is the most extensive formation within the basin. Because the Stockton, Lockatong, and Passaic Formations underlie most of the basin, they are the predominant aquifers, yielding 95 percent of the water drawn from the bedrock (NJDEP, 1987).

Most ground water in the bedrock of the Newark Basin flows through a network of interconnected fractures, bedding plane partings, and other openings. The size and abundance of hydraulically connected fractures decreases with depth; Kasabach (1966) noted that most ground water in the Stockton and Passaic Formations in Hunterdon County is restricted to the uppermost 500 feet.

The chemical quality of ground water is strongly affected by the minerals the water contacts as it moves through the aquifer. The sedimentary formations of the Newark Basin consist of mudstone, siltstone, and sandstone, with minor conglomerate. The following petrologic and mineralogic descriptions of those formations are shortened from Van Houten (1969).

The Stockton Formation consists mainly of well-sorted arkose with subordinate, poorly sorted conglomerate and mudstone. The arkose and conglomerate are cemented with silica and calcite and consist of quartz (50 to 70 percent), feldspar (15 to 40 percent), subordinate muscovite, chert, and metamorphic rock fragments, minor biotite and chlorite, and hematite with magnetite cores. The conglomerate consists of quartz, feldspar, metamorphic rock, and shale clasts in a poorly sorted arkosic matrix. The mudstone contains much illite, muscovite and feldspar. Sodic feldspar predominates over potassic feldspar.

The Lockatong Formation consists of cyclically deposited sediments recording repeated expansion and waning of an extensive lake. Some of the cycles are represented by rocks deposited, in part, by chemical precipitation. These include gray to black dolomitic mudstone and marlstone, carbonate-rich argillite consisting of analcime (35-40 percent) with albite, dolomite, calcite, illite, chlorite, and localized lenses of crystalline calcite and pyrite. The rocks deposited during other cycles are predominantly detrital and include black pyritic shale, carbonate-rich mudstone and calcareous argillite. Mineralogically these detrital rocks consist mostly of sodic feldspar, potassic feldspar, illite, muscovite, chlorite, calcite and quartz. The pyritic shale can have organic carbon concentrations as high as 5 percent (Turner-Peterson, 1980).

The Brunswick Group sediments consist mostly of reddish-brown feldspathic mudstone and micaceous siltstone with some claystone and fine-grained sandstone. The percentage of quartz ranges from 10 to 30 percent in the mudstone to 50 to 75 percent in the siltstone. For both mudstone and siltstone, the total of feldspar, illite, subordinate chlorite, and hematite coatings on grains is less than 15 percent. Molds of dissolved glauberite, now filled with calcite and barite, are common. Beds of gypsum are locally present in the subsurface.

In addition to small bodies of conglomerate, which occur in all of the Newark Basin sedimentary formations, substantial bodies of conglomerate lie along the western margin of the basin. These reach widths of as much as 3 miles in Hunterdon County. The clasts are predominantly rounded Paleozoic quartzite pebbles, but angular Paleozoic limestone clasts predominate locally. Clasts of Proterozoic gneiss predominate in only a very few patches.

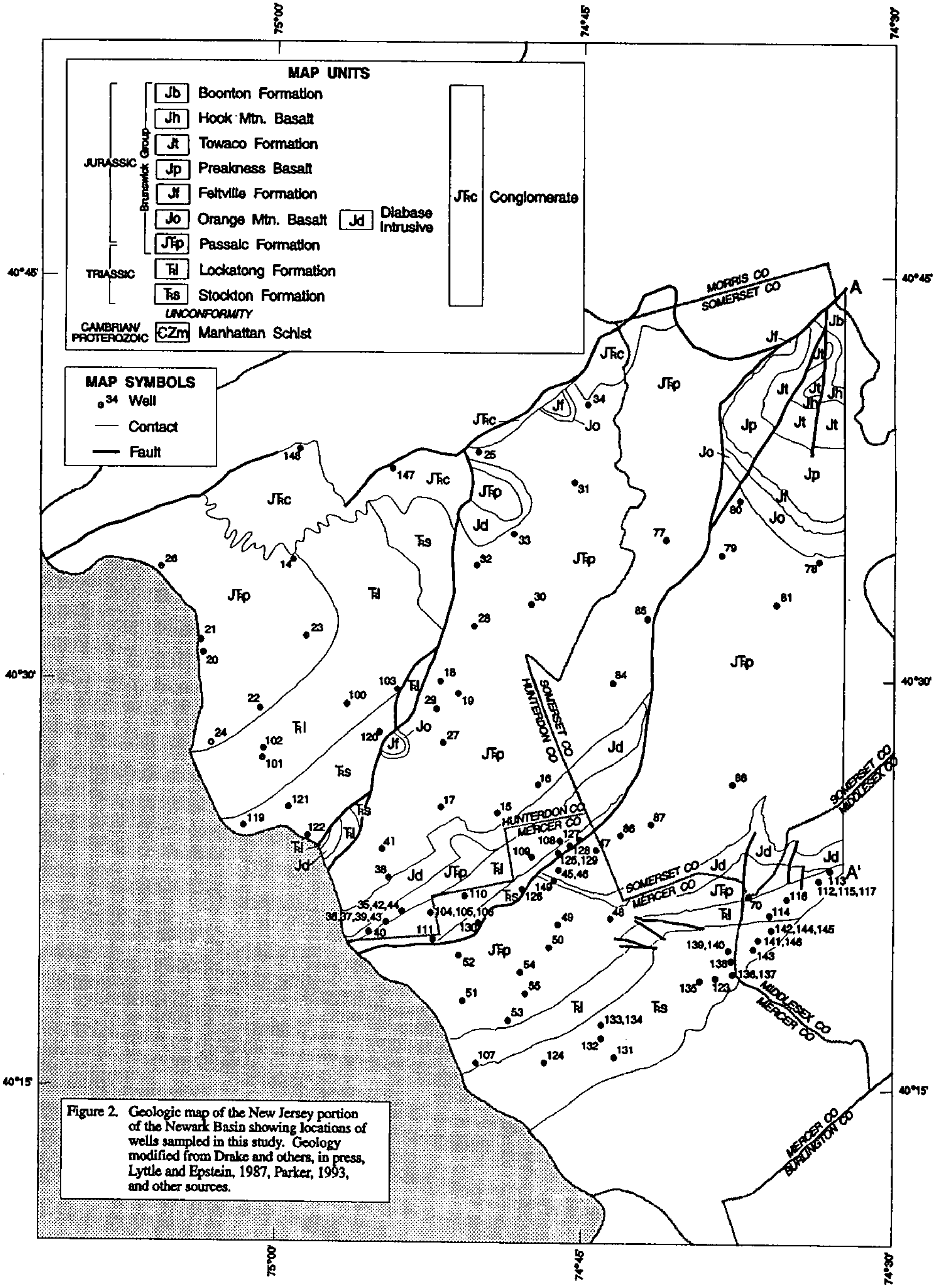
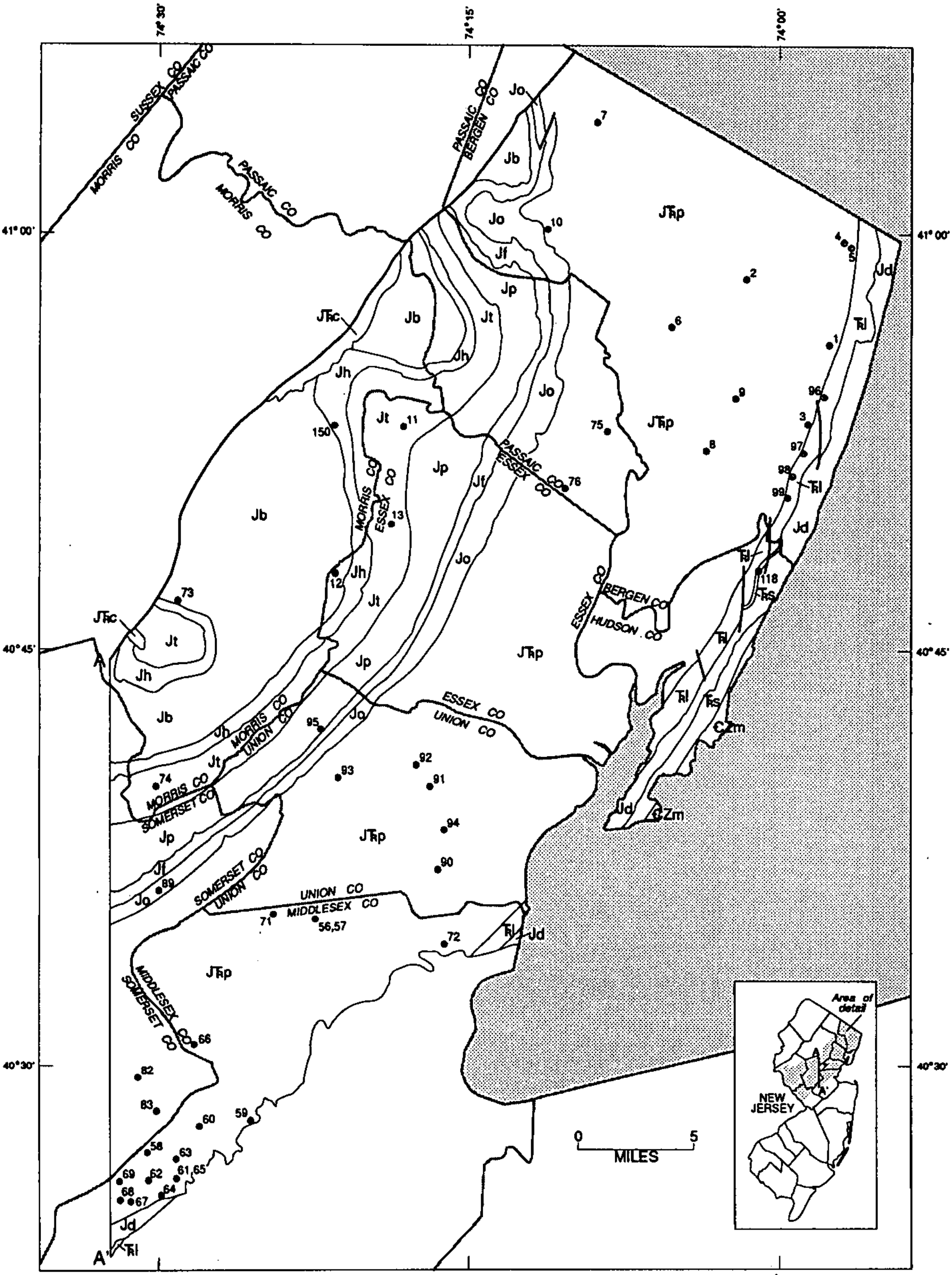


Figure 2. Geologic map of the New Jersey portion of the Newark Basin showing locations of wells sampled in this study. Geology modified from Drake and others, in press, Lyttle and Epstein, 1987, Parker, 1993, and other sources.


74°30'
74°15'
74°00'
41°00'
40°45'
40°30'
SUSSEX CO
PASSAIC CO
MORRIS CO
MORRIS CO
PASSAIC CO
BERGEN CO
ESSEX CO
HUDSON CO
UNION CO
SOMERSET CO
MIDDLESEX CO
Jo
Jb
Jf
Jp
Jt
Jh
Jd
JTRc
JTRp
TRl
TRs
CZm
A
A'
0
5
MILES
Area of detail
NEW JERSEY

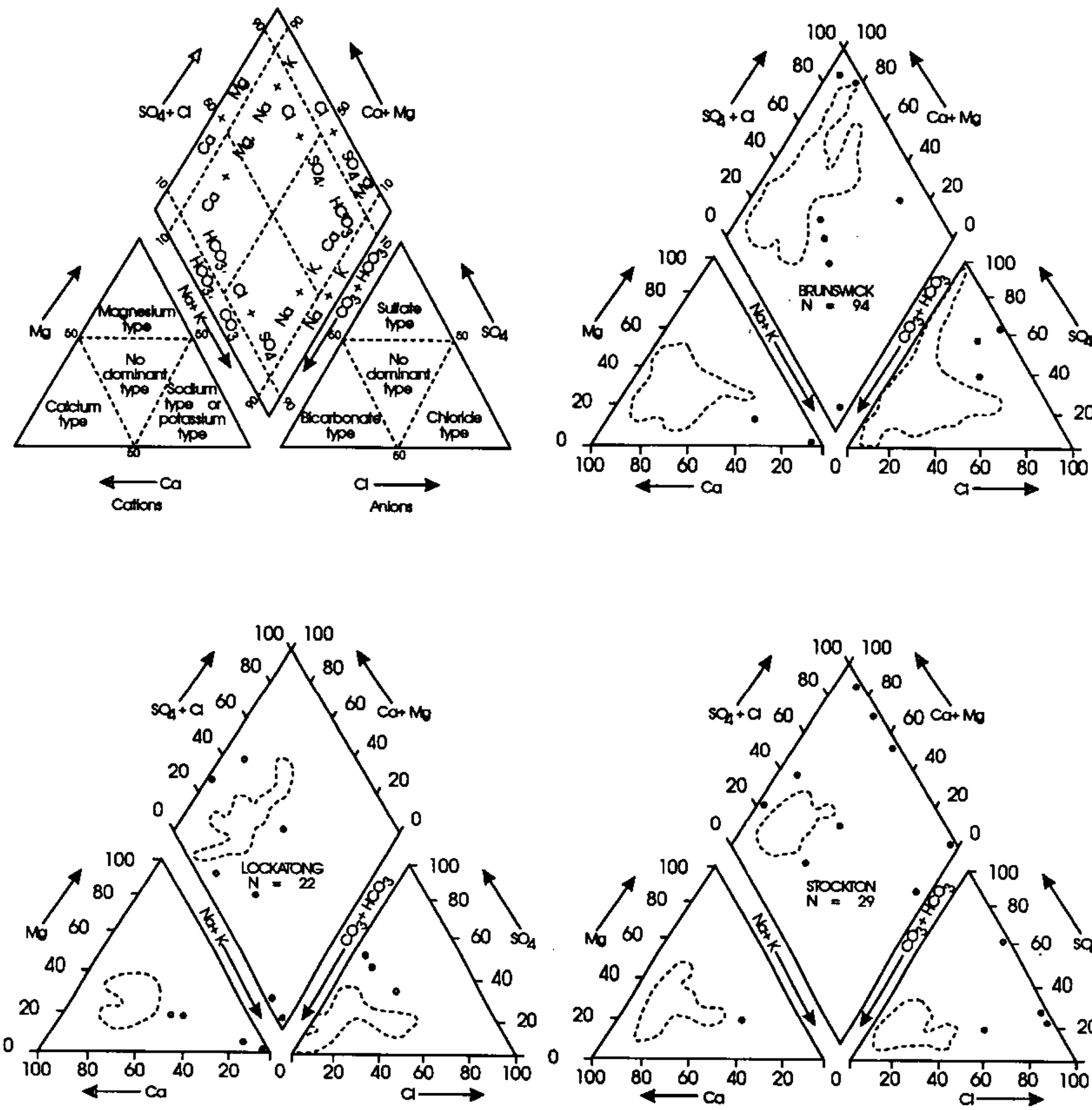


Figure 3. Piper diagrams showing the chemical types of water in the Brunswick Group sedimentary rocks and the Lockatong and Stockton Formations. Diagram in upper left shows domains of dominant water types. Dominant cations and anions in the water are plotted as the percentage of total equivalents per liter. Triangles in lower left and right show cation and anion plots respectively. Lines extrapolated from points in the triangles plot as a point in the diamond representing the ionic composition of the water as depicted. Dashed lines bound areas with the highest concentration of points for individual formations.

GROUND-WATER CHEMISTRY

The chemistry of precipitation at Washington Crossing State Park (table 2) is presented here for illustration purposes, and is probably representative of precipitation elsewhere in the Newark Basin. Precipitation at the park, like most precipitation, is a dilute, acidic, oxidizing solution. The chemistry of precipitation is controlled by dissolved atmospheric gases (such as oxygen and carbon dioxide), natural and anthropogenic airborne particulates, and other natural and anthropogenic inputs. Although specific conductances greater than 100 microsiemens per centimenter (µS/cm) have been reported in urban areas, values less than 50 µS/cm are more normal (Hem, 1985). Atmospheric carbon dioxide produces a pH of about 5.7 in rainwater. Human activites have increased the acidity of precipitation in New Jersey.

Table 2. Water quality characteristics of precipitation at Washington Crossing State Park, Mercer County, New Jersey.
[µS/cm, microsiemens per centimeter, based on samples collected weekly through 1990 (National Atmospheric Deposition Program, 1991)]

	pH (standard)	Conductivity (µS/cm)	Solute concentration (milligrams per liter)							
			Ca	Mg	K	Na	NH_4	NO_3	Cl	SO_4
Minimum	3.86	5.5	0.01	0.005	0.003	0.014	0.03	0.21	0.06	0.45
Median	4.32	26.1	0.09	0.032	0.016	0.123	0.28	1.75	0.27	2.16
Maximum	6.44	84.6	0.55	0.341	0.135	2.290	1.11	7.96	3.74	7.14

As water from precipitation percolates from the land surface through the unsaturated zone and flows through the ground-water system, it generally becomes more alkaline, mineralized, and reducing by chemical interaction with the materials it contacts. The median values of alkalinity, specific conductance and dissolved oxygen for ground waters of the sedimentary units in the Newark basin (tables 3, 4, and 7) are consistent with this. The median pH for precipitation is 4.32, equivalent to no or zero alkalinity. In the ground water the median alkalinity is 134 milligrams per liter. The specific conductance (µS/cm) is an indicator of the amount of dissolved material. It increased from a median value of 26.1 µS/cm in the precipitation to 417 µS/cm in the ground water. Rain water in direct contact with the atmosphere has a dissolved oxygen concentration which varies from approximately 14 milligrams per liter at 0 °C to 8.5 milligrams per liter at 25 °C (American Water Works Association, 1975). For the Newark Basin ground water samples, the mean concentration of dissolved oxygen is 2.7 milligrams per liter; it is thus less oxidizing (more reducing) than rainwater.

Water-quality characteristics of all the Newark Supergroup samples collectively, and for wells in the Stockton Formation, Lockatong Formation, and Brunswick Group separately, are in tables 3 and 4. Location and construction information on wells is in table 6 (at end of report) and figure 2. Chemical analyses of water from each well are in table 7 (at end of report).

In general terms, ground waters in sedimentary bedrock of the Newark Basin are somewhat oxidizing, slightly alkaline, fresh (less than 1000 mg/L total dissolved solids), noncorrosive, and hard. In order of decreasing median abundance, the measurable cations are (1) calcium, (2) sodium, (3) magnesium, (4) potassium, (5) strontium, (6) barium, (7) zinc, (8) lithium, (9) iron, (10) manganese, and (11) arsenic. The anions are (1) bicarbonate, (2) sulfate, (3) chloride, (4) nitrate plus nitrite, (5) fluoride, (6) orthophosphate.

Piper diagrams (fig. 3) were used to classify the waters of the Stockton, Lockatong, and Brunswick in terms of their major and minor cations and anions. In all three formations calcium-magnesium-sodium bicarbonate type waters dominate; calcium sulfate type waters are subordinate. Calcium sulfate type waters are associated with high dissolved solids in the Brunswick Group formations (fig. 4). Some sodium chloride type waters were also present in the Brunswick Group and Stockton Formation. A few samples from the Lockatong Formation were sodium bicarbonate type water.

The differences in ground-water quality among formations (tables 3, 4, 7; fig. 5) are related mainly to differences in their rock and mineral compositions. Some of the more obvious differences based on median concentrations are: (1) Waters from the Brunswick Group sedimentary rocks are hardest and highest in calcium, magnesium, chlo-

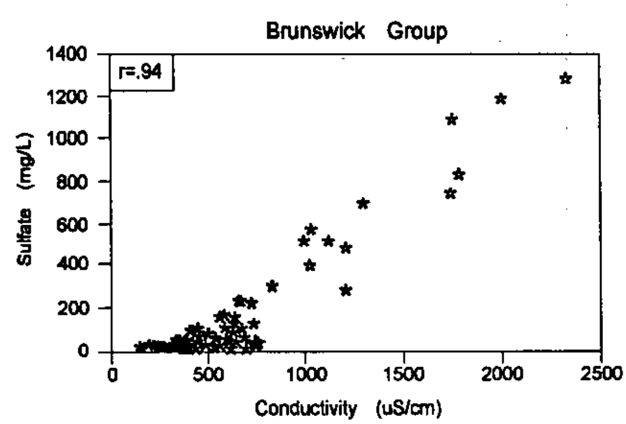


Figure 4. Scatter diagram showing dissolved sulfate and conductivity for ground water samples from the sedimentary rocks of the Brunswick Group, New Jersey.

Table 3. Statistical summary of water quality characteristics for wells in the Newark Supergroup sedimentary rocks New Jersey[1]

[p, primary drinking water standard; s, secondary drinking water standard; µs/cm, microsiemens per centimeter, mg/L; milligrams per liter; µg/L, micrograms per liter; --, no data available]

Characteristic or constituent	Number of Samples	Minimum	25th percentile	Median	75th percentile	Maximum	Maximum contaminant level (standards) p:primary s:secondary	Maximum contaminant level (standards) percent exceeded
Characteristics								
Temperature (C)	147	9.5	12.5	13	13.5	17	--	--
Specific Conductance (us/cm)	147	140	342	417	550	2040	--	--
Oxygen, dissolved (mg/L)	147	<0.1	0.5	2.7	5.0	14.7	--	--
pH (standard units)	148	5.5	7.1	7.6	7.8	9.3	6.5-8.5(s)	6.1 <6.5, 3.4 >8.5
Field Alkalinity (mg/L as $CaCO_3$)	147	21	101	134	161	338	--	--
Solids[2], dissolved (mg/L)	147	106	259	316	416	1540	500(s)	13.6
Corrosivity (pH units)[3]	142	-3.86	-0.68	-0.23	-0.05	1.04	-1 to 1(s)	31.2 <-1, 0 >1
Hardness, (mg/L as CaCO)	147	12	140	180	220	1100	50-250(s)	3.4 <50, 20.8 >250
Major and Minor Dissolved Constituents (mg/L)								
Calcium	147	2.5	35	45	62	365	--	--
Magnesium	147	0.27	10	15	19	69	--	--
Sodium	147	2.1	12	15	27	270	50(s)	8.5
Potassium	147	0.4	1	1.3	2	6.6	--	--
Chloride	147	1.7	10	16	28	320	250(s)	0
Sulfate	147	1.1	22	36	64	1200	250(s)	8.2
Fluoride	44	0.01	0.1	0.1	0.2	1.4	4(p)	0
Silica	147	11	19	22	26	45	--	--
Nutrients, Dissolved (mg/L)								
Nitrogen, NH_3, (as N)	54	0.01	0.01	0.01	0.02	0.28	--	--
Nitrogen, NO_2, (as N)	55	0.01	0.01	0.01	0.01	0.02	1(p)	0
Nitrogen, NH_3 + Organic, (as N)	54	0.2	0.2	0.3	0.5	1.1	--	--
Nitrogen, NO_2+NO_3, (as N)	55	0.1	0.29	1.5	3.0	7.6	10(p)	0
Nitrate, [NO_2+NO_3]-[NO_2], (as N)	55	0.1	0.33	1.6	3.0	7.4	10(p)	0
Phosphorous Ortho, (as P)	49	0.01	0.01	0.02	0.05	0.16	--	--
Phosphorous, (as P)	40	0.01	0.02	0.04	0.06	0.3	--	--
Trace and Minor Dissolved Constituents (µg/L)								
Aluminum	57	<10	<10	<10	8.5	30	50 - 200(s)	0
Arsenic	43	<1	<1	2	3	19	50(p)	0
Barium	119	<2	34.5	110	200	1200	2000(p)	0
Beryllium	119	<0.5	<0.5	<0.5	<0.5	1	--	--
Cadmium	147	<1	<1	<1	<1	3	5(p)	0
Chromium	43	<1	<1	<1	<1	5	100(p)	0
Cobalt	119	<3	<3	<3	<3	<3	--	--
Copper	147	<10	<10	<10	<10	200	1300(p)	--
Iron	147	<3	<3	7	24	11000	300(s)	14.5
Lead	147	<10	<10	<10	<10	16	15(p)	0.7
Lithium	121	<4	9	20	29	100	--	--
Manganese	147	<1	<1	5	55	1600	50(s)	27
Mercury	43	0.1	0.1	0.1	0.1	0.3	2(p)	0
Molybdenum	119	<10	<10	<10	<10	170	--	--
Strontium	119	50	227.5	430	712.5	11000	--	--
Vanadium	121	<6	<6	<6	<6	25	--	--
Zinc	148	<3	9	22	54	1100	5000(s)	0
Organic Constituents								
Carbon, Organic, (mg/L, as C)	43	0.3	0.7	0.8	1.4	3.1	--	--
Phenols Total, (µg/L)	38	<1	<1	2	3	7	--	--

1 Analyses from wells sampled twice were averaged into one value and are counted here as one sample.
2 Product of constant derived using linear regression analysis and specific conductance
3 pH unit below or above $CaCO_3$ saturation defined as zero using the Langelier Index (American Water Works Association, 1975).

Table 4. Statistical summary of water quality characteristics for wells in the Brunswick Gp., Lockatong and Stockton Fms. [1]

[p, s: drinking water standards; µs/cm, microsiemens per centimeter, mg/L;milligrams per liter; mg/L, micrograms per liter; --, no data available]

Characteristic or constituent	Number of Samples	Minimum	25th percentile	Median	75th percentile	Maximum	Drinking water standards (maximum contaminant level) p:primary s:secondary	percent exceeded
BRUNSWICK GROUP SEDIMENTARY ROCKS								
Characteristics								
Temperature (C)	94	9.5	12.5	13	13.5	14.5	--	
Specific Conductance (us/cm)	94	155	374	450	632	2040	--	--
Dissolved Oxygen (mg/L)	94	<0.1	0.70	2.9	5	14.7	--	--
pH (standard units)	95	6	7.4	7.6	7.8	9.3	6.5-8.5(s)	3.1< 6.5, 2.1> 8.5
Field Alkalinity (mg/L as $CaCO_3$)	95	21	112	141	161	338	--	--
Solids[2], dissolved (mg/L)	94	117	283	340	478	1540	500(s)	19.1
Corrosivity (pH units)[3]	93	-3.09	-0.51	-0.19	-0.02	1.04	-1 to 1(s)	22.5 <-1, 0> 1
Hardness (mg/L as $CaCO_3$)	94	13	160	200	280	1100	50 to 250(s)	1.1< 50, 26.6> 250
Major and Minor Dissolved Constituents (mg/L)								
Calcium	94	3	40	50	73	365	--	--
Magnesium	94	1.4	12	16	21	69	--	--
Sodium	94	2.1	12	15	27	270	50(s)	7.4
Potassium	94	0.4	1	1.3	1.9	6.6	--	--
Chloride	94	2.8	12	18	32	110	250(s)	0
Sulfate	94	1.1	29	44	78	1200	250(s)	11.7
Silica	94	11	19	22	25	45	--	--
Trace and Minor Dissolved Constituents (µg/L)								
Barium	71	<2	27	79.5	205	1100	2000(p)	0.0
Iron	94	<3	<3	60	22	11000	300(s)	13
Lithium	71	<4	18	24	33	100	--	--
Manganese	94	<1	<1	2	46	1600	50(s)	24
Strontium	71	50	225	530	925	11000	--	--
Zinc	94	<3	6	18	50	740	5000(s)	0
LOCKATONG FORMATION								
Characteristics								
Temperature (C)	22	10.5	12.5	13	13.5	17		
Specific Conductance (µs/cm)	22	221	336	447	585	900	--	--
Dissolved Oxygen (mg/L)	22	<0.1	0.2	0.5	2.5	7.5	--	--
pH (standard units)	22	6.6	7.2	7.6	7.7	8.8	6.5-8.5(s)	0 <6.5, 9.1 >8.5
Field Alkalinity (mg/L as $CaCO_3$)	21	61	93	151	220	321	--	--
Solids[2], dissolved (mg/L)	22	167	254	338	442	680	500(s)	4.5
Corrosivity (pH units)[3]	20	-1.74	-0.77	-0.29	-0.06	0.54	-1 to 1(s)	31.8 <-1, 0 >1
Hardness (mg/L as $CaCO_3$)	22	12	130	155	220	350	50-250(s)	9.1< 50, 13.6>250
Major and Minor Dissolved Constituents (mg/L)								
Calcium	22	2.5	30	46	55	79	--	--
Magnesium	22	1.2	7.8	11	21	37	--	--
Sodium	22	7	12	27	35	140	50(s)	13.6
Potassium	22	0.8	1.5	2.7	4.7	6.6	--	--
Chloride	22	1.7	6.2	11.5	26	70	250(s)	0
Sulfate	22	10	17	41	62	135	250(s)	0
Silica	23	13	20	26	34	42	--	--
Trace and Minor Dissolved ConstituentS (µg/L)								
Barium	21	10	33	73	153	1200	2000(p)	0
Iron	22	<3	7	19	260	2900	300(s)	19
Lithium	21	6	9	16	25	96	--	--
Manganese	22	<2	11	26	260	790	50(s)	43
Strontium	20	78	240	460	520	730	--	--
Zinc	22	7	12	30	170	1100	5000(s)	0
STOCKTON FORMATION								
Characteristics								
Temperature (C)	29	11.5	12.5	13	13.5	16.5	--	--
Specific Conductance (µs/cm)	29	140	287	346	400	808	--	--
Dissolved Oxygen (mg/L)	29	0.1	1.0	2.9	5.1	7.7	--	--
pH (standard units)	29	5.5	6.6	7	7.6	8.6	6.5-8.5(s)	13.7< 6.5,3.4> 8.5
Field Alkalinity (mg/L as $CaCO_3$)	29	21	85	104	145	177	--	--
Solids[2], dissolved (mg/L)	29	106	217	262	302	618	500(s)	3.4
Corrosivity (pH units)[3]	29	-3.86	-1.73	-1.06	-0.29	0.808	-1 to 1(s)	69 <-1, 0 >1
Hardness (mg/L as $CaCO_3$)	29	21	120	140	170	200	50-250(s)	6.9 <50, 0 >250
Major and Minor Dissolved Constituents (mg/L)								
Calcium	29	7.8	27	36	43	47	--	--
Magnesium	29	0.27	10	13	16	25	--	--
Sodium	27	7.8	9.1	13	15	155	50(s)	3.4
Potassium	29	0.8	1	1.3	1.7	3.2	--	--
Chloride	29	3.3	11	13	21	130	250(s)	0
Sulfate	29	5.1	18	23	37	94	250(s)	0
Silica	29	11	19	23	26	29	--	--
Trace and Minor Dissolved Constituents (µg/L)								
Barium	25	26	135	160	220	390	2000(p)	0
Iron	29	<3	<3	6	17	1200	300(s)	11.1
Lithium	25	4	6	8	9	47	--	--
Manganese	29	<1	<1	4	40	500	50(s)	18.5
Strontium	25	71	168	290	423	580	--	--
Zinc	29	<3	11	21	43	140	5000(s)	0

1 Analyses from wells sampled twice were averaged into one value and are counted here as one sample.
2 Product of constant derived using linear regression analysis and specific conductance
3 pH unit below or above $CaCO_3$ saturation defined as zero using the Langelier Index (American Water Works Association, 1975).

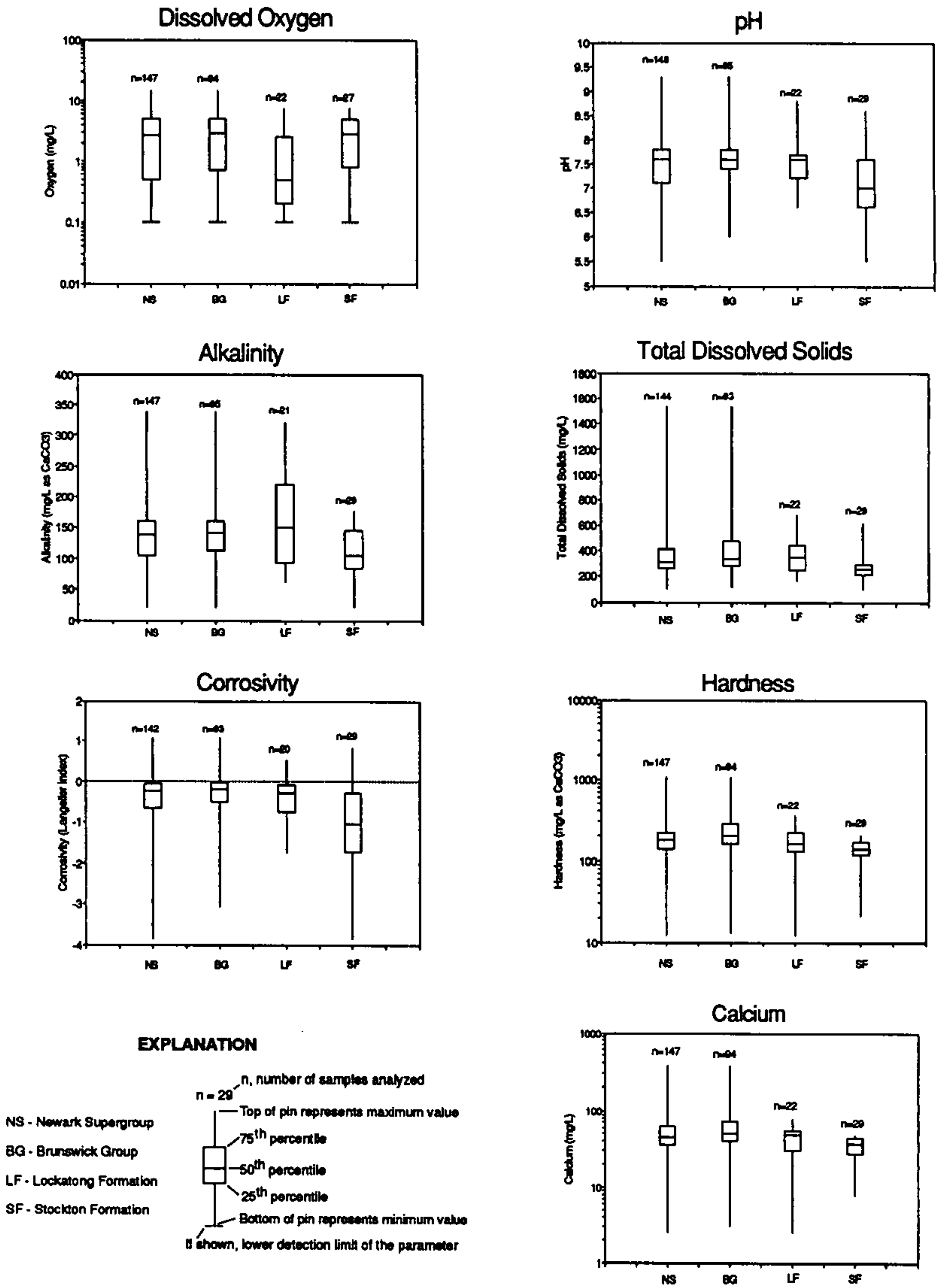
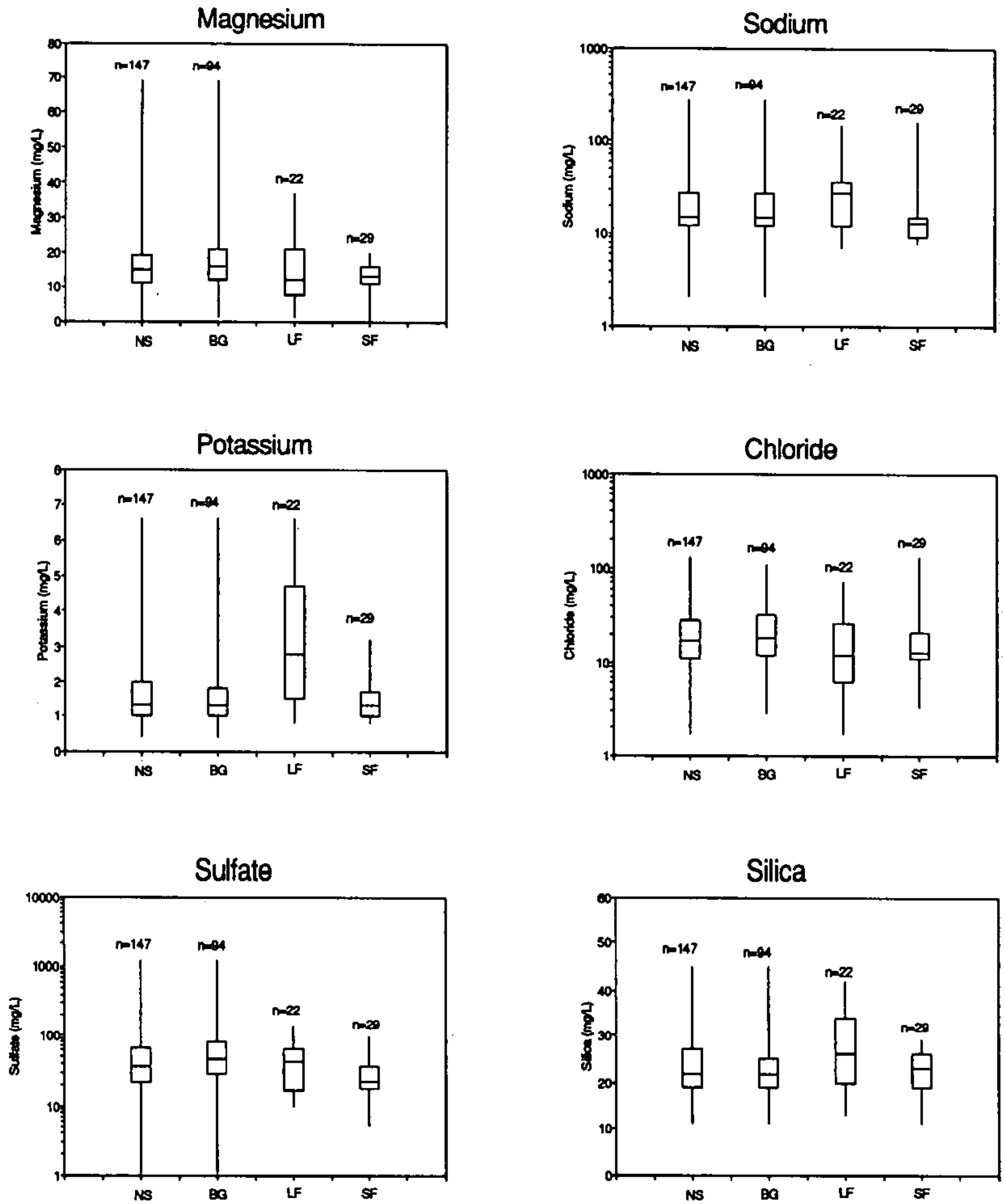


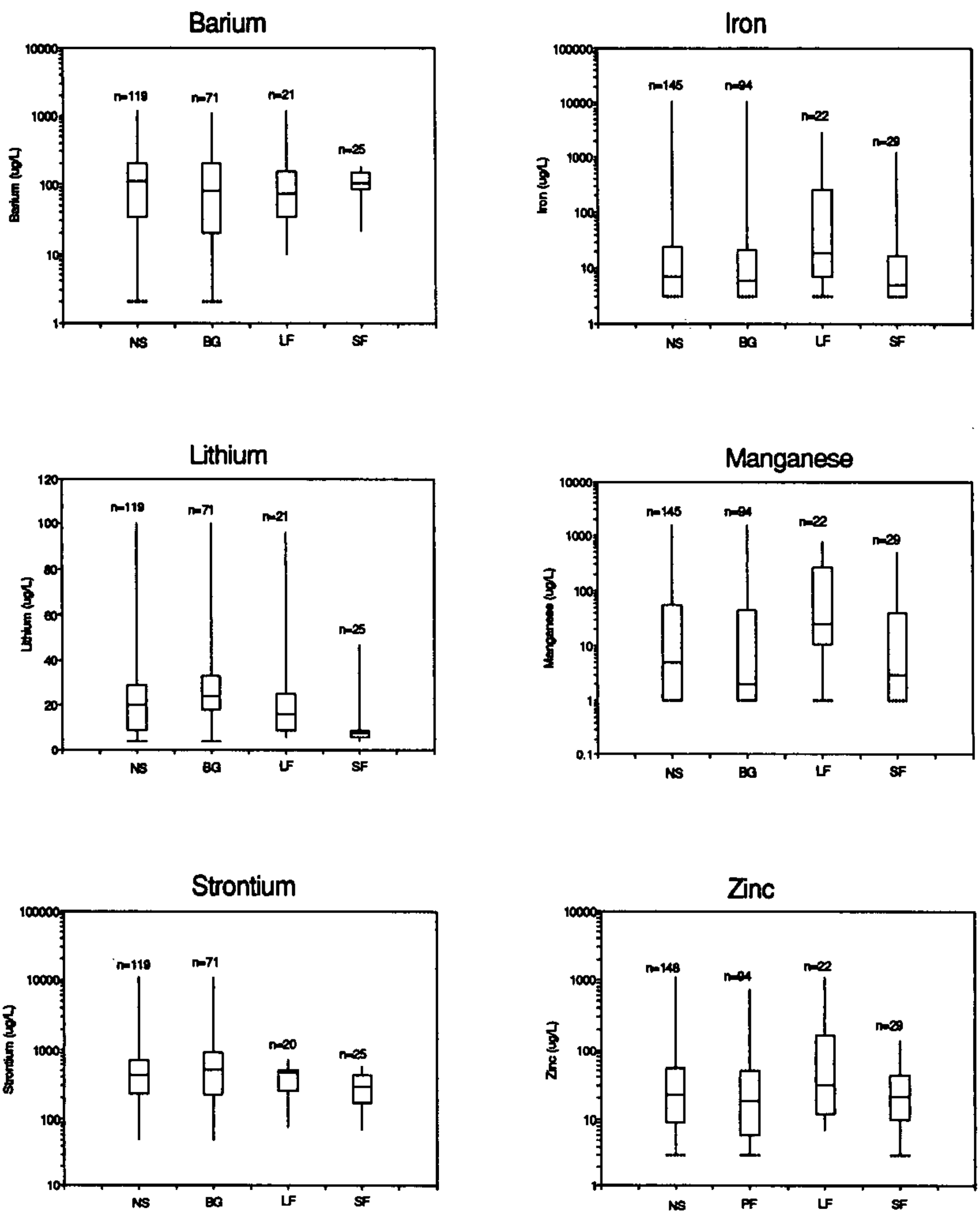
Figure 5. Concentration distributions in ground-water from sedimentary bedrock of the Newark Supergroup and constituent units.



NS - Newark Supergroup LF - Lockatong Formation

BG - Brunswick Group SF - Stockton Formation

Figure 5. (cont.) Concentration distributions in ground-water from sedimentary bedrock of the Newark Supergroup and constituent units.



NS - Newark Supergroup LF - Lockatong Formation

BG - Brunswick Group SF - Stockton Formation

Figure 5. (cont.) Concentration distributions in ground-water from sedimentary bedrock of the Newark Supergroup and constituent units.

ride, lithium, and strontium. They have higher extreme dissolved solid, sulfate, and iron values. (2) Waters from the Lockatong Formation are highest in potassium, sodium, silica, iron, and manganese, and lowest in dissolved oxygen and chloride. (3) Waters from the Stockton Formation are highest in barium and lowest in pH, dissolved solids, Langelier Index (most corrosive), sodium and lithium. The highest barium concentration, however, is from a sample from the Lockatong. Also, the interquartile ranges (25th to 75th percentile) of most constituents and total dissolved solids are generally much lower in the Stockton than in the other formations.

In a formation with nearly homogeneous hydraulic, mineralogic, and chemical properties, water would approach an equilibrium composition. Most formations, including those of the Newark Basin, are not homogeneous, however, and a characteristic range of compositions is the norm.

High concentrations of certain ground-water consituents or characteristics are sometimes aerially clustered. This is because hydrogeologic conditions associated with the high concentrations may be of a limited aerial extent. As an example, wells 58 through 65 in North Brunswick Township (table 6, at back of report) form a cluster of high iron and manganese concentrations in the Brunswick Group sedimentary rocks (table 7, at back or report). This observation indicates that high iron and manganese are probably common in this township.

Previous workers have noted an increase in total dissolved solids and a decline in water quality with well depth in the Newark Basin (Kasabach, 1966; Anderson, 1968), but this is not apparent from relationships between well depth and conductivity (fig. 6). Conductivity reflects the concentration of numerous dissolved ions such as sulfate, sodium and chloride. The expected relationship between well depth and conductivity in the Brunswick sediments and Lockatong Formation is weak or nonexistent. For all wells in the Stockton Formation, there is a significant positive correlation coefficient of r = 0.61; however, if the deepest well is not considered, r becomes 0.02, which indicates an insignificant correlation.

One possible reason for the lack of correlation between well depth and conductivity might be a low correlation between well depth and depth to the highest yielding fractures. Wells in Newark Basin bedrock are generally cased through the unconsolidated overburden and draw water from an open borehole in bedrock. The borehole thus acts as a mixing chamber for waters drawn into it from various depths. The quality of water is therefore a function of the quality and quantity of water being drawn from different depths. Only where the highest yielding fractures are known to be near the bottoms of the wells

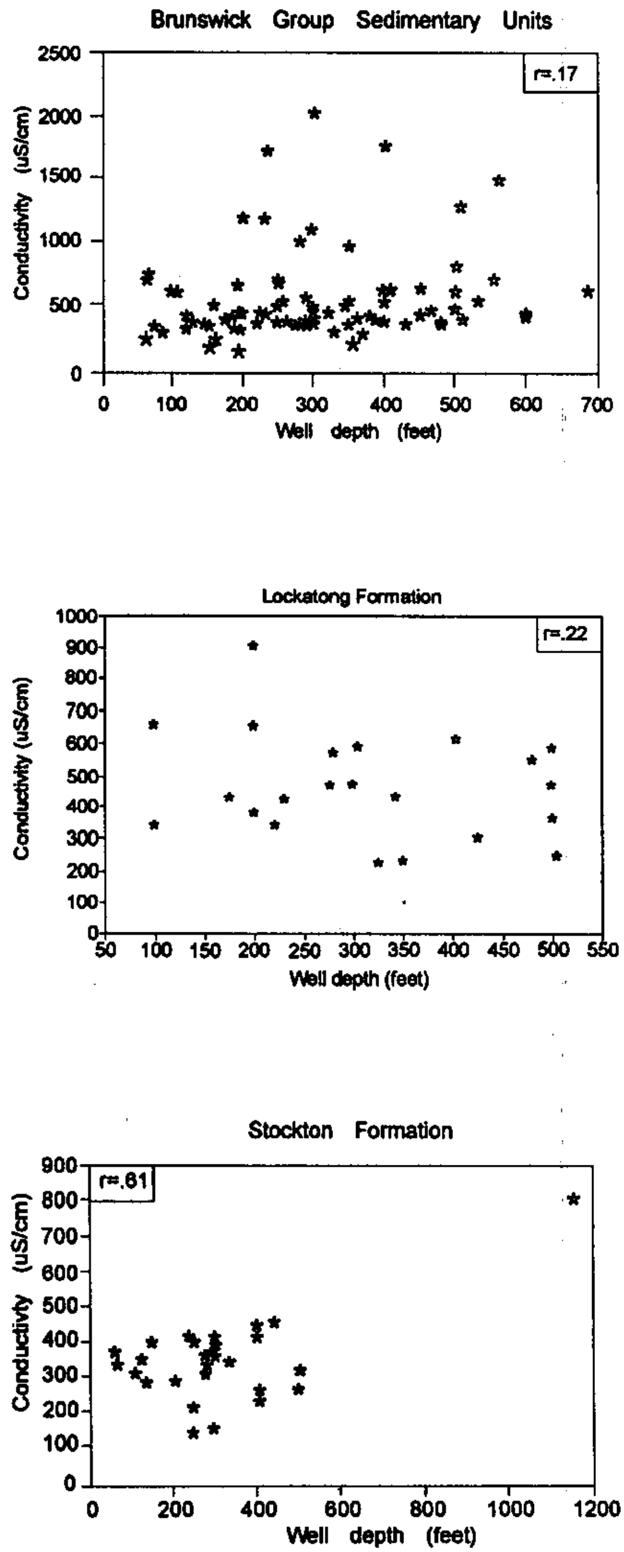


Figure 6. Scatter diagrams showing conductivity and well depth for ground-water samples from the Newark Basin sedimentary units in New Jersey.

can well depth be used to investigate the relation between depth and conductivity or dissolved solids concentration.

In an alternative interpretation, the relationship between well depth and dissolved solids may be shown more clearly in the local studies of Kasabach (1966) and Anderson (1968) than in this regional study because the overall relationship is marked by regional variability in the depth of major water-producing fractures.

Nineteen of the wells used in this survey were sampled twice. Analytical values varied with time through a considerable range. For example, for total dissolved solids 12 of the sample pairs varied by less than 10 percent, 3 by more than 10 but less than 20 percent, and 3 by greater than 20 percent. If all the variables that can affect water quality remain the same, the analytical results should be similar. Without reviewing specific information such as pumping rates, rainfall, and seasonality, it is difficult to determine why results are not always similar.

DRINKING WATER STANDARDS

Ground-water quality in the sedimentary formations of the Newark Supergroup in New Jersey is generally good, but locally may require treatment for undesirable characteristics and constituents. State-recommended secondary drinking water standards are exceeded far more often than the health-based primary standards (N.J.A.C. 7:10-1.1 through 7.3). An excellent summary of federal and state drinking water standards, water testing, and water treatment is in Shelton (1991). Much of the information on standards (below) is from that reference.

PRIMARY DRINKING WATER STANDARDS

Primary drinking water standards target contaminants that, in the judgement of the Commissioner, may have an adverse affect on the health of persons. These standards, at a minimum, apply to public water supplies.

Radionuclides

Naturally occurring radionuclides exceed primary drinking water standards in a small percentage of the samples. A study of natural radioactivity in the ground water of the Newark Basin by Szabo and Zapecza (1987) showed that uranium enrichment occurs in black mudstones near the contact between the Lockatong and Passaic Formations, and that complex hydrogeochemical relationships control the radionuclide content of ground water. Gross alpha-particle activity and ^{226}radium concentrations in water are ultimately related to uranium decay within the water and within the surrounding sediment, respectively. The percentage of analyses exceeding actual and recommended radioactivity standards in the Newark Supergroup sediments (modified from Szabo and Zapecza, 1987) in New Jersey are:

Characteristic or constituent	Number of samples	Standard (picocuries per liter)	Percent exceeding standard
Gross alpha	259	15	5.8
^{226}Ra	177	5[1]	3.9
Uranium	60	30[2]	3.3

[1]Standard for ^{226}Ra + ^{228}Ra [2]Recommended standard

Barium

Barium levels greater than 1 mg/L are reported in Szabo and Zapecza (1987), but none exceed the present primary drinking water standard or maximum allowable concentration level of 2.0 mg/L. A reported barium concentration of 2.13 mg/L in Hunterdon County was investigated by the DEP in 1988. Barite ($BaSO_4$) mineralization occurs locally throughout the Newark Basin (Dombroski, 1980), and presumably accounts for most of the barium in ground water. However, anthropogenic sources are also possible.

Lead

The highest lead concentration in this study is 16 parts per billion from a well in the Brunswick Group. It barely exceeded the primary drinking water action level of 15 parts per billion.

SECONDARY DRINKING WATER STANDARDS

Secondary drinking water standards are recommended standards that protect the public from characteristics and constituents that affect the aesthetic quality of the water (for example, its appearance, taste or odor). Undesirable characteristics and constituents in water are treated in public and private water supplies using various systems. Analyses exceeding the secondary drinking water standards, compiled from tables 3 and 4, are in table 5.

Corrosivity

Corrosivity and scaling potential are measured using the Langelier Index, a calculation that uses pH, alkalinity, calcium concentration, total dissolved solids, and water temperature to determine if calcium carbonate will dissolve or precipitate (American Water Works Association, 1975). Normally acceptable corrosivity ranges between slightly corrosive (-1 pH unit) and slightly encrusting (+1 pH unit). If the water is too corrosive (<-1), it can corrode plumbing systems, release harmful metals such as lead and copper, and shorten the life of water systems. If the water is slightly scaling (0 to +1), calcium carbonate will precipitate out and encrust the insides of plumbing systems with a protective coating. If the Langelier Index is

Table 5. Percentages of samples exceeding secondary drinking water standards.

[mg/L, milligrams per liter; LI, Langelier Index]

Characteristic or constituent	Secondary drinking water standard (mg/L)	Brunswick Group		Lockatong Formation		Stockton Formation		All sedimentary rock	
		Number of samples	Percent exceeding standard	Number of samples	Percent exceeding standard	Number of samples	Percent exceeding standard	Number of samples	Percent exceeding standard
Corrosivity (LI)	-1 to 1	93	22.5<-1, 0>1	22	31.8<-1, 0>1	29	69<1, 0>1	144	31.2<-1, 0>12
Hardness	50 to 250	94	1.1<50, 26.6>250	22	9.1<50, 13.6>250	29	6.9<50, 0>250	147	3.4<50, 20.8>.150
Iron	0.300	94	13	22	19	29	11.1	147	14.5
Manganese	0.05	94	24	22	43	29	18.5	147	26.9
pH[1]	6.5 to 8.5	95	3.1<6.5, 2.1>8.5	22	<6.5, 9.1>8.5	29	13.7<6.5, 3.4>8.5	148	6.1<6.5, 3.4>8.5
Sodium	50	94	7.4	22	13.6	29	3.4	147	8.5
Solids, dissolved	500	94	19.1	22	14.5	29	3.4	147	13.6
Sulfate	250	94	11.7	22	0	29	0	147	8.2

1 See glossary

greater than 1, too much scale can build up. This will impede the flow of water and degrade the heat conducting properties of boilers and water heaters. The Stockton Formation has the highest percentage of well water samples considered too corrosive (69 percent <-1). In comparison, the Brunswick Group has 22.5 percent <-1 and the Lockatong Formation 31.8 percent < -1. None of the samples were too encrusting.

Hardness

Hardness is mainly the result of calcium and magnesium dissolved in water. High hardness affects lather formation in soaps and can indicate a potential scale problem in hot water heaters and boilers. Calcite ($CaCO_3$) and dolomite ([Ca,Mg]CO_3) are common minerals that contribute calcium and magnesium to water as they dissolve. In this study 26.6 percent of the wells in the Brunswick Group, 13.6 percent of the wells in the Lockatong Formation, and 6.9 percent of the wells in the Stockton Formation were found to have high hardness (>250 mg/L).

Iron and Manganese

Iron and manganese generally occur together because they have similar chemical properties. Some manganese generally substitutes for iron in iron-bearing minerals. For example, pyrite (FeS), biotite (hydrous iron aluminosilicate), and some pyroxenes and amphiboles all contain iron with some manganese. Generally, the lower the concentration of dissolved oxygen in water, the higher the concentration of dissolved iron and manganese. When iron and manganese in water come into contact with oxygen, they precipitate and may leave red and black stains on laundry and plumbing fixtures. High iron and manganese levels affect the taste of the water. Well water from the Lockatong Formation has the lowest overall dissolved oxygen content and the highest percentage of wells exceeding the iron standard (19 percent) and manganese standard (43 percent). Excessive iron and manganese are also encountered in the Brunswick and Stockton Formations.

Sodium

Sodium occurs in many minerals, for example halite (NaCl) and the plagioclase feldspars (sodium-calcium-aluminosilicates). High sodium can have an adverse health impact on people with high blood pressure and other sodium-sensitive ailments. The Lockatong Formation has the greatest percentage of wells with values above the drinking water standard (13.6 percent), followed by the Brunswick Group (7.4 percent) and Stockton Formation (3.4 percent).

Total Dissolved Solids

Total dissolved solids is a measure of the amount of dissolved material in the water. The concentration of dissolved solids can be measured directly or estimated from the conductivity value. It is a general indicator of the overall quality of the water, and high levels can reduce the life of hot water heaters. The total dissolved solid content of ground water is mainly a function of the ease with which the minerals in the aquifer can be dissolved and the residence time of the ground water. The percentage of wells drawing water from the Brunswick Group, Lockatong Formation and Stockton Formation that exceeded the drinking-water standard are 19.1, 4.5, and 3.4 respectively. In the Brunswick Group, the total dissolved solid concentrations are related to high sulfates (fig. 4).

Sulfates

Sulfur-bearing minerals such as gypsum ($CaSO_4.2H_2O$) and pyrite (FeS) can increase the sulfate concentration in ground water when they are dissolved. High sulfate levels in water lead to scale formation in boilers and heat exchangers, affect the water's taste, and can have a laxative effect. In this study, only wells drawing water from the Brunswick Group (11.7 percent) have sulfate concentrations exceeding the secondary standard. The Brunswick Group rocks have localized deposits of gypsum, a sulfate mineral.

REFERENCES

American Water Works Association, 1975, Standard methods for the examination of water and wastewater (14th ed.) - corrosivity, method 203 and oxygen (dissolved), method 422: Washington, D.C., American Water Works Association, 1193 p.

Anderson, H.R., 1968, Geology and ground-water resources of the Rahway area, New Jersey: New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply Special Report 27, 72 p.

Carswell, L.D., 1976, Appraisal of water resources in the Hackensack River Basin, New Jersey: U.S. Geological Survey Water Resources Investigation 76-74, 43 p.

Dombroski, D.R., 1980, A geological and geophysical investigation of concealed contacts near an abandoned barite mine, Hopewell, New Jersey: M.S. thesis, Rutgers University, New Brunswick, New Jersey, 33 p.

Drake, A.A., Jr., Volkert, R.A., Monteverde, D.H., Herman, G.C., Houghton, H.F., Parker, R.A., and Dalton, Richard, in press, Geologic Map of New Jersey: northern bedrock sheet: U.S. Geological Survey Miscellaneous Field Studies Map, scale 1:100,000.

Fishman, M.J., and Friedman, L.G., 1985, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Open-File Report 85-495, 709 p.

Hem, J.D., 1985, Study and interpretation of the chemical characteristics of natural water (3rd ed.): U.S. Geological Survey Water-Supply Paper 2254, 263 p.

Kasabach, H.F., 1966, Geology and ground-water resources of Hunterdon County, N.J.: New Jersey Division of Water Policy and Supply Special Report 24, 128 p.

Lyttle, P.T., and Epstein, Jack, 1987, Geologic Map of the Newark $1^{\circ} \times 2^{\circ}$ quadrangle, New Jersey, Pennsylvania, and New York: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-1715, scale 1:250,000.

National Atmospheric Deposition Program, 1991, Annual and seasonal data summary of precipitation chemistry collected during 1990 in Washington Crossing State Park, Mercer County, New Jersey - update to the Directory of Precipitation Monitoring Sites (1988), *for* National Atmospheric Deposition Program/National Trends Network, National Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado, p. 284-285.

New Jersey Department of Environmental Protection, 1985, Sole source aquifer designation petition - aquifer systems of the Coastal Plain, Piedmont, Highlands, and Valley and Ridge Physiographic Provinces. Submitted to C. Daggett, Regional Administrator, U.S. Environmental Protection Agency, 77 p.

------------------------, 1987, New Jersey water withdrawal report: discusses surface- and ground-water withdrawals in New Jersey: New Jersey Division of Water Resources, Bureau of Water Allocation, 34 p.

Nichols, W.D., 1968, Ground-water resources of Essex County, New Jersey: New Jersey Department of Conservation and Economic Development, Division of Water Supply Special Report 28, 56 p.

Olsen, P.E., 1980, The latest Triassic and Early Jurassic formations of the Newark Basin (eastern North America, Newark Supergroup) - stratigraphy, structure, and correlation: New Jersey Academy of Science Bulletin, v. 25, p. 25-51.

Parker, Ronald, 1993, Stratigraphic relations of the sedimentary rocks below the Lower Jurassic Orange Mountain Basalt, northern Newark Basin, New Jersey and New York, U.S.. Geological Survey Miscellaneous Field Investigation Map MF-2208, scale 1:100,000.

Shelton B. S., 1991, Interpreting drinking water quality analysis. What do the numbers mean?: for copies contact Publications Distribution Center, Cook College - Rutgers University, P.O. Box 231, New Brunswick, NJ 08903.

Szabo, Zoltan, and Zapecza, O.S., 1987, Relation between natural radionuclide activities and chemical constituents in ground water in the Newark Basin, New Jersey, *in* Graves, Barbara, ed., Radon, radium and other radioactivity in ground water: Ann Arbor, Michigan, Lewis Publishers Inc., p. 283-308.

Turner-Peterson, C.E., 1980, Sedimentology and uranium mineralization in the Triassic-Jurassic Newark Basin, Pennsylvania and New Jersey, *in* Turner-Peterson, C.E., ed., Uranium in sedimentary rocks - application of the facies concept to exploration: Society of Economic Paleontologists and Mineralogists Short Course Notes, Rocky Mountain Section, p. 149-175.

Van Houten, F.B., 1969, Late Triassic Newark Group, north-central New Jersey and adjacent Pennsylvania and New York, *in* Subitzky, Seymour, ed., Geology of selected areas in New Jersey and Pennsylvania and guidebook of excursions: New Brunswick, Rutgers University Press, p. 314-347.

Zapecza, O.S., and Szabo, Zoltan, 1987, Source and distribution of natural radioactivity in ground water in the Newark Basin, New Jersey, *in* Graves, Barbara, ed., Radon, radium and other radioactivity in ground water: Ann Arbor, Michigan, Lewis Publishers, p. 47-68.

Table 6. Records of bedrock wells in Newark Basin, New Jersey for which water analyses are available.

[Well number corresponds to wells located on figure 2 and cited elsewhere in report; altitude of land surface, above sea level; depth of well, below land surface; top of open interval, depth below land surface; bottom of open interval, depth below land surface; primary use of water, C= commercial, F = fire, H = domestic, I = irrigation, N = industrial, P = public supply, R = recreation, S = stock, T = institutional, U = unused; -- data not available]

Well number	Water Allocation permit #	GWSI number	County	Municipality	Latitude (degrees)	Longitude (degrees)	Land surface altitude (ft.)	Depth (ft.)	Open Top (ft.)	interval Bottom (ft.)	Primary use of water
BRUNSWICK GROUP SEDIMENTARY ROCKS											
1	23-02273	30234	Bergen	Cresskill Boro	405621	735748	40	279	72	279	N
2	23-04135	30221	Bergen	Emerson Boro	405827	740104	35	478	76.6	478	P
3	26-00791	30225	Bergen	Englewood City	405316	735904	5	354	135	354	N
4	--	30226	Bergen	Norwood Boro	405940	735624	30	300	41	300	I
5	23-02599	30231	Bergen	"	405934	735609	50	153	64	153	I
6	43-00032	30232	Bergen	Paramus Boro	405646	740438	70	306	54	306	C
7	23-04818	30034	Bergen	Ramsey Boro	410426	740835	345	600	104	600	P
8	46-00174	30216	Bergen	South Hackensack Twp	405213	740302	10	230	160	230	N
9	--	30222	Bergen	Teaneck Twp	405407	740143	10	363	116	363	I
10	43-00022	30230	Bergen	Wyckoff Twp	410022	741052	366	352	44.2	352	P
11	26-04269	130090	Essex	Fairfield Boro	405315	741739	170	200	90	200	P
12	25-12755	130052	Essex	Livingston Twp	404757	742135	180	301	69.8	301	P
13	26-04743	130082	Essex	Roseland Boro	404948	741833	210	450	--	--	P
14	24-07347	190039	Hunterdon	Alexandria Twp	403455	745905	460	192	42	192	S
15	27-06454	190045	Hunterdon	East Amwell Twp	402530	744909	290	160	50	160	H
16	27-07104	190050	Hunterdon	"	402633	744711	310	350	50	350	H
17	27-02828	190046	Hunterdon	"	402543	745150	200	147	20	147	T
18	24-15044	190030	Hunterdon	Flemington Boro	403014	745157	180	510	82.5	510	P
19	24-09411	190042	Hunterdon	"	402951	745104	180	400	50	400	P
20	24-06082	190016	Hunterdon	Frenchtown Boro	403112	750343	130	688	300	688	P
21	--	190005	Hunterdon	"	403140	750335	140	286	45	286	P
22	24-14333	190017	Hunterdon	Kingwood Twp	402909	750032	480	450	50	450	H
23	24-12391	190025	Hunterdon	"	403157	745834	530	467	50	467	H
24	24-16019	190061	Hunterdon	"	402812	750259	460	400	50	400	H
25	--	190009	Hunterdon	Lebanon Boro	403837	745004	240	222	93	222	P
26	44-00025	190012	Hunterdon	Milford Boro	403424	750548	--	100	--	100	P
27	24-05461	190043	Hunterdon	Raritan Twp	402756	745150	145	300	40	300	I
28	--	190032	Hunterdon	"	403215	745024	120	502	44	502	N
29	24-07201	190041	Hunterdon	"	402917	745212	180	400	52	400	N
30	25-18075	190065	Hunterdon	Readington Twp	403304	744733	180	190	67	190	H
31	24-03131	190064	Hunterdon	"	403730	744533	100	193	23	193	N
32	24-11326	190018	Hunterdon	"	403430	745020	360	190	60	190	H
33	24-12071	190019	Hunterdon	"	403541	744824	330	150	67	150	H
34	25-17491	190063	Hunterdon	Tewksbury Twp	404019	744446	200	230	107	230	T
35	--	190085	Hunterdon	West Amwell Twp	402143	745359	450	388	50	388	H
36	27-06336	190051	Hunterdon	"	402128	745434	400	200	40	200	H
37	27-06112	190058	Hunterdon	"	402130	745414	400	400	40	400	H
38	27-06721	190056	Hunterdon	"	402239	745424	430	345	50.5	345	H
39	27-06916	190054	Hunterdon	"	402131	745419	400	322	50	322	H
40	27-06760	190055	Hunterdon	"	402055	745526	390	430	52	430	H
41	27-00171	190074	Hunterdon	"	402341	745436	290	107	30.3	107	C
42	27-04956	190052	Hunterdon	"	402146	745357	450	290	30	290	H
43	27-07097	190057	Hunterdon	"	402134	745421	410	350	50	350	H
44	27-05579	190053	Hunterdon	"	402146	745337	360	193	42	193	H
45	27-04973	210277	Mercer	Hopewell Boro	402314	744611	200	380	50	380	P
46	--	210282	Mercer	"	402314	744622	230	60	10	60	H
47	28-10058	210263	Mercer	Hopewell Twp	402406	744415	200	120	51	120	H
48	28-03764	210267	Mercer	"	402140	744340	214	400	37.5	400	C
49	--	210088	Mercer	"	402128	744613	179	150	20	150	U
50	27-06942	210242	Mercer	"	402040	744635	160	600	50	600	N
51	27-04615	210244	Mercer	"	401846	745046	210	235	105	235	P
52	27-07048	210253	Mercer	"	402024	745103	290	250	63	250	H
53	--	210289	Mercer	"	401753	744835	220	300	12	300	U
54	27-02563	210269	Mercer	Pennington Boro	401947	744750	200	272	43.3	272	P
55	27-04196	210275	Mercer	"	401905	744736	200	300	81.2	300	P
56	25-03970	231072	Middlesex	Edison Twp	403536	742228	80	560	74	560	P
57	25-04516	231055	Middlesex	"	403527	742223	80	532	40.2	532	P
58	28-04791	231050	Middlesex	North Brunswick Twp	402721	743031	100	234	26	234	I
59	25-17373	231051	Middlesex	"	402804	742539	50	160	53	160	H
60	28-11860	231049	Middlesex	"	402824	742751	110	175	50	175	I
61	--	231083	Middlesex	"	402630	742959	110	409	20	409	U
62	28-04269	231119	Middlesex	"	402621	743009	110	65	23.5	65	F
63	28-05084	231048	Middlesex	"	402703	742928	120	74	25	74	H
64	28-12317	231047	Middlesex	"	402602	742910	110	85	50	85	I
65	29-16276	231076	Middlesex	"	402630	742959	110	68	12	68	U
66	25-21440	231053	Middlesex	Piscataway Twp	403110	742812	60	300	55	300	I
67	28-01429	231075	Middlesex	South Brunswick Twp	402543	743107	110	251	31.2	251	U
68	--	230531	Middlesex	"	402526	743129	130	257	42	257	N
69	28-06766	231044	Middlesex	"	402630	743206	130	185	50	185	C
70	48-00074	231117	Middlesex	"	402206	743711	60	280	40	280	P
71	25-12130	230340	Middlesex	South Plainfield Boro	403555	742429	75	500	97.8	500	P
72	26-04831	231054	Middlesex	Woodbridge Twp	403503	741542	20	300	50	300	C
73	25-14520	270153	Morris	Morristown Twp	404707	742839	300	265	67.8	265	P
74	25-04545	270979	Morris	Passaic Twp	404038	742946	250	500	40	500	P
75	26-04613	310033	Passaic	Clifton City	405247	740820	80	408	50	408	N
76	26-04825	310034	Passaic	"	405047	741015	180	300	50	300	I
77	25-20242	350017	Somerset	Branchburg Twp	403530	744059	80	200	61	200	T
78	25-06282	350009	Somerset	Bridgewater Twp	403437	743337	100	556	39	556	N
79	25-03926	350020	Somerset	"	403456	743815	140	506	34	506	I
80	--	350036	Somerset	"	403652	743722	190	120	20	120	H

Table 6. (cont.) Records of bedrock wells in Newark Basin, New Jersey for which water analyses are available.

[Well number corresponds to wells located on figure 2 and cited elsewhere in report; altitude of land surface, above sea level; depth of well, below land surface; top of open interval, depth below land surface; bottom of open interval, depth below land surface; primary use of water, C= commercial, F = fire, H = domestic, I = irrigation, N = industrial, P = public supply, R = recreation, S = stock, T = institutional, U = unused; -- data not available]

Well number	Water Allocation permit #	GWSI number	County	Municipality	Latitude (degrees)	Longitude (degrees)	Land surface altitude (ft.)	Depth (ft.)	Open interval Top (ft.)	Open interval Bottom (ft.)	Primary use of water
BRUNSWICK GROUP SEDIMENTARY ROCKS (cont.)											
81	25-12785	350018	Somerset	Bridgewater Twp	403304	743527	30	280	20	280	P
82	25-17490	350021	Somerset	Franklin Twp	403001	743058	110	330	50	330	I
83	25-21995	350023	Somerset	"	402852	743004	110	300	50	300	N
84	25-14233	350011	Somerset	Hillsborough Twp	403021	744343	85	480	60	480	H
85	25-22435	350024	Somerset	"	403239	744147	60	150	60	150	H
86	28-14495	350026	Somerset	Montgomery Twp	402438	744314	160	200	50	200	H
87	28-04605	350016	Somerset	"	402509	744142	110	300	41.6	300	U
88	28-09725	350019	Somerset	"	402630	743749	100	250	50	250	I
89	25-12669	350034	Somerset	Warren Twp	403655	742941	280	130	50	130	I
90	--	390133	Union	Linden City	403726	741623	40	223	32	223	U
91	--	390102	Union	Kenilworth Boro	404027	741644	85	251	49	251	U
92	--	390119	Union	"	404106	741719	70	290	--	290	U
93	25-09083	390168	Union	Mountainside Boro	404046	742104	140	300	43	300	P
94	26-02302	390251	Union	Roselle Boro	403854	741603	60	350	26	350	P
95	45-00268	390385	Union	Summit City	404201	742136	295	371	97.8	371	P
LOCKATONG FORMATION											
96	26-04217	30218	Bergen	Englewood City	405419	735809	60	230	53.2	230	T
97	26-04227	30219	Bergen	Leonia Boro	405221	735920	10	350	58	350	I
98	26-03836	30217	Bergen	"	405125	735955	10	200	39	200	R
99	26-04331	30220	Bergen	Palisades Park Boro	405048	740024	5	280	70	280	R
100	24-14494	190036	Hunterdon	Delaware Twp	402929	745621	470	480	50	480	H
101	27-06869	190023	Hunterdon	Kingwood Twp	402731	750033	530	500	50	500	H
102	24-10527	190035	Hunterdon	"	402756	750032	500	175	50	175	H
103	24-07700	190024	Hunterdon	Raritan Twp	403006	745402	420	500	50	500	T
104	--	190080	Hunterdon	West Amwell Twp	402153	745204	370	200	20	200	H
105	27-04488	190060	Hunterdon	"	402148	745220	390	405	30	405	I
106	27-04512	190059	Hunterdon	"	402150	745218	390	200	21	200	I
107	27-04214	210028	Mercer	Ewing Twp	401553	745012	123	300	33	300	U
108	28-09577	210261	Mercer	Hopewell Twp	402406	744548	410	277	47	277	H
109	27-07262	210260	Mercer	"	402355	744726	360	500	50	500	H
110	27-06992	210266	Mercer	"	402217	745050	340	100	31	100	T
111	27-07969	210281	Mercer	"	402042	745200	210	425	50	425	H
112	48-00030	231081	Middlesex	South Brunswick Twp	402300	743330	70	221	25	221	N
113	--	231118	Middlesex	"	402312	743304	90	100	42	100	H
114	28-04388	231065	Middlesex	"	402150	743601	100	325	72	325	C
115	28-00247	230936	Middlesex	"	402258	743340	80	305	26.5	305	N
116	28-04393	230526	Middlesex	"	402218	743512	80	505	37	505	U
117	28-06846	231046	Middlesex	"	402301	743320	80	342	67	342	N
STOCKTON FORMATION											
118	26-04992	170005	Hudson	North Bergen Twp	404800	740045	220	1155	50	1155	N
119	--	190015	Hunterdon	Delaware Twp	402502	750124	260	250	26	250	H
120	24-14404	190037	Hunterdon	"	402829	745456	450	280	53	280	H
121	27-04579	190070	Hunterdon	"	402545	745916	310	400	200	400	P
122	47-00008	190077	Hunterdon	Stockton Boro	402425	745830	200	278	41.4	278	P
123	28-06196	210137	Mercer	West Windsor Twp	401945	743733	60	300	125	300	N
124	27-00471	210243	Mercer	Ewing Twp	401628	744643	120	67	42	67	H
125	28-05619	210087	Mercer	Hopewell Boro	402335	744547	200	237	60.3	237	P
126	27-05819	210264	Mercer	Hopewell Twp	402243	744758	240	285	51	285	H
127	28-11785	210265	Mercer	"	402418	744520	360	275	50	275	H
128	28-02507	210262	Mercer	"	402358	744550	400	135	22	135	H
129	48-00016	210189	Mercer	Hopewell Twp	402340	744553	220	250	--	--	P
130	27-06890	210268	Mercer	"	402135	744940	400	150	50	150	H
131	--	210248	Mercer	Lawrence Twp	401642	744324	80	408	32	408	I
132	28-08874	210146	Mercer	"	401721	744410	125	500	50	500	U
133	28-00401	210188	Mercer	"	401742	744410	120	286	23.5	154	P
134	--	210194	Mercer	"	401740	744407	120	110	--	--	P
135	--	210198	Mercer	Princeton Twp	401927	743927	60	301	--	301	P
136	48-00018	210286	Mercer	West Windsor Twp	401949	743728	60	400	56	400	C
137	48-00019	210287	Mercer	"	401945	743732	60	205	43	205	C
138	28-07735	210271	Mercer	"	402008	743740	60	300	60	300	C
139	48-00005	210205	Mercer	"	402029	743816	60	503	35	503	P
140	28-01886	210247	Mercer	"	402022	743758	60	335	38.6	335	P
141	--	231115	Middlesex	Plainsboro Twp	402043	743650	115	297	--	--	U
142	28-16112	230792	Middlesex	"	402059	743601	97.6	60	31	60	U
143	28-01854	231063	Middlesex	Plainsboro Twp	402026	743730	96	443	422	443	N
144	28-16251	230801	Middlesex	"	402100	743601	97.1	125	100	125	U
145	28-03175	231114	Middlesex	"	402053	743619	103.8	250	45.5	250	F
146	28-00689	231116	Middlesex	"	402045	743648	120	406	--	--	U
CONGLOMERATE											
147	24-06788	190028	Hunterdon	Clinton Town	403737	745440	180	475	76	475	P
148	24-01207	190069	Hunterdon	Union Twp	403750	745811	380	148	61.5	148	T
DIABASE BASALT											
149	25-13895	270196	Mercer	Hopewell Twp	405319	742109	300	293	19	293	P
WATCHUNG BASALT											
150	27-07162	210258	Morris	Montville Twp	402244	744642	280	350	42	350	H

Table 7a. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - major constituents

[Well number as on figure 2; (mS/cm), microsiemens per centimeter; --, no data]

Well number	GWSI number	Date	Temperature water (°C)	Specific conductance (µS/cm)	Oxygen dissolved (mg/L)	pH standard units field	Alkalinity field (mg/L as $CaCO_3$)	Solids, (residue at 180°C), dissolved	Total dissolved solids (calculated)	Hardness total (mg/L as $CaCO_3$)	Calcium dissolved (mg/L as $CaCO_3$)	Magnesium dissolved (mg/L as Mg)	Sodium dissolved (mg/L as Na)	Potassium dissolved (mg/L as K)	Chloride dissolved (mg/L as Cl)	Sulfate dissolved (mg/L as SO_4)	Fluoride dissolved (mg/L as F)	Silica dissolved (mg/L as SiO_2)	Nitrogen: Ammonia (mg/L)	Nitrogen: Nitrate (mg/L)	Nitrogen: Ammonia + organic (mg/L)	Nitrogen: NO_2 + NO_3 (mg/L)	Phosphorus: Dissolved (mg/L)	Phosphorus: Ortho, dissolved (mg/L)
BRUNSWICK GROUP SEDIMENTARY ROCKS																								
1	30234	03-05-86	13.5	400	3.8	7.8	125	--	302	160	52	8.2	17	1.3	19	30	--	20	--	--	--	--	--	--
2	30221	03-05-86	12	404	1	7.9	113	--	305	170	49	11	15	1.3	29	37	--	18	--	--	--	--	--	--
3	30225	03-07-86	13.5	232	5.2	8.3	75	--	175	78	26	3.1	16	0.9	8.4	23	--	23	--	--	--	--	--	--
4	30226	03-05-86	11.5	365	6.4	7.9	101	--	276	150	45	10	10	1.3	22	26	--	22	--	--	--	--	--	--
		07-24-87	13.5	343	5.6	7.7	98	217	259	140	47	5.6	14	1	12	33	0.1	19	<0.01	<0.01	0.6	4.7	0.02	0.02
5	30231	03-05-86	9.5	350	5.5	8.1	101	--	265	150	50	6.2	12	1	14	36	--	20	--	--	--	--	--	--
6	30232	09-12-88	12	436	3.9	7.3	141	256	330	210	56	17	10	0.9	17	35	<0.10	18	<0.010	<0.010	0.3	3.7	0.04	0.03
7	30034	03-11-86	11.5	458	3.8	7.7	129	--	346	180	40	20	22	0.8	41	38	--	21	--	--	--	--	--	--
		03-02-88	11.5	493	3.3	7.4	124	272	373	190	43	21	23	1	48	34	0.3	21	0.03	<0.010	0.2	1.7	0.02	0.01
8	30216	03-07-86	12.5	1200	2	7.8	87	--	907	400	130	17	62	0.9	110	290	--	25	--	--	--	--	--	--
9	30222	03-20-86	11.5	400	8.2	8.2	111	--	302	110	20	15	39	1	19	56	--	14	--	--	--	--	--	--
		09-10-87	15	440	4.3	7.9	112	240	333	140	30	16	36	1	25	56	0.2	15	0.01	<0.01	<0.2	1.9	0.06	0.05
10	30230	03-06-86	11.5	550	5.5	7.6	169	--	416	250	44	33	16	1.2	49	27	--	19	--	--	--	--	--	--
11	130090	03-12-86	12	1200	0.4	7.8	101	--	907	500	130	42	48	1.4	12	490	--	23	--	--	--	--	--	--
12	130052	05-11-87	11.5	432	3	7.5	110	234	327	170	38	18	13	0.7	36	29	0.1	24	<0.01	<0.01	0.3	1.1	0.09	0.08
13	130082	08-12-87	12.5	451	5	8.1	97	--	341	210	49	22	11	0.9	49	52	--	25	<0.010	<0.010	0.6	3.1	--	0.02
14	190039	07-21-87	12.5	155	7.8	6.1	31	106	117	55	14	4.8	8.5	0.5	7.2	19	0.1	22	<0.01	<0.01	0.5	3	0.06	0.02
15	190045	01-30-86	11	510	3.1	7.4	177	--	386	240	76	13	21	3.9	17	77	--	17	--	--	--	--	--	--
16	190050	08-17-88	14.5	362	3.9	7.6	148	230	274	150	46	7.9	25	1.5	12	25	0.7	22	<0.010	<0.010	0.2	1.3	0.02	0.01
17	190046	02-04-86	13	355	5	7.8	115	--	268	160	46	12	8.9	0.7	32	12	--	21	--	--	--	--	--	--
18	190030	07-09-85	13	419	1.8	7.9	146	--	317	200	40	25	12	1.1	13	59	--	21	--	--	--	--	--	--
19	190042	07-09-85	13.5	635	3.1	7.6	175	--	480	330	73	36	15	1.1	34	130	--	21	--	--	--	--	--	--
20	190016	07-23-85	13.5	640	2.7	7.8	119	--	484	210	51	19	49	1.3	22	160	--	16	--	--	--	--	--	--
21	190005	07-23-85	13.5	353	0.2	8	108	--	267	140	34	12	15	1.1	10	36	--	12	--	--	--	--	--	--
22	190017	01-29-86	12	610	0.2	9.1	321	--	461	17	3.7	1.8	150	1.5	18	1.6	--	11	--	--	--	--	--	--
		03-08-88	12	689	0.2	9.4	330	405	521	8	1.8	0.91	160	1.8	18	0.6	1.4	10	<0.010	<0.010	<0.20	<0.100	0.04	0.01
23	190025	02-12-86	13	478	1.2	9.3	211	--	361	67	14	7.5	74	0.7	3.5	42	--	17	--	--	--	--	--	--
24	190061	01-28-86	10.5	400	2.7	7.7	163	--	302	190	47	16	21	2.2	7.7	73	--	15	--	--	--	--	--	--
25	190009	07-18-85	11.5	374	8	7.7	140	--	283	180	40	19	7.2	1.1	13	22	--	18	--	--	--	--	--	--
26	190012	04-30-87	12	614	5.2	7.5	108	328	464	200	54	17	32	1.7	60	78	<0.1	15	<0.01	<0.01	0.3	2	0.02	0.01
27	190043	07-22-87	13	1120	0.1	7.7	120	898	847	600	180	37	27	1.2	6.6	520	0.2	23	0.05	<0.01	0.4	<0.1	0.02	<0.01
28	190032	07-29-87	13.5	834	1.9	7.5	121	619	631	430	140	19	21	0.8	11	300	0.2	18	<0.01	<0.01	0.5	0.85	0.03	0.02
29	190041	07-26-85	13	1780	0.4	7.3	156	--	1346	910	250	69	38	1.6	16	850	--	20	--	--	--	--	--	--
30	190065	01-31-86	11	325	6.4	7.8	159	--	246	160	36	16	9.3	0.7	5.8	15	--	19	--	--	--	--	--	--
31	190064	01-06-86	12.5	665	4.8	7.6	114	--	503	350	94	28	19	1.4	24	230	--	21	--	--	--	--	--	--
32	190018	01-07-86	12.5	340	0.5	7.7	119	--	257	150	35	15	14	1.1	12	30	--	23	--	--	--	--	--	--

Table 7a. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - major constituents (cont.)

[Well number as on figure 2; (mS/cm), microsiemens per centimeter; --, no data]

																			Nitrogen				Phosphorus	
Well number	GWSI number	Date	Temperature water (°C)	Specific conductance (µS/cm)	Oxygen dissolved (mg/L)	pH standard units field	Alkalinity field (mg/L as $CaCO_3$)	Solids, (residue at 180°C), dissolved	Total dissolved solids (calculated)	Hardness total (mg/L as $CaCO_3$)	Calcium dissolved (mg/L as $CaCO_3$)	Magnesium dissolved (mg/L as Mg)	Sodium dissolved (mg/L as Na)	Potassium dissolved (mg/L as K)	Chloride dissolved (mg/L as Cl)	Sulfate dissolved (mg/L as SO_4)	Fluoride dissolved (mg/L as F)	Silica dissolved (mg/L as SiO_2)	Ammonia (mg/L)	Nitrate (mg/L)	Ammonia + organic (mg/L)	NO_2 + NO_3 (mg/L)	Dissolved (mg/L)	Ortho, dissolved (mg/L)
BRUNSWICK GROUP SEDIMENTARY ROCKS (cont.)																								
33	190019	06-07-88	12	199	6	6.4	45	143	150	77	19	7.1	7.4	0.4	6	31	0.3	40	<0.010	<0.010	1.1	1.3	0.06	0.02
34	190063	05-27-87	12.5	462	1.2	7.4	206	326	349	290	66	31	11	1.1	39	32	<.1	16	0.02	<0.01	0.4	2.7	0.01	<0.01
35	190085	08-07-87	14.5	413	1.9	8.2	126	--	312	210	67	9.2	14	6.6	10	98	--	19	0.17	<0.010	0.5	<0.100	--	<0.010
36	190051	07-09-86	15	471	0.6	7.1	149	--	356	210	60	14	15	4.7	28	43	--	35	--	--	--	--	--	--
37	190058	06-26-86	14	632	1.1	7.5	160	--	478	270	90	11	17	4.2	68	52	--	24	--	--	--	--	--	--
38	190056	07-08-86	13.5	505	0.2	7.9	160	--	382	250	67	19	12	1.8	21	73	--	40	--	--	--	--	--	--
39	190054	01-29-86	10.5	460	4.8	7.9	183	--	348	210	60	14	27	2.9	26	57	--	31	--	--	--	--	--	--
40	190055	01-29-86	12.5	360	0.2	7.7	141	--	272	160	46	11	12	3.4	4.5	47	--	24	--	--	--	--	--	--
		06-09-88	13	395	0.1	8	157	230	299	170	50	11	13	3.5	3.9	42	0.7	24	0.07	<0.010	0.3	<0.100	<0.010	<0.010
41	190074	02-13-86	13	595	2.1	7.5	173	--	450	310	92	20	12	1.9	65	65	--	25	--	--	--	--	--	--
		03-09-88	13.5	610	4.1	6.5	167	357	461	270	80	18	11	1.9	39	52	0.1	26	<0.010	<0.010	<0.20	3.1	0.02	<0.010
42	190052	06-26-86	13.5	419	0.6	7.4	92	--	317	170	49	11	14	5.6	37	51	--	35	--	--	--	--	--	--
43	190057	06-27-86	13.5	543	1.2	7.7	146	--	411	240	69	16	17	5.2	42	64	--	30	--	--	--	--	--	--
44	190053	01-31-86	12.5	460	0.4	7.6	133	--	348	200	62	12	18	5	24	76	--	32	--	--	--	--	--	--
45	210277	07-31-85	13.5	430	3.1	7.6	152	--	325	190	56	13	13	1.1	21	18	--	23	--	--	--	--	--	--
		03-01-88	13	462	4.1	7.6	149	258	349	--	59	13	13	1.1	23	30	0.1	22	0.02	<0.010	<0.20	4.8	0.06	0.05
46	210282	07-10-86	13	252	6.1	6	21	--	191	81	20	7.4	14	1.1	24	32	--	24	--	--	--	--	--	--
47	210263	07-08-86	13	430	6.7	7.8	161	--	325	220	43	26	9.2	1.3	12	26	--	19	--	--	--	--	--	--
48	210267	08-23-85	13.5	544	3.9	7.2	120	--	411	210	58	15	29	2.4	61	59	--	34	--	--	--	--	--	--
49	210088	08-22-85	12	--	2.7	7.7	182	--	--	200	44	22	2.1	1.3	2.8	14	--	12	<0.010	<0.010	--	0.11	--	--
50	210242	07-11-85	12.5	445	1.6	7.8	181	--	336	190	46	19	22	1.1	22	33	--	20	--	--	--	--	--	--
51	210244	08-15-88	13	449	2.9	7.6	152	262	339	200	50	18	13	0.9	13	33	0.1	20	<0.010	<0.010	0.2	2.2	--	0.03
52	210253	01-14-86	13	382	0.3	7.9	139	--	289	170	49	12	17	1.3	8.7	64	--	18	--	--	--	--	--	--
53	210289	06-19-85	12	365	3.6	7.8	128	--	276	180	44	16	11	1.2	13	17	--	24	--	--	--	--	--	--
54	210269	07-10-85	13.5	367	5	7.7	142	--	277	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
55	210275	07-10-85	13	372	3.6	7.8	142	--	281	170	42	16	12	1.1	17	28	--	21	--	--	--	--	--	--
56	231072	09-10-85	13.0	1150	2.9	7.5	144	--	779	680	230	25	26	1.9	16	580	--	21	--	--	--	--	--	--
		09-23-88	12.5	2000	0.1	7.4	121	1840	1512	1200	410	43	40	2.6	17	1200	0.1	19	0.13	<0.010	0.4	1.1	<0.010	0.01
57	231055	09-10-85	12.5	560	6.5	7.8	142	--	423	280	68	26	15	1.8	14	160	--	22	--	--	--	--	--	--
58	231050	06-25-86	13.5	1740	1.2	7.9	113	--	1315	310	73	29	270	2.5	31	760	--	13	--	--	--	--	--	--
59	231051	07-23-87	13	263	0.1	7.7	94	170	199	94	23	9	15	3.5	16	14	0.1	33	0.21	<.01	0.8	<.1	0.03	0.02
60	231049	06-26-86	13	407	0.2	7	143	--	308	190	37	23	12	1.3	12	49	--	37	--	--	--	--	--	--
61	231083	12-23-85	12.5	595	0.1	6.9	228	--	450	280	87	16	25	1.5	47	53	--	32	--	--	--	--	--	--
		09-15-88	12.5	732	<0.1	7.1	215	434	553	330	99	19	28	1.5	79	47	0.2	31	0.28	<0.010	0.4	<0.100	0.15	0.09
62	231119	07-28-86	15	692	0.3	6.8	199	--	523	300	91	18	22	1.7	54	63	--	32	--	--	--	--	--	--
63	231048	06-25-86	15	340	0.7	6.9	152	--	257	140	33	14	14	1.8	9.2	18	--	40	--	--	--	--	--	--

Table 7a. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - major constituents (cont.)

[Well number as on figure 2; (mS/cm), microsiemens per centimeter; --, no data]

Well number	GWSI number	Date	Temperature water (°C)	Specific conductance (µS/cm)	Oxygen dissolved (mg/L)	pH standard units field	Alkalinity field (mg/L as $CaCO_3$)	Solids, (residue at 180°C), dissolved	Total dissolved solids (calculated)	Hardness total (mg/L as $CaCO_3$)	Calcium dissolved (mg/L as $CaCO_3$)	Magnesium dissolved (mg/L as Mg)	Sodium dissolved (mg/L as Na)	Potassium dissolved (mg/L as K)	Chloride dissolved (mg/L as Cl)	Sulfate dissolved (mg/L as SO_4)	Fluoride dissolved (mg/L as F)	Silica dissolved (mg/L as SiO_2)	Nitrogen: Ammonia (mg/L)	Nitrogen: Nitrate (mg/L)	Nitrogen: Ammonia + organic (mg/L)	Nitrogen: $NO_2 + NO_3$ (mg/L)	Phosphorus: Dissolved (mg/L)	Phosphorus: Ortho, dissolved (mg/L)
BRUNSWICK GROUP SEDIMENTARY ROCKS (cont.)																								
64	231047	06-25-86	13	304	0.8	6.5	79	--	230	94	22	9.4	12	4	34	17	--	45	--	--	--	--	--	--
65	231076	05-23-86	13.5	748	0.2	7.2	217	--	565	310	94	18	28	2	71	51	--	28	--	--	--	--	--	--
66	231053	02-11-86	12.5	1750	0.3	7.5	119	--	1323	1100	360	42	69	4	12	1100	--	22	--	--	--	--	--	--
		08-17-88	13	2330	<0.1	7.3	111	2020	1761	1100	370	45	79	4.1	13	1300	0.1	22	0.26	<0.010	0.6	<0.100	0.01	<0.010
67	231075	07-24-86	13	504	0.3	7.1	161	--	381	190	62	9.2	28	2.3	36	32	--	32	--	--	--	--	--	--
68	230531	10-03-85	--	550	--	7	188	--	416	230	77	8.5	35	4.4	47	43	--	30	--	--	--	--	--	--
69	231044	01-08-86	12.5	435	0.2	7.6	213	--	329	180	47	15	35	2	14	33	--	22	--	--	--	--	--	--
70	231117	08-13-85	13.5	359	0.8	7.6	64	--	271	140	35	13	15	2	15	65	--	17	--	--	--	--	--	--
71	230340	09-10-85	13.5	589	5.2	7.6	170	--	445	280	82	18	17	1.4	26	110	--	21	--	--	--	--	--	--
		04-29-87	13	679	5	7.6	164	396	513	290	85	19	19	1.4	36	110	<.1	22	0.02	<0.01	0.8	3.5	0.05	0.04
72	231054	02-05-86	12.5	515	0.2	7.5	237	--	389	200	54	16	52	3.2	8.2	67	--	25	--	--	--	--	--	--
73	270153	04-21-87	11.5	398	6.6	7.3	142	227	301	190	42	21	11	1.3	23	28	<.1	15	0.01	<0.01	0.3	2.8	0.02	<0.01
74	270979	09-01-87	13.5	499	0.1	8.1	169	--	377	140	26	17	68	0.7	15	88	--	20	<0.010	<0.010	0.4	1.6	--	0.01
75	310033	08-19-88	14	634	10.8	7.5	128	407	479	290	63	33	23	1.2	60	90	<0.10	19	<0.010	<0.010	0.2	5.5	0.03	0.02
76	310034	08-19-88	12.5	477	14.7	6.9	107	314	361	200	54	16	14	0.8	56	32	<0.10	22	<0.010	<0.010	<0.20	5.1	0.06	0.05
77	350017	01-09-86	13.0	465	2.6	7.8	131	--	340	220	50	24	13	1.1	7.2	110	--	22	--	--	--	--	--	--
78	350009	07-24-85	14	735	3.8	7.2	200	--	556	300	79	25	34	1.2	27	130	--	30	--	--	--	--	--	--
79	350020	09-09-85	13.5	1300	1.9	7.6	104	--	983	730	230	36	44	1.3	19	710	--	19	--	--	--	--	--	--
80	350036	06-06-88	14	328	3.5	6.5	99	219	248	130	34	12	14	1	25	20	0.3	23	<0.010	<0.010	0.2	0.73	--	--
81	350018	07-30-85	13	1020	2.2	7.4	130	--	771	500	130	41	35	1.7	25	400	--	21	--	--	--	--	--	--
82	350021	02-12-86	12.5	305	3.7	7.8	141	--	231	150	35	14	11	1.8	7.8	7.9	--	24	--	--	--	--	--	--
83	350023	07-24-86	12.5	360	3.9	7.9	109	--	272	150	39	13	14	1.4	9.3	55	--	26	--	--	--	--	--	--
84	350011	07-21-87	13.5	400	0.1	7.7	158	241	302	190	45	19	13	0.7	15	32	0.1	22	<0.01	<0.01	0.3	0.33	0.3	<0.01
85	350024	01-10-86	12	375	2.6	7.7	133	--	284	160	39	16	11	0.9	13	21	--	17	--	--	--	--	--	--
		07-22-87	13.5	379	2.4	7.8	132	225	287	180	43	17	12	1	13	19	0.1	16	<0.01	<0.01	0.7	5.3	0.05	0.03
86	350026	07-08-86	13	327	2.8	7.8	127	--	247	150	33	15	9	1.2	8.8	18	--	18	--	--	--	--	--	--
87	350016	09-18-85	13	396	7.1	7.7	160	--	299	190	44	19	10	1.3	8.4	27	--	18	--	--	--	--	--	--
88	350019	01-15-86	12.5	665	2	7.8	139	--	503	360	97	28	20	2.1	7.4	240	--	25	--	--	--	--	--	--
		08-17-88	13	725	3.5	7.4	142	507	548	340	91	28	19	1.9	9.9	220	0.1	24	<0.010	<0.010	0.6	4.7	0.02	<0.010
89	350034	05-07-87	10.5	380	8.9	7.2	47	199	287	120	30	10	25	1.8	50	29	<0.1	13	0.08	0.02	0.7	0.77	0.01	0.01
90	390133	07-02-85	13	452	6.5	7.6	174	--	342	210	60	14	9.6	0.7	18	36	--	22	0.02	<0.010	0.3	1.9	--	--
91	390102	07-03-85	15	735	5.4	7.4	338	--	556	350	120	13	13	1	32	31	--	18	<0.010	<0.010	0.3	<0.100	--	--
92	390119	07-02-85	12.5	585	4.6	7.8	104	--	442	250	72	17	18	1	13	170	--	19	<0.010	<0.010	0.2	3.1	--	--
93	390168	11-21-85	13	402	6.2	7.1	170	--	304	210	64	13	11	1.2	21	45	--	24	--	--	--	--	--	--
94	390251	11-21-85	13	990	3.4	7.5	142	--	748	630	180	43	31	1.6	34	520	--	28	--	--	--	--	--	--

Table 7a. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - major constituents (cont.)

[Well number as on figure 2; (mS/cm), microsiemens per centimeter; --, no data]

Well number	GWSI number	Date	Temperature water (°C)	Specific conductance (µS/cm)	Oxygen dissolved (mg/L)	pH standard units field	Alkalinity field (mg/L as $CaCO_3$)	Solids, (residue at 180°C), dissolved	Total dissolved solids (calculated)	Hardness total (mg/L as $CaCO_3$)	Calcium dissolved (mg/L as $CaCO_3$)	Magnesium dissolved (mg/L as Mg)	Sodium dissolved (mg/L as Na)	Potassium dissolved (mg/L as K)	Chloride dissolved (mg/L as Cl)	Sulfate dissolved (mg/L as SO_4)	Fluoride dissolved (mg/L as F)	Silica dissolved (mg/L as SiO_2)	Nitrogen: Ammonia (mg/L)	Nitrogen: Nitrate (mg/L)	Nitrogen: Ammonia + organic (mg/L)	Nitrogen: NO_2 + NO_3 (mg/L)	Phosphorus: Dissolved (mg/L)	Phosphorus: Ortho, dissolved (mg/L)
BRUNSWICK GROUP SEDIMENTARY ROCKS (cont.)																								
95	390385	07-29-87	11	297	6	6.7	79	203	225	120	37	7.8	10	0.8	27	18	0.1	30	<0.01	<0.01	0.5	0.34	0.09	0.06
LOCKATONG FORMATION																								
96	30218	07-18-86	13.5	421	5.8	6.6	61	--	318	150	39	12	27	1.6	63	42	--	25	--	--	--	--	--	--
97	30219	07-16-86	12.5	213	6.8	7.8	69	--	161	85	25	5.4	12	1.1	11	17	--	55	--	--	--	--	--	--
		07-24-87	12.5	247	6.5	7.6	68	140	187	81	24	5.1	11	1	12	17	1	27	<0.01	<0.01	0.4	3	0.03	0.02
98	30217	07-14-86	13	374	5.2	7	79	--	283	150	45	9.9	12	1.5	28	43	--	24	--	--	--	--	--	--
99	30220	07-15-86	13.5	569	7.5	6.9	93	--	430	200	55	15	41	2.6	89	52	--	28	--	--	--	--	--	--
100	190036	01-31-86	12	550	0.2	8.8	321	--	416	47	9.9	5.4	130	1.7	3.9	11	--	18	--	--	--	--	--	--
101	190023	12-18-85	11.5	470	0.9	7.6	262	--	355	190	62	9.1	34	3.5	4.8	21	--	36	--	--	--	--	--	--
102	190035	12-19-85	10.5	426	0.4	7.3	220	--	322	190	63	8.7	26	5.4	6.2	40	--	26	--	--	--	--	--	--
103	190024	12-18-85	13.5	585	0.6	8.8	306	--	442	12	2.5	1.2	140	1	5.3	11	--	13	--	--	--	--	--	--
104	190080	07-09-86	14.5	900	0.8	7.7	273	--	680	350	79	37	59	3.7	70	96	--	26	--	--	--	--	--	--
105	190060	06-25-86	13	612	0.1	7.6	215	--	463	280	67	28	29	4.5	24	77	--	23	--	--	--	--	--	--
106	190059	06-25-86	13	652	0.1	7.4	234	--	493	270	62	27	30	2.8	22	84	--	23	--	--	--	--	--	--
107	210028	07-05-83	13	470	0.1	7.1	--	--	355	220	54	21	12	1.1	26	62	--	15	--	0.02	<0.05	7.6	--	--
108	210261	06-27-86	13.5	464	0.4	7.6	159	--	351	220	47	25	7	1.1	26	40	--	16	--	--	--	--	--	--
109	210260	07-01-86	13.5	356	0.1	7.7	151	--	269	140	45	7.8	18	6.3	3.6	31	--	27	--	--	--	--	--	--
110	210266	06-27-86	17	653	3.1	7.6	167	--	494	240	54	26	40	3	67	54	--	41	--	--	--	--	--	--
111	210281	07-30-86	14.5	298	0.5	7.9	151	--	225	130	30	14	12	0.8	1.7	10	--	29	--	--	--	--	--	--
112	231081	08-22-85	13	336	0.5	7.2	110	--	254	130	34	9.9	20	4.7	8.2	51	--	30	--	--	--	--	--	--
113	231118	02-14-86	12	332	0.3	7.5	175	--	251	150	38	12	15	6.6	11	13	--	41	--	--	--	--	--	--
114	231065	07-23-86	13	221	0.9	8	83	--	167	80	20	7.3	12	1.6	7.6	19	--	17	--	--	--	--	--	--
115	230936	08-22-85	12.5	572	0	6.8	126	--	432	200	53	17	37	6.2	11	150	--	34	--	--	--	--	--	--
		06-22-88	12.5	618	0.1	7	118	336	467	180	48	15	33	5.9	14	120	0.3	34	0.09	<0.010	<0.20	<0.100	<0.010	0.02
116	230526	07-03-86	14	242	2.5	8.1	93	--	183	59	14	5.9	28	1.8	6.2	17	--	20	--	--	--	--	--	--
117	231046	07-02-86	12.5	429	0.5	7.5	144	--	324	160	47	10	25	5.3	9.5	68	--	34	--	--	--	--	--	--
STOCKTON FORMATION																								
118	170005	03-20-86	16	800	.2	8.6	101	--	--	22	8.4	0.25	150	0.9	130	95	--	10	--	--	--	--	--	--
		08-04-87	16.5	817	0.1	8.6	95	454	618	21	8	0.29	160	0.7	130	92	1	12	<0.01	<0.01	0.5	<0.1	0.06	<0.01
119	190015	07-23-87	11.5	140	7.2	6.7	63	101	106	61	15	5.8	8.5	0.8	3.3	13	0.1	27	<0.01	<0.01	0.4	0.49	0.14	0.12
120	190037	01-28-86	12	325	6.4	7.7	119	--	246	150	35	16	8.8	1	10	26		19	--	--	--	--	--	--
		07-21-87	12.5	342	6.6	7.8	123	202	259	160	37	17	9.2	1	11	27	0.1	19	<0.01	<0.01	0.3	1.9	0.06	0.04
121	190070	08-16-85	12.5	418	2.8	7.8	160	--	316	200	39	25	13	1.3	21	24	--	23	--	--	--	--	--	--
122	190077	08-16-85	13	411	5.6	7.1	126	--	311	180	55	11	14	1.3	17	63	--	25	--	--	--	--	--	--
		04-22-87	12.5	209	9.8	6.7	127	140	158	81	23	5.8	10	1.2	4.9	32	<0.1	26	0.01	<0.01	0.3	1.5	0.06	0.05
123	210137	07-09-86	12.5	362	2.5	7	103	--	274	140	36	13	18	1.3	16	34	--	20	--	--	--	--	--	--

Table 7a. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - major constituents (cont.)

[Well number as on figure 2; (mS/cm), microsiemens per centimeter; --, no data]

Well number	GWSI number	Date	Temperature water (°C)	Specific conductance (µS/cm)	Oxygen dissolved (mg/L)	pH standard units field	Alkalinity field (mg/L as $CaCO_3$)	Solids, (residue at 180°C), dissolved	Total dissolved solids (calculated)	Hardness total (mg/L as $CaCO_3$)	Calcium dissolved (mg/L as $CaCO_3$)	Magnesium dissolved (mg/L as Mg)	Sodium dissolved (mg/L as Na)	Potassium dissolved (mg/L as K)	Chloride dissolved (mg/L as Cl)	Sulfate dissolved (mg/L as SO_4)	Fluoride dissolved (mg/L as F)	Silica dissolved (mg/L as SiO_2)	Nitrogen: Ammonia (mg/L)	Nitrogen: Nitrate (mg/L)	Nitrogen: Ammonia + organic (mg/L)	Nitrogen: $NO_2 + NO_3$ (mg/L)	Phosphorus: Dissolved (mg/L)	Phosphorus: Ortho, dissolved (mg/L)
STOCKTON FORMATION (cont.)																								
124	210243	06-17-85	14	334	4.9	7.5	104	--	253	150	36	14	9.1	0.9	14	18	--	26	--	--	--	--	--	--
125	210087	07-31-85	12.5	417	1.1	7.6	144	--	315	190	45	18	14	1	22	36	--	19	--	--	--	--	--	--
126	210264	07-02-86	13.5	346	<0.1	7.9	161	--	262	160	38	16	8.1	1	5.6	17	--	19	--	--	--	--	--	--
127	210265	07-08-86	13	362	0.5	7.9	177	--	274	190	43	19	8	0.9	3.6	21	--	22	--	--	--	--	--	--
128	210262	06-27-86	14	282	4.4	7.3	78	--	213	120	27	12	9.5	0.8	11	25	--	20	--	--	--	--	--	--
129	210189	07-31-85	13.5	404	1.3	7.8	152	--	305	200	45	20	13	0.8	12	54	--	19	--	--	--	--	--	--
130	210268	01-14-86	12.5	398	1.6	7.8	171	--	301	200	47	19	8.7	1.4	11	31	--	11	--	--	--	--	--	--
131	210248	09-03-87	13	229	4.6	6.6	72	145	173	120	22	7.4	14	1.1	8.5	20	0.1	28	0.06	<0.01	0.6	3	0.1	0.09
132	210146	04-22-87	12	265	5.6	6.6	94	163	200	120	30	11	8.9	1.3	11	23	<0.1	24	<0.01	<0.01	0.5	1.6	0.06	0.05
133	210188	07-17-85	13	370	4.1	7	138	--	280	160	37	17	13	1.1	17	18	--	26	--	--	--	--	--	--
134	210194	07-17-85	13	310	6.9	6.9	100	--	234	120	27	13	11	0.9	20	16	--	29	--	--	--	--	--	--
135	210198	09-09-87	12	394	3.5	6.5	131	236	298	170	44	15	14	1.4	13	28	0.2	24	0.01	<0.01	<0.2	0.74	0.11	0.07
136	210286	07-09-86	13	450	2.9	7.3	169	--	340	150	37	14	40	3.2	23	46	--	19	--	--	--	--	--	--
137	210287	08-27-85	13	288	6.7	6.5	84	--	218	110	26	11	14	1.3	15	19	--	22	--	--	--	--	--	--
138	210271	08-27-85	13	416	0.8	6.9	126	--	314	170	46	14	15	1.9	23	43	--	20	--	--	--	--	--	--
139	210205	08-13-85	13	324	1	6.3	86	--	245	130	31	12	17	2	16	38	--	17	--	--	--	--	--	--
140	210247	08-13-85	13.5	343	1.6	6.6	94	--	259	130	35	11	16	1.7	25	16	--	20	--	--	--	--	--	--
141	231115	07-16-85	16.5	154	--	5.5	21	--	116	32	7.8	2.9	11	2.8	12	5.1	--	29	0.04	<0.010	0.4	4.1	--	<0.010
142	230792	04-24-86	12.5	370	0.3	7.5	145	--	280	170	46	14	10	1.6	12	18	--	28	0.01	<0.010	0.2	0.15	--	0.02
143	231063	07-23-86	13.5	459	3.2	6.4	85	--	347	140	36	12	33	2.3	59	38	--	23	--	--	--	--	--	--
144	230801	04-24-86	12.5	350	0.3	7.6	145	--	265	160	45	12	9.7	1.7	11	15	--	27	0.05	<0.010	0.2	<0.100	--	0.02
145	231114	07-16-85	13.5	214	--	6.5	70	--	162	78	18	7.9	7.8	1.3	5.5	9	--	25	0.13	<0.010	0.3	1.1	--	0.13
146	231116	07-16-85	13	251	3.6	6.2	54	--	190	77	19	7.2	14	1.8	26	17	--	27	<0.010	<0.010	0.2	1.8	--	0.14
		04-28-87	11.5	272	6.6	5.8	23	155	206	64	15	6.4	21	2	41	20	<.1	24	<.01	<.01	0.9	1.6	0.08	0.07
CONGLOMERATE																								
147	190028	05-13-88	12.5	342	2.7	8	138	205	259	160	35	18	17	0.7	17	22	0.3	17	--	--	--	--	--	--
148	190069	03-03-88	12.5	342	5.2	7	93	195	259	150	39	12	8.2	0.8	33	16	0.2	23	0.02	<0.010	<0.20	1	0.16	0.16
DIABASE																								
149	270196	05-05-88	12	484	3	7.4	149	303	366	220	55	20	7.7	6.7	39	35	0.1	27	<0.010	<0.010	<0.20	2.1	0.02	<0.010
BASALT																								
150	210258	07-01-86	13	276	8.2	7.1	87	--	209	130	35	9.6	5.9	0.7	16	22	--	37	--	--	--	--	--	--

Table 7b. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - minor constituents

[Well number as on figure 2; (mg/L, milligrams per liter; mg/L, micrograms per liter; --, no data]

Well number	Date	Aluminum dissolved (µg/L as Al)	Arsenic dissolved (µg/L as As)	Barium dissolved (µg/L as Ba)	Beryllium dissolved (µg/L as Be)	Cadmium dissolved (µg/L as Cd)	Chromium dissolved (µg/L as Cr)	Cobalt dissolved (µg/L as Co)	Copper dissolved (µg/L as Cu)	Iron dissolved (µg/L as Fe)	Lead dissolved (µg/L as Pb)	Lithium dissolved (µg/L as Li)	Manganese dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Molybdenum dissolved (µg/L as Mo)	Strontium dissolved (µg/L as Sr)	Vanadium dissolved (µg/L as V)	Zinc dissolved (µg/L as Zn)	Uranium natural dissolved (µg/L as U)	Carbon organic dissolved (mg/L as C)	Phenols total (µg/L)
BRUNSWICK GROUP SEDIMENTARY ROCKS																					
1	03-05-86	--	--	140	<0.5	<1.0	--	<3	10	<3	<10	11	1	--	<10	110	<6	6	16	--	--
2	03-05-86	--	--	220	<0.5	<1.0	--	<3	<10	<3	<10	17	<1	--	<10	710	11	3	4.4	--	--
3	03-07-86	--	--	150	<0.5	<1.0	--	<3	<10	6	<10	18	2	--	<10	480	<6	6	25	--	--
4	03-05-86	--	--	130	<0.5	<1.0	--	<3	20	11	<10	10	3	--	<10	280	<6	150	4.2	--	--
	07-24-87	<10	3	--	--	<1	<1	--	3	3	<5	--	1	<0.1	--	--	--	<3	--	1.5	2
5	03-05-86	--	--	110	<0.5	<1.0	--	<3	<10	5	<10	11	1	--	<10	160	<6	12	3.6	--	--
6	09-12-88	<10	2	--	--	<1.0	<1	--	<1	4	<5	--	<1	<0.1	--	--	--	4	--	0.7	<1
7	03-11-86	--	--	110	<0.5	<1.0	--	<3	<10	<3	<10	9	<1	--	<10	170	<6	<3	2.7	--	--
	03-02-88	<10	10	--	--	<1.0	1	--	1	30	<5	--	7	<0.1	--	--	--	8	--	0.7	2
8	03-07-86	--	--	21	<0.5	<1.0	--	<3	<10	7	<10	28	2	--	<10	2700	25	4	9.4	--	--
9	09-10-87	<10	3	--	--	<1	<1	--	2	<3	<5	--	<1	<0.1	--	--	--	24	--	1	4
	03-20-86	--	--	100	<0.5	<1.0	--	<3	<10	9	<10	19	1	--	10	650	<6	21	2.9	--	--
10	03-06-86	--	--	300	<0.5	<1.0	--	<3	<10	<3	<10	12	<1	--	<10	380	<6	<3	1.2	--	--
11	03-12-86	--	--	45	<0.5	<1.0	--	<3	60	<3	<10	29	46	--	<10	2000	8	3	1.3	--	--
12	05-11-87	1	<1	--	--	<1	<1	--	2	5	<5	--	<1	<0.1	--	--	--	22	--	0.8	<1
13	08-12-87	<10	--	200	<0.5	<1.0	--	<3	<10	<3	10	6	<1	--	<10	500	<5	<3	--	--	--
14	07-21-87	<10	<1	--	--	<1	<1	--	13	<3	<5	--	1	0.3	--	--	--	7	--	1.2	3
15	01-30-86	--	--	18	<0.5	<1.0	--	<3	20	4	<10	23	5	--	<10	890	<6	22	22	--	--
16	08-17-88	<10	3	--	--	<1.0	<1	--	3	4	<5	--	6	<0.1	--	--	--	270	--	0.5	--
17	02-04-86	--	--	600	<0.5	<1.0	--	<3	<10	5	<10	22	<1	--	<10	150	<6	260	0.7	--	--
18	07-09-85	7	--	300	<0.5	<1.0	--	<3	<10	<3	<10	30	<1	--	<10	690	10	20	5.2	--	--
19	07-09-85	--	--	110	<0.5	<1.0	--	<3	<10	4	<10	49	9	--	<10	680	<6	11	--	--	--
20	07-23-85	--	--	74	<0.5	<1.0	--	<3	<10	10	<10	60	7	--	70	5100	<6	13	10	--	--
21	07-23-85	--	--	44	<0.5	<1.0	--	<3	<10	<3	<10	20	19	--	170	1700	<6	23	--	--	--
22	01-29-86	--	--	19	<0.5	<1.0	--	<3	<10	8	<10	29	<1	--	<10	87	<6	<3	0.4	--	--
	03-08-88	<10	<1	--	--	3	<1	--	<1	3	<5	--	1	<0.1	--	--	--	<3	--	0.4	2
23	02-12-86	--	--	70	<0.5	<1.0	--	<3	<10	<3	<10	<4	<1	--	<10	910	<6	61	1	--	--
24	01-28-86	--	--	72	<0.5	<1.0	--	<3	<10	3	10	22	14	--	10	4400	<6	600	16	--	--
25	07-18-85	--	--	89	<0.5	<1.0	--	<3	<10	<3	<10	5	<1	--	<10	85	<6	<3	0.4	--	--
26	04-30-87	6	4	--	--	<1	<1	--	2	4	<5	--	<1	<0.1	--	--	--	14	--	0.8	3
27	07-22-87	<10	16	--	--	<1	<1	--	<1	280	<5	--	190	<0.1	--	--	--	5	--	1.3	--
28	07-29-87	<10	2	--	--	<1	<1	--	<1	<3	<5	--	65	0.2	--	--	--	<3	--	1.9	3
29	07-26-85	--	--	20	<0.5	<1.0	--	<3	<10	6	<10	77	64	--	10	3700	<6	26	6.6	--	--
30	01-31-86	--	--	460	<0.5	<1.0	--	<3	20	<3	<10	14	<1	--	<10	340	<6	270	2.8	--	--
31	01-06-86	--	--	110	<0.5	<1.0	--	<3	<10	8	<10	46	<1	--	<10	2000	6	<3	3.2	--	--
32	01-07-86	--	--	16	<0.5	<1.0	--	<3	<10	<3	<10	29	10	--	<10	50	<6	77	3.1	--	--

Table 7b. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - minor constituents (cont.)

[Well number as on figure 2; (mg/L, milligrams per liter; mg/L, micrograms per liter; --, no data]

Well number	Date	Aluminum dissolved (µg/L as Al)	Arsenic dissolved (µg/L as As)	Barium dissolved (µg/L as Ba)	Beryllium dissolved (µg/L as Be)	Cadmium dissolved (µg/L as Cd)	Chromium dissolved (µg/L as Cr)	Cobalt dissolved (µg/L as Co)	Copper dissolved (µg/L as Cu)	Iron dissolved (µg/L as Fe)	Lead dissolved (µg/L as Pb)	Lithium dissolved (µg/L as Li)	Manganese dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Molybdenum dissolved (µg/L as Mo)	Strontium dissolved (µg/L as Sr)	Vanadium dissolved (µg/L as V)	Zinc dissolved (µg/L as Zn)	Uranium natural dissolved (µg/L as U)	Carbon organic dissolved (mg/L as C)	Phenols total (µg/L)
BRUNSWICK GROUP SEDIMENTARY ROCKS (cont.)																					
33	06-07-88	--	<1	--	--	<1.0	2	--	51	<3	<5	--	<1	<0.1	--	--	--	120	--	1.4	<1
34	05-27-87	4	<1	--	--	<1	<1	--	1	<3	<5	--	<1	<0.1	--	--	--	10	--	1.2	3
35	08-07-87	--	--	16	<0.5	<1.0	--	<3	<10	1500	<10	23	220	--	30	240	<6	140	--	--	--
36	07-09-86	--	--	17	<0.5	<1.0	--	<3	20	6	<10	40	10	--	<10	160	<6	100	7.2	--	--
37	06-26-86	--	--	14	<0.5	<1.0	--	<3	<10	9	<10	47	15	--	<10	250	<6	740	2.4	--	--
38	07-08-86	--	--	7	<0.5	1	--	<3	<10	8	<10	24	99	--	<10	150	<6	400	0.8	--	--
39	01-29-86	--	--	18	<0.5	<1.0	--	<3	<10	1700	<10	41	45	--	10	620	<6	590	3.2	--	--
40	01-29-86	--	--	3	<0.5	<1.0	--	<3	<10	10	<10	33	64	--	<10	190	<6	220	2.4	--	--
	06-09-88	10	2	--	--	<1.0	5	--	3	37	<5	--	68	<0.1	--	--	--	220	--	0.7	3
41	02-13-86	--	--	53	<0.5	<1.0	--	<3	<10	<3	<10	15	5	--	<10	390	<6	22	2.4	--	--
	03-09-88	<10	9	--	--	2	1	--	3	<3	<5	--	2	<0.1	--	--	--	23	--	0.7	2
42	06-26-86	--	--	24	<0.5	<1.0	--	<3	<10	1800	<10	34	250	--	20	140	<6	740	1.1	--	--
43	06-27-86	--	--	5	<0.5	<1.0	--	<3	<10	11	<10	50	5	--	<10	160	<6	49	16	--	--
44	01-31-86	--	--	11	<0.5	<1.0	--	<3	<10	250	<10	40	98	--	10	220	<6	69	11	--	--
45	07-31-85	--	--	250	<0.5	<1.0	--	<3	<10	<3	<10	25	<1	--	<10	360	<6	58	2.9	--	--
	03-01-88	<10	1	--	--	<1.0	<1	--	4	6	<5	--	<1	<0.1	--	--	--	16	--	0.8	1
46	07-10-86	--	--	95	<0.5	<1.0	--	<3	200	18	<10	6	2	--	<10	88	<6	82	<0.40	--	--
47	07-08-86	--	--	410	<0.5	<1.0	--	<3	<10	<3	10	25	1	--	<10	420	<6	55	4.8	--	--
48	08-23-85	--	--	13	<0.5	<1.0	--	<3	<10	8	<10	22	2	--	<10	370	6	18	6.4	--	--
49	08-22-85	10	--	--	--	2	--	--	42	24	16	--	1	--	--	--	--	31	--	--	--
50	07-11-85	30	--	210	<0.5	<1.0	--	<3	<10	4	<10	20	2	--	<10	880	<6	26	--	--	--
51	08-15-88	10	4	220	<0.5	1	<5	<3	<10	3	<10	15	1	<0.1	20	470	<6	26	--	0.6	7
52	01-14-86	--	--	140	<0.5	<1.0	--	<3	<10	29	<10	24	32	--	<10	760	<6	10	1.9	--	--
53	06-19-85	--	--	120	<0.5	<1.0	--	<3	<10	3	<10	19	10	--	<10	340	<6	37	1.5	--	--
54	07-10-85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--
55	07-10-85	--	--	230	<0.5	1	--	<3	<10	3	<10	18	<1	--	10	310	<6	9	--	--	--
56	09-10-85	--	--	30	<0.5	1	--	<3	<10	9	<10	53	<1	--	10	4600	<6	14	--	--	--
	09-23-88	<10	2	--	--	<1.0	3	--	1	240	<5	--	15	<0.1	--	--	--	20	--	0.4	<1
57	09-10-85	--	--	61	<0.5	<1.0	--	<3	<10	8	<10	31	<1	--	<10	5200	19	24	--	--	--
58	06-25-86	--	--	16	<0.5	<1.0	--	<3	<10	42	<10	100	26	--	<10	4500	<6	18	<0.40	--	--
59	07-23-87	<10	<1	--		<1	<1	--	<1	360	<5	--	75	<0.1		--		3		1.4	3
60	06-26-86	--	--	210	<0.5	<1.0	--	<3	<10	2200	<10	13	160	--	<10	170	<6	50	--	--	--
61	12-23-85	20	--	1100	<0.5	<1.0	--	<3	<10	3100	<10	30	600	--	<10	530	<6	5	<0.40	--	--
	09-15-88	<10	<1	--	--	<1.0	<1	--	2	3600	<5	--	710	<0.1	--	--	--	<3	--	1.9	1
62	07-28-86	20	--	550	<0.5	<1.0	--	<3	<10	3600	<10	24	1100	--	<10	530	<6	9	0.9	--	--
63	06-25-86	--	--	280	<0.5	<1.0	--	<3	<10	2200	<10	28	520	--	<10	270	<6	4	<0.40	--	--

Table 7b. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - minor constituents (cont.)

[Well number as on figure 2; (mg/L, milligrams per liter; mg/L, micrograms per liter; --, no data]

Well number	Date	Aluminum dissolved (µg/L as Al)	Arsenic dissolved (µg/L as As)	Barium dissolved (µg/L as Ba)	Beryllium dissolved (µg/L as Be)	Cadmium dissolved (µg/L as Cd)	Chromium dissolved (µg/L as Cr)	Cobalt dissolved (µg/L as Co)	Copper dissolved (µg/L as Cu)	Iron dissolved (µg/L as Fe)	Lead dissolved (µg/L as Pb)	Lithium dissolved (µg/L as Li)	Manganese dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Molybdenum dissolved (µg/L as Mo)	Strontium dissolved (µg/L as Sr)	Vanadium dissolved (µg/L as V)	Zinc dissolved (µg/L as Zn)	Uranium natural dissolved (µg/L as U)	Carbon organic dissolved (mg/L as C)	Phenols total (µg/L)
BRUNSWICK GROUP SEDIMENTARY ROCKS (cont.)																					
64	06-25-86	--	--	270	<0.5	2	--	<3	<10	11000	<10	21	1600	--	<10	210	<6	45	<0.40	--	--
65	05-23-86	20	--	1100	<0.5	<1.0	--	<3	<10	1300	<10	33	660	--	<10	590	<6	9	1.5	--	--
66	02-11-86	--	--	8	<0.5	1	--	<3	<10	240	<10	100	300	--	10	11000	<6	110	2.2	--	--
	08-17-88	20	6	--	--	<1.0	2	--	<1	170	<5	--	320	<0.1	--	--	--	16	--	0.3	--
67	07-24-86	--	--	300	<0.5	<1.0	--	<3	<10	1100	<10	22	610	--	<10	320	<6	14	<0.40	--	--
68	10-03-85	--	--	23	<0.5	<1.0	--	<3	<10	22	<10	21	65	--	<10	380	<6	45	--	--	--
69	01-08-86	--	--	<2	<0.5	<1.0	--	<3	<10	<3	<10	27	100	--	<10	850	<6	100	4.8	--	--
70	08-13-85	--	--	73	<0.5	1	--	<3	<10	41	<10	13	180	--	20	370	<6	<3	<0.40	--	--
71	09-10-85	--	--	85	<0.5	<1.0	--	<3	<10	5	<10	26	<1	--	<10	820	7	4	2.6	--	--
	04-29-87	<10	2	--		<1	<1	--	4	5	<5	--	2	<0.1	--	--	--	10	--	0.9	3
72	02-05-86	--	--	55	<0.5	<1.0	--	<3	<10	750	10	38	200	--	<10	610	<6	7	3.4	--	--
73	04-21-87	<10	<1	--		1	<1	--	<1	4	<5	--	<1	<0.1	--	--		6	--	0.6	2
74	09-01-87	<10	--	55	<0.5	<1.0	--	<3	10	77	<10	21	11	--	<10	540	<6	7	--	--	--
75	08-19-88	<10	4	--		<1.0	4	--	<1	24	<5	--	<1	<0.1	--	--	--	<3	--	0.8	--
76	08-19-88	--	<1	--	--	<1.0	<1	--	<1	14	<5	--	<1	<0.1	--	--	--	33	--	0.7	1
77	01-09-86	--	--	89	<0.5	<1.0	--	<3	<10	<3	<10	32	<1	--	<10	930	<6	160	3.9	--	--
78	07-24-85	--	--	85	<0.5	<1.0	--	<3	<10	4	<10	33	<1	--	<10	770	9	12	--	--	--
79	09-09-85	--	--	37	<0.5	<1.0	--	<3	<10	7	<10	84	5	--	20	3700	9	26	7.1	--	--
80	06-06-88	<10	<1	--	--	<1.0	<1	--	39	<3	<5	--	<1	<0.1	--	--	--	9	--	1.2	2
81	07-30-85	--	--	65	<0.5	<1.0	--	<3	<10	22	<10	77	<1	--	<10	2500	15	18	--	--	--
82	02-12-86	--	--	190	<0.5	<1.0	--	<3	<10	<3	<10	33	<1	--	<10	1100	10	44	5.8	--	--
83	07-24-86	--	--	200	<0.5	<1.0	--	<3	<10	<3	<10	25	2	--	<10	1100	10	16	2.3	--	--
84	07-21-87	<10	19	--		<1	<1	--	<1	<3	<5	--	<1	0.3	--	--	--	21	--	1.5	2
85	01-10-86	--	--	220	<0.5	<1.0	--	<3	<10	<3	<10	21	<1	--	<10	730	<6	28	--	--	--
	07-22-87	<10	3	--		<1	<1	--	6	<3	<5	--	<1	0.3	--	--	--	16	--	1.4	2
86	07-08-86	--	--	450	<0.5	<1.0	--	<3	<10	<3	<10	20	3	--	40	720	<6	<3	3.2	--	--
87	09-18-85	--	--	260	0.9	<1.0	--	<3	<10	14	<10	38	1	--	20	1600	<6	13	4.5	--	--
88	01-15-86	--	--	33	<0.5	1	--	<3	<10	<3	<10	48	4	--	<10	3800	<6	71	4.1	--	--
	08-17-88	7	8	--	--	<1.0	<1	--	3	<3	<5	--	3	<0.1	--	--	--	30	--	0.5	--
89	05-07-87	4	<1	--	--	<1	<1	--	6	34	<5	--	380	<0.1	--	--	--	150	--	3.1	2
90	07-02-85	10	--	--	--	<1.0	--	--	3	7	5	--	<1	--	--	--	--	20	--	--	--
91	07-03-85	<10	--	--	--	<1.0	--	--	4	11	7	--	1200	--	--	--	--	12	--	--	--
92	07-02-85	<10	--	--	--	<1.0	--	--	1	11	5	--	2	--	--	--	--	9	3	--	--
93	11-21-85	--	--	150	<0.5	<1.0	--	<3	<10	7	<10	18	1	--	<10	430	<6	11	2.1	--	--
94	11-21-85	--	--	110	<0.5	<1.0	--	<3	<10	14	<10	26	<1	--	<10	4300	13	12	4.7	--	--
95	07-29-87	<10	<1	--	--	<1	<1	--	3	<3	<5	--	<1	0.3	--	--	--	8	--	2.1	<1

Table 7b. Chemical analyses of water samples from wellsin sedimentary rocks of the Newark Basin in New Jersey - minor constituents (cont.)

[Well number as on figure 2; (mg/L, milligrams per liter; mg/L, micrograms per liter; --, no data]

Well number	Date	Aluminum dissolved (µg/L as Al)	Arsenic dissolved (µg/L as As)	Barium dissolved (µg/L as Ba)	Beryllium dissolved (µg/L as Be)	Cadmium dissolved (µg/L as Cd)	Chromium dissolved (µg/L as Cr)	Cobalt dissolved (µg/L as Co)	Copper dissolved (µg/L as Cu)	Iron dissolved (µg/L as Fe)	Lead dissolved (µg/L as Pb)	Lithium dissolved (µg/L as Li)	Manganese dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Molybdenum dissolved (µg/L as Mo)	Strontium dissolved (µg/L as Sr)	Vanadium dissolved (µg/L as V)	Zinc dissolved (µg/L as Zn)	Uranium natural dissolved (µg/L as U)	Carbon organic dissolved (mg/L as C)	Phenols total (µg/L)
LOCKATONG FORMATION																					
96	07-18-86	--	--	170	<0.5	<1.0	--	<3	<10	<3	<10	9	<1	--	<10	200	<6	25	1	--	--
97	07-24-87	<10	<1	--	--	<1	<1	--	<1	9	<5	--	1	<0.1	--	--	--	50	--	0.5	2
	07-16-86	--	--	290	<0.5	<10	--	<3	<10	9	<10	8	3	--	<10	450	<6	<3	8.8	--	--
98	07-14-86	--	--	160	<0.5	<1.0	--	<3	<10	<3	<10	7	<1	--	<10	250	<6	180	5.7	--	--
99	07-15-86	--	--	92	<0.5	<1.0	--	<3	<10	14	<10	16	42	--	<10	530	<6	100	14	--	--
100	01-31-86	--	--	10	<0.5	<1.0	--	<3	<10	9	<10	48	11	--	<10	78	<6	54	0.5	--	--
101	12-18-85	--	--	18	<0.5	<1.0	--	<3	<10	100	<10	15	48	--	<10	310	<6	840	--	--	--
102	12-19-85	--	--	73	<0.5	<1.0	--	<3	<10	370	<10	16	260	--	<10	480	<6	34	--	--	--
103	12-18-85	--	--	1200	<0.5	<1.0	--	<3	<10	7	<10	96	2	--	<10	140	<6	12	<0.40	--	--
104	07-09-86	--	--	46	<0.5	<1.0	--	<3	<10	7	<10	25	26	--	<10	730	<6	44	6.8	--	--
105	06-25-86	--	--	33	<0.5	<1.0	--	<3	<10	440	<10	29	330	--	<10	580	<6	28	4.1	--	--
106	06-25-86	--	--	35	<0.5	<1.0	--	<3	<10	260	<10	21	220	--	<10	470	<6	31	2.9	--	--
107	07-05-83	<10	--	--	--	<1.0	--	--	1	6	2	--	15	--	--	--	--	7	--	--	--
108	06-27-86	--	--	43	<0.5	<1.0	--	<3	<10	18	<10	6	21	--	<10	450	<6	170	1.4	--	--
109	07-01-86	--	--	23	<0.5	<1.0	--	<3	<10	140	<10	17	220	--	20	330	<6	1100	0.9	--	--
110	06-27-86	--	--	33	<0.5	<1.0	--	<3	30	16	<10	12	2	--	<10	470	<6	580	1.2	--	--
111	07-30-86	--	--	150	<0.5	<1.0	--	<3	<10	35	<10	11	12	--	<10	350	<6	26	<0.40	--	--
112	08-22-85	--	--	140	0.6	<1.0	--	<3	<10	270	<10	20	300	--	<10	510	<6	230	<0.40	--	--
113	02-14-86	10	--	250	<0.5	<1.0	--	<3	<10	2900	<10	26	290	--	<10	470	<6	11	<0.40	--	--
114	07-23-86	--	--	81	<0.5	<1.0	--	<3	<10	<3	<10	6	25	--	20	230	<6	11	0.5	--	--
115	06-22-88	--	3	--	--	<1.0	<1	--	<1	1400	<5	--	790	<0.1	--	--	--	19	--	2	4
	08-22-85	<10	--	53	<0.5	<1.0	--	<3	<10	1900	<10	33	970	--	<10	540	<6	15	<0.40	--	--
116	07-03-86	--	--	29	<0.5	<1.0	--	<3	<10	19	<10	9	16	--	10	140	<6	7	0.9	--	--
117	07-02-86	--	--	150	<0.5	<1.0	--	<3	<10	21	<10	25	280	--	<10	590	<6	7	<0.40	--	--
STOCKTON FORMATION																					
118	03-20-86	--	--	26	<0.5	<1.0	--	<3	<10	9	<10	47	<1	--	<10	220	<6	25	--	--	--
	08-04-87	<10	<1	--	--	<1	<1	--	<1	4	<5	--	<1	<0.1	--	--	--	18	--	2	<1
119	07-23-87	<10	<1	--	--	<1	<1	--	4	4	<5	--	<1	<0.1	--	--	--	32	--	1.7	3
120	01-28-86	--	--	170	<0.5	<1.0	--	<3	<10	<3	<10	6	<1	--	<10	130	<6	150	12	--	--
	07-21-87	<10	1	--	--	<1	<1	--	<1	<3	<5	--	<1	<0.1	--	--	--	73	--	1.4	4
121	08-16-85	--	--	200	<0.5	<1.0	--	<3	<10	3	<10	12	<1	--	<10	230	<6	42	7	--	--
122	08-16-85	--	--	120	<0.5	<1.0	--	<3	<10	9	<10	7	<1	--	<10	510	<6	93	0.4	--	--
	04-22-87	<10	2	--	--	<1	<1	--	<1	25	<5	--	1	<0.1	--	--	--	16	--	0.6	5
123	07-09-86	20	--	160	<0.5	<1.0	--	<3	<10	<3	<10	8	6	--	<10	430	<6	38	6.5	--	--
124	06-17-85	--	--	250	<0.5	<1.0	--	<3	<10	6	<10	5	<1	--	<10	170	<6	12	4.4	--	--
125	07-31-85	--	--	120	<0.5	<1.0	--	<3	<10	17	<10	8	<1	--	10	230	<6	74	--	--	--

Table 7b. Chemical analyses of water samples from wells in sedimentary bedrock of the Newark Basin in New Jersey - minor constituents (cont.)

[Well number as on figure 2; (mg/L, milligrams per liter; mg/L, micrograms per liter; --, no data]

Well number	Date	Aluminum dissolved (µg/L as Al)	Arsenic dissolved (µg/L as As)	Barium dissolved (µg/L as Ba)	Beryllium dissolved (µg/L as Be)	Cadmium dissolved (µg/L as Cd)	Chromium dissolved (µg/L as Cr)	Cobalt dissolved (µg/L as Co)	Copper dissolved (µg/L as Cu)	Iron dissolved (µg/L as Fe)	Lead dissolved (µg/L as Pb)	Lithium dissolved (µg/L as Li)	Manganese dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Molybdenum dissolved (µg/L as Mo)	Strontium dissolved (µg/L as Sr)	Vanadium dissolved (µg/L as V)	Zinc dissolved (µg/L as Zn)	Uranium natural dissolved (µg/L as U)	Carbon organic dissolved (mg/L as C)	Phenols total (µg/L)
STOCKTON FORMATION (cont.)																					
126	07-02-86	--	--	290	<0.5	<10	--	<3	<10	<3	<10	8	140	--	<10	290	<6	81	1.1	--	--
127	07-08-86	20	--	91	<0.5	<1.0	--	<3	<10	110	<10	8	40	--	<10	450	<6	64	<0.40	--	--
128	06-27-86	--	--	20	<0.5	<1.0	--	<3	<10	<3	<10	5	<1	--	<10	210	<6	79	0.9	--	--
129	07-31-85	--	--	88	<0.5	<1.0	--	<3	<10	<3	<10	5	<1	--	40	510	<6	47	--	--	--
130	01-14-86	--	--	210	<0.5	<1.0	--	<3	<10	140	<10	19	48	--	<10	370	<6	21	1.3	--	--
131	09-03-87	<10	<1	--	--	<1	2	--	3	8	<5	--	<1	<0.1	--	--	--	11	--	0.8	1
132	04-22-87	<10	<1	--	--	1	<1	--	<1	10	<5	--	4	<0.1	--	--	--	3	--	0.7	7
133	07-17-85	--	--	200	<0.5	1	--	<3	10	<3	<10	7	8	--	<10	400	<6	30	--	--	--
134	07-17-85	--	--	160	<0.5	<1.0	--	<3	<10	<3	<10	7	<1	--	<10	160	<6	3	1.1	--	--
135	09-09-87	<10	<1	--	--	<1	1	--	12	<3	<5	--	<1	<0.1	--	--	--	11	--	1.1	2
136	07-09-86	20	--	120	<0.5	<1.0	--	<3	<10	7	<10	11	91	--	20	580	<6	21	49	--	--
137	08-27-85	--	--	150	<0.5	<1.0	--	<3	<10	3	<10	4	16	--	<10	130	<6	140	8.1	--	--
138	08-27-85	--	--	160	<0.5	<1.0	--	<3	<10	8	<10	7	3	--	<10	490	<6	21	--	--	--
139	08-13-85	--	--	140	<0.5	<1.0	--	<3	20	8	<10	5	22	--	<10	270	<6	39	--	--	--
140	08-13-85	--	--	190	<0.5	<1.0	--	<3	<10	<3	<10	5	260	--	<10	250	<6	12	--	--	--
141	07-16-85	--	--	250	0.6	<1.0	--	<3	10	840	<10	9	40	--	<10	71	<6	82	--	--	--
142	04-24-86	--	--	360	1	<1.0	--	<3	<10	120	<10	6	120	--	<10	380	<6	11	--	--	--
143	07-23-86	--	--	160	<0.5	<1.0	--	<3	<10	5	<10	8	7	--	<10	420	<6	10	3.5	--	--
144	04-24-86	--	--	390	<0.5	<1.0	--	<3	<10	370	<10	7	290	--	<10	410	<6	<3	<0.40	--	--
145	07-16-85	--	--	150	<0.5	1	--	<3	20	1200	<10	9	500	--	<10	120	<6	24	--	--	--
146	07-16-85	--	--	160	1	<1.0	--	<3	<10	170	10	10	10	--	<10	140	<6	7	1.1	--	--
	04-28-87	10	<1	--	--	<1	<1	--	7	110	<5	--	30	<0.1	--	--	--	10	--	0.8	<1
CONGLOMERATE																					
147	05-13-88	10	9	--	--	<1.0	<1	--	1	<3	<5	--	<1	<0.1	--	--	--	4	--	0.7	2
148	03-03-88	<10	3	--	--	<1.0	<1	--	3	35	<5	--	3	0.2	--	--	--	16	--	0.4	2
DIABASE																					
149	05-05-88	<10	2	--	--	<1.0	<1	--	<10	3	<10	--	<1	<0.1	--	--	--	46	--	0.8	2
BASALT																					
150	07-01-86	--	--	5	<0.5	<1.0	--	<3	10	5	<10	7	<1	--	<10	66	<6	49	<0.40	--	--

GLOSSARY

Alkalinity - A measure of the buffering capacity of a solution to hydrogen ions. Measured by titrating a known concentration of acid into a specific volume of sample until the pH of the sample solution drops to a defined end point. In most natural waters alkalinity is produced by the dissolved carbon dioxide species bicarbonate and carbonate. It is usually reported in mg/L as $CaCO_3$.

Anion - A negatively charged ion or radical.

Anthropogenic - Involving human impact on nature.

Calcite - A common rock-forming mineral composed of calcium carbonate ($CaCO_3$). Usually colorless or white, but exceptionally may be red, yellow or blue.

Cation - A positively charged ion or radical.

Celsius or centigrade (^oC) - Temperature scale that defines zero as the freezing point of water and 100 degrees as the boiling point. It is converted to the Fahrenheit scale by the formula $^oC = 5/9(^oF - 32)$.

Conductance (specific) - A measure of the ability of the water to conduct an electrical current. It is inversely proportional to electrical resistance and is related to the total concentration of ionizable solids in the water. It is usually reported as microsiemens per centimeter (µS/cm) at 25 degrees Celsius.

Dissolved oxygen - A measure of the concentration of gaseous oxygen dissolved in water. For water in contact with the atmosphere, the concentration is a function of temperature, atmospheric pressure and, to a lesser extent, solute concentration. Dissolved oxygen is usually reported in mg/L.

Gross alpha particle activity - A measure of alpha radiation (positively charged helium nuclei) emitted from radionuclides in a sample of water.

Langelier Index - Estimates the degree of saturation of water with respect to calcium carbonate. Water that is undersaturated with respect of calcium carbonate would be considered corrosive because there would not be a protective deposit of calcite on plumbing. Water that is oversaturated with respect to calcium carbonate would be considered scale producing because calcite is being deposited. A Langelier index of zero indicates that the water is in equilibrium with calcium carbonate.

Lithification - Hardening of soft sediment into rock.

Major constituent (ground water) - Constituents with a concentration generally greater than 5 mg/L.

Micrograms per liter (µg/L) - Unit expressing the weight of solute per unit volume of water. Generally 1.0 µg/L is equivalent to one part solute in one billion parts water.

Microsiemen (µS) - Unit of specific electrical conductance. One microsiemen is equivalent to one micromho which is the reciprocal of the electrical resistance unit microohm.

Milliequivalent per liter (meq/L) - Unit expressing the concentration of valance charge contributed by a particular chemical constituent (for example: Na^{+1} and $C1^{-1}$) in one liter of water. The sum of the milliequivalents of cations and anions in a solution should equal zero.

Milligrams per liter (mg/L) - Unit expressing the weight of solute per unit volume of water. Generally 1.0 mg/L is equivalent to one part solute in one million parts water.

Minor constituent (ground water) - Constituent with concentration generally between 0.01 and 10 mg/L.

Nutrients - Wastewater term applied to phosphorous and nitrogen in water.

Picocuries per liter (pCi/L) - A unit for reporting radioactivity in water. One picocurie per liter is equal to 0.037 disintegrations per second in a liter of sample.

pH - The negative base 10 logarithm of the hydrogen ion activity (moles per liter). A pH of 7 is considered neutral, less than 7 is acidic, and greater than 7 is alkaline.

Primary drinking water standard - Federal and state-regulated Maximum Contaminant Levels allowed in public drinking water supplies to protect human health.

Secondary drinking water standard - Federal and state-recommended Lower and Maximum Contaminant Levels regulated to protect the public welfare, usually set to regulate aesthetic qualities of water such as taste, odor, or color.

Total dissolved solids - A measure of the dissociated organic and inorganic matter, dissolved and particulate, in water. It is obtained by weighing the residue left after evaporating a known quantity of water at a prescribed temperature. Total dissolved solids is usually reported in mg/L.

Trace constituent (ground water) - Constituents with concentrations generally less than 0.1 mg/L.

Volatile organic compound(VOC) - Any organic compound that participates in atmospheric photochemical activity. Many such compounds are ubiquitous ground-water pollutants.

NATURAL GROUND-WATER QUALITY IN BEDROCK OF THE NEWARK BASIN, NEW JERSEY
(New Jersey Geological Survey Report GSR 35)

ISSN 0741-7357