GEOLOGICAL SURVEY CIRCULAR 203

THE INDUSTRIAL UTILITY OF PUBLIC WATER SUPPLIES IN THE MOUNTAIN STATES, 1952

By E. W. Lohr, C. S. Howard, R. T. Kiser, J. D. Hem, and H. A. Swenson

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

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E R R A T U M

The data on page 26 for Butte, Montana should follow the data on page 38 for Bozeman.

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INTRODUCTION

The location of industrial plants is dependent on an ample water supply of suitable quality. Information relating to the chemical characteristics of the water supplies is not only essential to the location of many plants but also is an aid in the manufacture and distribution of many commodities.

Public water supplies are utilized extensively as a source of supply for many industrial plants, used either as delivered for domestic consumption or with further treatment if necessary to meet specific needs of the plant, such as water for processing, cooling, and steam generation. The industrial use of water in the United States in 1950 was estimated to be more than 75 billion gallons per day from private sources. In addition, about 6 billion gallons per day was estimated to be taken from public water supplies.

U. S. Geological Survey Water-Supply Paper 658, "The industrial utility of public water supplies in the United States, 1932" contains information pertaining to the public water supplies of 670 of the larger cities throughout the United States. This report, which is still in print and being distributed, has filled an important need in the field of water-supply engineering. The demand for more up-to-date information and more extended coverage has led to studies by the Geological Survey for revision of the information contained in the 1932 report. The revised report, which will include data pertaining to public water supplies of more than 1,200 cities in the United States, will eventually be published as a Geological Survey Water-Supply Paper. However, in order that the information might be available at the earliest possible time, nine preliminary reports are being issued which give data on the larger cities in each state. These nine reports are being released as Geological Survey Circulars, each covering a group of states as delineated by the Bureau of Census in taking the census of the population of the country. (See fig. 1). The reports give descriptive information and analytical data for approximately three-fourths of the cities that will be included in the final report for each of the states.

This circular is the second of the series and includes data for the States of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. The report gives the population (1950) of the city, population supplied, ownership, sources and treatment of supplies, capacity of treatment plants, storage facilities for both raw and finished waters, and chemical analyses of the water for 11 cities in Arizona, 8 in Colorado, 12 in Idaho, 9 in Montana, 8 in Nevada, 9 in New Mexico, 9 in Utah, and 8 in Wyoming. The data for each city are essentially the same as will appear in the complete report for the whole country.

Data for the supplies in Arizona and New Mexico were compiled by J. D. Hem, district chemist, Albuquerque, N. Mex.; in Idaho, Nevada, Utah and for the cities of Grand Junction in Colorado, Anaconda, Butte, and Missoula in Montana, and Rock Springs in Wyoming by R. T. Kiser, chemist, under supervision of C. S. Howard, regional chemist, Salt Lake City, Utah; and for the remaining cities in Colorado, Montana, and Wyoming by H. A. Swenson, chemist, under the supervision of P. C. Benedict, regional engineer, Lincoln, Nebr.

Review and final assembly of the data were made by E. W. Lohr in the Washington office, under the supervision of S. K. Love, Chief, Quality of Water Branch.

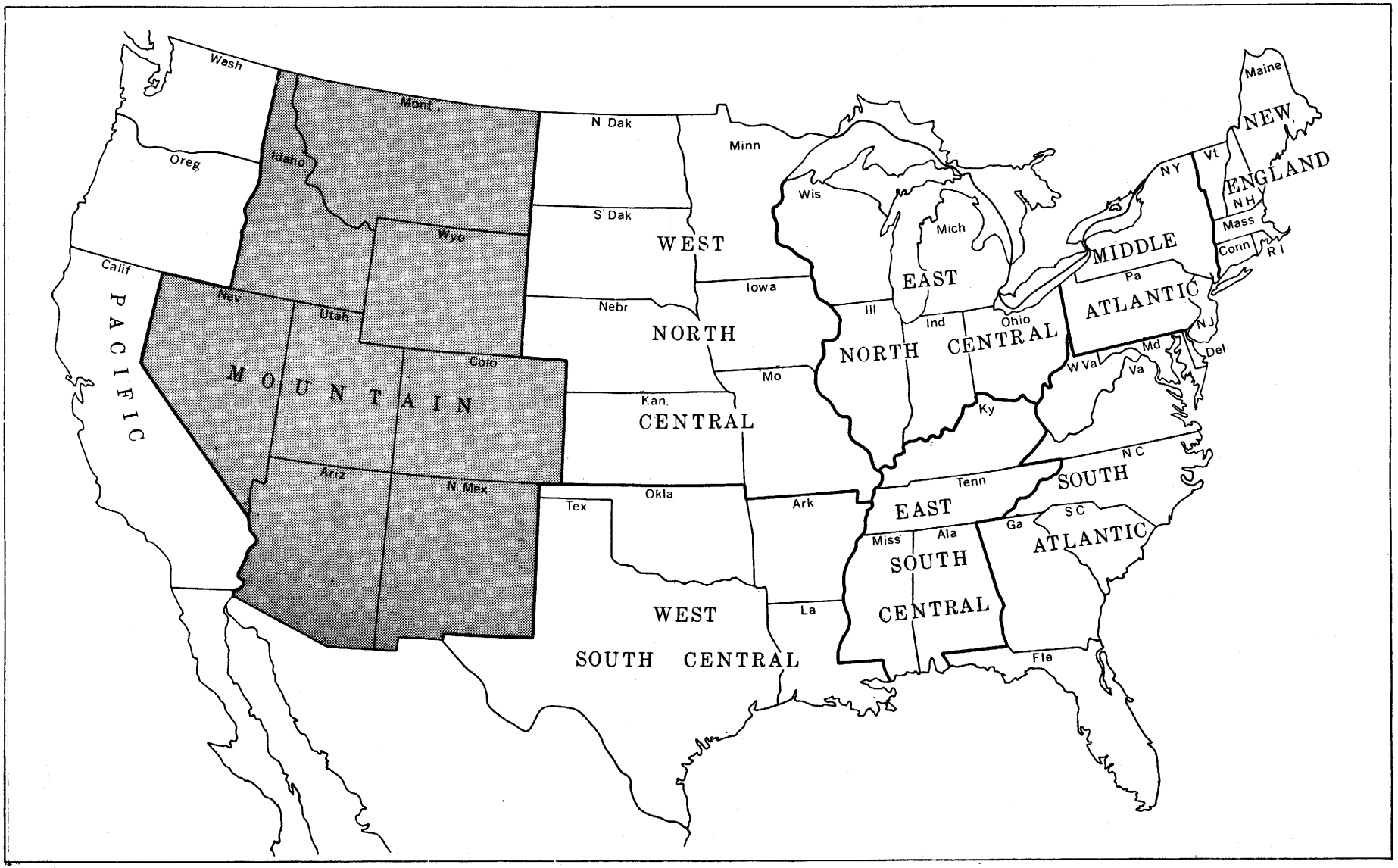

Figure 1. - Map of the United States showing sections covered by the nine circulars on the Industrial Utility of Public Water Supplies of the United States, 1952. The shaded portion represents the section of the country covered by this circular.

ARIZONA

AMPHITHEATER
(Population, 12,664)

Ownership: (See Tucson)

DOUGLAS
(Population, 9,442)

Ownership: Municipal; supplies also suburban area and can supply water to Agua Prieta, Mex. (population, estimated 6,000) in emergencies. Total population regularly served, about 21,000.

Source: 6 wells. Five closely spaced wells, each 340 ft deep, near Phelps Dodge Corp. smelter, 1 mile west of town; 1 well, 320 ft deep, in Overlock addition. The yield of each of the wells is reported to be 1,000 gpm. Three wells are regularly used and the other three are held in reserve for emergencies. Most of the supply comes from the main well field.

Treatment: None.

Storage: Elevated tanks, 900,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Main well 1/field	Overlock addition well		Main well 1/field	Overlock addition well
Silica (SiO_2)	21	27	Hardness as $CaCO_3$:		
Iron (Fe)	.28	.07	Total	25	176
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	6.2	41			
Magnesium (Mg)	2.4	18	Color	0	0
Sodium (Na)	325	46	pH	8.9	7.7
Potassium (K)	2.8	3.0	Specific conductance (micromhos at 25 C.)	1,600	530
Carbonate (CO_3)	21	0			
Bicarbonate (HCO_3)	130	239			
Sulfate (SO_4)	183	55	Turbidity	--	--
Chloride (Cl)	288	14	Temperature (F.)	76	73
Fluoride (F)	3.2	1.0	Date of collection	9/12/51	9/12/51
Nitrate (NO_3)	1.8	12			
Dissolved solids	930	330			
Depth (feet)				340	320
Diameter (inches)				20	16
Date drilled				1943	--
Percent of supply				±70	±30

1/Composite.

FLAGSTAFF
(Population, 6,771)

Ownership: Municipal; serves also suburban areas. Total population served, about 11,000.

Source: Lake Mary (storage reservoir in Walnut Canyon, $8\frac{1}{2}$ miles southeast of Flagstaff). Additional supply from spring flow and small amount of surface runoff entering two 50,000,000 gal equalizing reservoirs north of city.

Treatment: Lake Mary supply: Coagulation with alum, activated carbon, sedimentation, rapid sand filtration, chlorination, and final adjustment of pH with lime. Spring supply: chlorination. Copper sulfate is added at times to control algae.

Rated capacity of treatment plant: 1,700,000 gpd.

Raw-water storage: Lake Mary, 8,000,000,000 gal.

Finished-water storage: Equalizing reservoirs, 100,000,000 gal.

Finished water from Lake Mary supply enters the equalizing reservoirs during periods of low consumption and is mixed with spring flow before use. About two-thirds of the total supply was obtained from Lake Mary in 1950. The proportion obtained from the two sources varies from year to year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Lake Mary (raw water)	Lake Mary (finished water)	Springs (raw water)
Silica (SiO_2)	4.4	2.7	15
Iron (Fe)	1.1	.16	.02
Manganese (Mn)	--	--	--
Calcium (Ca)	8.6	19	3.4
Magnesium (Mg)	3.7	4.2	.8
Sodium (Na)	2.0	1.8	1.4
Potassium (K)	1.8	1.7	3.2
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	37	40	15
Sulfate (SO_4)	5.6	30	3.0
Chloride (Cl)	.8	2.2	.8
Fluoride (F)	.3	.1	.4
Nitrate (NO_3)	.4	.3	1.9
Dissolved solids	67	88	36
Hardness as $CaCO_3$:			
Total	37	65	12
Noncarbonate	6	32	0
Color	55	4	3
pH	7.1	8.0	6.8
Specific conductance (micromhos at 25 C.)	73.2	139	37.4
Turbidity	100	--	--
Temperature (F.)	38	39	58
Date of collection	2/5/52	2/5/52	7/31/51

GLENDALE
(Population, 8,179)

Ownership: Municipal; serves also suburban areas. Total population served, about 12,000.

Source: 5 wells (1 to 5) 1,710, 1,000, 700, 700, and 810 ft deep. The yield of the wells is reported to be 1,200, 700, 500, 350, and 600 gpm. Well 5 is held in reserve for emergencies.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: 450,000 gal.

Partial analyses of samples indicate that the water from wells 2 and 4 is similar in chemical composition to that of well 3; that from well 5 is high in dissolved solids and nitrate.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 1	Well 2		Well 1	Well 2
Silica (SiO_2)	21	23	Hardness as $CaCO_3$:		
Iron (Fe)	.22	.00	Total	65	150
Manganese (Mn)	--	--	Noncarbonate	0	36
Calcium (Ca)	19	27			
Magnesium (Mg)	4.2	20	Color	2	2
Sodium (Na) + Potassium (K)	121	61	pH	8.1	7.8
Carbonate (CO_3)	0	0	Specific conductance (micromhos at 25 C.)	713	578
Bicarbonate (HCO_3)	85	138	Turbidity	--	--
Sulfate (SO_4)	94	55	Temperature (F.)	95	78
Chloride (Cl)	111	73	Date of collection	9/19/51	9/19/51
Fluoride (F)	.6	.6			
Nitrate (NO_3)	2.0	7.8			
Dissolved solids	420	334			

Depth (feet)	1,710	700
Diameter (inches)	16	16
Date drilled	--	--
Percent of supply	40	20

MESA
(Population, 16, 790)

Ownership: Municipal; serves also suburban areas. Total population supplied, about 18, 000.

Source: 4 wells (4 to 7) 450, 500, 500, and 700 ft deep. The yield of the wells is reported to be 1, 800, 1, 800, 1, 900, and 2, 100 gpm, respectively. Well 4 is used for emergency service only.

Treatment: Chlorination.

Storage: 300, 000 gal.

Water from three continuously used wells is similar in composition to that from well 5. Water from emergency service well is reported to be considerably higher in dissolved solids.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 5	Well 7		Well 5	Well 7
Silica (SiO_2)	26	--	Hardness as $CaCO_3$:		
Iron (Fe)	.08	--	Total	235	--
Manganese (Mn)	--	--	Noncarbonate	84	--
Calcium (Ca)	58	--			
Magnesium (Mg)	22	--	Color	0	--
Sodium (Na)	146	--	pH	7.7	7.7
Potassium (K)	4.0	--	Specific conductance (micromhos at 25 C.)	1, 180	1, 170
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	184	186			
Sulfate (SO_4)	39	--	Turbidity	--	--
Chloride (Cl)	255	257	Temperature (F.)	65	65
Fluoride (F)	.0	--	Date of collection	9/19/51	9/19/51
Nitrate (NO_3)	2.9	--			
Dissolved solids	683	--			

Depth (feet)	500	700
Diameter (inches)	20	20
Date drilled	--	1951
Percent of supply	30	--

PHOENIX
(Population, 106,818)

Ownership: Municipal; serves also a large suburban area. Total population served, about 156,000.

Suburban Pump and Water Co., Phoenix, Ariz.; serves the suburban communities of Sunnyslope and South Phoenix, and other areas outside the corporate limits. Estimated population served, 32,000.

North Central Avenue Water Utilities Co., Phoenix, Ariz.; serves suburban area north of Phoenix. Estimated population served, 10,000.

Mariposa Water Utilities Co.;Phoenix, Ariz.; serves suburban areas north and northwest of the city. Estimated population served, 10,000.

Total population served, all supplies, 208,000.

Source: Municipal; Verde River (Bartlett Reservoir) about 50 miles northeast of Phoenix; 14 wells, all less than 100 ft deep and reported to yield a total of 3,000,000 gpd, and one infiltration gallery along the Verde River near Fort McDowell, 33 miles northeast of Phoenix, comprising the Verde system; 8 wells near Scottsdale, 11 miles east of Phoenix, each 500 ft deep and reported to yield a capacity total of 20,000,000 gpd. Emergency supply, 12 wells, in downtown Phoenix, all about 300 ft deep and reported to yield 18,000,000 gpd.

Suburban Pump and Water Co. 18 wells, 169 to 600 ft deep with a reported average yield of 430 gpm.

North Central Avenue Water Utilities Co. 5 wells (1 to 5),300 to 506 ft deep, with a reported average yield of 880 gpm.

Mariposa Water Utilities Co., Phoenix, Ariz. 10 wells (includes 1 standby and 1 under construction, 1951), 200 to 600 ft deep with a reported average yield of 400 gpm.

Treatment: Municipal, Verde River; lime, coagulation with alum and ferric sulfate, activated carbon, sedimentation, rapid sand filtration, carbon dioxide, and chlorination. Ground water, chlorination only.

Suburban Pump and Water Co. supply, chlorination.

North Central Avenue Water Utilities Co. supply, none.

Mariposa Water Utilities Co. supply, none.

Rated capacity of treatment plant: Municipal, Verde River, 30,000,000 gpd.

Raw-water storage: The city's right to withdraw water from Bartlett Reservoir is by agreement with the Salt River Valley Users Association and amounts available depend on storage in that and other reservoirs, and other factors.

Finished-water or water as supplied to consumers storage: Municipal, reservoirs, 55,000,000 gal.

Suburban Pump and Water Co., two reservoirs, 325,000 and 525,000 gal.

North Central Avenue Water Utilities Co., reservoir, 300,000 gal.

Mariposa Water Utilities Co. 300,000 gal (30,000 gal pressure tank on each well).

About 90 percent of the municipal supplies used in 1950 came from Verde well fields and Bartlett Reservoir. The water treatment plant is located near Fort McDowell.

Analyses: A, represents combined flow of water from surface water treatment plant and Verde well field (infiltration gallery included). B, represents composite of Verde system water and water from Scottsdale wells as supplied to city at time of sampling. The Scottsdale wells furnish water of higher dissolved solids content and hardness than the Verde system. The dissolved solids for the Scottsdale wells is reported to range from 746 to 1,560 ppm, and the hardness, from 396 to 564 ppm. The dissolved solids for downtown

Phoenix wells is reported to range from 985 to 2,020 ppm, and the hardness from 350 to 711 ppm. C, represents water from a well at 16th Ave. and Purdue Ave. (Sunnyslope) of the Suburban Pump and Water Co. supply. Partial analyses of samples from six other wells of this supply showed a range in dissolved solids from about 300 to 1,200 ppm. D, represents water from reservoir pumped into by all the wells of the supply of the North Central Avenue Water Utilities Co. E, represents water from Camelback No. 1 well, 7th Ave. and Camelback Road, of the supply of the Mariposa Water Utilities Co. Most of the other wells in this system yield water considerably higher in dissolved solids than the one sampled.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	A	B	C	D	E
Silica (SiO_2)	17	24	27	27	25
Iron (Fe)	.01	.01	.01	.03	.01
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	40	52	82	77	45
Magnesium (Mg)	22	28	36	56	41
Sodium (Na) / Potassium (K)	28	71	55	147	48
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	187	223	165	270	154
Sulfate (SO_4)	64	88	82	123	43
Chloride (Cl)	20	84	166	222	112
Fluoride (F)	.4	.6	.1	.6	.2
Nitrate (NO_3)	2.3	6.9	20	98	69
Dissolved solids	290	473	567	887	475
Hardness as $CaCO_3$:					
Total	190	244	352	422	281
Noncarbonate	38	62	218	202	155
Color	5	4	4	3	2
pH	7.7	7.8	7.8	7.9	7.9
Specific conductance (micromhos at 25 C.)	473	790	985	1,490	813
Turbidity	--	--	--	--	--
Temperature (F.)	65	68	72	76	78
Date of collection	9/18/51	9/18/51	9/18/51	9/18/51	9/18/51
Depth (feet)			376		580
Diameter (inches)			12		10
Date drilled			--		--
Percent of supply			--		--

PRESCOTT
(Population, 6,764)

Ownership: Municipal; supplies also suburban areas. Total population supplied, about 14,000.

Source: Surface system (25 percent of supply in 1950) includes one reservoir on Hassayampa River about 5 miles south of Prescott, and two reservoirs on Bannion Creek about 2 miles south of Prescott. Ground water system (75 percent of supply in 1950) includes infiltration gallery on Granite Creek just north of Prescott, and two wells in Chino Valley 15 miles north of Prescott. The wells are 700 and 550 ft deep, and reported to yield 1,100 and 1,850 gpm, respectively. More than 25 percent of the supply is normally obtained from the surface system.

Treatment: (Surface system only) Prechlorination, coagulation with ferric chloride, activated carbon, sedimentation, slow sand filtration, postchlorination, and ammoniation. Well supply, chlorination only.

Rated capacity of treatment plant: 1,700,000 gpd.

Raw-water storage: Total 290,000,000 gal. Hassayampa Reservoir, 21,500,000 gal; Upper Bannion Creek Reservoir, 200,000,000 gal; Lower Bannion Creek Reservoir (Goldwater Lake), 67,000,000 gal.

Finished-water storage: 4,500,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Surface 1/ supply	Well 1		Surface 1/ supply	Well 1
Silica (SiO_2)	17	72	Hardness as $CaCO_3$:		
Iron (Fe)	.05	.05	Total	136	104
Manganese (Mn)	--	--	Noncarbonate	62	0
Calcium (Ca)	33	25			
Magnesium (Mg)	13	10	Color	0	0
Sodium (Na)	11	17	pH	7.3	8.0
Potassium (K)	7.4	4.2	Specific conductance (micromhos at 25 C.)	330	260
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	90	151			
Sulfate (SO_4)	69	6.6	Turbidity	--	--
Chloride (Cl)	13	7.0	Temperature (F.)	--	--
Fluoride (F)	.2	.4	Date of collection	9/20/51	9/20/51
Nitrate (NO_3)	3.4	3.0			
Dissolved solids	207	219			

Depth (feet)	700
Diameter (inches)	16
Date drilled	--
Percent of supply	--

1/ Finished water.

TEMPE
(Population, 7,684)

Ownership: Municipal; serves also suburban areas. Total population served, about 10,000.

Source: 3 wells, one at Apache Blvd. and Hudson Manor (depth 420 ft), one at College Ave. and S. P. R. R. tracks (depth 513 ft), and one (standby) at College Ave. and 7th Street (depth 238 ft). The yield of the wells is reported to be 2,400, 1,700, and 1,700 gpm, respectively.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: One reservoir, 1,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Well	2/Well		1/Well	2/Well
Silica (SiO_2)	28	27	Hardness as $CaCO_3$:		
Iron (Fe)	.14	.21	Total	264	389
Manganese (Mn)	--	--	Noncarbonate	142	20
Calcium (Ca)	60	95			
Magnesium (Mg)	28	37	Color	0	0
Sodium (Na)	115	259	pH	7.7	7.4
Potassium (K)	5.0	5.2	Specific conductance (micromhos at 25 C.)	1,110	1,910
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	150	450	Temperature (F.)	71	65
Sulfate (SO_4)	52	103	Date of collection	9/19/51	9/19/51
Chloride (Cl)	238	338			
Fluoride (F)	.2	.2			
Nitrate (NO_3)	2.8	14			
Dissolved solids	661	1,100			

Depth (feet)	420	513
Diameter (inches)	20	20
Date drilled	1950	--
Percent of supply	±50	±50

1/Apache Blvd. and Hudson Manor.
2/College Ave. and R. R. tracks.

TUCSON
(Population, 45,454)

Ownership: Municipal; serves also parts of the suburban communities of Amphitheater and Wakefield and other suburban areas. Total population served, about 75,000.

Suburban area (east and northeast of corporate limits of the city) served by Vista Water Co., Eastside Water Co., Polar Water Co., and Lansdale Water Co., all owned by one local group. Each company has separate wells and distribution system for the area it serves. Total population served, about 19,500.

Source: Municipal; 20 wells, 200 to 510 ft deep in North Side well field; 16 wells, 118 to 476 ft deep in South Side well field. Only three wells in the North Side well field are under 300 ft in depth, and only five in the South Side well field are under 200 ft.

Suburban area; Vista Water Co. 2 wells, each 200 ft deep; Eastside Water Co. 7 wells, 210 to 339 ft deep; Polar Water Co. 8 wells, 200 to 318 ft deep; Lansdale Water Co. 3 wells (depths not reported).

Treatment: Municipal supply, chlorination; private water-companies supply, none.

Storage: Municipal, 5 reservoirs and 4 elevated tanks, 14,200,000 gal; private companies, elevated tanks, 100,000 gal.

North Side plant serves area east of Park or Tyndall Avenues. South Side plant serves area west of Park or Tyndall Avenues.

The analyses show reasonably well the composition of the water served by the two well fields and the private companies in the respective areas of the city proper and the suburban area designated.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	North Side Plant 3	South Side Reservoir at Osborn & 18th	Polar Water Co. well 1	East Side Water Co. well 2
Silica (SiO_2)	32	34	27	28
Iron (Fe)	.00	.00	.00	.00
Manganese (Mn)	--	--	--	--
Calcium (Ca)	40	65	34	29
Magnesium (Mg)	6.5	14	6.0	5.2
Sodium (Na) / Potassium (K)	33	78	26	20
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	166	253	157	139
Sulfate (SO_4)	39	129	17	9.4
Chloride (Cl)	11	31	8.5	6.5
Fluoride (F)	.3	.9	.3	.3
Nitrate (NO_3)	6.9	2.7	10	5.5
Dissolved solids	255	484	210	177
Hardness as $CaCO_3$:				
Total	126	220	110	94
Noncarbonate	0	12	0	0
Color	1	1	1	1
pH	8.0	8.0	8.1	8.1
Specific conductance (micromhos at 25 C.)	382	736	320	264
Turbidity	--	--	--	--
Temperature (F.)	80	76	80	84
Date of collection	9/14/51	9/14/51	9/14/51	9/14/51
Depth (feet)			200	280
Diameter (inches)			8	12
Date drilled			1937	1932
Percent of supply			--	--

WAKEFIELD
(Population, 8,906)

Ownership: (See Tucson)

YUMA
(Population, 9,145)

Ownership: Arizona Edison Co.; serves also West Yuma and other suburban areas. Total population served, about 20,000.
Source: Colorado River (direct diversion). Standby diversion facilities on Yuma Main Canal.
Treatment: Coagulation with alum, copper sulfate added to control algae in settling basins when needed, sand filtration (4 rapid and 3 slow sand filters), and chlorination.
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: --
Finished-water storage: 1,000,000 gal.

Flow in Colorado River at Yuma is regulated by large reservoirs, and the chemical quality of the water is nearly constant for long periods. Analysis represents weighted-average concentration of dissolved matter in the river water as determined by daily sampling of the Yuma Main Canal for the period Oct. 1, 1949 to Sept. 30, 1950.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Colorado River (raw water)	Raw water (at plant)	Finished water
Silica (SiO_2)	13	--	--
Iron (Fe)	.05	--	--
Manganese (Mn)	--	--	--
Calcium (Ca)	84	--	--
Magnesium (Mg)	27	--	--
Sodium (Na)	88	--	--
Potassium (K)	2.9	--	--
Carbonate (CO_3)	0	--	--
Bicarbonate (HCO_3)	163	161	155
Sulfate (SO_4)	265	--	--
Chloride (Cl)	75	92	93
Fluoride (F)	.3	--	--
Nitrate (NO_3)	1.4	--	--
Dissolved solids	637	--	--
Hardness as $CaCO_3$:			
Total	320	--	--
Noncarbonate	187	--	--
Color	--	--	--
pH	--	--	--
Specific conductance (micromhos at 25 C.)	985	1,070	1,070
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	1949-50	9/17/51	9/17/51

COLORADO

BOULDER
(Population, 19,999)

Ownership: Municipal; also supplies about 5,000 people outside the city limits, and Public Service Electric Plant. Total population served, about 25,000.
Source: A series of nine natural lakes, some of which are enlarged by dams, fed by melting Arapahoe Glacier, approximately 18 miles west of the city. The water flows from Silver Lake, the lowest reservoir in the mountain system, to foot of Arapahoe Falls; thence it is conveyed by pipe line to Lakewood Reservoir, the control reservoir for the city, 13 miles away; from this reservoir the water is conveyed to two distribution reservoirs at the city limits.
Treatment: None.
Storage: 1,666,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	City tap		City tap
Silica (SiO_2)	6.2	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	11
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	4.0		
Magnesium (Mg)	.1	Color	29
Sodium (Na)	1.0	pH	6.8
Potassium (K)	.3	Specific conductance (micromhos at 25 C.)	31.7
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	14	Turbidity	.8
Sulfate (SO_4)	.5	Temperature (F.)	65
Chloride (Cl)	.5	Date of collection	5/23/51
Fluoride (F)	.1		
Nitrate (NO_3)	1.0		
Dissolved solids	26		

COLORADO SPRINGS
(Population, 45,472)

Ownership: Municipal; also supplies 5,000 people outside the city limits; 5,000 to 25,000 at Camp Carson and Peterson Field. Total population supplied, 55,000 to 75,000.

Source: Streams and impounding reservoirs above 9,000 ft in elevation, on north slopes of Pikes Peak; Fountain Creek, auxiliary supply. Fountain Creek water is blended with the regular supply as needed, depending on the amount of snowfall on the watershed of the regular supply.

Treatment: Chlorination and ammoniation for the regular supply; coagulation with alum and lime, copper sulfate, sedimentation, rapid sand filtration, and chlorination for the auxiliary supply.

Rated capacity of treatment plant: 25,000,000 gpd; auxiliary supply, 5,000,000 gpd.

Raw-water storage: Reservoirs, 4,830,000,000 gal.

Finished-water storage: 3,000,000 gal.

The water flows by gravity to the distribution system. A part of the supply is diverted for the generation of electric power. The supply from Fountain Creek is pumped as needed.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Regular supply Finished water	1/Raw water	Finished 1/water
Silica (SiO_2)	8.4	15	14
Iron (Fe)	.4	.02	.01
Manganese (Mn)	.00	.00	.00
Calcium (Ca)	6.0	46	50
Magnesium (Mg)	.9	9.5	9.1
Sodium (Na)	5.1	26	26
Potassium (K)		4.2	4.0
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	18	205	202
Sulfate (SO_4)	4.0	20	26
Chloride (Cl)	2.5	15	17
Fluoride (F)	2.5	3.0	3.0
Nitrate (NO_3)	.9	2.4	2.1
Dissolved solids	33	244	255
Hardness as $CaCO_3$:			
Total	19	154	162
Noncarbonate	4	0	0
Color	--	3	1
pH	7.4	8.1	8.3
Specific conductance (micromhos at 25 C.)	50.9	411	426
Turbidity	--	4	.8
Temperature (F.)	--	56	60
Date of collection	4/12/50	5/25/51	5/25/51

1/Fountain Creek, auxiliary supply.

DENVER
(Population, 415,786)

Ownership: Municipal; supplies also Aurora, Edgewater, Englewood, Fort Logan, Mountain View, Sheridan, and other communities in the metropolitan area. Total population supplied outside the city limits, about 77,000. Total population supplied, about 493,000.

Source: South Platte River (35 percent) and tributaries, Bear and Cherry Creeks, and infiltration galleries along Cherry Creek (3 percent); Fraser River and tributaries (19 percent); storage, South Platte and Fraser Rivers (43 percent).

Treatment: Kassler Plant at Waterton (South Platte River water): coagulation with alum when necessary, slow sand filtration, and chloramine. Marston Lake Plant, south side (South Platte River water), Marston Lake Plant, north side (South Platte River water), and Moffat Plant (Fraser River water): coagulation with alum, or sodium aluminate and alum, or lime and alum, activated carbon when necessary for taste and odor control, rapid sand filtration, and chloramine. Infiltration galleries (Cherry Creek), chlorination only. Copper sulfate is applied to raw-water reservoirs directly supplying treatment plants, when necessary, for algae control.

Rated capacity of treatment plants: Kassler (slow sand filters), 30,000,000 gpd; Marston Lake (south side), 21,000,000 gpd; Marston Lake (north side), 64,000,000 gpd (anthracite filters); Moffat, 56,000,000 gpd; chlorinators (infiltration galleries), 6,000,000 gpd.

Raw-water storage: South Platte sources, storage and operating reservoirs, 69,915,000,000 gal; Moffat diversion sources, operating reservoirs, 3,503,000,000 gal; Soda Lakes (Bear Creek) and Long Lake (Moffat diversion), operating and storage reservoirs, 665,000,000 gal. Total raw water storage, 74,083,000,000 gal.

Finished-water storage: 121,000,000 gal.

South Platte River water is impounded or stored in Antero Reservoir, Eleven Mile Canyon Reservoir, Lake Cheesman, and Marston Lake. Bear Creek water is diverted near Morrison into Harriman Lake and Soda Lakes and thence to Marston Lake. Cherry Creek water is collected through the infiltration galleries. Fraser River water is brought from beyond the continental divide by the Moffat Tunnel, about 25 miles northwest of the city, into South Boulder Creek and from there by conduit into Ralston Creek Reservoir, a storage reservoir mainly for winter use (summer demands are supplied by direct diversion). Water from Ralston Creek Reservoir is brought by conduit to the Moffat treatment plant, $3\frac{1}{2}$ miles west of the city.

Under normal conditions water is drawn directly from the streams and storage is drawn upon only when the requirements are too great to be supplied by direct withdrawal.

ANALYSES

(Analyses, in parts per million, by Denver Water Department)

	South Platte River (finished water)			Infiltration galleries Cherry Cr.
	Maximum	Minimum	Average	
Silica (SiO_2)	7.4	4.5	6.5	30
Iron (Fe)	--	--	--	--
Manganese (Mn)	--	--	--	--
Calcium (Ca)	39	32	34	61
Magnesium (Mg)	14	12	13	9.5
Sodium (Na)	33	26	27	48
Potassium (K)	--	--	--	--
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	122	102	112	202
Sulfate (SO_4)	56	49	52	83
Chloride (Cl)	51	32	40	22
Fluoride (F)	1.0	.8	.9	.6
Nitrate (NO_3)	.5	.2	.4	14
Dissolved solids	--	--	--	--
Hardness as $CaCO_3$:				
Total	156	129	139	192
Noncarbonate	55	46	46	26
Color	--	--	--	--
pH	--	--	--	--
Specific conductance (micromhos at 25 C.)	455	401	423	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	1950	1950	1950	6/4/51

Regular determinations at treatment plant, 1950 1/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	92	94	78	8.3	8.6	7.9	127	154	92	4.6	12	2.0
Finished water	88	94	70	8.0	8.5	7.5	127	154	92	1.7	2.8	1.0

Regular determinations at treatment plant, 1950 2/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	92	95	90	8.0	8.5	7.7	145	150	140	5.9	12	2.3
Finished water	--	--	--	7.7	8.0	7.3	--	--	--	1.3	4.0	1.0

1/Marston Lake, north side.
2/Marston Lake, south side.

Regular determinations at treatment plant, 1950 1/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	93	104	68	7.6	8.1	7.4	147	169	102	13.6	28	4.0
Finished water	85	107	66	7.7	8.0	7.0	133	171	88	1.0	1.0	1.0

1/Kassler slow-sand filters.

ANALYSES

(Analyses, in parts per million, by Denver Water Department)

	Fraser River (finished water)		
	Maximum	Minimum	Average
Silica (SiO_2)	8.0	7.0	7.5
Iron (Fe)	--	--	--
Manganese (Mn)	--	--	--
Calcium (Ca)	21	11	14
Magnesium (Mg)	5.1	1.8	2.9
Sodium (Na)	7.2	2.7	4.7
Potassium (K)	--	--	--
Carbonate (CO_3)	--	--	--
Bicarbonate (HCO_3)	61	26	39
Sulfate (SO_4)	36	19	24
Chloride (Cl)	1.0	.5	.9
Fluoride (F)	.2	.1	.1
Nitrate (NO_3)	.3	.2	.2
Dissolved solids	--	--	--
Hardness as $CaCO_3$:			
Total	73	35	48
Noncarbonate	23	14	14
Color	--	--	--
pH	--	--	--
Specific conductance (micromhos at 25 C.)	127	92	106
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	1950	1950	1950

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	37	74	16	7.4	8.2	6.5	53	150	20	25	95	11
Finished water	35	62	16	7.4	8.6	7.1	61	154	20	.9	2.5	.4

ENGLEWOOD
(Population, 16,869)

Ownership: Supplied by Denver (see Denver).

FORT COLLINS
(Population, 14,937)

Ownership: Municipal; also supplies 4,000 people outside the city limits. Total population supplied, 18,937.
Source: Cache La Poudre River. The treatment plant is located 16 miles northwest of Fort Collins, on the Cache La Poudre River.
Treatment: Sedimentation, rapid sand filtration,and chlorination.
Rated capacity of treatment plant: 9,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 11,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	9.1	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	34
Manganese (Mn)	.00	Noncarbonate	21
Calcium (Ca)	12		
Magnesium (Mg)	1.0	Color	22
Sodium (Na)	2.9	pH	6.8
Potassium (K)	.6	Specific conductance (micromhos at 25 C.)	94.1
Carbonate (CO_3)	0	Turbidity	3
Bicarbonate (HCO_3)	16	Temperature (F.)	54
Sulfate (SO_4)	25	Date of collection	5/23/51
Chloride (Cl)	2.0		
Fluoride (F)	.1		
Nitrate (NO_3)	.8		
Dissolved solids	77		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	24	35	0	7.2	7.5	7.0	22	30	20	50	60	33

GRAND JUNCTION
(Population, 14,504)

Ownership: Municipal; supplies also about 3,000 people outside the city limits. Total population supplied, about 17,500.
Source: Kahnah Creek (tributary to Gunnison River). Intake located about 27 miles southeast of Grand Junction.
Treatment: Coagulation with sodium aluminate and occasionally alum, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 8,500,000 gpd.
Raw-water storage: Reservoirs on Grand Mesa, approximately 520,000,000 gal.
Finished-water storage: 23,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Tap at City Hall		Tap at City Hall
Silica (SiO_2)	20	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	84
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	22		
Magnesium (Mg)	7.2	Color	10
Sodium (Na)	5.4	pH	7.8
Potassium (K)	3.8	Specific conductance (micromhos at 25 C.)	180
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	110	Turbidity	30
Sulfate (SO_4)	9.1	Temperature (F.)	--
Chloride (Cl)	1.9	Date of collection	4/30/51
Fluoride (F)	.3		
Nitrate (NO_3)	.6		
Dissolved solids	118		

GREELEY
(Population, 20,354)

Ownership: Municipal; also supplies 6,000 people outside the city limits. Total population supplied, 26,354.
Source: Cache La Poudre River. The treatment plant is located approximately 40 miles northwest of Greeley. The auxiliary supply is taken from the Seaman Dam on the North Cache La Poudre River.
Treatment: Coagulation with alum, lime, charcoal, rapid sand and slow sand filtration, and chlorination.
Rated capacity of treatment plant: 12,000,000 gpd.
Raw-water storage: 3,314,000,000 gal.
Finished-water storage: 22,500,000 gal.

The water from the Cache La Poudre River watershed is made up primarily from melted snow and the turbidity of the water is practically zero with the exception of about one month of the year during spring runoff.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.2	8.5	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.02	Total	40	48
Manganese (Mn)	.00	.00	Noncarbonate	0	0
Calcium (Ca)	12	14			
Magnesium (Mg)	2.4	3.1	Color	22	7
Sodium (Na)	4.2	4.6	pH	7.3	7.7
Potassium (K)	2.2	.9	Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.)	99.1	121
Bicarbonate (HCO_3)	51	61	Turbidity	3	.4
Sulfate (SO_4)	4.0	1.0	Temperature (F.)	--	--
Chloride (Cl)	1.5	4.0	Date of collection	5/23/51	5/22/51
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.3	.4			
Dissolved solids	71	80			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness. as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	22	--	--	7	--	--	16	--	7	10	27	0
Finished water	22	--	--	7	--	--	16	--	7	3	--	--

PUEBLO
(Population, 63,685)

Ownership: Municipal; the city is divided into two water districts, each with its own water system. District 1 supplies 30,000 people in the city; about 3,000 outside the city limits; 3,000 at the Pueblo Air Force Base and Interstate Gas Co. District 2 supplies 33,685 in the city; 8,000 outside city limits. The total population served by both districts, about 78,000.

Source: District 1, Arkansas River. Wells and transmountain diversion as auxiliary supply. The transmountain diversion is taken from the Colorado River basin and diverted to the eastern slope by what is known as Wurts Ditch which is located about 1 mile southwest of the top of Tennessee Pass. District 2, Arkansas River. The maximum allowable diversion from the Arkansas River is 25.5 second-feet. When the demand exceeds this quantity the auxiliary supply is drawn upon. Plant intakes for both districts are located about a quarter of a mile apart on the river.

Treatment: District 1, copper sulfate, coagulation with alum, sedimentation, activated carbon, rapid sand filtration, chlorination,and ammoniation. District 2, plain sedimentation, and chlorination.

Rated capacity of treatment plant: District 1, 25,000,000 gpd. District 2, no treatment plant.

Raw-water storage: District 1, 50,000,000 gal. District 2, 30,000,000 gal.

Finished-water storage: District 1, 5,500,000 gal. District 2, 26,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water 1/	Finished water 1/		Raw water 1/	Finished water 1/
Silica (SiO_2)	10	8.8	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.04	Total	162	191
Manganese (Mn)	.00	.02	Noncarbonate	87	117
Calcium (Ca)	43	50			
Magnesium (Mg)	13	16	Color	9	1
Sodium (Na)	19	25	pH	7.8	7.6
Potassium (K)	1.3	1.7	Specific conductance (micromhos at 25 C.)	410	491
Carbonate (CO_3)	0	0	Turbidity	70	.4
Bicarbonate (HCO_3)	92	90	Temperature (F.)	63	--
Sulfate (SO_4)	117	151	Date of collection	5/24/51	5/24/51
Chloride (Cl)	6.0	11			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	3.0	4.2			
Dissolved solids	269	329			

Regular determinations at treatment plant, 1950 1/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	138	176	62	8.2	8.6	8.0	308	479	103	436	3793	21
Finished water	125	166	52	7.5	7.9	7.1	317	493	104	1.8	3.4	.95

1/District 1.

BLACKFOOT
(Population, 5,180)

Ownership: Municipal; supplies also about 100 other people outside Blackfoot. Total population supplied, about 5,280.
Source: 2 wells, 179 and 182 ft deep. The yield of the wells is reported to be 600 and 800 gpm. Well 2 is used mostly during the summer months. Emergency supply from East Side Well, 110 ft deep.
Treatment: None.
Storage: 2 elevated tanks, 100,000 and 300,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Well 1		Well 1
Silica (SiO_2)	27	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	322
Manganese (Mn)	--	Noncarbonate	30
Calcium (Ca)	86		
Magnesium (Mg)	26	Color	5
Sodium (Na)	19	pH	7.5
Potassium (K)	5.1	Specific conductance (micromhos at 25 C.)	642
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	356	Turbidity	--
Sulfate (SO_4)	45	Temperature (F.)	--
Chloride (Cl)	15	Date of collection	3/28/51
Fluoride (F)	.2		
Nitrate (NO_3)	10		
Dissolved solids	398		

Depth (feet)	179
Diameter (inches)	15
Date drilled	1921
Percent of supply	75

BOISE
(Population, 34,393)

Ownership: Boise Water Corp.; supplies also about 25,000 people in suburban areas. Total population supplied, about 59,000.
Source: 14 wells from 300 to 600 ft deep, 80 percent of supply; dug well and infiltration galleries, 20 percent of supply.
Treatment: Chlorination of water from dug well and infiltration galleries; deep wells not treated.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoirs, 8,500,000 gal.

The water varies throughout the city as some of the wells are pumped directly into the mains. At night, to relieve pressure on the mains, water from the mains is pumped into reservoir 4.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Reservoir 4 (composite)		Reservoir 4 (composite)
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	1.0	Total	85
Manganese (Mn)	--	Noncarbonate	11
Calcium (Ca)	29		
Magnesium (Mg)	3.1	Color	10
Sodium (Na)	12	pH	7.3
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.)	228
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	91	Turbidity	--
Sulfate (SO_4)	34	Temperature (F.)	58
Chloride (Cl)	3.1	Date of collection	6/4/51
Fluoride (F)	.3		
Nitrate (NO_3)	.5		
Dissolved solids	157		

BURLEY
(Population, 5,924)

Ownership: Municipal; supplies also about 200 people outside the city limits. Total population supplied, about 6,100.
Source: 2 wells (Pumphouse well and Hoggan well), 469 and 485 ft deep. The yield of the wells is reported to be 800 and 1,200 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: Elevated tank, 100,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Pumphouse 1/ well	Hoggan 2/ well		Pumphouse 1/ well	Hoggan 2/ well
Silica (SiO_2)	59	58	Hardness as $CaCO_3$:		
Iron (Fe)	.01	--	Total	137	97
Manganese (Mn)	--	.1	Noncarbonate	15	0
Calcium (Ca)	35	27			
Magnesium (Mg)	12	7.3	Color	5	--
Sodium (Na)	32	46	pH	7.8	7.3
Potassium (K)	7.7		Specific conductance (micromhos at 25 C.)	429	--
Carbonate (CO_3)	0	--	Turbidity	--	--
Bicarbonate (HCO_3)	148	149	Temperature (F.)	66	--
Sulfate (SO_4)	26	23	Date of collection	3/27/51	1/8/51
Chloride (Cl)	45	33			
Fluoride (F)	.4	.6			
Nitrate (NO_3)	1.3	2.7			
Dissolved solids	288	291			
Depth (feet)				469	485
Diameter (inches)				18-15	16
Date drilled				1926	1940
Percent of supply				90	10

1/Chlorinated.
2/Analyzed by State Dept. of Public Health, Boise, Idaho.

BUTTE
(Population, 33,251)

Ownership: Butte Water Co.; supplies Centerville, Meaderville, Silver Bow Park-Floral Park, Walkerville, and other communities. Total population supplied, about 50,000.
Source: Big Hole River; Basin Creek Reservoir; Yankee Doodle Creek.
Treatment: None.
Storage; 650,000,000 gal.

ANALYSES

(Analyses, in parts per million, by State Board of Health, Helena, Mont.)

	1/City tap	Big Hole River	Basin Creek	Moulton 2/supply
Silica (SiO_2)	20	--	--	--
Iron (Fe)	.16	--	--	--
Manganese (Mn)	--	--	--	--
Calcium (Ca)	16	16	16	11
Magnesium (Mg)	4.0	5.4	6.4	4.3
Sodium (Na)	5.3	12	14	14
Potassium (K)	2.4			
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	64	82	77	52
Sulfate (SO_4)	11	12	25	24
Chloride (Cl)	3.0	5.0	4.5	4.5
Fluoride (F)	.4	.3	.9	.2
Nitrate (NO_3)	1.3	--	--	--
Dissolved solids	98	3/91	3/105	3/84
Hardness as $CaCO_3$:				
Total	56	61	67	45
Noncarbonate	4	0	3	3
Color	12	--	--	--
pH	7.4	--	--	--
Specific conductance (micromhos at 25 C.)	137	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	11/17/51	12/12/44	12/12/44	12/12/44

1/Analyzed by U. S. Geological Survey.
2/From Yankee Doodle Creek.
3/Sum of determined constituents.

CALDWELL
(Population, 10,487)

Ownership: Municipal; supplies also about 500 people outside the city limits. Total population supplied, about 11,000.
Source: 14 artesian wells (12 flowing), from 112 to 405 ft deep, 6 to 20 in. in diameter. The yield of the wells ranges from 427 to 1,200 gpm.
Treatment: None.
Storage: 500,000 gal.

ANALYSES

(Analyses, in parts per million, by State Dept. of Public Health, Boise, Idaho)

	Pump House No. 1 (6 wells)	Pump House No. 2 (5 wells)	Pump House 1/No. 3	Pump House 2/No. 4	City Hall 3/Well
Silica (SiO_2)	33	33	32	32	28
Iron (Fe)	.02	.02	.02	.02	.02
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	11	19	20	12	14
Magnesium (Mg)	2.6	2.5	3.1	2.5	1.4
Sodium (Na)	14	38	37	12	41
Potassium (K)					2.9
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	73	144	146	71	135
Sulfate (SO_4)	5.4	9.4	9.5	4.6	12
Chloride (Cl)	2	7	8	2	6.9
Fluoride (F)	.4	.7	.7	.3	.7
Nitrate (NO_3)	< 1	< 1	< 1	< 1	.3
Dissolved solids	106	182	186	94	173
Hardness as $CaCO_3$:					
Total	39	59	63	40	41
Noncarbonate	0	0	0	0	0
Color	--	--	--	--	--
pH	7.4	7.4	7.7	7.3	8.2
Specific conductance (micromhos at 25 C.)	--	--	--	--	254
Turbidity	0	0	0	0	--
Temperature (F.)	--	--	--	--	68
Date of analysis	6/24/49	6/24/49	6/24/49	6/24/49	4/ 6/4/51
Depth (feet)	--	--	--	--	--
Diameter (inches)	--	--	--	--	--
Date drilled	--	--	--	--	--
Percent of supply	38	48	4	10	--

1/College Heights Well.
2/Cemetery Well.
3/Analyzed by U. S. Geological Survey.
4/Date of collection.

COEUR D'ALENE
(Population, 12,198)

Ownership: Idaho Water Co. (subsidiary of Boise Water Corp.).
Source: Coeur d'Alene Lake.
Treatment: Chlorination.
Raw-water storage: Coeur d'Alene Lake.
Finished-water storage: 1,750,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Finished 1/water	Finished water		Finished 1/water	Finished water
Silica (SiO_2)	--	10	Hardness as $CaCO_3$:		
Iron (Fe)	0.37	--	Total	27	21
Manganese (Mn)	--	--	Noncarbonate	8	0
Calcium (Ca)	7	--			
Magnesium (Mg)	2.4	--	Color	--	--
Sodium (Na) / Potassium (K)	1.3	1.8	pH	7.0	--
Carbonate (CO_3)	0	0	Specific conductance (micromhos at 25 C.)	--	53
Bicarbonate (HCO_3)	24	25	Turbidity	7	--
Sulfate (SO_4)	10	3.0	Temperature (F.)	39	51
Chloride (Cl)	--	.2	Date of collection	4/29/48	11/2/49
Fluoride (F)	--	.2			
Nitrate (NO_3)	--	.4			
Dissolved solids	58	--			

1/Analyzed by State Dept. of Health, Boise, Idaho.

IDAHO FALLS
(Population, 19,218)

Ownership: Municipal. Total population supplied, 19,230.
Source: 4 wells (Big Pump no. 3 well, Boulevard Well, I Street Well, and Central Park Well), 365, 365, 395, and 1,630 ft deep. Emergency supply from 21st Street Well, 342 ft deep. The yield of these wells is reported to be 4,000, 3,400, 3,200, 3,000, and 4,000 gpm. During the winter months Big Pump No. 3 furnishes 90 percent and the Boulevard Well, 10 percent of the supply. I Street Well and Central Park Well are used as needed during the summer months.
Treatment: None.
Storage: Elevated tank, 500,000 gal.

ANALYSES

(Analyses, in parts per million, by State Dept. of Public Health, Boise, Idaho)

	Big Pump no. 3 Well 1/	2/Wells (composite)	Central Park Well
Silica (SiO_2)	26	--	--
Iron (Fe)	.02	0.2	0.18
Manganese (Mn)	--	--	--
Calcium (Ca)	74	76	50
Magnesium (Mg)	23	22	16
Sodium (Na)	22	17	24
Potassium (K)	4.2		
Carbonate (CO_3)	0	--	12
Bicarbonate (HCO_3)	312	305	178
Sulfate (SO_4)	42	40	44
Chloride (Cl)	22	17	22
Fluoride (F)	.2	.2	.1
Nitrate (NO_3)	6.7	--	--
Dissolved solids	366	376	272
Hardness as $CaCO_3$:			
Total	279	280	190
Noncarbonate	24	30	25
Color	5	--	0
pH	7.8	7.4	8.3
Specific conductance (micromhos at 25 C.)	598	--	--
Turbidity	--	--	2
Temperature (F.)	56	50	51
Date of collection	3/28/51	3/ 5/12/45	1/22/51
Depth (feet)	365		1,630
Diameter (inches)	22		20-16
Date drilled	1937		1946-7
Percent of supply	--		--

1/Analyzed by U. S. Geological Survey.
2/Big Pump no. 3, Boulevard, and I Street wells.
3/Date of analysis.

KELLOGG
(Population, 4,913)

Ownership: Idaho Water Co. (subsidiary of Boise Water Corp.); supplies also Osburn, Smelterville, Wardner, and about 225 people outside the city. Total population supplied, about 7,100.

Source: Big Creek (south and west forks) supplies Kellogg, Smelterville, and consumers outside the city limits. Wardner is supplied from Slaughterhouse Gulch, and Osburn from McFarren and Meyers Creeks. There is a closed connection with the Bunker Hill system for emergencies.

Treatment: Chlorination.

Raw-water storage: 4 tanks totaling 190,000 gal.

Finished-water storage: --

ANALYSIS

(Analysis, in parts per million, by State Dept. of Public Health, Boise, Idaho)

	Big Creek		Big Creek
Silica (SiO_2)	7	Hardness as $CaCO_3$:	
Iron (Fe)	.05	Total	28
Manganese (Mn)	.0	Noncarbonate	2
Calcium (Ca)	6.4		
Magnesium (Mg)	2.9	Color	--
Sodium (Na)	1.6	pH	7.1
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	32	Temperature (F.)	46
Sulfate (SO_4)	3.5	Date of collection	10/23/50
Chloride (Cl)	1		
Fluoride (F)	.0		
Nitrate (NO_3)	.0		
Dissolved solids	47		

LEWISTON
(Population, 12, 985)

Ownership: Municipal.
Source: Clearwater River; auxiliary supply from 2 wells (1 and 2) 362 and 275 ft deep. The yield of the wells is reported to be 400 and 800 gpm. The wells are connected to the low-level distribution system and are used about 2 months of the year.
Treatment: Clearwater River: prechlorination and ammoniation, coagulation with alum and lime, fluoridation, sedimentation, rapid sand filtration, and adjustment of pH for corrosion control. Well water, chlorination only.
Rated capacity of treatment plant: 6, 000, 000 gpd.
Raw-water storage: None.
Finished-water storage: 2 open brick reservoirs, 1, 000, 000 gal each; 2 open concrete reservoirs, combined capacity 7, 600, 000 gal; 1 concrete tank, 250, 000 gal; and clear well, 125, 000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Raw water	Finished 2/water	Well 2
Silica (SiO_2)	--	12	60
Iron (Fe)	0.05	.03	.06
Manganese (Mn)	--	--	.0
Calcium (Ca)	5.2	12	17
Magnesium (Mg)	1.9	2.4	5.8
Sodium (Na)	2.9	6.9	31
Potassium (K)		2.1	
Carbonate (CO_3)	0	0	--
Bicarbonate (HCO_3)	29	43	149
Sulfate (SO_4)	1.6	14	3.4
Chloride (Cl)	1	2.5	4
Fluoride (F)	.1	1.2	.8
Nitrate (NO_3)	--	.3	.0
Dissolved solids	49	77	200
Hardness as $CaCO_3$:			
Total	21	40	66
Noncarbonate	0	5	0
Color	5	5	--
pH	7.2	7.5	8.0
Specific conductance (micromhos at 25 C.)	--	109	--
Turbidity	7	--	--
Temperature (F.)	60	--	--
Date of collection	10/16/50	9/7/51	9/27/48

1/Clearwater River. Analyzed by State Dept. of Public Health, Boise, Idaho.
2/Clearwater River.

Regular determinations at treatment plant, 1949-50

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water.....	33	42	10	7.2	7.3	6.9	29	32	5	14	550	3
Finished water...	26	37	14	7.8	9.1	6.9	32	61	15	0	--	--

MOSCOW
(Population, 10,593)

Ownership: Municipal; supplies about 30 people outside the city limits. Total population supplied, about 10,620.

Source: 4 wells (1 to 4). Wells 1 to 3, each 254 ft deep; well 4, about 350 ft deep. The yield of these wells is reported to be 500-600, 820, 1,200, and 400-600 gpm. Wells 1, 2, and 3 are located close together. Well 4 is about three-quarters of a mile from wells 1, 2, and 3.

Treatment: None.

Storage: 800,000 gal.

ANALYSES

(Analyses, in parts per million, by State Dept. of Public Health, Boise, Idaho)

	Well 3	Well 4		Well 3	Well 4
Silica (SiO_2)	57	59	Hardness as $CaCO_3$:		
Iron (Fe)	1.2	2.0	Total	137	137
Manganese (Mn)	.02	.02	Noncarbonate.....	0	0
Calcium (Ca)	35	32			
Magnesium (Mg).....	12	14	Color.....	--	--
Sodium (Na)	16	14	pH	7.2	7.2
Potassium (K)			Specific conductance (micromhos at 25 C.).....	--	--
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	171	171			
Sulfate (SO_4)	25	23	Turbidity	--	21
Chloride (Cl)	3	2	Temperature (F.)...	51	51
Fluoride (F)	.3	.3	Date of collection...	2/26/51	2/26/51
Nitrate (NO_3)	.0	.0			
Dissolved solids.....	240	236			

Depth (feet)	254	350
Diameter (inches)	15	24
Date drilled	1927	--
Percent of supply	--	--

NAMPA
(Population, 16,185)

Ownership: Municipal; supplies also about 250 people outside the city limits. Total population supplied, about 16,450.
Source: 5 artesian wells (1 to 5), 452, 452, 503, 575, and 452 ft deep. The yield of wells 1 and 2 combined is reported to be 1,000 gpm. The yield of wells 3, 4, and 5 is reported to be 900, 980, and 700 gpm.
Treatment: None.
Storage: 225,000 gal.

ANALYSES

(Analyses, in parts per million, by Idaho State Dept. of Health, Boise, Idaho)

	Wells 1 and 2	Well 3	Well 4	Well 5
Silica (SiO_2)	28	32	28	31
Iron (Fe)	.0	.0	.0	.0
Manganese (Mn)	.0	.0	.0	.0
Calcium (Ca)	12	16	14	14
Magnesium (Mg)	2.2	1.2	1.7	1.7
Sodium (Na) / Potassium (K)	53	54	51	49
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	161	168	163	154
Sulfate (SO_4)	8.2	9.0	5.0	7.6
Chloride (Cl)	7	8	8	7
Fluoride (F)	1.5	1.2	1.2	1.5
Nitrate (NO_3)	0	0	0	0
Dissolved solids	185	201	186	188
Hardness as $CaCO_3$:				
Total	39	45	42	42
Noncarbonate	0	0	0	0
Color	0	0	0	0
pH	7.6	7.7	7.7	7.6
Specific conductance (micromhos at 25° C.)	--	--	--	--
Turbidity	0	0	0	0
Temperature (F.)	75	76	80	76
Date of collection	4/25/51	4/25/51	4/25/51	4/25/51
Depth (feet)	452	503	575	452
Diameter (inches)	10, 8	16	16	16
Date drilled	1927-8	1949	1948	1947
Percent of supply	--	--	--	--

POCATELLO
(Population, 26,131)

Ownership: Municipal; supplies also about 500 people outside the city limits. Total population supplied, about 26,600.
Source: Gibson Jack Creek (70 percent of supply); Mink Creek (20 percent of supply); 8 wells from 70 to 105 ft deep (10 percent of supply). The yield of the wells ranges from 350 to 1,200 gpm. Well 5 is used regularly; the other 7 wells are used mostly during the summer months. Well 5 is 100 ft deep and is reported to yield 1,000 gpm.
Treatment: Chlorination.
Raw-water storage: Approximately 11,000,000 gal.
Finished-water storage: --

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Mink Creek (raw water)	Well 5	Gibson Jack Creek (finished water)
Silica (SiO_2)	23	23	14
Iron (Fe)	.03	.02	.12
Manganese (Mn)	--	--	--
Calcium (Ca)	58	65	30
Magnesium (Mg)	15	24	6.6
Sodium (Na)	12	32	6.0
Potassium (K)	2.7	5.1	1.4
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	249	300	116
Sulfate (SO_4)	8.8	35	6.4
Chloride (Cl)	16	38	9.1
Fluoride (F)	.1	.2	.1
Nitrate (NO_3)	.2	5.3	.5
Dissolved solids	260	368	136
Hardness as $CaCO_3$:			
Total	206	260	102
Noncarbonate	2	14	7
Color	12	5	12
pH	8.2	7.5	7.9
Specific conductance (micromhos at 25 C.)	437	629	219
Turbidity	--	--	--
Temperature (F.)	42	52	42
Date of collection	3/29/51	3/29/51	3/29/51
Depth (feet)		100	
Diameter (inches)		18	
Date drilled		--	
Percent of supply		--	

TWIN FALLS
(Population, 17,600)

Ownership: Municipal; supplies 33 people outside the city limits. Total population supplied, 17,633.
Source: Snake River. The city water is obtained from the lower-line canal of the Twin Falls irrigation system.
Treatment: Coagulation with alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd. (The filter plant is being enlarged so that it will have a capacity of 10,000,000 gpd.)
Raw-water storage: None.
Finished-water storage: Reservoir, 500,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	19	17	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.03	Total	192	197
Manganese (Mn)	--	--	Noncarbonate	28	44
Calcium (Ca)	49	51			
Magnesium (Mg)	17	17	Color	5	7
Sodium (Na)	22	23	pH	8.1	7.9
Potassium (K)	4.3	4.2	Specific conductance (micromhos at 25 C.)	459	483
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	200	186	Turbidity	--	--
Sulfate (SO_4)	47	56	Temperature (F.)	49	45
Chloride (Cl)	24	27	Date of collection	3/26/51	3/26/51
Fluoride (F)	.7	.7			
Nitrate (NO_3)	.9	.3			
Dissolved solids	280	293			

Regular determinations at treatment plant, 1951

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	190	--	8.2	8.3	8.1	--	--	--	--	--	--
Finished water	--	180	--	7.4	7.5	7.4	--	--	--	--	--	--

MONTANA

ANACONDA
(Population, 11,254)

Ownership: Anaconda Copper Mining Co. Water supplied to copper smelter with branch line for city distribution.
Source: Warm Springs Creek impounded in Georgetown Lake, Silver Lake, Twin Lake, and Storm Lake; auxiliary supply 3 wells, 35, 40, and 50 ft deep, used when surface-water supply is turbid.
Treatment: Chlorination and ammoniation.
Raw-water storage: 11,958,000,000 gal in Georgetown Lake; 4,281,000,000 gal in Silver Lake; relatively small quantities stored in Twin and Storm Lakes.
Finished-water storage: None.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Hafner Wells	Warm Springs 1/Creek		Hafner Wells	Warm Springs 1/Creek
Silica (SiO_2)	14	11	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.04	Total	179	76
Manganese (Mn)	--	--	Noncarbonate	27	8
Calcium (Ca)	52	24			
Magnesium (Mg)	12	3.9	Color	5	5
Sodium (Na)	3.0	1.6	pH	8.2	7.6
Potassium (K)	1.1	.8	Specific conductance (micromhos at 25 C.)	339	150
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	186	83			
Sulfate (SO_4)	25	8.1	Turbidity	--	--
Chloride (Cl)	1.9	1.2	Temperature (F.)	45	46
Fluoride (F)	.3	.3	Date of collection	6/22/51	6/22/51
Nitrate (NO_3)	1.9	.6			
Dissolved solids	203	94			

Depth (feet)	35, 40, 50
Diameter (inches)	15
Date drilled	1935-36
Percent of supply	48

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	101	116	58	7.9	8.7	7.6	92	108	77	--	--	--

1/Finished water.
2/Warm Springs Creek water.

BILLINGS
(Population, 31,834)

Ownership: Municipal; also supplies about 10,000 people outside the city limits. Total population supplied, about 41,800.
Source: Yellowstone River.
Treatment: Primary sedimentation (coagulation with alum during period of high turbidity); coagulation with alum, chlorination, ammoniation, secondary settling, addition of lime, polyphosphate, rapid sand filtration, and postchlorination. Activated carbon and copper sulfate are used during part of the year.
Rated capacity of treatment plant: 18,.000,000 gpd.
Raw-water storage: 7,000,000 gal.
Finished-water storage: 6,740,000 gal.

Rated capacity of the plant will be increased late in 1951 to 22,000,000 gpd.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	12	10	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.05	Total	139	148
Manganese (Mn)	.10	.02	Noncarbonate	19	28
Calcium (Ca)	35	38			
Magnesium (Mg)	13	13	Color	3	3
Sodium (Na)	28	29	pH	8.2	7.7
Potassium (K)	2.4	2.6	Specific conductance (micromhos at 25 C.)	388	407
Carbonate (CO_3)	0	0	Turbidity	9	2
Bicarbonate (HCO_3)	147	146	Temperature (F.)	56	57
Sulfate (SO_4)	71	78	Date of collection	9/17/51	9/17/51
Chloride (Cl)	6.5	7.5			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.4	1.6			
Dissolved solids	242	257			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	120	186	49	8.2	8.6	7.9	153	284	58	47	620	10
Finished water	122	193	54	8.2	8.5	7.7	168	302	76	25	160	9

BOZEMAN
(Population, 11,325)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 11,500.
Source: Bozeman Creek (2/3 of supply) and Lyman Creek (1/3 of supply). Middle Creek is used as an auxiliary supply.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plants: 9,000,000 gpd.
Raw-water storage: 3,000,000 gal.
Finished-water storage: 6,000,000 gal.

Bozeman Creek water enters the distribution system on the south side of the city and Lyman Creek water on the north side. The system is interconnected and consumers may receive either one or a mixture of the supplies.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Lyman Creek (raw water)	Lyman Creek (finished water)	Bozeman Creek (raw water)	Bozeman Creek (finished water)
Silica (SiO_2)	9.0	7.7	20	20
Iron (Fe)	.02	.08	.02	.02
Manganese (Mn)	.02	.02	.03	.03
Calcium (Ca)	40	40	27	27
Magnesium (Mg)	16	16	7.9	7.9
Sodium (Na)	.5	.5	3.1	3.0
Potassium (K)	.4	.7	1.7	1.8
Carbonate (CO_3)	6	0	0	0
Bicarbonate (HCO_3)	170	183	121	121
Sulfate (SO_4)	18	13	8.0	8.0
Chloride (Cl)	1.0	1.5	.5	.5
Fluoride (F)	.1	.1	.1	.1
Nitrate (NO_3)	1.1	1.4	1.0	.6
Dissolved solids	178	171	132	132
Hardness as $CaCO_3$:				
Total	166	166	100	100
Noncarbonate	17	16	1	1
Color	2	2	4	4
pH	8.4	8.2	7.5	7.5
Specific conductance (micromhos at 25 C.)	306	309	208	207
Turbidity	2	2	3	3
Temperature (F.)	53	53	45	45
Date of collection	9/22/51	9/22/51	9/22/51	9/22/51

GREAT FALLS
(Population, 39,214)

Ownership: Municipal; also supplies about 5,000 people outside the city limits. Total population supplied, about 44,200.
Source: Missouri River. The water flows through 36 and 48 in. pipe lines from the intakes into a sump, from which it is pumped to the treatment plant.
Treatment: Coagulation with alum and lime, activated carbon, break-point chlorination, sedimentation, carbon, rapid sand filtration, and ammoniation.
Rated capacity of treatment plant: 24,000,000 gpd.
Raw-water storage: 470,000 gal in suction well.
Finished-water storage: Clear well, 667,000 gal; tanks, 10,575,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	19	16	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.31	Total	151	151
Manganese (Mn)	.09	.00	Noncarbonate	10	23
Calcium (Ca)	40	41			
Magnesium (Mg)	12	12	Color	5	3
Sodium (Na)	20	20	pH	8.1	7.4
Potassium (K)	3.8	3.0	Specific conductance (micromhos at 25 C.)	372	386
Carbonate (CO_3)	0	0	Turbidity	8	2
Bicarbonate (HCO_3)	172	156	Temperature (F.)	--	62
Sulfate (SO_4)	38	47	Date of collection	9/25/51	9/25/51
Chloride (Cl)	11	15			
Fluoride (F)	.8	.8			
Nitrate (NO_3)	2.4	.8			
Dissolved solids	234	241			

Regular determinations at treatment plant, 1951 1/

July 1950 to July 1951	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	150	200	146	8.4	8.6	8.0	142	202	120	69	1500	5
Finished water	130	180	126	7.7	8.1	7.5	142	202	120	.68	1.10	.45

1/Fiscal year.

HELENA
(Population, 18,581)

Ownership: Municipal; supplies about 200 people outside the city limits. Total population supplied, about 18,800.
Source: Tenmile Creek impounded in Chessman Reservoir, about 60 percent of supply (low service); Springs collected in Hale Reservoir, about 40 percent of supply(high service). Three wells (Wolston, Tenmile, and Eureka), emergency supply, have not been used for several years.
Treatment: Chlorination and ammoniation. Copper sulfate is used for algae control.
Rated capacity of treatment plants: 12,000,000 gpd.
Raw-water storage: 550,000,000 gal.
Finished-water storage: 5,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Finished 1/water	Finished 2/water		Finished 1/water	Finished 2/water
Silica (SiO_2)	16	25	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.01	Total	33	190
Manganese (Mn)	.14	.00	Noncarbonate	19	42
Calcium (Ca)	9.0	54			
Magnesium (Mg)	2.6	13	Color	18	2
Sodium (Na)	2.5	7.3	pH	7.1	7.7
Potassium (K)	1.8	2.3	Specific conductance (micromhos at 25 C.)	92.6	395
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	17	181	Turbidity	6	1
Sulfate (SO_4)	20	52	Temperature (F.)	63	52
Chloride (Cl)	3.0	4.0	Date of collection	9/24/51	9/24/51
Fluoride (F)	.2	.1			
Nitrate (NO_3)	1.4	2.6			
Dissolved solids	76	259			

1/Tenmile Creek system.
2/Hale Reservoir system.

KALISPELL
(Population, 9,737)

Ownership: Municipal; supplies about 650 people outside the city limits. Total population supplied, about 10,400.
Source: Noffsinger Spring; emergency supply, 2 wells. Both spring and wells are located on the bank of Stillwater River.
Treatment: None.
Storage: 1,750,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Noffsinger Spring		Noffsinger Spring
Silica (SiO_2)	13	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	145
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	43		
Magnesium (Mg)	9.1	Color	3
Sodium (Na)	3.5	pH	7.6
Potassium (K)	2.7	Specific conductance (micromhos at 25 C.)	274
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	180	Turbidity	--
Sulfate (SO_4)	2.6	Temperature (F.)	55
Chloride (Cl)	1.0	Date of collection	6/21/51
Fluoride (F)	.0		
Nitrate (NO_3)	.1		
Dissolved solids	157		

MILES CITY
(Population, 9,243)

Ownership: Municipal; supplies 10 people outside the city limits. Total population supplied, 9,253.

Source: Yellowstone River (about 90 percent of supply) and 1 well 553 ft deep (about 10 percent of supply). The well water is mixed with the river water before it enters the treatment plant.

Treatment: Softening with excess lime, or lime and soda ash, coagulation with alum, settling, recarbonation, rapid sand filtration, chlorination, and ammoniation. Recarbonation is sometimes carried out in the clear well.

Rated capacity of treatment plant: 4,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 400,000 gal.

The percentage of river water and well water used varies throughout the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Yellowstone River (raw water)	Well (raw water)	Finished water (composite)
Silica (SiO_2)	12	11	8.5
Iron (Fe)	.02	.06	.06
Manganese (Mn)	--	.04	.04
Calcium (Ca)	60	1.1	13
Magnesium (Mg)	20	.1	8.1
Sodium (Na)	68	340	112
Potassium (K)	2.9	.9	2.8
Carbonate (CO_3)	0	41	0
Bicarbonate (HCO_3)	177	729	85
Sulfate (SO_4)	215	32	216
Chloride (Cl)	11	26	13
Fluoride (F)	.5	2.2	.7
Nitrate (NO_3)	1.8	2.0	1.4
Dissolved solids	496	830	422
Hardness as $CaCO_3$:			
Total	231	3	66
Noncarbonate	86	0	0
Color	4	22	3
pH	8.3	8.8	7.9
Specific conductance (micromhos at 25 C.)	737	1,320	663
Turbidity	270	10	2
Temperature (F.)	48	52	52
Date of collection	9/26/51	9/26/51	9/26/51

16098

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water.....	--	--	--	7.8	--	--	239	479	86	--	74	32
Finished water...	68	--	--	8.2	--	--	60	--	--	--	--	--

MISSOULA
(Population, 22,485)

Ownership: The Montana Power Co.; supplies also about 2,000 people outside the city limits. Total population supplied, about 24,500.
Source: Rattlesnake Creek; emergency supply 6 wells (1 to 6), 122, 90, 116, 86, 69, and 122 ft deep.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plant: 80,000,000 gpd.
Raw-water storage: 8 lakes in the upper drainage basin of Rattlesnake Creek with a total capacity of 820,000,000 gal; reservoir at intake dam 3,000,000 gal.
Finished-water storage: Distribution reservoir 1,000,000 gal.

Storage lakes are located about 13 miles directly north of Missoula. The water is diverted from the creek at the intake dam, which is located about $3\frac{1}{2}$ miles north of the city. The water is screened and treated at the intake dam.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Rattlesnake Creek (finished water)		Rattlesnake Creek (finished water)
Silica (SiO_2)	5.2	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	16
Manganese (Mn)	--	Noncarbonate	3
Calcium (Ca)	4.5		
Magnesium (Mg)	1.1	Color	5
Sodium (Na)	.8	pH	7.5
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	27
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	15	Turbidity	--
Sulfate (SO_4)	1.8	Temperature (F.)	55
Chloride (Cl)	1.2	Date of collection	6/22/51
Fluoride (F)	.1		
Nitrate (NO_3)	.1		
Dissolved solids	22		

NEVADA

BOULDER CITY
(Population, 3,903)

Ownership: U. S. Government.
Source: Lake Mead.
Treatment: Softening by the excess lime-soda ash process.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: 100,000 gal.
Finished-water storage: 4,000,000 gal.

ANALYSES

(Analyses by Metropolitan Water District of Southern Calif., Laverne, Calif.) 1/

	Lake 2/Mead	Lake 3/Mead		Lake 2/Mead	Lake 3/Mead
Silica (SiO_2)	9.6	9.4	Hardness as $CaCO_3$:		
Iron (Fe)	--	.01	Total	291	129
Manganese (Mn)	--	--	Noncarbonate	167	64
Calcium (Ca)	78	23			
Magnesium (Mg)	23	18	Color	--	0
Sodium (Na) + Potassium (K)	80	128	pH	8.0	8.7
Carbonate (CO_3)	0	7	Specific conductance (micromhos at 25 C.)	900	--
Bicarbonate (HCO_3)	151	65	Turbidity	--	0
Sulfate (SO_4)	246	247	Temperature (F.)	64	80
Chloride (Cl)	59	60	Date of collection	10/22/48	11/8/48
Fluoride (F)	--	--			
Nitrate (NO_3)	1.6	1.8			
Dissolved solids	572	526			

Regular determinations at treatment plant, 1948

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	137	140	134	8.3	8.3	8.3	320	344	293	0	0	0
Finished water	73	75	70	8.8	9.3	8.5	128	144	113	0	0	0

1/Parts per million.
2/Raw water.
3/Finished water.

ELKO
(Population, 5,393)

Ownership: Municipal.
Source: 5 wells (10 and 12 to 15) 400, 570, 495, 488, and 465 ft deep. The yield of the wells is reported to be 500, 650, 550, 650, and 500 gpm. Water for limited irrigation use is obtained from springs.
Treatment: None.
Storage: 2,500,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells (composite, city tap)		Wells (composite, city tap)
Silica (SiO_2)	86	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	119
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	37		
Magnesium (Mg)	6.6	Color	7
Sodium (Na)	39	pH	7.5
Potassium (K)	12	Specific conductance (micromhos at 25 C.)	438
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	169	Temperature (F.)	--
Sulfate (SO_4)	45	Date of collection	5/20/51
Chloride (Cl)	23		
Fluoride (F)	.4		
Nitrate (NO_3)	1.7		
Dissolved solids	334		

Depth (feet)	400-570
Diameter (inches)	12, 16
Date drilled	1936-1948
Percent of supply	100

ELY
(Population, 3,558)

Ownership: Municipal: also provides the entire supply for Kennicott Copper Corp. at Ruth, and other consumers outside the city limits. Total population supplied, about 4,550.
Source: Murry Springs.
Treatment: None.
Storage: None.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Murry Springs (city tap)		Murry Springs (city tap)
Silica (SiO_2)	9.7	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	197
Manganese (Mn)	--	Noncarbonate	10
Calcium (Ca)	46		
Magnesium (Mg)	20	Color	3
Sodium (Na)	3.3	pH	7.7
Potassium (K)	.9	Specific conductance (micromhos at 25 C.)	360
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	228	Temperature (F.)	--
Sulfate (SO_4)	11	Date of collection	12/11/51
Chloride (Cl)	2.7		
Fluoride (F)	.0		
Nitrate (NO_3)	2.0		
Dissolved solids	195		

HENDERSON
(Population, 3,643)

Ownership: Colorado River Commission of Nevada; supplies also the unincorporated towns of Victory Village, Carver Park, and Pittman. Total population supplied, about 6,300.
Source: Lake Mead.
Treatment: Chlorination, and copper sulfate for algae control in reservoirs.
Rated capacity of treatment plant: 22,000,000 gpd.
Raw-water storage: Reservoirs, 34,961,000 gal.
Finished-water storage: None.

ANALYSIS

(Analysis, in parts per million, by Carl Wilson, Los Angeles, Calif.)

	Finished water		Finished water
Silica (SiO_2)	12	Hardness as $CaCO_3$:	
Iron (Fe)	.05	Total	263
Manganese (Mn)	--	Noncarbonate	125
Calcium (Ca)	74		
Magnesium (Mg)	19	Color	--
Sodium (Na)	92	pH	--
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	6	Turbidity	--
Bicarbonate (HCO_3)	156	Temperature (F.)	--
Sulfate (SO_4)	233	Date of collection	11/29/48
Chloride (Cl)	58		
Fluoride (F)	--		
Nitrate (NO_3)	--		
Dissolved solids	571		

LAS VEGAS
(Population, 24,624)

Ownership: Las Vegas Land and Water Co.
Source: 11 artesian wells (1 to 11) with depths ranging from 472 to 1,250 ft, and 3 springs. All of the wells are flowing wells, 5 of which are not equipped with pumps. The yield of the wells is reported to range from 241 to 1,665 gpm.
Treatment: None.
Storage: Reservoirs, 3,750,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Composite sample from reservoirs	Well 6	Well 11	Spring 1
Silica (SiO_2)	14	14	14	13
Iron (Fe)	.10	--	--	--
Manganese (Mn)	.00	--	--	--
Calcium (Ca)	49	50	48	51
Magnesium (Mg)	26	26	24	25
Sodium (Na)	6.7	7	12	4
Potassium (K)	1.9			
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	236	238	224	238
Sulfate (SO_4)	46	43	50	37
Chloride (Cl)	3.9	3.5	4.5	2.9
Fluoride (F)	.3	.2	.3	.3
Nitrate (NO_3)	1.8	2.1	1.6	1.5
Dissolved solids	266	263	264	252
Hardness as $CaCO_3$:				
Total	229	232	218	230
Noncarbonate	36	37	34	35
Color	5	5	5	5
pH	7.6	7.7	7.7	7.6
Specific conductance (micromhos at 25 C.)	439	430	432	424
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	11/2/51	11/2/51	11/2/51	11/2/51
Depth (feet)	--	500	940	
Diameter (inches)	--	11-13	11	
Date drilled	--	1941	1945	
Percent of supply	100	--	--	

NORTH LAS VEGAS
(Population, 3,875)

Ownership: Municipal; supplies also about 50 people outside the city limits.
Total population supplied, about 3,925.
Source: 8 artesian wells ranging in depth from about 300 to 750 ft.
Treatment: None.
Storage: Reservoir, 145,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Composite sample from reservoir		Composite sample from reservoir
Silica (SiO_2)	18	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	206
Manganese (Mn)	--	Noncarbonate	21
Calcium (Ca)	43		
Magnesium (Mg)	24	Color	3
Sodium (Na)	5.0	pH	7.6
Potassium (K)	5.3	Specific conductance (micromhos at 25 C.)	397
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	226	Temperature (F.)	70
Sulfate (SO_4)	33	Date of collection	3/29/51
Chloride (Cl)	3.2		
Fluoride (F)	.1		
Nitrate (NO_3)	1.3		
Dissolved solids	235		

RENO
(Population, 32,497)

Ownership: Sierra Pacific Power Co.; supplies also Sparks. Total population supplied, about 40,700.
Source: Truckee River (70 percent of supply) and Hunter Creek (30 percent of supply); auxiliary supply from 2 wells (1 and 2) 590 and 404 ft deep. The yield of the wells is reported to be 2,750 and 2,700 gpm.
Treatment: Sedimentation and chlorination of surface water sources. The well water is not treated.
Rated capacity of treatment plant: 40,000,000 gpd.
Raw-water storage: Reservoirs, 77,300,000 gal.
Finished-water storage: None.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Composite (city tap)		Composite (city tap)
Silica (SiO_2)	28	Hardness as $CaCO_3$:	
Iron (Fe)	.09	Total	40
Manganese (Mn)	--	Noncarbonate	16
Calcium (Ca)	9.8		
Magnesium (Mg)	3.8	Color	7
Sodium (Na)	4.1	pH	7.0
Potassium (K)	1.6	Specific conductance (micromhos at 25 C.)	110
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	29	Turbidity	--
Sulfate (SO_4)	27	Temperature (F.)	--
Chloride (Cl)	1.2	Date of collection	5/20/51
Fluoride (F)	.1		
Nitrate (NO_3)	.3		
Dissolved solids	91		

SPARKS
(Population, 8,203)

Ownership: Sierra Pacific Power Co. (See Reno)

ALBUQUERQUE
(Population, 96,815)

Ownership: Municipal.

Source: 42 wells, mostly in four principal well fields. Main plant (along east edge of valley between Central Ave. and Indian School Road) 20 wells 142 to 716 ft deep; Candelaria (Candelaria Road at Arno Street) 4 wells 288 to 578 ft deep; San Jose (South Broadway at San Jose Road) 6 wells 306 to 503 ft deep; Atrisco (at Helen Circle) 8 wells 356 to 558 ft deep; 4 wells at other locations in the city.

Treatment: Chlorination, and settling in clear wells.

Finished-water storage: 22,100,000 gal.

Water from Main plant and Candelaria fields is directly pumped to main pumping station and supplies portions of city in valley east of Rio Grande and nearby parts of city on east mesa. Water from Atrisco field supplies west mesa and valley areas west of Rio Grande and is also pumped directly to outlying areas in eastern part of east mesa. San Jose field is used only during periods of heavy water demand.

Water from Main plant and Candelaria fields was similar at time of sampling and is represented by one analysis for Main plant. The individual wells in the main well field differ somewhat in the chemical character of their waters and, therefore, the composition of water supplied at any point in the system will vary from time to time depending on which wells are in use. Tap samples collected at approximate weekly intervals at the Geological Survey laboratory ranged in conductance from 327 to 516 micromhos during 1950, and from 352 to 749 micromhos during 1951.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Main Pump 1/Station	Atrisco Pump 2/Station		Main Pump 1/Station	Atrisco Pump 2/Station
Silica (SiO_2)	71	63	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.0	Total	116	85
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	32	24			
Magnesium (Mg)	8.8	6.1	Color	2	1
Sodium (Na)	42	71	pH	7.9	7.6
Potassium (K)			Specific conductance (micromhos at 25 C.)	404	471
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	161	163	Temperature (F.)	76	61
Sulfate (SO_4)	54	82	Date of collection	10/12/51	10/12/51
Chloride (Cl)	12	12			
Fluoride (F)	.7	.9			
Nitrate (NO_3)	.6	.7			
Dissolved solids	310	340			
Depth (feet)				--	365-558
Diameter (inches)				--	14-10
Date drilled				--	1950-51
Percent of supply				±75	±10

1/Broadway and Tijeras. Composite sample from wells 2-S, 3-S, 4, 6-S, 11-S, 13, and 19 in main well field.

2/Composite sample from wells 1, 2, and 4 in Atrisco well field.

CARLSBAD
(Population, 17,975)

Ownership: Municipal.
Source: 7 wells (4, 6, 7 to 9, and 11 and 12) on west side near Carlsbad Canal, 233, 125, 143, 152, 115, 163, and 245 ft deep. Two wells (14 and 15) on east side near the Country Club area, each 200 ft deep, were under construction in 1951. The yield of the wells is reported to be 1,200, 1,600, 700, 1,250, 1,100, 1,100, and 3,000 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 350,000 gal.

The chloride concentration of water from the wells fluctuates somewhat during the year. All wells in the west-side group yield water of similar composition. The analyses represent water of maximum and minimum dissolved solids obtained from these wells at the time of the collection of the samples.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 9	Well 12		Well 9	Well 12
Silica (SiO_2)	14	15	Hardness as $CaCO_3$:		
Iron (Fe)	.0	--	Total	544	598
Manganese (Mn)	--	--	Noncarbonate	326	384
Calcium (Ca)	144	159			
Magnesium (Mg)	45	49	Color	0	2
Sodium (Na)	83	114	pH	7.9	--
Potassium (K)	3.2		Specific conductance (micromhos at 25 C.)	1,370	1,540
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	266	262	Temperature (F.)	64	--
Sulfate (SO_4)	321	390	Date of collection	5/10/51	5/10/51
Chloride (Cl)	133	158			
Fluoride (F)	.4	--			
Nitrate (NO_3)	3.2	3.0			
Dissolved solids	878	1,020			
Depth (feet)				115	245
Diameter (inches)				$15\frac{1}{2}$	18
Date drilled				1945	1948
Percent of supply				--	--

CLOVIS
(Population, 17,318)

Ownership: Public Service Co. of New Mexico.
Source: 9 wells (2, and 4 to 11) 362, 360, 345, 348, 354, 361, 351, 407, and 438 ft deep. The yield of the wells is reported to be from 550 to 840 gpm.
Treatment: Sedimentation and chlorination.
Rated capacity of treatment plant: 7,500,000 gpd.
Raw-water storage: --
Finished-water storage: 1,715,000 gal.

All wells yield water of similar composition.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Well 2		Well 2
Silica (SiO_2)	32	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	156
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	28		
Magnesium (Mg)	21	Color	0
Sodium (Na)	39	pH	7.8
Potassium (K)	8.0	Specific conductance (micromhos at 25 C.)	457
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	235	Turbidity	--
Sulfate (SO_4)	23	Temperature (F.)	--
Chloride (Cl)	13	Date of collection	5/8/51
Fluoride (F)	2.6		
Nitrate (NO_3)	9.5		
Dissolved solids	292		

GALLUP
(Population, 9,133)

Ownership: Municipal.
Source: 10 wells (two of which are held in reserve for emergencies) located in the city, 375 to 1,800 ft deep. The yield of the wells is reported to be from 60 to 235 gpm.
Treatment: Partial softening with lime, coagulation with alum, pressure filtration, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 4,600,000 gal.

The composition of the water delivered to the consumers varies somewhat depending on the proportions obtained from different wells. Hardness is reduced to a range between 150 to 200 ppm in the finished water. The samples represent a composite of raw water from all wells in use at time of sampling and the treated water supplied to consumers at time of sampling.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	14	15	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.01	Total	334	160
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	86	21			
Magnesium (Mg)	29	26	Color	3	3
Sodium (Na)	166	167	pH	7.5	8.0
Potassium (K)			Specific conductance (micromhos at 25 C.)	1,230	974
Carbonate (CO_3)	0	23	Turbidity	--	--
Bicarbonate (HCO_3)	424	173	Temperature (F.)	--	--
Sulfate (SO_4)	297	293	Date of collection	12/5/50	12/5/50
Chloride (Cl)	26	25			
Fluoride (F)	.6	.4			
Nitrate (NO_3)	.5	.5			
Dissolved solids	828	656			

HOBBS
(Population, 13,875)

Ownership: Municipal.
Source: 9 wells (1, and 3 to 10) 207, 207, 207, 207, 145, 152, 210, 210, and 210 ft deep. Three of the wells (4, 6, and 7) are held in reserve and constitute an emergency supply. The yield of the wells is reported to be from 400 to 1,250 gpm.
Treatment: Chlorination.
Storage: 800,000 gal.

All wells yield water of similar quality.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Well 9		Well 9
Silica (SiO_2)	56	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	252
Manganese (Mn)	--	Noncarbonate	82
Calcium (Ca)	78		
Magnesium (Mg)	14	Color	2
Sodium (Na)	41	pH	7.5
Potassium (K)	3.2	Specific conductance (micromhos at 25 C.)	681
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	207	Temperature (F.)	67
Sulfate (SO_4)	81	Date of collection	5/9/51
Chloride (Cl)	61		
Fluoride (F)	1.2		
Nitrate (NO_3)	9.7		
Dissolved solids	463		

Depth (feet)	210
Diameter (inches)	16
Date drilled	1947
Percent of supply	--

LAS CRUCES
(Population, 12,325)

Ownership: Municipal; also serves suburban areas. Total population served, about 15,000.

Source: 7 wells (1 to 7). Six wells (1 to 6) 294 to 301 ft deep are located at the reservoir 1 mile east of the city; the other well, 215 ft deep, at Washington school. The yield of the wells is reported to be 250, 205, 270, 310, 250, 400, and 800 gpm. Most of the supply is taken from the reservoir well field.

Treatment: Chlorination.

Storage: Reservoir, 2,885,000 gal.

The analysis of the sample from well 3 shows the quality of the best water from the reservoir well field. Dissolved solids in the water from the other wells as shown by partial analysis ranges between that shown for well 3 and that for well 7 at Washington school.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 3	Well 7		Well 3	Well 7
Silica (SiO_2)	30	32	Hardness as $CaCO_3$:		
Iron (Fe)	.07	.13	Total	238	629
Manganese (Mn)	--	--	Noncarbonate	92	270
Calcium (Ca)	69	196			
Magnesium (Mg)	16	34	Color	0	0
Sodium (Na)	57	173	pH	7.6	7.3
Potassium (K)	7.0	6.0	Specific conductance (micromhos at 25 C.)	741	1,810
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	178	439			
Sulfate (SO_4)	112	401	Turbidity	--	--
Chloride (Cl)	78	153	Temperature (F.)	70	65
Fluoride (F)	.4	.1	Date of collection	9/10/51	9/10/51
Nitrate (NO_3)	.6	7.8			
Dissolved solids	474	1,260			

Depth (feet)	301	215
Diameter (inches)	10	16
Date drilled	1938	1951
Percent of supply	--	--

LAS VEGAS
(City and town)
(Population, 13,763)

Ownership: Public Service Co. of New Mexico. Serves Las Vegas (city), population 7,494 and Las Vegas (town) population, 6,269. Also serves suburban areas outside of these two places. Total population served, about 14,800.
Source: Gallinas River impounded in reservoirs 6 miles above community.
Treatment: Sedimentation and chlorination. Alum coagulation used occasionally (2 to 3 weeks a year average) for settling prior to the entry of the water to the reservoir.
Rated capacity of treatment plant: (Alum plant) 1,000,000 gpd.
Raw-water storage: 4 reservoirs, 8,000,000, 68,000,000, 103,000,000, and 30,000,000 gal. Total, 209,000,000 gal.
Finished-water storage: 8,000,000 gal.

Analyses represent raw water from the two largest reservoirs. The alum plant was not being used at the time of the collection of the samples.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Peterson Reservoir	Bradner Reservoir		Peterson Reservoir	Bradner Reservoir
Silica (SiO_2)	8.9	9.6	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.01	Total	126	152
Manganese (Mn)	--	--	Noncarbonate	6	4
Calcium (Ca)	43	52			
Magnesium (Mg)	4.4	5.4	Color	0	0
Sodium (Na)	3.4	6.1	pH	8.2	8.2
Potassium (K)	1.0	1.2	Specific conductance (micromhos at 25 C.)	251	308
Carbonate (CO_3)	0	6			
Bicarbonate (HCO_3)	145	168			
Sulfate (SO_4)	12	14	Turbidity	--	--
Chloride (Cl)	2.0	3.0	Temperature (F.)	--	--
Fluoride (F)	.2	.2	Date of collection	6/5/51	6/5/51
Nitrate (NO_3)	.2	.2			
Dissolved solids	150	181			

ROSWELL
(Population, 25,738)

Ownership: Municipal.
Source: 10 wells (2 to 11) 320 to 586 ft deep. Wells 2 to 9 are located near the Atchison, Topeka and Santa Fe Railroad in the downtown area; wells 10 and 11 in new well field 6 miles west of the city, near Highway 70. The yield of the wells is reported to be from 500 to 3,300 gpm.
Treatment: None.
Storage: 5,000,000 gal.

The analyses given represent waters of about maximum and minimum dissolved-solids content pumped into system. Water delivered to consumers ranges between these extremes.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 6	Well 10		Well 6	Well 10
Silica (SiO_2)	15	15	Hardness as $CaCO_3$:		
Iron (Fe)	.0	--	Total	664	588
Manganese (Mn)	--	--	Noncarbonate	484	394
Calcium (Ca)	187	168			
Magnesium (Mg)	48	41	Color	0	2
Sodium (Na)	124	54	pH	7.7	7.9
Potassium (K)	2.2	3.4	Specific conductance (micromhos at 25 C.)	1,740	1,250
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	219	237	Turbidity	--	--
Sulfate (SO_4)	486	421	Temperature (F.)	--	--
Chloride (Cl)	185	58	Date of collection	5/11/51	5/11/51
Fluoride (F)	.7	.7			
Nitrate (NO_3)	6.7	7.5			
Dissolved solids	1,160	886			

Depth (feet)	330	586
Diameter (inches)	16	13½
Date drilled	--	--
Percent of supply	±20	±20

SANTA FE
(Population, 27,998)

Ownership: Public Service Co. of New Mexico.
Source: Santa Fe Creek (impounded). Auxiliary supply from 5 wells (Alto Street, Hickox, Torreon, Ferguson, and Santa Fe) 313, 200, 570, 470, and 725 ft deep, respectively.
Treatment: Plain sedimentation, chlorination, and addition of polyphosphate (Calgon) for corrosion control. Copper sulfate is used to control algae in the reservoirs.
Raw-water storage: 1,326,000,000 gal.
Finished-water storage: 5,000,000 gal.

The surface supply is used exclusively in years when runoff is sufficient. Water from Torreon, Ferguson, and Santa Fe wells is of about the same composition. Water from the Hickox and Alto Street wells is somewhat higher in dissolved solids.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Santa Fe Creek (finished water)	Torreon Well	Santa Fe Well
Silica (SiO_2)	11	15	16
Iron (Fe)	.03	.0	.02
Manganese (Mn)	--	--	--
Calcium (Ca)	8.0	46	56
Magnesium (Mg)	2.4	7.0	5.1
Sodium (Na)	3.0	4.8	5.7
Potassium (K)	.9	1.2	1.2
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	30	130	154
Sulfate (SO_4)	6.3	5.5	21
Chloride (Cl)	1.7	12	11
Fluoride (F)	.2	.0	.1
Nitrate (NO_3)	.2	30	15
Dissolved solids	58	207	217
Hardness as $CaCO_3$:			
Total	30	144	160
Noncarbonate	5	38	34
Color	--	0	0
pH	7.9	7.9	8.0
Specific conductance (micromhos at 25 C.)	72.0	311	347
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	6/9/43	6/7/51	6/7/51
Depth (feet)		570	725
Diameter (inches)		12	16 to 17
Date drilled		1951	1951
Percent of supply		--	--

TUCUMCARI
(Population, 8,419)

Ownership: Municipal; supplies also a small area outside the city limits. Total population supplied, about 8,470.
Source: 10 wells; 2 wells (1 and 2) in West field, 350 and 333 ft deep and reported to yield 240 and 260 gpm; 8 wells (14 to 21) in Metropolitan Park, 250 to 378 ft deep and reported to yield an average of 160 gpm.
Treatment: Chlorination.
Raw-water storage: 3,000,000 gal.
Finished-water storage: 900,000 gal.

An additional well in Metropolitan Park was under construction in 1951.
The analyses show the quality of water produced from the two well fields. Most of supply comes from the Metropolitan Park field.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 1	Well 20		Well 1	Well 20
Silica (SiO_2)	16	20	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.01	Total	116	191
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	17	32			
Magnesium (Mg)	18	27	Color	0	--
Sodium (Na)	118	54	pH	8.0	7.7
Potassium (K)	3.6	5.0	Specific conductance (micromhos at 25 C.)	707	572
Carbonate (CO_3)	10	0			
Bicarbonate (HCO_3)	315	299	Turbidity	--	--
Sulfate (SO_4)	84	48	Temperature (F.)	--	--
Chloride (Cl)	11	10	Date of collection	5/7/51	5/7/51
Fluoride (F)	1.0	1.4			
Nitrate (NO_3)	5.3	5.7			
Dissolved solids	433	342			
Depth (feet)				350	378
Diameter (inches)				12	14
Date drilled				--	--
Percent of supply				--	--

BRIGHAM CITY
(Population, 6,790)

Ownership: Municipal; supplies also about 2,000 people at the Indian school outside the city limits. Total population supplied, about 8,800.
Source: Halling Spring, located at the head of Box Elder Canyon near Mantua. Auxiliary supply, 2 wells, 205 and 412 ft deep and reported to yield 900 and 1,600 gpm. Well 1 is used as needed during summer months. Well 2 has not been used for 2 years.
Treatment: None.
Storage: 3 reservoirs, 1,200,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Halling Spring	1/Well 1	1/Well 2
Silica (SiO_2)	13	13	16
Iron (Fe)	.04	.0	.2
Manganese (Mn)	--	0	0
Calcium (Ca)	44	52	49
Magnesium (Mg)	21	20	19
Sodium (Na)	8.3	4.5	8.8
Potassium (K)	2.7		
Carbonate (CO_3)	0	--	--
Bicarbonate (HCO_3)	239	226	228
Sulfate (SO_4)	9.2	17	13
Chloride (Cl)	9.6	10	12
Fluoride (F)	.2	.2	.1
Nitrate (NO_3)	2.7	4.4	3.1
Dissolved solids	224	243	243
Hardness as $CaCO_3$:			
Total	196	212	201
Noncarbonate	0	27	14
Color	5	--	--
pH	7.9	7.8	8.2
Specific conductance (micromhos at 25 C.)	404	--	--
Turbidity	--	--	--
Temperature (F.)	53	--	--
Date of collection	3/30/51	4/50	4/18/50
Depth (feet)		205	412
Diameter (inches)		12	16-12
Date drilled		1935	1946
Percent of supply		--	--

1/Analyzed by Utah State Dept. of Health, Salt Lake City.

LOGAN
(Population, 16,832)

Ownership: Municipal.
Source: Dewitt Springs, located in Logan Canyon 7 miles from the canyon mouth. Emergency supply from a canal from the Logan River.
Treatment: No treatment of spring water. Chlorination of canal water when used.
Storage: 3,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Dewitt Springs	Logan River		Dewitt Springs	Logan River
Silica (SiO_2)	5.3	8.0	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.01	Total	196	211
Manganese (Mn)	--	--	Noncarbonate	8	14
Calcium (Ca)	49	50			
Magnesium (Mg)	18	21	Color	5	5
Sodium (Na)	1.4	3.0	pH	8.1	8.1
Potassium (K)	1.6	2.7	Specific conductance (micromhos at 25 C.)	352	379
Carbonate (CO_3)	0	6			
Bicarbonate (HCO_3)	230	228			
Sulfate (SO_4)	8.1	14	Turbidity	--	--
Chloride (Cl)	1.8	5.5	Temperature (F.)	47	45
Fluoride (F)	.0	.1	Date of collection	3/30/51	3/30/51
Nitrate (NO_3)	2.7	.8			
Dissolved solids	193	212			

MURRAY
(Population, 9,006)

Ownership: Municipal; supplies also about 150 people outside the city limits. Total population supplied, about 9,150.

Source: McGhie Springs and tunnels located near mouth of Big Cottonwood Canyon; auxiliary supply, 27 flowing wells and Little Cottonwood Creek (see Salt Lake City). Twenty-one of the flowing wells, 44 to 290 ft deep, are in the Vine Street group. The remaining 6 flowing wells are in the Baker group.

Treatment: None.

Storage: Reservoir: 1,000,000 gal.

The flow from McGhie Springs and tunnels is reported to be about 2,200 gpm; the flow from the wells is estimated to be between 1,800 and 2,200 gpm. About 225 gpm is available from Little Cottonwood Creek when needed. The water from the wells and Little Cottonwood Creek is used to some extent 6 months of the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	McGhie Springs and tunnels	Vine Street Wells	Baker Wells
Silica (SiO_2)	8.2	20	14
Iron (Fe)	.03	.02	.02
Manganese (Mn)	--	--	--
Calcium (Ca)	39	53	58
Magnesium (Mg)	12	17	22
Sodium (Na)	3.9	16	35
Potassium (K)	1.8	3.7	3.6
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	136	199	214
Sulfate (SO_4)	38	47	70
Chloride (Cl)	4.5	17	42
Fluoride (F)	.2	.3	.2
Nitrate (NO_3)	.8	3.2	5.9
Dissolved solids	174	270	363
Hardness as $CaCO_3$:			
Total	147	202	235
Noncarbonate	35	39	60
Color	5	5	5
pH	8.1	8.0	7.7
Specific conductance (micromhos at 25 C.)	297	446	607
Turbidity	--	--	--
Temperature (F.)	45	52	52
Date of collection	3/9/51	3/9/51	3/9/51
Depth (feet)		44 to 290	--
Diameter (inches)		5	--
Date drilled		--	--
Percent of supply		--	--

OGDEN
(Population, 57,112)

Ownership: Municipal.

Source: System of 46 artesian wells 84 to 600 ft deep, about 10 miles northeast of the city, located beneath Pine View Reservoir in Ogden Canyon; auxiliary supplies from creeks tributary to Ogden River (Wheeler, Coldwater, and Warmwater Canyons), Divine Springs in Ogden Canyon, and 4 wells, 600, 484, 495, and 472 ft deep.

Treatment: Chlorination. Open reservoirs are treated with copper sulfate for algae control.

Storage: 60,000,000 gal.

The artesian well field was developed before the construction of Pine View Dam impounding the Ogden River in Pine View Reservoir covering the well field. To preserve the supply the wells were capped and undercut at an average depth of 9 ft below the original outlet.

The flow of the wells passes through steel pipes to 3 collector mains which empty into a steel collector tank encased in concrete. From the collector tank the water is carried by a 38 in. steel pipe 9,000 ft long to a point just below Pine View Dam where it connects with the city main through Ogden Canyon. The flow of the wells in controlled and after the filling of Pine View Reservoir was 24 second-feet; an increase of 39 percent over the original maximum natural flow.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Artesian Wells	Airport Well 1 (East well)	Airport 1/Well 2 (West well)	Airport 1/Well 3 (C. A. A.)	Well at 23rd St. & Van Buren Ave.
Silica (SiO_2)	11	21	16	14	25
Iron (Fe)	.01	.23	.5	.1	.09
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	45	49	55	36	120
Magnesium (Mg)	11	15	22	16	33
Sodium (Na)	8.5	31	18	46	235
Potassium (K)	4.0	8.0			13
Carbonate (CO_3)	0	0	--	--	0
Bicarbonate (HCO_3)	183	272	268	273	162
Sulfate (SO_4)	12	7.7	12	2.2	12
Chloride (Cl)	8.8	23	22	22	595
Fluoride (F)	.1	.2	.2	.2	.2
Nitrate (NO_3)	4.7	.0	--	0	.7
Dissolved solids	188	279	290	282	2/1,120
Hardness as $CaCO_3$:					
Total	158	184	228	156	435
Noncarbonate	8	0	8	0	302
Color	2	--	--	--	--
pH	7.6	8.1	7.9	8.0	7.5
Specific conductance (micromhos at 25 C.)	334	479	--	--	2,070
Turbidity	--	--	--	--	--
Temperature (F.)	65	--	--	--	--
Date of collection	4/17/51	9/11/50	11/6/48	3/23/49	9/11/50

1/Analyzed by Utah State Dept. of Health, Salt Lake City.

2/Concentration variable.

OREM
(Population, 8,351)

Ownership: Municipal. Total population supplied, about 10,000.
Source: Alta Ditch (fed by spring about 5 miles up Provo Canyon), group of small springs in lower Provo Canyon, Provo River impounded in Deer Creek Reservoir (see Salt Lake City); emergency supply from 2 drilled wells, 468 and 470 ft deep, each with a reported yield of 500 gpm.
Treatment: Chlorination. The well water, when used, is pumped directly into the distribution system and is not treated.
Raw-water storage: None.
Finished-water storage: 3 reservoirs, 2,650,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Alta Ditch (raw water)	Springs (chlorinated water)	Canyon Road Well
Silica (SiO_2)	4.8	8.2	15
Iron (Fe)	.01	.02	.01
Manganese (Mn)	--	--	--
Calcium (Ca)	30	51	58
Magnesium (Mg)	10	18	24
Sodium (Na)	1.2	6.8	7.4
Potassium (K)	.6	1.6	.8
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	128	240	223
Sulfate (SO_4)	12	28	56
Chloride (Cl)	1.1	7.0	15
Fluoride (F)	.2	.2	.2
Nitrate (NO_3)	1.3	3.5	3.4
Dissolved solids	122	243	300
Hardness as $CaCO_3$:			
Total	116	201	243
Noncarbonate	11	5	60
Color	5	5	5
pH	8.0	7.6	7.6
Specific conductance (micromhos at 25 C.)	221	427	470
Turbidity	--	--	--
Temperature (F.)	50	54	59
Date of collection	8/28/51	8/28/51	8/28/51
Depth (feet)			468
Diameter (inches)			12, 10, 8
Date drilled			1946
Percent of supply			--

PROVO
(Population, 28,937)

Ownership: Municipal; supplies also about 400 people outside the city limits. Total population supplied, about 29,350.

Source: Springs in Provo Canyon: Yellow Jacket Spring, Spring Dell Spring, Mary's Spring, Canyon Glen Spring, and several other small springs. Auxiliary supplies, creeks tributary to Provo River: Upper Falls, Bridal Falls, Lost Creek, and South Fork Creek; Provo River impounded in Deer Creek Reservoir (see Salt Lake City). The creeks of the auxiliary supply contribute 9 to 10,000,000 gpd during summer months. During 1950 water used from Provo River amounted to 378 acre-ft.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: Reservoir, 5,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Springs, composite (reservoir)		Springs, composite (reservoir)
Silica (SiO_2)	7.4	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	152
Manganese (Mn)	--	Noncarbonate	16
Calcium (Ca)	38		
Magnesium (Mg)	14	Color	6
Sodium (Na)	2.9	pH	7.7
Potassium (K)	1.3	Specific conductance (micromhos at 25 C.)	300
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	166	Temperature (F.)	46
Sulfate (SO_4)	19	Date of collection	3/23/51
Chloride (Cl)	2.4		
Fluoride (F)	.0		
Nitrate (NO_3)	1.7		
Dissolved solids	167		

SALT LAKE CITY
(Population, 182,121)

Ownership: Municipal; supplies also Holladay and about 18,350 people in suburban areas outside the city limits. Total population supplied, about 204,100.

Source: Big Cottonwood Creek,35 percent of supply; Parley's Creek impounded in Mountain Dell Reservoir, 21 percent of supply; Little Cottonwood Creek, 16 percent of supply; City Creek,15 percent of supply; Emigration Tunnel, 4 percent of supply. Auxiliary supplies from 99 wells in artesian basin about 7 miles southeast of Salt Lake City,4 percent of supply; 5 pumped wells, 464, 440, 385, 535, and 500 ft deep,5 percent of supply.

Treatment: Chlorination and ammoniation of surface-water sources; chlorination of water from artesian basin; pumped well water and Emigration Tunnel water not treated. Copper sulfate is used at Mountain Dell Reservoir for algae control.

Raw-water storage: Mountain Dell Reservoir, 1,050,000,000 gal; Twin Lakes, 306,000,000 gal; Mary Lake, 242,000,000 gal.

Finished-water storage: 11 reservoirs with a combined capacity of 52,900,000 gal.

The composition of the water varies throughout the distribution system and changes considerably at different times of the year, although all supplies are mixed to some degree before reaching the consumer, except for City Creek which supplies the northern part of the city. The analyses given are believed to show reasonably well the composition of the water from the various sources of supply.

An important future source of water (beginning 1952) supplied by the Metropolitan Water District will be Provo River impounded in Deer Creek Reservoir and carried in the Salt Lake Aqueduct. Two reservoirs, with a combined capacity of 40,000,000 gal, are now under construction to receive water from Deer Creek Reservoir.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Big Cottonwood Creek	Parley's Creek	Little Cottonwood Cr.	City Creek	Deer Creek Reservoir
Silica (SiO_2)	7.1	13	6.7	9.2	10
Iron (Fe)	.04	.02	.14	.05	.04
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	36	77	22	62	59
Magnesium (Mg)	12	10	4.9	17	16
Sodium (Na)	3.7	16	4.4	8.7	12
Potassium (K)		4.6			2.1
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	123	269	60	248	196
Sulfate (SO_4)	38	33	30	17	58
Chloride (Cl)	4.0	20	2.1	16	10
Fluoride (F)	.2	.2	.3	.1	.3
Nitrate (NO_3)	.7	.2	.9	.2	1.3
Dissolved solids	162	309	101	252	270
Hardness as $CaCO_3$:					
Total	139	233	75	224	213
Noncarbonate	38	12	26	22	52
Color	--	--	--	--	--
pH	8.2	8.0	7.9	8.0	7.4
Specific conductance (micromhos at 25 C.)	281	515	169	443	436
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	3/24/49	10/20/49	4/22/49	3/24/49	11/25/49

	Emigration Tunnel	Artesian wells (composite)	Well 1056-A
Silica (SiO_2)	15	14	19
Iron (Fe)	.05	.03	.05
Manganese (Mn)	--	--	--
Calcium (Ca)	125	54	83
Magnesium (Mg)	33	18	31
Sodium (Na)	17	23	35
Potassium (K)		2.9	2.9
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	320	196	286
Sulfate (SO_4)	185	63	99
Chloride (Cl)	20	28	41
Fluoride (F)	.1	.2	.0
Nitrate (NO_3)	2.4	4.8	15
Dissolved solids	555	308	471
Hardness as $CaCO_3$:			
Total	448	208	334
Noncarbonate	186	48	100
Color	--	--	--
pH	7.4	7.9	7.5
Specific conductance (micromhos at 25 C.)	835	512	755
Turbidity	--	--	--
Temperature (F.)	--	59	--
Date of collection	5/9/49	8/8/49	8/18/49
Depth (feet)	--	58 to 440	464
Diameter (inches)	--	--	20
Date drilled	--	--	1945
Percent of supply	4	4	3

SOUTH SALT LAKE
(Population, 7,704)

Ownership: Municipal; supplies also about 1,000 people in a school outside the city limits. Total population supplied, about 8,700.

Source: 6 flowing wells (1, and 4 to 8) 585, 932, 750, 631, 895, and 970 ft deep. Auxiliary water is purchased from Salt Lake City, supplied by pipe line from wells in artesian basin (see Salt Lake City), and is automatically drawn upon whenever the pressure in the city mains drops below a certain point.

Treatment: None.

Storage: Elevated tank, 350,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Flowing wells (composite)		Flowing wells (composite)
Silica (SiO_2)	16	Hardness as $CaCO_3$:	
Iron (Fe)	.06	Total	372
Manganese (Mn)	--	Noncarbonate	174
Calcium (Ca)	88		
Magnesium (Mg)	37	Color	7
Sodium (Na)	52	pH	7.8
Potassium (K)	3.0	Specific conductance (micromhos at 25 C.)	903
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	241	Turbidity	--
Sulfate (SO_4)	233	Temperature (F.)	62
Chloride (Cl)	40	Date of collection	3/9/51
Fluoride (F)	.2		
Nitrate (NO_3)	.9		
Dissolved solids	630		

Depth (feet)	585 to 970
Diameter (inches)	4
Date drilled	1946-50
Percent of supply	86

TOOELE
(Population, 7,269)

Ownership: Municipal.
Source: Middle Canyon Springs located 2 miles southeast of Tooele, and Settlement Canyon Spring located 1½ miles south of Tooele. These springs furnish about 80 percent of the total supply. Auxiliary supply from 3 wells (1 to 3), 452, 70, and 79 ft deep. The wells furnish about 20 percent of the total supply.
Treatment: None.
Storage: Reservoirs with a combined capacity of 4,000,000 gal.

Wells 2 and 3 are located just below the springs in Middle and Settlement Canyons, respectively, so that the water from these wells is probably very similar in composition to the spring water. Well 1 is the main one in use during the summer months.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Middle Canyon Springs	Settlement Canyon Spring	1/Well 1
Silica (SiO_2)	12	13	13
Iron (Fe)	.02	.02	2/4.5
Manganese (Mn)	.00	.00	--
Calcium (Ca)	76	70	85
Magnesium (Mg)	22	23	21
Sodium (Na)	14	22	12
Potassium (K)	2.7	2.9	4
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	298	305	276
Sulfate (SO_4)	39	20	35
Chloride (Cl)	15	36	30
Fluoride (F)	.1	.1	--
Nitrate (NO_3)	2.4	1.8	--
Dissolved solids	320	326	370
Hardness as $CaCO_3$:			
Total	280	269	297
Noncarbonate	36	19	72
Color	5	5	--
pH	7.7	7.6	8
Specific conductance (micromhos at 25 C.)	558	586	--
Turbidity	--	--	--
Temperature (F.)	40	51	--
Date of collection	3/1/51	3/1/51	1/3/47
Depth (feet)			452
Diameter (inches)			12-10
Date drilled			1946
Percent of supply			--

1/Analyzed by University of Utah, Salt Lake City, Utah.
2/Iron and aluminum oxides.

WYOMING

CASPER
(Population, 23,673)

Ownership: Municipal; also supplies about 1,000 people outside the city limits. Total population supplied, about 24,700.
Source: Inflitration gallery along banks of North Platte River; impounding reservoir on Elkhorn Creek used to service small number of homes in higher part of city; 3 dug wells (1 to 3) each 30 ft deep, as stand-by.
Treatment: Chlorination, and copper sulfate for algae control as needed.
Raw-water storage: Elkhorn Creek Reservoir, 1,000,000 gal.
Finished-water storage: 4 open concrete reservoirs, 11,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Infiltration gallery (finished water)		Infiltration gallery (finished water)
Silica (SiO_2)	11	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	329
Manganese (Mn)	.01	Noncarbonate	180
Calcium (Ca)	91		
Magnesium (Mg)	25	Color	4
Sodium (Na)	59	pH	7.7
Potassium (K)	3.9	Specific conductance (micromhos at 25 C.)	869
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	182	Turbidity	1
Sulfate (SO_4)	275	Temperature (F.)	60
Chloride (Cl)	21	Date of collection	10/27/51
Fluoride (F)	.3		
Nitrate (NO_3)	1.1		
Dissolved solids	615		

CHEYENNE
(Population, 31,935)

Ownership: Municipal; also supplies 10,000 to 12,000 people at Warren Air Base. Total population supplied, about 41,900 to 43,900.
Source: 14 wells ranging from 152 to 947 ft deep (11 of the wells are under 400 ft in depth) furnish 25 percent of regular supply; 5 reservoirs including Granite Springs, Crystal Lake, Old North Crow, New North Crow, and South Crow--all on branches of Crow Creek furnish 75 percent of regular supply.
Treatment: Well water, chlorination; creek water, coagulation with alum, slow sand filtration, chlorination, and copper sulfate, as needed, for algae control.
Rated capacity of treatment plant: 12,000,000 gpd.
Raw-water storage: 5 impounding reservoirs (capacity not known).
Finished-water storage: 11,000,000 gal in open concrete basins and steel tank.

The well water is chlorinated and pumped to storage in a steel tank which automatically discharges when filled, to finished creek water in open concrete basins. A mixture of well water and creek water is delivered to the mains.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Crow Creek Reservoirs (raw water)	Several wells Raw water (composite)	Finished water (city tap)
Silica (SiO_2)	13	23	14
Iron (Fe)	.02	.09	.03
Manganese (Mn)	.02	.02	.02
Calcium (Ca)	26	39	29
Magnesium (Mg)	4.4	5.8	4.5
Sodium (Na)	4.8	8.2	5.0
Potassium (K)	1.9	2.0	1.9
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	100	155	105
Sulfate (SO_4)	6.0	6.0	7.0
Chloride (Cl)	2.5	3.0	5.5
Fluoride (F)	1.0	.5	1.0
Nitrate (NO_3)	.7	5.7	1.2
Dissolved solids	122	174	134
Hardness as $CaCO_3$:			
Total	83	121	91
Noncarbonate	1	0	5
Color	6	2	4
pH	7.6	8.1	7.8
Specific conductance (micromhos at 25 C.)	189	268	207
Turbidity	3	.9	2
Temperature (F.)	44	53	56
Date of collection	10/22/51	10/22/51	10/22/51

LARAMIE
(Population, 15,581)

Ownership: Municipal.
Source: Soldier Springs, 24 percent of supply; City Springs, 30 percent of supply; Pope wells (1 to 3) 156, 162, and 158 ft deep (well 1 is not in use), 14 percent of supply; Sodergreen Lake 32 percent of supply (industrial and commercial use only). Sodergreen Lake, normally a nonpotable water, is also used for emergency purposes.
Treatment: Chlorination of City Springs, Soldier Springs, and Pope wells. (Fluoridation unit to be installed.) Sodergreen Lake is not treated.
Finished-water storage: 2 concrete reservoirs 5,000,000 and 2,000,000 gal.

The flow of City Springs is gathered by gravity system of tiles and sumps and enters reservoir about 1 mile east of town. The city main from the reservoir is interconnected with 16-in. line from Soldier Springs and 12-in. line from Pope wells. When city consumption is less than rate of flow from Soldier Springs and Pope wells, water backs into city reservoir. Pope wells are used in summer months only.
Water from Sodergreen Lake is used by Union Pacific Railroad, University of Wyoming (irrig. and hydraulics), and city cemetery.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Pope well 3 (raw water)	City Springs (raw water)	Finished water (composite) 1/
Silica (SiO_2)	9.0	8.8	11
Iron (Fe)	.04	.04	.02
Manganese (Mn)	.00	.00	.00
Calcium (Ca)	56	53	51
Magnesium (Mg)	12	16	16
Sodium (Na)	1.8	1.3	1.3
Potassium (K)	1.2	1.0	.6
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	224	234	227
Sulfate (SO_4)	1.0	3.0	3.0
Chloride (Cl)	3.0	3.0	3.0
Fluoride (F)	.1	.1	.1
Nitrate (NO_3)	5.9	5.6	5.5
Dissolved solids	201	207	205
Hardness as $CaCO_3$:			
Total	190	200	192
Noncarbonate	6	8	6
Color	2	2	2
pH	7.8	8.1	8.1
Specific conductance (micromhos at 25 C.)	361	370	362
Turbidity	1	.9	.8
Temperature (F.)	46	46	49
Date of collection	10/21/51	10/22/51	10/22/51

1/ City Springs and Soldier Springs.

	Pope well 3 (raw water)	City Springs (raw water)	Finished water (composite) 1/
Depth (feet)	158		
Diameter (inches)	15		
Date drilled	1939		
Percent of supply	--		

1/City Springs and Soldier Springs.

RAWLINS
(Population, 7,415)

Ownership: Municipal.

Source: 19 springs approximately 32 miles south of Rawlins for regular supply. Cross connection with the Union Pacific Railroad supply, State Penitentiary wells, and 1 municipal well 680 ft deep for emergency or auxiliary supply. The water is conducted (7 miles of gathering line) in wooden-stave pipe, 16-inch diameter, for a distance of 32 miles--thence to storage. Springs have concrete boxes constructed for receiving.

Treatment: None.

Storage: 4 ground, steel-covered tanks, 7,750,000, 7,750,000, 2,000,000, and 500,000 gal. Total storage 18,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	32	Hardness as $CaCO_3$:	
Iron (Fe)	.27	Total	148
Manganese (Mn)	.01	Noncarbonate	1
Calcium (Ca)	53		
Magnesium (Mg)	3.8	Color	2
Sodium (Na)	14	pH	7.8
Potassium (K)	2.7	Specific conductance (micromhos at 25 C.)	345
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	179	Temperature (F.)	52
Sulfate (SO_4)	33	Date of collection	10/23/51
Chloride (Cl)	2.0		
Fluoride (F)	.1		
Nitrate (NO_3)	1.2		
Dissolved solids	237		

RIVERTON
(Population, 4,142)

Ownership: Municipal.
Source: 10 wells 385 to 662 ft deep with diameters from 6 to 10 in.
Treatment: None.
Storage: Steel elevated tanks, 200,000 gal.

All wells are connected to a collecting line to storage and to the city mains, although all the wells are not pumped as a unit. It is reported that the North Park (1 well) and South Park (2 wells) wells, the shallowest of all the wells, yield water that is considerably more mineralized and harder than the water from the deeper wells, and hence these wells are considered primarily as standby wells. Normally the supply is obtained by pumping alternately several of the deeper wells at one time.

The analyses given represent reasonably well the water as served to the consumers.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Fenton Well	Burch Well		Fenton Well	Burch Well
Silica (SiO_2)	11	13	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.03	Total	7	17
Manganese (Mn)	.02	--	Noncarbonate	0	0
Calcium (Ca)	2.9	6.5			
Magnesium (Mg)	.1	.3	Color	1	--
Sodium (Na)	160	142	pH	8.7	8.6
Potassium (K)	.5	.4	Specific conductance (micromhos at 25 C.)	725	664
Carbonate (CO_3)	9	7			
Bicarbonate (HCO_3)	192	191			
Sulfate (SO_4)	161	125	Turbidity	1	--
Chloride (Cl)	13	9.9	Temperature (F.)	56	55
Fluoride (F)	.4	.4	Date of collection	10/27/51	10/22/48
Nitrate (NO_3)	.6	.8			
Dissolved solids	472	394			

Depth (feet)	609	600
Diameter (inches)	10	8
Date drilled	1947	1947
Percent of supply	--	--

ROCK SPRINGS
(Population, 10,857)

Ownership: Southern Wyoming Utilities Co. (controlled by Union Pacific Rail-Road Co.). Supplies also the city of Green River (population, 3,187). Total population supplied, 14,044.
Source: Green River.
Treatment: Coagulation with alum and lime, rapid sand filtration, and chlorination. Activated carbon used during periods of high turbidity.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 8,250,000 gal at Rock Springs.

The treatment plant and intake are on the river at Green River.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Tap water		Tap water
Silica (SiO_2)	7.7	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	250
Manganese (Mn)	.00	Noncarbonate	102
Calcium (Ca)	61		
Magnesium (Mg)	24	Color	5
Sodium (Na)	54	pH	7.7
Potassium (K)	4.0	Specific conductance (micromhos at 25 C.)	686
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	182	Temperature (F.)	44
Sulfate (SO_4)	206	Date of collection	3/13/51
Chloride (Cl)	7.5		
Fluoride (F)	.1		
Nitrate (NO_3)	.6		
Dissolved solids	474		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	120	170	100	8.2	8.4	7.2	200	290	120	500	5000	30
Finished water	110	160	90	7.4	8.0	7.0	205	300	125	0	30	0

SHERIDAN
(Population, 11,500)

Ownership: Municipal; also supplies about 2,000 people outside the city limits. Total population supplied, about 13,500.
Source: Headwaters of Goose Creek impounded in Twin Lakes Reservoir in the Bighorn Mountains 17 miles from the city.
Treatment: Plain sedimentation (12 hr detention), chlorination, and fluoridation.
Rated capacity of treatment Plant; 800,000 gpd.
Raw-water storage: Reservoir, 490,000,000 gal; settling basins 3,000,000 gal.
Finished-water storage: 5,800,000 gal.

The treatment plant is located several miles downstream from Twin Lakes Reservoir. Water from the treatment plant is piped through 16-in. pipe to storage in the city.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.3	10	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.04	Total	27	26
Manganese (Mn)	.05	.03	Noncarbonate	0	0
Calcium (Ca)	7.0	6.7			
Magnesium (Mg)	2.3	2.3	Color	5	5
Sodium (Na)	2.9	3.2	pH	7.1	7.2
Potassium (K)	.6	.4	Specific conductance (micromhos at 25 C.)	78.6	67.9
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	36	34			
Sulfate (SO_4)	2.0	1.0	Turbidity	3	2
Chloride (Cl)	1.5	1.5	Temperature (F.)	35	--
Fluoride (F)	.1	.8	Date of collection	11/7/51	11/7/51
Nitrate (NO_3)	.7	.3			
Dissolved solids	57	54			

WORLAND
(Population, 4,202)

Ownership: Municipal; also supplies 51 people outside the city limits. Total population supplied, 4,253.
Source: Two tile collection fields along the bank of the Big Horn River, 50 percent of the supply; Bighorn River 50 percent of the supply. The tile system collects irrigation return waters which are then mixed with the river water in the sedimentation basin.
Treatment: Coagulation with alum, sedimentation, filtration, and chlorination.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 780,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Bighorn River (raw water)	South tile field (raw water)	Finished water (composite)
Silica (SiO_2)	10	25	14
Iron (Fe)	.02	.10	.03
Manganese (Mn)	.05	.12	.11
Calcium (Ca)	114	143	145
Magnesium (Mg)	40	47	52
Sodium (Na)	136	167	188
Potassium (K)	11	6.1	8.5
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	245	411	351
Sulfate (SO_4)	465	505	605
Chloride (Cl)	44	36	52
Fluoride (F)	.6	.7	.6
Nitrate (NO_3)	5.2	16	5.4
Dissolved solids	986	1,150	1,240
Hardness as $CaCO_3$:			
Total	448	552	575
Noncarbonate	247	215	288
Color	4	5	5
pH	7.8	8.1	7.7
Specific conductance (micromhos at 25 C.)	1,360	1,630	1,750
Turbidity	5	2	2
Temperature (F.)	--	57	64
Date of collection	11/5/51	11/5/51	11/5/51