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HYDROLOGIC RECONNAISSANCE OF CURLEW VALLEY, UTAH AND IDAHO

by

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ABSTRACT

The Curlew Valley drainage basin which extends across the Utah-Idaho State line lies between latitude 41°40′ and 42°30′ north and longitude 112°30′ and 113°20′ west, and covers about 1,200 square miles. The valley is bounded on the west, north, and east by mountain ranges having peaks ranging from about 6,500 to nearly 10,000 feet above mean sea level, and is open to the south where it drains into Great Salt Lake.

The Utah part of Curlew Valley (Utah subbasin) covers about 550 square miles. It is an arid to semiarid, largely uninhabited area, with community centers at Snowville and Kelton. Average annual precipitation in the Utah subbasin is less than 8 inches on part of the valley floor and reaches a maximum that exceeds 35 inches on one of the highest mountain peaks. The estimated total average volume of precipitation is about 332,000 acre-feet of water a year.

The main source of water in the Utah subbasin is the ground-water reservoir in the valley fill. Confined aquifers in alluvial and lacustrine deposits and intercalated volcanic rocks in the valley fill yield several hundred to several thousand gallons of water per minute to individual large-diameter irrigation wells west of Snowville and near Kelton.

Annual recharge to the ground-water reservoir in the Utah subbasin is about 40,000 acre-feet of water, of which about 36,000 acre-feet is underflow from the Idaho part of Curlew Valley and about 3,600 acre-feet is from precipitation on the Utah part. Natural discharge from the ground-water reservoir is about 40,000 acre-feet of water annually. About 34,000 acre-feet of this amount is discharged by evapotranspiration and about 6,000 acre-feet of the discharge from Locomotive Springs flows into Great Salt Lake. Annual ground-water pumpage (nearly 10,000 acre-feet in 1966) is reflected in water-level declines in the heavily pumped areas west of Snowville and near Kelton. Recoverable water in storage in the upper 100 feet of saturated valley fill is estimated to be about 1 million acre-feet.

Measured concentrations of dissolved solids in ground water are as low as 323 mg/l (milligrams per liter) in the western part of the Utah subbasin and as high as 10,430 mg/l near Great Salt Lake. Most of the ground water in the western part of the subbasin is of suitable chemical quality for domestic supply and irrigation; some of the water in the eastern part is not of suitable chemical quality for these uses. Most of the water throughout the valley is suitable for stock use. A slight increase in the dissolved-solids content of the water withdrawn from wells near Snowville during recent years suggests that pumping has induced the upward movement of highly mineralized water from a deeper to a more shallow aquifer. Thus the ultimate quantity of ground water that can be withdrawn from the Utah subbasin may depend on the chemical quality of the ground water.

INTRODUCTION

Purpose and scope of the investigation

This report is the fifth in a series of reports prepared by the U. S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights, that describe the water resources of selected basins in western Utah. Previously published reports in this series are listed on page 35 and the areas covered by them are shown in figure 1. The purpose of this report is to present available hydrologic data on the Utah part of Curlew Valley, to provide an evaluation of the potential water-resource development of the valley, and to identify needed studies that would help provide an understanding of the valley's water supply.

The investigation on which this report is based was made during the period July to December 1967 and consisted largely of a study of existing geologic and hydrologic data for the valley. These data were supplemented by data collected during brief field trips in July and October 1967 to check well and spring locations, measure ground-water levels and discharge of wells, map phreatophytes, and collect water samples for chemical analysis.

Location, extent, and physiographic features of the area

The drainage basin of Curlew Valley which extends across the Utah-Idaho State line lies between latitude 41°40′ and 42°30′ north and longitude 112°30′ and 113°20′ west (fig. 1) and covers about 1,200 square miles. The valley is bounded on the west by the Raft River and Black Pine Mountains; on the north by the Sublett Range and Deep Creek Mountains; and on the east by Blue Spring Hills, North Promotory Mountains, and Hansel Mountains (pl. 1). The Sublett Range protrudes from the north into the valley forming east and west drainage arms that join south of the State line. Curlew Valley is open to the south where it drains into Great Salt Lake.

The altitude of the valley floor ranges from about 4,200 feet along the shore of Great Salt Lake to about 4,800 feet along the foothills of the bounding mountain ranges. A line of low hills and knolls, including Cedar Hill and Wildcat Hills, extends across the southern part of the valley interrupting the generally uniform north to south slope.

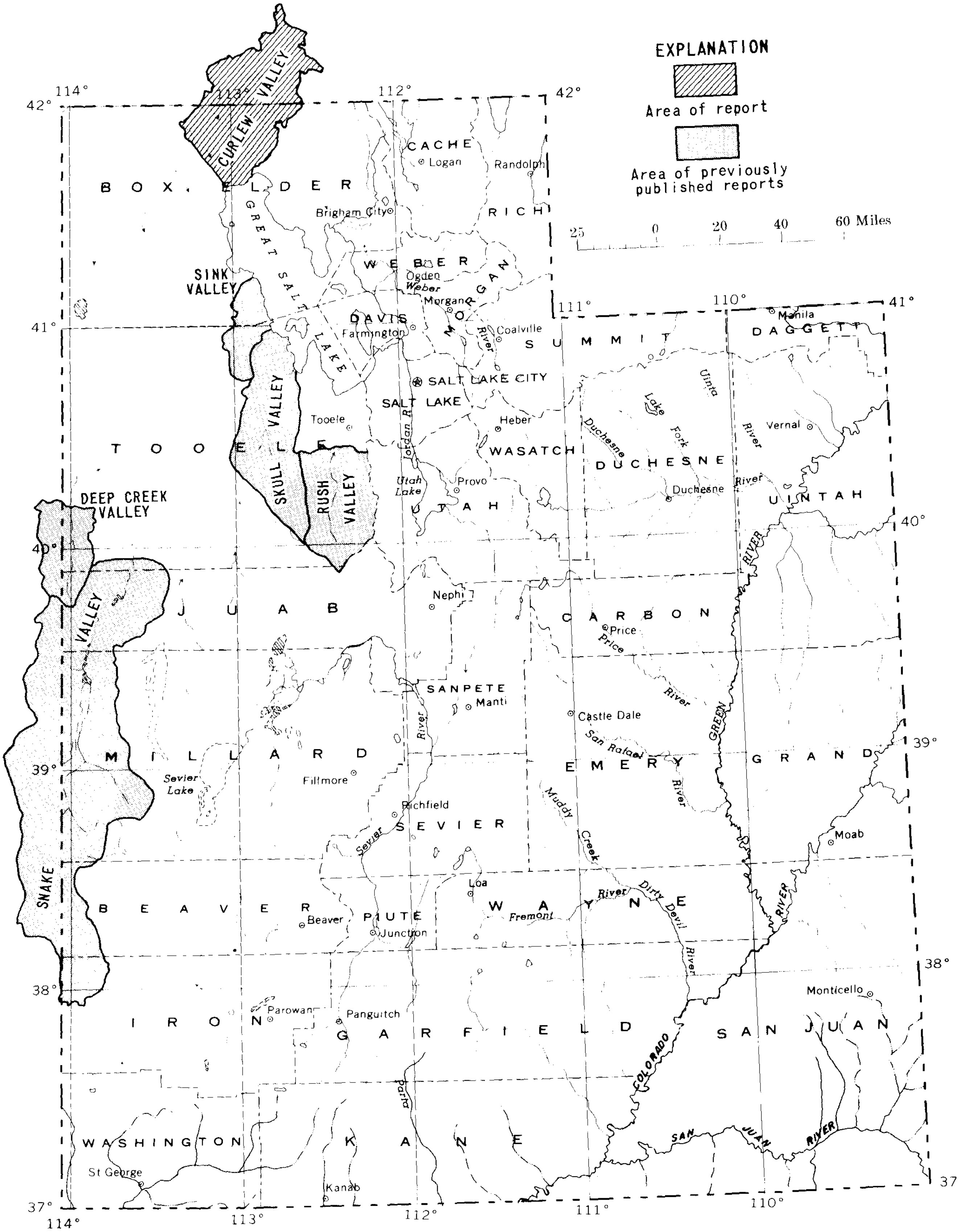

Figure 1.—Location of the Curlew Valley drainage basin and other areas described in previously published reports in this series.

Altitudes of the highest peaks in the mountains that bound the valley range from about 6,500 feet in the Hansel Mountains to nearly 10,000 feet in the Raft River Mountains. Altitudes of the lowest passes on the drainage divide that separates Curlew Valley from the Snake River basin are about 5,200 feet near Buist, Idaho, and about 5,275 feet near Strevell, Idaho (pl. 1).

The Utah part of Curlew Valley, also referred to in this report as the Utah subbasin, is a roughly triangular area covering about 550 square miles. It extends southward about 25 miles from the Utah-Idaho State line to Great Salt Lake and ranges in width from about 30 miles near the north boundary to about 10 miles near the south boundary. The area is sparsely populated; the only community centers in the subbasin are Snowville (population in 1960, 159) and Kelton (28). Interstate Highway 80 (U. S. Highway 30S) passes across the north end of the subbasin, and Utah Highway 70 enters it from the southwest. Other parts of the subbasin are accessible by graded and dirt service roads.

Previous work

The Utah part of Curlew Valley was included in a reconnaissance of the ground-water resources of Tooele and Box Elder Counties, Utah, by Carpenter (1913) and in a ground-water reconnaissance by D. A. Griswold (U. S. Soil Conservation Service, written commun., 1956). In 1959, G. L. Whitaker and K. E. Kittock made a reconnaissance of irrigation development and gaging-station sites in Deep Creek valley (U. S. Geol. Survey, written commun., 1959). The Utah part of Curlew Valley has also been included in an annual series of reports on ground-water conditions in Utah, which is published as the Utah Division of Water Resources cooperative investigations report series (Baker, Price, and others, 1967).

Sources of geologic data in Curlew Valley include the geologic maps of Utah (Stokes, 1964) and Idaho (Ross and Forrester, 1947), a report on the geology of the Raft River Mountains (Felix, 1956), and a report of oil exploration and test drilling in Box Elder County, Utah (Peace, 1956, p. 25-31).

Acknowledgments

The cooperation of landowners in Curlew Valley who permitted measurements at wells and who provided general information about the area is gratefully acknowledged. The Raft River Rural Electric Cooperative and Utah Power and Light Co. were very helpful in providing power records from which ground-water pumpage was estimated.

Well- and spring-numbering system

Wells, springs, and surface-water data sites are numbered in this report using the system of numbering wells in Utah, which is based on the cadastral land-survey system of the Federal Government. The number, in addition to designating the well, spring, or other data site, locates its position to the nearest 10-acre tract in the land net. By this system the State is divided into

four quadrants by the Salt Lake Base Line and Meridian. These quadrants are designated by the uppercase letters A, B, C, and D, thus: A, for the northeast quadrant; B, for the northwest; C, for the southwest; and D, for the southeast quadrant. Numbers designating the township and range, respectively, follow the quadrant letter, and the three are enclosed in parentheses. The number after the parentheses designates the section, and the lowercase letters give the location of the well within the section. The first letter indicates the quarter section, which is generally a tract of 160 acres, the second letter indicates the 40-acre tract, and the third letter indicates the 10-acre tract. The number that follows the letters indicates the serial number of the well within the 10-acre tract. Thus, well (B-14-9)18bdd-1, in Box Elder County, is in the SE¼SE¼NW¼ sec. 18, T. 14 N., R. 9 W., and is the first well constructed or visited in that tract. (See fig. 2.)

Springs are designated by the letter S preceding the serial number (final number at the end of the location number), for example, (B-12-10)36cab-S1. Surface-water data sites are numbered similarly except the serial number is not used, for example, (B-14-8)3ccc.

The system of numbering wells and springs in Idaho is only slightly different from that used in Utah. For example, location 16S-32E-9cd1 indicates T. 16 S., R. 32 E., sec. 9, SE¼SW¼, and is the first data point inventoried in the given tract. A 40-acre tract is the smallest tract used in Idaho's well-numbering system.

Use of metric units

In this report, the units which indicate concentrations of dissolved solids and individual ions determined by chemical analysis and the temperatures of water are metric units. This change from reporting in "English units" has been made as a part of a gradual change to the metric system that is underway within the scientific community. The change is intended to promote greater uniformity in reporting of data. Chemical data for concentrations are reported in milligrams per liter (mg/l) rather than in parts per million (ppm), the units used in earlier reports in this series. For concentrations less than 7,000 mg/l, the number reported is about the same as for concentrations in parts per million.

Water temperature is reported in degrees Celsius (centigrade or °C), but the customary English unit of degrees Fahrenheit (°F) follows in parentheses in the text. Air temperature is reported in °F, but the equivalent temperature in °C follows in parentheses in the text for easier comparison with water temperature in tables. The reporting of temperatures in both metric and English units is done to assist those readers who are not familiar with the Celsius temperature scale. The following conversion table will also help to clarify the relation between degrees Fahrenheit and degrees Celsius:

TEMPERATURE-CONVERSION TABLE

For conversion of temperature in degrees Celsius (°C) to degrees Fahrenheit (°F). Conversions are based on the equation, °F = 1.8°C + 32; Temperatures in °F are rounded to nearest degree. Underscored equivalent temperatures are exact equivalents. For temperature conversions beyond the limits of the table, use the equation given, and for converting from °F to °C, use °C = 0.5556 (°F - 32). The equations say, in effect, that from the freezing point (0°C, 32°F) the temperature rises (or falls) 5°C for every rise (or fall) of 9°F.

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-20	-4	-10	14	0	32	10	50	20	68	30	86	40	104
-19	-2	-9	16	+1	34	11	52	21	70	31	88	41	106
-18	0	-8	18	2	36	12	54	22	72	32	90	42	108
-17	+1	-7	19	3	37	13	55	23	73	33	91	43	109
-16	3	-6	21	4	39	14	57	24	75	34	93	44	111
-15	5	-5	23	5	41	15	59	25	77	35	95	45	113
-14	7	-4	25	6	43	16	61	26	79	36	97	46	115
-13	9	-3	27	7	45	17	63	27	81	37	99	47	117
-12	10	-2	28	8	46	18	64	28	82	38	100	48	118
-11	12	-1	30	9	48	19	66	29	84	39	102	49	120

CLIMATE

The climate of Curlew Valley is semiarid and is characterized by moderately cold winters and hot summers with small amounts of annual precipitation. Average annual precipitation in the basin is less than 8 inches on part of the valley floor but reaches a maximum that exceeds 35 inches in one of the higher mountain ranges (see pl. 1). Measurements made at Snowville and Kelton, Utah (table 1) indicate that most of the precipitation falls during the winter and spring. The winter snowpack in the mountains is extremely important to the valley's water supply. Precipitation was below average in the basin during the period 1952-62 (fig. 3).

The mean monthly and annual air temperatures are slightly higher at Kelton than at Snowville as indicated in table 1. During the periods of record, the mean monthly temperature at Snowville ranged from 22°F (-6°C) in January to 69°F (20°C) in July and August; at Kelton it ranged from 22°F (-6°C) in January to 71°F (22°C) in July.

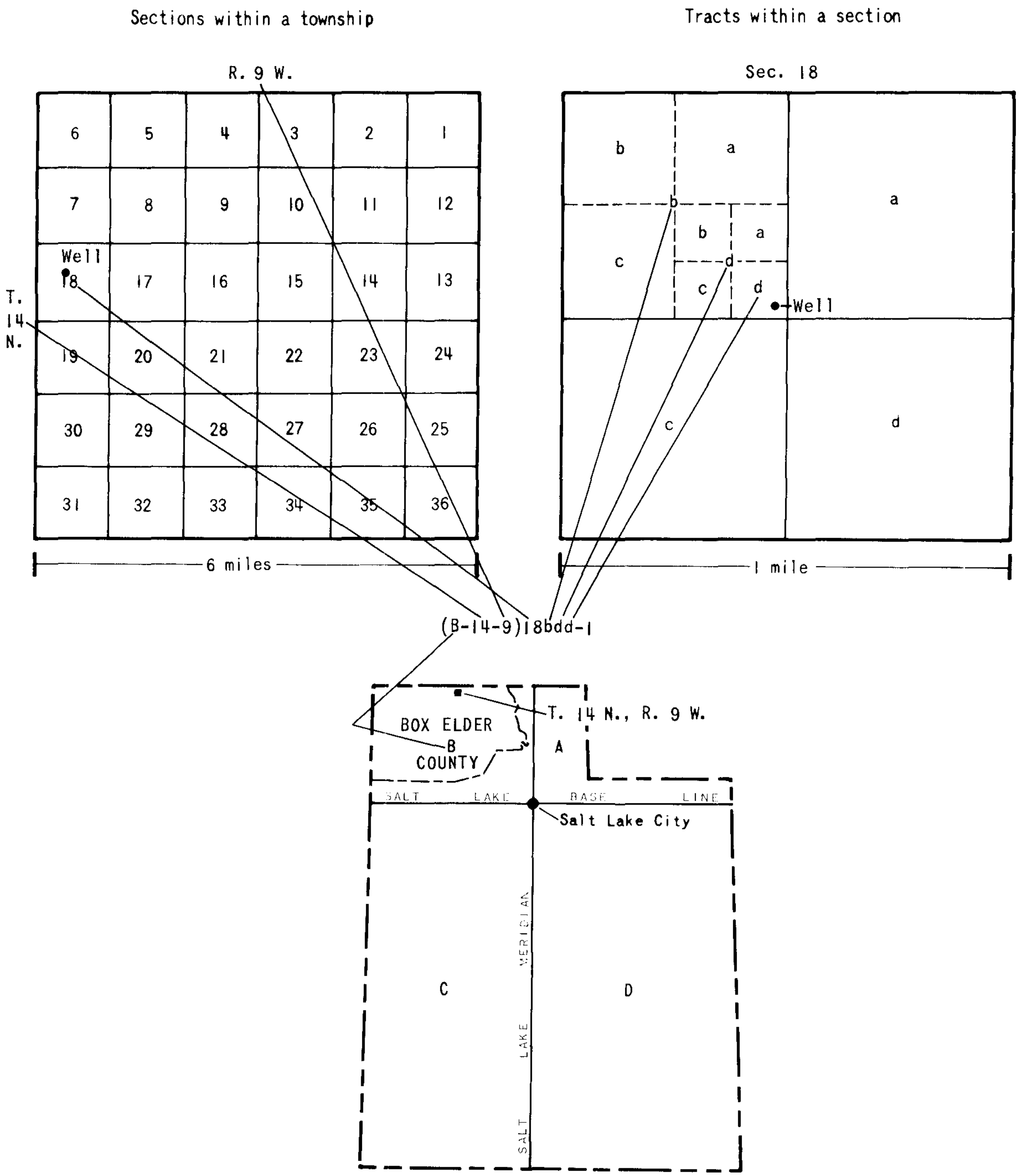

Figure 2.—Well- and spring-numbering system used in Utah.

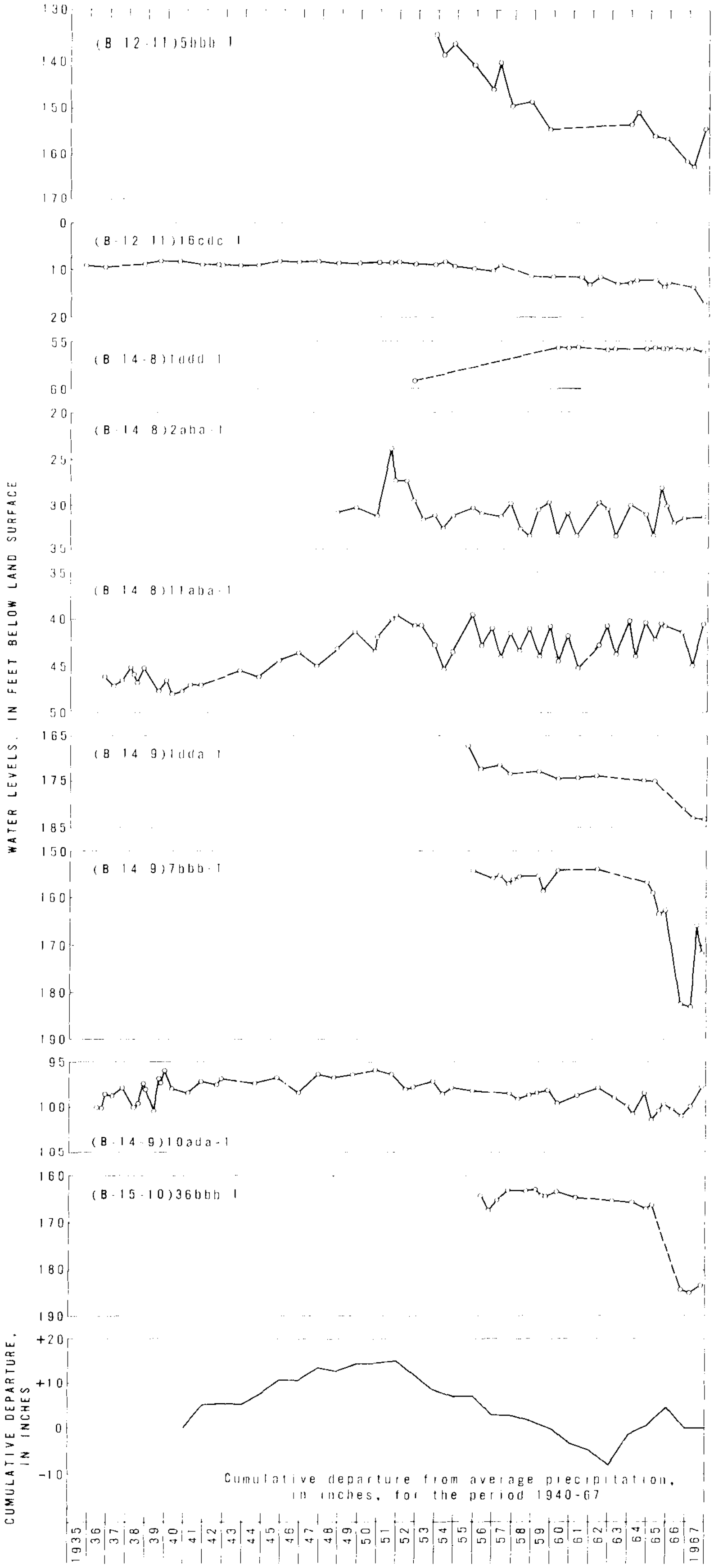

Figure 3.--Hydrographs of selected wells in the Utah part of Curlew Valley and cumulative departure from average annual precipitation at Snowville.

Table 1.--Mean monthly and annual precipitation and air temperature at Snowville and Kelton

Station	Period of record	Years	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Mean monthly and annual precipitation, in inches															
Snowville	1890-1966	53	1.13	0.85	1.17	1.24	1.60	0.97	0.50	0.58	0.71	0.95	1.01	1.07	11.78
Kelton	1879-1929	51	.67	.64	.52	.62	.76	.51	.41	.29	.51	.57	.43	.70	6.63
Mean monthly and annual air temperature, in °F															
Snowville	1899-1966	63	22	27	35	44	52	60	69	68	57	46	35	24	45
Kelton	1890-1929	25	22	28	38	45	54	64	71	70	58	49	35	24	46

The average number of days between the last spring and first fall temperature of 28°F (-2°C) was 122 at Snowville during the period 1950-66. Temperatures of 28°F (-2°C) or lower are considered to be killing frosts for most agricultural crops; therefore, the average length of the growing season in the valley is about 122 days.

Potential evapotranspiration in the Utah subbasin is estimated to be about 41 inches per year. This estimate was made by using the Blaney-Criddle equation (Cruff and Thompson, 1967, p. M15-M16), which assumes a constant supply of water. Estimates of evaporation alone made by the U. S. Weather Bureau from data collected from class A weather station evaporation pans in the region are about 42 inches per year. (See Kohler and others, 1959.)

GEOLOGY

The general geology of the Curlew Valley drainage basin is shown on plate 1, which is adapted from the geologic maps of Utah (Stokes, 1964) and Idaho (Ross and Forrester, 1947). Rocks of Precambrian, Paleozoic, Tertiary, and Quaternary age are exposed in the basin. The rocks of Precambrian and Paleozoic age form the mountain ranges that bound Curlew Valley and rocks of Tertiary and Quaternary age form the valley fill.

Rocks of Precambrian and Paleozoic age

The oldest rocks exposed in the Curlew Valley drainage basin include the Albion Range Group of Precambrian(?) age, intrusive igneous rocks of Precambrian age, and the Oquirrh Formation and undivided rocks of Paleozoic age.

The Albion Range Group and intrusive igneous rocks form the bulk of the east-trending Raft River Mountains which have been mapped by Felix (1956, p. 76-97). The intrusive rocks form the core of the mountains and are exposed only in the upper ends of deep canyons; they consist chiefly of granite, granite porphyry, and amphilbolite. The Albion Range Group, which is widely exposed throughout the east half of the Raft River Mountains, consists chiefly of quartzite, various types of schist, and some dolomite. These rocks have been folded into a major anticline whose east-trending axis coincides with the axis of the mountain range.

Rocks of Paleozoic age overlie the Precambrian rocks in an apparent thrust sheet at the east end of the Raft River Mountains (Felix, 1956, p. 94) and crop out extensively in the other mountain ranges that bound Curlew Valley. Similar rocks have been penetrated beneath the valley fill in oil test wells (Peace, 1956, p. 17).

In Utah, the Paleozoic rocks are divided into the Oquirrh Formation (Pennsylvanian and Permian) and undifferentiated older Paleozoic rocks. The Oquirrh consists primarily of massive and bedded limestone and lesser amounts of dolomite, shale, sandstone, and quartzite. The older Paleozoic rocks are chiefly of carbonate composition.

The Paleozoic rocks exposed in the Curlew Valley drainage basin in Idaho are of Carboniferous age but are not divided into formations. The undivided Carboniferous rocks are chiefly limestones and dolomites (Ross and Forrester, 1947).

The rocks of Precambrian and Paleozoic age as a whole are generally poorly permeable and transmit water very slowly. These rocks, especially the Precambrian metamorphic and granitic rocks in the Raft River Mountains, provide little base flow to streams and are not known to contain any important aquifers. However, all the rocks of Precambrian and Paleozoic age have undergone considerable structural deformation and as a result are complexly folded, fractured, and jointed. Faults, joint and fracture zones, bedding planes, and solution cavities in the carbonate rocks provide local channels through which rainfall and snowmelt can be absorbed and transmitted underground.

Rocks of Tertiary and Quaternary age

The rocks of Tertiary and Quaternary age form the valley fill in Curlew Valley. The oldest of these rocks is a thick sequence of tightly bedded, predominantly tuffaceous, continental sedimentary rocks and assorted volcanic rocks of late Tertiary age. They are referred to both as the Salt Lake Formation (in Utah and Idaho) and as the Payette Formation (only in Idaho) (see Felix, 1956, p. 86). These rocks are widely exposed in the northernmost part of Curlew Valley in Idaho and in a small area on the southeast flank of the Raft River Mountains. Where the valley fill has been fully penetrated by oil test wells in Curlew Valley, the rocks of Tertiary age form the base of the fill and rest on the Oquirrh Formation at a depth of 3,880 feet [table 5, well (B-14-10)14acd-1]. The valley fill consists chiefly of tuff, tuffaceous shale, sandstone, marlstone, and conglomerate but includes some intercalated lava flows and pyroclastic material. The rocks are tightly bedded, structurally deformed, and slightly to moderately indurated.

The sedimentary rocks of Tertiary age have a low permeability because they are predominantly fine grained, tightly bedded, and partly indurated. However, similar rocks reportedly yield moderate quantities of water to wells locally in the Raft River valley (Nace and others, 1961, p. 20). These rocks may, therefore, yield moderate quantities of water to individual wells in Curlew Valley where they occur near the surface, as along Deep Creek.

Tertiary lava flows and pyroclastic rocks of felsic to mafic composition are exposed locally throughout the drainage basin of Curlew Valley. Rhyolite, dacite, and quartz latite flows and pyroclastic rocks cap Wildcat Hills. Basalt and basaltic andesite flows form Cedar Hill. The basaltic rocks are also exposed locally in the southwest part of the valley and in the North Promontory Mountains (pl. 1), and Tertiary to Quaternary volcanic rocks (including the Snake River Group) are exposed locally in the Idaho part of the valley.

The exposed volcanic rocks in the basin are too limited in extent to affect ground-water recharge or runoff and are not known to contain any important aquifers. However, similar volcanic rocks in the valley fill (see below) constitute some of the most productive aquifers in the Utah part of the valley.

Overlying the Tertiary continental sedimentary rocks of the valley fill is a sequence of younger alluvial and lacustrine deposits and intercalated volcanic rocks of Tertiary and Quaternary age. The sequence is not exposed in the valley but has been penetrated by numerous wells. According to drillers' logs (table 5), it consists chiefly of layers of clay, clay and gravel, gravel, and boulders with intercalated lava flows and pyroclastic material. The relation between the intercalated volcanic rocks and the volcanic rocks exposed in Cedar Hill and other parts of the valley is not clear from available data. It is assumed that both the exposed and intercalated rocks were extruded during a period of volcanic activity that apparently began in Tertiary time and continued sporadically into the Pleistocene Epoch. Volcanic disturbances were followed by deposition of sedimentary rocks, which results in the interfingering of the two lithologic units. The intercalated volcanic rocks are widespread in the area north of Cedar Hill. Near Kelton the volcanic rocks are exposed but apparently have not been penetrated by wells.

The maximum thickness of the alluvial and lacustrine deposits and intercalated volcanic rocks in the valley fill is not known because the contact between this sequence and the underlying Tertiary rocks is not recognized in the logs of wells that fully penetrated the valley fill (see table 5, logs of wells (B-14-9)6adc-1, (B-14-10)14acd-1, and (B-14-10)22cdb-1). Most of the irrigation wells that bottom in alluvial and lacustrine deposits or volcanic rocks are 400-600 feet deep, and well (B-14-10)14bbc-1 bottomed in gravel at 840 feet, which indicates that the alluvial and lacustrine deposits extend at least to that depth.

The alluvial and lacustrine deposits and intercalated volcanic rocks form the main ground-water reservoir in Curlew Valley. They yield several hundred to several thousand gallons of water per minute to properly constructed large-diameter wells in the area west of Snowville and near Kelton. Locomotive Springs, which discharges approximately 40 cfs (cubic feet per second), issues from the volcanic rocks.

Rocks of Quaternary age

The rocks of Quaternary age exposed in Curlew Valley include the deposits of Pleistocene Lake Bonneville and alluvial and colluvial deposits of Pleistocene to Holocene (Recent) age. The deposits of Lake Bonneville, which at one time had a surface altitude of about 5,200 feet and inundated a major part of Curlew Valley, include shoreline and lakebed deposits. The shoreline deposits consist chiefly of sand and gravel in spits and bars and on terraces which formed around the shores of this ancient lake, and they are most prominent at the 5,200-foot and the 4,800-foot levels in and around the margins of the valley. Clay and silt deposited in the bed of Lake Bonneville underlie a major part of the valley floor in Tps. 11-13 N. in Utah. These deposits are fair to poorly drained and have a moderate to high salt content. The segment labeled Qlcm on plate 1 is generally marshy and flooded by fresh to brackish water.

A major part of the northern two-thirds of the valley is composed of well-drained surficial gravel deposits. Alluvium and colluvium of late Quaternary age are deposited along active streams and on steep slopes.

The younger Quaternary deposits do not contain important aquifers because they are limited in extent or are above the main ground-water reservoir in most places. However, the alluvium, colluvium, and lake-shore deposits on higher slopes absorb some of the runoff from precipitation and transmit the water to the ground-water reservoir.

WATER RESOURCES

Volume of precipitation

Lines of equal normal annual precipitation (isohyets) for the period 1931-60 are shown on plate 1. The average annual volume of precipitation that falls in the Curlew Valley drainage basin was estimated from these isohyets as follows: The area between successive isohyets was determined by planimeter. These areas, in acres, were then multiplied by the average of the bounding isohyets, in feet of precipitation, in order to obtain the average annual volume of precipitation within each isohyetal interval (table 2). The estimated average annual precipitation in the Curlew Valley drainage basin thus obtained is 868,000 acre-feet, of which 536,000 acre-feet falls in Idaho and 332,000 acre-feet falls in Utah.

Of the precipitation that falls in the basin, most is returned to the atmosphere, part runs off in streams, and part percolates directly to the ground-water reservoir.

Surface water

The surface-water resources of the Utah subbasin of Curlew Valley include runoff into the subbasin from the Raft River and Hansel Mountains and inflow through Deep Creek, which enters Utah near Snowville. Water from these sources supplements ground-water supplies used for irrigation in the Kelton and Snowville areas.

Table 2.—Estimated average annual precipitation and recharge from precipitation in the Curlew Valley drainage basin

Precipitation (inches)	Area (acres)	Estimated annual precipitation		Estimated annual recharge	
		Feet	Acre-feet	Percentage of precipitation	Acre-feet
			IDAHO		
More than 35	2,138	2.92	6,243	42	2,620
30-35	5,830	2.71	15,799	35	5,530
25-30	9,670	2.29	22,144	28	6,190
20-25	72,200	1.88	135,736	21	28,500
16-20	94,980	1.50	142,470	14	19,950
12-16	97,220	1.17	113,747	8	9,100
Less than 12	109,000	.92	100,280	0	0
Totals (rounded)	391,000	-	536,000	-	72,000
			UTAH		
30-35	192	2.71	520	35	180
25-30	582	2.29	1,333	28	370
20-25	973	1.88	1,829	21	380
16-20	3,890	1.50	5,835	14	820
12-16	19,540	1.17	22,862	8	1,830
Less than 12	326,000	.92	299,920	0	0
Totals (rounded)	351,000	-	332,000	-	3,600

There are no stream-gaging stations in Curlew Valley. The only available streamflow records are several miscellaneous estimates and measurements of the flow of Deep Creek near Snowville; consequently, the volume of surface inflow to the Utah part of the valley can only be roughly approximated. Bagley and others (1964) compiled a map showing theoretical mean annual runoff in Utah. According to that map, the mean annual runoff from the Raft River Mountains is about 1 inch near the base of the range and more than 12 inches near the summit. Runoff from the other upland areas is less than 1 inch. There is practically no runoff from the valley flat.

Some water enters the Utah subbasin as inflow through Deep Creek, which has its source in Holbrook Spring near Holbrook, Idaho. The flow of the creek is impounded in Curlew Valley Reservoir, about 4 miles north of the Utah-Idaho State line. No measurements of flow across the

Utah-Idaho State line are known to have been made prior to completion of the Curlew Valley Reservoir, but since the reservoir was filled, the U. S. Geological Survey has made miscellaneous estimates and measurements at various locations on the creek near Snowville. These records are given in the following table:

Date	Estimated discharge (cfs)
1959	
Apr. 21	3
May 12	1
May 26	4
June 23	1.5
Aug. 7	2
Sept. 16	4
Oct. 14	3
1960	
July 5	10
Oct. 6	5[1]
1967	
Aug.	8[2]

[1] Current-meter measurement.

[2] Parshall flume measurement, about 1 mile north of Snowville. Bottom of flume was covered with moss; therefore, figure is probably slightly high.

The above figures do not reflect the natural flow of Deep Creek because the flow is regulated at Curlew Valley Reservoir and irrigation return flow enters the creek between the reservoir and the Utah-Idaho State line.

The rate of flow in Deep Creek near Snowville is probably greatest during the irrigation season and least during the winter months when Curlew Valley Reservoir is being filled. Assuming that an average of 6 cfs (cubic feet per second) flows across the Utah-Idaho State line during July, August, and September (see above table) and an average of 2 cfs flows across the line during the remaining months of the year, average annual inflow through Deep Creek would be on the order of 2,000 acre-feet. This amount is small compared to the amount of ground-water inflow from Idaho (see p. 16).

Virtually no surface water flows out of the Utah part of Curlew Valley with the exception of water that runs off during severe local storms. All the flow of Deep Creek and other streams in the subbasin is either diverted for irrigation, lost by seepage, or consumed by

evapotranspiration before it reaches Great Salt Lake. Some water from Locomotive Springs flows overland into Great Salt Lake; the amount is estimated in the section on ground-water discharge (p. 17).

Ground water

Alluvial and lacustrine deposits and intercalated volcanic rocks in the valley fill form the main ground-water reservoir in Curlew Valley. Aquifers in these rocks yield several hundred to several thousand gallons of water per minute to individual large-diameter wells west of Snowville and in the vicinity of Kelton. Pumpage from the ground-water reservoir is mainly for irrigation, but some water is also pumped for domestic and stock supply. An approximate quantitative appraisal of the ground-water reservoir in the Utah subbasin is given in the following sections.

Recharge

The principal sources of recharge to the ground-water reservoir in the Utah part of Curlew Valley are precipitation that falls in the Raft River and Hansel Mountains and ground-water inflow from Idaho. Recharge by seepage from Deep Creek and from irrigation losses occurs, but the amount is probably very small.

The volume of recharge from precipitation was estimated by a method of Hood and Waddell (1968, p. 22). This method, which was adapted from an earlier method of Eakin and others (1951, p. 79-81), assigns a certain percentage (depending on geology, altitude, and other factors) of the average precipitation in each isohyetal interval to ground-water recharge. Using the isohyetal map on plate 1 to determine the average volume of precipitation in each isohyetal interval, as described on page 12, and multiplying the volumes by recharge percentage figures, as shown in table 2, the total average annual volume of recharge from precipitation in the Utah subbasin was estimated to be about 3,600 acre-feet. This amount is about 5 percent of the total estimated average annual volume of recharge from precipitation (75,600 acre-feet) in the entire drainage basin (table 2).

A form of Darcy's Law (Darcy, 1856) was used to estimate the quantity of subsurface water crossing the Utah-Idaho State line. For the purpose of this report the form that was used is as follows:

$Q = TIL$ where,

Q = quantity of water (gallons per day)
T = coefficient of transmissibility (gallons per day per foot)
I = hydraulic gradient (feet per mile)
L = width of cross section through which discharge occurs (miles)

Coefficients of transmissibility were estimated according to a method described by Meyer (1963) from reported specific capacities (quantity of water withdrawn per unit of drawdown, in gallons per minute per foot) of wells near the State line. The estimated average coefficients of

transmissibility near the State line ranged from about 10,000 to 100,000 gpd per ft (gallons per day per foot). The hydraulic gradient and length of cross section were taken from plate 1. Hence, subsurface inflow is estimated as follows:

Contour segment 1.	Q = TIL (100,000) (30) (8)	= 24 mgd (million gallons per day)
Contour segment 2.	Q = TIL (10,000) (3) (12)	= 3.6 mgd
Contour segment 3.	Q = TIL (100,000) (40) (1)	= 4 mgd
	Total underflow (rounded)	32 mgd

A flow of 32 mgd is approximately equal to 36,000 acre-feet per year. Combining this figure with the estimated recharge from the Raft River and Hansel Mountains (about 3,600 acre-feet), total annual recharge in the Utah subbasin is estimated to be about 40,000 acre-feet per year.

Occurrence and movement

Ground water in the valley fill of the Utah subbasin is chiefly under artesian (confined) conditions. Water levels rise above the tops of aquifers tapped by most of the wells for which water levels and aquifer depths are known. (See tables 4 and 5.)

Some water in the recharge areas on the east and west sides of the subbasin is probably under water-table (unconfined) conditions. Information from wells (B-14-7)5aca-1 and (B-15-11)36ccc-1 supports this conclusion. Water tapped by well (B-14-8)28aba-1 is probably perched water. The water level in that well was 145 feet higher than the level in well (B-14-8)28bbb-1, which is about half a mile to the west and about 10 feet lower in altitude. It seems probable that perched water occurs elsewhere in the subbasin where poorly permeable rocks, such as clay and solid lava, impede downward percolation of ground water.

Ground water in the Utah subbasin generally moves toward the axis of the valley from the surrounding recharge areas in Utah and Idaho and then southward toward Great Salt Lake. In the Kelton area, ground water moves generally southeastward toward the lake. (See pl. 1.)

Discharge

Ground water is discharged from the Utah part of Curlew Valley by evapotranspiration, by discharge from springs and seeps, by pumpage, and by subsurface flow to Great Salt Lake.

Evapotranspiration

Because of the abundance of phreatophytes in the southern part of Curlew Valley (pl. 1), discharge of ground water by evapotranspiration plays a major role in the total water budget. Greasewood (*Sarcobatus vermiculatus*) is the predominant phreatophyte, with lesser amounts of rabbitbrush (*Chrysothamnus greenei*), pickleweed (*Allenrolfea occidentalis*), saltgrass (*Distichlis spicata*), and other marsh grasses (see pl. 1)[1]. Near Snowville, a small amount of water is

[1] Phreatophytes were identified by Lois Arnow, Herbarium, Botany Dept., University of Utah.

transpired from a small area of cottonwood and rushes. Water discharging from Locomotive Springs forms small lakes and marsh areas where evaporation losses are high.

Discharge of ground water by evapotranspiration in the Utah part of Curlew Valley is estimated to be about 34,000 acre-feet per year as shown in table 3. The rates of evapotranspiration presented in table 3 are based on depth to water and density of plant growth.

Table 3.-- Estimated average annual ground-water discharge by evapotranspiration in the Utah part of Curlew Valley

Source	Estimated depth to water (feet)	Estimated areal density of growth (percent)	Rate of evapotranspiration (acre-feet per acre per year)	Area (acres)	Discharge (acre-feet, rounded)
Greasewood	20-40	20-40	0.10[1]	23,000	2,300
Greasewood and rabbitbrush	5-20	50-60	1.00[2]	3,260	3,300
Saltflats (some greasewood, saltgrass, and pickleweed)	0-5	0-5	.10[3]	28,540	2,900
Pickleweed and greasewood	0-10	10-20	.45[2]	4,580	2,100
Cottonwood and rushes	0-10	10-20	5.00[1]	80	400
Open-water surfaces (some hydrophytes)	-	-	3.50[4]	4,580	16,000
Saltgrass and other marsh grasses	0-5	90-100	3.00[3]	2,340	7,000
Total (rounded)					34,000

[1] Taken from Robinson (1958, p. 62 and 69).
[2] Taken from Mower and Nace (1957, p. 21).
[3] Taken from Feth, Barker, Moore, Brown, and Veirs (1966, p. 68-70).
[4] Taken from Kohler, Nordenson, and Baker (1959, pl. 2).

Discharge from springs and seeps

Locomotive Springs (pl. 1) is the only large spring in the Utah subbasin of Curlew Valley. Measurements made by the Utah Department of Natural Resources, Division of Fish and Game, indicate that the total discharge from Locomotive Springs is about 29,000 acre-feet of water per year. Evaporation from open-water bodies and evapotranspiration in areas of phreatophytes that are irrigated by the springs consume an estimated 23,000 acre-feet per year. The remaining 6,000 acre-feet per year flows into Great Salt Lake.

Numerous small springs and seeps discharge in the subbasin, but their total yield is small. None of the springs discharges more than a few gallons per minute, and the water that is not put to beneficial use is consumed by evapotranspiration near the springs.

Subsurface seepage to Great Salt Lake

Some of the ground water that moves downgradient through Curlew Valley discharges directly into Great Salt Lake as diffuse seepage beneath the lake surface. The volume of seepage could not be determined in this investigation but is assumed to be negligible when compared to other means of natural ground-water discharge. The fine-grained lakebed sediments that form the bulk of the valley fill in the lower end of Curlew Valley have a low permeability and impede the movement of ground water toward the lake. Therefore, most of the ground water moving toward the lake is forced upward toward the land surface and is discharged by evapotranspiration in the area north of the lake.

Pumpage

Nearly all ground water pumped from the Utah part of Curlew Valley is pumped from large-diameter (10 inches or more) irrigation wells in the area west of Snowville and in the Kelton area. The total annual volume of water pumped for irrigation, in acre-feet, during the years for which records are available, is given in the following table:

Year	Snowville area	Kelton area	Total
1964	4,200	3,400	7,600
1965	4,300	3,300	7,600
1966	6,000	3,900	9,900
1967	6,200	3,500	9,700

Some water is pumped from about 25 small-diameter domestic and stock wells in the Utah subbasin. The volume of water pumped from these wells was not determined but is probably less than 10 acre-feet per year.

Water-level fluctuations

Ground-water levels in the Utah part of Curlew Valley respond mainly to changes in ground-water storage caused by changes in amounts of recharge and discharge. Increases and decreases in natural recharge cause corresponding rising and lowering of water levels throughout the basin, whereas pumpage has a more localized effect on water levels.

Hydrographs of water levels in observation wells in the subbasin indicate a general decline of ground-water levels during the period 1954-67 in the areas of intensive pumping for irrigation west of Snowville and near Kelton. (See hydrographs for wells (B-14-9)1dda-1, (B-14-9)7bbb-1, and (B-15-10)36bbb-1, west of Snowville and well (B-12-11)5bbb-1 near Kelton,

fig. 3.) These declines were caused not only by increased pumping but also by decreased natural recharge owing to below-normal precipitation in the basin during the period 1952-62. (See fig. 3.) The greatest declines (more than 20 feet in well (B-15-10)36bbb-1) occurred in the area west of Snowville during the period 1964-66, coinciding with and following a brief period of above-normal precipitation. These declines, therefore, may be attributed chiefly to pumpage.

In contrast to declining water levels west of Snowville and near Kelton, levels have changed very little in the area of Deep Creek near Snowville. (See hydrographs for wells (B-14-8)1ddd-1, (B-14-8)2aba-1, and (B-14-8)11aba-1 in fig. 3.) This area is not heavily pumped, and recharge from the infiltration of irrigation water apparently prevents significant declines in water levels even during periods of below-normal precipitation.

Storage

Recoverable ground water in storage is that part of the stored water that will drain by gravity from the ground-water reservoir as water levels are lowered. It is the product of the specific yield of the reservoir rocks, the saturated thickness, and the area. The specific yield of the upper 100 feet of the ground-water reservoir in the Utah subbasin is estimated to be at least 5 percent. The reservoir underlies about 250,000 acres. Assuming a uniform lowering of water levels of 100 feet, the ground-water reservoir would yield at least 1 million acre-feet, or 25 times the estimated average annual recharge. Some of the ground water stored in the upper 100 feet of the ground-water reservoir, however, is saline and is not suitable for irrigation or domestic supply.

Budget

The volumes of water recharged to and discharged from the ground-water reservoir in the Utah subbasin of Curlew Valley are summarized in the following table:

	Acre-feet per year
Recharge:	
Underflow from Idaho subbasin (p. 15)	36,000
From precipitation in Utah subbasin (p. 15)	3,600
Seepage from Deep Creek (p. 15)	negligible
Total recharge (rounded)	40,000
Discharge:	
Evapotranspiration (includes part of the flow from Locomotive Springs, p. 16)	34,000
Discharge of Locomotive Springs into Great Salt Lake (p. 17)	6,000
Subsurface seepage to Great Salt Lake (p. 18)	negligible
Pumpage (based on pumpage for 1966 and 1967) (p. 18)	10,000
Total discharge	50,000

The withdrawal of water from storage through wells is one of the factors causing an imbalance between recharge and discharge. The effect of withdrawals from pumped wells is shown by the hydrographs of irrigation wells (B-12-11)5bbb-1, (B-14-9)1dda-1, and (B-14-9)7bbb-1 and observation well (B-15-10)36bbb-1 in an area of heavy pumping (fig. 3). Usually, after pumping for a given time, water levels will recover; however, in these wells the general decline leads to the conclusion that recharge is insufficient to balance discharge and that water is being withdrawn from storage.

Perennial yield

The perennial yield of a ground-water reservoir is the maximum amount of water of suitable chemical quality that can be withdrawn economically each year for an indefinite period of years. The perennial yield cannot exceed the natural discharge and will be limited to the amount of natural discharge that can economically be salvaged for beneficial use.

The total volume of water discharged annually from the ground-water reservoir in the Utah part of Curlew Valley by natural means is estimated to be on the order of 40,000 acre-feet. Of this amount, about 29,000 acre-feet of water is discharged at the Locomotive Springs Fish and Wildlife Refuge; this discharge is considered by the Utah Division of Fish and Game to be essential for effective management of the refuge. That leaves about 11,000 acre-feet of water per year that is now being used by phreatophytes and which might be salvaged for beneficial use. The salvage of water must be done in or near the area of phreatophytes, and the amount of water that could be economically salvaged probably would be only a part of the water now being wasted.

Chemical quality of water

Surface water plays a minor role in the resources of the Utah subbasin, therefore, the chemical quality of surface water will not be discussed at length. Only two analyses of water from Deep Creek have been made (table 6). Both samples were taken at the same location (pl. 2) and show little change in quality with respect to time. The water does not meet recommendations of the U. S. Public Health Service for public supply (see page 21) but is suitable for stock (see page 21). The suitability of the water from Deep Creek for irrigation is shown in figure 4.

The chemical quality of ground water differs considerably throughout the Utah part of Curlew Valley. The diagrams shown on plate 2 are based on the chemical analyses given in table 6 and illustrate the differences in the chemical composition of the ground water in the subbasin.

In the area west of Deep Creek, the dissolved-solids content of the ground water ranges from 323 to 2,640 mg/l (milligrams per liter). Calcium and bicarbonate are the predominant ions in the water in the northern part of the area west of Deep Creek; sodium and chloride are the predominant ions in the southern part. The rather high mineral content and temperature of water from two deep wells, (B-14-9)4bbb-1 and (B-15-9)28cbb-1 (table 6), may be caused by the upward movement of warm highly mineralized water along a concealed fault (see pl. 1). The dissolved-solids content of water from these wells and from several other wells in the area has

increased slightly during recent years. This increase suggests that pumping has induced additional upward movement of more highly mineralized water from the deeper aquifer.

In the area east of Deep Creek, the dissolved-solids content of the ground water ranges from 888 to 10,400 mg/l. Sodium and chloride are generally the predominant ions in water of the area, but in the sample from well (B-14-8)11aba-1 sodium and sulfate predominated. The similarity in the chemical character of water from Locomotive Springs and water from wells in the area of Deep Creek near Snowville suggests that the principal supply of water for Locomotive Springs may be moving along the east side of Curlew Valley between Cedar Hill and the Hansel Mountains.

Chemical quality in relation to use

Water used for domestic and public supply should be clear, colorless, and free of objectionable tastes and odors. The U. S. Public Health Service (1962) has established quality standards for drinking water which, although applying only to carriers and others subject to Federal quarantine regulations, have been adopted by several states. The recommended maximum limits for some of the chemical constituents are listed below:

Constituent	Concentration (mg/l)
Iron (Fe)	0.3
Manganese (Mn)	.05
Chloride (Cl)	250
Sulfate (SO_4)	250
Fluoride (F)	2.0[1]
Dissolved solids	500

[1] Latest recommendations (1963) give lower, optimum, and upper control limits for fluoride based on the annual average of maximum daily air temperature. For the study area, these limits are: lower 0.8 mg/l; optimum 1.0 mg/l; and upper 1.3 mg/l. Fluoride concentrations greater than twice the optimum limit are grounds for rejection of the supply.

In the area west of Deep Creek most ground water meets these limits. Most ground water in the area east of Deep Creek and in the Kelton area exceeds the maximum limits for chloride and dissolved solids.

Very little information is available concerning the rating of water for stock supplies. However, the State of Montana (McKee and Wolf, 1963, p. 113) rates water containing dissolved solids of less than 2,500 mg/l as good, 2,500-3,500 mg/l as fair, 3,500-4,000 mg/l as poor, and more than 4,500 mg/l as unfit for stock. Using these criteria, most of the water sampled in Curlew Valley is acceptable for stock use.

The most important chemical quality characteristics that affect the usefulness of water for irrigation are: (1) total concentration of soluble salts, (2) relative proportion of sodium to other cations, (3) concentration of boron or other constituents that may be toxic to plants, and

(4) bicarbonate concentration in excess of the concentration of calcium plus magnesium. The U. S. Salinity Laboratory Staff (1954, p. 79-81) has devised a method for classifying water for irrigation use by plotting data on specific conductance (conductivity) versus sodium-adsorption ratio (SAR) on a diagram (see fig. 4). This method of classification is based on "average conditions" with respect to soil texture, infiltration rate, drainage, quantity of water used, climate, and salt tolerance of crops. Most of the water sampled in Curlew Valley has a low-sodium and medium- to high-salinity hazard.

LAND USE AND DEVELOPMENT

Past and present

The land in Curlew Valley is used chiefly for the cultivation of crops and for livestock grazing. The amount of land used for crops is small compared to the total acreage of the valley floor because the widespread lakebed sediments contain salts in high enough concentrations to render the soil unfavorable for cultivation. The soil is especially saline near Great Salt Lake.

At the time of this investigation (1967), total cropland in the Utah subbasin amounts to about 10,000 acres, of which approximately 4,000 acres are irrigated (U. S. Agr. Stabilization and Conservation Service, oral commun., 1967). Irrigation was first started in the valley in the vicinity of Snowville and Curlew Valley Reservoir after 1916, the year that Curlew Valley Reservoir (formerly Stone Reservoir) was constructed. Use of water from wells for irrigation apparently began about 1953 in the Kelton area and about 1955 in the area west and north of Rose Ranch. The chief irrigated crops are alfalfa and grain; grain is also the chief nonirrigated crop.

The Locomotive Springs area is utilized as a wildlife refuge by the Utah Division of Fish and Game, and some of the spring water is used for irrigation of saltgrass near the springs. The water from nearly all other springs in the Utah subbasin is used chiefly for stock.

Future

Approximately 130 square miles of public land in the Utah subbasin, which is not now farmed, may be suitable for farming. If the land were to be farmed, additional water supplies would be needed for irrigation. Based on figures available for present (1967) annual pumpage and irrigated acreage, it is estimated that 2.5 feet of water per acre is used on crops. If all the public land previously mentioned were to be farmed, an additional 200,000 acre-feet of water would be required annually. Recent interest in mineral extraction from Great Salt Lake makes the valley a potential site for industrial development which would also require a certain amount of water of good quality. Incorporated into agricultural and industrial needs is the additional water supply needed for population growth which accompanies these other types of growth. Domestic needs would be minimal, however, in comparison with the other needs.

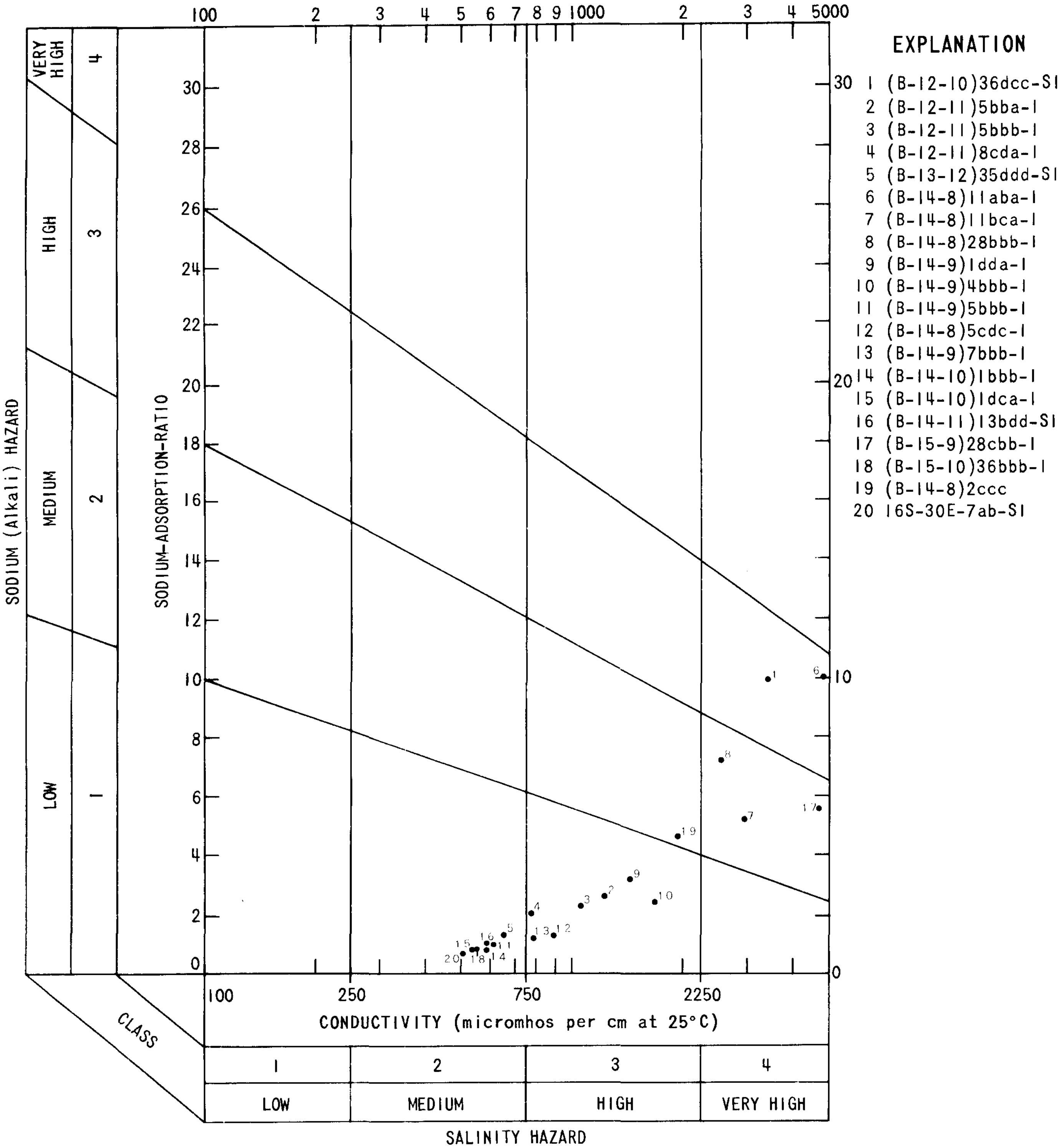

Figure 4.—Classification of water with regard to suitability for irrigation. (Index values are for analyses in table 6.)

The quantity of water that could be developed in the Utah subbasin may ultimately depend on the chemical quality of the water in deeper aquifers. Reducing the head in shallow aquifers by intensive pumping, as in the area west of Snowville, may induce upward movement of saline water from the deeper confined aquifers into the shallow fresh water aquifers and cause a progressive deterioration of the quality of the pumped water.

PROPOSALS FOR FUTURE STUDY

Because of an increasing interest in development of ground water in Curlew Valley, the growing competition for the water, and potential problems resulting from increased pumping—such as declining water levels, well interference, possible decrease in flow of Locomotive Springs, and deterioration of the chemical quality of the water—it is proposed that a detailed study be made in the valley as soon as is economically feasible. Such a study should include a detailed evaluation of the hydrologic system in the entire basin, including refined estimates of ground-water storage, total inflow from precipitation and other possible sources, and total outflow by natural means and pumpage.

The proposed study should include:

1. Collection of additional climatic records to refine estimates of total precipitation, runoff, and ground-water recharge.

2. A complete well and spring inventory to determine more accurately the volume of water pumped, the amount discharged through springs, and the reliability of water supplies.

3. More detailed geologic mapping, especially in areas of potential ground-water recharge.

4. Test drilling (several wells would be needed) to determine more accurately the subsurface geology and to delineate major aquifers.

5. Pumping tests to determine the water-bearing properties of the aquifers.

6. Detailed mapping of phreatophytes throughout the basin.

7. Continuation and expansion of the observation-well network and detailed collection of water samples for chemical analysis.

8. Continuation of well-discharge measurements.

9. More frequent and accurate surface-water discharge measurements (including seepage runs) at Locomotive Springs and at several places on Deep Creek.

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BASIC DATA

Table 4.—Records of selected wells and springs in Curlew Valley

Location: See text for description of well- and spring-numbering system.
Casing: Finish - 0, open end; P, perforated.
Altitude: Altitude of land-surface datum above mean sea level; A, altitude estimated with altimeter and accurate to 5 feet; T, altitude taken from topographic map and accurate to 40 feet.
Water level: Static water levels; measured depths given in feet and tenths below land-surface datum; reported depths given in feet.
Method of lift: J, jet pump; P, piston pump; S, submersible pump; T, turbine pump; W, windmill.
Specific capacity: gpm/ft, gallons per minute per foot of drawdown.
Use of water or well: H, domestic; I, irrigation; O, observation; P, public supply; R, recreation; S, stock; T, test hole; U, unused.
Remarks and other data available: C, chemical analysis in table 6; D, driller's log in table 5; W, hydrograph in figure 3.

Location	Owner, user, or name	Year drilled	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Casing: Finish	Altitude (feet)	Water level: Below land-surface datum (feet)	Water level: Date of measurement	Method of lift	Well performance: Rate of discharge (gpm)	Well performance: Drawdown (feet)	Well performance: Specific capacity (gpm/ft)	Well performance: Duration of test (hours)	Well performance: Date of measurement	Use of water or well	Temperature (°C)	Remarks and other data available
UTAH SUBBASIN																		
(B-11-9)																		
5cca-S1	Sparks Spring (Locomotive Springs)	-	-	-	-	-	4,220T	-	-	-	700	-	-	-	3- 9-67	R	-	C.
6cdc-S1	OFF Spring (Locomotive Springs)	-	-	-	-	-	4,220T	-	-	-	760	-	-	-	5- 9-67	R	-	C.
(B-11-10)																		
1adc-S1	Bar M Spring (Locomotive Springs)	-	-	-	-	-	4,220T	-	-	-	5,100	-	-	-	5- 9-67	R	-	C.
12aac-S1	Teal Spring (Locomotive Springs)	-	-	-	-	-	4,220T	-	-	-	-	-	-	-	-	R	-	C.
(B-12-9)																		
27bcb-1	-	-	-	2	-	-	4,300T	26.2	10-10-67	W	1	-	-	-	10-10-67	S	15	C.
(B-12-10)																		
36cab-S1	West Locomotive Spring (Locomotive Springs)	-	-	-	-	-	4,220T	-	-	-	11,000	-	-	-	Mar.-Apr. 1967	R,I	-	11,000 gpm is estimated flow of West Locomotive and Baker Springs combined. C.
36dcc-S1	Baker Spring (Locomotive Springs)	-	-	-	-	-	4,220T	-	-	-	-	-	-	-	-	R,I	-	C.
(B-12-11)																		
5abb-1	G. Fehlman	-	-	-	-	-	4,340T	-	-	T	250	-	-	-	8- 8-67	I	-	
5bba-1	do	-	-	-	-	-	4,355A	-	-	T	1,610	-	-	-	8- 8-67	I	16	C.
5bbb-1	Fehlman and Oman	-	240	16	-	-	4,360T	135	11- 5-53	T	940	-	-	-	7-11-67	I	14	C, W.
6abb-1	H. Kunzler	1955	278	16	-	P200-?	4,400T	185	10-10-55	T	125	65	1.9	-	10-10-55	I	-	D.
7abb-1	J. H. Holmgren	1955	250	16	-	-	4,320T	105	10-18-55	-	-	-	-	-	-	-	-	Abandoned. D.
8abb-1	H and M Cattle Co.	1963	275	16	254	P90-205	4,300T	92	3-30-63	T	700	86	8.2	4	3-30-63	I	-	D.
8bbb-1	J. H. Holmgren	1954	350	16	215	P105-215	4,320T	95	9- -54	-	150	70	2.1	-	9- -54	I	-	Abandoned. D.
8cda-1	G. Fehlman	1936	510	6	-	P180-?	4,280T	60.5	10-10-36	J	-	-	-	-	-	S	-	Plugged at 195 ft. C, D.
16cdc-1	U.S. Bureau of Land Management	1935	126	8	126	0	4,230T	17.1	10- 5-67	P	30	-	-	-	10-30-35	S,O	-	D, W.
28baa-1	A. Crandall	1890	60	2	60	0	4,210T	2.8	9-27-67	-	-	-	-	-	-	U	-	Flowed 0.6 gpm in 1935 with 1 ft head.
(B-13-9)																		
1adc-1	J. H. Hewlett	1967	420	20	207	0	4,580T	343	10-25-67	-	1,500	25	60	3	10-25-67	I	-	D.
(B-13-12)																		
35ddd-S1	Unnamed spring	-	-	-	-	-	4,620T	-	-	-	1	-	-	-	10- 9-67	S	14	C.
(B-14-7)																		
2bab-1	D. G. Nelson	1966	398	6,4	398	P203-397	5,250T	-	-	-	-	-	-	-	-	T	-	Filled and abandoned. D.
5aca-1	Snowville Water Works	1967	250	8	250	P50-250	4,650T	50	1967	-	-	-	-	-	-	H	-	D.
29dbb-1	D. Holmgren	-	180	2	-	-	5,800T	-	-	W	1	-	-	-	10-10-67	S	13	C.
(B-14-8)																		
1ccc-1	C. F. Neal	1964	137	12	137	0	4,565A	120	10-14-64	-	75	-	-	-	10-14-64	I	11	Unlogged to 120 ft; sand and gravel 120-137 ft.
1ddd-1	A. P. Larkin	-	-	-	-	-	4,635A	56.2	10- 6-67	-	-	-	-	-	-	O	-	W.
2aba-1	J. Larkin	-	48	4	-	-	4,540A	31.5	10- 6-67	-	-	-	-	-	-	O	-	W.
2daa-1	T. Cockran	1960	240	16	-	P45-55, 65-75, 95-109, 199-209	4,550A	48	7-10-60	-	-	-	-	-	-	I	-	D.
3dcb-1	W. Hurd	1965	63	6	63	P52-63	4,590T	40	11- 3-65	-	-	-	-	-	-	S	-	D.
5dcc-1	C. Taylor	1965	400	20,18, 14	381	P0-381	4,510A	176	10-26-65	-	2,050	47	44	24	10-26-65	I	18	D.
5ddb-1	-	-	-	-	-	-	4,495A	215.5	8- 9-67	-	-	-	-	-	-	S	-	
5ddc-1	C. Taylor	1965	400	-	-	-	4,510A	-	-	-	-	-	-	-	-	T	-	
11aad-1	D. Cutler	1955	100	-	-	-	4,590T	-	-	-	-	-	-	-	-	U	-	Clay and gravel to 100 ft. Dry hole.
11aba-1	B. S. Cutler	1936	64	4	-	0	4,550T	40.5	10- 6-67	-	-	-	-	-	-	S,O	10	C, W.
11abb-1	C. Copia	-	100	6	-	-	4,550T	39.0	10-11-67	-	-	-	-	-	-	I	-	
11bca-1	W. M. Rigby	1966	416	16	416	P131-395	4,525A	56	12-16-66	T	4,000	45	89	14	12-14-66	I	13	C, D.
20baa-1	K. H. Cornwall	1959	303	16,10	302	P273-302	4,560T	282	4-10-59	-	25	-	-	-	4- 7-59	I	11	Unlogged to 200 ft; shattered shale 200-303 ft.
28aba-1	D. Rigby	-	-	4	-	-	4,550A	130.8	7-12-67	-	-	-	-	-	-	S	-	
28bbb-1	do	1967	562	12	562	P140-160, 195-560	4,540A	276	8- 9-67	-	400	121	3.3	4	8- 9-67	I	14	Original depth 650 ft; filled in to 562 ft. C, D.
32aaa-1	Bar B Co.	1949	330	4	330	P320-330	4,550T	306	8-24-49	-	16	-	-	-	8-24-49	S	-	D.
(B-14-9)																		
1aaa-1	C. Taylor	1965	275	-	-	-	4,500T	-	-	-	-	-	-	-	-	T	-	D.
1dda-1	do	1955	380	16	360	P250-360	4,480A	183.3	10-11-67	-	522	-	-	-	1965	I,O	12	C, D, W.
1ddd-1	do	1955	312	5	312	P117-312	4,480A	135	9-27-55	-	-	-	-	-	-	H	-	D.
1ddd-2	do	1956	255	8	192	0	4,480A	166	7-27-56	-	-	-	-	-	-	H	-	D.
3aaa-1	do	1964	205	-	-	-	4,480T	-	-	-	-	-	-	-	-	T	-	D.
4bbb-1	R. Taylor	-	350	4	-	-	4,430T	181.9	12-12-55	-	-	-	-	-	-	S	22	C.
5aaa-1	C. Taylor	1962	275	6	186	0	4,440T	188	12- 5-62	-	-	-	-	-	-	S	-	D.
5abb-1	do	1963	405	18	405	P190-398	4,450T	210	4-12-63	T	2,890	-	-	-	8- 9-67	I	-	D.
5bbb-1	R. Taylor	1955	300	12	300	P250-292	4,430T	188	7-23-55	T	1,520	-	-	-	8- 9-67	I	17	C, D.
5cca-1	C. Taylor	1955	355	4	216	P137-216	4,425T	180	9-25-55	-	-	-	-	-	-	-	-	D.

Table 4—Continued

Location	Owner, users, or name	Year drilled	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Casing: Finish	Altitude (feet)	Water level: Below land-surface datum (feet)	Water level: Date of measurement	Method of lift	Well performance: Rate of discharge (gpm)	Well performance: Drawdown (feet)	Well performance: Specific capacity (gpm/ft)	Well performance: Duration of test (hours)	Well performance: Date of measurement	Use of water or well	Temperature (°C)	Remarks and other data available
(B-14-9)																		
5cdc-1	C. Taylor	1966	400	20,18, 16	360	P1-192, 200-360	4,420T	-	-	T	4,280	-	-	-	7-13-67	I	16	C, D.
6adc-1	Utah Southern Oil Co.	1956	7,569	-	-	-	4,420T	-	-	-	-	-	-	-	-	T	-	Oil test (Peace, 1956). D.
7bbb-1	Latter-day Saints Church	1955	608	14	608	-	4,410A	171.5	10- 6-67	T	2,530	-	-	-	6- 9-65	I,O	18	C, W.
9baa-1	G. Hanna	1955	341	14	341	P207-255	4,410A	175.4	10- 6-67	-	1,000	130	7.7	-	11- 4-55	O	-	Original depth 672 ft; plugged at 341 ft. Gamma-ray and electrical logs in files of the U.S. Geological Survey. C, D.
9bbb-1	do	1964	360	18,16	350	P170-190, 250-300	4,415A	175.1	8- 9-67	T	2,000	-	-	-	7-12-67	I	21	D.
10ada-1	A. Rose	-	171	6	135	-	4,400T	97.6	10- 6-67	-	-	-	-	-	-	H,O	-	W.
11bcb-1	do	1953	245	8	-	-	4,410T	170	2-14-53	-	-	-	-	-	-	I	-	D.
13abb-1	Bar B Co.	1949	75	4	-	0	4,500T	-	-	-	-	-	-	-	-	-	-	Dry hole. D.
18bdd-1	L. Nelson	1967	400	20	400	P150-170, 260-400	4,360A	150	6-10-67	-	-	-	-	-	-	I	-	D.
19bbb-1	V. Hanna	1966	350	20,18, 16	339	P150-168, 250-339	4,360A	164	8- -66	-	-	-	-	-	-	-	-	D.
21bbb-1	do	1964	586	5	-	-	4,360T	155	8-27-64	-	-	-	-	-	-	T	-	D.
(B-14-10)																		
1bbb-1	C. Taylor	1955	414	22,16	414	P185-382	4,455A	186	11- 1-55	T	1,435	81	18	-	9-26-55	I	16	Original depth 420 ft. C, D.
1dca-1	do	1951	243	5	-	P100-120	4,430T	169.1	4-26-55	-	-	-	-	-	-	-	-	C, D.
5baa-1	J. Carr Inc.	1959	276	14	-	P95-?	4,610T	82	6-25-59	-	-	-	-	-	-	S	-	D.
5bba-1	do	1959	303	16	-	P105-?	4,610A	105	6-15-59	-	-	-	-	-	-	S	-	D.
14acd-1	Utah Southern Oil Co.	1955	6,465	-	-	-	4,390T	-	-	-	-	-	-	-	-	T	-	Oil test (Peace, 1956). D.
14bbc-1	M. Palmer	1957	840	21,18	-	-	4,410A	181.0	7-12-67	T	900	63	14	-	2-20-57	I	-	D.
22cdb-1	Utah Southern Oil Co.	1956	6,463	-	-	-	4,420T	-	-	-	-	-	-	-	-	T	-	Oil test (Peace, 1956). D.
(B-14-11)																		
7cbb-1	-	-	-	-	-	-	5,140T	147.4	10-10-67	T	-	-	-	-	-	S	-	
13bdd-S1	Pilot Spring	-	-	-	-	-	4,645A	-	-	-	15	-	-	-	8- 9-66	S	10	C.
13dda-1	-	-	-	16	-	-	4,600T	48.3	10-11-67	-	-	-	-	-	-	U	-	
(B-15-7)																		
29dac-1	D. Nelson	1966	175	6	175	P118-170	4,800T	90	10- 5-66	S	-	-	-	-	-	H	-	D.
30cbc-1	R. Showell	1936	228	4	-	-	4,550T	12	11- -36	-	60	-	-	-	11- -36	H	10	D.
32aca-1	B. Elison	1967	315	20,16	315	P24-315	4,780T	20	2-28-67	-	900	150	6.0	6	2-28-67	I	-	D.
33aad-S1	Town of Snowville	-	-	-	-	-	4,790T	-	-	-	-	-	-	-	-	P	-	C.
(B-15-8)																		
25ddd-1	E. Hurd	1937	100	4	100	0	4,550T	17	2- -37	-	50	-	-	-	2- -37	-	10	D.
(B-15-9)																		
28cbb-1	J. E. Lee	1955	400	14	400	-	4,475A	213.9	12-12-55	T	2,340	-	-	-	8- 9-67	I	24	C.
29dbc-1	C. Taylor	1966	480	20,18, 16	400	P200-400	4,480T	228	3- -66	T	1,585	-	-	-	7-12-67	I	20	D.
35abb-1	J. Rose	1967	404	20	138	0	4,500T	182	1967	-	2,700	-	-	-	1967	I	-	D.
(B-15-10)																		
33dda-1	R. Rudd	1967	355	6	355	P280-355	4,590T	252	4-19-67	T	-	-	-	-	-	S	13	D.
36bbb-1	P. Mayo	1956	613	20,18, 16	610	P175-603	4,465A	183.6	10- 5-67	T	2,140	32	66.8	-	5- 2-56	I,O	17	C, D, W.
(B-15-11)																		
31ddd-1	Idaho-Utah Cattle Assoc.	1967	410	8	410	P295-410	5,100T	280	10-30-67	-	-	-	-	-	-	S	-	Mixed clay and gravel to 410 ft.
36ccc-1	E. Carbridge	1967	320	8,6	320	P240-320	4,900T	248	3-14-67	S	-	-	-	-	-	S	13	D.
IDAHO SUBBASIN																		
15S-32E																		
36a-1	-	-	131	-	-	-	-	81	-	-	-	-	-	-	-	I	16	
16S-30E																		
1cd-1	Soil Conservation Service	-	362	4	-	-	4,650T	340.9	7-12-48	-	-	-	-	-	-	U	-	
6da-1	V. Commons	-	30	12	-	-	4,790T	22.2	7-12-48	-	-	-	-	-	-	U	-	
7ab-S1	-	-	-	-	-	-	4,800T	-	-	-	1	-	-	-	10- 9-67	S	13	C.
9ab-1	Soil Conservation Service	-	-	4	-	-	4,640T	49.8	4-22-59	-	-	-	-	-	-	S	-	
16S-32E																		
2bc-1	V. Steed	-	190	-	-	-	4,610T	45	-	-	-	-	-	-	-	-	-	D.
3ac-1	Harold Pratt	-	57	4	-	-	4,595A	42	8- 9-67	-	-	-	-	-	-	I	-	
7da-1	U.S. Bureau of Land Management	1965	485	6,4	-	P405-485	4,800T	420	10-21-65	-	8	5	1.6	2	10-21-65	S	-	D.
14cc-1	A. Bradshaw	1939	45	4	-	-	4,570T	25	8- 9-67	-	-	-	-	-	-	H,S	12	
16aa-1	Scott	1922	100	4	-	-	4,570T	19.8	5-26-47	-	-	-	-	-	-	H,S	11	
23bc-1	T. Harris	-	108	4	-	-	4,550T	19.5	2-27-47	-	-	-	-	-	-	-	-	D.
24aa-1	B. Eliason	1922	125	4	-	-	4,700T	-	-	-	-	-	-	-	-	H,S	-	
25ab-1	K. J. Robins	1947	48	4	-	-	4,700T	-	-	-	40	-	-	-	7- 8-48	H,S, I	11	
25ab-2	V. Anderson	1958	201	16	200	-	4,700T	85	12- 9-58	-	2,500	25	100	-	12- 9-58	I	-	D.
27ab-1	H. Harris	1935	77	4	-	-	4,540T	20.7	8- 9-67	-	-	-	-	-	-	H,S	-	
28ba-1	W. R. Roe	1930	104	4	-	-	4,590T	56.2	9-21-31	-	-	-	-	-	-	H,S	-	

Table 5.—Selected drillers' logs of wells in Curlew Valley

Altitudes are in feet above sea level for land surface at well; determined by interpolation from topographic maps.
Thickness in feet.
Depth in feet below land surface.

Material	Thickness	Depth
UTAH SUBBASIN		
(B-12-11)6abb-1. Log by D. E. Rogers. Alt. 4,400 ft.		
Topsoil	4	4
Sand and gravel	32	36
Clay, sandy, and gravel	34	70
Clay and gravel	40	110
Boulders	18	128
Clay, red	7	135
Clay, red, and gravel	25	160
Clay, yellow, and gravel	25	185
Clay, yellow	15	200
Clay, yellow, and boulders	30	230
Gravel, sandy, fine	35	265
Clay, yellow	2	267
Gravel and clay	3	270
Clay, yellow	8	278
(B-12-11)7abb-1. Log by D. E. Rogers. Alt. 4,320 ft.		
Topsoil	12	12
Clay, gray, and gravel	36	48
Clay, yellow, and gravel	5	53
Clay, red, and gravel	20	73
Clay, yellow, and gravel	17	90
Clay, red	15	105
Sandstone	2	107
Rock, white, chalky	11	118
Clay, sandy, red	7	125
Rock, white, chalky	2	127
Clay, sandy, yellow	33	160
Clay, red	15	175
Clay, white	5	180
Clay, blue	20	200
Clay, red	20	220
Clay, green	20	240
Clay, red	10	250
(B-12-11)8abb-1. Log by R. C. Denton. Alt. 4,300 ft.		
Clay and silt	25	25
Gravel	3	28
Clay and gravel	4	32
Conglomerate	9	41
Sand and gravel	15	56
Clay and gravel	28	84
Sand and gravel	11	95
Gravel	12	107
Gravel and boulders	12	119
Clay and sand	10	129
Gravel, large	18	147
Clay and gravel	8	155
Clay, sand, and gravel	32	187
Clay and gravel	14	201
Clay	74	275
(B-12-11)8bbb-1. Log by D. E. Rogers. Alt. 4,320 ft.		
Topsoil	28	28
Rock and gravel	75	103
Clay	2	105
Rock and gravel; water bearing	35	140
Clay, yellow	77	217
Clay, sandy	13	230
Sandstone	1	231
Clay, white	4	235
Clay, sandy, and sand stratas in clay	115	350
(B-12-11)8cda-1. Log by Hughes and Coss. Alt. 4,280 ft.		
Topsoil	9	9
Gravel	6	15
Clay, brown	145	160
Gravel and sand; water at 180 ft	40	200
Sand, white	10	210
Clay, yellow	290	500
Sand, gray, fine; warm salty water	10	510
(B-12-11)16cdc-1. Log by C. A. Holland. Alt. 4,230 ft.		
Clay, sandy	30	30
Clay and gravel; some water	42	72
Gravel; water	48	120
Clay and gravel	6	126
(B-13-9)1adc-1. Log by A. P. Lloyd. Alt. 4,580 ft.		
Clay	12	12
(B-13-9)1adc-1 - Continued		
Lava, black, broken	198	210
Lava, red, porous	58	268
Lava, brown	12	280
Lava, hard, gray	25	305
Lava, brown, porous	20	325
Lava, hard, brown	7	332
Lava, soft, brown; water at 343 ft	32	364
Lava, hard, black	8	372
Lava, soft, brown	13	385
Lava, hard, black	17	402
Lava, soft, brown	10	412
Lava, hard, black	8	420
(B-14-7)2bab-1. Log by J. C. Petersen. Alt. 5,250 ft		
Silt and gravel	28	28
Gravel, large	19	47
Clay and small gravel	4	51
Clay and layered gravel	46	97
Clay, white, and sand	4	101
Clay and gravel	21	122
Clay, white, and sand	2	124
Gravel, large	4	128
Clay, layered	32	160
Gravel, large	7	167
Clay, white and brown, and coarse sand	2	169
Limestone, large, gravelly	24	193
Cobbles	1	194
Limestone, large, gravelly	11	205
Limestone, large, gravelly, and sand	8	213
Clay, silt, sand, gravel, and gravelly limestone	65	278
Clay, gravel, cobbles, and limestone	24	302
Sand, gravel, cobbles, and limestone	15	317
Clay, white, gray, and black, gravel, and cobbles	35	352
Sand and gravel	6	358
Clay, white, gray and black, and cobbles	12	270
Sand, gravel, and cobbles	9	379
Clay, white, gray, and black, and gravel	5	384
Sand, gravel, and cobbles	13	397
Clay and gravelly limestone	1	398
(B-14-7)5aca-1. Log by Wayman Yarbrough. Alt. 4,650 ft.		
Clay and gravel	50	50
Sand and gravel; first water	10	60
Cobbles	10	70
Clay and sand	20	90
Sand and gravel	15	105
Clay and boulders	10	115
Gravel	10	125
Conglomerate	10	135
Clay and boulders	15	150
Clay, yellow	40	190
Clay and gravel	20	210
Clay and sand	15	225
Gravel	10	235
Clay and boulders	15	250
(B-14-8)2daa-1. Log by G. Beukenhurst. Alt. 4,550 ft.		
Topsoil	3	3
Clay and cobbles	45	48
Gravel; water bearing	2	50
Clay and cobbles	22	72
Gravel; water bearing	2	74
Clay and cobbles	166	240
(B-14-8)3dcb-1. Log by Siaperas Drilling Co. Alt. 4,590 ft.		
Topsoil	10	10
Clay	12	22
Clay and sand	19	41
Sand and gravel	14	55
Gravel; water bearing	8	63
(B-14-8)5dcc-1. Log by Wayman Yarbrough. Alt. 4,510 ft.		
Silt and sand	40	40
Clay and sand	21	61
Lava	32	93
(B-14-8)5dcc-1 - Continued		
Clay and sand; water	20	113
Clay	71	184
Clay, cobbles, and lava	1	185
Boulders and lava	2	187
Lava, hard	11	198
Clay	14	212
Gravel, cemented	2	214
Clay	3	217
Gravel, cemented	1	218
Clay	6	224
Gravel, cemented	1	225
Clay and pea gravel	13	238
Gravel, pea	4	242
Clay and gravel	5	247
Gravel	1	248
Clay and sand	20	268
Clay, hard	2	270
Clay and sand	40	310
Gravel	2	312
Clay, hard, sand and gravel	12	324
Clay and sand	16	340
Clay and boulders	2	342
Clay	2	344
Clay, sand, and cobbles	3	347
Clay, sand, and gravel	18	365
Sand	2	367
Clay and sand	8	375
Limestone and boulders	6	381
Limestone, hard, gray	19	400
(B-14-8)11bca-1. Log by T. J. Burkhart Co. Alt. 4,525 ft.		
Clay, light	30	30
Clay, light, sandy	4	34
Lava, fractured	7	41
Lava, hard	10	51
Clay, light, sandy	26	77
Clay, light, dense	25	102
Clay, brown	29	131
Sand and gravel	14	145
Gravel	15	160
Gravel, crushed	40	200
Clay, dark	16	216
Clay, gray, dense	4	220
Gravel	17	237
Clay, blue, and gravel	44	281
Gravel, pea	6	287
Gravel	26	313
Clay, dark, and gravel	33	346
Gravel	7	353
Clay, light	28	381
Clay, gravel, and slate	14	395
Slate	21	416
(B-14-8)28bbb-1. Log by T. J. Burkhart. Alt. 4,540 ft.		
Clay, light	20	20
Sand, light	4	24
Lava, dark	108	132
Clay and sand	6	138
Clay and gravel	7	145
Sand and gravel; water	10	155
Clay, light	20	175
Clay, dark	13	188
Lava, dark	58	246
Clay and gravel	240	486
Sand and gravel	25	511
Bedrock	139	650
(B-14-8)32aaa-1. Log by L. H. Stoddard. Alt. 4,550 ft.		
Topsoil	3	3
Clay	47	50
Lava	112	162
Limestone, blue	121	283
Lava	47	330
(B-14-9)1aaa-1. Log by T. Siaperas. Alt. 4,500 ft.		
Silt	24	24
Clay, sandy	32	56
Clay	34	90
Lava	5	95
Clay, sandy	15	110
Clay	14	124
Clay, sandy	17	141
Clay	29	170
Gravel, dry	26	196

Material	Thickness	Depth
UTAH SUBBASIN - Continued		
(B-14-9)1aaa-1 - Continued		
Lava	4	200
Lava, fractured	30	230
Lava, fractured, and gravel	45	275
(B-14-9)1dda-1. Log by T. J. Burkhart. Alt. 4,480 ft.		
Topsoil	2	2
Clay, sandy	4	6
Clay	5	11
Sand	2	13
Clay and gravel	43	56
Lava	51	107
Shale and fractured lava	32	139
Shale, sandy	15	154
Shale	34	188
Lava	70	258
Shale and small gravel	18	276
Gravel, cemented	38	314
Gravel and sand	18	332
Gravel, cemented	40	372
Clay	8	380
(B-14-9)1ddd-1. Log by F. P. Conley. Alt. 4,480 ft.		
Clay, sandy	42	42
Clay	4	46
Lava	58	104
Clay	77	181
Lava	61	242
Clay, brown	14	256
Gravel, coarse	2	258
Clay	6	264
Clay, sandy	48	312
(B-14-9)1ddd-2. Log by F. P. Conley. Alt. 4,480 ft.		
Topsoil	21	21
Clay	20	41
Lava	65	106
Clay, brown	24	130
Clay; water	5	135
Clay, brown	55	190
Clay and porous lava	2	192
Lava, porous	10	202
Lava	41	243
Clay	10	253
Sand and pea gravel	2	255
(B-14-9)3aaa-1. Log by J. C. Petersen. Alt. 4,480 ft.		
Topsoil	5	5
Clay and silt	29	34
Sand, fine, brown	4	38
Clay, brown	4	42
Clay and sand	3	45
Clay, brown	12	57
Clay, sand, and gravel	15	72
Clay, buff	7	79
Clay, sandy, and small gravel	8	87
Clay and lava	9	96
Clay, red	36	132
Clay, white	14	146
Cobbles, lava	2	148
Sand and fractured lava	3	151
Clay, white	1	152
Cobbles, lava, and clay	40	192
Sand and fractured lava	13	205
(B-14-9)5aaa-1. Log by Wayman Yarbrough. Alt. 4,440 ft.		
Topsoil	1	1
Hardpan	4	5
Clay, brown	60	65
Clay, light brown, and gravel	55	120
Clay, brown	60	180
Gravel and boulders	6	186
Rock	36	222
Clay and sand	8	230
Clay, sandy	45	275
(B-14-9)5abb-1. Log by Wayman Yarbrough. Alt. 4,450 ft.		
Topsoil	14	14
Clay	124	138
Sand and gravel	12	150
Clay	45	195
Lava	15	210
Clay	2	212
Lava	5	217
Clay	18	235
Sand and gravel	30	265
Clay	10	275
Silt	5	280
(B-14-9)5abb-1 - Continued		
Clay	20	300
Silt	35	335
Clay	5	340
Silt	15	355
Sandstone	5	360
Sand and gravel	25	385
Clay	20	405
(B-14-9)5bbb-1. Log by T. J. Burkhart. Alt. 4,430 ft.		
Topsoil	2	2
Clay	24	26
Clay and gravel	50	76
Clay	84	160
Clay and gravel	7	167
Lava	24	191
Clay, sandy	49	240
Gravel and sandy clay	35	275
Clay, sandy	5	280
Gravel and sandy clay	20	300
(B-14-9)5cca-1. Log by F. P. Conley. Alt. 4,425 ft.		
Clay, sandy	113	113
Clay	66	179
Lava	73	252
Shale, red	13	265
Clay, sandy	64	329
Gravel	11	340
Clay, sandy	15	355
(B-14-9)5cdc-1. Log by Wayman Yarbrough. Alt. 4,420 ft.		
Topsoil and hardpan	2	2
Clay	27	29
Hardpan	2	31
Clay	22	53
Clay and gravel	14	67
Sandstone	8	75
Clay, sandy	19	94
Clay and sandstone	6	100
Clay	10	110
Sandstone	2	112
Clay, light	41	153
Clay and sandstone	2	155
Clay	17	172
Clay, hard	3	175
Clay	3	178
Clay and lava pebbles; water	4	182
Lava, boulders	28	210
Lava	6	216
Lava, porous; water	6	222
Lava, hard	9	231
Lava, gravelly	2	233
Lava, porous, boulders	15	248
Lava, hard	5	253
Sand, red, and clay	11	264
Clay, sandy	8	272
Clay	2	274
Clay, sandy	27	301
Clay	6	307
Clay, sandy	16	323
Clay	4	327
Sandstone and clay	11	338
Clay	5	343
Clay, hard, and gravel	1	344
Clay	1	345
Clay, hard, and gravel	2	347
Sand and clay	18	365
Sand; water	1	366
Clay, sandy	9	375
Sandstone	2	377
Gravel	2	379
Clay, sandy	21	400
(B-14-9)6adc-1.[1] Log by Utah Southern Oil Co. Alt. 4,420 ft.		
Valley fill; mostly light-colored tuffs with interbeds of tuffaceous limestone, sandstone, and conglomerate; lava stringers frequent 160-205 and 390-575 ft	3,080	3,080
Consolidated sedimentary rocks; include mostly limestone, sandstone, and shale of Devonian to Permian age	4,489(?)	7,569(?)
(B-14-9)9baa-1. Log by J. S. Lee and Sons. Alt. 4,410 ft		
Clay, brown	120	120
Clay, gray	65	185
Lava	70	255
Clay, brown, sandy	45	300
(B-14-9)9baa-1 - Continued		
Clay	212	512
Lava	148	660
Lava, loose	12	672
(B-14-9)9bbb-1. Log by Wayman Yarbrough. Alt. 4,415 ft.		
Topsoil	20	20
Clay, brown, and topsoil	60	80
Clay, light	40	120
Clay, blue	20	140
Sand, red	20	160
Clay, brown	15	175
Clay, blue green	11	186
Lava and gravel; water	9	195
Lava, black	5	200
Lava, red	5	205
Lava, hard	40	245
Lava, red, hard	7	252
Clay, red, sandy	8	260
Clay	10	270
Clay, brown	15	285
Sand	5	290
Clay, hard	5	295
Sand	10	305
Clay, hard	10	315
Clay, brown	10	325
Sand	10	335
Clay	5	340
Sandstone	5	345
Clay, sandy	10	355
Clay	5	360
(B-14-9)11bcb-1. Log by F. A. Cagle. Alt. 4,410 ft.		
Topsoil	3	3
Clay	31	34
Rock	10	44
Clay	16	60
Rock	44	104
Clay, red	16	120
Clay, blue	25	145
Lava	100	245
(B-14-9)13abb-1. Log by L. H. Stoddard. Alt. 4,500 ft.		
Topsoil	1	1
Clay	28	29
Lava	31	60
Sandstone	15	75
(B-14-9)18bdd-1. Log by Wayman Yarbrough. Alt. 4,360 ft.		
Clay, yellow	60	60
Clay, brown, hard	6	66
Clay, yellow	112	178
Lava, dark	87	265
Clay, brown, sandy	25	290
Clay, yellow, sticky	10	300
Clay, yellow, sandy	85	385
Clay, blue, sticky	15	400
(B-14-9)19bbb-1. Log by Wayman Yarbrough. Alt. 4,360 ft.		
Topsoil	5	5
Clay and silt	9	14
Sand, fine	3	17
Clay, brown	3	20
Sand and small gravel	3	23
Clay	2	25
Sand and silt	2	27
Clay	5	32
Sand and small gravel	5	37
Gravel, sand, and clay	2	39
Clay, brown	6	45
Clay and gravel	3	48
Gravel, small, sand, and clay	81	129
Sand and clay	32	161
Bentonite	3	164
Lava	16	180
Lava, cinders	3	183
Lava	15	198
Clay	2	200
Lava, hard	14	214
Lava, red	4	218
Lava, black	6	224
Lava, gray, hard	6	230
Lava, porous	5	235
Lava, hard	10	245
Clay and lava boulders	3	248
Lava, hard	12	260
Clay, hard	30	290
Clay, sandy	30	320
Sand, gray	30	350

Table 5.—Continued

Material	Thickness	Depth
UTAH SUBBASIN - Continued		
(B-14-9)21bbb-1. Log by J. C. Peterson. Alt. 4,360 ft.		
Topsoil	4	4
Clay and sand	14	18
Silt and sand	2	20
Gravel, small	1	21
Clay and sand	10	31
Clay, sand, and gravel	24	55
Clay	4	59
Sand and clay	1	60
Gravel	3	63
Clay, brown	7	70
Sand, brown	5	75
Clay, blue green, and tuff	6	81
Sand, brown, fine	2	83
Clay	5	88
Sand, brown and black	4	92
Clay and lava gravel	24	116
Gravel, fine, and cobbles	2	118
Gravel, lava	3	121
Clay and lava	10	131
Clay and lava gravel	2	133
Clay, red brown	3	136
Sand, fine	2	138
Clay, red	1	139
Clay, red, and small gravel	5	144
Clay, red	3	147
Sand	2	149
Clay, sand, and gravel	1	150
Sand	2	152
Clay and gravel	3	155
Clay, red	30	185
Clay, sandy	21	206
Lava and clay	30	236
Clay, lava, and gravel	31	267
Lava	7	274
Gravel	2	276
Clay, lava, and gravel	12	288
Sand, gravel, and clay	6	294
Sand, fine, coarse gravel, and clay	24	318
Clay, buff	3	321
Sand, fine	8	329
Clay, white	10	339
Sand, fine	1	340
Clay, buff	5	345
Sand, fine, and gravel	6	351
Clay, red	9	360
Clay, sandy	6	366
Sand, medium	2	368
Sand and clay	15	383
Sand, gravel, and cobbles	5	388
Clay, buff	15	403
Clay, sandy	9	412
Clay, buff	4	416
Clay, red	5	421
Sand, coarse	5	426
Clay	3	429
Clay, sandy	9	438
Sand, fine	4	442
Clay, black	5	447
Sand, fine	3	450
Clay, sandy	6	456
Clay, tuff	6	462
Clay, lava cobbles, and small gravel	9	471
Clay and lava	3	474
Gravel and sand	1	475
Clay, sandy, and lava cobbles	3	478
Cobbles and clay with small gravel	3	481
Sand, gravel, and lava cobbles	4	485
Sand, fine	3	488
Clay, gravel, and sand; water	4	492
Gravel and sand, coarse, and clay	2	494
Gravel, clay, and cobbles	2	496
Clay, gravel, and cobbles	50	546
Sand, clay, gravel; water	40	586
(B-14-10)1bbb-1. Log by F. P. Conley. Alt. 4,455 ft.		
Topsoil	22	22
Lava, gray, with crevices	30	52
Lava, soft, light red, with crevices	13	65
Lava, dark red, hard	7	72
Lava, hard, gray, with large crevices	13	85
Lava, hard, gray	23	108
Lava, very hard	54	162
Clay, light brown	13	175
Clay, sandy; first water	13	188
Rock, hard, white, brittle	20	208
Clay, brown, sandy; water	3	211
(B-14-10)1bbb-1 - Continued		
Sandstone	4	215
Clay, metallic	60	275
Gravel and brown lava	10	285
Gravel, cemented	3	288
Cinders, lava, and sand	22	310
Sand and gravel, cemented	10	320
Sandstone, brown	23	343
Sand, brown, and shale	7	350
Clay, yellow	15	365
Gravel and sand	17	382
Sandstone	13	395
Gravel and sand	10	405
Clay	10	415
Sand	5	420
(B-14-10)1dca-1. Log by F. P. Conley. Alt. 4,430 ft.		
Clay	17	17
Gravel	3	20
Lava	13	33
Clay	87	120
Lava	60	180
Clay and sand	28	208
Clay, sandy	35	243
(B-14-10)5baa-1. Log by F. A. Cagle. Alt. 4,610 ft.		
Gravel	80	80
Clay	36	116
Rock	34	150
Clay	37	187
Bentonite	20	207
Gravel and sandstone	69	276
(B-14-10)5bba-1. Log by F. A. Cagle. Alt. 4,610 ft.		
Gravel and clay	105	105
Gravel and sand; water bearing	3	108
Hardpan	112	220
Gravel and clay	20	240
Clay	43	283
Sandstone and clay, layered	20	303
(B-14-10)14acd-1.1/ Log by Utah Southern Oil Co. Alt. 4,390 ft.		
Valley fill; chiefly tuffaceous rocks, light-colored, partially lineated, soft, often sandy or silty, often grading into tuffaceous limestone and containing interbedded conglomerate and lava; interbedded tuffaceous conglomerate and lava flows to 15 feet thick (330-540 ft); entirely conglomerate (730-870 ft); calcareous siltstone and minor interbedded shale (3,820-3,880 ft)	3,880	3,880
Consolidated sedimentary rocks, undivided; include mostly limestone, sandstone, and shale of Devonian to Permian age	2,585	6,465
(B-14-10)14bbc-1. Log by F. P. Conley. Alt. 4,410 ft.		
Topsoil	25	25
Gravel	14	39
Clay	8	47
Lava, solid	98	145
Lava, decomposed	15	160
Lava, hard	37	197
Clay, light brown	10	207
Lava, solid	60	267
Clay, white	19	286
Clay, brown	99	385
Lava, hard	35	420
Clay, brown	60	480
Sandstone	50	530
Clay, white, with stratas of sandstone	285	815
Gravel	25	840
(B-14-10)22cdb-1.1/ Log by Utah Southern Oil Co. Alt. 4,420 ft.		
Valley fill; chiefly light-colored tuffs and calcareous rocks with interbedded tuffaceous conglomerate; minor lava stringers (200-215 ft)	440	440
Consolidated sedimentary rocks, undivided; mostly limestone, sandstone, and shale of Devonian to Permian age	6,023	6,463
(B-15-7)29dac-1. Log by S. Siaperas Drilling Co. Alt. 4,800 ft.		
Topsoil	12	12
Sandstone	116	128
Gravel	2	130
Sandstone and sand	28	158
Gravel	3	161
Sand and sandstone	14	175
(B-15-7)30cbc-1. Log by David Musselman. Alt. 4,550 ft.		
Clay, white	110	110
Clay, blue	44	154
Limestone and gravel	31	185
Mud, blue	43	228
(B-15-7)32aca-1. Log by Wayman Yarbrough. Alt. 4,780 ft.		
Topsoil, gravel, and clay	15	15
Clay, hard, and gravel	60	75
Boulders	25	100
Clay, hard	15	115
Sand, clay, and gravel	30	145
Gravel, cemented, and sand	30	175
Clay	15	190
Gravel, cemented	5	195
Gravel and sand	15	210
Clay and boulders	30	240
Shale and gravel	15	255
Boulders and clay	20	275
Sand, cemented, and gravel	15	290
Gravel, cemented	25	315
(B-15-8)25ddd-1. Log by David Musselman. Alt. 4,550 ft.		
Clay, white	39	39
Hardpan and conglomerate	2	41
Clay, green	53	94
Hardpan	1	95
Gravel	5	100
(B-15-9)29dbc-1. Log by Wayman Yarbrough. Alt. 4,480 ft.		
Topsoil and gravel	2	2
Gravel, cemented	53	55
Sandstone	10	65
Sand	5	70
Clay	10	80
Sand	10	90
Clay	5	95
Sandstone	20	115
Clay	5	120
Sandstone	5	125
Sand	10	135
Clay	10	145
Sand and pea gravel	10	155
Clay	10	165
Clay, sandy	13	178
Limestone	2	180
Clay	10	190
Sandstone	10	200
Lava	10	210
Gravel, loose; water	28	238
Gravel and sand	12	250
Clay and sand	45	295
Lava	10	305
Clay	10	315
Gravel	10	325
Sandstone	25	350
Clay, sandy	25	375
Sandstone	10	385
Clay and sand	10	395
Sandstone	5	400
Sand	5	405
Sandstone	10	415
Clay	10	425
Gravel, cemented	5	430
Sandstone	10	440
Gravel, cemented	8	448
Clay	7	455
Lava, boulders	5	460
Lava	20	480
(B-15-9)35abb-1. Log by Wayman Yarbrough. Alt. 4,500 ft.		
Clay, yellow	98	98
Rock, dark	47	145
First water	40	185
Rock, gray	60	245
Rock, brown	5	250
Rock, gray	30	280
Little water	10	290
Rock, brown	87	377
Lava, porous	27	404

Table 5.–Continued

Material	Thickness	Depth
UTAH SUBBASIN		
(B-15-10)33dda-1. Log by A. P. Lloyd. Alt. 4,590 ft.		
Gravel	30	30
Boulders	21	51
Clay and gravel	21	72
Clay, brown	15	87
Lava, black	80	167
Clay, gray	66	233
Clay, brown	122	355
(B-15-10)36bbb-1. Log by F. P. Conley. Alt. 4,465 ft.		
Topsoil	2	2
Clay and gravel	33	35
Gravel	10	45
Clay, sandy	33	78
(B-15-10)36bbb-1 - Continued		
Clay, sticky	32	110
Clay and gravel	13	123
Boulders, lava	4	127
Sandstone	10	137
Lava	37	174
Lava, fractured, mineralized	62	236
Lava, fractured, and clay	17	253
Clay, brown, red, and gray, and sandstone	58	311
Sandstone	2	313
Clay	1	314
Sandstone and clay, layered	91	405
Clay and pea gravel	11	416
Sandstone and clay, layered	158	574
Gravel, pea	14	588
(B-15-10)36bbb-1 - Continued		
Gravel, porous, and sandstone	10	598
Lava, porous	9	607
Lava, nonporous	6	613
(B-15-11)36ccc-1. Log by A. P. Lloyd. Alt. 4,900 ft.		
Clay, gravel, and cobbles	150	150
Limestone, dark gray	3	153
Clay and boulders	28	181
Limestone	54	235
Clay and gravel	24	259
Clay and sand	8	267
Clay, gray, and boulders	33	300
Limestone, gray	20	320
IDAHO SUBBASIN		
16S-32E-2bc-1. Log by H. Vanderwood. Alt. 4,610 ft.		
Topsoil	2	2
Clay	33	35
Clay, sandy	3	38
Gravel and sand	3	41
Clay	2	43
Gravel and sand	4	47
Gravel	29	76
Clay and gravel	9	85
Clay	11	96
Gravel	1	97
Clay	6	103
Gravel	5	108
Clay	3	111
Gravel	9	120
Clay	5	125
Gravel	40	165
Clay	2	167
Gravel	11	178
Rock	2	180
Clay and gravel	5	185
16S-32E-2bc-1 - Continued		
Clay	5	190
16S-32E-7da-1. Log by B. L. Brackenbury. Alt. 4,800 ft.		
Topsoil	5	5
Clay and gravel	85	90
Limestone	10	100
Clay	15	115
Limestone	5	120
Clay and gravel	75	195
Rock	60	255
Limestone	80	335
Limestone and clay	93	428
Clay and limestone	57	485
16S-32E-23bc-1. Alt. 4,550 ft.		
Clay; water at 27 ft	48	48
Gravel; water at 48 ft	10	58
Clay	12	70
Sandstone	15	85
No record	23	108
16S-32E-25ab-2. Log by H. Vanderwood. Alt. 4,700 ft.		
Topsoil	2	2
Sand	4	6
Cobbles	1	7
Clay, sandy	13	20
Sand	8	28
Clay	19	47
Clay and gravel	2	49
Clay	11	60
Clay and gravel	4	64
Clay, gravel, and boulders	15	79
Clay	7	86
Clay and gravel	10	96
Gravel	3	99
Gravel and sand	5	104
Gravel and boulders	6	110
Gravel, coarse, and sand	17	127
Boulders and sandy clay	37	164
Gravel, coarse, and sand	17	181
Gravel, coarse, and clay	18	199
Boulders; water	2	201

1/ Adapted from log of Peace (1956, p. 28).

Table 6.—Chemical analyses of water from selected wells, springs, and a surface-water sampling site in Curlew Valley

Sodium and potassium: Where no value is given for potassium, sodium plus potassium values are reported as sodium.
Dissolved solids: Values of less than 1,000 mg/l are residue on evaporation at 180°C, except as indicated by c (calculated from sum of determined constituents); values greater than 1,000 mg/l are calculated from sum of determined constituents.
Agency making analysis: DH, Utah State Department of Health; GS, U.S. Geological Survey; SC, Utah State Chemist; SU, Utah State University.

Location	Date of collection	Temperature (°C)	Milligrams per liter															Percent sodium	Sodium-adsorption ratio	Specific conductance (micromhos/cm at 25°C)	pH	Agency making analysis
			Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$					
UTAH SUBBASIN																						
(B-11-9)																						
5cca-S1	4-19-60	-	32	109	66	1,130	51	225	0	152	1,970	-	2.2	0.27	3,620	544	359	80	21	6,570	7.6	GS
6cdc-S1	7-19-60	-	16	187	180	3,450	140	59	0	390	5,990	-	11	.92	10,430	1,210	1,160	84	43	16,700	7.6	GS
(B-11-10)																						
1adc-S1	10-12-60	-	33	127	69	910	35	209	0	118	1,640	-	1.6	-	3,050	600	429	75	16	5,400	7.7	GS
12aac-S1	4-19-60	-	29	119	67	1,330	56	210	0	155	2,280	-	2.8	.34	4,140	572	400	82	24	7,690	7.9	GS
(B-12-9)																						
27bcb-1	10-10-67	15	39	1.6	12	790	17	564	0	268	720	2.2	19	1.1	2,200	54	0	96	47	3,690	8.1	GS
(B-12-10)																						
36cab-S1	10-12-60	-	46	122	52	861	60	208	0	93	1,570	-	2.8	-	2,920	518	347	76	16	5,240	7.6	GS
36dcc-S1	10-10-67	-	33	120	59	537	28	216	0	68	1,050	.8	2.1	.14	2,010	544	367	67	10	3,650	7.9	GS
(B-12-11)																						
5bba-1	7-12-67	16	40	72	39	112	14	222	0	51	255	.4	2.6	.09	756	340	158	40	2.6	1,210	7.6	GS
5bbb-1	10-17-57	14	22	111	26	105		188	0	68	272	-	3.1	-	699c	382	228	37	2.3	1,050	7.1	GS
8cda-1	4- 3-53	-	-	51	23	69	32	171	0	58	151	-	-	-	460	222	81	36	2.0	760	-	DH
(B-13-12)																						
35ddd-S1	10-10-67	14	21	59	21	48	4.5	198	0	27	100	.3	0	.07	391	232	70	31	1.4	657	7.5	GS
(B-14-7)																						
29dbb-1	10-11-67	13	17	122	65	57	4.1	248	0	50	315	.5	4.5	.09	960	570	367	18	1.0	1,410	7.5	GS
(B-14-8)																						
2ccc (Deep	6-17-49	-	-	81	46	226	19	321	0	237	302	-	.4	.26	1,100	391	128	53	5.0	1,810	-	GS
Creek)	10-11-67	-	22	99	54	229	13	306	0	229	368	1.2	.1	.18	1,170	468	217	51	4.6	1,920	7.6	GS
11aba-1	10-16-57	10	28	252	112	765		544	0	1,460	555	-	2.5	-	3,440	1,090	642	60	10	4,820	7.3	GS
11bca-1	7-12-67	13	44	172	90	340	18	316	0	264	690	1.6	.2	.08	1,720	800	541	47	5.2	2,950	7.6	GS
28bbb-1	8- 9-67	14	43	108	46	362	18	272	0	88	650	.9	.5	.09	1,450	460	237	62	7.3	2,520	7.6	GS
(B-14-9)																						
1dda-1	5-24-56	12	48	102	36	132		359	0	76	233	-	2.3	-	806c	404	110	42	2.9	1,360	7.4	GS
	6-17-57	-	45	100	47	118		355	0	67	240	-	.4	-	792	444	153	37	2.4	1,370	7.2	GS
	7-17-58	-	42	97	37	138		343	0	68	244	-	.7	-	796c	396	115	43	3.0	1,380	7.7	GS
	7-12-60	-	44	94	38	141		337	0	66	250	-	.5	-	800c	392	116	44	3.1	1,380	7.9	GS
	7-27-64	12	42	95	41	147		336	0	79	262	-	.6	-	878	408	132	44	3.2	1,420	7.6	GS
4bbb-1	5-24-56	22	61	146	35	123		186	0	34	426	-	3.6	-	921c	508	355	34	2.4	1,680	7.2	GS
5bbb-1	7-27-55	17	64	66	16	27	8.0	174	0	22	90	.2	4.4	.02	436	230	88	20	.8	608	7.4	GS
	5-24-56	18	55	67	16	34		176	0	29	93	-	4.0	-	379c	234	90	21	.8	626	7.6	GS
	6-17-57	-	57	71	14	31		179	0	23	90	-	3.2	-	377c	232	85	23	.9	618	7.4	GS
	5-28-58	-	50	68	14	34		175	0	22	94	-	3.2	-	371c	227	84	25	1.0	616	7.8	GS
	7-12-60	-	55	67	15	34		176	0	23	94	-	1.9	-	377c	228	84	25	1.0	612	7.8	GS
	7-27-64	17	50	63	16	35		176	0	23	94	-	.7	-	422	224	80	26	1.0	608	7.4	GS
5cdc-1	7-13-67	16	51	85	20	53	11	176	0	24	180	.3	3.1	.04	587	296	152	27	1.3	889	7.4	GS
7bbb-1	5-24-56	18	64	69	21	37		170	0	28	130	-	2.9	-	436c	260	121	24	1.0	734	7.6	GS
	7-17-58	-	61	75	18	47		169	0	23	142	-	2.8	-	452c	263	124	28	1.3	766	7.8	GS
	10-15-58	-	65	77	20	45		174	0	22	145	-	2.2	-	462c	274	131	26	1.2	782	7.9	GS
9baa-1	1- 6-55	-	-	-	-	-	-	-	-	-	2,120	-	-	-	-	1,450	-	-	-	6,550	-	GS
	1- 9-55	-	-	-	-	-	-	-	-	-	91	-	-	-	-	232	-	-	-	651	-	GS
(B-14-10)																						
1bbb-1	5-24-56	16	60	46	24	28		194	0	31	66	-	.9	-	352c	214	55	22	.8	558	7.6	GS
	6-17-57	-	61	57	16	31		193	0	24	66	-	.8	-	351c	209	51	24	.9	567	7.3	GS
	7-17-58	-	58	59	16	31		190	0	25	69	-	1.8	-	353c	213	57	24	.9	564	7.9	GS
	7-12-60	-	59	59	15	34		191	0	28	70	-	.6	-	360c	210	53	26	1.0	560	8.0	GS
	7-27-64	16	54	61	16	37		186	0	28	82	-	.9	-	404	218	65	27	1.1	592	7.6	GS
	8- 8-67	16	52	66	15	28	6.8	188	0	27	82	.4	.3	.03	391	224	70	21	.8	583	7.4	GS
1dca-1	9-12-55	-	-	57	15	25	10	199	0	22	63	-	-	-	323c	204	41	20	.8	530	-	SU
(B-14-11)																						
13bdd-S1	8-12-66	14	15	43	25	37		180	0	28	80	-	.1	-	332	210	62	27	1.1	585	7.5	GS
(B-15-7)																						
33aad-S1	11-22-50	-	13	71	42	225		212	0	43	433	.7	5.5	-	888	350	176	58	5.2	-	7.9	SC
(B-15-9)																						
28cbb-1	9-12-55	-	-	316	85	518	34	152	0	103	1,380	-	-	.10	2,480	1,140	1,020	49	6.7	4,200	-	SU
	5-24-56	25	72	321	83	381		142	0	48	1,290	-	3.9	-	2,270	1,140	1,020	42	4.9	4,170	7.2	GS
	6-17-57	-	74	314	87	436		146	0	125	1,300	-	5.9	-	2,410	1,140	1,020	45	5.6	4,140	6.9	GS
	5-28-58	-	71	325	91	411		140	0	41	1,360	-	4.4	-	2,370	1,180	1,070	43	5.2	4,300	7.5	GS
	7-12-60	-	74	319	94	417		145	0	45	1,360	-	5.2	-	2,390	1,180	1,060	43	5.3	4,350	7.6	GS
	5-24-61	-	75	339	81	382	30	144	0	42	1,340	.3	2.4	.40	2,360	1,180	1,060	41	4.8	4,340	7.5	GS
	7-27-64	24	64	345	97	439	29	140	0	66	1,480	.1	.6	.13	2,590	1,260	1,150	42	5.4	4,620	7.1	GS
	8- 8-67	24	77	369	92	452	32	144	0	35	1,500	.5	12	.03	2,640	1,300	1,180	42	5.5	4,700	7.3	GS
(B-15-10)																						
36bbb-1	5-24-56	17	56	59	17	18		198	0	23	51	-	2.2	-	324c	218	56	15	.5	502	7.4	GS
	6-17-57	-	63	61	10	25		173	0	18	60	-	2.8	-	325c	194	52	22	.8	548	7.4	GS
IDAHO SUBBASIN																						
16S-30E																						
7ab-S1	10-10-67	13	15	50	19	24	1.2	207	0	23	47	0.3	1.1	0.03	292	202	32	20	0.7	504	7.5	GS

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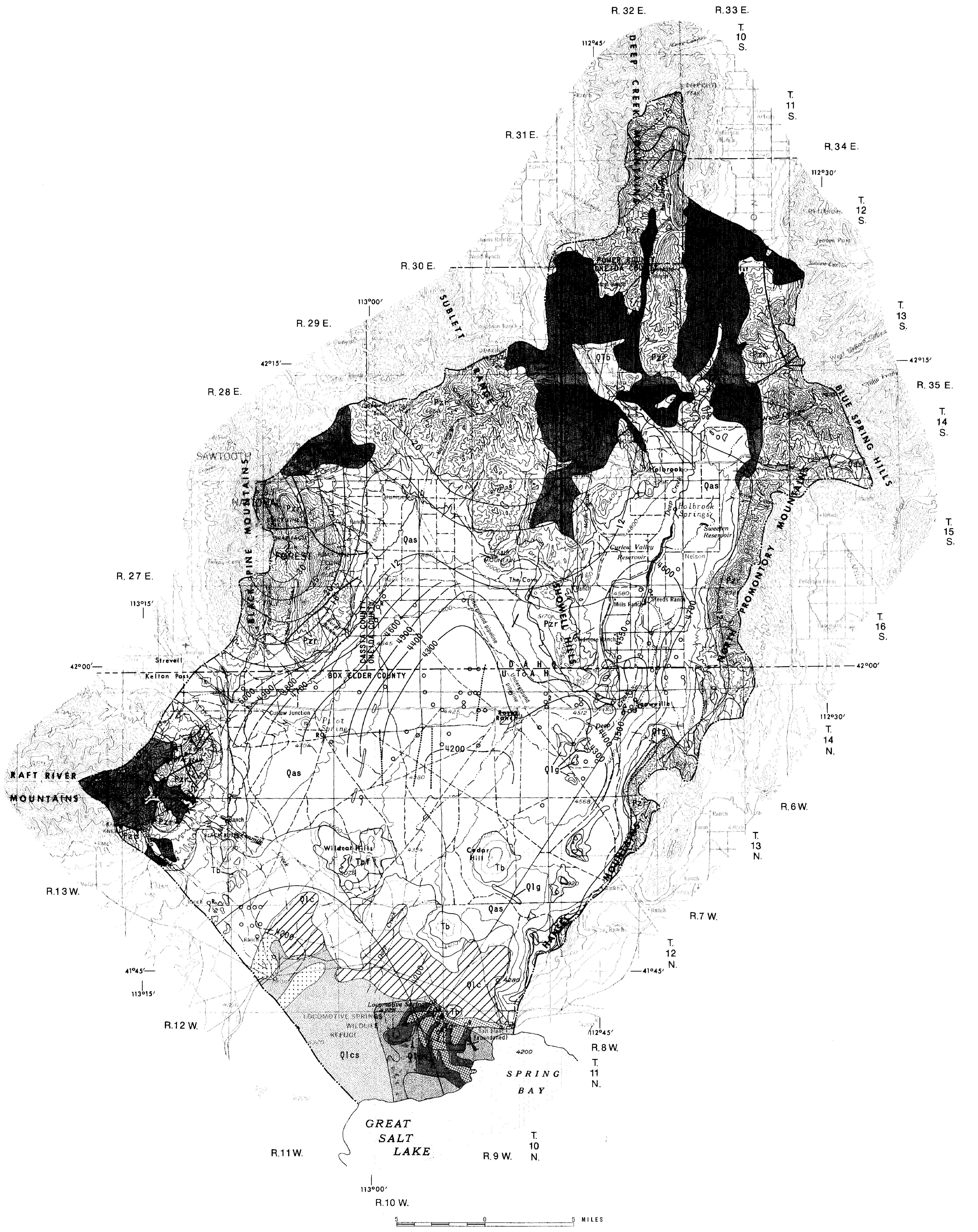


Base from Army Map Service 1:250,000 series:
Pocatello (1954) and Brigham City (1954)

EXPLANATION

GEOLOGY

QUATERNARY

Qas

Alluvial surfaces and colluvium

Mostly sloping and well-drained land; also includes alluvium along active streams and colluvium on steep slopes; provide ground-water recharge locally

Qlcs
Qlc
Qlcm

Lakebed deposits

Qlcs, *mostly permanently moist clay with a high salt content*

Qlc, *mostly clay and silt with some salt*

Qlcm, *marshy land, includes open bodies of moderately to highly saline water; low permeability inhibits recharge*

Qlg

Lakeshore deposits

Mostly sand and gravel in spits and bars and on lake terraces; moderately to highly permeable; facilitate ground-water recharge

TERTIARY and QUATERNARY

QTb or Tb
Tpf

Volcanic rocks

QTb or Tb, *basaltic and basaltic andesite flows and pyroclastics, includes the Snake River Group in Idaho*

Tpf, *rhyolite, dacite, and quartz-latite flows and pyroclastics; basaltic rocks yield moderate to large quantities of water to wells*

TERTIARY

Continental sedimentary rocks

Include the Salt Lake and Payette Formations; consists chiefly of tuff, tuffaceous shale, sandstone, and marlstone; interbedded conglomerate and volcanic rocks; generally of low permeability but may yield moderate quantities of water to wells locally, possibly underlies most of Curlew Valley

CAMBRIAN(?) to PERMIAN

Pzr

Sedimentary rocks undivided

Include chiefly limestone, shale, and sandstone of Paleozoic age (mostly Oquirrh Formation); generally of low permeability, but facilitate recharge where fractured and brecciated or honeycombed by solution cavities

PRECAMBRIAN

p€M

Metamorphic and igneous rocks

Metamorphic rocks (mostly schist of the Albion Range Group) and crystalline igneous rocks of Precambrian age; generally of low permeability, but facilitate recharge where fractured and brecciated or honeycombed by solution cavities

Approximate contact

Normal fault

Solid line where exposed, dashed where inferred, dotted where concealed [concealed faults in T. 14 N., R. 9 W., inferred from quality of ground water and oil test drilling; concealed faults in T. 14 N., R. 10 W., inferred from oil test drilling only (Peace, 1956)]

Thrust fault

Barbs on overriding block

HYDROLOGY

20

Line of equal normal annual precipitation. Intervals: 4 and 5 inches

4800

Water-level contour

Dashed where approximate; contour interval 100 feet, supplementary 50-foot contour is dotted. Datum is mean sea level

R

Spring

R, *indicates record in table 4*

2

Well

2, *indicates number of wells in nearly the same location*

Miscellaneous stream discharge measuring site

Surface drainage divide

EVAPOTRANSPIRATION

Greasewood

Greasewood and rabbitbrush

Pickleweed and greasewood

Saltgrass and other marsh grasses

Open-water surface (some hydrophytes)

Saltflats (some greasewood, saltgrass, and pickleweed)

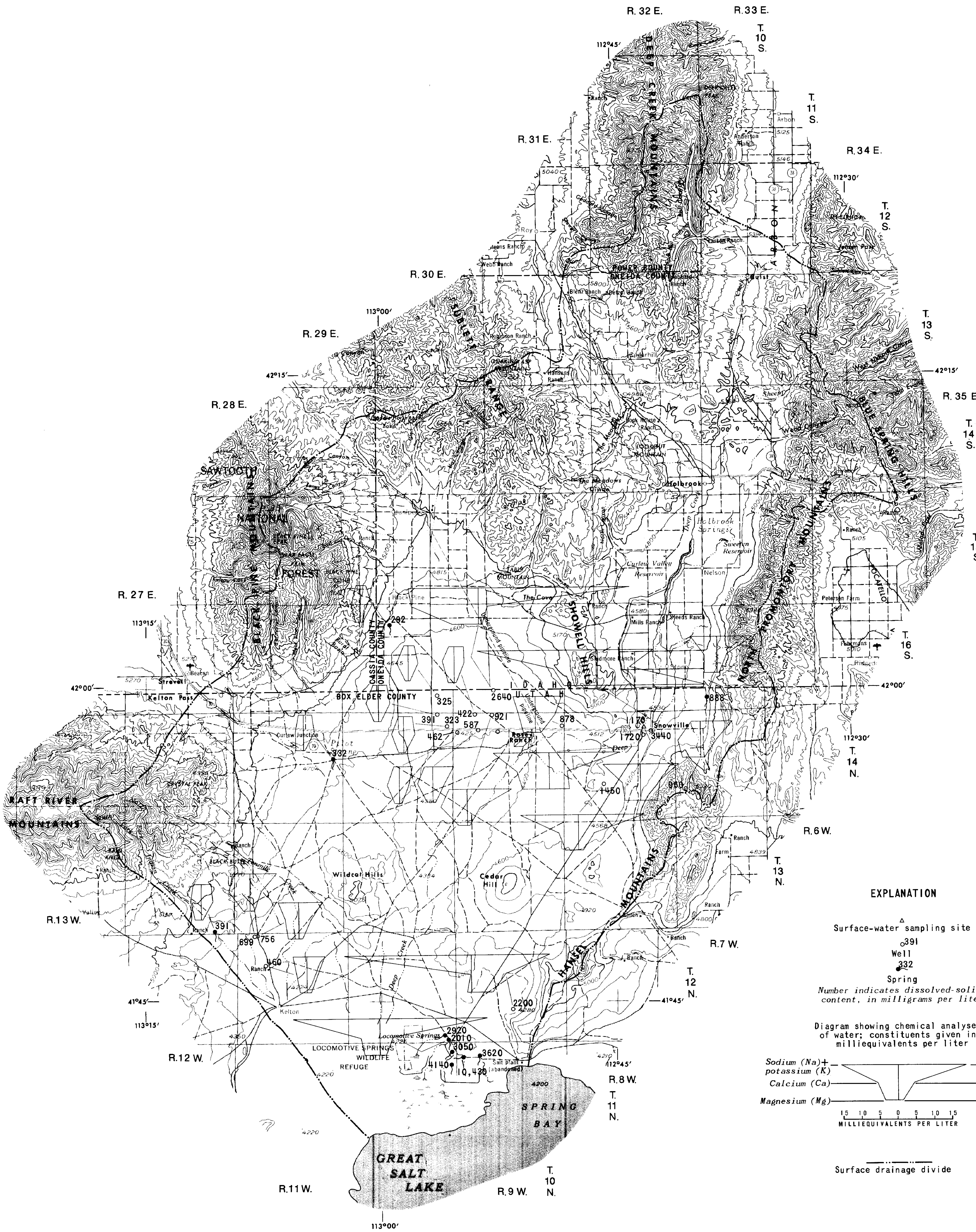
Hydrogeology by E. L. Bolke and Don Price. Geology adapted from Ross and Forrester (1947) and Stokes (1964). Isohyetal analysis: for Idaho by U.S. Weather Bureau River Forecast Center, Portland, Oregon; for Utah by State Climatologist and Water Supply Forecast Unit, Salt Lake City, Utah

GENERALIZED HYDROGEOLOGIC MAP OF CURLEW VALLEY, UTAH AND IDAHO

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES

TECHNICAL PUBLICATION NO. 25
PLATE 2 1969



EXPLANATION

△ Surface-water sampling site

○391 Well

●332 Spring

Number indicates dissolved-solids content, in milligrams per liter

Diagram showing chemical analyses of water; constituents given in milliequivalents per liter

Sodium (Na)+ potassium (K)
Calcium (Ca)
Magnesium (Mg)
Chloride (Cl)
Bicarbonate (HCO_3)
Sulfate (SO_4)
15 10 5 0 5 10 15
MILLIEQUIVALENTS PER LITER

Surface drainage divide

5 0 5 MILES

5 0 5 KILOMETERS

CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

Base from Army Map Service 1:250,000 series: Pocatello (1954) and Brigham City (1954)

By E. L. Bolke

MAP OF CURLEW VALLEY, UTAH AND IDAHO, SHOWING CHEMICAL QUALITY OF WATER AND LOCATION OF SAMPLING SITES