WATER-QUALITY DATA FOR THE MISSOURI RIVER AND MISSOURI RIVER ALLUVIUM NEAR WELDON SPRING, ST. CHARLES COUNTY, MISSOURI--1991-92

By Michael J. Kleeschulte

U.S. GEOLOGICAL SURVEY
Open-File Report 93-109

Prepared in cooperation with the
U.S. DEPARTMENT OF ENERGY

Rolla, Missouri
1993

U.S. DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	by	To obtain
inch	25.4	millimeter
foot	0.3048	meter
mile	1.609	kilometer
acre	4,047	square meter
gallon	3.785	liter
pound	4.536	kilogram
foot per second	0.3048	meter per second
cubic foot per second	0.02832	cubic meter per second
feet per minute	0.3048	meter per minute
million gallons per day	0.04381	cubic meter per second

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows:

$$°F = 1.8\ °C + 32$$

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

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ABSTRACT

This report contains the water-quality data collected at two cross sections across the Missouri River and from monitoring wells in the Missouri River alluvium near Defiance, Missouri. The upstream river cross section was about 1 mile upstream from the mouth of Femme Osage Creek and the St. Charles County well field, and the downstream cross section was about 100 feet upstream from tributary 5300 and 1.3 miles downstream from the well field. Water was sampled from alluvial wells, including four monitoring well clusters consisting of a paired shallow and deep well, the Daniel Boone Gun Club well, and a composite sample from the wells in the St. Charles County well field.

The sampling results indicate the general water composition from the Missouri River changes with different flow conditions. During low-base flow conditions, the water generally contained about equal quantities of calcium and sodium plus potassium and similar quantities of bicarbonate and sulfate. During high-base flow conditions, water from the river predominantly was a calcium bicarbonate type. During runoff conditions, the water from the river was a calcium bicarbonate type, and sulfate concentrations were larger than during high-base flow conditions but smaller than during low-base flow conditions.

The total and dissolved uranium concentrations at both the upstream and downstream cross sections, as well as from the different vertical samples across the river, were similar during each sampling event. However, sodium, sulfate, nitrate, and total and dissolved uranium concentrations varied with different flow conditions. Sodium and sulfate concentrations were larger during low-base flow conditions than during high-base flow or runoff conditions, while nitrate concentrations decreased during low-base flow conditions. Both total and dissolved uranium concentrations were slightly larger during runoff events than during low-base or high-base flow conditions.

The general composition of water from the alluvial wells was predominantly calcium bicarbonate. Water from each of the wells had a similar composition except for the raw water sample collected from the St. Charles County well field, which plotted as an intermediate value on a trilinear diagram of Missouri River water and alluvial water.

Constituent concentrations were similar in water samples from the shallow and deep clustered wells; however, slight differences in constituent concentrations were detected as the distance of the wells sampled increased from the river. Sulfate and arsenic concentrations generally decreased towards the river, while barium and manganese concentrations generally increased towards the river. Uranium concentrations were largest in the two well clusters nearest the river.

The summary statistics indicate several analytes were detected in much larger concentrations in the alluvial water than in the river water. These include (median concentrations for the river and alluvial well samples are shown in brackets or parentheses) calcium [57, 120 mg/L (milligrams per liter)], bicarbonate (203, 549 mg/L), alkalinity (170, 450 mg/L), silica (10, 28 mg/L), ammonia [0.02 (estimated), 0.38 mg/L], barium [145, 370 μg/L (micrograms per liter)], iron [0.005 (estimated), 7.2 mg/L], manganese [1 (estimated), 380 μg/L], and strontium (370, 660 μg/L). Six analytes had much

larger concentrations in the river water samples than the alluvial water samples. These include the following analytes: sodium (40, 8 mg/L), sulfate (115, 39 mg/L), chloride (21, 6 mg/L), nitrate (1.65, less than 0.05 mg/L), total organic carbon (9.0, 1.5 mg/L), and dissolved uranium (4.8, 0.4 μg/L).

INTRODUCTION

The 9-acre Weldon Spring quarry site is along the limestone bluffs that are adjacent to the Missouri River flood plain about 2.5 mi (miles) northeast of Defiance (fig. 1). Disposal of wastes into the quarry began in the 1940's when the U.S. Army used the quarry for the disposal of rubble and residues from the manufacture of trinitrotoluene (TNT) from a nearby ordnance works. During 1958, the Atomic Energy Commission acquired the quarry, and beginning in 1959 and continuing through 1969, the quarry was used for the disposal of low-level radioactive wastes (primarily uranium and thorium; Kleeschulte and Emmett, 1986).

During 1972, St. Charles County purchased a well field for public water supply that is located in the Missouri River alluvium about 0.6 mi east of the quarry site. Water pumped from the well field averaged about 8.8 Mgal/d (million gallons per day) during 1990 (D.N. Mugel, U.S. Geological Survey, oral commun., 1992). Because of the potential for the wastes from the quarry to migrate into the well field, the U.S. Department of Energy has been monitoring the water quality in wells located between the quarry and the well field. Sampling has indicated that one monitoring well has uranium concentrations larger than other alluvial wells in the area. However, the degree of variability in background chemical and radiochemical constituent concentrations in the alluvium was unknown.

During 1991, the U.S. Geological Survey, in cooperation with the U.S. Department of Energy, began a study to determine the background water-quality concentration for selected chemical and radiochemical constituents in the nearby Missouri River and in the Missouri River alluvium near the quarry. This report describes the sampling methodology, water-quality results, and sampling quality assurance and quality control.

The author especially acknowledges the cooperation of Mr. D.D. Howell, Mr. Norman Engelage, and Mr. Sam Pugh for allowing the installation of monitoring wells on their property for sampling purposes. The author thanks Mr. Tom Aaron of the St. Charles County Water Department for allowing the sampling of raw water from the St. Charles County alluvial well field and the members of the Daniel Boone Gun Club for access to their well for sampling. These data could not have been obtained without their cooperation.

MISSOURI RIVER

During 1986, a ground-water model of the St. Charles County well field indicated that two-thirds of the water pumped from the well field comes directly from infiltration from the Missouri River (Layne-Western Company, Inc., 1986). Because of the extensive interaction between the alluvium and the Missouri River, a study of the water quality in the alluvium would not be complete without including the water quality of the Missouri River.

Methodology

The Missouri River was sampled at two cross sections during this study. The upstream cross section was about 1 mi upstream from the mouth of Femme Osage Creek and the downstream cross section was located about 100 ft (feet) upstream from tributary 5300 (fig. 1). The water samples were collected during three low-base flow periods, three high-base flow periods, and during the rising stage of two runoff periods to assess the water-quality variability under different flow conditions. The sampling frequency was hydrologically determined, not time dependent; however, during base-flow periods, the samples were not collected sooner than at 1-month intervals to ensure proper flushing of the stream between sampling events.

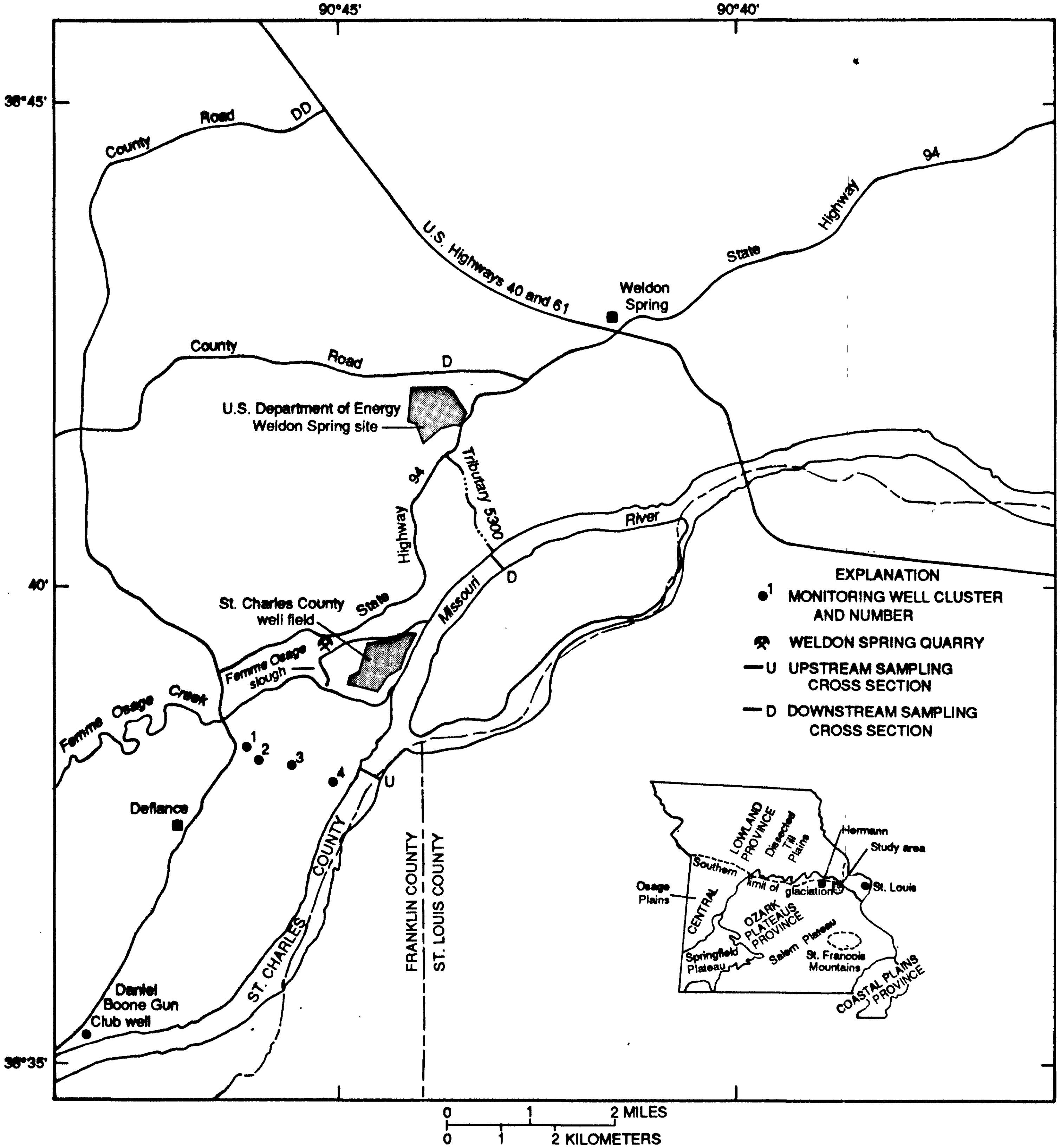

Figure 1. Study area (physiography from Fenneman, 1938).

Each composite sample consisted of the total water collected from 10 vertical samples (visually estimated to be of equal width) using the equal-width-increment method. The sampling locations (vertical samples) at each cross section were numbered consecutively 1 through 10. Vertical sample 1 was the sample site closest to the north bank of the river, vertical sample 10 was the site closest to the south bank, and vertical samples 5 and 6 were approximately in the middle of the river.

The water sample was collected with a 100-lb (pound), brass, depth-integrating sampler suspended by a steel cable on a power winch. The sampler was painted with an epoxy coating and equipped with a plastic intake nozzle to limit trace-element contamination from water in contact with the sampler. The water was collected in quart glass bottles that were inserted into the sampler. Water that was collected from each vertical sample was composited in a polyethylene churn splitter. After sample collection, the chemical constituents to be analyzed in the "dissolved" phase were filtered through a 0.45-micrometer membrane filter. Constituents to be analyzed as total concentrations were collected as raw or unfiltered samples.

An additional set of samples was collected during one low-base flow, one high-base flow, and one runoff event to determine if there was a variability in radiochemical constituent concentrations from one bank of the Missouri River to the other. The northern bank of the river receives ground-water inflow from the Dissected Till Plains and the southern bank receives inflow from the Ozark Plateaus Province (fig. 1). There was concern that the radiochemical ground-water quality in these physiographic provinces may be different because the St. Francois Mountains in southeast Missouri contain granites that may increase the radiochemical concentrations in the ground water, in particular, uranium concentrations.

These additional water samples were collected for radiochemical analysis at five equally spaced sites along the upstream and downstream cross sections (vertical samples 1, 3, 5, 7, and 9) and were collected using the same equipment as the composite samples. The water collected from each vertical sample was transferred from the quart glass bottle directly into a 1-gallon plastic container and each plastic container held water only from one vertical sample.

The daily mean discharge of the Missouri River at Hermann (fig. 1) on the day before the sampling event was used to estimate the discharge at the sampling site. This discharge was used because there are no large streams that discharge into the Missouri River between Hermann and the sampling sites and there typically is about one day travel time between Hermann and the sampling sites. Mean velocity for the Missouri River at Hermann during base-flow conditions was about 3.4 ft/s (feet per second; data on file at the U.S. Geological Survey in Rolla, Missouri). Hermann is 49 river mi upstream from the sampling sites so travel times are approximately 21 hours during base-flow conditions. Mean velocity for the Missouri River at Hermann was about 4.4 ft/s at a discharge of 113,000 ft^3/s (cubic feet per second; data on file at the U.S. Geological Survey in Rolla, Missouri). During the runoff sample collected on June 19, 1991, the travel time from Hermann would be approximately 16 hours.

Specific conductance, pH, water temperature, dissolved-oxygen concentration, and alkalinity were determined onsite. Specific conductance values were measured using a portable conductivity meter with temperature compensation designed to express readings in microsiemens per centimeter at 25 °C (degrees Celsius). The potentiometric method was used to measure both the pH value and alkalinity. Water temperature was measured with a mercury thermometer to the nearest 0.5 °C. Dissolved oxygen concentrations were measured using a portable temperature compensated meter. Alkalinity was determined on shore by incremental titration past the inflection point with 0.1600 normal sulfuric acid. The analyses from the composite samples are listed in table 1 (at the back of this report) and the analyses from each vertical sample used to define the radiochemical constituent distribution across the Missouri River are listed in table 2 (at the back of this report).

Water-Quality Data

Stiff diagrams can be used to illustrate the general water type and composition by plotting the proportions of each major ionic species contained in the water. Representative stiff diagrams drawn for the composite samples (fig. 2) indicate that the low-base flow water samples generally contained equal quantities of calcium and sodium plus potassium and similar quantities of bicarbonate and sulfate. The high-base flow composite samples predominantly were a calcium bicarbonate type water. During runoff conditions, the river water was a calcium bicarbonate type, and sulfate concentrations were larger than during high-base flow conditions but smaller than during low-base flow conditions.

A boxplot (fig. 3) can be used to visually examine the central tendency and dispersion of a group of data or for comparing two or more groups of data. The boxplot consists of the median value (50th percentile) plotted as a horizontal line and a box drawn from the 25th percentile to the 75th percentile. The box height equals the interquartile range (IQR). A vertical line is drawn from the 75th percentile upward to the upper adjacent value, which is defined as the largest data point less than or equal to the upper quartile plus 1.5 times the IQR. Likewise, a vertical line is drawn from the 25th percentile downward to the lower adjacent value, which is defined as the smallest data point greater than or equal to the lower quartile minus 1.5 times the IQR. Values more extreme in either direction than the adjacent values are plotted individually. The values equal to 1.5 to 3.0 times the IQR are called "outside values" and are represented by an asterisk; those values greater than 3.0 times the IQR are called "far-out values" and are represented by a circle.

The total and dissolved uranium concentrations in water from the Missouri River at different locations and during different flow conditions are shown in figure 4. The distribution of uranium concentrations at the upstream cross section was determined by compiling into one data set all the analyses from the samples collected at the upstream cross section, including the uranium analyses from the composite samples and the vertical samples collected across the river for radiochemical analyses. The same was done for the downstream sampling cross section. The distribution of uranium concentrations at vertical sample 1 was determined by compiling into one data set the analyses from the samples collected for radiochemical analyses from only vertical sample 1 at both the upstream and downstream cross sections during all three flow conditions. The same was done for samples collected at vertical samples 3, 5, 7, and 9. The distribution of uranium concentrations during low-base flow was determined by compiling into one data set all the analyses from the composite samples plus the vertical samples collected for radiochemical analyses from both the upstream and downstream cross sections during low-base flow. The same was done for the analyses representing high-base flow and runoff conditions.

Total and dissolved uranium concentrations (median concentrations shown in brackets or parentheses) were slightly larger during runoff conditions [5.9, 5.6 μg/L (micrograms per liter)] than during low-base flow (5.4, 4.7 μg/L) or high-base flow (5.0, 4.3 μg/L) conditions (fig. 4). Thorium concentrations were not included in these boxplots because, in all samples, thorium concentrations were less than the detection limit of 1.0 pCi/L (picocurie per liter).

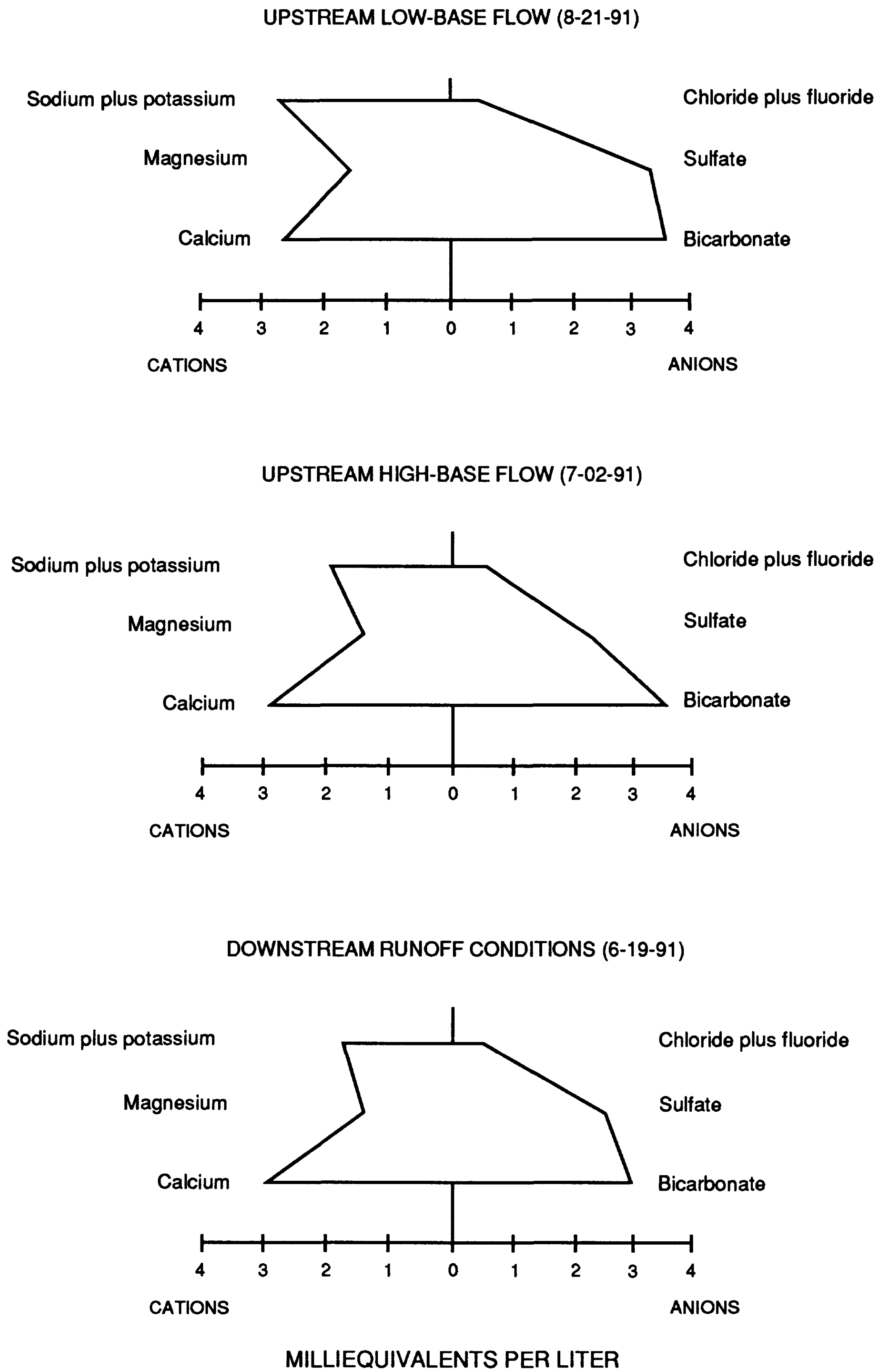

Figure 2. Representative stiff diagrams for cross-section composite water samples collected during low-base flow, high-base flow, and runoff conditions.

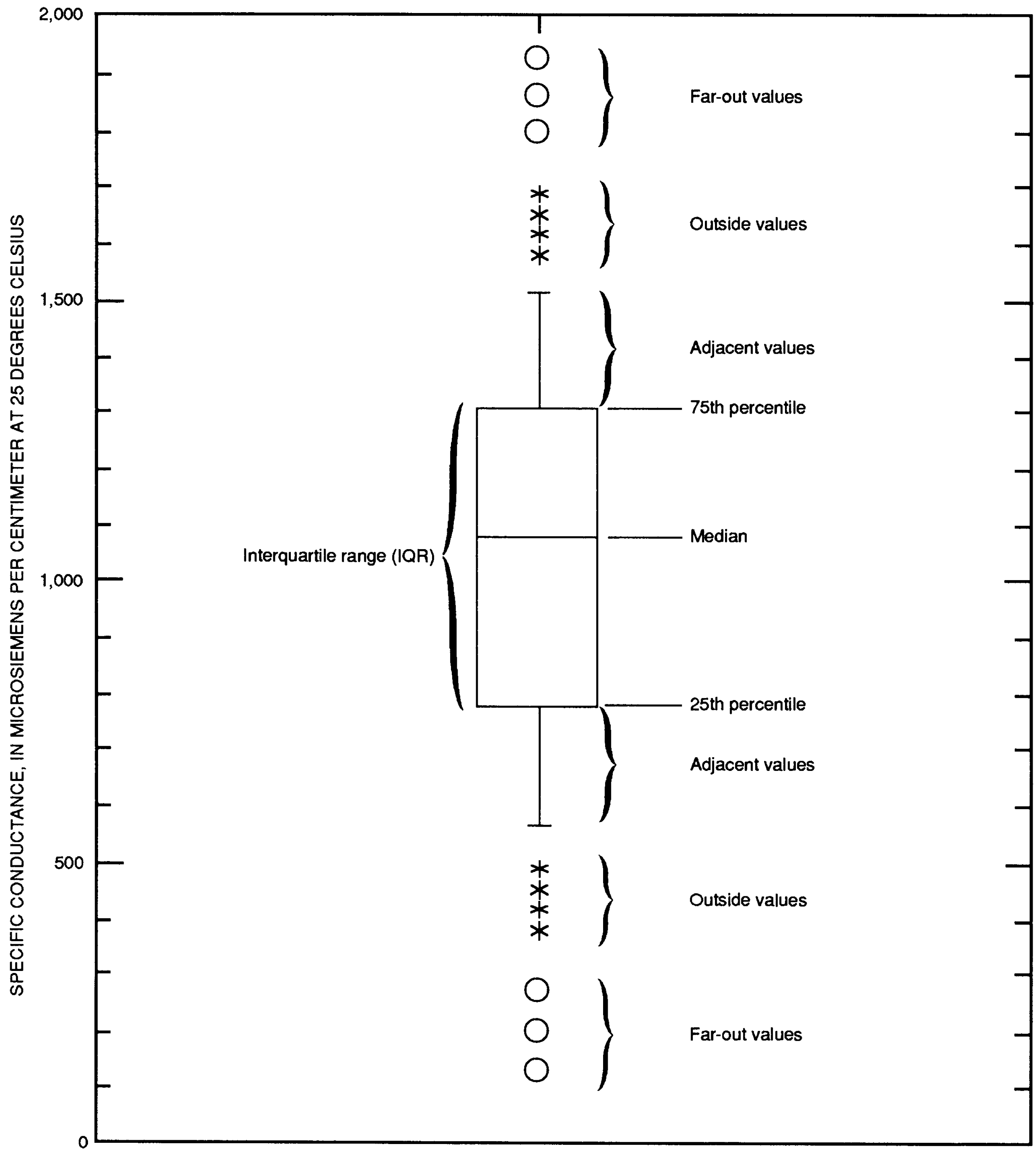

Figure 3. Boxplot example.

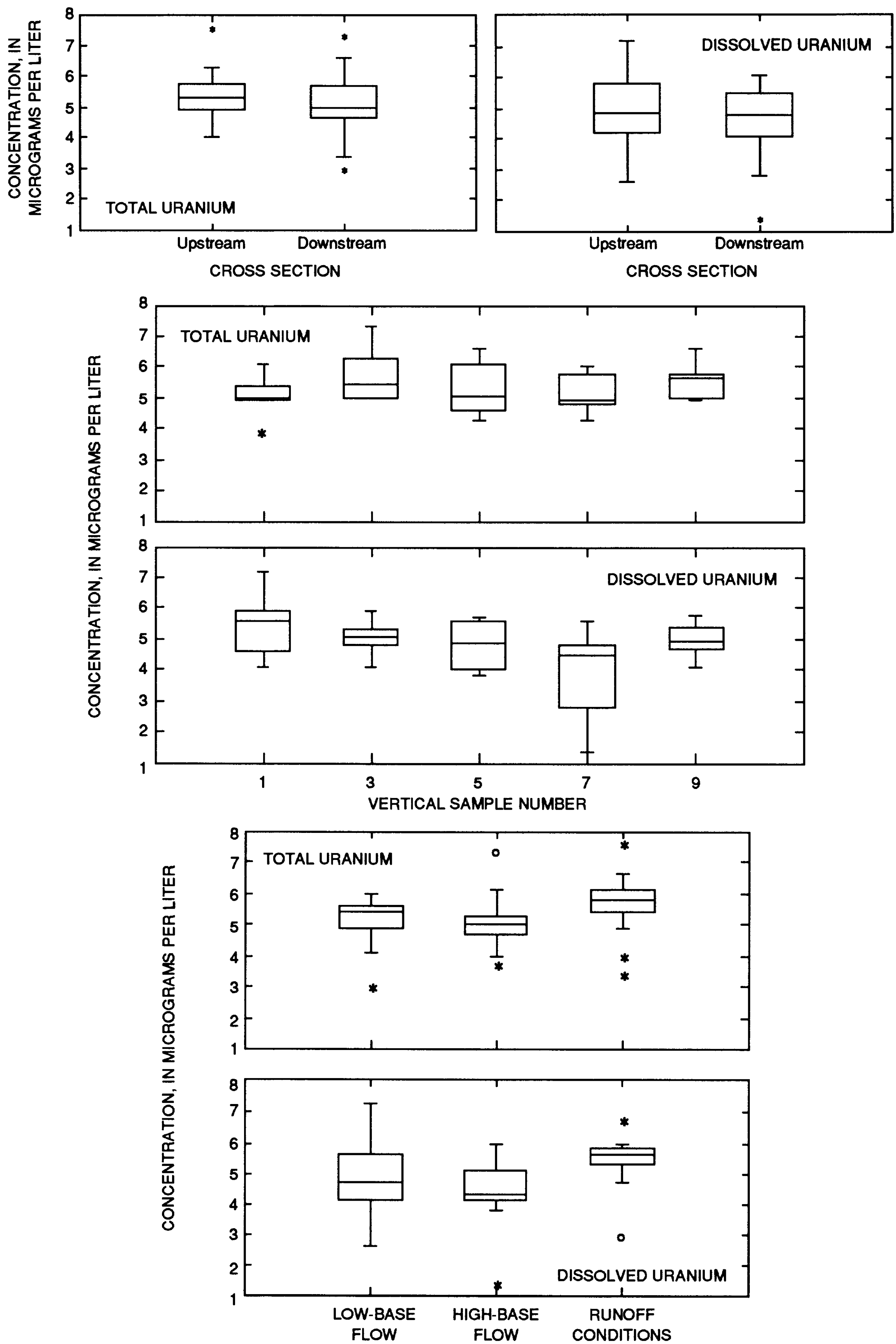

Figure 4. Total and dissolved uranium concentrations in water from the Missouri River.

Sodium, sulfate, and nitrate concentrations in water from the Missouri River during different flow conditions are shown in figure 5. Sodium and sulfate concentrations (median concentrations shown in brackets or parentheses) were larger during low-base flow [58, 160 mg/L (milligrams per liter)] than during high-base flow (38, 110 mg/L) or runoff conditions (37, 110 mg/L). Nitrate concentrations (median concentration shown in parentheses) were lower during low-base flow (0.60 mg/L) than during high-base flow (2.2 mg/L) or runoff conditions (2.0 mg/L).

MISSOURI RIVER ALLUVIUM

The background concentrations and the variability of chemical constituents both areally and with depth in water from the Missouri River alluvium near the St. Charles County well field were unknown. Four monitoring well clusters consisting of a shallow and a deep well were installed across the alluvium on the north side of the Missouri River near Defiance (fig. 1) to assess the concentrations and variability of chemical constituents. This area of the alluvium was chosen because it is near the Weldon Spring quarry site (about 1.4 mi upstream from the quarry) but upgradient from the ground-water flow from the quarry (Kleeschulte and Emmett, 1986). Water samples also were collected from existing wells, including the Daniel Boone Gun Club well 3 mi southwest of Defiance, and wells from the St. Charles County well field.

Methodology

The water-quality samples from the monitoring wells were collected during the first two sampling events using a stainless steel submersible pump that used Teflon[1] gears to positively displace the water through a discharge line consisting of a garden hose. Water-quality samples from the monitoring wells were collected during the last two sampling events and from the Daniel Boone Gun Club well using a centrifugal pump that discharged water through a garden hose. The raw water sample from the St. Charles County water treatment plant was collected as a grab sample from the water intake causeway using a polyethylene churn splitter. This sample represents a composite of the water from the wells that were being pumped in the well field at the time of sampling.

The ground-water levels were measured from the top of casing. Specific conductance, pH, water temperature, and alkalinity were determined onsite using the same methods that were described in the previous section for the Missouri River sampling. Dissolved oxygen concentrations were determined by colorimetry to the nearest 0.05 mg/L using a diethylene glycol and rhodazine-D method developed by Chemetrics. Oxidation-reduction potentials (Eh), sulfide, total iron, dissolved iron, total ferrous iron, and dissolved ferrous iron also were measured onsite. Oxidation-reduction potentials were determined by measuring the voltage developed at the surface of a platinum electrode immersed in the sample. Sulfide concentrations were determined using the methylene blue method, total iron concentrations were determined using the ferrozine method, and ferrous iron concentrations were determined using the phenanthroline method as described by the Hach Company. Concentrations were measured by a portable spectrophotometer calibrated and set to the 665-nanometer wavelength for sulfide determination and set to the 510-nanometer wavelength for the total iron and ferrous iron determination.

Monitoring Well Installation

The holes for the monitoring well clusters (fig. 1) were drilled with hollow-stem augers. Ideally, the deep well would penetrate the alluvium to the top of bedrock; however, this penetration was only accomplished in deep well 1 farthest from the river. Augering was stopped in the other three deep wells when saturated fine-grained sands began sloughing around the auger flights, causing increased

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[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.

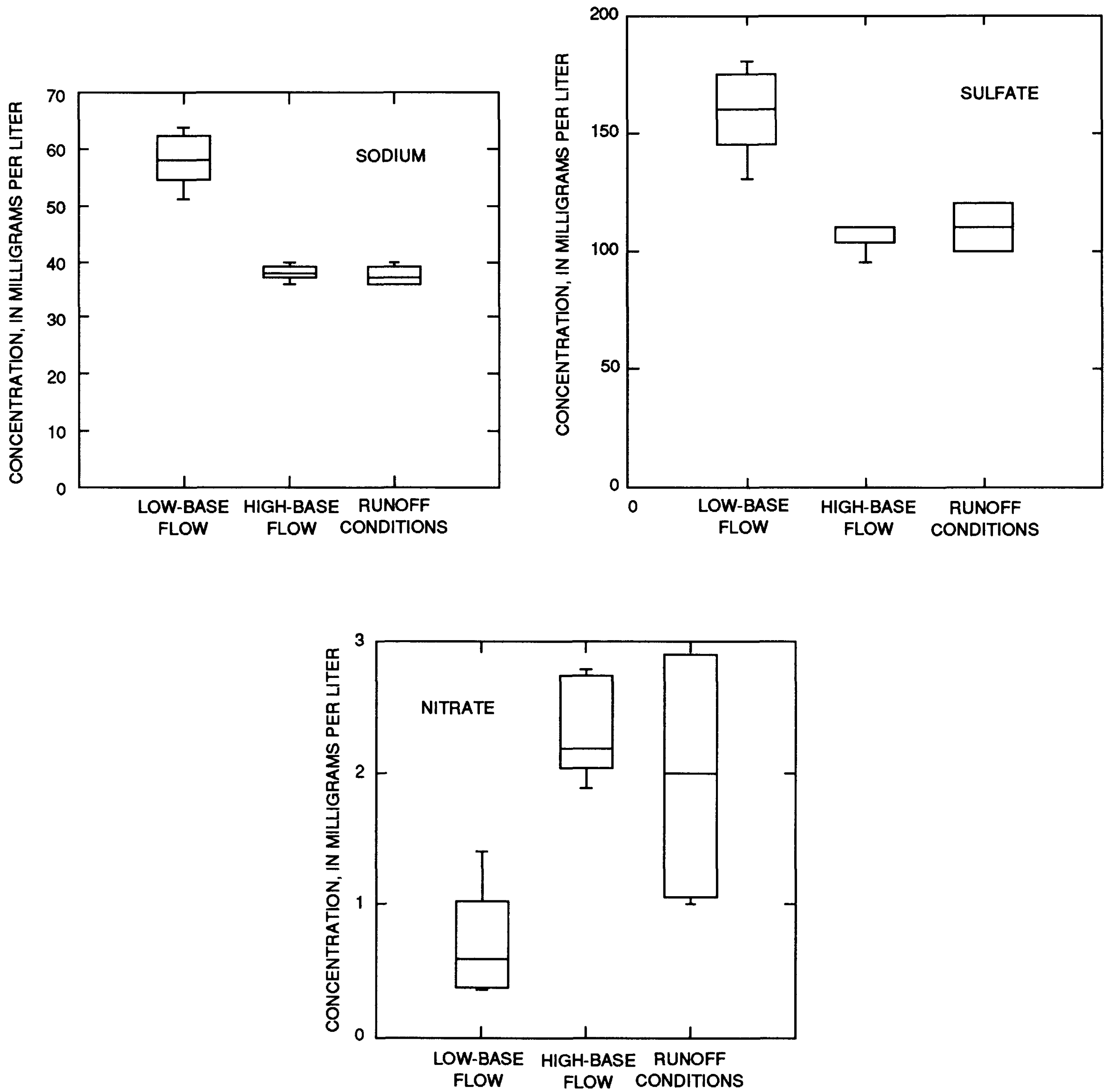


Figure 5. Sodium, sulfate, and nitrate concentrations in water from the Missouri River.

drag on the augers, and deepening of the hole could possibly result in loss of the auger flights. Consequently, the shallow wells ranged from 29.9 to 49.8 ft deep and the deep wells ranged from 37.5 to 69.5 ft deep (table 3, at the back of this report).

The monitoring well riser pipe and screen consisted of flush-wall, schedule 40 polyvinyl chloride pipe with O-rings inserted at each pipe joint. The slot size used for the well screen was 0.010 in. (inch). The natural sand pack used around the well screen to a depth of about 5 ft above the screen was formed by allowing the sands around the auger flights to collapse around the screen as the augers were slowly removed from the hole. In the shallow wells, occasionally sloughing of the sands would not occur; in these instances 30 to 40 mesh, washed sands were added to a depth of about 5 ft above the well screen.

The seal above the sand pack was constructed by placing 0.375-in. bentonite chips above the sand pack for a total thickness of about 5 ft. The remainder of the annular space was sealed by alternating fill material between natural sands and bentonite chips. This alternating sequence continued to within 5 ft of land surface, where the remaining annular space was filled with bentonite. Each well was secured with a metal protective casing.

During the drilling of the deep wells, core samples were taken with a stainless steel, split-spoon sampler. The core samples were collected at 5-ft intervals when possible. Typically, coring was discontinued at a depth of 35 to 40 ft because, when the coring bit was removed to insert the coring tool, saturated sands would flow inside the hollow stem auger, which prevented the coring tool from being reinserted. Occasional grab samples were collected after coring stopped. The core samples are described in table 4 (at the back of this report).

Vertical control was established at the top of casing and at land surface near the wells by surveying, and geophysical logging was performed at each deep well. The starting reference point for the vertical control was not an established benchmark. The altitude that was assigned to the reference point corresponded to the altitude of the reference point as shown on a 7.5 minute U.S. Geological Survey topographic map (table 3). Gamma logs for each of the deep wells are shown in figure 6. During the geophysical logging, the probe was lowered 12 ft/min (feet per minute) and the time constant (time interval between each gamma count measurement) was 2 seconds.

Water-Quality Data

The water from the alluvium predominantly was a calcium bicarbonate type (fig. 7). The stiff diagram of the water from the St. Charles County well field had a slightly different shape than the diagram of water from the other alluvial wells. The calcium and bicarbonate concentrations (70 and 399 mg/L) from the well field were less than in the other alluvial wells, whereas the sulfate concentration (98 mg/L) was larger than in the other alluvial wells (table 5, at the back of this report).

Slight changes were detected in the water quality across the alluvium. Results of water-quality samples collected in the monitoring well clusters for selected chemical constituents of concern are shown in figure 8. Sulfate and arsenic concentrations generally decreased towards the river, while barium and manganese concentrations generally increased towards the river. Uranium concentrations were largest in the two monitoring well clusters (clusters 3 and 4) closest to the river.

COMPOSITION AND SUMMARY STATISTICS OF WATER FROM THE MISSOURI RIVER AND MISSOURI RIVER ALLUVIUM

The general composition of a water sample can be represented on a trilinear diagram. The values plotted on the diagram are expressed as percentages of the total milliequivalents per liter of the major cations and anions (Hem, 1985). The composition of water sampled from the Missouri River and alluvial wells during April 8 and 9, 1992, is shown on a trilinear diagram (fig. 9) together with the area that defines the general chemical composition of all samples collected from either the Missouri River

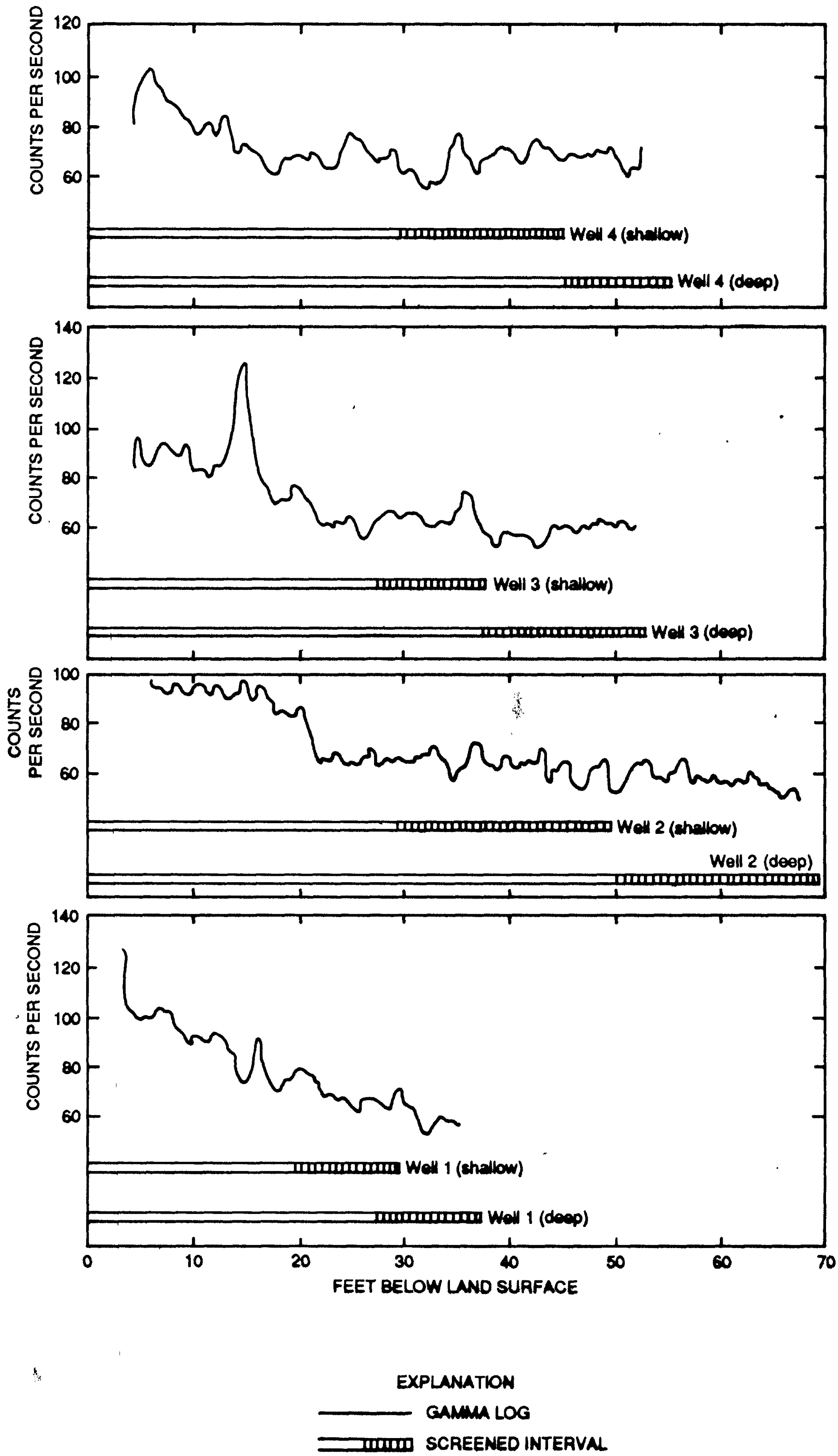


Figure 6. Gamma logs and screened-interval data.

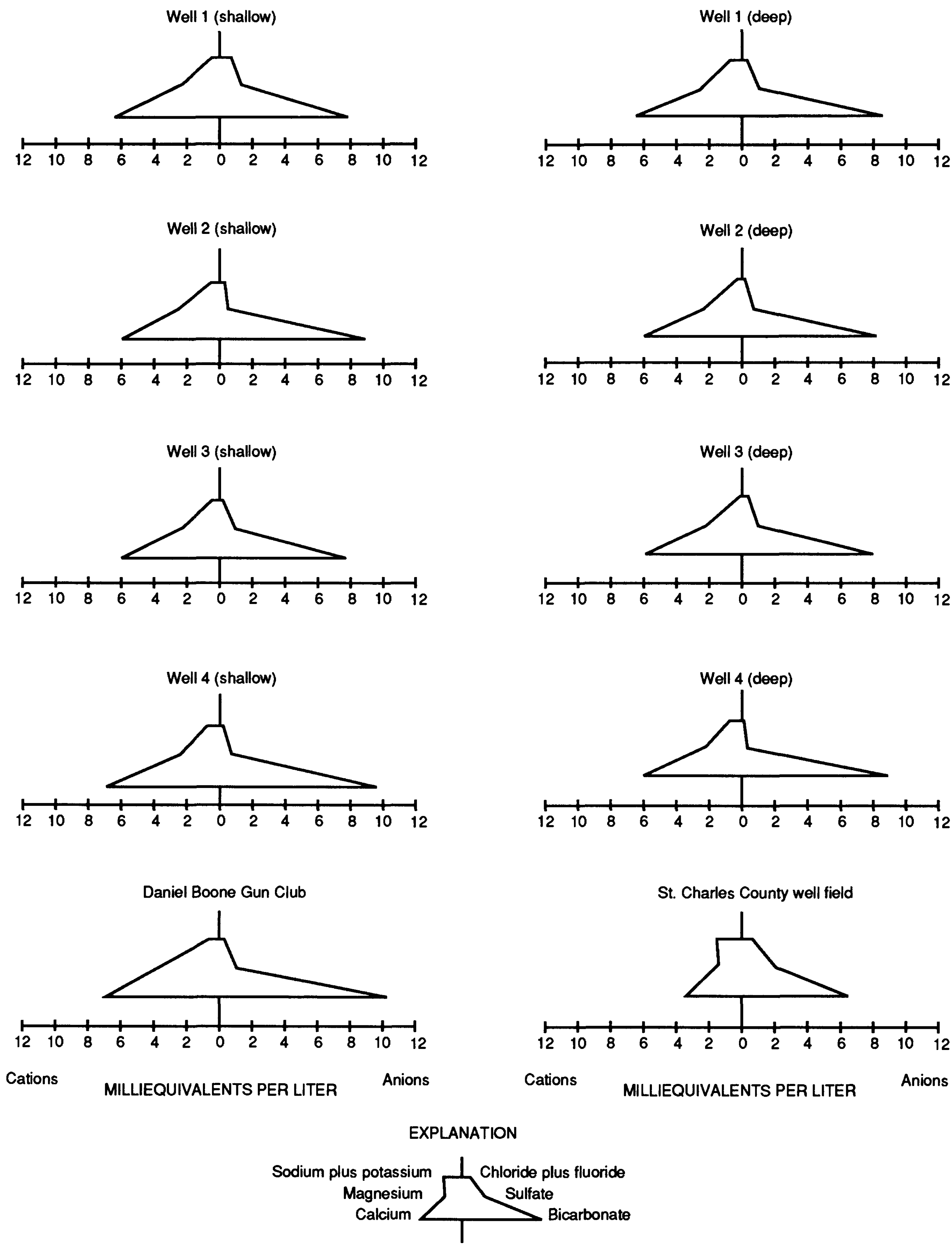


Figure 7. Representative stiff diagrams for water samples collected from wells in the Missouri River alluvium.

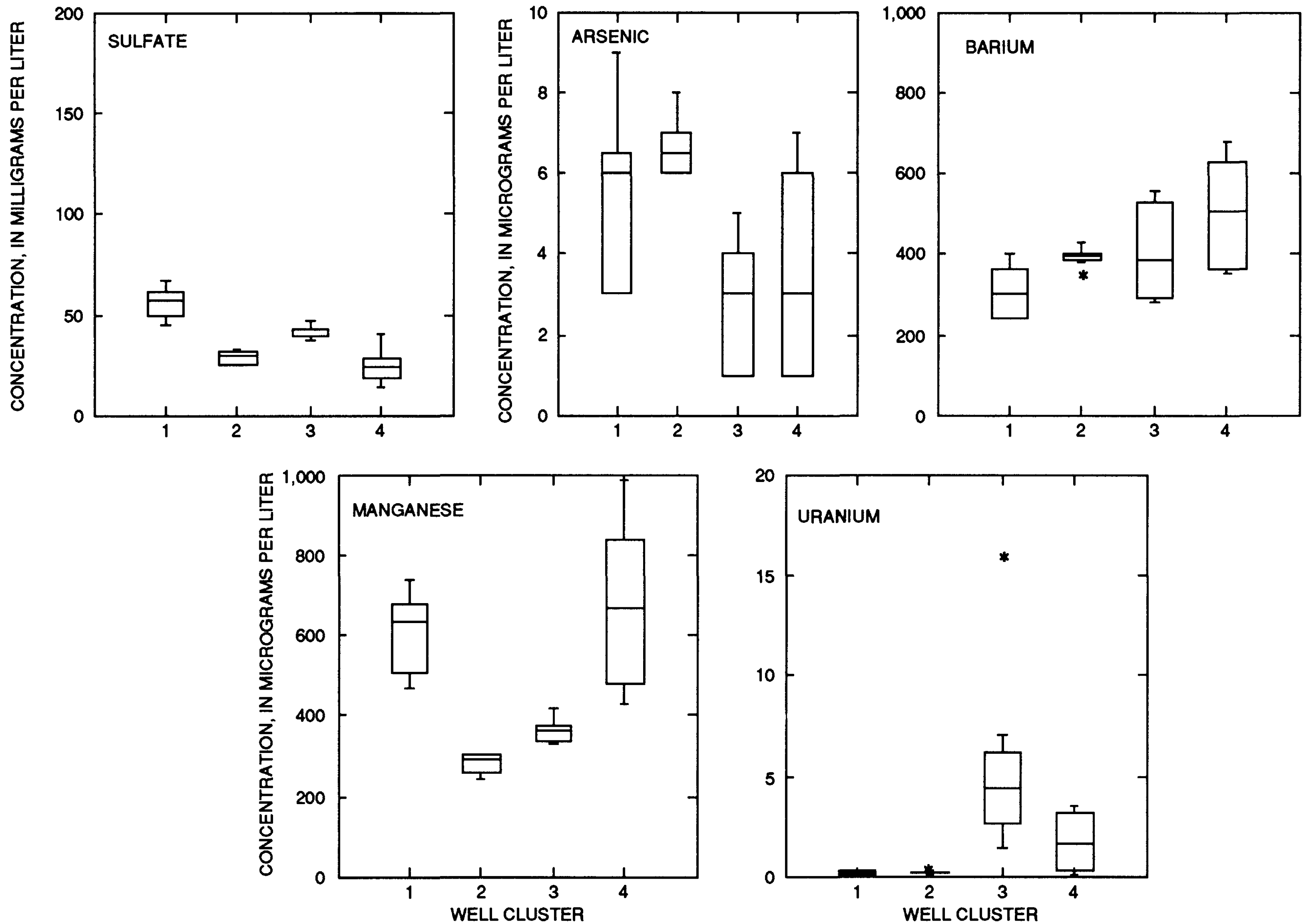
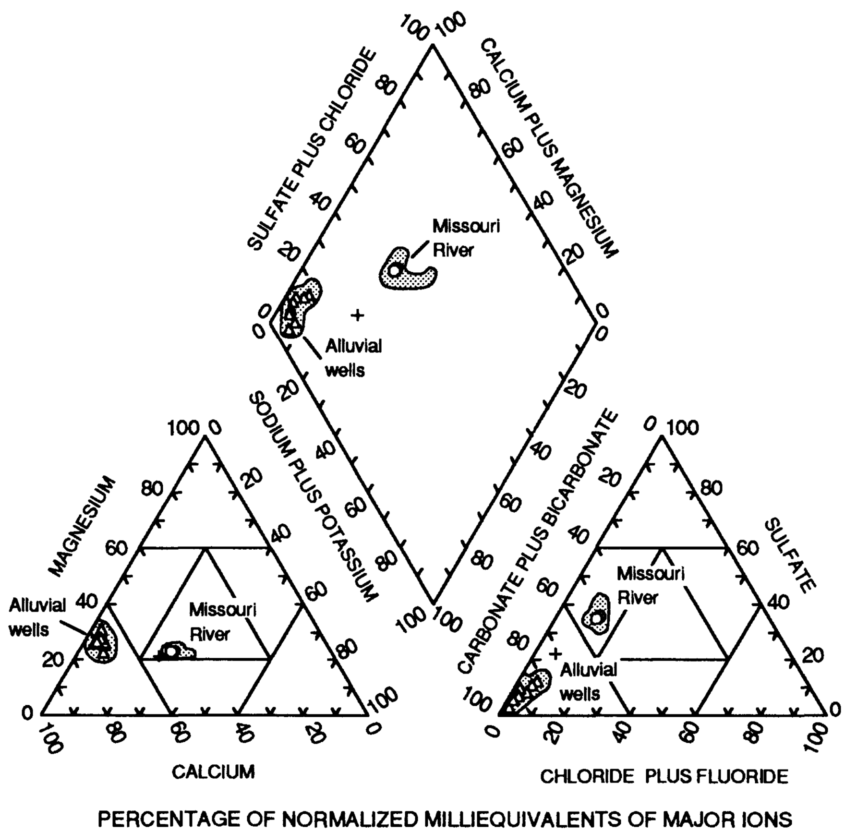


Figure 8. Selected chemical constituents in water samples from alluvial well clusters near Defiance.



EXPLANATION

SAMPLES COLLECTED APRIL 8-9, 1992

- ▫ Missouri River
- ▵ Alluvial wells near Defiance
- \+ St. Charles County well field

▩ AREA DEFINING THE MAJOR CONSTITUENTS IN ALL SAMPLES COLLECTED FROM THE MISSOURI RIVER AND THE MISSOURI RIVER ALLUVIUM

Figure 9. Trilinear diagram of major constituents in water samples from the Missouri River and the Missouri River alluvium.

or the alluvium during this project. The Missouri River samples plot in a cluster and, except for the sample collected from the St. Charles County well field, all the alluvial well samples plot in a cluster. The water from the St. Charles County well field plots in the area between the Missouri River samples and the alluvial well samples. Hem (1985) states water that plots as an intermediate of two end points on a trilinear diagram is a mixture of water represented by the two end points.

Summary statistics, including the maximum, minimum, mean, and the 95th, 75th, 50th (median), 25th, and 5th percentiles, were calculated for the water samples collected from the Missouri River and the alluvial wells (table 6, at the back of this report). The mean and percentiles for multiple-censored data were estimated using a log-probability regression procedure described by Gilliom and Helsel (1986) and Helsel and Cohn (1988). This procedure is used to estimate the values less than the detection limit of a constituent; these estimated values and the detected values then are used together to estimate the mean and percentiles. A parameter is considered censored if greater than 5 percent of the total number of data values is less than the detection limit. Generally, the 95th percentile value represents a value that is about two standard deviations larger than the mean value for the analyte.

The summary statistics indicate several analytes were present in larger concentrations in the alluvial water than in the river water. These include the following analytes: [the 50th percentile (median) for the river and alluvial well samples are shown in parentheses or brackets]; calcium (57, 120 mg/L), bicarbonate (203, 549 mg/L), alkalinity (170, 450 mg/L), silica (10, 28 mg/L), ammonia [0.02 (estimated), 0.38 mg/L], barium (145, 370 μg/L), iron [0.005 (estimated), 7.2 mg/L], manganese [1 (estimated), 380 μg/L], and strontium (370, 660 μg/L). Six analytes had larger concentrations in the river water samples than the alluvial water samples. These include the following analytes: sodium (40, 8 mg/L), sulfate (115, 39 mg/L), chloride (21, 6 mg/L), nitrate (1.65, less than 0.05 mg/L), total organic carbon (9.0, 1.5 mg/L), and dissolved uranium (4.8, 0.4 μg/L). The analysis of the sample from the St. Charles County well field was not included with the alluvial well data because of its plotting location on figure 9.

Concentrations for constituents of concern in the Missouri River and the Missouri River alluvium are shown in figure 10. Sulfate concentrations were larger in the water samples from the river, but barium and manganese concentrations were larger in the alluvium. Dissolved uranium concentrations typically were larger in the river; however, the variability of the uranium concentrations in the alluvium was much larger than the variability in the river samples.

QUALITY ASSURANCE AND QUALITY CONTROL

All water-quality samples were analyzed by laboratories of the U.S. Geological Survey. Samples were analyzed for inorganic substances according to methods described by Fishman and Friedman (1989), organic substances according to methods described by Wershaw and others (1983), and radiochemical constituents according to methods described by Thatcher and others (1977).

During the Missouri River sampling, one blank sample was collected during a high-base flow sampling event early in the project at the upstream site and one blank sample was collected midway through the project during low-base flow at the downstream site (table 1). These blank samples were both a sampler and filter blank. The blank samples were analyzed for major anions and cations, nutrients, trace elements, and radiochemical constituents. Deionized water, which had a specific conductance of less than 10 μS/cm (microsiemens per centimeter at 25 degrees Celsius), was used for the blank samples. These blank samples were subjected to all aspects of sample collection, processing, preservation, transportation, and laboratory handling as the environmental samples. Also, two split samples were collected during the project, one at the upstream site and one at the downstream site. These samples were analyzed for the same constituents as the regular samples.

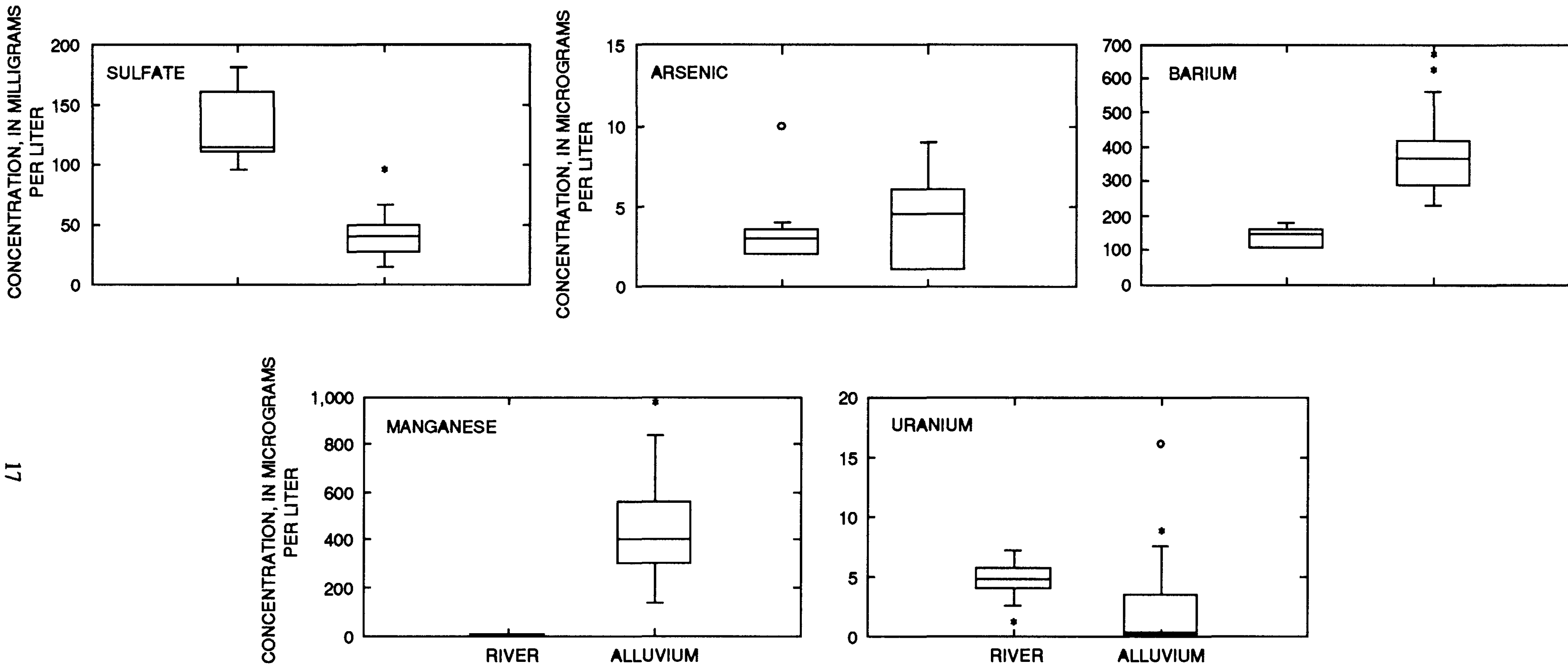


Figure 10. Selected chemical constituents in water samples from the Missouri River and the Missouri River alluvium.

Split samples were collected for the U.S. Department of Energy during the March and April 1992 sampling of the alluvial wells. Blank samples were collected during the May and June 1992 samplings (table 5). These blank samples represented trip and filter blanks and were subjected to the same processes as the alluvial well samples, except they were not processed through the sampling pump. The water for the blank samples was supplied by a U.S. Geological Survey laboratory and it had no inorganic analytes larger than the detection limit. The analytes detected in the blank samples were a result of the sampling process.

The total and dissolved iron concentrations and total and dissolved ferrous iron concentrations for the wells in the Missouri River alluvium were determined onsite using a portable spectrophotometer. These measurements were made to support the measured oxidation-reduction potential and, therefore, these onsite iron values are considered semi-quantitative. The degree of error associated with these measured concentrations is evident because several dissolved iron and dissolved ferrous iron concentrations were greater than the total iron and total ferrous iron concentrations (table 5).

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ABBREVIATIONS AND SYMBOLS USED IN TABLE 1

Q	Instantaneous discharge, in cubic feet per second
Cond	Specific conductance, in microsiemens per centimeter at 25 degrees Celsius
pH	In standard units
Temp	Water temperature, in degrees Celsius
Ca	Dissolved calcium, in milligrams per liter
Mg	Dissolved magnesium, in milligrams per liter
Na	Dissolved sodium, in milligrams per liter
K	Dissolved potassium, in milligrams per liter
HCO_3	Bicarbonate, in milligrams per liter
CO_3	Carbonate, in milligrams per liter
Alk	Alkalinity as calcium carbonate, in milligrams per liter
SO_4	Dissolved sulfate, in milligrams per liter
Cl	Dissolved chloride, in milligrams per liter
F	Dissolved fluoride, in milligrams per liter
Br	Bromide, in milligrams per liter
SiO_2	Dissolved silica, in milligrams per liter
DS	Dissolved solids, residue at 180 degrees Celsius, in milligrams per liter
NO_2	Dissolved nitrite as nitrogen, in milligrams per liter
$NO_2 + NO_3$	Dissolved nitrite plus nitrate as nitrogen, in milligrams per liter
NH_3	Dissolved ammonia as nitrogen, in milligrams per liter
P total	Total phosphorous, in milligrams per liter
PO_4	Dissolved orthophosphate as phosphorus, in milligrams per liter
Al	Dissolved aluminum, in micrograms per liter
As	Dissolved arsenic, in micrograms per liter
Ba	Dissolved barium, in micrograms per liter
Be	Dissolved beryllium, in micrograms per liter
B	Dissolved boron, in micrograms per liter
Cd	Dissolved cadmium, in micrograms per liter
Cr	Dissolved chromium, in micrograms per liter
Co	Dissolved cobalt, in micrograms per liter
Cu	Dissolved copper, in micrograms per liter
Fe	Dissolved iron, in micrograms per liter
Pb	Dissolved lead, in micrograms per liter
Li	Dissolved lithium, in micrograms per liter
Mn	Dissolved manganese, in micrograms per liter
Hg total	Total recoverable mercury, in micrograms per liter
Hg	Dissolved mercury, in micrograms per liter
Mo	Dissolved molybdenum, in micrograms per liter
Ni	Dissolved nickel, in micrograms per liter
Se	Dissolved selenium, in micrograms per liter
Ag	Dissolved silver, in micrograms per liter
Sr	Dissolved strontium, in micrograms per liter
V	Dissolved vanadium, in micrograms per liter
Zn	Dissolved zinc, in micrograms per liter
TOC	Total organic carbon, in milligrams per liter
Cy total	Total cyanide, in milligrams per liter
Cy	Dissolved cyanide, in milligrams per liter
U total	Total uranium, in micrograms per liter
U	Dissolved uranium, in micrograms per liter
Th-230	Dissolved thorium 230, in picocuries per liter
Th-232	Dissolved thorium 232, in picocuries per liter
SS	Suspended sediment, in milligrams per liter
--	No data available
<	Less than

Table 1.--*Water-quality data for the Missouri River*

Date	Flow condition	Q	Cond	pH	Temp	Ca	Mg	Na	K	HCO_3	CO_3
Missouri River composite sample upstream from the St. Charles County well field											
07-23-91	Low base	44,300	672	7.8	29.5	57	18	51	6.4	212	0
08-21-91	Low base	39,600	720	7.9	27.5	55	19	58	6.5	222	0
09-26-91	Low base	40,700	660	8.2	20.0	56	20	62	5.8	198	0
05-23-91	High base	83,300	544	7.8	24.5	55	18	36	5.3	194	0
07-02-91	High base	55,800	601	7.6	28.5	61	17	38	6.8	218	0
07-02-91	High base	55,800	608	7.6	28.5	60	17	40	6.4	219	0
04-08-92	High base	61,700	574	6.9	15.0	62	18	39	5.1	209	0
06-19-91	Runoff	113,000	600	7.7	--	61	17	36	7.0	176	0
11-22-91	Runoff	43,800	560	7.4	10.5	51	18	38	5.8	207	0
Missouri River composite sample downstream from the St. Charles County well field											
07-23-91	Low base	44,300	641	8.0	30.5	58	18	51	6.9	209	0
08-21-91	Low base	39,600	687	8.4	27.5	54	19	58	5.9	198	7
09-26-91	Low base	40,700	700	8.3	21.0	57	20	64	5.9	190	7
09-26-91	Low base	40,700	690	8.4	21.0	56	20	63	5.8	187	10
05-23-91	High base	83,300	540	7.9	25.0	55	17	36	4.8	191	0
07-02-91	High base	55,800	570	7.7	28.0	59	17	38	6.3	205	0
04-08-92	High base	61,700	580	7.4	15.0	61	18	39	5.4	201	0
06-19-91	Runoff	113,000	627	8.1	28.6	61	17	36	7.3	185	0
11-22-91	Runoff	43,800	563	7.1	10.0	51	18	40	5.7	207	0
Missouri River blank sample											
05-23-91	--	--	--	--	--	0.12	0.07	<0.20	<0.10	--	--
08-21-91	--	--	--	--	--	.17	.06	.20	<.10	--	--

Table 1.--*Water-quality data for the Missouri River*--Continued

Date	Flow condition	Alk	SO_4	Cl	F	Br	SiO_2	DS	NO_2	NO_2 + NO_3	NH_3
Missouri River composite sample upstream from the St. Charles County well field											
07-23-91	Low base	174	130	21	0.40	0.09	9.6	405	<0.01	1.4	0.02
08-21-91	Low base	182	160	20	.50	.07	7.0	414	.01	.64	<.01
09-26-91	Low base	162	170	21	.50	.09	7.0	425	<.01	.39	<.01
05-23-91	High base	159	95	15	.40	.05	10	333	<.01	2.2	.02
07-02-91	High base	178	110	22	.40	.06	13	360	<.01	2.7	.02
07-02-91	High base	180	110	23	.40	.07	13	361	<.01	2.8	.02
04-08-92	High base	171	110	23	.40	.08	12	381	.02	1.9	<.01
06-19-91	Runoff	144	120	18	.10	.07	13	383	<.01	2.9	.02
11-22-91	Runoff	170	100	26	.30	.09	10	351	.01	1.1	.13
Missouri River composite sample downstream from the St. Charles County well field											
07-23-91	Low base	171	130	21	0.30	0.09	9.8	409	<0.01	1.4	0.03
08-21-91	Low base	174	160	20	.50	.05	7.1	415	<.01	.60	<.01
09-26-91	Low base	168	180	20	.50	.09	7.4	434	<.01	.37	.02
09-26-91	Low base	170	180	21	.50	.09	7.1	436	<.01	.36	<.01
05-23-91	High base	157	97	16	.40	.06	9.4	326	<.01	2.2	.01
07-02-91	High base	168	110	22	.50	.07	13	362	<.01	2.8	.02
04-08-92	High base	165	110	24	.40	.08	12	384	.02	1.9	<.01
06-19-91	Runoff	152	120	19	.10	.06	13	370	<.01	2.9	.02
11-22-91	Runoff	170	100	27	.30	.10	10	339	.02	1.0	.14
Missouri River blank sample											
05-23-91	--	--	0.20	<0.10	0.10	<0.01	11	9	<0.01	<0.05	0.03
08-21-91	--	--	.50	<.10	<.10	.01	10	3	<.01	<.05	.01

Table 1.--*Water-quality data for the Missouri River*--Continued

Date	Flow condition	P total	PO_4	Al	As	Ba	Be	B	Cd	Cr	Co
			Missouri River composite sample upstream from the St. Charles County well field								
07-23-91	Low base	0.18	0.13	10	3	150	<0.5	140	<1.0	<1	<3
08-21-91	Low base	.14	.08	<10	3	120	<.5	120	<1.0	<1	<3
09-26-91	Low base	.23	<.01	20	--	110	--	140	--	--	<3
05-23-91	High base	.13	.10	<10	2	170	<.5	90	<1.0	<1	<3
07-02-91	High base	--	.15	<10	4	160	<.5	110	<1.0	<1	<3
07-02-91	High base	.29	.16	<10	3	180	<.5	100	<1.0	<1	<3
04-08-92	High base	--	.15	<10	10	110	<10	80	<1.0	<1	<3
06-19-91	Runoff	.81	.16	<10	4	170	<.5	100	<1.0	<1	<3
11-22-91	Runoff	.39	.09	40	2	110	<.5	90	<1.0	<1	<3
			Missouri River composite sample downstream from the St. Charles County well field								
07-23-91	Low base	0.21	0.13	10	3	150	0.6	110	<1.0	<1	<3
08-21-91	Low base	.18	.07	<10	3	140	<.5	30	<1.0	<1	<3
09-26-91	Low base	.23	.03	50	--	110	--	130	--	--	<3
09-26-91	Low base	.09	<.01	20	--	120	--	130	--	--	<3
05-23-91	High base	.14	.10	20	2	150	<.5	80	<1.0	2	<3
07-02-91	High base	.15	.15	<10	3	150	<.5	110	2.0	<1	<3
04-08-92	High base	.14	.12	<10	2	120	<10	80	<1.0	<1	<3
06-19-91	Runoff	.85	.20	<10	4	170	<.5	100	<1.0	<1	<3
11-22-91	Runoff	.39	.09	80	2	110	<.5	90	<1.0	<1	<3
			Missouri River blank sample								
05-23-91	--	0.01	<0.01	<10	<1	27	<0.5	20	<1.0	<1	<3
08-21-91	--	.01	<.01	<10	<1	10	<.5	<10	<1.0	<1	5

Table 1.--*Water-quality data for the Missouri River*--Continued

Date	Flow condition	Cu	Fe	Pb	Li	Mn	Hg total	Hg	Mo	Ni	Se	Ag
					Missouri River composite sample upstream from the St. Charles County well field							
07-23-91	Low base	4	<3	<1	35	<1	<0.10	<0.1	<10	<1	1	<1.0
08-21-91	Low base	2	<3	<1	40	2	.20	<.1	<10	<1	2	<1.0
09-26-91	Low base	--	5	--	44	<1	<.10	--	<10	1	1	<1.0
05-23-91	High base	2	6	1	23	<1	<.10	<.1	<10	2	1	<1.0
07-02-91	High base	6	5	1	27	1	<.10	<.1	<10	2	2	<1.0
07-02-91	High base	2	5	<1	26	2	<.10	<.1	<10	<1	2	<1.0
04-08-92	High base	2	8	<1	26	<1	.20	<.1	<10	2	1	<1.0
06-19-91	Runoff	3	5	<1	28	<1	.20	<.1	<10	5	2	<1.0
11-22-91	Runoff	4	38	<1	23	3	<.10	<.1	<10	2	1	<1.0
					Missouri River composite sample downstream from the St. Charles County well field							
07-23-91	Low base	4	5	<1	35	1	<0.10	0.2	<10	2	2	<1.0
08-21-91	Low base	2	4	<1	38	2	<.10	<.1	<10	1	1	<1.0
09-26-91	Low base	--	32	--	45	3	<.10	--	<10	2	2	<1.0
09-26-91	Low base	--	4	--	45	2	<.10	--	<10	<1	2	<1.0
05-23-91	High base	2	13	<1	22	<1	<.10	<.1	<10	2	<1	<1.0
07-02-91	High base	3	7	1	26	2	.10	<.1	10	1	2	<1.0
04-08-92	High base	3	13	<1	26	1	<.10	<.1	<10	2	<1	<1.0
06-19-91	Runoff	3	10	<1	29	1	.20	<.1	<10	3	4	<1.0
11-22-91	Runoff	3	67	<1	25	2	<.10	<.1	<10	1	1	<1.0
						Missouri River blank sample						
05-23-91	--	8	<3	2	<4	<1	<0.10	<0.1	<10	<1	<1	<1.0
08-21-91	--	<1	4	<1	<4	2	<.10	<.1	<10	<1	1	<1.0

Table 1.--*Water-quality data for the Missouri River*--Continued

Date	Flow condition	Sr	V	Zn	TOC	Cy total	Cy	U total[a]	U	Th-230	Th-232	SS
					Missouri River composite sample upstream from the St. Charles County well field							
07-23-91	Low base	380	<6	8	5.1	<0.01	<0.01	5.6	6.2	<1.0	<1.0	243
08-21-91	Low base	430	<6	<3	5.7	<.01	<.01	5.5	6.3	<1.0	<1.0	159
09-26-91	Low base	450	<6	--	6.0	<.01	<.01	4.1	2.6	<1.0	<1.0	162
05-23-91	High base	340	<6	5	16	<.01	<.01	5.3	4.1	<1.0	<1.0	852
07-02-91	High base	340	6	14	9.8	<.01	<.01	5.1	4.4	<1.0	<1.0	566
07-02-91	High base	340	6	12	8.8	<.01	<.01	5.4	4.1	<1.0	<1.0	--
04-08-92	High base	360	<6	<10	--	<.01	<.01	6.1	5.5	<1.0	<1.0	322
06-19-91	Runoff	380	<6	14	37	<.01	<.01	7.6	5.6	<1.0	<1.0	2,810
11-22-91	Runoff	350	<6	11	9.2	<.01	<.01	4.0	6.7	<1.0	<1.0	380
					Missouri River composite sample downstream from the St. Charles County well field							
07-23-91	Low base	390	<6	8	6.1	<0.01	<0.01	5.8	6.1	<1.0	<1.0	250
08-21-91	Low base	430	<6	<3	6.0	<.01	<.01	6.0	2.8	<1.0	<1.0	142
09-26-91	Low base	460	<6	--	5.9	<.01	<.01	4.2	3.9	<1.0	<1.0	149
09-26-91	Low base	450	<6	--	6.7	<.01	<.01	3.0	4.6	<1.0	<1.0	
05-23-91	High base	340	<6	10	18	<.01	<.01	3.7	4.1	<1.0	<1.0	1,030
07-02-91	High base	330	6	10	10	<.01	<.01	5.0	5.9	<1.0	<1.0	610
04-08-92	High base	360	<6	<10	--	<.01	<.01	5.6	5.7	<1.0	<1.0	330
06-19-91	Runoff	380	7	16	30	<.01	<.01	5.4	5.1	<1.0	<1.0	2,810
11-22-91	Runoff	360	<6	23	9.1	<.01	<.01	3.4	2.9	<1.0	<1.0	429
					Missouri River blank sample							
05-23-91	--	3	<6	9	0.8	<0.01	<0.01	<1.0	<1.0	<1.0	<1.0	--
08-21-91	--	<1	<6	7	.4	<.01	<.01	<1.0	<1.0	<1.0	<1.0	--

[a] Some of the reported total uranium concentrations may have been affected by sediment in the raw water samples; therefore, the reported value may be lower than actual concentrations.

Table 2.--*Water-quality data for selected vertical samples from the Missouri River upstream and downstream from the St. Charles County well field*

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than]

Vertical sample number	Location	Specific conductance (µS/cm)	pH (standard units)	Temperature (°C)	Total uranium[a] (µg/L)	Dissolved uranium (µg/L)	Dissolved thorium 230 (pCi/L)	Dissolved thorium 232 (pCi/L)
Low-base flow (07-23-91)								
1	Upstream	629	7.8	29.5	5.1	7.2	<1.0	<1.0
	Downstream	641	7.9	30.5	5.4	4.1	<1.0	<1.0
3	Upstream	630	8.0	29.0	5.5	4.8	<1.0	<1.0
	Downstream	685	7.9	30.0	5.0	5.2	<1.0	<1.0
5	Upstream	627	7.9	30.0	5.4	4.3	<1.0	<1.0
	Downstream	679	8.0	30.5	4.6	5.6	<1.0	<1.0
7	Upstream	627	7.9	30.0	4.9	2.8	<1.0	<1.0
	Downstream	679	8.6	31.0	4.9	4.8	<1.0	<1.0
9	Upstream	632	8.0	31.0	5.7	4.7	<1.0	<1.0
	Downstream	683	8.6	31.0	5.6	4.7	<1.0	<1.0
High-base flow (05-23-91)								
1	Upstream	555	7.7	24.5	4.0	5.3	<1.0	<1.0
	Downstream	556	7.9	25.0	4.9	4.6	<1.0	<1.0
3	Upstream	537	7.9	24.5	5.0	4.9	<1.0	<1.0
	Downstream	542	8.0	24.5	7.3	4.1	<1.0	<1.0
5	Upstream	535	7.9	24.5	4.3	4.0	<1.0	<1.0
	Downstream	531	7.9	26.0	4.7	3.8	<1.0	<1.0
7	Upstream	531	7.9	25.0	4.8	4.3	<1.0	<1.0
	Downstream	529	8.0	25.0	4.3	1.4	<1.0	<1.0
9	Upstream	534	7.9	25.5	5.0	4.1	<1.0	<1.0
	Downstream	531	7.9	27.0	4.9	5.1	<1.0	<1.0
Runoff conditions (06-19-91)								
1	Upstream	594	7.7	27.5	4.9	5.9	<1.0	<1.0
	Downstream	602	8.1	28.0	6.1	5.8	<1.0	<1.0
3	Upstream	598	7.9	28.5	6.3	5.9	<1.0	<1.0
	Downstream	602	8.1	28.5	5.4	5.3	<1.0	<1.0
5	Upstream	595	8.0	28.5	6.1	5.7	<1.0	<1.0
	Downstream	597	8.1	28.5	6.6	5.4	<1.0	<1.0
7	Upstream	598	8.0	28.0	5.8	4.7	<1.0	<1.0
	Downstream	600	8.0	29.0	6.0	5.6	<1.0	<1.0
9	Upstream	596	8.0	29.0	5.8	5.8	<1.0	<1.0
	Downstream	598	8.1	29.5	6.6	5.4	<1.0	<1.0

[a] Some of the reported total uranium concentrations may have been affected by sediment in the raw water samples; therefore, the reported value may be lower than actual concentrations.

Table 3.--*Well-construction data for wells in the Missouri River alluvium*

Well (fig. 1)		Total depth (feet)	Screened interval (feet)	Drill hole diameter (inches)	Casing diameter (inches)	Altitude of land surface (feet)	Altitude of top of casing (feet)
Well 1	shallow	29.9	19.9 to 29.9	8.5	2.0	462.0	463.2
	deep	37.5	27.5 to 37.5	8.5	2.0		463.9
Well 2	shallow	49.8	29.8 to 49.8	10.5	4.0	465.8	465.8
	deep	69.5	49.5 to 69.5	8.5	2.0		465.9
Well 3	shallow	37.6	27.6 to 37.6	10.5	4.0	466.7	467.5
	deep	52.5	37.5 to 52.5	8.5	2.0		467.8
Well 4	shallow	44.6	29.6 to 44.6	8.5	2.0	459.2	459.8
	deep	54.7	44.7 to 54.7	8.5	2.0		459.4
Daniel Boone Gun Club		36.9	unknown	unknown	1.0	468.0	469.0

Table 4.--*Core sample descriptions from deep wells in the Missouri River alluvium near Defiance*

Depth, in feet	Core sample description
	Well 1 (deep)
0 - 9	No sample
10	Light gray, frequent orange-red iron stains, clayey silt; some fine-grained, clear quartz sand
15	Buff to gray, slightly calcareous clayey silt; some very fine-grained white to clear, some orange iron stained, quartz sand; some clear to yellow, subrounded, coarse quartz sand
20	Gray silt, with trace of black organic fragments; some mica fragments (muscovite)
25	Predominantly slightly calcareous silt, with clear to white, very fine-grained, quartz sand; trace of black organic fragments; trace of mica fragments
30	Predominantly slightly calcareous silt, with clear to white, subangular to subrounded, fine-grained quartz sand; trace of black organic fragments
35	Same as at 30 feet
36	Possible clay stringer
39	Possible clay stringer
41	Top of bedrock
	Well 2 (deep)
0 - 9	No sample
10	Tan to brown, silty clay; occasional fragments of white limestone; subrounded, light green quartz, some iron stain
15	Brown to white, angular, very fine-grained, quartz sand; some mica fragments; occasional white, medium-grained, limestone fragments; trace of black organic fragments
20	Brown to white, angular, very fine-grained silty quartz sand; some small mica fragments; some very fine-grained clear to white, with orange iron stain, quartz; trace of black organic fragments
25	Gray to white silty, very fine-grained quartz sand; some mica fragments; some limestone fragments; trace of black organic fragments
30	White to gray, silty to very fine-grained quartz sand; occasional fine grain, clear, quartz sand; some mica fragments; trace of black organic fragments; some limestone fragments
35	Clear to white, medium- to fine-grained, subrounded, quartz sand; occasional angular, coarse-grained, quartz sand; some brown, subrounded, medium-grained chert; trace of black organic fragments
40	Large gravel or cobbles
	Well 3 (deep)
0 - 9	No sample
10	Light to dark brown, silty clay; occasional white, angular chert fragments; some very fine-grained, clear, quartz sand
15	Gray silty clay, with frequent orange-red iron stains; some very fine-grained quartz sand
20	Green to brown silt; abundant clear to yellow, very fine-grained, subangular, quartz sand; trace of limestone fragments; trace of black organic fragments
25	No recovery
30	Clear, white to yellow, subangular to subrounded, fine- to very fine-grained quartz sand; occasional yellow, subangular to subrounded, medium- to very coarse-grained quartz; frequent black, organic fragments
35	Clear to yellow, some orange to red, subangular to subrounded, medium-grained, silty quartz sand; occasional white to yellow, angular to subrounded, coarse- to very coarse-grained quartz sand; general appearance is greenish-brown with frequent black organic fragments
40 - 50	Grab sample--clear to red, rounded to subangular, very fine- to very coarse-grained silty sand; frequent white to red, angular, small chert pebbles; some black organic fragments

Table 4.--*Core sample descriptions from deep wells in the Missouri River alluvium near Defiance*--Continued

Depth, in feet	Core sample description
	Well 4 (deep)
0 - 10	Brown to buff, calcareous, very fine-grained sandy silt; some clear, angular to subangular, fine-grained quartz; trace of black organic fragments
15	Frosted clear to yellow, subrounded, very fine- to fine-grained quartz sand; trace of black organic fragments
20	Clear to yellow, occasionally red, angular to subangular, fine-grained, silty quartz sand; occasional subrounded, medium-grained, quartz sand; trace of fine- to medium-grained black organic fragments; trace of pebble-size chert
25	Clear to white, subangular to subrounded, very fine- to fine-grained quartz sand; some fine-grained to pebble-size black organic fragments (coal?); occasional clear to red, subangular to angular, coarse-grained chert
42 -46	Possible clay layer (from driller)
48	Large gravel
50	Grab sample--subrounded to rounded, fine- to coarse-grained silty sand; some white to red coarse-grained chert; frequent coarse-grained black organic fragments; about 10 percent pebble-size subrounded, silicate (orthoclase?)
51 -53	Hard material (clay?)
55	Grab sample--clear to yellow, subangular, fine-grained quartz sand; subround to round very coarse-grained silty quartz sand; frequent brown to white, small to medium pebbles of chert and quartz; some black organic fragments
56	Possible gravel (from driller)

ABBREVIATIONS AND SYMBOLS USED IN TABLE 5

WL	Depth below land surface (water level), in feet
TD	Total depth of well, in feet
Cond	Specific conductance, in microsiemens per centimeter at 25 degrees Celsius
pH	In standard units
Eh	Oxidation-reduction potential converted to standard hydrogen electrode, in millivolts
Temp	Water temperature, in degrees Celsius
DO	Dissolved oxygen, in milligrams per liter
S^{2-}	Total hydrogen sulfide, in micrograms per liter
Ca	Dissolved calcium, in milligrams per liter
Mg	Dissolved magnesium, in milligrams per liter
Na	Dissolved sodium, in milligrams per liter
K	Dissolved potassium, in milligrams per liter
HCO_3	Bicarbonate, in milligrams per liter
CO_3	Carbonate, in milligrams per liter
Alk	Alkalinity as calcium carbonate, in milligrams per liter
SO_4	Dissolved sulfate, in milligrams per liter
Cl	Dissolved chloride, in milligrams per liter
F	Dissolved fluoride, in milligrams per liter
Br	Bromide, in milligrams per liter
SiO_2	Dissolved silica, in milligrams per liter
DS	Dissolved solids, residue at 180 degrees Celsius, in milligrams per liter
NO_2	Dissolved nitrite as nitrogen, in milligrams per liter
$NO_2 + NO_3$	Dissolved nitrite plus nitrate as nitrogen, in milligrams per liter
NH_3	Dissolved ammonia as nitrogen, in milligrams per liter
P total	Total phosphorous, in milligrams per liter
PO_4	Dissolved orthophosphate as phosphorus, in milligrams per liter
Al	Dissolved aluminum, in micrograms per liter
As	Dissolved arsenic, in micrograms per liter
Ba	Dissolved barium, in micrograms per liter
Be	Dissolved beryllium, in micrograms per liter
B	Dissolved boron, in micrograms per liter
Cd	Dissolved cadmium, in micrograms per liter
Cr	Dissolved chromium, in micrograms per liter
Co	Dissolved cobalt, in micrograms per liter
Cu	Dissolved copper, in micrograms per liter
Fe total	Total recoverable iron, onsite determination, in milligrams per liter
Fe	Dissolved iron, onsite determination, in milligrams per liter
Fe^{++} total	Total ferrous iron, onsite determination, in milligrams per liter
Fe^{++}	Dissolved ferrous iron, onsite determination, in milligrams per liter
Pb	Dissolved lead, in micrograms per liter
Li	Dissolved lithium, in micrograms per liter
Mn	Dissolved manganese, in micrograms per liter
Hg	Dissolved mercury, in micrograms per liter
Mo	Dissolved molybdenum, in micrograms per liter
Ni	Dissolved nickel, in micrograms per liter
Se	Dissolved selenium, in micrograms per liter
Ag	Dissolved silver, in micrograms per liter
Sr	Dissolved strontium, in micrograms per liter
V	Dissolved vanadium, in micrograms per liter
Zn	Dissolved zinc, in micrograms per liter
TOC	Total organic carbon, in milligrams per liter
Cy	Dissolved cyanide, in milligrams per liter
Gr α	Dissolved gross alpha as natural uranium, in micrograms per liter
Gr β-Cs	Dissolved gross beta as cesium-137, in picocuries per liter
Gr β-Sr/Y	Dissolved gross beta as strontium/yttrium-90, in picocuries per liter
Ra-226	Dissolved radium 226, radon method, in picocuries per liter
Ra-228	Dissolved radium 228, in picocuries per liter
U total	Total uranium, in micrograms per liter
U	Dissolved uranium, in micrograms per liter
Th-230	Dissolved thorium 230, in picocuries per liter
Th-232	Dissolved thorium 232, in picocuries per liter
--	No data available
<	Less than

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*

[Total iron concentrations were determined using the ferrozine method and ferrous iron concentrations were determined using the phenanthroline method as described by the Hach Company]

Well (fig. 1)	Date	Time	WL	TD	Cond	pH	Eh	Temp	DO	S^{2-}	Ca
Well 1 shallow	3-03-92	1740	17.08	29.9	849	6.4	-110	14.0	<0.05	3	120
	4-09-92	1500	16.26		755	6.8	--	13.5	.05	34	130
	5-15-92	1600	14.09		720	6.7	-102	14.0	.05	--	130
	6-10-92	0945	14.56		785	7.0	-100	13.5	<.05	7	130
Well 1 deep	3-03-92	1700	17.80	37.5	910	6.8	-140	14.0	<.05	18	130
	4-09-92	1345	16.64		772	6.9	--	14.5	<.05	12	130
	5-15-92	1430	14.38		757	6.5	-82	14.0	<.05	--	140
	6-10-92	0915	15.05		805	7.0	-120	14.0	<.05	16	130
Well 2 shallow	3-04-92	1700	20.37	49.8	828	6.9	-140	14.5	<.05	20	120
	4-09-92	1100	19.14		711	6.6	--	14.5	.05	14	120
	5-12-92	1300	16.76		655	7.1	-87	14.0	<.05	--	110
	6-09-92	1645	17.50		675	7.1	-135	14.5	.05	14	120
Well 2 deep	3-04-92	1600	20.39	69.5	741	6.7	-130	15.0	<.05	7	110
	4-09-92	1000	19.17		677	6.9	--	14.0	<.05	15	120
	5-12-92	1000	16.73		696	7.0	--	13.5	<.05	--	110
	6-09-92	1600	17.54		636	7.0	-130	14.5	.05	7	110
Well 3 shallow	3-04-92	1400	22.64	37.6	785	6.8	-10	15.5	.05	0	120
	4-08-92	1745	23.29		705	6.9	--	14.5	<.05	2	120
	5-12-92	1630	18.77		657	7.2	-120	14.5	<.05	--	120
	6-09-92	1415	19.81		659	6.8	--	15.0	<.05	<5	120
Well 3 deep	3-04-92	1230	22.83	52.5	770	6.8	-100	15.5	.05	0	120
	4-09-92	0820	21.40		692	6.8	--	14.0	.05	3	120
	5-12-92	1500	19.13		675	6.9	-220	14.5	<.05	--	120
	6-09-92	1450	20.29		654	6.9	-100	15.0	.3	<5	120

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Time	WL	TD	Cond	pH	Eh	Temp	DO	S^{2-}	Ca
Well 4 shallow	3-04-92	1015	14.87	44.6	908	6.8	-120	15.0	<0.05	14	140
	4-08-92	1620	12.80		802	6.7	--	15.5	<.05	13	140
	5-15-92	1230	13.07		756	6.8	-82	15.0	<.05	--	140
	6-09-92	1045	13.50		785	6.9	-90	16.0	<.05	<10	140
Well 4 deep	3-04-92	0915	14.64	54.7	820	6.6	-125	15.0	<.05	10	13
	4-08-92	1530	12.50		756	6.4	--	15.0	<.05	10	120
	5-15-92	1100	12.76		700	6.5	-92	15.0	<.05	--	120
	6-09-92	0920	13.50		729	6.9	-130	15.5	<.05	7	130
Daniel Boone Gun Club	3-05-92	1030	22.50	36.9	970	6.6	-40	17.0	--	0	150
	5-26-92	1215	19.25		805	6.6	83	15.0	<.05	--	140
	6-10-92	1200	21.24		825	6.7	-30	16.0	.05	150	140
St. Charles County well field	4-09-92	1600	--	100.00	570	7.0	--	15.5	--	11	70
Alluvial well blank	5-26-92	1300	--	--	--	--	--	--	--	--	.19
	6-10-92	1201	--	--	--	--	--	--	--	--	.24

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Mg	Na	K	HCO_3	CO_3	Alk	SO_4	Cl	F	Br	SiO_2
Well 1 shallow	3-03-92	28	10	3.1	487	0	399	67	21	0.30	0.03	33
	4-09-92	30	11	3.1	508	0	416	61	19	.40	.18	31
	5-15-92	29	10	3.4	560	0	459	60	20	.30	.07	31
	6-10-92	30	10	3.1	531	0	435	62	20	.30	.06	30
Well 1 deep	3-03-92	31	11	3.9	556	0	456	45	15	.50	.06	39
	4-09-92	30	11	3.8	531	0	435	54	16	.30	.12	36
	5-15-92	31	11	4.0	586	0	480	46	19	.30	.10	37
	6-10-92	30	10	3.5	565	0	463	52	19	.20	.08	34
Well 2 shallow	3-04-92	35	4.7	2.8	572	0	468	33	6.6	.20	.04	30
	4-09-92	33	4.8	3.0	549	0	450	25	5.9	.30	.09	30
	5-12-92	30	4.8	2.4	523	0	429	25	4.8	.30	.05	30
	6-09-92	34	4.6	2.9	534	0	438	25	2.7	.20	.04	29
Well 2 deep	3-04-92	27	5.2	2.8	496	0	406	33	5.3	.20	.03	32
	4-09-92	28	5.7	3.1	506	0	414	31	7.9	.30	.10	32
	5-12-92	26	5.4	3.0	508	0	416	30	6.8	.20	.05	31
	6-09-92	27	5.1	2.9	494	0	405	30	4.8	.30	.06	31
Well 3 shallow	3-04-92	30	4.3	5.9	510	0	418	47	5.3	.20	.01	18
	4-08-92	28	4.2	6.0	483	0	396	41	4.8	.30	.02	21
	5-12-92	27	4.3	5.5	505	0	414	40	4.5	.20	.04	22
	6-09-92	27	4.0	5.6	494	0	405	37	2.8	.20	.03	21
Well 3 deep	3-04-92	28	4.4	4.6	512	0	419	44	6.0	.20	.02	25
	4-09-92	27	4.5	4.0	495	0	406	39	13	.30	.08	26
	5-12-92	27	4.4	3.7	505	0	414	39	4.5	.20	.03	24
	6-09-92	28	4.3	3.8	559	0	458	40	2.5	.20	.03	21

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Mg	Na	K	HCO_3	CO_3	Alk	SO_4	Cl	F	Br	SiO_2
Well 4 shallow	3-04-92	31	13	7.1	625	0	512	41	26	0.20	0.03	25
	4-08-92	29	12	7.3	599	0	491	30	5.6	.30	.10	24
	5-15-92	29	13	7.9	627	0	514	26	5.0	.30	.17	24
	6-09-92	30	13	7.8	639	0	524	25	10	.30	.11	23
Well 4 deep	3-04-92	28	12	5.3	574	0	471	22	6.0	.20	.36	30
	4-08-92	27	11	5.3	558	0	458	14	5.2	.20	.08	28
	5-15-92	26	11	5.5	577	0	473	15	4.7	<.10	.21	27
	6-09-92	27	11	5.9	600	0	492	24	2.6	.20	.04	26
Daniel Boone Gun Club	3-05-92	46	8.7	2.8	671	0	550	60	11	.10	.03	19
	5-26-92	43	8.2	2.9	634	0	520	52	8.7	.20	.04	18
	6-10-92	41	7.9	2.9	634	0	519	42	5.6	.20	.04	18
St. Charles County well field	4-09-92	17	35	4.7	399	0	327	98	19	.30	.14	18
Alluvial well blank	5-26-92	.02	<.20	<.10	--	--	--	.10	<.10	<.10	<.01	.04
	6-10-92	.02	<.20	<.10	--	--	--	<.10	<.10	<.10	<.01	.04

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	DS	NO_2	NO_2 + NO_3	NH_3	P total	PO_4	Al	As	Ba	Be	B
Well 1 shallow	3-03-92	511	<0.01	<0.05	0.54	0.32	0.03	<10	--	240	<10	100
	4-09-92	593	<.01	<.05	.37	.42	.11	20	3	250	<10	120
	5-15-92	530	<.01	<.05	.42	.33	.21	<10	3	240	<10	110
	6-10-92	529	<.01	<.05	.39	.41	.17	10	3	240	<10	130
Well 1 deep	3-03-92	553	<.01	<.05	1.50	.41	.34	<10	9	400	<10	90
	4-09-92	538	<.01	<.05	.89	.55	<.01	<10	7	360	<10	110
	5-15-92	562	.02	<.05	1.10	.08	<.01	20	6	370	<10	120
	6-10-92	555	<.01	<.05	.91	.69	<.01	<10	6	350	<10	120
Well 2 shallow	3-04-92	489	<.01	<.05	.41	.52	.38	<10	--	390	<10	70
	4-09-92	476	<.01	<.05	.38	.53	<.01	<10	8	390	<10	80
	5-12-92	435	<.01	<.05	.49	.05	.04	<10	7	350	<10	80
	6-09-92	478	<.01	<.05	.40	.35	<.01	10	7	380	<10	80
Well 2 deep	3-04-92	449	<.01	<.05	.41	.34	.31	<10	--	400	<10	70
	4-09-92	464	<.01	<.05	.38	.58	.37	<10	6	430	<10	70
	5-12-92	434	<.01	<.05	.39	.64	.16	<10	6	400	<10	70
	6-09-92	449	<.01	<.05	.39	.41	<.01	<10	6	410	<10	70
Well 3 shallow	3-04-92	458	<.01	<.05	.04	<.01	.01	<10	--	290	<10	60
	4-08-92	460	<.01	<.05	.03	.02	.02	<10	1	290	<10	70
	5-12-92	445	<.01	<.05	.12	.02	.03	<10	3	290	<10	60
	6-09-92	436	<.01	<.05	.09	.04	.02	<10	1	280	<10	60
Well 3 deep	3-04-92	461	<.01	<.05	.18	.13	.10	<10	--	480	<10	60
	4-09-92	462	<.01	<.05	.20	.19	.14	<10	5	550	<10	60
	5-12-92	442	<.01	<.05	.24	.04	.10	<10	4	560	<10	50
	6-09-92	456	<.01	<.05	.21	.17	.08	<10	3	510	<10	70

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	DS	NO_2	$NO_2 + NO_3$	NH_3	P total	PO_4	Al	As	Ba	Be	B
Well 4 shallow	3-04-92	545	<0.01	<0.05	0.18	0.19	0.11	<10	7	370	<10	80
	4-08-92	506	<.01	<.05	.15	.12	.06	10	7	380	<10	90
	5-15-92	531	.01	<.05	.17	.05	<.01	<10	5	350	<10	90
	6-09-92	538	<.01	<.05	.16	.17	.08	<10	5	360	<10	90
Well 4 deep	3-04-92	497	<.01	<.05	.40	.39	<.01	<10	1	680	<10	80
	4-08-92	467	.02	<.05	.41	.32	.07	<10	<1	630	<10	80
	5-15-92	486	.01	<.05	.38	.06	<.01	<10	<1	630	<10	80
	6-09-92	505	<.01	<.05	.34	.39	<.01	<10	<1	630	<10	80
Daniel Boone Gun Club	3-05-92	599	<.01	<.05	.02	<.01	<.01	<10	--	250	<10	40
	5-26-92	576	<.01	<.05	.02	.03	<.01	<10	<1	250	<10	40
	6-10-92	528	<.01	<.05	<.01	.02	<.01	<10	<1	230	<10	40
St. Charles County well field	4-09-92	384	--	--	--	--	--	<10	1	330	<10	70
Alluvial well blank	5-26-92	2	<.01	<.05	.01	--	<.01	<10	<1	<2	<10	<10
	6-10-92	<1	<.01	<.05	<.01	--	<.01	<10	<1	<2	<10	<10

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Cd	Cr	Co	Cu	Fe total[a]	Fe[a]	Fe^{++} total[a]	Fe^{++}[a]	Pb	Li
Well 1 shallow	3-03-92	<1.0	<1	<3	<1	6.40	6.40	5.50	5.55	<1	33
	4-09-92	<1.0	<1	<3	<1	6.25	5.40	5.10	4.45	<1	32
	5-15-92	<1.0	<1	<3	<1	6.35	7.75	4.70	4.90	<1	32
	6-10-92	<1.0	1	<3	<1	5.60	5.90	3.70	5.40	<1	33
Well 1 deep	3-03-92	<1.0	<1	<3	<1	11.0	11.5	7.50	9.50	<1	34
	4-09-92	<1.0	<1	<3	<1	10.5	10.1	8.60	7.45	<1	32
	5-15-92	<1.0	<1	<6	<1	13.8	12.4	6.50	7.40	<1	33
	6-10-92	<1.0	<1	<3	<1	12.2	8.7	10.3	9.65	<1	33
Well 2 shallow	3-04-92	<1.0	<1	<3	<1	9.35	8.35	7.55	6.60	<1	43
	4-09-92	<1.0	<1	<3	<1	--	7.75	7.15	6.50	<1	40
	5-12-92	<1.0	<1	<3	<1	8.92	7.20	2.92	5.24	<1	40
	6-09-92	<1.0	<1	<3	<1	8.35	8.60	5.95	6.40	<1	43
Well 2 deep	3-04-92	<1.0	<1	<3	<1	9.15	8.45	6.30	5.15	<1	38
	4-09-92	<1.0	<1	<3	<1	8.65	8.95	5.75	6.90	<1	37
	5-12-92	<1.0	<1	<3	<1	8.64	8.20	1.72	4.32	<1	34
	6-09-92	<1.0	<1	<3	<1	9.50	7.15	2.80	3.80	<1	36
Well 3 shallow	3-04-92	<1.0	<1	<3	<1	.04	.05	<.01	.03	<1	40
	4-08-92	<1.0	<1	<3	<1	.15	.10	.04	.04	<1	34
	5-12-92	<1.0	<1	<3	<1	.52	.71	.45	.44	<1	34
	6-09-92	<1.0	<1	<3	<1	.22	.11	.02	.12	<1	35
Well 3 deep	3-04-92	<1.0	<1	<3	<1	4.00	4.10	4.00	3.42	<1	37
	4-09-92	<1.0	<1	<3	<1	6.90	6.15	5.50	6.20	<1	33
	5-12-92	<1.0	<1	<3	<1	6.04	6.88	4.36	5.16	<1	34
	6-09-92	<1.0	<1	<3	<1	3.00	2.70	2.07	3.12	<1	35

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Cd	Cr	Co	Cu	Fe total[a]	Fe[a]	Fe^{++} total[a]	Fe^{++}[a]	Pb	Li
Well 4 shallow	3-04-92	<1.0	<1	<3	<1	7.10	7.50	6.60	5.00	<1	39
	4-08-92	<1.0	<1	<3	<1	7.40	6.70	7.25	4.95	<1	38
	5-15-92	<1.0	<1	<3	<1	7.35	8.05	3.90	3.60	<1	37
	6-09-92	<1.0	<1	<3	<1	7.60	7.15	6.65	3.80	<1	39
Well 4 deep	3-04-92	<1.0	<1	4	<1	13.5	12.0	12.0	9.50	<1	39
	4-08-92	<1.0	<1	<3	<1	13.4	20.6	8.70	10.2	<1	39
	5-15-92	<1.0	<1	<6	<1	13.6	13.5	9.35	8.45	<1	39
	6-09-92	<1.0	<1	<3	<1	6.60	9.80	6.60	1.80	<1	39
Daniel Boone Gun Club	3-05-92	<1.0	<1	5	<1	1.58	1.41	1.81	1.51	<1	23
	5-26-92	<1.0	<1	7	<1	1.19	1.19	1.09	1.15	<1	19
	6-10-92	<1.0	<1	5	<1	1.40	1.03	.80	.98	<1	21
St. Charles County well field	4-09-92	<1.0	<1	<3	<1	3.54	2.66	2.68	2.16	<1	26
Alluvial well blank	5-26-92	<1.0	<1	<3	<1	--	<.003	--	--	<1	<4
	6-10-92	<1.0	<1	<3	<1	--	.007	--	--	<1	<4

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Mn	Hg	Mo	Ni	Se	Ag	Sr	V	Zn	TOC
Well 1 shallow	3-03-92	610	<0.1	<10	<1	<1	<1.0	560	<6	<10	2.0
	4-09-92	520	<.1	<10	1	<1	<1.0	570	<6	<10	--
	5-15-92	490	<.1	<10	<1	<1	<1.0	550	<6	<10	1.7
	6-10-92	470	<.1	<10	<1	<1	<1.0	550	<6	<10	1.5
Well 1 deep	3-03-92	660	<.1	<10	<1	<1	<1.0	690	<6	<10	2.0
	4-09-92	690	<.1	<10	<1	<1	<1.0	690	<6	<10	--
	5-15-92	740	<.1	<20	<1	<1	<1.0	720	<12	<10	1.8
	6-10-92	670	<.1	<10	<1	<1	<1.0	670	<6	<10	1.5
Well 2 shallow	3-04-92	290	<.1	<10	<1	<1	<1.0	660	<6	<10	1.8
	4-09-92	260	<.1	<10	<1	<1	<1.0	660	<6	<10	--
	5-12-92	240	<.1	<10	<1	<1	<1.0	640	<6	<10	1.5
	6-09-92	260	<.1	<10	<1	<1	<1.0	660	<6	<10	1.1
Well 2 deep	3-04-92	300	<.1	<10	<1	<1	<1.0	560	<6	<10	1.8
	4-09-92	300	<.1	<10	<1	<1	<1.0	590	<6	<10	--
	5-12-92	300	<.1	<10	<1	<1	<1.0	560	<6	<10	1.5
	6-09-92	290	<.1	<10	<1	<1	<1.0	560	<6	30	1.3
Well 3 shallow	3-04-92	330	<.1	<10	4	<1	<1.0	590	<6	<10	1.3
	4-08-92	330	<.1	<10	4	<1	<1.0	670	<6	<10	1.5
	5-12-92	380	<.1	<10	3	<1	<1.0	660	<6	10	1.3
	6-09-92	370	<.1	<10	3	<1	<1.0	660	<6	<10	1.0
Well 3 deep	3-04-92	370	<.1	<10	<1	<1	<1.0	580	<6	<10	1.5
	4-09-92	360	<.1	<10	<1	<1	<1.0	590	<6	20	--
	5-12-92	340	<.1	<10	<1	<1	<1.0	580	<6	<10	1.4
	6-09-92	420	<.1	<10	<1	<1	<1.0	580	<6	<10	1.0

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Mn	Hg	Mo	Ni	Se	Ag	Sr	V	Zn	TOC
Well 4 shallow	3-04-92	990	<0.1	<10	<1	<1	<1.0	870	<6	<10	1.8
	4-08-92	840	<.1	<10	<1	<1	<1.0	860	<6	<10	--
	5-15-92	840	<.1	<10	<1	<1	<1.0	860	<6	<10	1.9
	6-09-92	830	<.1	<10	<1	<1	<1.0	870	<6	<10	1.9
Well 4 deep	3-04-92	510	<.1	<10	<1	<1	<1.0	870	<6	<10	3.2
	4-08-92	430	<.1	<10	<1	<1	<1.0	800	<6	20	--
	5-15-92	450	<.1	<20	<1	<1	<1.0	800	<12	<10	1.9
	6-09-92	510	<.1	<10	<1	<1	<1.0	820	<6	<10	1.8
Daniel Boone Gun Club	3-05-92	160	<.1	<10	19	<1	<1.0	390	<6	310	1.5
	5-26-92	160	<.1	<10	17	<1	<1.0	390	<6	340	1.4
	6-10-92	140	<.1	<10	17	<1	<1.0	360	<6	400	1.1
St. Charles County well field	4-09-92	450	<.1	<10	<1	<1	<1.0	400	<6	<10	--
Alluvial well blank	5-26-92	<1	<.1	<10	<1	<1	<1.0	1	<6	<10	--
	6-10-92	1	<.1	<10	<1	<1	<1.0	1	<6	<10	--

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Cy	Gr α	Gr β-Cs	Gr β-Sr/Y	Ra-226	Ra-228	U total[b]	U	Th-230	Th-232
Well 1 shallow	3-03-92	<0.01	1.9	5.3	4.0	0.24	<1.0	<1.0	0.27	<1.0	<1.0
	4-09-92	<.01	1.9	5.2	3.9	.24	<1.0	1.2	.26	<1.0	<1.0
	5-15-92	<.01	1.1	5.8	4.3	.19	<1.0	<1.0	.17	<1.0	<1.0
	6-10-92	<.01	1.5	5.6	4.2	.19	<1.0	<1.0	.29	<1.0	<1.0
Well 1 deep	3-03-92	<.01	1.5	5.4	4.1	.06	<1.0	<1.0	.18	<1.0	<1.0
	4-09-92	<.01	2.8	5.7	4.3	.26	<1.0	<1.0	.04	<1.0	<1.0
	5-15-92	<.01	3.1	5.3	4.0	.26	<1.0	<1.0	.05	<1.0	<1.0
	6-10-92	<.01	1.5	5.2	3.9	.28	<1.0	<1.0	.11	<1.0	<1.0
Well 2 shallow	3-04-92	<.01	2.7	6.1	4.5	.44	1.1	<1.0	.27	<1.0	<1.0
	4-09-92	<.01	3.7	5.8	4.4	.44	1.2	<1.0	.19	<1.0	<1.0
	5-12-92	<.01	2.4	4.6	3.4	.39	<1.0	<1.0	.16	<1.0	<1.0
	6-09-92	<.01	3.0	4.9	3.7	.60	<1.0	<1.0	.39	<1.0	<1.0
Well 2 deep	3-04-92	<.01	2.5	4.0	3.0	.66	1.1	<1.0	.17	<1.0	<1.0
	4-09-92	<.01	5.1	4.6	3.5	.55	1.2	<1.0	.15	<1.0	<1.0
	5-12-92	<.01	2.1	6.0	4.5	.58	1.0	5.1	.12	<1.0	<1.0
	6-09-92	<.01	5.2	4.6	3.5	.50	<1.0	<1.0	.13	<1.0	<1.0
Well 3 shallow	3-04-92	<.01	21	15	12	.28	<1.0	21	16	<1.0	<1.0
	4-08-92	<.01	7.3	10	7.8	.26	<1.0	3.7	4.8	<1.0	<1.0
	5-12-92	<.01	5.0	9.1	6.8	.31	<1.0	4.6	4.0	<1.0	<1.0
	6-09-92	<.01	7.8	9.6	7.2	.24	<1.0	9.5	7.0	<1.0	<1.0
Well 3 deep	3-04-92	<.01	8.1	9.7	7.3	.63	1.5	3.9	3.6	<1.0	<1.0
	4-09-92	<.01	5.0	7.3	5.5	.63	1.5	1.5	1.4	<1.0	<1.0
	5-12-92	<.01	6.7	8.2	6.2	.70	1.2	1.9	1.6	<1.0	<1.0
	6-09-92	<.01	5.0	8.2	6.1	.69	1.4	6.3	5.3	<1.0	<1.0

Table 5.--*Water-quality data for wells in the Missouri River alluvium, March-June 1992*--Continued

Well (fig. 1)	Date	Cy	Gr α	Gr β-Cs	Gr β-Sr/Y	Ra-226	Ra-228	U total[b]	U	Th-230	Th-232
Well 4 shallow	3-04-92	<0.01	5.7	10	7.5	0.37	<1.0	4.1	3.2	<1.0	<1.0
	4-08-92	<.01	4.0	11	8.1	.35	<1.0	3.2	2.9	<1.0	<1.0
	5-15-92	<.01	4.3	12	8.8	.29	<1.0	5.3	3.2	<1.0	<1.0
	6-09-92	<.01	7.8	12	8.8	.33	<1.0	4.4	3.5	<1.0	<1.0
Well 4 deep	3-04-92	<.01	3.5	11	8.0	.52	1.2	<1.0	.36	<1.0	<1.0
	4-08-92	<.01	3.3	9.0	6.7	.61	1.7	<1.0	.09	<1.0	<1.0
	5-15-92	<.01	3.1	11	7.8	.51	1.4	<1.0	.26	<1.0	<1.0
	6-09-92	<.01	3.8	9.7	7.4	.52	1.5	<1.0	.36	<1.0	<1.0
Daniel Boone Gun Club	3-05-92	<.01	15	13	9.4	.24	1.1	10	9.1	<1.0	<1.0
	5-26-92	<.01	6.7	9.3	7.0	.20	<1.0	9.2	7.6	<1.0	<1.0
	6-10-92	<.01	8.5	6.9	5.2	.24	<1.0	6.9	6.9	<1.0	<1.0
St. Charles County well field	4-09-92	<.01	2.0	7.7	5.7	.38	1.2	<1.0	.10	<1.0	<1.0
Alluvial well blank	5-26-92	<.01	<.6	<.6	<.6	--	--	<1.0	--	--	--
	6-10-92	<.01	<.6	<.6	<.6	--	--	<1.0	--	--	--

[a] Concentrations are considered semi-quantitative.

[b] Some of the reported total uranium concentrations may have been affected by sediment in the raw water samples; therefore, the reported value may be lower than actual concentrations.

Table 6.--*Statistical summary of selected water-quality data from the Missouri River and Missouri River alluvial wells near Defiance*

[mg/L, milligrams per liter; <, less than; --, no data; µg/L, micrograms per liter; pCi/L, picocuries per liter]

Property or constituent	Type of site	Number of samples	Maximum	Minimum	Mean	Percentage of samples in which values were less than or equal to those shown				
						95	75	50 (Median)	25	5
Specific conductance, microsiemens per centimeter at 25 degrees Celsius	River	48	720	529	604	696	639	599	557	531
	Well	35	970	636	755	922	805	756	692	650
pH, standard units	River	48	8.6	6.9	a	8.5	8.0	7.9	7.8	7.2
	Well	35	7.2	6.4	6.8	7.1	6.9	6.8	6.7	6.4
Water temperature, degrees Celsius	River	47	31.0	10.0	26.2	31.0	29.5	28.0	24.6	11.6
	Well	35	17.0	13.5	14.7	16.2	15.0	14.5	14.0	13.5
Calcium, dissolved (mg/L as Ca)	River	18	62	51	57	62	61	57	55	51
	Well	35	150	13	123	142	130	120	120	91
Magnesium, dissolved (mg/L as Mg)	River	18	20	17	18	20	19	18	17	17
	Well	35	46	26	30	44	31	29	27	26
Sodium, dissolved (mg/L as Na)	River	18	64	36	46	64	58	40	38	36
	Well	35	13	4	8	13	11	8	5	4
Potassium, dissolved (mg/L as K)	River	18	7.3	4.8	6.1	7.3	6.6	5.9	5.6	4.8
	Well	35	7.9	2.4	4.3	7.8	5.5	3.8	3.0	2.7
Bicarbonate, (mg/L as HCO_3)	River	18	222	176	202	222	210	203	191	176
	Well	35	671	483	552	645	586	549	506	486
Alkalinity, (mg/L as $CaCO_3$)	River	18	182	144	168	182	174	170	161	144
	Well	35	550	396	452	529	480	450	414	398

Table 6.--*Statistical summary of selected water-quality data from the Missouri River and Missouri River alluvial wells near Defiance*--Continued

Property or constituent	Type of site	Number of samples	Maximum	Minimum	Mean	Percentage of samples in which values were less than or equal to those shown				
						95	75	50 (Median)	25	5
Sulfate, dissolved (mg/L as SO_4)	River	18	180	95	127	180	160	115	108	95
	Well	35	67	14	39	63	47	39	26	15
Chloride, dissolved (mg/L as Cl)	River	18	27	15	21	27	23	21	20	15
	Well	35	26	2.5	9.4	22	15	6	4.8	2.6
Fluoride, dissolved (mg/L as F)	River	18	.5	.1	.4	.5	.5	.4	.3	.1
	Well	35	.5	.1	.2	.4	.3	.2	.2	.1
Bromide, dissolved (mg/L as Br)	River	18	.10	.05	.08	.10	.09	.07	.06	.05
	Well	35	.36	.01	.08	.24	.10	.05	.03	.01
Silica, dissolved (mg/L as SiO_2)	River	18	13	7	10	13	13	10	7	7
	Well	35	39	18	27	37	31	28	23	18
Dissolved solids residue at 180 degrees Celsius	River	18	436	326	383	436	414	382	358	326
	Well	35	599	434	498	594	538	489	458	435
Nitrate, dissolved (mg/L as N)	River	18	2.90	.36	1.64	2.90	2.72	1.65	.63	.36
	Well	35	<.05	<.05	b	b	b	b	b	b
Nitrogen, ammonia, dissolved (mg/L as N)	River	18	.14	<.01	c.03	c.14	c.02	c.02	c.01	c.00
	Well	35	1.50	.01	.36	1.18	.41	.38	.16	.01
Phosphorous, total (mg/L as P)	River	16	.85	.09	.29	.86	.36	.20	.14	.09
	Well	35	.69	<.01	c.26	c.65	c.41	c.19	c.05	c.01

Table 6.--*Statistical summary of selected water-quality data from the Missouri River and Missouri River alluvial wells near Defiance*--Continued

Property or constituent	Type of site	Number of samples	Maximum	Minimum	Mean	Percentage of samples in which values were less than or equal to those shown				
						95	75	50 (Median)	25	5
Orthophosphate dissolved, (mg/L as P)	River	18	0.20	<0.01	[c]0.11	[c]0.20	[c]0.15	[c]0.11	[c]0.08	[c]0.03
	Well	35	.38	<.01	[c].09	[c].37	[c].11	[c].03	[c].01	[c]<.01
Aluminum, dissolved (µg/L as Al)	River	18	80	<10	[c]16	[c]80	[c]20	[c]6	[c]2	[c]1
	Well	35	20	<10	[c]4	[c]20	[c]5	[c]3	[c]1	[c]<1
Arsenic, dissolved (µg/L as As)	River	15	10	2	3	10	4	3	2	2
	Well	29	9	<1	[c]4	[c]8	[c]6	[c]5	[c]1	[c]<1
Barium, dissolved (µg/L as Ba)	River	18	180	110	139	180	162	145	110	110
	Well	35	680	230	389	640	430	370	290	238
Boron, dissolved (µg/L as B)	River	18	140	30	102	140	122	100	88	30
	Well	35	130	40	79	122	90	80	60	40
Copper, dissolved (µg/L as Cu)	River	15	6	2	3	6	4	3	2	2
	Well	35	<1	<1	b	b	b	b	b	b
Iron, dissolved (mg/L as Fe)	River	18	.067	<3	.013	[c].067	[c].013	[c].005	[c].005	[c].001
	Well	35	21	.05	6.9	15	8.7	7.2	4.1	.08
Lithium, dissolved (µg/L as Li)	River	18	45	22	31	45	38	28	26	22
	Well	35	43	19	35	43	39	35	33	21

Table 6.--*Statistical summary of selected water-quality data from the Missouri River and Missouri River alluvial wells near Defiance*--Continued

Property or constituent	Type of site	Number of samples	Maximum	Minimum	Mean	Percentage of samples in which values were less than or equal to those shown				
						95	75	50 (Median)	25	5
Manganese, dissolved (µg/L as Mn)	River	18	3	<1	[c]1	[c]3	[c]2	[c]1	[c]<1	[c]<1
	Well	35	990	140	453	870	610	380	300	156
Mercury, total recoverable, (µg/L as Hg)	River	18	.2	<.1	[c].1	[c].2	[c].1	[c]<.1	[c]<.1	[c]<.1
Mercury, dissolved (µg/L as Hg)	Well	35	<.1	<.1	b	b	b	b	b	b
Nickel, dissolved (µg/L as Ni)	River	18	5	<1	[c]2	[c]5	[c]2	2	[c]<1	[c]<1
	Well	35	19	<1	[c]2	[c]17	[c]1	< 1	[c]<1	[c]<1
Selenium, dissolved (µg/L as Se)	River	18	4	<1	[c]2	[c]4	[c]2	[c]2	[c]1	[c]<1
	Well	35	<1	<1	b	b	b	b	b	b
Strontium, dissolved (µg/L as Sr)	River	18	460	330	382	460	430	370	340	330
	Well	35	870	360	648	870	720	660	560	384
Zinc, dissolved (µg/L as Zn)	River	15	23	<3	[c]10	[c]23	[c]14	[c]10	[c]5	[c]4
	Well	35	400	<10	[c]33	[c]352	[c]4	[c]<1	[c]<1	[c]<1
Carbon, organic total (mg/L as C)	River	16	37.0	5.1	11.8	37.0	14.5	9.0	6.0	5.1
	Well	28	3.2	1.0	1.6	2.7	1.8	1.5	1.3	1.0

Table 6.--*Statistical summary of selected water-quality data from the Missouri River and Missouri River alluvial wells near Defiance*--Continued

Property or constituent	Type of site	Number of samples	Maximum	Minimum	Mean	Percentage of samples in which values were less than or equal to those shown				
						95	75	50 (Median)	25	5
Alpha, gross dissolved (µg/L as uranium natural)	Well	35	21.0	1.10	5.0	16.2	6.7	3.8	2.5	1.4
Beta, gross dissolved (pCi/L as cesium-137)	Well	35	15.0	4.0	7.9	13.4	10.0	7.3	5.3	4.5
Beta, gross dissolved (pCi/L as strontium/yttrium-90)	Well	35	12.0	3.0	5.9	9.9	7.5	5.5	4.0	3.3
Radium 226, dissolved, randon method (pCi/L)	Well	35	.70	.06	.39	.7	.5	.4	.2	.2
Radium 228, dissolved (pCi/L as Ra-228)	Well	35	1.7	<1.0	[c]1.0	[c]1.5	[c]1.2	[c].9	[c].8	[c].6
Uranium, total[d] (µg/L as U)	River	48	7.6	3.0	5.2	7.0	5.8	5.4	4.8	3.5
	Well	35	21.0	<1.0	[c]3.3	[c]12.2	[c]4.6	[c]1.5	<1.0	<1.0
Uranium, dissolved (µg/L as U)	River	48	7.2	1.40	4.8	6.5	5.7	4.8	4.1	2.7
	Well	35	16.0	.04	2.4	10.5	3.6	.4	.17	.05

[a] Mean pH will not satisfactorily summarize the typical hydrogen ion concentration if pH is not normally distributed.
[b] The minimum of censored properties is an estimated value and is not reported.
[c] Estimated.
[d] Some of the reported total uranium concentrations may have been affected by sediment in the raw water samples; therefore, the reported value may be lower than actual concentrations.