QUALITY OF GROUND WATER IN THE PAYETTE RIVER BASIN, IDAHO

By D. J. Parliman

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 86-4013

Prepared in cooperation with the

IDAHO DEPARTMENT OF WATER RESOURCES

Boise, Idaho

1986

U.S. DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS

Multiply	By	To obtain
acre	4,047	square meter
foot (ft)	0.3048	meter
gallon (gal)	3.785	liter
inch (in.)	25.40	millimeter
micromho per centimeter at 25 °Celsius (µmho/cm)	1.000	microsiemens per centimeter at 25 °Celsius
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer

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

$$°F=(°C)(1.8)+32$$

Water temperatures are reported to the nearest 0.5 °C.

WELL-NUMBERING SYSTEM

The numbering system (fig. 1) indicates the location of wells within the official rectangular subdivision of public lands, with reference to the Boise base line and meridian. The first two segments of the number designate township (north or south) and range (east or west). The third segment gives the section number; three letters, which indicate ¼ section (160-acre tract), ¼-¼ section (40-acre tract), ¼-¼-¼ section (10-acre tract); and the serial number of the well within the tract.

The U.S. Geological Survey in Idaho indicates quarter sections by the letters A, B, C, and D in counterclockwise order from the northeast quarter of each section. Within the quarter sections, 40-acre and 10-acre tracts are lettered in the same manner. For example, well 16N-3E-29BCD1 is in the SE¼SW¼NW¼, sec. 29, T. 16 N., R. 3 E., and is the first well inventoried in that tract.

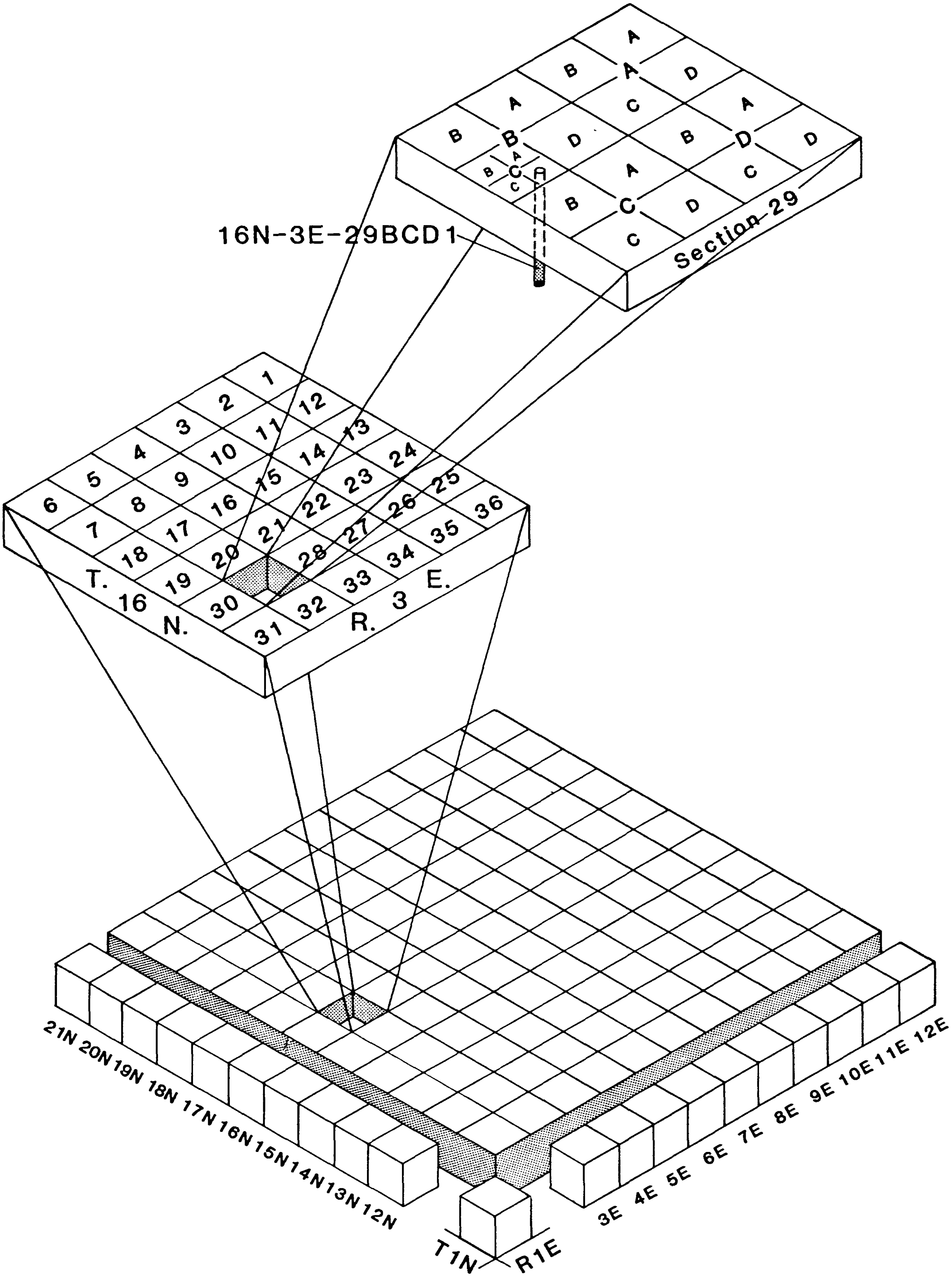

Figure 1.--Well-numbering system.

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ABSTRACT

Water-quality, geologic, and hydrologic data were collected for 74 wells in the Payette River basin, west-central Idaho, from July to October 1982. Historical (pre-1982) data from 13 wells were compiled with more recent (1982) data to define, on a reconnaissance level, water-quality conditions in major aquifers and to identify factors that may have affected ground-water quality.

Water from the major aquifers generally contains predominantly calcium, magnesium, and bicarbonate plus carbonate ions. Sodium and bicarbonate or sulfate are the predominant ions in ground water from about 25 percent of the 1982 samples. Areally, ground water from the upper Payette River basin has proportionately lower ion concentrations than water from the lower Payette River basin. Water samples from wells less than 100 feet deep generally have lower ion concentrations than samples from wells greater than 100 feet deep. Variations in ground-water quality probably are most affected by differences in aquifer composition and proximity to source(s) of recharge.

Ground water in the study area is generally suitable for most uses. In localized areas, pH and concentrations of hardness, alkalinity, dissolved solids, or dissolved nitrite plus nitrate as nitrogen, sulfate, fluoride, iron, or manganese exceed Federal drinking water limits and may restrict some uses of the water.

INTRODUCTION

This study is part of a cooperative program with the Idaho Department of Water Resources to obtain ground-water quality data in areas of Idaho where land- and water-resource development is expected to increase. Similar studies in this program were completed for southeastern Idaho (Seitz and Norvitch, 1979), north Idaho (Parliman and others, 1980), east-central Idaho valleys (Parliman, 1982b), eastern Snake River basin (Parliman, 1983b), and western Snake River basin (Parliman, 1982a, 1983a).

Purposes and Approach

The purposes of this study were to: (1) Define, on a reconnaissance level, water-quality conditions in major aquifers in the Payette River basin (fig. 2); (2) present available geologic and hydrologic data to assist in understanding the natural and man-caused factors that affect present and future water-quality conditions; (3) establish a hydrologic data base against which future data can be compared to evaluate changes; and (4) establish a radiochemical data base, particularly for the upper Payette River basin, where historical mining of radioactive placer deposits may have affected quality of ground water.

To accomplish these purposes, ground-water samples and well-inventory data for 74 wells in the study area were collected from July to October 1982. Selection of wells sampled was based on the following considerations: (1) Availability of well construction and borehole lithologic information; (2) hydrologic and geologic characteristics of the aquifers; (3) availability of historical (pre-1982) water-quality data; (4) degree of development of the aquifers; (5) depth to water and confined or unconfined characteristics of the aquifers; (6) potential use of ground water; (7) pre-1982 water-quality problems; and (8) potential vulnerability to pollution, such as septic-tank drain-field leachates. A few wells with thermal water (water temperature exceeds 20 °C) were included in this study. Thermal water in the Payette River basin was discussed by Wilson and others (1976) and Lewis and Young (1980).

Pre-1982 water-quality and well-inventory data were compiled for 13 wells. Pre-1982 data provide water-quality information in areas where more recent (1982) data are not available and may be used to assess possible temporal changes in ground-water quality.

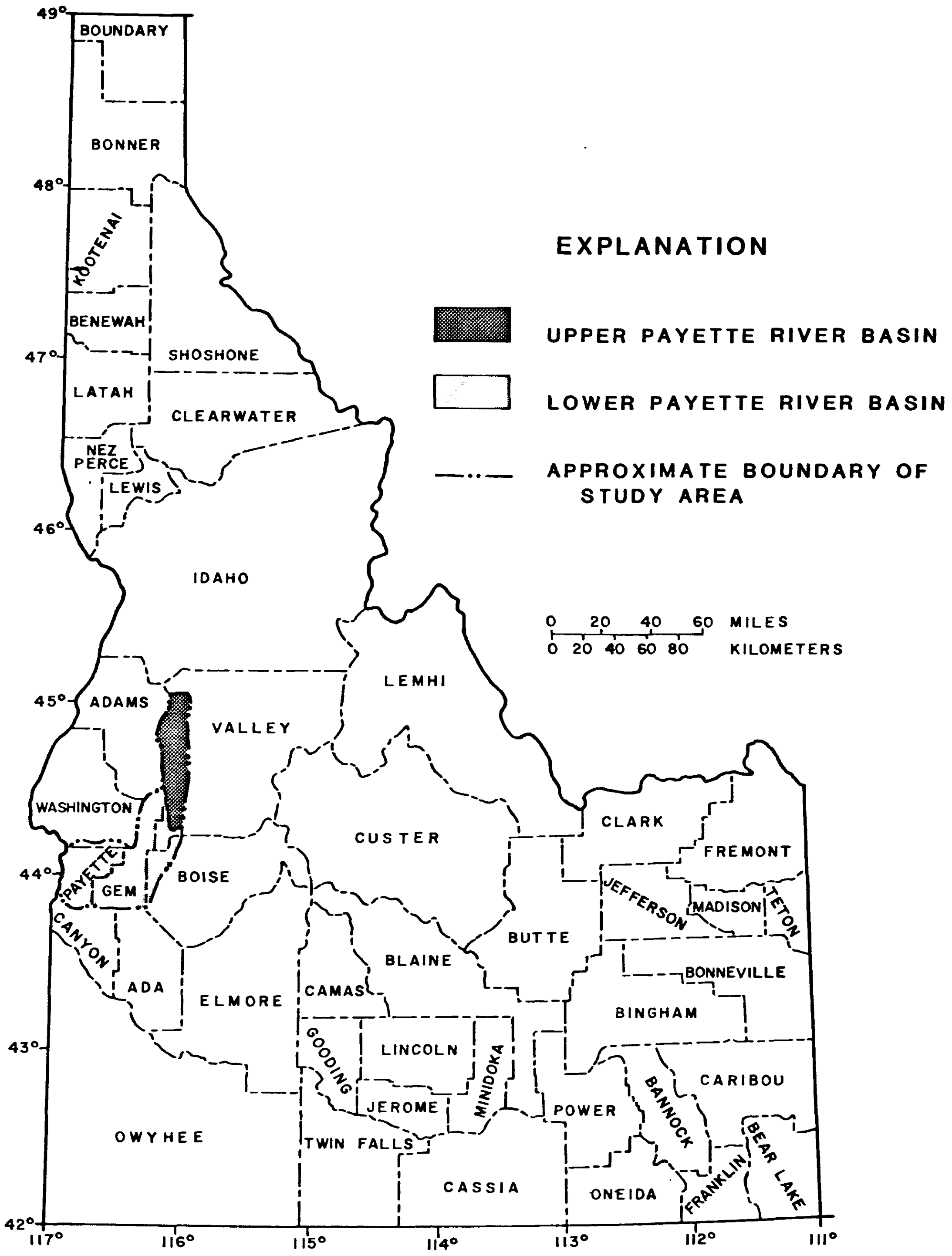


Figure 2.--Location of study area.

Well Locations, and Well-Inventory and Ground-Water Quality Data

Locations of wells used in this study are shown in figure 3. Two sites, 10N-4E-34CCA1 (well 45) and 9N-4E-15BDD1 (well 49), are adjacent to the study area and are included in tables 7 and 8 (data tables, back of report) for reference.

Well-inventory data for pre-1982 and 1982 sampling sites are presented in table 7. Water-quality data for pre-1982 and 1982 sites are presented in table 8. Water-quality sampling methodology is described in appendix A, and many terms related to hydrology and water-quality data are defined in appendix B (appendixes in back of report).

Acknowledgments

The author gratefully acknowledges the many private, public, commercial, and industrial well owners who provided access to their property and information about their wells. This study would not have been possible without their cooperation and assistance.

DESCRIPTION OF STUDY AREA

The Payette River basin, as described in this report, comprises about 2,100 mi^2 in parts of Valley, Boise, Gem, Payette, and Washington Counties in west-central Idaho and includes the upper Payette River basin (North Fork Payette River drainage) and the lower Payette River basin (main Payette River drainage). Drainage boundaries are approximated on the basis of hydrologic cataloging units of the U.S. Geological Survey (1975). Major landform features, county boundaries, land-surface altitudes, and locations of major towns are shown in figure 4.

Topography of the upper Payette River drainage (hereafter referred to as the upper area) is characterized by north- or northwest-trending mountains and deep, intermontane valleys. Predominant valleys are Long Valley (from Clear Creek to Payette Lake) and Round Valley. Land-surface altitudes range from about 4,800 ft to more than 8,000 ft above sea level. Valley lowland altitudes range from about 4,800 ft at Round Valley to about 5,000 ft at Payette Lake. Natural or manmade lakes and reservoirs are numerous on valley flats and flanks of mountains.

page 6 follows

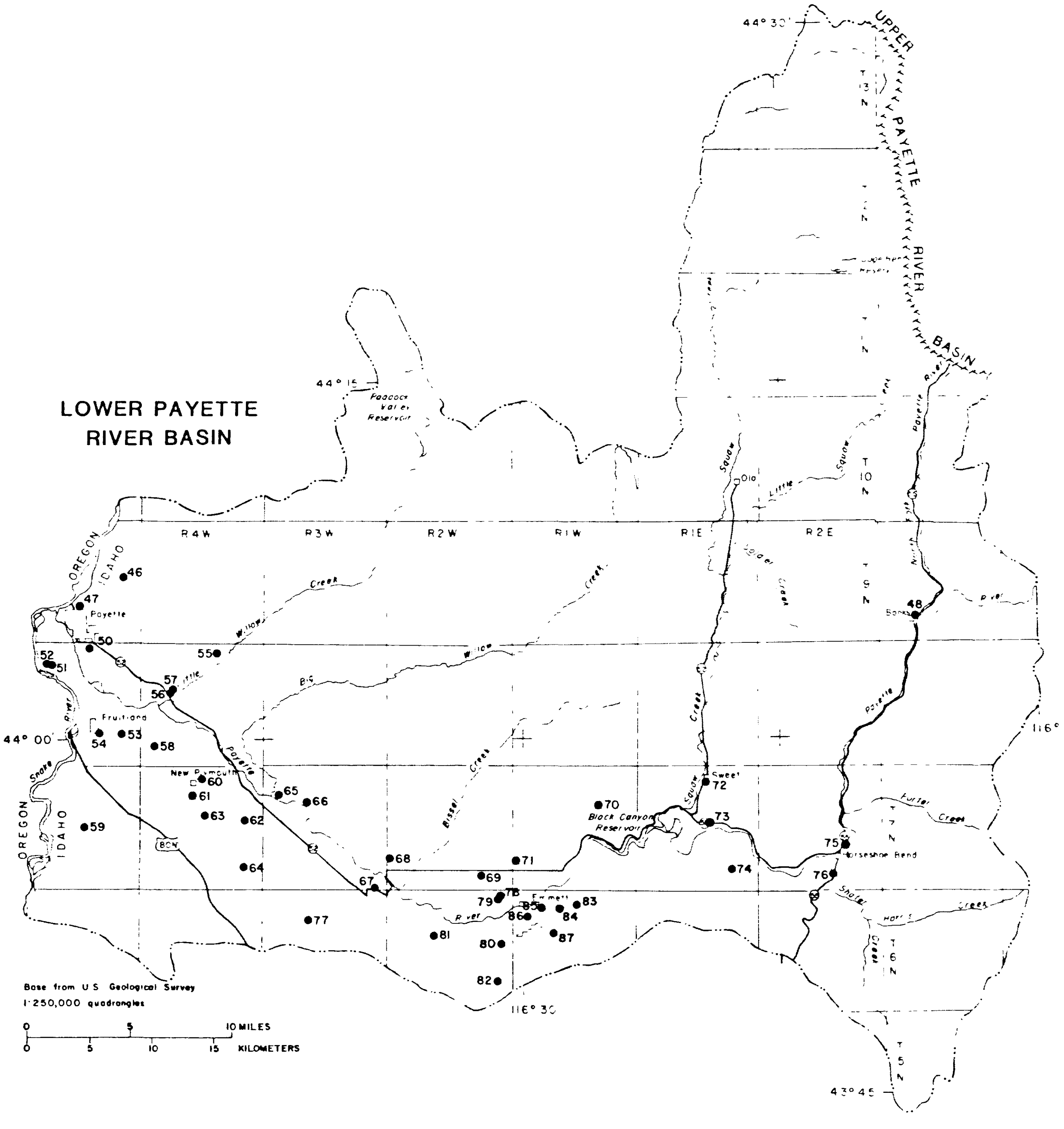
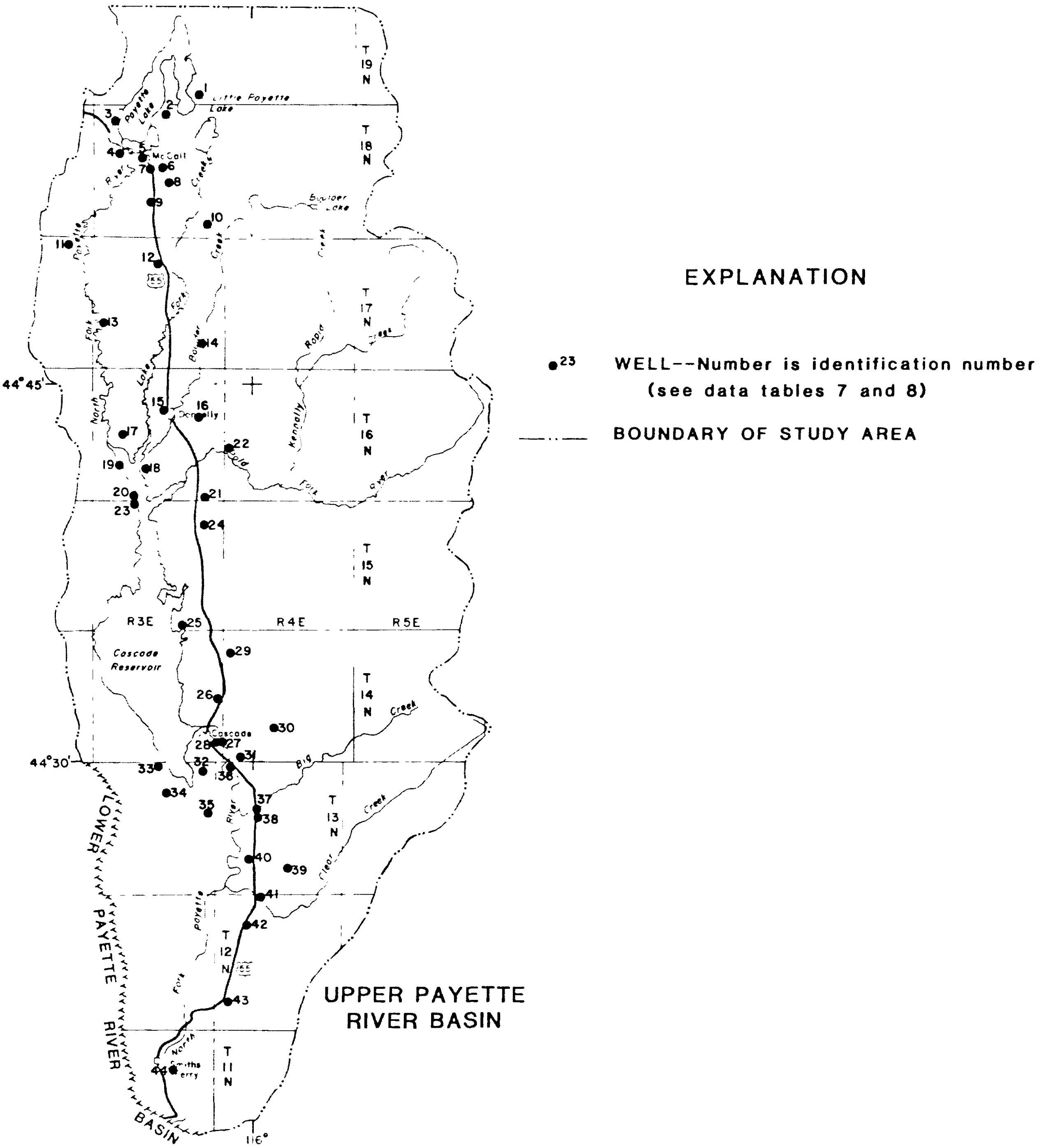


Figure 3.--Location and



identification of wells.

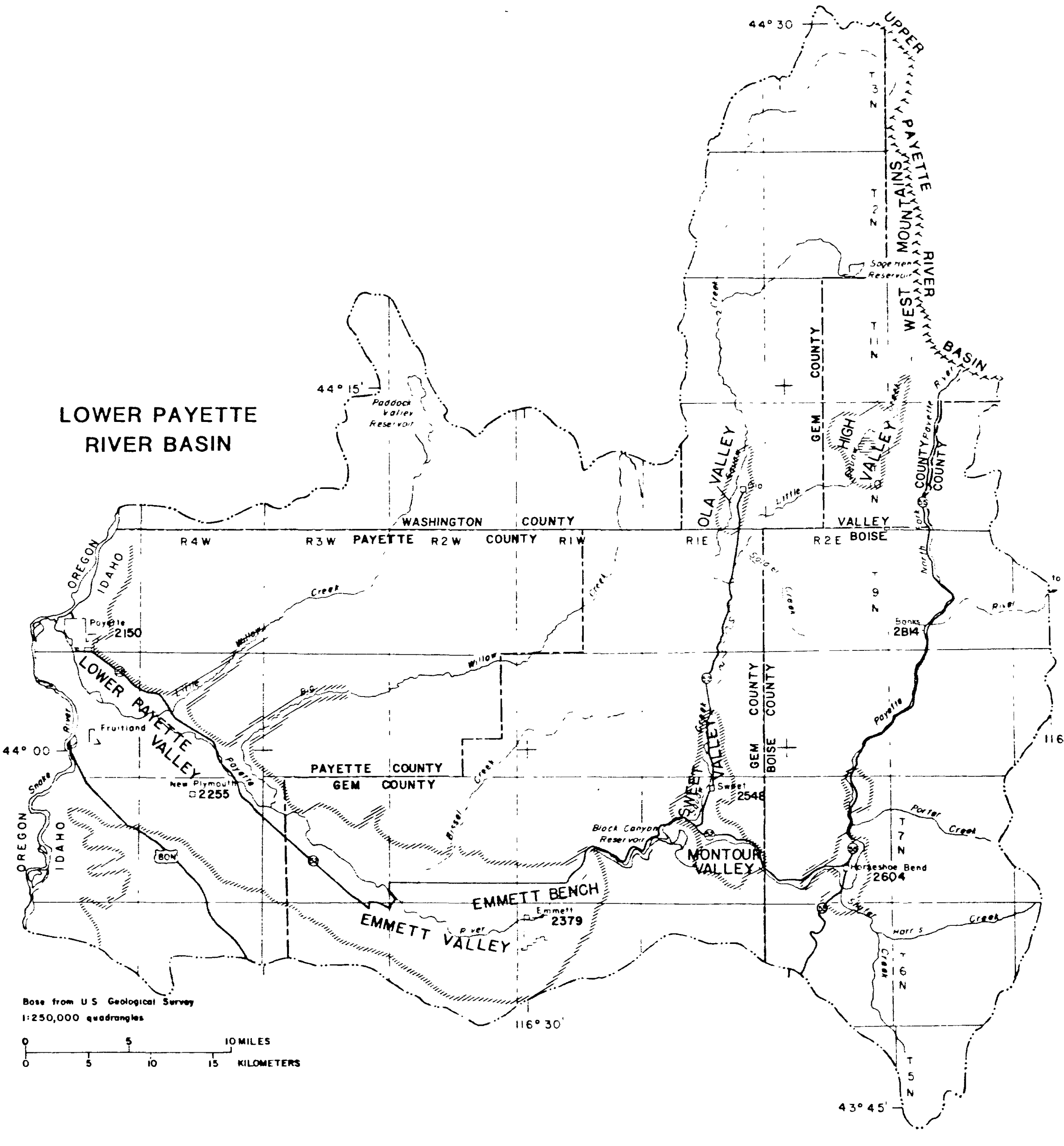
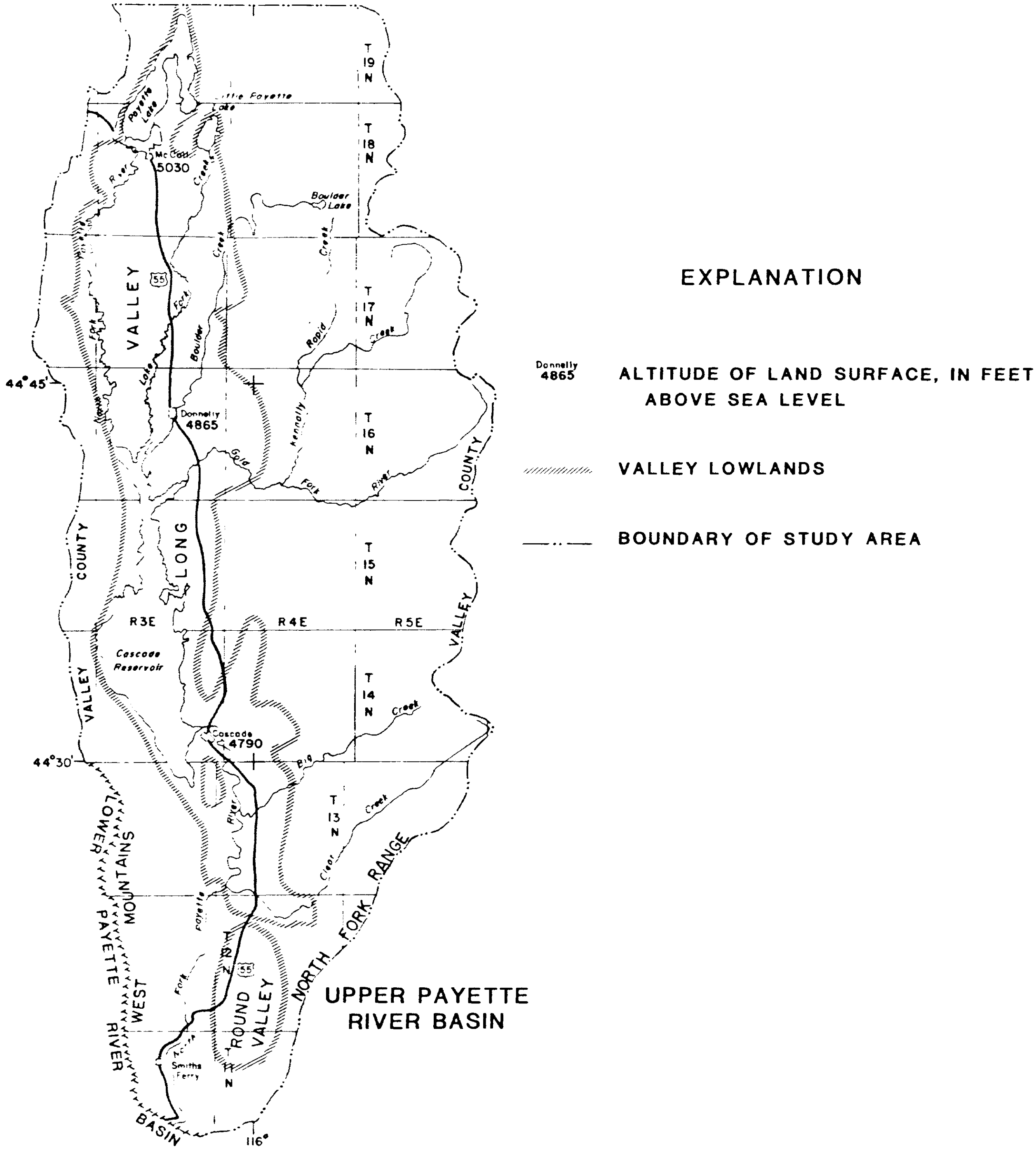


Figure 4.--Major landform features, county boundaries,



land-surface altitudes, and major towns.

Topography of the lower Payette River drainage (hereafter referred to as the lower area) is characterized by a broad, east-west trending valley (the Payette Valley, comprised of the lower Payette Valley and Emmett Valley), flanked by steep-sloped foothills and buttes. Land-surface altitudes range from about 2,100 ft to more than 8,000 ft, but most are less than 6,000 ft. In the Payette Valley, altitudes range from about 2,100 ft at Payette to about 2,400 ft at Emmett.

Figures showing separate upper and lower areas of the Payette River basin are on facing pages throughout this report.

Climate varies with land-surface altitude, relief, and direction of prevailing winds, and ranges from semiarid in the lower Payette Valley to subhumid in the mountains. Average annual precipitation is higher in the upper area than the lower area--average annual precipitation for 1977-81 ranged from about 12 in. near Payette to about 28 in. at McCall. Average annual precipitation at the highest altitudes is more than 50 in. Average annual air temperatures range from about 42 °F (5.5 °C) at McCall to about 51 °F (10.5 °C) at Payette (National Oceanic and Atmospheric Administration, 1977-81).

Greatest population density, about 36 people per square mile, is in the lower Payette Valley (fig. 4). Emmett Valley has about 19 people per square mile, and the remainder of the study area has about 1 person per square mile. Payette, Emmett, and McCall are the largest towns and have populations of about 5,500, 4,600, and 2,200, respectively (Idaho Bureau of Vital Statistics, oral commun., 1983). Smaller towns (more than 500 people) include New Plymouth, Fruitland, Horseshoe Bend, and Cascade.

The economy is based on irrigated agriculture, livestock production, tourism and seasonal recreation activities, wood-product manufacturing, and mining. Industry in the upper area is generally lumber milling. Industry in the lower area is generally plywood manufacturing, food processing, and feedlot cattle production.

Most of the valley lowlands and foothills are privately owned. Mountainous lands are generally owned by the Federal Government and managed by the U.S. Bureau of Land Management or the U.S. Forest Service. Land use in valley lowlands and foothills is predominantly irrigated agriculture or rangeland. Lakes, reservoirs, and mountains are popular recreation areas; second home or recreation home development has increased rapidly during the 1970's and 1980's, particularly in the Long Valley area.

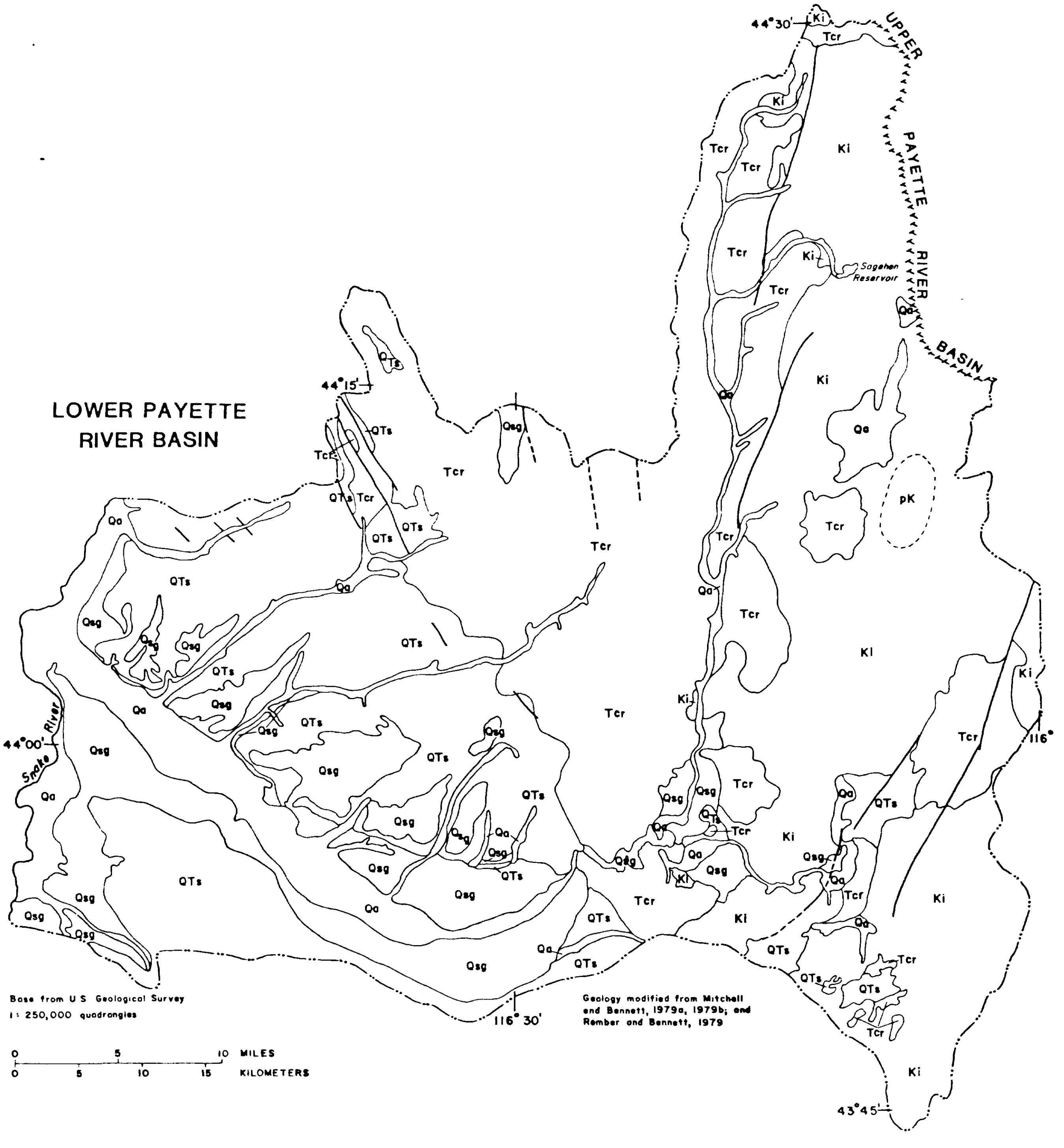
GEOLOGIC AND HYDROLOGIC SETTING

Surface geology of the Payette River basin is generalized from Idaho Bureau of Mines and Geology maps (Mitchell and Bennett, 1979a, 1979b; Rember and Bennett, 1979). Rock units include Quaternary alluvium and surficial deposits; Quaternary older alluvium, terrace, and glacial deposits; Quaternary and Tertiary lake, stream, and associated volcanic activity deposits; Tertiary Columbia River Basalt Group; Cretaceous Idaho batholith and related rocks; and pre-Cretaceous rocks. In this report, these units will be referred to as alluvium, older sediments, Quaternary and Tertiary sediments, Columbia River Basalt Group, batholith rocks, and metamorphic rocks. Generalized geology of the area and descriptions of rock units are shown in figure 5.

Structural geology is complex, particularly in the upper area, where structure is dominated by several major north- and northeast-trending fault systems and graben valleys. Faults in the lower area trend northwest and are associated with rock deformation and movement along the margin of the Snake River Plain (Lindholm and others, 1983). Major movement along these fault systems was probably in late Tertiary time, but recent seismic and microseismic observations show continuing activity (Wilson and others, 1976). Savage (1961) and Schmidt and Mackin (1970) reported detailed information on geology of the Payette River basin.

Most rock units in the Payette River basin contain some ground water (data are not available for metamorphic rocks). Sand and gravel lenses or beds in older sediments and Quaternary and Tertiary sediments are the most common sources of ground water for domestic, commercial or industrial, agricultural, or public supply uses. These sands and gravels commonly are interfingered or interbedded with clay lenses or beds, and localized artesian (confined) conditions are common in both upper and lower areas.

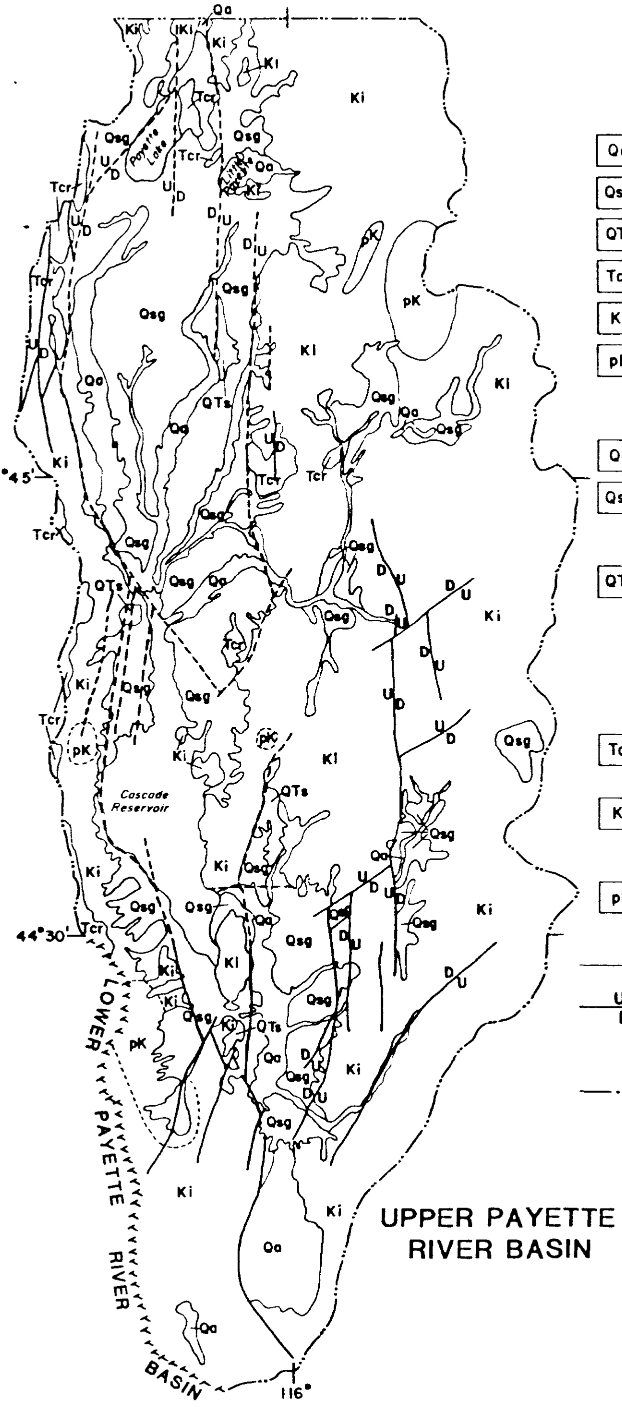
Ground-water recharge to aquifers in foothills and mountains is primarily by infiltration of precipitation. Recharge to aquifers in valley lowlands may be from several sources: (1) Infiltration from rivers, streams, irrigation canals, reservoirs, applied irrigation water, or precipitation; (2) movement between aquifers; or (3) leakage from septic-tank drain fields. Leakage of ground water along numerous fault zones in the Payette River basin may be an important factor in ground-water recharge, particularly in areas with thermal water.



Base from U S Geological Survey
1: 250,000 quadrangles

Geology modified from Mitchell and Bennett, 1979a, 1979b; and Rember and Bennett, 1979

Figure 5.--General-



EXPLANATION

CORRELATION OF MAP UNITS

Qa	Holocene	Quaternary
Qsg	Pleistocene	
QTs	Pleistocene to Miocene	Quaternary and Tertiary
Tcr	Miocene	Tertiary
Ki		Cretaceous
pK		Pre-Cretaceous

DESCRIPTION OF MAP UNITS

Qa ALLUVIUM AND SURFICIAL DEPOSITS

Qsg OLDER ALLUVIUM, TERRACE, AND GLACIAL DEPOSITS--Includes clay, silt, sand, and gravel of Pleistocene age

QTs LAKE, STREAM, AND ASSOCIATED VOLCANIC DEPOSITS--Includes clay, shale, volcanic ash, tuffaceous silt, sand, sandstone, oolitic limestone, diatomite, fine gravel, or conglomerate rocks of Idaho Group, including the Poison Creek Formation, Payette Formation, or Latah Formation

Tcr COLUMBIA RIVER BASALT GROUP, UNDIFFERENTIATED

Ki IDAHO BATHOLITH AND RELATED ROCKS--Includes quartz diorite, granodiorite, quartz monzonite, and undifferentiated granitic rocks

pK PRE-CRETACEOUS ROCKS--Includes schist, gneiss, and hornblende gneiss

——— CONTACT--Dashed where inferred

$\frac{U}{D}$ — — DIP-SLIP FAULT--U, upthrown block; D, downthrown block, where known. Dashed where inferred

——·· BOUNDARY OF STUDY AREA

ized geology.

Ground-water movement is generally from areas of recharge to areas of discharge and is in the direction of the slope of the water table (or of the water-level surface of a confined system). Interpretation of water-level data in the study area is difficult because data are sparse, valley lowland geology is complex, and subsurface lithologic information (from drillers' logs) is not always available. Also, well construction may permit water from unconfined and confined aquifers to mix (wells are often drilled for maximum yield and frequently have perforated casing intervals or are uncased at depth).

Figure 6 shows altitudes of water levels (from table 7, back of report) measured in 1982. Contours on the water-level surface for the lower area, based on March 1980 data, were delineated by Lindholm and others (1983). In the upper area, ground-water movement is generally southwestward toward the North Fork Payette River, then southward. In the lower area, ground-water movement is generally toward the Payette River, then westward toward the Snake River. Movement of locally confined water is probably in the same general direction as unconfined water. Unconfined and confined systems cannot be delineated on the basis of available data.

GROUND-WATER QUALITY

Ground-water analyses (table 8) represent water quality in major aquifers in the study area. Reporting units for analyses and formulas used for calculating water-quality characteristics (alkalinity, dissolved solids, and sodium-adsorption ratio) are discussed in table 8 headnotes and in appendix B. Throughout this report, references to depths of wells are as follows: shallow, 0 to 50 ft; moderately deep, 51 to 100 ft; and deep, greater than 100 ft.

Median, maximum, and minimum values for 1982 water-quality data are summarized in tables 1-3. Data populations are shown in table 4 for reference. No median values are calculated for data populations of fewer than five analyses. A generalized summary of water-quality trends derived from tables 1-3 follows:

1. Highest median values are most commonly in water from moderately deep wells completed in older sediments in the lower area.
2. Maximum concentrations are most commonly in water from moderately deep or deep wells completed in Quaternary and Tertiary sediments in the lower area.

page 16 follows

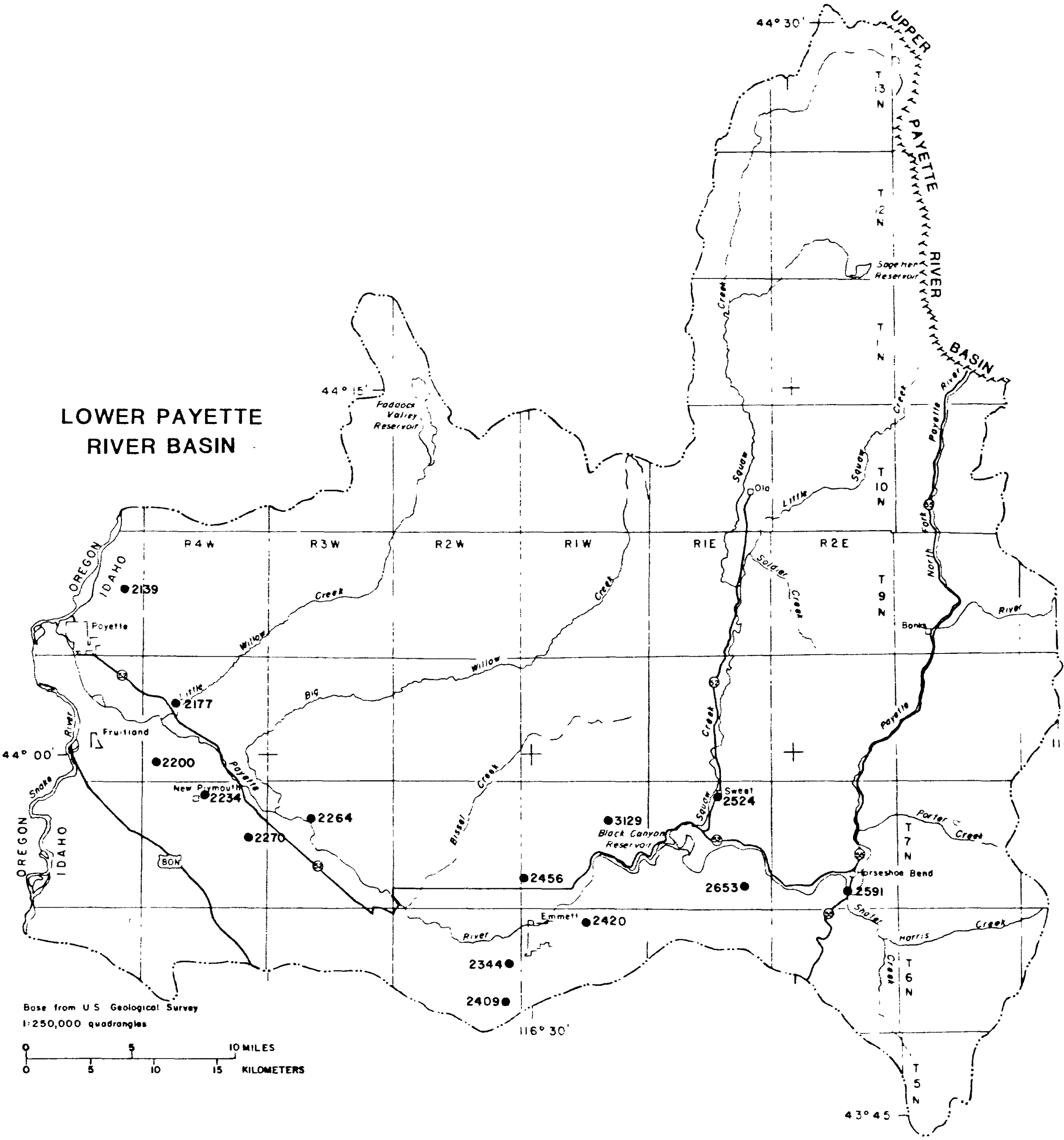
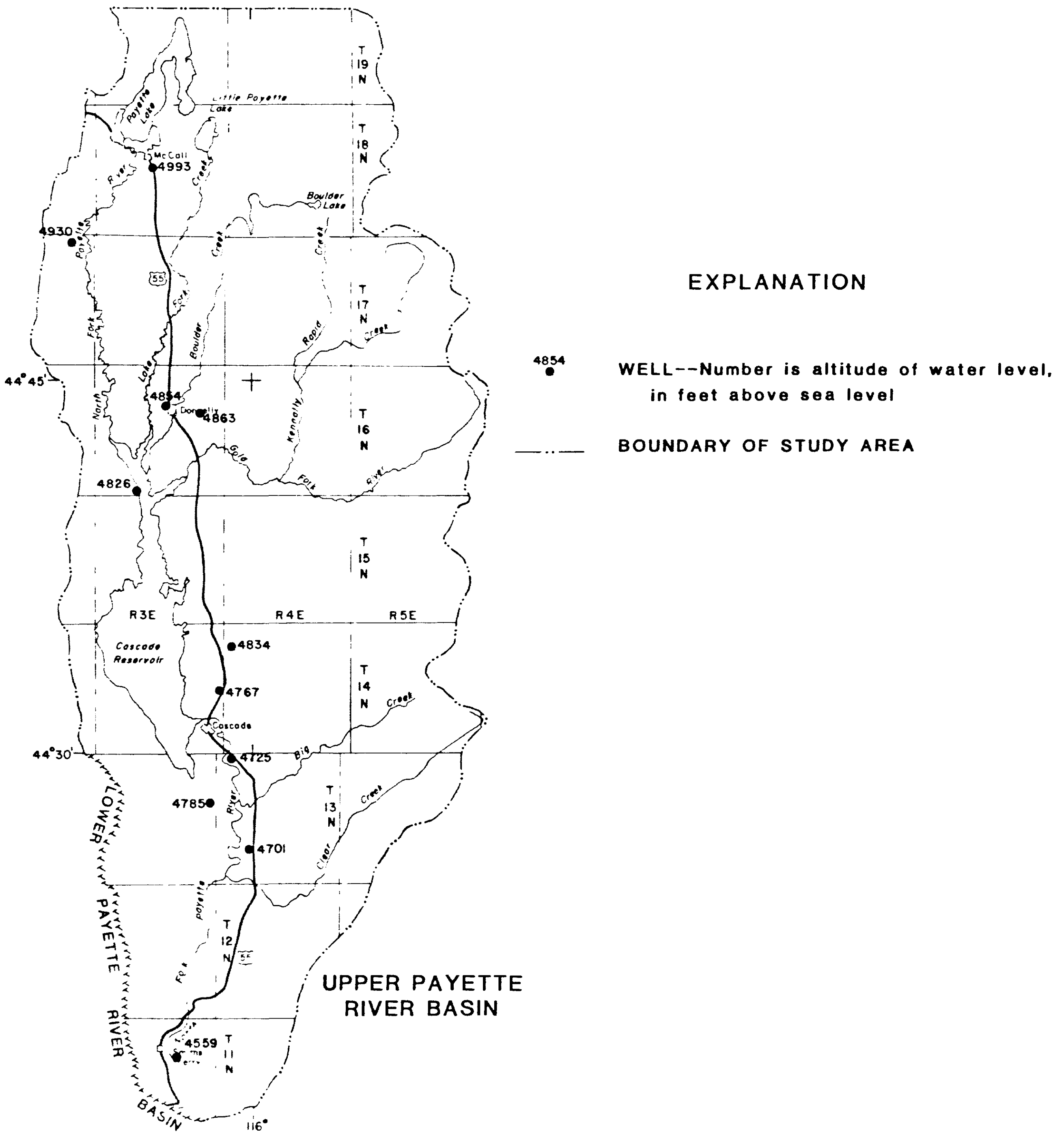


Figure 6.--Altitudes of water



levels in wells, summer-fall 1982.

HEADNOTES FOR TABLES 1-4

Data used:

Composite - all 1982 data
Aquifer - all 1982 data with defined aquifer
Well depth - all 1982 data with known total well depth

Aquifer:

Qa - Quaternary alluvium
Qsg - Older sediments
QTs - Quaternary and Tertiary sediments
Tcr - Columbia River Basalt Group
Ki - Idaho batholith rocks

Well depth:

Shallow - 0 to 50 feet total well depth
Moderately deep - 51 to 100 feet total well depth
Deep - greater than 100 feet total well depth

Notations and chemical abbreviations:

<, less than
--, value not calculated
*, only one datum available

Table 1.—Median values calculated for selected water-quality characteristics, 1982 data

		Composite			Aquifer									Well depth								
					Payette basin					Upper area		Lower area		Payette basin			Upper area			Lower area		
		Payette basin	Upper area	Lower area	Qa	Qsg	QTs	Tcr	Ki	Qsg	QTs	Qsg	QTs	Shallow	Moderately deep	Deep	Shallow	Moderately deep	Deep	Shallow	Moderately deep	Deep
Feet	Well depth	103	103	105	—	71	127	—	110	102	116	40	159	31	71	175	30	68	131	33	80	195
	Field analyses																					
µmhos/cm	Specific conductance	180	116	389	—	138	243	—	192	111	136	411	362	224	171	185	104	125	116	383	609	362
	pH	7.1	6.6	7.5	—	6.9	7.4	—	6.7	6.6	6.9	7.3	7.6	6.9	7.2	7.1	6.0	6.9	6.6	7.2	7.3	7.8
°C	Temperature	13.0	9.5	15.0	—	10.0	14.5	—	9.0	9.0	10.5	15.0	15.5	12.5	11.0	14.0	9.0	9.5	10.0	14.0	15.0	16.0
Milligrams per liter	Alkalinity as CaCO$_3$	84	57	160	—	71	110	—	72	53	71	190	160	98	92	78	46	64	54	180	190	140
	Bicarbonate as HCO$_3$	95	70	200	—	79	130	—	88	67	87	230	200	100	110	95	49	75	70	220	230	150
	Carbonate as CO$_3$	0	0	0	—	0	0	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oxygen (O$_2$)	1.7	3.0	.5	—	3	.6	—	5.8	4.2	.7	1.1	.5	1.5	3.0	1	—	4.3	2.2	.25	2.9	.3
	Laboratory analyses																					
Milligrams per liter	Dissolved solids (calculated)	243	121	276	—	259	245	—	—	--	—	297	263	247	418	178	—	--	121	275	415	250
	Hardness as CaCO$_3$	49	34	110	—	47	59	—	53	37	29	140	100	63	44	51	30	29	39	120	160	80
	Calcium (Ca)	14	9.1	32	—	14	15	--	14	9.5	7.7	39	29	20	13	12	8.3	8	9.8	34	45	23
	Magnesium (Mg)	3.4	2.6	8.4	—	3.5	3.6	—	2.6	2.9	2.0	10	6.8	3.3	3	3.6	2	1.4	3.0	9.4	12	4.5
	Sodium (Na)	16.5	7.9	37	—	8.5	32	—	11	7	15	40	36	22	21	11	7	8.5	7.4	40	51	35
	Potassium (K)	1.7	1.2	2.4	—	1.8	2.3	—	1.3	1.3	1.1	2.4	2.6	1.3	2.1	1.7	.8	1.2	1.4	1.8	2.9	2.3
	Nitrite plus nitrate as N	.2	.18	.58	—	.6	<.1	—	2.2	.35	<.1	1.1	.21	.2	.5	<.1	.18	.35	<.1	<.1	1.5	.21
	Chloride (Cl)	2.7	1.2	7.3	—	2.2	4.3	—	1.2	1.3	.9	5.6	8.1	3.5	2.2	2.5	1.6	1.3	.9	5.1	5.3	8.1
	Sulfate (SO$_4$)	5.5	<5	19	—	<5	10	—	<5	<5	<5	19	18	10	<5	7	<5	<5	<5	18	31	18
	Fluoride (F)	.3	.1	.5	—	.2	.4	—	.1	.1	.4	.7	.4	.5	.4	.2	<.1	.1	.1	.8	.4	.4
	Silica (SiO$_2$)	40	40	37	—	42	48	—	35	41	55	43	36	36	45	37	34	44	40	40	48	30
	Phosphorus (total, as P)	.08	.1	.06	—	.09	.09	—	.03	.09	.26	.07	.06	.04	.08	.09	.04	.07	.11	.06	.08	.03
	Boron (B)	25	<10	50	—	<10	40	—	<10	<10	15	70	45	45	30	20	<10	<10	<10	50	70	50
	Iron (Fe)	35	130	16	—	17	91	—	21	28	1,490	15	35	91	17	38	110	140	56	24	16	35
	Manganese (Mn)	21	29	12	—	15	70	—	6	15	190	16	23	33	17	24	18	29	33	59	15	9
	Zinc (Zn)	36	49	30	—	30	40	—	710	37	91	26	30	24	34	43	24	37	49	24	34	29

Table 2.--Maximum concentrations for selected water-quality characteristics, 1982 data

		Aquifer												Well depth								
		Composite			Payette basin					Upper area		Lower area		Payette basin			Lower area			Upper area		
		Payette basin	Upper area	Lower area	Qa	Qsg	QTs	Tcr	Ki	Qsg	QTs	Qsg	QTs	Shallow	Moderately deep	Deep	Shallow	Moderately deep	Deep	Shallow	Moderately deep	Deep
Feet	Well depth	400	274	400	30	194	400	274	392	194	226	120	400	50	100	400	50	100	274	47	100	400
	Field analyses																					
µmhos/cm	Specific conductance	2,310	212	2,310	104	980	2,310	403	641	201	212	980	2,310	980	2,310	963	128	194	212	980	2,310	963
	pH	9.1	7.8	9.1	6.0	8.0	9.1	7.6	8.7	7.5	7.8	8.0	9.1	8.0	8.3	9.1	6.8	7.8	7.5	8.0	8.3	9.1
°C	Temperature	22.5	20.0	22.5	11.5	19.5	20.0	18.0	22.5	18.0	20.0	19.5	18.0	19.5	16.5	22.5	11.5	16.5	20.0	19.5	16.5	22.5
Milligrams per liter	Alkalinity as $CaCO_3$	510	110	510	34*	440	510	300	110	110	110	440	510	440	380	510	60	92	110	440	380	510
	Bicarbonate as HCO_3	620	130	620	41	530	620	220	130	130	130	530	620	530	460	620	73	110	130	530	460	620
	Carbonate as CO_3	19	0	19	0	0	19	0	14	0	0	0	19	0	0	19	0	0	0	0	0	19
	Oxygen (O_2)	12	12	10.5	3.5	12	10.5	2.2	9.6	12	4.7	6.4	10.5	6.4	12	11	4.3	12	10.6	6.4	7.6	10.5
	Laboratory analyses																					
Milligrams per liter	Dissolved solids (calculated)	1,520	178	1,520	94*	660	1,520	269*	387	167	178	662	1,520	660	1,520	618	85*	—	178	662	1,520	622
	Hardness as $CaCO_3$	737	83	737	29	410	737	140	78	83	58	407	737	410	737	200	44	78	83	407	737	204
	Calcium (Ca)	170	29	170	8	120	170	33	29	22	15	120	170	120	170	62	14	29	22	120	170	62
	Magnesium (Mg)	76	7	76	2	26	76	15	4.3	7	5.1	26	76	26	76	20	3.3	3.7	7	26	76	20
	Sodium (Na)	240	42	240	8	81	240	33	120	21	42	81	240	78	240	180	10	37	42	78	240	180
	Potassium (K)	15	5.4	15	.8	14	15	1.6	2.8	5.4	3.7	14	15	9.5	9.6	15	.7	3.5	5.4	9.5	9.6	15
	Nitrite plus nitrate as N	16	7.1	16	1.9	7.6	16	3.6	3.1	7.1	.22	7.6	16	7.1	16	4.8	7.1	3.6	4.8	3.0	16	3.6
	Chloride (Cl)	210	12	210	3.5	45	210	6.8	38	3.9	12	45	210	45	210	38	3.5	9.2	12	45	210	38
	Sulfate (SO_4)	540	21	540	5	150	540	20	78	14	21	150	540	150	540	78	5	<5	21	150	540	78
	Fluoride (F)	11	2.5	11	.2	2.4	2.5	.3	11	.6	2.5	2.4	1.2	2.4	2.1	11	.2	2.1	2.5	2.4	1.2	11
	Silica (SiO_2)	80	80	67	37	61	80	37	40	53	80	61	67	61	67	80	39	58	80	61	67	56
	Phosphorus (total, as P)	1.6	1.6	.38	.04	1.6	.88	.09	.22	1.6	.88	.38	.22	.13	.45	1.6	.07	.45	1.6	.13	.18	.22
	Boron (B)	390	170	390	<10	130	210	50	390	70	170	130	210	130	210	390	70	170	70	130	210	390
	Iron (Fe)	7,200	7,200	1,800	200	4,200	7,200	56	57	4,200	7,200	610	1,800	610	4,200	7,200	530	4,200	7,200	610	72	1,800
	Manganese (Mn)	3,200	1,000	3,200	29	3,200	1,000	33	24	800	1,000	3,200	960	3,200	960	1,000	37	200	1,000	3,200	960	430
	Zinc (Zn)	3,200	1,100	3,200	180	1,100	340	170	3,200	1,100	300	240	340	240	910	3,200	180	910	1,100	240	260	3,200

Table 3.--Minimum concentrations for selected water-quality characteristics, 1982 data

					Aquifer									Well depth								
		Composite			Payette basin					Upper area		Lower area		Payette basin			Upper area			Lower area		
		Payette basin	Upper area	Lower area	Qa	Qsg	QTs	Tcr	Ki	Qsg	QTs	Qsg	QTs	Shallow	Moderately deep	Deep	Shallow	Moderately deep	Deep	Shallow	Moderately deep	Deep
Feet	Well depth	20	20	29	30	20	54	195	64	20	54	29	60	20	52	101	20	52	101	29	60	110
	Field analyses																					
µmhos/cm	Specific conductance	43	43	159	43	46	109	77	94	46	109	159	169	43	46	63	43	46	63	159	229	169
	pH	6.0	6.0	6.7	6.0	6.0	6.5	6.3	6.2	6.0	6.5	6.9	7.1	6.0	6.3	6.1	6.0	6.3	6.1	6.9	6.9	6.7
°C	Temperature	7.0	7.0	12.5	11.0	7.0	8.0	16.0	8.0	7.0	8.0	12.5	13.0	7.0	8.0	7.0	7.0	8.0	7.0	12.5	13.5	13.0
Milligrams per liter	Alkalinity as $CaCO_3$	16	16	72	16*	21	50	32	42	21	50	74	73	16	21	27	16	21	27	74	140	72
	Bicarbonate as HCO_3	1.0	1.0	61	20	26	1	39	51	26	1	90	61	20	26	1	20	26	1	90	170	61
	Carbonate as CO_3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oxygen (O_2)	0	0	0	1.8	0	0	0	.5	0	0	.1	0	.1	0	0	1.8	0	0	.1	.2	0
	Laboratory analyses																					
Milligrams per liter	Dissolved solids (calculated)	85	85	120	94*	111	85	269*	120	113	85	202	123	94	249	85	85*	---	85	202	239	121
	Hardness as $CaCO_3$	9	10	9	13	11	9	28	23	10	10	56	9	13	10	9	13	10	17	63	17	9
	Calcium (Ca)	2.7	2.7	3.8	4	3	2.7	7.5	7.9	2.8	2.7	16	3.8	4.1	2.7	3.8	4.1	2.7	5.1	19	6.6	3.8
	Magnesium (Mg)	.03	.44	.03	.6	.9	.03	2.2	.8	.88	.44	1.6	.03	.6	.2	.03	.6	.4	.8	1.6	.2	.03
	Sodium (Na)	3.3	3.3	8.3	6	3.4	5.3	3.3	9.7	3.9	5.3	8.3	14	4.7	4.3	3.3	4.7	4.3	3.3	8.3	18	9.7
	Potassium (K)	.4	.5	.4	.6	.5	.4	.8	.9	.5	.6	.9	.4	.6	.04	.04	.6	.5	.7	.9	.4	.4
	Nitrite plus nitrate as N	<.1	<.1	<.1	<.1	<.1	.6	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
	Chloride (Cl)	.3	.3	1.1	.5	.3	.5	1.1	1.1	.3	.5	1.1	1.2	.5	.4	.3	.5	.4	.3	1.1	1.2	1.5
	Sulfate (SO_4)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	Fluoride (F)	<.1	<.1	.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	.3	.1	<.1	<.1	<.1	<.1	<.1	.1	.4	.2	.1
	Silica (SiO_2)	16	20	16	20	16	16	30	18	26	30	18	16	18	17	16	20	33	26	18	17	16
	Phosphorus (total, as P)	.01	.02	.01	.04	.01	.01	.02	.01	.02	.03	.01	.01	.01	.01	.01	.02	.03	.02	.01	.01	.01
	Boron (B)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	20	<10	<10	<10	<10	<10	<10	30	20
	Iron (Fe)	<3	<3	<3	71	<3	<3	<3	8	<3	150	<3	<3	<3	<3	<3	28	<3	<3	<3	<3	<3
	Manganese (Mn)	<1	<1	<1	7	<1	<1	4	<1	<1	32	<1	<1	2	<1	<1	7	<1	<1	2	<1	<1
	Zinc (Zn)	<3	<3	<3	24	<3	<3	150	<3	<3	10	4	<3	<3	<3	4	<3	<3	4	4	<3	6

Table 4.--Population of data for selected water-quality characteristics, number of analyses available, 1982 data

		Composite			Aquifer									Well depth								
					Payette basin					Upper area		Lower area		Payette basin			Upper area			Lower area		
		Payette basin	Upper area	Lower area	Qa	Qsg	QTs	Tcr	Ki	Qsg	QTs	Qsg	QTs	Shallow	Moderately deep	Deep	Shallow	Moderately deep	Deep	Shallow	Moderately deep	Deep
Feet	Well depth	68	36	32	2	33	27	2	5	22	9	11	18	12	21	35	5	12	19	7	9	16
	Field analyses																					
µmhos/cm	Specific conductance	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	pH	70	37	33	2	34	27	2	5	22	9	12	18	11	20	34	5	11	18	6	9	16
°C	Temperature	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
Milligrams per liter	Alkalinity as $CaCO_3$	72	37	35	1	34	27	2	5	23	9	14	18	11	19	34	5	11	19	7	9	16
	Bicarbonate as HCO_3	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Carbonate as CO_3	71	37	34	2	33	27	2	5	24	9	14	18	11	19	34	5	11	19	7	9	16
	Oxygen (O_2)	62	33	29	2	31	22	2	5	20	7	11	15	10	17	32	4	10	17	6	7	15
	Laboratory analyses																					
Milligrams per liter	Dissolved solids (calculated)	40	10	30	1	16	19	1	3	4	4	12	15	7	7	21	1	0	7	6	7	14
	Hardness as $CaCO_3$	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Calcium (Ca)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Magnesium (Mg)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Sodium (Na)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Potassium (K)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Nitrite plus nitrate as N	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Chloride (Cl)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Sulfate (SO_4)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Fluoride (F)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Silica (SiO_2)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Phosphorus (total, as P)	74	39	35	2	38	27	2	5	24	9	14	18	12	21	35	5	12	19	7	9	16
	Boron (B)	72	37	35	2	37	26	2	5	23	8	14	18	12	21	33	5	12	17	7	9	16
	Iron (Fe)	72	37	35	2	37	26	2	5	23	8	14	18	12	21	33	5	12	17	7	9	16
	Manganese (Mn)	72	37	35	2	37	26	2	5	23	8	14	18	12	21	33	5	12	17	7	9	16
	Zinc (Zn)	71	37	34	2	37	25	2	5	23	8	14	17	12	21	32	5	12	17	7	9	15

3. Maximum temperature and concentrations of dissolved fluoride, boron, and zinc are in water from batholith rocks and deep wells.

4. Lowest median values and minimum concentrations are most commonly in water from various aquifers in the upper area.

Exceptions to the general trends include:

1. Highest median values of dissolved silica, phosphorus, iron, and manganese are in water from Quaternary and Tertiary sediments in the upper area.

2. Lowest median values and minimum concentrations of dissolved silica, phosphorus, iron, manganese, and zinc are in water from various aquifers in the lower area.

Chemical Composition of Ground Water

Generalized chemical composition of ground water is illustrated (fig. 7) by a trilinear plot, or Piper diagram (Piper, 1944). In a Piper diagram, selected cations (positively charged ions--calcium, magnesium, and sodium plus potassium) and anions (negatively charged ions--bicarbonate plus carbonate, sulfate, and chloride) for each ground-water analysis are shown as a percentage of the total cations and anions, in milliequivalents per liter, plotted as single points on each side triangle. Cation and anion plots for each sample then are projected into the central diamond field.

Trilinear plots of 1982 data show that ground water contains predominantly calcium and bicarbonate ions. Sodium and bicarbonate ions predominate in about 25 percent of current samples. Sulfate is the predominant anion in about 3 percent of 1982 samples.

Areal distribution and trends in ground-water composition are shown by ion concentration diagrams (pls. 1 and 2, back of report), also referred to as Collins' diagrams (Hem, 1970, p. 257-259). In Collins' diagrams, major cations (calcium, magnesium, sodium, and potassium) and anions (bicarbonate plus carbonate, sulfate, chloride, and fluoride plus nitrite plus nitrate as nitrogen) for each analysis are represented by vertical bar graphs. Total height of each bar graph is proportionate to the total concentration of

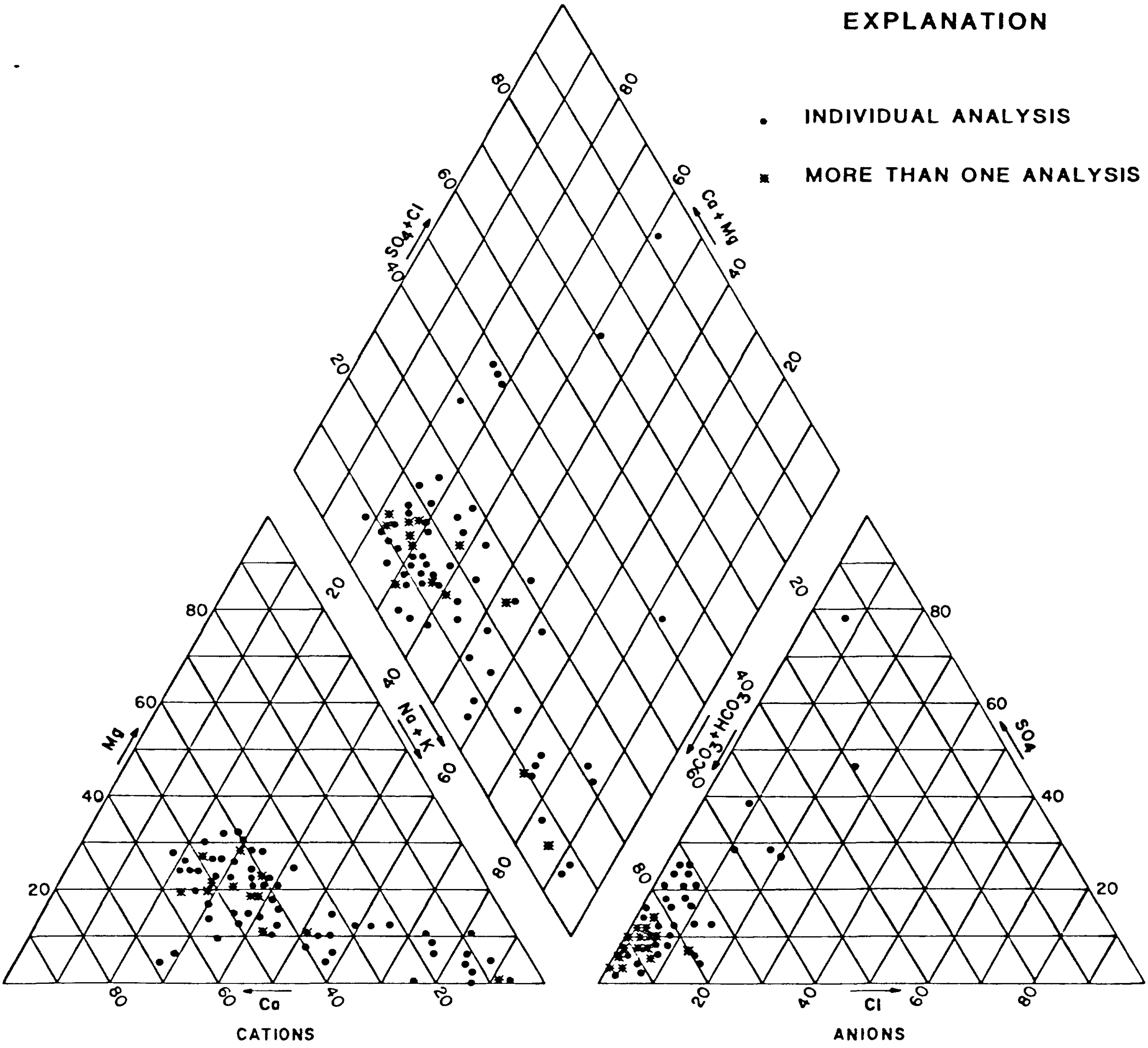


Figure 7.--Trilinear diagram of chemical analyses of ground water from the Payette River basin, 1982 data.

cations or anions. In theory, cation and anion concentrations should be balanced and ion columns should be of equal height. Unequal column height may indicate the need for additional cation or anion concentrations to be included in the diagram or may result (rarely) from reporting errors or inaccuracies in field or laboratory analyses.

When Collins' diagrams are plotted on a map of the study area, areal differences in ground-water composition become apparent. Plate 1 shows Collins' diagrams for selected representative water samples from wells less than 100 ft deep. Plate 2 shows diagrams for selected representative water samples from wells greater than 100 ft deep. The symbol representing the major aquifer for each well is included on the lower right corner of each diagram. Ion concentrations of less than 0.1 meq/L (milliequivalents per liter) are proportionately too small to be illustrated.

Collins' diagrams on plates 1 and 2 show that: (1) Ground water from the upper area has proportionately lower ion concentrations than water from the lower area, (2) water from shallow or moderately deep wells generally has lower ion concentrations than water from deep wells, (3) lowest concentrations of ions are in water from alluvium or older sediments between Cascade and Horseshoe Bend, (4) highest concentrations of ions are in water from older sediments or Quaternary and Tertiary sediments in the lower Payette Valley near New Plymouth and Payette, and (5) predominant ions in most samples are calcium or sodium and bicarbonate plus carbonate.

When wells are open to more than one aquifer, waters from varying sources may mix. Chemical analyses of water from these wells may seem unusual when compared with analyses from other wells of similar total borehole depth. For example, water from deep wells in the Cascade to Banks area has comparatively low ion concentrations in relation to water from other deep wells in the study area. Casings in these Cascade-Banks deep wells have multiple perforation intervals, and ground-water composition is similar to that from shallow aquifers.

Variability in chemical and physical characteristics of ground water in Payette River basin may be due to one or more factors: (1) Geochemical properties, such as solubility and exchange characteristics of aquifer materials, (2) contact time of water with aquifer materials, (3) mineral composition of aquifer materials, (4) relative proximity of sampling site to source(s) of recharge, and (5) influences of land- and water-use practices. Geochemical properties, contact time of water, and mineral composition of aquifer materials are factors that may result in relatively long-term changes in water quality. Geochemical factors affecting water quality are presented in reports by Krauskopf (1967) and Freeze and Cherry (1979). Effects of contact time are difficult to determine specifically but, in general, tend to bring the chemistry of the water closer to equilibrium with the surrounding rock.

In addition to influences of mineral composition of rock materials on water quality, water in the study area generally becomes more mineralized (greater dissolved-solids concentrations) with increased depth below land surface. It is nearly impossible, in most cases, to isolate the influence of depth of sample on water quality from other complicating factors, such as mixing of waters from varying sources in partially cased wells or wells perforated at several depths.

Proximity to the source of recharge and influences of land- and water-use practices contribute to the variability of ground-water quality. Precipitation is probably the least mineralized source of recharge; in general, ground water near a precipitation recharge area has lower dissolved mineral concentrations than ground water farther downgradient. Recharge water from sources such as streams, rivers, lakes, septic-tank drain fields, or landfills is of variable quality and may be highly mineralized. The influence of land-use practices on quality of recharge water may result in pronounced changes in localized ground-water quality, sometimes over relatively short periods of time. Changes in water quality in the study area resulting from land-use practices may be difficult to determine because historical data needed to establish background water quality are sparse.

Since the early 1970's, contamination of shallow water-yielding zones from septic-tank drain-field leachates near Cascade Reservoir and Clear Creek in the upper area has concerned health officials and water-quality specialists. Publications by Clark and Wroten (1975) and U.S. Bureau of Reclamation (1975) describe ongoing contamination studies.

Selected land-use features that could be sources of contamination in the upper and lower areas are shown in figure 8. Characteristic ground-water contaminants associated with selected land- and water-use practices are shown in table 5 and are discussed in a report by Todd and others (1976).

No attempt was made during this study to sample specifically for point-source contamination of ground water.

(p. 28 follows)

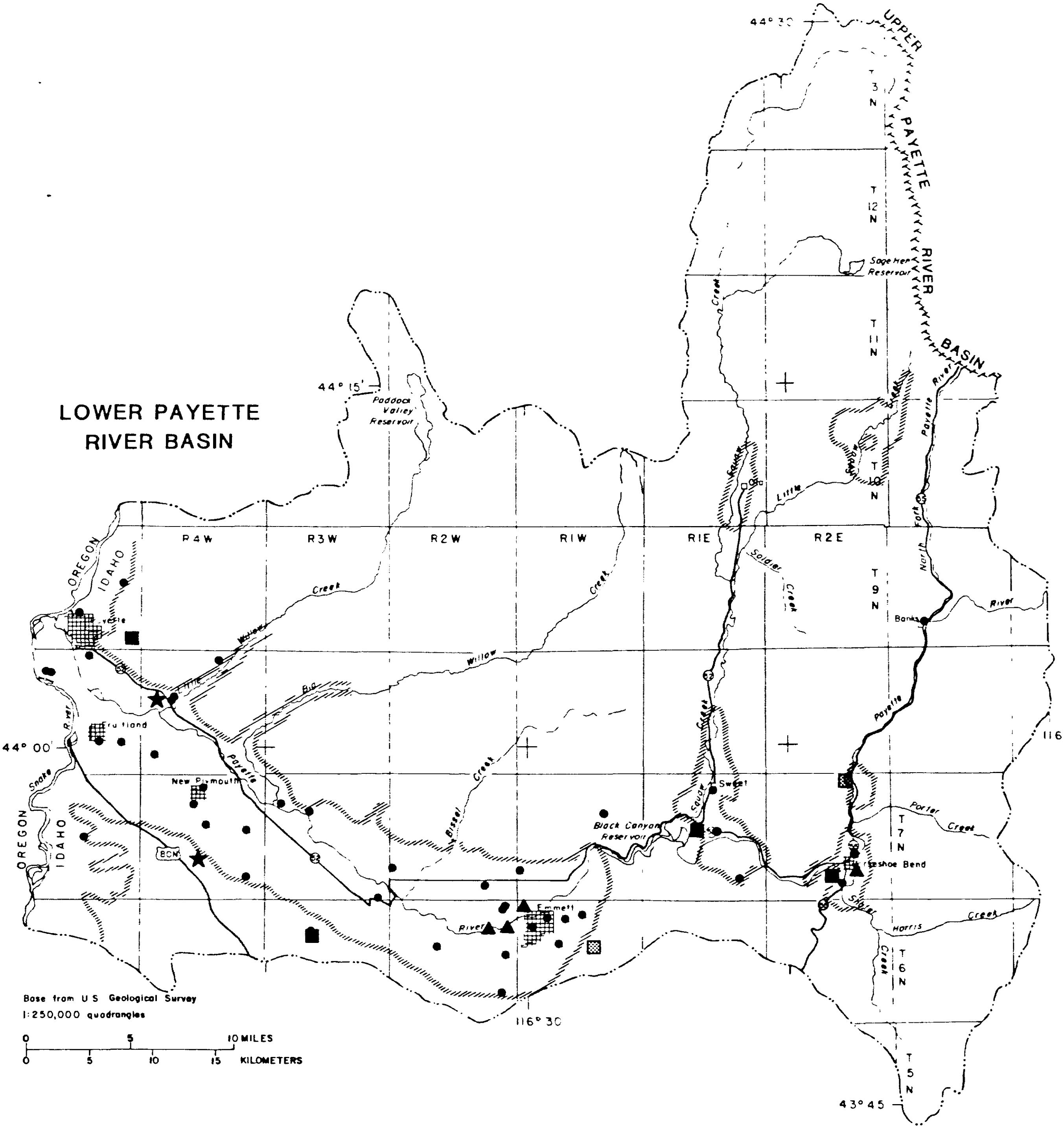
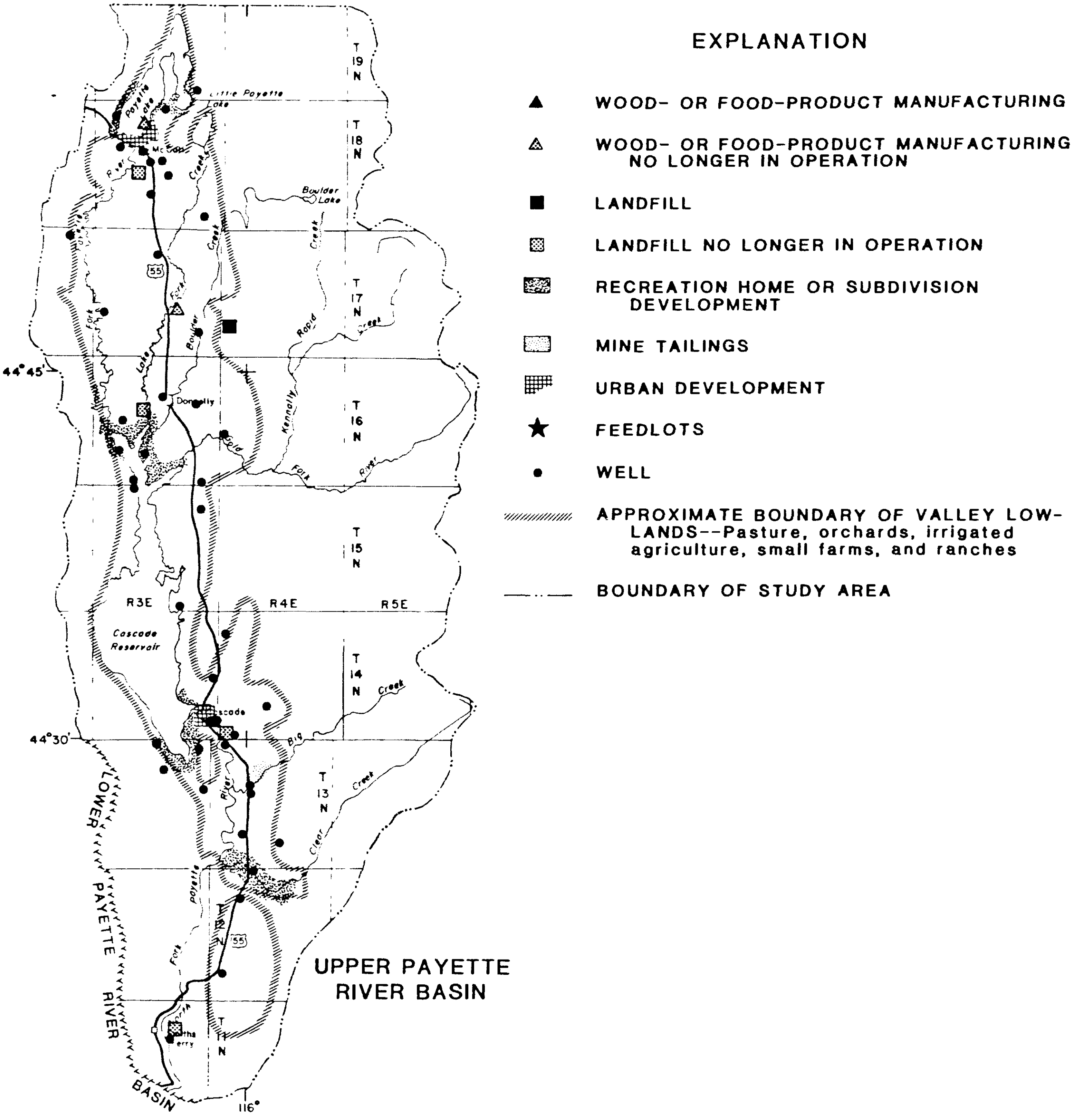


Figure 8.--Selected



land-use features.

Table 5.--Characteristic contaminants associated with selected land- and water-use practices (modified from Whitehead and Parliman, 1979, p. 34)

Source	Characteristic contaminants
Agriculture and feedlots	Fertilizers (chiefly nitrogen, phosphorus, and potassium), pesticides, bacteria, trace elements, organic chemicals
Landfills and dumps	Organic compounds, iron, manganese, methane, carbon dioxide, phosphates, chloride, nitrogen compounds, trace elements, bacteria
Cesspools, septic-tank drain fields	Dissolved solids, particularly chloride, sulfate, nitrogen compounds, and phosphates (detergents); bacteria; organic chemicals
Food processors or lumber mill wastes	High biological-oxygen demand, iron, manganese, sodium, chloride, nitrogen compounds, phosphates, bacteria, organic chemicals, tannins
Street runoff, manufacturing wastes, irrigation runoff	Dissolved solids, sodium, bacteria, phosphates, bicarbonate, sulfate, chloride, nitrogen compounds, trace elements, pesticides, organic chemicals, radiochemicals

The 1982 sampling locations and water-quality characteristics analyzed for each location were chosen, in part, to show possible areal or nonpoint-source contamination. General information on effects of ground-water contaminants on ground-water quality is included in reports by Todd (1970), Fairbridge (1972), Campbell and Lehr (1973), and Freeze and Cherry (1979).

Suitability of Water for Use

Ground-water quality characteristics (chemical constituents and physical properties) determine the suitability of ground water for use. Principal consumptive demands of ground water in the study area are for domestic, public supply, and agricultural (irrigation and livestock) uses. Source, significance, and regulations or criteria for selected water-quality characteristics commonly important to water users are presented in table 6. Ranges of concentrations for 1982 data are also shown. Federal drinking water regulations apply only to public water supplies but provide a base for comparison of water quality for most uses.

Ground water in the study area is suitable for most uses. Where ground water is unsuitable for use because of anomalously high chemical constituent concentrations or undesirable esthetic or economic considerations, it may be possible to reduce, remove, or control concentrations through appropriate water treatment processes. Some methods for treating water are discussed in reports by Nordell (1961) and Lehr and others (1980).

Public and Domestic Water Supplies

In localized areas of the Payette River basin, ground water has water-quality characteristics that may concern public or domestic water users or that could restrict its use:

1. Very hard water, soft water, or high concentrations of alkalinity may be esthetically or economically restrictive or may be a human health concern.

2. pH and concentrations of dissolved solids, nitrite plus nitrate as nitrogen, sulfate, fluoride, iron, and manganese exceed Federal public drinking water limits in several 1982 samples and are anomalously high in several other 1982 samples.

Table 6.--Selected water-quality characteristics and their relation to use--Continued

Constituent or property	Source or significance	Range of concentrations in sampled wells (1982 data)	Effects on usability
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and industrial wastes.	0.3-210 mg/L Cl	A salty taste can be detected when concentrations exceed 100 mg/L. In large quantities, increases the corrosiveness of water. Present available removal methods not generally economical for most uses. Recommended maximum limit for public water supplies is 250 mg/L.[1]
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, sulfides, and other sulfur compounds. May be derived from industrial wastes, both liquid and atmospheric.	<5-540 mg/L SO_4	Sulfate in water containing calcium forms hard scales in steam boilers. In large amounts, sulfate, in combination with other ions, imparts bitter taste to water. Some calcium sulfate is considered beneficial in brewing processes. Recommended maximum limit for public water supplies is 250 mg/L.[1]
Fluoride (F)	Dissolved in small quantities from most rocks and soils. Added to many public supplies.	<0.1-11 mg/L F	Fluoride concentrations in limited amounts have beneficial effect on the structure and resistance to decay of children's teeth. Excessive concentrations produce objectionable dental fluorosis (tooth mottling). Optimum recommended limits for public water supplies range from 1.4 to 2.4 mg/L and are based on annual average maximum daily air temperatures.[2]
Silica (SiO_2)	Dissolved from practically all rocks and soils.	16-80 mg/L SiO_2	Together with calcium and magnesium, silica forms a low heat-conducting, hard, glassy scale in boilers and turbines. Silica inhibits deterioration of zeolite-type water softeners and corrosion of iron pipes by soft (0-75 mg/L $CaCO_3$) water.
Phosphorus (P, total)	Dissolved from many rocks and minerals, particularly apatite. Phosphate fertilizer, sodium phosphate in detergent (component of sewage) may be pollution sources of phosphorus.	0.01-1.6 mg/L P	One of the major nutrients required for plant nutrition and is essential for life. May indicate organic contamination.
Boron (B)	Constituent of some minerals in igneous rocks. Not easily dissolved. May be liberated in volcanic gases. Water in volcanic areas may contain considerable concentrations of boron.	< 10-390 µg/L B (<0.01-0.39 mg/L B)	Potentially toxic to sensitive plants.
Iron (Fe)	Dissolved from practically all rocks and soils, especially igneous and sandstone rocks. Also caused by corrosion of pipes, pumps, and other cast iron or steel equipment or the presence of iron bacteria.	<3-7,200 µg/L Fe (<0.003-7.2 mg/L Fe)	When concentrations are more than 100 µg/L (more than 0.1 mg/L), iron commonly precipitates on exposure to air, causing turbidity, stain of plumbing fixtures and laundry, and tastes and colors that are objectionable in food, beverages, textile processes, and ice manufacture. Recommended maximum limit for public water supplies is 300 µg/L or 0.3 mg/L Fe.[1]
Manganese (Mn)	Occurs in various salts and minerals in nature, frequently in association with iron compounds.	<1-3,200 µg/L Mn (<0.001-3.2 mg/L Mn)	A micronutrient vital for plants and animals. Rarely toxic. Concentrations in excess of 50 µg/L may produce objectionable esthetic qualities similar to iron and sometimes intensified by the presence of iron. Recommended maximum limit for public water supplies is 50 µg/L or 0.05 mg/L Mn.[1]
Zinc (Zn)	Common mineral often associated with sulfides of other metals, especially lead, copper, cadmium, and iron. May be dissolved from galvanized pipe.	<3-3,200 µg/L Zn (<0.003-3.2 mg/L Zn)	Essential to human metabolism. More than 5,000 µg/L produces a bitter or astringent taste. Recommended maximum limit for public water supplies is 5,000 µg/L or 5 mg/L Zn.[1]

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[1] U.S. Environmental Protection Agency (1977c)

[2] U.S. Environmental Protection Agency (1977b)

Table 6.--Selected water-quality characteristics and their relation to use
[mg/L, milligrams per liter; µg/L, micrograms per liter; <, less than]

Constituent or property	Source or significance	Range of concentrations in sampled wells (1982 data)	Effects on usability
Temperature (°C)	Variations may be due to deeper water circulation, thermal activity, seasonal air temperature variation, or disposal of surface waste water.	7.0 °-22.5 °C	Affects the usefulness of water for many purposes. Temperature may affect palatability of water, solubility of chemical constituents, and coagulation, sedimentation, filtration, or chlorination processes.
pH	Hydrogen-ion concentration.	6.0-9.1	A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increased alkalinity; values lower than 7.0 indicated increased acidity. Corrosiveness of water generally increases with decreasing pH, but excessively alkaline water also may be corrosive. Recommended level for public water supplies ranges from 6.5 to 8.5.[1]
Specific conductance	An indicator of dissolved mineral content of water.	43-2,310 µmhos/cm	Indicator of dissolved mineral content. A measure of the capacity of the water to conduct a current of electricity, and varies with the concentration and degree of ionization of different minerals in solution; the more minerals, the larger the specific conductance.
Dissolved solids (calculated sum)	Mineral constituents dissolved from rocks and soils.	85-1,590 mg/L	Recommended maximum limit for public water supplies is 500 mg/L.[1] Water containing more than 1,000 mg/L of dissolved solids is unsuitable for many purposes.
Alkalinity as calcium carbonate ($CaCO_3$)	Nearly all produced by dissolved bicarbonate and carbonate.	1-510 mg/L	Measure of water's capacity to neutralize acids. May produce objectionable taste.
Bicarbonate (HCO_3), Carbonate (CO_3)	Action of carbon dioxide in water on carbonate cementing material and rocks, such as limestone, dolomite, and travertine.	1.0-620 mg/L HCO_3 0-19 mg/L CO_3	Produce alkalinity. When heated in the presence of calcium and magnesium, can form scales in pipes and release corrosive carbon-dioxide gas. Aid in coagulation for the removal of suspended matter from water.
Hardness as calcium carbonate ($CaCO_3$)	In most waters, nearly all hardness is due to calcium and magnesium.	10-740 mg/L	Soap-consuming capacity of a water. Forms white scales in teakettles and plumbing and rings in bathtubs. Although hardness is less of a factor with synthetic detergents than with soap, it is sometimes desirable to soften hard water for esthetic as well as economic reasons.
Calcium (Ca), Magnesium (Mg)	Dissolved from practically all soils and rocks, but especially from limestone, dolomite, and gypsum.	2.7-170 mg/L Ca 0.03-76 mg/L Mg	Causes most of the hardness in water. Calcium and magnesium combine with bicarbonate, carbonate, sulfate, and silica to form heat-retarding, pipe-clogging scales in boilers and in other heat-exchange equipment. A high concentration of magnesium has a laxative effect, especially on new users of the supply.
Sodium (Na), Potassium (K)	Dissolved from practically all rocks and soils, especially feldspars, clay minerals, and evaporites. Present in sewage and commercial fertilizers.	3.3-240 mg/L Na 0.4-15 mg/L K	More than 50 mg/L sodium and potassium in the presence of suspended matter causes foam in boilers, which accelerates scale formation and corrosion. Dissolved sodium concentrations may be important to sodium-restricted diets.
Sodium-adsorption ratio (SAR)	Dissolved calcium, magnesium, and sodium from rocks and soils.	0.3-9.1	Estimates the degree to which sodium in irrigation water tends to enter into cation-exchange reactions in soil. High values indicate that sodium replaces adsorbed calcium and magnesium. This replacement damages soil structure and decreases hydraulic conductivity.
Nitrite (NO_2) plus nitrate (NO_3) as nitrogen (N)	Atmosphere, legumes, plant debris, animal excrement, nitrogenous fertilizer in soil, and sewage.	<0.1-16 mg/L N	Small amounts help reduce cracking of high-pressure boiler steel. Encourages growth of algae and other organisms that produce undesirable taste and odors. Concentrations in excess of 10 mg/L are suspected as cause of methemoglobinemia (blue-baby disease) in infants. Mandatory maximum limit for public water supplies is 10 mg/L.[2]

3. Concentrations of dissolved chloride and zinc are anomalously high and approach drinking water limits in some samples.

Areal distribution and range of concentrations of water hardness, nitrite plus nitrate as nitrogen, and dissolved solids are discussed in following sections of this report. Distribution of pH, alkalinity, major anions, and dissolved iron, manganese, and zinc are included in the discussions as they relate to public and domestic water-use considerations.

Hardness, pH, and Alkalinity

Hardness in water, expressed in milligrams per liter as $CaCO_3$ (calcium carbonate), is caused principally by dissolved calcium and magnesium. Hardness commonly is defined in terms of grains of hardness: 1 grain per U.S. gallon = 17.12 mg/L (milligrams per liter) $CaCO_3$ hardness (Johnson Division, Inc., 1966, p. 66). The consumer judges hardness by the amount of soap required to produce a lather and by scale buildup in water pipes, plumbing fixtures, and cookware.

On a national basis, the U.S. Environmental Protection Agency (EPA, 1976b, p. 75) established the following water hardness categories: 0 to 75 mg/L, soft; 76 to 150 mg/L, moderately hard; 151 to 300 mg/L, hard; and more than 300 mg/L, very hard.

Hardness in domestic supplies probably is not objectionable at concentrations less than 100 mg/L (McKee and Wolf, 1963, p. 195). Chemically softened water may be preferable for esthetic reasons or for industrial uses but may be expensive. Also, use of sodium compounds in some water-softening processes may increase the sodium content of drinking water, a concern to people on sodium-restricted diets (EPA, 1977b, p. 120-125).

An increasing number of research articles that discuss the relation of water hardness and health are being published. Research suggests the incidence of cardiovascular disease may be higher in areas with soft water than in areas with hard water (EPA, 1977a).

Median and range values, in milligrams per liter, for 1982 hardness data in the study area are as follows:

Area	Median	Range
Upper	34	10-83
Lower	110	9-737
Upper and lower	49	9-737

Hardest water is from shallow or moderately deep wells completed in older sediments or Quaternary and Tertiary sediments in the lower area. The highest water hardness concentration (737 mg/L) is from well 57, and four wells (50, 54, 56, and 57) have pre-1982 or 1982 hardness concentrations exceeding 300 mg/L (table 8). Softest water is from moderately deep wells completed in Quaternary and Tertiary sediments in the upper area. Three wells (23, 37, and 81) have 1982 hardness concentrations of 10 mg/L or less (table 8).

Hydrogen ion activity in water is measured in pH units. In general, pH describes whether water is neutral (pH 7), acidic (pH less than 7), or basic (pH greater than 7). The pH is controlled primarily by chemical reactions and equilibria among the ions in solution and is an indicator of the chemical behavior certain solutions may exhibit toward minerals (Hem, 1970). Most natural waters have pH values between 5.0 and 9.0 (National Academy of Sciences, National Academy of Engineering, 1973, p. 80; hereafter referred to as NASNAE), but the range of minimum and maximum pH recommended for public water supplies is 6.5-8.5 (EPA, 1977c, p. 17146). Corrosion commonly is associated with pH values less than 6.5. Water with pH values greater than 8.5 may taste bitter. The impact of pH on water use varies, depending on overall water chemistry. Importance of pH to groundwater chemistry is reported in many texts, including those by Krauskopf (1967) and Freeze and Cherry (1979).

Median and range values for 1982 pH data in the study area are as follows:

Area	Median	Range
Upper	6.6	6.0-7.8
Lower	7.5	6.7-9.1
Upper and lower	7.1	6.0-9.1

Water from deep wells completed in Quaternary and Tertiary sediments in the study area generally has the highest pH. Water from shallow wells completed in alluvium and older sediments in the upper area generally has the lowest pH.

Highest 1982 pH (9.1) is in water from wells 62 and 81; lowest pH (6.0) is in water from wells 14, 36, and 41 (table 8). Water samples from 20 wells (pre-1982 and 1982 data) have pH values that exceed the Federal drinking water limit.

Alkalinity indicates the capacity of water to neutralize acid and therefore is a measure of the chemical ability of water to resist a pH change. In most natural water, alkalinity is produced chiefly by bicarbonate and carbonate ions and is expressed as concentrations of bicarbonate plus carbonate as $CaCO_3$.

High alkalinity concentrations are not considered a health hazard but are generally associated with high pH values, hardness, and excessive dissolved solids. Water that contains alkalinity concentrations of 400 mg/L or more may have an unpleasant, bitter taste (NASNAE, 1973, p. 54). Alkalinity of water used for municipal and manufacturing supplies is important because it affects the amounts of chemical additives needed for coagulation, softening, and control of corrosion in distribution systems and manufacturing processes.

Median and range values, in milligrams per liter, for 1982 alkalinity data in the study area are as follows:

Area	Median	Range
Upper	57	16-110
Lower	160	72-510
Upper and lower	84	16-510

Water from moderately deep wells completed in older sediments in the lower area generally has the highest alkalinity. Water from shallow wells completed in alluvium and older sediments in the upper area generally has the lowest alkalinity. Highest 1982 alkalinity (510 mg/L) is from well 51 and the lowest (16 mg/L) is from well 41. Alkalinity concentrations exceed 400 mg/L in pre-1982 and 1982 samples from wells 51, 56, and 60.

Ranges of hardness values (1982 data) and hardness values exceeding 300 mg/L, pH values exceeding drinking water limits, and alkalinity values exceeding 400 mg/L for pre-1982 and 1982 data are shown in figure 9.

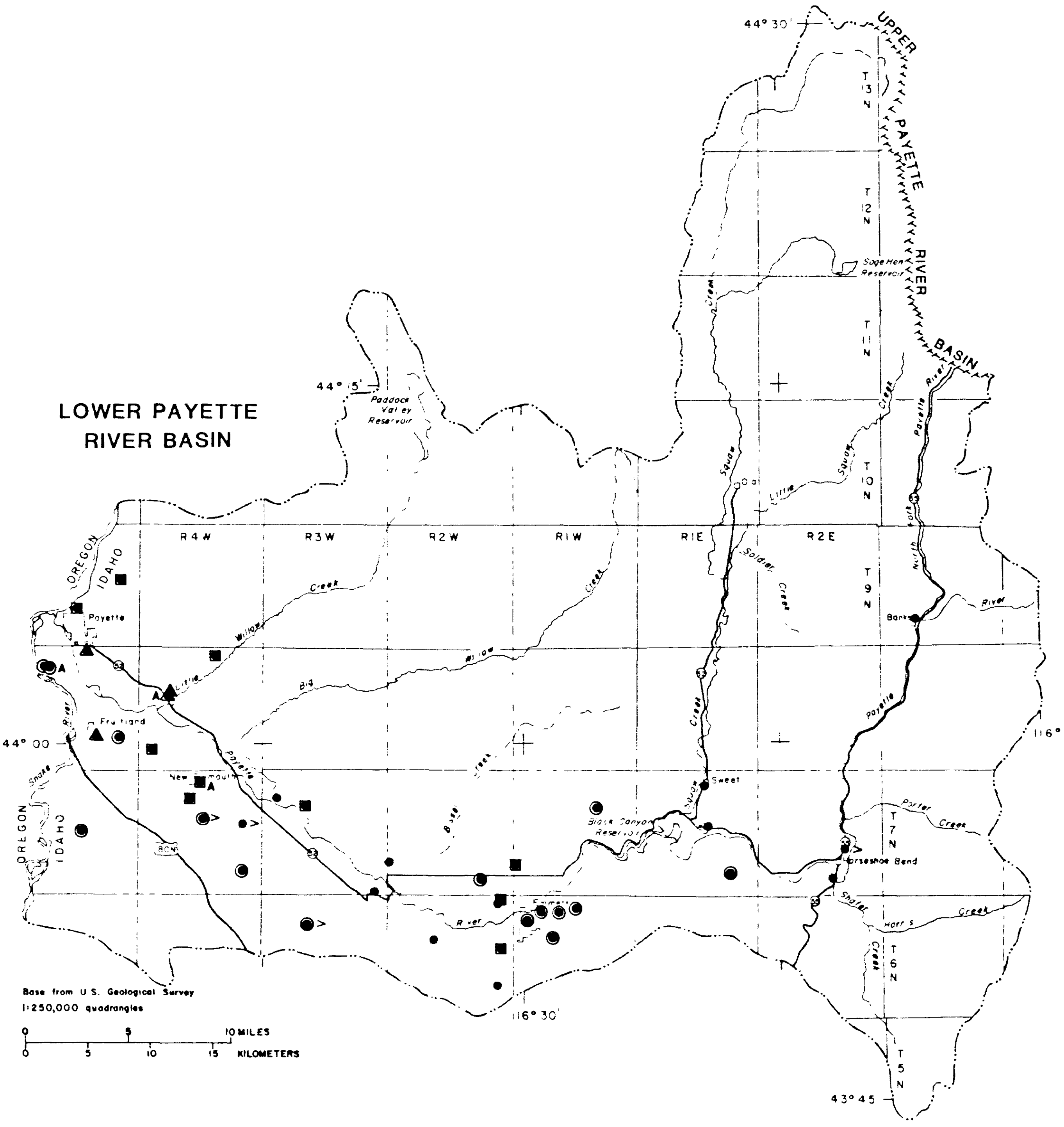
Nitrite Plus Nitrate as Nitrogen, Sulfate, Chloride, and Fluoride

Anion components of concern to ground-water users in the study area include bicarbonate, nitrite plus nitrate as nitrogen, sulfate, chloride, and fluoride. Bicarbonate is a major component in calculating alkalinity and dissolved-solids concentrations. Dissolved nitrite plus nitrate (reported in milligrams per liter dissolved nitrogen, hereafter referred to collectively as nitrate-nitrogen) or fluoride concentrations are not significant quantitatively (generally less than 8 mg/L nitrate-nitrogen and less than 3 mg/L fluoride) but may be physiologically unacceptable for drinking water use. Concentrations of sulfate and chloride may be major components of excessive dissolved solids and may be esthetically or physiologically unacceptable for many water uses (table 6). In localized areas, nitrate-nitrogen, sulfate, and fluoride concentrations exceed maximum drinking water limits.

The maximum public drinking water limit of 10 mg/L nitrate-nitrogen (EPA, 1977b, p. 5) is based on poisonings of infants who ingested high concentrations of nitrogen compounds. Nitrate-nitrogen in ground water may be dissolved from natural sources such as atmospheric nitrogen, decaying plants, and soluble compounds or minerals in soils and rock materials. Natural sources are usually minor contributors of nitrogen to most ground water. Anomalous concentrations of nitrate-nitrogen may be an indication of man-caused contamination. In the study area, potential man-caused sources of nitrate-nitrogen in water supplies are septic-tank effluent, crop and lawn fertilizers, feedlots, garbage dumps, landfills, and municipal and manufacturing wastes.

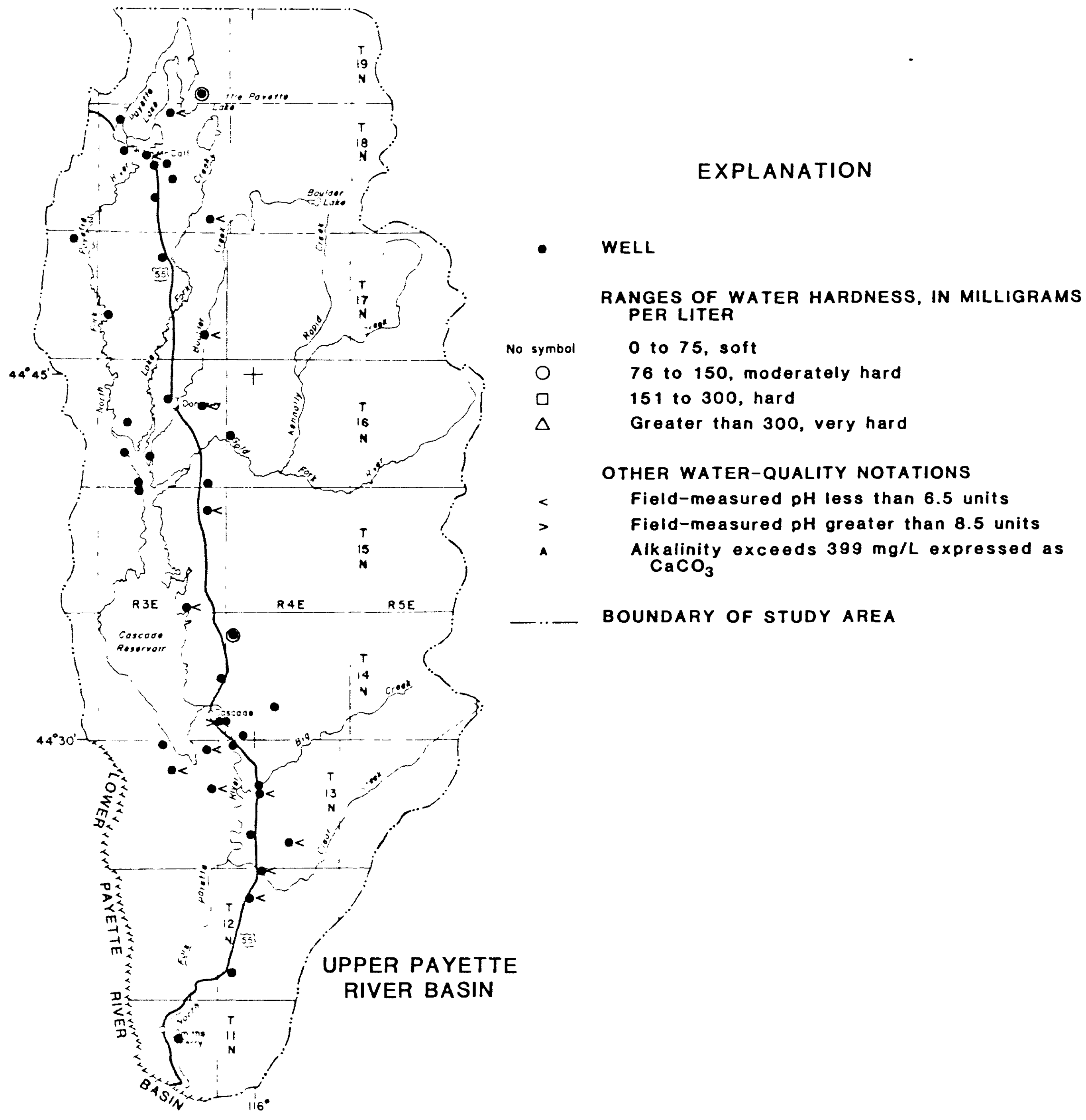
Median and range values, in milligrams per liter, for 1982 nitrate-nitrogen data in the study area are as follows:

Area	Median	Range
Upper	0.18	<0.1-7.1
Lower	.58	<.1-16
Upper and lower	.2	<.1-16



Base from U.S. Geological Survey 1:250,000 quadrangles

Figure 9.--Ranges of hardness, and pH and alkalinity



exceeding specified levels, pre-1982 and 1982 data.

Nitrate-nitrogen concentrations from well 57 (16 mg/L) exceeds the drinking water limit, and sample concentrations from wells 14 and 50 exceed 5.4 mg/L (upper 5 percent of 1982 data).

Highest median concentrations of nitrate-nitrogen are in water from moderately deep wells completed in older sediments in the lower area. Lowest median concentrations are generally in water from deep wells completed in Quaternary and Tertiary sediments in the upper area. Comparatively high concentrations in upper and lower areas may be due to contamination from land-use activities.

Fluoride in ground water is dissolved from soluble compounds or minerals in rocks. Low concentrations of fluoride help reduce dental cavities, especially in children. Significantly high concentrations of fluoride in drinking water, however, may produce mottling of teeth or bone damage. Effects of varying fluoride concentrations in drinking water are discussed in detail by EPA (1977a).

Optimum fluoride concentrations in a community water supply are determined by the local annual average maximum daily air temperature because the amount of water that children drink (the amount of fluoride ingested) depends largely on air temperature. Based on an annual average maximum daily air temperature of 53 °F (11.5 °C) for the upper area and 63.5 °F (17.5 °C) for the lower area (National Oceanic and Atmospheric Administration, 1977-81), maximum public drinking water limits for fluoride are 2.4 mg/L and 1.9 mg/L, respectively.

Median and range values, in milligrams per liter, for 1982 fluoride data in the study area are as follows:

Area	Median	Range
Upper	0.1	<0.1-2.5
Lower	.5	.1-11
Upper and lower	.3	<.1-11

Highest median concentrations are in water from shallow wells completed in older sediments in the lower area. The highest fluoride concentration is from a deep well (75) completed in batholith rocks in the lower unit. Lowest median concentrations are in water from shallow wells completed in older sediments in the upper area.

Pre-1982 and 1982 fluoride concentrations from well 27 (2.5 mg/L) and well 28 (3.8 mg/L) in the upper area and well 75 (11 mg/L) and well 83 (2.4 mg/L) in the lower area exceed drinking water limits (table 8).

Maximum public drinking water limits of 250 mg/L sulfate and 250 mg/L chloride (EPA, 1977c) are based on possible adverse esthetic and physiological effects on users. At concentrations exceeding 300 mg/L, sulfate may cause a detectable taste. At concentrations above 600 mg/L, dissolved sulfate may have laxative effects (EPA, 1977c, p. 17146). Dissolved chloride in concentrations as low as 100 mg/L may produce a salty taste in water (McKee and Wolf, 1963, p. 161-163). Sulfate and chloride in ground water may be dissolved from soluble compounds or minerals in rocks or may be from sources such as septic-tank effluents, landfill leachates, or agricultural, municipal, or manufacturing wastes.

Median and range values, in milligrams per liter, for 1982 sulfate and chloride data in the study area are as follows:

Area	Median	Range
	Sulfate	
Upper	<5	<5-21
Lower	19	<5-540
Upper and lower	5.5	<5-540
	Chloride	
Upper	1.2	0.3-12
Lower	7.3	1.1-210
Upper and lower	2.7	.3-210

Highest 1982 concentrations of sulfate and chloride are in water from shallow or moderately deep wells completed in older sediments or Quaternary and Tertiary sediments in the lower area. Lowest 1982 concentrations are in water from deep wells completed in Quaternary and Tertiary sediments in the upper area.

Pre-1982 and 1982 sulfate concentrations from wells 56 and 57 exceed the drinking water limit (250 mg/L). Chloride concentrations do not exceed the drinking water limit (250 mg/L) but approach the limit in a sample from well 57 (210 mg/L). Although concentrations of sulfate and chloride are generally low in the study area, they are important to water quality because increases in either concentration with time may indicate ground-water contamination.

Ranges of nitrate-nitrogen concentrations (1982 data) and concentrations of nitrate-nitrogen, sulfate, chloride, and fluoride exceeding specified levels in pre-1982 and 1982 data are shown in figure 10. Ranges of nitrate-nitrogen concentrations, based on percentage of the total 1982 data population, emphasize areas where concentrations do not exceed the drinking water limit but may be high. Nitrate-nitrogen concentrations greater than 1.8 mg/L represent the upper 25 percent of 1982 data; greater than 3.7 mg/L, the upper 10 percent of data; greater than 5.4 mg/L, the upper 5 percent of data; and greater than 9.9 mg/L, the upper 1 percent of data and the drinking water limit. Levels of dissolved sulfate and chloride concentrations emphasize the upper 5 percent of data rather than the drinking water limit.

Dissolved Solids, Iron, Manganese, and Zinc

Dissolved-solids concentrations are calculated as the sum of major cations (calcium, magnesium, sodium, and potassium) and anions (carbonate, bicarbonate, fluoride, nitrate, sulfate, and chloride) plus silica. Dissolved-solids concentrations are listed under "Solids, sum of constituents, dissolved" in table 8.

The most common natural source of dissolved solids (hereafter referred to as solids) in ground water is solution of minerals from soils and rocks. Localized variations in solids concentrations may be caused by differences in rock composition or may indicate possible ground-water contamination. Solids concentrations in ground water may be increased by infiltration of irrigation-return flow, wastewater disposal, or leachates from solid waste. A high solids concentration may influence the acceptability (on the basis of taste thresholds) of water for use and often is associated with the presence of excessive cation or anion concentrations that would be esthetically or otherwise objectionable to the consumer.

Occasionally, major cation or anion components necessary for solids calculations were not analyzed or were present in concentrations less than the minimum laboratory reporting value. For example, about 47 percent of 1982 sulfate concentrations in the study area were reported as

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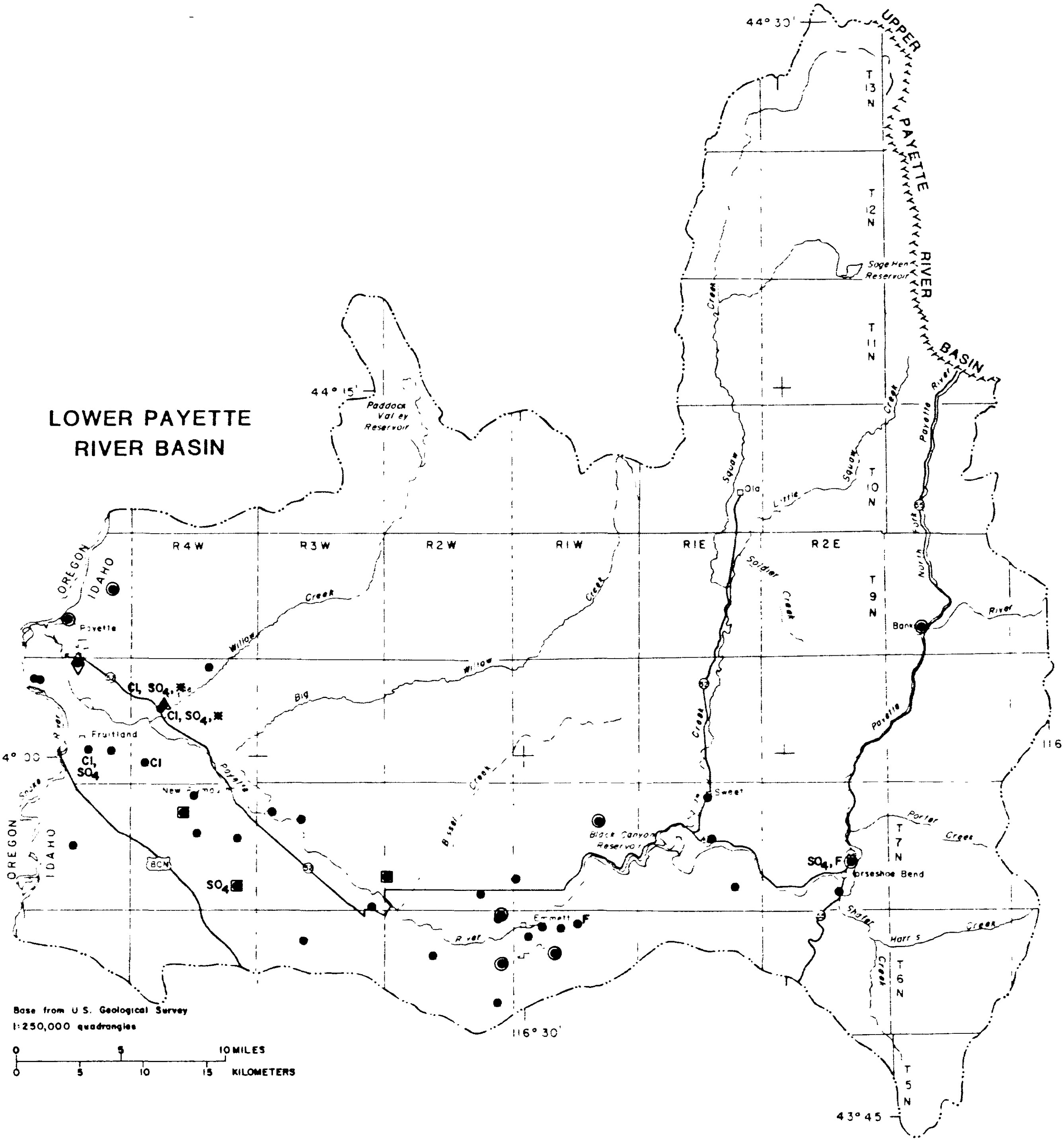
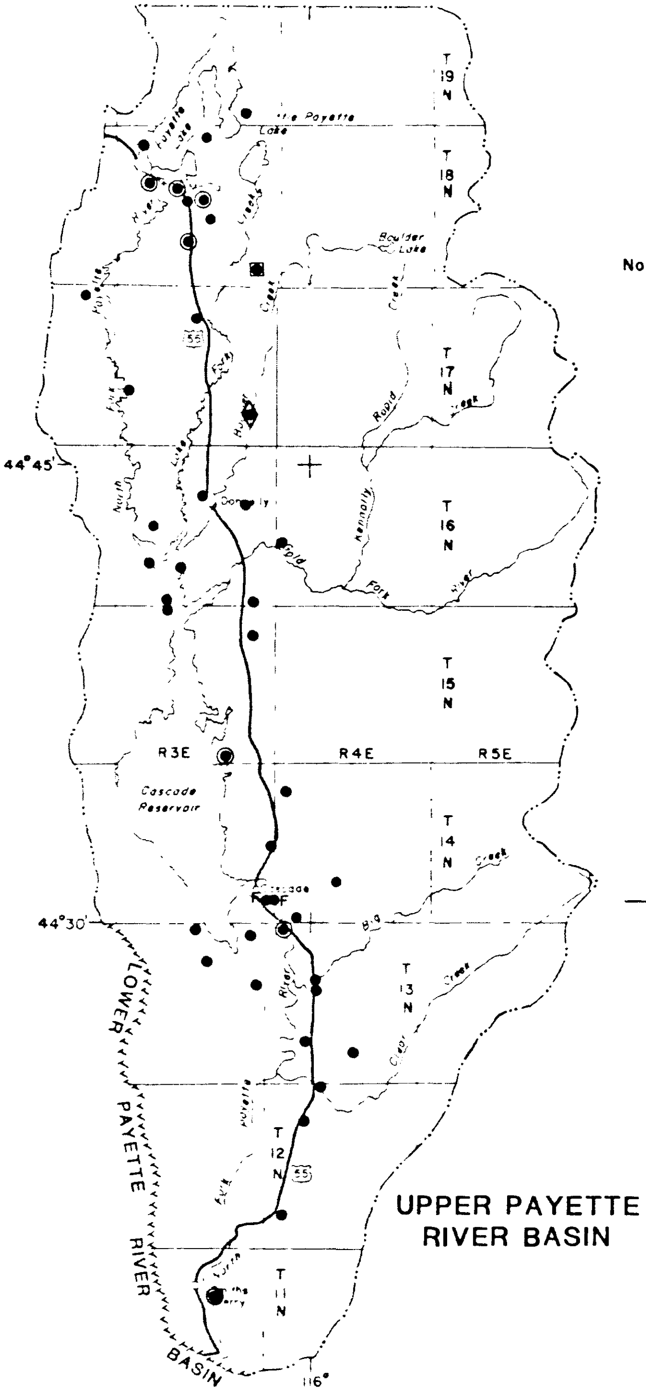


Figure 10.--Ranges of dissolved nitrate-nitrogen chloride, sulfate, and fluoride exceeding



EXPLANATION

●	WELL
	CONCENTRATION OF DISSOLVED NITRATE-NITROGEN, IN MILLIGRAMS PER LITER, AND SIGNIFICANCE TO WATER USE
No symbol	Less than 1.9, background concentrations
○	1.9 to 3.7, suitable for all uses
□	3.8 to 5.4, suitable for most uses
◇	5.5 to 9.9, anomalously high, but suitable for most uses
△	10 or higher, unsuitable for domestic or public supply except with treatment
Cl	DISSOLVED CHLORIDE EXCEEDS 39 mg/L (UPPER 5 PERCENT OF DATA POPULATION)
SO_4	DISSOLVED SULFATE EXCEEDS 77 mg/L (UPPER 5 PERCENT OF DATA POPULATION)
✱	DISSOLVED CONSTITUENT EXCEEDS 250 mg/L SULFATE DRINKING WATER LIMIT (U.S. ENVIRONMENTAL PROTECTION AGENCY, 1977b)
F	DISSOLVED FLUORIDE EXCEEDS 2.3 mg/L (UPPER AREA) OR 1.8 mg/L (LOWER AREA) (U.S. ENVIRONMENTAL PROTECTION AGENCY, 1977a)
—··—	BOUNDARY OF STUDY AREA

concentrations (1982 data), and dissolved specified limits (pre-1982 and 1982 data).

less than 5 mg/L (minimum laboratory reporting value for sulfate). All 1982 analyses include specific conductance values, however, and when necessary components are not available for solids calculation, solids can be approximated from specific conductance by application of an empirical method--concentrations of solids generally should be from 0.55 to 0.75 times the value of specific conductance (Hem, 1970, p. 235). The solids/specific conductance ratio for 1982 data (derived from available solids and specific conductance values for both the upper and lower areas) is 0.67.

By using the 0.67 ratio, specific conductance values may be used to approximate the degree of mineralization of ground water in the area relative to the Federal drinking water limit of 500 mg/L solids (EPA, 1977c, p. 17145). The following ranges of specific conductance are approximately equivalent to ranges of solids in this report: 0-373 µmhos/cm (0-250 mg/L solids), ground water has relatively low dissolved mineral concentrations; 374-746 µmhos/cm (251-500 mg/L solids), ground water is moderately mineralized; and greater than 746 µmhos/cm (greater than 500 mg/L solids), ground water is highly mineralized and exceeds the drinking water limit.

Median and range values, in micromhos per centimeter, for 1982 specific conductance data in the study area are as follows:

Area	Median	Range
Upper	116	43-212
Lower	389	159-2,310
Upper and lower	180	43-2,310

Water from moderately deep wells completed in Quaternary and Tertiary sediments in the lower area has the highest median specific conductance value. Water from shallow wells completed in alluvium or older sediments in the upper area has the lowest median specific conductance value.

Pre-1982 and 1982 samples from wells 50, 51, 54, 56, 57, and 60 in the lower area have specific conductance values that exceed 746 µmhos/cm (table 8). Seven additional samples (1982 data) from wells in the lower area have anomalously high specific conductance values, 600 µmhos/cm or greater (400 mg/L solids or greater), the upper 5 percent of the 1982 data population.

Highly mineralized water in the study area generally is caused by variations in aquifer composition rather than ground-water contamination and is the result of high concentrations of a few components discussed previously: calcium, sodium, bicarbonate, or sulfate. In addition to these cations and anions, highly mineralized water may result from excessive concentrations of a few metallic trace elements, particularly dissolved iron, manganese, and zinc.

Median and range values, in micrograms per liter, for 1982 iron, manganese, and zinc concentrations in the study area are as follows:

Area	Median	Range
	Iron	
Upper	130	<3-7,200
Lower	16	<3-1,800
Upper and lower	35	<3-7,200
	Manganese	
Upper	29	<1-1,000
Lower	12	<1-3,200
Upper and lower	21	<1-3,200
	Zinc	
Upper	49	<3-1,100
Lower	30	<3-3,200
Upper and lower	36	<3-3,200

Water from wells completed in Quaternary and Tertiary sediments in the upper area has the highest median concentrations of dissolved iron and manganese. Water from deep wells completed in Quaternary and Tertiary sediments and batholith rocks in the upper area has the highest median concentrations of dissolved zinc. Lowest concentrations of dissolved metallic trace elements are in water from wells in older sediments in the lower area.

Most concentrations of metallic trace elements are probably the result of geologic conditions of the area. Concentrations of dissolved iron exceed the maximum public drinking water limit of 300 μg/L (micrograms per liter), or 0.3 mg/L (EPA, 1977c, p. 17146) in pre-1982 and 1982 samples from 16 wells in the upper area and 5 wells in the lower area (24 percent of pre-1982 and 1982 data population). Concentrations of dissolved manganese exceed the maximum public drinking water limit of 50 µg/L (0.05 mg/L, EPA, 1977c, p. 17146) in samples from 15 wells in the upper area and 13 wells in the lower area (32 percent of pre-1982 and 1982 data population). Concentrations of dissolved zinc do not exceed the maximum public drinking water limit of 5,000 µg/L (5 mg/L, EPA, 1977c, p. 17146) but are comparatively high in samples from wells 5 (1,100 µg/L, 1.1 mg/L), 25 (1,000 µg/L, 1.0 mg/L), 34 (910 µg/L, 0.91 mg/L), and 39 (710 µg/L, 0.71 mg/L) in the upper area, and well 48 (3,200 µg/L, 3.2 mg/L) in the lower area (table 8).

Ranges of specific conductance (1982 data), and specific conductance exceeding 746 µmhos/cm, concentrations of dissolved iron and manganese exceeding drinking water limits, and anomalously high concentrations of dissolved zinc (pre-1982 and 1982 data) are shown in figure 11.

Radiochemical Data

Radioactive substances in water are of public concern because the effects of radioactivity, from natural or man-caused sources, are generally considered harmful to health (EPA, 1976a, 1976b, 1977a, 1977b). In 1982, samples for gross alpha and gross beta radiochemical analyses were collected from 9 wells in the upper area and 10 wells in the lower area to provide a base of data for the study area. Sample locations are shown and radiochemical data are compared in figure 12. The symbol "<" used with radiochemical data in figure 12 indicates minimum laboratory detection limits. The maximum public drinking water limit established for gross alpha radioactivity is 7.4 µg/L as natural uranium, and the limit for gross beta radioactivity is 50 pCi/L (picocuries per liter) as cesium-137 (Britton and others, 1983, p. 60).

Although some places in the upper area were historically placer mined for radioactive heavy minerals (Schmidt and Mackin, 1970), no radiochemical data trends are evident. Where laboratory data exceed minimum detection limits, values for gross alpha and gross beta radioactivity are generally higher in the lower area than in the upper area.

In the lower area, gross alpha values range from less than 2.0 to 92 µg/L as natural uranium, and gross beta values range from less than 1.1 to 16 pCi/L as cesium-137.

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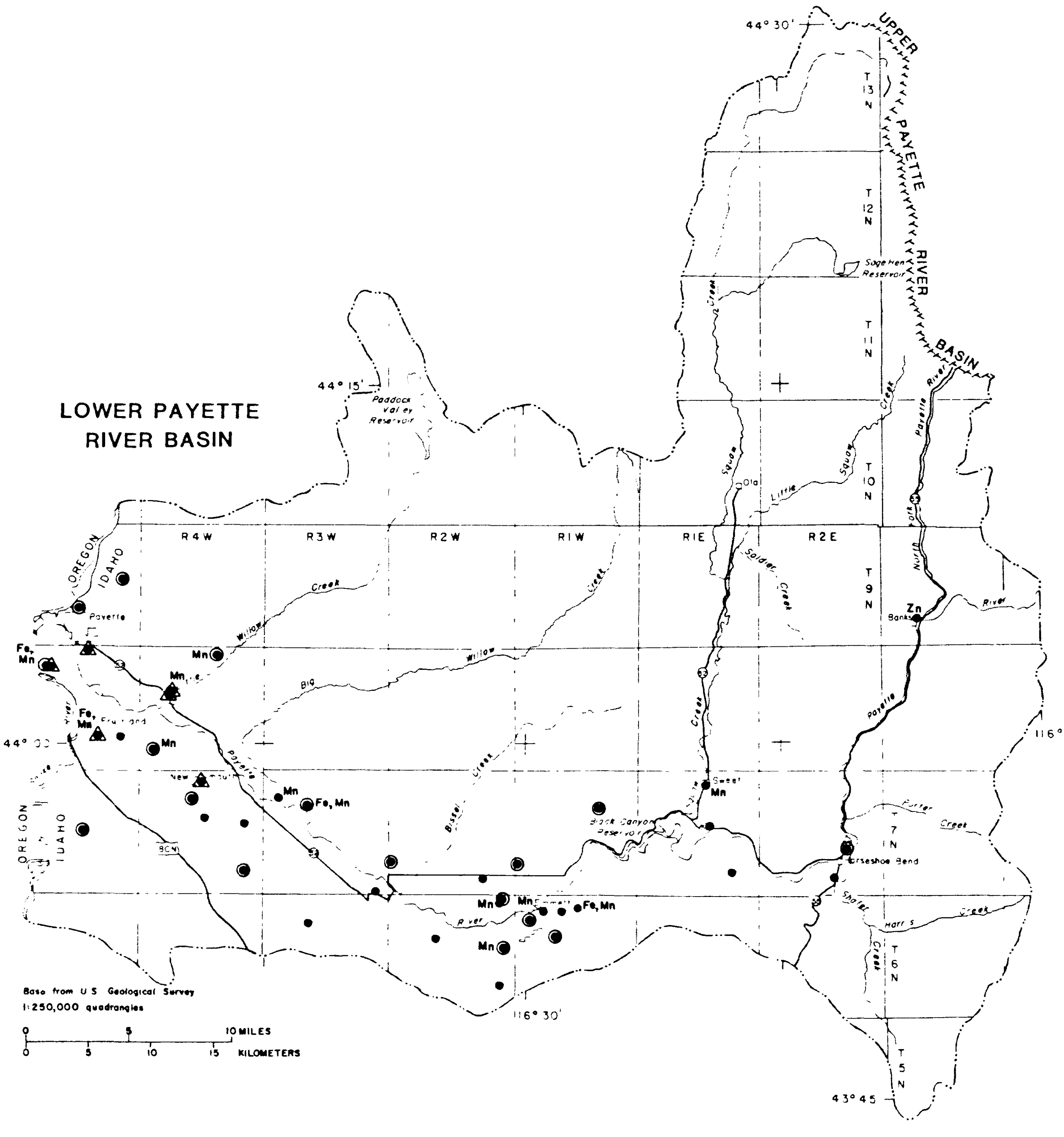
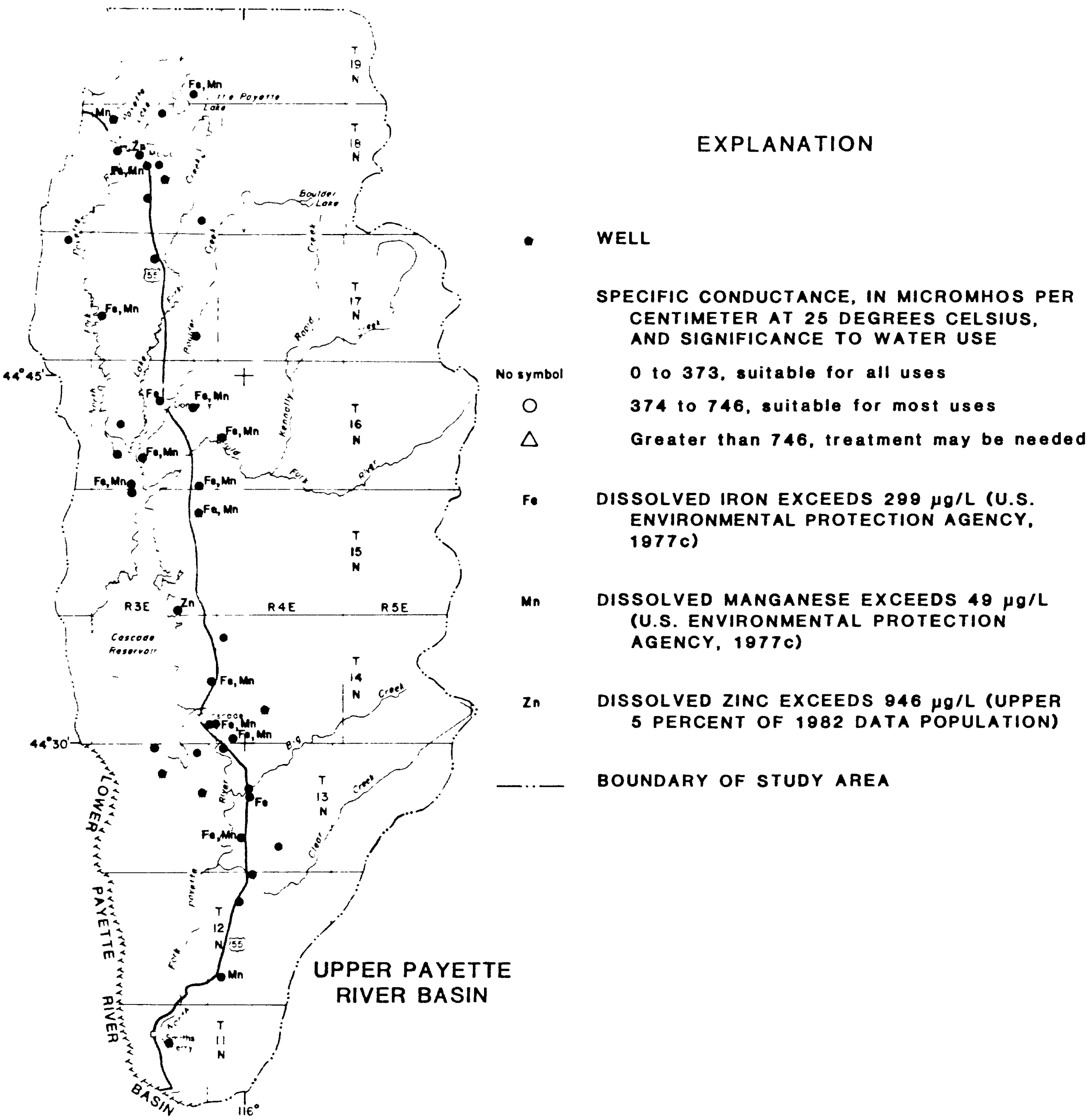


Figure 11.--Ranges of specific conductance and zinc exceeding specified



(1982 data), and dissolved iron, manganese,
levels (pre-1982 and 1982 data).

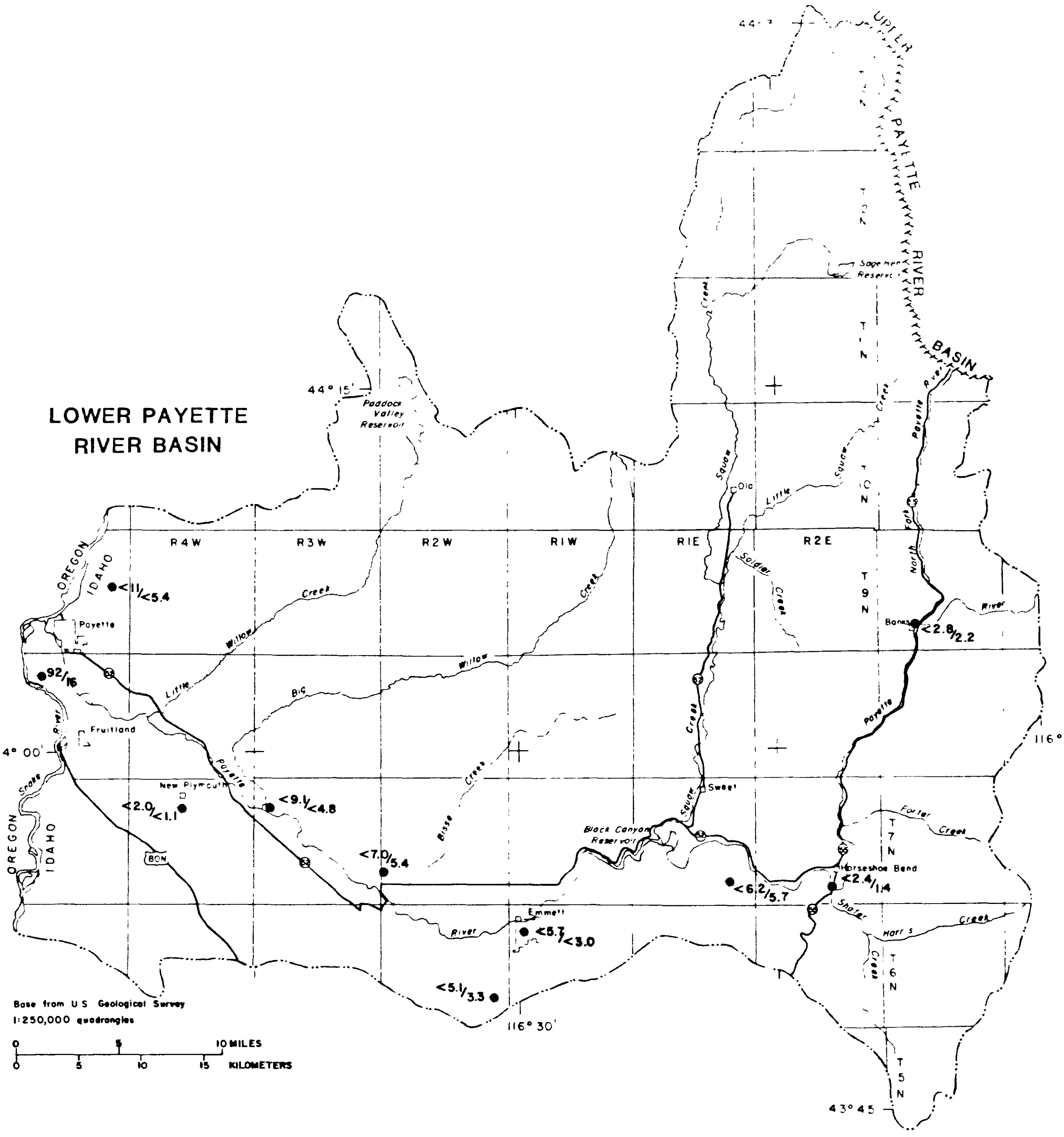
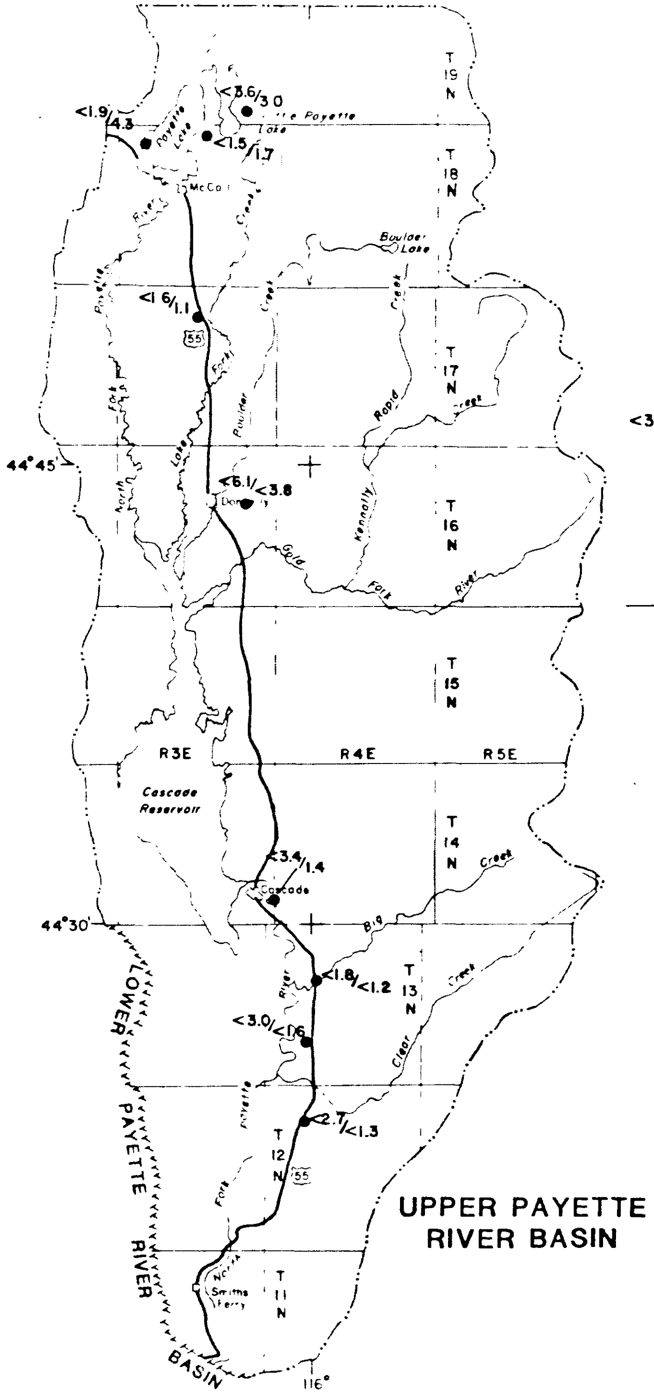


Figure 12.--Gross alpha and gross



EXPLANATION

$<3.6/3.0$ ● **WELL**--Upper number is dissolved gross alpha in micrograms per liter as natural uranium. Lower number is dissolved gross beta in picocuries per liter as cesium-137; < indicates minimum laboratory detection limit

—··— **BOUNDARY OF STUDY AREA**

beta radiochemical data, 1982.

Gross alpha values increase from Emmett to Payette and are generally higher near the foothills than in the valley. Gross beta values are relatively consistent in the lower area.

The maximum public drinking water limit for gross alpha radioactivity is exceeded in samples from wells 46, 51, and 65 in the lower area. Values from two wells are unusually high (51) or unusually low (61), compared with other analyses from the lower area. Causes of these unique radiochemical values, particularly the very high ones, are not evident.

Variations in Water-Quality Characteristics with Time

Each analysis listed in table 8 represents the quality of water in a small part of an aquifer at a particular instant in time. Ground-water quality is not constant, and a comparison of pre-1982 and 1982 data for a particular sampling site may show temporal change in one or more characteristics.

Short-term changes most often are due to seasonal fluctuations in volume or quality of recharge to aquifers. Long-term changes are the result of varying volume or quality of recharge to aquifers and are observed as trends in data over extended periods of time (several years or more). Trends may show improvement or degradation in water quality but, in most instances, reflect the effects of changing land- and water-use practices.

Nine of the 87 wells listed in tables 7 and 8 have been resampled since 1974. All wells with pre-1982 and 1982 data are in the lower area, and each well was resampled once. Comparative quality of water for each site is shown in figure 13 by means of percent difference between sums of pre-1982 and 1982 concentrations of nitrate-nitrogen, sulfate, and chloride. A positive percent difference indicates an overall increase in constituent concentrations between first and second sampling; a negative percent difference indicates a decrease in constituent concentrations. Variations in concentrations at most sites probably are due to changing natural conditions, but comparatively large variations may be due to contamination from local land- and water-use practices.

Agricultural Water Supplies

Major agricultural uses of ground water in the study area are for livestock and irrigation. Concentrations

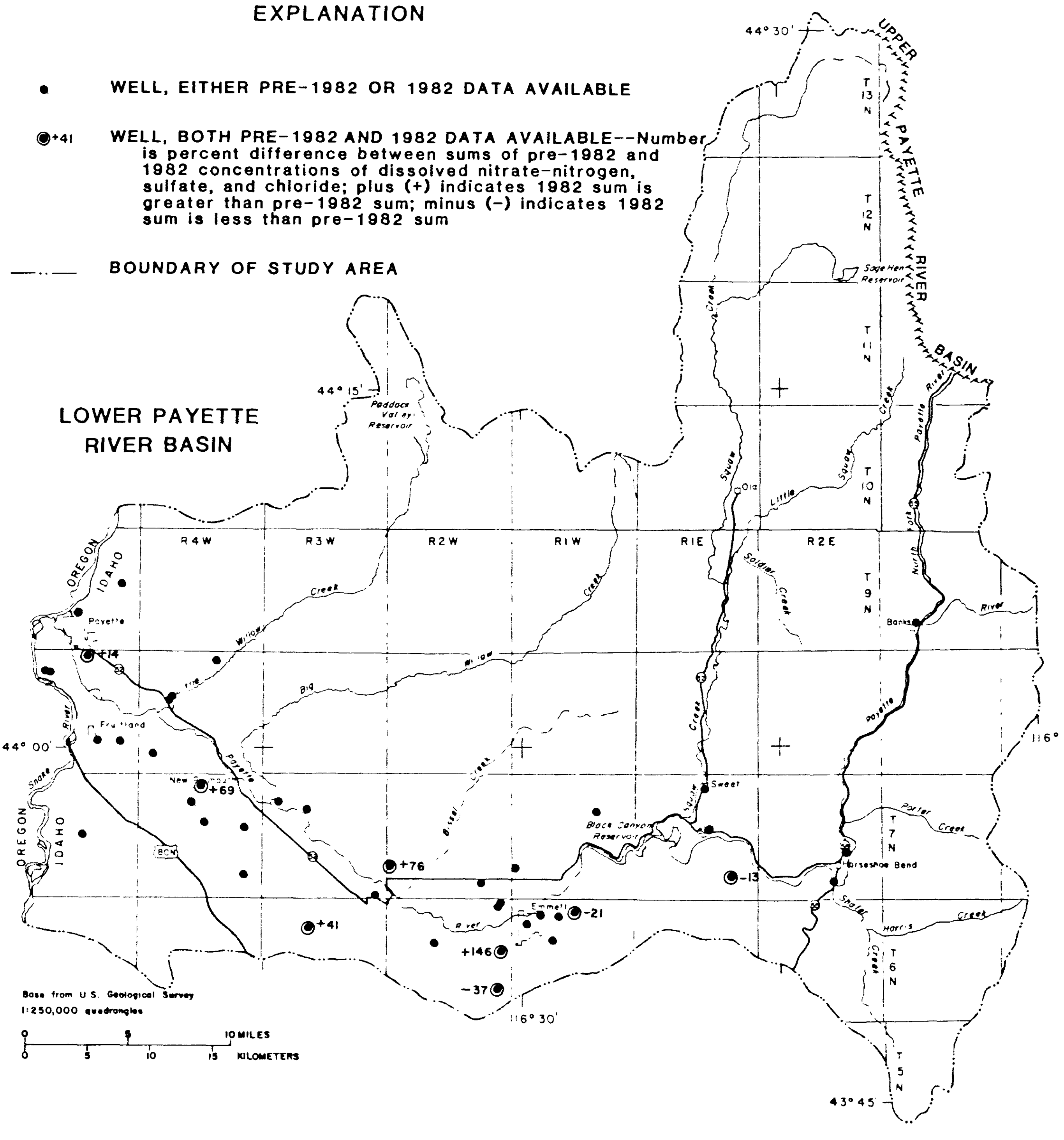


Figure 13.--Locations of wells with pre-1982 and 1982 water-quality data, and percent difference between sums of pre-1982 and 1982 concentrations of selected constituents, lower area.

of dissolved solids, salinity, and alkalinity are within tolerance levels for most livestock uses in 1982 (Todd, 1970; NASNAE, 1973). Fluoride concentrations exceed the recommended limit of 2 mg/L for livestock drinking water (NASNAE, 1973, p. 312) in a few samples (table 8 and fig. 10), but wells that contain high fluoride concentrations generally are not used for stock watering.

In semiarid areas such as the valleys and foothills of the Payette River basin, irrigation water quality is influenced by dissolved-solids concentration and relative proportion of sodium to other cations.

On the basis of specific conductance and sodium-adsorption ratio, the U.S. Salinity Laboratory Staff (Richards, 1954) developed a general classification to illustrate salinity and sodium (alkali) hazards of irrigation water. The suitability of ground water for irrigation in the study area, based on this classification, is shown in figure 14.

Most ground water in the study area has low or medium salinity hazard and low sodium hazard for irrigation uses. In the upper area, salinity and sodium hazards are low. Short growing seasons in mountain valleys of the upper area limit most irrigated agriculture to grazing pasture or hay crops. In the lower area, salinity hazard ranges from low to high, and sodium hazard is generally low. Use of highly mineralized ground water (medium or high salinity and sodium hazards) for irrigation in the lower area may be limited to salt-tolerant plants in areas that have adequate drainage for soil-salinity control management (Richards, 1954).

SUMMARY

From July to October 1982, water-quality, geologic, and hydrologic data were collected for 74 wells in the Payette River basin. Pre-1982 ground-water quality and well-inventory data were compiled for 13 wells in the area.

The study area comprises about 2,100 mi^2, in parts of Valley, Boise, Gem, Payette, and Washington Counties in west-central Idaho. The area is divided into upper and lower Payette River areas on the basis of tributary drainages to the Payette River, topography, and geology. The upper area consists of the North Fork Payette River drainage and is characterized by north- or northwest-trending mountains and deep, intermontane valleys. The lower area

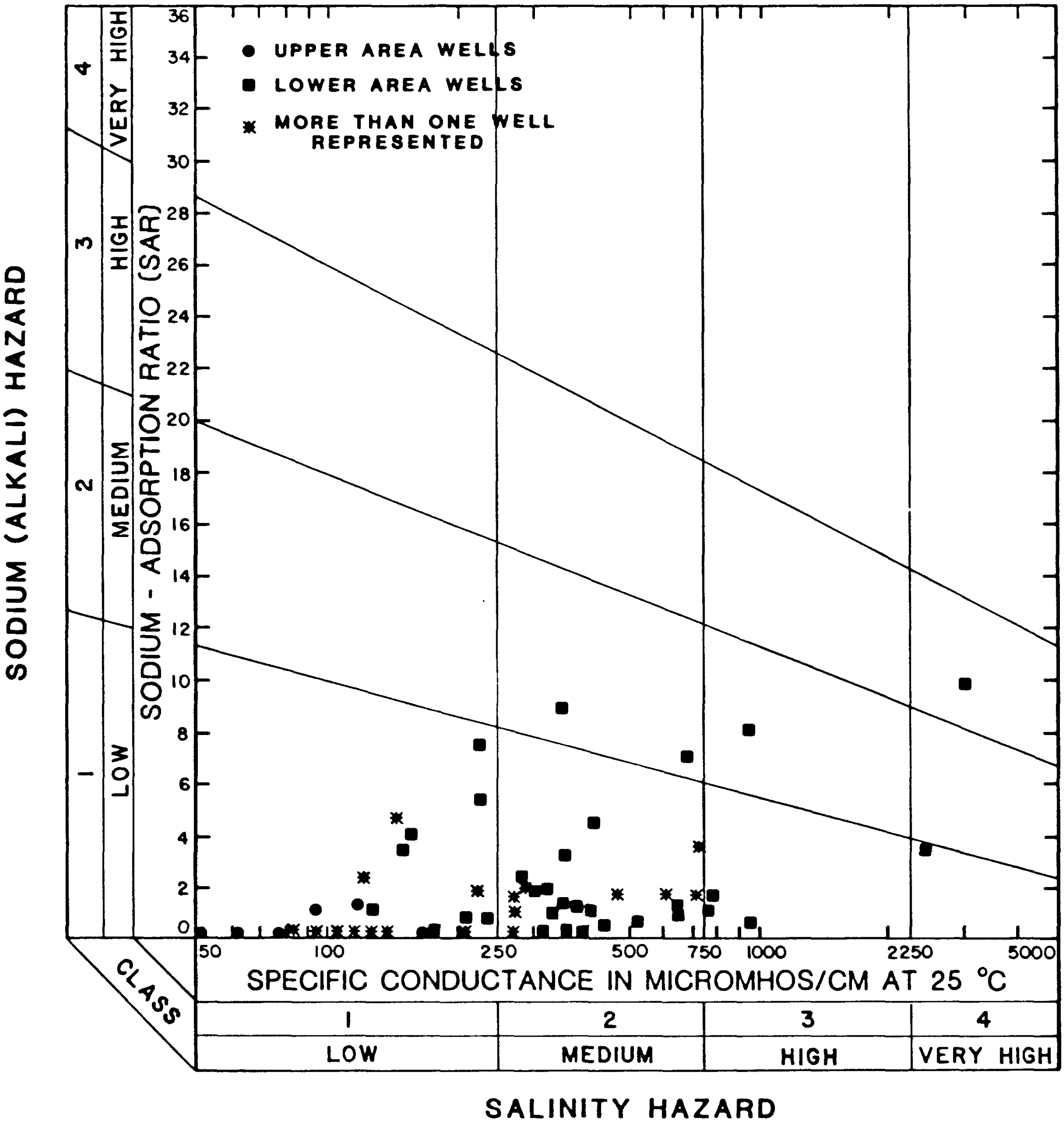


Figure 14.--Salinity and sodium hazards of irrigation water in the Payette River basin, pre-1982 and 1982 data.

consists of the main Payette River drainage and is characterized by a broad, east-west trending valley flanked by steep-sloped foothills and buttes.

Climate varies with land-surface altitude, relief, and direction of prevailing winds. Higher altitudes have more precipitation, colder winters, and cooler summers than lower altitudes.

Population density is greater in the lower area than in the upper area. Economy is based on irrigated agriculture, livestock production, tourism and seasonal recreation activities, wood-product manufacturing, and mining.

Geologic units (rock units) in the area include Quaternary alluvium and surficial deposits; Quaternary older alluvium, terrace and glacial deposits; Quaternary and Tertiary lake, stream, and associated volcanic deposits; Tertiary Columbia River Basalt Group; Cretaceous Idaho batholith and related rocks; and pre-Cretaceous rocks. Structural geology is complex, particularly in the upper area, where structure is dominated by several major north- and northeast-trending fault systems and graben valleys.

Most rock units in the area contain some ground water. Recharge to aquifers in the foothills and mountains is primarily from infiltration of precipitation. Recharge to aquifers in the valley lowlands is primarily from infiltration from rivers, streams, irrigation canals, reservoirs, applied irrigation water, or precipitation. Directions of regional ground-water movement generally approximate the directions of surface-water flow. Water under confined conditions probably moves in about the same directions as water in unconfined conditions.

A generalized summary of current water-quality trends follows: Highest median values of many constituents are most commonly in water from moderately deep wells completed in older sediments in the lower area. Maximum concentrations of constituents are most commonly in water from moderately deep or deep wells completed in Quaternary and Tertiary sediments in the lower area. Maximum temperature and highest concentrations of dissolved fluoride, boron, and zinc are in water from batholith rocks and deep wells. Lowest median values and minimum concentrations are most commonly in water from various aquifers in the upper area. Exceptions are: highest median values of dissolved silica, phosphorus, iron, and manganese are in water from Quaternary and Tertiary sediments in the upper area; lowest median values and minimum concentrations of dissolved silica, phosphorus, iron, manganese, and zinc are in water from various aquifers in the lower area.

Ground water contains predominantly calcium, magnesium, and bicarbonate plus carbonate ions; in a few areas, sodium and bicarbonate or sulfate are the predominant ions. Water from the upper area has lower ion concentrations than water from the lower area, and water from shallow or moderately deep wells generally has lower ion concentrations than water from deep wells. Variations in water composition probably are most affected by differences in aquifer composition and proximity to source(s) of recharge.

Ground water in the study area is suitable for most uses and, in general, contains low to moderate concentrations of hardness, dissolved solids, and metallic trace elements such as iron, manganese, and zinc. In localized areas, the ground water contains water-quality constituents that may concern water users or that could restrict some uses of the water. These constituents include hardness, pH, alkalinity, dissolved solids, or dissolved nitrite plus nitrate as nitrogen, sulfate, fluoride, iron, or manganese.

In the upper area, gross alpha and gross beta radioactivity values are generally low; the highest gross alpha value is from a well sample in an area historically placer mined for radioactive heavy minerals. In the lower area, gross alpha and gross beta values are slightly higher overall than in the upper area. Values for gross alpha exceed the maximum public drinking water limit in samples from three wells. One sample has a uniquely high radioactivity value, but causes of this anomaly are not evident.

A comparison of the percent difference between sums of pre-1982 and 1982 concentrations of nitrate-nitrogen, sulfate, and chloride shows wide variations in ground-water quality with time. Most variations in concentrations probably are due to changing natural conditions, but some variations may be due to contamination from local land- and water-use practices.

Major agricultural uses of ground water are for livestock and irrigation. Concentrations of dissolved solids, salinity, and alkalinity are generally within tolerance levels for most agricultural uses. Fluoride concentrations in a few samples exceed the recommended limit of 2 mg/L for livestock drinking water.

Most ground water has low or medium salinity and low sodium hazards for irrigation uses. Use of highly mineralized ground water for irrigation may be limited to salt-tolerant plants in areas that have adequate drainage for soil-salinity control management.

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DATA TABLES

Table 7.--Well-inventory data

Well-inventory data: Geologic, well construction, and hydrologic data collected for 74 wells inventoried in 1982 and 13 wells inventoried prior to 1982 are shown. Geologic data from drillers' logs include lithologic description and thickness of geologic units penetrated. Well construction information from drillers' logs, onsite inspection, and well owners' reports includes diameter of borehole, diameter and depth of well casings, type and depth of surface seal, and type of well completion, such as perforated casing or open hole. Hydrologic data include onsite water-level measurements and well-use information.

Identification number: See figure 3 for locations of wells.

Aquifer: Map symbol and description

Qa, Quaternary alluvium
Qsg, Quaternary older sediments
QTs, Quaternary and Tertiary sediments
Tcr, Columbia River Basalt Group
Ki, Cretaceous batholith rocks

Major water-yielding zone: Code (Price and Baker, 1974), description, and map symbol

110ALVM, Quaternary alluvium	Qa
111ALVM, Holocene alluvium	Qsg
111TRRCY, Holocene younger terrace gravels	
112ALVM, Pleistocene alluvium	
112PLSC, Pleistocene Series	
112OTSH, Pleistocene outwash	
112IDHO, Pleistocene to Miocene Idaho Group	QTs
120SDMS, Tertiary sediments	
122CBRV, Miocene Columbia River Basalt Group	Tcr
211IDAH, Upper Cretaceous Idaho batholith	Ki

Lithology of major water-yielding zone(s):

Lithology abbreviations

ALVM, alluvium
BLDR, boulder
BSLT, basalt
CGLM, conglomerate
CLAY, clay
GRNT, granite
GRVL, gravel
PEA GRVL, pea gravel
ROCK, rock
SAND, sand
SDGL, sand and gravel
SHLE, shale

Modifiers

BL, blue
BR, brown
CS, coarse
DK, dark
GR, gray
LG, large
W/, with
WHT, white

Well finish:

F, gravel with perforations
O, open end
P, perforated
S, screen
X, open hole

Use(s) of well:

C, commercial
H, domestic
I, irrigation
N, industrial
P, public
S, stock

Notations and acronyms:

ab, above
bl, below
E, estimated
LSD, land surface datum
wz, water-yielding zone
--, no information
?, conflicting or questionable reported data

Table 7.--Well-inventory data

Well location		Geology			Well construction							Water level			
Well identification number	Township, range, section	Aquifer	Major water-yielding zone	Lithology of major water-yielding zone(s)	Altitude of land surface (feet above sea level)	Reported depth of well (feet below LSD)	Casing diameter (inches)	Depth to first perforation or bottom of casing (feet below LSD)	Well finish	Date of well completion	Uses of well	Date measured	Depth to water (feet below LSD)	Altitude of water level (feet above sea level)	Comments
								Upper Area							
1	19N- 3E-35ACC1	Qsg	112PLSC	CLAY	5,060	175	6	152	X	1974	H				
2	18N- 3E- 3BCD1	Tcr	122CBRV	BSLT	5,020	274	8	170	X	1958	P				
3	6DAD1	Qsg	112PLSC	SDGL W/ CLAY	5,040	161	6	80	P	1966	P				
4	15CCB1	Qsg	112PLSC	LG GRVL	5,070	67	6	66	X	1974	H				
5	16BCB1	Qsg?	112PLSC?	—	5,055	E130	—	—	—	1950's?	I				
6	16DCD1	Qsg?	112PLSC?	—	5,040	—	6	—	—	1970?	P				
7	17BBC1	Qsg	112PLSC	GRVL	5,040	171	6	160	P	1971	H	8- 5-82	47.50	4,992.50	Blue clay unit ab wz
8	22CAA1	Qsg	112PLSC	SAND	5,200	194	6	154	P	1968	P				Basalt ab, granite bl wz, faults?
9	28ACD1	Qsg	112PLSC	SDGL	5,080	100	6	60	P	1969	H				Basalt, boulders ab wz?
10	36BCD1	Qsg	112PLSC	SAND,BL CLAY	5,080	177	6	140	P	1966	H				Blue clay bl wz
11	17N- 2E- 2AAC1	Qsg	112PLSC	SDGL	4,960	100	6	80	P	1968	H	8- 5-82	30.00	4,930.00	Blue clay ab and bl wz
12	3E-10BBB1	Qsg	112PLSC	CS WHT SAND	4,975	105	8	85	P	1975	P				Gray clay bl wz
13	19DCC1	Qsg	112PLSC?	—	4,855	E104	—	—	—	1950's?	H				
14	26DDA1	Qsg	112PLSC?	—	4,890	E30	—	—	—	1966?	H				
15	16N- 3E-10CDA1	Qsg	112PLSC	—	4,868	E26	concrete and brick pit	—	—	old?	P	7-30-82	13.70	4,854.30	
16	14AAB1	QTs	120SDMS	WHT SAND	4,865	110	6	80	P	1966	H	7-30-82	2.20	4,862.80	Blue clay from 17 ft bl LSD
17	17CDD1	Qsg	112OTSH	SAND	4,845	52	6	47	X	1974	H	8-13-82	10.80	4,834.20	
18	28CAA1	Qsg	112PLSC	PEA GRVL	4,840	E100	6	—	X	1980?	H				
19	29BCD1	QTs	120SDMS	DK SAND	4,834	120.8	6	92	S	1977	P				Blue clay from 35 ft bl LSD
20	32DDB1	QTs	120SDMS	SAND	4,836	72.8	6	51.5	S	1977	P	8- 6-81	9.90	4,826.10	Blue clay from 38 to 57 ft bl LSD
21	36CCD1	QTs	120SDMS	SAND,ROCK	4,930	205	4	105	P	1978	H				Blue clay ab wz
22	4E-19CBD1	Qsg	112PLSC	CS SAND	4,860	54	6	47	P	1977	H				
23	15N- 3E- 5AAA2	QTs	120SDMS	CS SAND	4,834	54	6	44	S	1976	P				Blue clay throughout
24	12BBA1	Tcr	122CBRV	SAND,SHLE, BSLT?	5,100	272	6	135	P	1970	H				Blue clay throughout
25	15N- 3E-35CCB1	Ki	211IDAH	GRNT	4,836	100.5	6	75	P	1976	P				
26	14N- 3E-24AAA1	QTs	120SDMS	—	4,780	E100	—	—	—	—	H,P	8-12-82	12.80	4,767.20	
27	36AAD1	QTs	120SDMS	BL GRVL	4,760	226	12	206	S	1977	N				Blue clay from about 30 ft bl LSD
28	36ABD1	Qa	110ALVM	—	—	—	—	—	—	—	H				
29	4E- 7BBA1	Ki	211IDAH	GRNT	4,860	64	6	38	X	1973?	H	8-12-82	25.60	4,834.40	
30	28BDD1	Qsg	112PLSC	SAND	4,880	50	6	37	P	1977	H				Blue clay ab wz
31	31DDA1	Qsg	112PLSC	SDGL	4,760	73	6	40	P	1978	H				No blue clay reported
32	13N- 3E- 1BDC1	Qsg	112PLSC	GRVL	4,900	95	6	86	P	1973	H				Granite basement
33	3BAB1	Qsg	112PLSC	BLDR,CGLM	4,960	131	8	55	P	1976	P				
34	10ADD1	Qsg	112PLSC	BLDR,SAND	5,000	80	6	28	X	1978	H				
35	13AAC1	Qsg	112PLSC	SDGL	4,800	98	6	18	F	1979	H	8-19-82	14.90	4,785.10	Mica in water

Table 7.—Well-inventory data—Continued

Well location		Geology			Well construction							Water level			
Well identification number	Township, range, section	Aquifer	Major water-yielding zone	Lithology of major water-yielding zone(s)	Altitude of land surface (feet above sea level)	Reported depth of well (feet below LSD)	Casing diameter (inches)	Depth to first perforation or bottom of casing (feet below LSD)	Well finish	Date of well completion	Uses of well	Date measured	Depth to water (feet below LSD)	Altitude of water level (feet above sea level)	Comments
								Upper Area—Continued							
36	4E- 5BBC1	Qa	110ALVM	WHT GRVL	4,735	30	6	20	P	1976	P	8-19-82	9.60	4,725.40	
37	16BBD1	Qsg	112PLSC	SDGL	4,770	95	6	75	P	1980	H				
38	16BCD1	Qsg	112PLSC	—	4,800	E120	6	—	—	—	H				
39	27CDB1	Ki	211IDAH	GRNT	4,920	192	8	41	X	1973	P				
40	29ADA1	QTs	120SDMS	—	4,720	E126	—	—	—	1970's?	H	8-25-82	18.90	4,701.10	Deepened from 86 ft
41	12N- 4E- 4BAB1	Qa	110ALVM	—	4,740	E30	—	—	—	—	H				
42	8ACC1	Qsg	111ALVM	GRNT,SAND	4,775	54	6	30	P	1966	H				
43	30DCA1	QTs	120SDMS	BL GRVL	4,788	87	6	87	O	1972	H				
44	11N- 3E-11CCC1	Qsg	112PLSC	BR SAND	4,560	115	6	45	P	1978	H,P	8- 6-82	1.30	4,558.70	Granite basement
								Lower Area							
45	10N- 4E-34CCA1	Ki	211IDAH	GRNT,SAND	3,280	221	6	198.5	X	1979	P	8-15-81	154.00	3,126.00	
46	9N- 5W-13CCB1	Qsg	111TRRCY	WHT SAND	2,195	88	6	83	S	1966	H	10-14-82	56.20	2,138.80	
47	27DAA1	Qsg	111TRRCY	GRVL,SAND	2,182	69	6	69	O	1972	H	8-28-75	45.55	2,136.45	
48	3E-28CBD1	Ki	211IDAH	GRNT	2,800	107	6	78	S	1977	H,P				
49	9N- 4E-15BDD1	Qsg	112PLSC	—	3,040	E90	—	—	—	1957?	C				
50	8N- 5W- 3BAD1	Qsg	111ALVM	—	2,156	25.5	12	—	—	—	I,P	8-28-75	7.76	2,148.24	
51	8BAA1	QTs	112IDHO	BL CLAY	2,140	220	6	87	X	1969	H				
52	8BAA2	Qsg	111ALVM	SDGL	2,140	E40	4	—	—	—	I				
53	26BCC1	Qsg	111TRRCY	SDGL	2,223	47.5	6	47.5	O	1970	I	8-28-75	14.65	2,208.35	
54	27ADD1	Qsg	111TRRCY	—	2,210	E30	4	30	O	1950's?	H,I				
55	4W- 3ACD1	QTs	112IDHO	BL SAND	2,335	183	5	129	P	1964	H				
56	17BDA1	Qsg	112ALVM	ALVM	2,195	18	48	18	O	1950's?	I	10-10-75	7.96	2,187.04	
57	17BDA2	QTs	112IDHO	BL CLAY	2,200	122	6	110	X	1976	S	10-13-82	23.20	2,176.80	
58	30DCA2	QTs	112IDHO	—	2,215	E60	6	—	—	1980?	H	10-15-82	15.14	2,209.86	
59	7N- 5W-15CDC1	QTs	112IHDO	GR SAND	2,350	206	6	202	X	1978	H				
60	4W- 3CBB1	Qsg	111TRRCY	SDGL	2,245	31.5	6	27	P	1973	H	10-15-82	11.10	2,233.90	
61	9ACB1	Qsg	111TRRCY	SDGL	2,272	62	10	45	F	1961	I				
62	13CBB1	QTs	112IDHO	SAND	2,280	137	6	135	X	1977	H	10-15-82	9.60	2,270.40	Blue clay ab wz
63	15BDC1	QTs	112IDHO	BL CLAY	2,320	167	6	157	X	1973	H	10-10-75	39.70	2,280.30	
64	25CCC1	QTs?	112IDHO?	—	2,400	E100	—	—	—	—	H				
65	3W- 7ACD1	QTs	112IDHO	SAND	2,225	65	4	63	X	1958	H	10-10-75	-12.40	2,237.40	Blue clay 18 to 65 ft bl LSD
66	9CBC1	QTs	112IDHO	SAND	2,335	195	6	194	X	1978	H	10-18-82	70.90	2,264.10	Blue clay and sand interbeds
67	36CDD1	QTs	112IDHO	—	2,285	E82	4	—	—	1966	H				
68	2W-30BCC1	Qsg	111TRRCY	—	2,370	E120	8	80	P	1981	P				
69	35ABA1	QTs	112IDHO	SDGL	2,451	99.8	36	99.8	O	1940's	H				
70	1W-11CBD1	Tcr	122CBRV	BSLT	2,300	130	8	18	X	1980?	H	10-20-82	70.85	2,239.15	
71	30CAB1	Qsg	111TRRCY	GRVL	2,500	71	6	71	O	1973	H	10- 8-75	52.40	2,447.60	Brown clay ab wz
												10- 8-82	44.30	2,455.70	
72	1E- 3CAA1	QTs	112IDHO	BL SHLE	2,555	E120	6	105	X	1977	H	10-20-82	31.00	2,524.00	
73	7N- 1E-15DBD1	QTs	112IDHO	SAND	2,600	128	4	95	X	1962	H				Blue clay 94 to 128 ft bl LSD
74	26DDB1	QTs	112IDHO	SDGL	2,695	400	10	160	F	1965	H	10- 9-75	61.40	2,633.60	
												10- 5-82	41.60	2,653.40	
75	2E-23CAC1	Ki	211IDAH	GRNT	2,720	392	6	159	X	1978	H				

Table 7.—Well-inventory data—Continued

Well location		Geology			Well construction							Water level			
Well identification number	Township, range, section	Aquifer	Major water-yielding zone	Lithology of major water-yielding zone(s)	Altitude of land surface (feet above sea level)	Reported depth of well (feet below LSD)	Casing diameter (inches)	Depth to first perforation or bottom of casing (feet below LSD)	Well finish	Date of well completion	Uses of well	Date measured	Depth to water (feet below LSD)	Altitude of water level (feet above sea level)	Comments
								Lower Area—Continued							
76	34ABD1	Qsg	112ALVM	—	2,600	47	6	—	—	—	P	10-21-82	9.00	2,591.00	
77	6N- 3W- 9BCD1	QTs	112IDHO	SAND	2,598	282	6	276	X	1973	H				
78	2W- 1BBD1	Qsg	111TRRCY	SAND	2,420	95	6	79	P	1975	H				
79	1BDD2	Qsg	111TRRCY	—	2,410	E120	6	—	—	—	H,S				
80	13CAA1	Qsg	111ALVM	GRVL	2,353	29	6	29	O	1973	H	10- 8-75	8.25	2,344.75	
												10- 6-82	8.60	2,344.40	
81	16BBA1	QTs	112IDHO	SAND	2,315	180	4	180	O	1953	H				
82	25BDB1	Qsg	111TRRCY	GRVL	2,430	39	6	39	O	1974	H	10- 8-75	22.60	2,407.40	
												10- 8-82	21.50	2,408.50	
83	1W- 3CBB1	Qsg	111TRRCY	GRVL	2,435	33	6	33	O	1973	H	10- 7-82	14.90	2,420.10	
84	4CCD1	Qsg	111TRRCY?	—	2,390	E30	4	—	—	1950's?	H				
85	5CDD1	QTs	112IDHO	SAND,CLAY	2,380	188	18	142	S	1975	P				
86	7AAC1	QTs	112IDHO	SAND,CLAY	2,370	202	24	157	S	1973	P				
87	9CCC1	QTs?	112IDHO?	—	2,405	385	6	373	X	Pre-1941	H				

Table 8.--Water-quality data

Concentrations of chemical constituents are reported in MG/L (milligrams per liter) or UG/L (micrograms per liter). One milligram equals 1,000 micrograms. Milligrams and micrograms, within the range of values presented, are numerically equal to parts per million and parts per billion. Temperature is expressed in DEG C (°C, degrees Celsius); specific conductance in UMHOS (micromhos per centimeter at 25 °C); and gross beta radioactivity as PCI/L (picocuries per liter). Alkalinity, calculated dissolved solids, and SAR (sodium-adsorption ratio) values are computed according to equations given in a report by the U.S. Geological Survey (1983, p. 23-24).

Well location: Township, range, and section

Identification number: See figure 3 for location of wells.

County:

015, Boise County
045, Gem County
075, Payette County
085, Valley County

Date of sample: Year, month, and day

Major water-yielding zone: Code (Price and Baker, 1974), description, and map symbol

110ALVM, Quaternary alluvium	Qa
111ALVM, Holocene alluvium	Qsg
111TRRCY, Holocene younger terrace gravels	
112ALVM, Pleistocene alluvium	
112PLSC, Pleistocene Series	
112OTSH, Pleistocene outwash	
112IDHO, Pleistocene to Miocene Idaho Group	QTs
120SDMS, Tertiary sediments	
122CBRV, Miocene Columbia River Basalt Group	Tcr
211IDAH, Upper Cretaceous Idaho batholith	Ki

Agency collecting sample:

9801, private agency
--, no information, but if "Agency analyzing sample" is 80020 (Denver Central Laboratory), then the agency collecting sample is probably the U.S. Geological Survey

Agency analyzing sample:

9801, private laboratory
80020, Denver Central Laboratory, U.S. Geological Survey, Colorado
--, data not available

Notations and chemical abbreviations:

CS-137, cesium-137
FET-FLD, fixed endpoint titration--field determination
SR/YT-90, strontium/yttrium-90
U-NAT, natural uranium
E, estimated or reported
<, less than
--, not analyzed for or data not available
0, analyzed for but not detected

Table 8.--Water-quality data

IDEN-TIFI-CATION NUMBER	WELL LOCATION	COUNTY	DATE OF SAMPLE	MAJOR WATER YIELDING ZONE	DEPTH OF WELL, TOTAL (FEET)	TEMPER-ATURE (DEG C)	PH (STAND-ARD UNITS)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L)
UPPER AREA:											
1.	19N 03E 35ACC1	085	82-07-27	112PLSC	175	9.0	6.5	201	197	170	146
2.	18N 03E 03BCD1	085	82-07-28	122CBRV	274	18.0	6.3	77	81	--	90
3.	18N 03E 06DAD1	085	82-07-30	112PLSC	161	7.0	6.8	175	175	120	121
4.	18N 03E 15CCB1	085	82-08-13	112PLSC	67.00	9.0	7.0	96	98	--	97
5.	18N 03E 16BCB1	085	82-08-03	112PLSC	130	10.0	6.4	151	152	--	121
6.	18N 03E 16DCD1	085	77-11-03	112PLSC	--	9.5	7.4	92	--	92	--
7.	18N 03E 17BBC1	085	82-08-05	112PLSC	170	10.0	7.5	147	145	--	107
8.	18N 03E 22CAA1	085	82-07-28	112PLSC	194	18.0	--	117	117	--	97
9.	18N 03E 28ACD1	085	82-08-05	112PLSC	100	10.0	7.0	103	103	--	100
10.	18N 03E 36BCD1	085	82-07-30	112PLSC	177	9.0	6.1	114	116	--	95
11.	17N 02E 02AAC1	085	82-08-05	112PLSC	112	10.0	7.5	154	152	--	91
12.	17N 03E 10BBB1	085	82-08-04	112PLSC	105	8.5	6.5	63	66	--	56
13.	17N 03E 19DCC1	085	82-08-05	112PLSC	E104	10.0	7.1	81	80	--	72
14.	17N 03E 26DDA1	085	82-08-18	112PLSC	E20.00	8.5	6.0	84	84	--	68
15.	16N 03E 10CDA1	085	82-07-30	112PLSC	E26.00	7.0	6.1	128	121	--	85
16.	16N 03E 14AAB1	085	82-07-30	120SDMS	110	9.5	6.6	212	184	170	123
17.	16N 03E 17CDD1	085	82-08-13	112OTSH	52.00	8.0	--	106	106	--	84
18.	16N 03E 28CAA1	085	82-08-04	112PLSC	--	8.0	6.8	108	100	110	80
19.	16N 03E 29BCD1	085	77-09-08	120SDMS	120	7.0	7.7	110	--	--	--
		085	82-08-06	120SDMS	121	8.0	7.0	109	112	--	--
20.	16N 03E 32DDB1	085	82-08-06	120SDMS	90.00	11.0	6.8	132	134	--	59
21.	16N 03E 36CCD1	085	82-08-12	120SDMS	205	13.0	6.5	116	117	180	128
22.	16N 04E 19CBD1	085	82-08-18	112PLSC	54.00	8.0	6.7	128	115	--	105
23.	15N 03E 05AAA2	085	82-08-04	120SDMS	54.00	10.5	7.4	171	175	--	140
24.	15N 03E 12BBA1	085	75-12-02	122CBRV	272	--	6.3	180	--	200	--
25.	15N 03E 35CCB1	085	82-08-03	211IDAH	101	9.0	6.2	118	122	--	104
26.	14N 03E 24AAA1	085	82-08-12	120SDMS	--	10.0	6.8	136	125	140	113
27.	14N 03E 36AAD1	085	82-08-12	120SDMS	226	20.0	7.1	185	194	--	135
28.	14N 03E 36ABD1	085	72-08-03	110ALVM	--	42.5	9.2	254	--	220	--
29.	14N 04E 07BBA1	085	82-08-12	211IDAH	64.00	8.0	7.6	194	201	--	138
30.	14N 04E 28BDD1	085	82-08-18	112PLSC	50.00	9.0	6.8	120	122	--	91
31.	14N 04E 31DDA1	085	82-08-18	112PLSC	73.00	9.5	6.9	122	124	--	107
32.	13N 03E 01BDC1	085	75-12-02	112PLSC	95.00	--	6.4	100	--	120	--
33.	13N 03E 03BAB1	085	82-08-17	112PLSC	131	11.0	6.6	103	105	120	84
34.	13N 03E 10ADD1	085	82-08-17	112PLSC	68.00	8.0	6.4	127	129	--	92
35.	13N 03E 13AAC1	085	82-08-19	112PLSC	98.00	12.0	6.5	76	82	--	79
36.	13N 04E 05BBC1	085	82-08-19	110ALVM	30.00	11.5	6.0	104	96	85	80
37.	13N 04E 16BBD1	085	82-08-19	112PLSC	E95.00	9.0	6.5	46	48	--	61
38.	13N 04E 16BCD1	085	75-12-02	112PLSC	120	--	6.4	--	--	120	--
39.	13N 04E 27CDB1	085	82-08-25	211IDAH	192	9.0	6.2	94	96	120	75

Table 8.--Water-quality data--Continued

DATE OF SAMPLE	OXYGEN, DIS- SOLVED (MG/L)	BICAR- BONATE FET-FLD (MG/L AS HCO3)	CAR- BONATE FET-FLD (MG/L AS CO3)	ALKA- LINITY FIELD (MG/L AS CACO3)	ALKA- LINITY LAB (MG/L AS CACO3)	HARD- NESS (MG/L AS CACO3)	HARD- NESS, NONCAR- BONATE (MG/L CACO3)	CALCIUM DIS- SOLVED (MG/L AS CA)	MAGNE- SIUM, DIS- SOLVED (MG/L AS MG)	SODIUM, DIS- SOLVED (MG/L AS NA)	SODIUM AD- SORP- TION RATIO (SAR)	POTAS- SIUM, DIS- SOLVED (MG/L AS K)
82-07-27	1.6	130	0	110	104	84	0	22	7.0	6.4	0.3	3.5
82-07-28	2.2	39	0	32	35	28	0	7.5	2.2	3.3	.3	1.6
82-07-30	--	95	0	78	72	51	0	12	5.0	8.3	.5	4.5
82-08-13	11.0	41	--	--	34	33	33	7.3	3.6	4.3	.3	2.7
82-08-03	10.6	76	0	62	64	57	0	14	5.3	4.9	.3	4.9
77-11-03	--	43	0	35	--	33	0	8.1	3.0	5.5	.4	1.9
82-08-05	.7	89	0	73	75	49	0	12	4.6	6.8	.4	5.4
82-07-28	8.2	73	--	--	62	44	44	10	4.7	5.0	.3	3.5
82-08-05	12.0	46	0	38	40	36	0	9.6	3.0	4.6	.3	2.1
82-07-30	10.0	37	0	30	33	39	9	11	2.7	6.3	.5	.90
82-08-05	.6	95	0	78	79	52	0	14	4.2	10	.6	2.2
82-08-04	--	33	0	27	30	23	0	6.3	1.7	3.9	.4	.70
82-08-05	1.0	54	0	44	44	27	0	6.4	2.6	4.8	.4	1.3
82-08-18	2.7	49	0	40	44	30	0	7.7	2.7	4.7	.4	1.1
82-07-30	--	63	0	52	57	44	0	12	3.3	7.0	.5	1.2
82-07-30	.7	130	0	110	101	58	0	15	5.1	15	.9	2.3
82-08-13	1.6	76	--	--	55	38	38	9.2	3.7	7.1	.5	1.5
82-08-04	.2	68	0	56	55	34	0	9.0	2.7	7.9	.6	1.6
77-09-08	--	1	--	1	--	--	--	--	--	--	--	--
82-08-06	4.7	70	0	57	67	44	0	12	3.3	5.3	.4	1.1
82-08-06	.7	78	0	64	69	17	0	4.5	1.5	21	2	3.5
82-08-12	.0	87	0	71	50	38	0	9.8	3.4	7.4	.5	3.7
82-08-18	--	81	0	66	64	15	0	4.0	1.2	21	2	.80
82-08-04	--	88	0	72	73	10	0	2.7	.83	33	5	2.3
75-12-02	--	--	--	48	--	2	--	.13	--	20	--	5.3
82-08-03	9.6	51	0	42	46	34	0	9.4	2.6	9.9	.8	1.3
82-08-12	--	87	0	71	66	38	0	12	2.0	14	1	1.1
82-08-12	1.0	98	0	80	78	17	0	5.1	1.0	42	5	1.0
72-08-03	--	62	22	87	--	4	0	1.6	.00	58	13	.40
82-08-12	6.9	110	0	92	102	78	0	29	1.3	13	.7	.90
82-08-18	4.3	73	0	60	57	41	0	14	1.5	10	.7	.80
82-08-18	.0	72	0	59	55	45	0	13	3.0	7.6	.5	1.0
75-12-02	--	--	--	30	--	0	0	.20	.10	--	--	3.8
82-08-17	8.6	65	0	53	52	35	0	9.1	3.0	10	.8	.80
82-08-17	5.6	73	0	60	52	44	0	14	2.2	8.4	.6	1.3
82-08-19	4.0	49	0	40	30	20	0	6.3	.96	9.6	1	.70
82-08-19	1.8	41	0	34	36	29	0	8.3	2.0	8.2	.7	.60
82-08-19	6.1	26	0	21	18	11	0	2.8	.88	5.3	.7	.50
75-12-02	--	--	--	25	--	2	--	.04	--	12	--	2.1
82-08-25	5.8	57	0	47	38	23	0	7.9	.83	11	1	.90

Table 8.--Water-quality data--Continued

DATE OF SAMPLE	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	SULFATE DIS-SOLVED (MG/L AS SO4)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SILICA, DIS-SOLVED (MG/L AS SIO2)	PHOS-PHORUS, TOTAL (MG/L AS P)	BORON, DIS-SOLVED (UG/L AS B)	IRON, DIS-SOLVED (UG/L AS FE)	MANGA-NESE, DIS-SOLVED (UG/L AS MN)	ZINC, DIS-SOLVED (UG/L AS ZN)	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137)
82-07-27	<0.10	0.60	8.0	<0.10	53	0.300	20	1300	800	37	<3.6	3.0
82-07-28	.57	1.1	<5.0	<.10	30	.090	<10	56	33	150	<1.5	1.7
82-07-30	.26	2.8	8.0	.20	33	.480	20	290	350	30	<1.9	4.3
82-08-13	3.6	.40	<5.0	.10	52	.120	<10	5	1	51	--	--
82-08-03	1.9	2.3	<5.0	<.10	51	.110	<10	4	1	1100	--	--
77-11-03	3.1	.80	1.4	.10	50	.100	<20	110	--	--	--	--
82-08-05	<.10	.60	<5.0	.20	51	1.60	10	630	360	36	--	--
82-07-28	<.10	.60	<5.0	<.10	51	.120	<10	4	6	58	--	--
82-08-05	2.2	1.6	<5.0	<.10	43	.450	<10	3	<1	18	<1.6	1.1
82-07-30	4.8	3.9	<5.0	<.10	37	.110	<10	3	<1	14	--	--
82-08-05	<.10	.60	<5.0	.10	38	.100	<10	27	15	4	--	--
82-08-04	1.4	.30	<5.0	<.10	26	.090	<10	<3	1	71	--	--
82-08-05	<.10	.70	<5.0	<.10	37	.110	<10	960	200	8	--	--
82-08-18	7.1	1.5	<5.0	<.10	34	.040	<10	28	14	<3	--	--
82-07-30	.18	2.0	<5.0	<.10	34	.020	70	530	37	20	--	--
82-07-30	<.10	.90	14	.40	46	.880	10	5300	1000	14	<6.1	<3.8
82-08-13	<.10	1.0	<5.0	<.10	44	.030	<10	1100	48	8	--	--
82-08-04	<.10	.60	8.0	.20	47	.500	<10	2500	360	54	--	--
77-09-08	--	--	--	--	--	--	--	--	--	--	--	--
82-08-06	.22	.50	<5.0	<.10	30	.030	--	--	--	--	--	--
82-08-06	.12	.70	<5.0	.90	57	.260	80	380	63	140	--	--
82-08-12	<.10	2.1	21	.20	80	.210	<10	7200	260	250	--	--
82-08-18	1.4	3.6	<5.0	.60	52	.060	<10	4200	76	140	--	--
82-08-04	<.10	9.2	<5.0	2.1	58	.260	170	160	32	32	--	--
75-12-02	--	2.5	--	.46	--	--	--	6700	130	--	--	--
82-08-03	3.1	1.1	<5.0	<.10	40	.020	<10	30	4	1000	--	--
82-08-12	<.10	1.3	9.0	.20	55	.220	<10	3000	730	300	--	--
82-08-12	<.10	12	<5.0	2.5	62	.410	70	330	120	10	<3.4	1.4
72-08-03	.09	15	17	3.8	45	.040	--	--	--	--	--	--
82-08-12	.11	1.2	<5.0	<.10	35	.030	<10	8	6	3	--	--
82-08-18	.18	1.6	<5.0	.10	39	.070	<10	110	18	74	--	--
82-08-18	.52	1.2	<5.0	<.10	33	.060	20	490	200	7	--	--
75-12-02	--	1.9	2.0	.48	--	--	--	--	20	--	--	--
82-08-17	<.10	1.0	14	.20	50	.040	<10	<3	2	49	--	--
82-08-17	.42	1.4	<5.0	<.10	36	.080	<10	130	25	910	--	--
82-08-19	.73	2.9	<5.0	.10	48	.070	<10	13	15	150	--	--
82-08-19	1.9	3.5	5.0	.20	37	.040	<10	200	7	180	--	--
82-08-19	.28	1.3	<5.0	.10	48	.050	<10	16	8	4	<1.8	<1.2
75-12-02	--	2.5	3.0	.48	--	--	--	620	40	--	--	--
82-08-25	<.10	1.2	<5.0	.20	40	.220	<10	21	24	710	--	--

Table 8.--Water-quality data--Continued

DATE OF SAMPLE	GROSS BETA, DIS- SOLVED (PCI/L AS SR/ YT-90)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER)	AGENCY COL- LECTING SAMPLE (CODE NUMBER)
82-07-27	2.9	80020	80020
82-07-28	1.6	80020	80020
82-07-30	4.1	80020	80020
82-08-13	--	0	0
82-08-03	--	80020	80020
77-11-03	--	--	--
82-08-05	--	80020	80020
82-07-28	--	0	0
82-08-05	1.1	80020	80020
82-07-30	--	80020	80020
82-08-05	--	80020	80020
82-08-04	--	80020	80020
82-08-05	--	80020	80020
82-08-18	--	80020	80020
82-07-30	--	80020	80020
82-07-30	<3.6	80020	80020
82-08-13	--	0	0
82-08-04	--	80020	80020
77-09-08	--	--	--
82-08-06	--	80020	80020
82-08-06	--	80020	80020
82-08-12	--	80020	80020
82-08-18	--	80020	80020
82-08-04	--	80020	80020
75-12-02	--	9801	9801
82-08-03	--	80020	80020
82-08-12	--	80020	80020
82-08-12	1.4	80020	80020
72-08-03	--	--	--
82-08-12	--	80020	80020
82-08-18	--	80020	80020
82-08-18	--	80020	80020
75-12-02	--	9801	9801
82-08-17	--	80020	80020
82-08-17	--	80020	80020
82-08-19	--	80020	80020
82-08-19	--	80020	80020
82-08-19	<1.1	80020	80020
75-12-02	--	9801	9801
82-08-25	--	80020	80020

Table 8.--Water-quality data--Continued

IDEN-TIFI-CATION NUMBER	WELL LOCATION	COUNTY	DATE OF SAMPLE	MAJOR WATER YIELDING ZONE	DEPTH OF WELL, TOTAL (FEET)	TEMPER-ATURE (DEG C)	PH (STAND-ARD UNITS)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L)
40.	13N 04E 29ADA1	085	82-08-25	120SDMS	E126	11.0	6.9	110	102	110	105
41.	12N 04E 04BAB1	085	82-10-29	110ALVM	E30.00	11.0	6.0	43	45	--	38
42.	12N 04E 08ACC1	085	82-10-29	111ALVM	53.70	16.5	6.3	98	99	--	79
43.	12N 04E 30DCA1	085	82-10-29	120SDMS	87.00	9.5	7.8	168	175	--	126
44.	11N 03E 11CCC1	085	82-08-26	112PLSC	115	10.5	6.5	85	86	--	--
LOWER AREA:											
45.	10N 04E 34CCA1	015	81-03-15	211IDAH	221	--	6.4	147	147	--	140
46.	09N 05W 13CCB1	075	82-10-14	111TRRCY	88.00	15.0	7.5	609	610	380	349
47.	09N 05W 27DAA1	075	75-08-28	111TRRCY	--	14.5	7.4	736	--	450	--
48.	09N 03E 28CBD1	015	82-03-20	211IDAH	E110	22.5	6.7	192	178	120	111
49.	09N 04E 15BDD1	015	77-09-23	112PLSC	--	12.5	7.8	186	--	130	--
50.	08N 05W 03BAD1	075	75-08-28	111ALVM	25.50	16.0	7.8	650	--	410	--
		075	82-10-01	--	--	17.5	7.4	761	752	470	490
51.	08N 05W 08BAA1	075	82-10-12	112IDHO	220	14.5	7.7	963	957	620	597
52.	08N 05W 08BAA2	075	82-10-12	111ALVM	E40.00	12.5	7.2	383	388	250	232
53.	08N 05W 26BCC1	075	75-08-28	111TRRCY	47.50	16.0	8.0	262	--	190	--
54.	08N 05W 27ADD1	075	82-10-19	111TRRCY	E30.00	15.0	7.4	980	977	660	650
55.	08N 04W 03ACD1	075	82-10-14	112IDHO	183	18.0	8.0	508	521	320	300
56.	08N 04W 17BDA1	075	75-10-10	112ALVM	18.00	14.0	7.6	3000	--	2300	--
57.	08N 04W 17BDA2	075	82-10-13	112IDHO	E80.00	15.5	7.3	2310	2270	1500	1520
58.	08N 04W 30DCA2	075	82-10-15	112IDHO	E60.00	15.5	7.6	655	649	420	408
59.	07N 05W 15CDC1	075	82-10-19	112IDHO	200	16.5	7.8	418	416	290	282
60.	07N 04W 03CBB1	075	77-11-03	111TRRCY	31.50	12.5	7.3	737	--	500	--
		075	82-10-15	111TRRCY	31.50	13.5	7.3	784	783	520	360
61.	07N 04W 09ACB1	075	82-10-13	111TRRCY	62.00	16.5	7.3	0	685	440	438
62.	07N 04W 13CBB1	075	82-10-15	112IDHO	137	17.0	9.1	169	171	120	102
63.	07N 04W 15BDC1	075	75-10-10	112IDHO	167	16.0	8.6	281	--	190	--
64.	07N 04W 25CCC1	075	82-10-19	112IDHO	E100	13.5	7.2	710	721	480	476
65.	07N 03W 07ACD1	075	75-10-10	112IDHO	65.00	14.0	8.0	234	--	170	--
		075	82-10-14	112IDHO	65.00	13.5	7.6	229	235	--	144
66.	07N 03W 09CBC1	045	82-10-18	112IDHO	195	15.0	7.4	605	598	390	322
67.	07N 03W 36CDD1	045	82-10-18	112IDHO	82.00	14.5	8.3	236	254	--	147
68.	07N 02W 30BCC1	045	82-10-18	111TRRCY	--	14.5	7.6	426	431	290	291
69.	07N 02W 35ABA1	045	75-10-09	112IDHO	99.80	14.5	7.3	346	--	--	--
		045	82-10-08	112IDHO	82.00	14.5	7.2	336	335	240	243
70.	07N 01W 11CBD1	045	82-10-20	122CBRV	E195	16.0	7.6	403	407	250	247
71.	07N 01W 30CAB1	045	75-10-08	111TRRCY	71.00	14.5	7.1	281	--	190	--
		045	82-10-08	111TRRCY	71.00	15.0	6.9	396	398	260	253
72.	07N 01E 03CAA1	045	82-10-20	112IDHO	120	13.0	7.8	356	359	240	--
73.	07N 01E 15DBD1	045	82-10-29	112IDHO	128	15.5	7.4	368	369	260	253
74.	07N 01E 26DDB1	045	75-10-09	112IDHO	400	15.5	7.9	290	--	200	--

Table 8.--Water-quality data--Continued

DATE OF SAMPLE	OXYGEN, DIS-SOLVED (MG/L)	BICAR-BONATE FET-FLD (MG/L AS HCO3)	CAR-BONATE FET-FLD (MG/L AS CO3)	ALKA-LINITY FIELD (MG/L AS CACO3)	ALKA-LINITY LAB (MG/L AS CACO3)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)	SODIUM AD-SORP-TION RATIO (SAR)	POTAS-SIUM, DIS-SOLVED (MG/L AS K)
82-08-25	0.0	--	0	50	47	29	0	7.7	2.4	9.4	0.8	1.0
82-10-29	3.5	20	0	--	24	13	0	4.1	.62	6.3	.8	.80
82-10-29	3.0	59	0	48	42	26	0	8.7	1.0	8.6	.8	.80
82-10-29	.2	110	0	88	87	13	0	4.4	.44	37	5	.60
82-08-26	7.5	29	0	24	20	22	0	7.5	.90	7.5	.7	1.4
81-08-15	--	--	--	--	--	37	--	11	2.4	14	1	1.6
82-10-14	3.9	350	0	290	297	220	0	63	16	53	2	2.5
75-08-28	5.3	440	0	300	--	250	0	69	20	67	2	3.5
82-08-20	4.6	88	0	72	57	60	0	18	3.6	9.7	.6	2.8
77-09-23	--	100	0	82	--	16	0	5.5	.60	36	4	.70
75-08-28	--	320	0	262	--	250	0	65	21	41	1	11
82-10-01	5.3	370	0	300	302	310	310	82	25	39	1	14
82-10-12	.2	620	0	510	501	89	0	16	12	180	8	15
82-10-12	.2	220	--	180	178	120	0	34	9.4	33	1	2.1
75-08-28	--	160	0	128	--	90	0	18	11	18	.8	3.6
82-10-19	.1	410	0	340	330	410	67	120	26	51	1	9.5
82-10-14	.5	280	0	230	227	190	0	45	20	36	1	2.9
75-10-10	--	1090	0	894	--	560	0	120	63	570	11	11
82-10-13	2.8	460	0	380	374	740	360	170	76	240	4	9.6
82-10-15	.2	210	0	170	175	240	74	71	16	36	1	5.7
82-10-19	1.5	130	2	110	112	150	40	42	11	25	.9	3.9
77-11-03	--	500	0	410	--	180	0	46	16	120	4	1.6
82-10-15	6.4	530	0	440	435	290	0	73	25	78	2	1.7
82-10-13	2.9	360	0	290	295	230	0	63	18	66	2	4.0
82-10-15	.0	61	14	50	82	22	22	8.5	.13	31	3	.80
75-10-10	--	100	12	102	--	82	0	31	1.0	26	1	.90
82-10-19	--	330	0	270	259	150	0	40	12	110	4	2.7
75-10-10	--	160	0	130	--	56	0	16	4.0	33	2	2.2
82-10-14	--	200	0	160	123	50	0	14	3.6	32	2	2.0
82-10-18	.0	370	0	300	294	200	0	62	12	61	2	2.2
82-10-18	.8	170	0	140	127	17	0	6.6	.17	51	6	.40
82-10-18	6.2	240	0	200	194	56	0	16	3.8	81	5	2.3
75-10-09	--	220	0	180	178	130	0	35	9.3	34	1	3.2
82-10-08	7.6	200	0	160	171	110	0	31	8.4	25	1	2.9
82-10-20	.0	220	0	300	178	140	0	33	15	33	1	.80
75-10-08	--	160	0	130	--	110	0	32	8.3	15	.6	3.2
82-10-08	3.9	230	0	190	184	160	0	45	12	18	.6	3.6
82-10-20	--	230	0	190	186	16	0	6.0	.36	81	9	1.3
82-10-29	5.3	200	--	--	160	64	64	17	5.2	54	3	8.4
75-10-09	--	150	0	120	--	60	0	18	3.6	42	2	3.1

Table 8.--Water-quality data--Continued

DATE OF SAMPLE	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N)	CHLORIDE, DISSOLVED (MG/L AS CL)	SULFATE DISSOLVED (MG/L AS SO4)	FLUORIDE, DISSOLVED (MG/L AS F)	SILICA, DISSOLVED (MG/L AS SIO2)	PHOSPHORUS, TOTAL (MG/L AS P)	BORON, DISSOLVED (UG/L AS B)	IRON, DISSOLVED (UG/L AS FE)	MANGANESE, DISSOLVED (UG/L AS MN)	ZINC, DISSOLVED (UG/L AS ZN)	GROSS ALPHA, DISSOLVED (UG/L AS U-NAT)	GROSS BETA, DISSOLVED (PCI/L AS CS-137)
82-08-25	<0.10	0.60	8.0	0.30	52	0.390	<10	2600	800	150	<3.0	<1.6
82-10-29	<.10	.50	<5.0	<.10	20	.040	<10	71	29	24	--	--
82-10-29	1.2	2.9	<5.0	.10	34	.040	<10	14	15	240	--	--
82-10-29	<.10	.80	<5.0	1.9	39	.140	20	150	88	42	2.7	1.3
82-08-26	2.7	.70	<5.0	.10	39	.090	--	--	--	--	--	--
81-08-15	--	1.6	16	.30	--	--	--	6100	260	--	--	--
82-10-14	1.8	4.4	31	.30	39	.070	90	5	15	34	11	5.4
75-08-28	2.4	6.1	35	.30	35	<.010	--	<10	--	--	--	--
82-08-20	2.2	8.9	6.0	.10	25	.050	30	57	12	3200	<2.8	2.2
77-09-23	.04	1.8	3.8	1.9	35	.050	50	220	--	--	--	--
75-08-28	3.7	17	50	.50	48	.350	--	<10	--	--	--	--
82-10-01	7.6	14	59	.50	50	.380	100	<3	8	16	--	--
82-10-12	<.10	27	10	.40	56	.200	140	270	39	340	92	16
82-10-12	<.10	7.7	18	.80	31	.060	40	610	3200	16	--	--
75-08-28	.49	2.4	8.3	.50	50	.080	--	40	--	--	--	--
82-10-19	<.10	45	150	.40	58	.030	50	460	700	24	--	--
82-10-14	.38	8.8	37	.30	30	.070	40	38	87	19	--	--
75-10-10	4.8	81	870	.40	52	.320	--	<10	--	--	--	--
82-10-13	16	210	540	.20	48	.070	210	50	140	30	--	--
82-10-15	.24	67	62	.40	53	.080	40	38	960	53	--	--
82-10-19	.22	32	52	.40	54	.020	50	4	4	96	--	--
77-11-03	3.1	1.2	8.5	.60	58	.130	140	60	--	--	--	--
82-10-15	.58	1.1	20	.60	61	.130	130	3	3	13	--	--
82-10-13	3.9	21	41	.50	50	.180	100	15	17	96	--	--
82-10-15	<.10	1.5	7.0	.30	16	.050	20	31	6	23	2.0	1.1
75-10-10	<.10	13	22	.30	20	.040	--	80	--	--	--	--
82-10-19	4.1	18	78	1.2	60	<.010	130	16	6	260	--	--
75-10-10	<.10	1.6	1.1	.50	30	.100	--	30	--	--	--	--
82-10-14	<.10	2.2	<5.0	.60	34	.110	40	72	97	<3	--	--
82-10-18	<.10	8.2	33	.40	30	<.010	70	1800	430	29	9.1	4.8
82-10-18	.11	2.6	<5.0	.40	17	<.010	40	7	6	5	--	--
82-10-18	3.9	2.9	18	.80	50	.140	80	<3	2	170	--	--
75-10-09	2.0	2.0	4.6	.40	58	.160	--	<3	--	--	--	--
82-10-08	1.2	1.2	5.0	.40	67	.170	70	<3	<1	93	--	--
82-10-20	3.6	6.8	20	.30	37	.020	50	<3	4	170	--	--
75-10-08	.57	2.5	11	.40	41	<.010	--	<10	--	--	--	--
82-10-08	1.5	5.3	18	.40	45	.090	30	17	<1	33	7.0	5.4
82-10-20	<.10	2.5	7.0	.50	27	.220	60	110	76	24	--	--
82-10-29	1.7	7.3	17	.60	55	.100	40	4	3	71	--	--
75-10-09	.63	6.1	16	1.8	34	.040	--	40	--	--	--	--

Table 8.--Water-quality data--Continued

DATE OF SAMPLE	GROSS BETA, DIS- SOLVED (PCI/L AS SR/ YT-90)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER)	AGENCY COL- LECTING SAMPLE (CODE NUMBER)
82-08-25	<1.6	80020	80020
82-10-29	--	80020	80020
82-10-29	--	80020	80020
82-10-29	1.2	80020	80020
82-08-26	--	80020	80020
81-08-15	--	80020	--
82-10-14	5.3	80020	80020
75-08-28	--	--	--
82-08-20	2.1	80020	80020
77-09-23	--	--	--
75-08-28	--	--	--
82-10-01	--	0	0
82-10-12	15	80020	80020
82-10-12	--	80020	80020
75-08-28	--	--	--
82-10-19	--	80020	80020
82-10-14	--	80020	80020
75-10-10	--	--	--
82-10-13	--	80020	80020
82-10-15	--	80020	80020
82-10-19	--	80020	80020
77-11-03	--	--	--
82-10-15	--	80020	80020
82-10-13	--	0	0
82-10-15	1.1	0	0
75-10-10	--	--	--
82-10-19	--	80020	80020
75-10-10	--	--	--
82-10-14	--	80020	80020
82-10-18	4.7	80020	80020
82-10-18	--	80020	80020
82-10-18	--	80020	80020
75-10-09	--	80020	80020
82-10-08	--	80020	80020
82-10-20	--	80020	80020
75-10-08	--	--	--
82-10-08	5.2	80020	80020
82-10-20	--	80020	80020
82-10-29	--	0	0
75-10-09	--	--	--

Table 8.--Water-quality data--Continued

IDEN-TIFI-CATION NUMBER	WELL LOCATION	COUNTY	DATE OF SAMPLE	MAJOR WATER YIELDING ZONE	DEPTH OF WELL, TOTAL (FEET)	TEMPER-ATURE (DEG C)	PH (STAND-ARD UNITS)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L)
74.	07N 01E 26DDB1(continued)	045	82-10-05	112IDHO	400	14.5	7.2	309	313	220	216
75.	07N 02E 23CAC1	085	82-10-21	211IDAH	E392	14.0	8.7	641	643	380	377
76.	07N 02E 34ABD1	085	82-10-21	112ALVM	E47.00	13.0	6.9	159	162	--	97
77.	06N 03W 09BCD1	045	75-10-08	112IDHO	282	17.5	7.4	203	--	150	--
		045	82-10-05	112IDHO	282	17.0	7.5	243	247	170	166
78.	06N 02W 01BDD1	045	77-11-03	111TRRCY	--	14.0	7.1	617	--	400	--
79.	06N 02W 01BDD2	045	82-10-07	111TRRCY	E120	16.5	7.8	276	268	--	175
80.	06N 02W 13CAA1	045	75-10-08	111ALVM	29.00	14.5	7.6	294	--	280	--
		045	82-10-06	111ALVM	29.00	14.0	7.1	488	497	300	299
81.	06N 02W 16BBA1	045	82-10-21	112IDHO	E180	16.5	9.1	236	237	--	152
82.	06N 02W 25BDB1	045	75-10-08	111TRRCY	39.00	15.0	7.9	448	--	200	--
		045	82-10-08	111TRRCY	39.00	19.5	8.0	300	304	220	209
83.	06N 01W 03CBB1	045	75-10-08	111TRRCY	33.00	13.5	7.5	321	--	220	--
		045	82-10-07	111TRRCY	E33.00	15.5	7.0	289	289	200	201
84.	06N 01W 04CCD1	045	82-10-08	111TRRCY	E30.00	13.0	6.9	389	392	240	243
85.	06N 01W 05CDD1	045	77-11-03	112IDHO	--	14.0	7.1	274	--	200	--
86.	06N 01W 07AAC1	045	82-10-06	112IDHO	202	15.5	7.1	269	279	180	172
87.	06N 01W 09CCC1	045	82-10-06	112IDHO	385	16.0	7.9	376	378	250	250

DATE OF SAMPLE	OXYGEN, DIS-SOLVED (MG/L)	BICAR-BONATE FET-FLD (MG/L AS HCO3)	CAR-BONATE FET-FLD (MG/L AS CO3)	ALKA-LINITY FIELD (MG/L AS CACO3)	ALKA-LINITY LAB (MG/L AS CACO3)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)	SODIUM AD-SORP-TION RATIO (SAR)	POTAS-SIUM, DIS-SOLVED (MG/L AS K)
82-10-05	8.6	180	0	150	143	130	0	34	10	14	0.6	3.2
82-10-21	.5	130	14	110	147	53	53	14	4.3	120	7	1.5
82-10-21	.2	90	0	74	75	63	0	19	3.8	8.3	.5	.90
75-10-08	--	98	0	80	--	69	0	22	3.5	20	1	1.7
82-10-05	10.5	120	0	98	93	76	0	24	3.8	20	1	1.7
77-11-03	--	360	0	300	--	200	0	54	16	72	2	4.0
82-10-07	.2	180	0	150	138	61	0	21	2.1	37	2	2.3
75-10-08	--	280	0	230	--	110	0	33	7.7	63	3	1.6
82-10-06	.3	310	0	250	241	160	0	44	11	48	2	1.8
82-10-21	.0	95	19	78	124	10	10	3.8	.03	54	8	.40
75-10-08	--	120	0	100	--	70	0	26	1.2	33	2	1.3
82-10-08	--	170	0	140	140	64	0	23	1.6	40	2	1.4
75-10-08	--	130	0	106	--	77	0	25	3.6	38	2	3.7
82-10-07	1.1	120	0	98	104	64	0	20	3.3	34	2	3.1
82-10-08	--	170	0	140	141	110	0	32	7.6	35	1	5.0
77-11-03	--	140	0	110	--	92	0	30	4.2	31	1	2.5
82-10-06	.3	130	0	110	96	84	0	26	4.6	21	1	2.4
82-10-06	.1	120	0	98	96	130	29	47	2.3	24	1	1.5

Table 8.--Water-quality data--Continued

DATE OF SAMPLE	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	SULFATE DIS-SOLVED (MG/L AS SO4)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SILICA, DIS-SOLVED (MG/L AS SIO2)	PHOS-PHORUS, TOTAL (MG/L AS P)	BORON, DIS-SOLVED (UG/L AS B)	IRON, DIS-SOLVED (UG/L AS FE)	MANGA-NESE, DIS-SOLVED (UG/L AS MN)	ZINC, DIS-SOLVED (UG/L AS ZN)	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137)
82-10-05	1.5	4.3	14	0.40	55	0.090	20	<3	<1	51	6.2	5.7
82-10-21	3.0	38	78	11	18	<.010	390	10	1	26	--	--
82-10-21	.74	3.4	<5.0	.70	18	<.010	10	<3	2	70	2.4	1.4
75-10-08	1.1	6.7	13	.30	34	.080	--	<10	--	--	--	--
82-10-05	1.7	8.7	19	.10	37	.020	30	9	2	150	--	--
77-11-03	1.8	6.7	41	.50	29	.040	50	60	--	--	--	--
82-10-07	<.10	6.2	<5.0	.70	30	.030	60	230	69	22	--	--
75-10-08	.19	1.7	7.5	1.0	23	.050	--	90	--	--	--	--
82-10-06	3.0	4.1	16	1.2	23	.020	100	14	59	240	--	--
82-10-21	<.10	2.9	<5.0	.70	21	.030	90	4	2	--	--	--
75-10-08	.20	3.1	27	.70	43	.080	--	20	--	--	--	--
82-10-08	<.10	5.1	14	1.3	47	.060	90	24	42	4	5.1	3.3
75-10-08	.02	7.0	42	1.6	37	.010	--	440	--	--	--	--
82-10-07	<.10	5.8	33	2.4	40	.060	50	590	270	28	--	--
82-10-08	2.6	7.9	38	.90	30	.110	50	<3	4	17	--	--
77-11-03	.03	10	26	1.2	27	5.50	90	70	--	--	--	--
82-10-06	.20	8.0	30	.70	26	.030	80	160	49	21	--	--
82-10-06	<.10	11	71	.90	29	.010	30	240	170	6	5.7	3.0

DATE OF SAMPLE	GROSS BETA, DIS-SOLVED (PCI/L AS SR/YT-90)	AGENCY ANA-LYZING SAMPLE (CODE NUMBER)	AGENCY COL-LECTING SAMPLE (CODE NUMBER)
82-10-05	5.5	80020	80020
82-10-21	--	0	0
82-10-21	1.4	80020	80020
75-10-08	--	--	--
82-10-05	--	80020	80020
77-11-03	--	--	--
82-10-07	--	80020	80020
75-10-08	--	--	--
82-10-06	--	80020	80020
82-10-21	--	0	0
75-10-08	--	--	--
82-10-08	3.2	80020	80020
75-10-08	--	--	--
82-10-07	--	80020	80020
82-10-08	--	80020	80020
77-11-03	--	--	--
82-10-06	--	80020	80020
82-10-06	2.9	80020	80020

APPENDIXES

Appendix A.--Sampling Methodology

Because certain water-quality characteristics may change between sample collection and laboratory analysis, onsite determinations of the following characteristics were made: water temperature, pH, specific conductance, bicarbonate and carbonate concentrations (endpoint titration method), and dissolved-oxygen concentration (modified Winkler method). Well-inventory data collected onsite included measurements of water level and discharge.

Methods used for collection and preservation of samples, onsite water-quality determinations, and well-inventory data collection are described in reports by U.S. Geological Survey (1977) and Beetem and others (1980). Onsite equipment included Sybron/Barnstead[1] conductivity bridge, Sargent-Welch pH meter with Sensorex sealed pH probe, and Millipore 0.45-micrometer average pore-diameter cellulose nitrate membrane filters. Sample analyses were performed at the U.S. Geological Survey Central Laboratory, Denver, Colo.

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

Appendix B.--Definition of Terms

Terms related to hydrology or water-quality data, as used in this report, are defined below.

Aquifer - a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs (U.S. Geological Survey, 1984, p. 12).

Alkalinity (calculated) - alkalinity values are computed as follows (U.S. Geological Survey, 1983, p. 23-24):

Alkalinity = [(bicarbonate) + (carbonate x 2.03)] x 0.8202

Dissolved - refers to that material in a water sample that passes through a 0.45-micrometer membrane filter (U.S. Geological Survey, 1984, p. 15).

Dissolved solids (calculated) - calculated dissolved-solids values are computed as follows (U.S. Geological Survey, 1983, p. 23-24).

Calculated dissolved solids = [(alkalinity) x 0.6] + (calcium) + (magnesium) + (sodium) + (chloride) + (sulfate) + (silicate) + (dissolved potassium, nitrogen, or fluoride, when available)

(Constituent concentrations in milligrams per liter.)

Micrograms per liter (UG/L, µg/L) - a unit expressing the concentration of chemical constituents in a solution as mass (micrograms) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to 1 milligram per liter (U.S. Geological Survey, 1984, p. 16). Within the range of values presented in this report, micrograms are numerically equal to parts per billion.

Milligrams per liter (MG/L, mg/L) - a unit for expressing the concentration of chemical constituents in a solution. Milligrams per liter represent the mass of a solute (milligrams) per unit volume (liter) of water (U.S. Geological Survey, 1984, p. 16). Within the range of values presented in this report, milligrams are numerically equal to parts per million.

Picocurie (PCI, pCi) - one trillionth (1×10^{-12}) of the amount of radioactivity represented by a curie (Ci). A curie is the amount of radioactivity that yields 3.7×10^{10} radioactive disintegrations per second, or 2.22 disintegrations per minute (U.S. Geological Survey, 1984, p. 18).

Potentiometric surface - an imaginary surface representing the static head of ground water and defined by the level to which water will rise in wells (Heath, 1984).

Sodium-adsorption ratio (SAR) - the expression of relative activity of sodium ions in exchange reaction with soil; an index of sodium or alkali hazard to the soil. SAR values are defined by the equation:

$$\mathrm{SAR} = \frac{(\mathrm{Na}+)}{\sqrt{\frac{(\mathrm{Ca}{+}{+}) + (\mathrm{Mg}{+}{+})}{2}}}$$

where, Na+ (sodium), Ca++ (calcium), and Mg++ (magnesium) represent the concentrations of the respective ions, in meq/L (milliequivalents per liter), the milligrams of a constituent per liter divided by the atomic weight of the constituent and multiplied by the constituent charge.

Specific conductance - a measure of the ability of water to conduct an electric current; expressed in micromhos per centimeter at 25 °C. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids concentration of water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in micromhos per centimeter). This relation is not constant from aquifer to aquifer and may vary in the same sources with changes in the composition of water.