Hydrology and Water Quality in Claypan Soil and Glacial Till at the Missouri Management Systems Evaluation Area near Centralia, Missouri--May 1991 to September 1993

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot	0.3048	meter
inch	25.4	millimeter
mile	1.609	kilometer
acre	0.4047	hectare
cubic foot	0.02832	cubic meter
cubic foot per second	0.02832	cubic meter per second

To convert degrees Celsius (°C) to degrees Fahrenheit (°F) use the following:

$$°F = 9/5\ °C + 32.$$

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

Hydrology and Water Quality in Claypan Soil and Glacial Till at the Missouri Management Systems Evaluation Area near Centralia, Missouri--May 1991 to September 1993

By Donald H. Wilkison, Dale W. Blevins, Brian P. Kelly, *and* William C. Wallace

ABSTRACT

Hydrologic and water-quality data were collected from a test plot instrumented to determine the quantity of nitrogen (N) fertilizer in surface runoff from, and in ground water below, a continuous corn cropping system with conventional tillage. This report presents the sampling design and data-collection techniques at the test plot and includes a compilation of the rainfall-, surface-, ground-, and unsaturated-zone water-quality data; soils, grain and stover data; and quality-assurance data.

Background data were collected at the plot for 1 year prior to the application in May 1992 of a fertilizer enriched with ^{15}N (ratio of ^{15}N to ^{14}N, relative to atmospheric nitrogen, expressed in per mil) to +3,080 per mil. The movement of the fertilizer through the hydrologic system was monitored through September 1993.

The first runoff event after the application of the spiked fertilizer had the largest ^{15}N enrichment from the spike. The spiked fertilizer was detected in the shallowest suction lysimeters less than 1 month after application and in shallow wells 6 days after ground-water recharge from fall rains in November 1992. The ^{15}N enrichment in water samples collected from gravity lysimeters in November 1992 ranged from +297 to +1,145 per mil. Grain harvested in 1992 had ^{15}N enrichment of +648 per mil.

In 1993, the ^{15}N enrichment in runoff increased in late spring and early summer and then declined through the summer. The ^{15}N enrichment in ground-water samples continued to increase through August 1993, while ^{15}N enrichment in the water samples from suction and gravity lysimeters gradually declined. The ^{15}N enrichment in grain was +188 per mil in 1993.

INTRODUCTION

This report presents data that were collected from the U.S. Geological Survey test plot near Centralia, Missouri. The data were collected during 1991-93 as part of the Management Systems Evaluation Area (MSEA) program.

The MSEA program began in 1990 to evaluate farming system effects on water quality in the midwest corn belt region and to develop alternative farming systems to protect water quality. The MSEA program involves research, education, and cooperation between agencies of the U.S. Department of Agriculture (Agricultural Research Service, Cooperative State Research Service, Extension Service, and Soil Conservation Service), the U.S. Environmental Protection Agency, and the U. S. Geological Survey (U.S. Department of Agriculture, 1994).

The Missouri MSEA is near a ground-water divide on the Goodwater Creek basin near Centralia in north central Missouri. The region is characterized by claypan soils that predominately are row-cropped to soybean, wheat, corn, and sorghum (Alberts and others, 1993). Nitrate and pesticide contamination of surface and ground water in the area is a concern (Kolpin and others, 1993; Scribner and others, 1993; Wilkison and Maley, 1994).

U.S. Geological Survey research at the Missouri MSEA site has been conducted on a 0.10 acre test plot.

The plot has 17 in. (inches) of top soil underlain by 24 in. of low-permeability claypan. The claypan is underlain by 55 ft (feet) of loess and glacial drift that compromise the surficial aquifer. Conventional tillage, herbicide application, and fertilization were used on corn at the plot during 1991-93 (Kelly and Blevins, 1993).

Data collected from the plot will be used to determine the quantity of nitrogen (N) fertilizer in surface runoff from, and in ground water below, a continuous corn cropping system with conventional tillage, and to determine the quantity of water and N transported through preferential flow paths compared to the soil matrix. This report presents the sampling design; data-collection techniques; a compilation of the rainfall-, surface-, ground-, and unsaturated-zone water-quality data; soils, grain and stover data; and the quality-assurance data.

METHODS

A test plot was instrumented to follow a ^{15}N- (ratio of ^{15}N to ^{14}N, relative to atmospheric nitrogen, expressed in per mil) enriched fertilizer (+3,080 per mil) and a bromide tracer through the hydrologic system. Conventional methods of corn production and herbicide application were conducted on the plot. A sampling schedule was established for each year. Sampling techniques and data-collection methods were established. Field and laboratory methods were established for collection and analysis of $\delta\ ^{15}N\text{-}NO_3$ [ratio of ^{15}N to ^{14}N in nitrate (NO_3) plus nitrite (NO_2), relative to atmospheric N, expressed in per mil] in water samples.

Sampling design

The plot is instrumented with a rainfall collector, a flume with a continuous stage recorder and an automatic sampler to measure and sample surface runoff, 14 monitoring wells (one equipped with a continuous water-level recorder) to measure and sample ground water, 8 suction lysimeters, 8 gravity lysimeters, an interflow (horizontal flow of water perched on top of the claypan) sampler, and 2 neutron access tubes to measure and sample soil moisture and ground water recharge (fig.1). The plot is bordered by a 6 in. high berm and a subsurface water barrier to prevent offsite runoff and soil water from moving onto the plot. An automated weather station is located within 300 ft of the test plot and records hourly rainfall and other meteorological data (Alberts and others, 1993).

Conventional tillage for corn was used on the plot during 1991-93. Hydrologic, water-quality, and soil data were collected at the plot for 1 year prior to the application of a bromide and a ^{15}N labeled fertilizer in May 1992 (Kelly and Blevins, 1993).

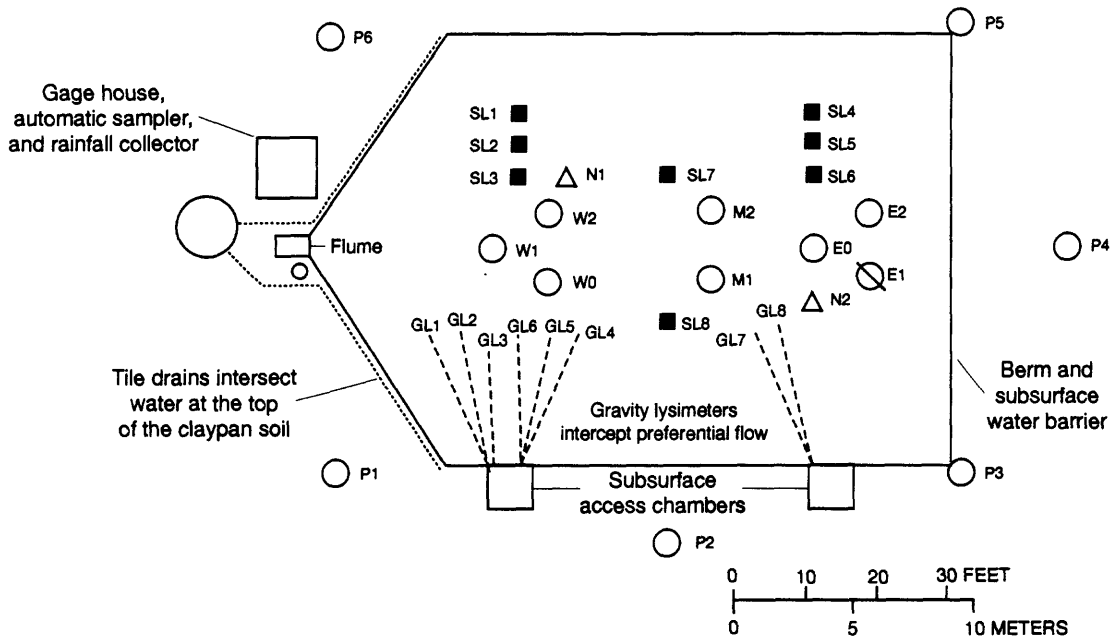
Data-collection techniques

Rainfall samples were collected by diverting runoff from the gage house roof into a 19-L (liter) polyethylene container. Rainfall samples were analyzed for dissolved nutrients and $\delta\ ^{15}N\text{-}NO_3$ (table 1, at the back of this report).

Runoff stage was recorded at 5-minute intervals (figs. 2 to 17, at the back of this report). Runoff samples were collected at 5-minute intervals by the automatic sampler and composited by discharge for the storm. Because of problems with the automatic sampler, runoff samples collected after July 11, 1992, were collected by diverting a portion of the flow from the flume into a 19-L collection chamber. These samples also were composited by discharge for the storms. Storm runoff was sampled for dissolved and total nutrients, bromide, total $\delta\ ^{15}N\text{-}NO_3$ [ratio of ^{15}N to ^{14}N in NO_3, NO_2, and ammonia (NH_4), relative to atmospheric N, expressed in per mil], dissolved $\delta\ ^{15}N\text{-}NO_3$ (ratio of ^{15}N to ^{14}N in NO_2 plus NO_3, relative to atmospheric N, expressed in per mil), and suspended sediment. Runoff water-quality data are listed in table 2, at the back of this report.

Ground-water samples were collected from 8 wells drilled into the glacial drift beneath the plot and 6 wells drilled around the perimeter of the plot. Wells inside the plot are grouped into 3 nests and screened at 3 depths (table 3, at the back of the report). Ground-water levels were recorded hourly at well E1. Water levels in the remaining wells were measured 3 times weekly. Water-level data are reported in figures 18 to 31, at the back of this report.

Ground-water samples were collected after purging the well system of three well casing volumes and monitoring specific conductance, temperature, and pH until they stabilized over 5-minute intervals. Samples were collected at the well head in high-density-polycarbonate containers. Ground water was sampled for dissolved nutrients, bromide, trace elements, and $\delta\ ^{15}N\text{-}NO_3$ (table 4, at the back of this report).



EXPLANATION

- O STILLING WELL AND STAGE RECORDER
- INTERFLOW COLLECTOR
- N1 △ NEUTRON PROBE ACCESS TUBE AND IDENTIFIER
- GL7 ----- GRAVITY LYSIMETER AND IDENTIFER
- ..... TILE DRAIN
- SL8 ■ SUCTION LYSIMETER AND IDENTIFIER
- P1 ○ MONITORING WELL AND IDENTIFIER
- E1 ⊘ MONITORING WELL WITH CONTINUOUS WATER-LEVEL RECORDER AND IDENTIFIER

Figure 1. Location of study area and instrumentation at study plot.

Water samples from suction lysimeters were composited by depth. Water from shallow suction lysimeters (1.5 ft below land surface) was sampled weekly; water from intermediate suction lysimeters (3 ft below land surface) was sampled every other week; and water from deep suction lysimeters (4 ft below land surface) was sampled monthly for dissolved nitrate and bromide (table 5, at the back of this report). Monthly composites of all suction lysimeter water samples were analyzed for $\delta\ ^{15}N\text{-}NO_3$. Soil moisture was measured weekly and determined by neutron probe (figs. 32 and 33, at the back of this report).

Water samples from the gravity lysimeters and interflow sampler were collected and analyzed for dissolved nutrients, bromide, and $\delta\ ^{15}N\text{-}NO_3$ (table 6, at the back of this report). Water samples from individual gravity lysimeters were collected after recharge events in 1991 and 1992 as flow permitted. Water samples from gravity lysimeters were composited by depth and collected weekly in 1993 because wet weather conditions allowed for almost continual flow in the lysimeters from January to September of that year. Interflow samples were collected after recharge events as flow permitted.

Samples for dissolved constituents were filtered through 0.45-µm (micrometer) pore diameter polycarbonate filters. All nutrient samples were collected in 125-mL (milliliter) brown polyethylene bottles, preserved with 0.5 mL of mercuric chloride, and maintained at 4 °C (degrees Celsius) prior to laboratory analysis. Bromide and trace element samples were collected in polyethylene bottles. Samples for $\delta^{15}N\text{-}NO_3$ analyses were collected using procedures described by Blevins and others (in press).

Soil samples were collected using either a hand-coring tool with a bucket auger or a trailer-mounted coring rig equipped with a split-spoon sampler. Soil samples were analyzed for NH_4, NO_3 and $\delta\ ^{15}N$ (ratio of ^{15}N to ^{14}N in N, relative to atmospheric N, expressed in per mil), and particle-size analysis (table 7, at the back of this report).

Grain and stover (the part of the plant above ground, excluding the grain) samples were collected each year at harvest. Grain and stover samples were analyzed for bromide, N, and $\delta\ ^{15}N$ (table 8, at the back of this report).

Quality assurance

Nine percent of all samples collected were quality-assurance samples. All ground-water samples for $\delta\ ^{15}N\text{-}NO_3$ analysis were collected in replicate to provide a backup sample in case reanalysis was needed. Nine percent of the replicates were analyzed for quality-assurance purposes. Sample duplicates from 24 percent of the samples were analyzed by an outside laboratory for $\delta\ ^{15}N\text{-}NO_3$ as an additional quality-assurance practice.

Four field spikes for $\delta\ ^{15}N\text{-}NO_3$ analysis were prepared by U.S. Geological Survey personnel. These spikes consisted of a 20 mg/L (milligrams per liter) solution of potassium nitrate with a $\delta\ ^{15}N\text{-}NO_3$ of +3.49 per mil. Spikes were processed in the field between the collection of environmental samples to assess potential cross contamination of samples.

Two field equipment blanks were collected in the field and processed to assess the ability to field clean the sampling and filtering equipment. These samples were collected between the processing of environmental samples. One liter of inorganic free water was poured into the sample collection chamber and then pumped through the filter unit. Samples were then collected, preserved, and stored with environmental samples until laboratory analysis.

Analytical procedures

Specific conductance, pH, water temperature, oxidation reduction potential, barometric pressure, dissolved oxygen, and alkalinity were measured in the field at the time of sample collection. Nutrient samples and trace-element samples were analyzed at the National Water-Quality Laboratory (Fishman and Friedman, 1989). Water samples were analyzed for $\delta\ ^{15}N\text{-}NO_3$ (Blevins and others, in press) at the U.S. Geological Survey, Stable Isotope Tracer Project Laboratory in Menlo Park, California.

Soil-fertility analyses were performed at the Kansas State University, Soil Testing Laboratory in Manhattan, Kansas. Nitrogen isotope analyses on soils were performed by Global Geochemistry, Canoga Park, California, and at the U.S. Geological Survey, Stable Isotope Tracer Project Laboratory in Menlo Park, California, which also analyzed grain and stover samples for $\delta\ ^{15}N$. Particle-size analyses were performed by Alpha Omega Geotech, Kansas City, Kansas.

HYDROLOGY AND WATER QUALITY

Analytical results are presented in tables 1, 2, and 4 to 8, at the back of this report. These results indicate that the first runoff event after the application of the spike had the largest ^{15}N enrichment from the spike. The ^{15}N in runoff continued to decline throughout the year, although they did increase again in the late winter and early spring of 1993 before declining again through the summer of 1993.

Spiked fertilizer was detected in the two shallowest wells, W0 and E0, 6 days after ground-water recharge from fall rains began on November 12, 1992. Spiked fertilizer in shallow ground water increased through August 1993. Spiked fertilizer was not detected in wells deeper than 18 ft during this study, nor was spiked fertilizer detected in wells surrounding the plot.

The spiked fertilizer was detected in the shallowest suction lysimeters less than 1 month after application; however, it was not detected in soil moisture at depths of 3.0 and 4.0 ft during the 1992 growing season (from May through October). Values of $\delta\ ^{15}N\text{-}NO_3$ in water samples from suction lysimeters collected in November 1992 ranged from +516 to +717 per mil.

The gravity lysimeters, constructed to intercept water at zero tension in the unsaturated zone, did not yield water between the application of spiked fertilizer and November 12, 1992. The $\delta\ ^{15}N\text{-}NO_3$ in the first gravity-lysimeter water samples collected in November had enrichment that ranged from +297 to +1,145 per mil. The ^{15}N enrichment in gravity lysimeters declined steadily through 1993.

Background $\delta\ ^{15}N\text{-}NO_3$ in interflow samples ranged from +9.24 to +15.3 per mil. The first interflow samples collected after the spike application had a $\delta\ ^{15}N\text{-}NO_3$ of +259 per mil. The $\delta\ ^{15}N\text{-}NO_3$ values in interflow samples collected in 1993 ranged from +60.0 to +486 per mil.

The ^{15}N enrichment was +670 per mil in stover and +648 per mil in grain harvested from the plot in 1992. In 1993, the ^{15}N enrichment was +141 per mil in stover and +188 per mil in harvested grain.

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Page

Table 1. Specific conductance, nutrient concentrations, and stable isotope concentrations in rainfall

[Specific conductance in microsiemens per centimeter at 25 degress Celsius; nutrient concentrations in milligrams per liter; $^{18}O/^{16}O$ value in per mil, relative to standard mean ocean water; nitrogen isotope values in per mil, relative to atmospheric standard; <, less than; --, no data]

Beginning date	Beginning time (24 hours)	Ending date	Ending time (24 hours)	Specific conductance	Nitrite, as nitrogen	Nitrate, as nitrogen	Ammonia, as nitrogen	Ammonia plus organic nitrogen as nitrogen	Ortho-phos-phate, as phos-phorus	$\delta^{18}O$	$\delta^{15}N$ of nitrate	$\delta^{15}N$ of nitrite plus nitrate
11-01-91	0000	11-01-91	1300	17	<0.01	0.20	0.17	<0.20	<0.01	--	--	--
[a]11-01-91	0000	11-01-91	1300	16	<.01	.20	.09	<.20	<.01	--	--	--
12-05-91	0000	12-05-91	1045	50	<.01	.26	.37	.40	<.01	--	--	--
12-11-91	0400	12-12-91	1030	8.6	<.01	.15	.20	.30	.01	--	--	--
12-26-91	0000	12-26-91	1410	15	<.01	.29	.21	.55	<.01	-11.4	--	--
02-17-92	1245	02-17-92	1455	150	<.01	.26	.32	.40	<.01	--	--	--
03-29-92	1710	03-29-92	1755	23	.01	.63	.54	.60	<.01	-6.35	--	--
07-02-92	1800	07-02-92	2300	75	.01	.58	.61	.90	.02	--	2.30	--
07-10-92	0030	07-10-92	1000	6.2	.01	.42	.40	.60	.03	--	--	--
11-12-92	0450	11-12-92	1000	--	.02	.09	.06	<.20	<.01	--	--	5.44
11-19-92	1700	11-20-92	1040	--	.01	.37	.26	.20	<.01	--	--	.53
03-29-93	0145	03-30-93	2300	--	<.01	.63	.49	.60	.02	--	--	4.69

[a]Duplicate sample.

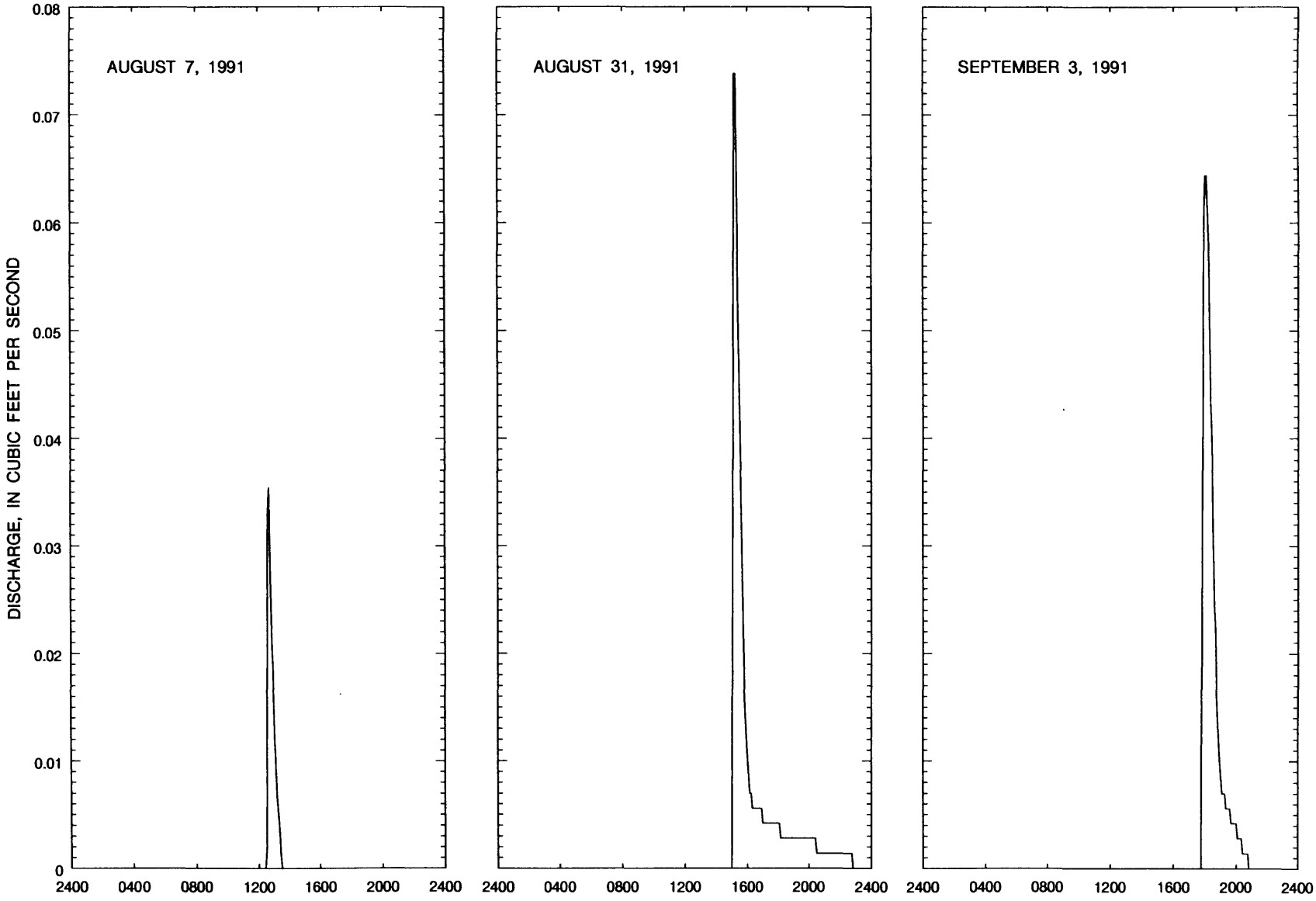

Figure 2. Storm hydrographs from tracer plot on August 7 and 31 and September 3, 1991.

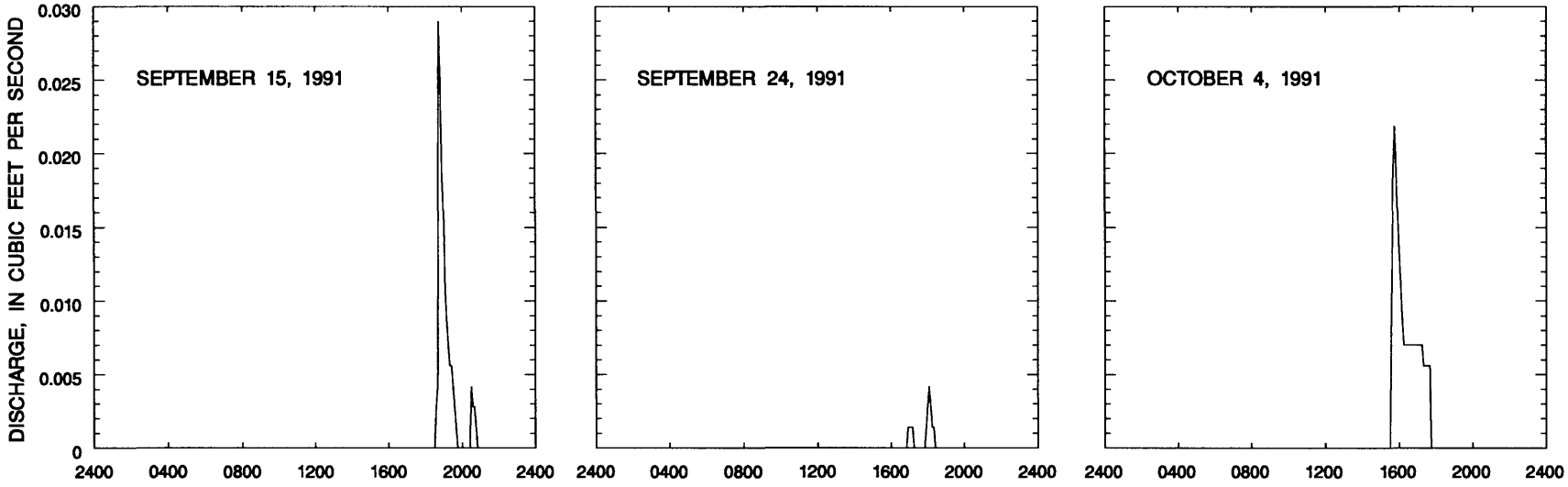

Figure 3. Storm hydrographs from tracer plot on September 15 and 24 and October 4, 1991.

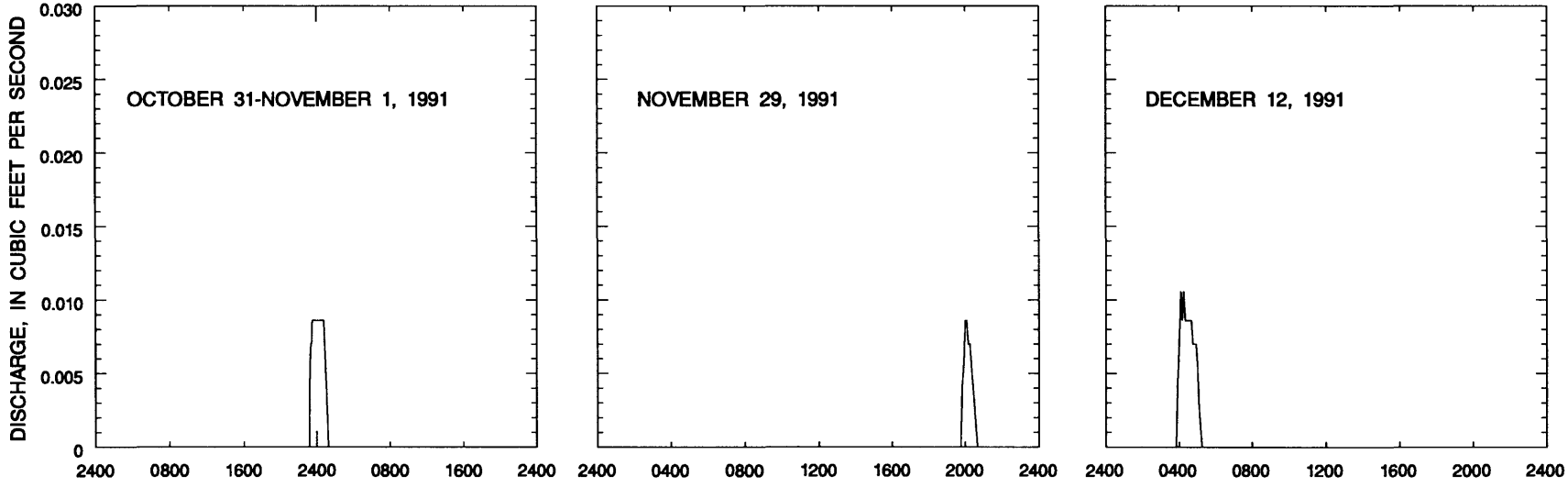

Figure 4. Storm hydrographs from tracer plot on October 31-November 1, November 29, and December 12, 1991.

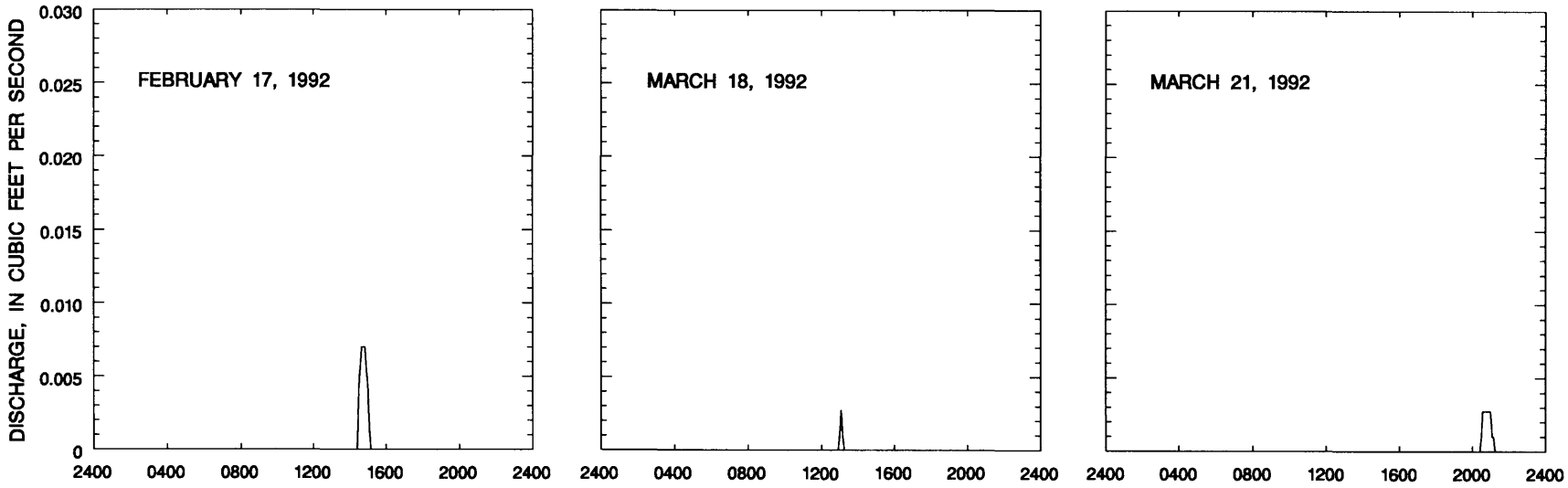

Figure 5. Storm hydrographs from tracer plot on February 17 and March 18 and 21, 1992.

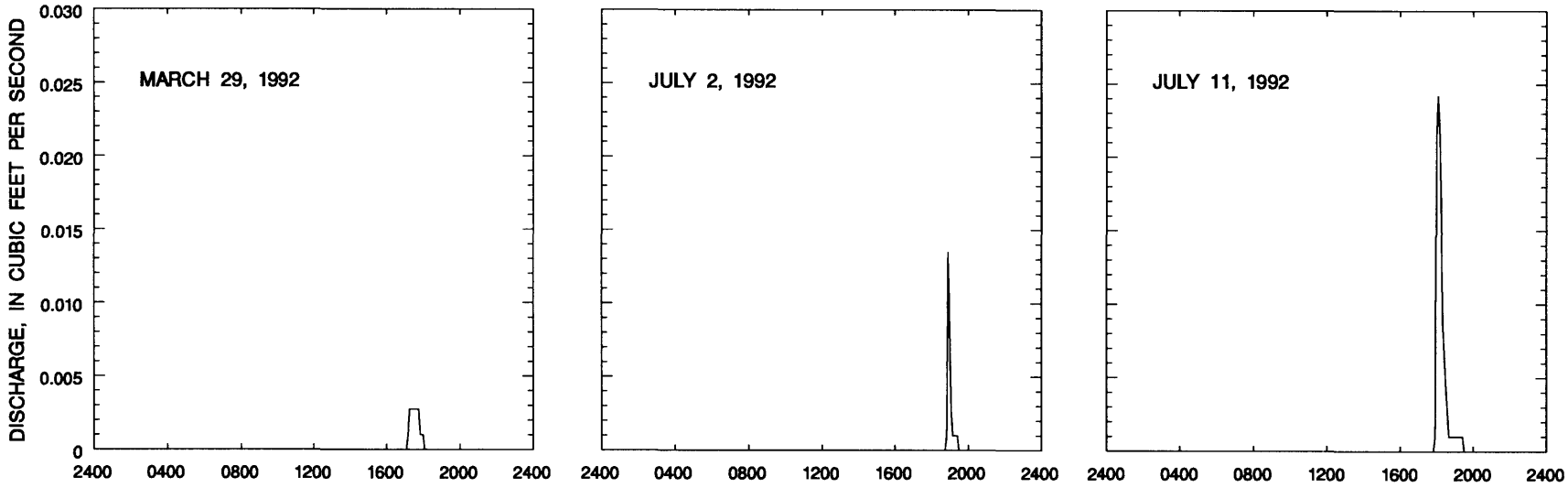

Figure 6. Storm hydrographs from tracer plot on March 29 and July 2 and 11, 1992.

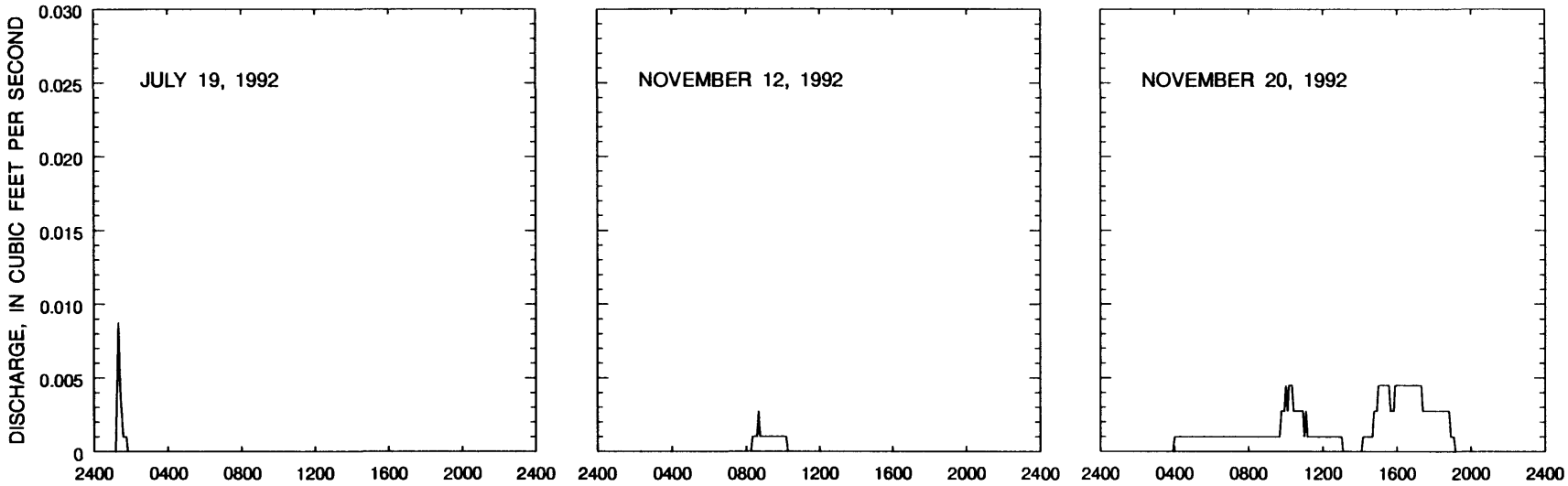

Figure 7. Storm hydrographs from tracer plot on July 19 and November 12 and 20, 1992.

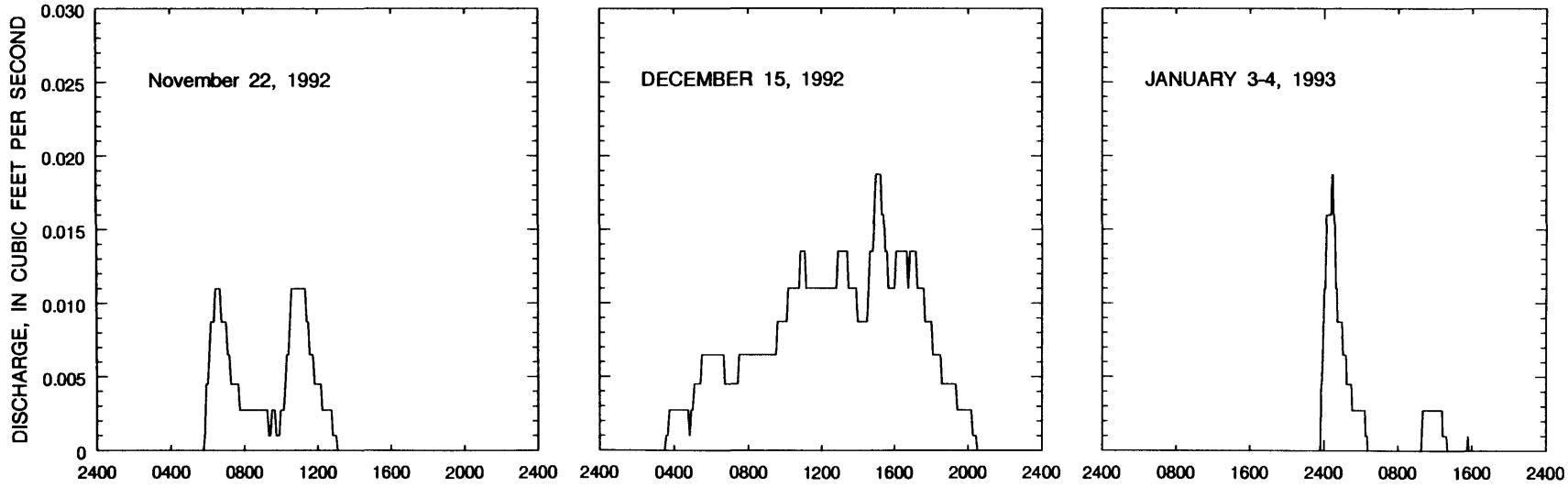

Figure 8. Storm hydrographs from tracer plot on November 22 and December 15, 1992, and January 3-4, 1993.

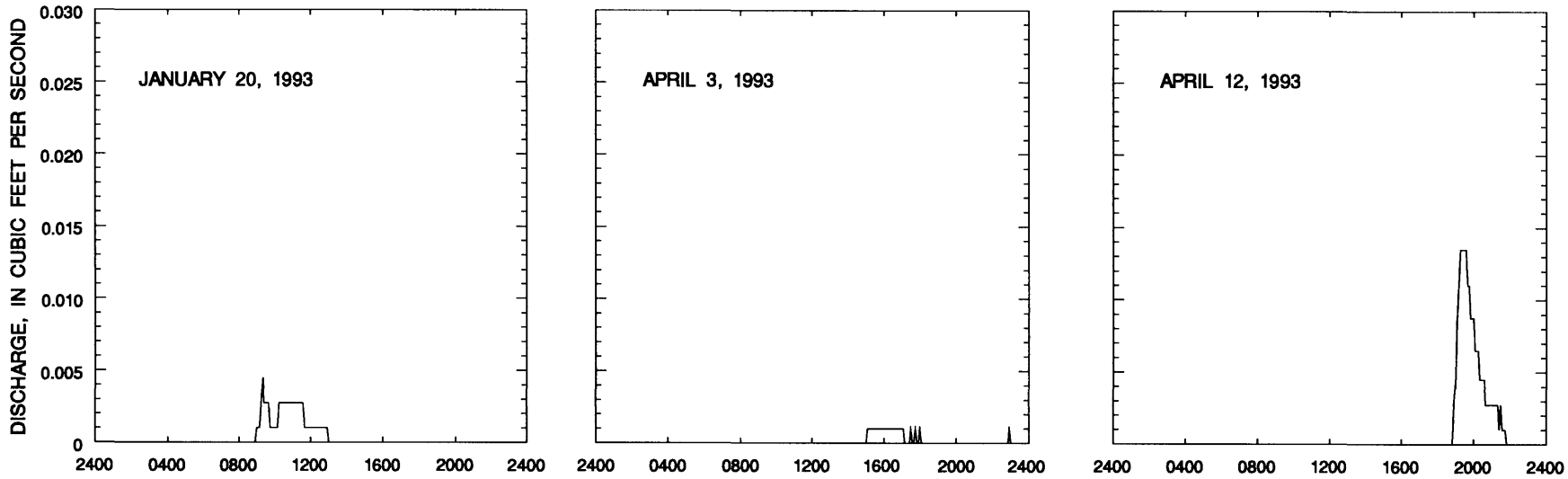

Figure 9. Storm hydrographs from tracer plot on January 20 and April 3 and 12, 1993.

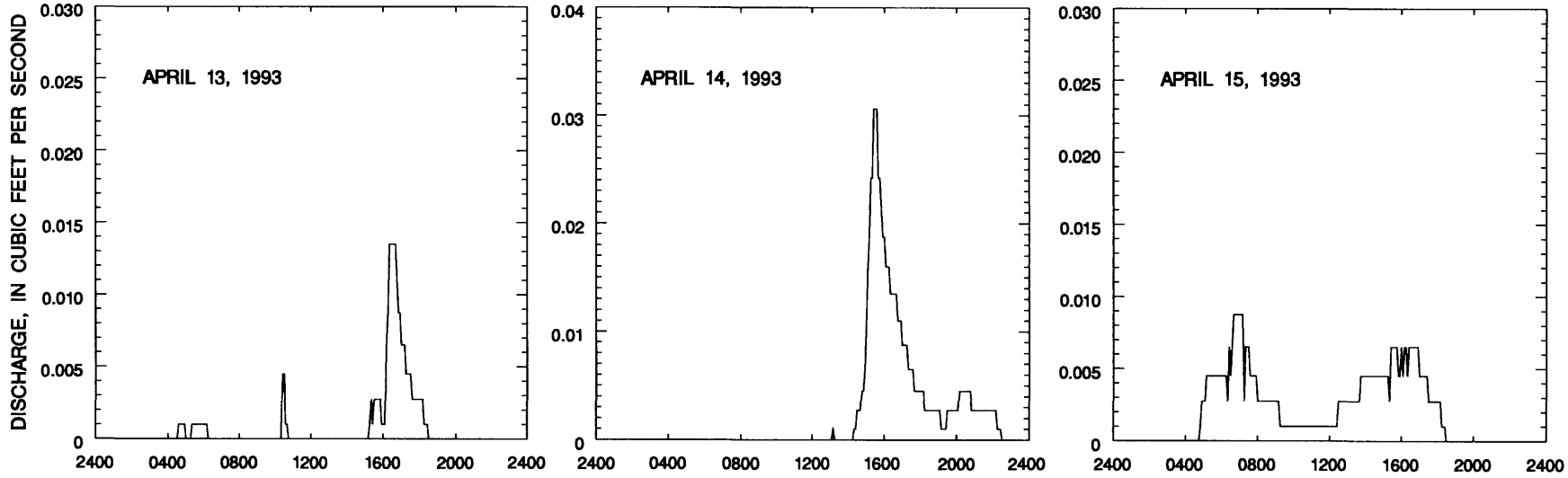

Figure 10. Storm hydrographs from tracer plot on April 13, 14, and 15, 1993.

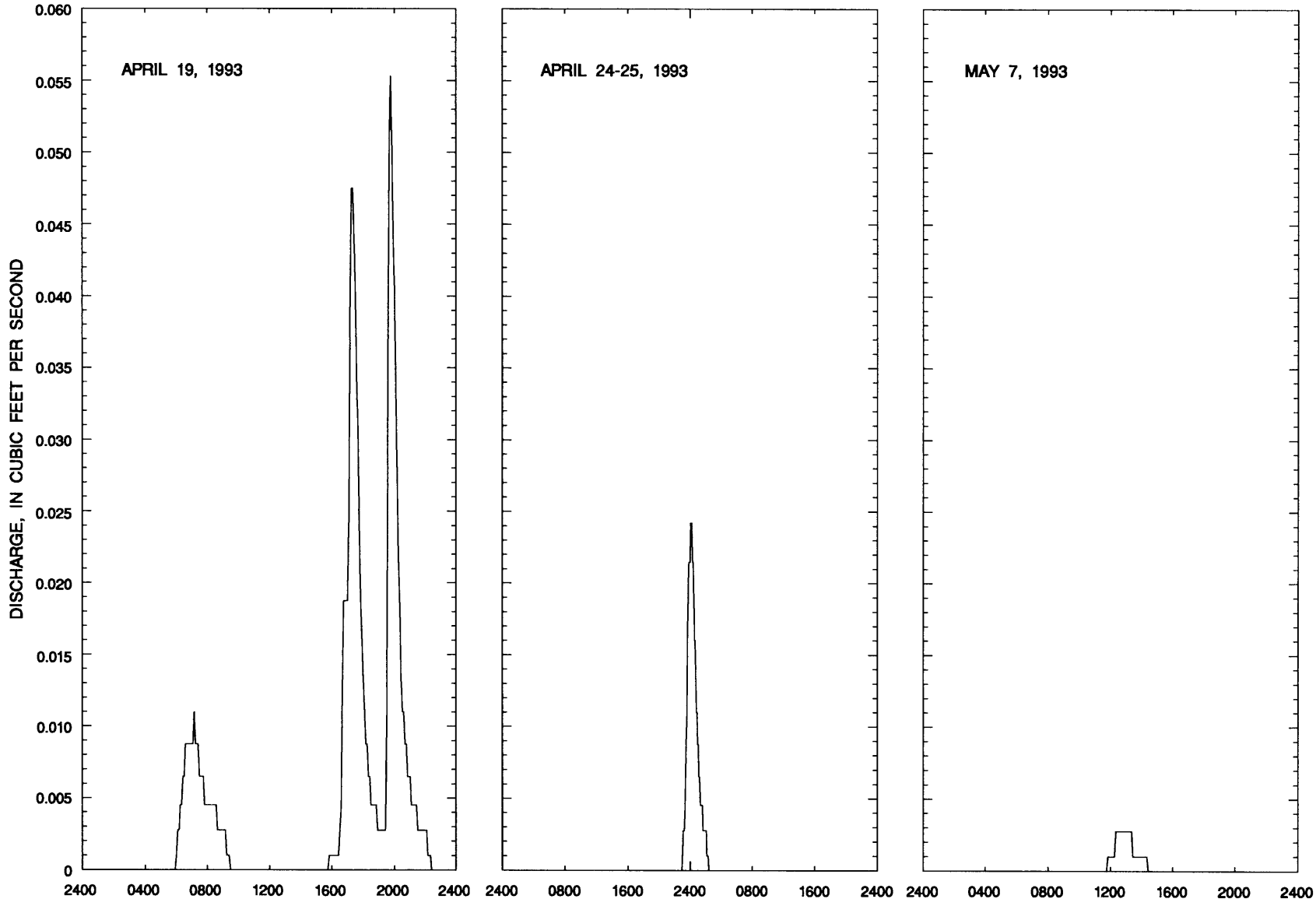

Figure 11. Storm hydrographs from tracer plot on April 19 and 24-25 and May 7, 1993.

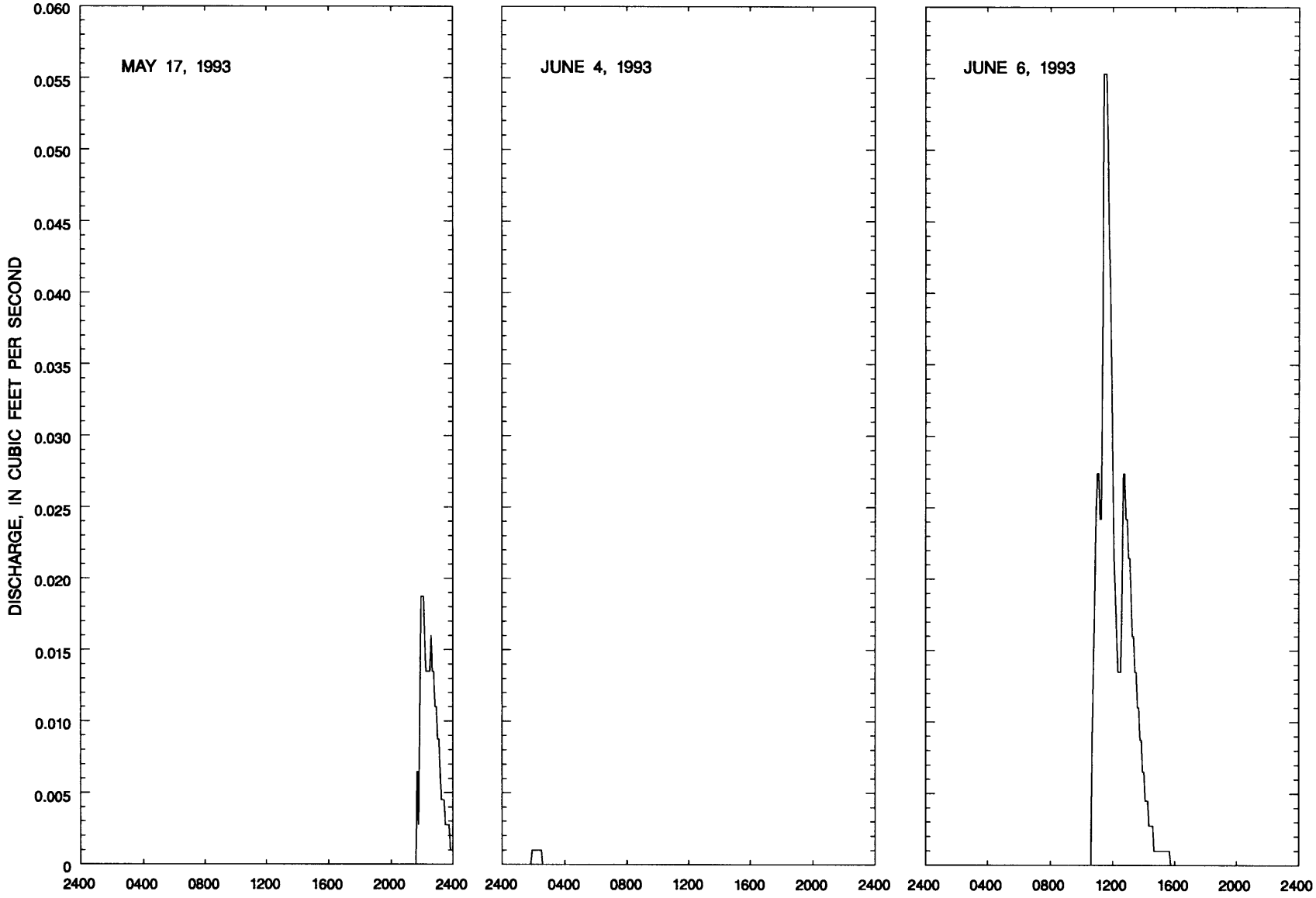

Figure 12. Storm hydrographs from tracer plot on May 17 and June 4 and 6, 1993.

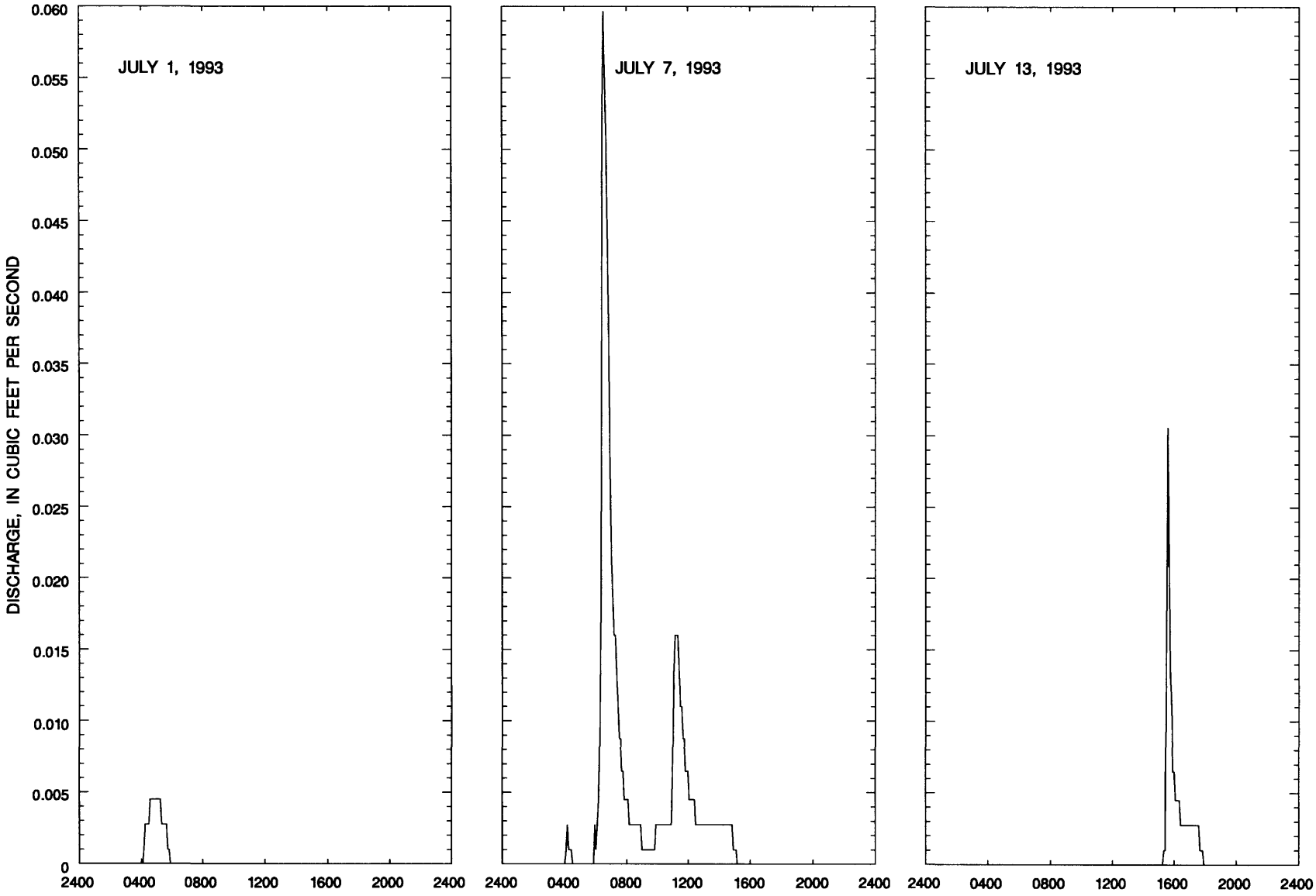

Figure 13. Storm hydrographs from tracer plot on July 1, 7, and 13, 1993.

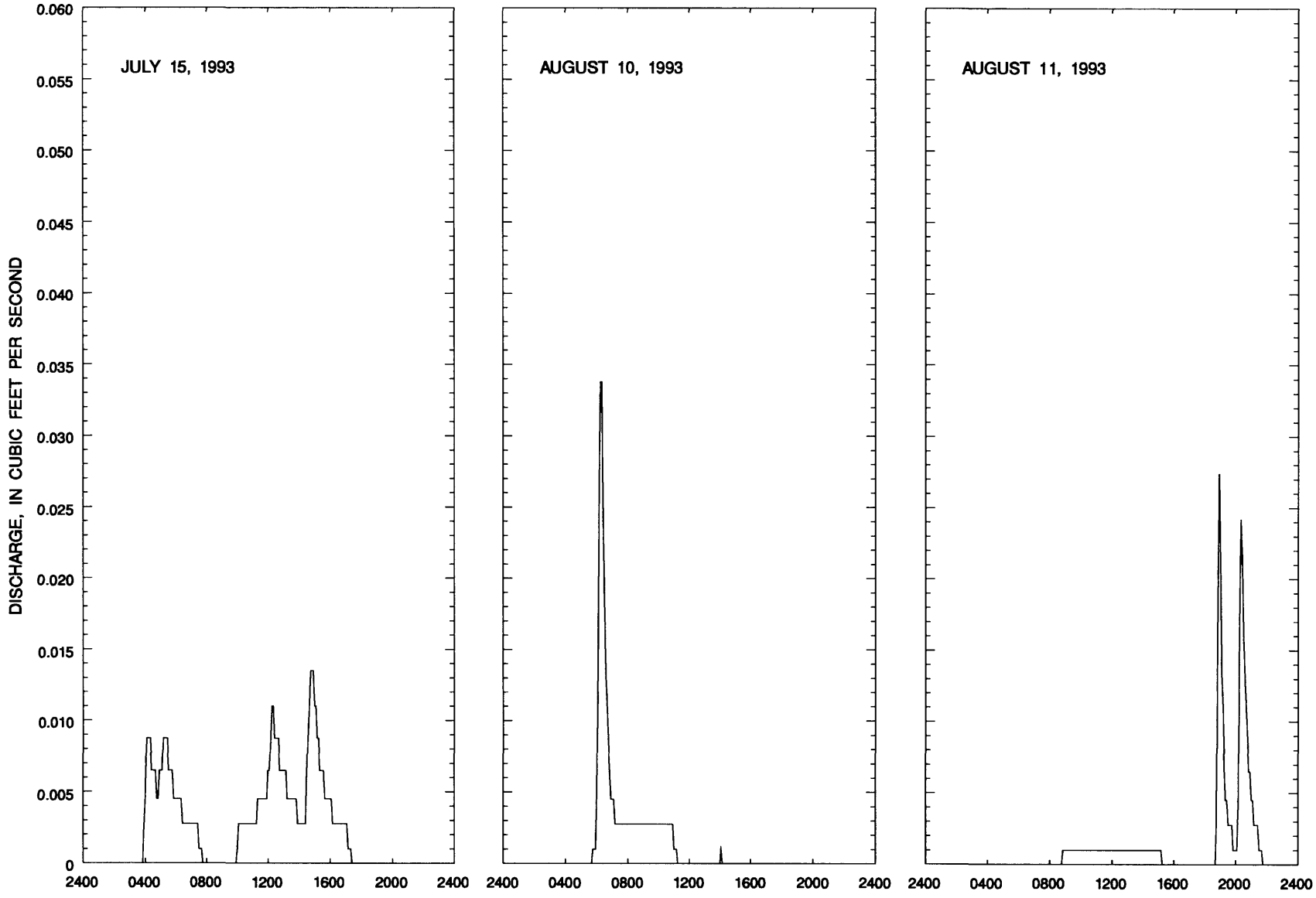

Figure 14. Storm hydrographs from tracer plot on July 15 and August 10 and 11, 1993.

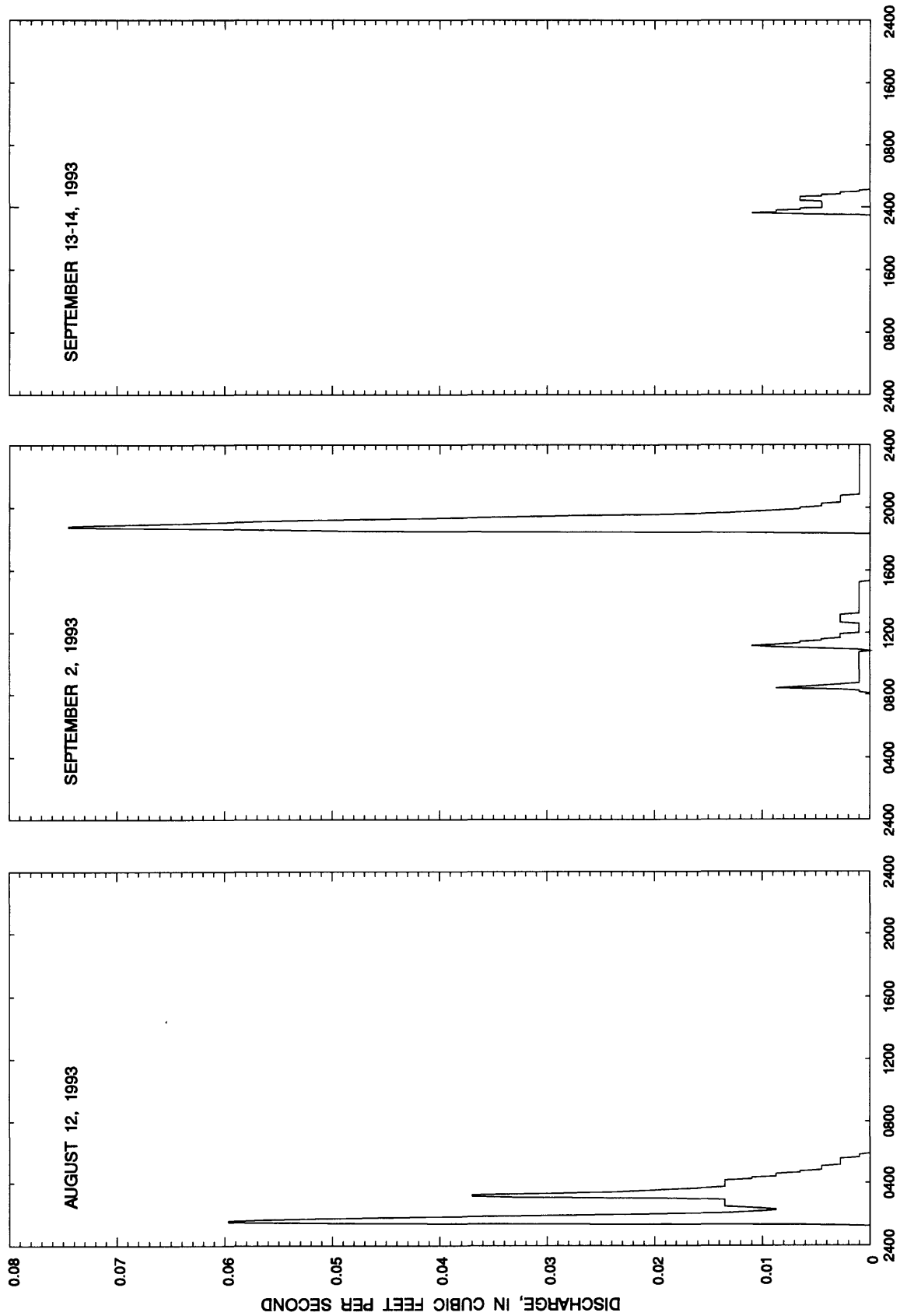

Figure 15. Storm hydrographs from tracer plot on August 12 and September 2 and 13-14, 1993.

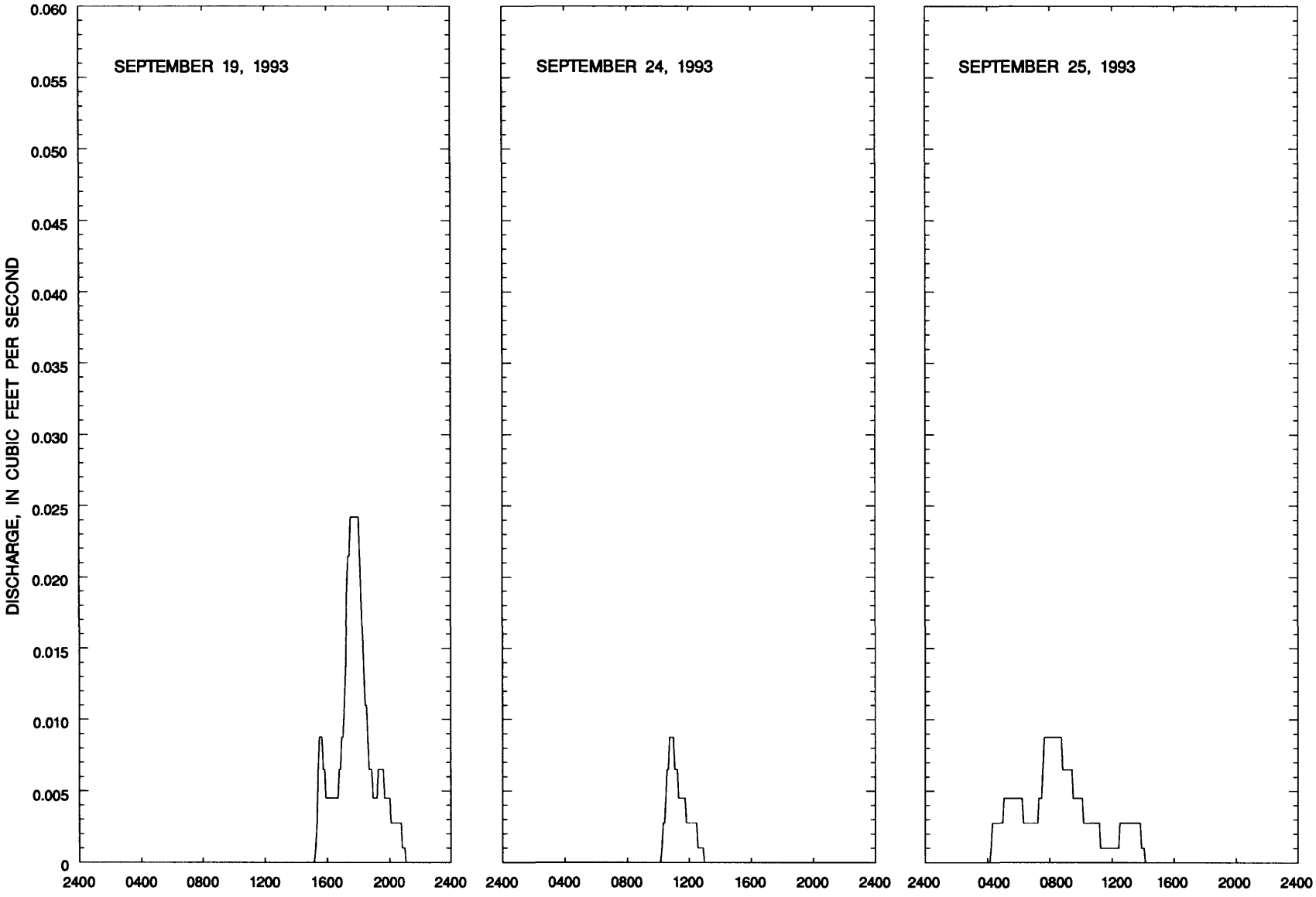

Figure 16. Storm hydrographs from tracer plot on September 19, 24, and 25, 1993.

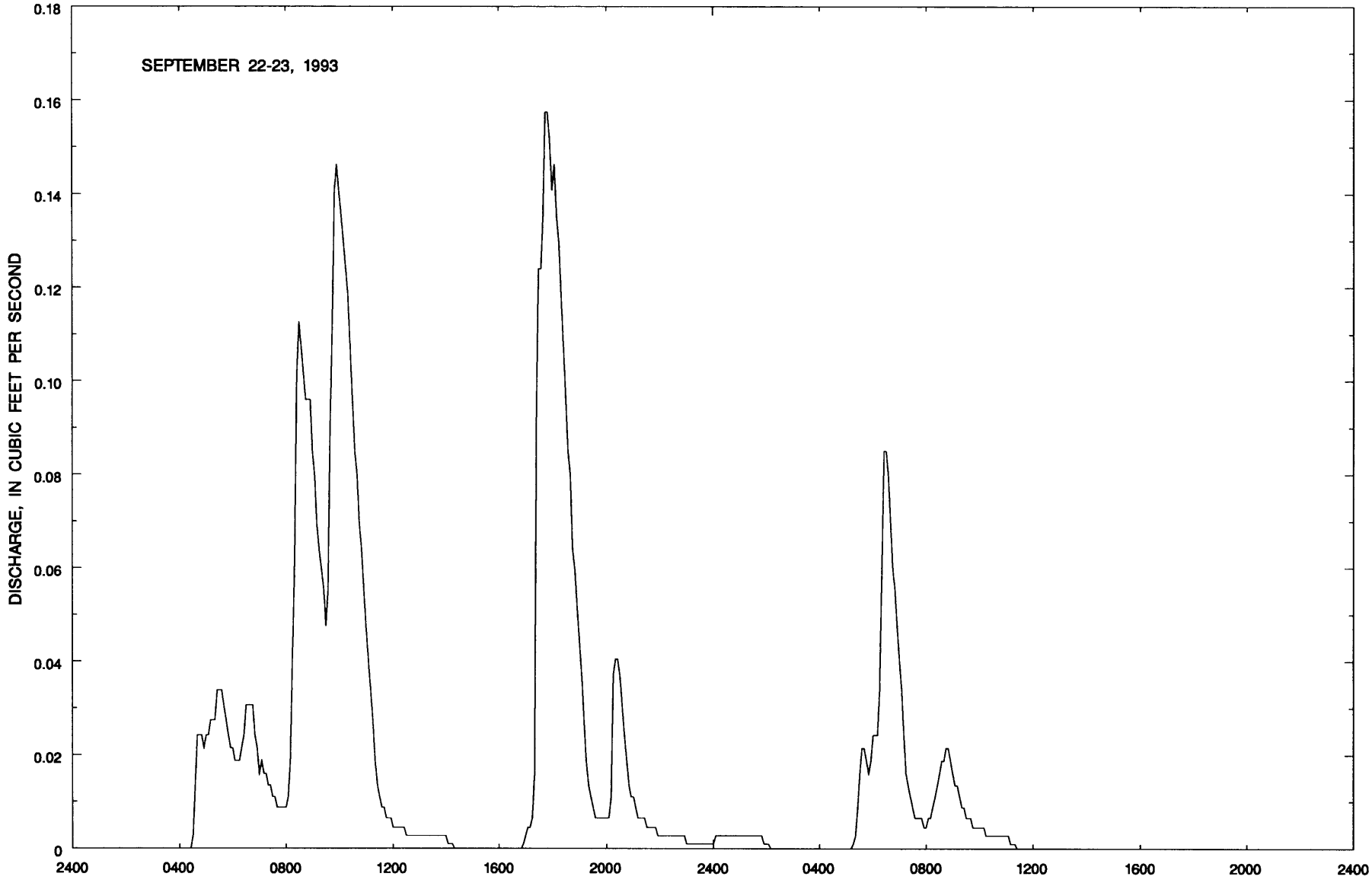

Figure 17. Storm hydrograph from tracer plot on September 22-23, 1993.

Table 2. Nutrient concentrations, nitrogen isotope values, and selected trace element concentrations in surface runoff

[Specific conductance in microsiemens per centimeter at 25 degress Celsius; chloride, bromide, nutrient, and suspended sediment concentrations in milligrams per liter; ISE, analysis by ion-specific electrode; $\delta\ ^{15}N$ values in per mil, relative to atmospheric nitrogen; mm, millimeter; --, missing value; <, less than]

Beginning date	Beginning time	Ending date	Ending time	Specific conduc-tance	Chloride, dissolved	Bromide, dissolved	Bromide, dissolved (ISE)	Nitrite dissolved, as nitrogen	Nitrite total, as nitrogen	Nitrite plus nitrate dissolved, as nitrogen	Nitrite plus nitrate total, as nitrogen
09-15-91	1845	09-15-91	2045	85	--	--	--	0.01	0.03	0.80	0.84
10-04-91	1535	10-04-91	1620	--	--	--	--	<.01	.03	.65	.67
10-04-91	1620	10-04-91	1740	--	--	--	--	.02	--	.88	--
[a]10-04-91	1620	10-04-91	1740	--	--	--	--	.02	.03	.92	.90
11-29-91	1950	11-29-91	2035	105	12	0.05	--	.12	.10	.75	.77
02-17-92	1430	02-17-92	1505	150	7.1	.05	--	.05	.05	1.8	1.8
03-29-92	1710	03-29-92	1800	140	5.3	.01	--	.02	.02	3.7	4.3
07-02-92	1850	07-02-92	1925	70	--	1.6	--	.03	.10	2.1	2.1
07-10-92	0250	07-10-92	0325	60	--	.08	--	.02	.02	.89	.89
07-11-92	1755	07-11-92	1925	35	--	.41	--	.03	.04	.64	.65
[a]07-11-92	1755	07-11-92	1925	40	--	.37	--	.03	.03	.66	.65
07-19-92	0115	07-19-92	0145	40	--	.13	--	.04	.04	.45	.44
09-20-92	2335	09-20-92	2340	50	--	.03	--	<.01	.02	.37	.35
11-12-92	0820	11-12-92	1010	45	--	2.6	--	.02	.03	.21	.21
11-20-92	0400	11-22-92	1300	90	--	3.8	--	.02	.03	.17	.18
11-20-92	0400	11-20-92	0800	120	--	7.8	--	.02	.05	.19	.17
11-20-92	0800	11-20-92	1030	100	--	39	--	.02	.05	.15	.16
11-20-92	1030	11-20-92	1330	95	--	3.4	--	.02	.06	.16	.18
11-20-92	1330	11-20-92	1400	105	--	3.1	--	.04	.05	.08	.13
11-20-92	1400	11-21-92	0930	60	--	2.3	--	.02	.05	.24	.25
11-21-92	0930	11-22-92	1040	60	--	2.4	--	.02	.04	.90	.23
11-22-92	1040	11-22-92	1300	80	--	2.1	--	.03	.04	.31	.34

Table 2. Nutrient concentrations, nitrogen isotope values, and selected trace element concentrations in surface runoff–Continued

Beginning date	Beginning time	Ammonia, dissolved, as nitrogen	Ammonia total, as nitrogen	Ammonia plus organic nitrogen dissolved, as nitrogen	Ammonia plus organic nitrogen total, as nitrogen	Phosphorus total	Orthophosphorus total as phosphorus	Orthophosphorus dissolved as phosphorus	$\delta^{15}N$ of ammonia, nitrite plus nitrate (per mil)	$\delta^{15}N$ of nitrite and nitrate (per mil)	Sediment, suspended	Percent sediment greater than 0.062 mm	Percent sediment less than 0.062 mm
09-15-91	1845	0.27	0.28	1.1	1.7	0.54	0.40	0.32	--	--	--	--	--
10-04-91	1535	.03	.08	.60	3.1	--	.15	.06	--	--	--	--	--
10-04-91	1620	.06	--	1.0	--	--	--	.07	--	--	--	--	--
[a]10-04-91	1620	.08	.09	.90	2.0	--	.08	.04	--	--	--	--	--
11-29-91	1950	.38	.55	1.2	3.7	--	.10	.10	--	--	--	--	--
02-17-92	1430	.13	.13	1.8	5.9	--	.11	.08	41.5	12.2	939	--	--
03-29-92	1710	.09	.08	.70	2.2	--	.04	.01	11.2	11.4	969	1.6	98.4
07-02-92	1850	.16	.20	.70	2.5	--	.17	.06	1,170	1,120	2,120	9.8	90.2
07-10-92	0250	.24	.24	.70	2.0	--	.08	.06	--	1,065	--	--	--
07-11-92	1755	.48	.46	.80	4.2	--	.07	.07	630	970	--	--	--
[a]07-11-92	1755	.43	.42	.80	2.7	--	.07	.06	585	882	--	--	--
07-19-92	0115	.18	.19	.60	3.0	--	.08	.07	210	--	--	--	--
09-20-92	2335	.03	.04	.50	1.1	--	.08	.07	--	--	--	--	--
11-12-92	0820	.05	.05	.30	.70	--	.03	.02	--	--	330	5.2	94.8
11-20-92	0400	.04	.04	.60	1.8	--	.02	.01	--	350	211	3.9	96.1
11-20-92	0400	.03	.04	.60	1.6	--	.02	.01	--	--	94	6.8	93.2
11-20-92	0800	.03	.02	.70	1.7	--	.02	<.01	--	--	154	8.3	91.7
11-20-92	1030	.02	.02	.70	1.9	--	.02	<.01	--	--	--	--	--
11-20-92	1330	.12	.05	1.7	.80	--	<.01	.03	--	--	139	4.2	95.8
11-20-92	1400	.05	.05	.40	2.7	--	.04	.02	--	--	827	1.8	98.2
11-21-92	0930	.05	.08	.50	1.3	--	.04	.03	--	--	125	18.3	81.7
11-22-92	1040	.04	.05	.80	1.1	--	.05	.04	--	--	91	3.9	96.1

Table 2. Nutrient concentrations, nitrogen isotope values, and selected trace element concentrations in surface runoff–Continued

Beginning date	Beginning time	Ending date	Ending time	Specific conductance	Chloride, dissolved	Bromide, dissolved	Bromide, dissolved (ISE)	Nitrite dissolved, as nitrogen	Nitrite total, as nitrogen	Nitrite plus nitrate dissolved, as nitrogen	Nitrite plus nitrate total, as nitrogen
11-25-92	0800	11-25-92	1800	90	--	4.1	--	0.02	0.02	0.22	0.21
12-15-92	0330	12-15-92	2010	100	--	2.9	--	--	.11	--	.60
01-03-93	2340	01-04-93	1315	60	--	9.7	--	.06	--	.89	--
01-04-93	1315	01-06-93	1159	135	--	28	--	.09	--	1.5	--
01-27-93	1620	01-28-93	2120	140	--	2.3	--	.11	--	2.5	--
03-03-93	1050	03-07-93	0825	145	--	2.5	--	.13	--	3.2	--
03-22-93	1615	03-22-93	2345	160	--	2.8	--	.08	--	2.1	--
03-30-93	1930	03-30-93	2355	105	--	--	1.7	.03	--	1.0	--
04-12-93	1855	04-19-93	2220	130	--	--	2.0	.01	--	.33	--
04-14-93	1344	--	--	230	--	--	2.6	<.01	--	.09	--
04-15-93	1200	--	--	130	--	--	--	<.01	--	<.05	--
05-07-93	1150	05-07-93	1415	160	--	--	2.8	.05	--	1.8	--
05-17-93	2140	05-17-93	2355	--	--	--	--	.06	--	3.0	--
06-06-93	1040	06-06-93	1540	165	--	--	1.5	.04	--	8.3	--
[b]06-06-93	1040	--	--	--	--	--	--	<.01	--	<.05	--
07-01-93	0410	07-01-93	0550	195	--	1.5	--	.08	--	8.6	--
07-13-93	1520	07-13-93	1750	80	--	.35	--	.01	--	.87	--
07-15-93	0355	07-15-93	1720	170	--	.21	--	<.01	--	.07	--
09-13-93	2305	09-14-93	0205	135	--	1.6	--	.01	--	.10	--
09-22-93	0430	09-23-93	1120	110	--	1.6	--	.01	--	.29	--

Table 2. Nutrient concentrations, nitrogen isotope values, and selected trace element concentrations in surface runoff–Continued

Beginning date	Beginning time	Ammonia, dissolved, as nitrogen	Ammonia total, as nitrogen	Ammonia plus organic nitrogen dissolved, as nitrogen	Ammonia plus organic nitrogen total, as nitrogen	Phosphorus total	Orthophosphorus total as phosphorus	Orthophosphorus dissolved as phosphorus	$\delta^{15}N$ of ammonia, nitrite plus nitrate (per mil)	$\delta^{15}N$ of nitrite and nitrate (per mil)	Sediment, suspended	Percent sediment greater than 0.062 mm	Percent sediment less than 0.062 mm
11-30-92	0800	0.06	0.03	0.70	1.0	--	0.02	0.02	254	--	--	--	--
12-15-92	0330	--	.13	.80	1.4	0.19	.13	--	378	362	124	37.3	62.7
01-03-93	2340	.13	--	.90	1.9	--	--	.04	382	380	458	6.3	93.7
01-04-93	1315	.12	--	1.1	2.0	--	--	.04	--	--	--	--	--
01-27-93	1620	.31	--	1.2	1.5	--	--	.10	370	--	62	87.5	12.5
03-03-93	1050	.16	--	1.2	1.5	--	--	.09	412	419	59	26.6	73.4
03-22-93	1615	.16	--	1.5	3.0	--	--	.04	455	507	481	8.0	92.0
03-30-93	1930	.10	--	1.0	2.7	--	--	.10	--	230	1,230	.6	99.4
04-12-93	1855	.07	--	1.1	3.1	--	--	.04	--	180	546	3.0	97.0
04-14-93	1344	.06	--	1.8	2.5	--	--	.02	--	77.0	--	--	--
04-15-93	1200	.04	--	1.0	1.3	--	--	.04	--	--	--	--	--
05-07-93	1150	.10	--	1.9	5.8	--	--	.10	169	190	977	1.6	98.4
05-17-93	2140	.69	--	2.6	7.2	--	--	.13	--	30.6	--	--	--
06-06-93	1040	.26	--	1.2	1.9	--	--	.14	--	63.9	--	--	--
[b]06-06-93	1040	.04	--	<.20	--	--	--	<.01	--	--	--	--	--
07-01-93	0410	.13	--	1.4	2.0	--	--	.14	121	124	--	--	--
07-13-93	1520	.10	--	.90	3.0	--	--	.12	--	--	--	--	--
07-15-93	0355	.02	--	1.1	1.4	--	--	.05	--	--	--	--	--
09-13-93	2305	.04	--	1.3	1.9	--	--	.18	--	72.0	63	25.5	74.5
09-22-93	0430	.15	--	1.1	2.2	--	--	.28	114	77.2	120	38.7	61.3

[a] Duplicate sample.
[b] Field equipment blank processed with inorganic free water.

Table 3. Well depths and screened intervals of sampled wells

Site number	Well depth (feet)	Screened interval (feet)
W0	11.8	4.3 - 11.8
W1	18.8	10.8 - 18.8
W2	26.8	19.3 - 26.8
M1	14.2	4.2 - 14.2
M2	22.2	14.7 - 22.2
E0	11.8	4.3 - 11.8
E1	16.6	6.6 - 16.6
E2	24.4	16.9 - 24.4
P1	11.5	4.0 - 11.5
P2	11.5	4.0 - 11.5
P3	11.2	3.7 - 11.2
P4	11.4	3.9 - 11.4
P5	11.1	3.6 - 11.1
P6	11.3	3.8 - 11.3

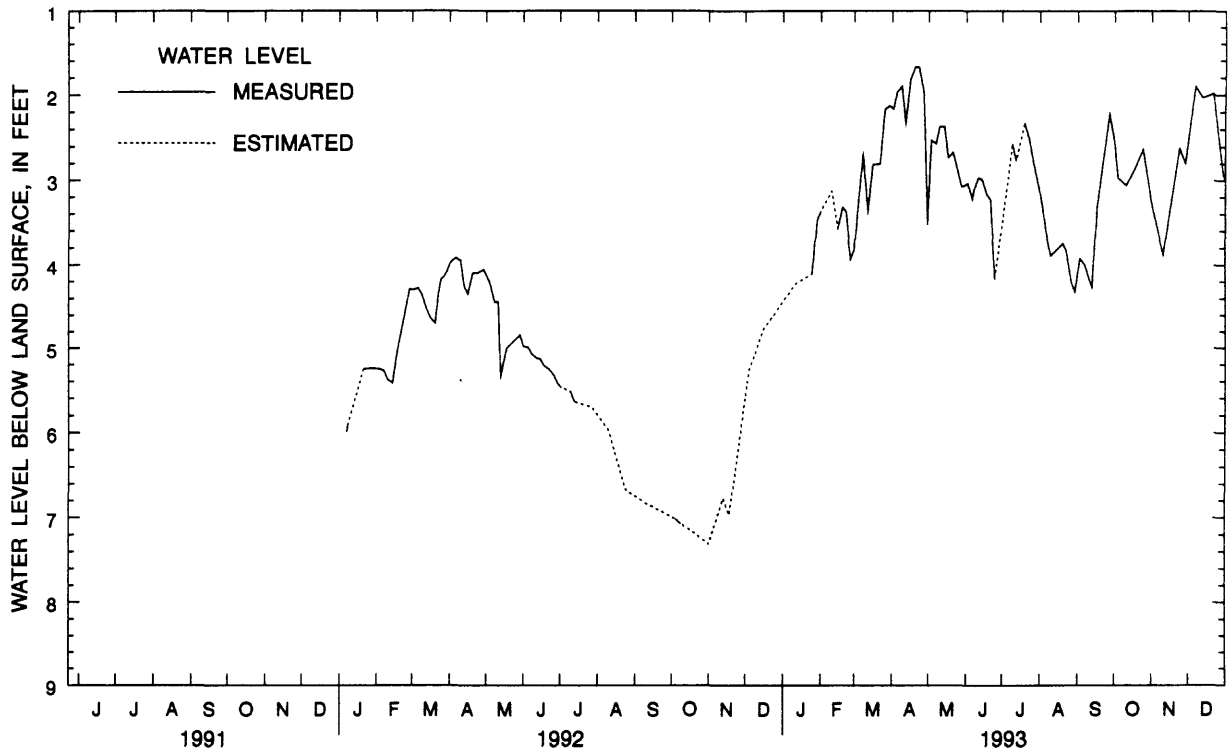

Figure 18. Ground-water level in well W0, January 1992 through December 1993.

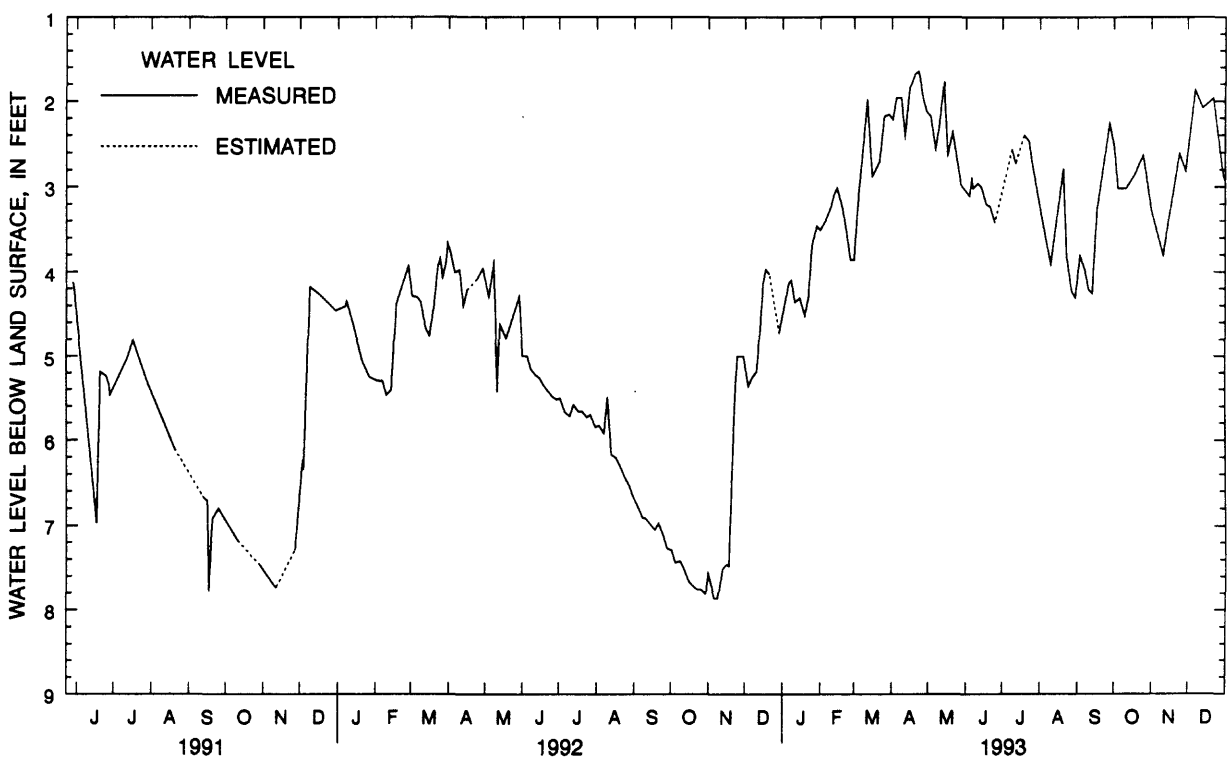

Figure 19. Ground-water level in well W1, June 1991 through December 1993.

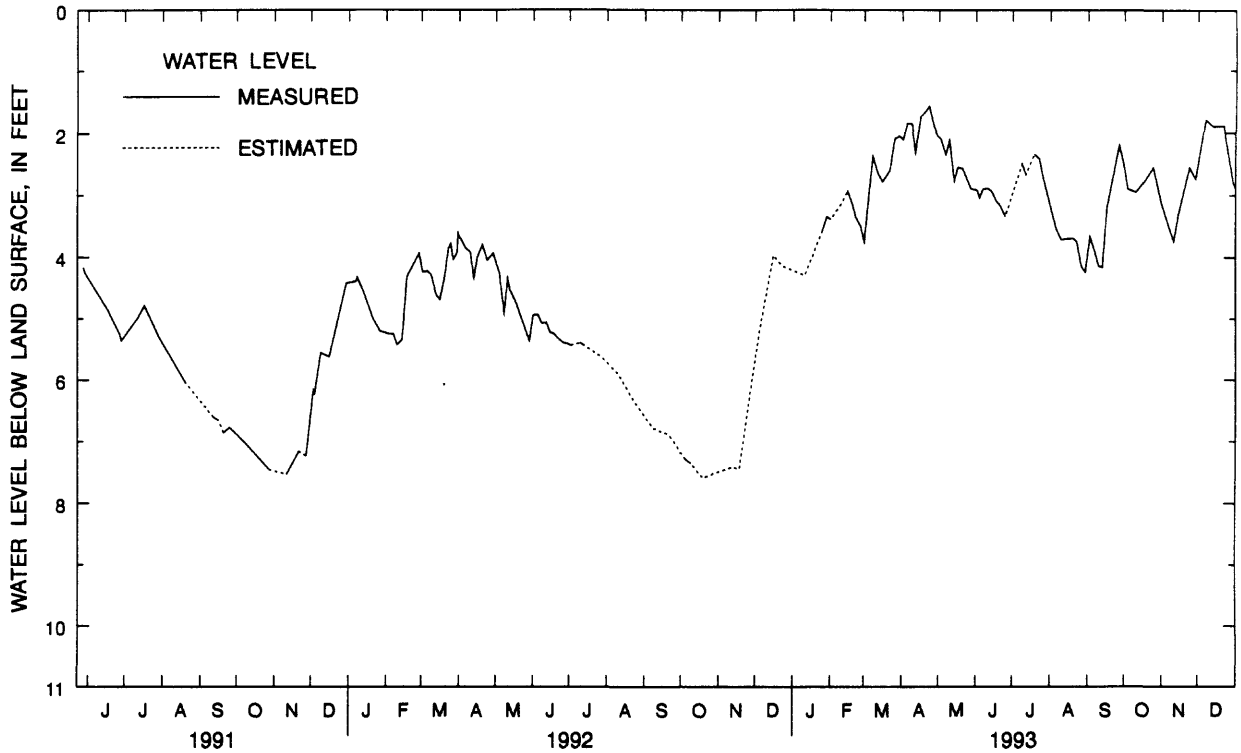

Figure 20. Ground-water level in well W2, June 1991 through December 1993.

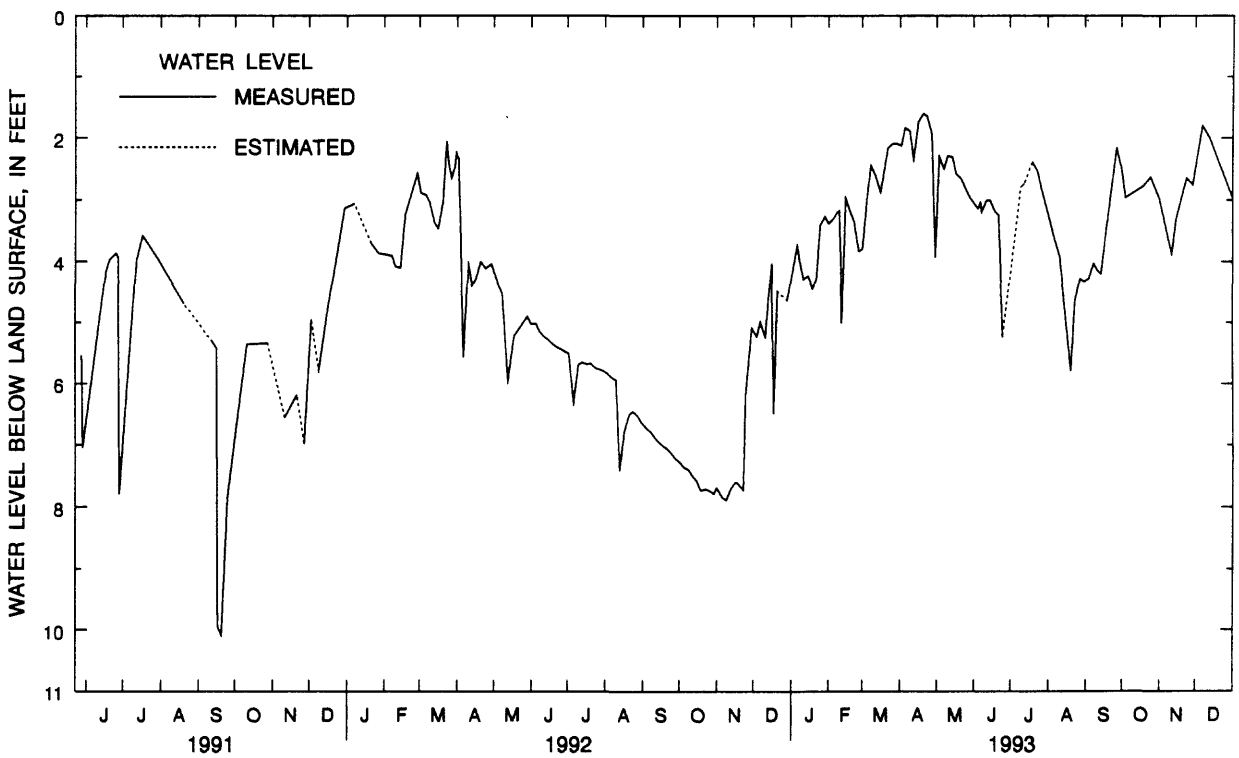

Figure 21. Ground-water level in well M1, June 1991 through December 1993.

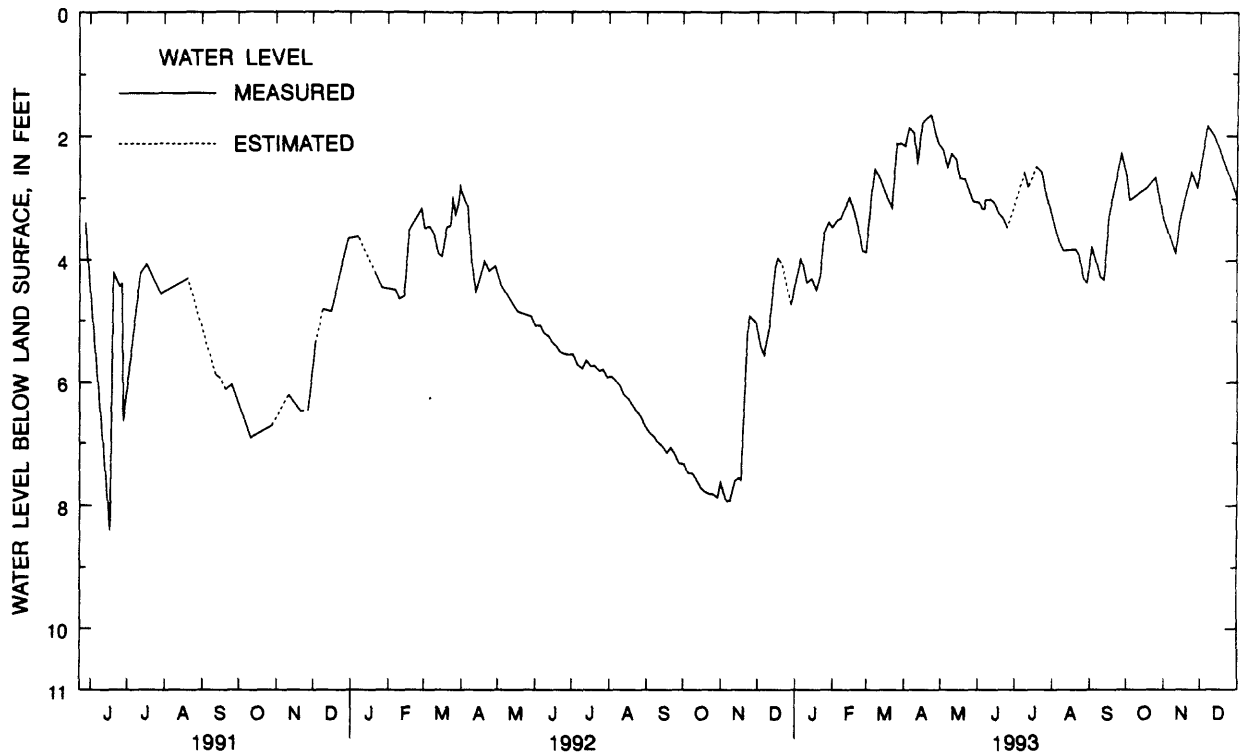

Figure 22. Ground-water level in well M2, June 1991 through December 1993.

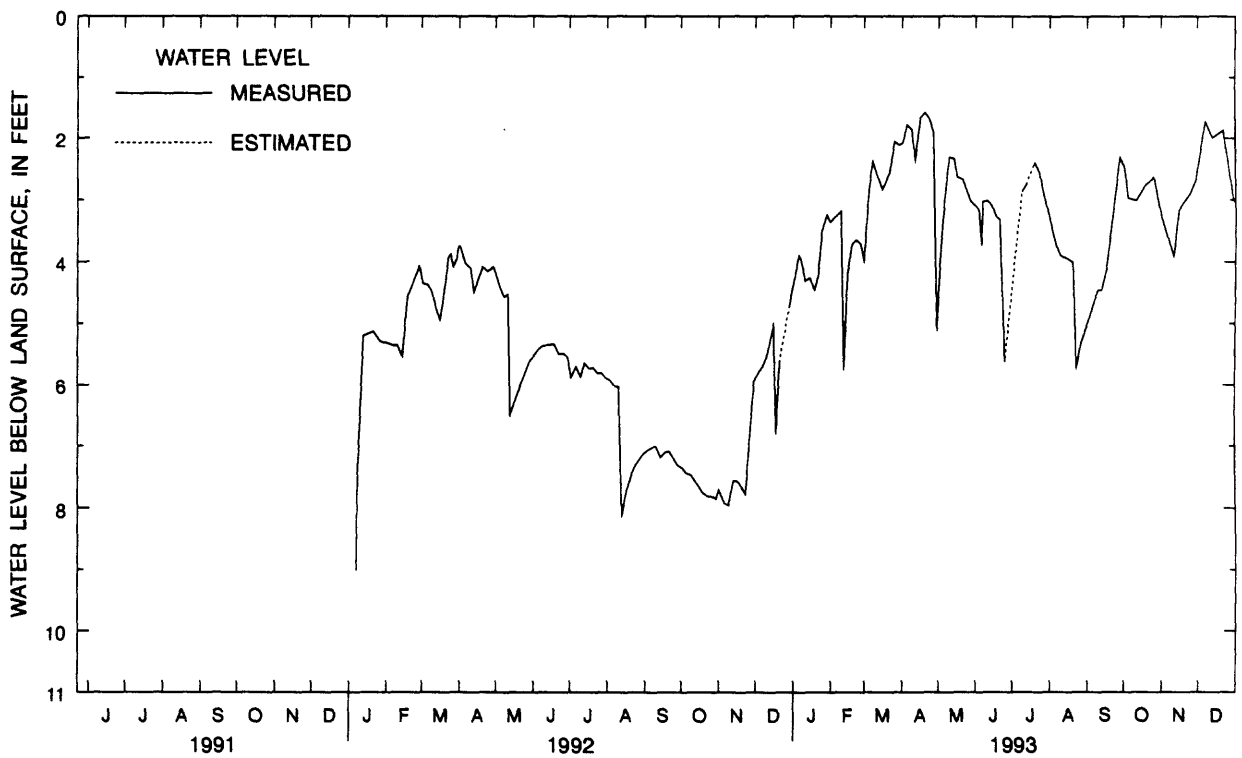

Figure 23. Ground-water level in well E0, January 1992 through December 1993.

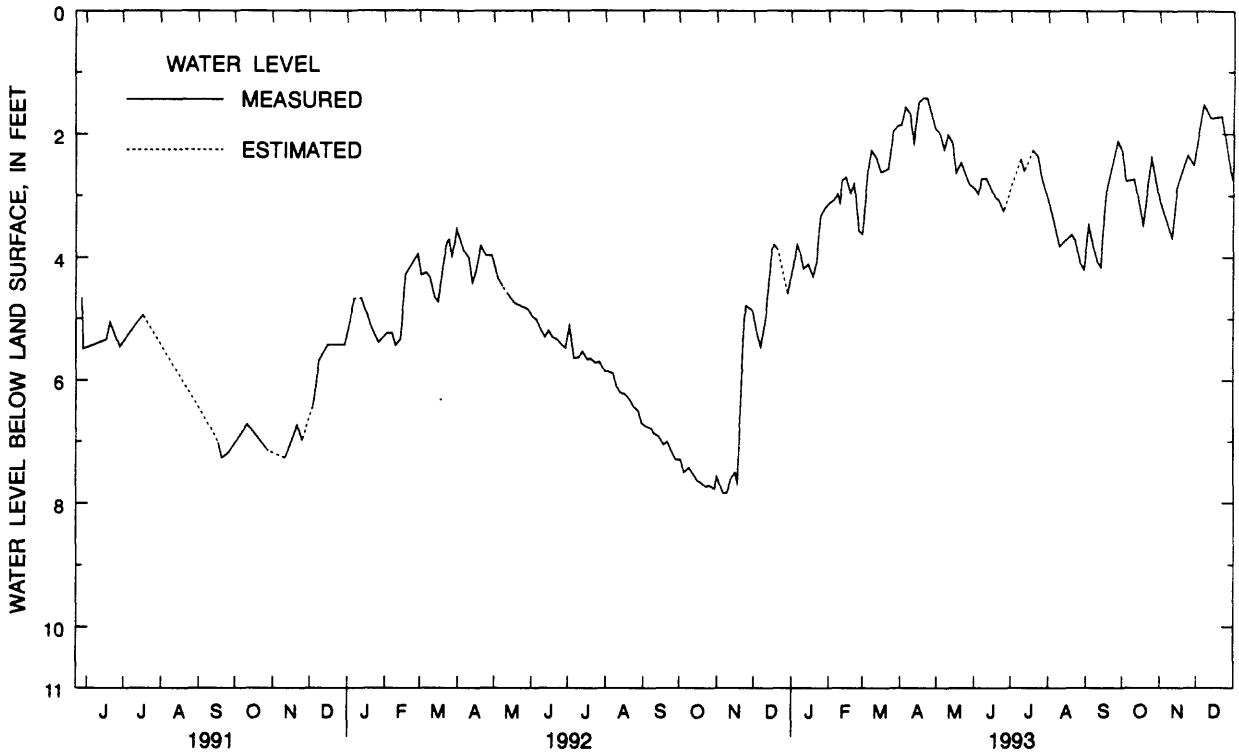

Figure 24. Ground-water level in well E1, June 1991 through December 1993.

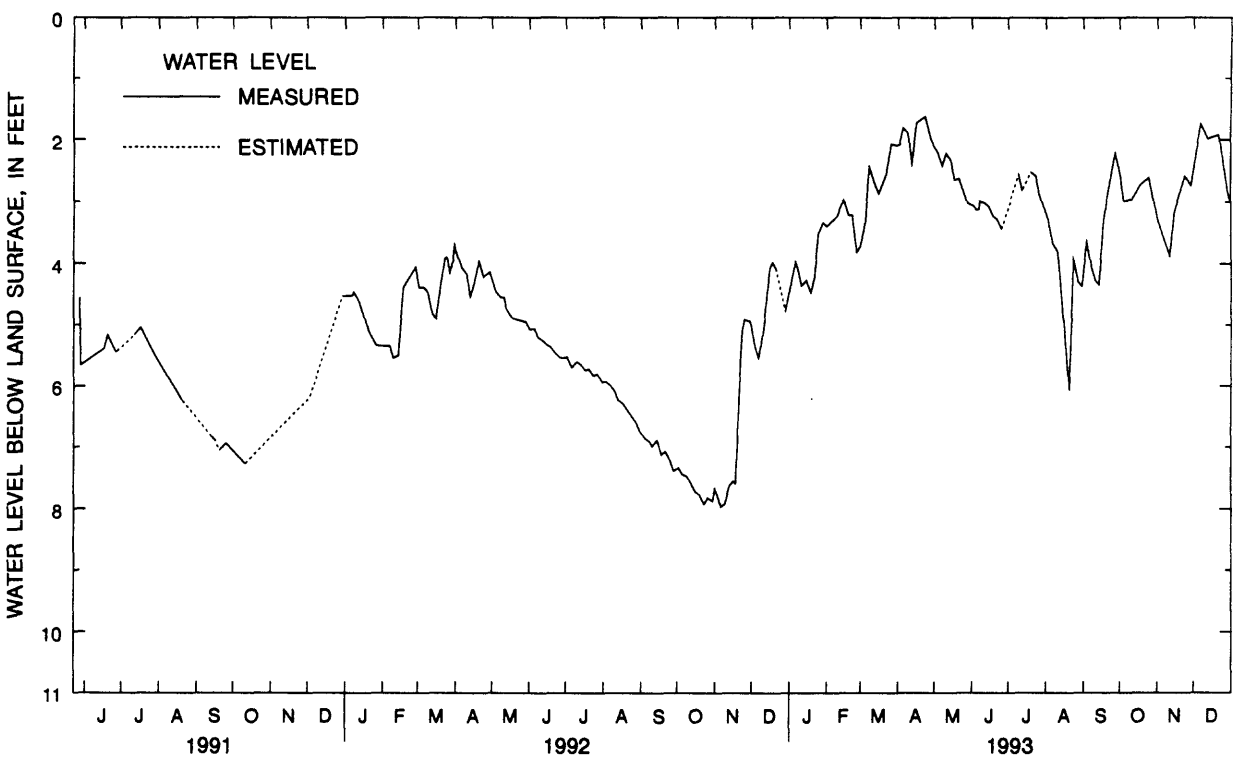

Figure 25. Ground-water level in well E2, June 1991 through December 1993.

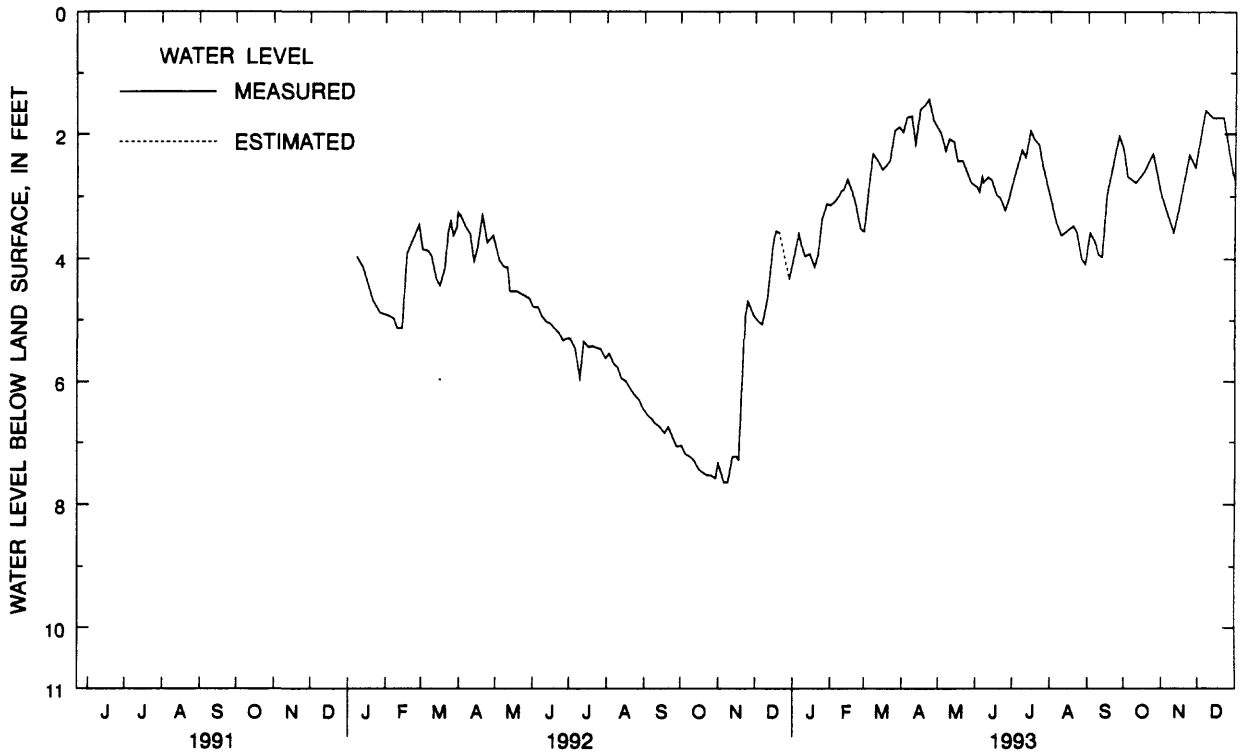

Figure 26. Ground-water level in well P1, January 1992 through December 1993.

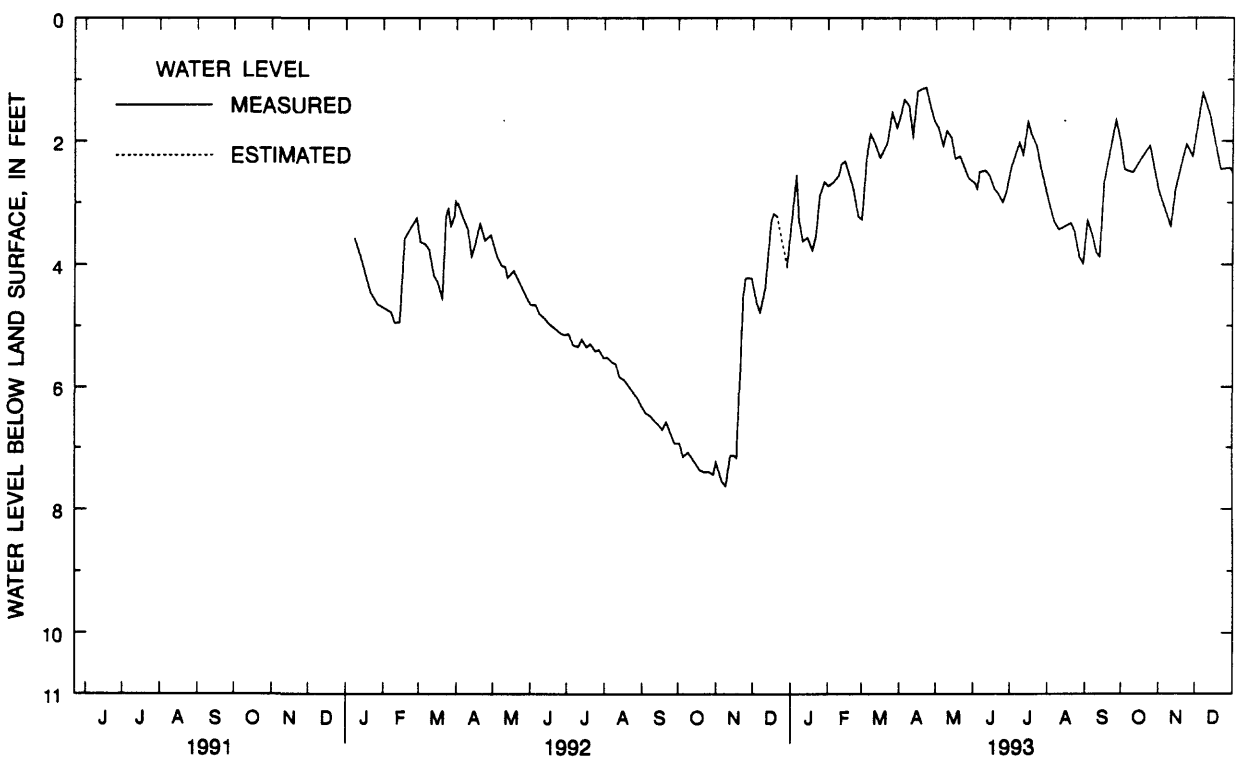

Figure 27. Ground-water level in well P2, January 1992 through December 1993.

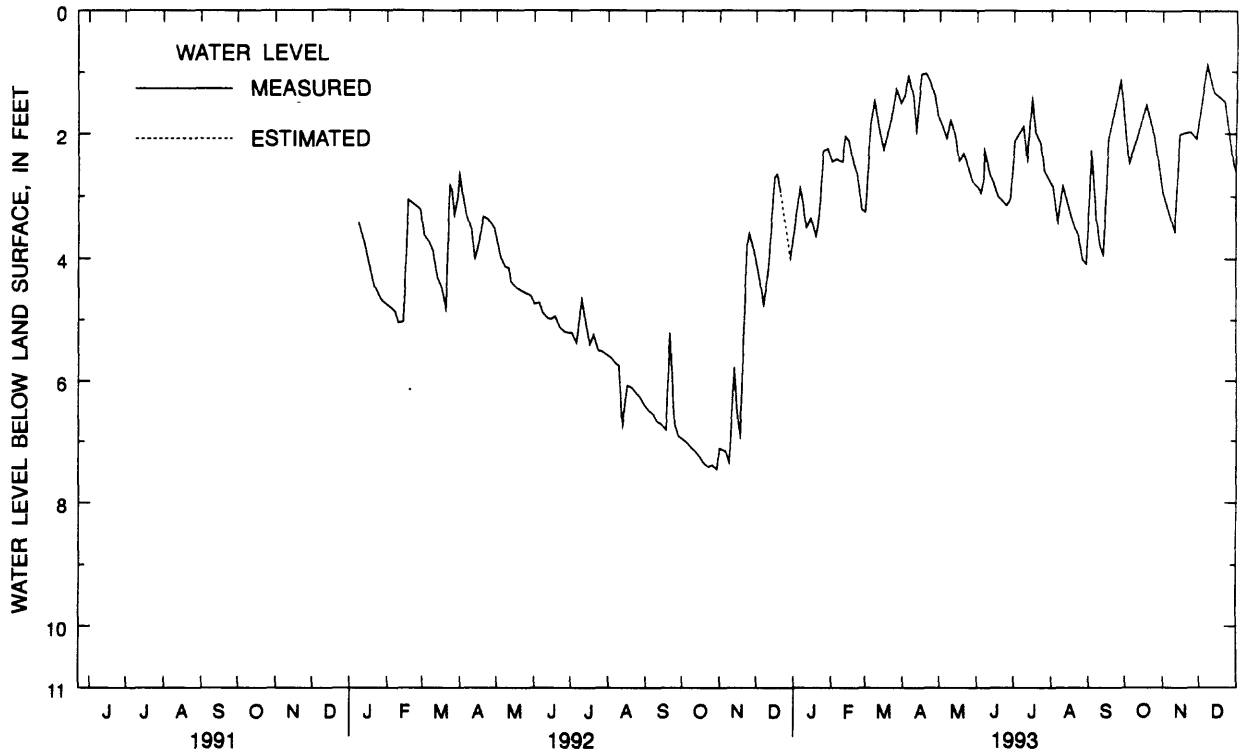

Figure 28. Ground-water level in well P3, January 1992 through December 1993.

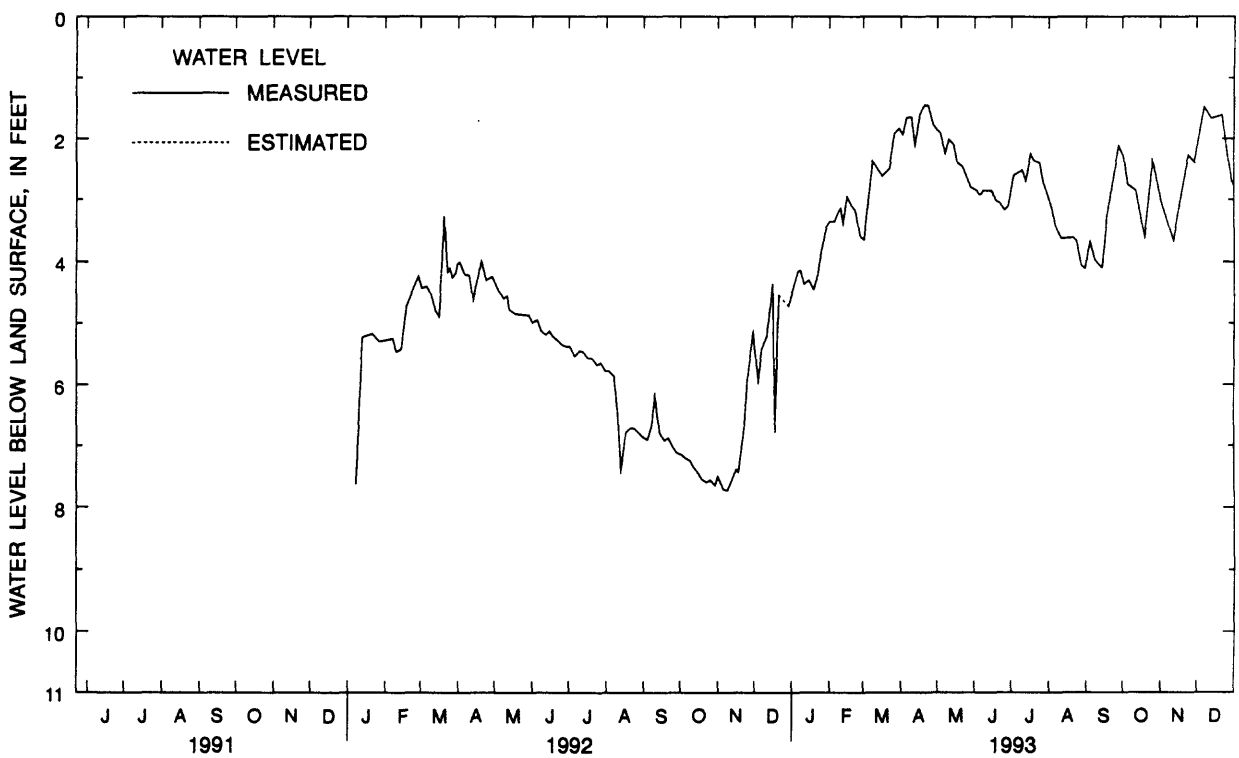

Figure 29. Ground-water level in well P4, January 1992 through December 1993.

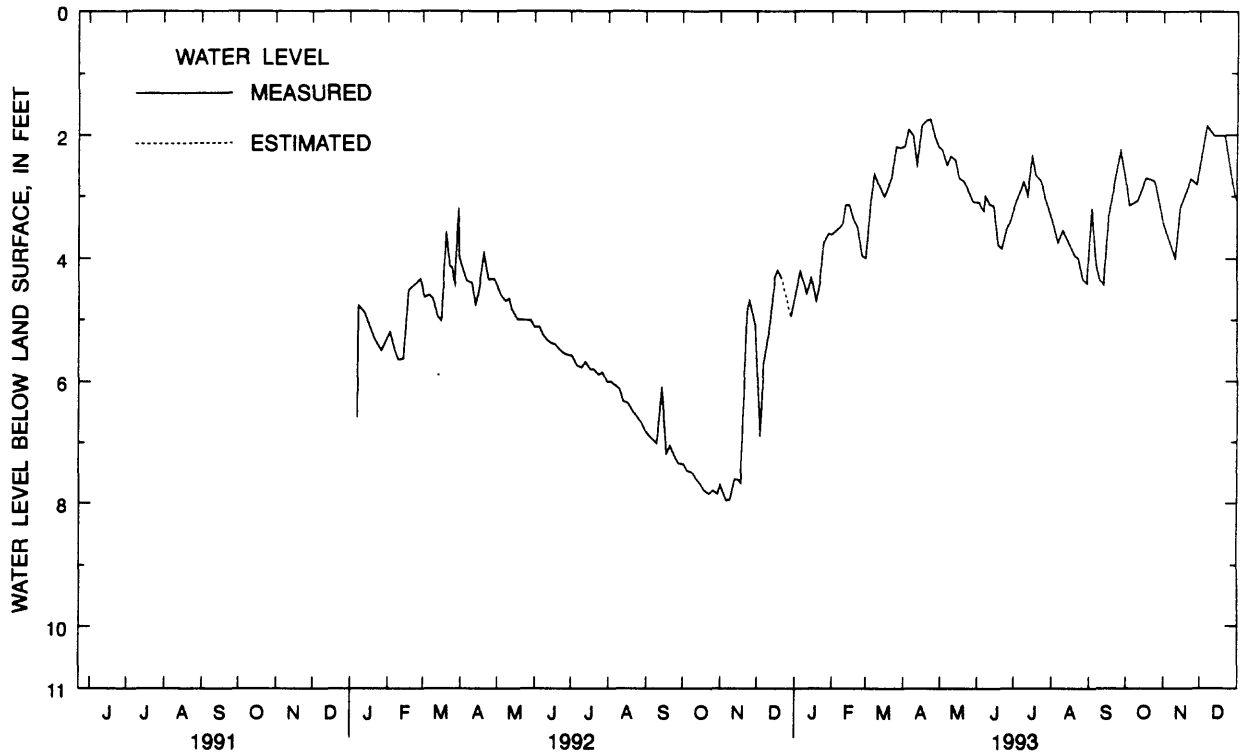

Figure 30. Ground-water level in well P5, January 1992 through December 1993.

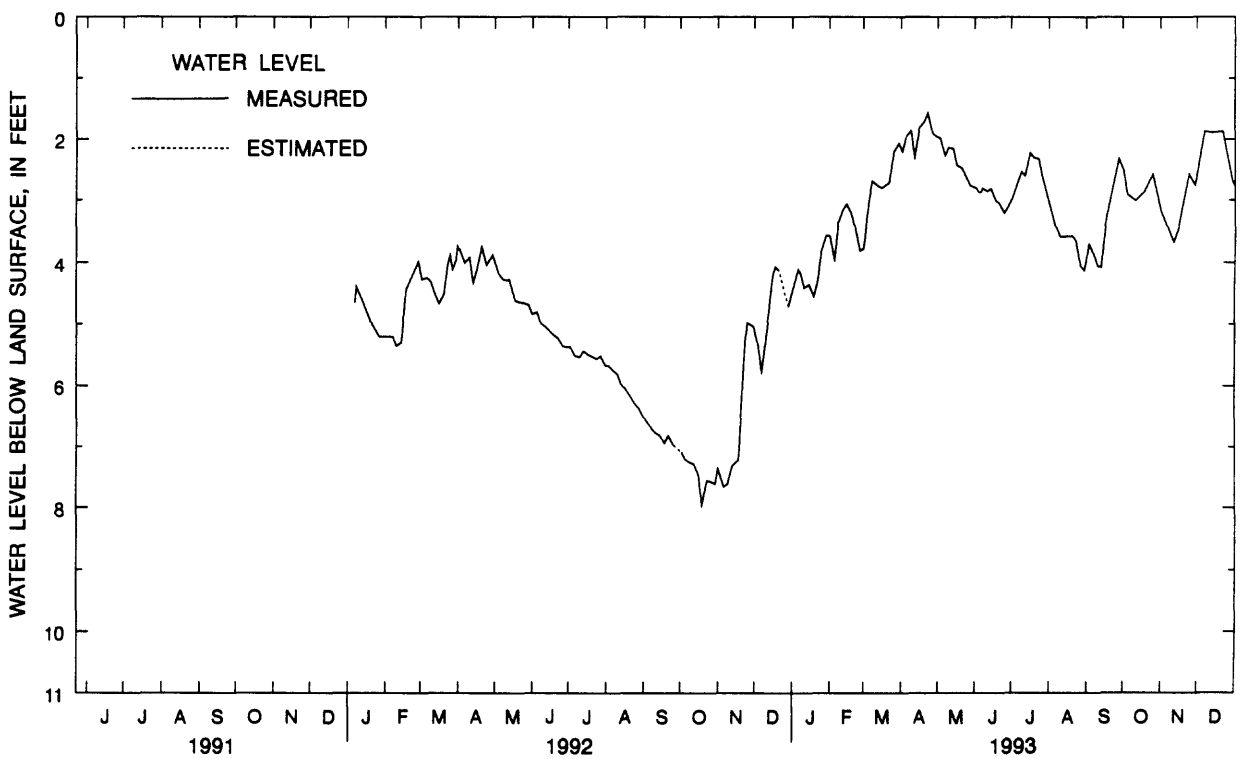

Figure 31. Ground-water level in well P6, January 1992 through December 1993.

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; oxidation reduction potential in millivolts relative to standard hydrogen electrode; barometric pressure in millimeters of mercury; trace element and nutrient concentrations in milligrams per liter, as dissolved; tritium in picocuries per liter; $\delta\ ^{15}N$ in per mil relative to atmospheric standard; --, missing value; <, less than]

Site number	Date	Specific conductance	pH (standard units)	Water temperature	Oxidation-reduction potential	Barometric pressure	Dissolved oxygen	Alkalinity
W0	05-11-92	492	6.7	13.0	308	762	8.0	70
	08-10-92	476	6.3	17.0	340	762	6.3	56
	11-18-92	640	6.3	6.5	427	767	4.6	60
	12-16-92	458	6.5	11.5	354	762	4.3	41
	02-10-93	455	6.6	10.0	346	762	5.2	40
	04-28-93	490	6.5	10.0	360	762	9.7	33
	06-22-93	495	6.4	14.0	380	762	6.3	37
	08-16-93	505	6.3	17.0	385	763	7.3	34
	[a]08-16-93	--	--	--	--	--	--	--
	[a]08-16-93	--	--	--	--	--	--	--
W1	05-29-91	580	--	--	--	--	--	--
	06-28-91	600	7.1	14.0	337	764	10.1	94
	[b]06-28-91	--	--	--	--	--	--	--
	07-29-91	620	7.1	15.0	307	--	10.1	156
	09-17-91	560	7.3	15.0	--	765	7.6	111
	12-04-91	710	7.4	12.5	380	772	5.8	210
	05-11-92	700	7.3	13.5	308	762	6.2	168
	08-10-92	680	7.1	16.0	321	--	--	153
	11-18-92	--	7.3	14.0	527	767	5.7	165
	12-16-92	620	7.3	12.5	409	762	6.9	134
	02-10-93	630	7.3	12.5	319	762	7.7	132
	[b]02-10-93	--	--	--	--	--	--	--
	04-28-93	640	7.3	11.5	360	762	8.8	124
	06-22-93	595	7.1	14.5	390	762	7.5	115
	[b]06-22-93	--	--	--	--	--	--	--
	08-16-93	620	7.0	15.0	410	--	7.7	99
W2	05-28-91	825	--	--	--	--	--	--
	06-27-91	835	7.3	14.0	229	764	2.3	188
	07-29-91	820	6.4	13.5	376	--	2.5	184
	09-16-91	835	7.3	13.5	332	765	2.2	186
	12-04-91	800	7.5	12.5	277	772	2.4	189
	05-11-92	840	7.3	13.0	278	762	2.2	175
	08-10-92	845	7.2	14.5	337	--	--	185
	11-19-92	770	7.3	13.0	373	767	2.6	183
	[b]11-19-92	--	--	--	--	--	--	--
	12-17-92	820	7.4	13.0	319	762	2.3	179
	[b]12-17-92	--	--	--	--	--	--	--
	02-10-93	805	7.4	13.0	308	762	2.5	180
	[b]02-10-93	--	--	--	--	--	--	--
	04-28-93	820	7.2	12.5	334	762	2.7	179
	06-22-93	810	7.3	15.5	387	762	2.4	185
	[b]06-22-93	--	--	--	--	--	--	--
	[a]06-22-93	--	--	--	--	--	--	--
	08-16-93	810	7.3	14.0	390	763	2.6	179
	[b]08-16-93	--	--	--	--	--	--	--

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells–Continued

Site number	Bicarbonate	Sulfate	Chloride	Fluoride	Bromide	Nitrite, as nitrogen	Nitrate, as nitrogen	Ammonia, as nitrogen
W0	85	--	--	--	0.20	0.02	12	0.02
	68	--	--	--	.22	<.01	13	<.01
	73	--	--	--	1.4	<.01	12	.02
	50	--	--	--	1.6	.04	18	.03
	48	--	--	--	.97	<.01	15	.02
	40	--	--	--	1.4	<.01	17	.02
	45	--	--	--	1.4	.04	16	.04
	41	--	--	--	1.1	<.01	14	.05
	[a]--	--	--	--	--	--	20	--
	[a]--	--	--	--	--	--	20	--
W1	--	29	34	0.3	.08	.01	30	.03
	115	34	39	.6	.12	.02	30	<.01
	[b]--	--	--	--	--	--	--	--
	190	37	33	.3	.14	.01	29	.02
	135	34	40	.5	.13	<.01	29	<.01
	256	--	40	--	.13	<.01	25	<.01
	205	--	--	--	.13	<.01	23	.02
	186	--	--	--	.14	<.01	23	<.01
	201	--	--	--	--	.01	22	.02
	163	--	--	--	.18	.03	22	.02
	161	--	--	--	.17	.02	21	.01
	[b]--	--	--	--	--	--	--	--
	151	--	--	--	.19	<.01	20	.04
	141	--	--	--	.21	<.01	19	.03
	[b]--	--	--	--	.21	<.01	19	.02
	121	--	--	--	.23	<.01	17	.05
W2	--	63	40	.6	.20	.03	5.0	<.01
	229	71	45	.7	.22	<.01	27	.01
	225	76	40	.6	.22	.02	29	.02
	226	69	45	.8	.23	<.01	30	<.01
	230	--	47	--	.24	<.01	28	<.01
	214	--	--	--	.22	<.01	27	.03
	226	--	--	--	.22	<.01	29	<.01
	224	--	--	--	.22	.01	29	.01
	[b]--	--	--	--	--	--	28	--
	218	--	--	--	.23	.02	27	.02
	[b]--	--	--	--	.22	--	27	--
	220	--	--	--	.19	<.01	27	.01
	[b]--	--	--	--	.22	.02	27	<.01
	218	--	--	--	.22	<.01	26	<.01
	225	--	--	--	.22	<.01	27	.03
	[a]--	--	--	--	--	--	20	--
	[a]--	--	--	--	--	--	20	--
	220	--	--	--	.21	<.01	26	.03
	[b]--	--	--	--	--	<.01	26	.03

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells–Continued

Site number	Ammonia plus organic nitrogen, as nitrogen	Ortho-phosphorous, as phosphorous	Tritium	δ deu-terium	$\delta^{18}O$	$\delta^{15}N$ of nitrate	$\delta^{15}N$ of nitrite plus nitrate	Organic carbon, as carbon
W0	0.60	0.04	--	--	--	--	9.9	--
	.50	.05	--	--	--	--	10.0	--
	.60	.05	--	--	--	74.4	74.6	--
	.30	.04	--	--	--	--	138	--
	.50	.04	--	--	--	79.9	80.6	--
	.60	.04	--	--	--	--	124	--
	.50	.05	--	--	--	--	103	--
	.60	.08	--	--	--	--	86.0	--
	[a]--	--	--	--	--	--	3.71	--
	[a]--	--	--	--	--	--	3.68	--
W1	.80	.02	--	--	--	--	--	--
	1.0	.06	33	-35.5	-6.20	9.90	11.0	--
	[b]--	--	--	--	--	9.70	--	--
	.90	.05	--	--	--	--	--	3.8
	.80	.06	--	--	-6.20	10.0	10.9	3.5
	.30	.10	--	-36.0	-6.20	--	--	3.7
	<.20	.08	--	--	--	12.4	11.3	--
	<.20	.08	--	--	--	--	11.2	--
	.30	.08	--	--	--	10.5	11.1	--
	<.20	.08	--	--	--	--	11.3	--
	.30	.08	--	--	--	--	11.2	--
	[b]--	--	--	--	--	--	11.1	--
	.30	.07	--	--	--	--	11.3	--
	.30	.07	--	--	--	--	11.9	--
	[b].20	.08	--	--	--	--	--	--
	.40	.06	--	--	--	--	14.9	--
W2	.40	<.01	--	--	--	--	--	--
	.90	.02	100	-38.5	-6.60	13.4	--	--
	.80	.01	--	--	--	--	--	1.8
	.70	.02	--	--	-6.55	--	--	1.6
	<.20	.02	--	-39.5	-6.60	--	--	1.7
	<.20	.03	--	--	--	--	15.2	--
	<.20	.03	--	--	--	--	15.1	--
	<.20	.02	--	--	--	--	15.1	--
	[b]--	--	--	--	--	--	--	--
	<.20	.02	--	--	--	--	15.0	--
	[b]--	--	--	--	--	--	--	--
	<.20	.03	--	--	--	--	--	--
	[b]<.20	.03	--	--	--	--	14.9	--
	<.20	.02	--	--	--	--	14.8	--
	<.20	.02	--	--	--	--	15.7	--
	[a]--	--	--	--	--	--	3.73	--
	[a]--	--	--	--	--	--	3.77	--
	[b]<.20	.02	--	--	--	--	13.3	--
	<.20	.03	--	--	--	--	--	--

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells–Continued

Site number	Date	Specific conductance	pH (standard units)	Water temperature	Oxidation-reduction potential	Barometric pressure	Dissolved oxygen	Alkalinity
M1	05-29-91	626	--	--	--	--	--	--
	06-28-91	566	6.6	16.5	356	764	8.5	44
	07-30-91	555	6.6	15.0	--	--	9.5	50
	09-17-91	540	6.7	--	--	--	--	42
	12-04-91	580	6.6	12.5	307	771	7.0	40
	05-11-92	543	6.4	12.5	323	672	8.2	43
	08-10-92	547	6.3	20.5	353	--	--	41
	11-19-92	505	6.3	14.5	367	767	5.7	43
	[b]11-19-92	--	--	--	--	--	--	--
	12-16-92	532	6.4	12.0	354	762	7.5	36
	02-10-93	545	6.5	11.0	325	762	7.2	30
	04-28-93	560	6.4	10.0	360	762	8.9	35
	06-22-93	555	6.5	14.5	400	762	6.7	35
	08-16-93	560	6.4	16.0	405	763	7.8	33
	[c]08-16-93	--	--	--	--	--	--	--
M2	05-29-91	614	--	--	--	--	--	--
	06-27-91	644	7.0	14.5	327	764	5.8	104
	07-29-91	620	7.1	14.5	317	--	6.1	106
	09-16-91	609	7.1	16.5	311	765	5.6	107
	12-04-91	560	7.2	13.0	327	772	4.5	110
	05-11-92	641	7.1	13.0	308	762	5.1	110
	08-10-92	635	6.9	15.5	342	--	--	107
	11-19-92	590	7.1	13.5	377	767	5.1	107
	[b]11-19-92	--	--	--	--	--	--	--
	12-16-92	588	7.1	13.0	358	762	4.8	100
	02-11-93	600	7.2	11.0	400	762	6.2	107
	04-28-93	620	7.1	12.0	350	762	5.2	100
	06-22-93	610	7.2	15.0	400	762	4.0	104
	08-16-93	625	7.1	16.0	400	763	3.6	104

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells--Continued

Site number	Bicarbonate	Sulfate	Chloride	Fluoride	Bromide	Nitrite, as nitrogen	Nitrate, as nitrogen	Ammonia, as nitrogen
M1	--	110	25	0.2	0.08	0.02	22	0.03
	54	93	24	.2	.10	.09	26	.04
	61	95	15	.2	.10	.02	24	.06
	52	82	27	.3	.10	<.01	26	.01
	48	--	24	--	.12	<.01	24	<.01
	53	--	--	--	.11	<.01	22	.02
	50	--	--	--	.12	<.01	25	<.01
	53	--	--	--	.12	<.01	25	.01
	[b]--	--	--	--	.12	--	--	--
	43	--	--	--	.66	.01	25	.01
	36	--	--	--	.92	.01	26	.02
	43	--	--	--	1.4	<.01	23	.03
	43	--	--	--	1.6	<.01	25	.01
	40	--	--	--	2.0	<.01	24	.03
	[c]--	--	--	--	<.01	<.01	<.05	.02
M2	--	70	30	.7	.15	.01	20	.04
	126	75	35	.7	.17	<.01	19	.02
	129	81	27	.6	.16	.01	20	.03
	131	74	30	.8	.15	<.01	21	<.01
	134	--	33	--	.17	<.01	22	<.01
	134	--	--	--	.17	<.01	23	.02
	131	--	--	--	.16	<.01	24	<.01
	130	--	--	--	.19	<.01	25	.01
	[b]--	--	--	--	--	--	23	--
	122	--	--	--	.18	.01	24	.01
	131	--	--	--	.17	.02	23	.02
	102	--	--	--	.18	<.01	23	.03
	127	--	--	--	.18	<.01	23	.03
	127	--	--	--	.18	<.01	22	.04

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells--Continued

Site number	Ammonia plus organic nitrogen as nitrogen	Orthro-phosphorous, as phosphorous	Tritium	δ deu-terium	δ ^{18}O	δ ^{15}N of nitrate	δ ^{15}N of nitrite plus nitrate exchange nitrate	Organic carbon, as carbon
M1	1.0	<0.01	--	--	--	--	--	--
	1.0	.03	--	--	-6.50	--	--	--
	1.0	.02	--	--	--	--	--	5.4
	.90	.05	--	--	--	--	--	--
	.30	.04	--	--	-6.50	--	--	4.5
	.20	.04	--	--	--	--	11.1	--
	.30	.04	--	--	--	--	11.6	--
	.40	.04	--	--	--	--	11.3	--
	[b]--	--	--	--	--	--	--	--
	<.20	.04	--	--	--	--	56.5	--
	.30	.04	--	--	--	--	63.4	--
	.40	.03	--	--	--	--	81.5	--
	.40	.04	--	--	--	--	97.0	--
	.40	.04	--	--	--	--	110	--
	[c]<.20	<.01	--	--	--	--	--	--
M2	.70	.01	--	--	--	--	--	--
	.80	.04	--	--	-6.45	--	--	2.1
	.60	.03	--	--	-6.45	--	--	2.0
	<.20	.05	--	--	-6.40	--	--	2.1
	<.20	.04	--	--	--	--	14.2	--
	<.20	.04	--	--	--	--	13.8	--
	[b]--	--	--	--	--	--	--	--
	<.20	.04	--	--	--	--	14.2	--
	<.20	.06	--	--	--	--	13.9	--
	<.20	.03	--	--	--	--	13.8	--
	<.20	.03	--	--	--	--	13.8	--
	.20	.04	--	--	--	--	13.9	--

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells--Continued

Site number	Date	Specific conductance	pH (standard units)	Water temperature	Oxidation-reduction potential	Barometric pressure	Dissolved oxygen	Alkalinity
E0	05-11-92	559	6.7	13.0	340	762	7.5	76
	08-10-92	541	6.4	17.0	354	762	7.4	66
	11-18-92	535	6.7	12.0	544	767	6.5	60
	[b]11-18-92	--	--	--	--	--	--	--
	12-16-92	507	6.6	11.5	364	762	6.1	57
	[b]12-16-92	--	--	--	--	--	--	--
	02-10-93	560	6.7	10.0	311	762	8.1	46
	04-28-93	595	6.5	11.0	330	762	9.0	39
	[b]04-28-93	--	--	--	--	--	--	--
	06-22-93	640	6.4	14.0	360	762	5.8	39
	[b]06-22-93	--	--	--	--	--	--	--
	08-16-93	690	6.4	18.0	385	761	--	37
	[b]08-16-93	--	--	--	--	--	--	--
E1	05-29-91	550	--	--	--	--	--	--
	06-28-91	547	6.9	15.0	332	764	7.3	67
	07-30-91	536	6.8	15.5	332	--	7.9	74
	09-17-91	554	6.7	15.0	--	765	5.3	62
	12-03-91	540	6.8	13.0	312	772	5.3	69
	05-11-92	538	6.6	13.0	308	762	6.0	55
	08-10-92	548	6.4	--	331	--	--	60
	11-18-92	585	6.8	14.0	537	767	5.5	91
	12-16-92	512	6.4	12.5	368	762	6.8	58
	02-10-93	520	6.4	11.0	335	762	6.6	41
	04-28-93	540	6.7	10.5	336	762	9.2	48
	[b]04-28-93	--	--	--	--	--	--	--
	06-22-93	535	6.6	13.5	405	762	6.6	58
	[b]06-22-93	--	--	--	--	--	--	--
	08-16-93	560	6.6	14.5	410	763	6.6	54
	[b]08-16-93	--	--	--	--	--	--	--
E2	05-29-91	684	--	--	--	--	--	--
	06-28-91	684	7.3	13.0	348	764	4.5	152
	07-29-91	677	7.3	14.0	309	--	4.8	148
	09-16-91	690	7.3	13.5	320	765	4.0	150
	[b]09-16-91	--	--	--	--	--	--	--
	12-03-91	685	7.3	13.5	281	761	3.4	155
	05-12-92	754	7.2	12.5	370	758	2.6	151
	08-11-92	780	7.1	13.0	368	--	--	148
	[b]08-11-92	--	--	--	--	--	--	--
	11-19-92	710	7.1	13.5	352	767	2.2	159
	12-16-92	780	7.3	13.0	358	762	2.7	154
	02-11-93	795	7.2	12.0	429	762	1.9	156
	04-28-93	830	7.0	12.5	350	762	2.1	163
	06-23-93	820	7.3	13.5	400	761	1.5	168
	[c]06-23-93	--	--	--	--	--	--	--
	08-17-93	--	7.1	13.5	480	761	1.7	171

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells–Continued

Site number	Bicar-bonate	Sulfate	Chloride	Fluoride	Bromide	Nitrite as nitrogen	Nitrate as nitrogen	Ammonia as nitrogen
E0	93	--	--	--	0.07	0.06	19	0.03
	80	--	--	--	.07	<.01	20	<.01
	73	--	--	--	1.6	<.01	24	.02
	[b]--	--	--	--	--	--	--	--
	69	--	--	--	.94	.02	21	.02
	[b]--	--	--	--	--	--	--	--
	56	--	--	--	2.5	.02	25	.02
	47	--	--	--	6.9	<.01	17	<.01
	[b]--	--	--	--	--	--	--	--
	47	--	--	--	9.0	<.01	38	.03
	[b]--	--	--	--	--	--	--	--
	45	--	--	--	11	<.01	40	.05
	[b]--	--	--	--	--	--	--	--
E1	--	56	31	0.5	.15	.01	21	.02
	82	72	33	.5	.16	<.01	19	.02
	90	72	27	.4	.16	.01	19	.02
	75	80	31	.4	.16	<.01	18	<.01
	84	--	37	--	.18	<.01	20	.01
	67	--	--	--	.19	<.01	11	.02
	73	--	--	--	.19	<.01	14	<.01
	111	--	--	--	.22	.01	25	.02
	71	--	--	--	.42	.01	15	.01
	50	--	--	--	.78	.01	13	.02
	59	--	--	--	.90	<.01	13	.01
	[b]--	--	--	--	--	--	13	--
	71	--	--	--	1.0	<.01	15	.04
	[b]--	--	--	--	.77	<.01	15	.04
	65	--	--	--	1.3	<.01	15	.02
	[b]--	--	--	--	--	<.01	16	.02
E2	--	52	35	.7	.18	<.01	23	<.01
	185	58	39	.8	.22	<.01	23	<.01
	180	61	33	.7	.20	.01	23	.02
	183	55	39	.8	.21	<.01	24	<.01
	[b]--	44	34	.7	.22	<.01	23	<.01
	189	--	43	--	.23	<.01	25	<.01
	185	--	--	--	.24	<.01	27	.02
	181	--	--	--	.24	<.01	31	<.01
	[b]--	--	--	--	.24	--	31	--
	194	--	--	--	.26	.01	34	.02
	188	--	--	--	.28	.02	32	.02
	190	--	--	--	.28	.01	33	<.01
	199	--	--	--	.23	<.01	31	.01
	199	--	--	--	.35	<.01	32	.04
	[c]--	--	--	--	<.01	<.01	<.05	.03
	199	--	--	--	.37	<.01	32	.02

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells--Continued

Site number	Ammonia plus organic nitrogen, as nitrogen	Orthro-phosphorous, as phosphorous	Tritium	δ deu-terium	$\delta^{18}O$	$\delta^{15}N$ of nitrate	$\delta^{15}N$ of nitrite plus nitrate	Organic carbon, as carbon
E0	0.30	0.03	--	--	--	7.5	10.3	--
	.30	.04	--	--	--	--	9.8	--
	.30	.04	--	--	--	43.2	43.6	--
	[b]--	--	--	--	--	--	43.5	--
	<.20	.03	--	--	--	--	32.7	--
	[b]--	--	--	--	--	--	32.8	--
	.30	.03	--	--	--	--	128	--
	.50	.03	--	--	--	246	248	--
	[b]--	--	--	--	--	--	249	--
	.30	.04	--	--	--	--	304	--
	[b]--	--	--	--	--	--	304	--
	.50	.04	--	--	--	335	340	--
	[b]--	--	--	--	--	--	339	--
E1	.50	.02	--	--	--	--	--	--
	1.0	.03	80	-40.0	-6.75	12.4	13.5	--
	.70	.03	--	--	--	--	--	2.7
	.60	.05	--	--	-6.70	11.1	13.1	3.0
	<.20	.05	--	-39.5	-6.65	--	13.7	2.0
	<.20	.04	--	--	--	--	13.2	--
	<.20	.04	--	--	--	--	13.4	--
	<.20	.03	--	--	--	--	14.7	--
	<.20	.04	--	--	--	--	33.5	--
	.30	.03	--	--	--	67.7	68.1	--
	.30	.03	--	--	--	--	85.6	--
	[b]--	--	--	--	--	--	--	--
	<.20	.06	--	--	--	72.3	72.5	--
	[b]<.20	.04	--	--	--	--	--	--
	<.20	.04	--	--	--	--	91.5	--
	[b]<.20	.04	--	--	--	--	--	--
E2	.20	<.01	--	--	--	--	--	--
	.70	.01	69	-40.0	-6.90	13.5	14.5	--
	.60	<.01	--	--	--	--	--	1.6
	.40	.02	--	--	-6.85	--	--	1.3
	.40	.02	--	--	--	--	--	--
	<.20	.02	--	-40.5	-6.90	--	--	1.3
	<.20	.01	--	--	--	--	15.5	--
	<.20	.01	--	--	--	--	15.9	--
	[b]--	--	--	--	--	--	--	--
	<.20	.02	--	--	--	--	16.2	--
	<.20	.01	--	--	--	--	16.2	--
	<.20	.01	--	--	--	--	16.3	--
	.30	.01	--	--	--	--	17.4	--
	<.20	.01	--	--	--	--	17.7	--
	[c]<.20	<.01	--	--	--	--	--	--
	<.20	.01	--	--	--	--	18.3	--

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells--Continued

Site number	Date	Specific conductance	pH (standard units)	Water temper-ature	Oxidation-reduction potential	Barometric pressure	Dissolved oxygen	Alkalinity
P1	05-12-92	465	6.6	12.5	309	758	5.9	72
	08-11-92	449	6.4	17.5	335	--	--	--
	11-19-92	395	6.5	15.0	407	--	--	--
	12-17-92	414	6.6	12.0	329	762	5.6	--
	02-11-93	400	6.7	8.0	361	762	6.9	--
	04-29-93	410	6.6	9.5	490	762	8.5	--
	06-23-93	430	6.6	14.5	360	761	6.9	--
	08-17-93	430	6.5	21.5	365	761	6.1	72
P2	05-12-92	618	6.4	12.5	358	758	4.1	64
	08-11-92	607	6.4	18.5	344	--	--	--
	11-19-92	550	5.7	15.0	382	767	3.4	--
	12-17-92	562	6.5	12.0	359	762	5.6	--
	02-11-93	550	6.5	7.5	376	762	6.3	--
	04-29-93	540	6.4	10.0	580	762	4.2	--
	06-23-93	545	6.4	14.5	360	761	3.6	--
	08-17-93	535	6.2	20.0	360	761	3.7	67
P3	05-12-92	407	6.4	12.0	385	758	4.6	55
	08-11-92	244	6.3	17.5	340	--	--	--
	11-19-92	167	6.4	14.0	382	--	4.4	--
	12-17-92	261	6.5	11.0	401	762	5.1	--
	02-11-93	290	6.4	7.0	376	762	--	--
	04-29-93	310	6.3	9.5	505	762	6.0	--
	06-23-93	325	6.3	15.5	350	761	5.3	--
	08-17-93	300	5.9	20.0	195	761	4.7	35
P4	05-12-92	891	6.6	12.0	354	758	1.2	199
	08-11-92	891	6.5	17.5	350	--	--	--
	11-19-92	805	6.7	14.5	362	767	2.7	--
	12-17-92	844	6.7	11.0	370	762	3.9	--
	02-11-93	880	6.4	8.0	371	762	4.9	--
	04-29-93	970	6.7	10.0	495	762	7.4	--
	06-23-93	1,000	6.6	14.0	305	761	5.8	--
	08-17-93	1,080	6.4	19.0	445	761	4.3	147
P5	05-12-92	758	6.4	12.0	348	758	3.6	83
	08-11-92	509	6.3	17.0	315	--	--	--
	11-19-92	435	6.6	14.5	362	767	3.0	--
	12-17-92	410	6.6	10.5	341	762	5.9	--
	02-11-93	400	6.6	6.5	371	762	7.1	--
	04-29-93	360	6.5	9.5	375	762	7.6	--
	06-23-93	400	6.4	14.5	350	761	4.1	--
	08-17-93	350	6.1	18.5	255	761	2.9	58
P6	05-12-92	556	6.9	12.5	359	758	6.1	129
	08-11-92	512	6.7	18.0	309	--	--	--
	11-20-92	490	6.8	12.5	--	767	4.5	--
	12-17-92	508	6.9	11.5	349	762	6.1	--
	02-11-93	505	7.0	8.5	366	762	7.3	--
	04-29-93	510	7.0	9.5	445	762	8.9	--
	06-23-93	505	6.8	14.5	370	761	7.0	--
	08-17-93	520	6.7	18.0	330	761	6.6	109

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells–Continued

Site number	Bicar-bonate	Sulfate	Chloride	Fluoride	Bromide	Nitrite as nitrogen	Nitrate as nitrogen	Ammonia as nitrogen
P1	88	--	--	--	0.11	--	14	--
	--	--	--	--	.11	--	15	--
	--	--	--	--	.12	0.01	13	0.01
	--	--	--	--	.13	.02	13	.01
	--	--	--	--	.13	.02	13	.02
	--	--	--	--	.13	<.01	12	.02
	--	--	--	--	.13	<.01	11	.02
	88	--	--	--	.06	<.01	10	.02
P2	78	--	--	--	.10	--	28	--
	--	--	--	--	.10	--	28	--
	--	--	--	--	.11	.01	28	.03
	--	--	--	--	.12	.01	25	<.01
	--	--	--	--	.12	.02	20	.02
	--	--	--	--	.11	<.01	13	.02
	--	--	--	--	.11	<.01	11	.03
	82	--	--	--	.11	<.01	12	.02
P3	67	--	--	--	.09	--	13	--
	--	--	--	--	.04	--	2.9	--
	--	--	--	--	.37	.02	.79	.06
	--	--	--	--	.08	.02	6.5	.02
	--	--	--	--	.07	.02	6.7	.02
	--	--	--	--	.32	<.01	6.0	.03
	--	--	--	--	.10	<.01	5.0	.02
	43	--	--	--	.15	<.01	3.6	.43
P4	243	--	--	--	.55	--	32	--
	--	--	--	--	.55	--	32	--
	--	--	--	--	.52	.01	21	.03
	--	--	--	--	.69	.01	28	<.01
	--	--	--	--	.61	.02	31	.01
	--	--	--	--	.91	<.01	24	.02
	--	--	--	--	1.3	.14	20	.14
	180	--	--	--	1.5	<.01	18	.05
P5	102	--	--	--	.11	--	12	--
	--	--	--	--	.15	--	11	--
	--	--	--	--	.11	.02	8.5	.04
	--	--	--	--	.14	.01	7.0	.01
	--	--	--	--	.10	.02	4.8	.02
	--	--	--	--	.12	<.01	3.5	.04
	--	--	--	--	.14	.04	4.1	.14
	70	--	--	--	.14	<.01	3.2	.21
P6	157	--	--	--	.11	--	12	--
	--	--	--	--	.10	--	13	--
	--	--	--	--	.13	<.01	11	.01
	--	--	--	--	.14	<.01	12	<.01
	--	--	--	--	.14	.02	13	.02
	--	--	--	--	.13	<.01	12	.04
	--	--	--	--	.14	<.01	14	.03
	133	--	--	--	.13	.01	14	.03

Table 4. Physical properties, selected trace element and nutrient concentrations, and stable isotope values in water samples from wells--Continued

Site number	Ammonia plus organic nitrogen as nitrogen	Orthro-phosphorous, as phosphorous	Tritium	δ deu-terium	$\delta\ ^{18}O$	$\delta\ ^{15}N$ of nitrate	$\delta\ ^{15}N$ of nitrite plus nitrate by exchange resins	Organic carbon, as carbon
P1	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	0.20	0.06	--	--	--	--	--	--
	<.20	.05	--	--	--	--	--	--
	.30	.05	--	--	--	--	--	--
	.30	.04	--	--	--	--	--	--
	.30	.05	--	--	--	--	--	--
	.30	.06	--	--	--	--	9.56	--
P2	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	.40	.05	--	--	--	--	--	--
	--	.04	--	--	--	--	--	--
	.30	.04	--	--	--	--	--	--
	.30	.03	--	--	--	--	--	--
	.30	.04	--	--	--	--	--	--
	.30	.04	--	--	--	--	12.7	--
P3	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	.30	.12	--	--	--	--	--	--
	.30	.06	--	--	--	--	--	--
	.40	.04	--	--	--	--	--	--
	.30	.04	--	--	--	--	--	--
	.30	.05	--	--	--	--	--	--
	.80	.10	--	--	--	--	16.0	--
P4	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	.40	.07	--	--	--	--	--	--
	<.20	.06	--	--	--	--	--	--
	.20	.05	--	--	--	--	--	--
	.30	.05	--	--	--	--	17.0	--
	.40	.07	--	--	--	--	17.6	--
	.60	.09	--	--	--	--	--	--
P5	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	.30	.05	--	--	--	--	--	--
	.20	.04	--	--	--	--	--	--
	.30	.04	--	--	--	--	--	--
	.40	.04	--	--	--	--	--	--
	.40	.07	--	--	--	--	--	--
	.70	.10	--	--	--	--	22.8	--
P6	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	.30	.06	--	--	--	--	--	--
	<.20	.05	--	--	--	--	--	--
	.30	.05	--	--	--	--	--	--
	.40	.04	--	--	--	--	9.57	--
	.30	.05	--	--	--	--	10.1	--
	.30	.05	--	--	--	--	10.2	--

[a] Field spike of 20 milligrams per liter, as nitrogen, potassium nitrate solution with $\delta\ ^{15}N$ of nitrate of +3.49 per mil.

[b] Duplicate sample.

[c] Field equipment blank processed with inorganic free water.

Table 5. Selected trace element and nitrate concentrations, and stable isotope values in water samples from suction lysimeters

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; trace element and nutrient concentrations in milligrams per liter; ISE, analysis by ion-specific electrode; $\delta\ ^{15}N$ in per mil relative to atmospheric standard; <, less than; --, missing value; ( ), computed monthly average value]

Site	Beginning date	Ending date	Depth (feet)	Specific conductance	Bromide (dissolved)	Nitrate as nitrogen (dissolved)	Nitrate as nitrogen (total)	Ammonia as nitrogen (total)	Ammonia plus organic as nitrogen (total)
SL1	[a]01-09-92	01-27-92	1.5	--	0.12	--	43	0.06	0.20
SL2	[a]01-09-92	01-27-92	3.0	--	.11	--	17	.08	.60
	07-29-92	08-10-92	3.0	--	.52	13	--	--	--
SL3	[a]01-09-92	01-27-92	4.0	--	.09	--	24	.05	1.0
	01-19-93	01-25-93	4.0	--	--	27	--	--	--
SL4	[a]01-09-92	01-27-92	1.5	--	.16	--	51	.05	.40
SL5	[a]01-09-92	01-27-92	3.0	--	.22	--	31	.11	.60
	01-19-93	01-25-93	3.0	--	--	52	--	--	--
SL6	[a]01-09-92	01-27-92	4.0	--	--	--	12	.10	--
	07-27-92	08-24-92	4.0	150	.14	10	--	--	--
SL7	[a]01-09-92	01-27-92	1.5	--	.10	--	90	.06	<.20
	01-19-93	01-25-93	1.5	--	--	80	--	--	--
	01-28-93	02-01-93	1.5	--	--	27	--	--	--
SL8	[a]01-09-92	01-27-92	1.5	--	.08	--	44	.05	1.6
	07-20-92	07-27-92	1.5	890	.04	67	--	--	--
	07-27-92	08-03-92	1.5	940	.05	72	--	--	--
	08-03-92	08-10-92	1.5	--	.05	--	--	--	--
	11-09-92	11-13-93	1.5	--	2.1	11	--	--	--
	01-25-93	01-28-93	1.5	--	--	67	--	--	--
	01-28-93	02-01-93	1.5	--	--	39	--	--	--

Table 5. Selected trace element and nitrate concentrations, and stable isotope values in water samples from suction lysimeters–Continued

Site	Beginning date	Ending date	Specific conductance	Bromide (dissolved)	Bromide (ISE, dissolved)	Nitrate as nitrogen (dissolved)	$\delta^{15}N$ of nitrite plus nitrate
Composite of 1.5 feet deep suction lysimeters	01-27-92	02-18-92	--	0.10	--	60	--
	02-18-92	02-26-92	--	.05	--	37	--
	02-26-92	03-02-92	--	.09	--	55	--
	03-02-92	03-09-92	--	.10	--	60	--
	03-09-92	03-16-92	--	.10	--	59	--
	03-16-92	03-23-92	--	.05	--	43	--
	03-23-92	03-30-92	--	.06	--	49	--
	03-30-92	04-06-92	--	.17	--	25	--
	04-06-92	05-04-92	--	(.09)	--	(51)	10.7
	[b]04-06-92	05-04-92	--	--	--	--	10.6
	04-06-92	04-13-92	--	.09	--	49	--
	04-13-92	04-20-92	--	--	--	52	--
	04-20-92	04-27-92	660	.09	--	51	--
	04-27-92	05-04-92	675	.09	--	53	--
	05-04-92	06-01-92	--	(.07)	--	(54)	11.4
	[b]05-04-92	06-01-92	--	--	--	--	11.3
	05-04-92	05-11-92	670	.08	--	52	--
	05-11-92	05-18-92	730	.08	--	55	--
	05-18-92	05-26-92	700	.09	--	54	--
	05-26-92	06-01-92	--	.03	--	53	--
	06-01-92	06-29-92	--	(2.5)	--	(41)	126
	[b]06-01-92	06-29-92	--	--	--	--	126
	06-01-92	06-08-92	--	.03	--	44	--
	06-08-92	06-15-92	--	.05	--	55	--
	06-15-92	06-22-92	730	9.4	--	5.1	--
	06-22-92	06-29-92	--	.37	--	59	--
	06-29-92	07-20-92	--	(.06)	--	(47)	14.02
	06-29-92	07-06-92	--	.06	--	47	--
	07-06-92	07-13-92	690	.08	--	--	--
	07-13-92	07-20-92	935	.04	--	--	--
	11-09-92	11-30-92	--	(22)	--	(23)	717
	11-09-92	11-13-92	232	2.1	--	11	--
	11-13-92	11-23-92	815	31	--	2.6	--
	11-23-92	11-30-92	725	34	--	56	--
	11-30-92	12-29-92	--	(180)	--	(61)	835
	11-30-92	12-07-92	1,190	44	--	100	--
	12-07-92	12-16-92	700	310	--	54	--
	12-16-92	12-21-92	580	200	--	38	--
	12-21-92	12-29-92	685	160	--	51	--
	01-19-93	01-28-93	--	--	--	67	972
	01-28-93	02-08-93	--	(19)	--	(38)	769
	01-28-93	02-01-93	--	--	24	33	--
	02-01-93	02-08-93	470	19	--	42	--
	03-01-93	03-30-93	--	(27)	--	(37)	760
	03-01-93	03-08-93	680	31	--	49	--

Table 5. Selected trace element and nitrate concentrations, and stable isotope values in water samples from suction lysimeters–Continued

Site	Beginning date	Ending date	Specific conductance	Bromide (dissolved)	Bromide (ISE, dissolved)	Nitrate as nitrogen (dissolved)	$\delta^{15}N$ of nitrite plus nitrate
Composite of 1.5 feet deep suction lysimeters--Continued	03-08-93	03-16-93	540	21	--	21	--
	03-16-93	03-22-93	580	28	--	41	--
	03-22-93	03-30-93	550	27	--	37	--
	03-30-93	04-27-93	--	(23)	--	(25)	730
	03-30-93	04-05-93	500	22	--	1.3	--
	04-05-93	04-12-93	530	21	--	31	--
	04-12-93	04-20-93	530	24	--	34	--
	04-20-93	04-27-93	545	25	--	34	--
	04-27-93	06-02-93	--	(23)	--	(44)	570
	04-27-93	05-03-93	540	25	--	36	--
	05-03-93	05-10-93	535	22	--	30	--
	05-10-93	05-17-93	575	22	--	41	--
	05-17-93	06-02-93	--	24	--	70	--
	06-02-93	06-30-93	--	(24)	--	(55)	436
	06-02-93	06-07-93	740	22	--	61	--
	06-07-93	06-14-93	710	24	--	60	--
	[c]06-07-93	--	--	--	--	<.05	--
	06-14-93	06-21-93	730	24	--	56	--
	06-21-93	06-30-93	550	25	--	43	--
	06-30-93	08-02-93	--	(20)	--	(52)	376
	06-30-93	07-08-93	580	21	--	48	--
	07-08-93	07-12-93	820	21	--	66	--
	07-12-93	07-19-93	660	16	--	50	--
	07-19-93	07-26-93	670	20	--	47	--
	07-26-93	08-30-93	--	(10)	--	(24)	469
	07-26-93	08-02-93	650	21	--	46	--
	08-02-93	08-10-93	505	<.01	--	31	--
	08-10-93	08-18-93	330	9.6	--	12	--
	08-18-93	08-30-93	270	--	--	6.7	--
	08-30-94	10-04-93	--	(5.1)	--	(3.7)	--
	08-30-93	09-07-93	260	7.0	--	6.4	--
	09-07-93	09-15-93	265	7.6	--	1.4	--
	09-15-93	09-20-93	260	.23	--	1.2	--
	09-20-93	10-04-93	310	5.4	--	5.9	--

Table 5. Selected trace element and nitrate concentrations, and stable isotope values in water samples from suction lysimeters–Continued

Site	Beginning date	Ending date	Specific conductance	Bromide (dissolved)	Bromide (ISE, dissolved)	Nitrate as nitrogen (dissolved)	$\delta^{15}N$ of nitrite plus nitrate
Composite of 3 feet deep suction lysimeters	01-27-92	02-18-92	--	0.15	--	24	9.97
	02-26-92	03-02-92	--	.16	--	24	--
	03-09-92	03-23-92	--	.18	--	25	--
	03-23-92	04-06-92	--	.06	--	40	--
	04-06-92	05-04-92	--	(.17)	--	(27)	10.2
	04-06-92	04-20-92	--	.13	--	27	--
	04-20-92	05-04-92	--	.17	--	27	--
	05-04-92	06-01-92	--	(.17)	--	(28)	10.6
	05-04-92	05-18-92	--	--	--	28	--
	05-18-92	06-01-92	--	.17	--	27	--
	06-01-92	06-29-92	--	(.17)	--	(28)	11.3
	06-01-92	06-15-92	--	.17	--	28	--
	06-15-92	06-29-92	665	.17	--	29	--
	06-29-92	07-27-92	--	(.18)	--	(24)	11.4
	06-29-92	07-13-92	630	.17	--	27	--
	07-13-92	07-27-92	580	.19	--	21	--
	11-13-92	11-23-92	820	28	--	53	649
	11-30-92	12-16-92	--	(90)	--	(55)	613
	11-30-92	12-07-92	825	29	--	56	--
	12-07-92	12-16-92	820	150	--	54	--
	01-19-93	01-25-93	--	--	--	52	450
	01-25-93	02-22-93	845	(18)	--	(60)	504
	01-25-93	02-08-93	--	--	19	59	--
	02-08-93	02-22-93	--	--	17	62	--
	02-22-93	03-30-93	--	(16)	--	(60)	430
	02-22-93	03-08-93	--	--	13	58	--
	03-08-93	03-22-93	845	28	--	61	--
	03-22-93	03-30-93	830	--	8.0	60	--
	03-30-93	04-27-93	--	(24)	--	(46)	572
	03-30-93	04-12-93	824	28	--	57	--
	04-12-93	04-27-93	660	20	--	35	--
	04-27-93	06-02-93	--	(8)	--	(55)	561
	04-27-93	05-10-93	--	--	8.1	57	--
	05-10-93	06-02-93	775	--	8.0	56	--
	06-02-93	06-30-93	--	(19)	--	(53)	372
	06-02-93	06-14-93	770	--	14	53	--
	06-14-93	06-30-93	735	24	--	53	--
	06-30-93	07-26-93	--	(24)	--	(58)	347
	06-30-93	07-12-93	--	--	--	58	--
	07-12-93	07-26-93	855	25	--	59	--
	07-26-93	08-30-93	--	(25)	--	(23)	483
	08-10-93	08-30-93	670	12	--	23	--
	08-30-93	09-27-93	570	22	--	--	--

Table 5. Selected trace element and nitrate concentrations, and stable isotope values in water samples from suction lysimeters–Continued

Site	Beginning date	Ending date	Specific conductance	Bromide (dissolved)	Bromide (ISE, dissolved)	Nitrate as nitrogen (dissolved)	$\delta^{15}N$ of nitrite plus nitrate
Composite of 4 feet deep	03-16-92	04-06-92	--	0.09	--	17	--
suction lysimeters	04-06-92	05-04-92	--	.08	--	19	8.01
	05-04-92	06-01-92	--	.09	--	19	--
	06-01-92	06-29-92	620	--	--	18	10.3
	06-29-92	07-27-92	600	.10	--	17	11.6
	11-13-92	11-23-92	740	22	--	33	--
	11-23-92	12-21-92	685	76	--	28	516
	01-28-93	02-22-93	--	--	7.8	20	380
	02-22-93	03-30-93	700	--	7.6	33	569
	03-30-93	04-27-93	755	12	--	24	384
	04-27-93	06-02-93	710	13	--	26	572
	06-02-93	06-30-93	660	13	--	23	363
	06-30-93	07-26-93	705	13	--	23	357
	07-26-93	08-30-93	680	23	--	50	538
	08-30-93	09-27-93	640	14	--	20	--

[a] Sample analyzed for dissolved nitrite, as nitrogen, and orthophosphorous, as phosphorous at less than 0.01 milligram per liter.
[b] Duplicate sample.
[c] Equipment blank processed with inorganic free water.

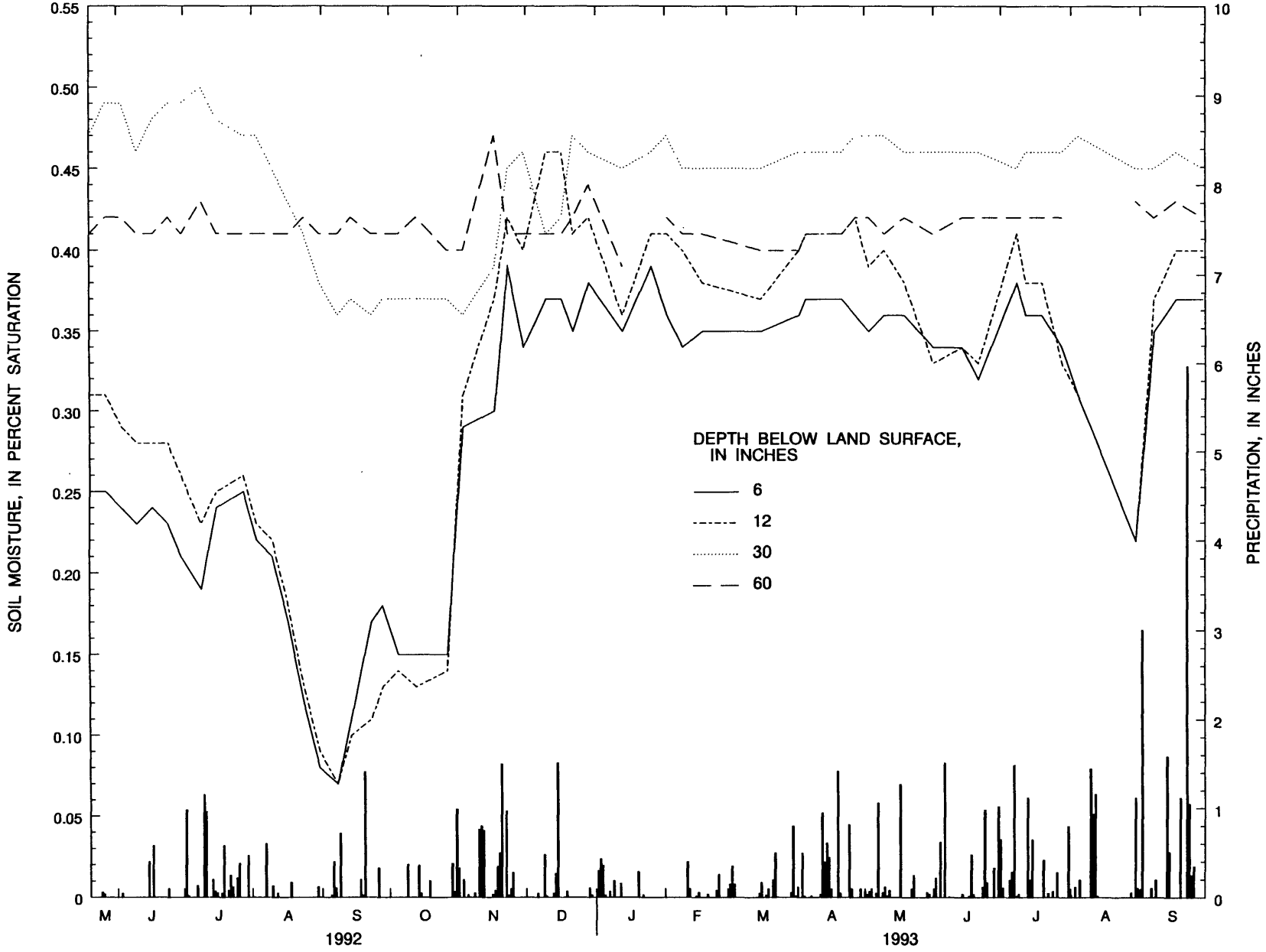

Figure 32. Soil moisture in neutron tube N1, May 1992 to September 1993.

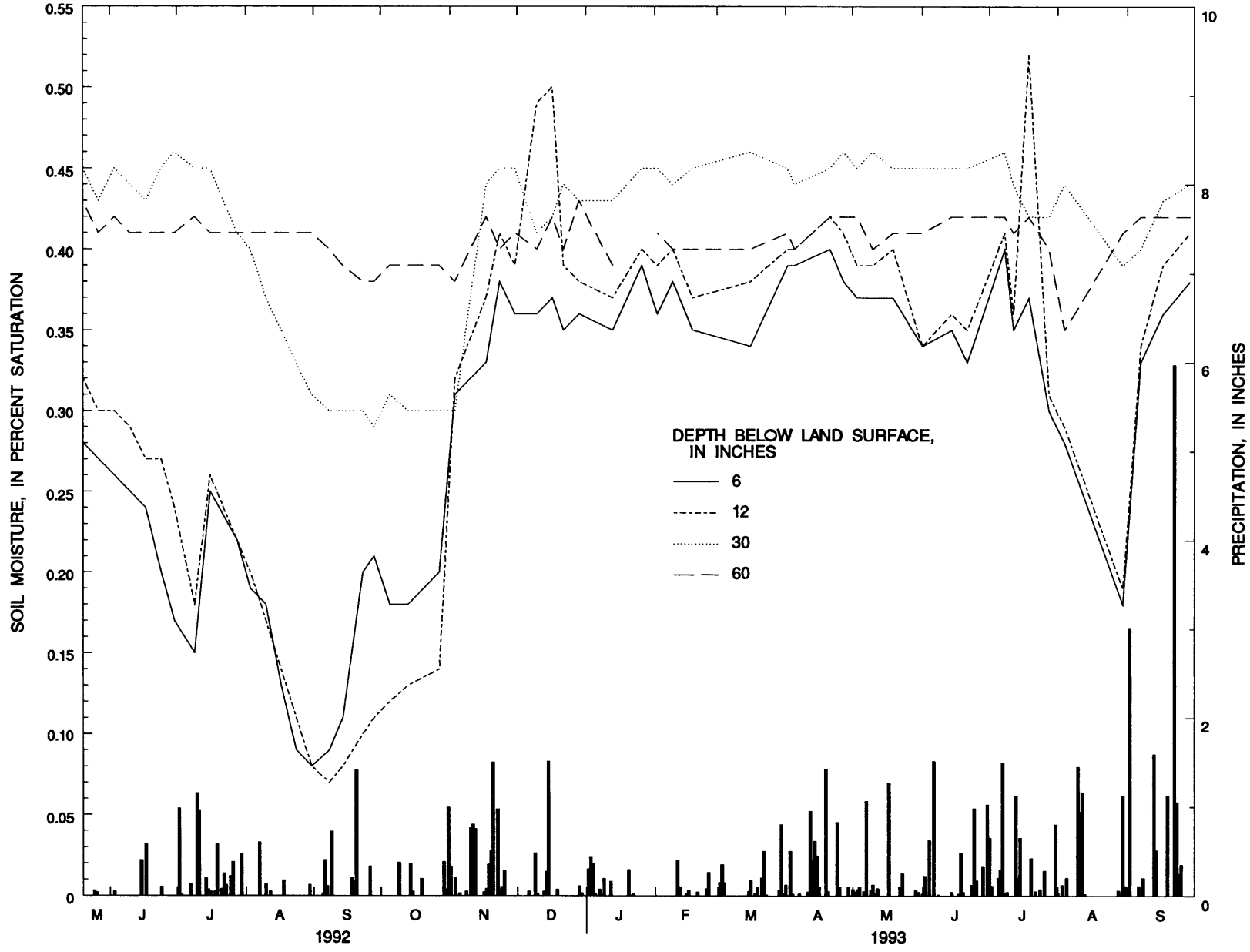

Figure 33. Soil moisture in neutron tube N2, May 1992 to September 1993.

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; bromide and nutrient concentrations in milligrams per liter, dissolved; $\delta^{15}N$ values in per mil relative to atmospheric nitrogen; --, missing value; <, less than; ISE, analysis by ion-specific electrode; (), computed monthly average value]

Site	Beginning date	Ending date	Specific conductance	Bromide	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
GL1	12-12-91	12-12-91	210	--	0.02	9.6	0.06	--	0.03	--
	12-23-91	12-23-91	505	--	<.01	29	.03	0.50	<.01	9.98
	12-23-91	12-30-91	810	--	<.01	59	.01	1.0	<.01	--
	12-30-91	01-03-92	--	--	--	--	--	--	--	--
	07-03-92	07-08-92	1,160	0.03	--	--	--	--	--	--
	11-20-92	11-20-92	530	42	--	28	--	--	--	814
	11-20-92	11-20-92	560	44	--	33	--	--	--	--
	11-20-92	11-20-92	520	48	--	34	--	--	--	--
	11-20-92	11-21-92	580	47	--	39	--	--	--	--
	11-21-92	11-22-92	510	45	--	38	--	--	--	--
	11-22-92	11-23-92	460	33	--	28	--	--	--	--
	11-23-92	11-24-92	540	41	--	35	--	--	--	--
	11-24-92	11-25-92	680	83	--	36	--	--	--	1,145
	12-11-92	12-11-92	545	22	--	31	--	--	--	1,054
	12-11-92	12-16-92	415	15	--	21	--	--	--	--
	12-16-92	12-18-92	430	240	--	22	--	--	--	--
	12-29-92	01-04-92	200	.02	--	6.9	--	--	--	--
	01-04-93	01-06-93	395	190	--	21	--	--	--	--

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
GL2	12-27-91	12-30-91	865	--	<0.01	62	0.01	1.0	0.01	--
	12-30-91	01-03-92	815	--	--	--	--	--	--	--
	11-20-92	11-20-92	540	31	--	40	--	--	--	401
	11-20-92	11-20-92	540	42	--	41	--	--	--	878
	11-20-92	11-20-92	560	45	--	42	--	--	--	--
	11-20-92	11-20-92	580	29	--	48	--	--	--	--
	11-20-92	11-21-92	550	320	--	47	--	--	--	878
	11-21-92	11-22-92	580	58	--	52	--	--	--	--
	11-22-92	11-23-92	495	47	--	47	--	--	--	--
	11-23-92	11-24-92	620	.49	--	41	--	--	--	--
	11-24-92	11-25-92	850	29	--	44	--	--	--	--
	11-25-92	11-30-92	800	35	--	42	--	--	--	--
	11-30-92	12-01-92	825	49	--	43	--	--	--	--
	12-01-92	12-03-92	690	41	--	43	--	--	--	--
	12-03-92	12-04-92	690	40	--	41	--	--	--	--
	12-04-92	12-07-92	685	30	--	42	--	--	--	--
	12-29-92	12-29-92	660	300	--	41	--	--	--	--
	12-29-92	01-04-93	670	420	--	34	--	--	--	--
	01-04-93	01-06-93	670	420	--	34	--	--	--	--
	01-06-93	01-08-93	650	370	--	41	--	--	--	--
	01-08-93	01-11-93	640	260	--	38	--	--	--	--
	01-11-93	01-15-93	--	--	--	36	--	--	--	--
	01-15-93	01-19-93	--	--	--	40	--	--	--	--

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
GL3	03-25-92	03-27-92	690	0.10	0.02	49	0.03	1.1	0.03	--
	03-30-92	04-02-92	660	.12	<.01	<.05	.01	1.6	<.01	9.92
	07-03-92	07-06-92	1,160	<.01	--	11	--	--	--	--
	11-23-92	11-23-92	480	14	--	50	--	--	--	297
	11-23-92	11-24-92	675	20	--	53	--	--	--	317
	11-24-92	11-25-92	860	19	--	57	--	--	--	--
	11-25-92	11-30-92	860	26	--	55	--	--	--	--
	11-30-92	12-01-92	650	29	--	--	--	--	--	--
	12-16-92	12-16-92	580	32	--	42	--	--	--	--
	12-16-92	12-18-92	660	180	--	45	--	--	--	--
	12-18-92	12-21-92	680	210	--	37	--	--	--	--
	12-21-92	12-29-92	670	280	--	46	--	--	--	--
	01-29-93	01-04-92	625	220	--	37	--	--	--	--
	01-04-93	01-06-92	630	250	--	40	--	--	--	--
	01-06-93	01-08-92	615	290	--	--	--	--	--	--
GL4	12-11-91	12-12-91	430	--	.04	18	.34	--	.07	--
	12-16-91	12-23-91	595	--	.01	35	.05	.50	.01	10.3
	12-23-91	12-27-91	650	--	.01	40	.04	.50	<.01	--
	07-03-92	07-08-92	160	<.01	--	6.7	--	--	--	--
	11-16-92	11-16-92	85	3.2	--	2.7	--	--	--	--
	11-20-92	11-20-92	505	41	--	38	--	--	--	1,071
	11-20-92	11-20-92	545	44	--	33	--	--	--	1,041
	11-20-92	11-20-92	570	20	--	40	--	--	--	--
	11-20-92	11-21-92	860	30	--	78	--	--	--	--
	11-21-92	11-22-92	450	38	--	30	--	--	--	--
	11-22-92	11-23-92	400	40	--	33	--	--	--	--
	11-23-92	11-24-92	625	43	--	40	--	--	--	--
	11-24-92	11-25-92	620	20	--	34	--	--	--	--
	11-25-92	11-30-92	700	37	--	34	--	--	--	--
	12-11-92	12-11-92	535	30	--	28	--	--	--	780
	12-16-92	12-18-92	560	150	--	34	--	--	--	--
	12-29-92	01-04-93	330	130	--	16	--	--	--	--
	01-04-93	01-06-93	395	180	--	--	--	--	--	--

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
GL5	11-04-91	11-04-91	780	0.03	<0.01	62	0.02	0.90	0.02	10.1
	11-18-91	11-18-91	540	<.01	<.01	45	.04	.70	.02	--
	11-18-91	11-19-91	495	--	<.01	40	.03	.60	.01	--
	11-19-91	11-21-91	520	.04	<.01	44	<.01	.60	<.01	--
	12-04-91	12-04-91	525	.07	<.01	37	.06	1.0	<.01	--
	12-04-91	12-05-91	--	--	--	--	--	--	--	--
	12-09-91	12-12-91	655	.10	<.01	47	.01	.70	.01	--
	12-12-91	12-12-91	825	.14	<.01	65	.01	.80	.01	--
	12-12-91	12-13-91	840	.16	<.01	68	<.01	.60	.01	--
	12-13-91	12-16-91	--	--	.01	71	.03	.70	.01	--
	12-18-91	12-20-91	825	--	<.01	58	.04	.60	<.01	10.2
	12-20-91	12-23-91	750	--	<.01	55	.04	.50	<.01	--
	12-23-91	12-27-91	910	--	<.01	56	.02	.60	<.01	--
	12-27-91	01-03-92	885	--	--	--	--	--	--	--
	01-27-92	01-27-92	--	.18	--	57	--	--	--	--
	11-12-92	11-12-92	430	11	--	46	--	--	--	--
	11-12-92	11-13-92	465	16	--	32	--	--	--	466
	[a]11-12-92	11-13-92	--	--	--	--	--	--	--	466
	11-12-92	11-12-92	455	19	--	16	--	--	--	--
	11-12-92	11-12-92	450	17	--	38	--	--	--	--
	11-12-92	11-12-92	500	22	--	15	--	--	--	--
	11-12-92	11-13-92	530	26	--	35	--	--	--	--
	11-13-92	11-13-92	480	22	--	31	--	--	--	--
	11-13-92	11-16-92	480	15	--	29	--	--	--	--
	11-16-92	11-17-92	510	15	--	31	--	--	--	--
	11-19-92	11-19-92	500	20	--	31	--	--	--	411
	11-19-92	11-20-92	620	24	--	41	--	--	--	--
	11-20-92	11-20-92	610	30	--	47	--	--	--	--
	11-20-92	11-20-92	690	31	--	46	--	--	--	--
	11-20-92	11-20-92	675	34	--	46	--	--	--	--
	11-20-92	11-20-92	730	26	--	51	--	--	--	--
	11-20-92	11-21-92	750	49	--	50	--	--	--	--
	11-21-92	11-21-92	770	35	--	53	--	--	--	--
	11-21-92	11-22-92	755	49	--	52	--	--	--	977
	11-22-92	11-23-92	465	38	--	41	--	--	--	--

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
GL5--	11-24-92	11-24-92	520	43	--	41	--	--	--	--
Continued	11-25-92	11-25-92	750	41	--	42	--	--	--	--
	11-25-92	11-25-92	750	45	--	43	--	--	--	--
	11-30-92	11-30-92	590	46	--	45	--	--	--	--
	12-01-92	12-01-92	800	33	--	44	--	--	--	--
	12-03-92	12-03-92	655	17	--	44	--	--	--	--
	12-04-92	12-04-92	695	37	--	45	--	--	--	--
	12-07-92	12-07-92	710	29	--	46	--	--	--	--
	12-08-92	12-08-92	720	31	--	49	--	--	--	--
	12-09-92	12-09-92	730	29	--	49	--	--	--	--
	12-11-92	12-11-92	800	33	--	49	--	--	--	883
	12-18-92	12-18-92	580	130	--	35	--	--	--	--
	12-21-92	12-21-92	590	170	--	36	--	--	--	--
	12-23-92	12-23-92	590	230	--	37	--	--	--	--
	12-29-92	12-29-92	615	260	--	39	--	--	--	--
	01-04-93	01-04-93	520	240	--	30	--	--	--	--
	01-06-93	01-06-93	450	150	--	26	--	--	--	--
	01-08-93	01-08-93	515	160	--	30	--	--	--	--
	01-11-93	01-11-93	532	190	--	31	--	--	--	--
	01-15-93	01-15-93	550	--	--	35	--	--	--	--
	01-19-93	01-19-93	600	--	--	31	--	--	--	--

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
GL7	07-03-92	07-08-92	465	0.06	--	--	--	--	--	--
	11-20-92	11-20-92	630	37	--	50	--	--	--	935
	11-20-92	11-20-92	650	46	--	52	--	--	--	932
	11-20-92	11-21-92	650	.01	--	51	--	--	--	--
	11-21-92	11-21-92	545	38	--	41	--	--	--	--
	11-21-92	11-22-92	420	26	--	33	--	--	--	--
	11-22-92	11-23-92	595	34	--	43	--	--	--	--
	11-23-92	11-24-92	540	23	--	33	--	--	--	--
	11-24-92	11-25-92	680	21	--	36	--	--	--	--
	12-11-92	12-16-92	470	15	--	29	--	--	--	--
	12-16-92	12-18-92	485	120	--	28	--	--	--	--
	12-18-92	12-21-92	500	210	--	30	--	--	--	--
	12-21-92	12-23-92	510	170	--	31	--	--	--	--
	12-29-92	01-04-93	390	95	--	21	--	--	--	--
	01-04-93	01-06-93	430	150	--	23	--	--	--	--
	01-06-93	01-08-93	480	200	--	27	--	--	--	--

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
GL8	01-08-92	01-09-92	--	--	<0.01	55	0.03	3.8	<0.01	--
	03-27-92	03-27-92	450	0.05	.05	35	.02	.60	<.01	--
	11-20-92	11-20-92	655	39	--	48	--	--	--	627
	11-20-92	11-20-92	750	36	--	50	--	--	--	--
	11-20-92	11-20-92	720	18	--	54	--	--	--	--
	11-20-92	11-20-92	780	42	--	57	--	--	--	--
	11-20-92	11-20-92	740	33	--	59	--	--	--	--
	11-20-92	11-21-92	750	24	--	60	--	--	--	--
	11-21-92	11-21-92	460	18	--	34	--	--	--	--
	11-21-92	11-22-92	475	17	--	34	--	--	--	--
	11-22-92	11-23-92	365	17	--	39	--	--	--	--
	11-23-92	11-24-92	450	.14	--	28	--	--	--	--
	11-24-92	11-25-92	575	16	--	30	--	--	--	--
	11-25-92	11-30-92	580	13	--	31	--	--	--	--
	12-30-92	12-01-92	675	27	--	37	--	--	--	--
	12-01-92	12-03-92	560	29	--	38	--	--	--	--
	12-03-92	12-04-92	570	32	--	42	--	--	--	--
	12-04-92	12-07-92	605	<.01	--	41	--	--	--	--
	12-07-92	12-11-92	670	<.01	--	44	--	--	--	938
	12-11-92	12-16-92	510	18	--	29	--	--	--	--
	12-16-92	12-18-92	500	43	--	30	--	--	--	--
	12-18-92	12-21-92	475	40	--	28	--	--	--	--
	12-21-92	12-23-92	510	210	--	31	--	--	--	--
	12-23-92	12-29-92	530	240	--	32	--	--	--	--
	12-29-93	01-04-93	460	150	--	25	--	--	--	--
	01-04-93	01-06-93	445	140	--	27	--	--	--	--
	01-06-93	01-08-93	455	170	--	26	--	--	--	--
	01-08-93	01-11-93	500	120	--	30	--	--	--	--
	01-11-93	01-13-93	525	180	--	32	--	--	--	--
	01-13-93	01-15-93	540	--	--	33	--	--	--	--
	01-15-93	01-19-93	225	--	--	33	--	--	--	--

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Bromide by ISE	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
Composite of	02-17-92	02-20-92	530	0.06	--	<0.01	41	--	--	--	10.4
1.5 feet deep	[a]02-17-92	02-20-92	--	--	--	--	--	--	--	--	10.4
gravity lysimeters	03-30-92	04-02-92	410	.04	--	<.01	29	--	--	--	10.5
	07-08-92	07-08-92	240	.02	--	--	15	--	--	--	11.1
	12-16-92	12-23-92	490	(108)	--	--	(27)	--	--	--	881
	01-04-93	01-08-93	370	34	--	--	(19)	--	--	--	859
	01-22-93	01-27-93	375	--	24	--	21	--	--	--	843
	01-27-93	02-03-93	410	--	28	--	24	--	--	--	918
	02-03-93	02-10-93	465	--	35	--	27	--	--	--	934
	02-10-93	02-17-93	--	--	14	--	23	--	--	--	857
	02-17-93	02-24-93	415	--	27	--	24	--	--	--	743
	02-24-93	03-03-93	240	--	12	--	11	--	--	--	684
	03-03-93	03-10-93	315	--	18	--	17	--	--	--	760
	03-10-93	03-17-93	360	--	19	--	19	--	--	--	726
	03-17-93	03-30-93	360	15	--	--	18	--	--	--	701
	03-30-93	04-07-93	330	13	--	--	.65	--	--	--	630
	04-07-93	04-20-93	300	9.2	--	--	14	--	--	--	561
	04-20-93	04-28-93	290	8.6	--	--	13	--	--	--	558
	04-28-93	05-10-93	250	7.1	--	--	23	--	--	--	464
	05-10-93	05-11-93	270	8.0	--	--	13	--	--	--	535
	05-11-93	05-19-93	380	11	--	--	23	--	--	--	373
	05-19-93	06-07-93	370	9.2	--	--	28	--	--	--	265
	07-02-93	07-09-93	310	4.4	--	--	19	--	--	--	228
	07-09-93	07-19-93	280	3.3	--	--	7.0	--	--	--	287
	08-02-93	08-17-93	80	.70	--	--	.64	--	--	--	61.0
	09-03-93	09-15-93	215	3.2	--	--	1.0	--	--	--	118
	09-15-93	10-01-93	245	4.0	--	--	2.40	--	--	--	48.6

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Bromide by ISE	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
Composite of	02-17-92	02-20-92	620	0.09	--	<0.01	51	--	--	--	10.4
2.3 feet deep	[a]02-17-92	02-20-92	620	.09	--	<.01	51	--	--	--	10.2
gravity lysimeters	03-30-92	04-02-92	665	.10	--	<.01	49	--	--	--	--
	07-03-92	07-03-92	710	.08	--	.08	50	--	--	--	11.8
	12-16-92	12-29-92	570	(160)	--	--	(34)	--	--	--	665
	01-04-93	01-13-93	540	150	--	--	(36)	--	--	--	878
	01-22-93	01-27-93	560	--	45	--	33	--	--	--	848
	01-27-93	02-03-93	500	--	37	--	29	--	--	--	860
	02-03-93	02-10-93	510	--	39	--	28	--	--	--	900
	02-10-93	02-17-93	410	--	36	--	30	--	--	--	799
	02-17-93	02-24-93	495	--	34	--	30	--	--	--	863
	02-24-93	03-03-93	505	--	34	--	31	--	--	--	798
	03-03-93	03-10-93	345	--	22	--	20	--	--	--	825
	03-10-93	03-17-93	440	--	26	--	25	--	--	--	752
	03-17-93	03-30-93	460	25	--	--	26	--	--	--	774
	03-30-93	04-07-93	420	17	--	--	.92	--	--	--	769
	04-07-93	04-20-93	410	15	--	--	23	--	--	--	769
	04-20-93	04-28-93	385	30	--	--	19	--	--	--	717
	04-28-93	05-10-93	415	33	--	--	11	--	--	--	738
	05-10-93	05-17-93	410	17	--	--	23	--	--	--	706
	05-17-93	06-02-93	425	35	--	--	24	--	--	--	631
	06-02-93	06-14-93	425	29	--	--	24	--	--	--	532
	07-02-93	07-12-93	345	12	--	--	22	--	--	--	496
	07-12-93	07-26-93	340	10	--	--	12	--	--	--	564
	07-26-93	08-17-93	230	2.5	--	--	2.9	--	--	--	128
	09-03-93	09-15-93	210	3.5	--	--	1.7	--	--	--	118
	09-15-93	10-04-93	260	4.6	--	--	2.6	--	--	--	106

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Bromide by ISE	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
Composite of	03-30-92	04-02-92	665	0.12	--	<0.01	<0.05	0.01	1.6	<0.01	9.92
3.8 feet deep	12-11-92	12-29-92	(650)	(145)	--	--	(42)	--	--	--	722
gravity lysimeters	12-29-93	01-08-93	(625)	(255)	--	--	(38)	--	--	--	744
	01-23-93	01-27-93	570	--	40	--	37	--	--	--	--
	01-27-93	02-01-93	575	--	42	--	36	--	--	--	587
	03-05-93	03-10-93	575	--	25	--	27	--	--	--	548
	03-10-93	03-17-93	610	--	30	--	26	--	--	--	752
	03-17-93	03-30-93	490	10	--	--	27	--	--	--	733
	03-30-93	04-07-93	420	4.0	--	--	.92	--	--	--	167
	04-07-93	04-20-93	420	4.1	--	--	19	--	--	--	152
	04-20-93	04-28-93	430	4.4	--	--	22	--	--	--	140
	04-28-93	05-10-93	460	4.8	--	--	25	--	--	--	157
	05-10-93	05-17-93	465	5.4	--	--	24	--	--	--	176
	05-17-93	06-02-93	455	--	5.4	--	24	--	--	--	185
	06-02-93	06-16-93	450	--	5.4	--	22	--	--	--	172
	06-16-93	06-23-93	470	--	--	--	21	--	--	--	164
	06-23-93	07-12-93	420	4.9	--	--	16	--	--	--	179
	07-12-93	07-26-93	400	4.1	--	--	5.4	--	--	--	146
	07-26-93	08-17-93	430	4.5	--	--	15	--	--	--	154
	09-03-93	09-15-93	290	2.5	--	--	3.1	--	--	--	59.5
	09-15-93	10-04-93	290	2.0	--	--	4.2	--	--	--	62.4

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Bromide by ISE	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
Interflow	11-19-91	11-19-91	1,030	0.11	--	<0.01	89	0.02	1.4	<0.01	--
	12-02-91	12-05-91	700	.07	--	.04	41	.03	1.0	<.01	--
	12-05-91	12-11-91	1,145	.10	--	.10	98	.13	.50	.01	
	12-11-91	12-12-91	515	.04	--	.09	32	.10	1.0	.02	--
	12-12-91	12-12-91	735	--	--	.14	52	.02	--	.02	--
	12-12-91	12-13-91	865	.12	--	.17	60	.02	.70	.02	--
	12-13-91	12-16-91	985	--	--	.47	71	.03	.80	.01	--
	12-16-91	12-23-91	895	--	--	.07	78	.06	.70	.01	9.26
	[a]12-16-91	12-23-91	--	--	--	--	--	--	--	--	9.24
	12-27-91	12-30-91	1,042	--	--	.15	88	.28	.90	<.01	--
	02-17-92	02-20-92	710	.06	--	.05	54	.06	.70	.01	9.35
	[a]02-17-92	02-20-92	--	--	--	--	--	--	--	--	9.42
	03-30-92	04-02-92	580	.04	--	<.01	32	<.01	.60	<.01	10.4
	[a]03-30-92	04-02-92	--	--	--	--	--	--	--	--	10.4
	07-19-92	07-20-92	1,410	.25	--	.03	120	.05	1.4	.28	11.2
	[a]07-19-92	07-20-92	--	--	--	--	--	--	--	--	11.2
	09-28-92	09-28-93	480	--	--	.26	30	.03	1.1	.03	15.3
	[a]09-28-92	09-28-93	--	--	--	--	--	--	--	--	15.3
	11-12-92	11-12-92	165	3.5	--	--	6.8	--	--	--	--
	11-12-92	11-13-92	165	2.2	--	--	7.7	--	--	--	--
	11-12-92	11-12-92	620	2.5	--	--	25	--	--	--	--
	11-12-92	11-13-92	455	2.6	--	--	42	--	--	--	--
	11-20-92	11-22-92	520	51	--	--	36	--	--	--	259
	11-22-92	11-23-92	450	50	--	--	35	--	--	--	--
	11-23-92	11-24-92	600	28	--	--	33	--	--	--	--
	11-24-92	11-25-92	690	12	--	--	34	--	--	--	--
	11-25-92	11-30-92	650	21	--	--	30	--	--	--	--
	11-30-92	12-04-92	615	16	--	--	33	--	--	--	316
	12-11-92	12-16-92	625	10	--	--	36	--	--	--	--
	12-16-92	12-23-92	620	--	--	--	(31)	--	--	--	258

Table 6. Specific conductance, bromide and nutrient concentrations, and nitrogen isotope values in water samples from gravity lysimeters and interflow collector—Continued

Site	Beginning date	Ending date	Specific conductance	Bromide	Bromide by ISE	Nitrite, as nitrogen	Nitrite plus nitrate, as nitrogen	Ammonia, as nitrogen	Organic nitrogen, as nitrogen	Ortho-phosporous as phosphorous	$\delta^{15}N$ nitrite plus nitrate
Interflow--	12-16-92	12-18-92	620	120	--	--	31	--	--	--	--
Continued	12-18-92	12-21-92	605	140	--	--	29	--	--	--	--
	12-21-92	12-23-92	635	120	--	--	33	--	--	--	--
	01-03-93	01-04-93	500	33	--	--	25	--	--	--	174
	01-25-93	01-27-93	435	--	15	--	19	--	--	--	346
	01-27-93	02-03-93	410	--	14	--	16	--	--	--	391
	02-03-93	02-10-93	480	--	20	--	19	--	--	--	486
	02-10-93	02-15-93	565	--	16	--	30	--	--	--	256
	02-15-93	02-24-93	470	--	20	--	19	--	--	--	309
	02-24-93	03-03-93	365	--	10	--	17	--	--	--	341
	03-03-93	03-10-93	375	--	7.0	--	19	--	--	--	189
	03-10-93	03-12-93	460	--	8.8	--	23	--	--	--	175
	03-12-93	03-30-93	505	--	6.2	--	25	--	--	--	193
	03-30-93	04-07-93	450	--	5.8	--	.67	--	--	--	239
	04-07-93	04-20-93	460	--	5.2	--	16	--	--	--	230
	04-20-93	04-27-93	--	--	5.4	--	13	--	--	--	250
	04-27-93	05-10-93	400	--	5.3	--	4.2	--	--	--	262
	05-10-93	06-07-93	360	--	2.5	--	7.5	--	--	--	100
	06-07-93	06-21-93	--	--	2.8	--	3.5	--	--	--	73.7
	06-21-93	07-12-93	375	2.3	--	--	9.1	--	--	--	97.0
	07-12-93	07-19-93	350	2.4	--	--	16	--	--	--	131
	09-03-93	09-15-93	360	1.4	--	--	5.4	--	--	--	43.6
	09-15-93	10-01-93	380	2.2	--	--	4.0	--	--	--	60.0

[a] Duplicate samples.

Table 7. Nutrient concentrations, nitrogen isotope values, and particle-size analyses of soils

[mg/kg, milligrams per kilogram; $\delta^{15}N$ results from U.S. Geological Survey Stable Isotope Laboratory, Menlo Park, California; nutrient results from Kansas State University Soil Testing Laboratory, Manhattan, Kansas; particle size results from Alpha-Omega Geotech, Kansas City, Kansas; mm, millimeter; ( ), duplicate analyses; --, missing value]

Site	Depth interval, in inches	Ammonia, as nitrogen, in mg/kg	Nitrate, as nitrogen, in mg/kg	$\delta^{15}N$ per mil	Particle size less than 0.062 mm, in percent
SL3	0- 7	8.4 (10.0)	9.5 (9.5)	7.7	96.0
SL3	7-20	11.0	26.1	7.5	92.3
SL3	20-33	12.0	7.4	6.4	98.8
SL3	33-46	8.1	2.6	3.8 (4.0)	96.7
SL6	0- 8	9.5 (11.2)	4.1 (4.1)	8.7	95.7
SL6	8-18	11.8	26.6	7.9	92.1
SL6	18-33	9.0	4.0	5.5	98.4
SL6	33-48	9.5	1.5	3.9	97.0
N1	0-18	5.1 (5.0)	13.9	--	--
N1	18-36	7.0	6.0	--	--
W0	0- 7	4.5 (4.0)	16.8 (13.5)	+8.54	--
W0	7-17	3.2 (4.7)	25.5 (27.0)	+8.28	--
W0	17-31	7.1	19.0	+6.36	--
W0	31-48	3.6	4.1	+6.95	--
E0	0-11	3.5 (3.5)	6.0 (5.5)	+9.13	--
E0	11-17	3.1 (2.5)	62.8 (53.2)	+6.25	--
E0	17-33	5.4	27.5	+4.91	--
E0	33-48	3.9	2.6	+4.15	--

Table 8. Yields, moisture content, bromide, nitrogen, and nitrogen isotope values in grain and stover

[mg/kg, milligrams per kilogram; δ^{15} N, ratio of ^{15}N to ^{14}N, relative to atmospheric nitrogen; <, less than; --, no data available; ( ), duplicate analyses]

Year	Grain yield (in bushels per acre)	Moisture content of grain (percent)	Bromide, in grain (mg/kg)	Nitrogen, in grain (percent)	δ^{15} N, in grain (duplicate analysis)	Grain/stover ratio (by weight)	Bromide, in stover (mg/kg)	Nitrogen, in stover (percent)	δ^{15} N, in stover (duplicate analysis)
1991	120	19.0	<0.20 (<0.20)	1.70	--	0.75	--	1.34	--
1992	150	17.9	50 (50)	1.23	+648	1.13	5,530	.95	+670
1993	118	18.0	80	1.30	+188 (+182)	1.10	1,970 (2,010)	.76	+141 (139)