Hydrogeologic and Agricultural-Chemical Data for the South Skunk River Alluvial Aquifer at a Site in Story County, Iowa, 1992–93

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 94–4244

Prepared in cooperation with the
U.S. DEPARTMENT OF AGRICULTURE,
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By ROBERT C. BUCHMILLER

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Iowa City, Iowa
1995

U.S. DEPARTMENT OF THE INTERIOR
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CONTENTS

FIGURES

TABLES

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
	Flow	
cubic foot per second (ft^3/s)	0.028317	cubic meter per second
	Temperature	
degree Fahrenheit (°F)	([1])	degree Celsius (°C)

[1]Temperature can be converted to degrees Celsius (°C) or degrees Fahrenheit (°F) by the equations:

$$°C=5/9(°F-32)$$

$$°F=9/5(°C)+32.$$

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (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.

Hydrogeologic and Agricultural-Chemical Data for the South Skunk River Alluvial Aquifer at a Site in Story County, Iowa, 1992–93

By Robert C. Buchmiller

Abstract

A reconnaissance study was conducted during 1992–93 to collect background hydrogeologic and agricultural-chemical data for the South Skunk River alluvial aquifer near Ames, Iowa. Observation wells were drilled to characterize the surficial geologic materials of a field-scale study site and to provide locations for collecting water-level and agricultural-chemical data. Walnut Creek, a tributary to the South Skunk River, forms a lateral boundary on the northern edge of the field site. Water-level measurements showed a hydraulic-head gradient towards the South Skunk River under both wet and dry conditions at the study site. Walnut Creek appears to be losing water to the aquifer during most hydrologic conditions. More than 20 milligrams per liter of nitrate as nitrogen were present consistently in water from the southeastern part of the study site. Nitrate-as-nitrogen concentrations in water samples from other locations routinely did not exceed 10 milligrams per liter. The herbicide atrazine was detected most often, 36 of 38 times, in water samples collected from observation wells adjacent to Walnut Creek. Atrazine was not used on the study site during 1992–93 but was found frequently in water samples from Walnut Creek. Therefore, Walnut Creek appears to be a source of herbicide contamination to the alluvial aquifer.

INTRODUCTION

A 2-year study to collect background water-level and agricultural-chemical data for a part of the South Skunk River alluvial aquifer in Story County, Iowa, was begun in 1992 by the U.S. Geological Survey (USGS). The study was conducted in cooperation with the U.S. Department of Agriculture's (USDA) Agricultural Research Service, National Soil Tilth Laboratory and the U.S. Environmental Protection Agency (USEPA) Robert S. Kerr Environmental Research Laboratory as part of the USEPA's Midwest Agrichemical Surface/Subsurface Transport and Effects Research (MASTER) program. The study site (fig. 1) is adjacent to Walnut Creek, a tributary to the South Skunk River. This location was selected because the Walnut Creek watershed is being studied as part of the USDA and USGS Management Systems Evaluation Area (MSEA) program. The MSEA program is a multi-agency initiative to study the effects of agricultural management systems on water quality (Soenksen and others, 1992). Thick glacial deposits underlie the upland areas of the Walnut Creek watershed but do not form a surficial aquifer. However, alluvium along the South Skunk River does form a surficial aquifer system that potentially is vulnerable to agricultural activities. Therefore, the study of the South Skunk River alluvial aquifer extends the water-quality information that is being collected in the Walnut Creek watershed to a hydrologically connected, yet different type of, hydrologic system.

Purpose and Scope

The purpose of the South Skunk River alluvial-aquifer study was to collect water-level and agricultural-chemical data that could be used as a basis for further multiscale research activities to investigate the occurrence, transport, and fate of agricultural

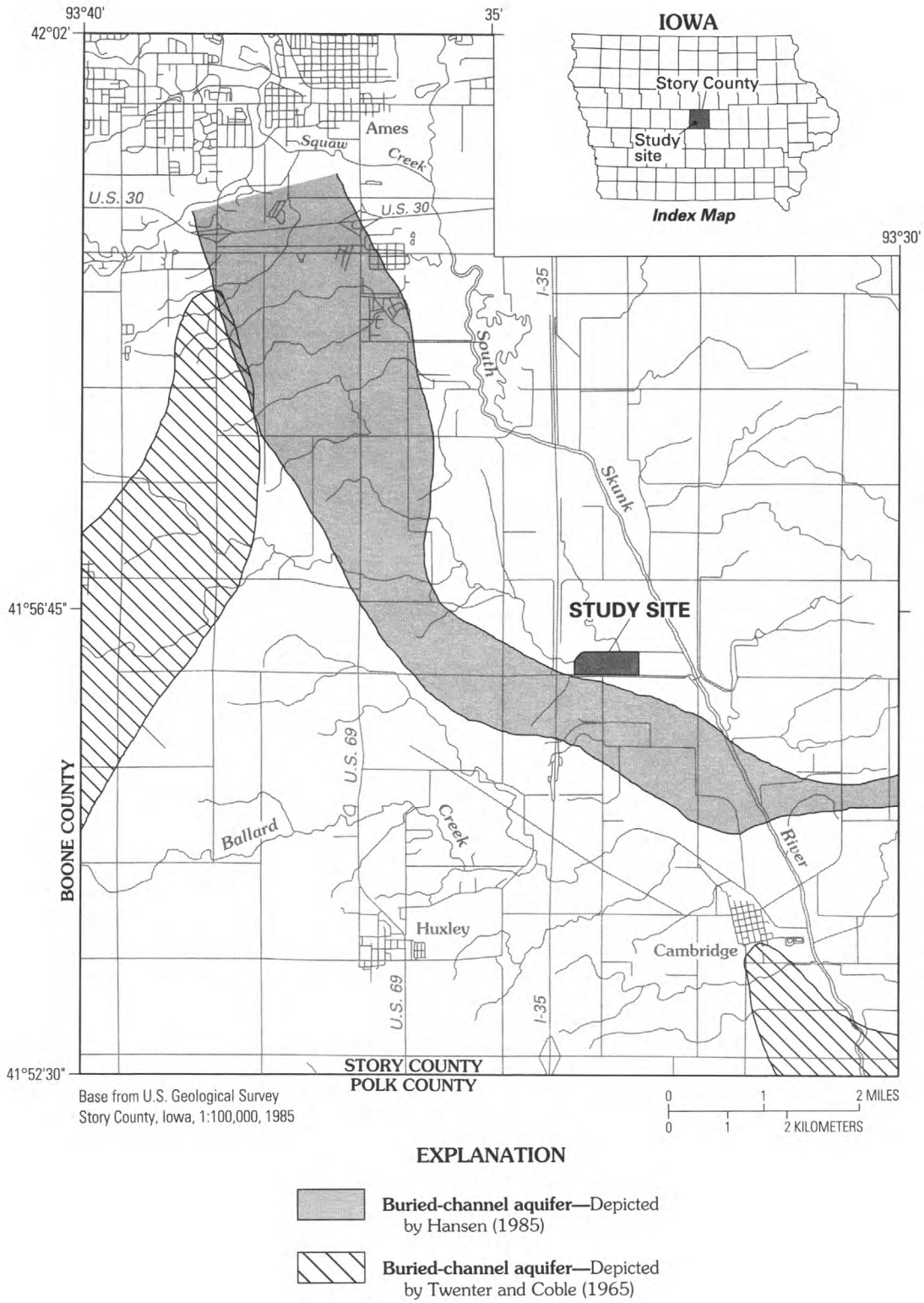


Figure 1. Location of study site in Story County, Iowa.

chemicals in near-surface aquifers. This report presents data that were collected for this study from May 1992 through September 1993. The data collection included drilling and installing observation wells at six locations in the South Skunk River alluvial aquifer near Walnut Creek. Periodic water-level measurements and results of analyses of water samples collected from these observation wells are presented in the report.

Acknowledgments

The author wishes to acknowledge and thank the staff and management of the National Soil Tilth Laboratory, Agricultural Research Service, Ames, Iowa, for their assistance and cooperation in this study. Karen Keck and Donna Schmitz, National Soil Tilth Laboratory, arranged for permission to install observation wells and make measurements on private property. The cooperation of James Mulvihill, Jr., owner of the property where this study took place, also is greatly appreciated. Although the information in this document has been funded wholly or in part by the USEPA, Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma, under the USEPA's MASTER program, it does not necessarily reflect the views of the Agency, and no official endorsement should be inferred.

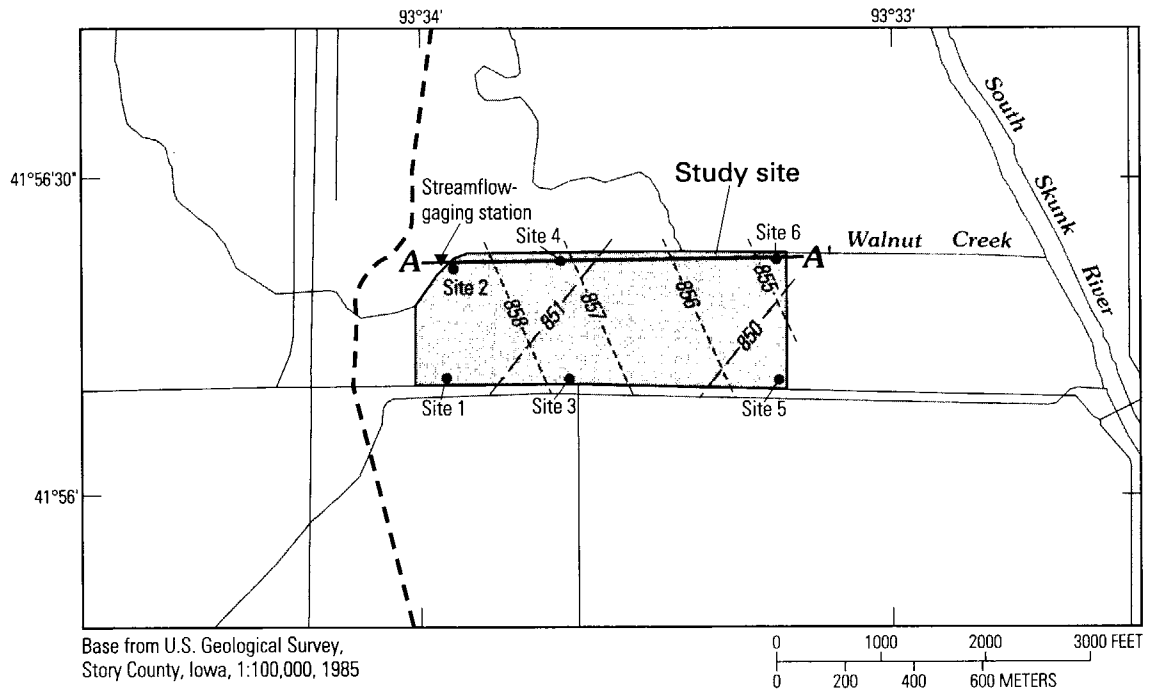
METHODS OF STUDY

Nested observation wells were drilled at six locations in the alluvium of the South Skunk River to characterize the surficial geologic materials at the study site and to provide locations for collecting water-level and agricultural-chemical data (fig. 2). Wells were installed by drilling with 4.25-in. (inside-diameter) hollow-stem augers. Well pipe was installed inside the auger flights after the target depth had been reached, and the augers then were removed, allowing the sand and gravel to collapse around the well pipe and form a natural sand pack. The top 5 ft of these boreholes were backfilled with bentonite pellets to prevent infiltration of water from the land surface along the well casing. A descriptive log of the material penetrated during the drilling of the deepest observation well at each of the six drill locations is given in table 1 at the end of this report.

Two 2-in.-diameter polyvinyl-chloride (PVC) observation wells were installed in separate boreholes at each of the six drill sites. The deeper of the two PVC wells was installed approximately 30 ft below land surface in the sand and gravel part of the aquifer. The second PVC well at each site was installed in the silty-sand layer above the main sand unit of the aquifer. This strategy was used to provide information on the vertical differences in water level and water quality at each drill site. The screened interval of the PVC wells was 2.5 ft long. In addition to the two PVC wells, various lengths of 0.25-in. (inside-diameter) polyethylene tubing were attached to the outside of the deepest PVC well at sites 1, 2, 5, and 6 to provide additional water-level measurement and water-sample collection ports. These tubes were completed at 2-ft intervals from just above the well screen to just below the silty-sand layer. Polyethylene tubes were slotted at the bottom 0.5 ft of the tubing and wrapped with fiberglass fabric to create a well screen. The tubes then were attached to the outside of the PVC pipe with nylon wire ties and lowered into the borehole with the PVC pipe. Water levels were measured in the PVC wells with a calibrated steel tape to the nearest 0.01 ft, and in the polyethylene tubes with an electronic water-level sensor attached to a calibrated wire line. Levels were run to the top of the PVC well casings and referenced to sea level datum. The identification number and depth of wells and tubing at each drill site, along with water-level measurements from May 1992 through August 1993, are included in table 2, at the end of this report.

PVC wells are identified in table 2 by the two letter prefix SR, the drill site number, and the approximate depth of the screened interval. For example, SR-1-12 is a PVC well located at drill site 1 and is approximately 12 ft deep. Polyethylene tubes are denoted by a letter rather than a screen depth. For example SR-1-A is a polyethylene tube at drill site 1. The depths of the slotted intakes of the tubes are given in table 2.

Water samples for agricultural-chemical analysis were collected from the PVC wells and polyethylene tubes from June 1992 to August 1993 (table 2). Measurements of specific conductance, pH, temperature, and dissolved oxygen were made onsite at the time of sample collection. Three well volumes of water were bailed from each of the PVC wells prior to water-sample collection to remove stagnant water from the well pipe. Samples were collected by pumping the PVC wells and polyethylene tubes with a peristaltic pump. The pump discharge was routed



EXPLANATION

— — *851* — — **Potentiometric contour**—Shows altitude at which water level would have stood in a tightly cased well, October 13, 1992. Contour interval is 1 foot. Datum is sea level

---- *858* ---- **Potentiometric contour**—Shows altitude at which water level would have stood in a tightly cased well, May 19, 1993. Contour interval is 1 foot. Datum is sea level

A———A' **Trace of section**—Shown in figure 3

- - - - - **Boundary of valley wall**

▼ **Streamflow-gaging station**

• Site 1 **Drill site and name**

Figure 2. Location of drill sites, streamflow-gaging station, trace of section on the alluvial aquifer, and water levels on October 13, 1992, and May 19, 1993.

through a flow-through chamber to avoid aeration for measurement of specific conductance, pH, temperature, and dissolved oxygen. Samples for laboratory analysis were collected in 1-liter baked glass jars upon stabilization of onsite measurements. Samples were chilled to 4 °C before transporting to the laboratory. Samples were analyzed by the National Soil Tilth Laboratory in Ames, Iowa, for nitrate as nitrogen and for the herbicides alachlor, atrazine, metolachlor, and metribuzin using methods described by QuickChem (1993) and Thurman and others (1990), respectively. Gas chromatography/mass spectrometry was used for herbicide analysis.

HYDROGEOLOGY

There is little geologic information available for much of the South Skunk River alluvial aquifer in Story County. Records of wells drilled in the alluvial aquifer are limited to a well that was drilled to a depth of about 40 ft approximately 1 mi northwest of the study area and Cambridge's public-supply well, which is located several miles south of the study area. The source of water for the Cambridge public water supply is described as a buried-channel aquifer (D. Sneck-Fahrer, U.S. Geological Survey, oral commun., 1994). A buried-channel aquifer is the alluvium of a river channel that was eroded into the bedrock surface prior to glaciation and subsequently has been buried by unconsolidated materials, typically of glacial origin. A map of the altitude of the bedrock surface in central Iowa by Hansen (1985) depicts a bedrock valley, known as the Skunk Channel, in the vicinity of Cambridge. The Skunk Channel trends approximately east-west where it intersects the present South Skunk River Valley and then northwesterly towards Ames (fig. 1). A slightly different interpretation of the location of the buried-channel aquifer is given in Twenter and Coble (1965). They interpret a buried-channel aquifer trending northwesterly that intersects the present South Skunk River Valley south of Cambridge (fig. 1). It appears from both interpretations that a buried-channel aquifer underlies the area near Cambridge and that it does not follow the present valley of the South Skunk River. The exact location, depth, and extent of the buried-channel aquifer is not well defined. There is insufficient information to define the thickness of the alluvial aquifer north of Cambridge or the geologic materials immediately underlying the alluvium at the study site. It is possible that the South Skunk River alluvial aquifer directly overlies the buried-channel aquifer at the study site and that the two aquifers are hydraulically connected.

A previous study of the South Skunk River alluvial aquifer was conducted by Austin and Chung (1984). The purpose of their study was to conduct a preliminary evaluation of the ground-water flow system and water quality. Austin and Chung concluded that the South Skunk River alluvial aquifer was hydraulically coupled with the South Skunk River but not with the tributary streams that cross the flood plain. They indicated that the South Skunk River is a gaining stream under most conditions and that regional alluvial ground-water flow has components downvalley and towards the South Skunk River.

The general sequence of material penetrated during drilling for this study consisted of a thin, dark, organic-rich topsoil underlain by a silty-clay subsoil that has a progressively larger sand content with depth. A change to a relatively silt-free sand was noted at depths of about 10 to 15 ft at each of the six drill sites. This sand forms the top part of the alluvial aquifer. Progressively coarser sand and gravel were noted at drill site 6, and materials eventually became too coarse to penetrate at a depth of 29.5 ft. The thickness of silt and clay overlying the aquifer decreased with increasing distance from the valley wall (just west of the study site, fig. 2). The total thickness of the aquifer at the study site is not known because the boreholes drilled for this study did not fully penetrate the sand and gravel. The extent of the gravel encountered at site 6 also is not known. A generalized west-east lithologic section of materials that were encountered during well construction is shown in figure 3.

WATER LEVELS

The ranges of water-level fluctuations measured in the PVC wells between May 1992 and August 1993 were between 6 and 8.5 ft. The lowest water levels were measured during October to December 1992. Water levels declined below the screened interval of the shallowest PVC well at each of the six drill sites at least once during this period. The highest water levels occurred in July 1992 at sites 4, 5, and 6 and in April 1993 at sites 1, 2, and 3. High water levels corresponded to periods of high streamflow in Walnut Creek and local rainfall and probably are indicative of the general hydrologic conditions throughout central Iowa. The vertical hydraulic gradient was predominantly

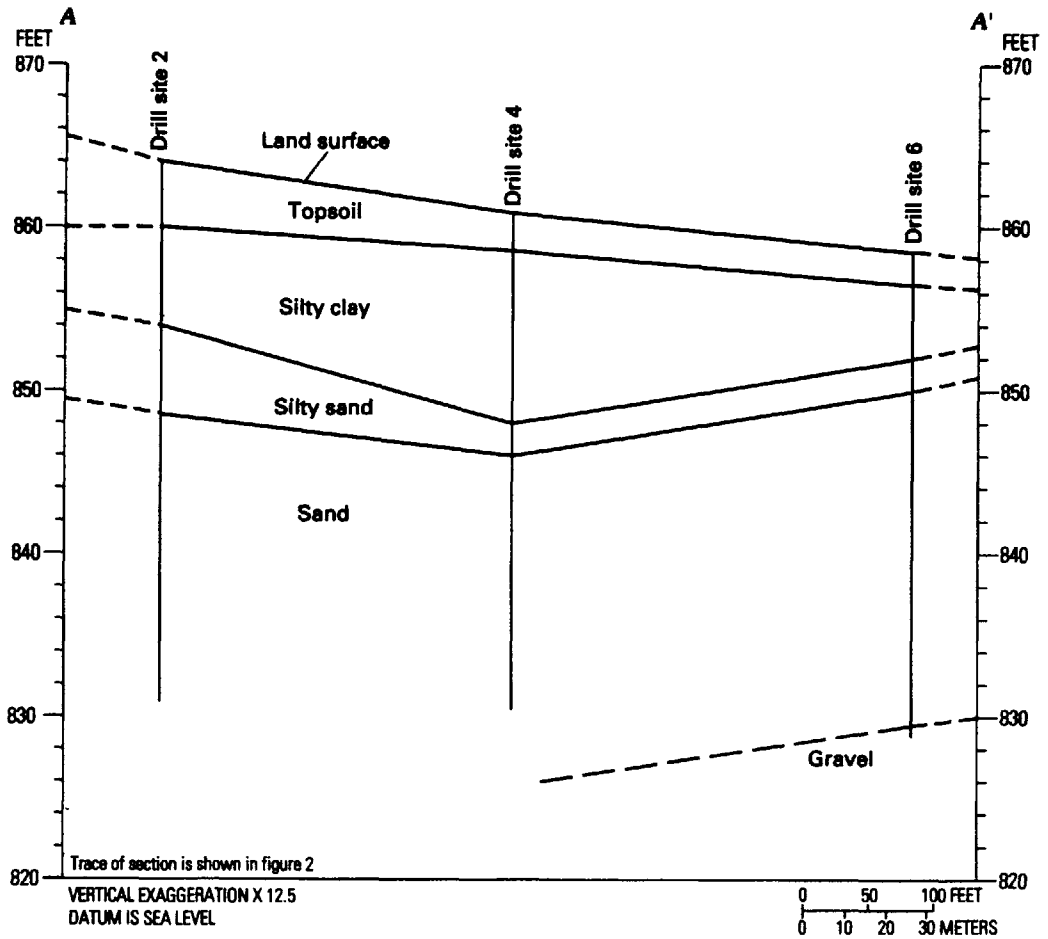


Figure 3. Generalized lithologic section of study site.

downward at each of the six drill sites during the study period, although gradient reversals occurred at some locations for short periods.

A comparison of water levels measured in the 32-ft-deep PVC well at site 2 with water levels in Walnut Creek at the adjacent gaging station is shown in figure 4. Ground-water levels were consistently lower than stream levels; the hydraulic gradient was from the stream to the aquifer. Periodic observations of Walnut Creek streamflow downstream of the gaging station located adjacent to drill site 2 indicated that the creek bed becomes dry under dry hydrologic conditions. During mid-October 1992, water was ponded in small pools in the creek bed adjacent to drill site 4, and the bed was completely dry adjacent to drill site 6.

Potentiometric contours are shown in figure 2 for representative dry and wet periods during the study. On October 13, 1992, streamflow was in recession, and ground-water levels were declining (fig. 4). Ground-water flow at this time was southeasterly—downvalley and towards the South Skunk River. These results and the observation of streamflow loss to the aquifer support the conclusions of Austin and Chung (1984) but also show that tributary streams can be a source of recharge. Streamflow conditions in Walnut Creek on May 19, 1993, showed the effects of a wet period when there were several months of substantial runoff from the uplands. Ground-water flow at the study site during this time was toward Walnut Creek and the South Skunk River. Part of Walnut Creek during this time was possibly a gaining stream as it crossed the alluvium. Water levels at drill site 2 and the streamflow-gaging station (fig. 4) show that Walnut Creek was still a losing stream at this location on May 19, 1993. Additional stream-stage data downstream of the gaging station would be needed to establish whether the entire reach of Walnut Creek downstream of the gaging station is a losing stream.

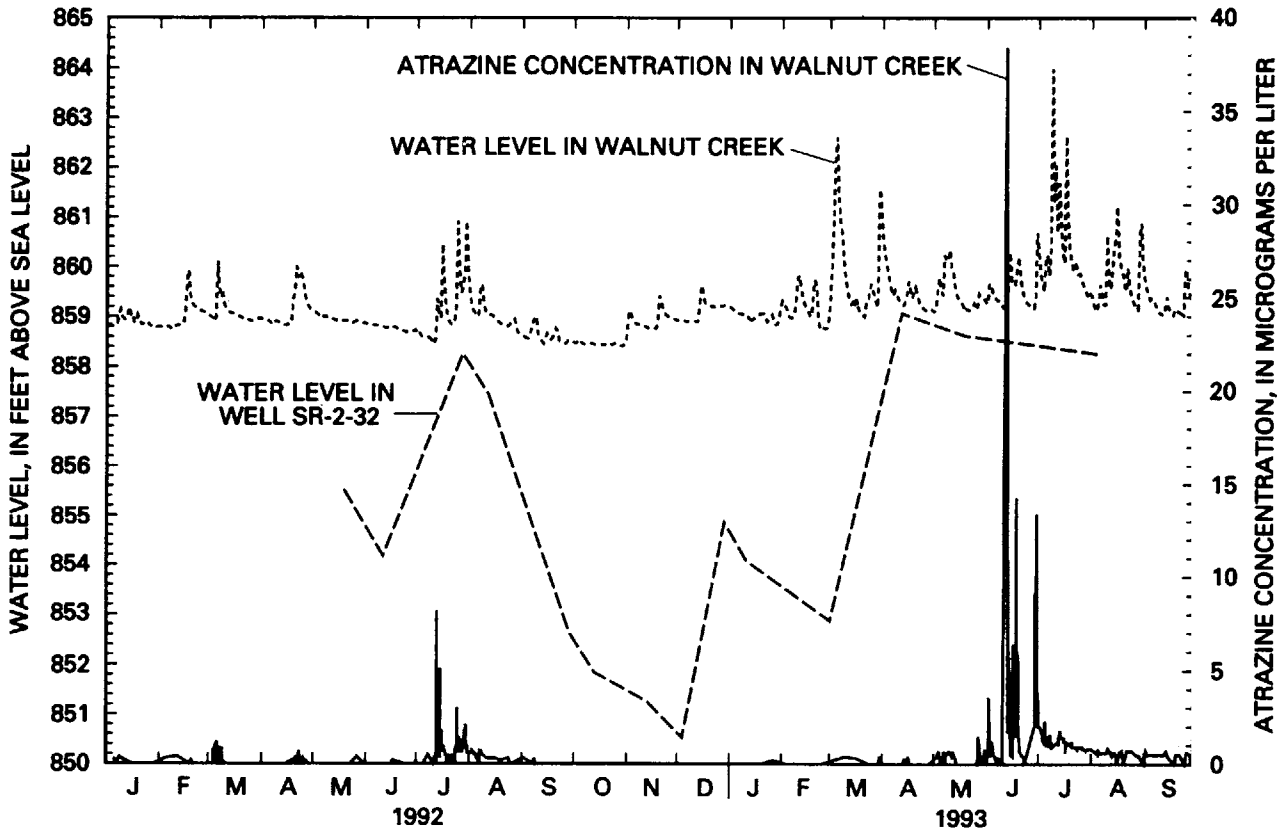


Figure 4. Water levels in Walnut Creek and the South Skunk River alluvial aquifer and concentrations of atrazine in Walnut Creek, January 1992 through September 1993.

AGRICULTURAL-CHEMICAL CONCENTRATIONS

Nitrate-as-nitrogen (NO_3-N) concentrations varied from less than 1.0 mg/L (milligram per liter) to more than 30 mg/L in samples collected from the PVC wells and polyethylene tubes. The largest NO_3-N concentrations occurred in water from drill site 5. The temporal variation in NO_3-N concentration in samples from site 5 is shown in figure 5. Samples from below 30-ft deep did not exceed 10 mg/L during the period of study, whereas a consistent pattern of NO_3-N concentrations in excess of 20 mg/L occurred throughout the period of study in samples from a depth of about 20 ft. One explanation for the smaller observed NO_3-N concentrations in water below 30 ft at this site is that water containing the large NO_3-N concentrations observed at about 20-ft deep is not moving downward to the 30-ft depth. This is substantiated by water-level measurements made at the site on November 13, 1992, December 29, 1992, January 11, 1993, April 12, 1993, and May 19, 1993 (table 2). On these dates, an upward hydraulic gradient was measured between the PVC well completed at about 31.5 ft below land surface and the polyethylene tube completed at 27 ft below land surface. Upward hydraulic gradients provide evidence of recharge to the alluvial aquifer from a deeper source, possibly the buried-channel aquifer discussed earlier. NO_3-N stratification and upward hydraulic gradients were not observed at the other observation-well sites. Denitrification of water in the alluvial aquifer with depth is also a possibility. There were no herbicide detections in water from drill site 5 where NO_3-N concentrations were the largest and most prevalent.

Corn and soybeans were grown on the study site during 1992 and 1993. The herbicide metolachlor was applied to the field site during 1992 and 1993. There were 270 water samples collected from the 37 PVC wells and polyethylene tubes between June 1992 and August 1993 (table 2) for NO_3-N and herbicide analysis. Atrazine was the most commonly detected herbicide of the four analyzed. Atrazine was detected in 36 samples, metolachlor in 6 samples, and metri-

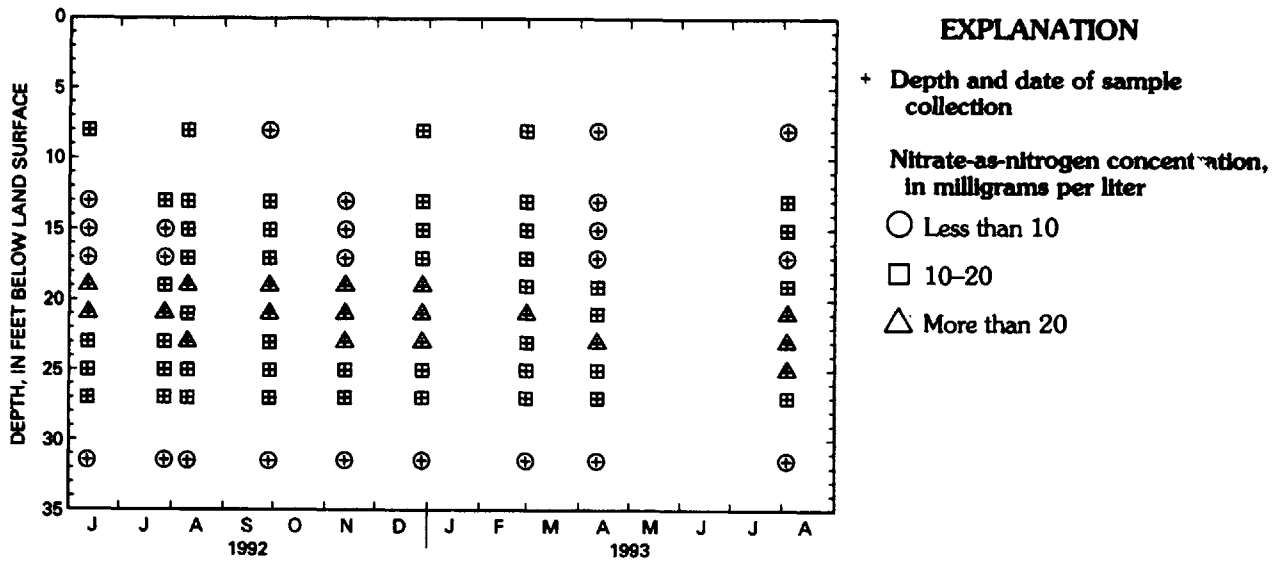


Figure 5. Concentrations of nitrate as nitrogen in water from drill site 5, South Skunk River alluvial aquifer, June 1992 through August 1993.

buzin in 2 samples. Alachlor was not detected in any sample. All herbicide concentrations were less than 1.0 µg/L (microgram per liter) except for one detection of metolachlor that was 3.2 µg/L. Atrazine concentrations were 0.5 µg/L or less.

Thirty-six of the 38 detections of atrazine occurred in water from drill sites 2 and 6 (table 2), which are adjacent to Walnut Creek. Atrazine occurred frequently in samples collected from Walnut Creek at the streamflow-gaging station adjacent to drill site 2 (fig. 4). It appears that Walnut Creek is a source of pesticide (atrazine) contamination to the alluvial aquifer; atrazine is present in ground water at locations along Walnut Creek, while almost no atrazine detections occur in ground water farther from the creek. Atrazine was not used on the study site during the study. Hydraulic gradients from the stream to the aquifer for substantial periods were measured during the study. Additional study would be needed to determine the magnitude and extent of tributary-source contamination of the alluvial aquifer.

SUMMARY

A reconnaissance study was conducted during 1992–93 at a field-scale study site located on the South Skunk River alluvial aquifer near Ames, Iowa. Observation-well drilling at the site determined that the top of a sand and gravel aquifer of unknown thickness is present at depths between 10 and 15 feet below land surface. The movement of ground water under the site is generally downvalley and towards the South Skunk River. The South Skunk River is probably a regional discharge line for ground water in the alluvial aquifer.

Variable nitrate-as-nitrogen concentrations occurred in samples from wells located at the site. Water from the drill site farthest from the valley wall and Walnut Creek, a tributary crossing the alluvial aquifer along the northern boundary of the study site, contained the largest nitrate-as-nitrogen concentrations—more than 20 mg/L from a depth of about 20 ft below land surface. No herbicides were detected in samples from the site with the largest nitrate-as-nitrogen concentrations. Atrazine was the most frequently detected herbicide. Atrazine was not applied to the site during the time of the study but was present in streamflow of Walnut Creek. Most, 36 of 38, atrazine detections in ground water were from drill-site locations adjacent to the creek, indicating that Walnut Creek is a source of herbicide contamination to the alluvial aquifer.

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SUPPLEMENTAL HYDROLOGIC INFORMATION

Table 1. Descriptive logs of selected boreholes drilled in the South Skunk River alluvium, Story County, Iowa, April 1992

Drill site: 1
Well identification: SR-1-33
Location: T. 82N., R. 23W., sec. 6, SE1/4
Altitude of land surface: 864 feet
Date: 4/9/92

Description	Depth interval (feet)
Topsoil, black, changing to dark-brown silty clay with depth	0 – 3.5
Silty clay, light-brown, moist, balls up	3.6 – 4.5
Silty clay, tan, cohesive, appears unsaturated	4.6 –10.0
Sandy clay, tan, wet, slightly cohesive	10.1 –14.5
No cuttings, saturated sand	14.6 –33.5

Drill site: 2
Well identification: SR-2-33
Location: T. 82N., R. 23W., sec. 6, SE1/4
Altitude of land surface: 864 feet
Date: 4/10/92

Description	Depth interval (feet)
Topsoil, black, increasing clay with depth	0 – 4.0
Same as above but becoming browner with depth	4.1 – 7.0
Silty clay, becoming lighter brown	7.1 – 9.0
Silt, tan	9.1 –11.0
Silt, tan, soft	11.1 –16.0
No cuttings, saturated sand	16.1 –33.0

Drill site: 3
Well identification: SR-3-28
Location: T. 82N., R. 23W., sec. 5, SW1/4
Altitude of land surface: 861 feet
Date: 4/15/92

Description	Depth interval (feet)
Topsoil, black grading to brown	0 – 2.0
Silty clay, dark-brown	2.1 – 4.0
Same as above	4.1 – 7.0
Silty clay, medium-brown	7.1 –10.0
Same as above, sandy	10.1 –14.0
No cuttings, saturated sand	14.1 –30.0

Drill site: 4
Well identification: SR-4-28
Location: T. 82N., R 23W., sec. 5, SW1/4
Altitude of land surface: 861 feet
Date 4/15/92

Description	Depth interval (feet)
Topsoil, black	0 – 2.0
Silty clay, dark-brown, balls up	2.1 – 8.0
Same as above, color change to medium-brown	8.1 –13.0
Silty clay, medium-brown, sandy	13.1 –15.0
No cuttings, saturated sand	15.1 –32.5

Table 1. Descriptive logs of selected boreholes drilled in the South Skunk River alluvium, Story County, Iowa, April 1992—Continued

Drill site: 5
Well identification: SR-5-32
Location: T. 82N., R. 23W., sec. 5, SW1/4

Altitude of land surface: 8[illegible] feet
Date: 4/14/92

Description	Depth interval (feet)
Topsoil, black-brown	0 – 2.5
Silty clay, medium-brown, soft, cohesive	2.5 – 7.0
Same as above, with fine sand	7.1 – 8.0
Silty clay, light-brown, sandy	8.1 – 9.0
No cuttings, saturated sand	9.1 –33.0

Drill site: 6
Well identification: SR-6-28
Location: T. 82N., R. 23W., sec. 5, SW1/4

Altitude of land surface: 8[illegible] feet
Date: 4/15/92

Description	Depth interval (feet)
Topsoil	0 – 2.0
Silty clay, dark-brown, cohesive	2.1 – 6.0
Silty clay, medium-brown, cohesive	6.1 – 7.0
Silty clay, medium-brown, sandy, cohesive	7.1 – 8.0
Same as above, lighter brown	8.1 – 9.0
No cuttings, saturated sand	9.1 –17.0
Sand, brown, fine, watery	17.1 –23.0
Sand, coarser, color changing to gray	23.1 –27.0
Sand, gravelly, hard drilling	27.1 –29.5
Could not drill deeper due to gravel	

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993

[Nitrate-as-nitrogen and herbicide analyses by National Soil Tilth Laboratory, Ames, Iowa. ft, feet; µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; --, not determined; <, less than indicated detection level]

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-1-12	13	05-11-92	855.12	--	--	--	--	--	--	--	--	--
		05-18-92	858.36	--	--	--	--	--	--	--	--	--
		05-26-92	854.82	--	--	--	--	--	--	--	--	--
		06-11-92	853.88	395	7.5	16.2		2.3	<0.2	<0.2	<0.2	<0.2
		07-27-92	857.75	--	--	--	--	8.0	< .2	< .2	< .2	< .2
		08-11-92	857.38	387	7.1	14.3	9.2	1.6	< .2	< .2	< .2	< .2
		09-28-92	852.14	420	7.1	14.1	--	2.0	< .2	< .2	< .2	< .2
		12-04-92	856.17	--	--	--	--	--	--	--	--	--
		12-29-92	854.67	310	7.0	7.0	9.5	4.3	< .2	< .2	< .2	< .2
		04-12-93	859.10	288	7.2	8.0	7.8	2.3	< .2	< .2	< .2	< .2
		05-19-93	858.60	215	7.0	9.4	--	--	--	--	--	--
		08-04-93	858.29	230	6.8	14.3	--	1.0	< .2	< .2	< .2	< .2
SR-1-E	19	06-11-92	--	744	6.8	11.3	--	--	--	--	--	--
		08-11-92	--	412	6.6	11.4	6.0	3.9	< .2	< .2	< .2	< .2
		09-28-92	--	480	6.8	12.4	--	4.3	< .2	< .2	< .2	< .2
		11-13-92	851.14	380	7.0	10.8	5.1	5.6	< .2	< .2	< .2	< .2
		12-04-92	852.47	--	--	--	--	--	--	--	--	--
		12-29-92	855.09	185	6.7	9.9	5.4	7.9	< .2	< .2	< .2	< .2
		01-11-93	854.27	--	--	--	--	--	--	--	--	--
		03-01-93	--	242	6.5	8.4	--	5.2	< .2	< .2	< .2	< .2
		04-12-93	859.56	507	6.6	9.2	4.8	5.3	< .2	< .2	< .2	< .2
		05-19-93	--	349	6.3	9.5	--	--	--	--	--	--
		08-04-93	--	278	6.5	12.3	--	2.3	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-1-D	21	06-11-92	--	725	6.9	11.7	--	--	--	--	--	--
		08-11-92	--	730	6.5	13.1	--	--	--	--	--	--
		09-28-92	--	335	6.8	12.2	--	5.0	< 0.2	< 0.2	< 0.2	< 0.2
		11-13-92	851.13	573	6.9	10.7	3.3	5.3	< .2	< .2	< .2	< .2
		12-04-92	852.55	--	--	--	--	--	--	--	--	--
		12-29-92	855.09	218	6.6	9.5	2.4	8.2	< .2	< .2	< .2	< .2
		01-11-93	854.27	--	--	--	--	--	--	--	--	--
		03-01-93	--	244	6.7	8.4	--	4.8	.2	< .2	< .2	< .2
		04-12-93	859.56	469	6.2	9.7	2.7	4.7	< .2	< .2	< .2	< .2
		05-19-93	--	552	6.5	9.9	--	--	--	--	--	--
		08-04-93	--	230	6.6	14.3	--	2.4	< .2	< .2	< .2	< .2
SR-1-C	23	06-11-92	--	731	7.1	11.1	--	--	--	--	--	--
		08-11-92	--	589	6.9	11.6	6.8	5.9	< .2	< .2	< .2	< .2
		09-28-92	--	555	6.7	11.9	--	5.7	< .2	< .2	< .2	< .2
		11-13-92	851.19	361	7.1	10.4	1.9	5.1	< .2	< .2	< .2	< .2
		12-04-92	852.47	--	--	--	--	--	--	--	--	--
		12-29-92	855.10	116	6.7	9.7	3.2	8.2	< .2	< .2	< .2	< .2
		01-11-93	854.27	--	--	--	--	--	--	--	--	--
		03-01-93	--	742	6.7	8.4	--	4.6	< .2	< .2	< .2	< .2
		04-12-93	859.56	208	6.5	9.5	4.0	5.5	< .2	< .2	< .2	< .2
		05-19-93	--	278	6.4	9.8	--	--	--	--	--	--
		08-04-93	--	392	6.6	13.5	--	1.7	< .2	< .2	< .2	< .2
SR-1-B	25	06-11-92	--	790	7.1	11.2	--	--	--	--	--	--
		09-28-92	--	560	6.6	12.0	.2	5.5	< .2	< .2	< .2	< .2
		11-13-92	851.16	175	7.0	10.4	1.9	5.2	< .2	< .2	< .2	< .2
		12-04-92	852.47	--	--	--	--	--	--	--	--	--
		12-29-92	855.11	161	6.7	9.6	2.7	8.0	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-1-B—Continued	25	01-11-93	854.27	--	--	--	--	--	--	--	--	--
		03-01-93	--	157	6.9	8.4	--	4.9	<0.2	<0.2	<0.2	<0.2
		04-12-93	859.52	81	6.7	9.7	2.5	6.0	< .2	< .2	< .2	< .2
		05-19-93	--	316	6.2	10.1	--	--	--	--	--	--
		08-04-93	--	304	6.3	12.5	--	2.1	< .2	< .2	< .2	< .2
SR-1-A	27	06-11-92	--	757	6.5	11.5	--	--	--	--	--	--
		08-11-92	--	408	6.5	11.5	5.3	4.6	< .2	< .2	< .2	< .2
		09-28-92	--	705	6.7	11.9	--	5.6	< .2	< .2	< .2	< .2
		11-13-92	851.13	443	6.9	10.5	2.0	4.9	< .2	< .2	< .2	< .2
		12-04-92	852.49	--	--	--	--	--	--	--	--	--
		12-29-92	855.09	195	6.9	9.6	2.4	7.9	< .2	< .2	< .2	< .2
		01-11-92	854.27	--	--	--	--	--	--	--	--	--
		03-01-93	--	247	6.6	8.4	--	4.6	.2	< .2	< .2	< .2
		04-12-93	859.41	238	6.5	9.6	3.1	5.4	< .2	< .2	< .2	< .2
		05-19-93	--	319	6.3	10.3	--	--	--	--	--	--
		08-04-93	--	423	6.4	12.2	--	2.1	< .2	< .2	< .2	< .2
SR-1-33	33.5	05-11-92	856.12	--	--	--	--	--	--	--	--	--
		05-18-92	855.35	--	--	--	--	--	--	--	--	--
		05-26-92	854.82	--	--	--	--	--	--	--	--	--
		06-11-92	853.88	748	7.4	13.5	--	7.6	< .2	< .2	< .2	< .2
		07-27-92	857.74	--	--	--	--	11.7	< .2	< .2	< .2	< .2
		08-11-92	857.36	573	7.2	13.1	4.3	6.2	< .2	< .2	< .2	< .2
		09-28-92	852.18	580	7.1	11.3	--	5.9	< .2	< .2	< .2	< .2
		10-13-92	851.27	--	--	--	--	--	--	--	--	--
		11-13-92	850.68	149	7.7	8.7	2.6	7.2	< .2	< .2	< .2	< .2
		12-04-92	855.40	--	--	--	--	--	--	--	--	--

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-1-33—Continued	33.5	12-29-92	854.65	204	6.9	9.0	2.8	10.9	< 0.2	< 0.2	< 0.2	< 0.2
		01-11-93	853.80	--	--	--	--	--	--	--	--	--
		03-01-93	852.42	685	7.4	8.4	--	5.9	< .2	< .2	< .2	< .2
		04-12-93	859.08	480	6.9	9.9	3.8	6.4	< .2	< .2	< .2	< .2
		05-19-93	858.67	595	6.9	10.7	--	--	--	--	--	--
		08-04-93	858.28	494	7.0	13.2	--	6.7	< .2	< .2	3.2	< .2
SR-2-14	14.5	05-11-92	861.13	--	--	--	--	--	--	--	--	--
		05-18-92	855.55	--	--	--	--	--	--	--	--	--
		05-26-92	855.07	--	--	--	--	--	--	--	--	--
		06-12-92	854.22	711	7.0	12.2		4.5	< .2	< .2	< .2	< .2
		07-28-92	858.27	--	--	--	--	8.5	< .2	< .2	< .2	< .2
		08-11-92	857.49	454	7.2	14.3	4.2	3.7	< .2	< .2	< .2	< .2
		09-28-92	852.68	633	7.2	14.3	--	4.0	< .2	< .2	< .2	< .2
		10-13-92	851.88	--	--	--	--	--	--	--	--	--
		12-04-92	853.72	--	--	--	--	--	--	--	--	--
		12-29-92	854.89	579	7.0	9.4	7.9	7.9	< .2	< .2	< .2	< .2
		01-11-93	854.10	--	--	--	--	--	--	--	--	--
		03-01-93	852.88	417	7.3	9.0	--	4.8	< .2	< .2	< .2	< .2
		04-12-93	859.03	119	7.1	9.4	3.6	4.6	< .2	< .2	< .2	< .2
		05-19-93	858.64	548	6.8	10.6	--	--	--	--	--	--
		08-04-93	858.31	226	6.8	13.2	--	2.7	< .2	< .2	< .2	< .2
SR-2-F	18	06-12-92	--	828	7.6	11.0	--	--	--	--	--	--
		08-11-92	--	805	7.3	11.3	7.4	7.1	< .2	< .2	< .2	< .2
		09-28-92	--	790	7.1	11.9	--	6.5	< .2	< .2	< .2	< .2
		11-13-92	851.20	337	7.1	10.2	4.4	6.0	< .2	< .2	< .2	< .2
		12-04-92	852.51	--	--	--	--	--	--	--	--	--

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-2-F—Continued	18	12-29-92	--	300	7.1	10.2	6.0	8.7	<0.2	<0.2	<0.2	<0.2
		03-01-93	--	1,023	7.0	9.5	--	5.1	.3	< .2	< .2	< .2
		04-12-93	--	217	7.0	10.2	3.9	5.6	< .2	< .2	< .2	< .2
		05-19-93	--	423	7.2	11.1	--	--	--	--	--	--
		08-04-93	--	619	6.9	11.6	--	3.6	< .2	< .2	< .2	< .2
SR-2-E	20	06-12-92	--	720	7.1	10.9	--	--	--	--	--	--
		08-11-92	--	480	7.4	10.8	1.3	3.9	< .2	< .2	< .2	< .2
		09-28-92	--	465	7.3	11.6	--	5.2	< .2	< .2	< .2	< .2
		11-13-92	851.19	211	7.7	10.1	1.8	4.9	< .2	< .2	< .2	< .2
		12-04-92	852.51	--	--	--	--	--	--	--	--	--
		12-29-92	--	564	7.2	10.1	2.0	8.4	< .2	< .2	< .2	< .2
		03-01-93	--	281	7.1	9.8	--	3.4	.2	< .2	< .2	< .2
		04-12-93	--	521	7.2	10.6	1.0	4.3	< .2	< .2	< .2	< .2
		08-05-93	--	573	7.0	11.5	--	3.7	< .2	< .2	< .2	< .2
SR-2-D	22	06-12-92	--	610	7.7	11.0	--	--	--	--	--	--
		08-11-92	--	507	7.4	11.0	1.2	3.3	< .2	< .2	< .2	< .2
		09-28-92	--	550	7.4	11.5	--	6.3	< .2	< .2	< .2	< .2
		11-13-92	851.20	546	7.3	10.1	1.6	6.1	.4	< .2	< .2	< .2
		12-29-92	--	199	7.2	10.4	1.3	7.4	< .2	< .2	< .2	< .2
		03-01-93	--	328	7.1	10.1	--	1.1	.3	< .2	< .2	< .2
		04-12-93	--	533	7.3	10.7	2.8	4.4	< .2	< .2	< .2	< .2
		08-04-93	--	565	7.0	11.2	--	8.1	.2	< .2	< .2	< .2
SR-2-C	24	06-12-92	--	667	7.6	11.1	--	--	--	--	--	--
		08-11-92	--	603	7.5	10.9	1.0	4.1	< .2	< .2	< .2	< .2
		09-28-92	--	600	7.4	11.4	--	4.2	< .2	< .2	< .2	< .2
		11-13-92	851.21	192	7.3	10.1	1.9	8.2	.5	< .2	< .2	< .2
		12-29-92	--	208	7.2	10.6	1.4	9.2	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-2-C— Continued	24	03-01-93	--	521	7.3	10.0	--	1.9	0.3	<0.2	<0.2	<0.2
		04-12-93	--	403	7.3	10.8	2.2	4.0	< .2	< .2	< .2	< .2
		05-19-93	--	583	7.2	11.2	--	--	--	--	--	--
		08-04-93	--	461	7.0	11.2	--	9.0	.3	< .2	< .2	< .2
SR-2-B	26	06-12-92	--	639	7.7	11.2	--	--	--	--	--	--
		08-11-92	--	346	7.5	10.6	1.3	6.2	< .2	< .2	< .2	< .2
		09-28-92	--	605	7.4	11.3	.4	6.0	< .2	< .2	< .2	< .2
		11-13-92	851.22	195	7.4	10.1	.6	5.8	< .2	< .2	< .2	< .2
		12-29-93	--	199	7.2	10.5	1.2	4.7	< .2	< .2	< .2	< .2
		03-01-93	--	355	7.3	10.1	--	3.7	.4	< .2	< .2	< .2
		04-12-93	--	497	7.3	11.1	.5	8.4	< .2	< .2	< .2	< .2
		08-04-93	--	493	7.0	11.4	--	7.9	< .2	< .2	< .2	< .2
SR-2-A	28	06-12-92	--	693	7.5	11.5	--	--	--	--	--	--
		08-11-92	--	681	7.6	11.2	1.2	7.8	< .2	< .2	< .2	< .2
		09-28-92	--	445	7.4	11.8	.3	7.4	< .2	< .2	< .2	< .2
		11-13-92	851.21	160	7.4	9.9	.3	4.9	< .2	< .2	< .2	< .2
		12-29-92	--	173	7.1	9.9	2.6	6.2	< .2	< .2	< .2	< .2
		03-01-93	--	195	7.6	9.7	--	--	--	--	--	--
		04-12-93	--	349	7.5	9.3	2.2	7.2	< .2	< .2	< .2	< .2
		05-19-93	--	570	7.2	11.4	--	--	--	--	--	--
		08-04-93	--	563	7.0	11.5	--	8.9	< .2	< .2	< .2	< .2
SR-2-32	32.5	05-18-92	855.52	--	--	--	--	--	--	--	--	--
		05-26-92	855.05	--	--	--	--	--	--	--	--	--
		06-12-92	854.18	728	7.6	11.7	--	11.4	< .2	< .2	< .2	< .2
		07-28-92	858.26	--	--	--	--	8.6	.3	< .2	< .2	< .2
		08-11-92	857.44	360	7.6	11.9	2.0	7.9	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-2-32—Continued	32.5	09-28-92	852.65	600	7.5	11.4	--	9.2	<0.2	<0.2	<0.2	<0.2
		10-13-92	851.84	--	--	--	--	--	--	--	--	--
		11-13-92	851.26	169	6.9	9.0	0.6	5.4	.5	< .2	< .2	< .2
		12-04-92	850.53	--	--	--	--	--	--	--	--	--
		12-29-92	854.86	179	6.8	9.5	2.5	7.7	< .2	< .2	< .2	< .2
		01-11-93	854.08	--	--	--	--	--	--	--	--	--
		03-01-93	852.88	649	7.5	9.6	--	--	< .2	< .2	< .2	< .2
		04-12-93	859.07	386	7.3	10.3	.8	5.2	.3	< .2	< .2	< .2
		05-19-93	858.62	226	7.0	11.0	--	--	--	--	--	--
		08-04-93	858.26	552	7.1	11.8	--	8.7	< .2	< .2	< .2	< .2
SR-3-12	12.5	05-11-92	855.01	--	--	--	--	--	--	--	--	--
		05-19-92	854.34	--	--	--	--	--	--	--	--	--
		05-26-92	853.94	--	--	--	--	--	--	--	--	--
		06-11-92	853.15	439	7.6	15.0	--	3.1	< .2	< .2	< .2	< .2
		07-27-92	856.83	--	--	--	--	5.9	< .2	< .2	< .2	< .2
		09-28-92	851.42	280	7.3	13.8	9.6	3.9	< .2	< .2	< .2	< .2
		10-13-92	850.63	--	--	--	--	--	--	--	--	--
		12-04-92	851.83	--	--	--	--	--	--	--	--	--
		12-29-92	853.71	357	7.1	8.2	6.9	12.7	< .2	< .2	< .2	< .2
		01-11-93	853.01	--	--	--	--	--	--	--	--	--
		03-01-93	852.83	165	7.3	7.4	--	4.2	< .2	< .2	< .2	< .2
		04-12-93	857.77	235	7.0	7.5	4.6	4.6	< .2	< .2	< .2	< .2
		05-19-93	856.62	261	6.7	8.8	--	--	--	--	--	--
		08-04-93	857.21	242	6.3	13.4	--	2.8	< .2	< .2	< .2	< .2
SR-3-28	30.5	05-11-92	857.47	--	--	--	--	--	--	--	--	--
		05-19-92	854.32	--	--	--	--	--	--	--	--	--
		05-26-92	853.90	--	--	--	--	--	--	--	--	--
		06-11-92	853.11	550	7.8	14.7	--	8.1	< .2	< .2	< .2	< .2
		07-27-92	856.83	--	--	--	--	4.4	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-3-28—Continued	30.5	09-28-92	851.42	405	7.4	12.0	3.0	8.1	<0.2	<0.2	<0.2	<0.2
		10-13-92	850.62	--	--	--	--	--	--	--	--	--
		11-13-92	850.25	387	7.4	11.9	3.5	3.7	< .2	< .2	< .2	< .2
		12-04-92	854.09	--	--	--	--	--	--	--	--	--
		12-29-92	853.70	97	6.9	9.0	.5	6.6	< .2	< .2	< .2	< .2
		01-11-93	853.04	--	--	--	--	--	--	--	--	--
		03-01-93	851.82	570	7.5	8.3	--	3.6	< .2	< .2	< .2	< .2
		04-12-93	857.73	339	7.1	10.3	2.1	4.1	< .2	< .2	< .2	< .2
		05-19-93	857.91	329	7.1	11.0	--	--	--	--	--	--
		08-04-93	857.24	311	6.5	13.0	--	13.4	< .2	< .2	< .2	< .2
SR-4-10	10.5	05-11-92	855.43	--	--	--	--	--	--	--	--	--
		05-19-92	854.99	--	--	--	--	--	--	--	--	--
		05-27-92	854.67	--	--	--	--	--	--	--	--	--
		06-12-92	854.11	927	7.4	10.8	--	3.7	< .2	< .2	< .2	< .2
		07-28-92	857.20	--	--	--	--	5.8	< .2	< .2	< .2	< .2
		09-28-92	854.17	640	7.2	17.8	5.1	1.6	< .2	< .2	< .2	< .2
		10-13-92	851.48	--	--	--	--	--	--	--	--	--
		12-04-92	852.76	--	--	--	--	--	--	--	--	--
		01-11-93	854.43	--	--	--	--	--	--	--	--	--
		03-01-93	853.00	285	7.4	7.4	--	5.7	< .2	< .2	< .2	< .2
		04-12-93	858.39	721	7.1	6.3	3.5	5.4	< .2	< .2	< .2	< .2
		05-19-93	857.13	485	6.8	7.6	--	--	--	--	--	--
		08-04-93	857.22	634	7.1	12.0	--	2.2	< .2	< .2	.3	< .2
SR-4-28	30.5	05-11-92	855.28	--	--	--	--	--	--	--	--	--
		05-19-92	854.87	--	--	--	--	--	--	--	--	--
		05-27-92	854.52	--	--	--	--	--	--	--	--	--
		06-12-92	853.87	740	7.7	7.5	--	--	--	--	--	--
		07-28-92	857.46	--	--	--	--	11.3	.3	< .2	< .2	.3

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-4-28—Continued	30.5	09-28-92	852.22	539	7.5	19.0	5.4	6.6	<0.2	<0.2	<0.2	<0.2
		10-13-92	851.22	--	--	--	--	--	--	--	--	--
		11-13-92	851.13	428	7.1	17.3	5.1	1.0	< .2	< .2	< .2	< .2
		12-04-92	852.36	--	--	--	--	--	--	--	--	--
		01-11-93	853.05	--	--	--	--	--	--	--	--	--
		03-01-93	852.78	723	7.5	5.5	--	8.4	< .2	< .2	< .2	< .2
		04-12-93	856.88	605	7.1	4.8	6.4	8.7	< .2	< .2	< .2	< .2
		05-19-93	857.15	325	7.1	5.3	--	--	--	--	--	--
		08-04-93	857.23	457	7.1	6.0	--	8.6	< .2	< .2	.3	< .2
SR-5-8	8	05-11-92	853.90	--	--	--	--	--	--	--	--	--
		05-19-92	853.33	--	--	--	--	--	--	--	--	--
		05-27-92	852.92	--	--	--	--	--	--	--	--	--
		06-11-92	852.28	735	7.4	15.4	--	13.1	< .2	< .2	< .2	< .2
		07-28-92	856.52	--	--	--	--	--	--	--	--	--
		08-12-92	--	409	7.2	13.9	4.8	11.9	< .2	< .2	< .2	< .2
		09-28-92	850.44	205	7.2	13.1	8.3	9.5	< .2	< .2	< .2	< .2
		10-13-92	849.74	--	--	--	--	--	--	--	--	--
		12-04-92	851.04	--	--	--	--	--	--	--	--	--
		12-29-92	852.77	197	6.9	6.4	8.1	15.9	< .2	< .2	< .2	< .2
		01-11-93	852.11	--	--	--	--	--	--	--	--	--
		03-01-93	851.07	483	7.2	5.4	--	13.1	< .2	< .2	< .2	< .2
		04-12-93	856.34	602	7.2	6.8	5.8	7.7	< .2	< .2	< .2	< .2
		05-19-93	855.76	459	6.9	8.8	--	--	--	--	--	--
		08-04-93	855.91	335	6.9	14.4	--	5.1	< .2	< .2	< .2	< .2
SR-5-H	13	06-12-92	--	727	7.6	11.9	--	9.3	< .2	< .2	< .2	< .2
		07-28-92	--	--	--	--	--	13.6	< .2	< .2	< .2	< .2
		08-12-92	--	438	7.4	11.5	1.2	13.5	< .2	< .2	< .2	< .2
		09-28-92	--	515	7.4	12.3	3.2	13.8	< .2	< .2	< .2	< .2
		11-13-92	849.15	173	7.5	11.2	.3	3.3	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-5-H— Continued	13	12-04-92	850.14	--	--	--	--	--	--	--	--	--
		12-29-92	851.80	198	7.2	8.6	0.2	15.6	<0.2	<0.2	<0.2	<0.2
		01-11-93	851.13	--	--	--	--	--	--	--	--	--
		03-01-93	--	345	7.2	8.1	--	12.6	< .2	< .2	< .2	< .2
		04-12-93	855.29	460	7.4	7.8	.6	3.4	< .2	< .2	< .2	< .2
		05-19-93	854.53	263	7.0	8.5	--	--	--	--	--	--
		08-04-93	--	535	7.2	12.2	--	11.0	< .2	< .2	< .2	< .2
SR-5-G	15	06-12-92	--	725	7.7	11.2	--	6.2	< .2	< .2	< .2	< .2
		07-28-92	--	--	--	--	--	8.3	< .2	< .2	< .2	< .2
		08-12-92	--	597	7.4	10.7	1.5	12.5	< .2	< .2	< .2	< .2
		09-28-92	--	650	7.3	11.8	2.8	11.8	< .2	< .2	< .2	< .2
		11-13-92	850.41	236	7.5	11.0	.4	2.3	< .2	< .2	< .2	< .2
		12-04-92	851.61	--	--	--	--	--	--	--	--	--
		12-29-92	853.28	463	7.3	9.2	.2	15.9	< .2	< .2	< .2	< .2
		01-11-93	852.61	--	--	--	--	--	--	--	--	--
		03-01-93	--	333	7.2	7.3	--	12.6	< .2	< .2	< .2	< .2
		04-12-93	856.45	369	7.4	8.2	.7	3.2	< .2	< .2	< .2	< .2
		05-19-93	855.27	597	6.9	8.9	--	--	--	--	--	--
		08-04-93	--	536	7.1	11.5	--	10.2	< .2	< .2	< .2	< .2
SR-5-F	17	06-12-92	--	740	7.9	11.6	--	6.4	< .2	< .2	< .2	< .2
		07-28-92	--	--	--	--	--	7.8	< .2	< .2	< .2	< .2
		08-12-92	--	577	7.5	10.5	1.5	15.9	< .2	< .2	< .2	< .2
		09-28-92	--	400	7.3	11.4	2.9	11.9	< .2	< .2	< .2	< .2
		11-13-92	848.95	438	7.5	10.9	.7	6.1	< .2	< .2	< .2	< .2
		12-04-92	850.14	--	--	--	--	--	--	--	--	--
		12-29-92	851.79	196	7.3	9.4	.7	16.0	< .2	< .2	< .2	< .2
		01-11-93	851.13	--	--	--	--	--	--	--	--	--
		03-01-93	--	494	7.2	8.3	--	14.1	< .2	< .2	< .2	< .2
		04-12-93	855.25	387	7.5	8.8	.7	2.3	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-5-F—Continued	17	05-19-93	854.53	198	7.0	9.3	--	--	--	--	--	--
		08-04-93	--	472	7.1	11.2	--	9.1	<0.2	<0.2	<0.2	<0.2
SR-5-E	19	06-12-92	--	712	7.8	11.5	--	24.8	< .2	< .2	< .2	< .2
		07-28-92	--	--	--	--	--	18.7	< .2	< .2	< .2	< .2
		08-12-92	--	427	7.6	10.5	1.6	24.6	< .2	< .2	< .2	< .2
		09-28-92	--	480	7.6	11.0	5.6	23.4	< .2	< .2	< .2	< .2
		11-13-92	848.95	534	7.5	10.7	.7	20.5	< .2	< .2	< .2	< .2
		12-04-92	850.14	--	--	--	--	--	--	--	--	--
		12-29-92	851.78	140	7.4	9.2	1.3	22.0	< .2	< .2	< .2	< .2
		01-11-93	851.13	--	--	--	--	--	--	--	--	--
		03-01-93	--	171	7.4	8.6	--	12.7	< .2	< .2	< .2	< .2
		04-12-93	855.25	445	7.6	8.8	1.1	13.7	< .2	< .2	< .2	< .2
		05-19-93	854.53	663	7.1	9.5	--	--	--	--	--	--
		08-04-93	--	808	7.0	11.2	--	18.5	< .2	< .2	< .2	< .2
SR-5-D	21	06-12-92	--	795	7.7	11.5	--	31.1	< .2	< .2	< .2	< .2
		07-28-92	--	--	--	--	--	25.1	< .2	< .2	< .2	< .2
		08-12-92	--	544	7.6	10.9	7.4	14.5	< .2	< .2	< .2	< .2
		09-28-92	--	510	7.5	10.8	10.8	24.4	< .2	< .2	< .2	< .2
		11-13-92	848.35	180	7.5	10.7	4.8	26.2	< .2	< .2	< .2	< .2
		12-04-92	850.14	--	--	--	--	--	--	--	--	--
		12-29-92	851.78	144	7.4	9.0	6.8	21.1	< .2	< .2	< .2	< .2
		01-11-93	851.14	--	--	--	--	--	--	--	--	--
		03-01-93	--	215	7.4	8.8	--	24.1	< .2	< .2	< .2	< .2
		04-12-93	855.22	447	7.5	9.0	1.1	15.7	< .2	< .2	< .2	< .2
		05-19-93	854.53	201	7.2	9.7	--	--	--	--	--	--
		08-04-93	--	384	7.0	11.2	--	33.3	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-5-C	23	06-11-92	--	308	7.8	13.1	--	16.6	<0.2	<0.2	<0.2	<0.2
		07-28-92	--	--	--	--	--	18.9	< .2	< .2	< .2	< .2
		08-12-92	--	536	7.7	10.5	3.2	25.1	< .2	< .2	< .2	< .2
		09-28-92	--	115	7.6	10.9	9.2	16.5	< .2	< .2	< .2	< .2
		11-13-92	848.95	515	7.5	10.5	4.0	20.0	< .2	< .2	< .2	< .2
		12-04-92	850.14	--	--	--	--	--	--	--	--	--
		12-29-92	851.78	135	7.3	8.9	5.5	20.1	< .2	< .2	< .2	< .2
		01-11-93	851.14	--	--	--	--	--	--	--	--	--
		03-11-93	--	387	7.3	8.7	--	16.8	< .2	< .2	< .2	< .2
		04-12-93	855.22	160	7.5	9.2	6.0	24.2	< .2	< .2	< .2	< .2
		05-19-93	854.53	169	7.1	10.1	--	--	--	--	--	--
		08-04-93	--	245	7.1	11.6	--	22.1	< .2	< .2	< .2	< .2
SR-5-B	25	06-11-92	--	297	7.9	12.2	--	14.0	< .2	< .2	< .2	< .2
		07-28-92	--	--	--	--	--	13.2	< .2	< .2	< .2	< .2
		08-12-92	--	193	7.7	10.6	1.2	15.4	< .2	< .2	< .2	< .2
		09-28-92	--	490	7.6	10.6	4.6	14.5	< .2	< .2	< .2	< .2
		11-13-92	848.95	349	7.5	10.4	2.0	14.3	< .2	< .2	< .2	< .2
		12-04-92	850.17	--	--	--	--	--	--	--	--	--
		12-29-92	851.75	149	7.3	9.1	2.0	17.6	< .2	< .2	< .2	< .2
		01-11-93	851.15	--	--	--	--	--	--	--	--	--
		03-11-93	--	423	7.5	8.7	--	14.6	< .2	< .2	< .2	< .2
		04-12-93	855.00	408	7.5	9.6	3.9	16.2	< .2	< .2	< .2	< .2
		05-19-93	854.53	178	7.0	10.2	--	--	--	--	--	--
		08-04-93	--	272	7.2	11.2	--	20.1	< .2	< .2	< .2	< .2
SR-5-A	27	06-11-92	--	319	7.9	12.4	--	13.0	< .2	< .2	< .2	< .2
		07-28-92	--	--	--	--	--	11.6	< .2	< .2	< .2	< .2
		08-12-92	--	562	7.7	10.4	1.1	14.9	< .2	< .2	< .2	< .2
		09-28-92	--	370	7.6	10.6	1.0	14.4	< .2	< .2	< .2	< .2
		11-13-92	848.95	309	7.4	10.4	.6	14.1	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-5-A—Continued	27	12-04-92	850.14	--	--	--	--	--	--	--	--	--
		12-29-92	851.75	349	7.2	8.5	1.0	17.6	<0.2	<0.2	<0.2	<0.2
		01-11-93	851.15	--	--	--	--	--	--	--	--	--
		03-01-93	--	187	7.4	8.4	--	13.2	< .2	< .2	< .2	< .2
		04-12-93	854.84	349	7.5	9.3	1.2	15.6	< .2	< .2	< .2	< .2
		05-19-93	854.53	188	7.0	10.3	--	--	--	--	--	--
		08-04-93	--	405	7.1	11.2	--	17.6	< .2	< .2	< .2	< .2
SR-5-30	31.5	05-11-92	853.61	--	--	--	--	--	--	--	--	--
		05-19-92	853.06	--	--	--	--	--	--	--	--	--
		05-27-92	852.68	--	--	--	--	--	--	--	--	--
		06-11-92	852.09	654	7.8	15.7	--	<1.0	< .2	< .2	< .2	< .2
		07-28-92	856.39	--	--	--	--	--	--	--	--	--
		08-12-92	--	309	7.6	10.8	1.3	<1.0	< .2	< .2	< .2	< .2
		09-28-92	850.27	500	7.5	10.0	3.8	1.3	< .2	< .2	< .2	< .2
		10-13-92	849.60	--	--	--	--	--	--	--	--	--
		11-13-92	849.74	288	7.4	10.3	.5	1.3	< .2	< .2	< .2	< .2
		12-04-92	850.04	--	--	--	--	--	--	--	--	--
		12-29-92	852.57	530	6.7	8.8	.5	3.0	< .2	< .2	< .2	< .2
		01-11-93	851.94	--	--	--	--	--	--	--	--	--
		03-01-93	850.94	632	7.4	8.8	--	<1.0	< .2	< .2	< .2	< .2
		04-12-93	856.02	322	7.3	9.8	.2	2.1	< .2	< .2	< .2	< .2
		05-19-93	855.35	563	7.3	10.5	--	--	--	--	--	--
		08-04-93	855.52	526	7.7	11.5	--	3.4	< .2	< .2	< .2	< .2
SR-6-8	9	05-11-92	854.71	--	--	--	--	--	--	--	--	--
		05-19-92	854.42	--	--	--	--	--	--	--	--	--
		05-27-92	854.24	--	--	--	--	--	--	--	--	--
		06-12-92	853.95	772	7.3	10.3	--	11.1	< .2	< .2	< .2	< .2
		07-28-92	856.98	--	--	--	--	6.4	.4	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-6-8—Continued	9	08-11-92	854.99	563	7.3	15.5	0.7	7.3	<0.2	<0.2	<0.2	<0.2
		09-28-92	851.13	463	7.1	16.8	3.8	2.7	.3	< .2	< .2	< .2
		10-13-92	--	--	--	--	--	--	--	--	--	--
		11-13-92	852.54	751	7.4	13.5	2.8	5.5	.3	< .2	< .2	< .2
		12-04-92	853.14	--	--	--	--	--	--	--	--	--
		01-11-93	853.79	--	--	--	--	--	--	--	--	--
		03-01-93	853.55	242	7.6	2.4	--	8.1	< .2	< .2	< .2	< .2
		04-12-93	856.08	449	7.0	4.0	1.7	4.7	< .2	< .2	< .2	< .2
		05-19-93	855.54	300	6.8	6.6	--	--	--	--	--	--
		08-04-93	855.89	799	7.0	12.2	--	<1.0	< .2	< .2	< .2	< .2
SR-6-F	11.5	06-12-92	--	759	7.0	6.7	--	11.9	--	--	--	--
		07-28-92	--	--	--	--	--	8.7	.4	< .2	< .2	< .2
		08-11-92	--	304	7.6	10.8	.8	6.4	--	--	--	--
		09-28-92	--	408	7.2	15.6	6.0	2.5	.4	< .2	< .2	< .2
		11-13-92	855.69	453	7.5	14.2	2.6	7.0	.3	< .2	< .2	< .2
		12-04-92	856.68	--	--	--	--	--	--	--	--	--
		01-11-93	856.13	--	--	--	--	--	--	--	--	--
		03-01-93	--	314	7.8	3.3	--	8.4	.2	< .2	< .2	< .2
		04-12-93	860.30	137	7.2	4.1	4.7	1.4	< .2	< .2	< .2	< .2
		05-19-93	859.89	301	6.7	5.4	--	--	--	--	--	--
		08-04-93	--	448	7.1	8.6	--	--	--	--	--	--
SR-6-E	13.5	06-12-92	--	745	7.6	8.0	--	11.6	.3	< .2	< .2	.2
		08-11-92	--	592	7.6	9.0	1.0	6.3	--	--	--	--
		09-28-92	--	578	7.3	15.2	5.2	2.2	.3	< .2	< .2	< .2
		11-13-92	855.54	614	7.5	14.3	2.5	7.2	< .2	< .2	< .2	< .2
		12-04-92	856.43	--	--	--	--	--	--	--	--	--

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-6-E—Continued	13.5	01-11-93	856.11	--	--	--	--	--	--	--	--	--
		03-01-93	--	342	7.7	4.1	--	8.2	<0.2	<0.2	<0.2	<0.2
		04-12-93	860.30	147	7.2	4.3	5.9	1.4	< .2	< .2	< .2	< .2
		05-19-93	859.89	444	6.9	4.9	--	--	--	--	--	--
		08-04-93	--	554	7.2	8.3	--	1.1	< .2	< .2	< .2	< .2
SR-6-D	15.5	06-12-92	--	710	7.8	9.6	--	--	--	--	--	--
		07-28-92	--	--	--	--	--	7.9	.4	< .2	< .2	< .2
		08-11-92	--	686	7.7	8.8	1.1	4.3	--	--	--	--
		09-28-92	--	378	7.2	15.0	4.2	--	.3	< .2	< .2	< .2
		11-13-92	855.05	441	7.4	14.7	.9	7.3	.3	< .2	< .2	< .2
		12-04-92	856.21	--	--	--	--	--	--	--	--	--
		01-11-93	856.13	--	--	--	--	--	--	--	--	--
		03-01-93	--	709	7.7	4.2	--	8.4	< .2	< .2	< .2	< .2
		04-12-93	860.30	86	7.2	5.2	.9	2.2	< .2	< .2	< .2	< .2
		05-19-93	859.89	670	6.9	6.1	--	--	--	--	--	--
		08-04-93	--	557	7.1	10.7	--	1.0	< .2	< .2	< .2	< .2
SR-6-C	19.6	06-12-92	--	781	7.8	6.1	--	--	--	--	--	--
		07-28-92	--	--	--	--	--	8.2	.4	< .2	< .2	< .2
		08-11-92	--	644	7.8	8.5	1.3	4.6	--	--	--	--
		09-28-92	--	592	7.2	14.1	4.5	2.3	.3	< .2	< .2	< .2
		11-13-92	854.98	330	7.3	14.5	.6	7.5	< .2	< .2	< .2	< .2
		12-04-92	856.13	--	--	--	--	--	--	--	--	--
		01-11-92	856.15	--	--	--	--	--	--	--	--	--
		03-01-93	--	366	7.6	5.4	--	8.2	< .2	< .2	< .2	< .2
		04-12-93	860.30	173	7.1	4.6	5.0	7.3	< .2	< .2	< .2	< .2
		05-19-93	859.89	613	7.0	4.8	--	--	--	--	--	--
		08-04-93	--	209	7.1	7.0	--	4.2	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-6-B	21.9	06-12-92	--	716	7.6	5.6	--	--	--	--	--	--
		07-28-92	--	--	--	--	--	5.5	0.3	<0.2	<0.2	<0.2
		08-11-92	--	508	7.8	8.2	1.0	8.2	--	--	--	--
		09-28-92	--	455	7.2	13.9	3.9	3.6	.3	< .2	.2	< .2
		11-13-92	855.00	529	7.2	14.4	.6	1.8	.2	< .2	< .2	< .2
		12-04-92	856.12	--	--	--	--	--	--	--	--	--
		01-11-93	856.15	--	--	--	--	--	--	--	--	--
		03-01-93	--	758	7.3	5.5	--	8.1	< .2	< .2	< .2	< .2
		04-12-93	860.30	320	7.2	4.9	1.2	7.5	< .2	< .2	< .2	< .2
		05-19-93	859.89	684	7.0	4.9	--	--	--	--	--	--
		08-04-93	--	366	7.2	7.9	--	3.5	< .2	< .2	< .2	< .2
SR-6-A	23.6	06-12-92	--	775	7.7	5.6	--	10.9	--	--	--	--
		07-28-92	--	--	--	--	--	5.4	--	--	--	--
		08-11-92	--	585	7.7	8.4	1.4	9.6	--	--	--	--
		09-28-92	--	449	7.2	13.6	3.6	4.0	.3	< .2	.2	< .2
		11-13-92	855.00	385	7.0	14.2	.6	3.3	.2	< .2	.2	< .2
		12-04-92	856.12	--	--	--	--	--	--	--	--	--
		01-11-93	857.11	--	--	--	--	--	--	--	--	--
		03-01-93	--	681	7.1	5.8	--	9.0	.2	< .2	< .2	< .2
		04-12-93	860.30	198	7.4	5.2	1.4	8.4	< .2	< .2	< .2	< .2
		05-19-93	859.89	672	7.1	5.2	--	--	--	--	--	--
		08-04-93	--	370	7.2	7.1	--	5.5	< .2	< .2	< .2	< .2
SR-6-28	29.5	05-11-92	854.33	--	--	--	--	--	--	--	--	--
		05-27-92	853.69	--	--	--	--	--	--	--	--	--
		06-12-92	853.23	756	7.5	6.7	--	10.1	--	--	--	--
		07-28-92	856.65	--	--	--	--	8.7	.4	< .2	< .2	< .2
		08-11-92	854.81	680	7.8	9.3	1.2	11.7	< .2	< .2	< .2	< .2

Table 2. Water levels and water-quality data for ground-water samples from South Skunk River alluvial aquifer, Story County, Iowa, May 1992–August 1993—Continued

Well identification	Depth (ft below land surface)	Date (month-day-year)	Water level (ft above sea level)	Specific conductance (µS/cm)	pH (standard units)	Temperature, water (°C)	Oxygen, dissolved (mg/L)	Nitrate as nitrogen (mg/L)	Atrazine (µg/L)	Alachlor (µg/L)	Metolachlor (µg/L)	Metribuzin (µg/L)
SR-6-28—Continued	29.5	09-28-92	850.96	508	7.2	14.3	5.3	6.8	0.2	<0.2	<0.2	<0.2
		10-13-92	850.11	--	--	--	--	--	--	--	--	--
		11-13-92	850.88	113	7.6	13.7	2.9	3.8	.2	< .2	< .2	< .2
		12-04-92	851.98	--	--	--	--	--	--	--	--	--
		01-11-93	852.98	--	--	--	--	--	--	--	--	--
		03-01-93	852.27	273	7.5	5.4	--	9.1	< .2	< .2	< .2	< .2
		04-12-93	856.21	433	7.1	5.3	5.7	8.4	< .2	< .2	< .2	< .2
		05-19-93	854.96	380	6.8	5.9	--	--	--	--	--	--
		08-04-93	855.85	376	6.7	8.0	--	5.6	< .2	< .2	< .2	< .2

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