HYDROLOGIC DATA FOR THE BIG SPRING BASIN, CLAYTON COUNTY, IOWA, WATER YEAR 1990

By S.J. Kalkhoff, R. L. Kuzniar, D.L. Kolpin, and C.A. Harvey

U. S. GEOLOGICAL SURVEY
Open-File Report 92-67

Prepared in cooperation with the
IOWA DEPARTMENT OF NATURAL RESOURCES
(GEOLOGICAL SURVEY BUREAU)

Iowa City, Iowa
1992

U.S. DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey
Rm. 269, Federal Building
400 South Clinton Street
Iowa City, Iowa 52244

Copies of this report can be purchased from:

U.S. Geological Survey
Open-File Reports
Earth Science Information Center
Box 25425
Denver, Colorado 80225

CONTENTS

ILLUSTRATIONS

TABLES

TABLES--Continued

TABLES--Continued

CONVERSION FACTORS, ABBREVIATIONS, AND VERTICAL DATUM

Multiply	*By*	*To obtain*
	Length	
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
acre	4,047	square meter
acre	0.4047	hectare
square foot (ft^2)	929.0	square centimeter
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
	Mass	
pound (lb)	0.454	kilogram
pound per day (lb/d)	0.454	kilogram per day
ton, short	0.907	megagram
ton per day (ton/d)	0.907	megagram per day
	Temperature	
degree Fahrenheit (°F)	(1)	degree Celsius (°C)

[1] °C = 5/9 (°F - 32).
°F = 9/5 (°C) + 32.

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

Water year: A water year is a 12-month period, from October 1 through September 30, designated by the calendar year in which it ends. Years are water years in this report unless otherwise stated.

HYDROLOGIC DATA FOR THE BIG SPRING BASIN, CLAYTON COUNTY, IOWA, WATER YEAR 1990

By S.J. Kalkhoff, R.L. Kuzniar, D.W. Kolpin, and C.A. Harvey

ABSTRACT

Hydrologic data were collected in the Big Spring basin located in Clayton County, Iowa, during the 1990 water year. The data were collected by the U.S. Geological Survey in cooperation with the Iowa Department of Natural Resources, Geological Survey Bureau, to provide information on variation and movement of agricultural chemicals in the hydrologic cycle in the basin. Precipitation, surface-water, and ground-water data were collected.

Rainfall recorded during water year 1990 at a monitoring site on Roberts Creek totaled 43.67 inches. The greatest monthly rainfall (14.45 inches) occurred in August. Calcium and sulfate were the predominant ions in the rain, and the median concentrations of nitrate and ammonia as nitrogen were 0.35 and 0.48 milligrams per liter, respectively.

Stream discharge, specific conductance, pH, and water temperature were monitored continuously, and monthly water-quality samples were collected at three sites in the basin. The predominant ions in samples from Roberts Creek at the point where it leaves the basin were calcium, magnesium, and bicarbonate. Nitrite plus nitrate as nitrogen concentrations in 42 samples ranged from less than 0.10 to 18 milligrams per liter. Pesticide concentrations in 34 samples ranged from less than 0.10 to 12 micrograms per liter. Alachlor was detected in 56 percent of the samples; atrazine in 100 percent; cyanazine in 68 percent; and metolachlor in 47 percent.

At Big Spring, the ground-water discharge point, the daily mean specific conductance ranged from 378 to 796 microsiemens per centimeter at 25 degrees Celsius, the daily median pH ranged from 6.5 to 7.2, and the daily mean water temperature ranged from 5.5 to 11.5 degrees Celsius. Calcium, magnesium, and bicarbonate generally were the predominant ions in solution. Concentrations of nitrite plus nitrate as nitrogen in 32 samples ranged from 3.4 to 16 milligrams per liter. Alachlor was detected in 22 percent of the samples; atrazine in 100 percent; cyanazine in 44 percent, and metolachlor in 6 percent. The maximum atrazine concentration was 4.5 micrograms per liter.

During a low-flow seepage study, May 29 and 30, 1990, the measured discharge lost by streams in the basin was 8.56 cubic feet per second, the measured dissolved nitrogen load lost was 0.29 ton per day, and the measured atrazine load lost was 0.028 pound per day. The total measured discharge and total dissolved nitrogen load leaving the basin in streams were 3.63 cubic feet per second and about 0.04 ton per day, respectively.

INTRODUCTION

There is interest nationally, as well as within the State of Iowa, to understand, quantify, and minimize the occurrence of agricultural chemicals in surface and ground water. In response to this interest, the Big Spring ground-water basin in Clayton County, Iowa, has been studied since 1980 and has become a nationally known demonstration area for improving ground-water quality through the modification of agricultural practices. Numerous multidisciplinary studies that deal with agronomy, geology, hydrology, biology, and socioeconomics of the basin currently are being conducted.

The unique ground-water-flow system in the Big Spring basin aids in studying the movement of agricultural chemicals in ground water. Much of the ground water in the basin is intercepted by a karst system within the Galena aquifer and is discharged at Big Spring. The extent of the ground-water drainage basin has been defined by dye tracing, potentiometric-surface mapping, and other hydrologic analyses (Hallberg and others, 1983). Nearly all land in the basin is farmed, and a clear link between agricultural chemicals and ground-water contamination has been established (Hallberg and others, 1983, 1984; Libra and others, 1986).

Beginning in October 1987, the U.S. Geological Survey, in cooperation with the Iowa Department of Natural Resources, Geological Survey Bureau, collected water quantity and quality data in the Big Spring basin. These data are needed to refine the understanding of the hydrologic cycle in the basin and the agricultural-chemical transport processes in the surface- and ground-water systems. The dynamic nature of surface- and ground-water flow in the basin requires that some facets of water quantity and quality be monitored continuously. The data collected in this study aids in the understanding of the flow system.

This report is the third in a series of data reports that present the data collected by the U.S. Geological Survey in the Big Spring basin. Previous reports document data collected by the U.S. Geological Survey in water years 1988 (Kalkhoff, 1989) and 1989 (Kalkhoff and Kuzniar, 1991)

Purpose and Scope

The purpose of this report is to present the hydrologic data collected in the Big Spring basin by the U.S. Geological Survey during water year 1990. These data include information on the quantity and quality of precipitation and surface and ground water. The scope of data-collection activities includes measuring the input (precipitation) and the output (stream and spring discharge) from the system. Also included is continuous monitoring of selected water-quality constituents (specific conductance, pH, and temperature) of the water leaving the hydrologic system. In addition, suspended-sediment load leaving the basin is determined.

In support of three studies to define the processes affecting surface-water quality, discharge measurements were made at numerous sites on streams in the Big Spring basin to define areas where seepage from surface water was contributing to the ground-water flow system. Water samples were collected for the analysis of nutrients and selected herbicides immediately after each discharge measurement. Hydrologic data collected in the Deer Creek subbasin to study surface- and ground-water relations in a small drainage basin also are presented in this report along with the results of analyses of water sampled in a losing reach of Roberts Creek to quantify the degradation of agricultural chemicals.

Hydrologic data are summarized and presented graphically in the text and in tables in the "Hydrologic Data" section in the back of the report. Additional water-discharge and chemical data, which are not included in this report, are collected by State, Federal, and university researchers through ongoing studies. A report detailing hydrogeologic observations from bedrock monitoring wells in the Big Spring basin was released in water year 1990 by the Iowa Department of Natural Resources, Geological Survey Bureau (Rowden and Libra, 1990).

Study Area

The study area (fig. 1), located in Clayton County in northeastern Iowa, corresponds to the 103-mi^2 ground-water basin that drains through Big Spring (Hallberg and others, 1983). Streams in the study area include Roberts Creek and its major tributary, Silver Creek, which drain approximately 69 percent (70.7 mi^2) of the area within the ground-water basin. The remaining area is drained by Howard Creek (approximately 18 mi^2), and Hatchery Creek (8.8 mi^2), and several small intermittent streams. The geology and aquifers in the Big Spring basin are described in detail by Hallberg and others (1983) and will be briefly summarized here. Unconsolidated aquifers are generally found throughout the basin in the loess and alluvial deposits. The Galena aquifer and the Saint Peter aquifer are in bedrock material underlying the entire basin.

Methodology

Precipitation was measured at three sites (fig. 1). At two sites, RC2 and BOOGD, precipitation was recorded digitally every 15 minutes. At Big Spring, precipitation was recorded continuously.

Precipitation samples were collected automatically at Big Spring with a wet/dry precipitation collector. During periods of precipitation, a container was exposed to catch the rain or snow. Between rains the container

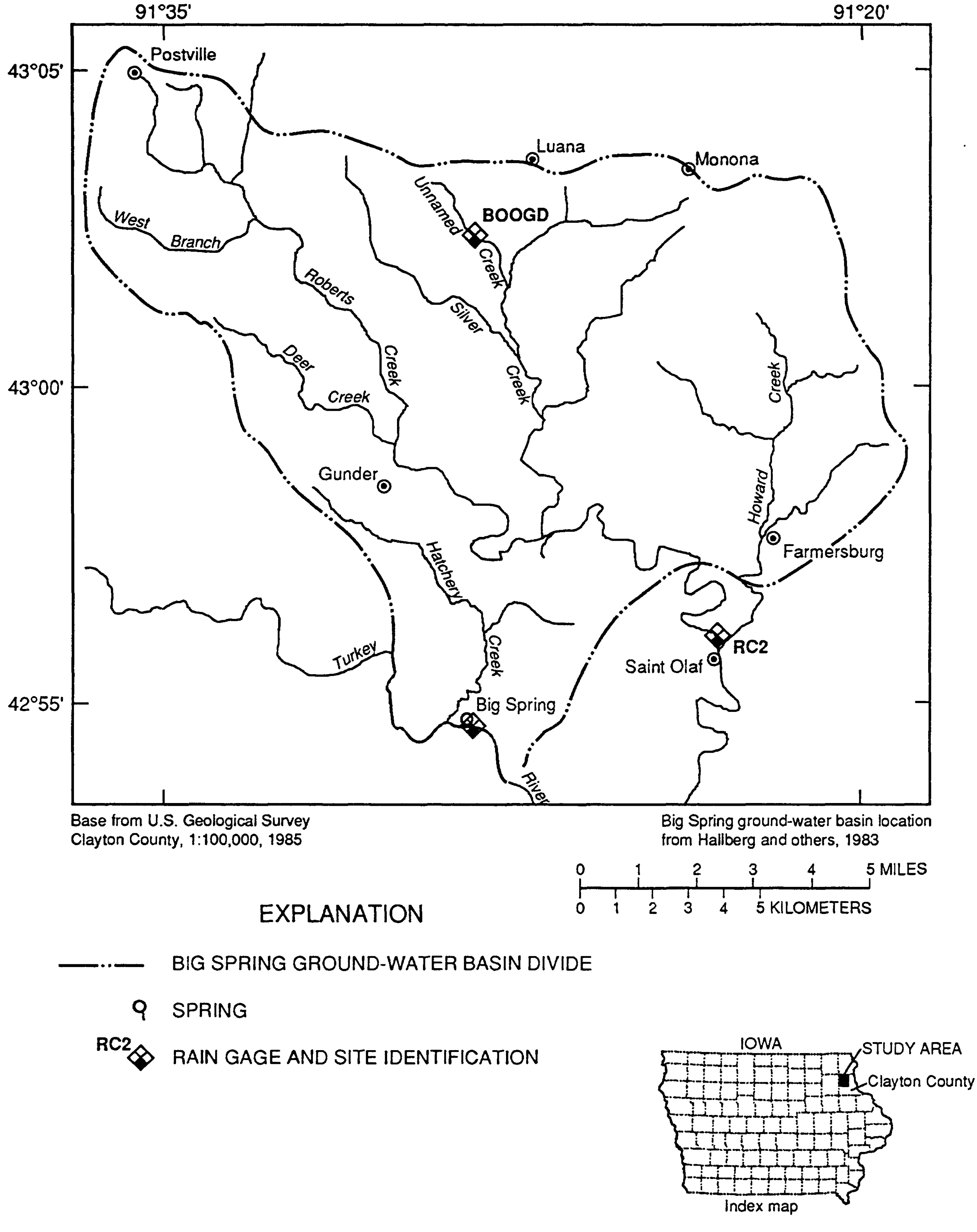

Figure 1. Location of Big Spring study area and rain gages.

was covered to avoid the collection of particulate matter. Buckets were removed, and the contents analyzed weekly. Site operations are described by the National Atmospheric Deposition Program/National Trends Network (1988).

Water quality was monitored continuously in Roberts Creek above Saint Olaf (site RC2), the primary surface-water discharge point, and at Big Spring, the primary ground-water discharge point (fig. 2). Water samples for chemical analyses were collected monthly at these two sites, Unnamed Creek near Luana (site BOOGD), and Deer Creek near Postville (site DC5). Stream and spring stage also were recorded continuously for later calculation of discharge. Additional samples were collected during periods of snowmelt and intense rainfall. Descriptions of the water-quality monitoring

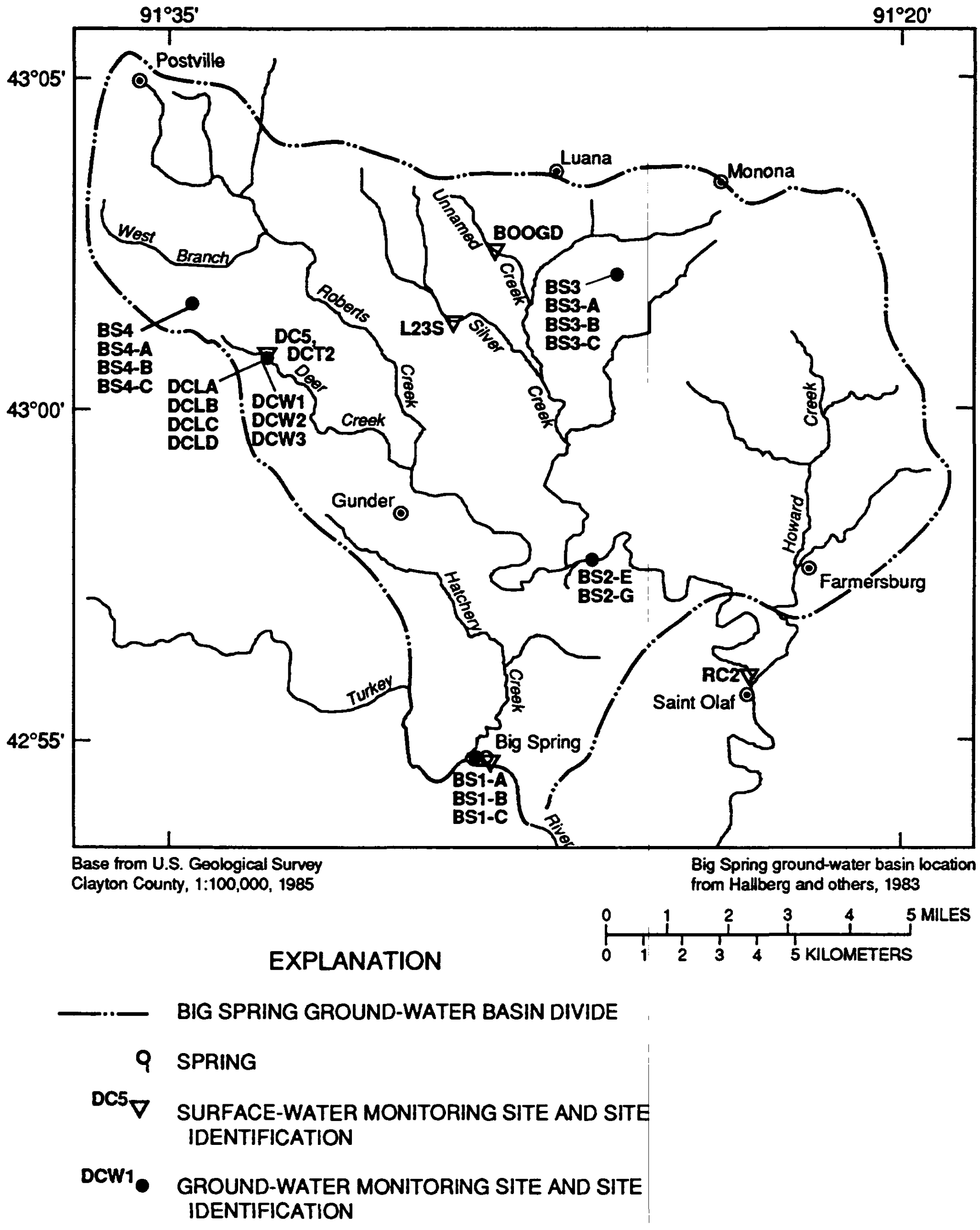

Figure 2. Location of surface- and ground-water-quality monitoring sites.

sites are shown in table 1 at the back of the report.

The water-quality constituents continuously monitored in Roberts Creek and Big Spring are specific conductance, pH, and water temperature. These constituents are measured using a multiple-parameter meter and digitally recorded at 15-minute intervals. The data are retrieved weekly by computer through a telephone modem. Values determined by the multiple-parameter field meter were calibrated weekly against conductance-reference and pH-buffer solutions. Temperature values were calibrated with a mercury thermometer. Stage was recorded continuously at stream sites DC5, RC2, L23S, and BOOGD with bubble-gage sensors and digital recorders (Rantz and others, 1982a, p. 32-39). Stage measurements were calibrated by comparison to permanent reference marks. Stream discharge was calculated from stage using stage-discharge relations (Kennedy, 1983, p. 30-32) or by using the theoretical-discharge equation for V-notch weirs (Rantz and others, 1982b, p. 305). From the 15-minute observations, daily mean values were calculated and permanently stored in the U.S. Geological Survey National Water Data Storage and Retrieval System (WATSTORE). Stream discharge normally was measured by current-meter methods (Buchanan and Somers, 1969). Because of low-flow conditions with shallow stream depths during most of the 1990 water year, the 0.6-depth method generally was used.

Water temperatures and dissolved-oxygen concentrations were measured in a flowing section of the stream or spring pool at the time of sample collection. Water temperatures were measured with a standard mercury or alcohol thermometer that had been compared with a laboratory-grade thermometer for accuracy. Dissolved-oxygen concentrations were measured with a dissolved-oxygen meter. Immediately after sample collection, the specific conductance and pH of the water were measured.

Suspended-sediment samples were collected periodically by local observers, technicians, and by automatic samplers during storms. The observers collected depth- integrated samples at one vertical using techniques described by Guy and Norman (1970). Samples were collected three times per week at Roberts Creek above Saint Olaf (site RC2), intermittently at Unnamed Creek near Luana (site BOOGD), and weekly at Big Spring.

Water levels in the principal water-supply aquifers in the basin were recorded at four well nests (table 2). At each well nest, water levels were recorded for the unconsolidated aquifers, the Galena aquifer, and the Saint Peter aquifer. Water levels were sensed by a float and then recorded hourly for subsequent storage in the WATSTORE data base. Additional wells (DCW1, DCW2, and DCW3) were used to monitor the relation between water levels in the unconsolidated aquifer and flow in Deer Creek.

Water samples for chemical analyses were collected from wells after a minimum of three casing volumes had been pumped from the well or the well had been bailed dry and allowed to recover. At the Deer Creek site, suction lysimeters were installed in the unconsolidated zone. Lysimeters were evacuated by a hand pump and allowed to equilibrate about 24 hours, allowing water to flow into the lysimeter under partial vacuum conditions. The sample was removed by purging with air.

The discharge measurement and water-quality sampling techniques used for the seepage study were the same as used for the routine sampling just described. The location and drainage areas of the seepage study sites are given in table 3. Samples for chemical analyses were prepared for shipment to the laboratory as described in table 4. Analyses of water samples by the University of Iowa Hygienic Laboratories in Iowa City and Des Moines, Iowa, followed the analytical methods listed in table 4. The U.S. Environmental Protection Agency's (1983) method 81.41 for the analyses of pesticides was modified to use dual capillary columns. Water samples collected as part of the degradation study were filtered through a 1-micrometer glass-fiber filter at the time of collection and then were shipped chilled for analysis of herbicide and herbicide metabolite concentrations by the U.S. Geological Survey laboratory in Lawrence, Kans. Samples were analyzed using solid-phase extraction techniques (Thurman and others, 1990).

Suspended-sediment concentrations were determined by the U.S. Geological Survey laboratory in Iowa City, Iowa, using standard filtration and evaporation methods (Guy,1969).

In this report, a shorthand terminology is used in describing the results of the chemical analyses of nitrogen species and herbicides. The results of the analyses of nitrogen species were reported in concentrations as nitrogen (nitrite plus nitrate as nitrogen, ammonia as nitrogen, and organic nitrogen). To save space and yet show that the results are concentrations as nitrogen, "nitrate-N" was used for nitrite plus nitrate as nitrogen; "ammonia-N" is used for ammonia as nitrogen, and "organic-N" is used for organic nitrogen. A fraction of the herbicides in a sample generally is lost during the extraction procedure. Therefore, results of the analyses are reported in total-recoverable concentrations. No attempt was made to correct herbicide concentrations for recovery rate.

Acknowledgments

This project was supported, in part, by the Iowa Department of Natural Resources, Geological Survey Bureau, through the Big Spring Basin Demonstration Project, with funds provided from the Iowa Groundwater Protection Act. George Hallberg, Coordinator of the Big Spring Basin Demonstration Project, and other members of the Iowa Department of Natural Resources, Geological Survey Bureau, Robert Libra, John Littke, Debra Quade, and Robert Rowden provided technical advice and field support. Jerry Spykerman, manager of the Big Spring Fish Hatchery, provided support for data collection at the spring and collected precipitation samples. Area residents, Leann Hilgerson, Karen and Eugene Voss, and Jerry Koonze collected sediment samples.

HYDROLOGIC DATA SUMMARY

Precipitation

Precipitation was measured and sampled 48 of 52 weeks at Big Spring during water year 1990. Data were not collected from August 21 to September 18 because the rain gage and sampler were damaged by flood waters from the Turkey River. Precipitation data for Roberts Creek above Saint Olaf (site RC2) are complete for the most part, but the precipitation data for Unnamed Creek near Luana (site BOOGD) are incomplete due to malfunctioning equipment in August and September.

Quantity

Rainfall for the 48 weeks that data were collected at Big Spring totaled 30.36 in., with a median weekly rainfall of 0.26 in. (table 5). An additional 4.19 in. were recorded at the nearby National Weather Service station in Elkader, Iowa (National Oceanic and Atmospheric Administration, 1990a, 1990b) during the period the gage was not operational at Big Spring.

Precipitation at Unnamed Creek near Luana (site BOOGD) and at Roberts Creek above Saint Olaf (site RC2) is listed in table 6. The total rainfall measured for water year 1990 was 43.67 in. at site RC2. The largest monthly rainfall occurred in August when 14.45 in. fell at site RC2. The largest daily rainfall at site RC2 was 5.23 in. on August 25, 1990.

Quality

Weekly precipitation samples were collected during the 41 weeks when measurable rainfall occurred at Big Spring. Results of chemical analyses of these samples are summarized in table 5. The median concentration of the predominant cation, calcium, was 0.48 mg/L (milligrams per liter), and the median concentration of the predominant anion, sulfate, was 1.7 mg/L. The median concentrations of nitrate-N and ammonia-N were 0.35 and 0.48 mg/L, respectively. Maximum concentrations of all major ions were less than 10 mg/L.

Surface Water

Deer Creek

Discharge and water-quality data were collected at site DC5 on Deer Creek near Postville (fig. 2) to determine the relation between ground and surface water in a small drainage basin.

Discharge

Stream discharge was continuously recorded from October 1, 1989, to January 4, 1990, and from May 3 to the end of the water year (table 7). Daily mean discharge recorded at site DC5 ranged from 0.13 ft^3/s at the end of September 1990 to 2.7 ft^3/s on August 24 after the greatest daily rainfall in the basin. Median monthly discharge ranged from 0.17 ft^3/s in September to 0.30 ft^3/s in June and August 1990.

Water Quality

Specific conductance of water from Deer Creek ranged from 231 to 680 µS/cm (microsiemens per centimeter at 25 °C), pH from 7.1 to 8.2 units, and dissolved oxygen from 6.7 to 14.5 mg/L (table 8). Chemical analyses of dissolved constituents in five samples collected from site DC5 on Deer Creek show that calcium and magnesium were the predominant cations in solution (table 9). Calcium concentrations ranged from 68 to 110 mg/L, and magnesium concentrations ranged from 23 to 30 mg/L. Sodium concentrations were less than 6.0 mg/L, and potassium concentrations were 2.1 mg/L or less. The predominant anion in solution was bicarbonate. Bicarbonate concentrations in three samples ranged from 330 to 380 mg/L. Sulfate concentrations ranged from 3.0 to 34 mg/L. Chloride concentrations were 12 mg/L or less. Nitrate-N was the predominant nitrogen species in 18 of 25 samples, and organic-N was the predominant nitrogen species in 7 samples (table 10). Nitrate-N concentrations ranged from 0.70 to 17 mg/L. Organic-N concentrations ranged from 0.20 to 9.9 mg/L.

Four herbicides, alachlor, atrazine, cyanazine, and metolachlor were detected in 27 samples collected at site DC5 on Deer Creek (fig. 3 and table 11). Alachlor concentrations ranged from less than 0.10 to 0.35 $\mu g/L$ (micrograms per liter) and were greater than 0.10 $\mu g/L$ in 7 percent of the samples. Atrazine concentrations ranged from less than 0.10 to 55 $\mu g/L$. Concentrations were equal to or greater than the detection level (0.10 $\mu g/L$) in 70 percent of the samples. Cyanazine concentrations ranged from less than 0.10 to 12 $\mu g/L$ and were equal to or greater than 0.10 $\mu g/L$ in about 26 percent of the samples. Metolachlor concentrations ranged from less than 0.10 to 69 $\mu g/L$ and were equal to or greater than 0.10 $\mu g/L$ in about 30 percent of the samples. Metribuzin, butylate, and trifluralin were not detected.

Several samples also were collected for the analysis of the stable isotopes hydrogen 2 (deuterium) and oxygen 18. The results of the analyses are shown graphically in figure 4 and are listed in table 12.

Silver Creek

Flow in Silver Creek at site L23S ceased from December 12, 1989, through January 7, 1990, and for 16 days during the period from January 12 to February 4, 1990 (fig. 5 and table 13). The maximum daily mean discharge (107 ft^3/s) was recorded on August 25, 1990. Daily mean discharge exceeded 1.0 ft^3/s 23 percent of the year and exceeded 0.10 ft^3/s approximately 70 percent of the year (fig. 6).

Unnamed Creek

Discharge

Generally there was no streamflow in Unnamed Creek near Luana (site BOOGD) from October 1, 1989, to February 4, 1990, and from March 16 to June 13, 1990 (table 14). The maximum daily mean discharge at site BOOGD was 21 ft^3/s on August 25, 1990. Daily mean discharge exceeded 1.0 ft^3/s 5 percent of the year and exceeded 0.10 ft^3/s approximately 22 percent of the year (fig. 6). There was no streamflow 56 percent of the days during water year 1990.

Water Quality

Collection of water-quality data was limited at Unnamed Creek near Luana (site BOOGD) due to lack of streamflow. Monthly samples were collected in February, March, July, August, and September 1990, and additional samples were collected during snowmelt and five rains. Nitrate-N concentrations ranged from 1.0 to 30 mg/L (table 10). Ammonia-N concentrations ranged from less than 0.10 to 5.3 mg/L. Organic-N concentrations ranged from 0.8 to 14 mg/L.

Four herbicides were detected in 14 samples from site BOOGD (table 11). Alachlor was detected in about 36 percent of the samples; atrazine in all samples; cyanazine in 64 percent of the samples; and metolachlor in 36 percent of the samples. Alachlor concentrations ranged from less than 0.10 to 8.6 $\mu g/L$; atrazine from

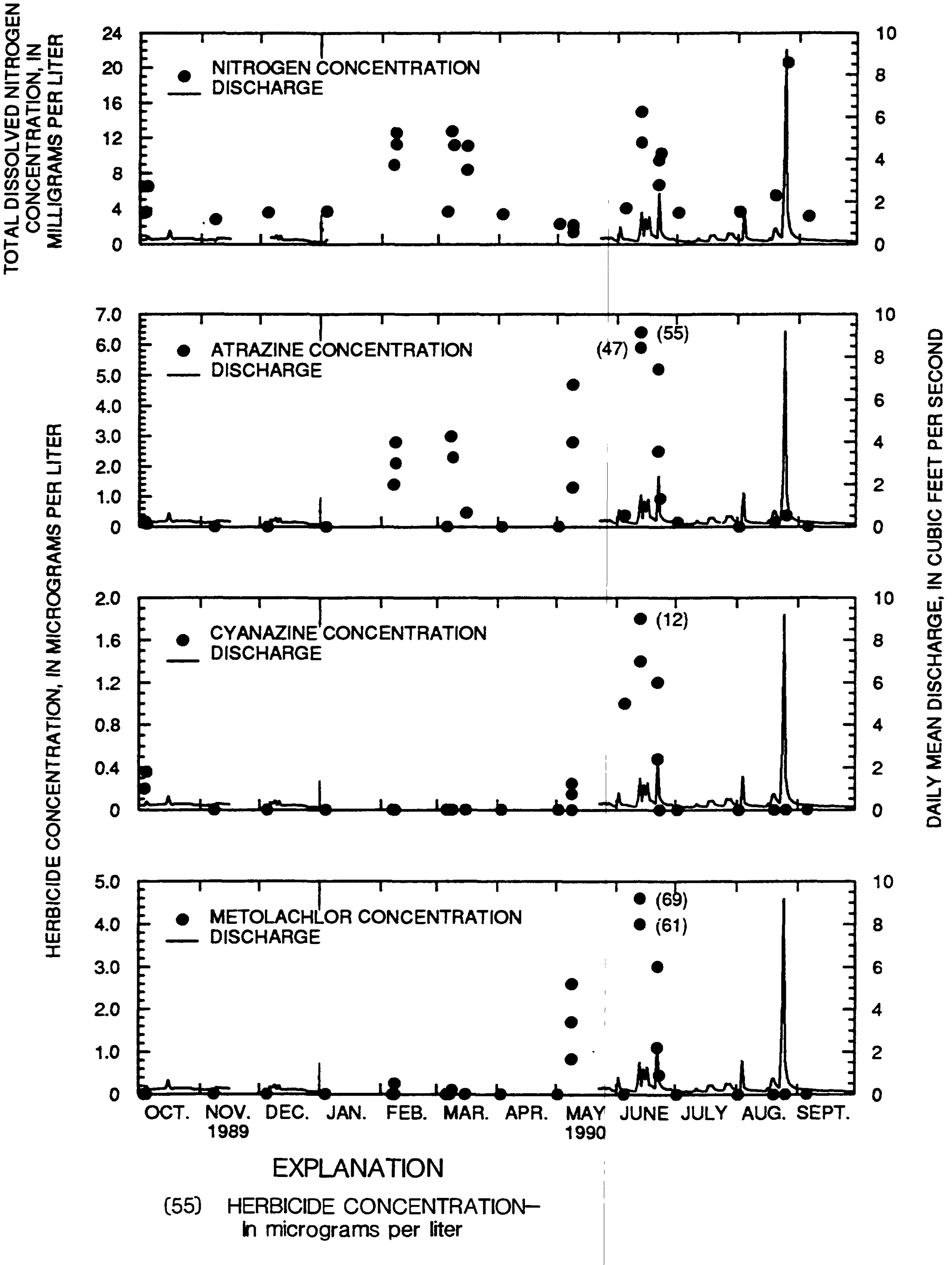

Figure 3. Selected chemical constituents and stream discharge at site DC5, Deer Creek near Postville, Iowa, water year 1990.

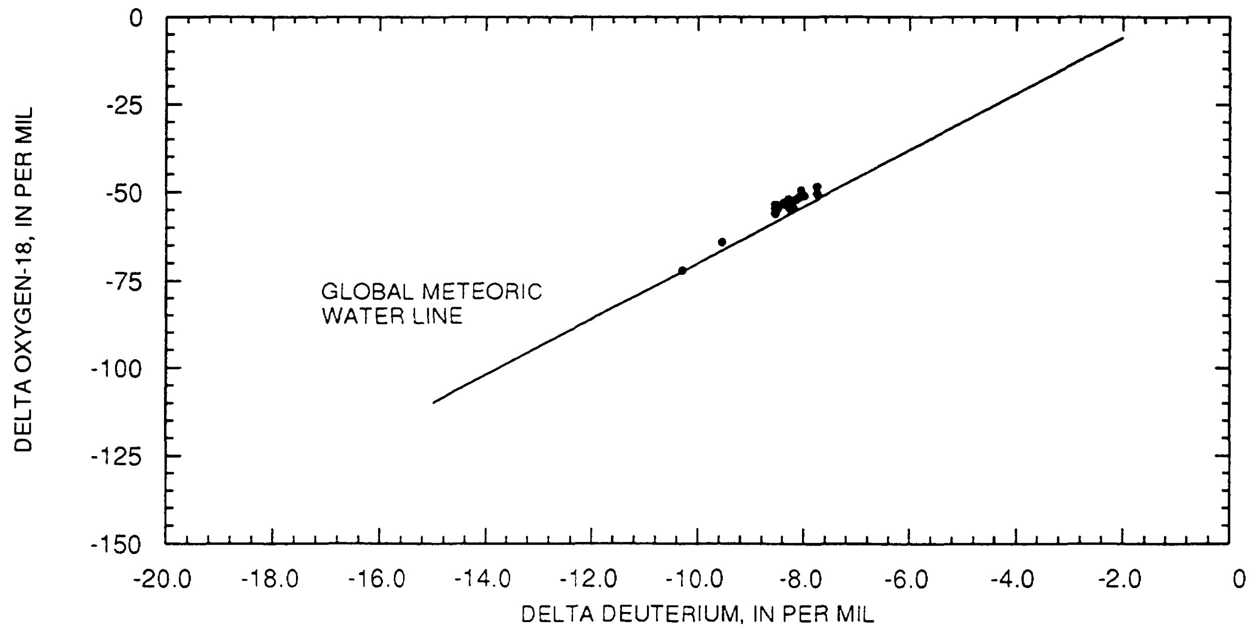

Figure 4. Relation of deuterium to oxygen-stable isotopes at sites in the Deer Creek watershed, water year 1990.

0.46 to 19 μg/L; cyanazine from less than 0.10 to 7.2 μg/L; and metolachlor from less than 0.10 to 3.8 μg/L.

The daily mean suspended-sediment concentrations ranged from 9 mg/L on September 14 to 1,140 mg/L on June 13 and 15, 1990. The daily suspended-sediment load ranged from 0 on days of no streamflow to 8.7 ton/d on March 11 during snowmelt (fig. 7 and table 15).

Roberts Creek

Discharge

Daily mean discharge at Roberts Creek above Saint Olaf (site RC2) is listed in table 16 and illustrated in figure 8. The median discharge at site RC2 for the 1990 water year was 2.4 ft^3/s. Maximum daily mean discharge (426 ft^3/s) occurred on August 25, 1990. Generally there was no recorded discharge from November 2, 1989, through January 9, 1990. No streamflow was recorded 22 percent of the days in water year 1990. Flow duration is shown in figure 6. Mean daily discharge exceeded 0.10 ft^3/s approximately 71 percent of the time during water year 1990, exceeded 1.0 ft^3/s approximately 60 percent of the time, and exceeded 10 ft^3/s approximately 16 percent of the time.

Water Quality

The maximum daily mean specific conductance of 797 μS/cm was recorded in Roberts Creek above Saint Olaf (site RC2) on August 29 (table 16). The minimum daily mean specific conductance (512 μS/cm) was recorded on July 20. The daily mean water temperature varied from 2.0 °C on March 23, 1990, to 27.5 °C on July 4. Daily median pH varied from 6.6 on October 5, 1989, to 9.1 on April 13 and 17 (table 17).

Six samples were collected from site RC2 on Roberts Creek during water year 1990 for analyses of major ions. Calcium and magnesium were the predominant cations. Bicarbonate was the predominant anion in solution (table 9). Sodium and potassium concentrations generally were less than 20 mg/L. Sulfate concentrations ranged from 23 to 46 mg/L, and chloride concentrations ranged from 25 to 35 mg/L. Silica concentrations were 12 mg/L or less.

Forty-two samples were collected from site RC2 on Roberts Creek for the analyses of nitrogen species, orthophosphorus, and organic-carbon concentrations (table 10). Total nitrate-N concentrations were greater than the detection level (0.10 mg/L) in all but one of the samples. Nitrate-N concentrations ranged from less than 0.10 to 18 mg/L. Ammonia-N was detected in 68 percent of the samples. Total

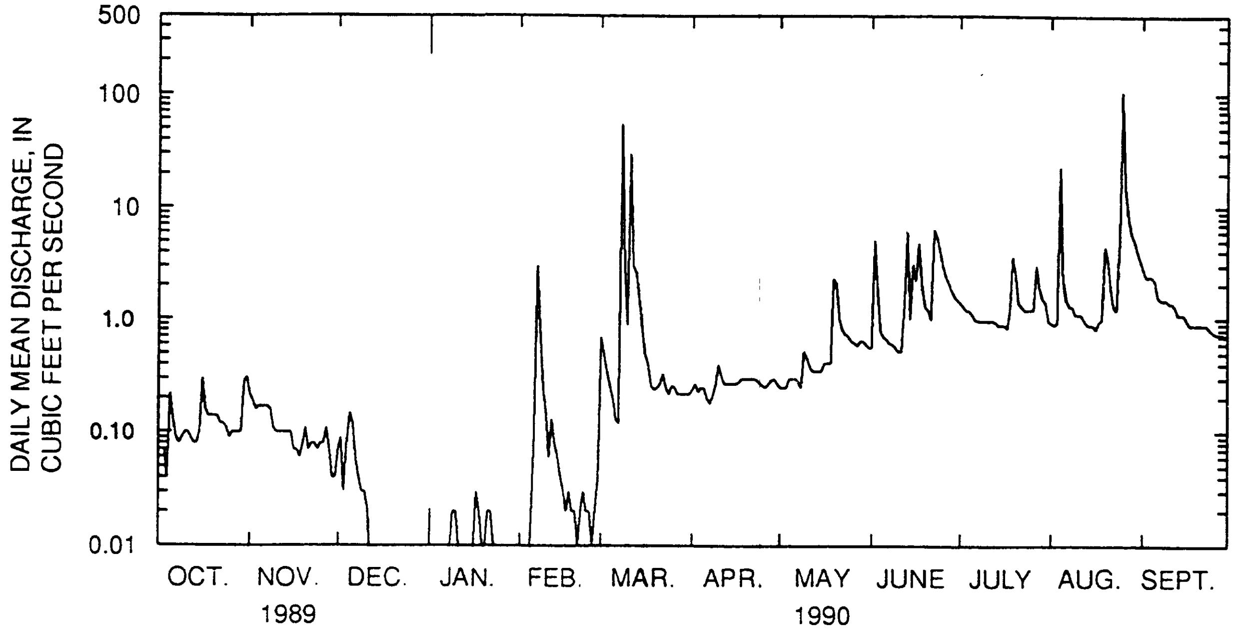

Figure 5. Daily mean discharge at site L23S, Silver Creek near Luana, Iowa, water year 1990.

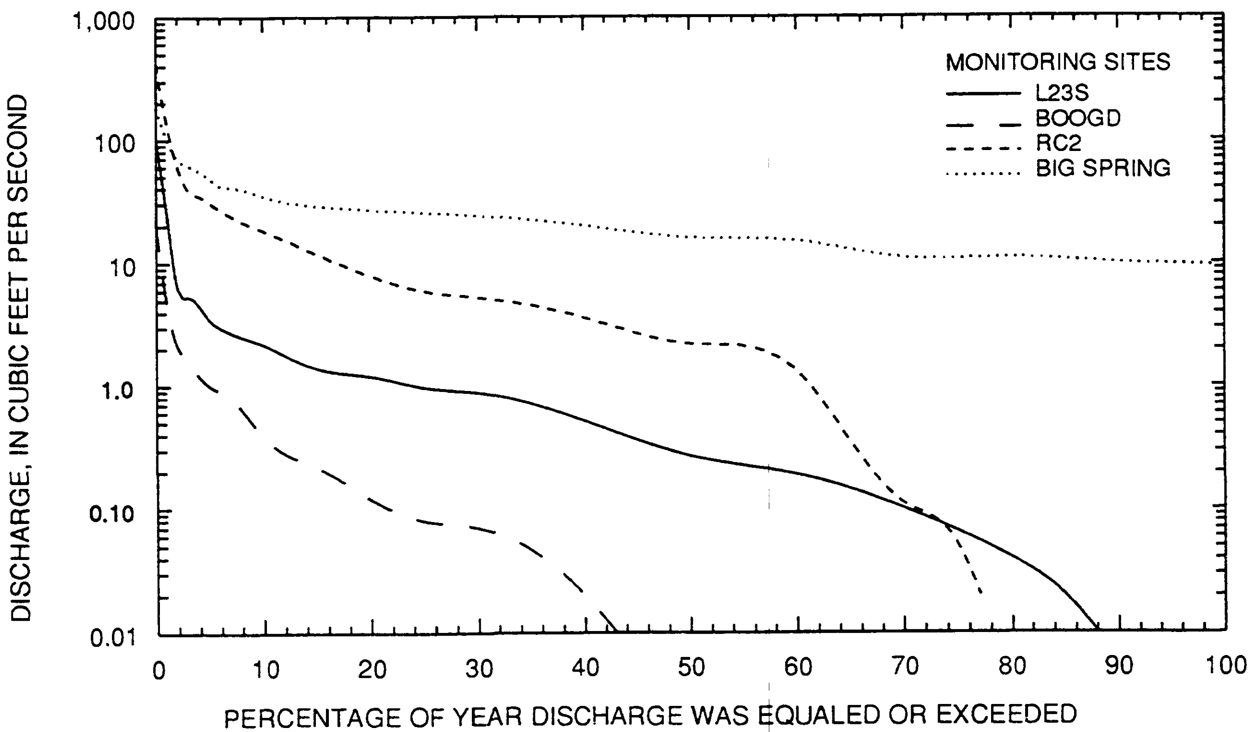

Figure 6. Flow duration at monitoring sites in the Big Spring basin, water year 1990.

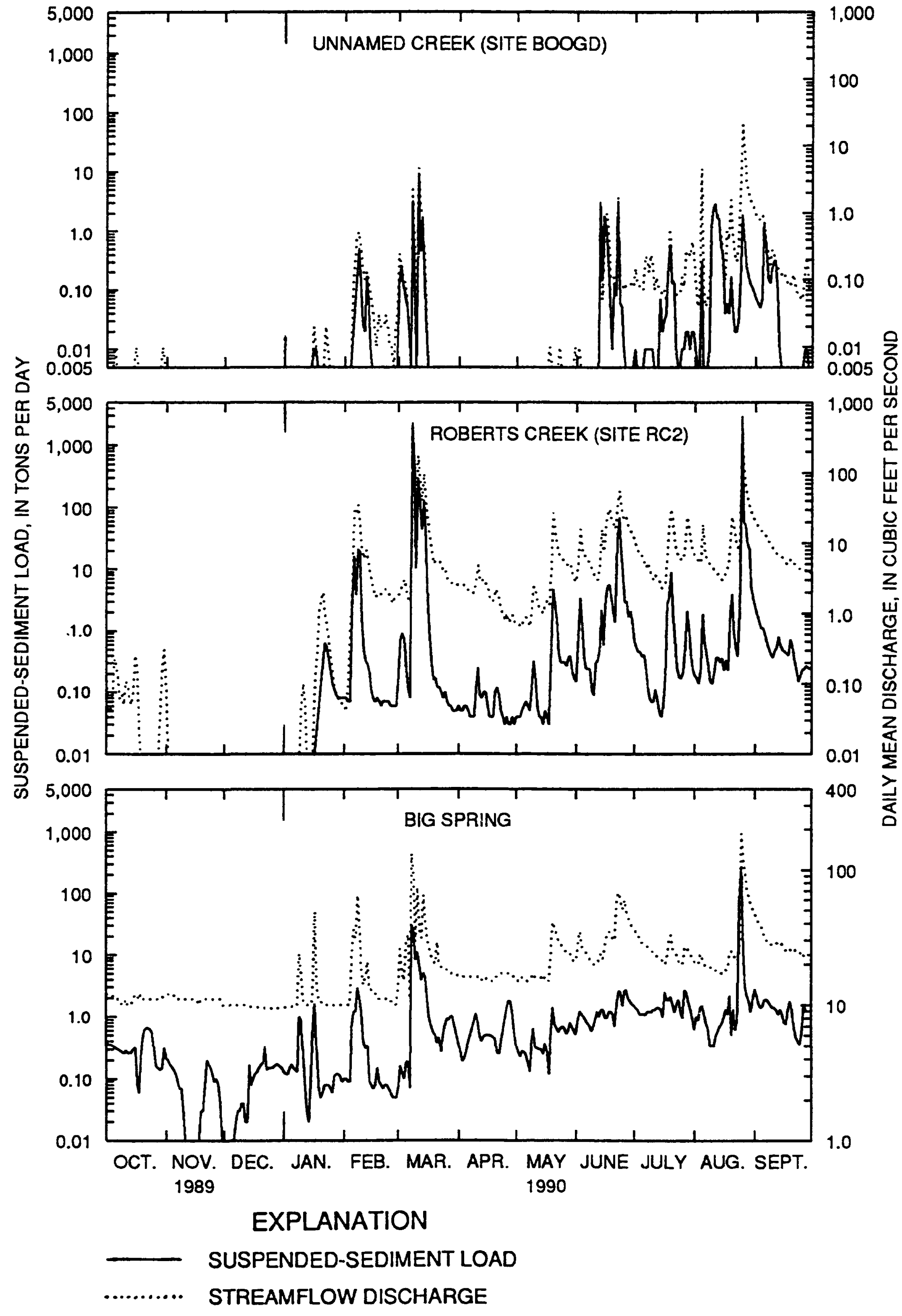

Figure 7. Suspended-sediment load and streamflow discharge at three monitoring sites in the Big Spring basin, water year 1990.

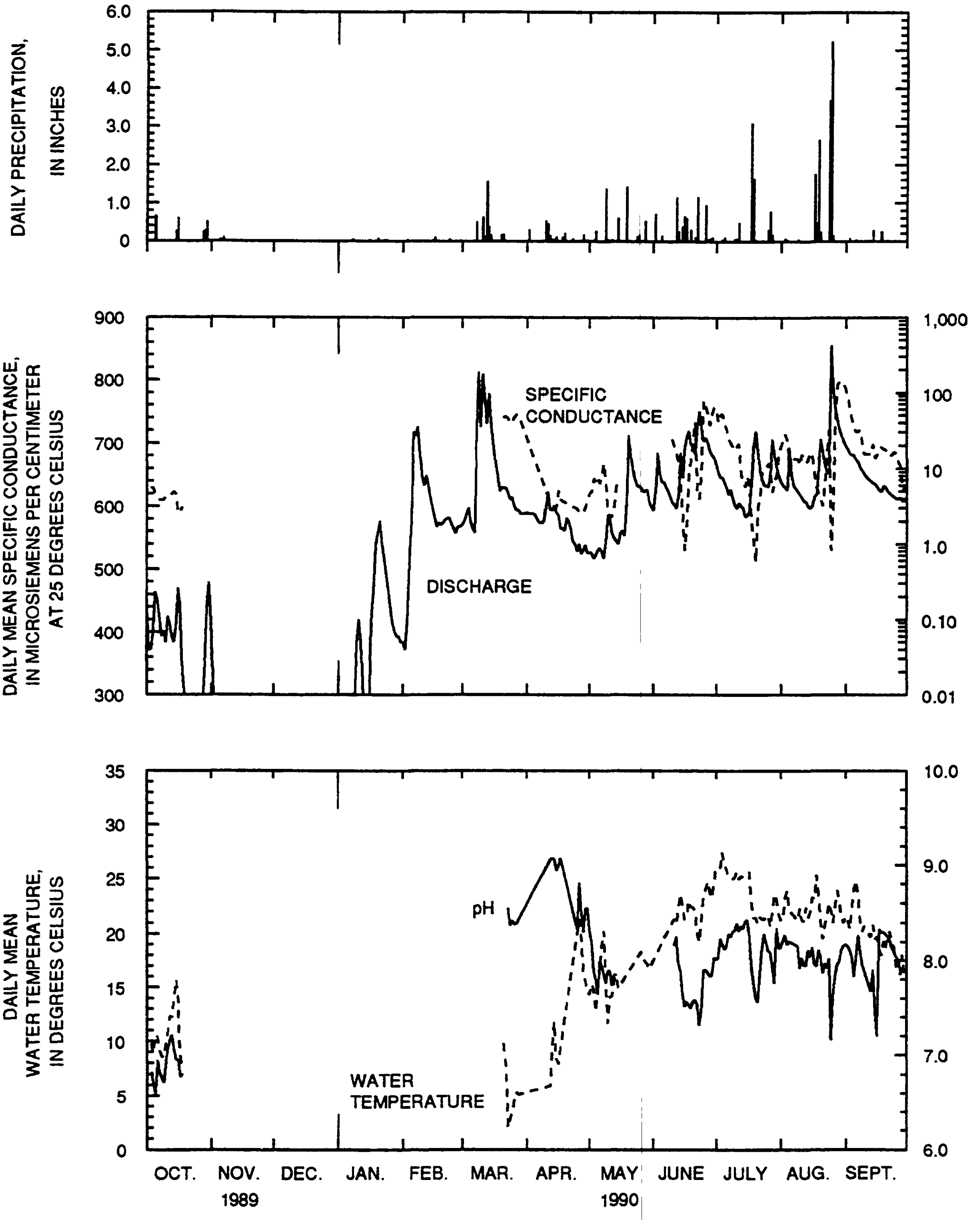

Figure 8. Daily precipitation, daily mean specific conductance, discharge, water temperature, and daily median pH at site RC2, Roberts Creek above Saint Olaf, Iowa, water year 1990.

ammonia-N concentrations ranged from less than 0.10 to 4.0 mg/L. Total organic-N concentrations ranged from 0.50 to 20 mg/L. Total orthophosphorus concentrations ranged from 0.20 to 2.1 mg/L.

Thirty-four samples were collected from site RC2 on Roberts Creek for the analyses of seven herbicides. Five of the seven herbicides were detected (concentration greater than 0.10 $\mu g/L$). Alachlor was detected in 56 percent of the samples; atrazine in 100 percent; cyanazine in about 68 percent; metolachlor in 47 percent; and metribuzin in 6 percent of the samples (table 11). Butylate and trifluralin were not detected. Alachlor concentrations ranged from less than 0.10 to 8.2 $\mu g/L$; atrazine from 0.16 to 12 $\mu g/L$; cyanazine from less than 0.10 to 8.5 $\mu g/L$, and metolachlor from less than 0.10 to 7.4 $\mu g/L$.

The daily mean suspended-sediment loads at site RC2 ranged from 0 on days of no streamflow to more than 2,900 ton/d on August 25 (fig. 7 and table 18). The largest monthly sediment loads were in March (more than 3,400 tons) and August (more than 3,100 tons).

Ground Water

Water levels were recorded continuously at five wells screened in unconsolidated material in the Big Spring basin. Well BS1-A is screened in alluvial material in the Turkey River valley; well BS3-C in weathered limestone and loess; wells BS4-B and BS4-C in glacial till of Pre-Illinoian age; and well DCW1 in Deer Creek alluvial material. Water levels in the Galena aquifer were recorded continuously at four monitoring wells (BS1-B, BS2-E, BS3-A, and BS4-A), and water-quality data were collected at the discharge point, Big Spring. Water levels in the Saint Peter aquifer were monitored continuously at two wells (BS2-G and BS4), and two wells (BS1-D and BS3) were measured monthly (table 19).

Unconsolidated Aquifers

The highest water levels in the unconsolidated aquifers were recorded during August or September 1990 (table 20). The highest recorded water levels in water year 1990 were 2.45 ft below land surface in well BS1-A, 9.88 ft below land surface in well BS3-C, 72.64 ft below land surface in well BS4-B, 55.78 ft below land surface in well BS4-C, and 3.09 ft below land surface in well DCW1. Water levels in well BS1-A (fig. 9) were the highest in August (2.45 ft below land surface) and the lowest in December 1989 (14.74 ft below land surface). Data were lost from well BS1-A from August 27 through September 5 because the recorder was inundated when the Turkey River flooded. The lowest water level in well BS3-C was 14.84 ft below land surface on October 19, and the lowest water level in well BS4-B was 73.78 ft below land surface on March 6 and 7, 1990. The lowest water level in well BS4-C was 57.06 ft below land surface on February 24, and the lowest water level in well DCW1 was 6.31 ft below land surface on October 3, 1989.

As part of an investigation to study the relation between shallow ground water and surface water, samples were collected for chemical analyses from two wells (DCW2 and DCW3) and four suction lysimeters (DCLA, DCLB, DCLC, and DCLD) completed in unconsolidated material in the Deer Creek watershed. The discharge from a tile line that drains the unconsolidated material in the Deer Creek watershed was also sampled (site DCT2). The location and well-construction data for the wells and lysimeters are given in table 2. Onsite determinations of selected water-quality constituents in water from wells DCW2 and DCW3 and the tile line are listed in table 21.

Five samples were collected from each well (DCW2 and DCW3) for the analysis of major ions. In samples from both wells, calcium and magnesium were the predominant cations in solution (table 22). Calcium concentrations ranged from 3.4 to 140 mg/L, and magnesium concentrations ranged from 1.6 to 38 mg/L. Sodium and potassium concentrations were less than 10 mg/L. Bicarbonate was the predominant anion. Bicarbonate concentrations ranged from 360 to 460 mg/L. Sulfate concentrations ranged from 8.8 to 96 mg/L, and chloride concentrations ranged from 1.0 to 38 mg/L.

Thirteen samples were collected from each of wells DCW2 and DCW3 for the analysis of nitrogen species, orthophosphorus, and organic carbon and for the analyses of seven herbicides (table 23). Nitrate-N was detected in 62 percent of the samples from well DCW2 and from 31

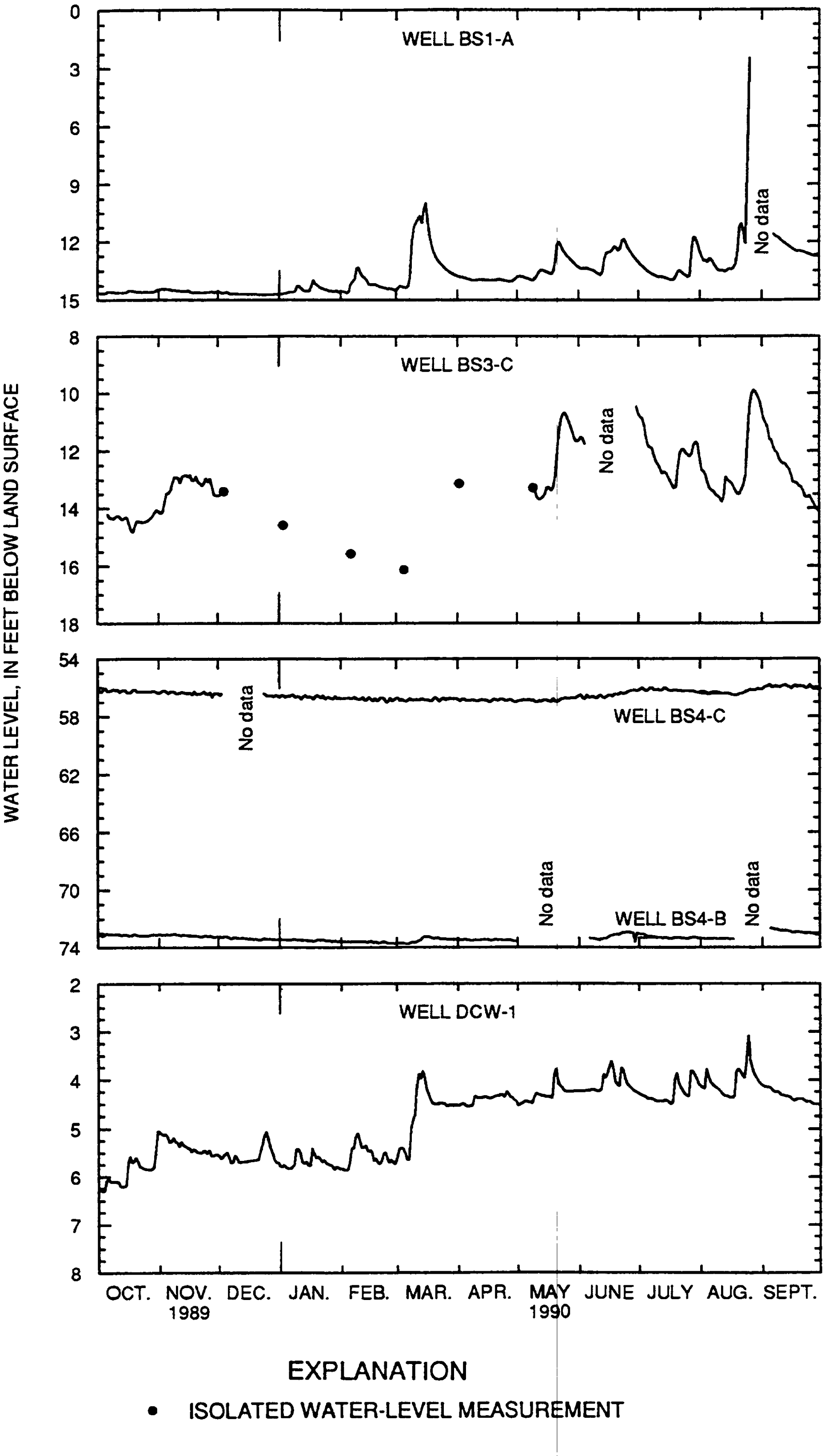

Figure 9. Daily mean water levels in unconsolidated aquifers in the Big Spring basin, water year 1990.

percent of the samples from well DCW3. Nitrate-N concentrations in well DCW2 ranged from less than 0.10 to 16 mg/L and ranged from less than 0.10 to 0.10 mg/L in well DCW3. Ammonia-N concentrations were greater than the detection level (0.10 mg/L) in 15 percent of samples from well DCW2 and were greater than the detection level in 77 percent of the samples from well DCW3. The largest concentration was 0.80 mg/L in a sample from well DCW2. Organic-N concentrations ranged from less than 0.10 to 0.60 mg/L. Orthophosphorus concentrations were less than the detection level (0.10 mg/L) in 81 percent of the samples. Atrazine, cyanazine, and metolachlor were detected in wells DCW2 and DCW3 (table 24). Atrazine was detected in 46 percent of the samples from well DCW2 and in 15 percent of the samples from well DCW3. Atrazine concentrations ranged from less than 0.10 to 2.4 $\mu g/L$ in well DCW2 and in less than 0.10 to 0.75 $\mu g/L$ in well DCW3. Cyanazine was detected in 15 percent of the samples from well DCW2 and in one sample from well DCW3.

Four lysimeters were used to collect water from the water table or unsaturated zone depending on the water level at the time of sampling. Lysimeters DCLA and DCLB were always in the saturated zone, lysimeter DCLC was in the saturated zone after October 16, 1989, and DCLD was in the saturated zone from March 10, 1990, through the remainder of the water year.

Nitrate-N concentrations in the deepest lysimeters, DCLA and DCLB, were less than the detection level in all but three samples (table 23). Nitrate-N concentrations in one sample from DCLA and two samples from DCLB were equal to or greater than the detection level. The maximum nitrate-N concentration in these two lysimeters was 0.70 mg/L. Nitrate-N concentrations in the two shallowest lysimeters, DCLC and DCLD, were greater than the detection level in all but one sample and ranged from less than 0.10 to 36 mg/L. Nitrate-N concentrations in samples from lysimeter DCLC ranged from less than 0.10 to 0.50 mg/L, and concentrations in samples from lysimeter DCLD ranged from 1.8 to 36 mg/L.

Ammonia-N concentrations were less than the detection level (0.10 mg/L) in all but one sample from all lysimeters. Organic-N concentrations in the four lysimeters ranged from less than 0.10 to 0.90 mg/ L. Total nitrogen concentrations (nitrate-N, ammonia-N, and organic-N) in samples from the lysimeters and the water level in well DCW1 are shown in figure 10.

Atrazine was the only herbicide detected in the lysimeter (DCLA) installed 8.5 ft below land surface (table 24). In lysimeter DCLB, which was installed at 7 ft below land surface, only alachlor and cyanazine were detected. Atrazine was the only herbicide detected in samples from lysimeter DCLC, the lysimeter installed at 5.5 ft below land surface. Atrazine concentrations ranged from less than 0.10 to 0.59 $\mu g/L$. Both atrazine and metolachlor were detected in samples from lysimeter DCLD. All samples had detectable atrazine concentrations, and five of nine samples had detectable metolachlor concentrations. Atrazine concentrations ranged from 0.12 to 3.6 $\mu g/L$, and metolachlor concentrations ranged from less than 0.10 to 0.83 $\mu g/L$ in samples from lysimeter DCLD. Atrazine and metolachlor concentrations in lysimeter water samples and the water level in well DCW1 are shown in figures 11 and 12.

Eleven samples were collected from tile-line discharge (site DCT2) in the Deer Creek watershed for the analyses of nitrogen species and for the analyses of seven selected herbicides. Nitrate-N concentrations ranged from 4.1 to 42 mg/L, and organic-N concentrations ranged from 0.60 to 2.1 mg/L. Ammonia-N was not detected (concentrations greater than 0.10 mg/L). Two of the seven herbicides were detected. Atrazine concentrations were greater than the detection level in 8 of the 11 samples. Atrazine concentrations ranged from less than 0.10 to 0.48 $\mu g/L$. Metolachlor concentrations were greater than the detection level (0.10 $\mu g/L$) in 2 of 11 samples, and the maximum concentration was 0.85 $\mu g/L$.

Several samples also were collected from wells DCW2 and DCW3 and from the tile line (site DCT2), for the analyses of the stable isotopes deuterium and oxygen 18. The results of the analyses are shown graphically in figure 4 and are listed in table 12.

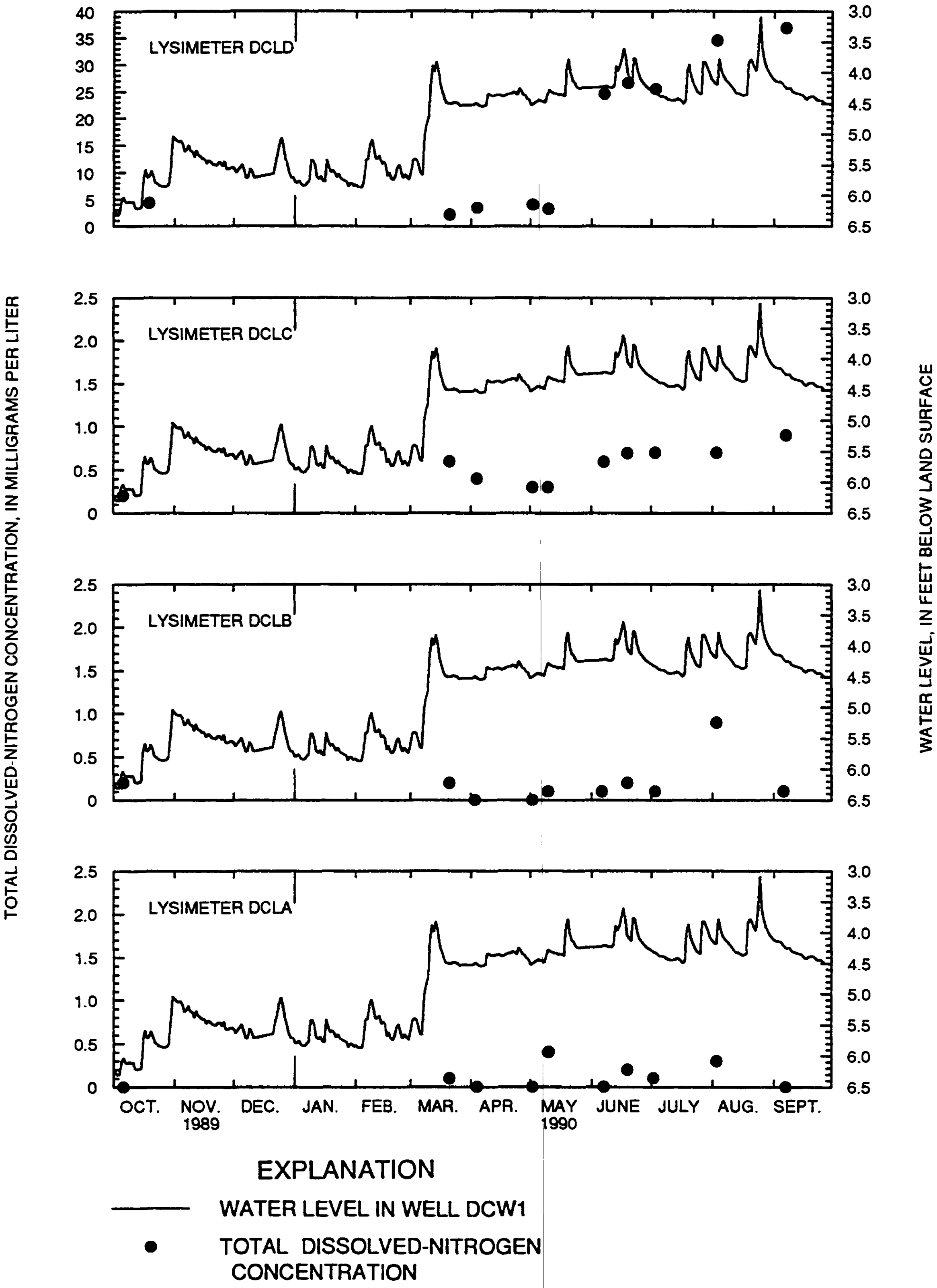

Figure 10. Total dissolved-nitrogen concentrations in water from lysimeters and water levels in well DCW1 in the unconsolidated aquifer of the Deer Creek watershed, water year 1990.

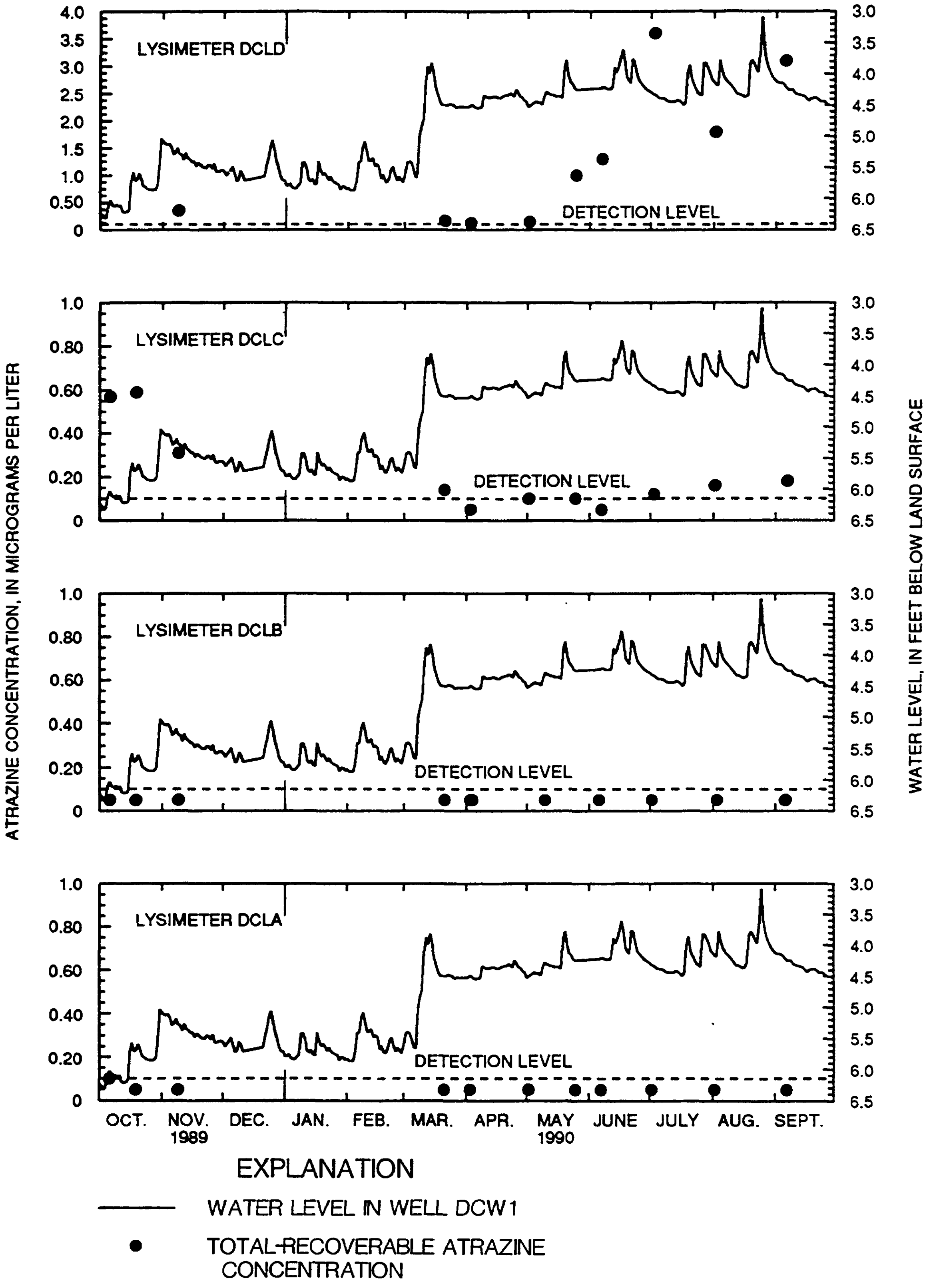

Figure 11. Total-recoverable atrazine concentrations in water from lysimeters and water levels in well DCW1 in the unconsolidated aquifer of the Deer Creek watershed, water year 1990.

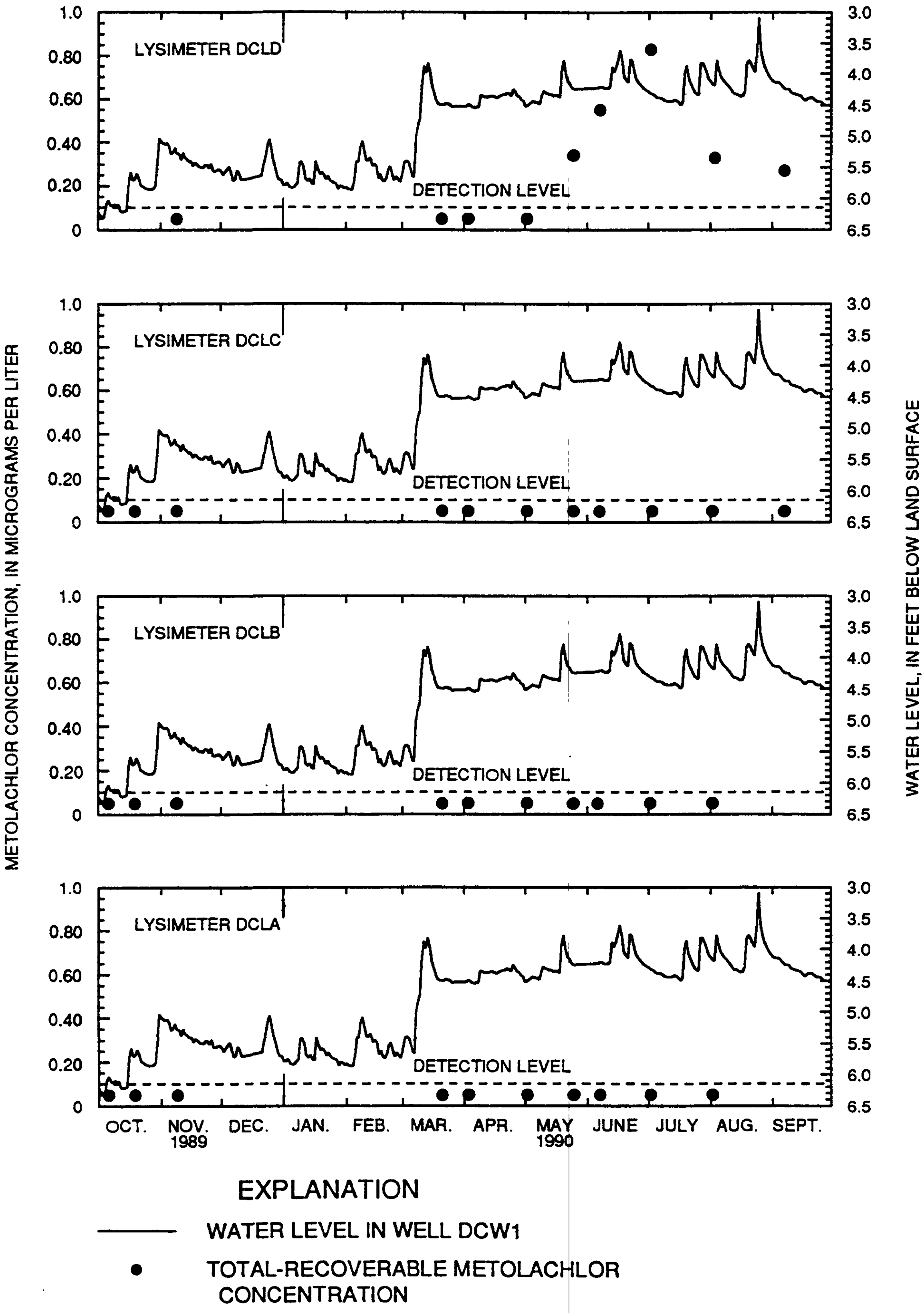

Figure 12. Total-recoverable metolachlor concentrations in water from lysimeters and water levels in well DCW1 in the unconsolidated aquifer of the Deer Creek watershed, water year 1990.

Galena Aquifer

Water Levels

The highest water levels in the Galena aquifer were measured in August or September 1990 except for the water levels in well BS1-B (table 25 and fig. 13). The highest daily mean water level in well BS1-B was 3.86 ft below land surface on March 16. The water-level data for this well were lost from August 25 through September 17 because the recorder was damaged by flooding of the Turkey River. The highest daily mean water levels in well BS2-E were 142.54 ft below land surface; 163.58 ft below land surface in well BS3-A, and 215.75 ft below land surface in well BS4-A. The lowest water levels in well BS1-B were 10.34 ft below land surface on January 4, 1990; in well BS2-E, 154.84 ft below land surface on January 4, 1990; in well BS3-A, 168.17 ft below land surface on November 28 and December 7, 1989; and in well BS4-A, 221.88 ft below land surface on February 25, 1990.

Big Spring

Discharge from Big Spring was continuously recorded and is shown in figure 14 and listed in table 26. The discharge values are the sum of discharge from the main spring and from an auxiliary spring (Back Spring) located about 500 ft east of the main spring. The maximum daily mean discharge was 187 ft^3/s on August 25, 1990, and the minimum daily mean discharge was 9.4 ft^3/s on December 26, 1989. Mean daily discharge equaled or exceeded 10 ft^3/s approximately 92 percent of the year, equaled or exceeded 20 ft^3/s approximately 40 percent of the year, and equaled or exceeded 30 ft^3/s approximately 14 percent of the year. The flow duration is shown in figure 6.

Continuous water-quality data collected at Big Spring are shown as daily mean and median values in figure 14 and are listed in tables 26 and 27. Daily mean specific-conductance values ranged from 378 μS/cm on March 9 during snowmelt to 796 μS/cm on February 6, 1990. The maximum daily median pH was 7.2 on December 24 through December 26, 1989, and the minimum daily median pH was 6.5 on March 13, 1990. Daily mean water temperatures ranged from 5.5 °C on March 9 during snowmelt to 11.5 °C on August 26 and 27, 1990. Daily mean suspended-sediment concentrations ranged from 0 on 8 days from November 11 through December 5, 1989, to 5,100 mg/L on August 25, 1990 (table 28). The daily suspended-sediment load ranged from 0 to 275 ton/d. The greatest monthly sediment loads were about 400 tons in August and about 100 tons in March 1990.

The predominant cations in six samples collected at Big Spring generally were calcium and magnesium (table 22). Calcium concentrations ranged from 40 to 91 mg/L, and magnesium concentrations ranged from 16 to 40 mg/L. Sodium and potassium concentrations were 25 mg/L or less. The predominant anion, bicarbonate, was present in concentrations that ranged from 330 to 400 mg/L. Sulfate concentrations ranged from 29 to 43 mg/L, and chloride concentrations ranged from 15 to 32 mg/L. Silica concentrations were 15 mg/L or less.

Thirty-two samples were collected from Big Spring during water year 1990 for the analyses of nitrogen species, orthophosphorus, and organic carbon. Both the total and dissolved constituents were analyzed. Nitrate-N generally was the predominant nitrogen species in solution (table 23). Nitrate-N concentrations ranged from 3.0 to 16 mg/L. Ammonia-N concentrations equaled or exceeded the detection level in about 38 percent of the samples. The maximum ammonia-N concentration was 1.8 mg/L. Organic-N concentrations ranged from less than 0.10 to 9.1 mg/L, orthophosphorus concentrations ranged from 0.20 to 1.3 mg/L, and organic-carbon concentrations ranged from less than 0.10 to 36 mg/L.

Four of seven herbicides analyzed were detected in 32 samples from Big Spring (table 24). Alachlor was detected in 22 percent of the samples; atrazine in 100 percent; cyanazine in 44 percent; and metolachlor in 6 percent. Butylate, metribuzin, and trifluralin were not detected. Alachlor concentrations ranged from less than 0.10 to 0.77 μg/L; atrazine concentrations from 0.14 to 4.5 μg/L; cyanazine concentrations from less than 0.10 to 0.47 μg/L; and metolachlor concentrations from less than 0.10 to 2.1 μg/L.

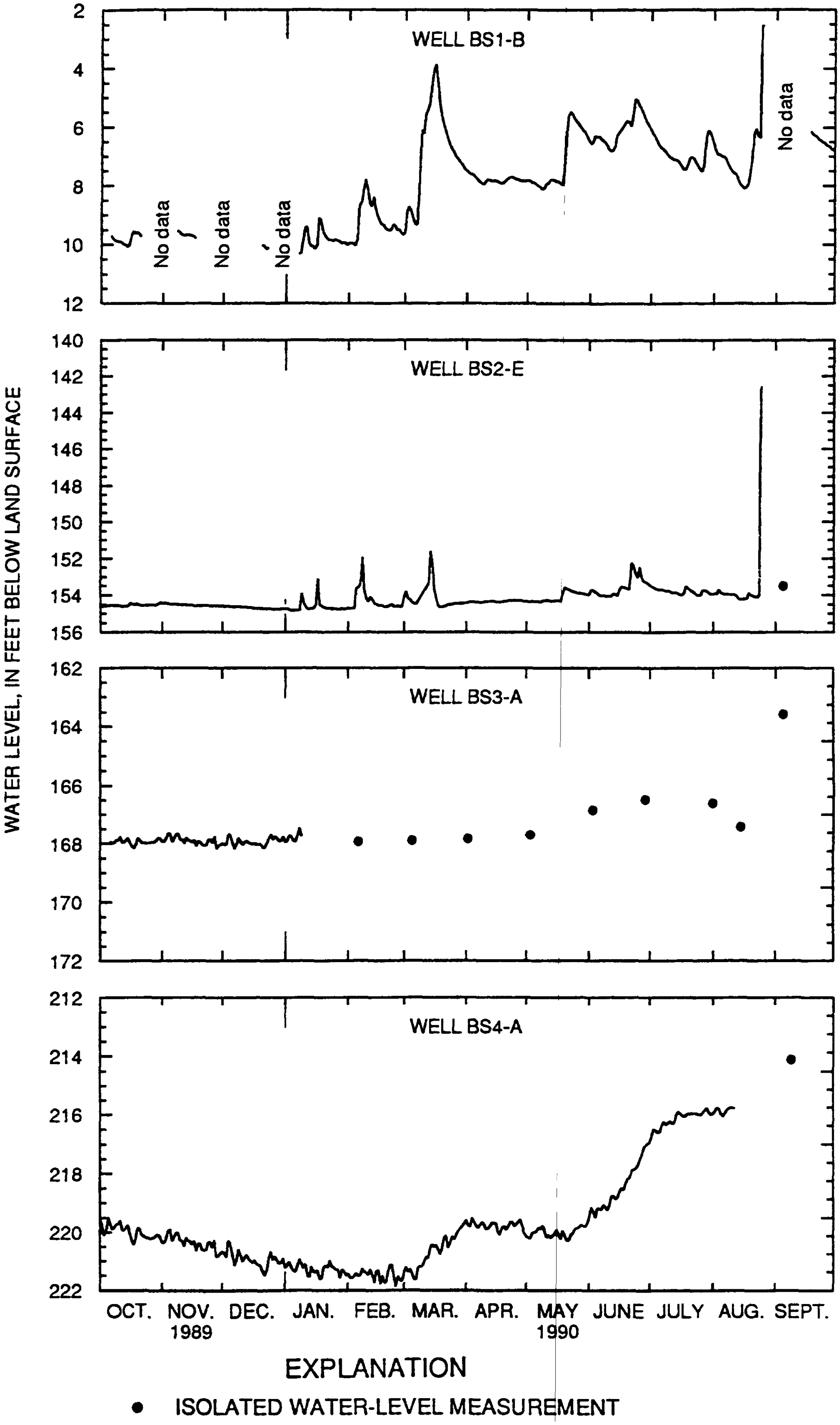

Figure 13. Daily mean water levels in the Galena aquifer in the Big Spring basin, water year 1990.

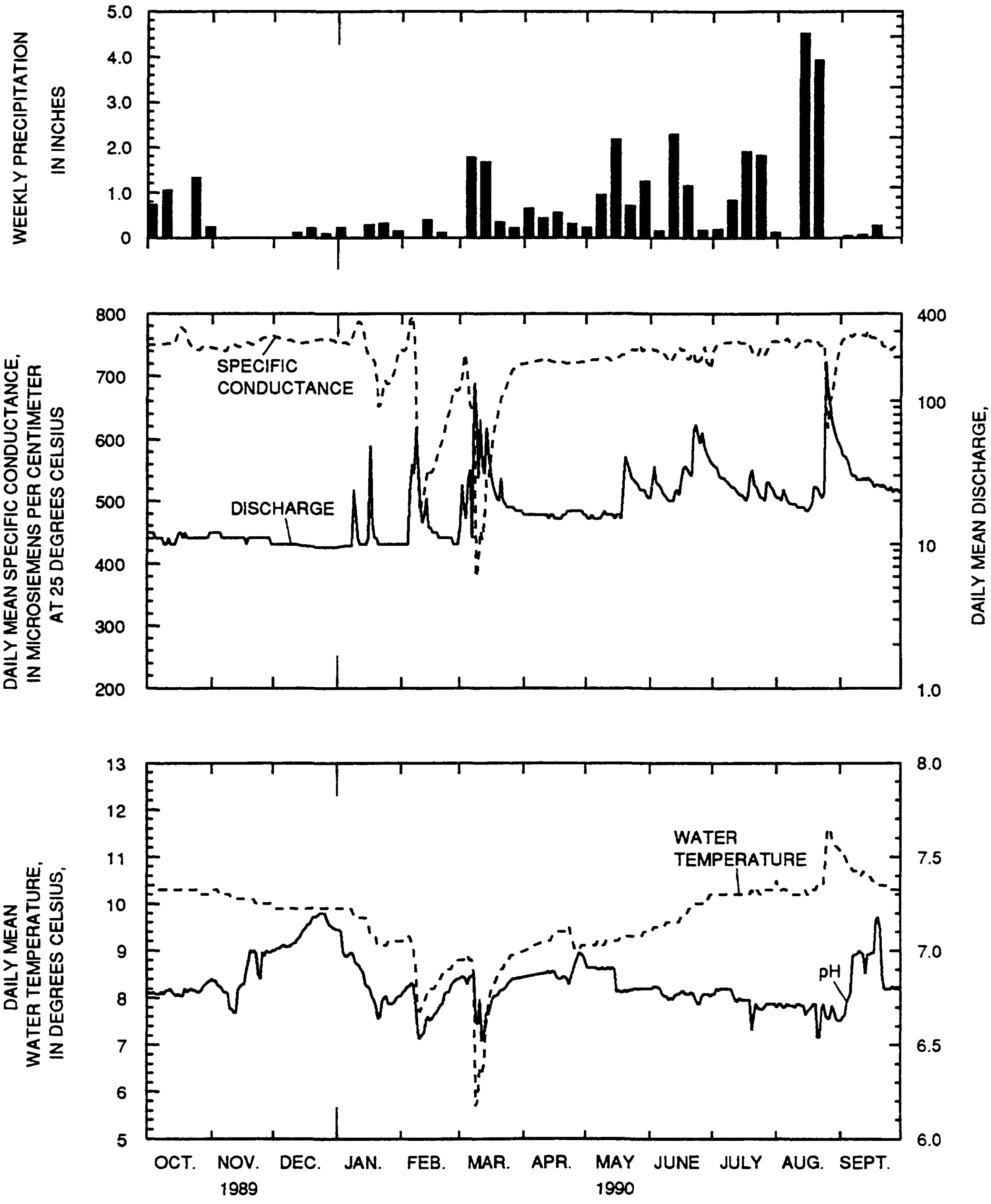

Figure 14. Weekly precipitation, daily mean specific conductance, discharge, water temperature, and daily median pH at Big Spring, water year 1990.

Saint Peter Aquifer

The highest water level in well BS2-G was 185.01 ft below land surface on October 11, and the highest water level in well BS4 was 368.45 ft below land surface on April 28, 1990. The lowest water level in well BS2-G was 186.31 ft below land surface on February 28, and the lowest water level in well BS4 was 371.69 ft below land surface on September 5, 1990. Water levels are shown in figure 15 and are listed in table 29.

Seepage Measurements

Stream discharge was measured at 39 sites (fig. 16) on May 29 and 30, 1990, to determine areas where streamflow was being lost to the ground-water system through seepage and to determine areas where water was flowing into streams from ground-water discharge. Water samples were collected concurrently to document nutrient and herbicide inflow from ground water and outflow into the underlying aquifer. The results of the data collection are presented in tables 30 and 31.

Discharge

Discharge increased in Roberts Creek from 0.35 ft^3/s at site RC13, the most upstream site, to 5.54 ft^3/s at site F45, approximately 11 mi downstream (fig. 17). Streamflow in this reach originated partially from two tributaries, West Branch Roberts Creek and Deer Creek, and from industrial discharge in the headwaters. West Branch Roberts Creek (site RC21) contributed 1.07 ft^3/s, Deer Creek (site DC2) contributed approximately 0.43 ft^3/s, and industrial discharge (site RC26) contributed 0.95 ft^3/s.

Discharge increased downstream from 5.54 ft^3/s at site F45 to 7.33 ft^3/s at site RC18. Silver Creek joins Roberts Creek in this 5.8-mi reach. The discharge at the first site (SC4) upstream of the mouth of Silver Creek was 1.30 ft^3/s. Discharge decreased from 7.33 ft^3/s at site RC18 to 3.29 ft^3/s at the site (RC2) where Roberts Creek leaves the Big Spring basin. Determination of seepage in Roberts Creek and Silver Creek is complicated by nonuniform point-source discharges in the headwaters of the streams. A municipal wastewater-treatment plant discharges upstream of site SC10, and a creamery discharges wastewater upstream of site SC13. Discharges were 0.42 and 0.95 ft^3/s, respectively, at sites SC10 and SC13. Discharge at site L23S on the main stem of Silver Creek was 0.56 ft^3/s. Downstream of the confluence of Silver Creek and the East Fork of Silver Creek at site SC1, the streamflow was 0.70 ft^3/s.

The total measured discharge lost from streams in the Big Spring basin during the seepage study was 8.56 ft^3/s. This includes a measured loss of 5.1 ft^3/s from Roberts Creek, 1.9 ft^3/s from the Silver Creek subbasin, and 1.55 ft^3/s from Hatchery Creek. The total measured discharge leaving the basin in streams was 3.63 ft^3/s.

Water Quality

Total dissolved-nitrogen concentrations (nitrate-N, ammonia-N, and organic-N) were less than 5.0 mg/L in samples from 7 sites, were 5.0 to 10 mg/L in samples from 28 sites, and were greater than 10 mg/L in samples from 3 sites in the Big Spring basin during the seepage study. The predominant nitrogen species was nitrate. Total dissolved-nitrogen-N concentrations in water from the main stem of Roberts Creek ranged from 22 mg/L at site RC13 to 4.5 mg/L at site RC2 (fig. 17) Total dissolved-nitrogen-N concentrations in water from Silver Creek ranged from 3.7 to 16 mg/L.

Total dissolved-nitrogen loads at sites on the main stem of Roberts Creek ranged from less than 0.01 to 0.14 ton/d. The greatest load (0.14 ton/d) was measured at the first site (RC18) downstream of the mouth of Silver Creek. The total measured nitrogen-load lost from streams in the Big Spring basin during the seepage study was 0.29 ton/d. This includes a measured nitrogen-load loss of 0.21 ton/d from Roberts Creek, 0.04 ton/d from the Silver Creek subbasin, and about 0.04 ton/d from Hatchery Creek. The total measured nitrogen load leaving the basin in streams was about 0.04 ton/d.

During the seepage study, samples were collected at 32 sites for the analyses of selected herbicides (table 31). Alachlor was detected in 31 percent of the samples; atrazine in 97 percent; cyanazine in 38 percent; and metolachlor in 19 percent. Alachlor concentrations ranged from less than 0.10 to 0.68 *μg/L*; atrazine ranged from less than 0.10

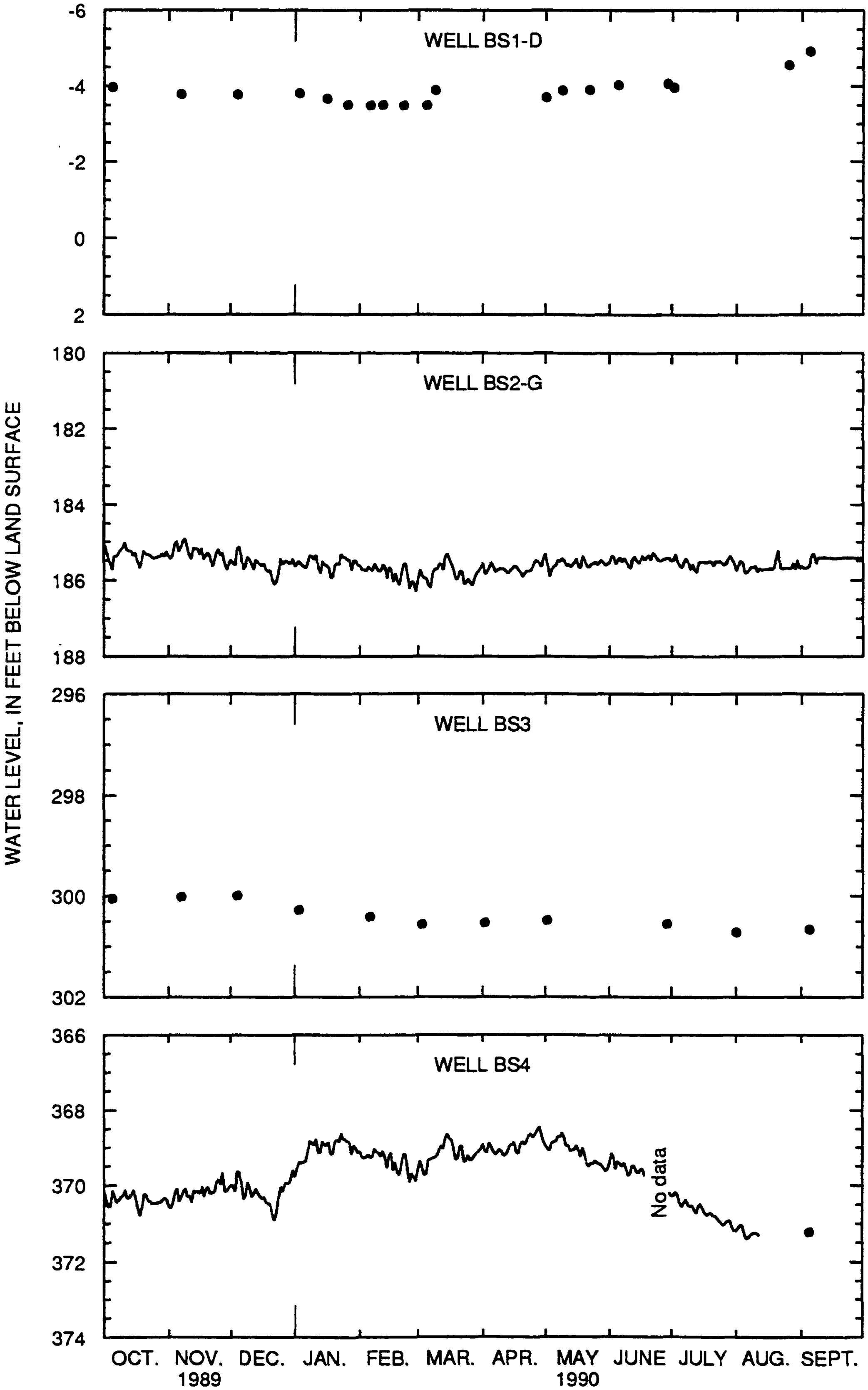

Figure 15. Daily mean water levels in the Saint Peter aquifer in the Big Spring basin, water year 1990.

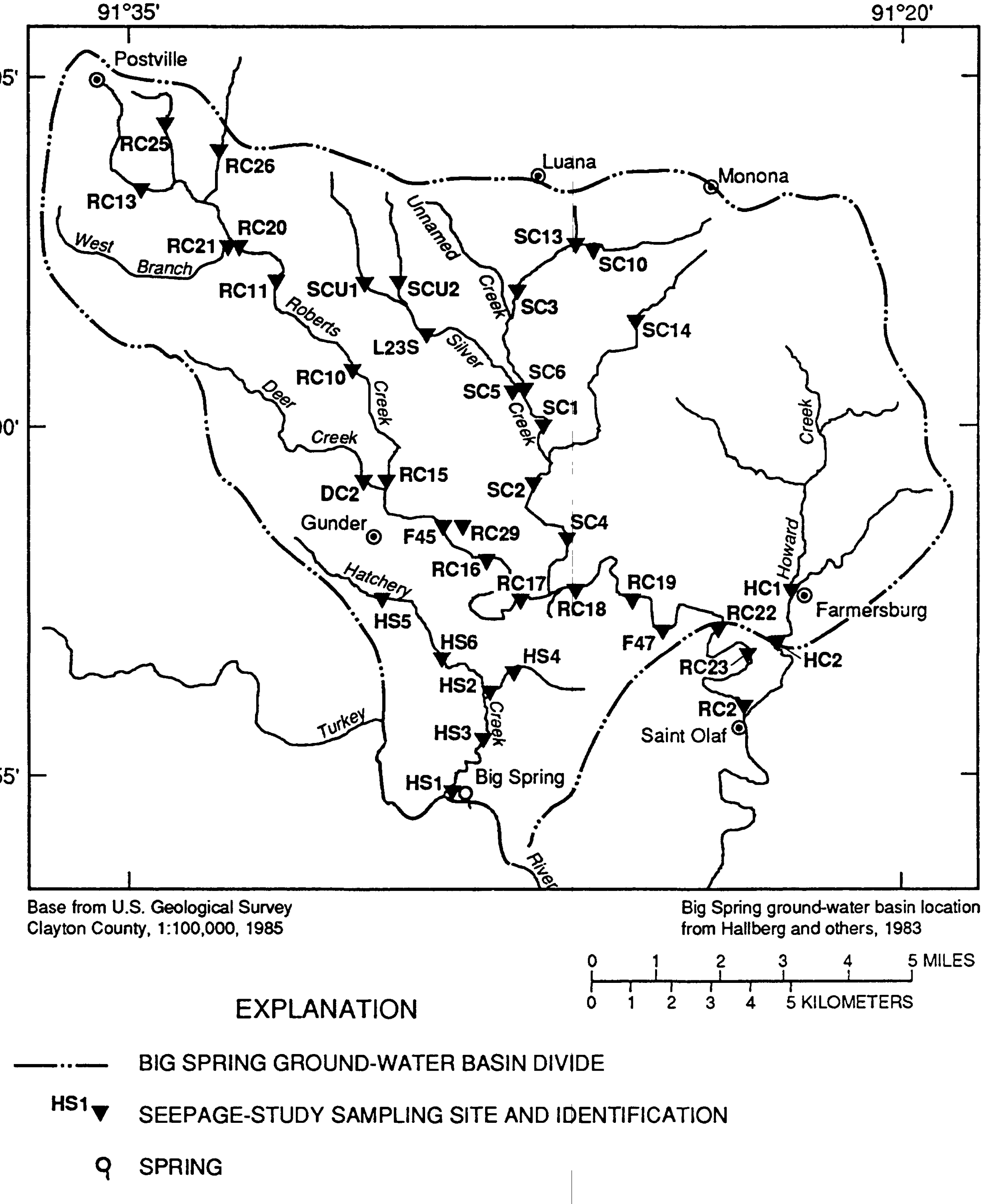

Figure 16. Location of seepage-study sampling sites.

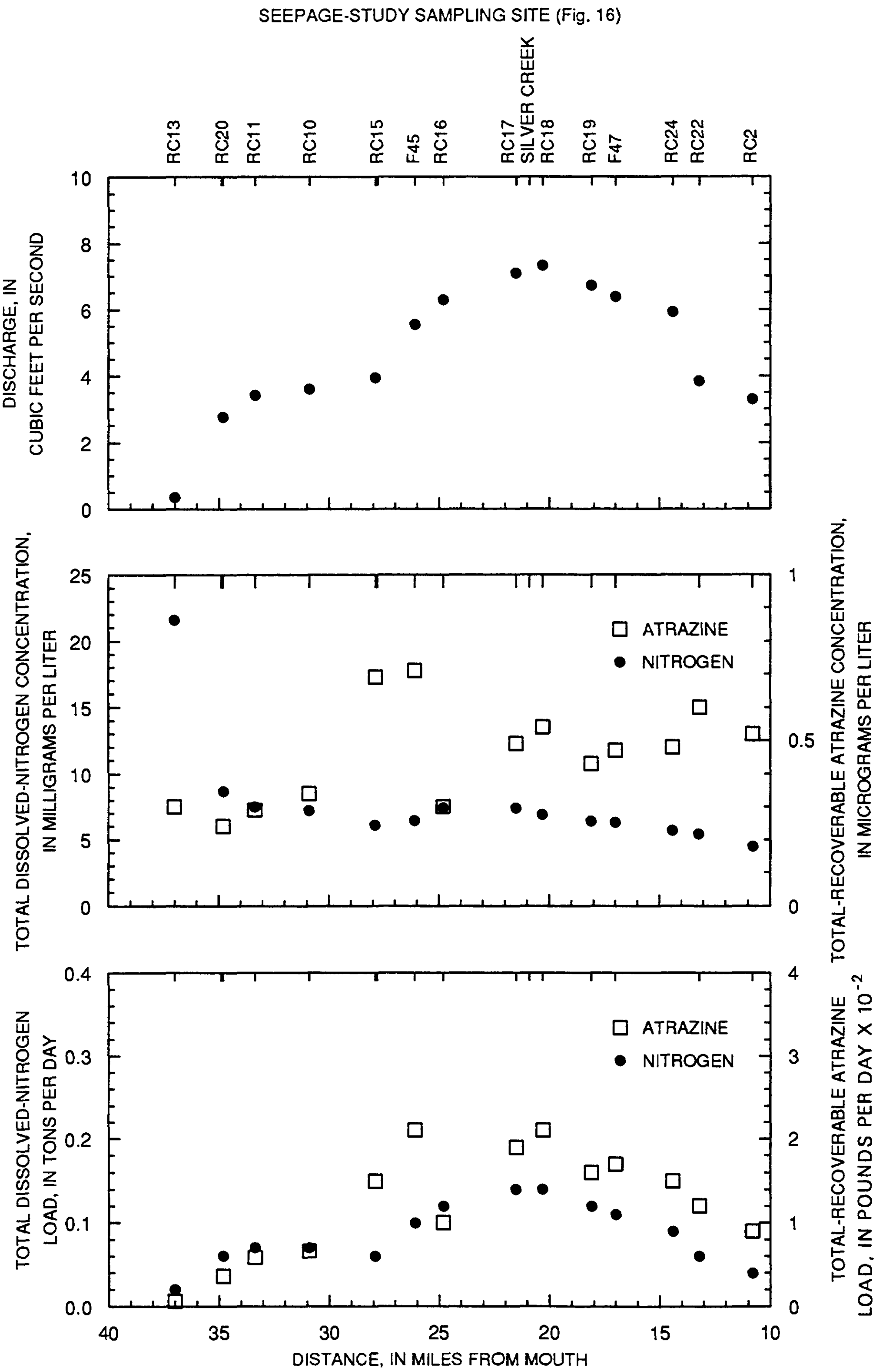

Figure 17. Stream discharge and total dissolved-nitrogen and total-recoverable atrazine concentrations and loads in Roberts Creek, May 29-30, 1990.

to 1.0 μg/L; cyanazine ranged from less than 0.10 to 0.21 μg/L; and metolachlor ranged from less than 0.10 to 1.3 μg/L. Metribuzin was detected in only one sample at 0.23 μg/L. Butylate and trifluralin were not detected.

The measured atrazine load in the main stem of Roberts Creek was greatest (0.021 lb/d) at site RC18, just downstream of the mouth of Silver Creek. Downstream at site RC2, the atrazine load was 0.009 lb/d. The total measured atrazine loss in the main stem of Roberts Creek was about 0.028 lb/d. The total measured atrazine loss in the Big Spring basin during the seepage study was approximately 0.033 lb/d.

Herbicide Degradation Study

Onsite measurements were made, and water-quality samples were collected at six sites on a losing reach of Roberts Creek (fig. 18) to study the degradation of herbicides in small streams. Data were collected from April through November 1990 during stable flow conditions (tables 32-34). Samples were analyzed for two atrazine metabolites and 10 common herbicides. Using the analyses of atrazine and two of its metabolites, a degradation ratio was calculated. The DDAR (deethylatrazine plus deisopropyl-atrazine-to-atrazine ratio) was calculated using the following equation.

$$DDAR = deethylatrazine + deisopropylatrazine/atrazine \, .$$

A total of 40 samples were collected at the six sites. Alachlor was detected in 65 percent of the samples; atrazine in 100 percent; cyanazine in about 15 percent; and metolachlor in 52 percent (table 33). Deethylatrazine was detected in all samples, and deisopropylatrazine was detected in 68 percent of the samples. The DDAR ratio was lowest in the June (fig. 19) samples when the atrazine concentrations were the largest. The highest DDAR ratios were in September and November. Prometon was detected in one sample. Propazine and simazine were detected in about 15 percent of the samples (table 34). Ametryn, prometryn, and terbutryn were not detected.

SELECTED REFERENCES

Buchanan, T.J., and Somers, W.P., 1969, Discharge measurements at gaging stations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A8, 65 p.

Guy, H.P., 1969, Laboratory theory and methods for sediment analysis: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter C1, 58 p.

Guy, H.P., and Norman, V.W., 1970, Field methods for measurement of fluvial sediment: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter C2, 59 p.

Hallberg, G.R., Hoyer, B.E., Bettis, E.A., and Libra, R.D., 1983, Hydrogeology, water quality, and land management in the Big Spring basin, Clayton County, Iowa: Iowa Department of Natural Resources, Geological Survey Bureau Open-File Report 83-3, 191 p.

Hallberg, G.R., Libra, R.D., Bettis, E.A., and Hoyer, B.E., 1984, Hydrogeologic and water quality investigations in the Big Spring basin, Clayton County, Iowa: Iowa Department of Natural Resources, Geological Survey Bureau Open-File Report 84-4, 231 p.

Kalkhoff, S.J., 1989, Hydrologic data for the Big Spring basin, Clayton County, Iowa, water year 1988: U.S. Geological Survey Open-File Report 89-230, 44 p.

Kalkhoff, S.J., and Kuzniar, R.L., 1991, Hydrologic data for the Big Spring basin, Clayton County, Iowa, water year 1989: U.S. Geological Survey Open-File Report 91-63, 66 p.

Kennedy, D.J., 1983, Computation of continuous records of streamflow: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A13, 53 p.

Libra, R.D., Hallberg, G.R., Hoyer, B.E., and Johnson, L.G., 1986, Agricultural impacts on ground water quality--The Big Spring basin study, Iowa: Proceedings of the Agricultural Impacts on Ground Water Conference, p. 253-373.

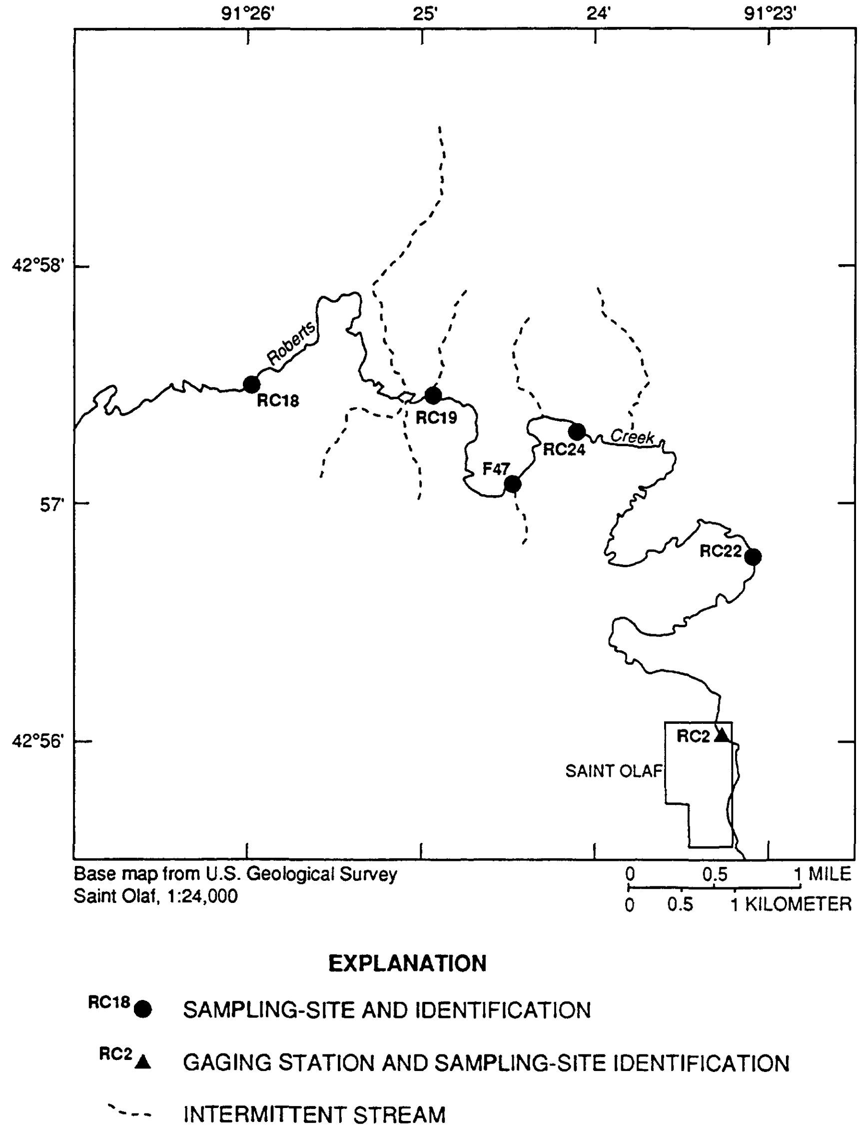

Figure 18. Location of degradation-study sampling sites in a selected reach of Roberts Creek.

National Atmospheric Deposition Program/ National Trends Network, 1988, Instruction manual NADP/NTN site operation: Boulder, Colorado State University Natural Resource Ecology Laboratory.

National Oceanic and Atmospheric Administration, 1990a, Climatological data Iowa August 1990: U.S. Department of Commerce, v. 101, no. 8, 30 p.

_____1990b, Climatological data Iowa September 1990: U.S. Department of Commerce, v. 101, no. 9, 30 p.

Rantz, S.E., and others, 1982a, Measurement and computation of streamflow--Volume 1. Measurement of stage and discharge: U.S. Geological Survey Water-Supply Paper 2175, p. 1-284.

_____1982b, Measurement and computation of streamflow--Volume 2. Computation of discharge: U.S. Geological Survey Water-Supply Paper 2175, p. 285-631.

Rowden, R.D., and Libra, R.D., 1990, Hydrogeologic observations from bedrock monitoring well nests in the Big Spring basin: Iowa Department of Natural Resources, Geological Survey Bureau Open-File Report 90-1, 27 p.

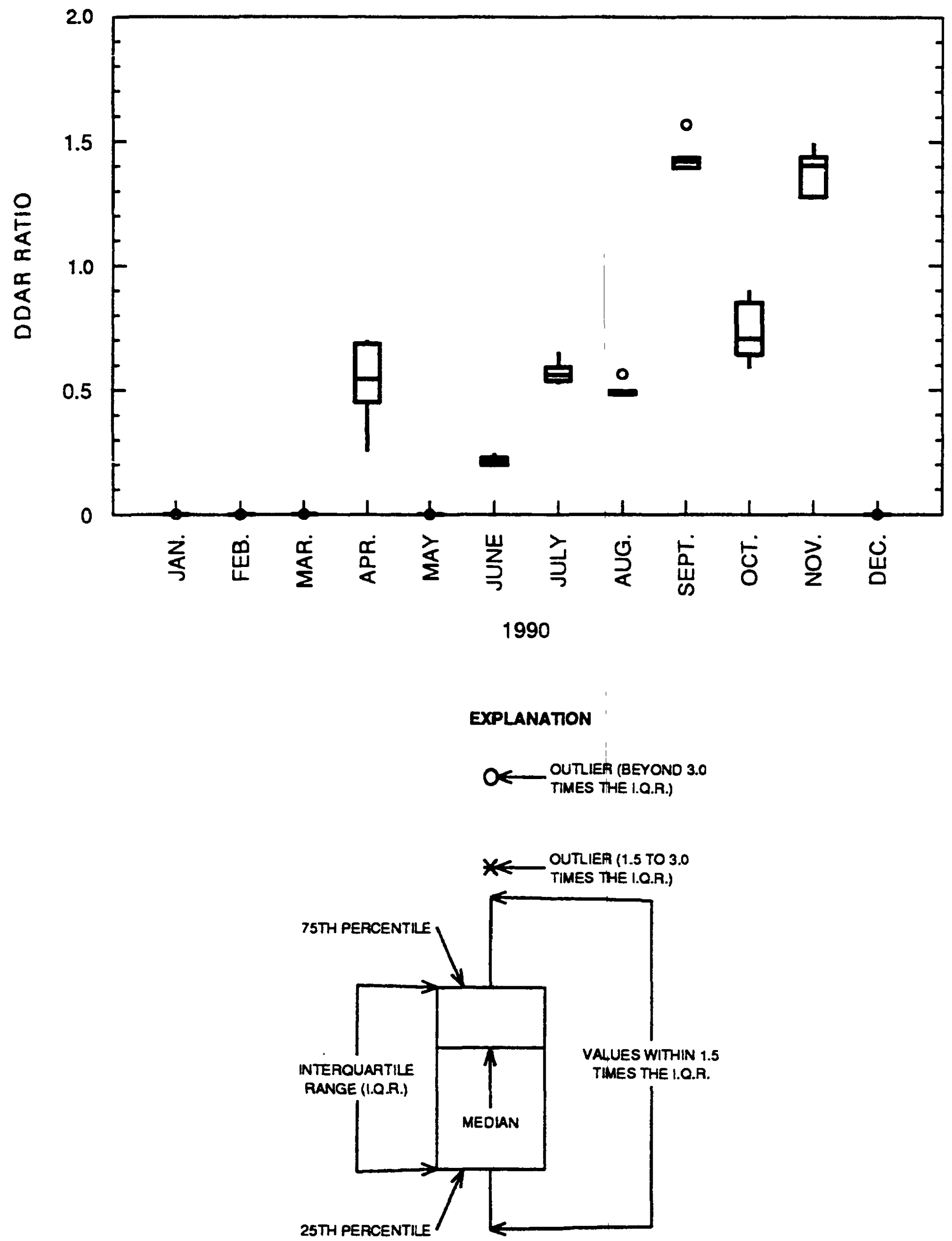

Figure 19. Deethylatrazine plus deisopropylatrazine-to-atrazine ratio (DDAR) in a selected reach of Roberts Creek, April-November 1990.

Thurman, E.M., Meyer, M.T., Pomes, M.L., Perry, C.A., and Schwab, W.P., 1990, Enzyme-linked immunosorbent assay compared with gas chromatography/ mass spectrometry for the determination of triazine herbicides in water: Analytical Chemistry, v. 62, p. 2043-2048.

U.S. Environmental Protection Agency, 1983, Methods for chemical analysis of water and wastes: Cincinnati, Ohio, EPA-600/4-79-020.

Wood, W.W., 1976, Guidelines for collection and field analysis of ground-water samples for selected unstable constituents: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 1, Chapter D2, 24 p

HYDROLOGIC DATA

Table 1. *Records of monitoring sites in the Big Spring basin, Clayton County, Iowa*

[Lat., Latitude; Long., Longitude, mi^2, square miles]

Site designation number (fig.2)	Site identification number	Site name	Location: Lat. (degrees, minutes, seconds)	Location: Long.	Drainage area (mi^2)	Type of record[1]
DC5	430040091325401	Deer Creek near Postville	430400	0913254	1.1	S,QW
BOOGD	05412060	Unnamed Creek near Luana	430224	0912807	1.15	S,P,QW
L23S	05412070	Silver Creek near Luana	430119	0912921	4.39	S
RC2	05412100	Roberts Creek above Saint Olaf	425549	0912303	70.7	S,P,QW
Big Spring	05411950	Big Spring near Elkader	425433	0912801	[2]103	G,P,QW

[1]S, surface water; G, ground water; P, precipitation; QW, water quality.
[2]Ground-water drainage.

Table 2. *Records of selected monitoring wells, lysimeters, and tile line in the Big Spring basin, Clayton County, Iowa*

[Sec., section; T., township; R., range; --, no data; well construction data from Iowa Department of Natural Resources, Geological Survey Bureau]

Site designation (fig. 2)	Site identification number	Location Sec.	T.	R.	Altitude (feet above sea level	Well depth (feet below land surface)	Open interval (feet below land surface)	Aquifer	Frequency of measurement
					Well nest BS1				
BS1-A	425433091285001	NWSE31	94N	05W	855	36	33-36	Unconsolidated	Continuous
BS1-B	425433091285002	NWSE31	94N	05W	855	85	61-85	Galena	Continuous
BS1-D	425433091285004	NWSE31	94N	05W	855	215	173-215	Saint Peter	Monthly
					Well nest BS2				
BS2-A	--	SENW16	94N	05W	950	60	50-60	Galena	Intermittent
BS2-B	--	SENW16	94N	05W	950	127	122-127	Galena	Intermittent
BS2-C	--	SENW16	94N	05W	950	128	118-128	Galena	Intermittent
BS2-D	--	SENW16	94N	05W	950	151	134-151	Galena	Intermittent
BS2-E	425736091260302	SENW16	94N	05W	950	180	165-180	Galena	Continuous
BS2-F		SENW16	94N	05W	950	286	272-286		Intermittent
BS2-G	425736091260303	SENW16	94N	05W	950	335	300-335	Saint Peter	Continuous
					Well nest BS3				
BS3	430145091253001	SWNW22	95N	05W	1,080	397	351-397	Saint Peter	Monthly
BS3-A	430145091253002	SWNW22	95N	05W	1,080	185	165-185	Galena	Continuous
BS3-B	430145091253003	SWNW22	95N	05W	1,080	60	--	Galena	Intermittent
BS3-C	430145091253004	SWNW22	95N	05W	1,080	26	11-26	Unconsolidated	Continuous
					Well nest BS4				
BS4	430133091344801	NWSE20	95N	06W	1,160	580	550-580	Saint Peter	Continuous
BS4-A	430133091344802	NWSE20	95N	06W	1,160	361	261-361	Galena	Continuous
BS4-B	430133091344803	NWSE20	95N	06W	1,160	139	130-139	Unconsolidated	Continuous
BS4-C	430133091344804	NWSE20	95N	06W	1,160	61	50-61	Unconsolidated	Continuous
					Single wells				
DCW1	430040091325402	SESE28	95N	06W	1,070	13	11-13	Unconsolidated	Continuous
DCW2	430040091325403	SESE28	95N	06W	1,070	11	8-11	Unconsolidated	Monthly
DCW3	430040091325410	SESE28	95N	06W	1,100	15	13-15	Unconsolidated	Monthly
					Lysimeters				
DCLA	430040091325404	SESE28	95N	06W	1,070	8.5	--	Unconsolidated	Monthly
DCLB	430040091325405	SESE28	95N	06W	1,070	7.0	--	Unconsolidated	Monthly
DCLC	430040091325406	SESE28	95N	06W	1,070	5.5	--	Unconsolidated	Monthly
DCLD	430040091325407	SESE28	95N	06W	1,070	4.0	--	Unconsolidated	Monthly
					Tile line				
DCT2	430040091325408	SESE28	95N	06W	1,070	--	--	--	Monthly

Table 3. *Location and drainage area of seepage-study sampling sites, Clayton County, Iowa*

[Lat., latitude; Long., longitude; mi^2, square miles; --, no data]

Site designation (fig. 16)	Site identification number	Site name	Location Lat. (minutes, seconds)	Location Long. (degrees, seconds)	Drainage area (mi^2)
HS5	--	Hatchery Creek near Gunder	425734	0913012	1.28
HS6	--	Hatchery Creek southeast of Gunder	425647	0912859	2.84
HS4	--	Hatchery Creek tributary north of Big Spring	425629	0912737	1.36
HS2	--	Hatchery Creek tributary near Big Spring	425606	0912806	1.85
HS3	--	Hatchery Creek near Big Spring	425536	0912806	7.02
HS1	--	Hatchery Creek at Big Spring	425446	0912853	8.80
RC13	--	Roberts Creek tributary near Postville	430327	0913440	2.28
RC25	--	Roberts Creek at Postville	430419	0913413	--
RC26	--	Roberts Creek tributary at Hwy 52	430409	0913312	--
RC21	--	West Branch Roberts Creek at mouth	430244	0913300	4.14
RC20	--	Roberts Creek near Postville	430240	0913253	11.1
RC11	--	Roberts Creek southeast of Postville	430211	0913216	13.2
RC10	--	Roberts Creek near Luana	430057	0913042	15.9
RC15	--	Roberts Creek at Gunder	425908	0913002	18.2
DC2	--	Deer Creek at Gunder	425908	0913025	5.56
F45	--	Roberts Creek east of Gunder	425830	0912858	26.0
RC29	--	Roberts Creek tributary 2 East of Gunder	425830	0912837	--
RC16	--	Roberts Creek north of Big Spring	425806	0912805	28.8
RC17	--	Roberts Creek near Big Spring	425735	0912722	30.4
SC10	--	East Fork Silver Creek near Monona	430240	0912620	3.05
SC13	--	East Fork Silver Creek tributary near Monona	430240	0912606	.28
SC3	--	East Fork Silver Creek near Luana	430203	0912730	4.28
SC6	--	East Fork Silver Creek south of Luana	430054	0912730	9.46
SCU1	--	Silver Creek southwest of Luana	430210	0913033	1.36
SCU2	--	Silver Creek tributary southwest of Luana	430201	0912949	.70
L23S	05412070	Silver Creek near Luana	430119	0912921	4.39
SC5	--	Silver Creek South of Luana	430049	0912744	5.59
SC1	--	Silver Creek northeast of Gunder	430002	0912653	17.3
SC14	--	Silver Creek tributary near Monona	430140	0912510	1.13
SC2	--	Silver Creek near Gunder	425916	0912712	25.2
SC4	--	Silver Creek East of Gunder	425824	0912630	28.8
RC18	--	Roberts Creek northeast of Big Spring	425736	0912603	61.8
RC19	--	Roberts Creek northwest of Saint Olaf	425733	0912510	63.6
F47	--	Roberts Creek west of Farmersburg	425706	0912434	64.3
RC24	--	Roberts Creek near Farmersburg	425724	0912358	65.2
RC22	--	Roberts Creek southwest of Farmersburg	425641	0912226	66.6
RC2	05412100	Roberts Creek above Saint Olaf	425549	0912303	70.7
HC1	--	Howard Creek at Farmersburg	425744	0912209	13.8
HC2	--	Howard Creek near Farmersburg	425648	0912223	17.8

Table 4. *Sample preparation and analytical methods*

[EPA methods from U.S. Environmental Protection Agency (1983). mg/L, milligrams per liter; µg/L, microgram per liter; --, no data]

Sample-preparation method	Chemical constituent
Acidification with nitric acid	Calcium, magnesium, sodium, potassium,
Chill	nitrate plus nitrite, ammonia, organic nitrogen, orthophosphate, organic carbon, alachlor, atrazine butlylate, cyanazine, metoloachlor, metribuzin, metolachlor, trifluralin
Acidification with sulfuric acid	Nitrate plus nitrite, ammonia, orthophosphate

Constituent	Analytical method	Quantitation or detection level
Onsite Measurements		
Stream discharge	Buchanan and Somers, 1969	--
Specific conductance	Wood, 1976	--
pH	Wood, 1976	--
Water temperature	Wood, 1976	--
Oxygen, dissolved	Wood, 1976	--
Bicarbonate, dissolved	Incremental titration	--
Carbonate, dissolved	Incremental titration	--
Alkalinity	Incremental titration	--
Inorganic compounds, dissolved		
Calcium	EPA 215.2	--
Magnesium	EPA 200.7	--
Sodium	EPA 273.1	--
Potassium	EPA 258.1	--
Sulfate	EPA 275.4	--
Chloride	EPA 325.3	--
Silica	EPA 370.1	--
Nutrients, total and dissolved		
Nitrite plus nitrate as nitrogen	EPA 353.2	0.10 mg/L
Ammonia as nitrogen	EPA 350.1	.10 mg/L
Organic nitrogen as nitrogen	EPA 415.1	.10 mg/L
Orthophosphate as phosphorus	EPA 365.1	.10 mg/L
Carbon, total organic as carbon	EPA 415.1	--
Pesticides, total recoverable		
Alachlor	[1]EPA 81.41	.10 µg/L
Atrazine	[1]EPA 81.41	.10 µg/L
Butylate	[1]EPA 81.41	.10 µg/L
Cyanazine	[1]EPA 81.41	.10 µg/L
Metolachlor	[1]EPA 81.41	.10 µg/L
Metribuzin	[1]EPA 81.41	.10 µg/L
Trifluralin	[1]EPA 81.41	.10 µg/L

[1]Modified for use of dual-capillary columns.

Table 5. *Statistical summary of precipitation quantity and quality at Big Spring, water year 1990*

[Constituents in milligrams per liter unless noted otherwise; μS/cm, microsiemens per centimeter at 25 degrees Celsius; N, nitrogen; <, less than detection level indicated]

Constituent	Number of measurable weekly samples	Quantity or concentration Median	Minimum	Maximum
Precipitation (inches)	48	0.26	0	4.53
pH (standard units)	34	5.89	4.19	6.98
Specific conductance (μS/cm)	34	13	5.8	40
Calcium	38	.48	.09	5.3
Magnesium	38	.08	.01	1.0
Sodium	38	.08	.01	.75
Potassium	38	.03	.004	.36
Sulfate	38	1.7	.46	6.8
Chloride	38	.14	.06	.52
Nitrate as N	41	.35	<.01	1.2
Ammonia as N	41	.48	<.01	2.2

Table 6. *Accumulated daily precipitation, water year 1990*

[---, missing data]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
					Unnamed Creek at Luana (site BOOGD, fig. 2)							
1	0	0	0	0	0	0	.02	0	0	0	---	---
2	0	0	0	0	.01	0	.22	0	1.08	0	---	---
3	0	0	0	0	.04	0	0	0	0	0	---	---
4	0	0	0	0	0	0	0	.30	0	.06	---	---
5	.89	.05	0	0	0	0	0	0	.14	.04	---	---
6	0	.08	0	0	0	0	0	0	.01	0	---	---
7	0	.09	0	0	0	0	0	0	.09	.07	---	---
8	0	0	0	.07	0	.08	0	0	.01	0	---	---
9	.04	.02	0	.09	0	.66	0	1.11	0	0	---	---
10	0	0	0	0	0	0	.71	.08	0	.09	---	---
11	0	0	0	0	0	.57	.62	.03	.03	.15	---	---
12	0	0	0	0	0	.14	.11	.02	.87	.35	---	---
13	0	0	0	0	0	1.52	.06	0	.44	0	---	---
14	0	0	0	0	0	.54	.01	0	0	.03	---	---
15	.32	0	0	0	.03	0	.13	.35	.62	0	---	---
16	.39	0	0	.03	.10	0	0	.04	.45	0	---	---
17	0	0	0	.04	0	0	0	0	.45	0	---	---
18	0	0	0	0	0	0	.21	0	0	.96	---	---
19	0	0	.15	0	0	0	.16	1.68	.27	1.47	---	---
20	0	0	0	.07	0	.18	.01	0	0	.04	---	---
21	0	0	0	0	0	0	.01	0	.03	0	---	---
22	0	0	0	0	0	.26	0	0	1.34	0	---	---
23	0	0	0	.03	.05	0	.05	0	0	0	---	---
24	0	0	0	0	0	0	0	0	0	.01	---	---
25	0	0	.01	0	0	0	0	---	0	0	---	---
26	0	0	0	0	0	0	.07	0	.41	.46	---	---
27	.02	.16	.01	0	0	0	.19	.04	.07	0	---	---
28	.17	0	0	0	0	0	0	.42	.04	0	---	---
29	.17	0	0	0		0	0	0	.09	0	---	---
30	.61	0	0	0		0	0	0	.01	0	---	---
31	.01			0		0		0		0		
Total measured	2.62	.40	.17	.33	.23	3.95	2.58	4.07	6.45	3.73	---	---
					Roberts Creek above Saint Olaf (site RC2, fig. 2)							
1	0	0	0	0	0	0	.01	0	.02	0	0	0
2	0	0	0	0	.01	0	.31	0	.73	0	0	0
3	0	0	0	0	.06	0	0	.04	.01	0	.08	.08
4	0	0	0	.01	0	0	0	.29	.02	.05	.04	0
5	.67	.05	0	0	0	0	0	.02	.16	.12	0	0
6	0	.06	0	0	0	0	0	0	---	0	---	.04
7	0	.12	0	0	0	0	0	.01	---	.02	---	0
8	0	0	0	.05	0	.51	0	0	---	0	---	0
9	0	.01	0	.02	0	0	0	1.38	---	0	.05	0
10	0	0	0	0	0	.02	.54	.06	0	.07	.01	0
11	0	0	0	0	0	.64	.47	.03	0	.09	.02	---
12	0	0	0	0	0	.13	.16	.04	1.15	.50	0	---
13	0	0	0	0	0	1.56	.05	0	.27	.01	0	.02
14	0	0	0	0	.01	.39	.05	.01	.02	.02	0	.30
15	.29	0	0	0	.04	.17	.12	.61	.40	.01	0	0
16	.61	.01	0	.04	.11	.01	0	.03	.66	.02	.01	0
17	0	0	0	0	0	.01	0	0	.61	.03	1.76	0
18	0	0	0	0	0	0	.11	0	.02	3.09	.50	.25
19	0	0	0	0	0	0	.21	1.44	.31	1.64	2.65	0
20	0	0	0	.09	0	.17	.02	0	0	.04	.26	.01
21	0	0	0	0	0	.18	0	0	.11	0	0	.03
22	0	0	0	0	0	0	0	0	1.16	0	0	0
23	0	0	0	.04	.07	.01	.07	0	0	.03	.01	0
24	0	0	0	.04	.01	0	0	.13	0	0	3.67	0
25	0	0	0	0	0	0	0	.17	0	0	5.23	0
26	0	0	0	0	0	0	.03	0	.95	.31	.16	.01
27	0	0	0	0	0	0	.03	.03	.05	.79	0	0
28	.25	0	0	0	0	0	.18	.54	.09	.18	0	.02
29	.30	0	0	0		0	.01	0	.12	0	0	0
30	.52	0	0	0		0	.04	0	0	.02	0	---
31	.03			0		0		0		0		
Total measured	2.67	.25	0	.29	.31	3.80	2.41	4.83	6.86	7.04	14.45	.76

Table 7. *Daily mean discharge at site DC5, Deer Creek near Postville, Iowa, water year 1990*

[Discharge in cubic feet per second; ---, data not collected]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.24	0.37	0.27	0.19	---	---	---	---	0.17	0.17	0.25	0.25
2	.20	.34	.23	.19	---	---	---	---	.83	.17	.21	.24
3	.20	.34	.23	.18	---	---	---	.19	.31	.17	.21	.24
4	.21	.35	.23	.19	---	---	---	.21	.24	.15	1.6	.22
5	.39	.32	.26	---	---	---	---	.23	.25	.14	.34	.20
6	.25	.32	.24	---	---	---	---	.21	.24	.13	.28	.20
7	.22	.36	.32	---	---	---	---	.19	.21	.15	.24	.20
8	.23	.31	.24	---	---	---	---	.18	.19	.13	.22	.20
9	.23	.29	.23	---	---	---	---	.33	.17	.12	.20	.19
10	.23	.27	.21	---	---	---	---	.23	.15	.14	.20	.18
11	.24	.27	.23	---	---	---	---	.25	.15	.16	.20	.18
12	.25	.27	.22	---	---	---	---	.23	.55	.28	.18	.17
13	.25	.27	.23	---	---	---	---	.25	1.5	.19	.18	.17
14	.25	.27	.21	---	---	---	---	.26	.38	.17	.17	.17
15	.30	.27	.20	---	---	---	---	.31	1.2	.16	.15	.16
16	.65	.26	.19	---	---	---	---	.28	.70	.15	.15	.16
17	.31	.27	.19	---	---	---	---	.30	1.3	.14	.31	.16
18	.31	.28	.19	---	---	---	---	.30	.47	.41	.46	.17
19	.32	.29	.26	---	---	---	---	.29	.44	.55	.68	.18
20	.32	.30	.20	---	---	---	---	.30	.36	.43	.75	.17
21	.31	.29	.18	---	---	---	---	.29	.30	.27	.49	.16
22	.29	.29	.17	---	---	---	---	.28	2.4	.22	.38	.16
23	.29	.27	.16	---	---	---	---	.30	.60	.20	.30	.16
24	.29	.32	.17	---	---	---	---	.26	.43	.20	2.7	.16
25	.29	.31	.19	---	---	---	---	.33	.33	.18	1.1	.14
26	.29	.30	.17	---	---	---	---	.31	.29	.22	1.5	.14
27	.29	.28	.17	---	---	---	---	.27	.25	.65	.80	.13
28	.29	.27	.18	---	---	---	---	.33	.25	.47	.51	.13
29	.35	.27	.18	---		---	---	.28	.28	.50	.42	.13
30	.59	.25	.19	---		---	---	.20	.21	.33	.34	.13
31	.45		.20	---		---		.18		.27	.29	

Table 8. *Onsite determinations of selected water-quality constituents at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*

[ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; --, missing data]

Date	Time (24-hour)	Instantaneous discharge (ft^3/s)	Specific conductance (µS/cm)	pH (standard units)	Water temperature (°C)	Dissolved oxygen (mg/L)
			Site DC5, Deer Creek (fig. 2)			
10-04-89	1145	0.25	554	8.2	7.0	14.3
10-05-89	1300	.80	540	7.4	9.0	--
11-08-89	0800	.18	550	7.9	7.5	12.3
12-05-89	1000	.17	525	8.0	1.0	14.5
01-04-90	0900	--	553	7.8	1.0	11.2
02-07-90	1015	.26	528	7.7	0	11.4
02-08-90	1200	.59	400	7.7	0.5	--
02-08-90	1425	--	248	7.6	.5	--
03-06-90	0845		578	7.9	0.0	13.3
03-08-90	2000	3.0	315	7.6	1.0	--
03-09-90	1325	.82	435	7.6	2.0	13.2
03-16-90	1115	--	648	7.8	6.0	--
04-03-90	0840	--	567	8.0	2.0	--
05-02-90	0900	.18	573	8.2	7.0	13.8
05-09-90	0415	.31	572	7.6	13.0	--
05-09-90	0830	.68	490	7.8	12.0	7.9
05-09-90	1200	.47	460	7.7	12.0	--
06-05-90	1045	.21	585	7.7	11.0	--
06-13-90	1045	2.8	300	7.2	17.0	--
06-13-90	1115	7.1	231	7.2	17.0	--
06-22-90	1130	4.1	425	7.1	15.0	--
06-22-90	1445	2.0	500	7.3	16.0	--
06-23-90	0900	.62	615	7.4	15.0	--
07-02-90	0900	.17	600	7.4	17.0	9.5
08-02-90	0850	.21	592	--	13.5	10.1
08-20-90	1410	.43	615	--	18.0	--
08-26-90	1340	.88	680	7.5	22.0	--
09-06-90	0750	.21	615	7.8	17.0	6.7

Table 8. *Onsite determinations of selected water-quality constituents at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Instantaneous discharge (ft^3/s)	Specific conductance ($\mu S/cm$)	pH (standard units)	Water temperature (°C)	Dissolved oxygen (mg/L)
		Site BOOGD, Unnamed Creek near Luana (fig. 2)				
02-06-90	1200	--	345	7.8	0	13.3
03-08-90	1300	24	280	7.6	.5	--
03-08-90	2250	1.3	360	7.6	1.0	--
06-13-90	1305	5.0	220	7.0	19.0	--
06-22-90	1150	4.7	340	7.1	15.0	--
06-22-90	1600	1.3	540	7.1	18.0	--
06-23-90	1000	.09	880	7.8	17.0	--
07-20-90	1400	.09	1,000	--	30.0	6.0
08-01-90	1625	.05	1,100	7.9	28.5	6.8
08-07-90	0815	.04	--	--	15.0	--
08-20-90	1215	.24	765	8.4	20.0	--
08-26-90	1445	13	790	7.6	23.0	--
09-05-90	1540	1.3	870	7.6	27.5	4.0
		Site RC2, Roberts Creek above Saint Olaf (fig. 2)				
01-22-90	1230	7.5	500	7.4	0.5	--
01-31-90	1415	3.1	672	7.7	2.0	--
02-06-90	0930	191	350	7.7	0	--
02-07-90	1320	38	--	--	--	--
02-07-90	1430	37	297	7.7	0	12.2
02-08-90	1500	191	365	7.7	.5	--
03-06-90	1300	3.5	450	7.7	0	12.0
03-08-90	1630	483	255	7.7	5.0	--
03-08-90	1915	1,210	315	7.6	1.0	--
03-08-90	1950	1,180	290	7.7	1.5	12.0
03-09-90	0845	153	320	7.6	0	13.2
03-10-90	0720	34	352	7.6	1.5	12
03-12-90	1000	71	446	7.7	2.0	--
03-16-90	1430	22	690	8.2	7.0	--
04-03-90	1345	2.6	640	9.1	8.5	--

Table 8. *Onsite determinations of selected water-quality constituents at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Instantaneous discharge (ft^3/s)	Specific conductance (μS/cm)	pH (standard units)	Water temperature (°C)	Dissolved oxygen (mg/L)
Site RC2, Roberts Creek above Saint Olaf--continued						
04-14-90	0110	2.9	523	8.6	5.5	--
05-01-90	1030	.84	621	8.2	12.5	9.6
05-20-90	1200	31	--	8.2	12.0	--
06-06-90	1320	6.9	630	7.8	16.0	9.2
06-17-90	1410	28	572	7.8	22.0	--
06-22-90	1300	41	666	7.6	21.0	--
06-22-90	1730	46	534	7.6	19.5	--
06-23-90	0630	73	608	7.3	17.0	--
07-03-90	0730	8.2	742	8.1	23.0	6.0
07-16-90	1330	2.6	606	8.0	28.0	--
07-20-90	1000	37	516	7.7	20.5	7.0
08-02-90	1330	6.1	690	8.4	24.0	12.1
08-08-90	1910	5.3	603	8.6	25.0	--
08-19-90	0255	15	553	8.1	24.0	--
08-20-90	0115	19	577	8.1	22.5	--
08-20-90	0515	27	631	8.1	21.5	--
08-20-90	1115	23	596	8.0	21.0	--
08-24-90	2050	19	667	8.1	23.5	--
08-25-90	0755	573	588	5.4	25.5	--
08-25-90	1205	437	462	7.1	19.5	--
08-25-90	1455	751	480	7.2	19.5	--
08-25-90	2135	262	508	7.3	20.0	--
08-26-90	0135	176	545	7.4	20.0	--
08-26-90	1015	113	588	7.7	20.0	--
08-26-90	1610	97	629	7.8	22.0	--
08-27-90	0535	72	693	7.7	21.0	--
08-27-90	1340	62	775	8.0	23.0	--
08-28-90	1320	42	787	8.0	25.0	--
08-30-90	1050	27	796	8.0	20.0	--
09-06-90	1210	.42	736	8.2	26.0	11.8

Table 9. *Concentrations of major ions at selected surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*

[Dissolved constituents are in milligrams per liter; --, data not collected; <, less than]

Date	Time (24-hour)	Calcium	Magne-sium	So-dium	Pot-tas-sium	Bi-carbo-nate	Car-bo-nate	Sul-fate	Chlo-ride	Silica
Site DC5, Deer Creek (fig. 2)										
10-04-89	1145	68	23	4.0	1.2	--	--	26	11	24
11-08-89	0800	85	28	4.7	1.6	360	0	31	12	18
12-05-89	1000	80	28	4.5	0.7	330	0	26	9.5	--
08-02-90	0850	110	30	5.3	1.0	--	--	34	11	24
09-06-90	0750	83	30	5.7	2.1	380	0	3.0	11	25
Site RC2, Roberts Creek above Saint Olaf (fig. 2)										
03-12-90	1000	33	12	4.6	27	--	--	23	34	12
04-03-90	1345	73	31	16	6.7	--	--	46	35	4.1
06-06-90	1320	66	27	11	12	270	0	41	28	--
07-20-90	1000	54	25	11	13	--	--	--	25	7.4
08-02-90	1330	110	39	10	9.4	--	--	46	31	6.6
09-06-90	1210	80	40	11	4.8	260	50	44	28	8.5

Table 10. *Selected nitrogen, phosphorus, and carbon species at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*

[Total constituents in milligrams per liter; N, nitrogen; P, phosphorus; C, carbon; --, data not collected; <, less than detection level indicated]

Date	Time (24-hour)	Nitrite plus nitrate, total (as N)	Ammonia, total (as N)	Organic nitrogen, total (as N)	Ortho-phos-phorus, total (as P)	Organic carbon, total (as C)
		Site DC5, Deer Creek (fig. 2)				
12-05-89	1000	3.3	<0.10	0.3	<0.10	1.4
01-04-90	0900	3.4	.10	.2	< .10	2.0
02-07-90	1015	2.7	2.8	3.4	.40	19
02-08-90	1200	1.8	3.4	6.1	1.1	28
02-08-90	1425	.9	3.1	8.6	2.0	25
03-06-90	0845	3.3	< .10	.4	< .10	2.4
03-08-90	2000	1.6	3.8	7.4	1.8	43
03-09-90	1325	2.8	3.0	5.4	1.0	43
03-16-90	1115	8.5	.40	1.2	.10	8.0
04-03-90	0840	3.1	< .10	.30	< .10	3.1
05-02-90	0900	2.1	< .10	.20	< .10	5.3
05-09-90	0415	1.4	< .10	.80	< .10	5.3
05-09-90	0830	.90	< .10	1.5	.20	12
05-09-90	1200	.70	< .10	1.3	< .10	12
06-05-90	1045	3.5	< .10	.60	.20	4.0
06-13-90	1045	1.5	.30	--	.80	41
06-13-90	1115	11	.40	9.9	1.5	74
06-22-90	1130	3.5	.20	3.0	.60	18
06-22-90	1445	6.6	.20	2.7	.60	16
06-23-90	0900	9.0	< .10	1.3	< .10	10
07-02-90	1000	3.3	< .10	.30	< .10	3.5
08-02-90	0850	2.8	< .10	.90	< .10	3.7
08-20-90	1410	3.7	.10	1.7	--	--
08-26-90	1340	17	.10	2.5	.10	17
09-06-90	0750	2.7	< .10	.50	.10	4.7

Table 10. *Selected nitrogen, phosphorus, and carbon species at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Nitrite plus nitrate, total (as N)	Ammonia, total (as N)	Organic nitrogen, total (as N)	Ortho-phos-phorus, total (as P)	Organic carbon, total (as C)
Site BOOGD, Unnamed Creek near Luana (fig. 2)						
02-06-90	1200	2.5	3.0	7.1	1.6	29
02-08-90	1300	1.5	2.8	8.7	1.7	33
02-22-90	1120	2.0	2.3	4.4	.9	35
03-08-90	2250	5.3	2.6	7.5	1.4	46
06-13-90	1305	9.4	.20	7.9	1.2	48
06-22-90	1150	12	.10	3.6	.50	22
06-22-90	1600	7.0	< .10	1.8	.40	15
06-23-90	1000	9.0	< .10	.9	.20	4.0
07-02-90	1415	6.0	1.7	2.9	.20	40
07-20-90	1400	5.0	2.9	14	--	21
08-01-90	1625	14	5.3	7.1	.20	9.8
08-07-90	0815	1.0	.10	.80	--	--
08-20-90	1215	6.0	.10	1.0	--	--
08-26-90	1445	30	.30	3.8	.10	6.0
09-05-90	1540	9.0	1.8	11	.10	9.8
Site RC2, Roberts Creek above Saint Olaf (fig. 2)						
01-22-90	1230	1.9	3.3	--	1.6	40
01-31-90	1415	.60	2.3	1.9	--	--
02-06-90	0930	2.0	3.7	8.6	2.10	22
02-07-90	1430	2.1	3.2	6.2	1.5	23
02-08-90	1500	2.1	4.0	7.1	1.9	27
03-06-90	1300	1.3	2.5	2.6	.60	17
03-08-90	1630	2.0	2.4	7.3	1.2	38
03-08-90	1915	2.2	3.2	13	1.2	93
03-08-90	1950	2.3	3.3	16	.90	86
03-09-90	0845	3.0	3.4	10	1.9	47

Table 10. *Selected nitrogen, phosphorus, and carbon species at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Nitrite plus nitrate, total (as N)	Ammonia, total (as N)	Organic nitrogen, total (as N)	Ortho-phos-phorus, total (as P)	Organic carbon, total (as C)
Site RC2, Roberts Creek above Saint Olaf--Continued						
03-10-90	0720	3.1	3.6	8.0	1.8	48
03-12-90	1000	6.4	2.8	8.8	1.0	31
03-16-90	1430	10	1.8	2.9	1.0	15
04-03-90	1345	2.7	< .10	.50	.20	4.0
04-14-90	0110	2.1	< .10	.80	--	--
05-01-90	1030	< .10	< .10	1.1	.20	4.7
05-20-90	1200	1.9	.50	1.7	--	--
06-06-90	1320	7.0	.60	1.7	.60	8.6
06-17-90	1410	6.8	.80	2.4	.90	12
06-22-90	1300	12	< .10	1.1	.30	6.8
06-22-90	1730	9.1	< .10	1.6	.30	12
06-23-90	0630	13	.4	2.0	.80	16
07-03-90	0730	9.5	< .10	.8	.30	4.9
07-16-90	1330	2.0	< .10	.8	--	--
07-20-90	1000	2.8	.4	2.0	.70	12
08-02-90	1330	4.3	< .10	1.1	.40	6.8
08-08-90	1910	4.4	--	1.7	--	--
08-20-90	0115	1.3	< .10	1.1	--	--
08-20-90	1115	1.9	.30	1.9	--	--
08-24-90	2050	4.8	< .10	1.7	.60	8.3
08-25-90	0755	2.4	.70	12	.30	6.7
08-25-90	1205	2.6	1.2	15	.50	7.9
08-25-90	1455	4.8	2.6	20	.20	9.4
08-25-90	2135	7.7	1.0	7.1	.30	9.1
08-26-90	0135	3.0	.70	2.7	.40	8.6
08-26-90	1015	18	.60	1.8	.40	8.2
08-26-90	1610	2.0	.40	1.8	.40	7.9
08-27-90	0535	4.0	.30	1.4	.30	7.5
08-27-90	1340	3.3	.20	1.2	.30	6.3
08-28-90	1320	3.0	< .10	1.2	.40	--
09-06-90	1210	9.8	< .10	.80	.20	3.9
09-13-90	0030	5.5	< .10	.90	--	--

Table 11. *Selected pesticides at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*

[Total-recoverable constituents in micrograms per liter; <, less than detection level indicated]

Date	Time (24-hour)	Ala-chlor	Atra-zine	Buty-late	Cyana-zine	Metola-chlor	Metri-buzin	Tri-flur-alin
			Site DC5, Deer Creek (fig. 2)					
10-04-89	1145	<0.10	0.18	<0.10	0.20	<0.10	<0.10	<0.10
10-05-89	1300	< .10	.10	< .10	.36	< .10	< .10	< .10
11-08-89	0800	< .10	< .10	< .10	<. 10	< .10	< .10	< .10
12-05-89	1000	< .10	< .10	< .10	< .10	< .10	< .10	< .10
01-04-90	0900	< .10	< .10	< .10	< .10	< .10	< .10	< .10
02-07-90	1015	< .10	1.4	< .10	< .10	< .10	< .10	< .10
02-08-90	1200	< .10	2.8	< .10	< .10	< .10	< .10	< .10
02-08-90	1425	< .10	2.1	< .10	< .10	.25	< .10	< .10
03-06-90	0845	< .10	< .10	< .10	< .10	< .10	< .10	< .10
03-08-90	2000	< .10	3.0	< .10	< .10	< .10	< .10	< .10
03-09-90	1325	< .10	2.3	< .10	< .10	< .10	< .10	< .10
03-16-90	1115	< .10	.46	< .10	< .10	< .10	< .10	< .10
04-03-90	0840	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-02-90	0900	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-09-90	0415	< .10	4.7	< .10	.25	2.6	< .10	< .10
05-09-90	1200	.35	1.3	< .10	< .10	.83	< .10	< .10
06-05-90	1045	< .10	.3	< .10	< .10	< .10	< .10	< .10
06-13-90	1045	.15	47	< .10	1.4	61	< .10	< .10
06-13-90	1115	< .10	55	< .10	12	69	< .10	< .10
06-22-90	1130	< .10	5.2	< .10	1.2	3.0	< .10	< .10
06-22-90	1445	< .10	2.5	< .10	.48	1.1	< .10	< .10
06-23-90	0900	< .10	.93	< .10	< .10	.40	< .10	< .10
07-02-90	0900	< .10	.15	< .10	< .10	< .10	< .10	< .10
08-02-90	0850	< .10	< .10	< .10	< .10	< .10	< .10	< .10
08-20-90	1410	< .10	.14	< .10	< .10	< .10	< .10	< .10
08-26-90	1340	< .10	.37	< .10	< .10	< .10	< .10	< .10
09-06-90	0750	< .10	< .10	< .10	< .10	< .10	< .10	< .10

Table 11. *Selected pesticides at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Ala-chlor	Atra-zine	Buty-late	Cyana-zine	Metola-chlor	Metri-buzin	Tri-flur-alin
		Site BOOGD Unnamed Creek near Luana (fig. 2)						
02-06-90	1200	<0.10	3.6	<0.10	0.35	<0.10	<0.10	<0.10
02-08-90	1300	< .10	4.7	< .10	.41	.46	< .10	< .10
02-22-90	1120	.13	1.2	< .10	< .10	< .10	< .10	< .10
03-08-90	2250	< .10	5.2	< .10	.18	< .10	< .10	< .10
06-13-90	1305	8.6	19	< .10	2.4	2.1	< .10	< .10
06-22-90	1150	1.6	7.0	< .10	1.4	3.8	< .10	< .10
06-22-90	1600	1.6	13	< .10	7.2	.30	< .10	< .10
06-23-90	1000	.15	1.8	< .10	.22	.12	< .10	< .10
07-02-90	1415	< .10	1.5	< .10	.23	< .10	< .10	< .10
07-20-90	1400	< .10	1.2	< .10	.15	< .10	< .10	< .10
08-01-90	1625	< .10	.57	< .10	< .10	< .10	< .10	< .10
08-20-90	1215	< .10	.63	< .10	< .10	< .10	< .10	< .10
08-26-90	1445	< .10	1.4	< .10	< .10	< .10	< .10	< .10
09-05-90	1540	< .10	.46	< .10	< .10	< .10	< .10	< .10
		Site RC2, Roberts Creek above Saint Olaf (fig. 2)						
01-22-90	1230	0.44	3.6	<0.10	0.30	0.47	<0.10	<0.10
01-31-90	1415	.14	1.4	< .10	< .10	.23	< .10	< .10
02-06-90	0930	< .10	1.6	< .10	.35	.23	< .10	< .10
02-07-90	1430	< .10	1.9	< .10	< .10	.38	< .10	< .10
02-08-90	1500	< .10	2.1	< .10	.21	.25	< .10	< .10
03-06-90	1300	< .10	1.3	< .10	< .10	< .10	< .10	< .10
03-08-90	1630	< .10	.81	< .10	.35	< .10	< .10	< .10
03-08-90	1915	.13	2.0	< .10	.17	< .10	< .10	< .10
03-08-90	1950	.18	2.5	< .10	.14	< .10	< .10	< .10
03-09-90	0845	.21	3.7	< .10	.27	.34	< .10	< .10

Table 11. *Selected pesticides at surface-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Ala- chlor	Atra- zine	Buty- late	Cyana- zine	Metola- chlor	Metri- buzin	Tri- flur- alin
			Roberts Creek above St. Olaf--Continued					
03-10-90	0720	0.17	3.7	<0.10	0.25	0.29	1.2	<0.10
03-12-90	1000	.40	5.5	< .10	.40	.97	< .10	< .10
03-16-90	1430	1.2	3.9	< .10	.25	.17	< .10	< .10
04-03-90	1345	< .10	.19	< .10	< .10	< .10	< .10	< .10
05-01-90	1030	< .10	.21	< .10	< .10	< .10	< .10	< .10
06-06-90	1320	6.6	3.0	< .10	2.6	7.4	< .10	< .10
06-17-90	1410	< .10	11	< .10	3.4	3.4	1.6	< .10
06-22-90	1600	1.6	11	< .10	3.4	3.4	< .10	< .10
06-22-90	1730	8.2	12	< .10	8.5	< .10	< .10	< .10
06-23-90	0630	.83	7.0	< .10	.46	.20	< .10	< .10
07-03-90	0730	< .10	.90	< .10	.14	< .10	< .10	< .10
07-20-90	1000	.26	.91	< .10	.34	< .10	< .10	< .10
08-02-90	1330	< .10	1.4	< .10	.20	< .10	< .10	< .10
08-19-90	0255	< .10	.25	< .10	< .10	< .10	< .10	< .10
08-20-90	0515	< .10	.16	< .10	< .10	< .10	< .10	< .10
08-25-90	0150	.20	.91	< .10	.11	< .10	< .10	< .10
08-25-90	1045	< .10	1.2	< .10	< .10	< .10	< .10	< .10
08-25-90	1815	.75	1.7	< .10	.22	.18	< .10	< .10
08-26-90	1015	.74	1.7	< .10	.20	.17	< .10	< .10
08-26-90	1535	.50	1.7	< .10	.19	.14	< .10	< .10
08-27-90	0335	.35	1.2	< .10	.12	< .10	< .10	< .10
08-27-90	1340	.20	.94	< .10	< .10	< .10	< .10	< .10
08-28-90	1320	< .10	1.1	< .10	< .10	< .10	< .10	< .10
09-06-90	1210	< .10	.26	< .10	< .10	< .10	< .10	< .10

Table 12. *Stable isotopic ratios at sites in the Deer Creek subbasin, Clayton County, Iowa, water year 1990*

[units are per mil]

Date	Hydrogen, 2:1 ratio	Oxygen, 18:16 ratio
Deer Creek (Site DC5, fig. 2)		
10-04-89	-54.0	-8.30
10-05-89	-48.5	-7.75
11-08-89	-54.5	-8.55
12-05-89	-53.0	-8.40
5-09-90	-53.5	-8.25
5-09-90	-51.5	-8.10
5-09-90	-51.0	-8.00
6-22-90	-72.0	-10.30
6-22-90	-64.0	-9.55
7-02-90	-53.5	-8.35
8-02-90	-54.0	-8.25
Deer Creek (well DCW2,fig. 2)		
10-04-89	-54.5	-8.20
11-08-89	-55.0	-8.25
12-05-89	-52.0	-8.30
7-02-90	-53.0	-8.35
8-02-90	-52.0	-8.15
Deer Creek (well DCW3, fig. 2)		
11-08-89	-56.0	-8.55
12-05-89	-54.5	-8.50
7-02-90	-53.5	-8.55
8-02-90	-54.0	-8.50
Deer Creek (tileline DCT2, fig. 2)		
7-02-90	-49.5	-8.05
8-02-90	-50.5	-7.75

Table 13. *Daily mean discharge at site L23S, Silver Creek near Luana, Iowa, water year 1990*

[Discharge in cubic feet per second]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.07	0.22	0.07	0	0	0.70	0.24	0.25	0.56	1.4	0.92	2.8
2	.07	.19	.09	0	0	.50	.27	.25	5.1	1.3	.88	2.4
3	.07	.16	.03	0	0	.35	.23	.25	1.8	1.2	.93	2.4
4	.04	.17	.08	0	0	.26	.25	.30	.79	1.2	23	2.4
5	.22	.17	.15	0	.02	.20	.25	.30	.70	1.1	2.3	2.2
6	.13	.17	.12	0	.10	.13	.20	.30	.67	.99	1.5	1.6
7	.09	.17	.06	0	3.0	.12	.18	.28	.61	.97	1.3	1.5
8	.08	.16	.04	.01	.80	55	.21	.25	.60	.97	1.3	1.5
9	.09	.11	.03	.02	.25	2.9	.26	.52	.56	.97	1.1	1.5
10	.10	.10	.03	.02	.15	.89	.40	.46	.52	.97	1.1	1.4
11	.10	.10	.02	.01	.06	30	.32	.38	.52	.97	1.1	1.4
12	.09	.10	0	0	.13	3.0	.27	.35	1.3	.97	.98	1.3
13	.08	.10	0	0	.08	2.6	.27	.35	6.3	.94	.90	1.1
14	.08	.10	0	0	.06	1.5	.27	.35	1.0	.88	.88	1.1
15	.10	.10	0	0	.04	.81	.27	.35	3.1	.88	.88	1.1
16	.30	.07	0	.01	.03	.49	.27	.41	2.2	.88	.81	.98
17	.16	.07	0	.03	.02	.40	.28	.41	4.8	.83	.94	.89
18	.14	.06	0	.02	.03	.26	.30	.41	2.0	1.3	1.0	.88
19	.14	.08	0	.01	.02	.24	.30	2.3	1.3	3.6	4.5	.88
20	.14	.11	0	.01	.02	.25	.30	2.1	1.2	2.6	3.4	.88
21	.14	.07	0	.02	.01	.27	.30	1.0	.99	1.4	1.9	.88
22	.12	.08	0	.02	.02	.33	.30	.81	6.4	1.3	1.3	.88
23	.12	.08	0	.01	.03	.25	.29	.74	5.5	1.2	1.2	.88
24	.11	.07	0	0	.02	.22	.27	.71	4.1	1.2	5.4	.81
25	.09	.08	0	0	.02	.26	.26	.64	3.0	1.2	107	.77
26	.10	.08	0	0	.01	.25	.25	.62	2.4	1.2	15	.74
27	.10	.11	0	0	.02	.22	.27	.58	2.1	3.0	8.3	.74
28	.10	.07	0	0	.04	.22	.29	.64	1.8	1.9	6.0	.74
29	.10	.04	0	0		.22	.30	.64	1.6	1.5	5.1	.72
30	.28	.04	0	0		.22	.27	.60	1.5	1.4	4.1	.69
31	.31		0	0		.22		.56		.96	3.4	

Table 14. *Daily mean discharge at site BOOGD, Unnamed Creek near Luana, Iowa, water year 1990*

[Discharge in cubic feet per second]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0	0	0	0	0	0.25	0	0	0	0.15	0.09	0.94
2	0	0	0	0	0	.15	0	0	.01	.09	.04	.80
3	0	0	0	0	0	.11	0	0	0	.08	.06	.80
4	0	0	0	0	0	.08	0	0	0	.08	4.7	.94
5	.01	0	0	0	.07	.05	0	0	0	.07	.07	.86
6	0	0	0	0	.22	.02	0	0	0	.23	.04	.35
7	0	0	0	0	.4	0	0	0	0	.20	.05	.24
8	0	0	0	0	.52	2.5	0	0	0	.13	.07	.17
9	0	0	0	0	.3	.32	0	0	0	.24	.52	.28
10	0	0	0	0	.15	.04	0	0	0	.17	1.2	.28
11	0	0	0	0	.1	4.7	0	0	0	.07	1.1	.16
12	0	0	0	0	.13	1.4	0	0	0	.11	1.0	.15
13	0	0	0	0	.09	.89	0	0	1.0	.08	.79	.14
14	0	0	0	0	.06	.23	0	0	.05	.07	.48	.12
15	0	0	0	0	.04	.04	0	0	.57	.06	.17	.13
16	.01	0	0	.02	.02	0	0	0	1.0	.07	.10	.11
17	0	0	0	.01	.01	0	0	0	.62	.05	.54	.09
18	0	0	0	0	.03	0	0	.01	.11	.12	.40	.08
19	0	0	0	0	.02	0	0	0	.10	.59	1.6	.09
20	0	0	0	0	.02	0	0	0	.11	.11	.46	.12
21	0	0	0	0	.02	0	0	0	.07	.08	.24	.08
22	0	0	0	.02	.03	0	0	0	1.7	.06	.19	.06
23	0	0	0	.01	.02	0	0	.01	.09	.06	.34	.06
24	0	0	0	0	.01	0	0	0	.09	.06	1.9	.05
25	0	0	0	0	.01	0	0	0	.07	.11	21	.06
26	0	0	0	0	0	0	0	0	.08	.08	9.1	.15
27	0	0	0	0	.02	0	0	0	.08	.27	3.0	.22
28	0	0	0	0	.03	0	0	0	.08	.27	2.2	.07
29	0	0	0	0		0	0	0	.09	.23	1.6	.07
30	.01	0	0	0		0	0	0	.08	.38	1.4	.07
31	0		0	0		0		.01		.25	1.0	

Table 15. *Daily mean suspended-sediment concentrations and daily suspended-sediment load at site BOOGD, Unnamed Creek near Luana, Iowa, water year 1990*

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
				Daily mean suspended-sediment concentration, in milligrams per liter								
1	---	---	---	---	---	192	---	---	---	13	25	27
2	---	---	---	---	---	649	---	---	---	12	25	26
3	---	---	---	---	---	405	---	---	---	13	25	25
4	---	---	---	---	---	383	---	---	---	13	24	26
5	---	---	---	---	---	382	---	---	---	13	24	575
6	---	---	---	---	---	417	---	---	---	14	23	581
7	---	---	---	---	---	394	---	---	---	14	24	250
8	---	---	---	---	354	479	---	---	---	14	27	277
9	---	---	---	---	168	98	---	---	---	15	879	299
10	---	---	---	---	81	10	---	---	---	15	736	396
11	---	---	---	---	81	689	---	---	---	15	963	742
12	---	---	---	---	498	119	---	---	---	15	642	242
13	---	---	---	---	252	696	---	---	1,140	16	772	23
14	---	---	---	---	40	240	---	---	1,130	384	413	9
15	---	---	---	---	37	---	---	---	1,140	139	824	10
16	---	---	---	227	40	---	---	---	414	138	160	14
17	---	---	---	240	60	---	---	---	---	316	40	15
18	---	---	---	162	51	---	---	---	---	775	39	13
19	---	---	---	82	47	---	---	---	55	368	39	12
20	---	---	---	53	49	---	---	---	450	447	38	11
21	---	---	---	44	47	---	---	---	407	597	36	11
22	---	---	---	42	---	---	---	---	689	37	35	11
23	---	---	---	39	34	---	---	---	256	26	34	12
24	---	---	---	---	32	---	---	---	198	26	34	12
25	---	---	---	---	30	---	---	---	64	26	33	13
26	---	---	---	---	---	---	---	---	19	25	32	13
27	---	---	---	---	28	---	---	---	10	24	32	12
28	---	---	---	---	29	---	---	---	10	24	31	13
29	---	---	---	---		---	---	---	12	24	30	15
30	---	---	---	---		---	---	---	13	24	30	15
31	---		---	---		---		---		25	29	
					Daily suspended-sediment load, in tons							
1	0	0	0	0	0	0.13	0	0	0	0.01	0.01	0.07
2	0	0	0	0	0	.26	0	0	---	0	0	.06
3	0	0	0	0	0	.12	0	0	0	0	0	.05
4	0	0	0	0	0	.08	0	0	0	0	.31	.07
5	0	0	0	0	---	.05	0	0	0	0	0	1.3
6	0	0	0	0	---	.02	0	0	0	.01	0	.55
7	0	0	0	0	---	0	0	0	0	.01	0	.16
8	0	0	0	0	.50	3.2	0	0	0	.01	.01	.13
9	0	0	0	0	.14	.08	0	0	0	.01	1.2	.23
10	0	0	0	0	.03	0	0	0	0	.01	2.4	.30
11	0	0	0	0	.02	8.7	0	0	0	0	2.9	.32
12	0	0	0	0	.17	.45	0	0	0	0	1.7	.10
13	0	0	0	0	.06	1.7	0	0	3.1	0	1.6	.01
14	0	0	0	0	.01	.15	0	0	.15	.07	.54	0
15	0	0	0	0	0	0	0	0	1.8	.02	.38	0
16	0	0	0	.01	0	0	0	0	1.1	.03	.04	0
17	0	0	0	.01	0	0	0	0	---	.04	.06	0
18	0	0	0	0	0	0	0	---	---	.25	.04	0
19	0	0	0	0	0	0	0	0	.01	.59	.17	0
20	0	0	0	0	0	0	0	0	.13	.13	.05	0
21	0	0	0	0	0	0	0	0	.08	.13	.02	0
22	0	0	0	0	---	0	0	0	3.2	.01	.02	0
23	0	0	0	0	0	0	0	---	.06	0	.03	0
24	0	0	0	0	0	0	0	0	.05	0	.17	0
25	0	0	0	0	0	0	0	0	.01	.01	1.9	0
26	0	0	0	0	0	0	0	0	0	.01	.79	.01
27	0	0	0	0	0	0	0	0	0	.02	.26	.01
28	0	0	0	0	0	0	0	0	0	.02	.18	0
29	0	0	0	0		0	0	0	0	.01	.13	0
30	0	0	0	0		0	0	0	0	.02	.11	0
31	0		0	0		0		---		.02	.09	
Total measured	0.00	0.00	0.00	0.02	0.93	14.94	0.00	0.00	9.69	1.44	15.11	3.37

Table 16. *Daily mean discharge and specific conductance at site RC2, Roberts Creek above Saint Olaf, Iowa, water year 1990*

[---, data not available to calculate mean values; water-quality instrumentation was removed from November 27 to March 20]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
					Daily mean discharge, in cubic feet per second							
1	0.14	0.09	0	0	0.05	1.8	2.6	0.77	2.8	11	6.6	20
2	.04	0	0	0	.04	2.0	2.5	.76	5.2	8.8	6.0	18
3	.04	0	0	0	.10	2.5	2.5	.64	16	7.6	5.6	16
4	.07	0	0	0	.60	3.0	2.5	.71	8.5	7.6	5.2	15
5	.23	0	0	0	2.0	2.0	2.4	.82	6.6	6.4	19	15
6	.18	0	0	0	30	1.6	2.1	.88	6.6	5.5	8.1	13
7	.11	0	0	0	27	1.4	1.9	.79	5.7	4.5	5.9	12
8	.06	0	0	0	35	35	1.9	.65	5.0	5.3	5.4	10
9	.07	0	0	0	17	187	2.0	1.1	4.2	4.1	4.9	9.3
10	.05	0	0	.05	8.0	35	3.0	2.4	3.6	3.3	4.5	8.4
11	.11	0	0	.10	6.0	175	4.9	2.2	3.3	3.0	4.1	7.7
12	.09	0	0	.05	8.0	80	2.9	1.4	3.0	3.5	3.7	7.2
13	.06	0	0	.01	6.0	39	2.8	1.2	4.6	3.2	3.6	6.7
14	.05	0	0	0	4.0	97	3.1	1.1	16	3.0	3.1	6.4
15	.08	0	0	0	3.0	41	2.6	1.0	7.6	2.3	3.0	6.2
16	.26	0	0	0	2.2	22	2.4	1.4	18	2.4	3.2	5.7
17	.16	0	0	.10	1.7	12	1.6	1.5	26	2.7	4.2	5.1
18	.02	0	0	.25	1.9	8.0	1.6	1.3	31	7.1	4.6	5.0
19	0	0	0	1.0	1.8	5.0	1.5	3.6	21	19	11	5.9
20	0	0	0	1.5	1.9	5.6	2.2	27	19	31	24	5.6
21	0	0	0	2.0	2.1	5.5	2.0	15	16	17	17	5.0
22	0	0	0	1.0	2.2	5.5	1.6	9.3	35	9.3	11	4.7
23	0	0	0	.65	2.2	4.7	1.1	7.1	56	7.1	8.6	4.4
24	0	0	0	.40	1.9	3.9	1.0	5.9	33	6.0	9.5	4.2
25	0	0	0	.25	1.6	4.1	.80	5.8	23	5.9	426	4.0
26	0	0	0	.15	1.4	3.1	1.0	5.5	25	5.8	117	4.0
27	0	.01	0	.09	1.7	2.8	.74	4.9	22	8.9	64	4.1
28	0	0	0	.07	1.7	2.8	.83	5.1	17	24	44	3.7
29	.03	0	0	.06		2.5	.96	5.2	15	15	33	3.7
30	.17	0	0	.06		2.5	.76	3.6	14	10	27	4.0
31	.31		0	.05		2.5		3.1		7.9	23	
					Daily mean specific conductance, in microsiemens per centimeter at 25 degrees Celsius							
1	---	602	---	---	---	---	---	620	---	753	694	785
2	---	---	---	---	---	---	---	623	---	733	703	773
3	629	---	---	---	---	---	---	644	---	744	714	755
4	629	---	---	---	---	---	---	638	---	746	704	738
5	618	---	---	---	---	---	---	645	---	730	674	727
6	613	---	---	---	---	---	---	636	---	723	---	717
7	610	---	---	---	---	---	---	651	---	707	---	718
8	609	---	---	---	---	---	---	668	---	701	---	721
9	610	---	---	---	---	---	---	632	---	695	675	700
10	615	---	---	---	---	---	---	594	706	689	666	683
11	616	---	---	---	---	---	---	582	695	694	682	---
12	616	---	---	---	---	---	607	584	687	699	677	---
13	619	---	---	---	---	---	605	600	667	650	669	682
14	623	---	---	---	---	---	597	631	633	640	674	698
15	619	---	---	---	---	---	599	645	587	631	685	676
16	589	---	---	---	---	---	625	---	530	648	682	561
17	591	---	---	---	---	---	610	---	572	631	650	630
18	598	---	---	---	---	---	---	---	657	577	629	694
19	---	---	---	---	---	---	---	---	672	547	619	690
20	---	---	---	---	---	---	---	---	698	512	612	690
21	---	---	---	---	---	740	---	---	734	598	601	680
22	---	---	---	---	---	742	---	---	619	616	636	681
23	---	---	---	---	---	739	---	---	612	653	683	681
24	---	---	---	---	---	731	---	---	664	655	721	686
25	---	---	---	---	---	733	596	---	768	---	530	684
26	---	---	---	---	---	740	590	---	758	668	600	670
27	---	---	---	---	---	745	591	---	747	652	733	663
28	---	---	---	---	---	744	590	---	728	623	793	626
29	---	---	---	---	---	---	599	---	746	641	797	630
30	612	---	---	---	---	---	608	---	757	650	795	---
31	632	---	---	---	---	---	---	---	---	684	796	---

Table 17. *Daily median pH and mean water temperature at site RC2, Roberts Creek above Saint Olaf, Iowa, water year 1990*

[---, data not available to calculate mean or median values; water-quality instrumentation was removed from November 27 to March 20]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
						Daily median pH						
1	7.9	7.0	---	---	---	---	---	8.3	---	8.0	8.1	8.2
2	7.9	---	---	---	---	---	---	8.2	---	8.0	8.2	8.2
3	---	---	---	---	---	---	---	7.9	---	8.2	8.3	8.1
4	6.7	---	---	---	---	---	---	7.8	---	8.2	8.2	8.0
5	6.6	---	---	---	---	---	---	7.6	---	8.1	8.2	7.8
6	6.9	---	---	---	---	---	---	8.0	---	8.2	---	8.0
7	6.8	---	---	---	---	---	---	7.9	---	8.3	---	8.3
8	6.8	---	---	---	---	---	---	7.8	---	8.2	---	8.1
9	6.7	---	---	---	---	---	---	7.8	---	8.3	8.1	8.0
10	6.9	---	---	---	---	---	---	7.9	---	8.3	8.0	7.9
11	7.1	---	---	---	---	---	---	7.9	8.2	8.4	8.1	---
12	7.2	---	---	---	---	---	9.1	7.7	8.2	8.3	8.0	---
13	7.2	---	---	---	---	---	9.1	7.8	8.0	8.4	8.0	7.6
14	7.1	---	---	---	---	---	9.1	7.8	7.9	8.3	8.1	7.7
15	7.0	---	---	---	---	---	8.9	---	7.7	8.4	8.0	7.8
16	7.0	---	---	---	---	---	9.0	---	7.5	8.4	8.1	7.9
17	6.8	---	---	---	---	---	9.1	---	7.6	8.3	8.0	8.3
18	6.8	---	---	---	---	---	---	---	7.5	7.9	8.1	8.3
19	---	---	---	---	---	---	---	---	7.5	7.8	8.1	8.3
20	---	---	---	---	---	---	---	---	7.6	7.6	8.0	8.3
21	---	---	---	---	---	---	---	---	7.6	7.6	7.9	8.3
22	---	---	---	---	---	---	---	---	7.5	7.8	8.0	8.2
23	---	---	---	---	---	8.6	---	---	7.3	8.1	7.9	8.1
24	---	---	---	---	---	8.4	---	---	7.5	8.3	8.0	8.1
25	---	---	---	---	---	8.4	8.3	---	7.9	8.2	7.2	8.0
26	---	---	---	---	---	8.4	8.8	---	7.9	8.1	7.6	8.0
27	---	---	---	---	---	8.4	8.5	---	7.9	8.1	7.8	---
28	---	---	---	---	---	8.4	8.3	---	7.8	8.0	8.0	---
29	---	---		---	---	---	8.5	---	7.8	7.8	8.0	---
30	7.1	---		---	---	---	8.6	---	8.0	8.3	8.1	---
31	7.0			---	---			---		8.1	8.2	
						Daily mean water temperature, in degrees Celsius						
1	---	7.5	---	---	---	---	---	14.5	---	26.0	21.0	21.5
2	---	---	---	---	---	---	---	15.5	---	26.0	21.5	21.0
3	10.0	---	---	---	---	---	---	15.0	---	26.0	23.0	20.5
4	9.0	---	---	---	---	---	---	12.5	---	27.5	24.0	22.0
5	10.5	---	---	---	---	---	---	14.5	---	26.5	22.0	24.0
6	10.5	---	---	---	---	---	---	17.0	---	25.5	---	25.0
7	9.0	---	---	---	---	---	---	19.0	---	25.5	---	23.5
8	8.5	---	---	---	---	---	---	20.0	---	25.0	---	21.5
9	8.5	---	---	---	---	---	---	15.5	---	25.0	21.0	20.0
10	10.0	---	---	---	---	---	---	11.5	21.0	25.0	22.5	20.5
11	11.0	---	---	---	---	---	---	14.0	21.5	25.5	21.0	---
12	12.5	---	---	---	---	---	6.0	14.0	21.0	25.0	21.0	---
13	12.0	---	---	---	---	---	9.5	15.5	22.5	25.0	22.5	19.5
14	14.0	---	---	---	---	---	12.0	16.0	23.5	25.0	21.5	21.0
15	15.5	---	---	---	---	---	8.5	15.0	22.5	25.5	22.0	19.5
16	13.5	---	---	---	---	---	8.0	---	21.5	25.5	23.5	13.5
17	9.0	---	---	---	---	---	9.5	---	21.5	25.5	23.0	14.5
18	7.5	---	---	---	---	---	---	---	23.0	23.0	25.5	14.5
19	---	---	---	---	---	---	---	---	22.5	21.5	23.5	15.5
20	---	---	---	---	---	---	---	---	22.5	21.5	21.0	15.5
21	---	---	---	---	---	10.0	---	---	22.0	21.0	19.5	17.5
22	---	---	---	---	---	7.5	---	---	20.0	21.5	21.0	16.0
23	---	---	---	---	---	2.0	---	---	19.0	21.5	21.5	---
24	---	---	---	---	---	3.0	---	---	21.5	21.5	23.0	---
25	---	---	---	---	---	3.5	---	---	23.5	---	22.0	---
26	---	---	---	---	---	4.5	21.5	18.5	24.0	21.5	21.0	16.5
27	---	---	---	---	---	5.5	19.5	17.5	24.5	20.5	22.5	16.0
28	---	---	---	---	---	5.0	16.0	17.5	23.5	22.0	24.0	18.0
29	---	---	---	---		---	15.5	17.0	23.0	23.5	23.0	16.0
30	12.5	---	---	---		---	14.5	16.5	25.0	23.0	21.5	---
31	9.0		---	---		---		---		22.0	21.0	

Table 18. *Daily mean suspended-sediment concentrations and daily suspended-sediment load at site RC2, Roberts Creek above Saint Olaf, Iowa, water year 1990*

[---, data not available to calculate values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
					Daily mean suspended-sediment concentration, in milligrams per liter							
1	---	---	---	---	10	15	8	17	20	24	11	43
2	---	---	---	---	9	28	8	22	29	23	10	38
3	---	---	---	---	8	26	8	23	77	22	9	32
4	---	---	---	---	9	20	8	25	61	22	17	28
5	---	---	---	---	24	12	8	29	23	23	37	26
6	---	---	---	---	48	9	8	29	14	28	31	24
7	---	---	---	---	28	10	8	27	15	21	25	20
8	---	---	---	---	49	730	8	27	18	8	18	18
9	---	---	---	---	48	622	8	37	9	7	11	16
10	---	---	---	---	21	102	14	47	10	8	12	16
11	---	---	---	---	13	458	18	28	33	9	20	23
12	---	---	---	---	11	534	11	16	40	12	37	27
13	---	---	---	---	11	414	10	13	39	10	38	44
14	---	---	---	---	13	471	12	12	51	6	36	33
15	---	---	---	---	10	285	14	11	29	7	44	29
16	---	---	---	---	9	63	10	12	53	10	26	30
17	---	---	---	---	10	28	10	11	75	23	27	31
18	---	---	---	---	10	15	10	9	65	103	18	29
19	---	---	---	---	10	12	10	35	60	69	62	45
20	---	---	---	---	10	11	16	62	42	103	59	38
21	---	---	---	---	10	8	22	67	32	35	23	25
22	---	---	---	34	10	8	21	59	241	25	18	18
23	---	---	---	31	10	7	16	23	430	13	17	12
24	---	---	---	24	10	7	14	19	223	11	60	16
25	---	---	---	17	10	9	14	20	114	11	---	21
26	---	---	---	12	10	8	14	20	40	13	---	22
27	---	---	---	11	10	8	14	20	50	18	---	24
28	---	---	---	10	10	8	14	27	37	33	---	24
29	---	---	---	9		8	15	28	50	26	---	24
30	---	---	---	9		8	16	22	37	15	---	24
31	---		---	10		8		20		11	52	--
					Daily suspended-sediment load, in tons							
1	---	---	0	0	0.08	0.16	0.06	0.04	0.15	0.69	0.19	2.4
2	---	0	0	0	.08	.70	.05	.04	.72	.54	.17	1.8
3	---	0	0	0	.07	.90	.05	.04	3.4	.46	.14	1.4
4	---	0	0	0	.07	.72	.06	.05	1.4	.46	.24	1.1
5	---	0	0	0	2.7	.23	.06	.06	.42	.39	1.9	1.1
6	---	0	0	0	16	.11	.05	.07	.25	.41	.67	.85
7	---	0	0	0	3.8	.08	.04	.06	.24	.25	.41	.62
8	---	0	0	0	21	2,270	.04	.05	.24	.12	.26	.49
9	---	0	0	0	19	547	.04	.11	.11	.08	.15	.40
10	---	0	0	0	1.7	10	.12	.32	.09	.07	.14	.37
11	---	0	0	0	.51	290	.25	.17	.30	.07	.22	.47
12	---	0	0	0	.32	117	.09	.06	.33	.11	.37	.53
13	---	0	0	0	.28	44	.08	.04	.50	.08	.37	.80
14	---	0	0	0	.21	129	.10	.04	2.2	.05	.31	.57
15	---	0	0	0	.11	33	.10	.03	.60	.04	.36	.49
16	---	0	0	0	.08	4.0	.06	.05	3.3	.06	.23	.46
17	---	0	0	0	.07	.92	.04	.04	5.3	.17	.33	.43
18	---	0	0	0	.08	.32	.04	.03	5.6	2.7	.23	.40
19	0	0	0	0	.07	.16	.04	.40	3.4	3.6	1.9	.73
20	0	0	0	0	.06	.17	.10	4.7	2.2	8.9	3.9	.57
21	0	0	0	0	.07	.12	.12	2.7	1.4	1.7	1.0	.33
22	0	0	0	.64	.07	.12	.09	1.5	30	.65	.56	.23
23	0	0	0	.54	.07	.10	.05	.44	68	.25	.39	.15
24	0	0	0	.35	.07	.08	.04	.31	20	.18	2.1	.18
25	0	0	0	.22	.06	.10	.03	.31	7.2	.17	2,960	.23
26	0	0	0	.14	.06	.07	.04	.30	2.9	.21	57	.24
27	0	0	0	.11	.06	.06	.03	.27	3.0	.51	52	.27
28	0	0	0	.09	.06	.06	.03	.38	1.7	2.1	26	.25
29	---	0	0	.08		.05	.04	.39	2.1	1.1	21	.24
30	---	0	0	.08		.05	.03	.22	1.4	.42	5.0	.26
31	---		0	.08		.05		.17		.24	3.3	
Total measured	0	0	0	2.33	66.8	3,450	1.97	13.4	168	26.8	3,140	18.4

Table 19. *Miscellaneous water-level measurements in the Big Spring basin, Clayton County, Iowa, water year 1990*

[Water levels in feet below land surface; negative value is water level above land surface]

Date	Water level	Date	Water level
		Well BS1-D	
10-05-89	-4.10	3-05-90	-3.36
11-07-89	-3.87	3-09-90	-3.36
12-04-89	-3.80	5-01-90	-3.71
1-03-90	-3.31	5-09-90	-3.99
1-16-90	-3.64	5-22-90	-4.01
1-26-90	-3.38	6-05-90	-4.22
2-06-90	-3.36	6-29-90	-4.26
2-12-90	-3.38	7-02-90	-4.10
2-22-90	-3.36	8-26-90	-5.03
		9-05-90	-4.52
		Well BS2-A	
5-02-90	55.22	8-01-90	55.30
6-05-90	55.29	9-05-90	55.33
6-29-90	55.30		
		Well BS2-B	
5-02-90	126.06	8-01-90	126.07
6-05-90	126.04	9-05-90	126.06
6-29-90	126.10		
		Well BS2-C	
5-02-90	124.47	8-01-90	123.71
6-05-90	124.98	9-05-90	123.40
6-29-90	123.70		
		Well BS2-D	
5-02-90	136.71	8-01-90	134.83
6-05-90	135.14	9-05-90	134.69
6-29-90	135.02		
		Well BS2-F	
5-02-90	282.44	8-01-90	281.69
6-05-90	282.07	9-05-90	281.64
6-29-90	281.80		
		Well BS3	
10-05-89	300.04	4-02-90	300.52
11-07-89	300.01	5-02-90	300.48
12-04-89	299.98	6-29-90	300.54
1-03-90	300.28	8-01-90	300.71
2-06-90	300.28	8-13-90	300.77
3-05-90	300.55	9-05-90	300.65

Table 20. *Daily mean water levels in unconsolidated aquifers, Clayton County, Iowa, water year 1990*

[Water levels in feet below land surface; --, data not available to calculate mean values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
						Well BS1-A (fig. 2)						
1	14.61	14.46	14.60	14.70	14.57	14.50	13.78	13.81	13.33	13.02	12.46	---
2	14.64	14.45	14.58	14.70	14.58	14.39	13.81	13.78	13.38	13.15	12.74	---
3	14.65	14.45	14.66	14.68	14.59	14.28	13.83	13.79	13.38	13.23	12.97	---
4	14.66	14.45	14.62	14.66	14.65	14.31	13.85	13.81	13.38	13.33	12.94	---
5	14.65	14.45	14.61	14.64	14.59	14.35	13.88	13.85	13.36	13.44	13.06	---
6	14.59	14.45	14.61	14.60	14.19	14.38	13.92	13.89	13.40	13.52	12.85	11.42
7	14.57	14.47	14.70	14.59	14.05	14.30	13.95	13.93	13.44	13.58	12.93	11.57
8	14.59	14.50	14.67	14.59	13.94	13.88	13.98	13.98	13.48	13.65	13.13	11.69
9	14.60	14.50	14.67	14.56	13.38	12.00	14.00	13.99	13.53	13.70	13.30	11.73
10	14.62	14.52	14.67	14.29	13.33	11.26	14.00	13.88	13.60	13.76	13.43	11.82
11	14.62	14.53	14.69	14.28	13.64	11.03	13.97	13.74	13.66	13.79	13.50	11.93
12	14.63	14.54	14.72	14.41	13.80	10.81	13.96	13.55	13.72	13.81	13.47	12.01
13	14.63	14.54	14.71	14.51	13.86	10.66	13.97	13.47	13.54	13.79	13.50	12.10
14	14.64	14.55	14.71	14.54	13.98	11.05	13.97	13.47	12.87	13.82	13.55	12.17
15	14.64	14.56	14.71	14.55	14.19	10.35	13.98	13.54	12.59	13.86	13.44	12.24
16	14.57	14.56	14.71	14.56	14.19	9.97	13.98	13.57	12.53	13.90	13.40	12.32
17	14.51	14.60	14.71	14.31	14.20	10.95	13.98	13.62	12.52	13.93	13.42	12.38
18	14.53	14.62	14.71	13.98	14.20	11.70	13.99	13.67	12.39	13.97	13.35	12.45
19	14.54	14.62	14.71	14.17	14.24	12.19	14.00	13.58	12.23	13.94	13.17	12.49
20	14.56	14.62	14.72	14.24	14.29	12.53	13.99	13.06	12.29	13.74	12.63	12.48
21	14.57	14.61	14.72	14.32	14.33	12.76	13.94	12.13	12.43	13.52	11.24	12.49
22	14.58	14.62	14.73	14.39	14.34	12.95	13.94	12.00	12.29	13.47	11.03	12.52
23	14.59	14.62	14.73	14.43	14.38	13.08	13.97	12.20	11.90	13.58	11.48	12.57
24	14.59	14.63	14.74	14.46	14.40	13.20	14.00	12.41	11.86	13.67	12.09	12.61
25	14.59	14.60	14.74	14.48	14.43	13.32	14.02	12.58	12.10	13.73	7.75	12.64
26	14.59	14.59	14.74	14.54	14.41	13.41	14.03	12.72	12.32	13.81	2.45	12.70
27	14.59	14.59	14.74	14.52	14.43	13.49	14.05	12.84	12.49	13.73	---	12.72
28	14.60	14.57	14.74	14.58	14.47	13.57	14.05	12.95	12.65	12.36	---	12.69
29	14.60	14.62	14.72	14.55		13.63	14.00	13.05	12.80	11.72	---	12.67
30	14.56	14.61	14.70	14.52		13.69	13.90	13.15	12.92	11.82	---	12.68
31	14.48		14.70	14.62		13.74		13.24		12.11	---	
						Well BS3-C (fig. 2)						
1	---	14.12	13.57	---	---	---	---	---	11.64	10.68	12.25	10.54
2	---	14.20	13.54	---	---	---	---	---	11.51	10.81	12.66	10.88
3	---	14.14	---	---	---	---	---	---	11.57	10.86	12.71	11.03
4	---	13.84	---	14.62	---	---	---	---	11.76	11.09	12.84	11.17
5	---	13.48	---	---	---	---	---	---	---	11.52	13.09	11.58
6	14.20	13.48	---	---	---	---	---	---	---	11.80	13.30	11.62
7	14.32	13.40	---	---	---	---	---	---	---	11.87	13.37	11.88
8	14.36	13.13	---	---	---	---	---	---	---	11.90	13.42	12.00
9	14.38	12.91	---	---	---	---	---	---	---	12.15	13.52	12.08
10	14.31	12.94	---	---	---	---	---	13.38	---	12.37	13.58	12.28
11	14.28	12.93	---	---	---	---	---	13.64	---	12.47	13.65	12.38
12	14.29	13.12	---	---	---	---	---	13.71	---	12.61	13.79	12.44
13	14.39	12.90	---	---	---	---	---	13.68	---	12.78	13.61	12.44
14	14.39	12.86	---	---	---	---	---	13.61	---	12.73	12.90	12.55
15	14.33	12.84	---	---	---	---	---	13.49	---	12.76	12.99	12.64
16	14.34	12.91	---	---	---	---	---	13.28	---	12.90	13.06	12.84
17	14.54	12.84	---	---	---	---	---	13.27	---	13.03	13.11	13.08
18	14.76	13.03	---	---	---	---	---	13.39	---	13.16	13.23	13.09
19	14.84	13.03	---	---	---	---	---	13.29	---	13.30	13.37	13.13
20	14.64	12.89	---	---	---	---	---	12.90	---	13.24	13.49	13.23
21	14.46	13.07	---	---	---	---	---	12.07	---	12.56	13.50	13.25
22	14.47	13.14	---	---	---	---	---	11.39	---	12.07	13.35	13.39
23	14.48	13.22	---	---	---	---	---	10.90	---	11.95	13.17	13.60
24	14.50	13.13	---	---	---	---	---	10.73	---	11.95	12.85	13.62
25	14.49	12.95	---	---	---	---	---	10.67	---	12.07	11.58	13.55
26	14.46	13.08	---	---	---	---	---	10.81	---	12.14	10.47	13.69
27	14.42	12.96	---	---	---	---	---	10.99	---	12.19	10.00	13.82
28	14.36	13.23	---	---	---	---	---	11.18	---	12.09	9.88	13.94
29	14.27	13.54	---	---		---	---	11.39	---	11.78	9.96	14.05
30	14.16	13.56	---	---		---	---	11.60	10.44	11.68	10.10	14.13
31	14.07		---	---		---		11.67		11.76	10.25	

Table 20. *Daily mean water levels in unconsolidated aquifers, Clayton County, Iowa, water year 1990*--Continued

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
						Well BS4-B (fig. 2)						
1	73.08	73.09	73.27	73.49	73.61	73.72	73.46	---	---	73.05	---	---
2	73.12	73.04	73.27	73.47	73.62	73.68	73.47	---	---	73.07	---	---
3	73.19	73.04	73.32	73.46	73.62	73.71	73.50	---	---	73.06	---	---
4	73.17	73.12	73.21	73.48	73.61	73.71	73.45	---	---	73.12	---	---
5	73.03	73.07	73.24	73.50	---	73.74	73.47	---	---	73.21	---	72.64
6	73.04	73.12	73.30	73.50	---	73.78	73.50	---	73.36	73.26	---	72.68
7	73.09	73.09	73.38	73.47	73.62	73.78	73.54	---	73.40	73.23	---	72.73
8	73.09	73.06	73.38	73.44	73.59	73.69	73.53	---	73.39	73.24	---	72.75
9	73.07	73.05	73.29	73.45	73.60	73.65	73.52	---	73.42	73.29	---	72.77
10	73.07	73.12	73.33	73.49	73.61	73.67	73.49	---	73.47	73.31	---	72.83
11	73.06	73.12	73.38	73.46	73.61	73.64	73.50	---	73.50	73.32	73.34	72.84
12	73.12	73.19	73.37	73.53	73.59	73.56	73.51	---	73.44	73.33	---	72.85
13	73.14	73.11	73.34	73.51	73.61	73.53	73.46	---	73.40	73.36	---	72.84
14	73.12	73.15	73.36	73.49	73.67	73.38	73.45	---	73.40	73.32	---	72.88
15	73.11	73.15	73.39	73.54	73.60	73.23	73.47	---	73.35	73.34	---	72.89
16	73.14	73.18	73.42	73.52	73.58	73.25	73.46	---	73.25	73.38	---	72.96
17	73.20	73.16	73.41	73.55	73.68	73.25	73.52	---	73.16	73.41	---	72.97
18	73.17	73.23	73.42	73.59	73.63	73.29	73.53	---	73.14	73.40	---	72.92
19	73.09	73.18	73.42	73.54	73.68	73.37	73.47	---	73.09	73.31	---	72.95
20	73.08	73.21	73.44	73.47	73.72	73.40	73.48	---	73.07	73.31	---	72.95
21	73.15	73.24	73.49	73.48	73.66	73.36	73.49	---	73.11	73.33	---	72.96
22	73.17	73.24	73.50	73.50	73.62	73.34	73.47	---	73.03	73.34	---	72.99
23	73.20	73.24	73.45	73.47	73.63	73.42	73.50	---	72.97	73.36	---	73.02
24	73.20	73.19	73.40	73.53	73.69	73.45	73.52	---	72.96	73.38	---	72.98
25	73.20	73.20	73.41	73.54	73.77	73.43	73.51	---	72.94	73.40	---	72.99
26	73.20	73.25	73.43	73.53	73.72	73.44	73.48	---	72.95	73.40	---	73.05
27	73.17	73.18	73.44	73.60	73.72	73.47	73.50	---	72.96	73.34	---	73.06
28	73.12	73.29	73.45	73.58	73.75	73.46	73.53	---	72.96	73.31	---	73.10
29	73.09	73.28	73.47	73.55		73.46	73.59	---	73.64	73.29	---	73.12
30	73.11	73.27	73.46	73.61		73.46	73.59	---	73.01	73.33	---	73.13
31	73.12		73.45	73.58		73.46		---		73.37	---	
						Well BS4-C (fig. 2)						
1	56.01	56.39	56.39	56.68	56.77	56.71	56.77	56.94	56.55	56.18	56.30	56.11
2	56.25	56.32	56.52	56.53	56.78	56.74	56.93	56.91	56.47	56.08	56.26	55.98
3	56.28	56.21	56.40	56.54	56.73	56.91	56.84	56.91	56.76	56.00	56.26	55.91
4	56.12	56.18	---	56.67	56.73	56.81	56.74	56.82	56.79	56.14	56.32	55.88
5	56.01	56.29	---	56.59	56.69	56.94	56.88	56.88	56.50	56.23	56.46	55.78
6	56.25	56.41	---	56.61	56.77	56.97	56.92	56.88	56.69	56.15	56.42	55.97
7	56.22	56.27	---	56.52	56.74	56.89	56.91	56.82	56.66	56.01	56.32	55.96
8	56.17	56.25	---	56.46	56.63	56.74	56.87	56.91	56.62	56.01	56.29	55.87
9	56.10	56.31	---	56.69	56.80	56.87	56.85	56.84	56.71	56.17	56.31	55.94
10	56.19	56.41	---	56.60	56.79	56.87	56.91	56.99	56.73	56.15	56.33	55.97
11	56.11	56.39	---	56.62	56.82	56.83	56.95	57.03	56.58	56.12	56.36	55.89
12	56.33	56.36	---	56.82	56.64	56.86	56.88	56.90	56.52	56.20	56.39	55.84
13	56.20	56.28	---	56.62	56.90	56.89	56.84	56.97	56.67	56.15	56.42	55.82
14	56.17	56.36	---	56.51	56.85	56.74	56.83	56.87	56.75	55.99	56.41	55.93
15	56.16	56.39	---	56.68	56.63	56.83	56.90	56.85	56.64	56.05	56.39	55.96
16	56.35	56.40	---	56.63	56.81	56.88	56.88	56.87	56.53	56.17	56.40	56.09
17	56.36	56.35	---	56.65	56.94	56.86	57.03	56.96	56.50	56.20	56.51	55.90
18	56.31	56.50	---	56.82	56.73	56.92	56.94	57.00	56.62	56.21	56.52	55.83
19	56.13	56.24	---	56.61	56.92	56.95	56.79	56.75	56.44	56.17	56.52	55.97
20	56.09	56.45	---	56.51	56.85	56.76	56.83	56.97	56.43	56.17	56.50	55.89
21	56.27	56.43	---	56.61	56.69	56.64	56.91	57.00	56.48	56.21	56.40	55.91
22	56.29	56.44	---	56.71	56.69	56.83	56.83	56.89	56.34	56.20	56.43	56.04
23	56.27	56.37	56.43	56.51	56.78	56.99	56.78	56.78	56.41	56.23	56.34	56.03
24	56.28	56.25	56.39	56.80	57.06	56.78	56.84	56.79	56.40	56.24	56.27	55.79
25	56.26	56.43	56.44	56.67	56.96	56.71	56.93	56.70	56.33	56.25	56.22	55.97
26	56.27	56.45	56.58	56.68	56.72	56.87	56.87	56.77	56.25	56.25	56.13	56.11
27	56.26	56.32	56.56	56.77	56.92	56.79	56.83	56.75	56.21	56.24	56.17	56.08
28	56.26	56.69	56.55	56.78	56.87	56.74	56.84	56.71	56.14	56.22	56.17	56.13
29	56.24	56.39	56.64	56.58		56.76	56.96	56.74	56.18	56.24	56.14	56.09
30	56.25	56.42	56.53	56.78		56.76	57.03	56.74	56.20	56.34	56.04	56.05
31	56.32		56.54	56.70		56.77		56.65		56.34	56.12	

Table 20. *Daily mean water levels in unconsolidated aquifers, Clayton County, Iowa, water year 1990*--Continued

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
						Well DCW1 (fig. 2)						
1	6.13	5.08	5.57	5.79	5.83	5.61	4.53	---	---	4.29	4.13	4.12
2	6.23	5.12	5.63	5.79	5.87	5.43	4.52	---	---	4.32	4.17	4.14
3	6.31	5.13	---	5.76	5.87	5.40	4.49	4.53	---	4.33	4.19	4.15
4	6.30	5.12	---	5.82	5.87	5.42	4.51	4.46	---	4.35	3.78	4.15
5	6.10	5.17	5.49	5.84	5.71	5.51	4.54	4.44	---	4.38	3.93	4.17
6	6.03	5.29	5.60	5.84	5.41	5.64	4.55	4.46	4.23	4.39	4.05	4.22
7	6.11	5.26	5.72	5.80	5.41	5.66	4.54	4.46	4.21	4.39	4.10	4.25
8	6.12	5.19	5.70	5.76	5.17	5.02	4.53	4.49	4.21	4.40	4.14	4.25
9	6.10	5.28	5.56	5.43	5.09	4.84	4.34	4.37	4.23	4.43	4.17	4.25
10	6.12	5.29	5.61	5.42	5.24	4.73	4.36	4.28	4.24	4.44	4.21	4.30
11	6.11	5.38	5.71	5.51	5.40	4.16	4.38	4.31	4.24	4.44	4.25	4.32
12	6.21	5.27	---	5.70	5.39	3.88	4.38	4.32	4.20	4.44	4.30	4.33
13	6.22	5.35	---	5.73	5.35	3.99	4.37	4.34	3.89	4.44	4.33	4.34
14	6.21	5.37	---	5.69	5.48	3.82	4.36	4.34	3.97	4.42	4.33	4.35
15	6.20	5.41	---	5.76	5.45	3.96	4.36	4.36	3.89	4.43	4.35	4.36
16	5.72	5.40	---	5.78	5.49	4.20	4.38	4.35	3.76	4.46	4.37	4.40
17	5.58	5.48	---	5.41	5.68	4.31	4.39	4.36	3.61	4.50	4.36	4.43
18	5.71	5.43	---	5.53	5.62	4.42	4.37	4.38	3.76	4.46	4.35	4.40
19	5.69	5.45	---	5.62	5.72	4.49	4.35	3.90	4.04	3.99	3.84	4.39
20	5.60	5.49	5.65	5.59	5.74	4.50	4.34	3.78	4.10	3.86	3.78	4.39
21	5.68	5.50	5.64	5.63	5.68	4.50	4.34	4.02	4.14	4.07	3.83	4.39
22	5.79	5.51	5.47	5.70	5.54	4.50	4.31	4.13	3.76	4.16	3.91	4.42
23	5.81	5.46	5.34	5.65	5.49	4.48	4.32	4.16	3.80	4.23	3.97	4.45
24	5.84	5.46	5.16	5.72	5.62	4.49	4.36	4.23	3.98	4.30	3.63	4.44
25	5.85	5.52	5.06	5.74	5.71	4.50	4.25	4.25	4.09	4.33	3.09	4.45
26	5.86	5.44	5.21	5.76	5.65	4.54	4.29	4.25	4.14	4.35	3.61	4.49
27	5.86	5.57	5.39	5.77	5.70	4.53	4.36	---	4.18	3.82	3.79	4.50
28	5.85	5.57	5.51	5.86	5.74	4.53	4.37	---	4.22	3.82	3.90	4.50
29	5.81	5.55	5.65	5.80		4.53	4.42	---	4.25	3.90	3.97	4.51
30	5.48	5.54	5.71	5.81		4.53	4.44	---	4.27	3.98	4.04	4.50
31	5.04		5.71	5.85		4.53		---		4.09	4.08	

Table 21. *Onsite measurements of selected water-quality constituents at selected ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; ft³/s, cubic feet per second; --, missing data]

Date	Time (24-hour)	Water level,- (feet below land surface)	Specific conductance (µS/cm)	pH (standard units)	Water temperature (°C)	Dissolved oxygen (mg/L)
			Deer Creek well (DCW2, fig. 2)			
10-04-89	1300	7.27	811	6.9	13.5	--
11-08-89	1000	6.30	763	6.9	13.0	--
12-05-89	1230	6.53	780	7.0	10.0	--
01-04-90	1100	6.90	720	7.0	9.0	--
02-07-90	0940	6.53	730	7.0	7.0	1.8
03-06-90	1000	6.69	730	7.1	6.0	13.0
03-21-90	1500	5.60	784	7.0	7.0	--
04-03-90	1000	5.61	725	7.0	5.0	--
05-02-90	1100	5.52	750	7.0	7.0	1.2
06-05-90	1300	5.19	742	6.8	8.0	0.8
07-02-90	1115	5.93	600	7.4	17.0	9.5
08-02-90	0850	5.74	592	--	13.5	10.1
08-20-90	1410	5.40	606	--	18.0	--
08-26-90	1340	--	680	7.5	22.0	--
09-06-90	0750	5.76	615	7.8	17.0	6.7
			Deer Creek well (DCW3, fig. 2))			
10-05-89	0900	9.51	647	7.2	13.5	--
11-08-89	1130	9.60	635	7.2	12.0	--
12-05-89	1330	8.96	590	7.2	11.0	--
01-04-90	1220	9.19	635	7.3	8.0	--
02-07-90	0830	9.29	590	7.1	7.0	2.7
03-06-90	1110	9.34	645	7.2	7.0	2.3
03-21-90	1540	7.60	658	7.0	7.0	--
04-03-90	1130	8.04	620	7.2	7.0	--
05-02-90	1200	8.28	672	7.2	8.0	1.7
06-05-90	1150	6.94	653	7.0	7.0	1.4
07-02-90	1215	5.59	515	6.5	11.0	1.2
08-02-90	1130	5.48	605	--	13.0	1.6
09-06-90	1030	5.07	600	7.1	14.0	1.2

Table 21. *Onsite measurements of selected water-quality constituents at selected ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Instantaneous discharge (ft^3/s)	Specific conductance (µS/cm)	pH (standard units)	Water temperature (°C)	Dissolved oxygen (mg/L)
			Deer Creek tile line 2 (DCT2, fig. 2)			
11-08-89	0915	0.003	475	6.3	10.5	--
12-05-89	0900	.0006	510	7.0	7.0	--
01-04-90	0820	.0005	567	6.9	6.0	--
02-07-90	1030	.002	518	6.7	4.0	--
03-06-90	0800	.0008	590	7.0	3.0	--
04-03-90	0815	.002	700	6.7	4.0	--
05-02-90	0815	.0006	621	6.8	7.0	--
06-05-90	1100	.003	900	--	--	--
07-02-90	0940	.001	770	5.9	17.0	--
08-02-90	0815	.004	740	--	14.0	--
09-06-90	0730	.004	705	6.6	17.0	--
			Big Spring (fig. 2)			
10-05-89	1145	--	735	7.1	11.0	--
11-08-89	1500	--	680	7.1	10.0	--
12-05-89	1400	--	700	7.3	10.0	10.6
01-04-90	1300	--	715	7.3	10.0	9.6
01-22-90	1125	--	635	5.0	9.5	--
02-06-90	1445	23	760	7.1	8.5	7.8
02-08-90	1545	38	--	7.2	9.0	7.2
02-12-90	1105	--	--	7.0	8.5	--
03-05-90	1245	14	635	7.1	9.0	--
03-08-90	1730	--	630	7.2	8.5	--
03-09-90	1630	35	352	7.0	8.5	8.2
03-10-90	0815	--	375	7.0	6.0	7.0
03-12-90	1200	--	--	7.1	6.0	7.5
03-16-90	1330	--	568	7.2	8.0	--
04-02-90	1340	15	713	7.3	9.0	--

Table 21. *Onsite measurements of selected water-quality constituents at selected ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Instantaneous discharge (ft^3/s)	Specific conductance (μS/cm)	pH (standard units)	Water temperature (°C)	Dissolved oxygen (mg/L)
			Big Spring--Continued			
05-01-90	1410	14	710	7.2	9.0	8.2
06-06-90	1030	20	741	7.0	10.5	8.4
06-22-90	1700	--	740	6.8	--	--
06-23-90	0700		725	6.8	--	--
07-02-90	1600		748	6.8	10.0	9.0
07-20-90	1240	--	738	6.7	10.5	--
08-01-90	1320	22	755	6.7	10.5	9.0
08-19-90	1320	--	757	6.7	10.5	--
08-19-90	1520	--	756	6.7	10.5	--
08-20-90	1600	--	762	6.7	10.5	--
08-26-90	1215	--	618	6.7	11.5	--
08-27-90	1045	--	663	6.7	11.5	--
08-28-90	1040	--	715	6.7	11.5	--
08-30-90	1200	--	756	6.6	11.0	--
09-05-90	1430	--	763	6.7	11.0	--

Table 22. *Concentrations of major ions at selected ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*

[Dissolved constituents are in milligrams per liter; --, data not collected]

Date	Time (24-hour)	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Carbonate	Sulfate	Chloride	Silica
Deer Creek well (DCW2, fig. 2)										
10-04-89	1300	130	36	7.7	0.7	--	--	96	27	11
11-08-89	1000	120	35	6.2	1.9	450	0	81	26	11
12-05-89	1230	120	36	6.8	.6	410	0	84	26	--
08-02-90	1030	140	37	6.3	< .1	--	--	81	35	9.8
09-06-90	0930	120	38	7.4	.9	360	0	83	38	11
Deer Creek well (DCW3, fig. 2)										
10-05-89	0900	100	29	6.6	2.0	--	--	19	2	27
11-08-89	1130	100	28	5.7	.6	460	0	15	2.5	27
12-05-89	1330	3.4	1.6	5.9	1.6	460	0	8.8	2.5	--
08-02-90	1215	120	29	5.7	1.2	--	--	20	1.0	29
09-06-90	1030	81	28	6.4	1.9	430	0	15	1.0	28
Big Spring (fig. 2)										
10-05-89	1145	90	38	21	3.8	390	0	43	31	15
12-05-89	1400	91	40	19	3.8	400	0	36	32	--
01-04-90	1300	84	40	21	3.2	390	0	43	15	--
03-12-90	1200	40	16	5.9	25	--	--	29	27	12
04-02-90	1340	83	32	12	4.8	--	--	40	29	15
06-06-90	1030	85	36	14	3.6	330	0	34	28	--

Table 23. *Selected nitrogen, phosphorus, and carbon species at ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*

[Total constituents in milligrams per liter; N, nitrogen; P, phosphorus; C, carbon; <, less than detection level indicated; --, data not collected]

Date	Time (24-hour)	Nitrite plus nitrate, total (as N)	Ammonia, total (as N)	Organic nitrogen, total (as N)	Ortho-phos-phorus, total (as P)	Organic carbon, total (as C)
Deer Creek well (DCW2, fig. 2)						
10-04-89	1300	* 0.10	*<0.10	* 0.20	*<0.10	2.0
11-08-89	1000	*< .10	*< .10	*< .10	*< .10	2.0
12-05-89	1230	*< .10	*< .10	* .10	*< .10	1.3
01-04-90	1100	< .10	< .10	< .10	< .10	2.3
02-07-90	0940	< .10	< .10	.10	< .10	2.6
03-06-90	1000	< .10	< .10	.20	< .10	1.7
03-21-90	1500	.80	< .10	.20	< .10	2.4
04-03-90	1000	.90	< .10	.10	< .10	1.9
05-02-90	1100	.30	< .10	< .10	< .10	1.8
06-05-90	1300	3.7	< .10	.20	< .10	2.9
07-02-90	1115	12	< .10	.30	< .10	3.4
08-02-90	1030	15	.80	.60	.20	3.2
09-06-90	0930	16	.20	.50	< .10	3.5
Deer Creek well (DCW3, fig. 2)						
10-05-89	0900	*<0.10	* 0.20	*<0.10	*<0.10	1.2
11-08-89	1130	*< .10	* .20	*< .10	*< .10	1.8
12-05-89	1330	*< .10	*< .10	* .10	*< .10	3.8
01-04-90	1220	< .10	< .10	.10	< .10	2.7
02-07-90	0830	.10	.20	.50	.30	4.0
03-06-90	1110	< .10	.10	.20	< .10	1.4
03-21-90	1540	< .10	.20	.10	< .10	1.3
04-03-90	1130	.10	.20	.30	.20	1.7
05-02-90	1200	< .10	.20	.10	.20	1.5
06-05-90	1150	.10	.20	.30	.20	3.4
07-02-90	1215	< .10	.20	.30	< .10	4.1
08-02-90	1130	.10	< .10	.10	< .10	1.7
09-06-90	1030	< .10	.10	.20	< .10	1.5

Table 23. *Selected nitrogen, phosphorus, and carbon species at ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Nitrite plus nitrate, total (as N)	Ammonia, total (as N)	Organic nitrogen, total (as N)	Ortho-phos-phorus, total (as P)	Organic carbon, total (as C)
Deer Creek lysimeter (DCLA, fig. 2)						
10-06-89	0950	*<0.10	*<0.10	*<0.10	*<0.10	1.5
03-21-90	1410	< .10	< .10	.10	< .10	1.2
04-04-90	0800	< .10	< .10	< .10	< .10	1.3
05-02-90	0845	< .10	< .10	< .10	< .10	--
05-10-90	0810	< .10	< .10	.40	< .10	1.3
06-07-90	0810	< .10	< .10	< .10	.20	1.4
06-19-90	1201	< .10	< .10	.20	< .10	1.4
07-02-90	0910	< .10	< .10	.10	< .10	1.3
08-03-90	0830	.10	< .10	.20	< .10	1.5
09-07-90	0740	< .10	< .10	< .10	< .10	1.4
Deer Creek lysimeter (DCLB, fig. 2)						
10-06-89	0952	*<0.10	* 0.10	* 0.10	*<0.10	1.7
03-21-90	1411	.10	< .10	.10	< .10	1.8
04-04-90	0801	< .10	< .10	< .10	< .10	1.5
05-02-90	0846	< .10	< .10	< .10	< .10	1.1
05-10-90	0811	< .10	< .10	.10	< .10	1.5
06-06-90	0757	< .10	< .10	.10	.10	3.9
06-19-90	1202	< .10	< .10	.20	< .10	1.7
07-02-90	0911	< .10	< .10	.10	< .10	1.7
08-03-90	0831	.70	< .10	.20	< .10	1.8
09-07-90	0742	< .10	< .10	.10	< .10	1.7

Table 23. *Selected nitrogen, phosphorus, and carbon species at ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Nitrite plus nitrate, total (as N)	Ammonia, total (as N)	Organic nitrogen, total (as N)	Ortho-phos-phorus, total (as P)	Organic carbon, total (as C)
		Deer Creek lysimeter (DCLC, fig. 2)				
10-06-89	0954	*<0.10	*<0.10	*0.20	* 0.10	3.8
03-21-90	1412	.40	< .10	.20	< .10	2.7
04-04-90	0802	.20	< .10	.20	< .10	2.4
05-02-90	0847	.10	< .10	.20	< .10	2.5
05-10-90	0812	.10	< .10	.20	< .10	2.5
06-06-90	0758	.40	< .10	.20	.20	3.7
06-19-90	1203	.50	< .10	.20	< .10	3.4
07-02-90	0912	.50	< .10	.20	< .10	3.4
08-03-90	0832	.40	< .10	.30	< .10	3.6
		Deer Creek lysimeter (DCLD, fig. 2)				
10-19-89	1048	*3.5	*<0.10	*0.80	* 0.10	--
03-21-90	1413	1.8	--	.30	< .10	3.2
04-04-90	0803	3.1	< .10	.30	< .10	3.1
05-02-90	0848	3.6	< .10	.40	< .10	2.8
05-10-90	0813	2.9	< .10	.30	< .10	2.8
06-06-90	0759	24	< .10	.70	.10	4.8
06-19-90	1204	26	--	.70	< .10	5.0
07-02-90	0913	25	< .10	.60	< .10	4.8
08-03-90	0833	34	< .10	.60	< .10	4.7
08-09-90	0743	36	< .10	.90	< .10	5.4
		Deer Creek Tile 2 (DCT2, fig. 2)				
11-08-89	0915	*18	*<0.10	*1.6	* 0.10	12
12-05-89	0900	* 6.7	*< .10	* .70	*< .10	5.0
01-04-90	0820	4.1	< .10	.70	< .10	6.0
02-07-90	1030	12	< .10	2.1	< .10	11
03-06-90	0800	7.4	< .10	.9	< .10	8.0
04-03-90	0815	23	< .10	1.1	< .10	9.0
05-02-90	0815	8.7	< .10	.60	< .10	9.0
06-05-90	1100	42	< .10	--	--	15
07-02-90	0940	23	< .10	1.3	< .10	11
08-02-90	0815	19	< .10	1.6	< .10	14
09-06-90	0730	17	< .10	1.6	< .10	15

Table 23. *Selected nitrogen, phosphorus, and carbon species at ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Nitrite plus nitrate, total (as N)	Ammonia, total (as N)	Organic nitrogen, total (as N)	Ortho-phos-phorus, total (as P)	Organic carbon, total (as C)
Big Spring (fig. 2)						
10-05-89	1145	*5.9	*<0.10	* 0.50	*0.50	1.0
11-08-89	1500	*5.7	*< .10	*< .10	* .50	1.3
12-05-89	1400	*5.9	*< .10	* .20	* .40	< .10
01-04-90	1300	*6.3	*< .10	* .20	* .40	1.3
01-22-90	1125	3.7	1.0	2.9	1.0	12
02-06-90	1445	5.0	.20	.70	.80	4.5
02-08-90	0915	4.4	.40	1.9	1.0	9.4
02-12-90	1105	3.0	1.8	2.9	1.0	14
03-05-90	1245	4.9	< .10	1.1	.80	7.6
03-08-90	1730	3.8	.80	5.3	1.1	19
03-09-90	1630	3.4	1.6	6.4	1.2	36
03-10-90	0815	3.8	1.6	6.2	1.3	33
03-12-90	1200	*5.4	*1.4	*5.0	*1.1	27
03-16-90	1330	8.1	.40	1.5	.70	9.7
04-02-90	1340	*7.8	*< .10	* .20	* .30	2.6
05-01-90	1410	6.0	< .10	.20	.30	1.2
06-06-90	1030	* 9.1	*< .10	* .20	* .30	1.9
06-22-90	1700	10	< .10	.60	.30	4.5
06-23-90	0700	12	< .10	.50	.40	3.4
07-02-90	1600	14	< .10	.20	.20	2.5
07-20-90	1240	10	< .10	.30	.30	2.1
08-01-90	1320	9.7	< .10	.30	.30	3.0
08-19-90	1320	9.4	< .10	.20	--	--
08-20-90	1600	9.2	< .10	.50	--	--
08-24-90	0600	8.9	< .10	.40	.40	2.3
08-24-90	1600	7.4	.20	9.1	.40	5.5
08-25-90	1000	9.8	.20	2.9	.40	4.7
08-26-90	1215	12	.10	1.3	.40	4.6
08-27-90	1045	14	< .10	.90	.40	3.7
08-28-90	1040	16	< .10	.60	.30	--
08-30-90	1200	14	< .10	.40	.20	2.0
09-05-90	1430	12	< .10	.20	.20	2.9

* Dissolved constituents.

Table 24. *Selected pesticides at ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*

[Total-recoverable constituents in micrograms per liter; <, less than the detection level indicated]

Date	Time (24-hour)	Alachlor	Atrazine	Butylate	Cyanazine	Metolachlor	Metribuzin	Trifluralin
				Deer Creek well (DCW2, fig. 2)				
10-04-89	1300	<0.10	0.10	<0.10	0.23	<0.10	<0.10	<0.10
11-08-89	1000	< .10	< .10	< .10	< .10	< .10	< .10	< .10
12-05-89	1230	< .10	< .10	< .10	< .10	< .10	< .10	< .10
01-04-90	1100	< .10	.12	< .10	.16	< .10	< .10	< .10
02-07-90	0940	< .10	< .10	< .10	< .10	< .10	< .10	< .10
03-06-90	1000	< .10	< .10	< .10	< .10	< .10	< .10	< .10
03-21-90	1500	< .10	< .10	< .10	< .10	< .10	< .10	< .10
04-03-90	1000	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-02-90	1100	< .10	< .10	< .10	< .10	< .10	< .10	< .10
06-05-90	1300	< .10	.13	< .10	< .10	< .10	< .10	< .10
07-02-90	1115	< .10	2.4	< .10	< .10	.13	< .10	< .10
08-02-90	1030	< .10	.23	< .10	< .10	< .10	< .10	< .10
09-06-90	0930	< .10	.18	< .10	< .10	< .10	< .10	< .10
				Deer Creek well (DCW3, fig. 2)				
10-05-89	0900	<0.10	<0.10	<0.10	0.34	<0.10	<0.10	<0.10
11-08-89	1130	< .10	< .10	< .10	< .10	< .10	< .10	< .10
12-05-89	1330	< .10	.27	< .10	< .10	< .10	< .10	< .10
01-04-90	1220	< .10	.75	< .10	< .10	< .10	< .10	< .10
02-07-90	0830	< .10	< .10	< .10	< .10	< .10	< .10	< .10
03-06-90	1110	< .10	< .10	< .10	< .10	< .10	< .10	< .10
03-21-90	1540	< .10	< .10	< .10	< .10	< .10	< .10	< .10
04-03-90	1130	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-02-90	1200	< .10	< .10	< .10	< .10	< .10	< .10	< .10
06-05-90	1150	< .10	< .10	< .10	< .10	< .10	< .10	< .10
07-02-90	1215	< .10	< .10	< .10	< .10	< .10	< .10	< .10
08-02-90	1130	< .10	< .10	< .10	< .10	< .10	< .10	< .10
09-06-90	1030	< .10	< .10	< .10	< .10	< .10	< .10	< .10

Table 24. *Selected pesticides at ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Ala-chlor	Atra-zine	Buty-late	Cyana-zine	Metola-chlor	Metri-buzin	Tri-flur-alin
Deer Creek lysimeter (DCLA, fig. 2)								
10-06-89	0950	<0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
10-19-89	1045	< .10	< .10	< .10	< .10	< .10	< .10	< .10
11-09-89	0755	< .10	< .10	< .10	< .10	< .10	< .10	< .10
03-21-90	1410	< .10	< .10	< .10	< .10	< .10	< .10	< .10
04-03-90	1040	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-02-90	0845	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-25-90	0715	< .10	< .10	< .10	< .10	< .10	< .10	< .10
06-07-90	0810	< .10	< .10	< .10	< .10	< .10	< .10	< .10
07-02-90	0910	< .10	< .10	< .10	< .10	< .10	< .10	< .10
08-02-90	0915	< .10	< .10	< .10	< .10	< .10	< .10	< .10
09-07-90	0740	< .10	< .10	< .10	< .10	< .10	< .10	< .10
Deer Creek lysimeter (DCLB, fig. 2)								
10-06-89	0952	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
10-19-89	1046	< .10	< .10	< .10	< .10	< .10	< .10	< .10
11-09-89	0756	< .10	< .10	< .10	< .10	< .10	< .10	< .10
03-21-90	1411	< .10	< .10	< .10	< .10	< .10	< .10	< .10
04-03-90	1041	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-02-90	0846	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-25-90	0716	< .10	< .10	< .10	< .10	< .10	< .10	< .10
06-06-90	0757	< .10	< .10	< .10	.10	< .10	< .10	< .10
07-02-90	0911	< .10	< .10	< .10	< .10	< .10	< .10	< .10
08-02-90	0916	.14	< .10	< .10	< .10	< .10	< .10	< .10
09-07-90	0741	< .10	< .10	< .10	< .10	< .10	< .10	< .10

Table 24. *Selected pesticides at ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Ala-chlor	Atra-zine	Buty-late	Cyana-zine	Metola-chlor	Metri-buzin	Tri-flur-alin
				Deer Creek lysimeter (DCLC, fig. 2)				
10-06-89	0954	<0.10	0.57	<0.10	<0.10	<0.10	<0.10	<0.10
10-19-89	1047	< .10	.59	< .10	< .10	< .10	< .10	< .10
11-09-89	0757	< .10	.31	< .10	< .10	< .10	< .10	< .10
03-21-90	1412	< .10	.14	< .10	< .10	< .10	< .10	< .10
04-03-90	1042	< .10	< .10	< .10	< .10	< .10	< .10	< .10
05-02-90	0847	< .10	.10	< .10	< .10	< .10	< .10	< .10
05-25-90	0717	< .10	.10	< .10	< .10	< .10	< .10	< .10
06-06-90	0758	< .10	< .10	< .10	< .10	< .10	< .10	< .10
07-02-90	0912	< .10	.12	< .10	< .10	< .10	< .10	< .10
08-02-90	0917	< .10	.16	< .10	< .10	< .10	< .10	< .10
				Deer Creek lysimeter (DCLD, fig. 2)				
11-09-89	0758	<0.10	0.35	<0.10	<0.10	<0.10	<0.10	<0.10
03-21-90	1413	< .10	.16	< .10	< .10	< .10	< .10	< .10
04-03-90	1043	< .10	.12	< .10	< .10	< .10	< .10	< .10
05-02-90	0848	< .10	.14	< .10	< .10	< .10	< .10	< .10
05-25-90	0718	< .10	1.0	< .10	< .10	.34	< .10	< .10
06-06-90	0759	< .10	1.3	< .10	< .10	.55	< .10	< .10
07-02-90	0913	< .10	3.6	< .10	< .10	.83	< .10	< .10
08-02-90	0918	< .10	1.8	< .10	< .10	.33	< .10	< .10
09-07-90	0743	< .10	3.1	< .10	< .10	.27	< .10	< .10
				Deer Creek tile 2 (DCT2, fig. 2)				
11-08-89	0915	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10
12-05-89	0900	< .10	.10	< .10	< .10	< .10	< .10	< .10
01-04-90	0820	< .10	< .10	< .10	< .10	< .10	< .10	< .10
02-07-90	1030	< .10	.10	< .10	< .10	< .10	< .10	< .10
03-06-90	0800	< .10	< .10	< .10	< .10	< .10	< .10	< .10
04-03-90	0815	< .10	.17	< .10	< .10	< .10	< .10	< .10
05-02-90	0815	< .10	.10	< .10	< .10	< .10	< .10	< .10
06-05-90	1100	< .10	.37	< .10	< .10	.85	< .10	.23
07-02-90	0940	< .10	.48	< .10	< .10	.16	< .10	< .10
08-02-90	0815	< .10	.42	< .10	< .10	< .10	< .10	< .10
09-06-90	0730	< .10	< .10	< .10	< .10	< .10	< .10	< .10

Table 24. *Selected pesticides at ground-water monitoring sites in the Big Spring basin, Clayton County, Iowa, water year 1990*--Continued

Date	Time (24-hour)	Alachlor	Atrazine	Butylate	Cyanazine	Metolachlor	Metribuzin	Trifluralin
			Big Spring (fig. 2)					
10-05-89	1145	<0.10	0.38	<0.10	0.26	<0.10	<0.10	<0.10
11-08-89	1500	< .10	.22	< .10	< .10	< .10	< .10	< .10
12-05-89	1400	< .10	.19	< .10	< .10	< .10	< .10	< .10
01-04-90	1300	< .10	.14	< .10	< .10	< .10	< .10	< .10
01-22-90	1125	.22	1.4	< .10	.24	< .10	< .10	< .10
02-06-90	1445	< .10	.69	< .10	< .10	< .10	< .10	< .10
02-07-90	1545	< .10	1.2	< .10	< .10	< .10	< .10	< .10
02-12-90	1105	< .10	2.7	< .10	.16	2.1	< .10	< .10
03-05-90	1245	< .10	.68	< .10	< .10	< .10	< .10	< .10
03-08-90	1730	< .10	1.0	< .10	< .10	< .10	< .10	< .10
03-09-90	1630	< .10	3.0	< .10	.22	< .10	< .10	< .10
03-10-90	0815	.13	2.7	< .10	.19	< .10	< .10	< .10
03-12-90	1200	.13	4.5	< .10	.22	< .10	< .10	< .10
03-16-90	1330	< .10	2.1	< .10	.29	< .10	< .10	< .10
04-02-90	1340	< .10	.37	< .10	< .10	< .10	< .10	< .10
05-01-90	1410	< .10	.19	< .10	< .10	< .10	< .10	< .10
06-06-90	1030	.77	1.6	< .10	.47	< .10	< .10	< .10
06-22-90	1700	.25	2.3	< .10	.40	.18	< .10	< .10
06-23-90	0700	.39	1.4	< .10	.45	< .10	< .10	< .10
07-02-90	1600	.12	1.8	< .10	.21	< .10	< .10	< .10
07-20-90	1240	< .10	.98	< .10	< .10	< .10	< .10	< .10
08-01-90	1320	< .10	.64	< .10	< .10	< .10	< .10	< .10
08-19-90	1520	< .10	.61	< .10	< .10	< .10	< .10	< .10
08-20-90	1600	< .10	.49	< .10	< .10	< .10	< .10	< .10
08-24-90	0600	< .10	.44	< .10	< .10	< .10	< .10	< .10
08-24-90	1600	< .10	.40	< .10	< .10	< .10	< .10	< .10
08-25-90	0600	< .10	.89	< .10	.12	< .10	< .10	< .10
08-26-90	1215	< .10	.93	< .10	.15	< .10	< .10	< .10
08-27-90	1045	< .10	.86	< .10	.12	< .10	< .10	< .10
08-28-90	1040	< .10	1.2	< .10	< .10	< .10	< .10	< .10
08-30-90	1200	< .10	.43	< .10	< .10	< .10	< .10	< .10
09-05-90	1430	< .10	.32	< .10	< .10	< .10	< .10	< .10

Table 25. *Daily mean water levels in the Galena aquifer, Clayton County, Iowa, water year 1990*

[Water levels in feet below land surface; ---, data not available to calculate mean values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
						Well BS1-B (fig. 2)						
1	---	---	---	---	9.95	9.58	7.50	7.80	6.55	6.09	6.58	---
2	---	---	---	---	9.94	8.87	7.57	7.82	6.48	6.21	6.77	---
3	---	---	---	---	9.96	8.71	7.60	7.87	6.28	6.31	6.93	---
4	---	---	---	10.34	10.02	8.87	7.62	7.88	6.31	6.46	6.91	---
5	---	---	---	10.33	9.80	9.12	7.71	7.92	6.30	6.59	7.00	---
6	9.69	---	---	10.32	8.69	9.30	7.78	7.98	6.38	6.68	6.99	---
7	9.80	---	---	10.30	8.56	9.32	7.86	8.02	6.44	6.73	7.08	---
8	9.86	9.52	---	10.28	8.12	7.68	7.90	8.11	6.50	6.80	7.25	---
9	9.88	9.56	---	9.87	7.78	6.10	7.94	8.08	6.61	6.91	7.38	---
10	9.91	9.65	---	9.42	8.11	6.20	7.85	7.92	6.73	6.99	7.49	---
11	9.91	9.67	---	9.39	8.55	5.57	7.78	7.89	6.80	7.03	7.57	---
12	9.98	9.67	---	9.93	8.70	5.40	7.79	7.79	6.79	7.09	7.58	---
13	10.00	9.65	---	10.04	8.38	5.16	7.82	7.78	6.63	7.10	7.77	---
14	10.07	9.67	---	10.06	8.75	4.46	7.81	7.79	6.27	7.13	7.92	---
15	10.00	9.68	---	10.13	9.03	4.01	7.82	7.84	6.16	7.21	8.00	---
16	9.70	9.71	---	10.02	9.17	3.86	7.83	7.84	6.07	7.33	8.09	---
17	9.54	9.77	---	9.10	9.30	4.53	7.88	7.90	5.96	7.43	8.05	---
18	9.60	---	---	9.16	9.32	5.15	7.90	7.96	5.86	7.43	7.94	6.13
19	9.59	---	---	9.54	9.44	5.62	7.88	7.43	5.77	7.28	7.61	6.21
20	9.62	---	10.03	9.67	9.49	5.93	7.82	6.22	5.82	7.06	7.11	6.28
21	9.71	---	10.04	9.77	9.50	6.14	7.75	5.58	5.94	7.01	6.22	6.32
22	---	---	10.14	9.84	9.45	6.39	7.70	5.46	5.54	7.05	6.04	6.41
23	---	---	10.09	9.84	9.30	6.59	7.68	5.55	5.05	7.18	6.29	6.45
24	---	---	---	9.87	9.36	6.72	7.71	5.70	5.06	7.30	6.35	6.50
25	---	---	---	9.82	9.49	6.82	7.77	5.80	5.24	7.41	---	6.53
26	---	---	---	9.86	9.49	6.98	7.77	5.89	5.36	7.49	---	6.62
27	---	---	---	9.87	9.60	7.07	7.80	6.00	5.52	7.29	---	6.64
28	---	---	---	9.96	9.65	7.16	7.82	6.10	5.69	6.37	---	6.73
29	---	---	---	9.92		7.26	7.82	6.15	5.84	6.10	---	6.77
30	---	---	---	9.94		7.35	7.81	6.31	5.95	6.15	---	6.79
31	---		---	10.01		7.45		6.45		6.35	---	
						Well BS2-E (fig. 2)						
1	154.54	154.42	154.58	154.75	154.70	154.12	154.43	154.34	153.98	153.43	153.95	---
2	154.60	154.44	154.62	154.74	154.71	153.79	154.39	154.36	153.71	153.51	153.92	---
3	154.59	154.43	154.60	154.79	154.72	154.17	154.37	154.37	153.70	153.55	153.93	---
4	154.58	154.46	154.60	154.84	154.72	154.26	154.37	154.35	153.82	153.63	153.69	---
5	154.56	154.49	154.62	154.83	153.61	154.40	154.38	154.35	153.86	153.67	153.85	---
6	154.55	154.50	154.64	154.83	153.61	154.47	154.39	154.35	153.99	153.69	153.92	153.49
7	154.55	154.47	154.64	154.83	153.39	154.49	154.40	154.35	154.03	153.70	153.94	---
8	154.56	154.48	154.61	154.80	151.96	---	154.40	154.38	154.03	153.72	153.95	---
9	154.56	154.52	154.61	153.90	153.69	---	154.40	154.31	154.04	153.76	153.96	---
10	154.58	154.51	154.64	154.42	154.20	---	154.36	154.28	154.06	153.77	153.96	---
11	154.58	154.55	154.64	154.65	154.37	---	154.35	154.29	154.06	153.78	153.98	---
12	154.62	154.51	154.64	154.76	154.10	---	154.34	154.29	154.06	153.86	153.99	---
13	154.60	154.54	154.66	154.75	154.23	153.40	154.34	154.33	153.91	153.86	154.07	---
14	154.59	154.53	154.69	154.75	154.45	151.60	154.34	154.32	153.95	153.87	154.21	---
15	154.59	154.55	154.69	154.70	154.48	152.36	154.35	154.32	154.02	153.89	154.24	---
16	154.41	154.55	154.70	154.54	154.56	153.68	154.36	154.30	153.76	153.99	154.24	---
17	154.48	154.59	154.71	153.11	154.58	154.18	154.37	154.31	153.54	154.01	154.21	---
18	154.52	154.59	154.73	154.53	154.58	154.60	154.37	154.32	153.56	153.87	154.20	---
19	154.49	154.57	154.72	154.60	154.64	154.66	154.36	153.92	153.60	153.51	153.89	---
20	154.50	154.60	154.73	154.66	154.63	154.64	154.34	153.58	153.64	153.61	154.00	---
21	154.55	154.57	154.75	154.70	154.60	154.62	154.32	153.64	153.68	153.74	154.04	---
22	154.56	154.58	154.75	154.72	154.53	154.56	154.30	153.69	152.22	153.80	154.09	---
23	154.56	154.57	154.73	154.71	154.49	154.50	154.27	153.75	152.40	153.87	154.12	---
24	154.57	154.56	154.73	154.76	154.63	154.50	154.27	153.80	152.83	153.98	154.01	---
25	154.57	154.59	154.74	154.74	154.62	154.50	154.29	153.83	153.03	154.00	142.54	---
26	154.56	154.59	154.77	154.74	154.59	154.45	154.29	153.87	152.50	154.01	---	---
27	154.56	154.57	154.76	154.77	154.64	154.44	154.29	153.90	153.04	153.74	---	---
28	154.55	154.60	154.76	154.75	154.63	154.45	154.29	153.90	153.21	153.73	---	---
29	154.54	154.58	154.76	154.72		154.45	154.31	153.91	153.29	153.77	---	---
30	154.47	154.59	154.75	154.76		154.44	154.34	153.96	153.34	153.86	---	---
31	154.40		154.75	154.73		154.44		153.98		153.95	---	

Table 25. *Daily mean water levels in the Galena aquifer, Clayton County, Iowa, water year 1990*--Continued

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
						Well BS3-A (fig. 2)						
1	---	167.93	167.99	167.95	---	---	---	---	---	---	166.61	---
2	---	167.93	168.04	167.91	---	---	167.83	167.71	---	---	---	---
3	---	167.81	168.03	167.70	---	---	---	---	166.85	---	---	---
4	---	167.64	167.66	167.75	---	---	---	---	---	---	---	---
5	---	167.66	167.71	167.90	---	167.90	---	---	---	---	---	163.58
6	167.93	167.93	167.97	167.93	167.92	---	---	---	---	---	---	---
7	168.00	167.81	168.17	167.71	---	---	---	---	---	---	---	---
8	167.96	167.67	168.03	167.46	---	---	---	---	---	---	---	---
9	167.87	167.65	167.81	167.74	---	---	---	---	---	---	---	---
10	167.89	167.87	167.95	167.82	---	---	---	---	---	---	---	---
11	167.75	167.86	168.04	---	---	---	---	---	---	---	---	---
12	167.96	167.99	167.95	---	---	---	---	---	---	---	---	---
13	167.94	167.79	167.91	---	---	---	---	---	---	---	---	---
14	167.88	167.88	167.97	---	---	---	---	---	---	---	---	---
15	167.80	167.90	168.00	---	---	---	---	---	---	---	---	---
16	167.97	167.95	168.03	---	---	---	---	---	---	---	---	---
17	168.09	167.87	167.98	---	---	---	---	---	---	---	---	---
18	168.16	168.09	168.05	---	---	---	---	---	---	---	---	---
19	168.02	167.91	168.02	---	---	---	---	---	---	---	---	---
20	167.80	167.96	168.03	---	---	---	---	---	---	---	---	---
21	167.88	168.05	168.14	---	---	---	---	---	---	---	---	---
22	167.97	168.07	168.13	---	---	---	---	---	---	---	---	---
23	167.97	168.05	167.98	---	---	---	---	---	---	---	---	---
24	167.99	167.85	167.81	---	---	---	---	---	---	---	---	---
25	167.99	167.86	167.67	---	---	---	---	---	---	---	---	---
26	167.98	167.97	167.87	---	---	---	---	---	---	---	---	---
27	167.96	167.74	167.75	---	---	---	---	---	---	---	---	---
28	167.95	168.17	167.80	---	---	---	---	---	---	---	---	---
29	167.90	168.08	167.91	---		---	---	---	---	---	---	---
30	167.80	168.04	167.90	---		---	---	---	---	---	---	---
31	167.82		167.76	---		---		---		---	---	
						Well BS4-A (fig. 2)						
1	219.54	220.35	220.68	221.24	221.44	221.40	219.59	220.14	219.47	216.94	215.97	---
2	219.76	220.38	220.72	221.14	221.58	221.21	219.78	220.19	219.16	216.75	215.88	---
3	220.11	220.23	220.87	221.04	221.58	221.39	219.81	220.21	219.27	216.49	215.77	---
4	219.98	219.97	220.30	221.22	221.53	221.28	219.52	220.03	219.50	216.53	215.78	---
5	219.49	219.91	220.38	221.33	221.43	221.45	219.64	220.00	219.19	216.61	215.97	---
6	219.71	220.30	220.74	221.37	221.51	221.64	219.78	219.99	219.20	216.58	216.06	---
7	219.91	220.17	221.15	221.17	221.50	221.63	219.85	219.84	219.22	216.37	215.95	---
8	219.83	220.03	220.99	220.95	221.26	221.22	219.75	219.89	219.06	216.24	215.85	---
9	219.72	220.03	220.60	221.10	221.37	221.19	219.67	219.77	219.14	216.34	215.79	---
10	219.72	220.28	220.79	221.24	221.41	221.18	219.73	219.94	219.24	216.31	215.75	---
11	219.60	220.30	221.02	221.11	221.46	221.02	219.91	220.17	219.08	216.22	215.76	---
12	219.92	220.49	220.90	221.52	221.29	220.86	219.88	220.11	218.77	216.30	215.79	---
13	219.95	220.19	220.79	221.55	221.47	220.91	219.79	220.20	218.76	216.29	---	---
14	219.84	220.29	220.92	221.21	221.74	220.57	219.67	220.12	218.87	216.00	---	---
15	219.76	220.32	221.00	221.36	221.37	220.43	219.71	220.07	218.81	215.90	---	---
16	220.03	220.43	221.07	221.39	221.32	220.52	219.68	219.91	218.62	215.97	---	---
17	220.30	220.31	220.98	221.33	221.79	220.45	220.00	220.07	218.49	216.03	---	---
18	220.44	220.65	221.12	221.63	221.51	220.60	220.10	220.24	218.56	216.08	---	---
19	220.21	220.40	221.13	221.60	221.75	220.76	219.85	219.95	218.35	216.01	---	---
20	219.85	220.42	221.16	221.22	221.73	220.58	219.79	220.12	218.18	215.96	---	---
21	219.91	220.62	221.37	221.16	221.39	220.20	219.92	220.29	218.14	215.99	---	---
22	220.11	220.62	221.49	221.23	221.13	220.13	219.81	220.28	217.88	215.94	---	---
23	220.14	220.61	221.30	220.99	221.16	220.54	219.65	220.10	217.87	215.94	---	---
24	220.19	220.35	220.90	221.20	221.58	220.39	219.65	220.04	217.82	215.97	---	---
25	220.21	220.35	220.67	221.22	221.88	220.16	219.80	219.89	217.71	216.00	---	---
26	220.23	220.54	220.96	221.30	221.52	220.25	219.73	219.87	217.52	216.01	---	---
27	220.21	220.27	220.85	221.29	221.65	220.13	219.64	219.82	217.36	215.93	---	---
28	220.20	220.86	220.97	221.59	221.70	219.98	219.57	219.76	217.12	215.84	---	---
29	220.13	220.83	221.09	221.30		219.88	219.78	219.77	217.04	215.77	---	---
30	220.09	220.74	221.06	221.35		219.80	220.03	219.80	216.99	215.91	---	---
31	220.15		220.93	221.49		219.71		219.70		216.00	---	

Table 26. *Daily mean discharge and specific conductance at Big Spring, Clayton County, Iowa, water year 1990*

[---, data not available to calculate mean values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Daily mean discharge, in cubic feet per second												
1	12	12	10	9.5	10	13	16	16	21	36	21	48
2	12	12	10	9.6	10	26	16	15	27	35	21	42
3	12	12	10	9.6	10	18	16	15	35	34	20	41
4	12	12	10	9.7	10	15	16	16	27	30	24	39
5	11	12	10	9.7	24	28	16	15	26	29	22	35
6	11	11	10	9.7	36	33	16	15	25	29	20	31
7	11	11	10	9.7	31	11	16	15	23	28	19	30
8	11	11	10	9.7	65	132	16	15	22	27	19	30
9	10	11	10	24	38	87	16	16	21	26	19	28
10	10	11	10	17	19	29	16	17	20	25	19	28
11	11	11	10	11	14	74	16	16	20	25	18	28
12	10	11	10	10	16	37	16	16	20	24	18	29
13	10	11	9.9	10	21	31	15	16	23	23	18	28
14	10	11	9.8	10	13	65	16	16	24	22	18	29
15	11	11	9.7	10	13	42	16	15	22	22	17	28
16	12	11	9.7	11	12	31	15	16	28	21	17	27
17	12	11	9.7	49	12	26	15	16	34	20	18	25
18	11	10	9.6	14	12	23	15	15	35	22	19	26
19	12	11	9.6	11	11	21	15	24	33	30	25	26
20	11	11	9.6	11	11	20	16	41	31	33	25	25
21	11	11	9.5	10	11	29	16	37	30	26	24	26
22	11	11	9.5	10	11	20	17	33	62	25	22	25
23	11	11	9.5	10	11	19	17	29	68	23	21	24
24	11	11	9.5	10	11	18	17	28	58	21	23	24
25	11	11	9.5	10	11	18	17	27	51	21	187	25
26	11	11	9.4	10	10	18	17	26	60	20	117	23
27	11	11	9.5	10	10	18	17	24	49	27	96	24
28	11	11	9.5	10	10	17	17	24	44	27	71	24
29	11	11	9.5	10		17	17	24	41	25	62	23
30	11	10	9.5	10		17	16	22	38	24	55	23
31	12		9.5	10		17		21		22	51	
Daily mean specific conductance, in microsiemens per centimeter at 25 degrees Celsius												
1	750	745	764	750	742	682	---	722	743	736	755	752
2	750	744	762	751	740	700	---	724	743	747	756	759
3	---	744	762	752	744	736	---	725	741	752	756	760
4	---	742	760	754	763	723	---	726	742	753	754	766
5	---	744	760	753	789	681	---	726	---	753	758	766
6	---	742	759	751	796	654	---	726	733	754	760	763
7	---	740	758	751	770	647	---	728	736	---	755	764
8	---	741	757	761	676	635	---	728	735	754	754	768
9	---	748	758	769	539	378	---	729	729	755	752	766
10	---	752	756	778	481	392	---	729	722	755	746	766
11	752	752	754	787	500	452	727	730	723	756	750	766
12	750	750	752	786	516	438	729	728	730	757	755	765
13	749	748	751	781	539	469	725	724	736	756	751	764
14	755	747	752	766	552	540	724	727	742	753	755	773
15	764	747	753	742	545	537	723	729	746	753	757	762
16	774	748	754	734	549	572	722	729	741	753	758	761
17	778	751	754	733	560	601	720	731	743	751	756	761
18	775	754	755	728	571	619	720	734	733	754	758	759
19	771	753	758	721	583	632	722	734	727	747	756	760
20	759	751	759	694	592	646	722	---	729	739	757	759
21	752	750	758	651	604	664	721	---	739	---	753	748
22	747	751	758	655	618	673	720	---	738	731	748	747
23	743	755	759	682	635	679	721	---	717	737	750	750
24	741	756	759	693	643	689	721	743	725	745	753	748
25	742	759	759	687	662	698	720	741	726	740	659	741
26	742	761	759	688	679	707	721	750	733	735	617	745
27	746	761	760	692	678	712	722	749	747	741	660	747
28	748	761	759	702	676	717	723	740	722	751	670	746
29	748	761	757	717		---	723	742	720	755	700	748
30	746	763	757	733		---	722	743	711	755	723	---
31	746		---	743		---		743		756	741	

Table 27. *Daily median pH and daily mean water temperature at Big Spring, Clayton County, Iowa, water year 1990*

[---, data not available to calculate median values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
					Daily median pH, in standard units							
1	6.7	6.8	7.0	7.1	6.8	6.8	---	6.9	6.8	6.8	6.7	6.6
2	6.7	6.8	7.0	7.1	6.8	6.9	---	6.9	6.8	6.8	6.7	6.7
3	6.8	6.8	7.0	7.1	6.8	6.9	---	6.9	6.8	6.8	6.7	6.7
4	6.8	6.8	7.0	7.0	6.8	6.8	---	6.9	6.8	6.8	6.7	6.7
5	6.8	6.8	7.0	7.0	6.8	6.8	---	6.9	---	6.8	6.7	6.8
6	6.8	6.8	7.0	7.0	6.8	6.9	---	6.9	6.8	6.8	6.7	6.8
7	6.8	6.8	7.0	7.0	6.8	6.9	---	6.9	6.8	---	6.7	7.0
8	6.8	6.8	7.0	7.0	6.7	6.9	---	6.9	6.8	6.8	6.7	7.0
9	6.8	6.8	7.0	7.0	6.6	6.6	---	6.9	6.8	6.8	6.7	7.0
10	6.8	6.7	7.0	6.9	6.5	6.6	---	6.9	6.7	6.8	6.7	7.0
11	6.8	6.7	7.0	6.9	6.6	6.7	6.9	6.9	6.8	6.8	6.7	7.0
12	6.8	6.7	7.0	6.9	6.6	6.5	6.9	6.9	6.7	6.7	6.7	7.0
13	6.8	6.7	7.1	6.9	6.6	6.6	6.9	6.9	6.8	6.7	6.7	7.0
14	6.8	6.8	7.1	6.9	6.6	6.7	6.9	6.9	6.8	6.8	6.7	7.0
15	6.8	6.8	7.1	6.8	6.6	6.7	6.9	6.9	6.8	6.7	6.7	7.0
16	6.8	6.8	7.1	6.8	6.6	6.7	6.9	6.8	6.8	6.7	6.7	7.0
17	6.8	6.8	7.1	6.8	6.7	6.7	6.9	6.8	6.8	6.7	6.7	7.0
18	6.8	6.9	7.1	6.8	6.7	6.8	6.8	6.8	6.8	6.7	6.7	7.2
19	6.8	6.9	7.1	6.7	6.7	6.8	6.8	6.8	6.8	6.7	6.7	7.2
20	6.8	7.0	7.2	6.7	6.7	6.8	6.9	6.8	6.8	6.6	6.7	7.2
21	6.8	7.0	7.2	6.6	6.7	6.8	6.9	6.8	6.8	6.7	6.5	6.8
22	6.8	7.0	7.2	6.6	6.8	6.8	6.8	6.8	6.8	6.7	6.5	6.8
23	6.8	7.0	7.2	6.7	6.8	6.8	6.8	6.8	6.7	6.7	6.7	6.8
24	6.8	6.9	7.2	6.8	6.8	6.8	---	6.8	6.7	6.7	6.7	6.8
25	6.8	6.8	7.2	6.8	6.8	6.8	---	6.8	6.7	6.7	6.7	6.8
26	6.8	7.0	7.2	6.7	6.8	6.8	6.9	6.8	6.8	6.7	6.6	6.8
27	6.8	7.0	7.2	6.7	6.8	6.8	7.0	6.8	6.8	6.7	6.6	6.8
28	6.8	7.0	7.1	6.7	6.8	6.8	7.0	6.8	6.8	6.7	6.7	---
29	6.8	7.0	7.1	6.7		---	7.0	6.8	6.8	6.7	6.7	6.8
30	6.8	7.0	7.1	6.8		---	7.0	6.8	6.8	6.7	6.6	---
31	6.8		---	6.8		---		6.8		6.7	6.6	
				Daily mean water temperature, in degrees Celsius								
1	10.5	10.5	10.0	10.0	9.0	9.0	---	9.0	9.5	10.0	10.5	11.0
2	10.5	10.5	10.0	10.0	9.0	9.0	---	9.0	9.5	10.0	10.5	11.0
3	10.5	10.5	10.0	10.0	9.5	9.0	---	9.0	9.5	10.0	10.5	11.0
4	10.5	10.5	10.0	10.0	9.5	9.0	---	9.0	9.5	10.0	10.5	11.0
5	10.5	10.0	10.0	10.0	9.5	9.0	---	9.0	---	10.0	10.5	11.0
6	10.5	10.0	10.0	10.0	9.0	9.0	---	9.0	9.5	10.0	10.5	11.0
7	10.5	10.0	10.0	10.0	9.0	9.0	---	9.0	9.5	---	10.0	10.5
8	10.5	10.0	10.0	10.0	8.5	8.5	---	9.0	9.5	10.0	10.0	10.5
9	10.5	10.0	10.0	10.0	8.0	5.5	---	9.0	9.5	10.0	10.0	10.5
10	10.5	10.0	10.0	9.5	7.5	6.0	---	9.0	9.5	10.0	10.0	10.5
11	10.5	10.0	10.0	9.5	8.0	6.5	9.0	9.0	9.5	10.0	10.0	10.5
12	10.5	10.0	10.0	9.5	8.0	6.5	9.0	9.0	9.5	10.0	10.0	10.5
13	10.5	10.0	10.0	9.5	8.0	6.5	9.0	9.0	9.5	10.0	10.0	10.5
14	10.5	10.0	10.0	9.5	8.0	7.5	9.0	9.0	9.5	10.0	10.0	10.5
15	10.5	10.0	10.0	9.5	8.0	8.0	9.5	9.0	9.5	10.0	10.5	10.5
16	10.5	10.0	10.0	9.5	8.0	8.0	9.5	9.0	9.5	10.0	10.0	10.5
17	10.5	10.0	10.0	9.5	8.0	8.0	9.5	9.0	9.5	10.0	10.0	10.5
18	10.5	10.0	10.0	9.5	8.5	8.5	9.5	9.5	9.5	10.0	10.0	10.5
19	10.5	10.0	10.0	9.5	8.5	8.5	9.5	9.5	10.0	10.0	10.5	10.5
20	10.5	10.0	10.0	9.5	8.5	8.5	9.5	9.5	10.0	10.5	10.5	10.5
21	10.5	10.0	10.0	9.0	8.5	8.5	9.5	9.5	10.0	---	10.5	10.5
22	10.5	10.0	10.0	9.0	8.5	8.5	9.5	9.5	10.0	10.0	10.5	10.5
23	10.5	10.0	10.0	9.0	8.5	8.5	9.5	9.5	10.0	10.5	10.5	10.5
24	10.5	10.0	10.0	9.0	8.5	9.0	---	9.5	10.0	10.0	10.5	10.5
25	10.5	10.0	10.0	9.0	8.5	9.0	---	9.5	10.0	10.0	11.0	10.5
26	10.5	10.0	10.0	9.0	8.5	9.0	9.0	9.5	10.0	10.5	11.5	10.5
27	10.0	10.0	10.0	9.0	8.5	9.0	9.0	9.5	10.0	10.5	11.5	10.5
28	10.0	10.0	10.0	9.0	9.0	9.0	9.0	9.5	10.0	10.5	11.5	10.5
29	10.0	10.0	10.0	9.0		---	9.0	9.5	10.0	10.5	11.5	10.5
30	10.0	10.0	10.0	9.0		---	9.0	9.5	10.0	10.5	11.0	10.5
31	10.0		---	9.0		---		9.5		10.5	11.0	

Table 28. *Daily mean suspended-sediment concentrations and daily suspended-sediment load at Big Spring, Clayton County, Iowa, water year 1990*

[---, data not available to calculate median values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Daily mean suspended-sediment concentration, in milligrams per liter												
1	11	7	0	5	4	2	---	8	9	24	11	38
2	11	6	0	5	4	3	---	7	15	23	18	31
3	11	5	0	5	3	---	4	6	19	21	16	23
4	---	5	0	6	3	2	5	6	17	19	23	20
5	---	4	0	6	18	2	---	7	16	18	25	24
6	---	4	1	6	18	2	---	6	14	18	20	32
7	---	3	1	5	19	2	---	4	13	18	15	31
8	---	2	1	5	42	578	---	3	12	20	12	28
9	---	2	1	22	31	416	---	9	10	21	7	25
10	10	1	1	20	23	146	26	14	13	20	7	23
11	10	0	1	9	11	178	19	7	17	21	7	22
12	10	0	1	3	8	112	12	7	23	22	10	21
13	10	0	1	1	7	68	10	7	18	24	12	21
14	10	0	6	1	3	80	11	7	23	24	14	28
15	10	0	3	3	2	73	11	6	23	21	17	25
16	10	0	4	17	2	33	12	9	16	18	21	19
17	2	0	4	23	2	16	12	6	16	46	26	18
18	2	0	5	7	5	12	12	3	20	33	22	29
19	7	1	6	2	3	10	12	9	19	32	36	42
20	15	1	7	2	---	9	10	21	17	35	8	31
21	21	3	7	2	2	7	6	12	11	28	22	16
22	22	7	13	3	3	8	6	---	24	19	10	11
23	22	6	6	3	3	5	8	9	40	27	15	9
24	21	5	6	3	2	9	---	10	38	34	1,360	9
25	19	4	6	3	2	14	19	11	24	21	5,100	14
26	10	3	6	2	2	19	29	10	39	18	401	42
27	5	3	6	4	2	18	39	9	43	46	105	31
28	5	3	7	5	2	22	39	9	33	40	33	---
29	5	1	7	4		22	26	13	29	29	24	---
30	5	0	6	4		---	14	12	26	21	16	---
31	10		6	4		---		10		16	27	
Daily suspended-sediment load, in tons												
1	0.37	0.22	0	0.13	0.10	0.07	---	0.35	0.52	1.5	0.63	2.8
2	.36	.20	0	.12	.10	.16	---	.27	.87	1.4	1.0	2.2
3	.36	.17	0	.12	.09	---	.19	.23	1.2	1.3	.89	1.6
4	---	.16	0	.15	.09	.10	.22	.28	1.1	1.1	1.4	1.4
5	---	.14	0	.17	.70	.19	---	.27	1.0	1.1	1.5	1.5
6	---	.12	.01	.15	1.2	.18	---	.24	.89	1.1	1.1	1.9
7	---	.09	.02	.14	1.2	.07	---	.18	.78	1.1	.79	1.9
8	---	.07	.03	.13	2.9	30	---	.13	.71	1.2	.63	1.7
9	---	.07	.03	1.0	2.0	24	---	.38	.58	1.2	.34	1.5
10	.26	.03	.04	.88	1.2	8.3	1.1	.64	.70	1.2	.35	1.4
11	.29	0	.04	.28	.41	11	.82	.32	.91	1.3	.34	1.4
12	.26	0	.02	.08	.31	6.7	.50	.31	1.2	1.3	.49	1.3
13	.26	0	.02	.03	.34	3.9	.40	.30	1.0	1.4	.58	1.1
14	.27	0	.17	.02	.09	5.0	.47	.30	1.3	1.4	.69	1.3
15	.31	0	.08	.09	.08	4.3	.50	.25	1.3	1.3	.78	1.1
16	.32	0	.10	.51	.07	2.0	.50	.37	.97	1.0	.95	.82
17	.08	0	.12	1.6	.08	.96	.50	.27	.97	2.5	1.3	.76
18	.06	0	.13	.26	.15	.71	.49	.12	1.2	1.9	1.1	1.3
19	.24	.03	.15	.07	.09	.55	.47	.50	1.2	1.9	2.2	1.8
20	.45	.03	.17	.05	---	.51	.44	1.4	1.1	2.1	.51	1.3
21	.62	.08	.18	.06	.07	.37	.26	.75	.70	1.6	1.3	.68
22	.66	.20	.33	.08	.08	.46	.25	---	1.6	1.2	.61	.47
23	.66	.17	.14	.08	.08	.27	.37	.56	2.6	1.6	.86	.40
24	.63	.15	.15	.08	.07	.46	---	.65	2.5	1.9	81	.36
25	.56	.12	.15	.07	.06	.70	.89	.69	1.5	1.2	275	.55
26	.29	.09	.15	.06	.05	.92	1.3	.65	2.6	.96	12	1.6
27	.16	.10	.16	.11	.05	.88	1.8	.53	2.7	2.7	3.1	1.3
28	.15	.08	.17	.12	.05	1.0	1.8	.59	2.0	2.4	2.2	---
29	.14	.04	.17	.12		.99	1.2	.80	1.8	1.7	1.8	---
30	.15	0	.16	.11		---	.59	.70	1.6	1.3	1.2	---
31	.32		.15	.09		---		.59		.96	1.9	
Total measured	8.23	2.36	3.04	6.96	11.7	104	15.1	13.6	39.1	45.8	398	35.4

Table 29. *Daily mean water levels in the Saint Peter aquifer, Clayton County, Iowa, water year 1990*

[Water levels in feet below land surface; ---, data not available to calculate mean values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
						Well BS2-G (fig. 2)						
1	185.03	185.39	185.48	185.65	185.63	186.00	185.56	185.31	185.54	185.50	185.75	185.64
2	185.18	185.45	185.56	185.58	185.73	185.74	185.85	---	185.37	185.48	185.62	185.69
3	185.42	185.36	185.62	185.52	185.74	185.90	185.80	185.91	185.38	185.32	185.50	185.69
4	185.56	185.08	185.18	185.60	185.77	185.96	---	185.72	185.58	185.53	185.54	185.68
5	185.73	184.99	185.13	185.65	185.66	185.97	185.54	185.65	---	185.63	185.82	185.58
6	185.38	185.25	185.36	185.69	185.71	186.14	---	185.61	185.41	185.67	185.81	185.32
7	185.39	185.14	185.72	185.56	185.76	186.21	185.79	185.48	185.52	185.53	185.74	185.33
8	185.30	184.97	185.65	185.37	185.57	185.81	---	185.52	185.43	185.44	185.66	185.57
9	185.21	184.91	185.41	185.38	185.68	185.71	185.70	185.44	185.51	185.53	185.67	185.43
10	185.15	185.13	185.46	185.47	185.77	185.73	---	185.48	185.65	185.72	185.63	185.42
11	185.01	185.35	185.59	185.35	185.77	185.58	185.71	185.63	185.68	185.59	185.80	185.42
12	185.21	185.45	185.73	185.69	185.60	185.59	---	185.58	185.46	185.73	185.70	185.41
13	185.24	185.15	185.48	185.82	185.67	185.73	185.83	185.66	185.39	185.80	185.74	185.43
14	185.24	185.18	185.52	185.51	185.95	185.41	---	185.60	185.50	185.54	185.73	185.42
15	185.36	185.18	185.58	185.60	185.67	185.31	---	185.54	185.56	185.53	185.73	185.43
16	185.28	185.32	185.63	185.63	185.72	185.45	185.63	185.44	185.48	185.52	185.73	185.44
17	185.50	185.16	185.58	185.68	186.04	185.59	185.66	185.67	185.36	185.54	185.69	185.45
18	185.68	185.46	185.74	185.95	185.83	185.76	---	185.66	185.47	185.54	185.73	185.43
19	185.52	185.36	185.78	185.90	186.04	185.98	185.80	185.37	185.41	185.51	185.66	185.42
20	185.24	185.28	185.75	185.60	186.13	185.96	185.92	185.47	185.34	185.51	185.44	185.43
21	185.30	185.40	185.98	185.57	185.84	185.77	---	185.64	185.46	185.63	185.23	185.43
22	185.34	185.64	186.11	185.60	185.59	185.78	185.76	185.66	185.27	185.50	185.67	185.43
23	185.34	185.52	186.05	185.32	185.57	186.09	185.77	185.58	185.33	185.52	185.73	185.43
24	185.41	185.29	185.82	185.41	185.87	186.07	185.75	185.57	185.43	185.51	185.69	185.43
25	185.43	185.19	185.44	185.41	186.22	185.98	---	185.52	185.49	185.55	185.69	185.43
26	185.42	185.35	185.59	185.47	186.04	186.06	185.51	185.60	185.50	185.62	185.69	185.43
27	185.39	185.29	185.52	185.47	186.08	186.14	185.50	185.53	185.47	185.58	185.71	185.43
28	185.38	185.58	185.50	185.75	186.31	185.94	---	185.48	185.44	185.47	185.56	185.43
29	185.30	185.73	185.56	185.49		185.83	185.65	185.54	185.43	185.37	185.73	185.43
30	185.38	185.58	185.57	185.50		185.76	185.44	185.62	185.43	185.45	185.48	185.43
31	185.26		185.46	185.63		185.67		185.58		185.56	185.70	
						Well BS4 (fig. 2)						
1	370.12	370.55	369.99	369.78	369.11	369.62	368.91	368.95	369.43	370.28	371.19	---
2	370.38	370.60	370.02	369.58	369.27	369.37	369.10	369.04	369.15	370.28	371.13	---
3	370.57	370.46	370.16	369.40	369.28	369.50	369.14	369.08	369.27	370.18	371.05	---
4	370.55	370.19	369.64	369.41	369.27	369.39	368.88	368.88	369.57	370.27	371.04	---
5	370.14	370.09	369.66	369.40	369.19	369.53	368.98	368.85	369.37	370.47	371.25	371.69
6	370.28	370.42	369.97	369.37	369.27	369.73	369.11	368.83	369.43	370.56	371.40	---
7	370.45	370.31	370.36	369.13	369.26	369.72	369.20	368.70	369.49	370.45	371.36	---
8	370.40	370.17	370.28	368.83	369.04	369.34	369.14	368.72	369.42	370.38	371.29	---
9	370.31	370.09	369.93	368.87	369.11	369.27	369.06	368.60	369.55	370.52	371.26	---
10	370.27	370.30	370.08	368.94	369.15	369.23	369.09	368.72	369.75	370.56	371.23	---
11	370.12	370.28	370.30	368.77	369.24	369.08	369.23	368.96	369.70	370.53	371.26	---
12	370.33	370.45	370.21	369.12	369.10	368.96	369.20	368.94	369.48	370.65	371.31	---
13	370.33	370.14	370.10	369.14	369.24	369.04	369.10	369.10	369.49	370.73	---	---
14	370.23	370.18	370.21	368.83	369.54	368.76	368.94	369.07	369.65	370.54	---	---
15	370.13	370.16	370.29	368.93	369.24	368.64	368.92	369.06	369.67	370.49	---	---
16	370.32	370.21	370.36	368.94	369.15	368.77	368.85	368.94	369.58	370.61	---	---
17	370.59	370.04	370.31	368.86	369.60	368.80	369.11	369.07	369.56	370.71	---	---
18	370.79	370.29	370.45	369.18	369.40	369.03	369.17	369.25	369.75	370.78	---	---
19	370.59	370.08	370.48	369.17	369.66	369.33	368.92	369.01	---	370.74	---	---
20	370.24	370.05	370.51	368.84	369.74	369.29	368.84	369.19	---	370.72	---	---
21	370.24	370.21	370.75	368.79	369.45	368.99	368.92	369.43	---	370.79	---	---
22	370.39	370.19	370.91	368.84	369.19	368.95	368.83	369.50	---	370.80	---	---
23	370.43	370.17	370.74	368.61	369.18	369.39	368.67	369.42	---	370.86	---	---
24	370.48	369.91	370.34	368.78	369.51	369.35	368.63	369.43	---	370.93	---	---
25	370.47	369.85	370.04	368.78	369.92	369.21	368.72	369.35	---	370.99	---	---
26	370.47	369.98	370.17	368.85	369.69	369.35	368.65	369.40	---	371.03	---	---
27	370.45	369.66	369.96	368.85	369.79	369.31	368.54	369.44	---	370.99	---	---
28	370.44	370.16	369.95	369.18	369.89	369.22	368.45	369.47	---	370.94	---	---
29	370.38	370.14	369.95	368.94		369.16	368.62	369.54	---	370.91	---	---
30	370.33	370.05	369.83	369.02		369.11	368.84	369.63	370.19	371.06	---	---
31	370.37		369.60	369.15		369.04		369.59		371.19	---	

Table 30. *Onsite determinations and chemical analyses of samples from streams in the Big Spring basin during low-flow conditions, May 29-30, 1990*

[ft³/s, cubic feet per second: µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; N, nitrogen; P, phosphorus; C, carbon; <, less than; --, missing data]

Site designation (fig. 16)	Date	Time	Discharge (ft³/s)	Specific conductance (µS/cm)	pH (standard units)	Water temperature (°C)	Nitrite plus nitrate, dissolved (mg/L as N)	Ammonia, dissolved (mg/L as N)	Organic nitrogen, dissolved (mg/L as N)	Orthophosphorus, dissolved (mg/L as P)	Total organic carbon mg/L (as C)
HS5	5-30-90	0710	0.20	713	8.0	10.0	5.5	<0.10	0.50	0.20	4.3
HS6	5-30-90	0840	.61	688	7.8	10.5	4.5	< .10	.40	.10	3.3
HS4	5-30-90	0930	.61	700	7.8	11.0	10	< .10	.20	< .10	2.2
HS2	5-30-90	1020	.60	693	8.2	11.0	9.4	< .10	.40	.20	2.7
HS3	5-30-90	1100	1.55	655	8.4	15.0	7.7	< .10	.40	.10	2.9
HS1	5-30-90	--	0	--	--	--	--	--	--	--	--
RC13	5-30-90	1100	.35	954	7.7	15.5	18	2.0	1.6	.90	6.9
RC26	5-30-90	1305	.95	630	8.0	21.5	4.9	< .10	.20	.50	2.0
RC25	5-30-90	0820	.12	798	7.5	10.5	7.4	< .10	.60	< .10	2.8
RC21	5-30-90	1600	1.07	644	8.2	22.5	6.8	< .10	.60	< .10	4.2
RC20	5-30-90	1500	2.76	711	8.0	21.5	8.1	< .10	.60	.20	3.6
RC11	5-30-90	1655	3.42	675	8.3	22.0	7.0	< .10	.50	.20	3.7
RC10	5-30-90	1620	3.61	625	8.9	22.0	6.6	< .10	.60	.10	4.5
RC15	5-30-90	1635	3.96	680	7.5	21.0	5.3	.10	.70	.20	4.6
DC2	5-30-90	1515	.43	670	7.3	20.0	1.9	.20	.80	.50	4.2
F45	5-30-90	1255	5.54	690	7.3	18.0	5.5	.20	.70	.20	4.3
RC29	5-30-90	1130	.47	660	7.4	15.0	6.4	< .10	.30	.10	2.4
RC16	5-30-90	0950	6.28	695	7.6	17.0	6.4	.20	.80	.20	4.8
RC17	5-30-90	0800	7.09	680	7.4	16.0	6.4	.20	.80	.20	4.9
SC10	5-30-90	0845	.42	1,020	8.0	11.0	15	.20	.90	2.0	3.6
SC13	5-30-90	0720	.95	1,000	8.0	28.0	2.4	.70	.60	7.2	3.7
SC3	5-30-90	1030	.90	1,250	8.4	18.0	6.0	.70	1.0	7.0	4.6
SC6	5-30-90	1600	.36	1,180	8.3	22.0	6.2	.50	1.3	4.4	8.6
SCU1	5-30-90	1250	.14	890	8.2	23.0	2.6	< .10	.60	.10	5.2
SCU2	5-30-90	1230	.02	713	8.0	18.0	5.6	< .10	.30	< .10	2.2
L23S	5-30-90	1420	.56	720	8.7	23.0	6.4	.10	1.7	.20	7.4
SC5	5-30-90	1300	1.13	600	8.4	17.0	7.6	< .10	.70	.20	4.3
SC1	5-30-90	1525	.70	855	8.7	22.0	6.8	.10	1.0	1.1	7.0
SC14	5-30-90	0955	.23	720	8.1	11.0	6.7	< .10	.60	.10	3.1
SC2	5-29-90	1715	.80	770	8.3	27.0	4.7	.40	2.1	1.0	8.8
SC4	5-29-90	1550	1.30	890	8.2	23.0	4.8	.40	1.3	1.7	9.0
RC18	5-30-90	0755	7.33	706	8.0	15.5	5.7	.20	1.0	.30	6.3
RC19	5-30-90	0945	6.72	713	8.2	17.0	5.6	.10	.70	.20	4.8
F47	5-30-90	1135	6.38	712	8.2	18.0	5.5	< .10	.80	.30	4.7
RC24	5-30-90	1325	5.93	663	8.8	20.5	5.0	< .10	.70	.20	6.3
RC22	5-30-90	1515	3.85	640	8.9	23.0	4.7	< .10	.70	.20	5.2
RC2	5-30-90	1655	3.29	621	8.8	24.0	4.0	< .10	.50	.10	5.0
HC1	5-29-90	1520	.32	676	8.4	21.5	1.7	< .10	.40	.10	3.2
HC2	5-29-90	1710	.34	602	8.3	23.0	1.7	< .10	.60	.20	4.1

Table 31. *Selected pesticides in samples from streams in the Big Spring basin during low-flow conditions, May 29-30, 1990*

[Total-recoverable constituents in micrograms per liter; <, less than; --, data not collected]

Site designation (fig. 16)	Date	Time (24-hour)	Alachlor	Atrazine	Butylate	Cyanazine	Metolachlor	Metribuzin	Trifluralin
HS5	5-30-90	0710	--	--	--	--	--	--	--
HS6	5-30-90	0840	<0.10	0.22	<0.10	<0.10	<0.10	<0.10	<0.10
HS4	5-30-90	0930	< .10	.23	< .10	< .10	< .10	< .11	< .10
HS2	5-30-90	1020	< .10	.23	< .10	.10	< .10	.23	< .10
HS3	5-30-90	1110	< .10	.26	< .10	< .10	< .10	< .10	< .10
HS1	5-30-90	--	--	--	--	--	--	--	--
RC13	5-30-90	1100	< .10	.30	< .10	< .10	< .10	< .10	< .10
RC26	5-30-90	1305	--	--	--	--	--	--	--
RC25	5-30-90	0820	--	--	--	--	--	--	--
RC21	5-30-90	1600	< .10	.19	< .10	< .10	< .10	< .10	< .10
RC20	5-30-90	1500	< .10	.24	< .10	< .10	< .10	< .10	< .10
RC11	5-30-90	1655	< .10	.29	< .10	< .10	< .10	< .10	< .10
RC10	5-30-90	1615	< .10	.34	< .10	.16	< .10	< .10	< .10
RC15	5-30-90	1635	< .10	.69	< .10	< .10	< .10	< .10	< .10
DC2	5-30-90	1515	--	--	--	--	--	--	--
F45	5-30-90	1255	< .10	.71	< .10	.10	.22	< .10	< .10
RC29	5-30-90	1130	< .10	< .10	< .10	< .10	< .10	< .10	< .10
RC16	5-30-90	0950	< .10	.30	< .10	.10	< .10	< .10	< .10
RC17	5-30-90	0800	< .10	.49	< .10	.14	.10	< .10	< .10
SC10	5-30-90	0805	< .10	.98	< .10	.19	< .10	< .10	< .10
SC13	5-30-90	0720	.27	.11	< .10	< .10	< .10	< .10	< .10
SC3	5-30-90	1030	.34	.36	< .10	< .10	< .10	< .10	< .10
SC6	5-30-90	1600	.23	.38	< .10	< .10	1.3	< .10	< .10
SCU1	5-30-90	1250	< .10	.39	< .10	< .10	< .10	< .10	< .10
SCU2	5-30-90	1230	--	--	--	--	--	--	--
L23S	5-30-90	1420	< .10	.37	< .10	< .10	< .10	< .10	< .10
SC5	5-30-90	1300	< .10	.33	< .10	< .10	< .10	< .10	< .10
SC1	5-30-90	1200	--	--	--	--	--	--	--
SC14	5-30-90	0955	< .10	.33	< .10	< .10	< .10	< .10	< .10
SC2	5-29-90	1715	< .10	.19	< .10	< .10	< .10	< .10	< .10
SC4	5-29-90	1550	.68	1.0	< .10	< .10	.14	< .10	< .10
RC18	5-30-90	0755	.22	.54	< .10	.14	< .10	< .10	< .10
RC19	5-30-90	0945	< .10	.43	< .10	.20	.12	< .10	< .10
F47	5-30-90	1135	.18	.47	< .10	.21	.12	< .10	< .10
RC24	5-30-90	1325	.16	.48	< .10	.21	< .10	< .10	< .10
RC22	5-30-90	1515	.12	.60	< .10	.21	< .10	< .10	< .10
RC2	5-30-90	1655	.10	.52	< .10	.17	< .10	< .10	< .10
HC1	5-29-90	1520	< .10	.13	< .10	< .10	< .10	< .10	< .10
HC2	5-29-90	1710	.13	.45	< .10	< .10	< .10	< .10	< .10

Table 32. *Onsite determinations, nitrogen species, and suspended sediment in a selected reach of Roberts Creek, Clayton County, Iowa, April-November 1990*

[ft^3/s, cubic feet per second; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 degrees Celsius; nitrogen species and suspended-sediment concentrations in milligrams per liter; <, less than detection level indicated; --, missing data]

Date	Time	Instantaneous discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)	pH (units)	Total nitrite plus nitrate (as N)	Total ammonia (as N)	Total organic nitrogen (as N)	Suspended sediment
Roberts Creek northeast of Big Spring (RC18, fig. 18)									
4-11-90	1330	8.39	5.0	601	8.6	2.9	<0.10	1.4	--
6-06-90	1200	8.60	15.0	710	8.0	7.2	.40	1.1	39
7-13-90	1845	7.20	23.0	603	8.1	3.8	< .10	.80	55
8-06-90	1930	8.41	22.0	632	9.0	6.2	< .10	1.5	12
9-11-90	0900	9.31	21.0	730	8.0	6.7	< .10	.80	13
10-09-90	1245	5.82	9.0	680	8.3	3.4	< .10	.90	29
11-28-90	1230	5.19	1.5	697	8.3	3.5	.10	.40	12
Roberts Creek northwest of Saint Olaf (RC19, fig. 18)									
4-12-90	0555	6.87	2.5	622	8.5	2.6	<0.10	1.7	--
6-07-90	0125	8.12	16.0	710	8.1	7.4	.20	1.1	50
7-14-90	1230	5.34	20.0	647	8.0	3.5	< .10	.80	38
8-07-90	0930	6.84	19.0	624	--	5.7	< .10	1.6	25
9-11-90	2100	8.56	24.0	715	8.1	6.4	< .10	.80	26
10-10-90	1340	5.02	9.5	643	8.3	2.7	< .10	1.0	29
11-29-90	1910	6.27	1.0	677	8.3	3.4	< .10	.50	7
Roberts Creek west of Farmersburg (F47, fig. 18)									
4-12-90	0110	7.32	3.0	696	8.6	2.8	0.10	1.6	--
6-06-90	2150	8.46	16.5	705	8.1	7.4	.20	1.2	78
7-14-90	0720	6.24	20.0	640	--	3.6	< .10	1.0	80
8-07-90	0535	8.26	18.0	637	--	5.8	< .10	1.8	62
9-11-90	1715	9.14	25.0	710	8.0	6.6	< .10	.80	38
10-10-90	0645	5.22	9.0	645	8.1	2.9	< .10	.80	28
11-29-90	1035	3.46	1.0	669	8.5	3.3	< .10	.60	10
Roberts Creek near Farmersburg (RC24, fig. 18)									
4-12-90	0940	5.35	3.0	601	8.6	2.6	<0.10	1.6	--
6-07-90	0420	7.37	15.0	700	8.1	7.4	.20	1.1	31
7-14-90	1600	4.77	23.0	620	7.8	3.4	< .10	.80	25
8-07-90	1235	6.38	23.0	618	8.7	5.6	< .10	1.5	13
9-11-90	2330	7.97	23.0	705	7.8	6.3	< .10	.90	24
10-10-90	1840	4.47	9.5	638	8.4	2.6	< .10	.70	28
11-30-90	0050	4.72	.5	644	8.4	3.3	< .10	.60	10
Roberts Creek southwest of Farmersburg (RC22, fig. 18)									
4-13-90	0730	3.14	3.0	601	8.5	2.5	<0.10	1.2	--
6-07-90	2005	5.73	19.0	675	8.1	7.3	< .10	1.0	32
7-15-90	1705	3.50	25.0	651	7.6	3.0	< .10	.70	40
8-08-90	0515	6.25	19.0	616	8.2	5.2	< .10	1.7	27
9-12-90	1300	7.52	25.0	690	--	6.0	< .10	.70	30
10-12-90	1040	3.85	9.0	697	--	2.4	< .10	.90	--
Roberts Creek above Saint Olaf (RC2, fig. 18)									
4-14-90	0110	2.28	5.5	591	8.6	2.1	<0.10	.80	--
6-08-90	0905	5.13	18.0	690	7.9	6.6	< .10	1.2	26
7-16-90	1330	2.58	28.0	606	8.0	2.0	< .10	.80	11
8-08-90	1910	5.12	25.0	603	8.6	4.4	< .10	1.7	14
9-13-90	0030	6.68	23.0	629	7.6	5.5	< .10	.90	50
10-13-90	1930	3.29	13.0	636	8.8	2.2	< .10	.60	--

Table 33. *Herbicide and herbicide metabolite concentrations in a selected reach of Roberts Creek, Clayton County, Iowa, April-November 1990*

[Total-recoverable constituents in micrograms per liter; DDAR, deisopropylatrazine plus deethylatrazine-to-atrazine ratio; <, less than detection level indicated]

Date	Time (24-hour)	Ala-chlor	Atra-zine	Cyana-zine	DDAR	Deiso-propyl-atra-zine	Deethyl-atra-zine	Metola-chlor
Roberts Creek northeast of Big Spring (RC18, fig. 18)								
4-11-90	1330	0.11	0.68	<0.20	0.27	<0.05	0.15	<0.05
6-06-90	1200	2.3	4.8	3.7	.25	.34	.67	1.0
7-13-90	1845	< .05	.37	< .20	.69	< .05	.21	< .05
8-06-90	1930	.06	2.49	< .20	.48	.25	.77	.15
9-11-90	0900	.06	.24	< .20	1.4	.08	.21	< .05
10-09-90	1245	.19	.40	< .20	.59	.06	.14	.11
11-28-90	1230	< .05	.09	< .20	1.4	< .05	.10	< .05
Roberts Creek northwest of Saint Olaf (RC19, fig. 18)								
4-12-90	0110	0.12	0.60	<0.20	0.45	0.07	0.16	0.05
6-06-90	2150	3.0	5.8	2.9	.23	.37	.73	.97
7-14-90	0720	< .05	.41	< .20	.59	< .05	.20	< .05
8-07-90	0535	.05	2.6	< .20	.48	.25	.82	.17
9-11-90	1715	.05	.21	< .20	1.6	.08	.20	< .05
10-10-90	0645	.14	.28	< .20	.76	.05	.13	.09
11-29-90	1035	< .05	.08	< .20	1.6	< .05	.10	< .05
Roberts Creek west of Farmersburg (F47, fig. 18)								
4-12-90	0555	0.11	0.54	<0.20	0.48	0.05	0.17	0.05
6-07-90	0125	3.2	6.3	2.5	.22	.37	.79	1.1
7-14-90	1230	< .05	.37	< .20	.62	< .05	.19	< .05
8-07-90	0930	.06	2.3	< .20	.49	.21	.76	.17
9-11-90	2100	.05	.22	< .20	1.4	.06	.21	< .05
10-10-90	1340	.14	.25	< .20	.69	< .05	.14	.07
11-29-90	1910	< .05	.10	< .20	1.6	< .05	.13	< .05
Roberts Creek near Farmersburg (RC24, fig. 18)								
4-12-90	0940	<0.05	0.36	<0.20	0.69	0.06	0.15	<0.05
6-07-90	0420	3.1	6.4	2.6	.21	.36	.76	1.0
7-14-90	1600	< .05	.39	< .20	.59	< .05	.19	< .05
8-07-90	1235	.05	2.2	< .20	.49	.22	.70	.16
9-11-90	2330	< .05	.21	< .20	1.4	.06	.19	< .05
10-10-90	1840	.12	.21	< .20	.72	< .05	.12	.07
11-30-90	0050	< .05	.09	< .20	1.5	< .05	.11	< .05
Roberts Creek southwest of Farmersburg (RC22, fig. 18)								
4-13-90	0730	0.12	0.48	<0.20	0.61	0.07	0.18	0.05
6-07-90	2005	3.4	9.0	1.8	.20	.45	1.0	1.2
7-15-90	1705	< .05	.15	< .20	.62	< .05	.07	< .05
8-08-90	0515	.05	1.8	< .20	.56	.19	.69	.20
9-12-90	1300	< .05	.21	< .20	1.4	.06	.19	< .05
10-12-90	1040	.15	.30	< .20	.90	.06	.17	.08
Roberts Creek above Saint Olaf (RC2, fig. 18)								
4-14-90	0110	0.06	0.37	<0.20	0.70	0.06	0.16	<0.05
6-08-90	0905	3.6	17	2.5	.08	1.05	.05	1.4
7-16-90	1330	< .05	.46	< .20	.55	< .05	.21	< .05
8-08-90	1910	< .05	.95	< .20	.50	.31	.11	.09
9-13-90	0030	.06	.19	< .20	1.7	.18	.08	.06
10-13-90	1930	.12	.29	< .20	.85	.06	.15	.08

Table 34. *Herbicide concentrations in a selected reach of Roberts Creek, Clayton County, Iowa, April-November 1990*

[Concentrations in micrograms per liter; <, less than detection level indicated]

Date	Time (24-hour)	Ametryn	Prometon	Pro-metryn	Propa-zine	Sima-zine	Ter-butryn
Roberts Creek northeast of Big Spring (RC18, fig. 18)							
4-11-90	1330	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6-06-90	1200	< .05	< .05	< .05	.09	.22	< .05
7-13-90	1845	< .05	< .05	< .05	< .05	< .05	< .05
8-06-90	1930	< .05	< .05	< .05	< .05	< .05	< .05
9-11-90	0900	< .05	< .05	< .05	< .05	< .05	< .05
10-09-90	1245	< .05	< .05	< .05	< .05	< .05	< .05
11-28-90	1230	< .05	< .05	< .05	< .05	< .05	< .05
Roberts Creek northwest of Saint Olaf (RC19, fig. 18)							
4-12-90	0555	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6-07-90	0125	< .05	< .05	< .05	.13	.34	< .05
7-14-90	1230	< .05	< .05	< .05	< .05	< .05	< .05
8-07-90	0930	< .05	< .05	< .05	< .05	< .05	< .05
9-11-90	2100	< .05	< .05	< .05	< .05	< .05	< .05
10-10-90	1340	< .05	.06	< .05	< .05	< .05	< .05
11-29-90	1910	< .05	< .05	< .05	< .05	< .05	< .05
Roberts Creek west of Farmersburg (F47, fig. 18)							
4-12-90	0110	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6-06-90	2150	< .05	< .05	< .05	.11	.29	< .05
7-14-90	0720	< .05	< .05	< .05	< .05	< .05	< .05
8-07-90	0535	< .05	< .05	< .05	< .05	< .05	< .05
9-11-90	1715	< .05	< .05	< .05	< .05	< .05	< .05
10-10-90	0645	< .05	.05	< .05	< .05	< .05	< .05
11-29-90	1035	< .05	< .05	< .05	< .05	< .05	< .05
Roberts Creek near Farmersburg (RC24, fig. 18)							
4-12-90	0940	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6-07-90	0420	< .05	< .05	< .05	.13	.34	< .05
7-14-90	1600	< .05	< .05	< .05	< .05	< .05	< .05
8-07-90	1235	< .05	< .05	< .05	< .05	< .05	< .05
9-11-90	2330	< .05	< .05	< .05	< .05	< .05	< .05
10-10-90	1840	< .05	.05	< .05	< .05	< .05	< .05
11-30-90	0050	< .05	< .05	< .05	< .05	< .05	< .05
Roberts Creek southwest of Farmersburg (RC22, fig. 18)							
4-13-90	0730	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6-07-90	2005	< .05	< .05	< .05	.19	.48	< .05
7-15-90	1705	< .05	< .05	< .05	< .05	< .05	< .05
8-08-90	0515	< .05	< .05	< .05	< .05	< .05	< .05
9-12-90	1300	< .05	< .05	< .05	< .05	< .05	< .05
10-12-90	1040	< .05	.06	< .05	< .05	< .05	< .05
Roberts Creek above Saint Olaf (RC2, fig. 18)							
4-14-90	0110	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6-08-90	0905	< .05	< .05	< .05	.22	.48	< .05
7-16-90	1330	< .05	< .05	< .05	< .05	< .05	< .05
8-08-90	1910	< .05	< .05	< .05	< .05	< .05	< .05
9-13-90	0030	< .05	< .05	< .05	< .05	< .05	< .05
10-13-90	1930	< .05	< .05	< .05	< .05	< .05	< .05

☆ U.S. GOVERNMENT PRINTING OFFICE: 1992- 657-149