Selected Ground-Water-Quality Data of the Lockport Dolomite in Darke, Miami, Montgomery, and Preble Counties, Ohio

By Denise H. Dumouchelle

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Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
gallon	3.785	liter (L)
foot per second (ft/s)	0.3048	meter per second (m/s)
square mile (mi^2)	2.590	square kilometer
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic yard (yd^3)	0.7646	cubic meter

Temperatures given in this report can be converted to alternative units by use of the following equations:

°F = 1.8(°C) + 32   °C = .5556 (°F) - 32

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

Abbreviated water-quality units used in this report: Chemical concentrations and water temperature are given in metric units. Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is approximately the same as for concentrations in parts per million.

Specific conductance of water is expressed in microsiemens per centimeter at 25 degrees Celsius (µS/cm). This unit is equivalent to micromhos per centimeter at 25 degrees Celsius (µmho/cm), formerly used by the U.S. Geological Survey.

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Abstract

In 1998, 25 samples of ground water from the Lockport Dolomite in western Ohio were analyzed for major ions, trace elements, and arsenic. Samples were collected from residential wells in Darke, Miami, Montgomery, and Preble Counties. The water sampled was untreated, except perhaps for water from one well. In general, samples from the northern part of the study area had the highest concentrations of common constituents such as calcium, magnesium, potassium, sulfate, boron, and strontium. Iron and strontium concentrations were generally high throughout the study area, with median concentrations of 4,500 µg/L (micrograms per liter) and 1,500 µg/L, respectively. Arsenic concentrations, which ranged from less than 1 µg/L to 29 µg/L, did not exceed the drinking-water standard of 50 µg/L.

Introduction

In July 1997, the U.S. Environmental Protection Agency (USEPA) began an investigation at a hazardous waste site about 3 mi west-northwest of Lewisburg, Ohio. The site was contaminated with waste printing ink, which could result in contamination of ground water by inorganic constituents, particularly trace metals. During the removal action, approximately 1,200 drums of waste ink, 2,500 yd^3 of contaminated soil, and 100,000 gal of ground water were removed from the site. The site overlies the Lockport Dolomite near the flank of a buried bedrock valley. The bedrock valley is filled with more than 100 ft of glacial sediments.

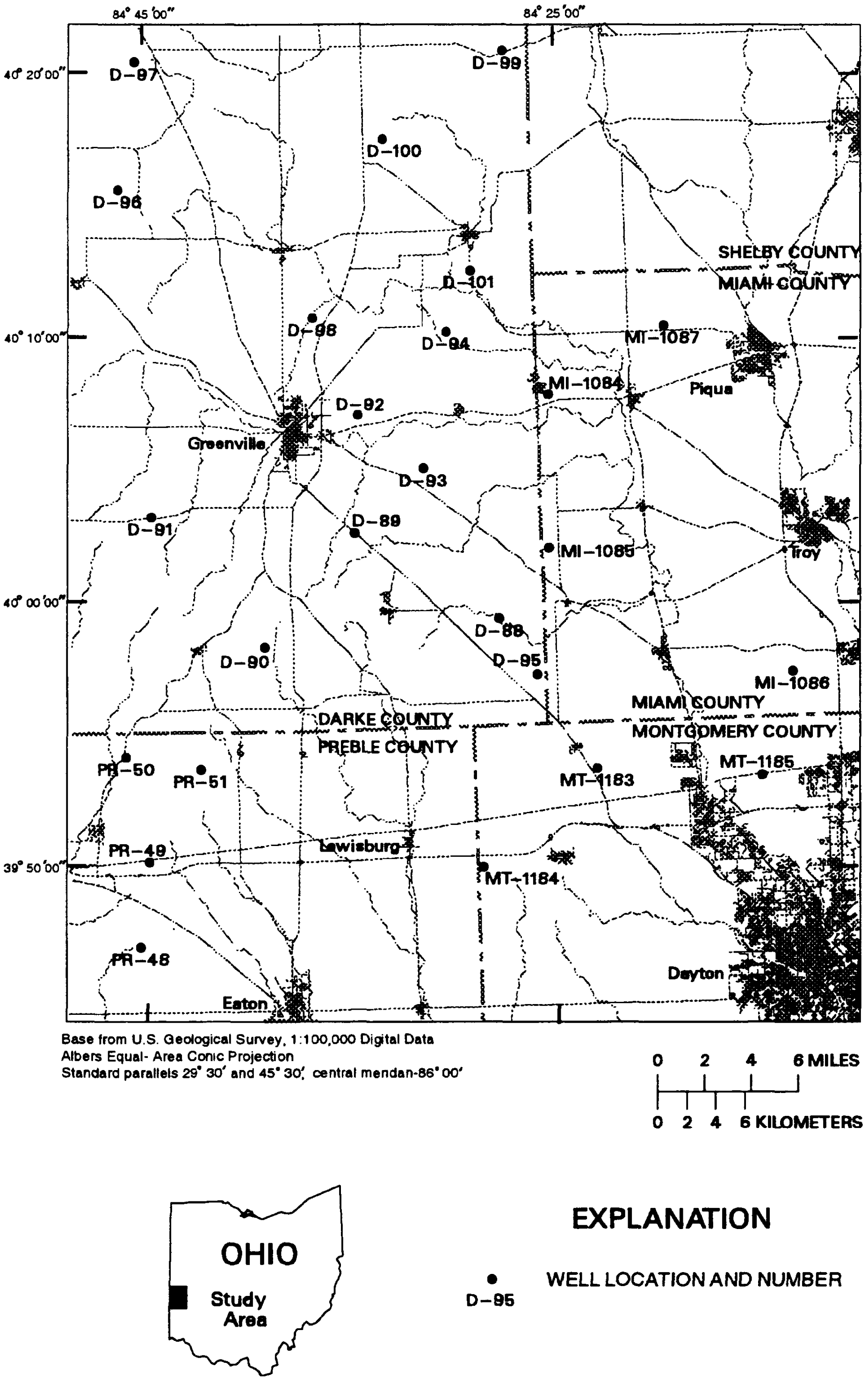
Because of the compounds in the waste ink, USEPA was interested in the inorganic ground-water quality in the Silurian Lockport Dolomite. The USEPA sampled many residential wells near the waste site but had little information on the natural range of water quality in the aquifer. To obtain a better understanding of the background concentrations, the U.S. Geological Survey (USGS), in cooperation with the USEPA, collected and analyzed ground-water samples from wells that were far enough from the site to be unaffected by the waste ink.

Purpose and scope

The purpose of this report is to present the data from ground-water samples collected from wells completed in the Lockport Dolomite in western Ohio. These data were collected to provide information on inorganic constituents to aid the USEPA in determining remedial measures. During May 1998, the USGS collected samples from 25 residential wells in Darke, Miami, Montgomery, and Preble Counties, Ohio. Wells from throughout the study area were sampled to provide data on the natural range of constituent concentrations. Data on well construction and water-quality characteristics — field measured properties, major ions, trace metals and arsenic — are presented in this report.

Description of study area

The study area is in rural western Ohio. Samples were collected from wells throughout Darke County and in western Miami, northwestern Montgomery, and northwestern Preble Counties (fig. 1). Western Ohio is in the north temperate climate zone. The warmest month,



Base from U.S. Geological Survey, 1:100,000 Digital Data
Albers Equal- Area Conic Projection
Standard parallels 29° 30′ and 45° 30′, central meridian-86° 00′

Figure 1. Location of sampled wells

July, has an average temperature of 74°F; the coldest month, January, has an average temperature of 26°F. The average annual precipitation is 37 in. (National Weather Service, 1998).

The study area lies within the Till Plains Section of the Central Lowland Physiographic Province (Fenneman, 1938). The topography is characterized by nearly level till plains with minor relief due to erosion and glacial features, such as kames and moraines. Buried bedrock valleys occur throughout the study area. These bedrock valleys are filled with glacial sediments. The bedrock underlying the glacial sediments consists mainly of the Lockport Dolomite. The glacial deposits and the Lockport Dolomite are both used for water supplies in the area.

Acknowledgments

The author thanks the homeowners for their cooperation in this study. The need to purge wells before collecting samples was an inconvenience, and their patience and understanding is appreciated.

Ground-water-quality sampling methods

Wells were selected on the basis of geographic location, availability of well logs, geology, access, and availability of untreated water. A number of well logs with legible addresses or location maps were obtained and used to pre-select wells throughout the study area. These well logs were compared to bedrock geology maps (Swinford, 1994a, b; Swinford and Slucher, 1994 a, b, c; Shrake and Swinford, 1994; Pavey and Swinford, 1994; Schumacher, 1993) to confirm that the wells were completed in the Lockport or sub-Lockport formations. The addresses from the pre-selected well logs were then used in the field to locate potential wells to sample. The final decision to sample was made when untreated water was available and permission was granted by the homeowner.

After locating a well to sample, the homeowner identified spigots that provided untreated water. All samples were collected from household spigots using the existing plumbing fixtures and well pumps. Well casings were either PVC (polyvinyl chloride plastic) or galvanized steel (table 1). In most cases, an outside spigot was used as the sampling point. PVC tubing and fittings were connected to the spigot for purging and sample collection.

Although sampled wells were in regular use, all wells were purged before sample collection. Purge volumes were determined by calculating the volume of water standing in the well casing. Calculations were made using data on casing diameter and well depth from the well log and the depth to water (measured before purging). Flow rates during purging were estimated with a stopwatch and a graduated bucket. During purging, field measurements of pH, specific conductance, dissolved-oxygen concentration, and temperature were made. Samples were collected after 1 to 3 casing volumes had been purged (table 1), and the field measurements had stabilized.

Samples were analyzed for major ions, trace metals, and arsenic by the USGS National Water Quality Laboratory in Arvada, Colo. The laboratory methods and analytical detection limits are given in table 2. Three duplicate samples were collected for quality assurance/quality control. Results from the duplicate samples were qualitatively compared with the results of the field samples; the results of the two sample sets were comparable. After all 25 samples were collected, an equipment blank was collected and analyzed to confirm that the sample-collection tubing did not alter the water quality of the samples.

Ground-water-quality data

The specific conductance, pH, temperature, and dissolved-oxygen data collected the field during the purging of the well are listed in table 3, along with results of laboratory analyses. Also listed in table 3 are minimum, maximum, and median values of each of the selected water-quality characteristics.

The sample from MI-1086 had significantly different concentrations of several constituents as compared to samples from the other wells in this study. Hardness, calcium, magnesium, potassium, barium, iron, and strontium concentrations were all less than the concentrations observed in the other samples; however, sodium, and to a lesser extent, chloride concentrations, were substantially higher. The sodium concentration, 220 mg/L, was at least one order of magnitude greater than the largest concentration in the other samples. Water that has been softened by ion-exchange methods can result in the replacement of calcium, magnesium, iron, manganese, and strontium by sodium (Driscoll, 1986). Unfortunately, no checks on the household plumbing were made to ensure that collected samples were untreated, so it is possible that th

Table 1. Data on well construction and purging characteristics for wells sampled in Darke, Miami, Montgomery, and Preble Counties, Ohio, May 1998.

[bls, below land surface; PVC, polyvinyl chloride plastic; Galv., galvanized steel; —, purge volume not calculated]

Well number	Total depth (feet, bls)	Open interval (feet, bls)	Casing material	Depth to water (feet, bls)	Purge time (minutes)	Casing volumes purged (calculated)	Comments
D-88	81	56 - 81	PVC	10.6	54	2.5	
D-89	101	83 - 101	PVC	21.32	117	3.0	
D-90	121	77 -121	PVC	11.0[a]	80	2.3	
D-91	121	79 -121	PVC	15.53	75	2.5	
D-92	121	84 - 121	PVC	29.97	32	1.1	
D-93	101	58 - 101	PVC	8.2	57	2.1	
D-94	101	69 - 101	PVC	12.1	57	2.0	
D-95	50	(b)	PVC	5.0[a]	39	3.4	
D-96	121	76 - 121	PVC	14.06	74	2.8	
D-97	215	125 - 215	PVC	95.7	26	—	8 - 9,000 gallons used daily
D-98	141	100 - 141	PVC	0.82	83	2.4	
D-99	111	101 - 111	PVC	14.95	75	2.6	
D-100	130	70 - 130	PVC	40.24	63	3.4	
D-101	141	97 - 141	PVC	37.57	62	3.5	
MI-1084	110	61 - 110	Galv.	39.3	65	—	Heavy use, lawn irrigation
MI-1085	81	43 - 81	PVC	8.08	38	—	
MI-1086	40	25 - 40	PVC	8.0[a]	33	1.3	
MI-1087	88	58 - 88	PVC	14.73	50	3.7	
MT-1183	81	27 - 81	PVC	6.0	51	1.4	
MT-1184	53	39 - 53[c]	Galv.	30.62	48	8.7	
MT-1185	100	27 - 100	Galv.	10.0	96	—	Heavy use, irrigation
PR-48	161	148 - 161	PVC	35.6	54	1.5	
PR-49	221	175 - 221	PVC	66.82	58	1.2	Well in use during sampling
PR-50	101	80 - 101	PVC	56.62	46	3.1	
PR-51	181	145 - 181	PVC	81.75	60	—	

[a] Water level was not measured. Depth given is that reported on the well log.

[b] No open interval reported on well log — assumed open end at bottom of casing.

[c] Open interval not recorded on well log — assumed to be open in rock.

Table 2. Analytical methods, detection limits, and drinking-water standards for selected dissolved constituents

[mg/L, milligrams per liter; µg/L, micrograms per liter; ICP, inductively coupled plasma; AA, atomic absorption; IC, ion chromotography; GFAA, graphite furnace atomic absorbtion; ---, no standard defined]

Constituent	Analytical method	Detection limit	Drinking-water standard[a]
Calcium (mg/L)	ICP	0.02	---
Magnesium (mg/L)	ICP	.004	---
Sodium (mg/L)	ICP	1	---
Potassium (mg/L)	AA	.1	--
Sulfate (mg/L)	IC	.1	250[b]
Chloride (mg/L)	IC	.1	250[b]
Fluoride (mg/L)	Colorimetry	.1	4[c]
Silica (mg/L)	ICP	.1	---
Arsenic (µg/L)	GFAA	1	50[c]
Barium (µg/L)	ICP	1	2,000[c]
Beryllium (µg/L)	ICP	1	4[c]
Boron (µg/L)	ICP	16	---
Cadmium (µg/L)	ICP	8	5[c]
Chromium (µg/L)	ICP	14	100[c]
Cobalt (µg/L)	ICP	12	---
Copper (µg/L)	ICP	10	1,300[d]
Iron (µg/L)	ICP	10	300[b]
Lead (µg/L)	ICP	100	15[d]
Lithium (µg/L)	ICP	4	---
Manganese (µg/L)	ICP	4	50[b]
Molybdenum (µg/L)	ICP	60	---
Nickel (µg/L)	ICP	40	100[c]
Silver (µg/L)	ICP	4	100[b]
Strontium (µg/L)	ICP	1	---
Vanadium (µg/L)	ICP	10	---
Zinc (µg/L)	ICP	20	5,000[b]

[a] U.S. Environmental Protection Agency, 1998.

[b] Secondary maximum contaminate level; a non-enforceable recommended standard, primarily based on aesthetic criteria.

[c] Maximum contaminant level; an enforceable health-based standard.

[d] Action level.

water sampled at MI-1086 had been softened. The median constituent concentrations for the study are not greatly affected by the inclusion of this sample in the statistics (table 3).

Specific conductance at two wells, D-97 and D-99, was considerably higher than the median value of 736 µs/cm. Water from D-97 had a specific conductance of 1,356 µs/cm, and water from D-99 had 1,520 µs/cm. As would be expected, the concentrations of many of the other constituents related to specific conductance were also higher than the medians in these two wells—for instance, hardness, calcium, magnesium, sodium, sulfate, and dissolved solids.

The dissolved-oxygen concentrations in three wells — D-97, MI-1086, and MT-1185 — were unexpectedly high (> 6 mg/L) for ground-water samples (the median was 0.06 mg/L). Nothing exceptional that could account for these high concentrations was noted during the sampling of these three wells; however, gas bubbles were observed in the sample tubing at many wells. Although the homeowners stated the water was unsoftened or untreated, these homes may have had aeration devices installed in their plumbing systems.

Ground-water samples collected from wells D-88, D-93, and MI-1085 had sulfate concentrations less than 0.5 mg/L, substantially lower than the median value of 39 mg/L. These three wells are in the center of the study area (fig. 1), however, no association between sulfate concentration and well location can be made because other samples from the central area had relatively high sulfate concentrations. For example, the sulfate concentration at well D-89 was 63 mg/L and at well D-95 was 250 mg/L. Samples from four wells — D-95 (250 mg/L), D-97 (580 mg/L), D-99 (690 mg/L), and D-100 (320 mg/L) — had sulfate concentrations at least an order of magnitude greater than the other samples (table 3). With the exception of D-95, these wells are in the northernmost part of the study area.

The chloride concentrations in samples from three wells — MI-1084, MI-1086, and MT-1185 — were higher than other wells in the study. The chloride concentrations were 46 mg/L, 73 mg/L, and 79 mg/L, respectively, whereas the median concentration was 5.1 mg/L.

Although the current (1998) drinking-water standard for arsenic is 50 µg/L, concentrations greater than 10 µg/L are noteworthy because the standard is under review and may be lowered to less than 10 µg/L (Richard A. Bendula, Ohio Environmental Protection Agency, written commun., 1998). Samples from 17 wells in this study had arsenic concentrations greater than or equal to 10 µg/L. Arsenic concentrations ranged from less than 1 µg/L to 29 µg/L, with a median concentration of 11 µg/L. Detectable arsenic concentrations, while not desirable from a drinking-water perspective, are not unknown in Ohio. In a 1994 study of 128 public water supplies, Ohio Environmental Protection Agency found raw-water arsenic concentrations between 2.5 and 75 µg/L in samples from 41 of the supplies. Water from limestone or dolomite aquifers accounted for 22 percent of these public-supply samples with detectable arsenic concentrations (Richard A. Bendula, Ohio Environmental Protection Agency, written commun., 1998).

The highest boron concentrations were found in samples from D-95, D-97, D-99, and D-100. These boron concentrations were 258 µg/L, 568 µg/L, 384 µg/L, and 442 µg/L respectively. The median boron concentration is 59.1 µg/L. Sulfate and molybdenum concentrations also were elevated in samples from these wells. Except for D-95, these wells are in the northern part of the study area.

At concentrations greater than 300 µg/L, iron can impart a metallic taste to drinking water and can cause staining of plumbing fixtures and laundry (Breen and Dumouchelle, 1991). Iron concentrations were greater than 300 µg/L in most wells in this study. Only three wells — MI-1086, MT-1183, and MT-1185 — had concentrations less than 300 µg/L; the median concentration was 1,500 µg/L. Two of these wells, MI-1086 and MT-1185, had concentrations less than 10 µg/L. Iron concentrations less than 100 µg/L can occur in water that is aerated during pumping or treatment (Driscoll, 1986). The high dissolved-oxygen concentrations noted in water from MI-1086 and MT-1185 indicated possible aeration systems in operation, which also could account for the low iron concentrations.

Like iron, high manganese concentrations (>50 µg/L) can cause staining. The median concentration of manganese was 24 µg/L, but samples from six wells had manganese concentrations greater than 50 µg/L: D-92 (89 µg/L), D-94 (61 µg/L), MI-1084 (78 µg/L), MI-1087 (57 µg/L), PR-48 (56 µg/L), and PR-50 (54 µg/L).

Strontium is considered a minor inorganic constituent in ground water, with concentrations ranging from 10 µg/L to 10,000 µg/L but usually less than 1,000 µg/L (Driscoll, 1986). However, unusually high concentrations of strontium in ground water have been noted in parts of Ohio (Hem, 1989). Strontium concentrations in this study ranged from less than 1 µg/L to 22,000 µg/L; the median concentration was 4,500 µg/L. The concentrations found in this study are comparable to those reported for the Lockport Dolomite in a study in northwestern Ohio (Breen and Dumouchelle, 1991).

Other inorganic constituents, such as barium, are considered trace constituents and generally have concentrations less than 100 µg/L (Driscoll, 1986). Barium concentrations in this study ranged from less than 1 µg/L to 420 µg/L, with a median concentration of 170 µg/L. Other trace constituents with detectable concentrations in some samples include cobalt, maximum concentration of 21 µg/L; copper, 10 µg/L; lithium, 31 µg/L; molybdenum, 120 µg/L; and zinc, 50 µg/L.

Summary

During May 1998, 25 ground-water samples were collected from wells completed in the Lockport Dolomite in western Ohio. Samples were collected from residential wells in Darke, Miami, Montgomery, and Preble Counties. The samples were collected from household spigots, using the existing pump and pipes. Homeowners identified spigots from which untreated water could be collected. Field measurements of pH, temperature, specific conductance, and dissolved oxygen concentration were made during the purging process. Samples were analyzed for major ions, trace metals, and arsenic.

Water from wells located in the northernmost part of the study area had the highest values of some field measurements and the greatest concentrations of several constituents, including specific conductance, greater than 1,000 µs/cm (median, 736 µs/cm); calcium concentrations greater than 130 mg/L (median, 87 mg/L), magnesium greater than 65 m/L (median, 36 mg/L), potassium greater than 1.7 mg/L (median, 1.4 mg/L), sulfate greater than 300 mg/L (median, 39 mg/L); boron greater than 120 µg/L (median, 59.1 µg/L), and strontium greater than 11,000 µg/L (median, 4,500 µg/L). No other associations were found between constituent concentrations and location.

Iron concentrations were generally high throughout the study area, ranging from less than 10 µg/L to 3,100 µg/L, with a median of 1,500 µg/L. The concentrations of some trace constituents such as strontium and barium also were higher than common—the median concentration of strontium was 4,500 µg/L, with a maximum of 22,000 µg/L; the median concentration of barium was 170 µg/L, with a maximum of 420 µg/L. Other trace elements analyzed for included lithium with concentrations from less than 4 µg/L to 31 µg/L (median, 10 µg/L), and manganese with concentrations from less than 4 µg/L to 89 µg/L (median, 24 µg/L)

Arsenic concentrations did not exceed the drinking-water standard of 50 µg/L; however, samples from 17 wells had arsenic concentrations above 10 µg/L. Arsenic concentrations ranged from less than 1 µg/L to 29 µg/L, with a median concentration of 11 µg/L.

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Table 3. Water-quality data for wells in the Lockport Dolomite in Darke, Miami, Montgomery, and Preble Counties, Ohio

[µs/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; NR, not reported; ---, not applicable. The first number in a statistic includes well MI-1086, if there is a difference in the statistic without well MI-1086, then a second statistic is listed]

Well number	Date	Specfic conductance (µs/cm)	pH (standard units)	Temperature, water (deg. C)	Oxygen, dissolved (mg/L)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)
D-88	5-20-1998	506	7.6	12.2	0.05	240	42
D-89	5-20-1998	655	7.0	12.7	.04	370	90
D-90	5-20-1998	615	7.0	12.4	.04	340	80
D-91	5-21-1998	505	7.2	12.7	.05	280	68
D-92	5-21-1998	663	6.9	12.6	.06	350	84
D-93	5-21-1998	562	7.1	16.2	.05	290	72
D-94	5-21-1998	798	6.9	12.2	.05	440	100
D-95	5-22-1998	952	7.2	12.5	.06	430	110
D-96	5-26-1998	737	7.2	12.0	.63	380	78
D-97	5-26-1998	1,356	7.1	12.6	6.32	650	140
D-98	5-26-1998	736	7.1	12.6	.30	410	93
D-99	5-27-1998	1,520	7.1	12.4	.13	800	200
D-100	5-27-1998	968	7.3	12.3	.13	430	91
D-101	5-27-1998	893	6.8	12.3	.25	500	120
MI-1084	5-18-1998	994	6.7	12.6	.07	520	120
MI-1085	5-18-1998	553	7.4	19.7	.13	270	56
MI-1086	5-18-1998	936	6.8	13.5	6.21	0	.08
MI-1087	5-28-1998	840	7.0	11.7	.03	470	100
MT-1183	5-18-1998	658	6.9	12.9	.91	360	82
MT-1184	5-20-1998	766	6.9	13.1	.06	420	87
MT-1185	5-28-1998	863	7.0	13.7	6.25	380	89
PR-48	5-19-1998	572	7.1	12.5	.05	290	69
PR-49	5-19-1998	549	7.2	12.5	.04	270	68
PR-50	5-19-1998	652	7.0	11.4	.05	380	90
PR-51	5-28-1998	582	7.1	12.7	.04	320	77
Minimum	---	505	6.7	11.4	0.03	0 / 240	0.08/ 42
Maximum	---	1,520	7.6	19.7	6.32	790	200
Median	---	736/ 700	7.1	12.6	.06	380	87/ 88

Table 3. Water-quality data for wells in the Lockport Dolomite in Darke, Miami, Montgomery, and Preble Counties, Ohio—Continued

[µs/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; NR, not reported; ---, not applicable. The first number in a statistic includes well MI-1086, if there is a difference in the statistic without well MI-1086, then a second statistic is listed]

Well number	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Alkalinity, total (as mg/L CaCO3)	Sulfate, dissolved (mg/L)	Chloride, dissolved (mg/L)	Fluoride, dissolved (mg/L)
D-88	31	26	1.7	276	0.2	2.9	1
D-89	34	4.0	1.3	282	63	9.2	0.4
D-90	33	9.2	1.4	338	12	2.4	.9
D-91	26	4.0	1.0	270	14	1.5	.6
D-92	33	14	1.3	332	27	9.3	.7
D-93	27	12	1.1	332	<.1	3.4	.8
D-94	45	7.9	1.5	368	67	15	.7
D-95	36	46	2.5	276	250	3.2	1.7
D-96	41	18	1.8	350	66	2.3	1.6
D-97	66	67	2.0	179	580	5.4	2.3
D-98	40	10	1.6	360	41	3.0	1.1
D-99	70	60	2.5	194	690	6.1	1.5
D-100	43	52	1.9	218	320	5.8	2.0
D-101	50	8.3	1.8	414	98	8.2	.9
MI-1084	51	19	2.0	388	98	46	1.0
MI-1085	30	19	1.2	280	.4	2.7	1.3
MI-1086	.04	220	<.1	322	34	73	.2
MI-1087	50	11	2.0	444	52	3.2	1.6
MT-1183	37	4.1	.8	272	52	9.2	.2
MT-1184	49	13	2.0	412	30	5.1	1.4
MT-1185	38	37	.8	282	39	79	.2
PR-48	26	19	1.3	310	11	1.5	1.5
PR-49	24	21	1.0	284	12	2.8	1.0
PR-50	36	5.6	1.2	334	37	5.7	.5
PR-51	30	7.5	1.2	328	12	1.0	1.2
Minimum	0.04/24	4.0	<0.1/.8	179	<0.1	1.0	0.2
Maximum	68	220/67	2.5	444	690	79	2.3
Median	36/36.5	14/13.5	1.4/1.35	328/330	39/40	5.1/4.3	1.0/1.05

Table 3. Water-quality data for wells in the Lockport Dolomite in Darke, Miami, Montgomery, and Preble Counties, Ohio—Continued

[µs/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; NR, not reported; ---, not applicable. The first number in a statistic includes well MI-1086, if there is a difference in the statistic without well MI-1086, then a second statistic is listed]

Well number	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents dissolved, calculated (mg/L)	Arsenic, dissolved (µg/L)	Barium, dissolved (µg/L)	Beryllium, dissolved (µg/L)	Boron, dissolved (µg/L)	Cadmium, dissolved (µg/L)
D-88	8.7	289	29	190	<1.0	86.2	<8
D-89	15	398	6	210	<1.0	21.8	<8
D-90	18	362	10	190	<1.0	44.4	<8
D-91	16	269	11	420	<1.0	22.3	<8
D-92	16	393	14	170	<1.0	60.4	<8
D-93	17	NR	19	320	<1.0	40.5	<8
D-94	19	467	12	270	<1.0	33.9	<8
D-95	17	630	2	21	<1.0	258	<8
D-96	18	459	24	82	<1.0	122	<8
D-97	14	1,010	10	11	<1.0	568	<8
D-98	18	445	17	150	<1.0	59.1	<8
D-99	15	1,160	6	11	<1.0	384	<8
D-100	14	674	12	25	<1.0	442	<8
D-101	20	552	12	150	<1.0	40.2	<8
MI-1084	20	572	10	150	<1.0	44.7	<8
MI-1085	13	311	11	320	<1.0	67.6	<8
MI-1086	11	NR	<1	<1	<1.0	40.7	<8
MI-1087	21	522	18	130	<1.0	60.5	<8
MT-1183	8.8	350	<1	43	<1.0	<16.0	<8
MT-1184	17	425	9	180	<1.0	64.3	<8
MT-1185	9.4	463	<1	52	<1.0	18.5	<8
PR-48	15	344	14	190	<1.0	95.9	<8
PR-49	15	329	12	190	<1.0	89.6	<8
PR-50	16	381	8	260	<1.0	26.6	<8
PR-51	17	350	13	230	<1.0	49.8	<8
Minimum	8.7	269	<1	<1/11	---	<16	---
Maximum	21	1,160	29	420	---	568	---
Median	16	425	11/11.5	170/175	---	59.1/54.5	---

Table 3. Water-quality data for wells in the Lockport Dolomite in Darke, Miami, Montgomery, and Preble Counties, Ohio—Continued

[µs/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; NR, not reported; ---, not applicable. The first number in a statistic includes well MI-1086, if there is a difference in the statistic without well MI-1086, then a second statistic is listed]

Well number	Chromium, dissolved (µg/L)	Cobalt, dissolved (µg/L)	Copper, dissolved (µg/L)	Iron, dissolved (µg/L)	Lead, dissolved (µg/L)	Lithium, dissolved (µg/L)	Manganese, dissolved (µg/L)
D-88	<14	<12	<10	1,100	<100	<4	<4
D-89	<14	<12	<10	1,700	<100	6	30
D-90	<14	<12	<10	1,200	<100	9	29
D-91	<14	<12	<10	890	<100	6	14
D-92	<14	<12	<10	1,200	<100	10	89
D-93	<14	<12	<10	1,500	<100	4	12
D-94	<14	16	<10	1,900	<100	15	61
D-95	<14	17	<10	1,700	<100	13	30
D-96	<14	<12	<10	1,500	<100	20	15
D-97	<14	<12	<10	1,400	<100	31	46
D-98	<14	<12	<10	1,700	<100	15	24
D-99	<14	<12	<10	3,100	<100	26	46
D-100	<14	<12	<10	1,800	<100	26	8
D-101	<14	21	<10	2,600	<100	23	28
MI-1084	<14	14	<10	2,300	<100	16	78
MI-1085	<14	<12	<10	960	<100	7	8
MI-1086	<14	<12	<10	<10	<100	<4	<4
MI-1087	<14	<12	<10	2,400	<100	28	57
MT-1183	<14	<12	10	61	<100	<4	12
MT-1184	<14	<12	<10	1,200	<100	22	17
MT-1185	<14	<12	<10	<10	<100	<4	<4
PR-48	<14	<12	<10	1,300	<100	7	56
PR-49	<14	<12	<10	1,100	<100	<4	21
PR-50	<14	<12	<10	1,500	<100	8	54
PR-51	<14	<12	<10	1,500	<100	10	15
Minimum	---	<12	<10	<10	---	<4	<4
Maximum	---	21	10	3,100	---	31	89
Median	---	<12	<10	1,500	---	10	24/26.5

Table 3. Water-quality data for wells in the Lockport Dolomite in Darke, Miami, Montgomery, and Preble Counties, Ohio—Continued

[µs/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; NR, not reported; ---, not applicable. The first number in a statistic includes well MI-1086, if there is a difference in the statistic without well MI-1086, then a second statistic is listed]

Well number	Molybdenum, dissolved (µg/L)	Nickel, dissolved (µg/L)	Silver, dissolved (µg/L)	Strontium, dissolved (µg/L)	Vanadium, dissolved (µg/L)	Zinc, dissolved (µg/L)
D-88	<60	<40	<4	5,200	<10	<20
D-89	<60	<40	<4	420	<10	<20
D-90	<60	<40	<4	2,700	<10	<20
D-91	<60	<40	<4	1,200	<10	<20
D-92	<60	<40	<4	1,700	<10	<20
D-93	<60	<40	<4	1,400	<10	<20
D-94	<60	<40	<4	2,300	<10	<20
D-95	70	<40	<4	12,000	<10	<20
D-96	<60	<40	<4	18,000	<10	<20
D-97	120	<40	<4	22,000	<10	<20
D-98	<60	<40	<4	7,200	<10	<20
D-99	<60	<40	<4	11,000	<10	<20
D-100	90	<40	<4	19,000	<10	<20
D-101	<60	<40	<4	1,400	<10	<20
MI-1084	<60	<40	<4	5,100	<10	24
MI-1085	<60	<40	<4	6,600	<10	<20
MI-1086	<60	<40	<4	<1	<10	<20
MI-1087	<60	<40	<4	8,700	<10	<20
MT-1183	<60	<40	<4	72	<10	<20
MT-1184	<60	<40	<4	2,900	<10	<20
MT-1185	<60	<40	<4	82	<10	50
PR-48	<60	<40	<4	12,000	<10	<20
PR-49	<60	<40	<4	5,100	<10	<20
PR-50	<60	<40	<4	750	<10	<20
PR-51	<60	<40	<4	4,500	<10	39
Minimum	<60	---	---	<1/72	---	<20
Maximum	120	---	---	22,000	---	50
Median	<60	---	---	4,500/4,800	---	<20

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