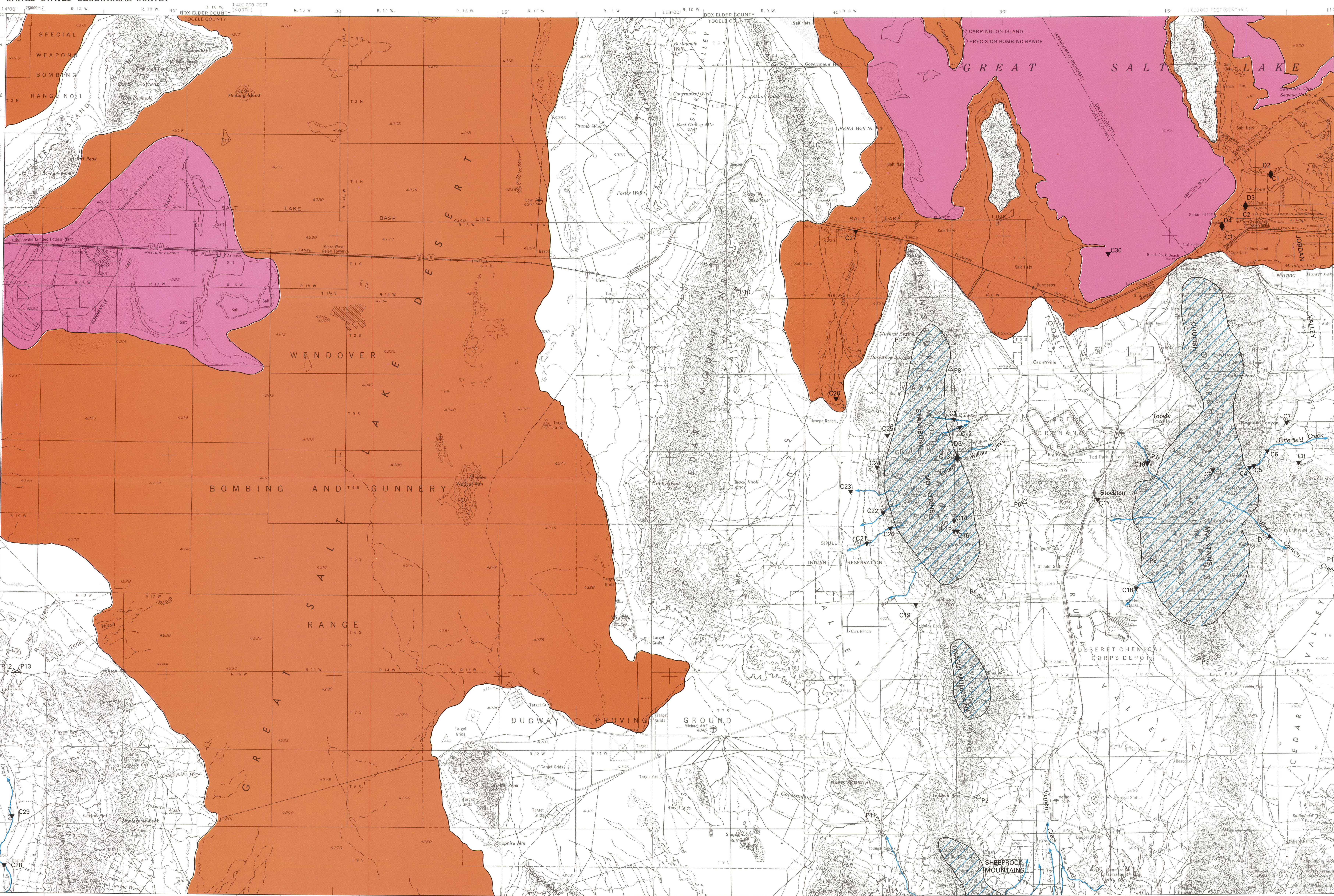

Base from U.S. Geological Survey, 1970

SCALE 1:250,000

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
TRANSVERSE MERCATOR PROJECTION
NATIONAL GEODETIC VERTICAL DATUM OF 1929

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1981—W80056

EXPLANATION

RUNOFF

Principal runoff-producing area

Theoretical mean annual runoff ranges from 4 to 20 inches or 215 to 1,100 acre-feet per square mile (from Bagley and others, 1964, fig. 16)

Perennial stream

Most of the flow of the perennial mountain streams is depleted or diverted for use at or near canyon mouths. Other streams in the area have only intermittent or ephemeral flow

SURFACE-WATER QUALITY

Fresh

Dissolved-solids concentrations of runoff generally range from 100 to 250 mg/L in and adjacent to principal runoff-producing areas and from 250 to 1,000 mg/L in lower stream reaches. Dissolved-solids concentrations of water in natural and manmade catchments may exceed 1,000 mg/L due to concentration by evaporation

Slightly saline to briny

Dissolved-solids concentrations are probably less than 1,000 mg/L in direct storm runoff but increase rapidly to more than 35,000 mg/L where the water collects in natural depressions and drains

Briny

Dissolved-solids concentrations exceed 100,000 mg/L. The brine in that part of Great Salt Lake shown on the map is at saturation during extremely low lake levels such as in 1963. The brine on the Bonneville Salt Flats is often at or near saturation

▲D5
Streamflow-gaging station
Number is site number in table 1

△P3
Crest-stage partial-record gaging station
Number is site number in table 2

▼C6
Surface-water sampling site
Number is site number in table 3

INTRODUCTION

This is one of a series of maps that describe the geology and related natural resources of the Tooele 2° Quadrangle. The purpose of this map is to describe on a regional scale the availability and chemical quality of surface water and to guide readers to more detailed site-specific information about the resource in this generally semiarid region. Most of the data used to compile this map were collected by the U.S. Geological Survey under cooperative programs with the Utah Departments of Natural Resources and Transportation. Those data are available in the files of the U.S. Geological Survey, Water Resources Division, Salt Lake City, Utah.

RUNOFF

Theoretical mean annual runoff in the Tooele Quadrangle ranges from less than 1 inch on valley floors (negligible on the Great Salt Lake Desert) to about 20 inches in the higher mountains (Bagley and others, 1964, fig. 16). The principal runoff-producing areas are the Oquirrh, Stansbury, Onaqui, and Sheeprock Mountains. Runoff from those mountains—mostly to Rush, Tooele, Skull, Cedar, and Jordan Valleys—averages about 136,000 acre-feet per year as shown in the following table:

Drainage basin	Estimated average annual runoff (acre-feet)	Source of estimate
Rush Valley	[1]70,000	Hood, Price, and Waddell (1969, p. 21)
Tooele Valley	57,000	([2])
Skull Valley	31,000	Hood and Waddell (1968, p. 21)
Cedar Valley	10,000	([3])
Jordan Valley	7,000	Hely, Mower, and Harr (1971, p. 97)

[1]Partly from West Tintic Mountains south of map area.
[2]A. C. Razem, U.S. Geological Survey (written commun., 1978).
[3]Estimated by writer (from Bagley and others, 1964, and records collected at gaging station 10166430, table 1).

Most of the runoff is intermittent or ephemeral, occurring chiefly during spring and early summer in response to the melting of mountain snowpacks. However, instantaneous peak discharges are most commonly generated by summer cloudburst activity as shown for site D1 in table 1 and sites P12 and P13 in table 2. There are 19 perennial mountain streams in the Tooele Quadrangle, the largest being South Willow, West Canyon, and Vernon Creeks (table 1). The flow of Butterfield Creek, one of the ungaged perennial streams, is sustained by inflow of water from an old mine tunnel.

It is interesting to note that even though the drainage basins of both South Willow and West Canyon Creeks receive as much as 40 inches of precipitation annually (U.S. Weather Bureau, no date), South Willow Creek produces about nine times more runoff per square mile than West Canyon Creek. This is attributed chiefly to the different geology in the two drainage basins (Moore and Sorensen, 1978). The drainage basin of South Willow Creek is underlain by sedimentary and metamorphic rocks of relatively low permeability that facilitate overland runoff, whereas the drainage basin of West Canyon Creek is underlain largely by more permeable carbonate rocks that facilitate ground-water recharge (transmit precipitation to deep aquifers instead of to streams).

Most of the flow of all the mountain streams that originate in the Tooele Quadrangle is depleted at or near those streams' canyon mouths, owing chiefly to seepage losses into permeable alluvial-fan deposits and to diversions for irrigation and other uses.

QUALITY

Surface water in the Tooele Quadrangle ranges from fresh to briny, according to the following classification commonly used by the U.S. Geological Survey:

Class	Dissolved-solids concentration (milligrams per liter)
Fresh	Less than 1,000
Slightly saline	1,000 to 3,000
Moderately saline	3,000 to 10,000
Very saline	10,000 to 35,000
Briny	More than 35,000

Dissolved-solids concentrations of runoff range from less than 100 mg/L (milligrams per liter) in and adjacent to the principal runoff-producing areas to more than 35,000 mg/L adjacent to Great Salt Lake. The brines in Great Salt Lake and the Bonneville Salt Flats contain more than 100,000 mg/L of dissolved solids.

Chemical analyses of water from selected surface-water sources in the Tooele Quadrangle are given in table 3. According to those analyses, the freshest waters in and adjacent to the principal runoff-producing areas are chiefly of a calcium bicarbonate type, whereas the more highly saline waters as well as the brines are of a sodium chloride type.

A number of studies have been made of the brines of Great Salt Lake and the Great Salt Lake Desert and the effect of man's activities on those brines. Waddell and Bolke (1973) describe effects of restricted circulation in Great Salt Lake (caused by a railroad causeway across the lake) on the salt balance of the lake. Lines (1979) describes the effects of man's activities on the hydrology and chemistry of the brines and on the surface conditions of a racetrack in the Bonneville Salt Flats area.

USE

The principal use of streamflow that originates in the Tooele Quadrangle is for irrigation—mostly in Tooele, Rush, Jordan, and Skull Valleys. The irrigation is limited to small areas near the mouths of the perennial streams. Some streamflow is diverted for public supply in the communities of Tooele and Stockton, and a small amount is used for watering of livestock. Runoff that reaches the lowermost parts of Jordan, Tooele, and Skull Valleys also helps to support a major migratory bird refuge adjacent to Great Salt Lake. Great Salt Lake, aside from being a major tourist attraction, is used primarily for recreation (mostly sailing and swimming) and for minerals extraction.

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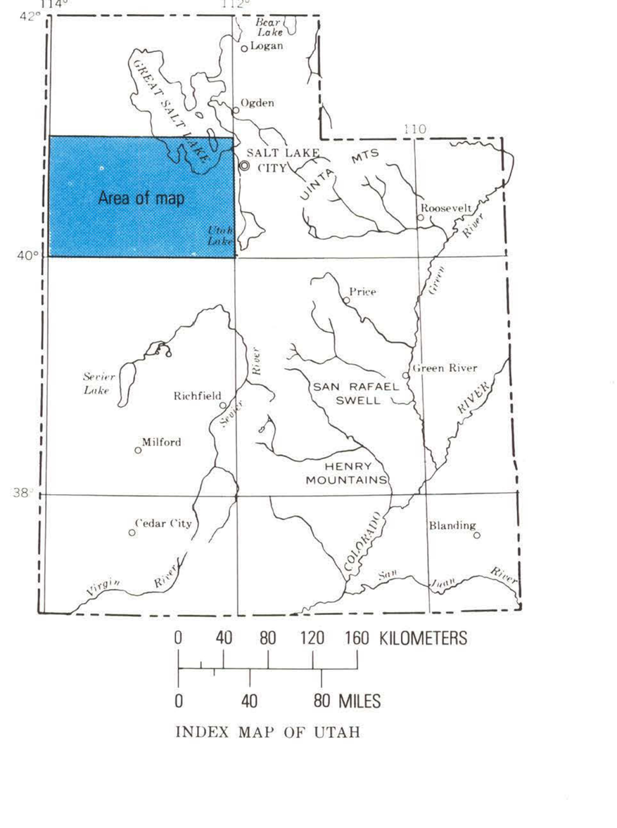

INDEX MAP OF UTAH

Table 1.—Summary of data collected at streamflow-gaging stations

Site No.	Station No.	Name	Approximate drainage area (square miles)	Period of record	Average discharge: Cubic feet per second	Average discharge: Acre-feet per year	Average discharge: Years	Recorded extremes (cubic feet per second): Maximum	Recorded extremes: Date	Recorded extremes: Minimum	Recorded extremes: Date
D1	10166430	West Canyon near Cedar Fort	27	1965–75	4.53	3,280	10	1,660	Aug. 28, 1971	0.02	Jan. 17, 22, 1967
D2	10172630	Goggin Drain near Magna	([1])	1963–68, 1971–78	114	82,590	12	1,040	Sept. 17 or 18, 1978	0	([2])
D3	10172640	Lee Creek near Magna	([1])	1971–78	4.29	3,110	7	113	Aug. 26, 27, 1977	.05	June 17, 1972
D4	10172650	Kennecott Drain near Magna	([1])	1963–67, 1971–78	102	73,900	12	[3]389	Mar. 18, 1964	11	July 29, 1977
([4])	10172700	Vernon Creek near Vernon	25	1958–78	2.50	1,810	20	825	Aug. 27, 1972	41	Nov. 20, 1961
D5	10172800	South Willow Creek near Grantsville	4	1963–78	6.31	4,570	15	[5]92	June 8, 1964	1.7	June 6–12, 1967

[1]Receives surface- and ground-water drainage from an area of unknown extent, mostly east of map area.
[2]Several days of no flow during many years.
[3]Result of break in tailings-pond dike.
[4]Gaging station about 2 miles south of map boundary in sec. 2, T. 10 S., R. 5 W.
[5]Annual peak discharge recorded by a crest gage operated at site D5 from 1960 to 1963.

Table 2.—Summary of data collected at crest-stage partial-record gaging stations

Site No.	Station No.	Name	Drainage area (square miles)	Period of record	Peak discharge: Cubic feet per second	Peak discharge: Probable date
P1	10166400	Tickville Gulch near Cedar Valley	15.6	1961–74	236	2–10–62
P2	10172720	East Government Creek tributary near Vernon	1.0	1961–74	6	2– 9–62
P3	10172740	Rush Valley tributary near Fairfield	.26	1961–74	32	9– 6–70
P4	10172760	Clover Creek near Clover	4.4	1961–74	87	8–13–65
P5	10172770	Dry Canyon near Stockton	1.4	1961–68	1.5	9–22–67 8–10–68
P6	10172780	Hickman Creek near St. John	12.8	1961–68	18	9–13–63
P7	10172790	Settlement Canyon near Tooele	5.8	1961–74	155	6–24–69
P8	10172810	Mack Canyon near Grantsville	2.8	1961–74	1	9– –62
P9	10172830	North Fork Muskrat Canyon near Timpie	1.8	1961–74	.6	6–11–70
P10	10172835	Skull Valley tributary near Delle	1.5	1960–74	20	9–13–63
P11	10172890	Government Creek near Dugway	59	1961–74	370	8–12–61
P12	10172895	Deep Creek near Ibapah	460	1959–68	1,250	8–25–61
P13	10172900	Bar Creek near Ibapah	12	1959–74	2,690	8–25–61
P14	10172905	Great Salt Lake Desert tributary near Delle	1.0	1961–74	25	9–13–63

Table 3.—Selected chemical analyses of water from miscellaneous surface-water sources

Discharge: e, estimated; m, measured.
Dissolved sodium: c, sodium (Na) and potassium (K) values are calculated and reported as sodium.
Dissolved solids: Calculated, except d, which is determined by evaporation at 180°C.
pH: Determined during laboratory analysis, except f, which is field determination when sample was collected.

Site No.	Name	Date of collection	Temperature (°C)	Discharge (ft³/s)	Dissolved silica (SiO_2)	Dissolved calcium (Ca)	Dissolved magnesium (Mg)	Dissolved sodium (Na)	Dissolved potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Dissolved sulfate (SO_4)	Dissolved chloride (Cl)	Dissolved fluoride (F)	Dissolved nitrate (NO_3)	Dissolved boron (B)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos per centimeter at 25°C)	Sodium-adsorption-ratio	pH
					Milligrams per liter																	
C1	Goggin Drain[1]	10–21–76	6.5	8.8m	15	130	140	1,400	71	400	10	790	1,900	0.8	—	1.10	4,660	900	560	7,450	20	8.4f
C2	Lee Creek (drain)[1]	3–31–77	15.0	1.8m	9.3	360	4,200	35,000	2,400	384	0	8,300	63,000	4.6	—	15	114,000	18,000	18,000	81,000	113	8.4f
C3	Kennecott Drain[1]	2–11–77	7.5	104m	23	280	93	780	43	241	0	750	1,400	2.0	—	.35	3,500	1,100	880	5,800	10	8.0f
C4	Upper Butterfield Creek	9– 8–65	12.0	.5e	16	67	18	44c	—	310	0	35	34	—	0.9	—	364	243	0	591	1.2	8.1
C5	Butterfield Tunnel	9– 8–65	13.5	1.5e	9.4	226	102	34c	—	136	0	877	25	—	.1	—	1,340	985	873	1,630	.5	7.4
C6	Lower Butterfield Creek	5–14–65	11.0	2.9m	4.2	147	.7	38c	—	186	0	516	34	—	1.7	—	935	656	503	1,210	.6	8.0
C7	Keystone Gulch	5–14–65	20.0	2.5m	18	216	96	60c	—	20	0	920	65	—	1.5	—	1,390	935	919	1,660	.9	6.9
C8	Rose Creek	5–14–65	14.5	1.4m	45	76	22	41c	—	226	4	78	72	—	2.1	—	470	286	94	728	1.1	8.4
C9	White Pine Fork, Middle Canyon	6–27–78	12.5	—	11	66	9.8	6.0	.7	190	—	16	8.9	.1	—	.02	212	210	49	368	.2	8.0
C10	Settlement Canyon	6–27–78	10.5	—	9.6	63	14	9.4	.8	210	—	17	14	.1	—	.02	231	220	43	415	.3	8.2
C11	Davenport Canyon	6–23–78	15.5	—	14	49	12	30	1.4	180	—	21	44	.2	—	.05	260	170	24	391	1.0	7.5
C12	North Willow Creek	6– 7–78	10.0	—	9.0	24	5.6	10	.8	83	—	10	23	.1	—	.02	123	83	15	198	.5	7.8
C13	South Willow Creek	6-13-78	8.5	—	7.4	23	5.8	7.1	.6	89	—	10	11	.1	—	.02	109	81	8	192	.3	7.7
C14	Hickman Creek tributary	9–21–64	—	.02e	11	57	13	16	1.3	199	0	27	27	.2	.2	.04	248	196	33	426	.5	8.0
C15	Morgan Canyon tributary	9–21–64	—	.02e	7.8	60	6.8	11	.8	202	0	13	14	.2	.5	.04	206	178	12	376	.4	7.9
C16	Unnamed stream	9–21–64	—	.02e	8.9	70	9.0	11	.7	239	0	21	15	.2	.7	.03	252	212	16	435	.3	7.9
C17	Soldier Creek[2]	9–26–64	—	—	6.0	62	15	6.4	.5	245	0	16	8.3	.2	5.2	.03	225	215	14	403	.2	8.0
C18	Ophir Creek	9–25–64	—	4e	5.9	55	16	5.8	.6	228	0	14	7.5	.1	3.0	.02	213	203	16	382	.2	7.9
C19	Barlow Creek[3]	5–29–65	—	.005e	1.8	35	28	13	.7	236	0	11	20	.2	.2	.04	222	204	10	418	.4	8.1
C20	Indian Hickman Creek	8– 1–63	—	2e	8.9	38	7.3	11	.9	154	0	8.8	16	.2	.0	.02	165	125	0	286	.4	7.6
C21	do.	5–29–65	—	1e	2.5	35	6.8	11	.6	122	8	8.0	16	.2	.7	.04	149	116	3	275	.4	—
C22	Antelope Canyon Creek	8– 1–63	—	—	8.9	17	4.4	10	.9	69	0	7.4	18	.2	.1	.02	102	60	3	169	.6	7.1
C23	Lost Creek	8– 1–63	—	.7e	11	22	5.4	16	.8	86	0	10	25	.3	.1	.04	131	76	5	222	.8	7.6
C24	Big Creek Canyon ditch	7–31–63	—	1.5e	8.4	16	4.1	11	.9	59	0	7.2	19	.3	.3	.02	98	56	8	157	.6	7.4
C25	Unnamed canal	7–31–63	—	—	11	33	8.0	18	1.0	132	0	12	30	.1	.2	.03	180	116	8	307	.7	7.2
C26	do.	7–18–63	—	—	18	152	62	1,990	68	208	0	294	3,220	.3	4.6	.49	6,100	635	464	10,100	34	7.2
C27	Delle Springs Creek	5–29–65	—	.2e	19	234	178	5,790	212	282	0	767	9,070	2.3	20	1.70	17,200	1,320	1,090	26,400	69	7.7
C28	Middle Fork Deep Creek	8–16–66	—	3e	30	20	30	26	3.7	210	0	30	18	.4	.4	.10	281	172	0	421	.9	8.1
C29	Deep Creek	8–17–66	—	2e	27	42	33	40	6.6	254	0	62	36	.5	1.1	.14	397	240	32	602	1.1	7.8
C30	Great Salt Lake[1]	5–23–66	16.5	—	—	193	6,470	60,700	4,040	383	—	15,100	105,000	7.3	—	20	203,000d	27,100	—	—	—	7.9

[1]Additional analyses, including values for concentrations of some trace elements and heavy metals, are available in the files of the U.S. Geological Survey, Salt Lake City, Utah.
[2]Sample collected from Stockton public water-supply system.
[3]Sample collected from pipeline.

SURFACE-WATER RESOURCES IN THE TOOELE 2° QUADRANGLE, UTAH

By
Don Price

1981

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