CHARACTERIZATION OF WATER QUALITY FOR STREAMS IN THE SOUTHERN YAMPA RIVER BASIN, NORTHWESTERN COLORADO

by R.S. Parker

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Multiply	*By*	*To obtain*
inch (in.)	25.40	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile	2.590	square kilometer

Degree Celsius (°C) may be converted to degree Fahrenheit (°F) by using the following equation:

$$°F = 9/5\ (°C + 32)\ .$$

The following terms and abbreviations also are used in this report:

milligrams per liter (mg/L)
microsiemens per centimeter at 25 degrees Celsius (µS/cm)

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By Randolph S. Parker

ABSTRACT

Water quality was characterized for streams in the southern part of the Yampa River basin. Data were analyzed from 40 sites and represent most flowing streams in the study area during water year 1981. Data analyzed were collected during water years 1976 through 1982.

The individual dissolved constituents analyzed include calcium, magnesium, potassium, sodium, bicarbonate, chloride, and sulfate. The mean, minimum, and maximum values for each constituent for each site are presented. Simple linear-regression equations were developed for each site to derive individual constituent concentrations from specific conductance. Data from all sites are combined, and equations for each constituent in three regions also are developed. Region 1 includes the drainage of Trout Creek and Williams Fork and parts of Milk and Dry Creeks; region 2 includes the drainage from the Williams Fork Mountains; and region 3 includes streams that drain from the Danforth Hills to the Axial Basin. These three regions provide a potential of three equations for each dissolved constituent, but the data from the regions are combined if the coefficients of the equations are not significantly different at the 5-percent level.

Many of these relations use the power form of the regression equation. For some constituents, such as calcium, this power form may have some physical basis. In some instances, the power form of the equation was used to yield positive values of constituent concentrations for specified specific-conductance values. These equations and their associated standard error provide a method for determining constituent concentrations and an associated error for specified values of specific conductance.

In this area, dissolved sulfate concentration is affected by geology and climate, and the range of concentration values is large. This range of values may mask increases in sulfate concentration that result from mining.

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INTRODUCTION

Historically, the Yampa River basin in northwestern Colorado has been an area of coal-mining development. Coal mining generally has been developed in the southern part of the basin and at lower elevations. Previously, minimal water-quality data have been available for this area, and data that were collected were oriented toward the main stem of the Yampa River and the major tributaries (Bauer and others, 1978, 1979; Steele and others, 1978; Wentz and Steele, 1980; Adams and others, 1983).

Additional water-quality data were needed to identify the existing water chemistry and to evaluate changes that may occur due to coal mining. Data were needed throughout the basin because the locations where future coal mining will develop is difficult to determine. Furthermore, information needs to be available for small streams where mining is likely to be developed and for the larger tributaries where cumulative effects from several mines are likely to occur. This report was prepared in cooperation with the U.S. Bureau of Land Management, who prepares assessments of the water quality in the areas of potential coal development. To meet these objectives, a synoptic data-collection network was defined, and data were collected from most of the streams in the southern Yampa River basin (Maura, 1982, 1985).

Purpose and Scope

The purpose of this report is to characterize the stream water quality by summarizing selected major dissolved constituents for the streams that drain the southern part of the Yampa River basin. Characterization is done initially by providing a statistical summary of the constituents for individual water-quality sites in the study area. These statistical summaries can be used to help assess water-quality within specified stream reaches. Water-quality data are available for sites on most perennial streams in the study area, and these data provide the best information about the immediate stream reach. Water-quality data from all sites are combined into regions, and linear-regression equations between dissolved constituents and specific conductance are calculated. Such equations provide an estimate of the water-quality relations within these regions. The equations also indicate an increase in error as individual sites are combined.

Summary statistics and linear-regression equations are presented for the major dissolved constituents of calcium, magnesium, potassium, sodium, chloride, bicarbonate, and sulfate. In addition to the major dissolved constituents, the statistics for dissolved fluoride and dissolved silica also are provided. However, these two constituents were not analyzed further. In this report, alkalinity is assumed to be representative of bicarbonate concentration. This assumption seems reasonable because the pH of 710 samples analyzed for this report ranged from 7.0 to 8.8 and had a mean of 8.0.

A primary method used in this report to characterize the stream water quality is to develop relations between the concentration of individual dissolved constituents and specific conductance. These relations characterize the relative importance of particular constituents in the dissolved solids total, and they provide a method to extend the easily obtained specific-conductance measurements into estimates of individual constituent concentrations.

Description of Study Area and Sampling Sites

The Yampa River basin is located in the Green River coal region where coal occurs in the Mesaverde Group of Late Cretaceous age. The coal beds are interbedded with and overlain by sandstones and shales of Late Cretaceous and Early Tertiary age. The deposits were formed in alternating marine, brackish, and freshwater environments.

The study area is limited to the part of the Yampa River basin that is south of the main stem of the Yampa River (fig. 1). It is bounded on the east by, and includes, the Oak Creek drainage and is bounded on the west by the Danforth Hills. In the eastern part of the study area, coal mining occurs in the Trout Creek, Oak Creek, and Grassy Creek basins. Coal mining also occurs in the Danforth Hills at the western edge of the study area. Increased coal mining has been projected for much of the study area.

The southern part of the Yampa River basin is diverse in hydrologic environments, but total annual precipitation decreases from east to west. One indication of the east-west trend in precipitation is indicated by long-term precipitation data at Steamboat Springs near the eastern edge of the study area, and at Hayden more than 20 mi to the west (fig. 1). Long-term average precipitation from 1951 to 1980 was 23.3 in. at Steamboat Springs and 15.9 in. at Hayden (National Climate Data Center, 1983, p. 5 and 7). A map of normal annual precipitation from 1931 through 1960 (U.S. Weather Service, 1985) shows an annual precipitation of about 12 in. at Maybell at the northwestern edge of the study area. Therefore, about an 11-in. decrease in precipitation occurs along the main stem of the Yampa River from the eastern to the western edge of the study area.

Snow is the predominant form of precipitation in the study area, and the quantity and percentage of snow usually increase as elevation increases. The eastern and southern parts of the study area include Oak, Fish, Willow, and Trout Creeks and the East Fork and South Fork of the Williams Fork and their tributaries and have divides at elevations of 8,000 ft or higher. For example, the headwaters of the East Fork and South Fork of the Williams Fork are at a maximum elevation of 12,100 ft. Annual precipitation ranges from about 20 to 40 in. in these drainage basins (U.S. Weather Service, 1985). Valley floors have elevations that range from 6,500 to 7,000 ft, and annual precipitation is about 20 inches. The higher elevations usually have a deep snowpack, and annual precipitation is about 40 in.

In the area south of Hayden and west to Craig (fig. 1) are the tributaries of Dry Creek, which include Stokes and Dill Gulches and the small streams, such as Flume and Smuin Gulches, that drain north directly into the Yampa River. These drainage basins have their headwaters in the Williams Fork Mountains located between the Yampa River and the Williams Fork. Average altitude of these mountains is about 7,000 to 7,600 ft; some peaks and limited areas are as high as 8,000 ft. Valley floors have elevations between 6,480 and 6,800 ft. Annual precipitation ranges from about 16 in. in the valley floors to about 20 in. in the higher elevations (U.S. Weather Service, 1985).

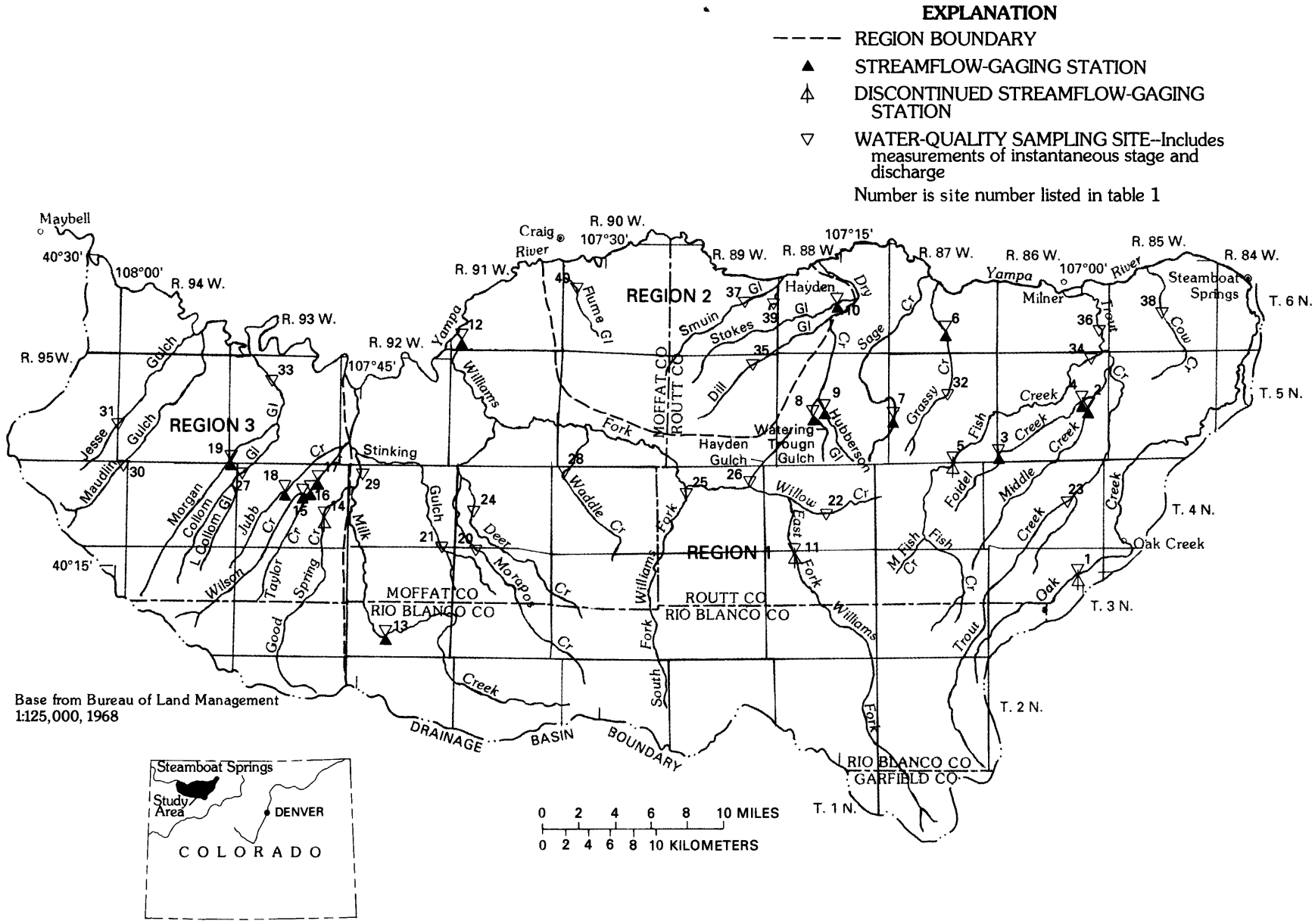

Figure 1.--The southern part of the Yampa River basin and the water-quality sites used in the analysis.

The area southwest of Craig is known as the Axial Basin and includes Taylor, Good Spring, Wilson, and Jubb Creeks, and Collom, Maudlin, Jesse, and Morgan Gulches. Drainage basins have divides in the Danforth Hills where elevations are about 8,000 ft; however, some peaks are as high as 8,800 ft. Streams drain from the higher elevations into the Axial Basin where the elevation is about 6,500 ft in the central area. Annual precipitation in the higher elevations ranges from 16 to 20 in. The Axial Basin is very dry and has an annual precipitation of about 12 in. (U.S. Weather Service, 1985).

Within the study area, 19 gaging stations (represented by the 8-digit station number in table 1) have water-quality data. Most of these data were collected in cooperation with the U.S. Bureau of Land Management during water year 1976 through water year 1982. Water-quality analyses are available for all or some part of this period for these stations.

An additional 21 miscellaneous sites (represented by the 15-digit station number in table 1) have water-quality data that were collected during water years 1981 and 1982 (Maura, 1982, 1985). These sites have from 2 to 12 analyses of water quality that represent streamflow conditions from high to low flow at each site. An attempt was made during sampling to have at least one data-collection site on all streams that flowed in the study area during water year 1981.

In all, 40 sites have water-quality data. These sites are listed in table 1 and are shown on the map in figure 1. The data represent water years 1976 through 1982 (October 1, 1975, through September 30, 1982), although many sites do not have data for each of the 7 years in this study period.

CHARACTERIZATION OF WATER QUALITY

Summary Statistics for Sampling Sites

Mean values, standard deviations, and minimum and maximum values for each water-quality constituent for each site in the study area are listed in table 2 (in the "Supplemental Data" section at the back of the report). Linear-regression coefficients for the relation of individual water-quality constituents to specific conductance for all sampling sites are listed in table 3 (in the "Supplemental Data" section at the back of the report).

These statistical summaries can be used to help assess water quality within specific stream reaches. When these relations are used, the range of specific conductance (table 2) used to develop these equations for each site needs to be considered. The range of specific conductance (the independent variable) is large and has a minimum value of 91 and a maximum value of 10,000 μS/cm.

Table 1.--*Surface-water sites used in water-quality regression analysis*

Site number in figure 1	Region	U.S. Geological Survey station number	Station name	Latitude	Longitude	Drainage area (square miles)
1	1	09238000	Oak Creek near Oak Creek	40°14'38"	107°00'53"	14.0
2	1	09243700	Middle Creek near Oak Creek	40°23'08"	106°59'33"	23.5
[1]3	1	09243800	Foidel Creek near Oak Creek	40°20'45"	107°05'04"	8.61
4	1	09243900	Foidel Creek at mouth, near Oak Creek.	40°23'25"	106°59'39"	17.5
5	1	09244100	Fish Creek near Milner	40°20'03"	107°08'19"	34.5
6	1	09244300	Grassy Creek near Mount Harris.	40°26'49"	107°08'42"	25.8
7	1	09244415	Sage Creek above Sage Creek Reservoir, near Hayden.	40°23'01"	107°11'34"	4.17
8	1	09244460	Watering Trough Gulch near Hayden.	40°22'57"	107°16'49"	2.65
9	1	09244464	Hubberson Gulch near Hayden	40°23'28"	107°16'15"	8.08
10	2	09244470	Stokes Gulch near Hayden	40°28'06"	107°14'47"	13.6
11	1	09248600	East Fork of Williams Fork above Willow Creek.	40°15'40"	107°17'40"	108
12	1	09249750	Williams Fork at mouth, near Hamilton.	40°26'14"	107°38'50"	419
13	1	09250000	Milk Creek near Thornburgh	40°11'37"	107°43'54"	65.0
14	3	09250400	Good Spring Creek at Axial	40°17'25"	107°47'22"	40.0
15	3	09250507	Wilson Creek above Taylor Creek, near Axial.	40°18'53"	107°47'58"	20.0
16	3	09250510	Taylor Creek at mouth, near Axial.	40°18'48"	107°47'57"	7.22
17	3	09250600	Wilson Creek near Axial	40°18'56"	107°47'50"	27.4
18	3	09250610	Jubb Creek near Axial	40°18'45"	107°49'18"	7.53
19	3	09250700	Morgan Gulch near Axial	40°20'09"	107°53'06"	25.6
20	1	401601107375400	Morapos Creek near Iles Grove.	40°16'01"	107°37'54"	16.8
21	1	401601107395300	Stinking Gulch near Thornburgh.	40°16'01"	107°39'53"	8.43
22	1	401747107161600	Willow Creek near Dunckley	40°17'47"	107°16'16"	19.6
23	1	401816107011000	Trout Creek near Oak Creek	40°18'16"	107°01'10"	31.1
24	1	401829107375600	Deer Creek near Hamilton	40°18'29"	107°37'56"	27.9
25	1	401857107243500	South Fork of Williams Fork at mouth, near Pagoda.	40°18'57"	107°24'35"	56.6
26	1	401913107204100	Hayden Gulch near Pagoda	40°19'13"	107°20'41"	5.79
27	3	401925107523500	Collom Gulch near Axial	40°19'25"	107°52'35"	12.8
28	1	401944107322900	Waddle Creek near Hamilton	40°19'44"	107°32'29"	16.3
29	1	401948107445600	Milk Creek near Iles Grove	40°19'48"	107°44'56"	134
30	3	402038107585100	Maudlin Gulch near Axial	40°20'38"	107°58'51"	12.8
31	3	402145108001000	Jesse Gulch near Axial	40°21'45"	108°00'10"	2.12
32	1	402330107082000	Grassy Creek at Grassy Gap	40°23'30"	107°08'20"	5.52
33	3	402409107503600	Morgan Gulch near mouth, near Axial.	40°24'09"	107°50'36"	52.1

Table 1.--*Surface-water sites used in water-quality regression analysis*--Continued

Site number in figure 1	Region	U.S. Geological Survey station number	Station name	Latitude	Longitude	Drainage area (square miles)
34	1	402530106585700	Fish Creek at mouth, near Milner.	40°25'30"	106°58'57"	77.9
35	2	402605107181500	Dill Gulch near Hayden	40°26'05"	107°18'15"	9.55
36	1	402720106591200	Trout Creek above Milner	40°27'20"	106°59'12"	110
37	2	402829107193700	Smuin Gulch near Hayden	40°28'29"	107°19'37"	11.3
38	1	402836106550100	Cow Creek near Steamboat Springs.	40°28'36"	106°55'01"	14.4
39	2	402845107185100	Smuin Tributary Creek near Hayden.	40°28'45"	107°18'51"	1.30
40	2	402911107323500	Flume Gulch near Craig	40°29'11"	107°32'35"	8.42

[1]Data from this station can be divided into premining and mining data.

Regional estimates for major ions

To provide general equations to be used in a predictive mode in various locations throughout the study area, water-quality data from all sites were combined. To define a linear-regression relation when there is such a large range in specific conductance (91 to 10,000 µS/cm) is difficult because of the interactions that can occur among the constituents and the stream environment. For this reason, the sites were divided into three regions. Division was complicated because of the range of drainage areas for these sites (table 1) and because of the variation in streamflow at each site. A low-flow sample at one site could have a water chemistry similar to a high-flow sample at another site.

Region 1 includes most of the study area (fig. 1). Streams that are contained in the region are Trout Creek and Williams Fork and their tributaries; the main stem of Milk Creek and its eastern tributary, Stinking Gulch; the main stem of Dry Creek and its tributaries, Hubberson Gulch and Watering Trough Gulch; and Sage, Grassy, Cow, and Oak Creeks. Twenty-five sites are located on these streams.

Region 2 is in the north-central part of the study area and includes Flume Gulch, Smuin Gulch, and two western tributaries of Dry Creek (Dill Gulch and Stokes Gulch) (fig. 1). Region 2 drains toward the Yampa River from the Williams Fork Mountains, which are located between the Yampa River and the Williams Fork. Five sites are located on the streams in region 2.

Region 3 is in the western part of the study area and includes the western tributaries of Milk Creek, Good Spring, Taylor, Wilson, and Jubb Creeks; Collom Gulch and its tributary, Little Collom Gulch; and Morgan, Maudlin, and Jesse Gulches (fig. 1). These streams drain the Danforth Hills and flow nearly parallel into the Axial Basin. The channels of these streams become less defined once they reach the floor of the Axial Basin. Ten sites

are located on the streams in region 3. Site 33 (fig. 1, table 1), which is on the floor of the Axial Basin, is of particular interest because ground water that collects on the downstream side of the Axial Basin reaches the surface here.

By combining the sites in the Axial Basin into one region (region 3) and the sites in the Williams Fork Mountains into another region (region 2) (fig. 1), the range of specific conductance values in region 1 is decreased, and the large values of specific conductance are fairly well confined to regions 2 and 3 (table 4, in the "Supplemental Data" section at the back of the report). Therefore, the specific conductance for region 2 ranges from 820 to 10,000 µS/cm, and the specific conductance for region 3 ranges from 255 to 6,820 µS/cm. The specific conductance for region 1 ranges from 91 to 3,900 µS/cm.

Some of the analyses in the remainder of this section use the power form of the linear-regression equations, and the intercept coefficient has not been corrected for transformation from log space (Aitchison and Brown, 1957). One bias-correction factor available is derived by multiplying the intercept coefficient by the natural logarithm to the power of one-half the square of the standard error (Miller, 1984). Because such a correction may be needed if constituent loads are calculated, the standard error is reported in percent and in absolute values for equations in the power form in the following analyses.

Calcium

A plot of the relation of dissolved calcium to specific conductance for all sites in the study area shows a curvilinear trend (fig. 2). After analyzing a limited set of water-quality data from this same study area, Turk and Parker (1982) reported that as specific conductance increases, a decreasing proportion of that increase is due to the dissolved calcium. They suggested that such a decreasing proportion of calcium could result from the precipitation of calcium as the dissolved-solids concentration (specific conductance) increased because of evapotranspiration. On the basis of this reasoning, the power form of the equation is used for the relation of dissolved calcium to specific conductance.

Three separate equations for dissolved calcium are presented. The equation for region 1 is:

$$Ca = 0.23\ Cs^{0.881}\ , \qquad (1)$$

where Ca = dissolved calcium, in milligrams per liter; and
Cs = specific conductance, in microsiemens per centimeter at 25 degrees Celsius.

This equation has a standard error of 14.1 percent (0.141) and a coefficient of determination (r^2) of 0.93.

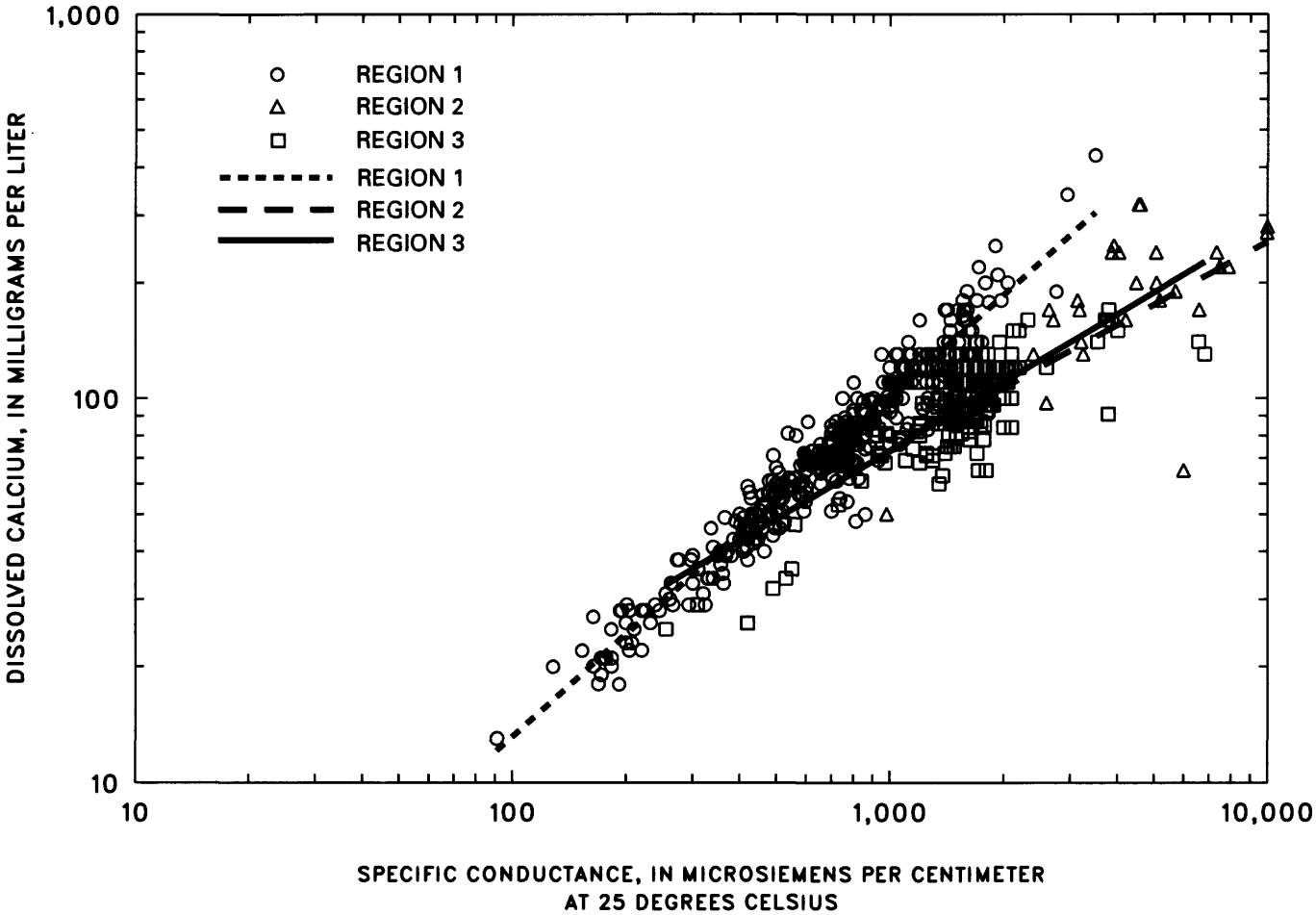

Figure 2.--Relation of concentration of dissolved calcium to specific conductance.

The equation for region 2 is:

$$Ca = 1.69\ Cs^{0.545} \quad . \tag{2}$$

This equation has a standard error of 31.1 percent (0.307) and an r^2 of 0.50.

The equation for region 3 is:

$$Ca = 1.25\ Cs^{0.589} \quad . \tag{3}$$

This equation has a standard error of 17.9 percent (0.178) and an r^2 of 0.65.

Magnesium

A plot of the relation of dissolved magnesium to specific conductance for all sites is shown in figure 3. The grouping of the sites resulted in two equations. An F-test on the regression coefficients indicates that regions 1 and 2 are not significantly different at the 5-percent level; therefore, two regions are combined for analysis of dissolved magnesium. The power form of the linear-regression equation is used for these relations because the simple linear form results in negative values of dissolved-magnesium concentration for specific-conductance values that are in the range of sampled values (table 4).

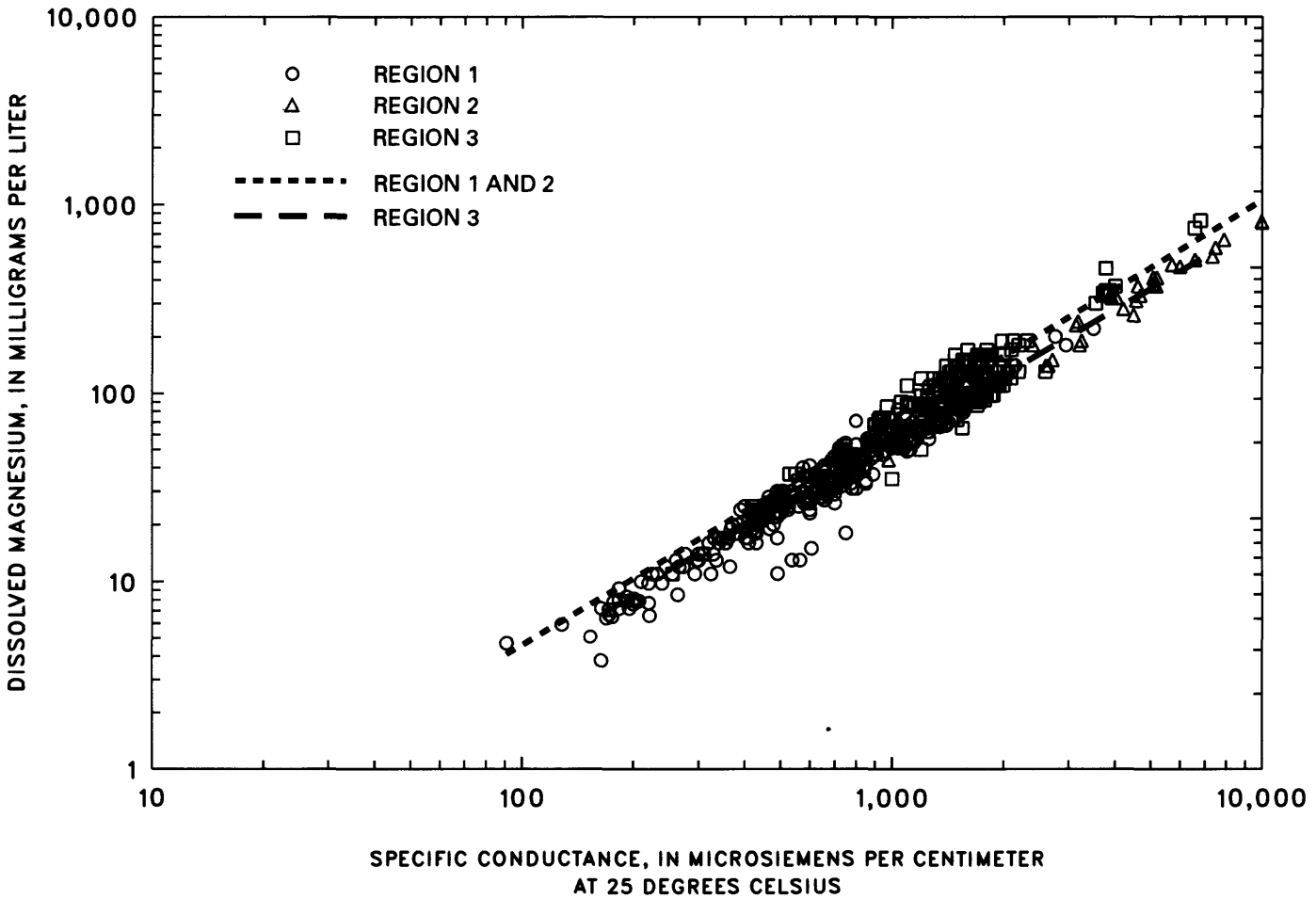

Figure 3.--Relation of concentration of dissolved magnesium to specific conductance.

The equation for regions 1 and 2 is:

$$Mg = 0.02\ Cs^{1.18}\ , \qquad (4)$$

where Mg = dissolved magnesium, in milligrams per liter. This equation has a standard error of 16 percent (0.163) and an r^2 of 0.97.

The equation for region 3 is:

$$Mg = 0.02\ Cs^{1.15}\ . \qquad (5)$$

The standard error for this equation is 12 percent (0.217), and the r^2 is 0.82.

Potassium

A plot of the relation of dissolved potassium to specific conductance is shown in figure 4. Although the concentration of dissolved potassium is less than 40 mg/L for all the samples in the study, three linear-regression equations were developed because the slope coefficients for these equations are significant at the 5-percent level.

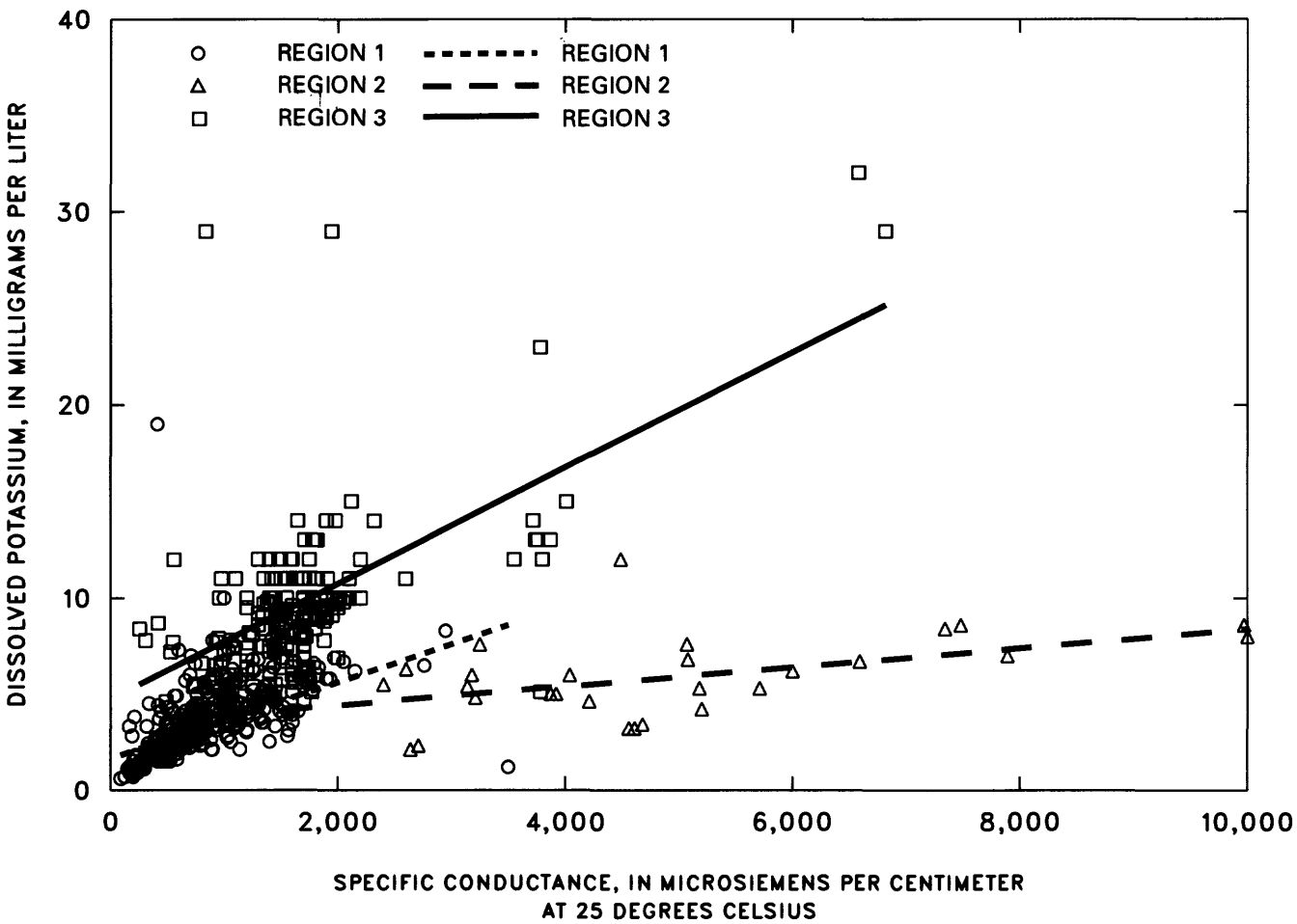

Figure 4.--Relation of concentration of dissolved potassium to specific conductance.

The equation for region 1 is:

$$K = 1.59 + 0.002\ Cs\ , \tag{6}$$

where K = dissolved potassium, in milligrams per liter. This equation has a standard error of 2 mg/L and an r^2 of 0.35.

The equation for region 2 is:

$$K = 3.44 + 0.0005\ Cs\ . \tag{7}$$

The equation has a standard error of 2 mg/L and an r^2 of 0.25.

The equation for region 3 is:

$$K = 4.76 + 0.003\ Cs\ . \tag{8}$$

The equation has a standard error of 3 mg/L and an r^2 of 0.34.

Sodium

A plot of the relation of dissolved sodium to specific conductance is shown in figure 5. If the simple linear-regression equation is used for the relation, the values of sodium concentration are negative for specific-conductance values that are well within the range sampled (table 4). Therefore, power forms of the equation are used to estimate sodium concentrations.

The equation for region 1 is:

$$Na = 0.004\ Cs^{1.34}\ , \tag{9}$$

where Na = dissolved sodium, in milligrams per liter. This equation has a standard error of 26 percent (0.261) and an r^2 of 0.91.

The equation for region 2 is:

$$Na = 0.022\ Cs^{1.197}\ . \tag{10}$$

This equation has a standard error of 15 percent (0.152) and an r^2 of 0.94.

The equation for region 3, is:

$$Na = 0.003\ Cs^{1.42}\ . \tag{11}$$

This equation has a standard error of 30 percent (0.297), and an r^2 of 0.79.

Chloride

A plot of the relation of dissolved chloride to specific conductance is shown in figure 6. The power form of the equation for this relation is used here because simple linear regression results in negative values of dissolved-chloride concentration for specific-conductance values in the data set (table 4).

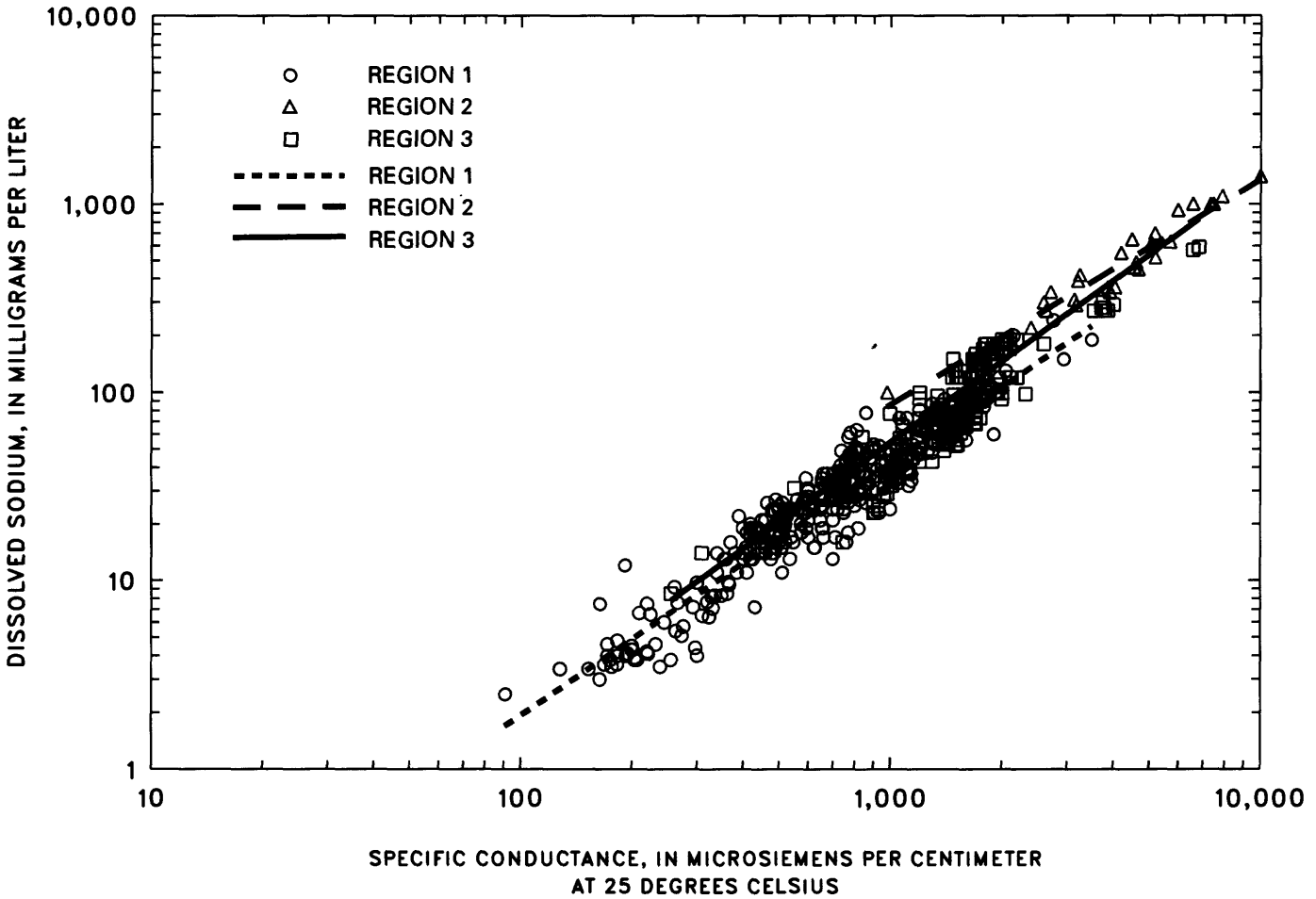

Figure 5.--Relation of concentration of dissolved sodium to specific conductance.

The equation for region 1 is:

$$Cl = 0.001\ Cs^{1.29}\ , \qquad (12)$$

where Cl = dissolved chloride, in milligrams per liter. This equation has a standard error of 47 percent (0.451) and an r^2 of 0.75.

The regression coefficients for regions 2 and 3 are not significantly different at the 5-percent level (F-test), and these regions were combined for the equation:

$$Cl = 0.01\ Cs^{1.04}\ . \qquad (13)$$

This equation has a standard error of 39 percent (0.383) and an r^2 of 0.73. This equation and the preceding F-test on the regression coefficients between the two regions were calculated without using the outlier sample from Stokes Gulch (site 10) where the chloride concentration was 30 mg/L at a specific conductance of 10,000 µS/cm (fig. 6).

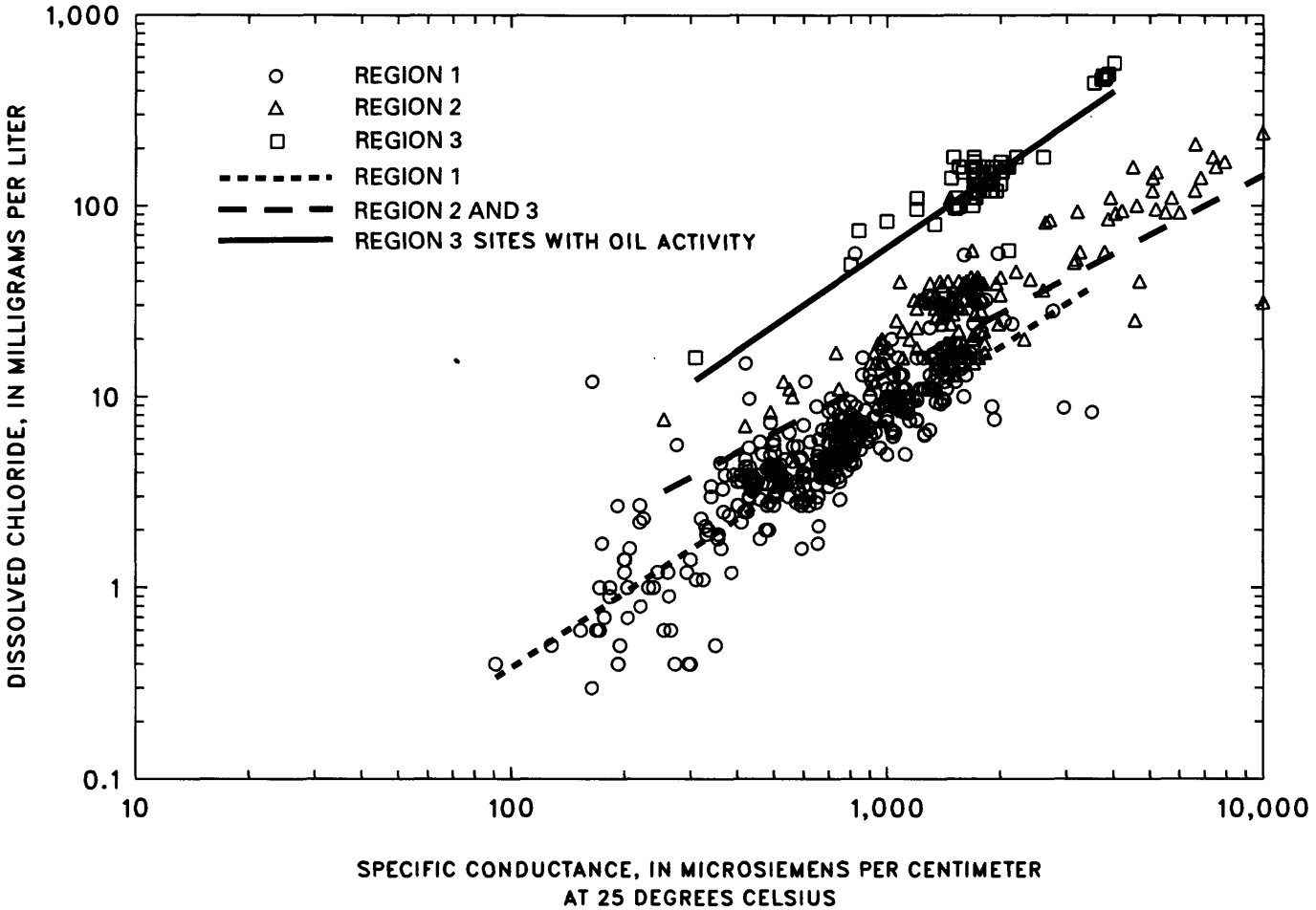

Figure 6.--Relation of concentration of dissolved chloride to specific conductance.

Data from three sites in the Axial Basin (region 3) seem to be consistently different from the other sites in regions 2 and 3 (fig. 6). Oil drilling is being done upstream from those sites and enables brines and deep ground water to mix with the surface water and alter the water chemistry. Data from these three sites are identified in figure 6, and a separate equation was developed for these three sites combined. These three sites were not included in the development of equation 13. Two of the sites are on Wilson Creek (sites 15 and 17), and the other is on Maudlin Gulch (site 30) (fig. 1, table 1). The equation for these three sites is:

$$Cl = 0.005\ Cs^{1.36}\ . \qquad (14)$$

This equation has a standard error of 26 percent (0.258) and an r^2 of 0.79.

Bicarbonate

A plot of the relation of dissolved bicarbonate to specific conductance is shown in figure 7. The changes in bicarbonate concentration with increasing specific conductance is similar to those observed for calcium concentration (fig 2). Because the increase in bicarbonate occurs at a decreasing rate, a power form of the linear-regression equation is used for this constituent. Three equations, one for each region, are defined for the relation of bicarbonate to specific conductance.

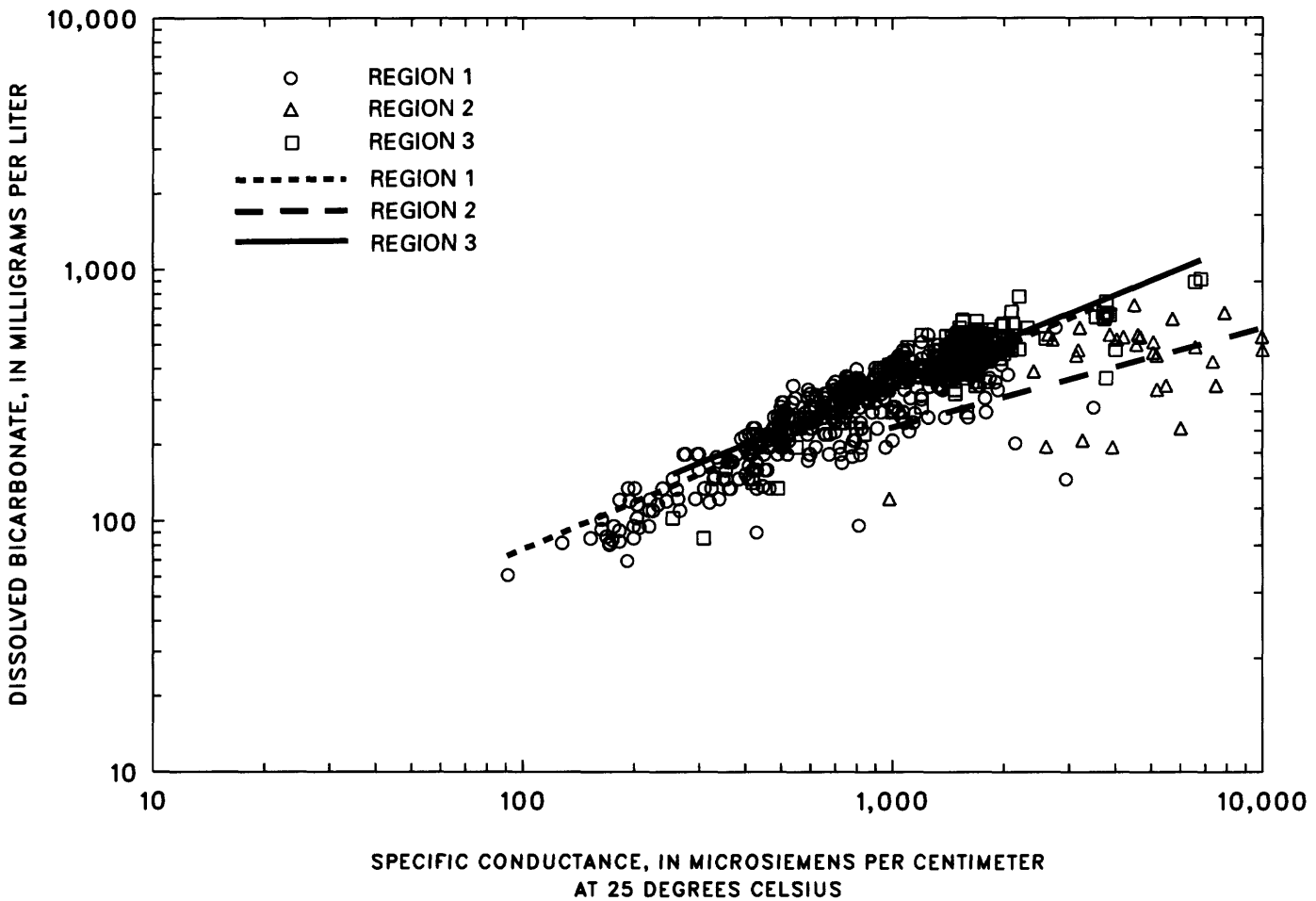

Figure 7.--Relation of concentration of dissolved bicarbonate to specific conductance.

The equation for region 1 is:

$$HCO_3 = 4.41\ Cs^{0.621}\ , \qquad (15)$$

where H = dissolved bicarbonate, in milligrams per liter. This equation has a standard error of 17 percent (0.233) and an r^2 of 0.72.

The equation for region 2 is:

$$HCO_3 = 15.05\ Cs^{0.397}\ . \qquad (16)$$

This equation has a standard error of 39 percent (0.383) and an r^2 of 0.20.

The equation for region 3 is:

$$HCO_3 = 5.64\ Cs^{0.596}\ . \qquad (17)$$

This equation has a standard error of 18 percent (0.178) and an r^2 of 0.65.

Sulfate

A plot of the relation of dissolved sulfate to specific conductance is shown in figure 8. The overall relation is curvilinear, and the sulfate concentration increases at an increasing rate. A simple linear regression results in negative values of sulfate concentration for values of specific conductance in the data set (table 4). To eliminate these negative values, the power form of the linear-regression equation is used for this relation.

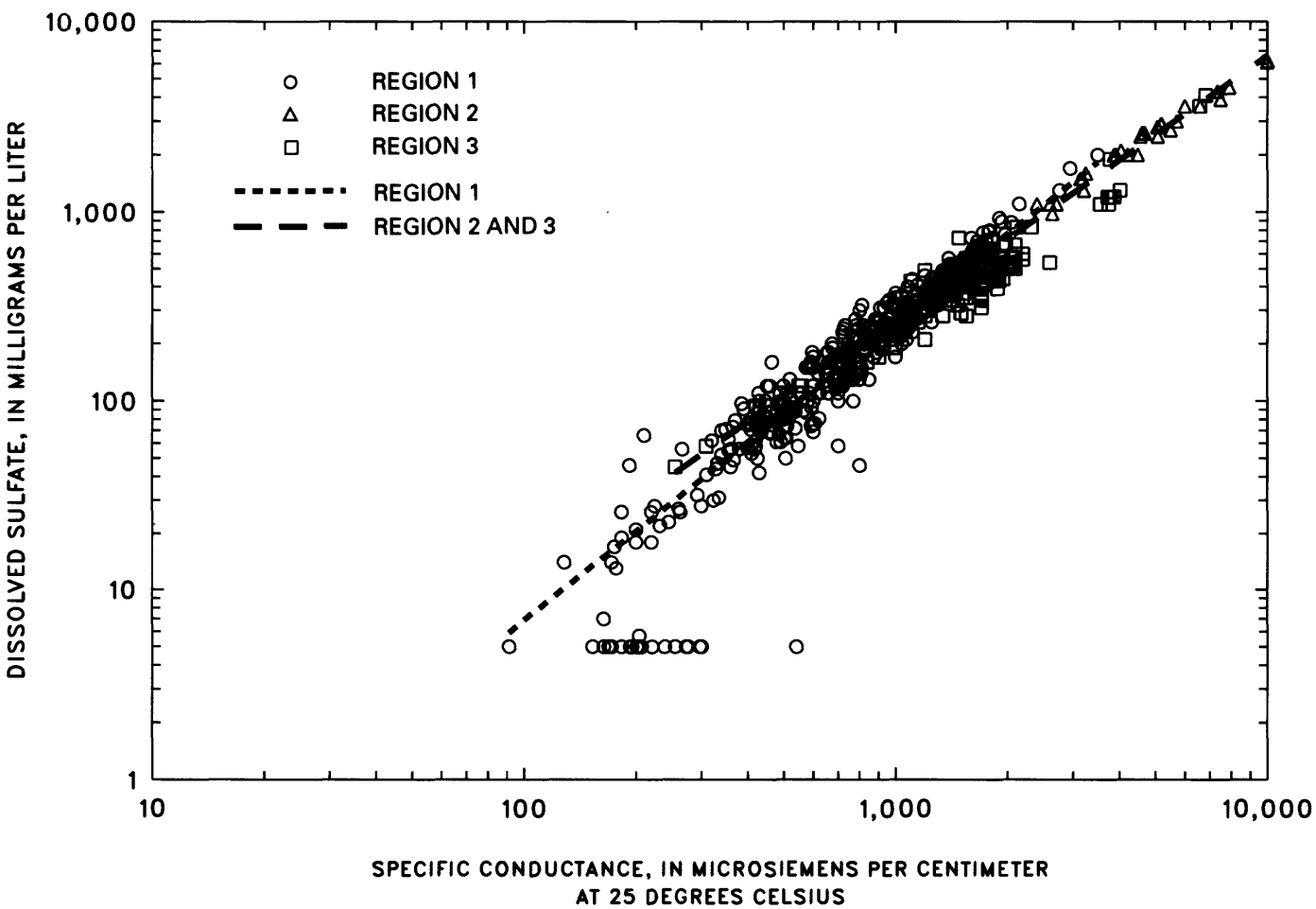

Figure 8.--Relation of concentration of dissolved sulfate to specific conductance.

Nineteen samples of sulfate concentration with a value of 5.0 mg/L and one sample with a value of 5.7 mg/L are clustered together and seem somewhat different from the rest of the data (fig. 8). These data primarily are from three sites: the site on Oak Creek (site 1), the site on the East Fork of Williams Fork (site 11), and the upper site on Trout Creek (site 23) (fig. 1, table 1). These three sites account for 19 of the 20 samples and for all but two of the samples collected at these three sites. These sites are located on larger streams that drain the igneous and metamorphic rocks of the higher mountains to the south of the study area (fig. 1). The one remaining sample is from the site on Willow Creek (site 22) where the sample had a sulfate concentration of 5 mg/L and a specific conductance of 540 µS/cm. Because these values seem to deviate from the general trend of the data, they are not included in the determination of the equation for region 1.

The equation for region 1 is:

$$SO_4 = 0.005\ Cs^{1.57}\ , \qquad (18)$$

where S = dissolved sulfate concentration, in milligrams per liter. This equation has a standard error of 25 percent (0.249) and an r^2 of 0.92.

The regression coefficients for the equation for the sites in region 2 and sites in region 3 were not significantly different at the 5-percent level (F-test), and these two regions were combined. The combined equation is:

$$SO_4 = 0.02\ Cs^{1.38}\ . \qquad (19)$$

This equation has a standard error of 19 percent (0.191) and an r^2 of 0.94.

Dissolved-sulfate concentrations have been used as an indicator of mine drainage in basins in parts of the United States where coal is being mined. Sulfate is used as an indicator because it is a byproduct of the reaction of pyritic materials with oxygen and water, and because the increase in sulfate concentration with the onset of mining has been well documented (Biesecker and George, 1966). Parker and Carey (1980) reported a threshold sulfate concentration in the coal region of Tennessee that, if exceeded, indicated that coal mining affected the streams.

In the Yampa River basin, specific-conductance values are larger (table 4) in parts of the basin where coal is not being mined, such as the Williams Fork Mountains (region 2). The large specific-conductance values have associated large concentrations of sulfate. For example, the maximum value of sulfate concentration for region 2 is 6,200 mg/L (site 10, table 2), and the maximum value of sulfate concentration for region 3 is 4,100 mg/L (site 33). These values can be compared to the maximum sulfate concentrations from sites in region 1 where coal is mined; this maximum concentration was 2,000 mg/L at site 4 (table 2). Therefore, within the Yampa basin, factors such as geology and climate (for example, evapotranspiration) can have a substantial effect on concentrations of sulfate.

Coal mining occurs upstream from several sites. The water-quality data from these sites can be used to study changes in sulfate concentration due to coal mining. However, all these sites are located in region 1.

If the sulfate concentrations at a single site were compared before and after coal mining began, changes in the sulfate concentration would be observed. At site 3 on Foidel Creek (fig. 1, table 1), data were collected from 1976 through 1982 water years. Surface coal mining began upstream from this site in 1980 and continued through the data-collection period. The data were divided by grouping the data from the 1976 through 1979 water years as a premining data set; data for the 1980 water year was not used, and the data from the 1981 through 1982 water years were grouped as a mining data set.

The mining data set has larger values of sulfate concentration (fig. 9). The mean value for sulfate concentration in the premining data set was 153 mg/L and, after mining began, the mean value was 314 mg/L. This increase is significant at the 5-percent level using a t-test on the mean concentrations.

Because the concentrations of sulfate are dependent on the streamflow at which they were sampled, the sampling sequence between the two data sets could affect the above comparison of concentration of sulfate in the two data sets. The mean values of the streamflow at sampling times were not significantly different at the 5-percent level (t-test); therefore, the overall streamflow sampling between the two data sets seems similar.

Other differences in premining and mining sulfate concentrations can be observed by comparing two contiguous drainage basins. Middle and Foidel Creeks have similar geology, slopes, aspects, and elevations. No mining occurs upstream from site 2 (fig. 1, table 1) on Middle Creek ; whereas, coal mining has occurred upstream from site 4 on Foidel Creek for several decades.

Sulfate concentrations are larger for site 4 on Foidel Creek (fig. 10). On Middle Creek at site 2, the mean concentration of sulfate is about 117 mg/L, and on Foidel Creek at site 4, the mean concentration of sulfate is about 507 mg/L. The means of the sulfate concentration in these two data sets are significantly different at the 5-percent level (t-test). The means of the streamflow discharge measured at the time of sampling at the two sites are not significantly different (5 percent). Therefore, the sampling sequence was not a factor in the observed differences in sulfate concentrations.

The differences in values of sulfate concentrations and the associated values of specific conductance can be determined for those sites where data were collected before and after coal mining began or for contiguous drainage basins that had similar physical characteristics, such as Middle and Foidel Creeks. However, determining differences in sulfate concentration due to coal mining is difficult in the Yampa River basin because of the large sulfate concentrations that occur naturally. The relative frequencies of sulfate concentrations for the sites that had some mining upstream in the Trout Creek drainage basin (in region 1 in fig. 1) are shown in figure 11. These sites include: Sites 3 and 4 on Foidel Creek, site 34 on Fish Creek, and site 36 on Trout Creek. The relative frequency of sulfate concentrations for sites in the Trout Creek drainage basin unaffected by mining also are shown in figure 11. The third distribution shown in fig. 11 is the frequency of sulfate concentrations for all the sites in regions 2 and 3. The difference in sulfate concentration between the sites unaffected and affected by mining in the Trout Creek drainage basin is noticeable, but the range of sulfate concentrations from throughout the study area easily could conceal these changes.

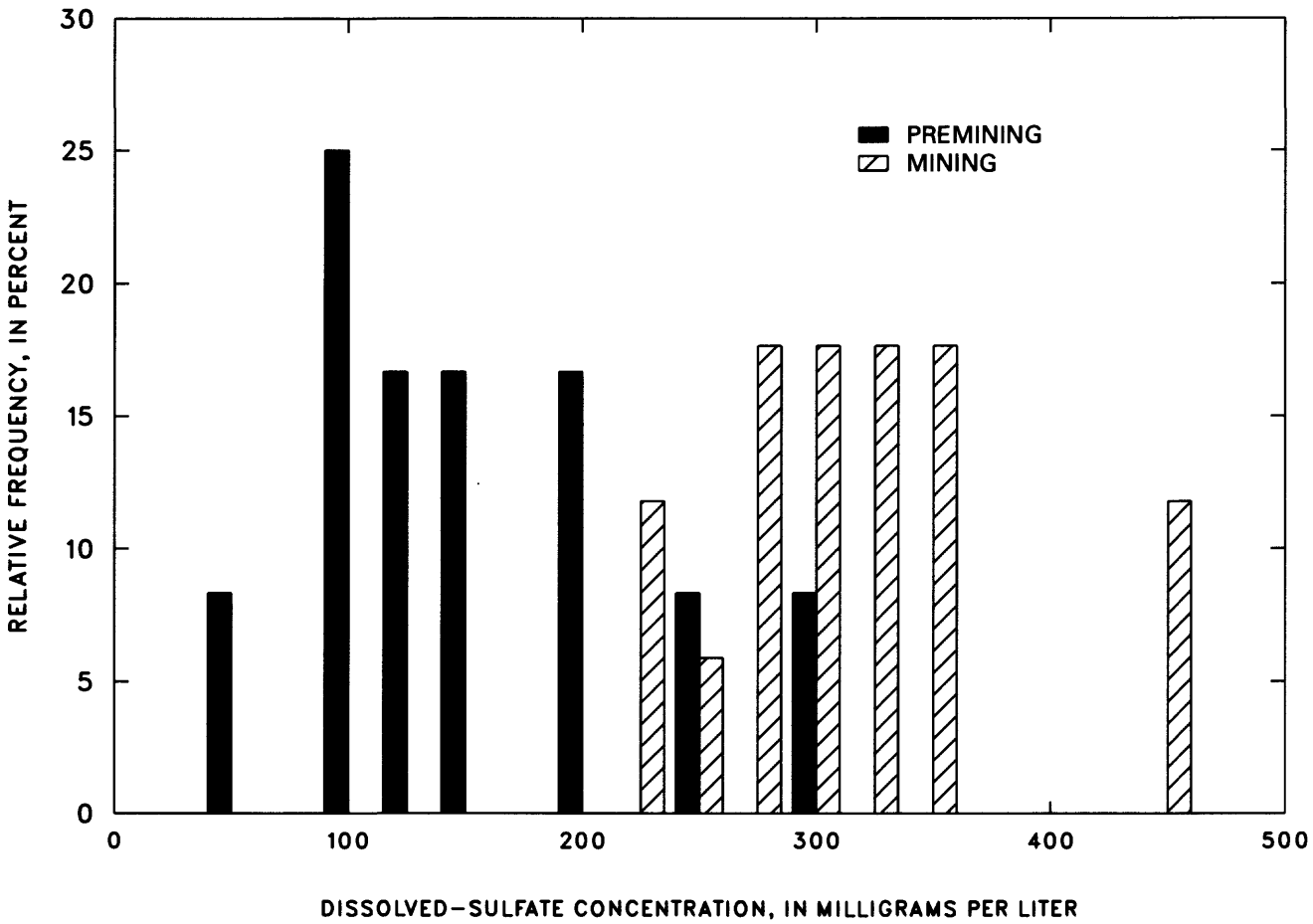

Figure 9.--Relative frequency of dissolved-sulfate concentrations for site 3 before and after coal mining began.

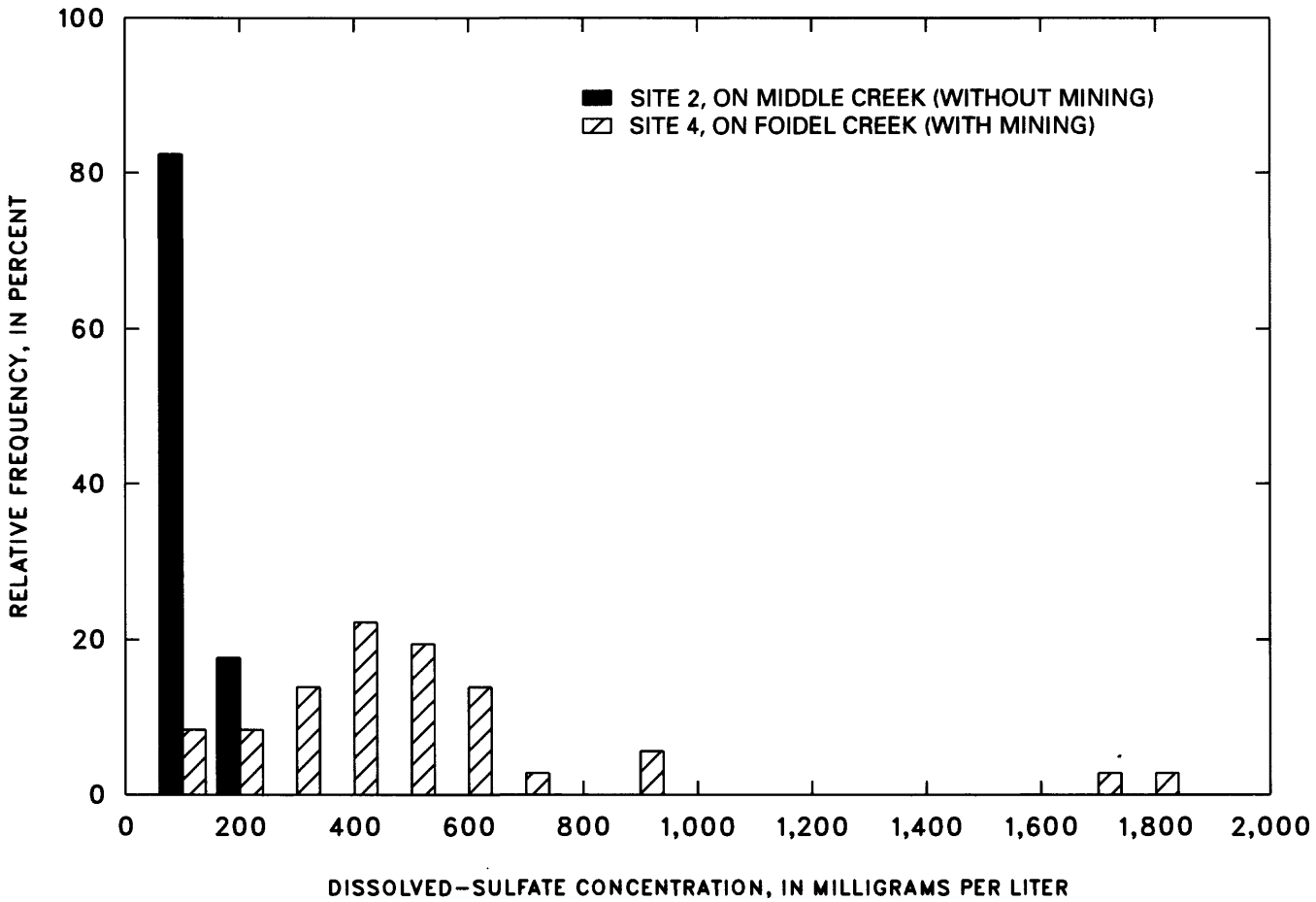

Figure 10.--Relative frequency of dissolved-sulfate concentrations for site 2 (without mining) and site 4 (with mining).

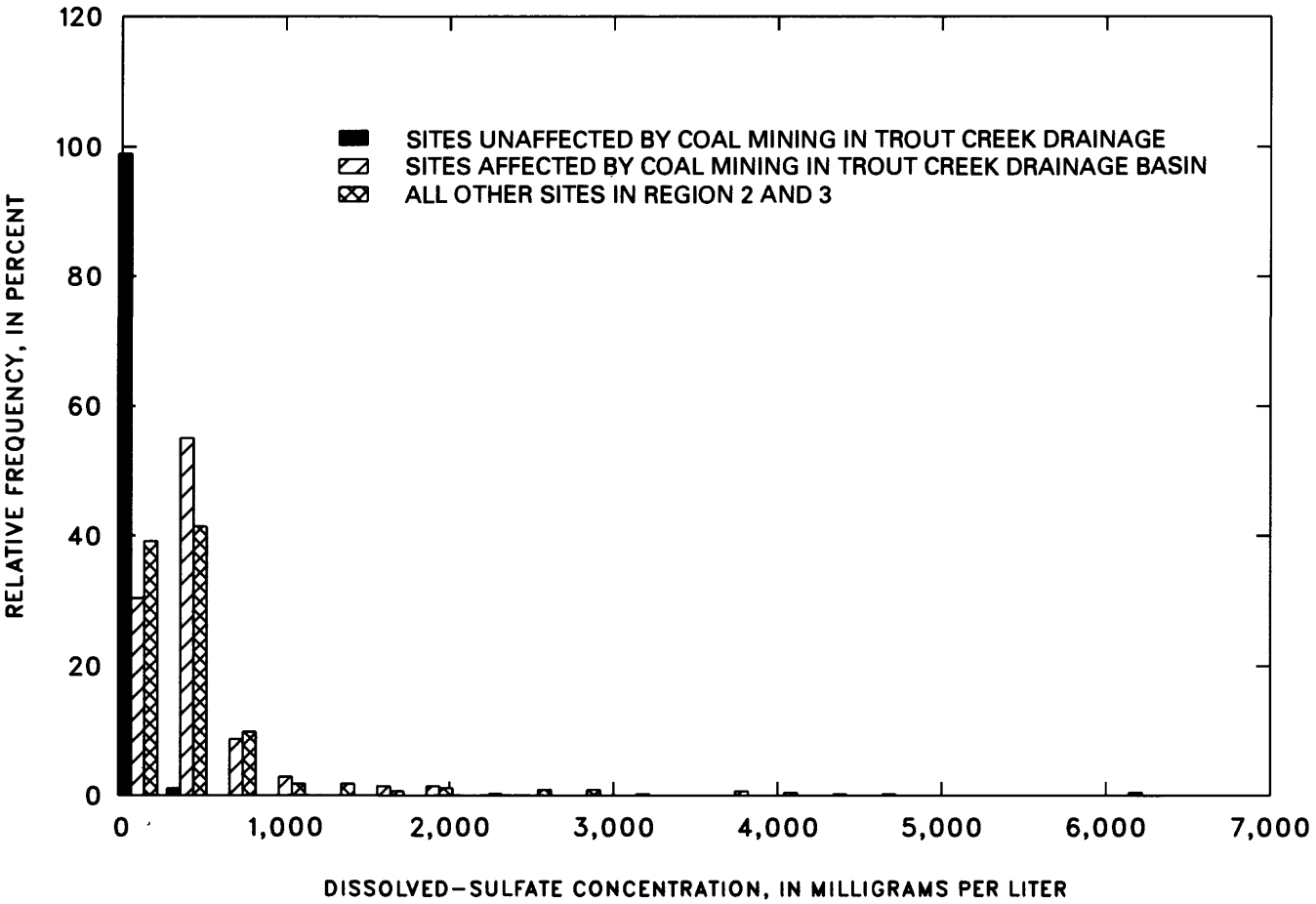

Figure 11.--Relative frequency of dissolved-sulfate concentrations for all sites affected by coal mining and all sites unaffected by mining in the Trout Creek drainage basin and all other sites in regions 2 and 3.

SUMMARY AND CONCLUSIONS

Water quality was characterized for the southern Yampa River basin. Constituents analyzed included: calcium, magnesium, potassium, sodium, bicarbonate, chloride, and sulfate. Water-chemistry data are available for 40 sites in the study area. These sites included most flowing streams in the study area during water year 1981. Data used in this analysis included water years 1976 through 1982.

Summary statistics for individual sites are presented, and the coefficients for simple linear-regression equations were derived for individual constituents and specific conductance for each site. These statistical summaries can be used to help assess water quality within specific stream reaches.

The sites were divided into regions to provide general equations between individual constituents and specific conductance for the study area. Region 1 includes Trout Creek, Williams Fork, and their tributaries. Parts of the Milk Creek and Dry Creek drainages also are included. Region 2 contains streams draining from the Williams Fork Mountains, and region 3 contains streams draining from the Danforth Hills to the Axial Basin.

Equations for each region were derived, and the coefficients were compared. Regions were combined if the regression coefficients were not significantly different between regions at the 5-percent level. These equations provide a method for determining constituent concentrations for specified values of specific conductance within the southern part of the Yampa River basin.

For the relation of dissolved calcium to specific conductance, three separate equations were derived that corresponded to the three regions. For the relation of dissolved magnesium to specific conductance, two equations were derived; one equation was for the combined regions 1 and 2 and a separate equation was for region 3. For the relations of dissolved potassium and dissolved sodium to specific conductance, three separate linear-regression equations were derived for each constituent that corresponded to the three regions. For the relation of dissolved chloride to specific conductance, three separate equations were derived: one for region 1, one for regions 2 and 3 combined, and one for a separate relation for three sites (sites 15, 17, and 30) that are located in region 3 and that have oil drilling upstream. For the relation of bicarbonate to specific conductance, three separate equations were derived that corresponded to the three regions. For the relation of dissolved sulfate to specific conductance, two equations were derived: one for region 1 and one for regions 2 and 3 combined.

In many regions of the country, sulfate can be used as an indicator of upstream coal mining because in those regions, sulfate concentrations are small, and values exceeding some threshold indicate the presence of coal mining. However, in the southern Yampa River basin, the sulfate concentrations are related to geology and climate and are frequently much larger than the increases in sulfate concentrations caused by coal mining. More detailed analyses are needed in the study area to identify the sources of the increases in dissolved sulfate and their contribution to dissolved-solids concentrations.

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SUPPLEMENTAL DATA

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; site numbers and descriptions are listed in table 1; locations are shown in figure 1]

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 09238000 (SITE 1--REGION 1)					
Specific conductance (µS/cm)	11	231.73	42.75	170.00	300.00
Calcium, dissolved (mg/L as Ca)	7	31.14	7.60	21.00	39.00
Magnesium, dissolved (mg/L as Mg)	7	10.69	2.57	7.10	14.00
Potassium, dissolved (mg/L as K)	7	1.17	.25	.90	1.50
Sodium, dissolved (mg/L as Na)	7	4.27	.81	3.50	5.70
Chloride, dissolved (mg/L as Cl)	7	1.37	1.88	.40	5.60
Bicarbonate (mg/L as $CaCO_3$)	7	118.71	33.90	67.00	150.00
Sulfate, dissolved (mg/L as SO_4)	7	5.10	.26	5.00	5.70
Fluoride, dissolved (mg/L as F)	7	.17	.20	.00	.60
Silica, dissolved (mg/L as SiO_2)	7	13.00	.82	12.00	14.00
STATION NUMBER 09243700 (SITE 2--REGION 1)					
Specific conductance (µS/cm)	60	620.65	155.48	310.00	890.00
Calcium, dissolved (mg/L as Ca)	53	68.26	13.31	36.00	93.00
Magnesium, dissolved (mg/L as Mg)	53	28.77	6.58	14.00	40.00
Potassium, dissolved (mg/L as K)	51	3.62	2.36	1.50	19.00
Sodium, dissolved (mg/L as Na)	53	29.58	11.28	6.50	51.00
Chloride, dissolved (mg/L as Cl)	49	4.39	1.36	1.10	8.10
Bicarbonate (mg/L as $CaCO_3$)	53	229.42	53.02	110.00	305.00
Sulfate, dissolved (mg/L as SO_4)	51	117.20	37.13	41.00	210.00
Fluoride, dissolved (mg/L as F)	51	.21	.05	.00	.30
Silica, dissolved (mg/L as SiO_2)	51	8.16	2.12	.20	14.00
STATION NUMBER 09243800 (SITE 3--REGION 1)					
Specific conductance (µS/cm)	39	862.38	294.39	210.00	1,350.00
Calcium, dissolved (mg/L as Ca)	33	97.09	27.23	25.00	130.00
Magnesium, dissolved (mg/L as Mg)	34	47.65	17.04	10.00	80.00
Potassium, dissolved (mg/L as K)	33	3.67	.99	2.10	6.20
Sodium, dissolved (mg/L as Na)	33	36.60	19.19	6.70	87.00
Chloride, dissolved (mg/L as Cl)	33	9.49	9.65	1.10	56.00
Bicarbonate (mg/L as $CaCO_3$)	32	263.12	78.02	130.00	410.00
Sulfate, dissolved (mg/L as SO_4)	33	236.12	105.80	46.00	460.00
Fluoride, dissolved (mg/L as F)	33	.25	.06	.20	.40
Silica, dissolved (mg/L as SiO_2)	33	8.59	2.61	2.80	14.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 09243900 (SITE 4--REGION 1)					
Specific conductance (µS/cm)	52	1,203.37	539.90	400.00	3,500.00
Calcium, dissolved (mg/L as Ca)	36	141.86	74.47	45.00	430.00
Magnesium, dissolved (mg/L as Mg)	37	69.03	39.98	16.00	220.00
Potassium, dissolved (mg/L as K)	35	4.24	1.62	1.20	8.30
Sodium, dissolved (mg/L as Na)	36	65.53	33.21	16.00	190.00
Chloride, dissolved (mg/L as Cl)	36	11.05	4.50	5.40	28.00
Bicarbonate (mg/L as $CaCO_3$)	36	246.78	68.61	74.00	350.00
Sulfate, dissolved (mg/L as SO_4)	36	506.67	385.39	100.00	2,000.00
Fluoride, dissolved (mg/L as F)	36	.24	.07	.10	.50
Silica, dissolved (mg/L as SiO_2)	34	5.45	2.63	.20	10.00
STATION NUMBER 09244100 (SITE 5--REGION 1)					
Specific conductance (µS/cm)	14	513.07	152.72	324.00	749.00
Calcium, dissolved (mg/L as Ca)	8	55.38	15.43	29.00	72.00
Magnesium, dissolved (mg/L as Mg)	8	32.75	15.37	11.00	54.00
Potassium, dissolved (mg/L as K)	8	2.44	.89	1.70	4.20
Sodium, dissolved (mg/L as Na)	8	15.99	6.31	6.40	24.00
Chloride, dissolved (mg/L as Cl)	8	2.95	2.36	1.10	8.60
Bicarbonate (mg/L as $CaCO_3$)	8	212.63	68.46	110.00	290.00
Sulfate, dissolved (mg/L as SO_4)	8	85.88	37.08	30.00	140.00
Fluoride, dissolved (mg/L as F)	8	.23	.13	.10	.50
Silica, dissolved (mg/L as SiO_2)	8	14.25	2.12	11.00	18.00
STATION NUMBER 09244300 (SITE 6--REGION 1)					
Specific conductance (µS/cm)	13	1,884.46	574.47	812.00	3,100.00
Calcium, dissolved (mg/L as Ca)	9	168.44	52.83	48.00	220:00
Magnesium, dissolved (mg/L as Mg)	9	116.22	42.52	39.00	200.00
Potassium, dissolved (mg/L as K)	9	5.99	1.11	3.30	6.90
Sodium, dissolved (mg/L as Na)	9	123.56	58.90	63.00	240.00
Chloride, dissolved (mg/L as Cl)	9	29.10	12.91	6.90	56.00
Bicarbonate (mg/L as $CaCO_3$)	9	278.33	114.22	79.00	480.00
Sulfate, dissolved (mg/L as SO_4)	9	815.56	273.50	320.00	1,300.00
Fluoride, dissolved (mg/L as F)	9	.26	.10	.20	.50
Silica, dissolved (mg/L as SiO_2)	9	6.62	2.06	2.20	9.60

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 09244415 (SITE 7--REGION 1)					
Specific conductance (µS/cm)	18	615.67	226.99	320.00	1,000.00
Calcium, dissolved (mg/L as Ca)	13	77.92	22.18	31.00	110.00
Magnesium, dissolved (mg/L as Mg)	13	40.31	14.05	16.00	65.00
Potassium, dissolved (mg/L as K)	13	4.52	2.02	2.30	10.00
Sodium, dissolved (mg/L as Na)	13	16.76	6.07	7.20	26.00
Chloride, dissolved (mg/L as Cl)	13	5.90	2.27	2.30	10.00
Bicarbonate (mg/L as $CaCO_3$)	13	227.85	56.78	97.00	320.00
Sulfate, dissolved (mg/L as SO_4)	13	158.31	74.77	42.00	260.00
Fluoride, dissolved (mg/L as F)	13	.18	.04	.10	.20
Silica, dissolved (mg/L AS SiO_2)	13	9.42	1.65	7.10	12.00
STATION NUMBER 09244460 (SITE 8--REGION 1)					
Specific conductance (µS/cm)	26	1,010.15	104.99	744.00	1,250.00
Calcium, dissolved (mg/L as Ca)	26	105.12	11.51	75.00	120.00
Magnesium, dissolved (mg/L as Mg)	26	57.38	6.85	39.00	69.00
Potassium, dissolved (mg/L as K)	26	5.53	.85	4.30	7.80
Sodium, dissolved (mg/L as Na)	26	39.38	7.28	26.00	61.00
Chloride, dissolved (mg/L as Cl)	26	10.50	2.38	7.60	20.00
Bicarbonate (mg/L as $CaCO_3$)	26	340.38	49.27	210.00	450.00
Sulfate, dissolved (mg/L as SO_4)	26	228.08	33.83	170.00	320.00
Fluoride, dissolved (mg/L as F)	26	.26	.08	.20	.50
Silica, dissolved (mg/L as SiO_2)	26	10.96	3.64	.10	19.00
STATION NUMBER 09244464 (SITE 9--REGION 1)					
Specific conductance (µS/cm)	41	1,009.07	429.29	340.00	1,750.00
Calcium, dissolved (mg/L as Ca)	28	116.39	34.47	34.00	170.00
Magnesium, dissolved (mg/L as Mg)	28	75.86	22.25	17.00	120.00
Potassium, dissolved (mg/L as K)	29	4.28	.77	3.10	6.80
Sodium, dissolved (mg/L as Na)	28	58.04	23.20	11.00	94.00
Chloride, dissolved (mg/L as Cl)	29	13.18	9.13	3.40	55.00
Bicarbonate (mg/L as $CaCO_3$)	28	300.71	86.24	100.00	420.00
Sulfate, dissolved (mg/L as SO_4)	29	388.62	147.06	70.00	710.00
Fluoride, dissolved (mg/L as F)	29	.24	.08	.00	.40
Silica, dissolved (mg/L as SiO_2)	29	7.92	1.89	4.00	11.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 09244470 (SITE 10--REGION 2)					
Specific conductance (µS/cm)	20	4,124.50	2,933.97	820.00	10,000.00
Calcium, dissolved (mg/L as Ca)	9	170.22	88.00	50.00	280.00
Magnesium, dissolved (mg/L as Mg)	9	438.22	276.63	44.00	810.00
Potassium, dissolved (mg/L as K)	9	7.08	1.49	4.70	8.60
Sodium, dissolved (mg/L as Na)	9	805.56	462.47	100.00	1,400.00
Chloride, dissolved (mg/L as Cl)	10	99.90	72.78	15.00	240.00
Bicarbonate (mg/L as $CaCO_3$)	10	273.00	114.12	100.00	440.00
Sulfate, dissolved (mg/L as SO_4)	10	3,275.00	1,962.04	350.00	6,200.00
Fluoride, dissolved (mg/L as F)	10	.26	.05	.20	.30
Silica, dissolved (mg/L as SiO_2)	10	4.35	4.40	.10	11.00
STATION NUMBER 09248600 (SITE 11--REGION 1)					
Specific conductance (µS/cm)	7	204.29	33.12	153.00	263.00
Calcium, dissolved (mg/L as Ca)	7	28.00	3.21	22.00	33.00
Magnesium, dissolved (mg/L as Mg)	7	7.31	1.16	5.10	8.50
Potassium, dissolved (mg/L as K)	7	1.01	.15	.80	1.20
Sodium, dissolved (mg/L as Na)	7	4.17	.61	3.40	5.40
Chloride, dissolved (mg/L as Cl)	7	.76	.33	.40	1.40
Bicarbonate (mg/L as $CaCO_3$)	7	97.43	13.44	70.00	110.00
Sulfate, dissolved (mg/L as SO_4)	7	8.00	7.94	5.00	26.00
Fluoride, dissolved (mg/L as F)	7	.14	.11	.10	.40
Silica, dissolved (mg/L as SiO_2)	7	14.71	1.60	12.00	16.00
STATION NUMBER 09249750 (SITE 12--REGION 1)					
Specific conductance (µS/cm)	53	428.30	140.02	128.00	860.00
Calcium, dissolved (mg/L as Ca)	53	44.02	11.42	20.00	67.00
Magnesium, dissolved (mg/L as Mg)	53	22.20	9.14	5.90	53.00
Potassium, dissolved (mg/L as K)	54	1.89	.82	.70	5.10
Sodium, dissolved (mg/L as Na)	53	18.51	11.17	3.40	78.00
Chloride, dissolved (mg/L as Cl)	54	4.14	2.78	.50	16.00
Bicarbonate (mg/L as $CaCO_3$)	54	158.93	45.10	67.00	270.00
Sulfate, dissolved (mg/L as SO_4)	53	74.53	38.94	14.00	220.00
Fluoride, dissolved (mg/L as F)	54	.18	.10	.10	.80
Silica, dissolved (mg/L as SiO_2)	53	11.45	2.38	2.60	15.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 09250000 (SITE 13--REGION 1)					
Specific conductance (µS/cm)	34	761.35	315.49	160.00	1,188.00
Calcium, dissolved (mg/L as Ca)	5	93.00	41.51	49.00	140.00
Magnesium, dissolved (mg/L as Mg)	5	35.80	19.64	12.00	53.00
Potassium, dissolved (mg/L as K)	5	3.04	.84	1.60	3.80
Sodium, dissolved (mg/L as Na)	5	26.76	13.91	9.80	42.00
Chloride, dissolved (mg/L as Cl)	5	7.02	2.80	3.30	10.00
Bicarbonate (mg/L as $CaCO_3$)	5	200.00	65.57	110.00	250.00
Sulfate, dissolved (mg/L as SO_4)	5	225.60	133.49	73.00	360.00
Fluoride, dissolved (mg/L as F)	5	.18	.08	.10	.30
Silica, dissolved (mg/L as SiO_2)	5	10.80	2.53	8.40	14.00
STATION NUMBER 09250400 (SITE 14--REGION 3)					
Specific conductance (µS/cm)	51	1,638.82	239.35	1,100.00	2,320.00
Calcium, dissolved (mg/L as Ca)	27	114.04	15.83	84.00	160.00
Magnesium, dissolved (mg/L as Mg)	27	138.52	20.51	110.00	190.00
Potassium, dissolved (mg/L as K)	27	11.54	1.45	6.90	14.00
Sodium, dissolved (mg/L as Na)	27	71.59	17.33	43.00	110.00
Chloride, dissolved (mg/L as Cl)	27	18.44	5.06	12.00	34.00
Bicarbonate (mg/L as $CaCO_3$)	27	427.04	42.92	343.00	515.00
Sulfate, dissolved (mg/L as SO_4)	27	527.04	92.44	410.00	830.00
Fluoride, dissolved (mg/L as F)	27	.54	.09	.30	.70
Silica, dissolved (mg/L as SiO_2)	26	12.45	1.77	9.70	15.00
STATION NUMBER 09250507 (SITE 15--REGION 3)					
Specific conductance (µS/cm)	16	1,557.50	232.48	1,100.00	1,820.00
Calcium, dissolved (mg/L as Ca)	8	99.25	12.50	85.00	120.00
Magnesium, dissolved (mg/L as Mg)	8	100.00	11.12	83.00	120.00
Potassium, dissolved (mg/L as K)	8	8.85	.72	7.90	10.00
Sodium, dissolved (mg/L as Na)	8	147.87	17.37	120.00	180.00
Chloride, dissolved (mg/L as Cl)	8	117.50	12.82	100.00	130.00
Bicarbonate (mg/L as $CaCO_3$)	8	351.25	25.88	290.00	370.00
Sulfate, dissolved (mg/L as SO_4)	8	447.50	50.07	350.00	520.00
Fluoride, dissolved (mg/L as F)	8	.48	.05	.40	.50
Silica, dissolved (mg/L as SiO_2)	8	13.38	1.60	11.00	16.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 09250510 (SITE 16--REGION 3)					
Specific conductance (µS/cm)	39	1,169.49	362.56	255.00	1,950.00
Calcium, dissolved (mg/L as Ca)	31	77.81	25.49	25.00	140.00
Magnesium, dissolved (mg/L as Mg)	31	84.32	28.70	11.00	140.00
Potassium, dissolved (mg/L as K)	31	8.95	4.26	4.40	29.00
Sodium, dissolved (mg/L as Na)	31	60.18	23.66	8.50	110.00
Chloride, dissolved (mg/L as Cl)	31	28.35	11.31	7.60	58.00
Bicarbonate (mg/L as $CaCO_3$)	31	304.39	76.95	84.00	410.00
Sulfate, dissolved (mg/L as SO_4)	31	322.48	139.74	45.00	660.00
Fluoride, dissolved (mg/L as F)	31	.46	.17	.20	1.00
Silica, dissolved (mg/L as SiO_2)	31	9.65	3.06	.60	15.00
STATION NUMBER 09250600 (SITE 17--REGION 3)					
Specific conductance (µS/cm)	64	1,706.86	400.07	309.00	2,600.00
Calcium, dissolved (mg/L as Ca)	60	101.28	16.86	29.00	120.00
Magnesium, dissolved (mg/L as Mg)	60	102.23	26.88	14.00	140.00
Potassium, dissolved (mg/L as K)	60	9.63	2.86	6.60	29.00
Sodium, dissolved (mg/L as Na)	60	149.57	38.25	14.00	190.00
Chloride, dissolved (mg/L as Cl)	60	134.53	36.56	16.00	180.00
Bicarbonate (mg/L as $CaCO_3$)	58	361.47	72.72	70.00	440.00
Sulfate, dissolved (mg/L as SO_4)	60	428.47	113.02	58.00	600.00
Fluoride, dissolved (mg/L as F)	60	.52	.10	.20	.70
Silica, dissolved (mg/L as SiO_2)	60	14.25	4.50	9.50	45.00
STATION NUMBER 09250610 (SITE 18--REGION 3)					
Specific conductance (µS/cm)	42	1,558.09	335.13	420.00	2,200.00
Calcium, dissolved (mg/L as Ca)	40	90.00	22.77	26.00	150.00
Magnesium, dissolved (mg/L as Mg)	39	131.64	35.77	25.00	190.00
Potassium, dissolved (mg/L as K)	40	7.19	2.21	4.60	15.00
Sodium, dissolved (mg/L as Na)	40	83.00	26.37	18.00	120.00
Chloride, dissolved (mg/L as Cl)	38	35.09	15.00	7.40	110.00
Bicarbonate (mg/L as $CaCO_3$)	40	412.55	91.37	116.00	640.00
Sulfate, dissolved (mg/L as SO_4)	39	469.08	137.38	94.00	830.00
Fluoride, dissolved (mg/L as F)	40	.34	.08	.20	.60
Silica, dissolved (mg/L as SiO_2)	40	11.86	3.76	1.70	18.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 09250700 (SITE 19--REGION 3)					
Specific conductance (µS/cm)	11	1,527.27	80.01	1,430.00	1,690.00
Calcium, dissolved (mg/L as Ca)	10	92.70	14.99	75.00	120.00
Magnesium, dissolved (mg/L as Mg)	10	137.00	8.23	130.00	150.00
Potassium, dissolved (mg/L as K)	10	9.29	.56	8.50	10.00
Sodium, dissolved (mg/L as Na)	10	63.70	9.65	53.00	85.00
Chloride, dissolved (mg/L as Cl)	10	16.70	2.11	13.00	20.00
Bicarbonate (mg/L as $CaCO_3$)	10	437.00	33.68	400.00	510.00
Sulfate, dissolved (mg/L as SO_4)	10	470.00	42.69	430.00	570.00
Fluoride, dissolved (mg/L as F)	10	.49	.10	.40	.70
Silica, dissolved (mg/L as SiO_2)	10	12.59	1.52	9.90	15.00
STATION NUMBER 401601107375400 (SITE 20--REGION 1)					
Specific conductance (µS/cm)	12	518.83	204.09	232.00	859.00
Calcium, dissolved (mg/L as Ca)	8	56.25	18.22	26.00	74.00
Magnesium, dissolved (mg/L as Mg)	8	34.88	15.62	11.00	57.00
Potassium, dissolved (mg/L as K)	8	2.74	.79	1.70	4.30
Sodium, dissolved (mg/L as Na)	8	20.39	10.35	4.60	36.00
Chloride, dissolved (mg/L as Cl)	8	3.86	3.82	1.00	13.00
Bicarbonate (mg/L as $CaCO_3$)	8	193.13	64.31	95.00	270.00
Sulfate, dissolved (mg/L as SO_4)	8	126.63	62.31	22.00	200.00
Fluoride, dissolved (mg/L as F)	8	.18	.07	.10	.30
Silica, dissolved (mg/L as SiO_2)	8	7.84	.58	7.00	8.70
STATION NUMBER 401601107395300 (SITE 21--REGION 1)					
Specific conductance (µS/cm)	15	1,118.27	918.22	465.00	3,900.00
Calcium, dissolved (mg/L as Ca)	7	66.00	18.78	40.00	100.00
Magnesium, dissolved (mg/L as Mg)	7	55.43	34.88	28.00	130.00
Potassium, dissolved (mg/L as K)	7	3.09	1.04	2.10	5.20
Sodium, dissolved (mg/L as Na)	7	52.29	40.18	26.00	140.00
Chloride, dissolved (mg/L as Cl)	7	7.51	6.56	3.40	22.00
Bicarbonate (mg/L as $CaCO_3$)	7	187.14	47.86	110.00	250.00
Sulfate, dissolved (mg/L as SO_4)	7	304.29	221.50	160.00	790.00
Fluoride, dissolved (mg/L as F)	7	.13	.05	.10	.20
Silica, dissolved (mg/L as SiO_2)	7	7.51	1.33	5.50	9.90

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 401747107161600 (SITE 22--REGION 1)					
Specific conductance (µS/cm)	9	461.56	77.02	335.00	547.00
Calcium, dissolved (mg/L as Ca)	8	58.00	5.90	46.00	64.00
Magnesium, dissolved (mg/L as Mg)	8	22.50	5.76	13.00	28.00
Potassium, dissolved (mg/L as K)	8	2.28	.35	1.80	2.70
Sodium, dissolved (mg/L as Na)	8	15.29	3.53	8.30	20.00
Chloride, dissolved (mg/L as Cl)	8	3.59	1.13	2.00	5.10
Bicarbonate (mg/L as $CaCO_3$)	8	214.50	46.50	146.00	280.00
Sulfate, dissolved (mg/L as SO_4)	8	51.00	22.61	5.00	75.00
Fluoride, dissolved (mg/L as F)	8	.21	.12	.10	.50
Silica, dissolved (mg/L as SiO_2)	8	14.38	1.51	12.00	16.00
STATION NUMBER 401816107011000 (SITE 23--REGION 1)					
Specific conductance (µS/cm)	7	184.00	61.40	91.00	297.00
Calcium, dissolved (mg/L as Ca)	7	22.57	7.81	13.00	38.00
Magnesium, dissolved (mg/L as Mg)	7	8.03	2.60	4.70	13.00
Potassium, dissolved (mg/L as K)	7	.97	.19	.60	1.20
Sodium, dissolved (mg/L as Na)	7	3.49	.60	2.50	4.40
Chloride, dissolved (mg/L as Cl)	7	.71	.46	.30	1.60
Bicarbonate (mg/L as $CaCO_3$)	7	86.86	31.45	50.00	150.00
Sulfate, dissolved (mg/L as SO_4)	7	6.14	3.02	5.00	13.00
Fluoride, dissolved (mg/L as F)	7	.13	.13	.00	.40
Silica, dissolved (mg/L as SiO_2)	7	14.71	1.38	12.00	16.00
STATION NUMBER 401829107375600 (SITE 24--REGION 1)					
Specific conductance (µS/cm)	11	776.45	340.26	331.00	1,300.00
Calcium, dissolved (mg/L as Ca)	8	70.25	20.20	34.00	90.00
Magnesium, dissolved (mg/L as Mg)	8	66.63	35.54	17.00	110.00
Potassium, dissolved (mg/L as K)	8	3.51	1.00	2.20	5.20
Sodium, dissolved (mg/L as Na)	8	30.64	14.79	7.10	48.00
Chloride, dissolved (mg/L as Cl)	8	4.56	1.76	1.90	6.70
Bicarbonate (mg/L as $CaCO_3$)	8	254.00	78.43	122.00	330.00
Sulfate, dissolved (mg/L as SO_4)	8	249.63	140.31	47.00	430.00
Fluoride, dissolved (mg/L as F)	8	.23	.05	.20	.30
Silica, dissolved (mg/L as SiO_2)	8	7.71	.95	6.30	8.60

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 401857107243500 (SITE 25--REGION 1)					
Specific conductance (µS/cm)	12	400.42	143.21	172.00	574.00
Calcium, dissolved (mg/L as Ca)	8	42.00	15.40	19.00	60.00
Magnesium, dissolved (mg/L as Mg)	8	19.46	8.81	6.70	30.00
Potassium, dissolved (mg/L as K)	8	1.83	.51	1.20	2.40
Sodium, dissolved (mg/L as Na)	8	14.00	6.38	4.60	21.00
Chloride, dissolved (mg/L as Cl)	8	2.19	.97	1.00	3.40
Bicarbonate (mg/L as $CaCO_3$)	8	155.63	63.45	66.00	230.00
Sulfate, dissolved (mg/L as SO_4)	8	53.75	28.14	14.00	87.00
Fluoride, dissolved (mg/L as F)	8	.18	.18	.10	.60
Silica, dissolved (mg/L as SiO_2)	8	10.99	1.86	9.00	15.00
STATION NUMBER 401913107204100 (SITE 26--REGION 1)					
Specific conductance (µS/cm)	8	1,385.88	162.56	987.00	1,490.00
Calcium, dissolved (mg/L as Ca)	8	126.38	13.81	101.00	140.00
Magnesium, dissolved (mg/L as Mg)	8	95.00	13.04	65.00	110.00
Potassium, dissolved (mg/L as K)	8	7.26	.51	6.40	7.90
Sodium, dissolved (mg/L as Na)	8	59.00	9.10	37.00	65.00
Chloride, dissolved (mg/L as Cl)	8	13.14	2.45	9.10	16.00
Bicarbonate (mg/L as $CaCO_3$)	8	316.63	19.19	283.00	340.00
Sulfate, dissolved (mg/L as SO_4)	8	471.25	67.07	310.00	520.00
Fluoride, dissolved (mg/L as F)	8	.24	.05	.20	.30
Silica, dissolved (mg/L as SiO_2)	8	12.14	2.00	8.10	14.00
STATION NUMBER 401925107523500 (SITE 27--REGION 3)					
Specific conductance (µS/cmM)	8	910.25	73.13	744.00	981.00
Calcium, dissolved (mg/L as Ca)	8	79.50	6.30	68.00	87.00
Magnesium, dissolved (mg/L as Mg)	8	69.00	9.84	52.00	85.00
Potassium, dissolved (mg/L as K)	8	6.20	.72	5.50	7.70
Sodium, dissolved (mg/L as Na)	8	26.13	5.96	16.00	36.00
Chloride, dissolved (mg/L as Cl)	8	14.75	3.24	11.00	20.00
Bicarbonate (mg/L as $CaCO_3$)	8	305.63	24.70	270.00	340.00
Sulfate, dissolved (mg/L as SO_4)	8	197.50	29.64	150.00	250.00
Fluoride, dissolved (mg/L as F)	8	.38	.07	.30	.50
Silica, dissolved (mg/L as SiO_2)	8	12.75	1.04	11.00	14.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 401944107322900 (SITE 28--REGION 1)					
Specific conductance (µS/cm)	10	705.90	102.13	536.00	800.00
Calcium, dissolved (mg/L as Ca)	8	68.63	11.72	54.00	85.00
Magnesium, dissolved (mg/L as Mg)	8	43.50	6.07	30.00	49.00
Potassium, dissolved (mg/L as K)	8	3.65	.48	3.10	4.50
Sodium, dissolved (mg/L as Na)	8	37.50	13.85	13.00	58.00
Chloride, dissolved (mg/L as Cl)	8	4.51	.52	3.50	5.10
Bicarbonate (mg/L as $CaCO_3$)	8	271.25	29.97	210.00	300.00
Sulfate, dissolved (mg/L as SO_4)	8	142.25	25.53	88.00	170.00
Fluoride, dissolved (mg/L as F)	8	.28	.05	.20	.30
Silica, dissolved (mg/L as SiO_2)	8	10.96	1.27	8.70	13.00
STATION NUMBER 401948107445600 (SITE 29--REGION 1)					
Specific conductance (µS/cm)	9	935.22	504.66	402.00	1,660.00
Calcium, dissolved (mg/L as Ca)	8	90.38	36.77	47.00	130.00
Magnesium, dissolved (mg/L as Mg)	8	61.75	40.81	17.00	120.00
Potassium, dissolved (mg/L as K)	8	4.18	1.55	2.10	6.00
Sodium, dissolved (mg/L as Na)	8	56.38	40.75	13.00	120.00
Chloride, dissolved (mg/L as Cl)	8	10.01	6.23	2.70	18.00
Bicarbonate (mg/L as $CaCO_3$)	8	220.63	86.21	125.00	330.00
Sulfate, dissolved (mg/L as SO_4)	8	344.63	236.34	77.00	700.00
Fluoride, dissolved (mg/L as F)	8	.25	.12	.10	.50
Silica, dissolved (mg/L as SiO_2)	8	11.56	3.06	8.40	16.00
STATION NUMBER 402038107585100 (SITE 30--REGION 3)					
Specific conductance (µS/cm)	8	3,778.75	130.87	3,550.00	4,010.00
Calcium, dissolved (mg/L as Ca)	8	157.50	8.86	140.00	170.00
Magnesium, dissolved (mg/L as Mg)	8	338.75	20.31	300.00	370.00
Potassium, dissolved (mg/L as K)	8	12.14	3.01	5.10	15.00
Sodium, dissolved (mg/L as Na)	8	280.00	10.69	270.00	300.00
Chloride, dissolved (mg/L as Cl)	8	480.00	35.86	440.00	560.00
Bicarbonate (mg/L as $CaCO_3$)	8	488.75	92.50	300.00	550.00
Sulfate, dissolved (mg/L as SO_4)	8	1,187.50	64.09	1,100.00	1,300.00
Fluoride, dissolved (mg/L as F)	8	.40	.05	.30	.50
Silica, dissolved (mg/L as SiO_2)	8	12.25	1.39	10.00	14.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 402145108001000 (SITE 31--REGION 3)					
Specific conductance (µS/cm)	7	1,717.14	122.03	1,480.00	1,820.00
Calcium, dissolved (mg/L as Ca)	7	117.14	11.13	100.00	130.00
Magnesium, dissolved (mg/L as Mg)	7	151.43	10.69	130.00	160.00
Potassium, dissolved (mg/L as K)	7	12.29	.95	11.00	13.00
Sodium, dissolved (mg/L as Na)	7	91.86	5.70	84.00	97.00
Chloride, dissolved (mg/L as Cl)	7	24.29	5.53	17.00	33.00
Bicarbonate (mg/L as $CaCO_3$)	7	387.14	63.70	270.00	460.00
Sulfate, dissolved (mg/L as SO_4)	7	660.00	51.96	600.00	730.00
Fluoride, dissolved (mg/L as F)	7	.69	.09	.50	.80
Silica, dissolved (mg/L as SiO_2)	7	15.57	3.41	12.00	20.00
STATION NUMBER 402330107082000 (SITE 32--REGION 1)					
Specific conductance (µS/cm)	12	863.50	759.69	192.00	3,200.00
Calcium, dissolved (mg/L as Ca)	7	65.00	26.02	18.00	93.00
Magnesium, dissolved (mg/L as Mg)	7	34.90	14.46	8.30	46.00
Potassium, dissolved (mg/L as K)	7	4.14	.75	2.80	5.30
Sodium, dissolved (mg/L as Na)	7	27.00	9.42	12.00	38.00
Chloride, dissolved (mg/L as Cl)	7	5.70	1.81	2.70	7.20
Bicarbonate (mg/L as $CaCO_3$)	7	204.14	85.32	57.00	280.00
Sulfate, dissolved (mg/L as SO_4)	7	153.71	58.62	46.00	210.00
Fluoride, dissolved (mg/L as F)	7	.21	.04	.20	.30
Silica, dissolved (mg/L as SiO_2)	7	10.93	1.36	9.60	13.00
STATION NUMBER 402409107503600 (SITE 33--REGION 3)					
Specific conductance (µS/cm)	3	5,726.67	1,690.13	3,780.00	6,820.00
Calcium, dissolved (mg/L as Ca)	3	120.33	25.89	91.00	140.00
Magnesium, dissolved (mg/L as Mg)	3	676.67	190.88	460.00	820.00
Potassium, dissolved (mg/L as K)	3	28.00	4.58	23.00	32.00
Sodium, dissolved (mg/L as Na)	3	480.00	173.49	280.00	590.00
Chloride, dissolved (mg/L as Cl)	3	105.67	43.32	57.00	140.00
Bicarbonate (mg/L as $CaCO_3$)	3	696.67	75.72	610.00	750.00
Sulfate, dissolved (mg/L as SO_4)	3	3,200.00	1,153.26	1,900.00	4,100.00
Fluoride, dissolved (mg/L as F)	3	.50	.10	.40	.60
Silica, dissolved (mg/L as SiO_2)	3	.47	.25	.20	.70

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 402530106585700 (SITE 34--REGION 1)					
Specific conductance (µS/cm)	14	670.57	170.86	429.00	1,060.00
Calcium, dissolved (mg/L as Ca)	7	61.29	10.55	45.00	76.00
Magnesium, dissolved (mg/L as Mg)	7	37.00	10.36	21.00	52.00
Potassium, dissolved (mg/L as K)	7	2.56	.51	1.80	3.50
Sodium, dissolved (mg/L as Na)	7	40.57	20.99	17.00	73.00
Chloride, dissolved (mg/L as Cl)	7	4.91	2.32	2.70	8.90
Bicarbonate (mg/L as $CaCO_3$)	7	192.71	47.96	140.00	250.00
Sulfate, dissolved (mg/L as SO_4)	7	190.00	89.44	80.00	330.00
Fluoride, dissolved (mg/L as F)	7	.19	.04	.10	.20
Silica, dissolved (mg/L as SiO_2)	7	11.21	1.84	8.30	13.00
STATION NUMBER 402605107181500 (SITE 35--REGION 2)					
Specific conductance (µS/cm)	4	5,540.00	1,826.34	3,480.00	7,890.00
Calcium, dissolved (mg/L as Ca)	3	203.33	15.28	190.00	220.00
Magnesium, dissolved (mg/L as Mg)	3	513.33	123.42	410.00	650.00
Potassium, dissolved (mg/L as K)	3	6.37	.93	5.30	7.00
Sodium, dissolved (mg/L as Na)	3	776.67	280.42	600.00	1,100.00
Chloride, dissolved (mg/L as Cl)	3	140.00	30.00	110.00	170.00
Bicarbonate (mg/L as $CaCO_3$)	3	496.67	68.07	420.00	550.00
Sulfate, dissolved (mg/L as SO_4)	3	3,333.33	1,040.83	2,500.00	4,500.00
Fluoride, dissolved (mg/L as F)	3	.33	.15	.20	.50
Silica, dissolved (mg/L as SiO_2)	3	1.67	1.15	.50	2.80
STATION NUMBER 402720106591200 (SITE 36--REGION 1)					
Specific conductance (µS/cm)	11	520.55	209.56	183.00	793.00
Calcium, dissolved (mg/L as Ca)	9	50.78	20.07	20.00	76.00
Magnesium, dissolved (mg/L as Mg)	9	24.78	11.78	8.00	39.00
Potassium, dissolved (mg/L as K)	9	2.02	.75	1.10	3.50
Sodium, dissolved (mg/L as Na)	9	18.88	13.38	4.00	40.00
Chloride, dissolved (mg/L as Cl)	9	2.30	1.76	.50	5.40
Bicarbonate (mg/L as $CaCO_3$)	9	131.89	39.36	68.00	180.00
Sulfate, dissolved (mg/L as SO_4)	9	133.78	82.64	26.00	250.00
Fluoride, dissolved (mg/L as F)	9	.17	.13	.10	.50
Silica, dissolved (mg/L as SiO_2)	9	10.53	1.71	7.60	12.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 402829107193700 (SITE 37--REGION 2)					
Specific conductance (µS/cm)	6	3,323.33	913.60	2,400.00	5,070.00
Calcium, dissolved (mg/L as Ca)	4	180.00	45.46	130.00	240.00
Magnesium, dissolved (mg/L as Mg)	4	257.50	85.78	180.00	380.00
Potassium, dissolved (mg/L as K)	4	6.13	1.02	5.40	7.60
Sodium, dissolved (mg/L as Na)	4	360.00	177.58	220.00	620.00
Chloride, dissolved (mg/L as Cl)	4	65.75	36.48	41.00	120.00
Bicarbonate (mg/L as $CaCO_3$)	4	365.00	31.09	320.00	390.00
Sulfate, dissolved (mg/L as SO_4)	4	1,725.00	741.06	1,100.00	2,800.00
Fluoride, dissolved (mg/L as F)	4	.25	.10	.10	.30
Silica, dissolved (mg/L as SiO_2)	4	3.20	2.17	0.90	6.00
STATION NUMBER 402836106550100 (SITE 38--REGION 1)					
Specific conductance (µS/cm)	9	440.11	201.36	164.00	749.00
Calcium, dissolved (mg/L as Ca)	6	74.33	25.09	27.00	100.00
Magnesium, dissolved (mg/L as Mg)	6	12.30	4.79	3.80	18.00
Potassium, dissolved (mg/L as K)	6	3.97	.59	3.30	4.90
Sodium, dissolved (mg/L as Na)	6	21.75	7.68	7.50	30.00
Chloride, dissolved (mg/L as Cl)	6	7.55	3.55	4.30	12.00
Bicarbonate (mg/L as $CaCO_3$)	6	191.00	59.31	76.00	240.00
Sulfate, dissolved (mg/L as SO_4)	6	77.50	49.42	7.00	160.00
Fluoride, dissolved (mg/L as F)	6	.13	.05	.10	.20
Silica, dissolved (mg/L as SiO_2)	6	14.00	2.53	12.00	18.00
STATION NUMBER 402845107185100 (SITE 39--REGION 2)					
Specific conductance (µS/cm)	6	3,975.00	1,491.73	2,640.00	6,590.00
Calcium, dissolved (mg/L as Ca)	6	166.67	19.66	140.00	200.00
Magnesium, dissolved (mg/L as Mg)	6	253.33	138.23	140.00	510.00
Potassium, dissolved (mg/L as K)	6	5.42	3.65	2.10	12.00
Sodium, dissolved (mg/L as Na)	6	533.33	267.93	270.00	1,000.00
Chloride, dissolved (mg/L as Cl)	6	120.50	52.62	82.00	210.00
Bicarbonate (mg/L as $CaCO_3$)	6	465.00	66.56	400.00	590.00
Sulfate, dissolved (mg/L as SO_4)	6	1,830.00	972.32	980.00	3,600.00
Fluoride, dissolved (mg/L as F)	6	.47	.10	.30	.60
Silica, dissolved (mg/L as SiO_2)	6	8.92	4.99	2.20	16.00

Table 2.--*Statistical summary of water-quality constituents for individual sites in the study area*--Continued

Constituent	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
STATION NUMBER 402911107323500 (SITE 40--REGION 2)					
Specific conductance (µS/cm)	7	4,411.43	487.87	3,870.00	5,200.00
Calcium, dissolved (mg/L as Ca)	7	291.43	46.34	240.00	350.00
Magnesium, dissolved (mg/L as Mg)	7	341.43	35.79	310.00	410.00
Potassium, dissolved (mg/L as K)	7	4.29	1.09	3.20	6.00
Sodium, dissolved (mg/L as Na)	7	425.71	71.61	340.00	520.00
Chloride, dissolved (mg/L as Cl)	7	85.86	42.29	25.00	150.00
Bicarbonate (mg/L as $CaCO_3$)	7	372.86	113.24	160.00	450.00
Sulfate, dissolved (mg/L as SO_4)	7	2,385.71	353.22	2,000.00	2,900.00
Fluoride, dissolved (mg/L as F)	7	.50	.06	.40	.60
Silica, dissolved (mg/L as SiO_2)	7	9.09	2.71	4.30	12.00

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*

[mg/L, milligrams per liter; r^2, coefficient of determination; site numbers and descriptions are listed in table 1; locations are shown in figure 1]

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 09238000 (SITE 1--REGION 1)					
Calcium, dissolved (mg/L as Ca)	7	-9.33	0.165	2.16	0.93
Magnesium, dissolved (mg/L as Mg)	7	-2.74	.055	.89	.90
Potassium, dissolved (mg/L as K)	7	.91	.001	.27	.04
Sodium, dissolved (mg/L as Na)	7	2.38	[1].008	.80	.18
Chloride, dissolved (mg/L as Cl)	7	-1.03	[1].010	2.00	.05
Bicarbonate (mg/L as $CaCO_3$)	7	-77.22	.904	10.19	.95
Sulfate, dissolved (mg/L as SO_4)	7	5.70	[1]-.002	.26	.17
STATION NUMBER 09243700 (SITE 2--REGION 1)					
Calcium, dissolved (mg/L as Ca)	52	14.29	.084	4.61	.88
Magnesium, dissolved (mg/L as Mg)	52	2.61	.04	2.36	.87
Potassium, dissolved (mg/L as K)	50	4.56	[1]-.001	2.40	.01
Sodium, dissolved (mg/L as Na)	52	-15.36	.07	4.36	.85
Chloride, dissolved (mg/L as Cl)	48	-.28	.007	.86	.60
Bicarbonate (mg/L as $CaCO_3$)	52	25.98	.40	29.67	.80
Sulfate, dissolved (mg/L as SO_4)	50	-21.70	.22	19.02	.73
STATION NUMBER 09243800 (SITE 3--REGION 1)					
Calcium, dissolved (mg/L as Ca)	38	12.70	.09	11.48	.83
Magnesium, dissolved (mg/L as Mg)	34	-2.96	.06	4.34	.94
Potassium, dissolved (mg/L as K)	33	2.02	.002	.88	.24
Sodium, dissolved (mg/L as Na)	33	-19.56	.06	9.91	.74
Chloride, dissolved (mg/L as Cl)	33	.73	.011	9.31	.10
Bicarbonate (mg/L as $CaCO_3$)	32	59.79	.278	66.72	.52
Sulfate, dissolved (mg/L as SO_4)	33	-72.22	.334	55.30	.74
STATION NUMBER 09243900 (SITE 4--REGION 1)					
Calcium, dissolved (mg/L as Ca)	36	-19.47	.12	15.65	.96
Magnesium, dissolved (mg/L as Mg)	37	-15.56	.06	5.25	.98
Potassium, dissolved (mg/L as K)	35	3.87	[1].0003	1.63	.01
Sodium, dissolved (mg/L as Na)	36	-3.70	.05	11.36	.89
Chloride, dissolved (mg/L as Cl)	36	9.83	[1].001	4.53	.02
Bicarbonate (mg/L as $CaCO_3$)	36	259.30	[1].03	82.74	.05
Sulfate, dissolved (mg/L as SO_4)	36	-330.05	.64	76.81	.96

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 09244100 (SITE 5--REGION 1)					
Calcium, dissolved (mg/L as Ca)	8	8.36	0.09	7.77	0.78
Magnesium, dissolved (mg/L as Mg)	8	-19.54	.10	2.63	.97
Potassium, dissolved (mg/L as K)	8	.12	.004	.63	.57
Sodium, dissolved (mg/L as Na)	8	-5.48	.04	1.05	.98
Chloride, dissolved (mg/L as Cl)	8	-1.35	[1].008	2.16	.28
Bicarbonate (mg/L as $CaCO_3$)	8	-18.60	.51	23.29	.93
Sulfate, dissolved (mg/L as SO_4)	8	-40.28	.23	6.36	.97
STATION NUMBER 09244300 (SITE 6--REGION 1)					
Calcium, dissolved (mg/L as Ca)	9	54.96	[1].06	45.64	.35
Magnesium, dissolved (mg/L as Mg)	9	-36.71	.08	7.50	.97
Potassium, dissolved (mg/L as K)	9	2.76	.002	.70	.64
Sodium, dissolved (mg/L as Na)	9	-58.93	.40	33.21	.72
Chloride, dissolved (mg/L as Cl)	9	8.82	[1].01	12.46	.18
Bicarbonate (mg/L as $CaCO_3$)	9	-58.06	.21	92.77	.61
Sulfate, dissolved (mg/L as SO_4)	9	-143.69	.51	80.14	.92
STATION NUMBER 09244415 (SITE 7--REGION 1)					
Calcium, dissolved (mg/L as Ca)	13	1.36	.11	4.65	.96
Magnesium, dissolved (mg/L as Mg)	13	-7.75	.07	3.53	.94
Potassium, dissolved (mg/L as K)	13	.01	.01	1.63	.40
Sodium, dissolved (mg/L as Na)	13	-3.29	.03	2.20	.88
Chloride, dissolved (mg/L as Cl)	13	-1.40	.01	.97	.83
Bicarbonate (mg/L as $CaCO_3$)	13	63.19	.30	34.38	.77
Sulfate, dissolved (mg/L as SO_4)	13	-87.18	.35	28.38	.87
STATION NUMBER 09244460 (SITE 8--REGION 1)					
Calcium, dissolved (mg/L as Ca)	26	12.06	.09	6.38	.70
Magnesium, dissolved (mg/L as Mg)	26	5.34	.05	4.28	.62
Potassium, dissolved (mg/L as K)	26	6.18	[1].001	.86	.01
Sodium, dissolved (mg/L as Na)	26	-14.86	.05	4.71	.60
Chloride, dissolved (mg/L as Cl)	26	3.20	[1].007	2.30	.10
Bicarbonate (mg/L as $CaCO_3$)	26	-92.92	.50	29.30	.77
Sulfate, dissolved (mg/L as SO_4)	26	58.02	.16	29.44	.27

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 09244464 (SITE 9--REGION 1)					
Calcium, dissolved (mg/L as Ca)	28	10.20	0.09	18.10	0.73
Magnesium, dissolved (mg/L as Mg)	28	1.46	.06	8.32	.86
Potassium, dissolved (mg/L as K)	29	3.64	[1].001	.76	.06
Sodium, dissolved (mg/L as Na)	28	-20.33	.06	8.09	.88
Chloride, dissolved (mg/L as Cl)	29	-6.13	.02	7.39	.37
Bicarbonate (mg/L as $CaCO_3$)	28	69.24	.25	59.98	.69
Sulfate, dissolved (mg/L as SO_4)	29	-97.55	.40	46.75	.90
STATION NUMBER 09244470 (SITE 10--REGION 2)					
Calcium, dissolved (mg/L as Ca)	9	27.71	.02	45.36	.77
Magnesium, dissolved (mg/L as Mg)	9	-71.56	.09	23.09	.99
Potassium, dissolved (mg/L as K)	9	5.01	.0003	1.05	.56
Sodium, dissolved (mg/L as Na)	9	-45.78	.14	44.88	.99
Chloride, dissolved (mg/L as Cl)	10	9.93	.02	59.64	.40
Bicarbonate (mg/L as $CaCO_3$)	10	95.33	.04	70.94	.77
Sulfate, dissolved (mg/L as SO_4)	10	-517.13	.65	250.44	.98
STATION NUMBER 09248600 (SITE 11--REGION 1)					
Calcium, dissolved (mg/L as Ca)	7	9.44	.09	1.24	.88
Magnesium, dissolved (mg/L as Mg)	7	2.26	.02	.89	.50
Potassium, dissolved (mg/L as K)	7	.88	[1].001	.16	.02
Sodium, dissolved (mg/L as Na)	7	.67	.02	.25	.86
Chloride, dissolved (mg/L as Cl)	7	.09	[1].003	.34	.11
Bicarbonate (mg/L as $CaCO_3$)	7	65.99	[1].26	15.31	.27
Sulfate, dissolved (mg/L as SO_4)	7	-30.27	.19	5.42	.61
STATION NUMBER 09249750 (SITE 12--REGION 1)					
Calcium, dissolved (mg/L as Ca)	53	14.14	.07	5.96	.73
Magnesium, dissolved (mg/L as Mg)	53	-4.83	.06	2.35	.94
Potassium, dissolved (mg/L as K)	53	.20	.004	.53	.51
Sodium, dissolved (mg/L as Na)	53	-11.98	.07	5.08	.80
Chloride, dissolved (mg/L as Cl)	53	-1.61	.01	2.08	.45
Bicarbonate (mg/L as $CaCO_3$)	53	37.33	.36	20.31	.86
Sulfate, dissolved (mg/L as SO_4)	53	-31.96	.25	17.63	.80

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 09250000 (SITE 13--REGION 1)					
Calcium, dissolved (mg/L as Ca)	5	-1.03	0.12	14.55	0.91
Magnesium, dissolved (mg/L as Mg)	5	-8.77	.06	6.76	.91
Potassium, dissolved (mg/L as K)	5	1.48	.002	.60	.61
Sodium, dissolved (mg/L as Na)	5	-4.48	.04	5.26	.89
Chloride, dissolved (mg/L as Cl)	5	1.07	.008	1.45	.80
Bicarbonate (mg/L as $CaCO_3$)	5	58.85	.24	21.16	.95
Sulfate, dissolved (mg/L as SO_4)	5	-88.41	.41	22.42	.98
STATION NUMBER 09250400 (SITE 14--REGION 3)					
Calcium, dissolved (mg/L as Ca)	27	77.37	.02	14.98	.14
Magnesium, dissolved (mg/L as Mg)	27	29.90	.07	10.93	.73
Potassium, dissolved (mg/L as K)	27	9.05	[1].002	1.42	.08
Sodium, dissolved (mg/L as Na)	27	-12.26	.05	11.07	.61
Chloride, dissolved (mg/L as Cl)	27	4.24	.01	4.60	.20
Bicarbonate (mg/L as $CaCO_3$)	27	369.10	.10	47.21	.22
Sulfate, dissolved (mg/L as SO_4)	27	42.84	.31	50.62	.71
STATION NUMBER 09250507 (SITE 15--REGION 3)					
Calcium, dissolved (mg/L as Ca)	8	144.15	[1]-.03	13.20	.04
Magnesium, dissolved (mg/L as Mg)	8	-39.69	.08	8.10	.54
Potassium, dissolved (mg/L as K)	8	3.21	.003	.69	.21
Sodium, dissolved (mg/L as Na)	8	-85.79	.14	11.49	.63
Chloride, dissolved (mg/L as Cl)	8	-62.22	.10	7.84	.68
Bicarbonate (mg/L as $CaCO_3$)	8	618.82	[1]-.11	31.89	.12
Sulfate, dissolved (mg/L as SO_4)	8	-290.01	.43	27.04	.75
STATION NUMBER 09250510 (SITE 16--REGION 3)					
Calcium, dissolved (mg/L as Ca)	31	9.59	.06	14.93	.67
Magnesium, dissolved (mg/L as Mg)	31	-5.24	.08	8.83	.91
Potassium, dissolved (mg/L as K)	31	2.04	.006	3.76	.24
Sodium, dissolved (mg/L as Na)	31	-11.90	.06	8.80	.87
Chloride, dissolved (mg/L as Cl)	31	-3.55	.03	5.84	.74
Bicarbonate (mg/L as $CaCO_3$)	31	123.48	.21	56.44	.65
Sulfate, dissolved (mg/L as SO_4)	31	-107.44	.37	48.52	.88

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 09250600 (SITE 17--REGION 3)					
Calcium, dissolved (mg/L as Ca)	60	34.94	0.04	9.43	0.69
Magnesium, dissolved (mg/L as Mg)	60	-10.22	.06	12.66	.78
Potassium, dissolved (mg/L as K)	60	9.92	[1]-.0002	2.89	.00
Sodium, dissolved (mg/L as Na)	60	-16.80	.10	15.17	.84
Chloride, dissolved (mg/L as Cl)	60	12.05	.07	26.03	.50
Bicarbonate (mg/L as $CaCO_3$)	58	81.80	.20	44.07	.76
Sulfate, dissolved (mg/L as SO_4)	60	-58.64	.28	46.99	.83
STATION NUMBER 09250610 (SITE 18--REGION 3)					
Calcium, dissolved (mg/L as Ca)	40	13.58	.05	15.71	.54
Magnesium, dissolved (mg/L as Mg)	39	-17.89	.10	14.57	.84
Potassium, dissolved (mg/L as K)	40	4.51	[1].002	2.16	.07
Sodium, dissolved (mg/L as Na)	40	-16.90	.06	15.05	.68
Chloride, dissolved (mg/L as Cl)	39	1.34	.02	13.37	.23
Bicarbonate (mg/L as $CaCO_3$)	40	42.47	.29	48.78	.81
Sulfate, dissolved (mg/L as SO_4)	39	-93.88	.36	59.53	.82
STATION NUMBER 09250700 (SITE 19--REGION 3)					
Calcium, dissolved (mg/L as Ca)	10	-170.55	.17	8.58	.71
Magnesium, dissolved (mg/L as Mg)	10	7.69	.08	5.75	.57
Potassium, dissolved (mg/L as K)	10	12.85	[1].002	.56	.09
Sodium, dissolved (mg/L as Na)	10	34.17	[1].02	10.12	.02
Chloride, dissolved (mg/L as Cl)	10	3.13	[1].01	2.13	.09
Bicarbonate (mg/L as $CaCO_3$)	10	-146.58	.45	26.56	.63
Sulfate, dissolved (mg/L as SO_4)	10	-63.20	.35	36.27	.35
STATION NUMBER 401601107375400 (SITE 20--REGION 1)					
Calcium, dissolved (mg/L as Ca)	8	7.31	.08	4.23	.95
Magnesium, dissolved (mg/L as Mg)	8	-7.91	.07	1.60	.99
Potassium, dissolved (mg/L as K)	8	.78	.003	.38	.80
Sodium, dissolved (mg/L as Na)	8	-7.60	.05	2.06	.97
Chloride, dissolved (mg/L as Cl)	8	-3.70	.01	2.86	.52
Bicarbonate (mg/L as $CaCO_3$)	8	23.58	.36	15.76	.96
Sulfate, dissolved (mg/L as SO_4)	8	-42.79	.29	10.18	.98

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 401601107395300 (SITE 21--REGION 1)					
Calcium, dissolved (mg/L as Ca)	7	30.72	0.04	6.23	0.91
Magnesium, dissolved (mg/L as Mg)	7	-13.12	.08	2.98	.99
Potassium, dissolved (mg/L as K)	7	1.32	.002	.57	.75
Sodium, dissolved (mg/L as Na)	7	-25.86	.09	7.11	.97
Chloride, dissolved (mg/L as Cl)	7	-5.15	.01	1.43	.96
Bicarbonate (mg/L as $CaCO_3$)	7	135.16	.11	37.56	.66
Sulfate, dissolved (mg/L as SO_4)	7	-127.21	.50	36.92	.98
STATION NUMBER 401747107161600 (SITE 22--REGION 1)					
Calcium, dissolved (mg/L as Ca)	8	22.30	.08	3.04	.77
Magnesium, dissolved (mg/L as Mg)	8	-14.39	.08	2.26	.87
Potassium, dissolved (mg/L as K)	8	2.28	[1]-.00001	.38	.00
Sodium, dissolved (mg/L as Na)	8	-3.97	.04	2.32	.63
Chloride, dissolved (mg/L as Cl)	8	-.14	.01	1.06	.23
Bicarbonate (mg/L as $CaCO_3$)	8	-78.16	.71	30.09	.76
Sulfate, dissolved (mg/L as SO_4)	8	36.72	[1].03	24.32	.01
STATION NUMBER 401816107011000 (SITE 23--REGION 1)					
Calcium, dissolved (mg/L as Ca)	7	.02	.12	2.28	.93
Magnesium, dissolved (mg/L as Mg)	7	.63	.04	.89	.90
Potassium, dissolved (mg/L as K)	7	.60	[1].002	.15	.44
Sodium, dissolved (mg/L as Na)	7	1.78	.01	.21	.90
Chloride, dissolved (mg/L as Cl)	7	.52	[1].001	.49	.02
Bicarbonate (mg/L as $CaCO_3$)	7	-.22	.58	16.12	.85
Sulfate, dissolved (mg/L as SO_4)	7	6.60	[1]-.002	3.31	.00
STATION NUMBER 401829107375600 (SITE 24--REGION 1)					
Calcium, dissolved (mg/L as Ca)	8	24.27	.05	6.77	.90
Magnesium, dissolved (mg/L as Mg)	8	-18.13	.10	3.43	.99
Potassium, dissolved (mg/L as K)	8	1.53	.002	.61	.68
Sodium, dissolved (mg/L as Na)	8	-4.44	.04	2.19	.98
Chloride, dissolved (mg/L as Cl)	8	.51	.005	.52	.92
Bicarbonate (mg/L as $CaCO_3$)	8	87.02	.26	24.01	.95
Sulfate, dissolved (mg/L as SO_4)	8	-84.68	.39	15.24	.99

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 401857107243500 (SITE 25--REGION 1)					
Calcium, dissolved (mg/L as Ca)	8	0.89	0.10	3.05	0.97
Magnesium, dissolved (mg/L as Mg)	8	-4.20	.06	1.42	.98
Potassium, dissolved (mg/L as K)	8	.58	.003	.23	.82
Sodium, dissolved (mg/L as Na)	8	-2.81	.04	1.65	.94
Chloride, dissolved (mg/L as Cl)	8	-.31	.01	.34	.90
Bicarbonate (mg/L as $CaCO_3$)	8	-17.27	.52	14.23	.97
Sulfate, dissolved (mg/L as SO_4)	8	-17.00	.18	11.48	.86
STATION NUMBER 401913107204100 (SITE 26--REGION 1)					
Calcium, dissolved (mg/L as Ca)	8	44.20	.06	10.69	.49
Magnesium, dissolved (mg/L as Mg)	8	-12.29	.08	3.68	.93
Potassium, dissolved (mg/L as K)	8	5.24	[1].001	.49	.22
Sodium, dissolved (mg/L as Na)	8	-17.17	.05	1.88	.96
Chloride, dissolved (mg/L as Cl)	8	237.29	.11	16.83	.56
Bicarbonate (mg/L as $CaCO_3$)	8	-91.58	.41	12.78	.97
Sulfate, dissolved (mg/L as SO_4)	8	-1.14	.01	1.93	.47
STATION NUMBER 401925107523500 (SITE 27--REGION 3)					
Calcium, dissolved (mg/L as Ca)	8	108.07	[1]-.03	6.34	.13
Magnesium, dissolved (mg/L as Mg)	8	-35.69	.12	5.52	.73
Potassium, dissolved (mg/L as K)	8	2.28	[1].004	.70	.19
Sodium, dissolved (mg/L as Na)	8	-35.17	.07	3.63	.68
Chloride, dissolved (mg/L as Cl)	8	-12.23	.03	2.60	.45
Bicarbonate (mg/L as $CaCO_3$)	8	196.97	[1].19	28.75	.22
Sulfate, dissolved (mg/L as SO_4)	8	-103.43	.33	18.52	.66
STATION NUMBER 401944107322900 (SITE 28--REGION 1)					
Calcium, dissolved (mg/L as Ca)	8	32.02	[1].05	11.83	.12
Magnesium, dissolved (mg/L as Mg)	8	-4.13	.06	2.90	.80
Potassium, dissolved (mg/L as K)	8	1.92	[1].002	.47	.17
Sodium, dissolved (mg/L as Na)	8	-45.34	.11	10.92	.47
Chloride, dissolved (mg/L as Cl)	8	1.32	.004	.40	.49
Bicarbonate (mg/L as $CaCO_3$)	8	60.16	.37	21.05	.72
Sulfate, dissolved (mg/L as SO_4)	8	-42.31	.25	15.55	.68

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 401948107445600 (SITE 29--REGION 1)					
Calcium, dissolved (mg/L as Ca)	8	21.44	0.07	7.60	0.96
Magnesium, dissolved (mg/L as Mg)	8	-15.76	.08	4.59	.99
Potassium, dissolved (mg/L as K)	8	1.33	.003	.44	.93
Sodium, dissolved (mg/L as Na)	8	-20.41	.08	7.16	.97
Chloride, dissolved (mg/L as Cl)	8	-1.40	.01	1.90	.92
Bicarbonate (mg/L as $CaCO_3$)	8	69.57	.20	12.81	.99
Sulfate, dissolved (mg/L as SO_4)	8	-103.78	.46	29.34	.99
STATION NUMBER 402038107585100 (SITE 30--REGION 3)					
Calcium, dissolved (mg/L as Ca)	8	79.49	[1].02	9.12	.09
Magnesium, dissolved (mg/L as Mg)	8	-202.98	.14	8.40	.85
Potassium, dissolved (mg/L as K)	8	-6.82	[1].01	3.17	.05
Sodium, dissolved (mg/L as Na)	8	182.29	[1].02	10.95	.10
Chloride, dissolved (mg/L as Cl)	8	-462.42	.25	16.04	.83
Bicarbonate (mg/L as $CaCO_3$)	8	1,831.11	[1].33	112.79	.14
Sulfate, dissolved (mg/L as SO_4)	8	-384.52	.42	36.52	.72
STATION NUMBER 402145108001000 (SITE 31--REGION 3)					
Calcium, dissolved (mg/L as Ca)	7	89.41	[1].02	12.00	.03
Magnesium, dissolved (mg/L as Mg)	7	143.19	[1].005	11.69	.00
Potassium, dissolved (mg/L as K)	7	8.72	[1].002	1.00	.07
Sodium, dissolved (mg/L as Na)	7	84.80	[1].004	6.22	.01
Chloride, dissolved (mg/L as Cl)	7	12.07	[1].01	5.98	.02
Bicarbonate (mg/L as $CaCO_3$)	7	-349.37	.48	56.17	.56
Sulfate, dissolved (mg/L as SO_4)	7	813.76	-.09	55.65	.04
STATION NUMBER 402330107082000 (SITE 32--REGION 1)					
Calcium, dissolved (mg/L as Ca)	7	-5.00	.11	4.95	.97
Magnesium, dissolved (mg/L as Mg)	7	-3.85	.06	3.08	.96
Potassium, dissolved (mg/L as K)	7	2.42	.003	.43	.72
Sodium, dissolved (mg/L as Na)	7	2.35	.04	2.95	.92
Chloride, dissolved (mg/L as Cl)	7	.88	.008	.44	.95
Bicarbonate (mg/L as $CaCO_3$)	7	-31.38	.44	18.81	.97
Sulfate, dissolved (mg/L as SO_4)	7	-5.84	.25	5.49	.99

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 402409107503600 (SITE 33--REGION 3)					
Calcium, dissolved (mg/L as Ca)	3	35.68	0.01	9.60	0.93
Magnesium, dissolved (mg/L as Mg)	3	34.07	.11	30.53	.99
Potassium, dissolved (mg/L as K)	3	13.73	.002	2.55	.84
Sodium, dissolved (mg/L as Na)	3	-107.80	.10	3.28	.99
Chloride, dissolved (mg/L as Cl)	3	-39.18	.02	9.87	.97
Bicarbonate (mg/L as $CaCO_3$)	3	537.52	.05	8.02	.99
Sulfate, dissolved (mg/L as SO_4)	3	-665.18	.67	239.62	.98
STATION NUMBER 502530106585700 (SITE 34--REGION 1)					
Calcium, dissolved (mg/L as Ca)	7	28.44	.05	5.38	.78
Magnesium, dissolved (mg/L as Mg)	7	2.76	.05	3.89	.88
Potassium, dissolved (mg/L as K)	7	1.85	[1].001	.51	.16
Sodium, dissolved (mg/L as Na)	7	-27.35	.10	9.03	.84
Chloride, dissolved (mg/L as Cl)	7	-2.23	.01	1.22	.77
Bicarbonate (mg/L as $CaCO_3$)	7	159.74	[1].11	59.65	.13
Sulfate, dissolved (mg/L as SO_4)	7	-106.28	.42	33.05	.89
STATION NUMBER 402605107181500 (SITE 35--REGION 2)					
Calcium, dissolved (mg/L as Ca)	3	148.30	[1].01	11.27	.73
Magnesium, dissolved (mg/L as Mg)	3	-6.50	.08	12.60	.99
Potassium, dissolved (mg/L as K)	3	4.78	[1].0002	1.20	.16
Sodium, dissolved (mg/L as Na)	3	-392.02	.19	63.87	.97
Chloride, dissolved (mg/L as Cl)	3	46.35	[1].02	28.57	.54
Bicarbonate (mg/L as $CaCO_3$)	3	318.44	[1].05	67.25	.67
Sulfate, dissolved (mg/L as SO_4)	3	-1,060.28	.71	40.14	.99
STATION NUMBER 402720106591200 (SITE 36--REGION 1)					
Calcium, dissolved (mg/L as Ca)	9	7.36	.09	5.48	.93
Magnesium, dissolved (mg/L as Mg)	9	-1.16	.05	2.19	.97
Potassium, dissolved (mg/L as K)	9	.63	.002	.45	.69
Sodium, dissolved (mg/L as Na)	9	-9.58	.06	4.42	.90
Chloride, dissolved (mg/L as Cl)	9	-1.14	.007	.92	.76
Bicarbonate (mg/L as $CaCO_3$)	9	63.89	.20	22.04	.82
Sulfate, dissolved (mg/L as SO_4)	9	-48.57	.37	14.53	.97

Table 3.--*Simple linear-regression coefficients for water-quality constituents for individual sites in the study area*--Continued

Ion	Number of samples	Regression intercept	Slope	Standard error (mg/L)	Coefficient of determination (r^2)
STATION NUMBER 402829107193700 (SITE 37--REGION 2)					
Calcium, dissolved (mg/L as Ca)	4	45.14	0.04	10.92	0.96
Magnesium, dissolved (mg/L as Mg)	4	-1.84	.08	3.73	.99
Potassium, dissolved (mg/L as K)	4	3.20	.001	.39	.90
Sodium, dissolved (mg/L as Na)	4	-173.25	.15	26.38	.98
Chloride, dissolved (mg/L as Cl)	4	-42.62	.03	8.45	.96
Bicarbonate (mg/L as $CaCO_3$)	4	377.02	[1].02	37.34	.35
Sulfate, dissolved (mg/L as SO_4)	4	-512.27	.65	58.21	.99
STATION NUMBER 402836106550100 (SITE 38--REGION 1)					
Calcium, dissolved (mg/L as Ca)	6	7.95	.13	3.13	.99
Magnesium, dissolved (mg/L as Mg)	6	-0.40	.02	.49	.99
Potassium, dissolved (mg/L as K)	6	3.07	[1].002	.54	.33
Sodium, dissolved (mg/L as Na)	6	1.43	.04	.97	.99
Chloride, dissolved (mg/L as Cl)	6	11.43	[1]-.01	3.62	.16
Bicarbonate (mg/L as $CaCO_3$)	6	62.24	.33	37.45	.78
Sulfate, dissolved (mg/L as SO_4)	6	-44.87	.24	20.32	.86
STATION NUMBER 402845107185100 (SITE 39--REGION 2)					
Calcium, dissolved (mg/L as Ca)	6	149.27	[1].004	20.74	.11
Magnesium, dissolved (mg/L as Mg)	6	-110.71	.09	23.50	.98
Potassium, dissolved (mg/L as K)	6	-.08	[1].001	3.37	.32
Sodium, dissolved (mg/L as Na)	6	-177.65	.18	27.28	.99
Chloride, dissolved (mg/L as Cl)	6	-10.53	.03	20.94	.87
Bicarbonate (mg/L as $CaCO_3$)	6	592.86	[1]-.01	90.15	.01
Sulfate, dissolved (mg/L as SO_4)	6	-749.31	.64	102.78	.99
STATION NUMBER 402911107323500 (SITE 40--REGION 2)					
Calcium, dissolved (mg/L as Ca)	7	-113.50	.09	13.06	.93
Magnesium, dissolved (mg/L as Mg)	7	104.54	.05	26.71	.54
Potassium, dissolved (mg/L as K)	7	10.64	[1]-.001	.91	.42
Sodium, dissolved (mg/L as Na)	7	-194.70	.14	22.47	.92
Chloride, dissolved (mg/L as Cl)	7	28.02	[1].01	45.79	.02
Bicarbonate (mg/L as $CaCO_3$)	7	457.26	[1]-.001	151.34	.00
Sulfate, dissolved (mg/L as SO_4)	7	-787.18	.72	44.28	.99

[1]Coefficient is not significant at the 5-percent level; therefore, use the mean of the ion concentration from table 2.

Table 4.--*Summary statistics of the independent variable, specific conductance, by region*

Region	Specific conductance (microsiemens per centimeter at 25 degrees Celsius)				
	Number of samples	Mean	Standard deviation	Minimum value	Maximum value
1	376	797	460	91	3,900
2	29	4,830	2,160	820	10,000
3	202	1,690	782	255	6,820

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