OCCURRENCE OF PESTICIDES, NITRITE PLUS NITRATE, ARSENIC, AND IRON IN WATER FROM TWO REACHES OF THE MISSOURI RIVER ALLUVIUM, NORTHWESTERN MISSOURI--JULY 1988 AND JUNE-JULY 1989

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CONVERSION FACTORS

Multiply	By	To obtain
acre	0.4047	hectare
foot (ft)	0.3048	meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
inch (in.)	25.4	millimeter
square mile (mi^2)	259.0	hectare
mile (mi)	0.62	kilometer

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

$$°F = 9/5\ °C + 32.$$

OCCURRENCE OF PESTICIDES, NITRITE PLUS NITRATE, ARSENIC, AND IRON IN WATER FROM TWO REACHES OF THE MISSOURI RIVER ALLUVIUM, NORTHWESTERN MISSOURI--JULY 1988 AND JUNE-JULY 1989

By

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ABSTRACT

During 1988, pesticides were detected in 4 of 59 wells sampled in the northwestern reach of the Missouri River alluvium between the Iowa border and St. Joseph, Missouri. During 1989, pesticides were detected in 7 of 50 wells sampled in the northwestern reach and in 3 of 31 wells sampled in the west-central reach between Kansas City and Miami, Missouri.

During June 1989, pesticides were detected in water from all 14 surface-water sites sampled in the west-central reach. Atrazine concentrations equalled or exceeded the U.S. Environmental Protection Agency's maximum contaminant level of 3 micrograms per liter in 8 of 14 surface-water samples.

During 1988, nitrite plus nitrate concentrations as nitrogen equalled or exceeded the Missouri drinking-water-supply criteria of 10 milligrams per liter in samples from 9 of 60 wells in the northwestern reach. During 1989, samples from 7 of 51 wells in the northwestern reach and 3 of 31 wells in the west-central reach equalled or exceeded the criteria.

Arsenic concentrations equalled or exceeded the Missouri drinking-water-supply criteria of 50 micrograms per liter in samples from five wells during 1988 and from two wells during 1989 in the northwestern reach of the Missouri River alluvium. Arsenic concentrations were less than 15 micrograms per liter in all wells sampled in the west-central reach. During 1989, the mean detected iron concentration was 8,000 micrograms per liter in samples from wells in the northwestern reach, and 6,300 micrograms per liter from wells in the west-central reach.

INTRODUCTION

The Missouri River alluvium primarily is used for agricultural crop production. Corn, soybeans, wheat, and grain sorghum are the dominant crops. Pesticides and nitrogen fertilizers are used extensively on these crops and may enter ground and surface water. Because ground water from the alluvium is the primary drinking-water source for many people in the area, the U.S. Geological Survey (USGS), in cooperation with the Missouri Department of Health (DOH), conducted a study during 1988 and 1989 to determine concentrations of pesticides, nitrite plus nitrate, arsenic, and iron in ground and surface water from two reaches of the Missouri River alluvium in northwestern Missouri. This report contains the results of analyses for pesticides, nitrite plus nitrate, arsenic, and iron in ground water from domestic- and livestock-supply and irrigation wells and results of analyses for pesticides in surface water.

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More than 90 percent of the planted corn and soybean acreage in Missouri was treated with pesticides during 1988 and 1989 (Missouri Department of Agriculture, 1989; 1990). Alachlor, atrazine, butylate, chlorpyrifos, cyanazine, and metolachlor were used on 46 percent of the corn acreage planted. Trifluralin commonly is applied on soybeans, often with alachlor, chlorimuron, imazaquin, and metribuzin for weed and grass control. During 1988 and 1989, the most common nitrogen fertilizer applied was dry urea. Nitrogen solutions, ammonium nitrate, and anhydrous ammonia also were applied.

Pesticides in water from a well may originate from a point source, such as mixing pesticides near the well, or from a non-point source caused by application of pesticides to a field and subsequent infiltration to the ground water. Nitrate may be present in ground water because of field application of fertilizers, wastes from feedlots, or leakage from septic systems or sewage-treatment plants.

Based on previous sampling by the DOH, arsenic and iron concentrations in ground water from the Missouri River alluvium (Missouri Department of Health, oral commun., 1988) occasionally are high enough to be of an esthetic or health concern. The distribution and source of arsenic and iron in the aquifer are unknown but may originate from a natural source (the mineral arsenopyrite), insecticides, or waste-water treatment facilities (O'Neil, 1990).

Study Area

The Missouri River alluvium is a large source of fresh ground water in Missouri. The alluvium has a total surface of about 2,000 mi^2 (square miles) in the State (Emmett and Jeffrey, 1969; 1970). Two reaches (fig. 1) of the alluvium were studied because of the large areal extent of the alluvium, the extensive agricultural land use, and lack of alternative drinking-water supplies. The two reaches studied have a total surface area of about 1,100 mi^2, or 704,000 acres (Emmett and Jeffrey, 1969; 1970).

The northwestern reach is from the Iowa border to St. Joseph, Missouri (fig. 2). The west-central reach is from Kansas City to Miami, Missouri (fig. 3). The width of the alluvium in the northwestern reach ranges from 3 to 16 mi (miles) in Missouri and has a total surface area of about 680 mi^2, or 435,000 acres (Emmett and Jeffrey, 1969), in parts of Andrew, Atchison, Buchanan, and Holt Counties. The width of the alluvium in the west-central reach ranges from 2 to 10 mi and has a total surface area of about 420 mi^2, or 269,000 acres (Emmett and Jeffrey, 1970), in parts of Carroll, Clay, Jackson, Lafayette, Ray, and Saline Counties.

Annual precipitation averages about 36 in. (inches). However, during 1988, precipitation was less than 50 percent of the average (Missouri Department of Agriculture, 1989; 1990). During 1989, precipitation was slightly less than average.

Previous Investigations

Emmett and Jeffery (1969, 1970) completed a reconnaissance of the ground-water resources of the alluvium in the northwestern and west-central reaches of the Missouri River. The thickness of the alluvium in the northwestern and west-central reaches ranges from 0 to 160 ft (feet), and averages about 90 ft in both reaches. The mean depth to water was 10 to 15 ft.

During 1984 and 1985, Detroy and Kuzniar (1988) investigated pesticide and nitrite plus nitrate concentrations in the Iowa River alluvial aquifer. Atrazine was detected in 15 of the 39 wells sampled [detection limit of 0.10 µg/L (microgram per liter)]. Nitrite plus nitrate concentrations exceeded the U.S. Environmental Protection Agency's (EPA) maximum contaminant level (MCL) of 10 mg/L (milligrams per liter) as nitrogen in 9 percent of the wells sampled and 50 percent of the wells had nitrite plus nitrate concentrations greater than or equal to 1.0 mg/L. Nitrite plus nitrate concentrations were larger in shallow wells.

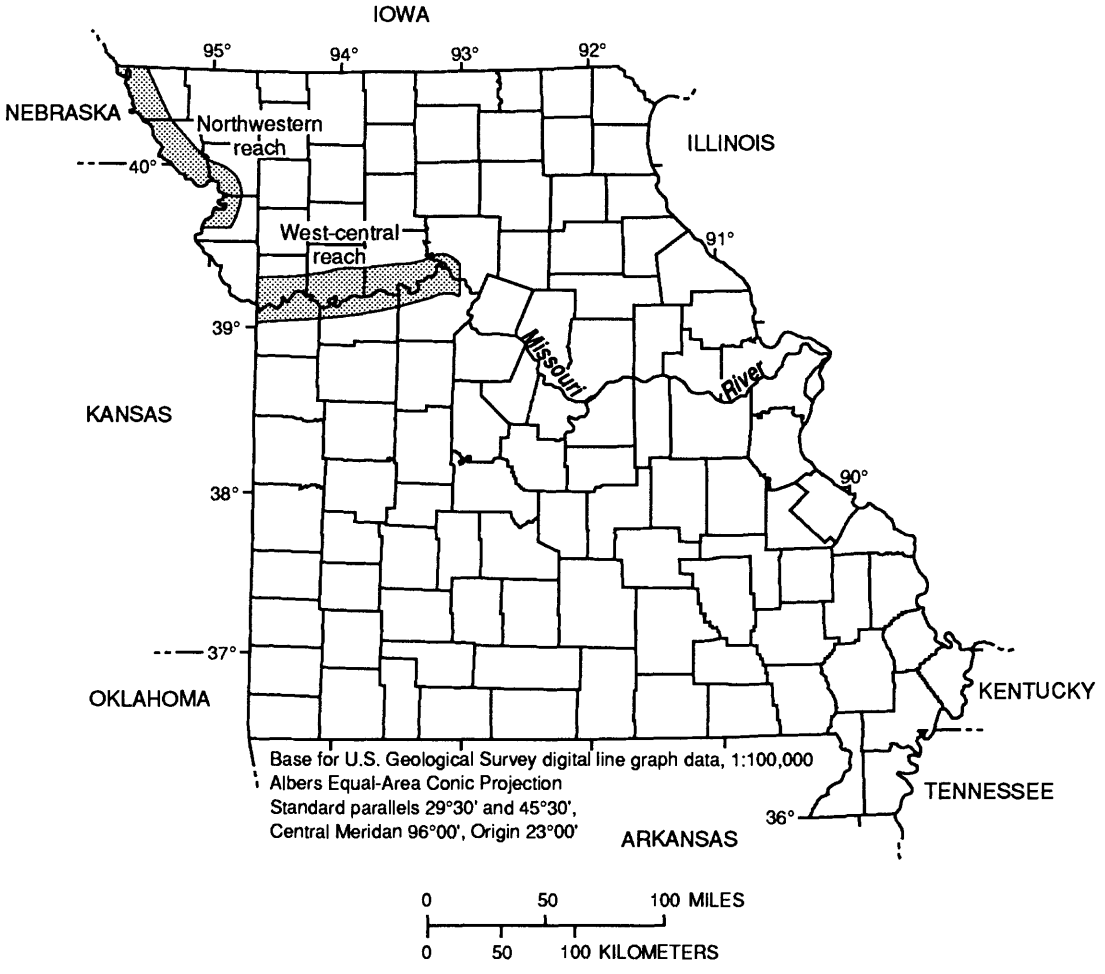

Figure 1. Location of sampled reaches of the Missouri River alluvium.

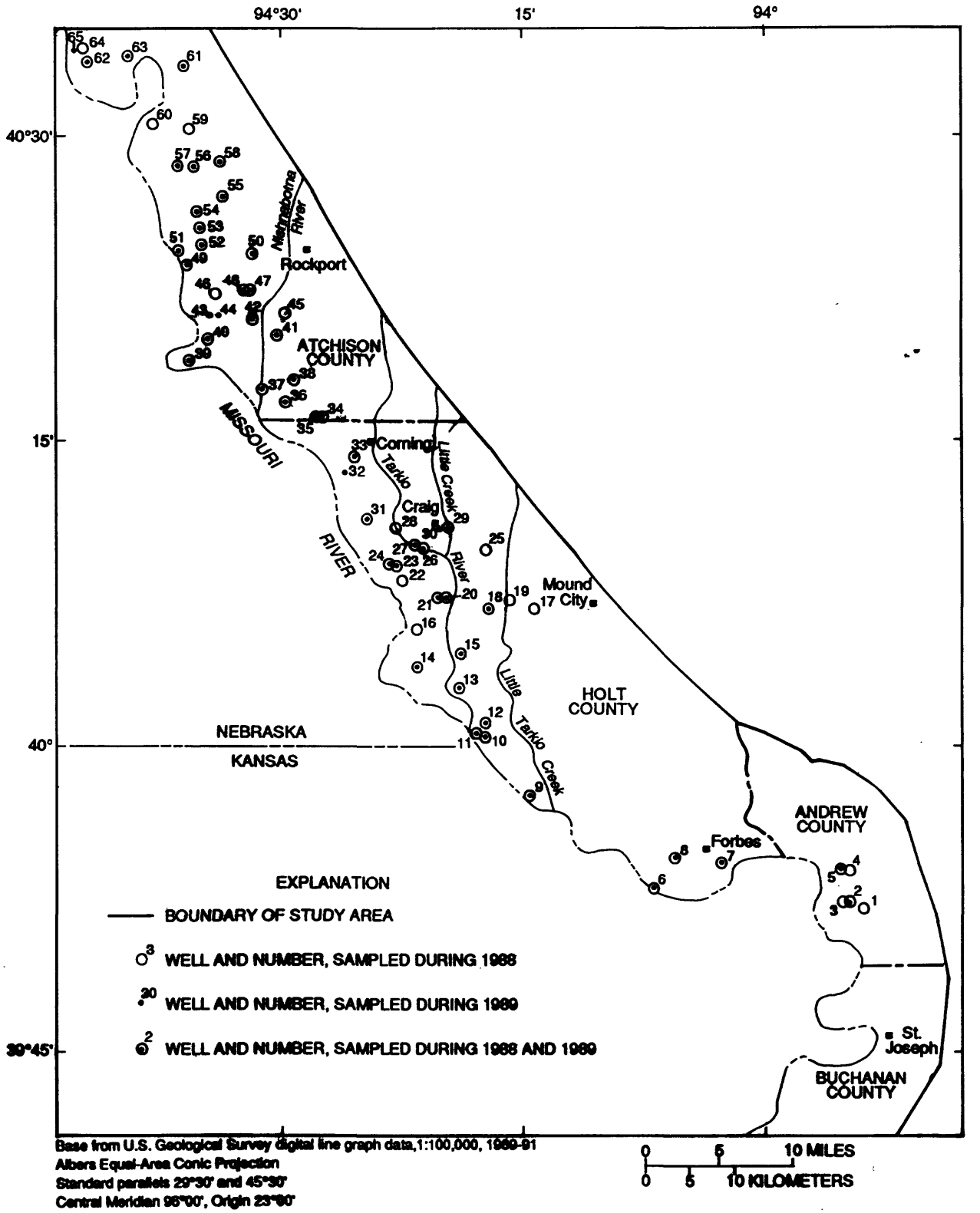

Figure 2. Location of wells sampled in the northwestern reach during 1988 and 1989.

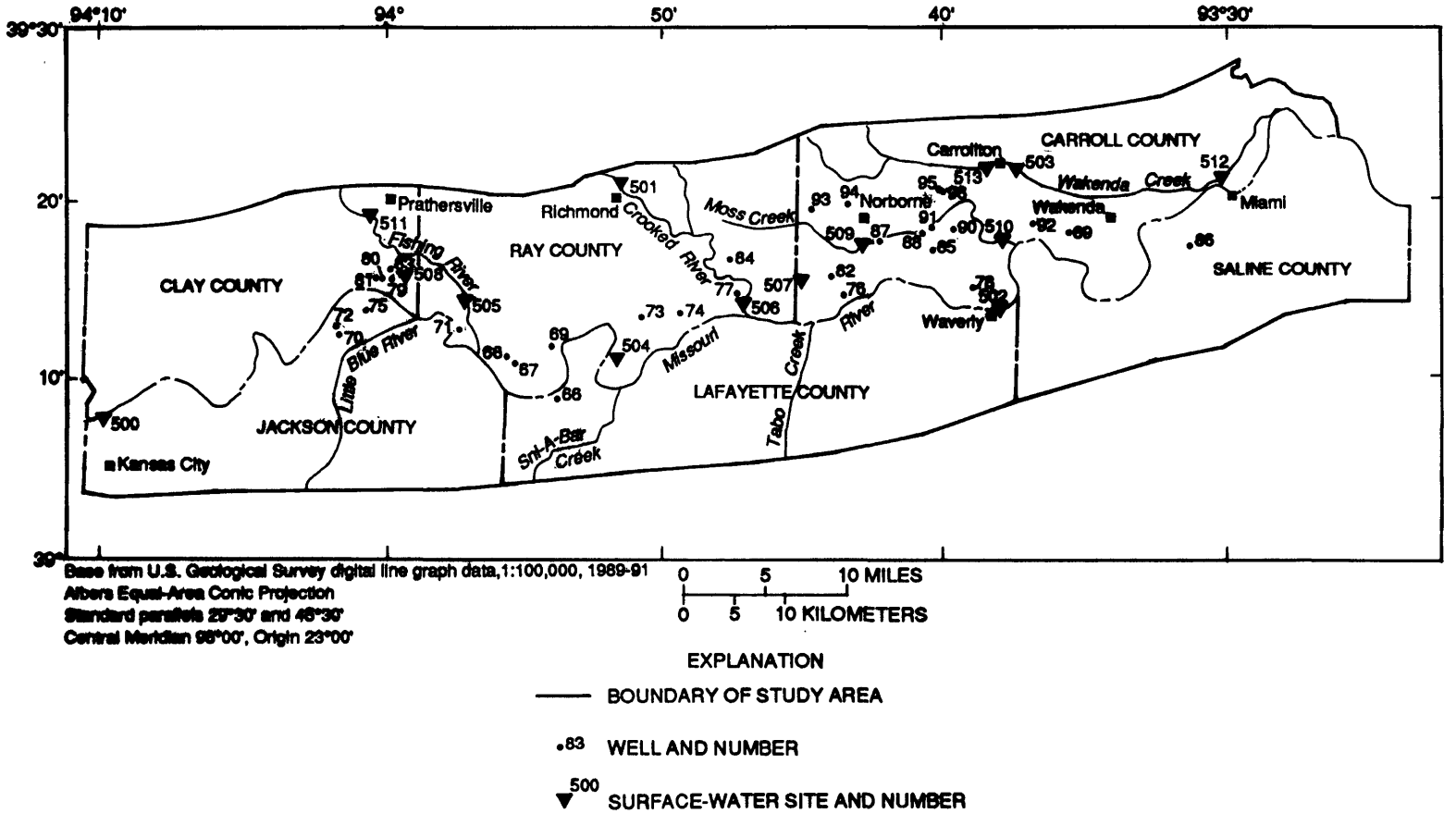

Figure 3. Location of wells and surface-water sites sampled in the west-central reach during 1989.

During 1985, Detroy and others (1988) analyzed pesticide and nitrite plus nitrate concentrations in water from 515 wells less than 201 ft deep in Iowa. Atrazine was detected in 18 percent of the wells sampled, and was the most frequently detected pesticide (detection limit of 0.10 µg/L). Nitrite plus nitrate concentrations exceeded the EPA MCL of 10 mg/L as nitrogen in 7 percent of the wells sampled.

During 1986 and 1987, Mesko and Carlson (1988) sampled ground and surface water from the Mississippi River alluvium in southeastern Missouri and analyzed samples for 34 pesticides and nitrite plus nitrate. Pesticides were detected in 27 percent of the 124 wells sampled. Alachlor, atrazine, cyanazine, metolachlor, metribuzin, propachlor, and trifluralin were among the most frequently detected pesticides. Nitrite plus nitrate concentrations exceeded the Missouri drinking-water-supply criteria of 10 mg/L in 18 percent of the 137 wells sampled. Pesticides were detected in water from all five of the surface-water sites sampled.

Sievers and Fulhage (1989) sampled four areas in Missouri for pesticide and nitrite plus nitrate concentrations in ground water. They sampled 25 wells in the Missouri River alluvium from Napoleon to Jefferson City, Missouri, during 1987 and 1988. Alachlor was detected in two wells (8 percent of the wells sampled). Nitrite plus nitrate concentrations were greater than 1.0 mg/L in 40 percent of the wells sampled and exceeded the Missouri drinking-water-supply criteria of 10 mg/L in 8 percent of the samples.

Tanner and Steele (1991) analyzed water samples for concentrations of atrazine, nitrite plus nitrate, arsenic, iron, and common cations and anions from 13 irrigation, industrial, and municipal wells located in the Missouri River alluvium in southeastern Nebraska. The depth of the wells sampled ranged from 53 to 109 ft, and averaged 75 ft deep. Atrazine was detected in one well. Dissolved nitrite plus nitrate concentrations were less than the detection limit of 0.1 mg/L as nitrogen in all of the wells sampled. Dissolved arsenic concentrations ranged from 3 to 14 µg/L with a mean concentration of 11 µg/L. Dissolved iron concentrations ranged from 870 to 12,000 µg/L with a mean concentration of 7,900 µg/L.

Selection and Description of Sampling Sites

In the northwestern reach (fig. 2), alluvial wells were selected for wide areal distribution by dividing the alluvium into 45 sections of about equal area. Within each section, two wells were randomly selected for sampling. Because a random sampling of domestic drinking water was desired, wells were not excluded from sampling if pesticides or fertilizers were mixed near the well. In some areas there were no wells available to sample. Of the sites sampled in the northwestern reach, 59 were domestic-supply, 4 were livestock-supply, and 2 were irrigation wells (table 1, at the back of this report). Well depths were available for 48 of the 65 wells sampled and most of the well depths were provided by the well owners. Sixty-five percent of the sampled wells for which well depths were available are less than 45 ft deep. Well depths range from 13 to 119 ft with a mean depth of 42 ft for the wells with depth information.

Sampling sites were chosen in the west-central reach (fig. 3) in the same manner as sites from the northwestern reach (fig. 2). Twenty-nine of the sampled wells were domestic-supply, 1 was a livestock-supply well, and 1 was an irrigation well. Well depths were provided by the well owners and were available for 21 of the 31 wells sampled. Well depths range from 15 to 100 ft with a mean depth of 33 ft.

Surface-water sites were selected for sampling in the west-central reach to determine concentrations of constituents where the streams entered the alluvium from the uplands and immediately upstream from where the streams flowed into the Missouri River (table 2, at the back of this report). The Missouri River, the four largest streams, and the outflows of the four largest lakes in the west-central reach were sampled because of their size and possible transport of constituents to the alluvium (fig. 3).

Methods

Ground-water samples were collected after purging the well for at least 10 minutes or until the water temperature remained constant. For most wells, pumping for 10 minutes removed three well volumes. Samples were collected directly from the spigot nearest the wells without passing through any hoses. No samples were collected that passed through water treatment or softening systems. Where possible, samples were collected before pressure tanks. Surface-water samples were collected for pesticide analysis from a depth-integrated sample collected in the middle of the stream. Lake samples were collected by dipping a collection bottle in the lake near the outflow.

All samples were collected in glass bottles and were unfiltered. Water samples were collected for pesticide analyses in 1-L (liter) glass bottles, chilled, and maintained at 4 °C (degrees Celsius). Samples for onsite screening by enzyme-linked immunoassay for triazine herbicides were subsampled from the 1-L pesticide bottle in July 1988. During 1989, the immunoassay onsite-screening samples and surface-water samples were collected in 125 mL (milliliters) amber glass bottles, chilled, and maintained at 4 °C. Samples collected for nitrite plus nitrate analyses were collected in 125 mL amber glass bottles and preserved with sulfuric acid to inhibit bacterial growth. Samples analyzed for arsenic and iron concentrations were collected in 125 mL glass bottles and acidified to a pH value of less than 2.0 with nitric acid.

The DOH laboratory analyzed samples collected in July 1988 to determine pesticide concentrations. In July 1988, selected samples were subsampled from the 1-L pesticide bottle and screened onsite at the time of sample collection for concentrations of triazine herbicides. The immunoassay used in this study reacts with triazine herbicides, including ametryn, atrazine, cyanazine, deethylatrazine, deisopropylatrazine, hydroxyatrazine, prometon, prometryn, propazine, and simazine. Concentrations of triazine herbicides in samples that were screened onsite were determined by visual comparison to a 0.5 µg/L standard. Samples collected in July 1989 were analyzed for triazine herbicides within five days after collection at a USGS laboratory. Results were quantified by comparison to standards using a differential photometer with a detection limit of 0.2 µg/L (Thurman and others, 1990). Samples collected in July 1989 were analyzed by the University of Iowa Hygienic Laboratory to determine pesticide concentrations. Detection limits for the analyses are in tables 3 to 6 (at the back of this report). The detection limit for atrazine was 2.4 µg/L during 1988. The detection limit for atrazine was 0.05 or 0.10 µg/L during 1989. The immunoassay results were used for quality assurance of data obtained from the other laboratories. Also, quality-assurance samples, including duplicates and a blank, were analyzed for a similar suite of pesticides by a USGS laboratory and the University of Iowa Hygienic Laboratory (tables 3 to 6).

Nitrite plus nitrate concentrations (detection limit of 0.05 mg/L) were determined using the methods of the DOH laboratory. Arsenic (detection limit of 5 µg/L) and iron (detection limit of 100 µg/L) concentrations, considered to be total recoverable, were determined using the methods of the DOH laboratory. Total iron concentrations for selected samples collected in July 1988 and July 1989 were determined colorimetrically with a spectrophotometer set at a wavelength of 510 nanometers at the time of sample collection. Methods were adapted from those described by the Hach Company[1], with Hach Company reagents containing 1,10 phenathroline and hydroxylamine hydrochloric acid.

Values of specific conductance, pH, and water temperature were determined at the time of sampling. Specific conductance was measured using a portable conductivity meter with temperature compensation designed to express readings in microsiemens per centimeter at 25 °C. The pH values

[1] Use of trade or firm names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

were measured using a portable pH meter calibrated with standard buffers bracketing the expected sample pH value. Water temperature was measured using a mercury thermometer to the nearest 0.5 °C.

PESTICIDES IN GROUND AND SURFACE WATER

This section describes the results of pesticide analyses on water samples collected from wells in the northwestern and west-central reaches of the Missouri River alluvium and also the results of pesticide analyses on water samples from surface-water sites in the west-central reach. Water samples were collected in July 1988 from 53 domestic-supply, 4 livestock-supply, and 2 irrigation wells in the northwestern reach, and water samples were collected in July 1989 from 46 domestic-supply, 3 livestock-supply, and 1 irrigation well. Water samples were collected in June-July 1989 from 29 domestic-supply, 1 livestock-supply, 1 irrigation well and 14 surface-water sites in the west-central reach.

Northwestern Reach

Water samples collected in July 1988 were analyzed for alachlor, atrazine, chlorpyrifos, metolachlor, and trifluralin (table 3). Pesticides were detected in water samples from four domestic-supply wells. The four wells were shallow (30 ft or less) sandpoint wells. Water samples from all four wells (wells 35, 55, 57, and 59) contained alachlor, and water from one of these wells (well 57) also contained metolachlor and trifluralin. Atrazine concentrations were less than the detection limit of 2.4 µg/L in water samples from all wells.

Water samples collected in July 1989 were analyzed for alachlor, atrazine, butylate, cyanazine, metolachlor, metribuzin, and trifluralin (table 4). Water samples from 2 of the 50 wells were analyzed for eight additional pesticides. At least one of the following pesticides--alachlor, atrazine, cyanazine, deethylatrazine, deisopropylatrazine, metolachlor, metribuzin, propazine, simazine, and trifluralin--was detected in water samples from seven domestic-supply wells. Atrazine (detection limit of 0.10 µg/L) was detected in water samples from all seven of these wells and was the most frequently detected pesticide. The atrazine concentration detected in water from one well exceeded the EPA MCL of 3 µg/L. All of the wells with detectable concentrations of herbicides were less than 41 ft deep, except for one well that was 80 ft deep.

During 1989, alachlor was detected in water samples from two (wells 35 and 57) of four wells (wells 35, 55, 57 and 59) where alachlor had been detected during 1988. Alachlor was not detected in the water sample from well 55, and well 59 was not resampled during 1989. Alachlor concentrations in water from well 35 decreased from 3.10 µg/L during 1988 to 1.10 µg/L during 1989, and alachlor concentrations in water from well 57 decreased from 3.60 µg/L during 1988 to 0.07 µg/L during 1989. However, alachlor was detected in one well (well 52) during 1989 that had not been sampled in July 1988.

During 1989, 7 of 50 wells had detectable pesticide concentrations in the northwestern reach as compared to 1 of 13 wells that had detectable pesticide concentrations sampled by Tanner and Steele (1991) in the Missouri River alluvium of southeastern Nebraska adjacent to the northwestern reach. The 13 wells that Tanner and Steele sampled range from 53 to 109 ft deep, and average 75 ft deep.

West-Central Reach

Water samples collected from wells in July 1989 were analyzed for alachlor, atrazine, butylate, cyanazine, metolachlor, metribuzin, and trifluralin (table 5). The water sample from well 96 was analyzed for eight additional pesticides. Pesticides were detected in water samples from three domestic-supply wells. The water sample from well 69 (no depth information available) contained 1.40 µg/L alachlor, the sample from well 73 (16 ft deep) contained metolachlor (0.11 µg/L) and metribuzin (0.19 µg/L), and the sample from well 96 (80 ft deep) contained 0.28 µg/L atrazine.

Alachlor concentrations exceeded 0.1 µg/L in water samples from 8 percent of the 25 wells that Sievers and Fulhage (1989) sampled in an area that partially overlaps the west-central reach of this study, whereas alachlor was detected in the water sample from 1 of the 30 well samples analyzed for alachlor in this study. No atrazine was detected by Sievers and Fulhage (1989).

Water samples collected in June 1989 from surface-water sites were analyzed for 13 pesticides (table 6). Atrazine was detected at all 14 sites in concentrations ranging from 0.12 to 6.60 µg/L, and atrazine concentrations equalled or exceeded the EPA MCL of 3 µg/L in water samples from 8 of the 14 sites. Deethylatrazine was detected at 13 surface-water sites. Alachlor and metolachlor were detected in water samples from 9 of the 14 sites. Alachlor concentrations ranged from 0.16 to 2.20 µg/L; metolachlor concentrations ranged from 0.05 to 1.50 µg/L. However, cyanazine and deisopropylatrazine were each detected at only one surface-water site.

NITRITE PLUS NITRATE IN GROUND WATER

This section describes the results of nitrite plus nitrate as nitrogen analyses on water samples collected from wells in the northwestern and west-central reaches of the Missouri River alluvium. Water samples were collected in July 1988 from 54 domestic-supply, 4 livestock-supply, and 2 irrigation wells in the northwestern reach; water samples also were collected in July 1989 from 47 domestic-supply, 3 livestock-supply, and 1 irrigation well. Water samples were collected in July 1989 from 29 domestic-supply, 1 livestock-supply, and 1 irrigation well in the west-central reach.

Northwestern Reach

In water samples collected in July 1988, concentrations of nitrite plus nitrate (as nitrogen) ranged from less than 0.05 (detection limit) to 50 mg/L (table 3). Nitrite plus nitrate was detected in water samples from 29 of the 60 wells sampled. No nitrite plus nitrate concentrations were detected in the two irrigation wells sampled. Nitrite plus nitrate concentrations from nine wells exceeded the Missouri drinking-water-supply criteria of 10 mg/L. All of the wells with nitrite plus nitrate concentrations greater than 10 mg/L were less than 45 ft deep, except well 45, which was 70 ft deep. Wells with nitrite plus nitrate concentrations greater than 10 mg/L were uniformly distributed across the northwestern reach of the study area.

In water samples collected in July 1989, concentrations of nitrite plus nitrate ranged from less than 0.05 (detection limit) to 55 mg/L (table 4). Nitrite plus nitrate concentrations were detected in water samples from 21 of the 50 wells sampled. Where depth information was available for the wells, the well depths range from 15 to 50 ft and average 25 ft for wells that had detectable concentrations of nitrite plus nitrate. Nitrite plus nitrate concentrations exceeded 10 mg/L in five of the wells sampled.

Nitrite plus nitrate concentrations were not detected in water from any of the irrigation wells sampled by Tanner and Steele (1991) in the Missouri River alluvium of southeastern Nebraska adjacent to the northwestern reach. All of the wells are deeper than 52 ft. Nitrite plus nitrate concentrations exceeded 10 mg/L in water samples from all 25 wells sampled by Sievers and Fulhage (1989).

West-Central Reach

Concentrations of nitrite plus nitrate (as nitrogen) in water samples collected in July 1989 ranged from less than 0.05 (the detection limit) to 14 mg/L (table 5). Nitrite plus nitrate concentrations were detected in water samples from 17 of the 31 wells sampled. Where depth information was available for the wells, the well depths are less than 40 ft and average 23 ft. Nitrite plus nitrate concentrations exceeded the Missouri drinking-water-supply criteria of 10 mg/L in water samples from 3 of the 31 wells sampled.

ARSENIC AND IRON CONCENTRATIONS AND PHYSICAL PROPERTIES OF GROUND WATER

During 1988, water samples from 55 domestic-supply, 3 livestock-supply, and 2 irrigation wells in the northwestern reach were analyzed for total recoverable arsenic concentrations; water samples from 2 domestic-supply wells were analyzed for total recoverable iron concentrations. The specific conductance of water samples from 21 domestic-supply, 4 livestock-supply, and 1 irrigation well was measured; the pH of water samples from 33 domestic-supply, 4 livestock-supply, and 1 irrigation well was determined; and the temperature of water samples from 44 domestic-supply, 4 livestock-supply, and 2 irrigation wells was measured.

During 1989, water samples from 46 domestic-supply, 3 livestock-supply, and 1 irrigation well in the northwestern reach were analyzed for total recoverable arsenic concentrations. Water samples from 42 domestic-supply, 2 livestock-supply, and 1 irrigation well were analyzed for total recoverable iron concentrations. The specific conductance of water samples from 46 domestic-supply, 3 livestock-supply, and 1 irrigation well was measured; the pH of water samples from 45 domestic-supply, 3 livestock-supply, and 1 irrigation well was determined; and the temperature of water samples from 37 domestic-supply, 3 livestock-supply, and 1 irrigation well was measured.

During 1989, water samples from 26 domestic-supply, 1 livestock-supply, and 1 irrigation well in the west-central reach were analyzed for total recoverable arsenic concentrations; water samples from 27 domestic-supply, 1 livestock-supply, and 1 irrigation well were analyzed for total recoverable iron concentrations. The specific conductance of water samples from 29 domestic-supply, 1 livestock-supply, and 1 irrigation well was measured; the pH of water samples from 29 domestic-supply, 1 livestock-supply, and 1 irrigation well was determined; and the temperature of water samples from 24 domestic-supply, 1 livestock-supply, and 1 irrigation well was measured.

Northwestern Reach

Water samples from 25 of the 60 wells sampled in July 1988 had total recoverable arsenic concentrations greater than 5 µg/L (table 3). Arsenic concentrations ranged from less than 5 to 490 µg/L. Water from five wells had arsenic concentrations greater than or equal to the Missouri drinking-water-supply criteria of 50 µg/L. The five wells with concentrations exceeding 50 µg/L were wells 4, 5, 16, 62, and 64 (fig. 2). Of these, wells 4 and 5 were within 1 mi of each other and wells 62 and 64 were within 1 mi of each other.

In July 1989, water samples from 20 of the 50 wells sampled had arsenic concentrations equal to or greater than 5 µg/L (table 4). Water from wells 5 and 62 had arsenic concentrations greater than 50 µg/L. Arsenic concentrations ranged from less than 5 to 53 µg/L. Arsenic concentrations ranged from 3 to 14 µg/L in water from 13 irrigation wells sampled by Tanner and Steele (1991) in the Missouri River alluvium of southeastern Nebraska.

Total recoverable iron concentrations were determined for samples for only two wells in July 1988 (table 3). In July 1989, water from 37 of the 45 well samples analyzed had iron concentrations greater than the detection limit of 100 µg/L (table 4). Concentrations of iron ranged from less than 100 to 18,000 µg/L with a mean detected concentration of 8,000 µg/L. The mean detected iron concentration of ground water from 13 irrigation wells in the Missouri River alluvium of southeastern Nebraska was 7,900 µg/L (Tanner and Steele, 1991).

In July 1988, specific conductance of water from wells ranged from 585 to 4,100 µS/cm (microsiemens per centimeter at 25 °C) with a mean of 1,180 µS/cm (table 3). The pH values of water ranged from 6.6 to 7.8. The water temperature ranged from 11.0 to 19.5 °C with a mean of 15.0 °C.

In July 1989, the specific conductance of water from wells ranged from 400 to 3,390 µS/cm with a mean of 969 µS/cm (table 4). The pH values of water ranged from 6.2 to 8.1. The water temperature ranged from 11.5 to 24.5 °C with a mean of 16.5 °C.

West-Central Reach

In July 1989, arsenic concentrations were detected in water samples from 6 of the 28 water samples analyzed (table 5). Arsenic concentrations ranged from less than 5 to 14 µg/L. None of the samples had arsenic concentrations exceeding 15 µg/L.

Water samples from 20 of the 29 wells sampled for total iron in the west-central reach had total iron concentrations greater than or equal to 100 µg/L (table 5). Iron concentrations ranged from less than 100 to 26,000 µg/L with a mean concentration of 6,300 µg/L.

In July 1989, specific conductance of water from wells ranged from 230 to 1,700 µS/cm with a mean value of 732 µS/cm, and the pH values ranged from 4.2 to 8.9. The temperature of water from wells ranged from 14.0 to 20.5 °C with a mean of 16.0 °C.

In surface-water samples collected in June 1989 from the west-central reach, specific conductance values ranged from 238 to 610 µS/cm. The pH values ranged from 7.6 to 8.7, and the mean water temperature was 26.7 °C.

SUMMARY

In July 1988, water samples from wells in the northwestern reach of the Missouri River alluvium between the Iowa border and St. Joseph, Missouri, were analyzed for five pesticides, nitrite plus nitrate, arsenic, iron, specific conductance, pH, and temperature. In June and July 1989, wells were resampled in the northwestern reach and 45 new sites in the west-central reach of the alluvium from Kansas City to Miami, Missouri, were sampled. Water samples collected during 1989 were analyzed for seven pesticides, nitrite plus nitrate, arsenic, iron, specific conductance, pH, and temperature, and three water samples were analyzed for eight additional pesticides. Water samples from surface-water sites were analyzed for 13 pesticides.

During 1988, alachlor, metolachlor, and trifluralin were detected in water samples from four domestic- or livestock-supply wells in the northwestern reach. Alachlor was detected in water samples from all four wells. Atrazine concentrations were less than the detection limit of 2.4 µg/L in water from all of the wells sampled.

During 1989, at least one of the following pesticides--alachlor, atrazine, cyanazine, deethylatrazine, deisopropylatrazine, metolachlor, metribuzin, propazine, simazine, and trifluralin--was detected in water samples from seven wells in the northwestern reach. At least one of these pesticides--alachlor, atrazine, metolachlor, and metribuzin--was detected in water from three wells in the west-central reach. During 1989, the detection limit for atrazine was 0.10 µg/L. Atrazine was detected in water samples from 7 of the 50 wells in the northwestern reach, but in water samples from only 3 of the 30 wells sampled in the west-central reach. Atrazine concentrations exceeded the EPA MCL of 3 µg/L in one water sample from the northwestern reach. All of the wells with pesticides detected in the water samples were less than 41 ft deep, except one well that was 80 ft deep.

Atrazine was detected in water from all 14 of the surface-water sites sampled from the west-central reach on June 29, 1989. Concentrations of atrazine equalled or exceeded the EPA MCL of 3 µg/L in water samples from 8 of the 14 sites. Alachlor, cyanazine, deethylatrazine, deisopropylatrazine, and metolachlor also were detected.

Nitrite plus nitrate concentrations exceeded the Missouri drinking-water-supply criteria of 10 mg/L as nitrogen in water samples from 9 of the 60 wells sampled in the northwestern reach during 1988 and in water samples from 6 of the 51 wells sampled during 1989. Water samples from 3 of the 31 wells sampled in the west-central reach exceeded 10 mg/L. For all wells where nitrite plus nitrate concentrations exceeded 10 mg/L, depths were less than 45 ft, except one well that was 70 ft deep.

Total recoverable arsenic concentrations in water from wells in the northwestern reach were equal to or larger than the detection limit of 5 µg/L in 25 of the 60 wells sampled during 1988 and in 20 of the 50 wells sampled during 1989. Arsenic concentrations exceeded the Missouri drinking-water-supply criteria of 50 µg/L in water samples from five of the wells sampled during 1988 and in water samples from two wells sampled during 1989. Arsenic concentrations were detected in 6 of the 28 wells sampled in the west-central reach, but none of the concentrations exceeded 15 µg/L.

Total recoverable iron concentrations were larger than the detection limit of 100 µg/L in 37 of the 45 well samples analyzed from the northwestern reach and in 20 of the 29 well samples analyzed in the west-central reach during 1989. The mean detected iron concentration was 8,000 µg/L in the northwestern reach and 6,300 µg/L in the west-central reach.

In July 1988, specific conductance values in well samples ranged from 585 to 4,100 µS/cm with a mean of 1,180 µS/cm in the northwestern reach. In July 1989, specific conductance values ranged from 400 to 3,390 µS/cm with a mean of 969 µS/cm. Specific conductances ranged from 230 to 1,700 µS/cm with a mean of 732 µS/cm in the west-central reach in July 1989. The pH values in the northwestern reach ranged from 6.6 to 7.8 in July 1988 and from 6.2 to 8.1 in July 1989. The pH values ranged from 4.2 to 8.9 in July 1989 in the west-central reach. In 1989, the mean temperature of water from the northwestern reach was 16.5 °C and was 16.0 °C in the west-central reach. In surface-water samples collected in June 1989 from the west-central reach, specific conductance values ranged from 238 to 610 µS/cm, pH values ranged from 7.6 to 8.7, and the mean water temperature was 26.7 °C.

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Table 1.--*Location and description of wells that were sampled during 1988 and 1989*

[DD MM SS, degrees, minutes, seconds; --, no data]

Well no. (figs. 2 and 3)	Sample date	County	Latitude (DD MM SS)	Longitude (DDD MM SS)	Well depth (feet)	Well diameter (inches)	Water use
			Northwestern reach				
1	07-05-88	Andrew	39 51 36	094 52 58	34	1.50	Domestic
2	07-05-88 07-10-89	Andrew	39 51 53	094 54 03	69	6.00	Domestic
3	07-05-88	Andrew	39 51 53	094 54 06	--	1.50	Domestic
4	07-05-88	Andrew	39 53 31	094 54 05	25	1.50	Domestic
5	07-05-88 07-10-89	Andrew	39 53 31	094 54 20	42	1.50	Domestic
6	07-05-88 07-11-89	Holt	39 52 34	095 06 39	40	2.00	Domestic
7	07-05-88 07-11-89	Holt	39 53 54	095 02 20	23	1.50	Domestic
8	07-05-88 07-11-89	Holt	39 54 03	095 05 18	87	2.00	Domestic
9	07-05-88 07-11-89	Holt	39 57 08	095 14 45	20	1.50	Domestic
10	07-05-88 07-11-89	Holt	40 00 17	095 17 41	35	1.50	Domestic
11	07-05-88 07-11-89	Holt	40 00 17	095 17 45	50	8.00	Domestic
12	07-05-88 07-11-89	Holt	40 00 45	095 17 42	60	--	Domestic
13	07-05-88 07-11-89	Holt	40 02 31	095 19 26	40	1.50	Domestic
14	07-05-88 07-11-89	Holt	40 03 31	095 22 20	60	5.00	Domestic
15	07-05-88 07-11-89	Holt	40 04 17	095 19 21	55	20	Domestic
16	07-06-88	Holt	40 05 22	095 22 20	--	1.50	Domestic
17	07-05-88	Holt	40 06 34	095 14 26	85	10	Irrigation
18	07-05-88 07-11-89	Holt	40 06 37	095 17 28	85	5.00	Domestic
19	07-06-88	Holt	40 07 02	095 16 05	52	8.00	Domestic
20	07-05-88 07-10-89	Holt	40 07 08	095 20 27	35	1.25	Domestic
21	07-05-88 07-10-89	Holt	40 07 08	095 20 33	65	6.00	Domestic
22	07-05-88	Holt	40 07 53	095 23 22	42	1.25	Domestic
23	07-05-88 07-10-89	Holt	40 08 44	095 23 49	40	8.00	Domestic
24	07-05-88 07-10-89	Holt	40 08 50	095 24 17	--	2.00	Domestic
25	07-06-88	Holt	40 09 36	095 17 38	90	5.00	Domestic

Table 1.--*Location and description of wells that were sampled during 1988 and 1989*--Continued

Well no. (figs. 2 and 3)	Sample date	County	Latitude (DD MM SS)	Longitude (DDD MM SS)	Well depth (feet)	Well diameter (inches)	Water use
26	07-05-88 07-10-89	Holt	40 09 36	095 22 10	20	20	Domestic
27	07-05-88 07-10-89	Holt	40 09 36	095 22 10	--	1.50	Domestic
28	07-07-88	Holt	40 10 29	095 23 50	--	1.25	Domestic
29	07-06-88 07-11-89	Holt	40 10 35	095 20 35	60	6.00	Domestic
30	07-11-89	Holt	40 10 35	095 20 35	--	1.50	Livestock
31	07-07-88 07-10-89	Holt	40 11 02	095 25 47	--	1.50	Domestic
32	07-10-89	Holt	40 13 17	095 27 12	--	--	Domestic
33	07-07-88 07-10-89	Holt	40 14 09	095 26 37	25	1.25	Domestic
34	07-06-88 07-10-89	Atchison	40 16 06	095 28 57	18	2.00	Domestic
35	07-06-88 07-10-89	Atchison	40 16 11	095 28 57	30	2.00	Domestic
36	07-06-88 07-10-89	Atchison	40 16 52	095 31 13	20	2.00	Domestic
37	07-05-88 07-11-89	Atchison	40 17 30	095 32 45	13	1.25	Domestic
38	07-05-88 07-11-89	Atchison	40 17 59	095 30 42	20	1.50	Domestic
39	07-06-88 07-11-89	Atchison	40 18 54	095 37 28	25	1.25	Domestic
40	07-05-88 07-11-89	Atchison	40 20 00	095 36 19	50	1.50	Domestic
41	07-05-88 07-11-89	Atchison	40 20 17	095 31 50	--	1.25	Domestic
42	07-05-88 07-11-89	Atchison	40 21 03	095 33 25	119	6.00	Irrigation
43	07-11-89	Atchison	40 21 13	095 35 59	--	--	Domestic
44	07-11-89	Atchison	40 21 14	095 35 36	--	--	Domestic
45	07-06-88	Atchison	40 21 22	095 31 17	70	6.00	Livestock
46	07-07-88	Atchison	40 22 15	095 35 50	--	--	Domestic
47	07-06-88 07-11-89	Atchison	40 22 30	095 33 38	--	1.50	Domestic
48	07-06-88 07-11-89	Atchison	40 22 31	095 34 01	25	36	Domestic
49	07-06-88 07-11-89	Atchison	40 23 43	095 37 46	18	1.50	Domestic
50	07-07-88 07-11-89	Atchison	40 24 18	095 33 34	61	5.00	Domestic

Table 1.--*Location and description of wells that were sampled during 1988 and 1989*--Continued

Well no. (figs. 2 and 3)	Sample date	County	Latitude (DD MM SS)	Longitude (DDD MM SS)	Well depth (feet)	Well diameter (inches)	Water use
51	07-05-88 07-11-89	Atchison	40 24 26	095 38 19	--	1.25	Domestic
52	07-05-88 07-11-89	Atchison	40 24 43	095 36 50	39	1.25	Domestic
53	07-07-88 07-11-89	Atchison	40 25 35	095 36 57	--	1.25	Domestic
54	07-07-88 07-11-89	Atchison	40 26 22	095 37 11	22	1.25	Domestic
55	07-07-88 07-11-89	Atchison	40 27 06	095 35 29	33	1.50	Domestic
56	07-07-88 07-11-89	Atchison	40 28 33	095 37 25	15	36	Domestic
57	07-07-88 07-11-89	Atchison	40 28 35	095 38 27	15	1.50	Domestic
58	07-06-88 07-11-89	Atchison	40 28 48	095 35 45	18	24	Livestock
59	07-07-88	Atchison	40 30 20	095 37 47	27	1.25	Domestic
60	07-07-88	Atchison	40 30 34	095 40 10	20	1.25	Domestic
61	07-06-88 07-10-89	Atchison	40 33 34	095 38 12	68	24	Livestock
62	07-06-88 07-10-89	Atchison	40 33 43	095 44 33	--	1.50	Domestic
63	07-06-88 07-11-89	Atchison	40 34 02	095 41 54	--	1.50	Domestic
64	07-06-88	Atchison	40 34 15	095 45 04	16	1.50	Livestock
65	07-10-89	Atchison	40 34 15	095 45 04	16	1.50	Domestic
			West-central reach				
66	07-13-89	Lafayette	39 08 06	094 02 57	20	1.25	Domestic
67	07-12-89	Ray	39 09 59	094 06 06	--	1.25	Domestic
68	07-12-89	Ray	39 10 22	094 06 39	25	--	Domestic
69	07-12-89	Ray	39 10 56	094 03 24	--	1.50	Livestock
70	07-20-89	Jackson	39 11 30	094 18 35	30	1.50	Domestic
71	07-12-89	Ray	39 11 48	094 10 05	18	1.50	Domestic
72	07-20-89	Jackson	39 11 54	094 18 50	100	12	Irrigation
73	07-12-89	Ray	39 12 37	093 57 05	16	1.25	Domestic
74	07-13-89	Ray	39 12 51	093 54 23	30	1.25	Domestic
75	07-20-89	Jackson	39 12 51	094 16 39	16	1.25	Domestic
76	07-13-89	Carroll	39 13 51	093 42 21	21	1.50	Domestic
77	07-12-89	Ray	39 14 01	093 50 09	23	1.25	Domestic
78	07-18-89	Carroll	39 14 19	093 33 02	17	2.00	Domestic
79	07-12-89	Clay	39 14 36	094 14 53	--	--	Domestic
80	07-12-89	Clay	39 14 41	094 15 35	--	--	Domestic

Table 1.--*Location and description of wells that were sampled during 1988 and 1989*--Continued

Well no. (figs. 2 and 3)	Sample date	County	Latitude (DD MM SS)	Longitude (DDD MM SS)	Well depth (feet)	Well diameter (inches)	Water use
81	07-12-89	Clay	39 14 41	094 15 54	--	--	Domestic
82	07-13-89	Carroll	39 14 54	093 43 20	20	1.25	Domestic
83	07-12-89	Clay	39 15 07	094 14 57	--	--	Domestic
84	07-12-89	Ray	39 15 45	093 50 47	--	--	Domestic
85	07-13-89	Carroll	39 16 22	093 35 58	25	1.25	Domestic
86	07-18-89	Saline	39 16 41	093 17 19	--	1.25	Domestic
87	07-13-89	Carroll	39 16 54	093 39 44	15	1.25	Domestic
88	07-12-89	Carroll	39 17 18	093 36 42	24	1.50	Domestic
89	07-12-89	Carroll	39 17 24	093 26 08	25	1.25	Domestic
90	07-12-89	Carroll	39 17 35	093 34 19	28	1.50	Domestic
91	07-12-89	Carroll	39 17 37	093 35 55	30	1.25	Domestic
92	07-12-89	Carroll	39 17 54	093 28 31	80	6.00	Domestic
93	07-18-89	Carroll	39 18 37	093 44 53	--	--	Domestic
94	07-13-89	Carroll	39 18 56	093 42 10	40	1.25	Domestic
95	07-13-89	Carroll	39 19 37	093 35 09	--	6.00	Domestic
96	07-13-89	Carroll	39 19 42	093 35 10	80	6.00	Domestic

Table 2.--*Location and description of sampled surface-water sites*

[DD MM SS, degrees, minutes, seconds]

Site no. (fig. 3)	Sample date	County	Latitude (DD MM SS)	Longitude (DDD MM SS)	Description of location
500	06-29-89	Jackson	39 06 43	094 35 16	Missouri River at Kansas City
501	06-29-89	Ray	39 20 00	093 58 45	Crooked River near Richmond
502	06-29-89	Lafayette	39 12 54	093 30 54	Missouri River at Waverly
503	06-29-89	Carroll	39 20 50	093 29 45	Wakenda Creek at Carrollton
504	06-29-89	Ray	39 10 07	093 58 53	Sunshine Lake outflow
505	06-29-89	Ray	39 13 19	094 09 28	Fishing River 3 miles from the junction with the Missouri River
506	06-29-89	Ray	39 13 45	093 50 36	Crooked River 1 mile from the junction with the Missouri River
507	06-29-89	Carroll	39 14 29	093 45 29	Unnamed lake on the Carrol-Ray County line
508	06-29-89	Clay	39 14 39	094 14 04	Cooley Lake outflow
509	06-29-89	Carroll	39 16 38	093 40 56	Moss Creek near Norborne
510	06-29-89	Carroll	39 16 54	093 30 39	Bowdry Lake outflow
511	06-29-89	Clay	39 18 21	094 16 26	Fishing River near Prathersville
512	06-29-89	Carroll	39 20 20	093 15 15	Wakenda Creek near Miami
513	06-29-89	Carroll	39 20 53	093 31 51	Wakenda Creek west of Carrollton

Table 3.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the northwestern reach, July 1988*

[Analyses by the Missouri Department of Health laboratory, Jefferson City, Missouri; well depth in feet below land surface; specific conductance in microsiemens per centimeter at 25 degrees Celsius; pH in standard units; temperature in degrees Celsius; pesticide, arsenic, and iron concentrations are total recoverable in micrograms per liter; nitrite plus nitrate concentrations are total in milligrams per liter as nitrogen; --, no data; <, less than]

Well (fig. 2)	Date	Well depth	Specific conductance	pH	Temperature	Alachlor	Atrazine	Chlorpyrifos
1	07-05-88	34	--	--	--	<0.10	<2.40	<0.013
2	07-05-88	69	--	--	--	<.10	<2.40	<.013
3	07-05-88	--	--	--	--	<.10	<2.40	<.013
4	07-05-88	25	--	--	--	<.10	<2.40	<.013
5	07-05-88	42	--	--	--	<.10	<2.40	<.013
6	07-05-88	40	--	--	--	<.10	<2.40	<.013
7	07-05-88	23	--	--	--	<.10	<2.40	<.013
8	07-05-88	87	--	--	--	<.10	<2.40	<.013
9	07-05-88	20	725	6.9	14.5	<.10	<2.40	<.013
10	07-05-88	35	1,050	7.0	15.0	<.10	<2.40	<.013
11	07-05-88	50	1,500	6.9	13.5	<.10	<2.40	<.013
12	07-05-88	60	1,650	6.8	13.5	<.10	<2.40	<.013
13	07-05-88	40	980	7.0	17.0	<.10	<2.40	<.013
14	07-05-88	60	--	7.2	17.0	<.10	<2.40	<.013
15	07-05-88	55	--	7.1	18.0	<.10	<2.40	<.013
16	07-06-88	--	996	6.9	14.0	<.10	<2.40	<.013
17	07-05-88	85	760	6.8	14.5	<.10	<2.40	<.013
18	07-05-88	85	--	6.9	17.0	<.10	<2.40	<.013
19	07-06-88	52	720	6.8	14.0	<.10	<2.40	<.013
20	07-05-88	35	1,410	6.9	15.0	<.10	<2.40	<.013
21	07-05-88	65	890	6.9	14.5	<.10	<2.40	<.013
22	07-05-88	42	--	7.0	17.0	<.10	<2.40	<.013
23	07-05-88	40	--	6.9	17.0	<.10	<2.40	<.013
24	07-05-88	--	--	7.0	17.0	<.10	<2.40	<.013
25	07-06-88	90	--	7.1	15.0	<.10	<2.40	<.013
26	07-05-88	20	--	7.2	17.0	<.10	<2.40	<.013
27	07-05-88	--	--	7.2	17.0	<.10	<2.40	<.013
28	07-07-88	--	970	7.0	15.0	<.10	<2.40	<.013
29	07-06-88	60	--	7.0	16.0	<.10	<2.40	<.013

Table 3.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the northwestern reach, July 1988*--Continued

Well (fig. 2)	Date	Well depth	Specific conductance	pH	Temperature	Alachlor	Atrazine	Chlorpyrifos
31	07-07-88	--	1,210	6.9	14.5	<0.10	<2.40	<0.013
33	07-07-88	25	785	7.0	13.5	<.10	<2.40	<.013
34	07-06-88	18	--	--	--	<.10	<2.40	<.013
35	07-06-88	30	--	--	--	3.10	<2.40	<.013
36	07-06-88	20	1,300	7.2	13.0	<.10	<2.40	<.013
37	07-05-88	13	1,150	6.9	19.5	<.10	<2.40	<.013
38	07-05-88	20	--	--	16.0	<.10	<2.40	<.013
39	07-06-88	25	900	7.0	13.5	<.10	<2.40	<.013
40	07-05-88	50	--	--	14.0	<.10	<2.40	<.013
41	07-05-88	--	--	--	14.0	<.10	<2.40	<.013
42	07-05-88	119	--	--	14.0	<.10	<2.40	<.013
45	07-06-88	70	--	6.9	18.0	<.10	<2.40	<.013
46	07-07-88	--	1,150	7.0	13.0	<.10	<2.40	<.013
47	07-06-88	--	585	7.8	16.5	<.10	<2.40	<.013
48	07-06-88	25	--	7.0	16.0	<.10	<2.40	<.013
49	07-06-88	18	950	6.9	16.5	<.10	<2.40	<.013
50	07-07-88	61	1,100	6.8	13.5	<.10	<2.40	<.013
51	07-05-88	--	--	--	13.0	<.10	<2.40	<.013
52	07-05-88	39	--	--	16.0	--	--	--
53	07-07-88	--	--	--	13.0	<.10	<2.40	<.013
54	07-07-88	22	--	--	14.0	<.10	<2.40	<.013
55	07-07-88	33	--	--	17.0	.19	<2.40	<.013
56	07-07-88	15	1,500	6.9	16.0	<.10	<2.40	<.013
57	07-07-88	15	--	--	15.0	3.60	<2.40	<.013
58	07-06-88	18	4,100	6.6	11.0	<.10	<2.40	<.013
[a,b]58	07-06-88	18	--	--	--	<.10	<.10	--
59	07-07-88	27	--	--	14.0	.46	<2.40	<.013
60	07-07-88	20	--	--	14.0	<.10	<2.40	<.013
61	07-06-88	68	790	7.0	14.0	<.10	<2.40	<.013
[a,b]61	07-06-88	68	--	--	--	<.10	<.10	--
62	07-06-88	--	1,200	7.0	15.0	<.10	<2.40	<.013
63	07-06-88	--	1,020	6.9	16.0	<.10	<2.40	<.013
64	07-06-88	16	1,400	6.9	13.5	<.10	<2.40	<.013

Table 3.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the northwestern reach, July 1988*--Continued

Well (fig. 2)	Date	Metolachlor	Trifluralin	Triazine herbicides by immunoassay	Nitrite plus nitrate	Arsenic	Iron
1	07-05-88	<0.11	<0.02	--	0.06	8	--
2	07-05-88	<.11	<.02	--	<.05	<5	--
3	07-05-88	<.11	<.02	--	16	<5	--
4	07-05-88	<.11	<.02	--	.05	90	--
5	07-05-88	<.11	<.02	--	<.05	54	--
6	07-05-88	<.11	<.02	--	<.05	<5	--
7	07-05-88	<.11	<.02	--	4.3	<5	--
8	07-05-88	<.11	<.02	--	<.05	<5	--
9	07-05-88	<.11	<.02	--	<.05	25	--
10	07-05-88	<.11	<.02	<0.5	.62	7	--
11	07-05-88	<.11	<.02	<.5	.11	7	--
12	07-05-88	<.11	<.02	--	8.4	<5	--
13	07-05-88	<.11	<.02	<.5	<.05	26	--
14	07-05-88	<.11	<.02	--	<.05	<5	--
15	07-05-88	<.11	<.02	--	<.05	27	--
16	07-06-88	<.11	<.02	--	<.05	160	--
17	07-05-88	<.11	<.02	--	<.05	<5	--
18	07-05-88	<.11	<.02	--	<.05	9	--
19	07-06-88	<.11	<.02	--	<.05	<5	--
20	07-05-88	<.11	<.02	--	<.05	18	--
21	07-05-88	<.11	<.02	--	<.05	<5	--
22	07-05-88	<.11	<.02	--	<.05	25	--
23	07-05-88	<.11	<.02	--	<.05	<5	--
24	07-05-88	<.11	<.02	--	50	<5	--
25	07-06-88	<.11	<.02	--	<.05	<5	--
26	07-05-88	<.11	<.02	--	4.2	<5	--
27	07-05-88	<.11	<.02	--	<.05	<5	--
28	07-07-88	<.11	<.02	--	5.4	<5	--
29	07-06-88	<.11	<.02	--	<.05	<5	--

Table 3.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the northwestern reach, July 1988*--Continued

Well (fig. 2)	Date	Metolachlor	Trifluralin	Triazine herbicides by immunoassay	Nitrite plus nitrate	Arsenic	Iron
31	07-07-88	<0.11	<0.02	<0.5	19	<5	[c]<100
33	07-07-88	<.11	<.02	<.5	<.05	38	[c]11,000
34	07-06-88	<.11	<.02	--	12	<5	--
35	07-06-88	<.11	<.02	--	20	<5	--
36	07-06-88	<.11	<.02	--	1.6	5	--
37	07-05-88	<.11	<.02	--	.16	6	--
38	07-05-88	<.11	<.02	--	<.05	9	--
39	07-06-88	<.11	<.02	<.5	<.05	25	--
40	07-05-88	<.11	<.02	--	.05	23	--
41	07-05-88	<.11	<.02	--	.31	<5	--
42	07-05-88	<.11	<.02	--	<.05	<5	--
45	07-06-88	<.11	<.02	--	32	<5	--
46	07-07-88	<.11	<.02	--	<.05	12	--
47	07-06-88	<.11	<.02	<.5	<.05	<5	--
48	07-06-88	<.11	<.02	--	4.4	<5	--
49	07-06-88	<.11	<.02	<.5	<.05	13	--
50	07-07-88	<.11	<.02	--	<.05	<5	--
51	07-05-88	<.11	<.02	--	.40	<5	--
52	07-05-88	--	--	--	<.05	7	--
53	07-07-88	<.11	<.02	--	.26	15	--
54	07-07-88	<.11	<.02	--	1.5	<5	--
55	07-07-88	<.11	<.02	--	1.1	<5	--
56	07-07-88	<.11	<.02	--	3.5	<5	--
57	07-07-88	29.3	.05	--	10	<5	--
58	07-06-88	<.11	<.02	--	28	<5	--
[a,b]58	07-06-88	<.10	<.10	--	--	--	--
59	07-07-88	<.11	<.02	--	1.1	<5	--
60	07-07-88	<.11	<.02	--	<.05	10	--
61	07-06-88	<.11	<.02	--	<.05	<5	--
[a,b]61	07-06-88	<.10	<.10	--	--	--	--
62	07-06-88	<.11	<.02	<.5	<.05	50	--
63	07-06-88	<.11	<.02	--	17	<5	--
64	07-06-88	<.11	<.02	<.5	1.50	490	--

[a] Ametryn, deethylatrazine, deisopropylatrazine, metribuzin, prometon, prometryn, propazine, simazine, and terbutryn were less than the detection limit of 0.05 microgram per liter at sites 58 and 61. Cyanazine was less than the detection limit of 0.2 microgram per liter at sites 58 and 61.

[b] Duplicate analyzed by U.S. Geological Survey laboratory.

[c] Iron concentrations determined colorimetrically using methods adapted from the Hach Company.

Table 4.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the northwestern reach, July 1989*

[Pesticide analyses by the University of Iowa Hygienic Laboratory, Ames, Iowa; nitrite plus nitrate, arsenic, and iron analyses by the Missouri Department of Health laboratory, Jefferson City, Missouri; iron also analyzed by U. S. Geological Survey by colorimetry; well depth in feet below land surface; specific conductance in microsiemens per centimeter at 25 degrees Celsius; pH in standard units; temperature in degrees Celsius; pesticide, arsenic, and iron concentrations are total recoverable in micrograms per liter; nitrite plus nitrate concentrations are total in milligrams per liter as nitrogen; --, no data; <, less than]

Well (fig. 2)	Date	Well depth	Specific conduc-tance	pH	Temper-ature	Alachlor	Ametryn	Atrazine	Butylate	Cyanazine	Deethyl-atrazine	Deiso-propyl-atrazine	Metolachlor
2	07-10-89	69	750	7.0	--	<0.10	--	<0.10	<0.10	<0.10	--	--	<0.10
5	07-10-89	42	1,000	--	--	--	--	--	--	--	--	--	--
6	07-11-89	40	600	6.9	--	<.10	--	<.10	<.10	<.10	--	--	<.10
7	07-11-89	23	400	7.1	--	<.10	--	<.10	<.10	<.10	--	--	<.10
8	07-11-89	87	600	6.7	--	<.10	--	<.10	<.10	<.10	--	--	<.10
9	07-11-89	20	625	6.7	--	<.10	--	<.10	<.10	<.10	--	--	<.10
10	07-11-89	35	860	6.4	17.0	<.10	--	<.10	<.10	<.10	--	--	<.10
11	07-11-89	50	1,000	6.3	14.0	<.10	--	<.10	<.10	<.10	--	--	<.10
12	07-11-89	60	1,180	6.7	14.5	<.10	--	<.10	<.10	<.10	--	--	<.10
13	07-11-89	40	--	--	--	<.10	--	<.10	<.10	<.10	--	--	<.10
14	07-11-89	60	1,100	7.0	18.5	<.10	--	<.10	<.10	<.10	--	--	<.10
15	07-11-89	55	1,440	6.4	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
18	07-11-89	85	922	6.9	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
20	07-10-89	35	1,270	7.1	24.5	<.10	--	<.10	<.10	<.10	--	--	<.10
21	07-10-89	65	932	7.1	21.0	<.10	--	<.10	<.10	<.10	--	--	<.10
23	07-10-89	40	795	7.1	22.0	<.10	--	.12	<.10	<.10	--	--	<.10
24	07-10-89	--	1,360	7.0	21.5	<.10	--	<.10	<.10	<.10	--	--	<.10
26	07-10-89	20	632	7.1	22.0	<.10	--	.33	<.10	<.10	--	--	<.10
27	07-10-89	--	612	7.1	21.5	<.10	--	<.10	<.10	<.10	--	--	<.10
29	07-11-89	60	810	6.4	17.5	<.10	--	<.10	<.10	<.10	--	--	<.10
30	07-11-89	--	805	6.9	14.0	<.10	--	<.10	<.10	<.10	--	--	<.10
31	07-10-89	--	962	7.1	16.0	<.10	--	<.10	<.10	<.10	--	--	<.10
32	07-10-89	--	952	7.1	17.0	<.10	--	<.10	<.10	<.10	--	--	<.10
33	07-10-89	25	778	7.2	16.0	<.10	--	<.10	<.10	<.10	--	--	<.10
34	07-10-89	18	750	7.0	--	<.10	--	.39	<.10	<.10	--	--	<.10
35	07-10-89	30	710	6.6	--	1.10	--	.79	<.10	<.10	--	--	<.10

Table 4.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the northwestern reach, July 1989*--Continued

Well (fig. 2)	Date	Well depth	Specific conduc-tance	pH	Temper-ature	Alachlor	Ametryn	Atrazine	Butylate	Cyanazine	Deethyl-atrazine	Deiso-propyl-atrazine	Metolachlor
36	07-10-89	20	780	7.1	--	<0.10	--	<0.10	<0.10	<0.10	--	--	<0.10
37	07-11-89	13	930	7.1	20.5	<.05	<0.05	11.6	--	<.2	3	0.62	<.05
38	07-11-89	20	962	7.2	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
39	07-11-89	25	814	7.2	14.5	<.10	--	<.10	<.10	<.10	--	--	<.10
40	07-11-89	50	666	7.3	18.0	<.10	--	<.10	<.10	<.10	--	--	<.10
41	07-11-89	--	1,020	6.8	17.5	<.10	--	<.10	<.10	<.10	--	--	<.10
42	07-11-89	119	1,190	6.9	16.5	<.10	--	<.10	<.10	<.10	--	--	<.10
43	07-11-89	--	791	7.3	23.0	<.10	--	<.10	<.10	<.10	--	--	<.10
44	07-11-89	--	1,430	6.9	17.0	<.10	--	<.10	<.10	<.10	--	--	<.10
47	07-11-89	--	664	8.1	16.5	<.10	--	<.10	<.10	<.10	--	--	<.10
48	07-11-89	25	937	7.2	15.5	<.10	--	<.10	<.10	<.10	--	--	<.10
49	07-11-89	18	857	6.6	14.0	<.10	--	<.10	<.10	<.10	--	--	<.10
50	07-11-89	61	1,150	6.3	13.0	<.10	--	<.10	<.10	<.10	--	--	<.10
51	07-11-89	--	933	6.3	13.5	<.10	--	<.10	<.10	<.10	--	--	<.10
52	07-11-89	39	820	6.2	14.5	.21	--	.10	<.10	<.10	--	--	<.10
53	07-11-89	--	1,440	6.2	13.5	<.10	--	<.10	<.10	<.10	--	--	<.10
54	07-11-89	22	615	6.4	15.5	<.10	--	<.10	<.10	<.10	--	--	<.10
55	07-11-89	33	928	6.2	20.0	<.10	--	<.10	<.10	<.10	--	--	<.10
56	07-11-89	15	1,370	6.5	15.5	<.10	--	<.10	<.10	<.10	--	--	<.10
57	07-11-89	15	1,090	6.3	13.5	<.10	--	.90	<.10	.28	--	--	.80
[a]57	07-11-89	15	--	--	--	<.10	--	1.20	<.10	.71	--	--	.92
[b]57	07-11-89	15	--	--	--	.07	<.05	.87	--	<.2	.13	<.05	.91
58	07-11-89	18	3,390	6.5	11.5	<.10	--	<.10	<.10	<.10	--	--	<.10
61	07-10-89	68	749	6.6	14.0	<.10	--	<.10	<.10	<.10	--	--	<.10
62	07-10-89	--	1,040	6.6	13.5	<.10	--	<.10	<.10	<.10	--	--	<.10
63	07-11-89	--	1,070	6.3	18.0	<.10	--	<.10	<.10	<.10	--	--	<.10
65	07-10-89	16	968	6.4	13.0	<.10	--	<.10	<.10	<.10	--	--	<.10

Table 4.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the northwestern reach, July 1989*--Continued

Well (fig. 2)	Date	Metribuzin	Prometon	Prometryn	Propazine	Simazine	Terbutryn	Triflur-alin	Triazine herbicides by immuno-assay	Nitrite plus nitrate	Arsenic	Iron
2	07-10-89	<0.10	--	--	--	--	--	<0.10	--	<0.05	<5	12,000
5	07-10-89	--	--	--	--	--	--	--	--	<.05	53	18,000
6	07-11-89	<.10	--	--	--	--	--	<.10	--	<.05	<5	8,100
7	07-11-89	<.10	--	--	--	--	--	<.10	--	2.1	<5	<100
8	07-11-89	<.10	--	--	--	--	--	<.10	--	<.05	<5	4,500
9	07-11-89	<.10	--	--	--	--	--	<.10	--	<.05	27	10,000
10	07-11-89	<.10	--	--	--	--	--	<.10	<0.2	.19	<5	[c]590
11	07-11-89	<.10	--	--	--	--	--	<.10	<.2	.21	<5	[c]6,200
12	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[c]1,800
13	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	26	[c]18,000
14	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[c]12,000
15	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	31	[c]14,000
18	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	11	[c]7,100
20	07-10-89	<.10	--	--	--	--	--	<.10	<.2	<.05	23	11,000
21	07-10-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	8,400
23	07-10-89	<.10	--	--	--	--	--	<.10	<.2	.08	<5	[c]7,200
24	07-10-89	<.10	--	--	--	--	--	<.10	<.2	55	<5	[c]<100
26	07-10-89	<.10	--	--	--	--	--	<.10	1.0	5.1	<5	[c]500
27	07-10-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[c]10,000
29	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	15	[c]12,000
30	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[c]10,000
31	07-10-89	<.10	--	--	--	--	--	<.10	--	3.5	<5	--
32	07-10-89	<.10	--	--	--	--	--	<.10	--	27	<5	<100
33	07-10-89	<.10	--	--	--	--	--	<.10	--	<.05	36	--
34	07-10-89	<.10	--	--	--	--	--	<.10	--	16	<5	180
35	07-10-89	<.10	--	--	--	--	--	<.10	--	19	<5	<100

Table 4.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the northwestern reach, July 1989*--Continued

Well (fig. 2)	Date	Metribuzin	Prometon	Prometryn	Propazine	Simazine	Terbutryn	Triflur-alin	Triazine herbicides by immuno-assay	Nitrite plus nitrate	Arsenic	Iron
36	07-10-89	<0.10	--	--	--	--	--	<0.10	--	0.99	--	8,300
37	07-11-89	.26	<0.05	<0.05	0.27	0.3	<0.05	<.02	4.5	<.05	6	[c]3,900
38	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	10	[c]5,600
39	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	24	--
40	07-11-89	<.10	--	--	--	--	--	<.10	--	<.05	30	[c]8,000
41	07-11-89	<.10	--	--	--	--	--	<.10	--	5.2	<5	[c]120
42	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[c]15,000
43	07-11-89	<.10	--	--	--	--	--	<.10	--	.12	<5	--
44	07-11-89	<.10	--	--	--	--	--	<.10	--	.49	6	[c]3,600
47	07-11-89	<.10	--	--	--	--	--	<.10	--	<.05	<5	[c]180
48	07-11-89	<.10	--	--	--	--	--	<.10	--	2.5	<5	[c]<100
49	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	12	[c]6,400
50	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	6	11,000
51	07-11-89	<.10	--	--	--	--	--	<.10	<.2	.88	<5	[c]<100
52	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	6	3,400
53	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	20	[c]17,000
54	07-11-89	<.10	--	--	--	--	--	<.10	--	.72	<5	[c]<100
55	07-11-89	<.10	--	--	--	--	--	<.10	<.2	<.05	10	[c]12,000
56	07-11-89	<.10	--	--	--	--	--	<.10	<.2	2.9	<5	--
57	07-11-89	<.10	--	--	--	--	--	.19	.9	10	<5	[c]800
[a]57	07-11-89	<.10	--	--	--	--	--	--	--	--	--	--
[b]57	07-11-89	<.05	<.05	<.05	<.05	<.05	<.05	--	--	--	--	--
58	07-11-89	<.10	--	--	--	--	--	<.10	<.2	27	<5	--
61	07-10-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	2,400
62	07-10-89	<.10	--	--	--	--	--	<.10	<.2	<.05	52	18,000
63	07-11-89	<.10	--	--	--	--	--	<.10	<.2	20	<5	[c]<100
65	07-10-89	<.10	--	--	--	--	--	<.10	<.2	<.05	18	7,800

[a] Duplicate analyzed by the Iowa Hygienic Laboratory.
[b] Duplicate analyzed by the U.S. Geological Survey Research Laboratory in Lawrence, Kansas.
[c] Iron concentrations determined colorimetrically using methods adapted from the Hach Company.

Table 5.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the west-central reach, July 1989*

[Pesticide analyses by the University of Iowa Hygienic Laboratory, Ames, Iowa; nitrite plus nitrate, arsenic, and iron analyses by the Missouri Department of Health laboratory, Jefferson City, Missouri; iron also analyzed by the U.S. Geological Survey with colorimetry; well depth in feet below land surface; specific conductance in microsiemens per centimeter at 25 degrees Celsius; pH in standard units; temperature in degrees Celsius; pesticide, arsenic, and iron concentrations are total recoverable in micrograms per liter; nitrite plus nitrate concentrations are total in milligrams per liter as nitrogen; <, less than; --, no data]

Well (fig. 2)	Date	Well depth	Specific conduc-tance	pH	Temper-ature	Alachlor	Ametryn	Atrazine	Butylate	Cyanazine	Deethyl-atrazine	Deiso-propyl-atrazine	Metolachlor
66	07-13-89	20	1,050	6.8	14.5	<0.10	--	<0.10	<0.10	<0.10	--	--	<0.10
67	07-12-89	--	897	7.1	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
68	07-12-89	25	805	7.1	16.0	--	--	--	--	--	--	--	--
69	07-12-89	--	770	7.1	20.5	1.40	--	<.10	<.10	<.10	--	--	<.10
70	07-20-89	30	810	7.0	17.0	<.10	--	<.10	<.10	<.10	--	--	<.10
71	07-12-89	18	1,700	6.7	--	<.10	--	<.10	<.10	<.10	--	--	<.10
72	07-20-89	100	925	4.2	14.0	<.10	--	<.10	<.10	<.10	--	--	<.10
73	07-12-89	16	857	7.2	17.0	<.10	--	<.10	<.10	<.10	--	--	.11
74	07-13-89	30	608	7.2	17.0	<.10	--	<.10	<.10	<.10	--	--	<.10
75	07-20-89	16	840	6.7	17.0	<.10	--	<.10	<.10	<.10	--	--	<.10
76	07-13-89	21	675	7.1	14.5	<.10	--	<.10	<.10	<.10	--	--	<.10
77	07-12-89	23	546	7.4	17.0	<.10	--	<.10	<.10	<.10	--	--	<.10
78	07-18-89	17	800	6.7	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
79	07-12-89	--	230	8.9	--	<.10	--	<.10	<.10	<.10	--	--	<.10
80	07-12-89	--	850	6.9	--	<.10	--	<.10	<.10	<.10	--	--	<.10
81	07-12-89	--	625	6.6	--	<.10	--	<.10	<.10	<.10	--	--	<.10
82	07-13-89	20	556	7.3	19.0	<.10	--	<.10	<.10	<.10	--	--	<.10
83	07-12-89	--	700	6.7	--	<.10	--	<.10	<.10	<.10	--	--	<.10
84	07-12-89	--	654	7.4	17.0	<.10	--	<.10	<.10	<.10	--	--	<.10
85	07-13-89	25	650	7.3	16.0	<.10	--	<.10	<.10	<.10	--	--	<.10
86	07-18-89	--	875	6.8	14.0	<.10	--	<.10	<.10	<.10	--	--	<.10
87	07-13-89	15	740	6.8	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
88	07-12-89	24	690	6.9	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
89	07-12-89	25	610	6.6	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
90	07-12-89	28	570	7.0	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
91	07-12-89	30	570	7.0	18.5	<.10	--	<.10	<.10	<.10	--	--	<.10
92	07-12-89	80	570	6.9	14.5	<.10	--	<.10	<.10	<.10	--	--	<.10
93	07-18-89	--	565	6.8	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
94	07-13-89	40	920	7.0	18.0	<.10	--	<.10	<.10	<.10	--	--	<.10
95	07-13-89	--	500	6.9	15.0	<.10	--	<.10	<.10	<.10	--	--	<.10
96	07-13-89	80	540	6.9	20.0	<.10	--	.28	<.10	<.10	--	--	<.10
[a]96	07-13-89	80	--	--	--	<.10	<0.05	<.05	--	<.2	<0.05	<0.05	<.05

Table 5.--*Physical properties and pesticide, nitrite plus nitrate, arsenic, and iron concentrations in water samples from alluvial wells in the west-central reach, July 1989*--Continued

Well (fig. 2)	Date	Metribuzin	Prometon	Prometryn	Propazine	Simazine	Terbutryn	Triflur-alin	Triazine herbicides by immuno-assay	Nitrite plus nitrate	Arsenic	Iron
66	07-13-89	<0.10	--	--	--	--	--	<0.10	<0.2	<0.05	14	[b]10,000
67	07-12-89	<.10	--	--	--	--	--	<.10	<.2	2.9	<5	[b]5,100
68	07-12-89	--	--	--	--	--	--	--	<.2	1.6	<5	[b]<100
69	07-12-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[b]<100
70	07-20-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[b]8,400
71	07-12-89	<.10	--	--	--	--	--	<.10	--	12	<5	--
72	07-20-89	<.10	--	--	--	--	--	<.10	--	<.05	--	[b]8,800
73	07-12-89	.19	--	--	--	--	--	<.10	<.2	2.4	<5	[b]360
74	07-13-89	<.10	--	--	--	--	--	<.10	<.2	1.7	<5	[b]270
75	07-20-89	<.10	--	--	--	--	--	<.10	<.2	14	<5	[b]<100
76	07-13-89	<.10	--	--	--	--	--	<.10	<.2	13	<5	[b]<100
77	07-12-89	<.10	--	--	--	--	--	<.10	<.2	7.9	7	[b]<100
78	07-18-89	<.10	--	--	--	--	--	<.10	<.2	<.05	--	[b]2,600
79	07-12-89	<.10	--	--	--	--	--	<.10	--	.11	<5	[b]100
80	07-12-89	<.10	--	--	--	--	--	<.10	--	.06	<5	10,000
81	07-12-89	<.10	--	--	--	--	--	<.10	--	<.05	<5	--
82	07-13-89	<.10	--	--	--	--	--	<.10	<.2	.98	<5	[b]120
83	07-12-89	<.10	--	--	--	--	--	<.10	--	.44	<5	470
84	07-12-89	<.10	--	--	--	--	--	<.10	<.2	3.0	<5	[b]<100
85	07-13-89	<.10	--	--	--	--	--	<.10	<.2	5.1	<5	[b]<100
86	07-18-89	<.10	--	--	--	--	--	<.10	<.2	<.05	--	[b]13,000
87	07-13-89	<.10	--	--	--	--	--	<.10	<.2	7.0	<5	[b]<100
88	07-12-89	<.10	--	--	--	--	--	<.10	<.2	<.05	12	[b]7,600
89	07-12-89	<.10	--	--	--	--	--	<.10	<.2	1.1	<5	[b]8,200
90	07-12-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[b]3,500
91	07-12-89	<.10	--	--	--	--	--	<.10	<.2	<.05	12	[b]8,400
92	07-12-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[b]6,200
93	07-18-89	<.10	--	--	--	--	--	<.10	<.2	<.05	6	[b]26,000
94	07-13-89	<.10	--	--	--	--	--	<.10	<.2	2.7	<5	[b]<100
95	07-13-89	<.10	--	--	--	--	--	<.10	<.2	<.05	6	[b]4,300
96	07-13-89	<.10	--	--	--	--	--	<.10	<.2	<.05	<5	[b]3,200
[a]96	07-13-89	<.05	<0.05	<0.05	<0.05	<0.05	<0.05	--	--	--	--	--

[a] Duplicate analyzed by the U.S. Geological Survey laboratory.
[b] Iron concentration determined by colorimetry using methods adapted by the Hach Company.

Table 6.--*Physical properties and pesticide concentrations in water samples from surface-water sites in the west-central reach, June 1989*

[Discharge in cubic feet per second; pesticide analyses by the U.S. Geological Survey Research Laboratory, Lawrence, Kansas; pesticide concentrations are total recoverable in micrograms per liter; specific conductance in microsiemens per centimeter at 25 degrees Celsius; pH in standard units; temperature in degrees Celsius; --, no data; <, less than]

Site (fig. 3)	Date	Discharge	Specific conductance	pH	Temperature	Alachlor	Ametryn	Atrazine	Cyanazine	Deethyl-atrazine
500	06-29-89	45,200	605	8.0	--	0.39	<0.05	4.20	<0.2	0.40
501	06-29-89	32.7	238	7.6	23.0	2.20	<.05	3.90	<.2	.41
502	06-29-89	46,500	510	7.8	24.5	.33	<.05	4.00	<.2	.35
503	06-29-89	--	423	7.8	27.0	<.05	<.05	3.60	<.2	.50
504	06-29-89	< 5.0	512	7.8	--	.16	<.05	3.60	<.2	.61
505	06-29-89	22	321	7.6	--	.92	<.05	2.60	<.2	.21
506	06-29-89	--	458	8.0	28.5	.24	<.05	2.60	<.2	.38
507	06-29-89	<.10	432	8.7	32.0	<.05	<.05	.31	.5	.08
508	06-29-89	.00	530	8.1	--	<.05	<.05	.12	<.2	.05
509	06-29-89	8.9	305	7.6	25.5	1.30	<.05	6.60	<.2	.75
510	06-29-89	38.8	490	8.1	26.5	.59	<.05	4.10	<.2	.84
511	06-29-89	7.6	400	7.7	25.5	.18	<.05	3.00	<.2	.37
512	06-29-89	--	610	8.0	29.0	<.05	<.05	1.50	<.2	<.05
513	06-29-89	--	438	7.7	25.0	<.05	<.05	2.80	<.2	.14
blank	06-29-89	--	--	--	--	<.05	<.05	<.05	<.2	<.05

Site (fig. 3)	Date	Deiso-propyl-atrazine	Metolachlor	Metribuzin	Prometon	Prometryn	Propazine	Simazine	Terbutryn
500	06-29-89	<0.05	1.00	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
501	06-29-89	<.05	.31	<.05	<.05	<.05	<.05	<.05	<.05
502	06-29-89	<.05	.94	<.05	<.05	<.05	<.05	<.05	<.05
503	06-29-89	<.05	.32	<.05	<.05	<.05	<.05	<.05	<.05
504	06-29-89	<.05	.05	<.05	<.05	<.05	<.05	<.05	<.05
505	06-29-89	<.05	.52	<.05	<.05	<.05	<.05	<.05	<.05
506	06-29-89	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
507	06-29-89	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
508	06-29-89	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
509	06-29-89	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
510	06-29-89	.38	<.05	<.05	<.05	<.05	<.05	<.05	<.05
511	06-29-89	<.05	1.50	<.05	<.05	<.05	<.05	<.05	<.05
512	06-29-89	<.05	.16	<.05	<.05	<.05	<.05	<.05	<.05
513	06-29-89	<.05	.20	<.05	<.05	<.05	<.05	<.05	<.05
blank	06-29-89	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05