The Industrial Utility of Public Water Supplies in the United States, 1952

Part 2. States West of the Mississippi River

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ERRATA SHEET -- WATER-SUPPLY PAPER 1300

Titles for figures 1 (p. 15), 2 (p. 30), and 3 (p. 33) were omitted and should read as follows:

Figure 1.--Number of persons using water in four ranges of hardness from large public supplies in the United States, 1952.

Figure 2.--Percent of population using water of different treatment from public supplies for 1,315 of the larger cities in the United States, 1952.

Figure 3.--Physical plant facilities for public water supplies for the larger cities in the United States, 1952.

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ABSTRACT

Public water supplies are utilized extensively by industries for processing, cooling, and steam generation. The requirements as to quality of water for each industry are specific, therefore information on the quality or chemical character of the water supply is essential not only in the location of industrial plants but also is an aid in the manufacture and distribution of products.

Data are given in this report on the water supplies for 1,315 of the larger cities (or places) throughout the United States. The population of these cities represents 58.3 percent of the total population (1950 census), and more than 90 percent of the total urban population, of the United States. Part 1 of the report contains data for 819 cities east of the Mississippi River, and part 2 includes data for 416 cities west of the river. All cities of 15,000 or more population and many cities of smaller population are included.

The information given for each place includes, in most instances, population of the place; ownership, source, and treatment of supply; storage facilities for both raw and finished water; and chemical analyses of the supplies.

The chemical quality of a water affects its industrial utility. A total of 2,506 chemical analyses of the supplies for the places included are shown. Surface-water supplies, generally, are more variable in composition than ground-water supplies, but contain less mineral matter in solution. Many of the treated public supplies require further treatment to make them satisfactory for some industrial uses. Of the total of 1,315 places included in the report, 711 receive surface-water supplies; 472 receive ground-water supplies, and 132 receive mixed supplies. The population served by these supplies is about 88,000,000, of which about 71,000,000 receive surface-water supplies and 17,000,000 ground-water supplies.

Hardness of water supplies with respect to industrial use is given much attention. The hardness of the large public supplies ranges from less than 5 parts per million to about 700 parts. About 52,000,000 people are furnished with water having hardness of 100 parts per million or less.

The weighted average hardness (average hardness of supplies weighted according to the population served) of finished water of surface supplies is 82 parts per million; of ground supplies, 162 parts; and of all supplies, 97 parts. The weighted average hardnesses of raw water of surface, ground, and all supplies are 96, 200, and 116 parts per million, respectively.

The average hardness (based on the average hardness of each supply and the number of supplies) of finished water of surface supplies is 85 parts per million; of ground supplies, 164 parts; and of all supplies, 121 parts. The average hardnesses of the raw water supplies are 94, 192 and 139 parts per million, respectively.

The median hardness of finished water of all supplies is 91 parts per million, and of the raw water supplies, 90 parts.

The treatment of a public water supply is planned principally to give a water that is bacterially safe for public use, and to eliminate or minimize certain undesirable characteristics of the water. Of the supplies for the places in this report, a total of 117 (3 surface supplies and 114 ground supplies) receive no treatment; 393 supplies receive no treatment other than chlorination; and the remainder receive treatment in addition to chlorination. The supplies for 171 cities are softened. Rapid sand filter plants are in use for 533 cities, exclusive of those in use at places where the water is softened. Slow sand-filter plants are in use at 35 places. A population of about 40,000,000 is served with water from these filter plants.

The total number of treatment plants, exclusive of facilities for chlorination, for most of the places in this report is 660. The total capacity of these plants in millions of gallons per day is 10,694.

A total of 693 places report raw-water storage facilities having a total capacity of 2,460,346 millions of gallons; a total of 1,081 places report finished-water storage facilities having a total capacity of 24,557 millions of gallons.

Investigations by others have shown that a definite relationship exists between fluoride in drinking water and the incidence of dental caries in the teeth of children. A total of about 85 percent of the population served from the large public supplies receive water having a fluoride concentration in the range of 0.0 to 0.5 part per million. Few large public supplies contain fluoride in concentrations in excess of 3 parts per million. A total of 155 places of those included in the report received fluoridated water in 1952.

INTRODUCTION

The most valuable of all our natural resources, except for the land itself, is water. Generally taken for granted and considered practically inexhaustible during the 19th century, water is today one of the most actively managed of all our natural resources. Large sums of money are spent each year for surveys, reclamation, conservation, power development, and flood control.

Water is different from most minerals in that it is fluid and active. Moreover, its chemical character is ever changing, not only because of natural processes in its trip from clouds to seas but also because of the myriad activities of man. Water supply is a complex problem, and it is of extreme importance to communities, agriculture, industries, and commerce. Without water these things could not exist; nor could life itself.

An adequate water supply of either ground water or surface water, or both, is often a prime requisite in the selection of sites for industrial plants. It is estimated that American industry in 1950 used 75 billion gallons of water per day from private sources and about 6 billion gallons per day from public water supplies. Furthermore, industries require a process water of specific characteristics or standards of quality. For example, process water used in the manufacture of textiles must be practically free of suspended matter, iron, and color and must be very low in dissolved minerals, especially calcium and magnesium. Specific requirements of quality for process water in certain industries are so exacting that extensive treatment for many natural waters is usually necessary to make them suitable for use. Therefore, an important factor in the selection of sites for industries, in addition to an adequate supply of water, is the specific quality of the supply.

Information as to the chemical character of the water is essential not only in the location of many industrial plants but also to the distribution of the products manufactured. The manufacturer of water-softening equipment would not expect to find a ready market for his product in an area where the water supplies are soft. The need for materials and appliances for control of corrosion in water pipes, and the selection of boiler-plant and water-softening equipment will be influenced by the chemical character of the water.

Many of the water-supply papers of the U. S. Geological Survey and reports made in cooperation with State agencies contain considerable information relating to the chemical quality of water in the United States. See page 46 for the partial list. Among these are the annual "quality of surface water" reports beginning in October 1941, which give the results of comprehensive investigations in different areas of the country for the year named. Other reports give the results of comprehensive investigations within a State, among which are those dealing with the public water supplies; still others give information on the geology and the occurrence and availability of ground-water supplies with brief discussions of the chemical character of the water encountered in the area of investigation.

Reports showing the chemical character of the public water supplies of the larger cities of the United States were published in 1923 and 1934. The last published report, Geological Survey Water-Supply Paper 658, contains data for 670 of the larger cities, representing 46 percent of the total population of the United States. It has filled an important need in the field of water-supply engineering. The insistent demand for more current information and a more extended coverage has led to the present report. Descriptive and analytical data for about 75 percent of all the places that are included in the two volumes of this report have been published in a recent series of nine Geological Survey circulars, each circular covering a prescribed section of the country. The present report gives data for 1,315 places, representing 58.3 percent of the total population of the United States. It includes data for all places of 15,000 or more population, 80 percent or more of the total urban population of each State, and at least 10 places for each State except Delaware. Many places of less than 15,000 population are included in order that either 80 percent of the total urban population of the State or 10 places for each State might be represented. It was felt that the use of the above criteria for the

selection of the places to be included in the report would give adequate representation for each State.

Part 1 of the report includes data for 819 places in the 26 States and the District of Columbia east of the Mississippi River; part 2, for 496 places in the 22 States west of the Mississippi. The text material and illustrations and the form of the tables are identical in both parts of the report and apply to the country as a whole. The statements made in regard to the supplies as a whole and to other subjects are generally applicable in each part of the report.

An important part of this report is the descriptive and analytical data pertaining to the water supplies of the individual places. Although not as complete and representative as desired in some instances, these data are intended to show conditions as they existed at the time of collection. From the data as presented inferences and conclusions can be drawn as to the general character of the water and its general usability for many industrial purposes. In the use of the data, it must be borne in mind that many supplies from surface sources are quite variable in composition; that ground-water supplies are more uniform in composition than surface supplies; and that most of the analytical data relate to the treated or finished water as served to the consumers, although much information is given as to the character of the raw-water supplies.

The general discussion of hardness and the illustrations and tables with reference to the distribution and use of water of different hardness are of considerable value or importance in the report, since hardness is a characteristic of water that affects both the domestic and industrial use of water. Caution is necessary in the use of generalized data relative to the hardness of public water supplies, when location of industrial plants or industrial activities require more specific data as to the chemical character of the water supplies.

Fluoride occurring naturally in water supplies and the fluoridation of public water supplies, because of the effects of fluoride on the incidence of dental caries in the teeth of growing children and not because of the effects on the industrial use of the water, are discussed at some length.

Discussions of the various aspects of water supply and treatment are necessarily brief in this report. Fuller and detailed discussions are to be found in papers and books on the subjects.

ACKNOWLEDGMENTS

State departments of health, city and waterworks officials, private water companies, and commercial laboratories furnished many analyses, water-supply and water-plant data on forms prepared by the Quality of Water Branch for the purpose, and collected samples of water for analysis. (See table 1.) For these data and assistance grateful acknowledgment is made.

Many of the personnel of the Surface Water Branch and the Ground Water Branch, Water Resources Division, assisted in obtaining data in certain areas pertaining to the supplies and collecting samples for analysis. Grateful acknowledgment is made for this cooperation and assistance.

DIVISION OF WORK

This report is the result of the efforts of many of the personnel of the Quality of Water Branch of the Geological Survey under the general supervision of S. K. Love, chief, Quality of Water Branch. The efforts of the various members of the branch who participated in the work were coordinated by E. W. Lohr, chemist, who also reviewed and compiled all data submitted by the district offices of the branch, wrote the body of the text, and was mainly responsible for the tables and illustrations.

The analyses made by the Geological Survey for inclusion in the report were made in the district laboratories by the Quality of Water Branch in different sections of the country under the immediate supervision of the district chemists at

the time. The district offices also collected other data pertaining to the supplies in the States comprising their districts. The States comprising the different districts, the location of the district offices, and the personnel in charge at the time the work was in progress, are named below.

State	District or Regional Office
Alabama Arkansas Mississippi Missouri (part) Tennessee	I. S. T. Building, University of Arkansas, Fayetteville, Ark. G. A. Billingsley J. W. Geurin
California	2520 Marconi Avenue, Sacramento 21, Calif. I. W. Walling
Connecticut District of Columbia Florida Maine Maryland Massachusetts New Hampshire New Jersey New York Rhode Island Vermont	General Services Administration Bldg., Washington 25, D. C. S. K. Love W. F. White E. W. Lohr
Colorado (part) Iowa Kansas Minnesota Missouri (part) Montana (part) Nebraska North Dakota South Dakota Wyoming (part)	510 Rudge Guenzel Bldg. Lincoln 8, Nebr. P. C. Benedict H. A. Swenson
Arizona Colorado (part) New Mexico	P. O. Box 293, University Station, Albuquerque, N. Mex. J. D. Hem
Georgia North Carolina South Carolina	P. O. Box 5668, Raleigh, N. C. F. H. Pauszek
Illinois Indiana Kentucky Michigan Ohio West Virginia Wisconsin	2822 East Main Street, Columbus, Ohio W. L. Lamar P. N. Brown
Kansas (part) Oklahoma	P. O. Box 4355, Oklahoma City, Okla. T. B. Dover

State	District or Regional Office
Delaware Pennsylvania	1302 Custom House, Philadelphia, Pa. N. H. Beamer E. F. McCarren
Louisiana Texas	302 West 15th St., Austin, Tex. B. Irelan J. R. Avrett
Colorado (part) Idaho Montana (part) Nevada Oregon Utah Washington Wyoming (part)	P. O. Box 2657, Fort Douglas, Salt Lake City, Utah C. S. Howard R. T. Kiser
Virginia	P. O. Box 1488, University Station, Charlottesville, Va. J. G. Connor

ANALYSES OF WATER FROM PUBLIC SUPPLIES

SOURCES OF ANALYSES

Most of the analyses in this report were made during its preparation in the laboratories associated with the District offices of the Quality of Water Branch of the Geological Survey. Analyses from other sources were freely used as indicated in table 1. The lack of space prohibits giving the names of the individual analysts, although the names of the laboratories making or furnishing the analyses are given in the tables of analyses for the individual places.

Table 1.--Distribution of sources of analyses used

Source	Number of analyses	Number of places
U. S. Geological Survey laboratories:		
This report	1,781	1,008
Other reports	185	56
State laboratories	268	107
Waterworks laboratories	155	109
Commercial laboratories	117	35
Totals	2,506	1,315

Many analyses and other data not printed in this report were available. These analyses and data were valuable aids in the selection of the analyses and data which are printed.

COLLECTION OF SAMPLES

Many samples for analysis were collected by the personnel of the Quality of Water Branch and other members of the Water Resources Division of the Geological Survey. Other samples were collected in containers furnished by the Geolog-

ical Survey by waterworks, city, and health-department officials. At many places samples were collected of both raw- and finished-water supplies especially at those places where the treatment of the raw water was extensive or where the water was softened. Many samples of finished water were collected at the treatment plants of the individual cities; other samples were collected from city taps of the distribution systems. The samples collected are considered to be representative of the supplies at the time of collection.

APPLICABILITY OF ANALYSES

The analyses made by the Geological Survey used in this report were made by methods developed by the Quality of Water Branch or adapted from methods in general use for the mineral analysis of water. (Am. Pub. Health Assoc., 1946; Am. Soc. for Testing Materials, 1947). The analyses made by other laboratories were carefully examined for possible errors in order that the information given might be reliable. The reporting of these analyses has been made to conform to the Geological Survey method of reporting the results of water analysis and any difference in the analyses as published and originally submitted is because of this. Many waterworks laboratories make daily determinations of alkalinity, pH, and hardness which give some indications as to the extremes in chemical composition of the supplies. These data are given in the tables of analyses whenever they were available. Every effort has been made to give reliable information as to the chemical character of the water supplies at the time the analyses were made and throughout the year.

Single analyses of supplies from lakes and large reservoirs represent fairly well the chemical character of the water throughout the year, but for many supplies taken directly from streams or from small impounding reservoirs a single analysis will not represent the character of the water for the year. It may so happen that the single analysis will represent about the average character of the water for the year. Many streams are very variable in character not only with the seasons but with rapid changes in stage. Obviously a single analysis of such streams will not show the extremes in chemical composition of the water, and many analyses of daily samples or frequent samples are necessary to show the composition of the water throughout the year.

Some waterworks laboratories make complete analyses of composites of daily samples. Where available, averages of these analyses are given in the table of analyses. Averages of analyses of 10-day composites of daily samples for a period of a year are shown for a number of supplies. Analyses of composites of daily samples with the maximum and minimum content of dissolved solids are shown in a few instances. The single analyses and other analyses taken together with the analytical data furnished by the waterworks laboratories give reliable information as to the chemical character of many surface-water and treated-water supplies.

For many places that have several sources of supply, analyses are usually given representative of the several sources or of the combined sources. It is obvious that if different sections of a city are served by different sources, an analysis of a sample collected in one section of the city may not represent the character of the water served in the other section or the entire city. Statements in the descriptive data for the supplies of these places are made to show the percent of supply from each source. In many instances it was not possible to give analyses of each of the sources of supply.

Ground water, in general, is much more uniform in composition than surface water. A single analysis may suffice to show the general character of the water throughout the year not only for a single source but also for multiple sources furnishing water of similar composition. However, many places obtain public supplies from several wells or groups of wells in several well fields that differ considerably in chemical composition. Sometimes water from these various sources is pumped directly into the distribution system in different sections of the city. Sometimes groups of wells or individual wells are pumped at different times. For most such supplies analyses are selected to show the character of the water of the entire supply, or the several sources of supply, or the range or differences in

composition of the water from the individual wells or several groups of wells. It is obviously necessary to consider the descriptions of the sources of supply, the percent of supply obtained from each source, and the analyses of the supplies in order to evaluate or plan in connection with the use of the data of such groundwater supplies.

EXPRESSION OF RESULTS

The dissolved mineral constituents are reported in parts per million. A part per million is a unit of weight of a constituent in a million unit weights of water. Equivalents per million, though not given in this report, are sometimes preferred to the expression of results in parts per million. An equivalent per million is a unit chemical combining weight of a constituent in a million unit weights of water. Equivalents per million for any constituent are obtained by dividing the concentration of the constituent in parts per million by the chemical combining weight of the constituent. For convenience in making this conversion the reciprocals of chemical combining weights of the most commonly reported constituents are given in the following table:

Constituent	Factor	Constituent	Factor
Iron (Fe^{+++})	0.0537	Carbonate (CO_3^{--})	0.3333
Manganese (Mn^{++})	.0364	Bicarbonate (HCO_3^-)	.0164
Calcium (Ca^{++})	.0499	Sulfate (SO_4^{--})	.0208
Magnesium (Mg^{++})	.0822	Chloride (Cl^-)	.0282
Sodium (Na^+)	.0435	Fluoride (F^-)	.0526
Potassium (K^+)	.0256	Nitrate (NO_3^-)	.0161

Results in parts per million can be converted to grains per United States gallon by dividing by 17.12

A calculated quantity of sodium and potassium as sodium, given in some analyses, is the quantity of sodium needed in addition to the calcium and magnesium to balance the anions.

Total hardness as used in this report means, in most instances, the hardness expressed as calcium carbonate caused by calcium and magnesium in the water; it is obtained by calculation from the results of determination of these two constituents by either gravimetric or volumetric methods. In a few instances, other substances such as aluminum, iron, manganese, strontium, and free acid, which also cause hardness, have been included in the calculations. Many determinations of hardness made at waterworks treatment plants are made with soap solutions, and such results for total hardness tend to be lower generally and less accurate than those obtained by calculation. The volumetric test for hardness using ethylenediamine tetraacetic acid is much more reliable and is rapidly replacing the soap test (Connors, 1950). Hardness is further discussed on pages 12, 13-28.

Color is expressed in units of the platinum cobalt scale proposed by Hazen (1892, p. 427-428).

Hydrogen-ion concentration is expressed on the pH scale.

Specific-conductance values are expressed as micromhos per centimeter at 25°C. In many reports conductance is designated by the letter "K", and values expressed as above may be written $K \times 10^6$ at 25°C. A micromho is a millionth of a reciprocal ohm.

Turbidity is expressed as units of turbidity on the silica scale (U. S. Geological Survey, 1902).

Alkalinity as reported in the tables of determinations made at treatment plants is expressed as calcium carbonate. Acidity, in some instances, is shown in these tables as a minus alkalinity.

COMPOSITION OF NATURAL WATERS

All natural waters contain dissolved mineral matter. Water in contact with soils and rocks even for only a few hours will dissolve some mineral matter. The quantity of mineral matter dissolved by a natural water depends primarily on the type of rocks and soils with which the water comes in contact and the length of the contact. Some streams are fed by both surface runoff and ground water from springs and seeps. Such streams reflect the chemical character of the more concentrated ground water during dry periods and are more dilute during periods of heavy surface runoff. Ground water usually contains more dissolved mineral matter than surface runoff for it remains in contact with soils and rocks for longer periods of time. The concentration of dissolved solids in a river water may be increased by drainage from mines and oil fields, by discharge of industrial and municipal wastes into the streams, and in irrigated areas by return drain waters.

The mineral constituents and physical properties of the raw and treated supplies in the tables of analyses are those that affect the value of the water for most purposes. The analyses generally include results for silica, iron, manganese, calcium, magnesium, sodium, potassium (or sodium and potassium together as sodium), carbonate, bicarbonate, sulfate, chloride, fluoride, nitrate, dissolved solids, and hardness. Results for color, pH, specific conductance, turbidity, and temperature are reported in many others. The source and significance of the constituents and properties of water supplies are discussed in the following paragraphs.

MINERAL CONSTITUENTS IN SOLUTION

Silica (SiO_2). --The element silicon is not found free in nature but it occurs as silica in sand, in quartz, and as silicates in feldspar, kaolinite, and other minerals. Silica is dissolved from practically all rocks. Its state in solution in natural water is not definitely known, but it is assumed to be colloidal, and it does not enter into the ionic balance between the acids and bases of a water analysis.

Many natural surface waters, especially lakes, contain less than 5 parts per million and few contain more than 30 parts per million. Well waters generally contain more silica than surface waters, but comparatively few contain more than 50 parts per million.

Silica affects the industrial use of water because it contributes to the formation of boiler scale, or it may help to cement other scale-forming substances into a hard scale; it is usually removed from feed water for high-pressure boilers. Silica also forms troublesome deposits on the blades of steam turbines.

The silica in the treated water of a public supply is usually less than in the raw water if in the treatment process coagulation and filtration are employed. The use of activated silica as a coagulant, either alone or in conjunction with alum, will not increase the silica content of the treated water.

Aluminum (Al). --Although aluminum is relatively abundant in many rocks and ores some of which are readily soluble, aluminum is present only in negligible quantities in most natural waters for it precipitates from the waters. Acid waters and water that has been in contact with certain types of rocks or ores may contain considerable quantities of aluminum. Aluminum contributes to hardness in water and may be deposited as scale in boilers. It is not reported in the tables of analyses. In a few samples the aluminum content is indicated by footnotes.

Iron (Fe). --Iron is dissolved from practically all rocks, and practically all natural water supplies contain iron in solution. Surface waters, unless acid, rarely contain more than several tenths of a part per million. Acid waters may carry relatively large quantities. Iron in water upon being exposed to air is readily oxidized to ferric hydroxide which will readily settle out of a surface supply unless acid; therefore surface waters generally carry relatively small quantities of iron.

Many ground waters may carry several parts per million of iron. Such waters on exposure to air become turbid with ferric hydroxide as a result of the oxidation

of the iron. The ferric iron will settle out and the water will eventually clear up if it is quiescent. Iron in solution will cause reddish-brown stains on white enamelware, porcelain fixtures, and fabrics washed in these ground waters, which are objectionable also for other domestic and industrial uses.

Many natural waters may be corrosive to the supply system, dissolving sufficient quantities of iron from the pipes to be objectionable in the use of the water for many purposes. Much of the iron in natural waters is removed by the treatment as practiced at the modern water-purification plants, but sometimes such treatment will leave the waters corrosive so that they will dissolve objectionable quantities of iron from pipes in the supply system or household installations.

Manganese (Mn). --Manganese is found in many natural waters, sometimes in appreciable quantities. Water impounded in large reservoirs may contain manganese that has been dissolved from the mud on the bottom of the reservoir. Some ground waters may contain very objectionable quantities of manganese. Waters that contain appreciable quantities of manganese usually contain also objectionable quantities of iron. Manganese is especially objectionable in water used in laundering and textile manufacturing, for it causes dark-brown stains on the fabrics. It will also stain porcelain fixtures. Water supplies containing objectionable quantities of manganese require special treatment for its removal.

Calcium (Ca) and magnesium (Mg). --Calcium and magnesium are dissolved from many rocks but more particularly from limestone, dolomite, and gypsum. Limestone, which is primarily calcium carbonate, and dolomite and dolomitic limestone made up of both calcium and magnesium carbonates are readily soluble in water containing carbon dioxide. Caves and solutions channels in these rocks are the result of this action of water. Comparatively large quantities of calcium are also dissolved from gypsum (calcium sulfate). Calcium is frequently the principal basic constituent in waters that contain relatively small quantities of dissolved solids and are soft waters. Calcium and magnesium are the most universally characteristic constituents of natural waters.

Calcium and magnesium cause hardness in water and contribute to the formation of boiler scale and deposits in hot-water heaters and pipes and in water systems. The calcium and magnesium content and hardness of waters used for public supplies greatly affect the industrial value of the waters.

Sodium (Na) and potassium (K). --The very active metals sodium and potassium are not found free in nature, but their compounds are relatively abundant in the earth's crust and are highly soluble in water. Sodium and potassium are found in all natural waters. Natural waters that contain only 3 or 4 parts of the two together are likely to contain about equal quantities of each. As the total quantity of these constituents increases the proportion of sodium becomes much greater. Waters carrying from 40 to 50 parts per million of the two may carry one-fourth or one-tenth of the quantity as potassium; waters containing more sodium may even have a smaller proportion of potassium.

Some well waters that carry moderate quantities of dissolved material in passage through the earth may undergo base exchange and change from hard waters to soft waters. These waters may contain several hundred parts per million of sodium bicarbonate. Waters in arid and semiarid regions are likely to carry considerable quantities of sodium salts, usually sulfate and chloride. Streams that receive drainage from irrigated lands may carry several thousands parts per million of sodium sulfate. The quantity of sodium and potassium found in the water of most public supplies has comparatively little effect on the industrial use of the water.

Carbonate (CO_3) and bicarbonate (HCO_3). --Carbonate as such is present in relatively few natural waters. Some waters that have been treated with lime contain carbonate or even hydroxide. Free carbon dioxide in rain water increased by a larger amount from decaying organic matter in percolating water, in lakes, and in streams in contact with carbonate rocks or calcareous material is converted into bicarbonate. Bicarbonate is the chief anion in a great many natural waters and in most of the waters used for public supplies. Waters that have been in contact with granitic rocks and rocks of similar characteristics usually contain less than 50 parts per million of bicarbonate and frequently less than 25 parts, whereas those that have been in contact with carbonate rocks may contain as much as 500 parts.

Carbonate and bicarbonate are often reported as alkalinity which is expressed as calcium carbonate. One part of alkalinity as calcium carbonate corresponds to 1.22 parts of bicarbonate.

Sulfate (SO_4). --Sulfate is present in most natural waters, although in many it may be a relatively small quantity. Sulfate may be dissolved in relatively large quantities from beds of gypsum and shale. Some surface waters receiving acid mine drainage may contain considerable quantities of sulfate some of which may be the result of oxidation of the sulfides of iron. Water in arid or semiarid regions may contain relatively large quantities of sodium sulfate.

Sulfate in waters that contain much calcium and magnesium contributes to the formation of hard scale in steam boilers and affects the use of waters in other industrial processes. Aluminum sulfate as a coagulant in the treatment of public supplies increases the sulfate content and decreases the bicarbonate content of the water.

Chloride (Cl). --Chloride is found in practically all natural waters, although many surface waters contain only a few parts per million. Streams in arid or semiarid regions may contain several hundred parts per million of chloride especially if they drain areas where chlorides occur in natural deposits or have been concentrated in soils through evaporation processes. Sewage increases the chloride content of river waters. Drainage from oil wells or other deep wells, salt springs, and industrial wastes may add large quantities of chloride to stream waters. Most public supplies from surface sources contain less than 25 parts per million of chloride. Ground waters usually contain larger quantities than surface waters and some public-supply wells may contain as much as 100 parts per million. The larger quantities of chloride may affect the industrial use of the water.

Fluoride (F). --Fluoride occurs in nature in fluorspar, cryolite, and in both sedimentary and igneous rocks. In most natural surface waters it is present only in very small concentrations; in ground waters it is present in larger concentrations, in some waters as much as several parts per million. Fluoride in water supplies in relation to the dental defect known as mottled enamel and fluoridation and natural fluorides in relation to the prevention of dental caries is discussed on page 39 . The fluoride content of public water supplies may be of little importance as far as the industrial use of the water is concerned.

Nitrate (NO_3). --Nitrate is considered the final oxidation product of nitrogenous matter and its presence in water supplies of more than several parts per million may indicate previous contamination by sewage or other organic matter. The effect of nitrate present in most public water supplies on the industrial use of the water is practically negligible. Studies indicate that nitrate in excess of about 44 parts per million in drinking water may be a contributing factor or the cause of a condition in infants known as methemoglobinemia ("blue babies"). (Waring, 1949).

Dissolved solids. --The results reported as dissolved solids represent approximately the total quantity of dissolved mineral matter in each water analyzed. (Howard, 1933, p. 4-6). The quantity of dissolved solids in most instances was determined by evaporating a given volume of water, drying the residue at some definite temperature (180°C, by U. S. Geol. Survey), and weighing the dried residue. In some instances the quantity reported was obtained by a summation of the individual constituents shown in the analysis, bicarbonate being included as carbonate. This summation of constituents for dissolved solids is indicated by a footnote in the tables of analyses. Relatively few supplies of places in this report contain more than 500 parts per million of dissolved solids and many of them have less than 100 parts. Ground-water supplies usually contain more dissolved material than surface water supplies. Part of the material reported as dissolved solids in colored waters is organic matter, which is not shown in the analyses.

PROPERTIES AND CHARACTERISTICS OF WATER

Color. --Color, in water analysis, refers to the appearance of water that is free of suspended material. Many turbid waters that appear yellow, red, or brown have little color after the suspended material is removed. Color in natural waters is almost entirely the result of extraction of coloring matter from decaying roots,

stems, leaves, and other organic materials in the water and in the ground. Swamp waters may have as much as 200 or 300 units of color. Industrial wastes may add color to water. Color in most public supplies is rather negligible. A color of less than 10 units usually passes unnoticed. Some impounded supplies if not filtered may have appreciable color. Color is objectionable in the use of the water for some industrial purposes.

Hydrogen-ion concentration. --Hydrogen-ion concentration in an aqueous solution or in water on the pH scale is represented by a number which is the negative logarithm of the hydrogen-ion concentration in moles per liter of solution. The pH range is from 0 to 14. A solution with a pH of 7 is said to be neutral. Progressive values of pH below 7 denote increasing acidity, and progressive values above 7 denote increasing alkalinity. The pH values are logarithmic, for example, a water with a pH of 6 has 10 times the concentration of hydrogen ions as one with a pH of 7.

There is a definite relationship between pH and acidity although acidity should not be confused with pH, for a water with a pH value of 6.0 may have a low total acidity whereas another highly buffered water having a pH of 7 may have a high total acidity. Acidity is the results of the effects of a combination of substances and conditions in water, and may be defined as the power of the water to neutralize hydroxyl ions. Acidity is usually caused by the presence of free carbon dioxide, mineral acids, and salts of strong acids and weak bases.

A definite relationship also exists in waters between pH and alkalinity (carbonate, bicarbonate, and hydroxide). (Langelier, 1946.) Alkalinity in a water may be defined as its power to neutralize hydrogen ions. Alkalinity is caused by the presence of carbonates, bicarbonates, hydroxides and, to a lesser degree, by silicates, phosphates, borates, and organic substances. Although pH values and alkalinity are interrelated, high alkalinity may not be necessarily associated with high pH values; for example, a relative dilute water with a pH of 7 may have a low total alkalinity, whereas, a buffered water with a pH of 6.0 may have a high total alkalinity. The combined effects of the several substances and conditions in the water affect the relationship between alkalinity and pH values.

The pH value of most natural water ranges between 6 and 8. Waters containing free mineral acids have pH values below 4.5. Some ground waters have pH values above 8, some below 6. On account of the relation between the pH of water and its corrosive properties, many water-treatment plants make final adjustment of the pH of the supplies to prevent or minimize corrosion in the distribution system and household installations. The pH values of public supplies have a very considerable and definite bearing on the utility of the supplies for many industrial purposes.

Specific conductance ($K \times 10^6$ at 25°C). --The specific conductance of a water is a measure of its capacity to conduct an electric current. The conductance varies with the concentration and degree of ionization of the different minerals in solution and with the temperature of the water. It furnishes a rough measure of the mineral content of the water but does not give any indication of the relative quantities of the constituents in solution. It is useful in following the changes in the total quantity of dissolved minerals in a water through a series of samples.

Turbidity. --Turbidity of water is due to suspended matter such as clay, silt, finely divided organic matter, microscopic organisms, and any such similar material. The terms "turbidity" and "suspended matter" are not synonymous or equivalent expressions. Turbidity is an expression of an optical approximation of the suspended matter, based on the similarity of the interference of the suspended matter to the passage of light rays through a water sample when compared with standard samples of recorded turbidity. The standard unit of turbidity is considered as that produced by one part per million of diatomaceous earth or fuller's earth (silica) in distilled water.

Practically all public supplies that are filtered are free from noticeable turbidity or suspended matter. A few unfiltered supplies and those that contain enough iron to give an appreciable precipitate on exposure to air may show noticeable turbidities. Suspended matter in surface-water supplies is usually a much more variable quantity than dissolved solids and must be taken into consideration in any utilization of the unfiltered supplies.

Temperature.--The results for temperature in the tables of analyses are shown in degrees Fahrenheit and represent the temperature of samples at the time of collection. In a few instances results for temperature are shown that were obtained at the treatment plants.

Corrosiveness, causes and prevention.--Corrosiveness of a water is that property which makes the water aggressive to metal surfaces and frequently results in "red water" caused by solution of iron, although all red-water troubles may not be the result of corrosion. As discussed previously, many well waters contain considerable quantities of iron in solution and when these supplies are exposed to the air the iron separates out as a precipitate. Some of this precipitate may be carried along in the mains and pipes in suspension in the water giving red-water effects. Corrosive waters causes the deterioration of water pipes, steam boilers, and water-heating equipment. Many waters that do not appreciably attack cold-water lines may aggressively attack hot-water lines.

The phenomena of corrosion are not thoroughly understood (Speller, 1951). The active agents in water aside from the solvent action of water itself are acids, substances which upon hydrolysis or decomposition produce acid reactions, carbon dioxide, oxygen, and hydrogen sulfide. The problem of prevention of corrosion, therefore, is the problem of controlling these active agents or minimizing their effects. Books and papers have been written on various aspects of the problem. (Proc. A. S. T. M., 1940; Betz and Betz, 1953).

The principal methods used in the treatment of municipal water supplies to prevent corrosion and red-water trouble involve treatment to maintain proper alkalinity, pH values and stability in the treated waters. (Amer. Water Work Assoc., 1950; Baker, 1948). Effluent from filter plants where alum is used in the treatment, many unfiltered supplies, and some naturally soft supplies, contain free carbon dioxide and have low pH values, may aggressively corrode metal surfaces in distribution mains and plumbing installations, producing red-water troubles, pitting, and tuberculation. To increase the alkalinity and to raise the pH values, agents such as lime or soda ash are added to the supplies before they enter the distribution system. Where the supplies are softened, the alkalinity and residual hardness can be controlled so that the effluent may be left in a slightly unstable condition with respect to calcium carbonate, and a light protective coating of calcium carbonate may be deposited in the mains of the distribution system (Langelier, 1936). A stability test may indicate whether a water is corrosive or will form a protective film (Enslow, 1939).

Deaerators and degasifiers for the removal of dissolved gases are used to some extent in the treatment of boiler feed waters and in private installations (Powell and Burns, 1936; Powell, Bacon, and Lill, 1946). Aeration removes to some extent carbon dioxide and hydrogen sulfide, although in the treatment of public water supplies this process is used more for the purpose of removal of iron and of tastes and odors than for corrosion control.

Phosphates, metaphosphates, and silicates, classed as anodic inhibitors, are used to some extent in the treatment of public supplies and in industrial and private installations for prevention of corrosion. The compounds are effective because not only do they neutralize the agents of corrosion but also, it is thought, they form protective films on the metal surfaces. Sodium hexametaphosphate has been found not only to be effective in stopping corrosion but also to promote removal of corrosion products from pipelines (Rice, 1947).

Corrosion inside of steel tanks and standpipes may be prevented by a process known as cathodic protection. Special electrical equipment is required which in operation reverses the electrochemical processes set up in the corrosion of metal, thereby rendering the metal surface passive (Pallo, 1948).

Hardness.--Hardness of water is that characteristic or quality shown by water containing certain substances in solution. Calcium and magnesium are the principal constituents causing hardness. Other substances, such as aluminum, iron, manganese, strontium, zinc, and free acid also cause hardness, but most of these are not present in water supplies in sufficient quantities to affect appreciably the hardness.

The terms "carbonate" and "noncarbonate" hardness are roughly equivalent to or are used in the same sense as the older terms "temporary" and "permanent"

hardness. Carbonate hardness refers to the hardness in equivalence with carbonate and bicarbonate; noncarbonate hardness to the remainder of the hardness. A water has no noncarbonate hardness if the total hardness does not exceed in chemical equivalence the carbonate and bicarbonate (the alkalinity) present in the water. Waters of high noncarbonate hardness usually contain large quantities of calcium and magnesium sulfates, chlorides, or nitrates in solution. The character of scale formed in steam boilers is affected by the relation of carbonate to noncarbonate hardness. The selection of the proper methods for softening is based largely on the type and degree of hardness present in the waters.

Hardness in water in respect to both domestic and industrial use receives great attention. In domestic use hardness is recognized by the difficulty in obtaining a lather without an excessive consumption of soap; the insoluble, sticky curd that results with the use of soap, and the scale formed in vessels in which the water is boiled. Industry gives great attention to hardness in water supplies because of its effects in the various processes of manufacturing and on the manufactured product, and because of the scale deposited in the use of hard water in hot-water pipes, hot-water heaters, and steam boilers, resulting in economic loss through loss of heat transfer, increased fuel consumption, and breakdown of equipment. Large sums of money are expended in softening supplies to make them suitable for both domestic and industrial uses.

HARDNESS OF PUBLIC WATER SUPPLIES

Data relating to the hardness of the water of the larger public supplies of the United States as shown in the descriptive and analytical data for each place are summarized in a number of tables and illustrations. Most of these data relate to the supplies as served to consumers representing water of natural hardness and water of which the hardness has been changed by treatment including softening. The data shown relate to only 58.8 percent of the total population of the United States. The percent of population represented by each of more than half of the States is much less than the total for the whole country. Furthermore, in several of the summaries the average hardness of the State is used which does not show any extremes in the hardness of the supplies within the State. The extremes in the hardness of the supplies in some States are much greater than in others, although the average hardness for those States may not be any higher than for a State where the ranges in the hardness are not so great. Furthermore, it must be borne in mind that the smaller municipalities, which are not represented in the report and consequently are not in the summaries, obtain their supplies for the most part from ground-water sources whose supplies generally are harder than surface waters. Therefore, it is important that the base data of these summaries be kept in mind when making any conclusions or inferences relative to the distribution of water of certain hardness as shown by the hardness of the larger public water supplies of the country.

These summaries of data on hardness are based on the average hardness of a supply for a year. In some instances only meager analytical data were available to show the hardness of the supply for a year. In these instances an average for hardness was selected, based on known factors, such as the sources of the supply whether from a large or a small stream, or from lakes, reservoirs, wells, or springs, the time of year the sample or samples for analysis were collected, and the general knowledge of the hardness of water supplies in the locale of the supply in question. The average hardness used for many places with varying hardness was that furnished by the waterworks laboratories. The average hardness of those places furnished from more than one source where not mixed prior to distribution was based on the hardness of the supplies and the percent furnished from each source. In some instances the total population of a place was divided according to the percent of supply from each source so that the proper tabulation could be made as to population and hardness. For those places furnished with ground water from several sources of supply with different hardness, proper evaluation for an average hardness was based on the percent of supply from each source and the hardness of each supply. For a few places furnished with both ground and surface

water, the population using each had to be estimated in the tabulations where division was necessary.

RANGES IN HARDNESS

Table 2 shows the number of persons, in thousands using water of different ranges of hardness from larger public supplies in the United States. It gives no information as to the distribution of hard water by area or locality. The table is reasonably accurate as to the use of water in different ranges of hardness by the consumers indicated, which represent about 90 percent of the total urban population of the United States.

Table 2. --Number of persons using water in different ranges of hardness from public supplies for 1,315 of the larger cities in the United States, 1952.

	Population (thousands)				
	Surface water	Ground water	Mixed supplies	Total	Accumulative total
1-10	1,344	434	109	1,887	1,887
11-20	5,673	397	219	6,289	8,176
21-30	11,632	471	252	12,355	20,531
31-40	3,680	706	297	4,683	25,214
41-50	2,482	550	353	3,385	28,599
51-60	3,709	910	222	4,841	33,440
61-80	4,794	647	1,097	6,538	39,978
81-100	9,561	1,482	1,067	12,110	52,088
101-120	5,524	1,075	602	7,201	59,289
121-140	12,266	550	2,863	15,679	74,968
141-160	831	1,253	247	2,331	77,299
161-180	355	312	385	1,052	78,351
181-200	358	304	681	1,343	79,694
201-250	977	1,707	125	2,809	82,503
251-300	935	1,142	388	2,465	84,968
301-350	185	706	176	1,067	86,035
351-400	12	848	--	860	86,895
401-450	--	516	--	516	87,411
451-500	10	200	--	210	87,621
501-550	--	26	--	26	87,647
551-600	--	85	4	89	87,736
601-650	--	40	--	40	87,776
651-700	16	34	--	50	87,826

The table is not necessarily accurate as to the use of water in different ranges of hardness by the total population of the United States, because only 58.3 percent of the total population is represented and the supplies are treated supplies, many of which are softened. The significant things to note about the table are the relative proportion of numbers of people using water in the lower ranges from surface-water sources and from ground-water sources and how this proportion changes with respect to the supplies in the upper ranges of hardness. The proportions of users of surface water and ground water for the total population of the country probably are very different from the proportions here shown for the users of the larger public supplies.

The data for hardness summarized in table 2 are further summarized in tables 3 and 4. Table 4 is similar to table 3 with the exception that the mixed supplies shown in table 3 have been separated into surface-water and ground-water supplies according to the percentage of supply from each source and the average hardness of each supply. The number of ranges for hardness in these two tables has been decreased from 23 shown in table 2 to four. It is significant that a large population is served with water in the range of hardness from 1 to 60 parts per million,

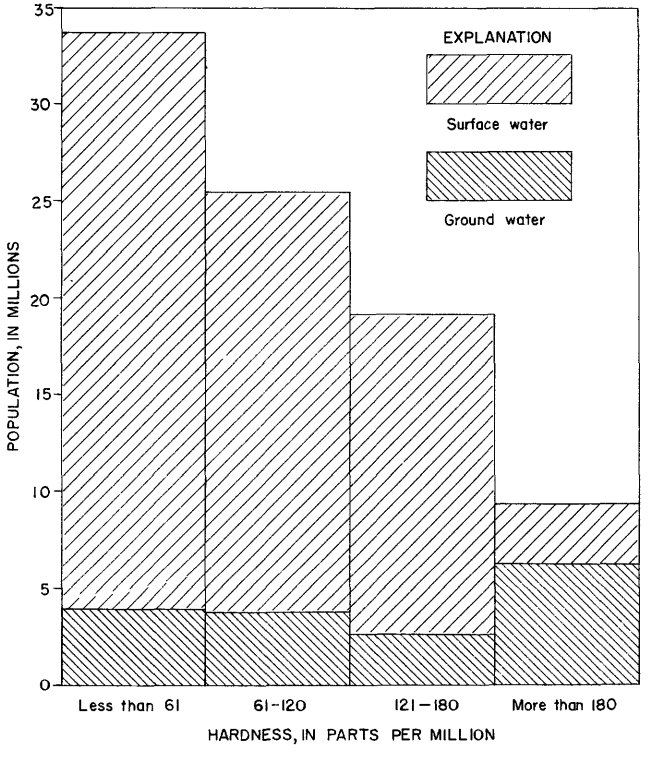
and in the ranges of hardness above 120 parts per million, ranges where softening is profitable and necessary for many domestic and industrial uses. These data are shown graphically on figure 1.

Table 3. --Number of persons using water in four ranges of hardness from public supplies, including mixed supplies, for 1,315 of the larger cities in the United States, 1952

Range in hardness (ppm)	Population (thousands)			
	Surface water	Ground water	mixed supplies	Total
1-60	28,520	3,468	1,452	33,440
61-120	19,879	3,204	2,766	25,849
121-180	13,452	2,115	3,495	19,062
180+	2,493	5,608	1,374	9,475
	64,344	14,395	9,087	87,826

Table 4. --Number of persons using water in four ranges of hardness from public supplies for 1,315 of the larger cities in the United States, 1952

Range in hardness (ppm)	Population (thousands)		
	Surface water	Ground water	Total
1-60	29,776	3,987	33,763
61-120	21,727	3,761	25,488
121-180	16,529	2,667	19,196
180+	2,921	6,458	9,379
	70,953	16,873	87,826



WEIGHTED AVERAGE HARDNESS

The data for hardness of the larger public water supplies of the United States are summarized in a different way in table 5. This table shows the weighted average hardness of both surface-water supplies and ground-water supplies, and both supplies combined for each State. To calculate the weighted-average hardness for the surface-water supplies of a State, the average hardness of each surface-water supply was multiplied by the population served by that supply; the sum of the products thus obtained was then divided by the total number of people served by the surface-water supplies. The weighted-average hardness for the ground-water supplies was obtained in the same way. Then the weighted average hardness for all supplies for the State was obtained by dividing the total of all the products by the total population served in the State. Thus the weighted average hardness of all supplies of a State represents the average hardness of each supply weighted according to the population served by that supply.

The data thus summarized in table 5 gives valuable information as to the distribution of hard water not so much within each State but for all the States. In some States the range in hardness of the supplies is not large, whereas in others the range is considerable. No supply in the State of Connecticut included in the report had a hardness of more than 60 parts per million. Only one place from each of the States of Maine, New Hampshire, Oregon, and Rhode Island, had a hardness of more than 60 parts per million. For a few States the range in hardness for the supplies extended from not less than 80 parts to well over 500 parts. The range in hardness of the supplies for the places in Texas is from 4 to 700 parts.

The weighted average hardness of the supplies for the States, Illinois, Indiana, Michigan, Minnesota, New York, Ohio, and Wisconsin, bordering on the Great Lakes is influenced by the hardness of the supplies taken from these lakes. The weighted-average hardness for each of these States except New York is decreased by the weighted average hardness of the supplies taken from the Great Lakes. The weighted average hardness of the supplies in Illinois, Michigan, and Wisconsin are influenced more than in the other States, because about 50 percent of the population of Illinois and Michigan and about 30 percent of the population of Wisconsin are represented by the population of the places included in this report. The weighted average of the supplies not taken from the lakes in these three States is much higher than the weighted average for the whole State and is probably much nearer the average of the supplies not included in the report.

The weighted average hardness for New York State is increased by the hardness of the supplies from lakes Erie and Huron, although the weighted average for the whole State is influenced more by the supply of New York City than all other supplies in the State combined that are included in the report. No other supplies in the whole country influence the weighted-average hardness of the State as much as the supplies for New York City and Chicago influence the weighted average for New York and Illinois. Data on the weighted-average hardness for the States named above are summarized in tables 6 and 7 for both finished and raw water.

Table 5.--Weighted average hardness of finished water from large public supplies in each State, 1952

State	Surface supplies			Ground supplies			All supplies		
	Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served	
		Thousands	Percent of population of State		Thousands	Percent of population of State		Thousands	Percent of population of State
Alabama	52	878	28.7	68	271	8.8	55	1,149	37.5
Arizona	200	167	22.2	225	271	36.2	216	438	58.4
Arkansas	36	355	18.6	54	187	9.8	42	542	28.4
California	107	7,962	75.2	164	1,945	18.4	118	9,907	93.6
Colorado	107	754	56.9	--	--	--	107	754	56.9
Connecticut	29	1,481	73.7	42	23	1.2	29	1,504	74.9
Delaware	53	128	40.3	81	44	13.7	60	172	54.0
District of Columbia	96	803	100	--	--	--	96	803	100
Florida	104	262	9.4	127	1,218	44.0	123	1,480	53.4
Georgia	24	1,237	35.9	114	294	8.6	41	1,531	44.5
Idaho	92	84	14.3	135	142	24.2	119	226	38.5
Illinois	135	4,901	56.3	348	549	6.3	156	5,450	62.6
Indiana	194	1,310	33.3	334	571	14.5	237	1,881	47.8
Iowa	138	429	16.3	265	592	22.6	212	1,021	38.9
Kansas	163	423	22.2	190	380	20.0	176	803	42.2
Kentucky	101	916	31.1	108	47	1.6	102	963	32.7
Louisiana	72	871	32.4	57	332	12.4	68	1,203	44.8
Maine	20	388	42.4	22	23	2.5	20	411	44.9
Maryland	48	1,677	71.6	27	34	1.4	48	1,711	73.0
Massachusetts	20	3,314	70.7	54	330	7.0	23	3,644	77.7
Michigan	100	3,359	52.7	218	510	8.0	115	3,869	60.7
Minnesota	74	1,012	33.9	261	282	9.5	114	1,294	43.4
Mississippi	73	161	7.4	24	361	16.6	39	522	24.0
Missouri	100	2,099	53.0	184	157	4.0	106	2,256	57.0
Montana	100	205	34.8	226	39	6.6	120	244	41.4
Nebraska	261	264	19.9	232	247	18.7	247	511	38.6
Nevada	79	54	33.5	204	42	26.5	135	96	60.0
New Hampshire	16	194	36.3	56	83	15.6	28	277	51.9
New Jersey	54	2,886	59.7	135	988	20.4	75	3,874	80.1
New Mexico	73	50	7.4	274	222	32.6	237	272	40.0
New York	46	10,660	71.8	112	1,122	7.6	52	11,782	79.4
North Carolina	33	1,194	29.4	66	57	1.4	34	1,251	30.8
North Dakota	111	104	16.8	296	49	7.9	170	153	24.7
Ohio	120	3,952	49.7	284	899	11.3	150	4,851	61.0
Oklahoma	119	774	34.6	163	122	5.5	125	896	40.1
Oregon	14	644	42.3	37	114	7.5	17	758	49.8
Pennsylvania	84	6,387	60.9	128	320	3.0	86	6,707	63.9
Rhode Island	33	672	84.9	26	42	5.2	32	714	90.1
South Carolina	17	615	29.1	25	125	5.9	18	740	35.0
South Dakota	136	67	10.2	394	114	17.5	299	181	27.7
Tennessee	84	790	24.0	50	543	16.5	70	1,333	40.5
Texas	120	1,971	25.6	143	1,890	24.5	132	3,861	50.1
Utah	171	194	28.2	212	179	25.9	191	373	54.1
Vermont	52	103	27.2	59	21	5.6	53	124	32.8
Virginia	60	1,466	44.2	151	93	2.8	65	1,559	47.0
Washington	22	1,029	43.2	118	308	13.0	44	1,337	56.2
West Virginia	71	541	27.0	170	108	5.4	88	649	32.4
Wisconsin	128	1,095	31.9	250	519	15.1	167	1,614	47.0
Wyoming	123	71	24.3	223	64	22.3	171	135	46.6
United States	82	70,953	47.1	162	16,873	11.2	97	87,826	58.3

Table 6.--Weighted average hardness of finished water from large public supplies of States bordering the Great Lakes, 1952

	Surface supplies			Ground supplies			All supplies		
	Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served	
		Thousands	Percent of population of State		Thousands	Percent of population of State		Thousands	Percent of population of State
Illinois:									
Supplied from Lake Michigan	133	4,256	48.9	--	--	--	133	4,256	48.9
Remainder of State	143	645	7.4	348	549	6.3	237	1,194	13.7
Whole State	135	4,901	56.3	348	549	6.3	156	5,450	62.6
Indiana:									
Supplied from Lake Michigan	136	326	8.3	--	--	--	136	326	8.3
Remainder of State	213	984	25.0	334	571	14.5	258	1,555	29.5
Whole State	194	1,310	33.3	334	571	14.5	237	1,881	47.8
Michigan:									
Supplied from Great Lakes	100	3,158	49.5	--	--	--	100	3,158	49.5
Remainder of State	89	201	3.2	218	510	8.0	182	711	11.2
Whole State	100	3,359	52.7	218	510	8.0	115	3,869	60.7
Minnesota:									
Supplied from Lake Superior	46	107	3.6	--	--	--	46	107	3.6
Remainder of State	77	905	30.3	261	282	9.5	121	1,197	39.8
Whole State	74	1,012	33.9	261	282	9.5	114	1,294	43.4
New York:									
Supplied from Great Lakes	125	964	6.5	--	--	--	125	964	6.5
New York City	30	7,800	52.6	143	500	3.4	37	8,300	56.0
Remainder of State	70	1,896	12.7	87	622	4.2	75	2,518	16.9
Whole State	46	10,660	71.8	112	1,122	7.6	52	11,782	79.4
Ohio:									
Supplied from Lake Erie	130	1,901	23.9	--	--	--	130	1,901	23.9
Remainder of State	111	2,051	25.8	284	900	11.3	164	2,950	37.1
Whole State	120	3,952	49.7	284	900	11.3	150	4,851	61.0
Wisconsin:									
Supplied from Lake Michigan	128	1,006	29.3	--	--	--	128	1,006	29.3
Remainder of State	120	89	2.6	250	519	15.1	231	608	17.7
Whole State	128	1,095	31.9	250	519	15.1	167	1,614	47.0

Table 7.--Weighted average hardness of raw water from large public supplies of States bordering the the Great Lakes, 1952

	Surface supplies			Ground supplies			All supplies		
	Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served	
		Thousands	Percent of population of State		Thousands	Percent of population of State		Thousands	Percent of population of State
Illinois:									
Supplied from Lake Michigan	131	4,256	48.9	--	--	--	131	4,256	48.9
Remainder of State	177	646	7.4	384	549	6.3	272	1,194	13.7
Whole State	137	4,902	56.3	384	549	6.3	162	5,450	62.6
Indiana:									
Supplied from Lake Michigan	135	326	8.3	--	--	--	135	326	8.3
Remainder of State	230	984	25.0	354	571	14.5	275	1,555	39.5
Whole State	206	1,310	33.3	354	571	14.5	251	1,881	47.8
Michigan:									
Supplied from Great Lakes	103	3,158	49.5	--	--	--	103	3,158	49.5
Remainder of State	278	201	3.2	314	510	8.0	304	711	11.2
Whole State	113	3,359	52.7	314	510	8.0	140	3,869	60.7

Table 7. --Weighted average hardness of raw water from large public supplies of States bordering the the Great Lakes, 1952--Continued

	Surface supplies			Ground supplies			All supplies		
	Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served	
		Thousands	Percent of population of State		Thousands	Percent of population of State		Thousands	Percent of population of State
Minnesota:									
Supplied from Lake Superior	44	107	3.6	--	--	--	44	107	3.6
Remainder of State	162	905	30.3	275	282	9.5	188	1,187	39.8
Whole State	150	1,012	33.9	275	282	9.5	177	1,294	43.4
New York:									
Supplied from Great Lakes	124	964	6.5	--	--	--	124	964	6.5
New York City	30	7,800	52.6	143	500	3.4	37	8,300	56.0
Remainder of State	71	1,895	12.7	87	622	4.2	75	2,518	16.9
Whole State	46	10,659	71.8	112	1,122	7.6	52	11,782	79.4
Ohio:									
Supplied from Lake Erie	128	1,901	23.9	--	--	--	128	1,901	23.9
Remainder of State	149	2,051	25.8	358	899	11.3	213	2,950	37.1
Whole State	139	3,952	49.7	358	899	11.3	179	4,851	61.0
Wisconsin:									
Supplied from Lake Michigan	129	1,006	29.3	--	--	--	129	1,006	29.3
Remainder of State	172	89	2.6	253	519	15.1	241	608	17.7
Whole State	132	1,095	31.9	253	519	15.1	171	1,614	47.0

The weighted average hardness for the supplies of 670 places in the United States in Water-Supply Paper 658 in 1932 was 102 parts per million; for the supplies in 1,315 places in this report, it is 97 parts. This difference of 5 parts in the hardness may seem difficult to explain when it is realized that the supplies of the more than 600 places included in this report and not included in the report in 1932, are comparatively small places and many obtain their supplies from ground water which has a much higher average hardness generally than surface waters. This decrease in the hardness is readily explained by changes in the sources of supply to water of lower hardness affecting a rather large part of the population, and by an increase, in practice, of softening of supplies. Some of the places where changes in the hardness of the supplies have been effected are Little Rock, Flint, Minneapolis, St. Paul, Kansas City (Mo.), Oklahoma City, Toledo, Wichita, and the metropolitan area of Southern California. In 1932 the number of places with softened supplies was 40; in this report of the same 670 places mentioned in Water-Supply Paper 658 the number of places with softened supplies is 85.

The weighted average hardness for the surface-water supplies in the report in 1932 was 85 parts per million; in this report it is 82 parts. The weighted average hardnesses for the ground-water supplies are 191 and 162 parts per million respectively. The decreases in the weighted average hardness of both surface and ground-water supplies are explained as above for the decrease in the weighted average for all the supplies for the country. Although the decrease in hardness of the ground-water supplies is much greater than in the surface-water supplies, this decrease has less weight in decreasing the weighted average for all supplies than the decrease in the surface supplies because the ground-water supplies represent only 11.2 percent of the total population, the surface supplies, 47.1 percent.

Data on weighted average hardness for the raw-water supplies are shown in table 8 in the same manner as they are shown in table 5 for the water supplies as served to the consumers. Average-hardness values for the raw supplies were obtained in the same manner as for the supplies as served to the consumers, although more estimates were made for the raw water averages of the individual supplies

than for the finished water supplies.

An examination of the tables shows the weighted average hardness of the raw-water supplies for the United States to be 116 parts per million as compared to 97 parts for the finished-water supplies; 96 parts for raw surface-water supplies as compared to 82 parts for the finished surface-water supplies; and 200 parts for the raw ground-water supplies as compared to 162 parts for the finished ground-water supplies.

Table 8.--Weighted average hardness of raw water from large public supplies in each State, 1952

State	Surface supplies			Ground supplies			All supplies		
	Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served		Hardness as $CaCO_3$ (ppm)	Population served	
		Thousands	Percent of population of State		Thousands	Percent of population of State		Thousands	Percent of population of State
Alabama	40	878	28.7	67	271	8.8	47	1,149	37.5
Arizona	200	167	22.2	225	271	36.2	215	438	58.4
Arkansas	23	355	18.6	60	187	9.8	36	542	28.4
California	184	7,962	75.2	206	1,945	18.4	188	9,907	93.6
Colorado	110	754	56.9	--	--	--	110	754	56.9
Connecticut	27	1,481	73.7	42	23	1.2	27	1,504	74.9
Delaware	55	128	40.3	56	44	13.7	55	172	54.0
District of Columbia	84	803	100	--	--	--	84	803	100
Florida	95	262	9.4	242	1,218	44.0	216	1,480	53.4
Georgia	15	1,237	35.9	167	294	8.6	44	1,531	44.5
Idaho	90	84	14.3	135	142	24.2	119	226	38.5
Illinois	137	4,901	56.3	384	549	6.3	162	5,450	62.6
Indiana	206	1,310	33.3	354	571	14.5	251	1,881	47.8
Iowa	210	429	16.3	342	592	22.6	286	1,021	38.9
Kansas	221	423	22.2	271	380	20.0	245	803	42.2
Kentucky	107	916	31.1	291	47	1.6	116	963	32.7
Louisiana	108	871	32.4	84	332	12.4	101	1,203	44.8
Maine	18	388	42.4	22	23	2.5	18	411	44.9
Maryland	38	1,677	71.6	27	34	1.4	38	1,711	73.0
Massachusetts	19	3,314	70.7	53	330	7.0	22	3,644	77.7
Michigan	113	3,359	52.7	314	510	8.0	140	3,869	60.7
Minnesota	150	1,012	33.9	275	282	9.5	177	1,294	43.4
Mississippi	56	161	7.4	20	361	16.6	31	522	24.0
Missouri	126	2,099	53.0	228	157	4.0	133	2,256	57.0
Montana	101	205	34.8	224	39	6.6	121	244	41.4
Nebraska	261	264	19.9	239	247	18.7	250	511	38.6
Nevada	101	54	33.5	204	42	26.5	147	96	60.0
New Hampshire	16	194	36.3	58	83	15.6	29	277	51.9
New Jersey	51	2,886	59.7	137	988	20.4	73	3,874	80.1
New Mexico	76	50	7.4	282	222	32.6	244	272	40.0
New York	46	10,660	71.8	112	1,122	7.6	52	11,782	79.4
North Carolina	23	1,194	29.4	123	57	1.4	28	1,251	30.8
North Dakota	255	104	16.8	345	49	7.9	283	153	24.7
Ohio	139	3,952	49.7	358	899	11.3	179	4,851	61.0
Oklahoma	150	774	34.6	224	122	5.5	160	896	40.1
Oregon	13	644	42.3	37	114	7.5	15	758	49.8
Pennsylvania	86	6,387	60.9	200	320	3.0	91	6,707	63.9
Rhode Island	21	672	84.9	25	42	5.3	21	714	90.1
South Carolina	17	615	29.1	23	125	5.9	18	740	35.0
South Dakota	253	67	10.2	426	114	17.5	362	181	27.7
Tennessee	77	790	24.0	49	543	16.5	66	1,333	40.5
Texas	162	1,971	25.6	144	1,890	24.5	153	3,861	50.1
Utah	171	194	28.2	212	179	25.9	191	373	54.1
Vermont	52	103	27.2	59	21	5.6	53	124	32.8
Virginia	48	1,466	44.2	157	93	2.8	54	1,559	47.0
Washington	24	1,029	43.2	118	308	13.0	45	1,337	56.2
West Virginia	66	541	27.0	185	108	5.4	86	649	32.4
Wisconsin	132	1,095	31.9	253	519	15.1	171	1,614	47.0
Wyoming	114	71	24.3	233	64	22.3	171	135	46.6
United States	96	70,953	47.1	200	16,873	11.2	116	87,826	58.3

Further examination of the tables shows that for six States the hardness reported for the raw-water supplies is the same as for the finished-water supplies. For 17 States where soft water supplies are generally found the weighted average hardness of the raw-water supplies is less than the finished-water supplies, indicating the addition of lime in the treatment of the raw-water supplies for pH adjustment and corrosion control; and for 19 States where hard-water supplies are more general, the hardness of the raw-water supplies is considerably higher than the finished-water supplies, indicating that softening was part of the treatment of the raw-water supplies in those areas.

The data on weighted average hardness in table 5 are further summarized on plate 1 and table 8 on plate 2. The States are separated into four groups according to the weighted average hardness of the supplies of each State and are shown on the maps by shaded patterns representing the four groups or ranges of hardness. These maps of weighted-average hardness of supplies by States have definite limitations, but they show, in a general way, the areas where water in definite ranges of hardness is found. It is obvious that hardness of water supplies does not follow State lines; moreover, each State, with one exception, has supplies with hardness that exceed the limits of the ranges of hardness for the particular group into which it falls. The map for the weighted average hardness of the raw-water supplies more nearly represents the average hardness of the natural waters than the map for the weighted average hardness of the finished-water supplies.

The classification of water supplies as soft, moderately hard, hard, and very hard is rather unsatisfactory even where the domestic use of the water is concerned, and much more so with respect to the industrial use of the water. Water with a hardness of 100 parts per million may be called a soft water by one accustomed to using a water with 300 or 400 parts of hardness, whereas, one accustomed to using a water with less than 50 parts hardness may call water with a hardness of 100 parts rather hard. A water with a hardness of 100 parts is not soft in terms of soap consumption in cleansing, washing, and laundering operations. About 60 percent of the population of the places in this report are furnished with water having a hardness of 100 parts per million or less. (See table 9 and plate 3.)

Table 9.--Population served, and the percent of population served with water from public supplies having hardness of 100 parts per million or less for 1,315 of the larger cities in the United States, 1952

State	Population served (thousands)	Percent	State	Population served (thousands)	Percent
Alabama	1,065	92.7	Nebraska	0	0
Arizona	32	7.3	Nevada	44	45.8
Arkansas	509	93.9	New Hampshire	252	91.0
California	2,643	26.7	New Jersey	2,686	69.3
Colorado	183	24.3	New Mexico	35	12.9
Connecticut	1,504	100	New York	10,187	86.5
Delaware	155	90.1	North Carolina	1,236	98.8
District of Columbia	803	100	North Dakota	46	30.1
Florida	857	57.9	Ohio	957	19.7
Georgia	1,382	90.3	Oklahoma	638	71.2
Idaho	140	61.9	Oregon	758	100
Illinois	215	3.9	Pennsylvania	3,580	53.4
Indiana	135	7.2	Rhode Island	714	100
Iowa	396	38.8	South Carolina	731	98.8
Kansas	155	19.3	South Dakota	33	18.2
Kentucky	627	65.1	Tennessee	1,064	79.8
Louisiana	1,133	94.2	Texas	2,012	52.1
Maine	411	100	Utah	0	0
Maryland	1,711	100	Vermont	112	90.3
Massachusetts	3,644	100	Virginia	1,524	97.8
Michigan	3,078	79.6	Washington	1,135	84.9
Minnesota	1,012	78.2	West Virginia	473	72.9
Mississippi	472	90.4	Wisconsin	133	8.2
Missouri	1,594	70.7	Wyoming	61	45.2
Montana	111	45.5	Total	52,378	59.6

The limitations of quality with respect to the hardness of water supplies for industrial use are so varied that any general classification would not be feasible or satisfactory. A supply with a hardness of 60 parts per million may be satisfactory for one or several industries and not satisfactory for others. The grouping of the supplies in this report into four groups or ranges of hardness follows the pattern used in Water-Supply Paper 658 and is convenient for comparison; the grouping does not fit any industrial classification. Some other grouping may be more practical or satisfactory than the above.

For the finished-water supplies 17 States fall into the first group, 1 to 60 parts per million of hardness; 14 States and the District of Columbia fall into the second group, 61 to 120 parts of hardness; 10 States fall into the third group, 121 to 180 parts of hardness; and 7 States fall into the group, above 180 parts of hardness. In the second group 3 States (California, Idaho, and Montana) have weighted-average hardnesses near the maximum for the group, and a total of 9 States and the District of Columbia have weighted average hardnesses above 90 parts. In the third group 4 States (Kansas, North Dakota, Wisconsin, and Wyoming) have weighted average hardnesses around 170 parts or near the upper range of hardness for the group.

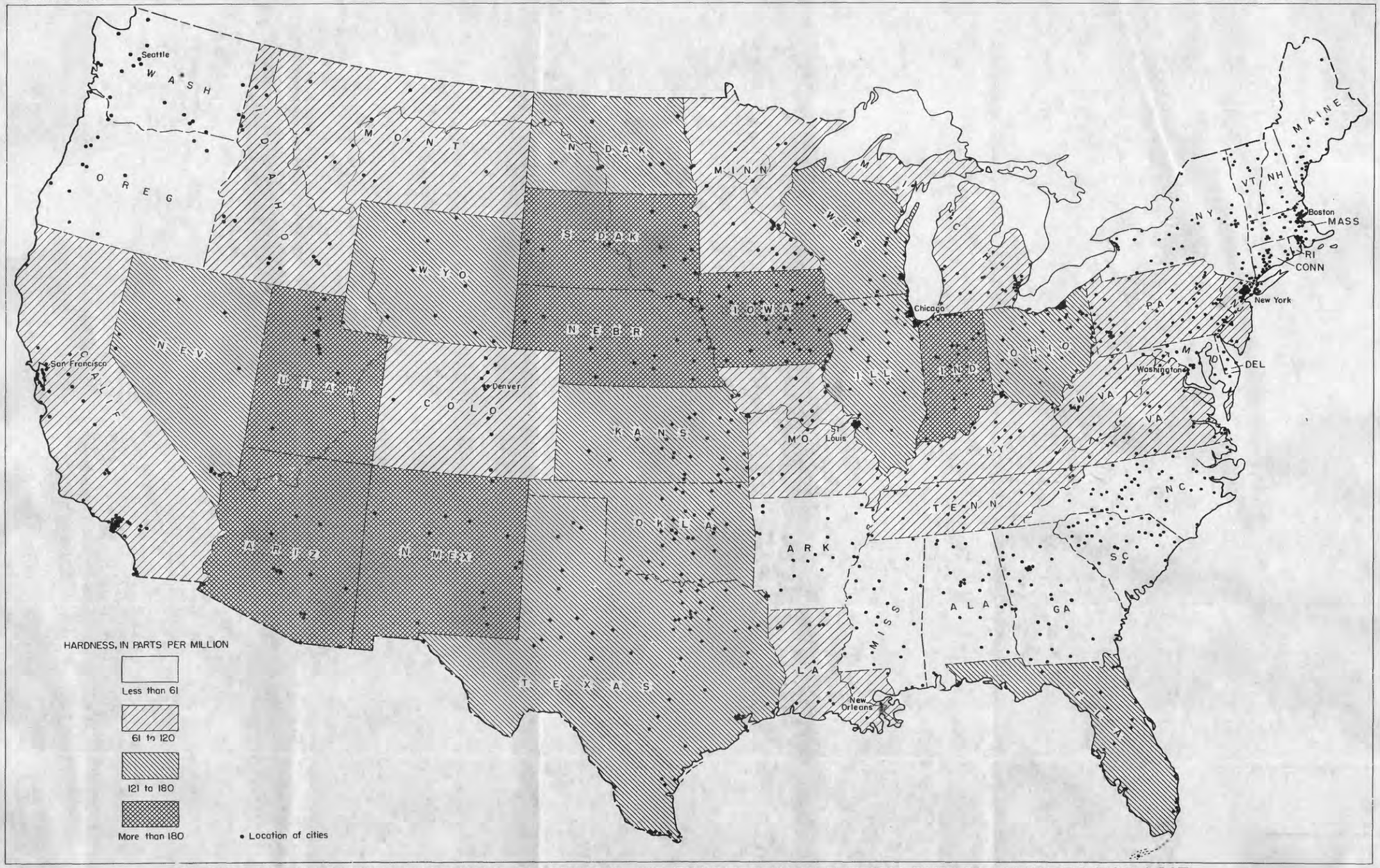
For the raw-water supplies, the States fall into the four groups as follows: 18 States in the first group; 8 States and the District of Columbia in the second group; 11 States in the third group; and 11 States in the last group. The significant fact in this grouping of the States according to the weighted average hardness of the finished-water supplies and the raw-water supplies is the difference in the number of States falling into the second and last groups. Supplies that have been softened generally fall in with the group with 61 to 120 parts of hardness, and raw-water supplies most likely to be softened fall in the third and last groups. This difference in the number of States in the second group has been the result of softening of supplies with hardness not only above 180 parts but also those with hardness in the upper ranges of the third group.

AVERAGE HARDNESS

Further summaries of data on the hardness of the finished-water supplies for the places in this report are shown in table 10 and plate 4. Table 10 shows the average hardness of both finished surface-water and ground-water supplies and also of both supplies combined for each State, based on the number of supplies shown in the table for each State. It is realized that for some of the States the averages are based on too few or insufficient data--for example, no ground-water supplies are included in the average for Colorado, and only one surface supply is included in the average for Nebraska.

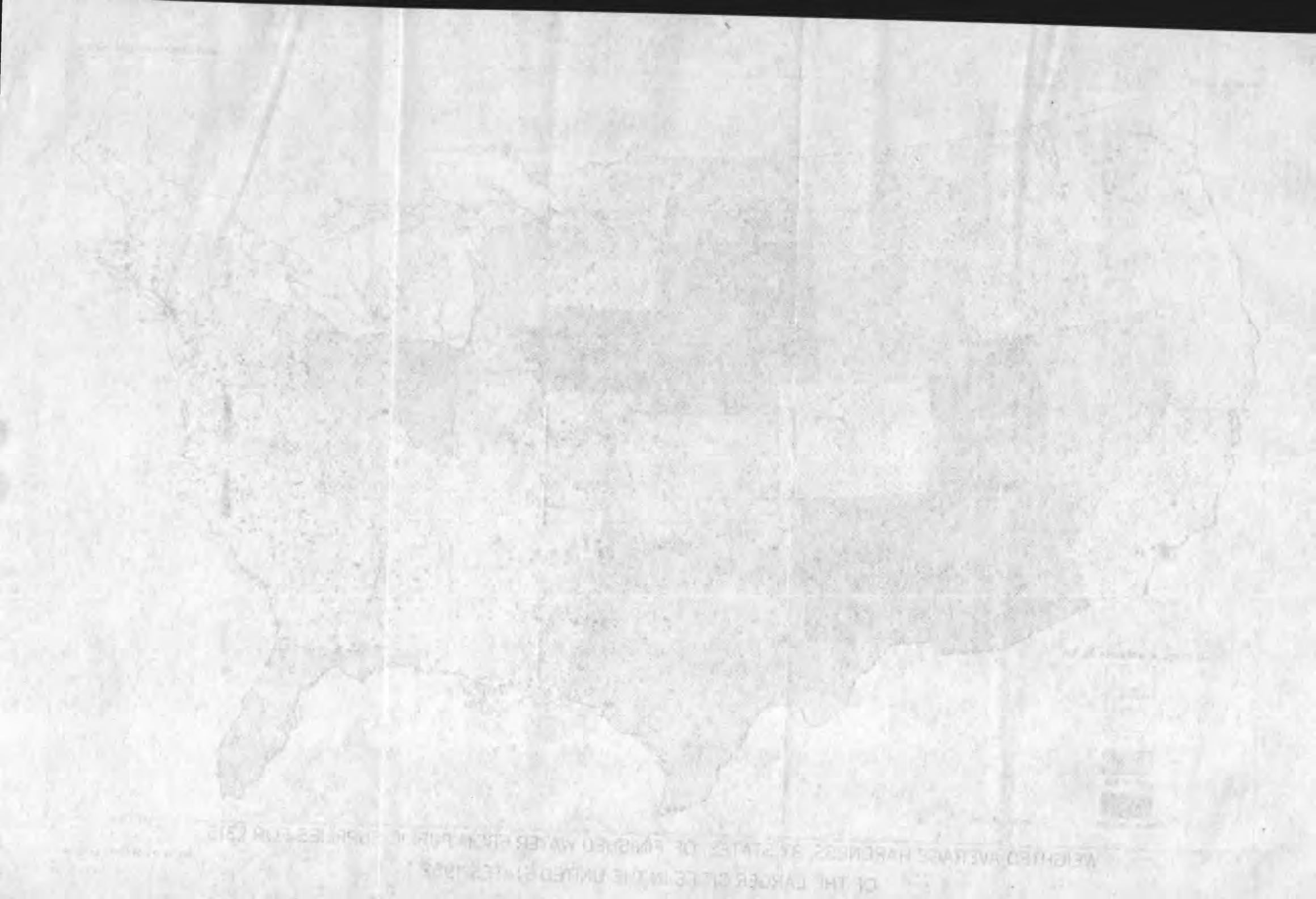
These arithmetical averages for the States as a whole are slightly higher than the weighted average hardness, for a small place has the same weight as a large place in the arithmetical averages and the larger places in many States are the ones that have the softer supplies or receive softened supplies, and consequently have more weight in a weighted average. The average hardness for the United States is 121 parts compared to 97 parts for the weighted average.

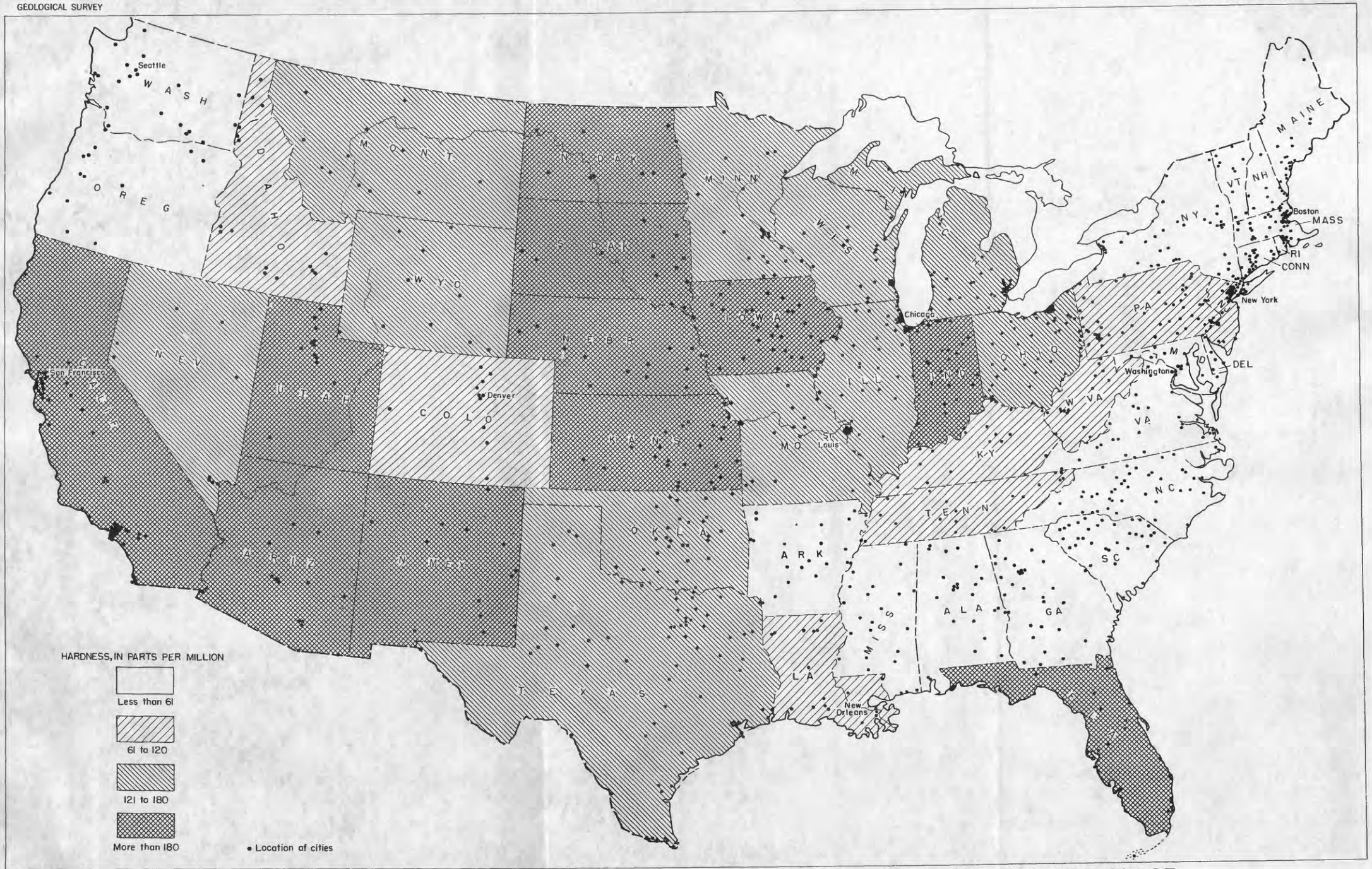
The grouping of the States for plate 4 according to the four ranges of hardness differs considerably from the grouping for plate 1 of weighted averages. The number of States in the group of 1 to 60 parts per million of hardness and the group of above 180 parts for plate 4 is 12 and 13, respectively, as compared to 17 and 7 for plate 1. The number of States in the other two groups is about the same, but the States making up the groups are different.



WEIGHTED AVERAGE HARDNESS, BY STATES, OF FINISHED WATER FROM PUBLIC SUPPLIES FOR 1,315 OF THE LARGER CITIES IN THE UNITED STATES, 1952

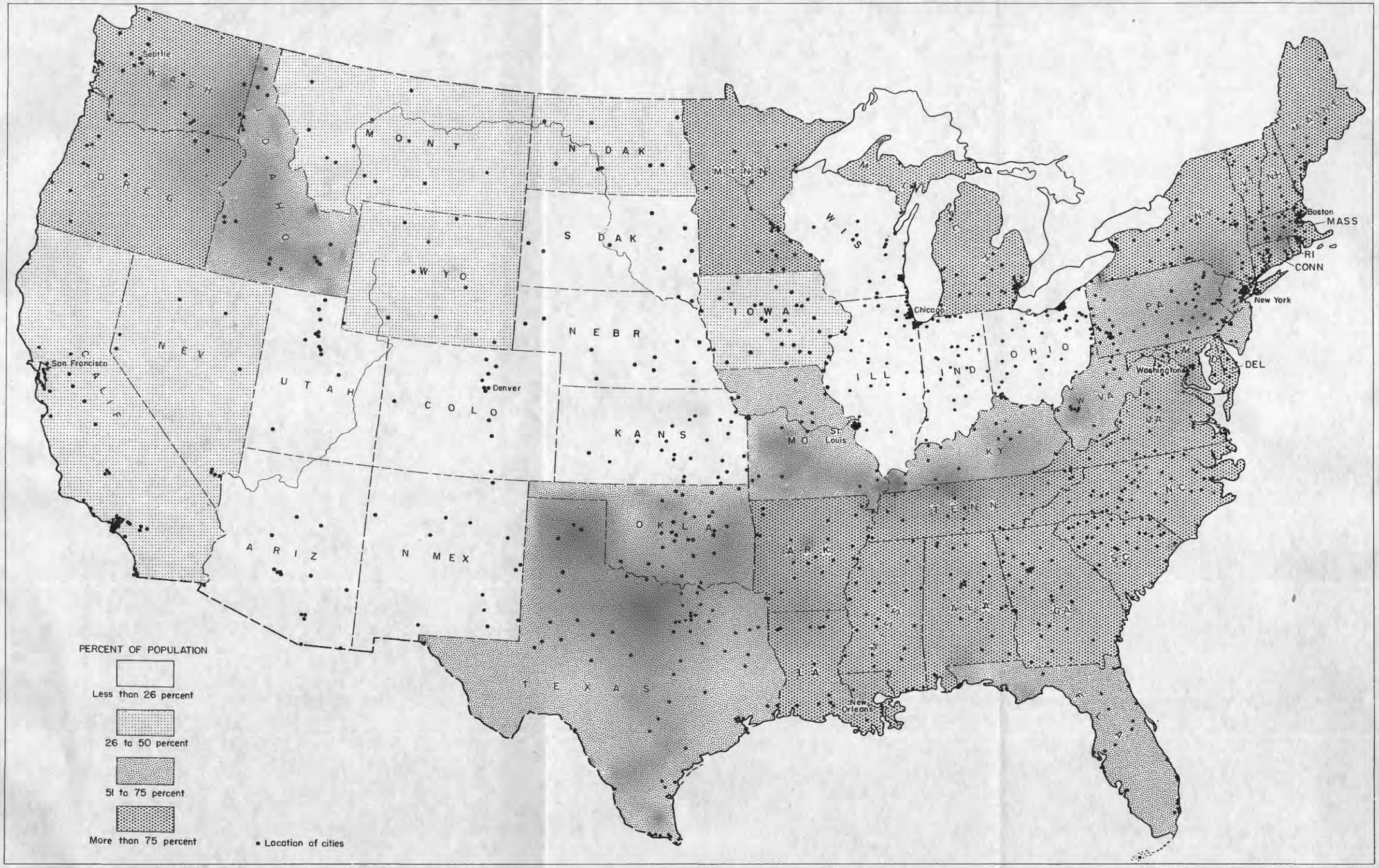
303739 O - 54 (Face p. 22) No. 1





WEIGHTED AVERAGE HARDNESS, BY STATES, OF RAW WATER FROM PUBLIC SUPPLIES FOR 1,315 OF THE LARGER CITIES IN THE UNITED STATES, 1952

303739 O - 54 (Face p. 22) No. 2



PERCENT OF POPULATION, BY STATES, SERVED FROM PUBLIC SUPPLIES WITH WATER HAVING HARDNESS OF 100 PARTS PER MILLION OR LESS FOR 1,315 OF THE LARGER CITIES IN THE UNITED STATES, 1952

303739 O - 54 (Face p. 22) No. 3

Table 10. --Number of supplies, and average hardness, by States, of finished water for 1,315 of the larger cities of the United States, 1952

State	Surface supplies		Ground supplies		All supplies	
	Number	Hardness as $CaCO_3$ (ppm)	Number	Hardness as $CaCO_3$ (ppm)	Number	Hardness as $CaCO_3$ (ppm)
Alabama	15	46	8	70	23	54
Arizona	5	186	20	215	25	210
Arkansas	13	51	15	70	28	61
California	29	132	57	176	86	161
Colorado	12	106	--	--	12	106
Connecticut	20	29	3	42	23	30
Delaware	2	61	7	76	9	74
District of Columbia	1	96	--	--	1	96
Florida	5	90	24	112	29	108
Georgia	16	31	17	114	33	75
Idaho	7	68	11	172	18	132
Illinois	20	133	14	324	34	212
Indiana	15	182	20	338	35	271
Iowa	13	140	24	274	37	227
Kansas	13	134	15	229	28	185
Kentucky	18	97	3	128	21	101
Louisiana	6	70	11	60	17	64
Maine	13	23	2	42	15	23
Maryland	9	44	2	26	11	40
Massachusetts	33	28	14	56	47	36
Michigan	19	107	14	216	33	153
Minnesota	5	78	18	265	23	224
Mississippi	3	81	20	28	23	35
Missouri	16	125	7	173	23	140
Montana	10	90	6	202	16	132
Nebraska	1	261	12	253	13	254
Nevada	4	132	6	168	10	154
New Hampshire	7	17	4	50	11	30
New Jersey	18	58	22	104	40	83
New Mexico	3	87	11	321	14	271
New York	44	77	19	104	63	85
North Carolina	38	35	4	76	42	39
North Dakota	6	128	5	275	11	195
Ohio	26	123	16	202	42	153
Oklahoma	20	174	8	156	28	169
Oregon	11	28	4	50	15	34
Pennsylvania	54	71	11	127	65	80
Rhode Island	8	38	4	28	12	34
South Carolina	21	23	14	22	35	22
South Dakota	5	154	8	379	13	292
Tennessee	13	89	9	86	22	88
Texas	34	162	46	125	80	140
Utah	3	196	12	222	15	217
Vermont	8	57	4	79	12	64
Virginia	25	49	7	140	32	69
Washington	14	32	9	82	23	53
West Virginia	16	71	5	168	21	94
Wisconsin	9	120	15	240	24	195
Wyoming	6	195	7	225	13	211
United States	712	85	594	164	1,306	121

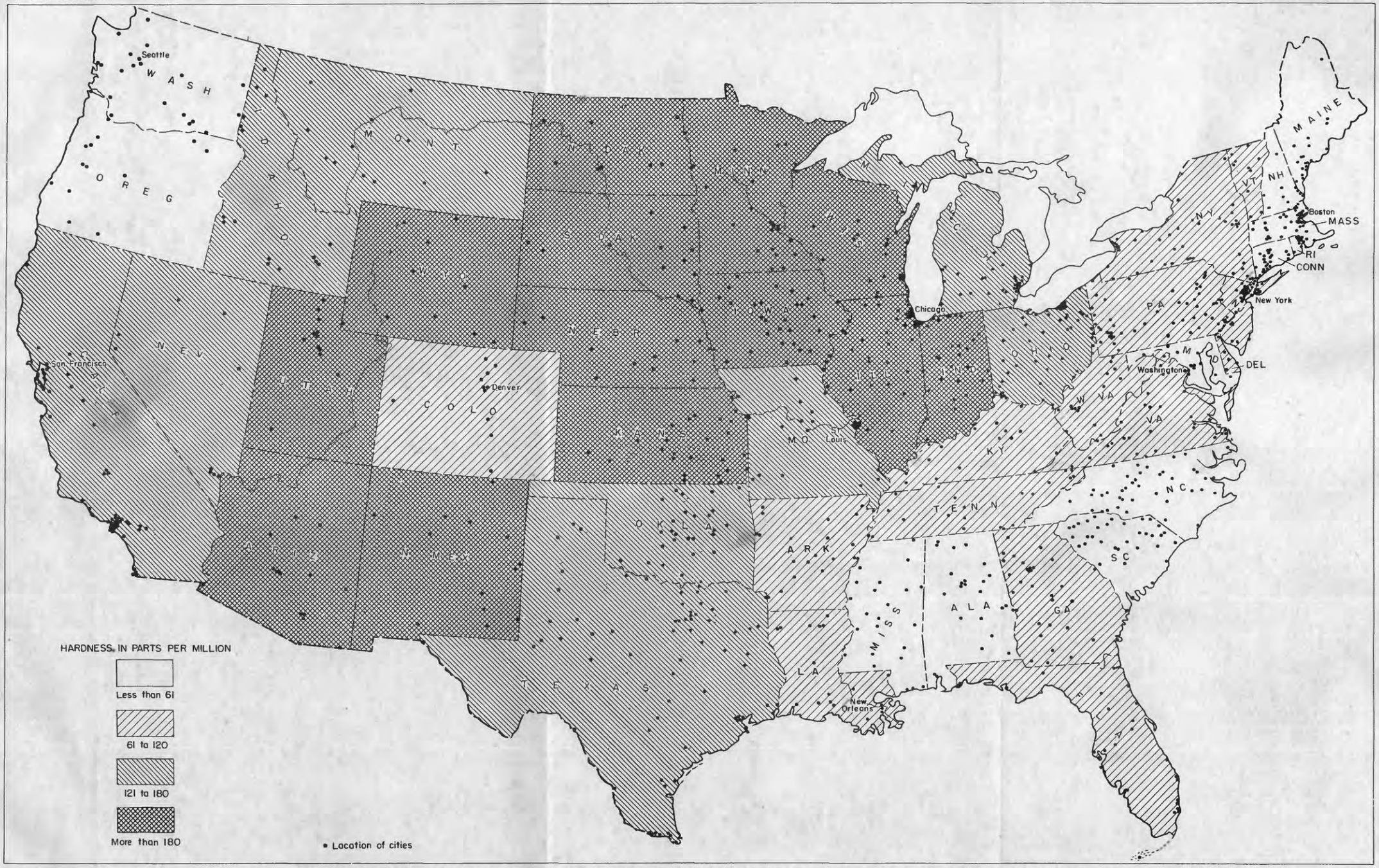
Further data on average hardness of the raw-water supplies of places in this report are shown in table 11 and plate 5. The results for average hardness of the raw-water supplies in table 11 were obtained in the same manner as for table 10 of the finished-water supplies. The averages for some of the States in table 10 differ only to a small degree, being either higher or lower, from the weighted averages of the raw-water supplies as shown in table 8, whereas for other States the two averages differ considerably. The average hardness for the United States is 139 parts as compared to 116 parts for the weighted average.

The arrangement of the States into the four groups, according to the ranges of average hardness as shown in plate 5, differs considerably as to the number falling into each group and as to the States making up each group, from the groupings made according to the weighted average hardness as shown on plate 2. The greatest difference as to number of States is in the two groups of the higher ranges of hardness, 121 to 180 parts and above 180 parts, respectively. In these two groups there are 4 States and 19 States respectively, as compared to 11 and 11 in the same groups for plate 2.

The data on hardness as summarized in table 11 and plate 5 when compared with those summarized in table 10 plate 4 also reveal important difference in the values for average hardness of the raw and finished supplies of the individual States and the grouping of the States into the four groups or ranges of hardness. The data as summarized in table 11 and plate 5 give more nearly accurate information as to the average hardness of the natural waters of the States than the data on average hardness weighted according to population or changed by reason of the treatment of the supplies, summarized in the preceding tables and illustrations. Plate 5 is a reasonably accurate representation of the areas of soft and hard waters in the United States.

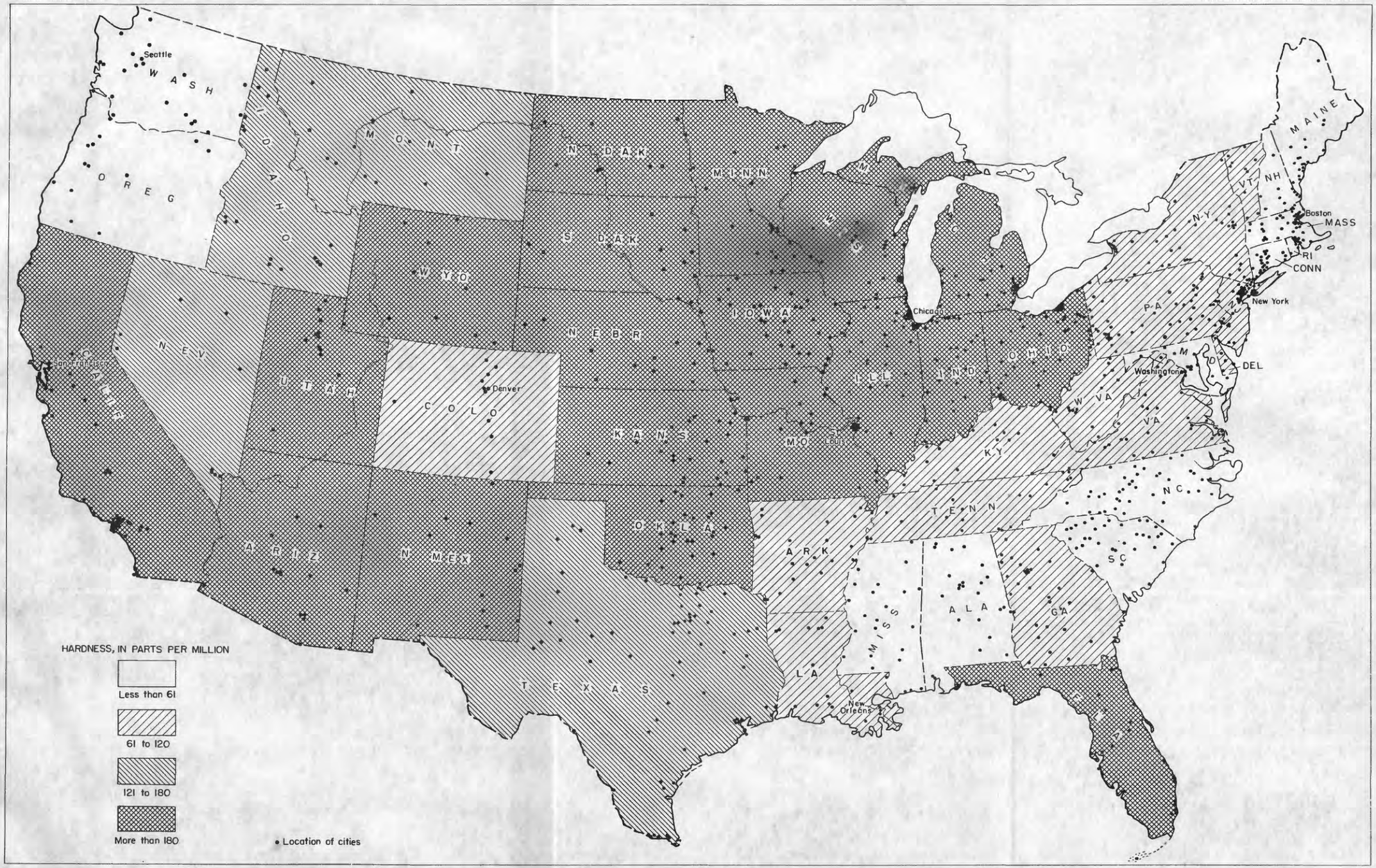
Table 11.--Number of supplies, and average hardness, by States, of raw water for 1,315 of the larger cities in the United States, 1952

State	Surface supplies		Ground supplies		All supplies	
	Number	Hardness as $CaCO_3$ (ppm)	Number	Hardness as $CaCO_3$ (ppm)	Number	Hardness as $CaCO_3$ (ppm)
Alabama	15	30	9	72	24	46
Arizona	5	183	20	215	25	209
Arkansas	13	38	15	80	28	61
California	32	150	56	189	88	175
Colorado	12	107	--	--	12	107
Connecticut	19	26	3	42	22	28
Delaware	2	45	7	72	9	66
District of Columbia	1	84	--	--	1	84
Florida	5	75	24	252	29	222
Georgia	16	24	18	126	34	78
Idaho	7	65	11	172	18	131
Illinois	19	174	14	358	33	252
Indiana	17	199	21	352	38	284
Iowa	13	195	24	355	37	299
Kansas	13	210	15	307	28	262
Kentucky	18	92	3	206	21	109
Louisiana	6	87	11	112	17	103
Maine	13	20	2	22	15	21
Maryland	8	36	3	30	11	34
Massachusetts	33	24	14	58	47	34
Michigan	19	135	14	298	33	204
Minnesota	5	148	18	280	23	251
Mississippi	3	61	20	34	23	37



AVERAGE HARDNESS, BY STATES, OF FINISHED WATER FROM PUBLIC SUPPLIES FOR 1,315 OF THE LARGER CITIES IN THE UNITED STATES, 1952

303739 O - 54 (Face p. 24) No. 1



AVERAGE HARDNESS, BY STATES, OF RAW WATER FROM PUBLIC SUPPLIES FOR 1,315 OF THE LARGER CITIES IN THE UNITED STATES, 1952

303739 O - 54 (Face p. 24) No. 2

Table 11. --Number of supplies, and average hardness, by States, of raw water for 1,315 of the larger cities in the United States, 1952 --Continued

State	Surface supplies		Ground supplies		All supplies	
	Number	Hardness as $CaCO_3$ (ppm)	Number	Hardness as $CaCO_3$ (ppm)	Number	Hardness as $CaCO_3$ (ppm)
Missouri	16	163	7	247	23	189
Montana	10	106	6	193	16	139
Nebraska	1	261	12	267	13	267
Nevada	4	182	6	168	10	174
New Hampshire	7	17	4	55	11	31
New Jersey	18	54	22	110	40	85
New Mexico	3	89	11	337	14	284
New York	44	78	19	106	63	87
North Carolina	38	22	4	126	42	32
North Dakota	6	231	5	300	11	262
Ohio	26	160	17	361	43	240
Oklahoma	20	176	8	246	28	196
Oregon	11	26	4	50	15	33
Pennsylvania	54	70	12	172	66	89
Rhode Island	8	31	5	26	13	29
South Carolina	21	18	14	19	35	19
South Dakota	5	256	8	452	13	392
Tennessee	13	85	9	84	22	85
Texas	34	177	46	126	80	148
Utah	3	196	12	222	15	217
Vermont	8	57	4	79	12	64
Virginia	25	43	9	141	34	69
Washington	14	33	9	83	23	52
West Virginia	16	62	5	202	21	95
Wisconsin	9	142	15	239	24	203
Wyoming	6	173	7	247	13	213
United States	714	94	602	192	1,316	139

MEDIAN HARDNESS

Data on the average hardness of public water supplies, by States, for 1,315 of the larger cities of the United States are summarized in a different way in table 12 for finished-water supplies and in table 13 for raw-water supplies than in the preceding tables. These two tables in addition to showing the median of the average hardnesses of the supplies of each State, show the range in average hardness of the supplies of each State based on the number of supplies indicated in each table. The number of supplies shown for each State may not necessarily coincide with the number of cities for each State included in the report, because a number of cities in several States are supplied from a single source of supply, and conversely, one city may have several sources of supply.

Table 12. --Number of supplies, range in average hardness, and median hardness of finished water, by States, for 1,315 of the larger cities in the United States, 1952

State	Number of supplies	Range in hardness	Median hardness	State	Number of supplies	Range in hardness	Median hardness
Alabama	23	14-115	49	Nebraska	13	112-370	274
Arizona	25	12-500	185	Nevada	10	33-320	162
Arkansas	28	11-250	45	New Hampshire	11	10-121	21
California	86	18-561	152	New Jersey	40	10-251	67
Colorado	12	11-317	68	New Mexico	14	30-626	168
Connecticut	23	11-46	32	New York	63	7-292	82
Delaware	9	24-144	61	North Carolina	42	6-113	36
District of Columbia	1	--	96	North Dakota	11	81-406	152
Florida	29	20-274	91	Ohio	42	46-427	120
Georgia	33	18-360	50	Oklahoma	28	8-675	130
Idaho	18	8-354	125	Oregon	15	9-95	36
Illinois	34	80-565	144	Pennsylvania	65	5-256	72
Indiana	35	76-640	286	Rhode Island	12	17-83	30
Iowa	37	83-632	192	South Carolina	35	3-107	17
Kansas	28	75-548	130	South Dakota	13	70-672	255
Kentucky	21	12-198	107	Tennessee	22	19-177	79
Louisiana	17	2-151	76	Texas	80	4-700	96
Maine	15	8-82	18	Utah	15	152-349	198
Maryland	11	3-85	35	Vermont	12	16-121	58
Massachusetts	47	8-80	39	Virginia	32	8-295	45
Michigan	33	43-405	132	Washington	23	12-155	46
Minnesota	23	46-464	241	West Virginia	21	28-264	70
Mississippi	23	2-150	23	Wisconsin	24	50-500	131
Missouri	23	55-294	120	Wyoming	13	12-575	170
Montana	16	16-404	121				

Table 13. --Number of supplies, range in average hardness, and median hardness of raw water, by States, for 1,315 of the larger cities in the United States, 1952

State	Number of supplies	Range in hardness	Median hardness	State	Number of supplies	Range in hardness	Median hardness
Alabama	24	7-115	41	Nebraska	13	155-370	284
Arizona	25	12-500	190	Nevada	10	33-320	202
Arkansas	28	10-250	35	New Hampshire	11	10-121	21
California	88	18-561	167	New Jersey	40	5-251	66
Colorado	12	11-308	64	New Mexico	14	35-626	212
Connecticut	22	11-46	28	New York	63	7-292	81
Delaware	9	22-144	35	North Carolina	42	6-195	23
District of Columbia	1	--	84	North Dakota	11	51-445	257
Florida	29	12-1,060	200	Ohio	43	95-677	217
Georgia	34	10-360	48	Oklahoma	28	8-700	134
Idaho	18	8-354	105	Oregon	15	8-95	35
Illinois	33	126-565	225	Pennsylvania	66	5-314	68
Indiana	38	112-640	285	Rhode Island	13	10-68	26
Iowa	37	96-632	268	South Carolina	35	3-107	16
Kansas	28	115-548	250	South Dakota	13	193-673	281
Kentucky	21	12-350	100	Tennessee	22	25-161	86
Louisiana	17	2-395	90	Texas	80	4-700	126
Maine	15	8-63	18	Utah	15	152-349	198
Maryland	11	3-80	32	Vermont	12	16-121	57
Massachusetts	47	8-95	28	Virginia	34	7-330	44
Michigan	33	43-405	185	Washington	23	12-155	46
Minnesota	23	44-464	250	West Virginia	21	16-264	87
Mississippi	23	3-226	20	Wisconsin	24	50-500	168
Missouri	23	55-317	183	Wyoming	13	12-700	150
Montana	16	3-404	144				

The range in hardness as shown in these two tables is the range in the average hardnesses for the number of supplies as indicated for each State. No intent is made to show the range in hardness of the individual supplies of each city. The tables show that for some States the range in average hardness of the supplies is comparatively small, whereas for other States it is large. The lower limits of the range in average hardness for all the States for finished-water supplies range from 2 to 152 parts, the upper limits from 46 to 709 parts. For the raw-water supplies, the lower limits of the range in average hardness for all the States is 2 to 193 parts; the upper limits, 46 to 1,060 parts. The ranges in average hardnesses, as here shown for the public water supplies included in this report for each State, tend to emphasize the fact that erroneous conclusions may be drawn from averages of hardness for each State.

The median of the average hardnesses is that value below which there are as many supplies with hardness less than the median as there are supplies with hardness greater than the median. The difference between the average hardness and the median indicates the difference in balance of the hardnesses of supplies with less and greater hardness than the median.

All data on hardness of public water supplies, by States, for the places included in this report are shown in summary table 14, in which are summarized the data on weighted average hardness, average hardness, and median hardness.

Table 14.--Summary of data on hardness of public water supplies, by States, for 1,315 of the larger cities in the United States, 1952

State	Finished water			Raw water		
	Weighted average hardness	Average hardness	Median hardness	Weighted average hardness	Average hardness	Median hardness
Alabama	55	56	49	47	46	41
Arizona	216	208	185	215	209	190
Arkansas	42	61	45	36	61	35
California	118	160	152	188	187	167
Colorado	107	106	68	110	89	64
Connecticut	21	29	32	27	28	28
Delaware	60	75	61	55	66	35
District of Columbia	96	96	96	84	84	84
Florida	123	91	91	216	222	200
Georgia	41	76	50	44	78	48
Idaho	119	136	125	119	131	105
Illinois	156	215	144	162	252	225
Indiana	237	272	286	251	284	285
Iowa	212	235	192	286	299	268
Kansas	176	185	130	245	262	250
Kentucky	102	101	107	116	109	100
Louisiana	68	64	76	101	103	90
Maine	20	23	18	18	21	18
Maryland	48	40	35	38	34	32
Massachusetts	23	36	39	22	34	28
Michigan	115	160	132	140	207	185
Minnesota	114	224	241	177	251	250
Mississippi	39	35	23	31	37	20
Missouri	106	141	120	133	188	183
Montana	120	137	121	121	139	144
Nebraska	247	254	274	250	267	284
Nevada	135	154	162	147	174	202
New Hampshire	28	30	21	29	31	21
New Jersey	75	86	67	73	85	66
New Mexico	237	271	168	244	284	212
New York	52	74	82	52	87	81

Table 14. --Summary of data on hardness of public water supplies, by States, for 1,315 of the larger cities in the United States, 1952--Continued

State	Finished water			Raw water		
	Weighted average hardness	Average hardness	Median hardness	Weighted average hardness	Average hardness	Median hardness
North Carolina ..	34	38	36	28	32	23
North Dakota	170	192	152	283	262	257
Ohio	150	155	120	179	240	217
Oklahoma.....	125	169	130	160	196	134
Oregon	17	37	36	15	33	35
Pennsylvania ...	86	81	72	91	89	68
Rhode Island ...	32	34	30	21	29	26
South Carolina ..	18	22	17	18	19	16
South Dakota	299	292	255	362	392	281
Tennessee	70	86	79	66	85	86
Texas	132	144	96	153	148	126
Utah	191	217	198	191	217	198
Vermont.....	53	64	58	53	64	57
Virginia	65	70	45	54	69	44
Washington	44	52	46	45	52	46
West Virginia ...	88	94	70	86	100	87
Wisconsin	167	195	131	171	203	168
Wyoming	171	211	170	171	221	150
United States..	97	121	91	116	139	90

SOURCES AND TREATMENT OF PUBLIC WATER SUPPLIES

Table 15 is a tabulation of data as to sources and general methods of treatment relative to the public water supplies of the larger cities of the United States in 1952. The data for the table were taken from those shown for the supply for each place in the report.

Table 15. --Source and treatment of the public water supplies for 1,315 of the larger cities in the United States, 1952

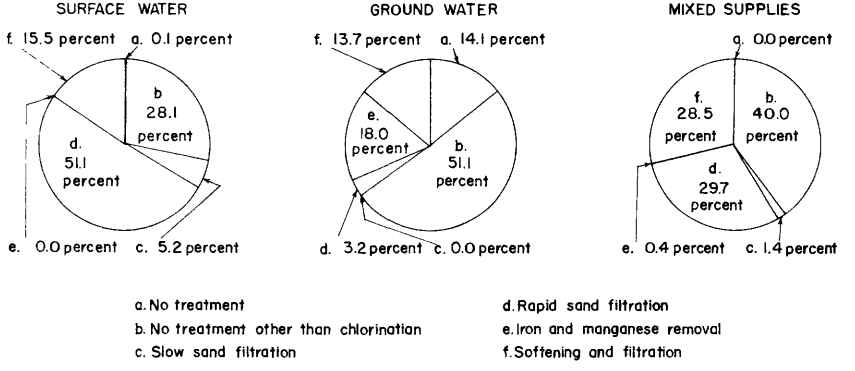
Source and treatment	Number of places	Population served		
		Thousands	Percent	Percent of population of United States
Surface water:				
No treatment	3	95	0.1	0.1
No treatment other than chlorination	143	18,095	28.1	12.0
Slow sand filtration	28	3,348	5.2	2.2
Rapid sand filtration	459	32,867	51.1	21.8
Softening				
With lime	44	3,917	6.1	2.6
With lime-soda ash	31	3,163	4.9	2.1
By cation exchange	3	2,859	4.5	1.9
Total softened supplies	78	9,939	15.5	6.6
Total surface-water supplies	711	64,344	100.0	42.7
Ground water (wells, infiltration galleries, and springs):				
No treatment	114	2,025	14.1	1.4
No treatment other than chlorination	213	7,335	51.0	4.9
Iron and manganese removal	64	2,594	18.0	1.7
Slow sand filtration	0	0	0	0
Rapid sand filtration	16	463	3.2	.3
Softening				
With lime	31	1,114	7.7	.7
With lime-soda ash	20	524	3.6	.4
By cation exchange	14	340	2.4	.2
Total softened supplies	65	1,978	13.7	1.3
Total ground-water supplies	472	14,395	100.0	9.6
Mixed supplies (surface and ground water):				
No treatment	0	0	0	0
No treatment other than chlorination	37	3,631	40.0	2.4
Iron and manganese removal	2	41	.4	.0
Slow sand filtration	7	132	1.4	.1
Rapid sand filtration	58	2,694	29.7	1.8
Softening				
With lime	10	1,164	12.8	.8
With lime-soda ash	12	1,096	12.1	.7
By cation exchange	6	329	3.6	.2
Total softened supplies	28	2,589	28.5	1.7
Total mixed supplies	132	9,087	100.0	6.0
Total all softened supplies	171	14,506	16.5	9.6
Total all supplies	1,315	87,826	100.0	58.3

NATURAL SURFACE WATER

Of the 711 places included in this report that are supplied with surface water only, 3 receive no treatment and 143 receive no treatment other than chlorination. See table 15 and fig. 2. The population thus served represents 28.2 percent of the population served with surface supplies only, and 12 percent of the total population of the United States. Falling into this category are some of the largest public supplies of the country. These supplies are usually taken from large lakes or from impounding reservoirs on streams that drain protected uninhabited watersheds. The storage capacity of these lakes and reservoirs is usually so large in relation to demand that sufficient time is given for the settling of any suspended matter and for natural purification. The growth of algae in these open bodies of water can be very troublesome.

Many of these waters are soft and contain small quantities of mineral matter in solution. Some may have little color, others may be highly colored. The lack of hardness and dissolved minerals are desirable characteristics as far as domestic use and many industrial uses are concerned, but on the other hand these waters are likely to be corrosive and may cause trouble in service mains and plumbing installations. Some of the waters that are not corrosive may be equally troublesome because of their hardness and mineral content.

The current trend is to treat public supplies so as to make them not only safe for drinking from a sanitary point of view but more satisfactory for general use and to protect expensive water-supply systems from corrosion and resultant troubles.



a. No treatment
b. No treatment other than chlorination
c. Slow sand filtration
d. Rapid sand filtration
e. Iron and manganese removal
f. Softening and filtration

TREATED SURFACE WATER

A total of 487 places of all the places supplies with surface water included in this report were furnished with water filtered through sand filters, exclusive of those supplies filtered in conjunction with softening. Of the population supplied with filtered water, 5.2 percent received water from slow sand filters, and 51.1 percent, from rapid sand filters. Seventy-eight of the surface water supplies were softened. These softened supplies represented 15.5 percent of population furnished with surface water only.

A total of 71.4 percent of the population served with surface water received water that was given more treatment than just chlorination. The above total does not include the surface water mixed with ground water and classed as mixed supplies.

GROUND WATER

Ground water, although used exclusively by only 472 of the places included in this report is used by the greater part of the rural population of the country and by the smaller cities and towns. Ground water is less subject to changes in chemical composition than surface water, is generally clearer, and is cooler in summer. On the other hand, ground water usually contains more dissolved mineral matter and frequently objectionable quantities of iron. Supplies from shallow sources and springs are sometimes subject to pollution.

The population served exclusively by ground-water supplies of the places in this report represents 16.4 percent of the total population of the 1,315 places, and only 9.6 percent of the total population of the country. Of the 472 places served with ground water, 114 places received water with no treatment; 213 places received water with no treatment other than chlorination. The population of these 327 places represents about 65 percent of the total population served exclusively with ground water. Sixty-five places were served with softened water, the population of which places represents about 14 percent of the total population served with ground water.

MIXED SUPPLIES

The population of 132 of the 1,315 places in this report was furnished with supplies, classed as mixed, from both surface and ground sources. In some instances the water from one source was not mixed with that from the other before entering the city mains; in other instances the water from the two sources was mixed prior to entering the mains. In some instances one or more sections of a city was furnished with water from one source, while at the same time other sections were furnished water from the other source. Ground water made up about 27 percent of the total supply of these places furnished with mixed supplies. The population served with mixed supplies is about 10 percent of the total population of the 1,315 places included in this report and 6.0 percent of the population of the country.

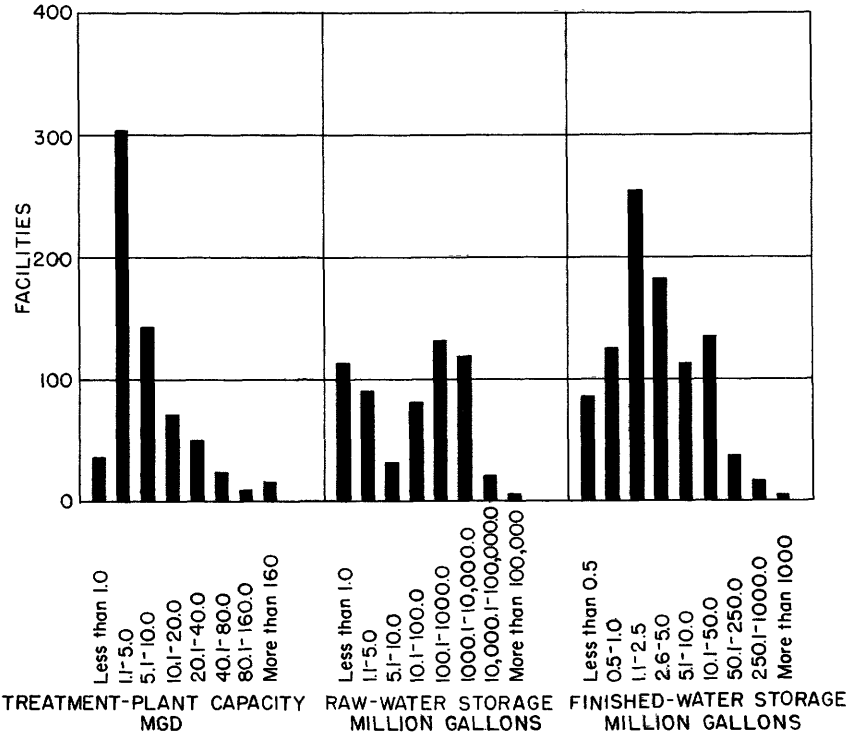
Most of these places received water which was given more treatment than chlorination. Most of the supplies were filtered or softened. In some instances one part of the supply received no treatment other than chlorination, whereas the other part received more treatment.

PHYSICAL PLANT FACILITIES

Data relative to the physical plant facilities for treatment, raw-water storage, and finished-water storage for most of the places included in this report, are shown in table 16 and graphically in figure 3. Facilities for chlorination only are not included in the statistics relative to the number and capacities of the treatment plants. For a few places the capacities of the treatment plants are not shown. Facilities for the storage of raw and finished water are included for all places included in the report for which storage data are shown. For some places storage data were not available or were not reported. In the tabulation of the data, chlorinated water is considered finished water. Many large cities, the supplies of which are taken from natural lakes or from large streams, have few facilities for raw-water storage and have no particular need for them. Many places taking their supplies from wells have few facilities for raw-water storage since many such supplies are pumped directly into the distribution systems.

Table 16. --Physical plant facilities for public water supplies for the larger cities in the United States, 1952

State	Treatment plants		Raw-water storage		Finished-water storage	
	Number of plants	Total capacity (mgd)	Number of places	Capacity (mg)	Number of places	Capacity (mg)
Alabama	15	139	11	5,736	24	61
Arizona	5	43	9	8,598	9	172
Arkansas	20	74	7	17,498	26	74
California	17	652	55	621,233	39	1,956
Colorado	7	242	15	187,354	7	221
Connecticut	10	115	21	113,154	11	1,260
Delaware	5	6	5	100	6	4
District of Columbia	2	225	1	560	1	118
Florida	17	217	10	766	24	59
Georgia	19	217	16	1,238	29	78
Idaho	4	19	11	3,015	7	22
Illinois	21	494	10	15,631	41	789
Indiana	23	317	13	7,993	30	141
Iowa	19	136	15	2,404	30	125
Kansas	17	150	9	1,039	19	10
Kentucky	16	222	11	3,058	21	164
Louisiana	11	185	6	40	13	45
Maine	4	20	8	8,774	17	162
Maryland	8	315	10	59,036	11	847
Massachusetts	13	116	52	562,570	50	2,570
Michigan	18	889	10	1,641	38	288
Minnesota	8	349	5	6,755	20	223
Mississippi	9	35	7	1,209	18	28
Missouri	18	503	14	4,176	28	379
Montana	4	53	11	18,279	6	33
Nebraska	4	123	7	96	5	95
Nevada	1	2	7	119	3	7
New Hampshire	3	6	7	9,536	7	85
New Jersey	15	300	36	54	50	1
New Mexico	2	4	9	2,851	9	47
New York	36	498	30	377,798	51	5,225
North Carolina	39	187	27	48,856	40	169
North Dakota	7	26	4	7	10	191
Ohio	31	888	28	32,164	46	686
Oklahoma	21	161	18	107,974	24	128
Oregon	6	45	6	15	15	385
Pennsylvania	35	936	36	49,028	45	2,502
Rhode Island	5	111	15	6,440	15	93
South Carolina	22	94	20	5,483	29	75
South Dakota	8	27	2	3,876	11	38
Tennessee	16	212	2	2	19	156
Texas	36	605	33	119,719	65	497
Utah	0	0	9	1,685	4	66
Vermont	1	6	8	1,606	5	56
Virginia	24	257	19	30,564	30	3,222
Washington	4	24	8	8,371	19	755
West Virginia	18	133	8	1,501	21	60
Wisconsin	12	293	7	20	26	140
Wyoming	4	23	5	724	7	49
Total	660	10,694	693	2,460,346	1,081	24,557



TREATMENT OF WATER

The treatment of water for public supplies is comprehensively discussed in technical books expressly written for that purpose (Amer. Water Works Assoc., 1950; Hopkins, 1948; Nordell, 1951). Improvements in the design of waterworks equipment and installations and the processes involved in the treatment and purification of water supplies are generally reported in the Journal of the American Water Works Association and other waterworks publications of a technical or professional nature. Statistics and descriptions have been collected for practically all public water-supply systems and purifications plants of the country. (U. S. Public Health Service, 1948).

The general discussions in this report relative to the treatment of public water supplies are of necessity brief and are intended to be mainly explanatory in character as to the data contained herein. The descriptions given of the treatment of some of the individual supplies are incomplete, and others are lacking in detail, but it is hoped that the descriptions that are given will be of some aid to those using the report, and of value in the interpretation and avaluation of the analytical data for each supply.

NATURAL PURIFICATION

It is generally recognized that waters impounded in artificial lakes and reservoirs improve in quality from storage. Suspended matter settles out, and the amount of color and the number of pathogenic and other bacteria decrease. On the other hand, conditions are favorable for the growth of algae and other microorganisms. Sanitary conditions within the catchment area of such supplies are

usually carefully controlled to prevent pollution of the supply.

On account of the great increase in urban population and industrial development, and the resultant pollution of many streams, relatively few places depend on natural purification of their supplies. Chlorine is regularly applied as a safety measure to those supplies that have no other treatment than natural purification.

FILTRATION

Filtration, simply defined, is a process of clearing a liquid of suspended material. Filtration in water treatment and purification is of extreme importance. Sand is usually the filtering medium, and the two principal types of filters are rapid sand filters and slow sand filters. The essential difference between filtration by means of rapid sand filters and slow sand filters is in the treatment of the raw water preceding filtration, the rate of filtration, and the method of cleaning the filters. The preliminary treatment of the raw water is important in the efficient operation of filters of both types. The rate of filtration is as much as 50 times more rapid in the rapid sand filter than in the slow sand filter. The rapid sand filter is cleansed or is washed by reversing the flow of water through the filtering medium, and the slow sand filter by removing and cleaning the top layer of sand.

Other filtering media and other types of filters are used in the treatment of water. Crushed and graded anthracite coal is sometimes used instead of sand and gravel. The rate of filtration through anthracite coal is more rapid than through sand, and the velocity needed for the wash water is lower, but coal is more expensive than sand and gravel. Pressure types of filters with upward or downward flow are used as opposed to the sand filters with gravity flow. Pressure filters may be horizontal as well as vertical in design. Pretreatment of the water is as necessary for the pressure filters as it is for the more conventional type sand filter.

RAPID SAND FILTRATION

The essential processes in the treatment of water where rapid sand filters are concerned are coagulation and sedimentation preceding filtration.

Plain sedimentation.--Plain or primary sedimentation, differentiated from that which follows after the addition of the coagulants to the raw water, is accomplished at many plants by allowing the raw water to stand in large basins or reservoirs for a length of time sufficient for the greater quantity of the suspended material to settle out. Finely divided and colloidal materials do not readily settle out, making it necessary to add coagulants before the filtration process. Plain sedimentation is an important preliminary step in the treatment of turbid waters even where rapid sand filters are used and is absolutely essential where slow sand filters are used, if coagulation is not used prior to filtration. Earlier this was the only treatment given surface waters, but the current practice is not to rely on plain sedimentation as a means of water purification. Impounded reservoir supplies are usually chlorinated as an added precaution when no other treatment is given.

Provisions are usually necessary for the removal of the settled material from reservoirs and basins by operation of sluice gates or other means. Capacity of reservoirs can be greatly lessened by this settled material and the useful life of the reservoir limited.

Coagulation.--To settle out the finely divided solid material, colloidal material, and bacteria and other micro-organisms, it is necessary to apply coagulants to the raw water after plain sedimentation. The most commonly used coagulant is aluminum sulfate, referred to as alum. Ferrous sulfate and ferric sulfate are less commonly used. Other coagulants are ferric chloride, sodium aluminate, sodium silicate, and bentonite. Lime and soda ash as conditioning agents are frequently used in conjunction with coagulants. Activated silica, originally sug-

gested by Baylis (1937) as an aid in coagulation, is finding increasing use as a coagulant in softening plants (Black, 1948) and in other treatment plants (Hay, 1944). Different coagulants have specific merits which must be recognized in selecting the ones to be used. Coagulants, either in dry or liquid form, are fed to the raw water by various regulating feeding devices. The ease in handling and application of the coagulant is sometimes an important consideration in the selection of the coagulant to be used.

The addition of alum in the coagulation process increases the sulfate content, reduces the alkalinity of the water, and tends to leave the water somewhat corrosive. The increase in the sulfate content of the water is of minor significance in the industrial use of the water. The adjustment of the pH of the water is usually necessary before delivery to the mains.

The action of the coagulant is to clump together the suspended material, so that it and most of the coagulant may settle out prior to filtration. Proper coagulation and subsequent settling are very important in the efficient operation of the modern rapid sand filtration plant. The quantity or dosage of coagulant to be added to the raw water was based formerly on the turbidity, later on the alkalinity of the water. Current practice is to determine the proper dosage by trial. Turbidity, pH, temperature of the water, and length of time of mixing are factors to be considered in determining the proper dosage. Finely divided suspended material is more difficult to coagulate than larger particles. Good coagulation is obtained only at definite pH ranges, and in some waters adjustment of pH is necessary. Length of time of mixing and temperature of the water affect coagulation and flocculation, and consequently the dosage required. The variable character of a water and the different types of waters must be considered; strict laboratory control is necessary throughout the whole treatment process.

Mixing and settling basins, filters.--There are various types of mixing basins, the function of which are to mix the chemicals with the water quickly and uniformly so as to bring about the proper flocculation of the coagulant and to keep the water in motion a certain length of time before it enters the settling basins or sedimentation basins. The coagulated water is detained in the settling basins to allow the floc to settle out. The design and arrangement of the settling basins are such that this settled floc or sludge can be removed continuously or periodically. The water finally enters the filters from the settling basins practically free of suspended matter and floc and a great many bacteria and micro-organisms.

The rapid sand filter is usually rectangular in shape, filled to the desired depth with graded gravel and sand, equipped with a system of underdrains to carry off the filtered water, and a means of washing by an upward flow of water.

The rate of flow of water through the filter is usually 2 to 3 gallons per minute per square foot of filter surface. The filtering rate and loss of head at most modern plants are recorded automatically. Washing is necessary when there is loss of head and flow of water through the filter. The washing process consists basically in an upward flow of water through the filter bed at such velocity that the filtering sand layer is agitated sufficiently to clean it of the material to be removed yet without appreciable loss of filter sand. Mechanical means of agitating the sand are sometimes employed during the washing process. The efficient operation of rapid sand filters requires constant attention to give an effluent of high quality.

SLOW SAND FILTRATION

Slow sand filters are the older type of sand filters and are often referred to as the European type, as compared with the rapid sand filters or the American type.

The filtering units are usually of large size requiring much more space, and therefore construction costs are much greater than for rapid sand filters of the same capacity. The rates of filtration range from 2 to 10 million gallons per acre of sand surface per day as compared to the 125 million gallons or more of the rapid sand filter.

Filtration by slow sand filters is definitely limited to waters of low turbidity, usually less than 20 parts (silica standard), of low color, and of low bacterial load. Water from lakes and large reservoirs may be filtered by slow sand filters without

pretreatment.

Slow sand filters are efficient in the removal of taste and odor because biological activity in the filters changes the forms of nitrogen and destroys some forms of organic matter. They can be operated with a minimum of attention. Because of construction costs and the lack of adaptability to waters of changing characteristics and to modifications of treatment of the water, few slow sand filters are being installed today.

DISINFECTION

Chlorine is the chief reagent used in the disinfection of water supplies and is added before delivery of the water to the mains. The quantity of chlorine to be added for effective disinfection depends upon the chlorine demand of the water. This quantity must satisfy the chlorine demand and leave a residual of free available chlorine of about 0.1 to 0.3 part per million. The chlorine residual can be conveniently determined by the well-known ortho-tolidine or ortho-tolidine arsenite test. Once the chlorine residual required for a water, determined by bacteriological check, is known, the chlorine dosage can be controlled to meet this requirement by an automatic feeding device. Excessive chlorination can thus be avoided.

Other agents used in the disinfection of water are chloride of lime, hypochlorites, chloramines, chlorine dioxide, ammonia in conjunction with chlorine, ozone, and ultra-violet light. Some of these agents find special application where control of tastes and odors are concerned, or where the volume of water to be treated is not large.

Prechlorination is practiced in many modern water-treatment plants. Numerous benefits result from the practice and in some instances it is a necessity, especially where control of tastes and odors are involved in the treatment scheme. In practice the chlorine may be added to the water before or with the coagulant. Prechlorination may find special application in waters softened with lime.

Superchlorination is practiced at some plants where the water is heavily polluted or contains taste-producing compounds. If the chlorine is added greatly in excess of the chlorine demand of the water, dechlorination, usually with sulfur dioxide or some of its derivatives, should follow to remove the surplus chlorine before the water enters the mains.

Chlorination does not normally affect the industrial value of the water except as it may affect the taste or odor.

ADJUSTMENT OF pH

Some adjustment of the pH of the water is usually necessary either during the main treatment process or before the filter effluent enters the mains. Finished water of too low pH will aggressively attack iron mains, resulting in the water carrying in solution troublesome quantities of iron, and damage to the mains by pitting and tuberculation. Lime or soda ash is usually used to adjust the pH of the water so that it will not be corrosive. Carbon dioxide is also used to adjust the pH of lime softened waters.

TASTES AND ODORS

One of the requirements of a good drinking water is that it be free of tastes and odors. Tastes and odors do not seriously affect the industrial use of water except in the food and beverage industries.

Tastes and odors in public water supplies may be divided into two general classes --those caused by plant growths of the algal type and those that are due to sewage and to polluting wastes from industrial plants such as coke, gas works, oil refinery, and cannery. The tastes and odors resulting from the growth and destruction of algae are usually accompanied by those resulting from decaying vegetation, such as

leaves, grass, and roots, and from bacterial slimes. The tastes and odors resulting from sewage and industrial pollution may be due to the tastes and odors of the polluting substances themselves or may be produced as a direct result of the presence of these substances in the water in the treatment process. These tastes and odors may be described as organic, medicated, or phenolic.

Various methods are used in the prevention and elimination of tastes and odors. Aeration is sufficient in some instances. Effective algicides are copper sulfate and chlorine, the latter either in elemental form or as calcium hypochlorite. But it must be emphasized that the growth of algae should be prevented or controlled, for the tastes and colors resulting from too great a destruction of algae is often worse than those produced by the algae in their life cycle. Activated carbon, usually added along with coagulants, is used at many plants. It may also be applied to reservoirs. Heavy application of chlorine in prechlorination or superchlorination is used in preventing so-called phenolic tastes as well as those resulting from heavy pollution. Ammonia, in conjunction with chlorine, also is used for the same purpose. In recent years chlorine dioxide is finding increasing application in the prevention and control of tastes and odors. (Aston, 1950.) The whole problem of prevention and elimination of tastes and odors is complicated.

IRON AND MANGANESE REMOVAL

Surface-water supplies, generally, have very little iron in solution. Some streams, however, receiving industrial wastes or acid mine drainage may carry objectionable quantities of iron and manganese as well. Some surface waters containing complex organic acids or substances may carry in solution considerable quantities of iron.

Many ground waters contain considerable quantities of iron dissolved from soil and rock material by carbon dioxide in solution in the water, in the absence of oxygen, as ferrous carbonate. Iron in solution as a result of oxidation of iron pyrites is present as ferrous sulfate. Organic acids in ground water may contribute to the solution of the iron. Many ground waters containing considerable quantities of iron frequently contain objectionable quantities of manganese.

The occurrence of iron in ground waters cannot be predicted with any degree of certainty. Samples of water from wells of about the same depth and in close proximity may differ decidedly in their iron content.

The principle of iron removal is simple but no single method may be entirely satisfactory because of the presence of other constituents, such as organic matter, manganese, and carbon dioxide. Iron in solution in the water in the ferrous condition is oxidized by aeration to ferric hydrate, which settles out. Surface-water supplies, because of natural aeration, require very little attention to iron removal. The regular treatment that is given most surface supplies and the aeration incident thereto is generally sufficient to remove most of the iron. If the water is softened, both iron and manganese are removed in the process. Some treated waters may dissolve iron from the distribution mains and service pipes.

Aeration followed by settling, and filtration through sand or fine gravel, will generally remove iron from most ground waters. Aeration not only brings the iron in water in contact with dissolved oxygen but releases carbon dioxide also, thus the precipitation of the iron is hastened. Aeration and oxidation may be accomplished by means of sprays, cascades, perforated trays, contact beds of coke, broken pebbles, coal, or some such material.

Manganese is not oxidized as readily as iron and a method of treatment that may be effective for iron removal may not be satisfactory for manganese removal. Manganese may be oxidized by chlorine, and catalytic manganese dioxide (Zapffe, 1933) deposited on contact beds of coke, coal, crushed stone, and the like. Such treatment followed by filtration effectively removes manganese. Carefully planned treatment is necessary for satisfactory removal of both iron and manganese (Nordell, 1951.)

Cation-exchange units will remove iron and manganese from waters provided the iron and manganese are in the soluble reduced state. Any prior oxidation of the iron before the water enters the exchange unit will result in the deposition of

oxidized iron on the exchanger, thus interfering with its effective action. These units are adaptable to the treatment of some well waters.

MUNICIPAL SOFTENING

Numerous data are available showing the value of the use of soft water and softened water supplies relative to soap consumption (Olson, 1939). The savings resulting from decreased soap consumption in many instances are sufficient to pay for the cost of softening the whole supply. Savings from decreased soap consumption is only one of the values resulting from the use of a softened public water supply. Many industries require soft process water and would be attracted to places where adequate supplies of such water are available.

The practice of softening of public water supplies is not new. (Baker, 1948.) It might be said as far as this country is concerned that it centered at Columbus, Ohio, because of the research carried on and the practices developed at the plant at that city. (Hoover, 1927, 1928, 1943.) The practice of softening public supplies has increased considerably since 1932. (Olson, 1945.)

A number of factors are involved in the proper selection of the method of softening water supplies, chief of which are the physical and chemical characteristics of the water and the extent of the reduction of the hardness. The softening process involves the removal by chemical precipitation or cation exchange of those substances in the water, principally calcium and magnesium, that cause hardness.

The larger municipalities use lime or the lime-soda ash process in softening their supplies. Lime is effective in removing carbonate hardness but soda ash in addition to lime is usually used to remove noncarbonate hardness. Excess lime serves the same purpose as soda ash in the excess lime treatment process. These methods of softening are used where the water generally requires filtration, volume demand is large, and competent technical supervision is provided.

Lime-softened waters are unstable (Hoover, 1942) being supersaturated with the normal carbonates of calcium and magnesium, and require recarbonation to prevent these carbonates from crystallizing out on the sand grains of a filter eventually destroying its effectiveness as a filter, or in the mains of the distribution system, lessening its capacity. When excess lime is used in the softening process, the softened water contains caustic alkalinity, and carbon dioxide is usually used to neutralize the excess lime. Phosphates are also used in stabilizing lime-softened waters.

The cation-exchange method of softening (Streicher and Bowers, 1950) involves the exchange of calcium and magnesium in the water for sodium in the exchange material. The exchange material when exhausted is regenerated with a solution of sodium chloride (common salt). Sea water or natural brines are used at a few plants. The operation of a cation-exchange softening plant requires less attention and less expert control than a lime or lime-soda ash softening plant. It is adaptable to those supplies where the water is relatively free of suspended matter and excessive quantities of iron and manganese and where the volume demand is not generally large.

It is not practical or desirable to soften a supply completely, although this is possible with a cation-exchange softener. At a few places this type of softener is used in conjunction with lime softening, employing what is known as split treatment. (Streicher, 1945.) Split treatment is used also in softening some groundwater supplies. In this method of treatment a portion of a supply may be completely softened by cation exchange, and then raw water, unsoftened water, or partially softened water may be mixed with it in such volume as to produce an effluent of a definite hardness.

Lime reduces the quantity of dissolved solids in water in the softening process; soda ash and cation exchangers do not.

The equipment required in water-softening plants using lime approximates that used in the filtrations plants of the rapid sand type. Greater facilities for handling chemicals are needed; some means for the production of carbon dioxide are required; and facilities for handling sludge are necessary. (American Water Works Assn., 1949). Some plants are recalcining the sludge and reusing the

lime or selling it for agriculture use.

Data in Water Supply Paper 658 in 1932 showed that of the 670 places in that report, 40 were furnished with softened water, representing a total population of 4,065,000, 7.2 percent of the total population of the 670 places, and 3.4 percent of the total population of the country. Data in table 11 of this report show that 171 places are furnished with softened water, representing a total population of 14,506,000, or 16.5 percent of the total population of the 1,315 places in this report and 9.6 percent of the total population of the country. Of the 670 places in Water Supply Paper 658 and also in this report, 85 places now have softened supplies. Thus 86 of the total of 171 places that have softened supplies are among the 645 places in this report but not in Water Supply Paper 658. These 645 places are small in population in comparison with the 670 places.

In this report the hardness of the public supplies that are softened ranges from less than 50 parts per million to about 150 parts. For many large supplies the hardness ranges between 70 and 85 parts. About one-third of the total population of the places in this report that receive softened water, receive water having a hardness greater than 100 parts per million. Many laundries and industrial plants require softer water than that furnished as public supplies and find it profitable and necessary to further soften. Municipalities can well afford to give more attention to softening of supplies to effect greater economies and satisfaction in the use of the water.

FLUORIDES AND FLUORIDATION

It was discovered about two decades ago that fluoride in drinking water caused the dental defect known as mottled enamel. (Churchill, 1931; Smith, Lantz, and Smith, 1931.) Through much study and observation as a result of this discovery the limit of fluoride concentration, below which mottling does not usually occur, was fairly well established. (Dean, 1936.) It was observed also that the prevalence of dental caries in areas where mottled enamel was endemic was no greater, in many instances less, than in areas where fluoride was not naturally present in the water supplies. (Dean, 1938.) Further study and observations along this line by Dean and his associates showed that there was a very definite relationship between fluoride in the water supplies and the prevalence of dental caries in the permanent teeth of children. (Dean, Jay, Arnold, and Elvove, 1941.) These and other studies showed that fluoride concentrations of about 1.0 to 1.5 parts per million in the water supplies, concentrations below which mottling of the enamel does not usually occur, greatly lessened the incidence of dental caries in the permanent teeth of children using the water. Other investigations showed also that fluoride compounds topically applied to the tooth surfaces of children's teeth lessened the incidence of caries (Knutson and Armstrong, 1943).

The results of these numerous studies and investigations naturally led to the question of fluoridation of water supplies in order to prevent or lessen the incidence of caries in the permanent teeth of children. Fluoridation has much support from dental and health associations. (Amer. Water Works Assn., 1952). In a news release of June 1, 1950, Assistant Surgeon General Bruce D. Forsyth of the U. S. Public Health Service, said:

"Artificial fluoridation of communal water supplies has been found to be effective in reducing the incidence and prevalence of dental caries among children as does water naturally containing fluorides. As a result of new evidence from its Grand Rapids project where community water has been fluoridated since January 25, 1945, the Public Health Service has now altered its basic policy to read: 'Using scientific methods and procedures, communities desiring to fluoridate their communal water supplies should be strongly urged to do so' ".

The compounds now most generally used for fluoridating public water supplies are sodium fluoride and sodium silicofluoride. Sodium fluoride is much more soluble than sodium silicofluoride, but it is much more costly per unit weight. Hydrofluosilicic acid is less frequently used, and hydrofluoric acid is rarely used. Because hydrofluoric acid is highly corrosive, its application requires considerable care.

The quantity of fluoride added to the water supply is such that the concentration as the fluoride ion generally ranges between 0.7 and 1.3 parts per million. The quantity of fluoride ingested by an individual will depend upon the quantity of water used by the individual and the fluoride content of the water. This quantity is further related to climatic conditions and the characteristics of the individual as to need for water. Some supplies may require only 0.7 part per million, whereas others may require nearly up to the permissible maximum of 1.5 parts. (U. S. Public Health, 1946.) The quantity of fluoride naturally present in the supply must be taken into account in fluoridating the supply. Some fluoride is removed by alum in the coagulation process in the regular treatment of public supplies and a larger quantity if the supply is softened, therefore, the application of the fluoride should be at such place in the treatment scheme so as not to be removed.

The practice of fluoridation has gained considerable impetus in the past 2 years (1951-52). At the time of the collection of most of the data on the supplies for the places in this report about 70 supplies were being fluoridated or facilities were under construction for fluoridating. However, since the collection of the data, and as of the end of the year 1952, reliable statistics (Amer. Water Works Assn., 1953) indicate that of the places in this report 155 were receiving fluoridated water, representing a population of about 12 million people or about 14 percent of the total population of all the places included in this report.

Table 17 shows the number of places and the population using water with different concentrations of fluoride from large public supplies at the time of the collection of these data. The table shows among other things that about 85 percent of the total population of the places in this report used water with a concentration of fluoride in the range of 0.0 to 0.5 part per million. A population of about 7 million people used water with a concentration of fluoride in the range of 0.6 to 1.5 parts per millions. Such a range of concentration of fluoride will include practically all those supplies that were being fluoridated at the time and in addition those supplies with natural fluoride of that range of concentration.

Table 17.--Number of places and population, in thousands, using water with different quantities of fluoride from large public supplies in the United States, 1952

Fluoride (ppm)	Surface supplies		Ground supplies		Mixed supplies		All supplies		Percent of total
	Places	Population	Places	Population	Places	Population	Places	Population	
<0.6	628	55,604	368	10,661	117	8,538	1,113	74,803	85.2
.6 - 1.0	39	3,991	56	2,120	6	132	101	6,243	7.1
1.1 - 1.5	10	412	16	302	3	52	29	766	.9
1.6 - 2.0	2	34	9	164	--	--	11	198	.2
2.1 - 3.0	1	65	5	149	--	--	6	214	.2
>3.0	--	--	6	136	--	--	6	136	.2
Not reported	31	4,238	12	863	6	365	49	5,466	6.2
Total	711	64,344	472	14,395	132	9,087	1,315	87,826	100

INDUSTRIAL TREATMENT OF WATER FROM PUBLIC SUPPLIES

The treatment that is given to a public water supply is planned primarily to give a water that is safe to drink and that is free from pathogenic bacteria, without too much regard for other uses of the water. The water may be generally satisfactory for most domestic uses, but many public supplies are far from satisfactory for many industrial uses. The additional treatment that may be required may range from almost nothing to that which includes sand filtration, softening, and corrosion control.

BOILER FEED WATER

One of the common uses of water from public supplies is in steam boilers for

the production of power and heat. Large boilers carrying high steam temperatures and pressures require water of rather exacting standards of quality. Table 18 suggests quality-tolerance limits for boiler-feed waters.

Table 18. --Suggested water-quality tolerance for boiler-feed water a/

	Allowable limits, in parts per million, for indicated pressure in lb/sq. in.			
	<150	150-250	250-400	>400
Oxygen consumed	15	10	4	3
Dissolved oxygen b/	1.4	.14	.0	.0
Hydrogen sulfide (H_2S)	c/5	c/3	0	0
Total hardness as $CaCO_3$	80	40	10	2
Aluminum oxide (Al_2O_3)	5	.5	.05	.01
Silica (SiO_2)	40	20	5	1
Bicarbonate (HCO_3) b/	50	30	5	0
Carbonate (CO_3)	200	100	40	20
Hydroxide (OH)	50	40	30	15
Total solids d/	3,000-500	2,500-500	1,500-100	50
Turbidity	20	10	5	1
Color	80	40	5	2
Sulfate-carbonate ratio (A. S. M. E.) (Na_2SO_4:Na_2CO_3)	1:1	2:1	3:1	3:1
pH value (minimum)	8.0	8.4	9.0	9.6

a/Moore, E. E., Progress report of the committee on quality tolerances of water for industrial uses: New England Water Works Assoc. Jour., v. 54, p. 263, 1940.

b/Limits applicable only to feed water entering boiler, not to original water supply.

c/Except when odor in live steam would be objectionable.

d/Depends on design of boiler.

The treatment of boiler water has received much attention generally. Details on the methods of treating water supplies for boiler feed, and on boiler-operating practices are found in books and papers on the subject. (Brown, 1946; Betz, 1953).

SCALE, CORROSION, EMBRITTLEMENT, FOAMING, AND PRIMING

Scaling in boilers and indirectly hardness in water supplies receive much attention in the treatment of boiler-feed waters. Scale consists of mineral deposits on boiler surfaces; it is composed principally of compounds of calcium and magnesium with usually smaller quantities of other substances such as silica and iron. Mineral matter in the boiler-feed water becomes greatly concentrated in the boiler; slightly soluble substances precipitate, and under the influence of heat, may be baked on the boiler surfaces as scale or carried as sludge in the boiler water.

Scale formed as a result of carbonate hardness in the water is usually more porous and less adherent than the scale formed as a result of noncarbonate-hardness minerals. Both may become hard and adherent because of the presence of some cementing material like silica or from conditions prevailing in the boiler. Silica scale, itself, is hard and adherent and of low thermal conductivity. Much use is made of phosphate compounds in the treatment of boiler waters in scale prevention and control. Silica may be removed by magnesium compounds in conjunction with hot lime or hot lime-soda softening.

Corrosion would result in a boiler from the use of a water containing noncarbonate hardness caused by the chlorides and nitrates of calcium and magnesium or by free acid. Such waters are rarely served to the public or used in boilers

without treatment. Dissolved gases--oxygen, carbon dioxide, ammonia--originally present in the boiler water, in the returned condensate, or formed as a result of the treatment, may corrode boilers. These gases may be removed by aeration or by daerating heaters. Controlled "causticity" or hydroxide concentration in boiler waters is important in the prevention of corrosion.

"Caustic embrittlement" or cracking of the boiler plate, a controversial subject for many years, may result from maintaining too high a causticity in the boiler water or from the use of waters containing considerable quantities of sodium bicarbonate or carbonate either originally present or as a result of treatment. It has been regarded by some as fundamentally due to poor boiler construction. The development of the embrittlement detector by the U. S. Bureau of Mines has facilitated the study of caustic embrittlement. (Schroeder and Berk, 1941.)

To prevent this type of failure, emphasis was formerly placed on the proper ratio of sulfate to carbonate in the boiler water; later investigations, however, have shown that the recommended ratios may not necessarily protect against embrittlement. (Berk and Schroeder, 1943.) Sodium nitrate and quebracho tannin (Bureau of Mines, 1951) are successfully used to prevent this type of failure. Simultaneous control of pH and of phosphate concentration in the boiler water may prevent embrittlement and is applicable where the water is primarily evaporated makeup or condensate.

Foaming and priming, associated activities in boiler waters, are attributed to a number of causes, some of which may be in the structural design and operation of the boiler itself. Foaming is generally attributed to too great a concentration in the water of soluble compounds of sodium and the presence of finely divided solids in suspension in the water. The standard method of controlling this condition, although sometimes not the most economical, is by blowdown to reduce the concentration of dissolved solids and to remove some of the sludge. Effective organic antifoam agents, such as polymerized esters, alcohols, and amides, have been developed in recent years. The insolubility of some of these agents in water makes it necessary to disperse them with other agents in feeding. Priming is usually the result of careless operation of the boiler.

SOFTENING

Municipal supplies when softened with lime and soda ash may contain anywhere from 25 to 100 parts per million or more of hardness. It is possible with the use of the cation-exchange type of softener to produce a completely softened water. However, for economical reasons this is rarely done in practice, except in the split treatment or in conjunction with lime softening. Many municipal supplies, even when softened, therefore, require softening for satisfactory use in boilers. The methods of softening employed may be hot lime, hot lime-soda ash, hot phosphate, and cation exchange. The method selected depends upon a number of factors, chief of which are character of the water, volume of water required, further treatment necessary after softening, and the conditions under which the boilers are operated.

INTERNAL TREATMENT

The practice of introducing chemicals in the water within the boiler to condition the water or make its use possible is known as internal treatment. (Blanning and Rich, 1934.) The practice began because of the inadequacy, in part, of the lime-soda softening or because of no treatment at all of waters used in boilers. Hardly any external treatment is adequate protection against scale formation of some kind; therefore the necessity for internal treatment.

These boiler compounds are both inorganic and organic in composition. They are used for the control of concentrations of carbonate and silica to prevent scale formation, corrosion, and such. The phosphate compounds, for example, are much used in the treatment of water that has already been softened with lime and

soda ash, or not softened at all, to further soften it and to prevent the formation of calcium scale in the boiler. Organic compounds such as tannin, lignin, agar, and starches are used in internal treatment. They are thought to have a dispersing action on inorganic precipitates or to exert to some extent a coating action on inorganic precipitates, decreasing their tendency to cohere and also adhere to the boiler surface.

Internal treatment may be used successfully where the water supply is only moderately hard and the boiler is operated at a moderate pressure and not at too high a rating. Internal treatment, rather than being a "cure all" for boiler operation difficulties, should supplement the rather thorough external treatment of the boiler water.

WATER FOR INDUSTRIAL PROCESSES

The use of huge volumes of water by industry demonstrates the extreme importance of water to industry, whether the water is used as an ingredient in the production of other materials, as a cleansing agent, or for cooling. Each industry requires a process water of characteristics peculiar to that industry, therefore, the requirements as to quality of process water are so varied that a water or a method of treatment that is entirely adequate for one process may not be suitable for another. (Nordell, 1951.) The following tables set forth some requirements as to both quantity and quality of water for a number of industrial uses.

Table 19.--Industrial requirements for water a/

Item	Unit	Water required (gal. per unit)
Airplane engine	to test	50,000-125,000
Alcohol	gal.	100
Aluminum	lb.	160
Aviation gas	gal.	7-10
Brewing:		
Beer	1 bbl.	470
Whiskey	gal.	80
Buildings:		
Office	person	b/27-45
Hospital	bed	b/135-350
Hotels	guest room	b/350-525
Laundries:		
Commercial	lb. "work"	4.3-5.7
Institutional	lb. "work"	3
Restaurants	meal	0.5-4.0
Butadiene	lb.	160
Canning:		
Apricots	100 cases No. 2 cans	8,000
Asparagus		7,000
Beans:		
Green		3,500
Lima		25,000
Pork and		3,500
Beets		2,500
Corn		2,500
Grapefruit:		
Juice		500
Sections		5,600
Peaches, pears		6,500
Peas		2,500
Pumpkin, squash		2,500
Sauerkraut		300
Spinach		16,000
Succotash		12,500
Tomatoes:		
Products		7,000
Whole		750
Cement	ton	750
Coke	100 tons	360,000
Distilling, grain:		
Combined wastes	1,000 bu. grain mashed	600,000
Thin slop		
Tailings		
Evaporator condensate		
Distilling, molasses	1,000 gal. 100 proof	8,400
Distilling, cooling water	1,000 gal. 100 proof	120,000
Electric power	kw.	80
Explosives	lb.	100+
Gasoline	gal.	7-10
Iron ore (brown ore)	ton	1,000
Meat:		
Packing house	100 hogs killed	550
Slaughterhouse	100 hogs killed	550
Stockyards	1 acre	160
Milk:		
Receiving station	1,000 raw lb.	180
Bottling works		250
Cheese factory		200
Creamery		110
Condensery		150
Dry milk factory		150
General dairy		340
Oil, edible	gal.	22
Oil field	100 bbl. crude	18,000
Oil refining	100 bbl.	77,000
Paper:		
Paper mill	1 ton	39,000
Pasteboard		14,000
Strawboard		26,000
Deinking		83,000
Paper pulp:		
Ground wood	1 ton dry	5,000
Soda		85,000
Sulfate		64,000
Sulfite		60,000
Poultry	1 bird	b/1
Rail freight	ton-mile	0.1
Records	1 disc	2.4
Smokeless powder	ton	50,000
Soap factories	ton	500
Steam power	ton of coal	c/60,000-120,000
Sugar refineries	lb.	0.5
Tanning:		
Vegetable	100-lb. raw hide	800
Chrome	100 lb. raw hide	800
Textile:		
Cotton:	1,000 lb. processed	
Sizing		820
Desizing		1,750
Kiering		1,240
Bleaching		300
Souring		3,400
Mercerizing		30,000
Dyeing:		
Basic		18,000
Direct		6,400
Vat		19,000
Sulfur		5,400
Developed		14,400
Naphthol		4,800
Aniline black		15,600
Print works		4,500
Finishing		6
Knit goods	lb. bleached	8
Rayon manufacture	1,000 lb. produced	135,000-160,000
Rayon hosiery	1,000 produced	9,000
Woolens	1,000 lb. finished	70,000

a/Jordan, H. E., Industrial requirements for water: American Water Works Assoc., v. 38, p. 66-67, 1946.
b/Per day.
c/60,000 for recirculating systems, 120,000 for nonrecirculating systems.

Table 20.--Suggested water-quality tolerances a/
(Allowable limits in parts per million)

Industry or use	Turbidity	Color	Hardness as $CaCO_3$	Iron (Fe)	Manganese (Mn)	Total solids	Alkalinity as $CaCO_3$	Odor, Taste	Hydrogen sulfide	Other requirements b/
Air conditioning	--	--	--	c/0.5	0.5	--	--	low	1	No corrosiveness, slime formation.
Baking	10	10	--	c/.2	.2	--	--	low	.2	P.
Brewing:										
Light beer	10	--	--	c/.1	.1	500	75	low	.2	P. NaCl less than 275 ppm (pH 6.5-7.0.)
Dark beer	10	--	--	c/.1	.1	1,000	150	low	.2	P. NaCl less than 275 ppm (pH 7.0 or more).
Canning:										
Legumes	10	--	25-75	c/.2	.2	--	--	low	1	P.
General	10	--	--	c/.2	.2	--	--	low	1	P.
Carbonated beverages	2	10	250	.2	.2	850	50-100	low	.2	P. Organic color plus oxygen consumed less than 10 ppm.
Confectionery	--	--	--	c/.2	.2	100	--	low	.2	P. pH above 7.0 for hard candy.
Cooling	50	--	50	c/.5	.5	--	--	--	5	No corrosiveness, slime formation.
Food: General	10	--	--	c/.2	.2	--	--	low	--	P.
Ice	5	5	--	c/.2	.2	--	--	low	--	P. SiO_2 less than 10 ppm.
Laundnring	--	--	50	c/.2	.2	--	--	--	--	
Plastics, clear, uncolored	2	2	--	c/.02	.02	200	--	--	--	
Paper and pulp:										
Groundwood	50	20	180	c/1.0	.5	--	--	--	--	No grit, corrosiveness.
Kraft pulp	25	15	100	c/.2	.1	300	--	--	--	
Soda and sulfite	15	10	100	c/.1	.05	200	--	--	--	
High-grade light papers	5	5	50	c/.1	.05	200	--	--	--	
Rayon (viscose):										
Pulp prodnction	5	5	8	c/.05	.03	100	total 50; hydroxide 8	--	--	Al_2O_3 less than 8 ppm, SiO_2 less than 25 ppm, Cu less than 5 ppm.
Manufacture	.3	--	55	.0	.0	--	--	--	--	pH 7.8 to 8.3.
Tanning	20	10-100	50-135	c/.2	.2	--	total 135; hydroxide 8	--	--	
Textiles: General	5	20	--	.25	.25	--	--	--	--	
Dyeing	5	5-20	--	c/.25	.25	200	--	--	--	Constant composition. Residual alumina less than 0.5 ppm.
Wool scouring	--	70	--	c/1.0	1.0	--	--	--	--	
Cotton bandage	5	5	--	c/.2	.2	--	--	low	--	

a/Moore, E. W., Progress report of the committee on quality tolerances of water for industrial uses: New England Wnter Works Assoc. Jour., v. 54, p. 271, 1940.
b/P indicates thnt potable wnter, conforming to U. S. Public Health Service standards, is necessary.
c/Limit given applies to both iron alone and the sum of iron and manganese.

Water that is used in the processing of foods and beverages must be safe for drinking, that is, free of pathogenic bacteria. Water that is used in washing and rinsing of food products prior to the actual processing should be free of pathogenic bacteria and other organisms that might subsequently cause food spoilage.

The most common improvement made in water from public supplies for use in industrial processes is softening. Softening may be accomplished by the methods used for boiler waters plus any other treatment necessary to meet specific requirements. Softening by cation exchange is practicable and profitable for laundries.

Water used for baking should be free of substances that might produce undesirable tastes, odors, and colors. Too much hardness in the water retards fermentation processes, although some calcium is necessary for some yeast action, and too little softens the gluten resulting in soggy bread. Water of zero hardness is used in making certain bakery products.

The quality of the water used in brewing (Pozen, 1940) affects considerably the final product. Waters low in alkalinity and comparatively high in calcium sulfate are desirable. Moderate quantities of chlorides also seem to be beneficial. Water used in the production of carbonated beverages should be free of suspended matter, color, tastes and odors, iron, manganese, and must be low in alkalinity because of the acid nature of the product. (Gullo, 1951.)

Process water for canning and freezing of foods should be free of tastes and odors, color, organic matter, iron, and manganese. Hardness causes toughening of some foods, such as peas and beans, and may cause deposits on others. (Lancefield, 1938.)

Water used in the manufacture of ice should be free of iron, manganese, tastes and odors, and should be low in dissolved solids. (West, 1944.) Calcium and magnesium can be rather easily removed, but the remaining salts are almost as troublesome as calcium. The use of demineralizing resins or distillation may be resorted to in order to remove certain elements not removed in ordinary treatment. The upper concentrations limits of minerals in water used in ice manufacture will depend to some extent on the practices followed in the actual freezing process itself.

Process water used in the manufacture of textiles and fine paper should be practically free of suspended matter, color, iron, and manganese. Iron and manganese cause staining, and color may be adsorbed resulting in an inferior product (Miller, 1944). Hardness interferes in washing operations, dyeing of fabrics, and in sizing of paper, although it is reported that some hardness is desirable in water used for scouring of wool.

Corrosion and scaling would result from the use of many public water supplies in cooling systems (Powell, 1948.) Corrosion may be lessened by the adjustment of the pH of the supply and the use of protective coatings for the pipes. Scale formation may be minimized by the use of organic inhibitors such as tannin or by treatment with phosphates and silicates.

DOMESTIC TREATMENT OF WATER FROM PUBLIC SUPPLIES

The treatment given to public water supplies undoubtedly is receiving more attention today than ever before. Domestic users and industry in general have more or less indirectly demanded this increased attention to treatment. The sanitary conditions of many streams and lakes are such that increased treatment of the supplies is required to make them satisfactory as public supplies. Many public supplies may be further improved by treatment for household use.

Hardness is objectionable in many public supplies and the installation of domestic softeners is often desirable as a matter of economy and satisfaction in the use of the water. The savings resulting from softening in decreased soap consumption, smaller plumbing repair bills, and longer life of hot-water heating equipment often more than pay for such equipment. Even where public supplies are softened in very hard water areas it is often desirable to further soften them in the home.

The cation-exchange type of softener is especially adapted for use in homes. Low cost of installation and simplicity of operation, in some types automatic, are attractive features, aside from the fact of being capable of delivering completely softened water which is so desirable in cleaning and laundering. The sodium cation exchanger in operation removes calcium and magnesium from the water in exchange for the sodium in the exchange material. This reaction is reversible. When the exchange material's capacity for softening is exhausted, it is regenerated by treating the exchange material with a solution of sodium chloride (common salt). Sodium from the salt solution is taken up by the exchange material and calcium and magnesium are released. Excess salt solution is washed out and the exchanger is ready again for softening.

Where public supplies are not softened, softening or conditioning agents, such as ammonia, borax, sodium carbonate, and such are much used in cleansing and laundering in the home. Trisodium sodium phosphate under various trade names is much used in this respect. Synthetic detergents, "soapless soaps", have recently been developed and are finding special application not only in the home but in industry as well. These agents, in common with soaps, possess properties of wetting, dispersing, and emulsifying, although they may not be equally effective for all three purposes. They are produced in greater variety than soaps, more specifically suited to an express purpose under a variety of conditions, are finding ready markets, and are replacing soaps for many purposes. (Larson, 1949.)

Home equipment is available from plumbing establishments and manufacters of water-conditioning equipment for control of corrosion in water pipes to prevent "red water" troubles. Most of these are designed to raise the pH of the water supply to make it less aggressive to metal surfaces.

Equipment or devices for elimination of tastes and odors may be used to some extent in homes, although it is not generally practicable to do much in a home to improve the taste or odor of a public supply.

PUBLICATIONS

The following reports contain information relating to the quality of the surface water of the United States and to the public water supplies of the United States and of several States. The reports were prepared by the U. S. Geological Survey or by the Survey with cooperating State agencies. Most of the reports listed are available for consultation in the larger public and institutional libraries. Copies of Geological Survey publications, except circulars, still in print may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., who will furnish lists and prices upon request. Publications out of print are preceded by an asterisk. Circulars may be obtained free of charge on application to the Director, U. S. Geological Survey, Washington 25, D. C., as long as stocks are available.

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912. Industrial utility of public water supplies in Georgia, 1940.
942. Quality of surface waters of the United States, 1941.
950. Quality of surface waters of the United States, 1942.
970. Quality of surface waters of the United States, 1943.
1022. Quality of surface waters of the United States, 1944.
1030. Quality of surface waters of the United States, 1945.
1047. Public water supplies in Eastern Texas.
1050. Quality of surface waters of the United States, 1946.
1069. Public water supplies in Central and North-Central Texas.
1070. Public water supplies in Southern Texas.
1102. Quality of surface waters of the United States, 1947.
1106. Public water supplies in Western Texas.
1132. (Parts 1-6) Quality of surface waters of the United States, 1948.
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*203. The industrial utility of public water supplies in the Mountain States, 1952.

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*232. The industrial utility of public water supplies in the Pacific States, 1952.
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*269. The industrial utility of public water supplies in the South Atlantic States, 1952.
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DESCRIPTIONS AND ANALYSES OF PUBLIC WATER SUPPLIES IN THE STATES WEST OF THE MISSISSIPPI RIVER

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 field[a]	Overlock addition well		Main well field[a]	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	Sept. 12, 1951	Sept. 12, 1951
Nitrate (NO_3)	1.8	12			
Dissolved solids	930	330			

[a] 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.

FLAGSTAFF--Continued

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	Feb. 5, 1952	Feb. 5, 1952	July 31, 1951

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.

GLENDALE--Continued

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)	121	61	pH	8.1	7.8
Potassium (K)			Specific conductance (micromhos at 25 C.)	713	578
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	85	138	Temperature (F.)	95	78
Sulfate (SO_4)	94	55	Date of collection	Sept. 19, 1951	Sept. 19, 1951
Chloride (Cl)	111	73			
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

GLOBE

(Population, 6,419)

Ownership: Municipal; supplies also suburban area outside the city limits. Total population supplied, about 7,900.

Source: 9 wells: 3 dug wells (1, 2, 3) 80, 235, and 80 ft deep near Pinal Creek 2 miles southeast of Globe, reported to yield 300, 500, and 300 gpm; 6 drilled wells, most of which are south of town, 500 to 695 ft deep, reported to yield 250, 150, 169, 80, 280, and 70 gpm. Emergency supply, Old Dominion mine (abandoned) controlled by Miami Copper Co., Miami, Arizona.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: 750,000 gal.

The dissolved solids in the water from the other wells ranges from about 275 to near 500 ppm.

GLOBE--Continued

ANALYSES

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

	Well 1	Pine Street Well		Well 1	Pine Street Well
Silica (SiO_2)	--	28	Hardness as $CaCO_3$:		
Iron (Fe)	--	.00	Total	166	182
Manganese (Mn)	--	--	Noncarbonate	16	0
Calcium (Ca)	45	45			
Magnesium (Mg)	13	17	Color	--	1
Sodium (Na)	30	41	pH	--	7.9
Potassium (K)			Specific conductance (micromhos at 25 C.)	423	510
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	183	259	Temperature (F.)	--	71
Sulfate (SO_4)	46	23	Date of collection	Apr. 12, 1946	Sept. 11, 1951
Chloride (Cl)	19	20			
Fluoride (F)	.4	.3			
Nitrate (NO_3)	5.8	9.2			
Dissolved solids	--	304			
Depth (feet)				80	530
Diameter (inches)				96-144	8
Date drilled				--	--
Percent of supply				25	15

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	Turbidity	--	--
Bicarbonate (HCO_3)	184	186	Temperature (F.)	65	65
Sulfate (SO_4)	39	--	Date of collection	Sept. 19, 1951	Sept. 19, 1951
Chloride (Cl)	255	257			
Fluoride (F)	.0	--			
Nitrate (NO_3)	2.9	--			
Dissolved solids	683	--			

MESA--Continued

	Well 5	Well 7
Depth (feet)	500	700
Diameter (inches)	20	20
Date drilled	--	1951
Percent of supply	30	--

MORENCI
(Population, 6,541)

Ownership: The Morenci Water and Electric Company, Morenci.
Source: 2 dug shafts (interconnected) 460 ft deep and 1 drilled well 750 ft deep, all in Eagle Creek canyon 4 miles east of Morenci. The water as pumped from the wells is hot.
Treatment: Chlorination.
Storage: Reservoir, 4,000,000 gal.

ANALYSIS

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

	Storage Reservoir Tap		Storage Reservoir Tap
Silica (SiO_2)	40	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	140
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	36		
Magnesium (Mg)	12	Color	3
Sodium (Na)	80	pH	8.0
Potassium (K)		Specific conductance (micromhos at 25 C.)	604
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	258	Temperature (F.)	90
Sulfate (SO_4)	25	Date of collection	Sept. 12, 1951
Chloride (Cl)	48		
Fluoride (F)	3.2		
Nitrate (NO_3)	.6		
Dissolved solids	379		

NOGALES
(Population, 6,153)

Ownership: Municipal; supplies also a small area in Mexico. Estimated total population supplied, 6,500. System can serve as emergency supply for Nogales, Mexico (Population, 30,000).
Source: Wells and infiltration gallery along Santa Cruz River 6 mi. east of Nogales.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plant: --
Raw-water storage: None.
Finished-water storage: 1,000,000 gal.

Analysis represents composite of water from all sources as furnished to consumers.

NOGALES--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	26	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	214
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	68		
Magnesium (Mg)	11	Color	3
Sodium (Na)	34	pH	7.8
Potassium (K)		Specific conductance (micromhos at 25 C.)	530
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	278	Temperature (F.)	64
Sulfate (SO_4)	38	Date of collection	Sept. 13, 1951
Chloride (Cl)	10		
Fluoride (F)	.4		
Nitrate (NO_3)	6.0		
Dissolved solids	333		

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 northof 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.

PHOENIX--Continued

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)	28	71	55	147	48
Potassium (K)					
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	Sept. 18, 1951	Sept. 18, 1951	Sept. 18, 1951	Sept. 18, 1951	Sept. 18, 1951

PHOENIX--Continued

	C	D	E
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 supply[a]	Well 1		Surface supply[a]	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	Sept. 20, 1951	Sept. 20, 1951
Nitrate (NO_3)	3.4	3.0			
Dissolved solids	207	219			

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

[a] 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)

	Well [a]	Well [b]		Well [a]	Well [b]
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	Sept. 19, 1951	Sept. 19, 1951
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

[a] Apache Blvd. and Hudson Manor.

[b] 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.

TUCSON--Continued

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)	33	78	26	20
Potassium (K)				
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	Sept. 14, 1951	Sept. 14, 1951	Sept. 14, 1951	Sept. 14, 1951
Depth (feet)			200	280
Diameter (inches)			8	12
Date drilled			1937	1932
Percent of supply			--	--

WAKEFIELD
(Population, 8,906)

Ownership: (See Tucson.)

WINSLOW
(Population, 6,518)

Ownership: Atchison, Topeka, and Santa Fe Railway Co.; supplies also suburban area outside the city limits. Total population supplied, about 9,000.
Source: Clear Creek (flow diverted into reservoir).
Treatment: Coagulation with alum and soda ash, activated carbon, sedimentation, filtration, addition of polyphosphate (Calgon), chlorination, and ammoniation.
Rated capacity of treatment plant: 1,350,000 gpd.
Raw-water storage: --
Finished-water storage: 7,000,000 gal.

The flow of Clear Creek is diverted into the reservoir 7 miles southeast of Winslow. The treatment plant is near the reservoir.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	7.3	6.3	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.03	Total	231	221
Manganese (Mn)	--	--	Noncarbonate	55	38
Calcium (Ca)	48	44			
Magnesium (Mg)	27	27	Color	5	5
Sodium (Na)	329	343	pH	8.1	8.4
Potassium (K)	4.0	3.2	Specific conductance (micromhos at 25 C.)	2,090	2,110
Carbonate (CO_3)	0	7			
Bicarbonate (HCO_3)	215	210			
Sulfate (SO_4)	40	42	Turbidity	--	--
Chloride (Cl)	525	525	Temperature (F.)	--	--
Fluoride (F)	.2	.1	Date of collection	Aug. 1, 1951	Aug. 1, 1951
Nitrate (NO_3)	1.4	2.0			
Dissolved solids	1,120	1,110			

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	Sept. 17, 1951	Sept. 17, 1951

ARKADELPHIA, ARKANSAS
(Population, 6,819)

Ownership: Arkadelphia Water Co. (General Water Works Corp.).
Source: Ouachita River.
Treatment: Coagulation with lime and alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 700,000 gpd.
Raw-water storage: None.
Finished-water storage: 440,000 gal.

The treatment plant is located on the bank of Ouachita River about 300 yd east of Ouachita College athletic field.
Analyses of samples collected daily from the Ouachita River at Arkadelphia show there is some variation in the chemical character of the water throughout the year, but the dissolved solids is usually low.

ANALYSES

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

	Raw water [a]	Finished water		Raw water [a]	Finished water
Silica (SiO_2)	6.4	4.8	Hardness as $CaCO_3$:		
Iron (Fe)	.12	.05	Total	29	59
Manganese (Mn)	--	.01	Noncarbonate	6	27
Calcium (Ca)	8.1	19			
Magnesium (Mg)	2.1	2.8	Color	--	6
Sodium (Na)	4.2	3.0	pH	--	8.6
Potassium (K)	1.7	1.1	Specific conductance (micromhos at 25 C.)	76.7	126
Carbonate (CO_3)	0	--	Turbidity	--	2
Bicarbonate (HCO_3)	28	[b] 39	Temperature (F.)	--	60
Sulfate (SO_4)	7.4	26	Date of collection	--	Dec. 4, 1951
Chloride (Cl)	4.1	3.8			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	1.4	1.1			
Dissolved solids	54	84			

[a] Average of analyses of 10-day composites of daily samples collected at Arkadelphia for the year October 1950 to September 1951.
[b] Includes the equivalent of less than 5 ppm of carbonate (CO_3).

BATESVILLE
(Population, 6,414)

Ownership: General Water Works Corporation, Pine Bluff, Ark.
Source: White River.
Treatment: Aeration, coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: --
Finished-water storage: 550,000 gal.

The treatment plant is on South Central Avenue near the river.

There is considerable variation in the chemical composition of the water throughout the year. The analyses represent water of about maximum content of dissolved solids and maximum hardness.

BATESVILLE--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	7.6	5.6	Hardness as $CaCO_3$:		
Iron (Fe)	.68	.23	Total	139	159
Manganese (Mn)	.00	.00	Noncarbonate	5	38
Calcium (Ca)	36	44			
Magnesium (Mg)	12	12	Color	7	4
Sodium (Na)	1.9	2.1	pH	7.8	7.4
Potassium (K)	1.4	1.2	Specific conductance (micromhos at 25 C.)	257	268
Carbonate (CO_3)	0	0	Turbidity	2	1
Bicarbonate (HCO_3)	164	148	Temperature (F.)	39	40
Sulfate (SO_4)	5.0	26	Date of collection	Nov. 21, 1951	Nov. 21, 1951
Chloride (Cl)	2.8	6.0			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	2.4	2.7			
Dissolved solids	151	188			

BENTON

(Population, 6,277)

Ownership: Municipal.
Source: Saline River.
Treatment: Coagulation with lime and alum, sedimentation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,350,000 gal.

The treatment plant is at 417 Hazel Street.
Analyses of samples collected daily from the Saline River at Benton show there is some variation in the chemical character of the water throughout the year, but the dissolved solids is usually low.

ANALYSES

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

	Raw water [a]	Finished water (city tap)		Raw water [a]	Finished water (city tap)
Silica (SiO_2)	--	4.6	Hardness as $CaCO_3$:		
Iron (Fe)	--	.12	Total	57	61
Manganese (Mn)	--	.00	Noncarbonate	6	21
Calcium (Ca)	16	18			
Magnesium (Mg)	4.1	4.0	Color	--	10
Sodium (Na)	2.4	2.0	pH	--	7.2
Potassium (K)	--	.7	Specific conductance (micromhos at 25 C.)	119	128
Carbonate (CO_3)	0	0	Turbidity	--	2
Bicarbonate (HCO_3)	62	49	Temperature (F.)	--	48
Sulfate (SO_4)	6.2	18	Date of collection	--	Dec. 4, 1951
Chloride (Cl)	2.8	3.8			
Fluoride (F)	--	.2			
Nitrate (NO_3)	1.5	.4			
Dissolved solids	75	79			

[a] Average of analyses of 10-day composites of daily samples collected from the river at Highway bridge, 2 miles west of Benton for the year Oct. 1950-Sept. 1951.

BLYTHEVILLE
(Population, 16,234)

Ownership: Blytheville Water Co.
Source: 3 wells (3 to 5), each 1,500 ft deep and reported to yield 1,200, 1,800, and 1,800 gpm, respectively.
Treatment: Aeration (spray and contact beds), sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 850,000 gal.

ANALYSES

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

	Well 4	Finished water[a]		Well 4	Finished water[a]
Silica (SiO_2)	10	9.9	Hardness as $CaCO_3$:		
Iron (Fe)	2.6	.06	Total	27	27
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	7.7	7.3			
Magnesium (Mg)	1.9	2.2	Color	--	--
Sodium (Na)	29	30	pH	6.6	7.6
Potassium (K)	3.4	5.1	Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.)	189	195
Bicarbonate (HCO_3)	98	101	Turbidity	--	--
Sulfate (SO_4)	11	10	Temperature (F.)	77	75
Chloride (Cl)	2.5	3.0	Date of collection	May 22, 1950	Apr. 24, 1946
Fluoride (F)	.0	.0			
Nitrate (NO_3)	.8	.8			
Dissolved solids	118	118			

Depth (feet)	1,500
Diameter (inches)	10
Date drilled	1938
Percent of supply	--

[a]Composite.

CAMDEN
(Population, 11,372)

Ownership: Municipal.
Source: Ouachita River.
Treatment: Aeration, coagulation with lime and alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,750,000 gpd.
Raw-water storage: --
Finished-water storage: 1,100,000 gal.

The treatment plant is located at end of East Washington St. The treatment plant capacity will be increased by 1,500,000 gpd within 9 months. Analyses of daily samples collected from the Ouachita River at Camden show some variation in chemical character, but the dissolved solids is usually low.

CAMDEN--Continued

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

	Raw water[a]	Finished water[b]		Raw water[a]	Finished water[b]
Silica (SiO_2)	9.8	4.5	Hardness as $CaCO_3$:		
Iron (Fe)	.43	.11	Total	26	53
Manganese (Mn)	--	.00	Noncarbonate	5	28
Calcium (Ca)	7.3	17			
Magnesium (Mg)	1.8	2.6	Color	--	7
Sodium (Na)	11	8.6	pH	7.3	7.5
Potassium (K)	2.0	1.3	Specific conductance (micromhos at 25 C.)	114	148
Carbonate (CO_3)	0	0	Turbidity	--	2
Bicarbonate (HCO_3)	26	30	Temperature (F.)	--	62
Sulfate (SO_4)	6.1	23	Date of collection	1946-47	Dec. 4, 1951
Chloride (Cl)	17	15			
Fluoride (F)	.1	.2			
Nitrate (NO_3)	1.7	.4			
Dissolved solids	81	92			

[a] Average of analyses of 10-day composites of daily samples collected at Camden for the year October 1946 to September 1947.
[b] City tap.

CONWAY
(Population, 8,610)

Ownership: Municipal.
Source: Cadron Creek.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: --
Finished-water storage: 1,150,000 gal.

The treatment plant is located about 6 miles northwest of Conway. There is some variation in the chemical character of the water throughout the year, but the dissolved solids at all times is low.

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

	Raw water	Finished water[a]		Raw water	Finished water[a]
Silica (SiO_2)	7.6	6.5	Hardness as $CaCO_3$:		
Iron (Fe)	.25	.31	Total	14	20
Manganese (Mn)	.00	.00	Noncarbonate	3	12
Calcium (Ca)	3.0	6.2			
Magnesium (Mg)	1.6	1.2	Color	27	5
Sodium (Na)	2.0	2.2	pH	6.6	6.9
Potassium (K)	1.3	1.8	Specific conductance (micromhos at 25 C.)	32.8	57.0
Carbonate (CO_3)	0	0	Turbidity	4	1
Bicarbonate (HCO_3)	13	10	Temperature (F.)	47	53
Sulfate (SO_4)	2.6	11	Date of collection	Nov. 21, 1951	Nov. 21, 1951
Chloride (Cl)	2.8	4.8			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	2.7	1.0			
Dissolved solids	32	40			

[a] City tap.

EL DORADO
(Population, 23,076)

Ownership: El Dorado Water Co.
Source: 6 wells (2, 6 to 10), 160, 720, 725, 700, 718, and 737 ft deep. The yield of the wells is reported to be 570, (well 6, not reported), 630, 1,050, 300, and 1,000 gpm. Wells 6 and 9 are for auxiliary or emergency supply.
Treatment: None.
Storage: 1,500,000 gal.

ANALYSES

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

	Well 2	Well 10	Wells (city tap)[a]
Silica (SiO_2)	40	10	18
Iron (Fe)	3.1	.02	.02
Manganese (Mn)	--	--	--
Calcium (Ca)	7.4	2.2	4.0
Magnesium (Mg)	3.8	.6	1.7
Sodium (Na)	9.5	106	102
Potassium (K)	4.4	1.5	
Carbonate (CO_3)	0	9	4
Bicarbonate (HCO_3)	17	213	224
Sulfate (SO_4)	20	.8	.8
Chloride (Cl)	18	36	33
Fluoride (F)	.0	.1	.2
Nitrate (NO_3)	.1	.1	1.5
Dissolved solids	114	275	286
Hardness as $CaCO_3$:			
Total	34	8	17
Noncarbonate	20	0	0
Color	--	--	--
pH	6.8	8.1	--
Specific conductance (micromhos at 25 C.)	133	454	--
Turbidity	--	--	--
Temperature (F.)	65	74	--
Date of collection	Nov. 28, 1945	Nov. 28, 1945	Feb. 15, 1950
Depth (feet)	160	737	
Diameter (inches)	--	15-10	
Date drilled	1926	1945	
Percent of supply	--	--	

[a]Analyzed by U. S. Public Health Service, Bethesda, Md.

FAYETTEVILLE
(Population, 17,091)

Ownership: Municipal; supplies also the communities of Combs, Farmington, Greenland, and Johnson. Total population supplied, about 20,100.
Source: West Fork White River (impounded), two-thirds of supply; Clear Creek (impounded), one-third of supply. Auxiliary or emergency supply, Wilson Lake.
Treatment: West Fork White River: coagulation with lime and iron salts, sedimentation, slow anthrafilt filtration, and chlorination. Clear Creek: coagulation with lime and alum, sedimentation, slow anthrafilt filtration, and chlorination.

FAYETTEVILLE--Continued

Rated capacity of treatment plants: West Fork White River plant, 2,000,000 gpd; Clear Creek plant, 1,000,000 gpd.
Raw-water storage: Not known.
Finished-water storage: West Fork White River reservoir, 3,750,000 gal; Clear Creek reservoir, 1,000,000 gal.

West Fork White River treatment plant is located on Mount Sequoyah in Fayetteville. Clear Creek treatment plant is 4 miles north of Fayetteville on Johnson Road. The plants supply different sections of the city and the only mixing of the finished water from the two sources is that which might occur in the distribution mains.

ANALYSIS

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

	Finished water (city tap)[a]		Finished water (city tap)[a]
Silica (SiO_2)	5.2	Hardness as $CaCO_3$:	
Iron (Fe)	.29	Total	71
Manganese (Mn)	.00	Noncarbonate	15
Calcium (Ca)	26		
Magnesium (Mg)	1.5	Color	5
Sodium (Na)	3.1	pH	7.3
Potassium (K)	1.5	Specific conductance (micromhos at 25 C.)	153
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	68	Temperature (F.)	60
Sulfate (SO_4)	12	Date of collection	Dec. 3, 1951
Chloride (Cl)	4.8		
Fluoride (F)	.1		
Nitrate (NO_3)	4.0		
Dissolved solids	93		

[a] At U. S. G. S. laboratory, Bureau of Research, University of Arkansas.

FORREST CITY
(Population, 7,607)

Ownership: Municipal.
Source: 3 wells (1 to 3), 530, 502, and 530 ft deep, and reported to yield 450, 350, and 750 gpm, respectively.
Treatment: Aeration, softening with lime, coagulation with lime and alum, sedimentation (upward flow cylindrical tanks), recarbonation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,250,000 gal.

FORREST CITY--Continued

ANALYSES

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

	Well 1	Well 2	Finished water (city tap)
Silica (SiO_2)	24	27	22
Iron (Fe)	1.7	1.2	.32
Manganese (Mn)	--	--	.00
Calcium (Ca)	58	53	11
Magnesium (Mg)	23	21	17
Sodium (Na)	6.7	11	12
Potassium (K)	4.1	4.1	1.4
Carbonate (CO_3)	0	0	7
Bicarbonate (HCO_3)	297	287	106
Sulfate (SO_4)	5.3	3.3	17
Chloride (Cl)	6.0	7.0	5.0
Fluoride (F)	.2	.0	.3
Nitrate (NO_3)	.5	.2	.3
Dissolved solids	274	268	148
Hardness as $CaCO_3$:			
Total	239	219	97
Noncarbonate	0	0	0
Color	--	--	7
pH	7.0	7.0	8.7
Specific conductance (micromhos at 25 C.)	407	359	219
Turbidity	--	--	2
Temperature (F.)	64	64	52
Date of collection	June 26, 1946	June 26, 1946	Dec. 26, 1951
Depth (feet)	530	502	
Diameter (inches)	8	8	
Date drilled	1937	1935	
Percent of supply	--	--	

FORT SMITH
(Population, 47,942)

Ownership: Municipal; supplies also Alma, Camp Chaffee, Mountainburg, Van Buren, and other communities. Total population supplied, about 72,300.
Source: Clear Creek impounded in Lake Fort Smith, approximately 22 miles northeast of the city.
Treatment: Coagulation with iron salts and lime, sedimentation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 9,000,000 gpd.
Raw-water storage: Lake Fort Smith, 3,900,000,000 gal.
Finished-water storage: 23,000,000 gal.

The treatment plant is 1 mile north of Mountainburg.

FORT SMITH--Continued

ANALYSES

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

	Raw water[a]	Finished water[b]		Raw water[a]	Finished water[b]
Silica (SiO_2)	7.6	6.6	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.20	Total	14	29
Manganese (Mn)	--	.00	Noncarbonate	0	11
Calcium (Ca)	3.6	9.1			
Magnesium (Mg)	1.3	1.6	Color	10	20
Sodium (Na)	2.1	1.6	pH	6.8	7.7
Potassium (K)	.3	.4	Specific conductance (micromhos at 25 C.)	41.0	71.2
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	18	22	Turbidity	--	3
Sulfate (SO_4)	3.0	12	Temperature (F.)	--	41
Chloride (Cl)	1.5	2.5	Date of collection	July 27, 1949	Dec. 27, 1951
Fluoride (F)	.1	.1			
Nitrate (NO_3)	1.3	.8			
Dissolved solids	31	59			

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	13	20	9	6.7	7.1	6.3	23	29	15	22	152	3
Finished water	21	34	13	8.9	9.4	8.4	48	60	28	0	0	0

[a]Collected at spillway, Lake Fort Smith.
[b]City tap.

HELENA
(Population, 11,236)

Ownership: Municipal; also supplies suburban area. Total population supplied, 12,000.
Source: 3 wells (NW, NE, and SE), 493, 612, and 495 ft deep, and reported to yield 750, 750, and 1,000 gpm.
Treatment: Chlorination, and Calgon and soda ash for corrosion control.
Rated capacity of treatment plant: 3,460,000 gpd.
Raw-water storage: --
Finished-water storage: 1,550,000 gal.

HELENA--Continued

ANALYSES

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

	NW well (raw water)	Finished water (city tap)		NW well (raw water)	Finished water (city tap)
Silica (SiO_2)	20	29	Hardness as $CaCO_3$:		
Iron (Fe)	.57	.33	Total	46	42
Manganese (Mn)	--	.00	Noncarbonate	0	0
Calcium (Ca)	12	10			
Magnesium (Mg)	3.9	4.0	Color	--	20
Sodium (Na)	169	166	pH	7.4	8.0
Potassium (K)	7.6	3.5	Specific conductance (micromhos at 25 C.)	999	749
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	394	358	Turbidity	--	1
Sulfate (SO_4)	.8	3.5	Temperature (F.)	66	56
Chloride (Cl)	69	74	Date of collection	June 27, 1946	Dec. 26, 1951
Fluoride (F)	.8	.7			
Nitrate (NO_3)	.2	.8			
Dissolved solids	479	472			

HOPE

(Population, 8,605)

Ownership: Municipal.

Source: 5 wells (1 to 5), 1,480, 620, 620, 620, and 1,500 ft deep. The yield of the wells is reported to be 292, 147, 156, 340, and 250 gpm.

Treatment: Chlorination (average residual 0.15 ppm).

Rated capacity of treatment plant: 1,800,000 gpd.

Raw-water storage: None.

Finished-water storage: 786,000 gal.

ANALYSES

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

	Well 1	Well 2	Well 3	Well 4	Well 5
Silica (SiO_2)	8.0	17	17	19	9.9
Iron (Fe)	.16	.18	.11	.25	.07
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	3.4	21	16	21	.8
Magnesium (Mg)	1.2	3.4	2.9	4.0	1.9
Sodium (Na)	419	115	124	107	444
Potassium (K)	3.8	3.0	2.9	3.2	16
Carbonate (CO_3)	28	0	0	0	10
Bicarbonate (HCO_3)	517	267	260	264	549
Sulfate (SO_4)	44	46	52	43	44
Chloride (Cl)	292	36	41	31	320
Fluoride (F)	.3	.6	.4	.0	2.2
Nitrate (NO_3)	.2	.0	.0	.0	3.6
Dissolved solids	1,060	376	386	361	1,120
Hardness as $CaCO_3$:					
Total	14	66	52	69	10
Noncarbonate	0	0	0	0	0
Color	--	--	--	--	7
pH	8.2	8.3	8.1	8.1	8.4
Specific conductance (micromhos at 25 C.)	1,880	622	635	593	1,920
Turbidity	--	--	--	--	--
Temperature (F.)	100	78	78	78	98
Date of collection	Oct. 26, 1945	Oct. 26, 1945	Oct. 26, 1945	Oct. 26, 1945	Mar. 27, 1951

HOPE--Continued

	Well 1	Well 2	Well 3	Well 4	Well 5
Depth (feet)	1,480	620	620	620	1,500
Diameter (inches)	8-6-4	8	8	10	12-8
Date drilled	1918	1933	1933	1943	1950
Percent of supply	--	--	--	--	--

HOT SPRINGS
(Population, 29,307)

Ownership: Municipal.
Source: 4 artificial lakes (Hot Springs, Dillion, Bethel, and Sanderson).
Treatment: Prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 4 lakes.
Finished-water storage: 1,200,000 gal.

ANALYSIS

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

	Finished water (city tap)		Finished water (city tap)
Silica (SiO_2)	4.5	Hardness as $CaCO_3$:	
Iron (Fe)	.18	Total	33
Manganese (Mn)	.00	Noncarbonate	15
Calcium (Ca)	11		
Magnesium (Mg)	1.3	Color	7
Sodium (Na)	1.7	pH	8.8
Potassium (K)	.5	Specific conductance (micromhos at 25 C.)	76.5
Carbonate (CO_3)	--	Turbidity	2
Bicarbonate (HCO_3)	[a]22	Temperature (F.)	--
Sulfate (SO_4)	12	Date of collection	Dec. 3, 1951
Chloride (Cl)	4.0		
Fluoride (F)	.1		
Nitrate (NO_3)	.0		
Dissolved solids	50		

[a] Includes the equivalent of less than 5 ppm of carbonate (CO_3).

JONESBORO
(Population, 16,310)

Ownership: Municipal; supplies also Nettleton. Total population supplied, about 17,700.
Source: 5 wells (1, 2, Lamarr St., Culberhouse, and Johnson St.), 132, 150, 215, and 150 ft deep (depth not reported on Johnson St. well). The yield of the wells is reported to be 1,000, 800, 1,200, 1,100, and 900 gpm.
Treatment: Aeration, ammoniation, chlorination, and fluoridation.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: --
Finished-water storage: Elevated tank, 1,500,000 gal; ground reservoir, 1,000,000 gal.

JONESBORO--Continued

ANALYSES

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

	Well 1	Well 2	Lamarr well	Finished water (city tap)
Silica (SiO_2)	26	26	32	27
Iron (Fe)	.09	.15	.10	.06
Manganese (Mn)	--	--	--	--
Calcium (Ca)	12	19	12	19
Magnesium (Mg)	7.0	9.4	4.0	9.4
Sodium (Na)	17	13	11	18
Potassium (K)	1.8	2.9	1.4	1.6
Carbonate (CO_3)	0	0	0	--
Bicarbonate (HCO_3)	62	96	64	[a]87
Sulfate (SO_4)	26	15	3.6	26
Chloride (Cl)	14	13	9.5	18
Fluoride (F)	.0	.0	.0	.1
Nitrate (NO_3)	2.8	.8	8.6	3.2
Dissolved solids	141	150	122	165
Hardness as $CaCO_3$:				
Total	59	86	46	86
Noncarbonate	8	7	0	15
Color	--	--	--	--
pH	6.5	7.0	6.7	8.4
Specific conductance (micromhos at 25 C.)	217	230	165	263
Turbidity	--	--	--	--
Temperature (F.)	61	61	60	--
Date of collection	May 3, 1950	May 3, 1950	May 3, 1950	Apr. 25, 1946
Depth (feet)	132	150	215	
Diameter (inches)	10	10	10	
Date drilled	1929	1929	1930	
Percent of supply	--	--	--	

[a]Includes the equivalent of less than 5 ppm of carbonate (CO_3).

LITTLE ROCK
(Population, 105,213)

Ownership: Little Rock Municipal Water Works. Supplies also Cammack Village, North Little Rock, Park Hill, and other suburban areas. Total population supplied, about 164,700.

Source: Alum Fork of Saline River impounded in Lake Winona, 33 miles west of the city. The watershed is uninhabited and lies almost wholly within the Ouachita National Forest. Arkansas River, emergency supply.

Treatment: Coagulation with lime and alum, ammoniation, chlorination, sedimentation, rapid sand filtration, alkali for the adjustment of pH, and fluoridation.

Rated capacity of treatment plant: 23,000,000 gpd.

Raw-water storage: Lake Winona, 13,500,000,000 gal; auxiliary reservoir, 92,000,000 gal.

Finished-water storage: 10,200,000 gal.

Raw water is delivered to the treatment plant, located in the city, by gravity flow. The elevation of the treatment plant is such that the major portion of the distribution system is also served by gravity.

LITTLE ROCK--Continued

ANALYSES

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

	Raw water[a]	Finished water[b]		Raw water[a]	Finished water[b]
Silica (SiO_2)	3.5	4.5	Hardness as $CaCO_3$:		
Iron (Fe)	--	.14	Total	11	18
Manganese (Mn)	--	.00	Noncarbonate	3	6
Calcium (Ca)	2.4	4.5			
Magnesium (Mg)	1.2	1.7	Color	35	12
Sodium (Na)	1.0	2.1	pH	7.1	7.1
Potassium (K)	--	.4	Specific conductance (micromhos at 25 C.)	--	46.9
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	10	15	Turbidity	10	1
Sulfate (SO_4)	.0	4.9	Temperature (F.)	--	58
Chloride (Cl)	2.0	3.0	Date of collection	Jan. 18, 1951	Dec. 26, 1951
Fluoride (F)	.0	1.0			
Nitrate (NO_3)	--	.1			
Dissolved solids	25	31			

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	7	10	5	6.5	7.2	6.1	10	18	8	14	40	5
Finished water	14	22	8	8.3	9.7	7.0	20	30	12	0	0	0

[a] Analyzed by Little Rock Water Department.
[b] City tap.

MAGNOLIA
(Population, 6,918)

Ownership: Municipal.
Source: 4 wells (1 to 4), 435, 428, 410, and 425 ft deep, and reported to yield 320, 380, 468, and 500 gpm.
Treatment: Chlorination.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 811,000 gal.

MAGNOLIA--Continued

ANALYSES

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

	Well 3	Well 4	Finished water (city tap)
Silica (SiO_2)	10	12	11
Iron (Fe)	.02	.08	.14
Manganese (Mn)	--	--	.00
Calcium (Ca)	8.8	5.6	7.8
Magnesium (Mg)	1.6	.8	1.8
Sodium (Na)	69	86	75
Potassium (K)	4.5	1.9	2.1
Carbonate (CO_3)	--	--	0
Bicarbonate (HCO_3)	[a]192	[a]218	197
Sulfate (SO_4)	18	8.9	16
Chloride (Cl)	5.0	6.0	7.2
Fluoride (F)	.0	.1	.2
Nitrate (NO_3)	.2	.2	.8
Dissolved solids	215	230	224
Hardness as $CaCO_3$:			
Total	29	17	27
Noncarbonate	0	0	0
Color	--	--	7
pH	8.5	8.3	7.9
Specific conductance (micromhos at 25 C.)	338	359	348
Turbidity	--	--	2
Temperature (F.)	--	71	58
Date of collection	Jan. 17, 1946	Nov. 8, 1950	Dec. 4, 1951
Depth (feet)	413	425	
Diameter (inches)	12	8	
Date drilled	1944	1951	
Percent of supply	--	--	

[a]Includes the equivalent of less than 5 ppm of carbonate (CO_3).

MALVERN
(Population, 8,072)

Ownership: Municipal; supplies also a small number of people outside the city limits. Total population supplied, about 8,120.
Source: Ouachita River.
Treatment: Coagulation with lime and alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,200,000 gpd.
Raw-water storage: --
Finished-water storage: 960,000 gal.

The treatment plant is located on Front Street near Missouri Pacific Depot in Malvern. Analyses of composites of daily samples collected from the Ouachita River near Malvern show a variation in chemical character, but the dissolved solids is low.

MALVERN--Continued

ANALYSES

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

	Raw water[a]	Finished water[b]		Raw water[a]	Finished water[b]
Silica (SiO_2)	7.5	2.5	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.18	Total	22	41
Manganese (Mn)	.00	.00	Noncarbonate	1	18
Calcium (Ca)	6.3	13			
Magnesium (Mg)	1.5	2.1	Color	--	5
Sodium (Na)	4.6	2.5	pH	7.4	7.4
Potassium (K)	1.0	.9	Specific conductance (micromhos at 25 C.)	64.9	99.5
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	28	28	Turbidity	--	2
Sulfate (SO_4)	4.3	19	Temperature (F.)	--	46
Chloride (Cl)	2.6	3.2	Date of collection	1946-47	Dec. 4, 1951
Fluoride (F)	.3	.1			
Nitrate (NO_3)	1.9	.6			
Dissolved solids	48	61			

[a]Average of analyses of 10-day composites of daily samples from the Ouachita River near Malvern for the year October 1946 to September 1947.
[b]City tap.

NEWPORT
(Population, 6,254)

Ownership: Municipal.
Source: 3 wells (East 1, West 2, and 3) each 103 ft deep, and reported to yield 550, 500, and 1,600 gpm, respectively. White River, emergency supply.
Treatment: Aeration, coagulation with soda ash and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,450,000 gpd.
Raw-water storage: --
Finished-water storage: 450,000 gal.

The well field and treatment plant are located west of U. S. Highway 67 bridge, three-fourths of a mile from the center of the city.

NEWPORT--Continued

ANALYSES

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

	East well 1	West well 2	Well 3	Finished water (composite)
Silica (SiO_2)	36	26	34	34
Iron (Fe)	1.7	5.4	6.5	.50
Manganese (Mn)	--	--	.51	.00
Calcium (Ca)	37	50	46	35
Magnesium (Mg)	8.2	10	11	9.8
Sodium (Na)	13	28	8.7	8.6
Potassium (K)	1.8	1.6	2.0	1.9
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	162	203	178	135
Sulfate (SO_4)	5.1	12	8.6	9.5
Chloride (Cl)	12	35	13	16
Fluoride (F)	.3	.0	.1	.1
Nitrate (NO_3)	.2	1.2	1.5	1.0
Dissolved solids	202	268	213	182
Hardness as $CaCO_3$:				
Total	126	166	160	128
Noncarbonate	0	0	14	17
Color	--	--	6	5
pH	7.5	7.7	7.0	8.1
Specific conductance (micromhos at 25 C.)	283	450	309	260
Turbidity	--	--	1	1
Temperature (F.)	--	--	61	52
Date of collection	Aug. 2, 1946	Apr. 5, 1946	Nov. 21, 1951	Nov. 21, 1951
Depth (feet)	103	103	103	
Diameter (inches)	8	8	12	
Date drilled	1930	1930	1950	
Percent of supply	--	--	--	

NORTH LITTLE ROCK
(Population, 44,097)

Ownership: Supplied by Little Rock (see Little Rock.)

PARAGOULD
(Population, 9,668)

Ownership: Municipal.
Source: 3 wells (1 to 3), 500, 505, and 507 ft deep, and reported to yield 1,000, 900, and 900 gpm, respectively.
Treatment: Chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: --
Finished-water storage: 250,000 gal.

PARAGOULD--Continued

ANALYSIS

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

	Finished water[a]		Finished water[a]
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	1.0	Total	14
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	3.2		
Magnesium (Mg)	1.5	Color	--
Sodium (Na)	63	pH	8.2
Potassium (K)	3.2	Specific conductance (micromhos at 25 C.)	288
Carbonate (CO_3)	9		
Bicarbonate (HCO_3)	162	Turbidity	--
Sulfate (SO_4)	1.4	Temperature (F.)	--
Chloride (Cl)	3.2	Date of collection	Apr. 25, 1946
Fluoride (F)	.1		
Nitrate (NO_3)	.8		
Dissolved solids	183		

[a]Composite sample, wells 1 and 2.

PINE BLUFF
(Population, 37,162)

Ownership: General Waterworks Corp.
Source: 3 wells (8 to 10), 835-850, 838, and 835-850 ft deep, and reported to yield 1,250, 1,000, and 1,050 gpm, respectively.
Treatment: Aeration, rapid anthrafilt filtration, sedimentation, polyphosphate (Calgon) for corrosion control, and chlorination.
Rated capacity of treatment plant: 6,170,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoir, 13,000,000 gal.

ANALYSES

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

	Well 8	Well 9	Well 10	Finished water (composite)
Silica (SiO_2)	12	12	13	18
Iron (Fe)	3.3	14	3.3	.64
Manganese (Mn)	--	--	--	.00
Calcium (Ca)	7.0	11	7.0	6.9
Magnesium (Mg)	2.3	3.3	2.2	2.7
Sodium (Na)	12	11	14	13
Potassium (K)	6.9	7.2	6.4	6.3
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	65	82	70	67
Sulfate (SO_4)	3.3	.6	3.7	4.2
Chloride (Cl)	2.8	3.0	2.5	2.8
Fluoride (F)	.4	.4	.4	.3
Nitrate (NO_3)	.2	.2	.2	.7
Dissolved solids	80	89	85	92
Hardness as $CaCO_3$:				
Total	27	41	26	28
Noncarbonate	0	0	0	0

PINE BLUFF, Analyses--Continued

	Well 8	Well 9	Well 10	Finished water (composite)
Color	--	--	--	6
pH	7.9	7.9	8.0	6.8
Specific conductance (micromhos at 25 C.)	119	139	132	125
Turbidity	--	--	--	2
Temperature (F.)	--	--	--	76
Date of collection	Nov. 8, 1945	Nov. 8, 1945	Nov. 8, 1945	Dec. 26, 1951
Depth (feet)	835-850	838	835-850	
Diameter (inches)	16	24-16-10	24-16-10	
Date drilled	1938	1929	1945	
Percent of supply	--	--	--	

RUSSELLVILLE
(Population, 8,166)

Ownership: Russellville Water Co.
Source: Illinois Bayou.
Treatment: Aeration, coagulation with lime and alum, Calgon, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,400,000 gpd.
Raw-water storage: None.
Finished-water storage: 743,000 gal.

The treatment plant is located about 5 miles north of the city, just off U. S. Highway 64. There is some variation in the chemical character of the water during the year but the dissolved solids is low at all times.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	6.3	4.5	Hardness as $CaCO_3$:		
Iron (Fe)	.25	.25	Total	15	33
Manganese (Mn)	.00	.00	Noncarbonate	3	19
Calcium (Ca)	3.6	9.8			
Magnesium (Mg)	1.4	2.0	Color	30	12
Sodium (Na)	1.4	1.9	pH	6.8	7.1
Potassium (K)	1.0	.8	Specific conductance (micromhos at 25 C.)	30.9	69.6
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	14	17			
Sulfate (SO_4)	2.4	15	Turbidity	3	5
Chloride (Cl)	1.8	3.0	Temperature (F.)	47	53
Fluoride (F)	.2	.3	Date of collection	Nov. 21, 1951	Nov. 21, 1951
Nitrate (NO_3)	1.0	2.2			
Dissolved solids	29	53			

SEARCY
(Population, 6,024)

Ownership: Municipal; supplies also Bald Knob and Judsonia. Total population supplied, about 9,200.
Source: Little Red River.
Treatment: Aeration, coagulation with lime and alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,070,000 gal.

The treatment plant is $2\frac{1}{2}$ miles north of Searcy. Analyses of daily samples collected from the Little Red River near Heber Springs show a variation in chemical character of the water, but the dissolved solids is low.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	6.9	5.7	Hardness as $CaCO_3$:		
Iron (Fe)	.13	.41	Total	20	50
Manganese (Mn)	--	--	Noncarbonate	5	28
Calcium (Ca)	5.2	17			
Magnesium (Mg)	1.6	1.8	Color	27	4
Sodium (Na)	1.5	1.5	pH	6.9	8.8
Potassium (K)	.8	.8	Specific conductance (micromhos at 25 C.)	42.0	108
Carbonate (CO_3)	0	4			
Bicarbonate (HCO_3)	18	18			
Sulfate (SO_4)	3.9	22	Turbidity	2	1
Chloride (Cl)	2.0	4.5	Temperature (F.)	45	45
Fluoride (F)	.1	.1	Date of collection	Nov. 21, 1951	Nov. 21, 1951
Nitrate (NO_3)	1.8	1.2			
Dissolved solids	34	70			

SPRINGDALE
(Population, 5,835)

Ownership: Municipal; supplies also suburban area. Total population supplied, about 5,950.
Source: Shiloh Spring. Emergency supply, lake fed by spring.
Treatment: Coagulation with alum and lime, sedimentation, rapid anthrafilt filtration, and chlorination.
Rated capacity of treatment plant: 1,150,000 gpd.
Raw-water storage: --
Finished-water storage: 585,000 gal.

SPRINGDALE--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.9	9.9	Hardness as $CaCO_3$:		
Iron (Fe)	.05	.21	Total	104	115
Manganese (Mn)	.00	.00	Noncarbonate	20	22
Calcium (Ca)	37	41			
Magnesium (Mg)	2.9	3.1	Color	16	8
Sodium (Na)	5.4	5.4	pH	7.0	7.7
Potassium (K)	1.2	1.3	Specific conductance (micromhos at 25 C.)	220	244
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	103	114	Turbidity	8	9
Sulfate (SO_4)	7.4	7.7	Temperature (F.)	59	60
Chloride (Cl)	8.5	9.8	Date of collection	Dec. 6, 1951	Dec. 6, 1951
Fluoride (F)	.2	.1			
Nitrate (NO_3)	13	14			
Dissolved solids	146	157			

Regular determinations at treatment plant, 1951 [a]

	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	100	110	45	7.1	7.2	6.9	115	154	52	--	--	--
Finished water	105	154	50	7.7	7.8	7.4	133	162	72	0	0	0

[a] Year ending Nov. 30, 1951.

STUTTGART

(Population, 7,276)

Ownership: Municipal.

Source: 3 wells (1 to 3), 125, 125, and 850 ft deep. The yield of the wells is reported to be 400, 200, and 1,100 gpm.

Treatment: None.

Storage: 265,000 gal.

ANALYSES

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

	Well 1	Well 3	3 wells (composite)
Silica (SiO_2)	24	1.0	28
Iron (Fe)	1.1	2.8	.74
Manganese (Mn)	--	--	.02
Calcium (Ca)	55	28	72
Magnesium (Mg)	12	12	17
Sodium (Na)	27	32	28
Potassium (K)	1.6	7.0	1.2
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	266	190	326
Sulfate (SO_4)	16	1.8	23
Chloride (Cl)	8.5	28	14
Fluoride (F)	.1	.0	.2
Nitrate (NO_3)	.0	.2	.1
Dissolved solids	279	213	348
Hardness as $CaCO_3$:			
Total	187	119	250
Noncarbonate	0	0	0

STUTTGART, Analyses, --Continued

	Well 1	Well 3	3 wells (composite)
Color	--	--	10
pH	7.6	8.1	7.4
Specific conductance (micromhos at 25 C.)	438	387	540
Turbidity	--	--	2
Temperature (F.)	--	--	48
Date of collection	July 17, 1946	July 17, 1946	Dec. 26, 1951
Depth (feet)	125	850	
Diameter (inches)	--	6	
Date drilled	--	1946	
Percent of supply	--	--	

TEXARKANA
(Population, 40,628; 15,875 in Arkansas)

Ownership: Municipal; supplies also suburban areas. Total population supplied, about 42,628.

Source: 3 well fields and 1 impounding reservoir: Arkansas Station, 22 wells ranging in depth from 40 ft to 50 ft; Texas Station, 12 wells ranging in depth from 40 ft to 50 ft; Bringle Station (used for emergency), 6 wells each about 37 ft deep; and Bringle Lake (Clear Creek impounded).

Treatment: Wells: aeration, alkali for adjustment of pH, and chlorination. Lake: prechlorination, coagulation with lime and alum, sedimentation, rapid sand filtration, postchlorination, and carbonation at times.

Rated capacity of treatment plant: 3,075,000 gpd.

Raw-water storage: --

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

The Arkansas Station well field is near East 9th St. and Jefferson Ave.; Texas Station is about 1 mile west of Texarkana; Bringle Station, 6 miles northwest of Texarkana; and the impounding reservoir, at Bringle Station well field.

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

	Raw water[a]	Arkansas Station		Finished water[b]	Finished water[c]
		Raw water	Finished water		
Silica (SiO_2)	5.1	38	36	26	36
Iron (Fe)	.03	.48	.19	.01	.11
Manganese (Mn)	--	.05	.01	--	.--
Calcium (Ca)	9.3	7.6	17	2.4	16
Magnesium (Mg)	2.7	5.1	5.6	1.2	4.4
Sodium (Na)	5.5	19	20	7.4	19
Potassium (K)	4.2	2.5	2.6	2.5	2.8
Carbonate (CO_3)	0	0	16	0	0
Bicarbonate (HCO_3)	34	31	18	10	55
Sulfate (SO_4)	3.0	5.6	5.7	3.0	2.0
Chloride (Cl)	14	33	36	8.0	37
Fluoride (F)	.2	.1	.1	.0	.2
Nitrate (NO_3)	.5	12	13	9.4	2.5
Dissolved solids	68	151	176	71	149
Hardness as $CaCO_3$:					
Total	34	40	65	11	58
Noncarbonate	6	14	24	3	13

[a] Bringle Lake. [b] Texas Station. [c] Bringle Station.

TEXARKANA, Analyses--Continued

	Raw water [a]	Arkansas Station		Finished water [b]	Finished water [c]
		Raw water	Finished water		
Color	--	5	8	--	--
pH	6.6	5.8	9.1	5.6	6.6
Specific conductance (micromhos at 25 C.)	115	199	235	64.0	220
Turbidity	--	2	4	--	--
Temperature (F.)	--	66	65	--	--
Date of collection	Sept. 22, 1943	Dec. 4, 1951	Dec. 4, 1951	Sept. 22, 1943	Sept. 22, 1943

[a] Bringle Lake. [b] Texas Station. [c] Bringle Station.

VAN BUREN
(Population, 6,413)

Ownership: Supplied by Fort Smith. (See Fort Smith.)

WEST HELENA
(Population, 6,107)

Ownership: Municipal; also supplies about 1,000 people outside the city limits. Total population supplied, about 7,100.
Source: 3 wells (4 to 6) 621, 623, and 621 ft deep. The yield of the wells is reported to be 750, 250-300, and 750 gpm.
Treatment: Aeration, addition of lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 365,000 gal.

ANALYSES

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

	Well 5	Wells (finished water)		Well 5	Wells (finished water)
Silica (SiO_2)	15	22	Hardness as $CaCO_3$:		
Iron (Fe)	.33	.20	Total	116	115
Manganese (Mn)	--	.00	Noncarbonate	0	0
Calcium (Ca)	31	28			
Magnesium (Mg)	9.4	11	Color	--	10
Sodium (Na)	163	168	pH	7.5	7.8
Potassium (K)	6.5	6.9	Specific conductance (micromhos at 25 C.)	980	843
Carbonate (CO_3)	0	0	Turbidity	--	2
Bicarbonate (HCO_3)	542	536	Temperature (F.)	67	62
Sulfate (SO_4)	.8	2.0	Date of collection	June 27, 1946	Dec. 26, 1951
Chloride (Cl)	24	34			
Fluoride (F)	.0	.0			
Nitrate (NO_3)	.2	1.5			
Dissolved solids	526	540			

Depth (feet)	623
Diameter (inches)	26-10
Date drilled	1936
Percent of supply	--

WEST MEMPHIS
(Population, 9,112)

Ownership: Municipal.
Source: 3 wells (1 to 3), each 1,509 ft deep. The yield of the wells is reported to be 300, 800, and 1,500 gpm.
Treatment: None.
Storage: 400,000 gal.

ANALYSES

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

	Well 1	Well 2		Well 1	Well 2
Silica (SiO_2)	10	11	Hardness as $CaCO_3$:		
Iron (Fe)	.25	.16	Total	12	10
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	3.3	2.6			
Magnesium (Mg)	1.0	.9	Color	--	--
Sodium (Na)	41	45	pH	7.6	7.4
Potassium (K)	2.5	1.3	Specific conductance (micromhos at 25 C.)	195	236
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	120	122	Temperature (F.)	76	76
Sulfate (SO_4)	3.3	5.5	Date of collection	Nov. 2, 1945	Mar. 8, 1950
Chloride (Cl)	1.2	3.0			
Fluoride (F)	.0	.0			
Nitrate (NO_3)	1.1	.7			
Dissolved solids	125	131			

Depth (feet)	1,509	1,509
Diameter (inches)	10-6	10
Date drilled	1929	1946
Percent of supply	--	--

ALAMEDA, CALIFORNIA
(Population, 64,430)

Ownership: East Bay Municipal Utility District. (See Oakland.)

ALBANY
(Population, 17,590)

Ownership: East Bay Municipal Utility District. (See Oakland.)

ALHAMBRA
(Population, 51,359)

Ownership: Municipal.
Source: 9 wells ranging in depth from 300 to 872 ft. The yield of the wells is reported to be from 900 to 3,150 gpm. Emergency supply from wells owned by California Water and Telephone Co., South Pasadena.
Treatment: None.
Storage: Reservoirs and tanks, 27,675,000 gal.

ANALYSES

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

	Well 2	Well 8	Well 12	Longden Well	Garfield Reservoir [a]
Silica (SiO_2)	--	--	--	--	--
Iron (Fe)	.04	.02	.02	.0	.00
Manganese (Mn)	.00	.00	.00	.00	.00
Calcium (Ca)	35	40	42	36	53
Magnesium (Mg)	7.0	10	11	7.8	15
Sodium (Na)	19	25	23	28	27
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	0	0	--	0	--
Bicarbonate (HCO_3)	129	154	146	132	151
Sulfate (SO_4)	21	17	24	26	40
Chloride (Cl)	13	26	27	17	46
Fluoride (F)	.8	.5	.4	.8	.5
Nitrate (NO_3)	11	20	19	21	36
Dissolved solids	221	261	262	238	326
Hardness as $CaCO_3$:					
Total	115	143	149	123	196
Noncarbonate	9	17	29	15	72
Color	--	--	--	--	--
pH	7.4	7.3	7.3	7.3	7.8
Specific conductance (micromhos at 25 C.)	317	389	400	371	535
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Feb. 9, 1951	Feb. 9, 1951	Feb. 9, 1951	Feb. 9, 1951	Feb. 9, 1951
Depth (feet)	734	764	862	778	
Diameter (inches)	30-18-16	30-20-16	20	26-20	
Date drilled	1931	1935	1948	1926	
Percent of supply	--	--	--	--	

[a] Receives water from Wells 8, Longden, and Garfield.

ALISAL
(Population, 16,714)

Ownership: Pacific Gas & Electric Co., Adcock Water Co., and Alisal Heights Water Co. Pacific Gas & Electric Co. supplies about 9,450 people in Alisal and all of Salinas; Adcock Water Co. supplies about 6,500 people in the eastern part of Alisal; Alisal Heights Water Co. supplies about 800 people in the western part of Alisal. Total population supplied, about 30,700.

Source: Pacific Gas & Electric Co.: 8 wells 342 to 668 ft deep; yield reported to be from 500 to 1,260 gpm; Adcock Water Co.: 3 wells (5 to 7) 515, 501, and 380 ft deep; yield reported to be 550, 750, and 475 gpm; Alisal Heights Water Co.: 2 wells (1 and 2) 221 and 182 ft deep; yield of each well reported to be 320 gpm.

Treatment: None.

Storage: Pacific Gas & Electric Co., 200,000 gal; Adcock Water Co.: elevated tanks, 14,000 gal; Alisal Heights Water Co.: elevated tanks, 4,500 gal.

ANALYSES

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

	Clay Street well[a]	Well 6[b]	Well 7[b]	Well 1[c]
Silica (SiO_2)	--	36	44	--
Iron (Fe)	.0	.0	.0	.0
Manganese (Mn)	.0	--	--	.0
Calcium (Ca)	49	40	37	41
Magnesium (Mg)	22	13	12	14
Sodium (Na)	53	26	49	47
Potassium (K)	--	2.0	3.6	--
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	195	175	141	137
Sulfate (SO_4)	57	9.5	7.2	12
Chloride (Cl)	76	40	80	84
Fluoride (F)	.0	.4	.4	.0
Nitrate (NO_3)	3.5	2.5	12	22
Dissolved solids	[d]357	258	329	333
Hardness as $CaCO_3$:				
Total	212	153	142	160
Noncarbonate	53	10	26	48
Color	0	0	0	--
pH	7.4	7.6	8.1	6.9
Specific conductance (micromhos at 25 C.)	--	420	519	--
Turbidity	--	--	--	--
Temperature (F.)	--	67	65	--
Date of collection	Mar. 24, 1950	May 16, 1952	May 16, 1952	Mar. 6, 1950
Depth (feet)	351	501	380	221
Diameter (inches)	14	14	14	12
Date drilled	1924	1947	1933	1946
Percent of supply	--	--	--	--

[a] Pacific Gas & Electric Co.

[b] Adcock Water Co.; analysis by Geological Survey, Sacramento, Calif.

[c] Alisal Heights Water Co.

[d] Sum of determined constituents.

ARCADIA
(Population, 23,066)

Ownership: Municipal.
Source: 11 wells ranging in depth from 462 to 862 ft. The yield of the wells ranges from 500 to 3,600 gpm. Emergency supply from wells owned by Southern California Water Co.
Treatment: None.
Storage: Reservoirs, 10,500,000 gal.

Analyses indicate that there is considerable variation in the character of the water from the individual wells of approximately same depth and at different depths. The analyses selected show the range in dissolved solids and hardness in the water from the different wells.

ANALYSES

(Analyses, in parts per million, by Pomeroy & Assoc., Pasadena, Calif.)

	Orange Grove Well 1A	Orange Grove Well 4A	Longden Well 1[a]	Camino Real Well 1	Rancho Well 8
Silica (SiO_2)	11	12	18	14	14
Iron (Fe)	--	--	--	--	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	26	44	48	39	79
Magnesium (Mg)	5.2	14	11	11	24
Sodium (Na)	50	33	13	19	18
Potassium (K)	1.7	1.8	3.0	1.5	2.1
Carbonate (CO_3)	--	--	--	--	--
Bicarbonate (HCO_3)	156	187	201	182*	204
Sulfate (SO_4)	48	60	11	21	121
Chloride (Cl)	13	15	7.0	9.3	14
Fluoride (F)	1.0	.8	.4	.9	.8
Nitrate (NO_3)	5.6	7.4	13	2.5	28
Dissolved solids	[b]238	[b]280	234	[b]208	[b]401
Hardness as $CaCO_3$:					
Total	86	167	164	143	296
Noncarbonate	0	14	0	0	128
Color	--	--	--	--	--
pH	7.5	7.5	7.6	7.8	7.4
Specific conductance (micromhos at 25 C.)	--	--	355	--	--
Turbidity	--	--	1.1	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Feb. 7, 1951	Feb. 7, 1951	May 8, 1951	Feb. 7, 1951	Feb. 7, 1951
Depth (feet)	462	466	550	714	--
Diameter (inches)	22	16	26	20	--
Date drilled	1921	1921	1927	1949	--
Percent of supply	--	--	--	--	--

[a] Analyzed by California State Dept. of Public Health.
[b] Sum of determined constituents.

BAKERSFIELD
(Population, 34,784)

Ownership: California Water Service Co.; supplies East Bakersfield and other consumers outside the city limits. Total population supplied, about 81,000.
Source: 78 wells ranging in depth from 60 to 682 ft. The yield of the wells (data on 44 wells) is reported to range from 160 to 1,250 gpm, and to average 716 gal.
Treatment: None.
Storage: Reservoirs, 10,300,000 gal.

ANALYSES

(Analyses, in parts per million, by California Water Service Co., San Jose, Calif.)

	Well 79-01	Well 70-01	Well 7-06	Well 11-03	Range of constituents [a]
Silica (SiO_2)	14	20	24	21	9 - 33
Iron (Fe)	.08	.01	.04	.00	.00- .63
Manganese (Mn)	.04	.06	.01	.01	.00- 1.7
Calcium (Ca)	5.2	23	34	62	5.2 -128
Magnesium (Mg)	1.2	3.9	7.8	14	1.0 - 75
Sodium (Na)	34	25	24	37	10 -171
Potassium (K)	--	--	--	--	-- --
Carbonate (CO_3)	--	--	--	--	-- --
Bicarbonate (HCO_3)	85	115	142	205	59 -250
Sulfate (SO_4)	11	16	24	59	6.2 -384
Chloride (Cl)	7	10	19	38	5 -411
Fluoride (F)	--	--	--	---	-- --
Nitrate (NO_3)	.6	3.1	1.8	16	.0 - 35
Dissolved solids	[b] 115	[b] 157	[b] 205	[b] 348	108 -1,010
Hardness as $CaCO_3$:					
Total	18	73	118	214	18 -628
Noncarbonate	0	0	1	44	-- --
Color	--	--	--	--	-- --
pH	7.0	7.0	7.0	7.0	6.6 8.3
Specific conductance (micromhos at 25 C.)	180	253	339	572	180 1,620
Turbidity	--	--	--	--	-- --
Temperature (F.)	--	--	--	--	-- --
Date of collection	Oct. 27, 1950	Sept. 11, 1950	Apr. 23, 1951	Apr. 23, 1951	1948 - 1951
Depth (feet)	615	300	250	240	60 - 682
Diameter (inches)	16	16	16	16	-- --
Date drilled	1949	1948	1946	1941	-- --
Percent of supply	--	--	--	--	-- --

[a] Based on 78 analyses (1 analysis from each well) made between 1948 and 1951. Mean values: hardness, 108 ppm; dissolved solids, 218 ppm; specific conductance, 354 micromhos.
[b] Sum of determined constituents.

BELL
(Population, 15,430)

Ownership: Southern California Water Co.
Source: 4 wells, 540, 586, 490, and 950 ft deep. The yield of the wells is reported to be 585, 275, 1,200, and 1,070 gpm.
Treatment: None.
Storage: 250,000 gal.

ANALYSES

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

	Watson Well	Wells[a]		Watson Well	Wells[a]
Silica (SiO_2)	15	12	Hardness as $CaCO_3$:		
Iron (Fe)	.00	.03	Total	204	201
Manganese (Mn)	.0	.0	Noncarbonate	38	5
Calcium (Ca)	57	57			
Magnesium (Mg)	15	14	Color	--	--
Sodium (Na)	37	37	pH	8.2	7.9
Potassium (K)	--	--	Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	6	0	Turbidity	--	--
Bicarbonate (HCO_3)	189	238	Temperature (F.)	--	--
Sulfate (SO_4)	80	46	Date of collection	Apr. 26, 1951	May 12, 1948
Chloride (Cl)	25	27			
Fluoride (F)	--	--			
Nitrate (NO_3)	--	--			
Dissolved solids	[b]328	[b]310			
Depth (feet)				490	--
Diameter (inches)				16	--
Date drilled				1946	--
Percent of supply				--	100

[a] Composite.
[b] Sum of determined constituents.

BERKELEY
(Population, 113,805)

Ownership: East Bay Municipal Utility District. (See Oakland.)

BEVERLY HILLS
(Population, 29,032)

Ownership: Municipal; supplies also West Hollywood. Total population supplied, about 41,000.
Source: 17 wells ranging in depth from 90 to 702 ft (83 percent of supply); Colorado River (17 percent of supply; 22 percent in 1952), furnished by the Metropolitan Water District of Southern California (see Los Angeles.) The yield of the wells is reported to range from 100 to 900 gpm, and to average 540 gal.
Treatment: Aeration, softening with excess lime, recarbonation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 7,500,000 gpd.
Raw-water storage: 1,171,000 gal.
Finished-water storage: 18,780,000 gal.

BEVERLY HILLS--Continued

ANALYSES

(Analyses, in parts per million, by City of Beverly Hills)

	Franklin Well 9	Tatum Well 1-A	City Well 1-A	Melrose M Well
Silica (SiO_2)	10	27	35	23
Iron (Fe)	0	.15	0	0
Manganese (Mn)	--	--	--	--
Calcium (Ca)	61	50	76	31
Magnesium (Mg)	27	30	39	9
Sodium (Na)	47	158	195	186
Potassium (K)				
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	281	415	517	371
Sulfate (SO_4)	72	106	79	43
Chloride (Cl)	30	100	190	120
Fluoride (F)	1.2	.4	.3	.5
Nitrate (NO_3)	18	--	--	--
Dissolved solids	[a]405	[a]676	[a]868	[a]594
Hardness as $CaCO_3$:				
Total	263	248	350	114
Noncarbonate	32	0	0	0
Color	--	--	--	--
pH	--	7.5	7.2	8.0
Specific conductance (micromhos at 25 C.)	600	1,050	1,380	1.000
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Spring, 1951	Spring, 1951	Spring, 1951	Spring, 1951
Depth (feet)	90	400	411	600
Diameter (inches)	16	16	16	16
Date drilled	1921	1930	1948	1948
Percent of supply	--	--	--	--

[a] Sum of determined constituents.

BEVERLY HILLS--Continued

ANALYSES

(Analyses, in parts per million, by City of Beverly Hills)

	Plant 1 (raw water)	Plant 1 (finished water)	Plant 2 (raw water)	Plant 2 (finished water)
Silica (SiO_2)	20	20	12	12
Iron (Fe)	.20	.10	.20	.20
Manganese (Mn)	--	--	--	--
Calcium (Ca)	75	25	42	22
Magnesium (Mg)	30	26	16	12
Sodium (Na), Potassium (K)	148	148	160	159
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	398	207	403	303
Sulfate (SO_4)	108	110	68	70
Chloride (Cl)	138	148	84	90
Fluoride (F)	.4	.4	.6	.6
Nitrate (NO_3)	--	--	--	--
Dissolved solids	[a] 716	[a] 580	[a] 581	[a] 515
Hardness as $CaCO_3$:				
Total	310	170	170	102
Noncarbonate	0	0	0	0
Color	--	--	--	--
pH	7.5	8.2	8.0	8.1
Specific conductance (micromhos at 25 C.)	1,100	920	920	840
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	October, 1951	October, 1951	October, 1951	October, 1951

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[b]	--	330	300	--	--	7.6	--	320	300	--	--	--
Finished water[b]	--	176	150	--	--	8.1	--	168	160	--	--	--
Raw water[c]	--	330	304	--	--	8.0	--	172	164	--	--	--
Finished water[c]	--	250	230	--	--	8.1	--	106	98	--	--	--

[a] Sum of determined constituents.
[b] Plant 1.
[c] Plant 2.

• BURBANK
(Population, 78,577)

Ownership: Municipal.
Source: 11 wells (3, 4, 6, 7, and 9 to 15) ranging in depth from 180 to 790 ft, 98 percent of supply; Colorado River distributed by the Metropolitan Water District of Southern California, 2 percent of supply (5 percent in 1952), (see Los Angeles.) The yield of the wells is reported to range from 500 to 2,860 gpm.
Treatment: The well water is not treated. Colorado River water is softened and filtered by the Metropolitan Water District of Southern California.
Raw-water storage: Approximately 35,000,000 gal.
Finished-water storage: --

BURBANK--Continued

ANALYSES

(Analyses, in parts per million, by Carl Wilson, Los Angeles)

	Well 4	Well 7	Well 10	Well 11	Well 14
Silica (SiO_2)	20	19	25	24	19
Iron (Fe)	0	0	0	0	0
Manganese (Mn)	0	0	0	0	0
Calcium (Ca)	67	66	52	51	50
Magnesium (Mg)	18	17	14	15	14
Sodium (Na)	33	39	35	19	31
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	275	275	242	189	222
Sulfate (SO_4)	43	49	47	46	41
Chloride (Cl)	24	25	12	16	16
Fluoride (F)	--	--	--	--	--
Nitrate (NO_3)	13	12	.5	5	4
Dissolved solids	[a]354	[a]362	[a]305	[a]269	[a]284
Hardness as $CaCO_3$:					
Total	241	235	187	189	182
Noncarbonate	16	10	0	34	0
Color	--	--	--	--	--
pH	7.5	7.4	7.9	7.9	7.8
Specific conductance (micromhos at 25 C.)	--	--	--	--	--
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Sept. 1951	Sept. 1951	Sept. 1951	Sept. 1951	Sept. 1951
Depth (feet)	227	630	588	653	730
Diameter (inches)	16	20	20	20	20
Date drilled	1924	1939	--	--	1950
Percent of supply	--	--	--	--	--

[a] Sum of determined constituents.

BURLINGAME
(Population, 19,886)

Ownership: Municipal.
Source: Water purchased from City of San Francisco: Crystal Springs Reservoir (93 percent of supply) and Pilarcitos Reservoir (7 percent of supply). (See San Francisco.)
Treatment: Water from Crystal Springs Reservoir is chlorinated by City of San Francisco. Water from Pilarcitos Reservoir is chlorinated by City of Burlingame.
Finished-water storage: 3,550,000 gal.

CHULA VISTA
(Population, 15,927)

Ownership: California Water and Telephone Co. (See National City.)

COMPTON
(Population, 47,991)

Ownership: Municipal; supplies also about 1,000 people outside the city limits. Total population supplied, about 49,000.
Source: 9 wells (1, 2, 6, and 8 to 13), 256, 282, 280, 717, 642, 466, 640, 410, and 738 ft deep. The yield of the wells is reported to be 630, 790, 360, 740, 1,200, 1,080, 2,000, 450, and 1,350 gpm. Emergency supply from the Colorado River distributed by the Metropolitan Water District of Southern California. (See Los Angeles.)
Treatment: None.
Storage: Reservoirs, 6,000,000 gal.

ANALYSES

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

	Well 1	Well 6	Well 9	Well 10	Well 11
Silica (SiO_2)	---	--	--	---	--
Iron (Fe)	.03	.17	.08	.03	.04
Manganese (Mn)	.0	.0	.0	.0	.0
Calcium (Ca)	57	87	51	68	58
Magnesium (Mg)	12	18	6.7	12	10
Sodium (Na)	40	48	44	27	43
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	0	0	0	0	5
Bicarbonate (HCO_3)	212	256	173	210	205
Sulfate (SO_4)	71	126	88	65	71
Chloride (Cl)	22	40	15	26	21
Fluoride (F)	.4	.4	.3	.4	.3
Nitrate (NO_3)	.0	.0	.0	.1	.0
Dissolved solids	336	505	315	387	400
Hardness as $CaCO_3$:					
Total	191	294	154	219	187
Noncarbonate	18	81	12	47	10
Color	--	--	--	--	--
pH	7.9	7.6	8.2	7.8	8.3
Specific conductance (micromhos at 25 C.)	--	--	--	--	--
Turbidity	0	0	0	0	0
Temperature (F.)	--	--	--	--	--
Date of collection	Mar. 21, 1951	Mar. 21, 1951	Mar. 21, 1951	Mar. 21, 1951	Mar. 21, 1951
Depth (feet)	256	280	642	466	640
Diameter (inches)	12	8	28-16	16	16
Date drilled	1920	1880	1947	1947	1948
Percent of supply	--	--	--	--	--

CONTRA COSTA DISTRICT
(Population, ------)

Ownership: California Water Service Co.; supplies Concord, Crockett, Port Chicago, and San Ramon Valley. Total population supplied, about 63,000.
Source: San Joaquin River through the Contra Costa Canal (47 percent of supply), Sacramento River (45 percent of supply), Port Chicago wells (5 percent of supply), and other wells (3 percent of supply). There is an emergency connection with the East Bay Municipal Utility District. (See Oakland.)

CONTRA COSTA DISTRICT--Continued

Treatment: Surface water: prechlorination, coagulation with alum, sedimentation, activated carbon, rapid sand filtration, postchlorination, and adjustment of pH with soda ash or lime. Water from the Galindo wells is softened with zeolite.
Rated capacity of treatment plant: 12,000,000 gpd.
Raw-water storage: 1,000,000,000 gal.
Finished-water storage: 5,590,000 gal.

ANALYSES

(Analyses, in parts per million, by California Water Service Co., San Jose, Calif.)

	Galindo Well 2-37	Government Ranch Well 1-03	Mallard Reservoir (raw water)[a]	Finished water[b]
Silica (SiO_2)	25	21	8	8
Iron (Fe)	.06	.15	.93	.10
Manganese (Mn)	.10	.18	.13	.11
Calcium (Ca)	46	41	26	30
Magnesium (Mg)	36	31	22	19
Sodium (Na)	41	119	65	56
Potassium (K)	--	--	--	--
Carbonate (CO_3)	--	--	0	--
Bicarbonate (HCO_3)	279	288	107	112
Sulfate (SO_4)	56	79	60	77
Chloride (Cl)	38	113	103	70
Fluoride (F)	.1	.1	0	.0
Nitrate (NO_3)	11	11	.6	3.7
Dissolved solids	[c] 391	[c] 557	[c] 338	[c] 319
Hardness as $CaCO_3$:				
Total	262	230	155	152
Noncarbonate	34	0	68	61
Color	--	--	0	--
pH	7.9	7.5	7.2	8.0
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Feb. 8, 1950	Jan. 23, 1950	Jan. 3 1950	1949

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	--	238	88	7.5	7.9	7.2	155	262	152	--	--	--
Finished water	92	--	--	8.0	--	--	152	--	--	--	--	--

[a] Surface waters.
[b] Composite sample, distribution system.
[c] Sum of determined constituents.

CULVER CITY
(Population, 19,720)

Ownership: Southern California Water Co.; supplies also about 4,100 people outside the city limits. Total population supplied, about 23,800.
Source: 10 wells. Sentney Plant: wells (5 to 8, 10, and 12), 266, 810, 287, 320, 290, and 650 ft deep; Pacific Plant: well (4), 335 ft deep; Sepulveda Plant: well (3), 300 ft deep; Manning Plant: wells (4 and 5), 304 and 855 ft deep. The yield of the wells is reported to range from 135 to 1,150 gpm.
Treatment: Aeration, coagulation with ferrous chloride, activated carbon, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,350,000 gal.

ANALYSES

(Analyses, in parts per million, by Smith-Emery Co., Los Angeles, Calif.)

	Sentney Wells	Pacific Well	Sepulveda Well	Manning Wells
Silica (SiO_2)	12	14	12	12
Iron (Fe)	.06	.1	.25	.04
Manganese (Mn)	.03	.03	.12	.00
Calcium (Ca)	87	115	106	87
Magnesium (Mg)	42	46	49	30
Sodium (Na)	87	44	95	46
Potassium (K)	--	--	--	--
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	360	299	366	337
Sulfate (SO_4)	151	209	188	97
Chloride (Cl)	90	89	125	43
Fluoride (F)	--	--	--	--
Nitrate (NO_3)	--	--	--	--
Dissolved solids	[a]646	[a]665	[a]756	[a]481
Hardness as $CaCO_3$:				
Total	389	474	467	340
Noncarbonate	94	231	166	64
Color	--	--	--	--
pH	8.0	7.8	8.0	7.6
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Mar. 27, 1950	Apr. 7, 1950	Apr. 7, 1950	June 2, 1950
Depth (feet)	266-810	335	300	304-855
Diameter (inches)	14-18	16	16	10-14
Date drilled	1931-1946	1932	1938	1938-1944
Percent of supply	--	--	--	--

[a] Sum of determined constituents.

DALY CITY
(Population, 15,191)

Ownership: Municipal; supplies also about 100 people outside the city limits. Total population supplied, about 15,300.

Source: 6 wells (1, 6 to 10) 256, 400, 500, 500, 500, and 522 ft deep; yield reported to be 55, 300, 300, 350, 300, and 1,000 gpm. The wells furnish 82 percent of the total supply. Auxiliary supply from San Andres Reservoir. (See San Francisco.)

Treatment: The well water is not treated. Water from San Francisco is chlorinated by City of San Francisco.

Storage: 3 reservoirs, 3,000,000 gal.

ANALYSES

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

	Well 1	Well 7	Well 8	Well 10
Silica (SiO_2)	--	--	--	--
Iron (Fe)	2.0	.0	.0	3.0
Manganese (Mn)	.0	.0	.0	.0
Calcium (Ca)	13	14	13	14
Magnesium (Mg)	12	12	12	14
Sodium (Na)	34	34	31	29
Potassium (K)	--	--	--	--
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	93	102	93	98
Sulfate (SO_4)	12	8.0	6.0	8.9
Chloride (Cl)	31	46	44	45
Fluoride (F)	.0	.0	.0	.0
Nitrate (NO_3)	31	5.5	4.4	1.3
Dissolved solids	226	222	202	210
Hardness as $CaCO_3$:				
Total	82	85	81	91
Noncarbonate	6	1	6	12
Color	--	--	--	--
pH	7.4	7.1	7.9	7.3
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Nov. 29, 1950	Nov. 29, 1950	Nov. 29, 1950	Nov. 29, 1950
Depth (feet)	256	500	500	522
Diameter (inches)	14	12	12	14
Date drilled	1908	1937	1938	1949
Percent of supply	--	--	--	--

EAST BAKERSFIELD
(Population, 38,177)

Ownership: California Water Service Co. (See Bakersfield.)

EAST LOS ANGELES
(Population, 92,100)

Ownership: California Water Service Co.
Source: 43 wells ranging in depth from 276 to 815 ft. The depth of most of the wells is around 500 ft.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 8,140,000 gal.

ANALYSIS

(Analysis, in parts per million, by California Water Service Co., San Jose, Calif.)

	Typical composite of wells		Typical composite of wells
Silica (SiO_2)	28	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	212
Manganese (Mn)	.0	Noncarbonate	43
Calcium (Ca)	57		
Magnesium (Mg)	17	Color	--
Sodium (Na)	37	pH	7.9
Potassium (K)	--	Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	206		
Sulfate (SO_4)	55	Turbidity	--
Chloride (Cl)	46	Temperature (F.)	--
Fluoride (F)	.0	Date of collection	1950
Nitrate (NO_3)	.0		
Dissolved solids	[a] 342		
Depth (feet)			--
Diameter (inches)			--
Date drilled			--
Percent of supply			100

[a] Sum of determined constituents.

EL CERRITO
(Population, 18,011)

Ownership: East Bay Municipal Utility District. (See Oakland.)

EUREKA
(Population, 23,058)

Ownership: Municipal; supplies also about 8,000 people outside the city limits. Total population supplied, about 31,000.
Source: Mad River (diversion dam); emergency supply, 3 deep wells.
Treatment: Prechlorination; coagulation with alum, sodium aluminate, and lime; sedimentation, chlorination, and rapid sand filtration. Copper (Cuprose) for control of algae.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: Approximately 750,000,000 gal impounded behind Mad River Dam.
Finished-water storage: 2,125,000 gal.

EUREKA--Continued

ANALYSES

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

	Mad River[a]	Wells[b]		Mad River[a]	Wells[b]
Silica (SiO_2)	--	--	Hardness as $CaCO_3$:		
Iron (Fe)	0.4	0.2	Total	66	92
Manganese (Mn)	.0	.0	Noncarbonate	6	5
Calcium (Ca)	20	14			
Magnesium (Mg)	3.9	14	Color	--	--
Sodium (Na)	2.8	20	pH	8.0	7.9
Potassium (K)	--	--	Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	73	107	Turbidity	--	0
Sulfate (SO_4)	4.3	.0	Temperature (F.)	--	--
Chloride (Cl)	5.4	30	Date of collection	June 15, 1950	June 14, 1950
Fluoride (F)	.0	.0			
Nitrate (NO_3)	.0	3.5			
Dissolved solids	[c] 73	[c] 134			

Regular determinations at treatment plant, 1951-52

	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	50	110	20	--	--	--	50	120	36	--	2000	5
Finished water	40	95	8	--	--	--	60	118	33	--	50	5

[a] Finished water except for final chlorination.
[b] Hawthorne Street wells.
[c] Sum of determined constituents.

FRESNO
(Population, 91,669)

Ownership: Municipal; supplies also about 16,000 people outside the city limits. Total population supplied, about 108,000.
Source: 45 wells ranging in depth from 80 to 319 ft. The depths of most of the wells are between 100 and 200 ft. The yield of the wells is reported to range from 1,000 to 2,425 gpm, and to average 1,489.
Treatment: None.
Storage: 1,880,000 gal.

FRESNO--Continued

ANALYSES

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

	Well 2	Well 3	Well 24	Well 27	Well 32[a]
Silica (SiO_2)	73	80	71	73	58
Iron (Fe)	.02	.01	.0	.0	.01
Manganese (Mn)	--	--	--	--	.00
Calcium (Ca)	34	28	15	18	25
Magnesium (Mg)	19	17	8.3	13	14
Sodium (Na)	29	23	18	16	22
Potassium (K)	5.9	5.2	3.4	4.4	4.3
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	202	172	101	130	174
Sulfate (SO_4)	13	9.3	9.6	8.4	3.3
Chloride (Cl)	20	18	6.8	8.0	18
Fluoride (F)	.0	.0	.0	.0	.1
Nitrate (NO_3)	27	22	14	14	5.4
Dissolved solids	330	286	202	217	236
Hardness as $CaCO_3$:					
Total	163	140	72	98	120
Noncarbonate	0	0	0	0	0
Color	7	5	10	3	---
pH	7.8	7.6	7.7	7.6	7.6
Specific conductance (micromhos at 25 C.)	451	378	231	269	--
Turbidity	0	1	3	0	--
Temperature (F.)	--	--	--	--	--
Date of collection	Oct. 17, 1951	Oct. 17, 1951	Oct. 17, 1951	Oct. 17, 1951	May 2, 1947
Depth (feet)	142	123	162	130	182
Diameter (inches)	20	18	18	18	20
Date drilled	1922	1923	1925	--	1941
Percent of supply	--	--	--	--	--

[a] Analyzed by Twining Laboratories, Fresno, Calif.

GLENDALE
(Population, 95,702)

Ownership: Municipal; supplies also about 400 people outside the city limits. Total population supplied, about 96,100.

Source: 11 wells (Grandview 1 to 4, 6, 9 to 12, and Glorietta 3 and 4) ranging in depth from 180 to 640 ft and Verdugo Stream, about 99 percent of supply. The yield of the wells is reported to range from 835 to 3,190 gpm, and averages 2,117 gpm. Most of the supply is from the wells. Auxiliary supply (about 1 percent of the total; 7 percent in 1952), Colorado River distributed by the Metropolitan Water District of Southern California. (See Los Angeles.)

Treatment: None (Colorado River water is softened and filtered by Metropolitan Water District of Southern California). (See Los Angeles.)

Storage: 170,000,000 gal.

GLENDALE--Continued

ANALYSES

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

	Grandview Well 6	Grandview Well 11	Grandview Wells[a]	Glorietta Well 3	Verdugo Stream
Silica (SiO_2)	--	--	19	--	--
Iron (Fe)	.60	1.3	--	3.8	.68
Manganese (Mn)	.00	.00	0	.00	.00
Calcium (Ca)	54	52	56	36	54
Magnesium (Mg)	14	13	12	14	21
Sodium (Na)	57	32	71	20	26
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	223	214	243	149	188
Sulfate (SO_4)	73	55	67	23	80
Chloride (Cl)	39	14	51	14	23
Fluoride (F)	.4	.4	--	.4	.5
Nitrate (NO_3)	5.7	1.4	3.5	26	10
Dissolved solids	[b]354	[b]274	[b]399	[b]211	[b]308
Hardness as $CaCO_3$:					
Total	193	183	189	150	223
Noncarbonate	10	7	0	28	67
Color	--	--	--	--	--
pH	7.7	7.9	7.7	7.1	6.8
Specific conductance (micromhos at 25 C.)	628	491	--	389	545
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Oct. 19, 1951	Oct. 19, 1951	Nov. 29, 1949	Oct. 19, 1951	Oct. 19, 1951
Depth (feet)	476	640	--	180	
Diameter (inches)	18	18	--	16	
Date drilled	1923	1929	--	1928	
Percent of supply	--	--	--	--	

[a]Analyzed by Carl Wilson, Los Angeles, Calif.
[b]Sum of determined constituents.

HAWTHORNE
(Population, 16,316)

Ownership: Municipal; supplies also about 3,150 people outside the city limits. Total population supplied, about 19,500.
Source: 7 wells (1 to 4, 6 to 8) 569, 679, 760, 670, 490, 500, and 532 ft deep. The yield of the wells is reported to range from 328 to 750 gpm. Emergency supply from the Lennox system of the Southern California Water Company.
Treatment: Prechlorination, coagulation with ferric chloride, softening with excess lime, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 550,000 gal.
Finished-water storage: 1,500,000 gal.

HAWTHORNE--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	31	Hardness as $CaCO_3$:	
Iron (Fe)	0	Total	63
Manganese (Mn)	0	Noncarbonate	0
Calcium (Ca)	12.		
Magnesium (Mg)	8.0	Color	--
Sodium (Na)	82	pH	8.9
Potassium (K)	--	Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	44		
Bicarbonate (HCO_3)	109	Turbidity	--
Sulfate (SO_4)	7.0	Temperature (F.)	--
Chloride (Cl)	52	Date of collection	February, 1950
Fluoride (F)	--		
Nitrate (NO_3)	.0		
Dissolved solids	[a]290		

[a] Sum of determined constituents.

HUNTINGTON PARK
(Population, 29,450)

Ownership: Municipal.
Source: 11 wells ranging in depth from 510 to 1,550 ft. The yield of the wells is reported to range from 200 to 1,440 gpm. Emergency supply from wells owned by Southern California Water Co. in Bell and Maywood.
Treatment: None.
Storage: 7,442,000 gal.

The weighted average hardness and dissolved solids of the water served are 228 ppm and 365 ppm, respectively.

ANALYSES

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

	Well 2	Well 6	Well 7	Well 10	Well 12
Silica (SiO_2)	15	20	23	14	17
Iron (Fe)	.03	.00	.00	.00	.04
Manganese (Mn)	.00	.00	.05	.00	.00
Calcium (Ca)	72	85	48	47	46
Magnesium (Mg)	23	47	15	20	13
Sodium (Na)	54	60	42	44	45
Potassium (K)	1.9	1.4	3.0	2.4	2.3
Carbonate (CO_3)	--	--	--	--	--
Bicarbonate (HCO_3)	216	248	193	201	204
Sulfate (SO_4)	121	205	76	82	69
Chloride (Cl)	75	89	22	24	23
Fluoride (F)	.4	.4	.3	.4	.4
Nitrate (NO_3)	7.1	.4	.8	3.5	.0
Dissolved solids	[a]479	747	349	373	345
Hardness as $CaCO_3$:					
Total	287	408	181	201	170
Noncarbonate	110	205	23	35	3

[a] Sum of determined constituents.

HUNTINGTON PARK, Analyses--Continued

	Well 2	Well 6	Well 7	Well 10	Well 12
Color	--	--	--	--	--
pH	7.4	7.5	7.7	7.7	7.8
Specific conductance (micromhos at 25 C.)	824	1,000	518	548	521
Turbidity	< 1	< 1	< 1	< 1	< 1
Temperature (F.)	--	--	--	--	--
Date of collection	Sept. 25, 1951	Sept. 25, 1951	Sept. 26, 1951	Sept. 25, 1951	Sept. 25, 1951
Depth (feet)	533	756	984	1,200	1,504
Diameter (inches)	12	12	12	18	14
Date drilled	1920	1908	1909	1937	1945
Percent of supply	--	--	--	--	--

INGLEWOOD
(Population, 46,185)

Ownership: Municipal; supplies also about 100 people outside the city limits. Total population supplied, about 46,300.

Source: About 25 wells ranging in depth from 282 to 798 ft. Most of the wells are under 500 ft in depth.

Treatment: Chlorination.

Storage: 4,800,000 gal.

ANALYSES
(Analyses, in parts per million, by Carl Wilson)

	Wells 9, 11, 19, 24[a]	Well 22	Well 29	Well 33
Silica (SiO_2)	19	19	19	44
Iron (Fe)	.0	.0	.08	.15
Manganese (Mn)	.0	.0	.0	.10
Calcium (Ca)	71	84	77	73
Magnesium (Mg)	14	24	21	25
Sodium (Na)	52	67	79	104
Potassium (K)	--	--	--	--
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	249	261	281	386
Sulfate (SO_4)	94	70	79	74
Chloride (Cl)	32	115	87	108
Fluoride (F)	.0	--	--	.0
Nitrate (NO_3)	1.8	7	18	.0
Dissolved solids	[b] 406	[b] 515	[b] 518	[b] 618
Hardness as $CaCO_3$:				
Total	235	308	279	285
Noncarbonate	31	94	49	0
Color	0	0	0	0
pH	7.7	7.3	7.5	7.5
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	0	0	0	0
Temperature (F.)	--	--	--	--
Date of collection	Oct. 26, 1949	Oct. 26, 1949	Oct. 26, 1949	July 14, 1949

[a] Composite sample.
[b] Sum of determined constituents.

INGLEWOOD--Continued

	Wells 9, 11, 19, 24 [a]	Well 22	Well 29	Well 33
Depth (feet)	--	403	532	495
Diameter (inches)	--	18	18	18
Date drilled	--	1938	1945	1949
Percent of supply	--	--	--	--

LONG BEACH
(Population, 250,767)

Ownership: Municipal; supplies also about 20,000 people outside the city limits. Total population supplied, about 271,000.

Source: 29 wells (Alamitos wells, 8, 9, and 13; Citizens wells 5 to 7; Development wells 3 to 8; Wilson well; Wise wells 1 and 2; Commission wells 1 to 7 and 9 and 10; and North Long Beach wells 1, and 3 to 6), 58 percent of the supply; Colorado River distributed by the Metropolitan Water District of Southern California, 42 percent of the supply. (See Los Angeles.) The depth of the wells ranges from 324 to 1,700 ft, and the yield, from 343 to 1,830 gpm.

Treatment: Well water: prechlorination, coagulation with ferric chloride, diatomaceous earth, activated carbon, caustic soda, Calgon, sedimentation, rapid sand filtration, and postchlorination. Water from the Colorado River is softened and filtered by the Metropolitan Water District of Southern California.

Rated capacity of treatment plant: 25,000,000 gpd.

Raw-water storage: 12,173,000 gal.

Finished-water storage: Clear wells, 3,763,000 gal; other, 100,000,000 gal.

ANALYSES

(Analyses, in parts per million, by Long Beach Water Department)

	Wells (composite, raw water) [a]	Wells (composite, finished water) [a]	Finished water [ab]
Silica (SiO_2)	18	17	14
Iron (Fe)	.0	.0	.0
Manganese (Mn)	--	--	--
Calcium (Ca)	15	15	19
Magnesium (Mg)	1	1	2.3
Sodium (Na)	67	80	101
Potassium (K)	2	2	3
Carbonate (CO_3)	2	6	4
Bicarbonate (HCO_3)	178	165	164
Sulfate (SO_4)	7	8	64
Chloride (Cl)	22	39	48
Fluoride (F)	.5	.3	.3
Nitrate (NO_3)	--	--	--
Dissolved solids	[c] 223	[c] 251	[c] 338
Hardness as $CaCO_3$:			
Total	41	41	62
Noncarbonate	0	0	0
Color	50	8	6
pH	8.5	8.5	8.5
Specific conductance (micromhos at 25 C.)	--	--	--
Turbidity	<1	<1	<1
Temperature (F.)	--	--	--
Date of collection	1951-52	1951-52	1951-52

[a] Samples collected from July 1, 1951 to June 30, 1952.
[ab] Composite, wells and Colorado River, from distribution system.
[c] Sum of determined constituents.

LOS ANGELES
(Population, 1,970,358)

Ownership: Municipal; supplies also 26,000 people outside the city limits. Total estimated population supplied, 2,063,000 (1952).

Sources of supply and the order of their use for calender year 1952: Los Angeles Owens-Mono Aqueduct 74.4 percent; Los Angeles River Sources 17.8 percent; miscellaneous local wells 4.3 percent; Colorado River distributed by Metropolitan Water District of Southern California 3.5 percent. The first three sources are now at approximate capacity use and with rising demand the city will increase its use of water from the Colorado River, which will eventually provide a large proportion of the supply.

Treatment: Chlorination (except for a part of the supply from the emergency wells, which is not treated). All major reservoirs are chlorinated at the outlets; occasional chlorine residuals are carried from one reservoir to another.

Raw-water storage: Grant Lake, 15,500,000,000 gal; Crowley Lake, 60,000,000,000 gal; Tinemaha Reservoir, 5,000,000,000 gal; Haiwee Reservoir, 19,000,000,000 gal; Bouquet Canyon Reservoir, 11,900,000,000 gal; Lower San Fernando Reservoir, 6,700,000,000 gal; Chatsworth Reservoir, 3,200,000,000 gal; and other smaller reservoir. Tinemaha Reservoir is used for storage only at times of excessive river flow, being primarily designed as a regulatory basin.

Finished-water storage: Many minor reservoirs and tanks for pressure regulation. Total storage of both raw and treated water, 131,000,000,000 gal.

The Los Angeles Owens-Mono Aqueduct sources include four streams in Mono Basin, the Owens River and streams tributary thereto and tributary to Owens Lake, and at times about 100 deep wells in the Owens Valley. The Mono Basin streams are diverted to Grant Lake and thence through an eleven-mile tunnel to the Owens River. These waters, together with approximately 38 percent of the Owens River waters, which have their origin above the Owens River Gorge, are impounded in Crowley Lake. Releases of water from Crowley Lake mingle with the remaining approximate 62 percent of the Owens River waters and, after regulation through Tinemaha, Haiwee, Fairmont, and Bouquet Canyon Reservoirs, are discharged into San Fernando Reservoir to supply the San Fernando Valley, the southwest part of Los Angeles proper, and are mixed with other sources in other parts of the City. The total length of the Los Angeles Owens-Mono Aqueduct is 338 miles, which includes approximately 66 miles of the natural channel of the Owens River.

The Los Angeles River sources include spreading grounds, infiltration galleries, and wells in the Los Angeles River drainage basin. The more important groups of wells are the Vanowen, Whitnall, Verdugo, Headworks, and Crystal Springs.

LOS ANGELES--Continued

ANALYSES

(Analyses, in parts per million, by City of Los Angeles)

	Owens Valley Aqueduct[a]	Los Angeles River Sources	
		(abc)	Vanowen Wells[a]
Silica (SiO_2)	18	24	23
Iron (Fe)	.04	.02	.00
Manganese (Mn)	.01	.01	.01
Calcium (Ca)	25	77	58
Magnesium (Mg)	5	20	16
Sodium (Na)	34	52	33
Potassium (K)	4	4	3
Carbonate (CO_3)	2	0	0
Bicarbonate (HCO_3)	138	231	192
Sulfate (SO_4)	23	139	96
Chloride (Cl)	17	36	18
Fluoride (F)	.6	.4	.4
Nitrate (NO_3)	.1	12	5
Dissolved solids	[d]200	[d]478	[d]350
Hardness as $CaCO_3$:			
Total	84	274	210
Noncarbonate	0	84	53
Color	--	--	--
pH	8.3	7.6	7.7
Specific conductance (micromhos at 25 C.)	317	724	538
Turbidity	3	2	2
Temperature (F.)	58	65	63
Date of collection	--	--	--
Depth (feet)			267-595
Diameter (inches)			--
Date drilled			--
Percent of supply			8

[a] Average for 1950-51 fiscal year.

[b] This analysis was calculated according to the percentage derived from each of the sources.

[c] Los Angeles River, galleries, and wells.

[d] Sum of determined constituents.

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Ownership: Metropolitan Water District of Southern California; supplies 16 constituent areas in 5 counties (Los Angeles, Orange, Riverside, San Bernardino, and San Diego) in amounts from 0 to 98 percent of supply; 22 percent of the total water production for these areas. Total population supplied, about 3,563,000 (estimated as of July 1949).

Source: Colorado River impounded in Lake Havasu. Emergency supply from San Gabriel River impounded in Morris Reservoir.

Treatment: La Verne plant (all Colorado River water except that through San Diego Aqueduct): treatment varies somewhat, but in general is as follows: prechlorination, activated carbon, coagulation with chlorine-activated silica sol (sodium silicate), intermittent partial lime softening, rapid sand filtration, zeolite or polystyrene resin softening of part of the water so that the total effluent has a hardness of about 125 ppm, postchlorination, final adjustment of pH with lime. San Diego Aqueduct: chlorination.

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA--Continued

Rated capacity of treatment plant: 200,000,000 gpd (designed to be increased to 400,000,000 gpd).

Raw-water storage: Lake Havasu, 233,600,000,000 gal; Copper Basin Reservoir, 7,886,000,000 gal; Lake Mathews, 34,870,000,000 gal; Morris Reservoir, 12,810,000,000 gal; Gene Reservoir, 2,050,000,000 gal; San Jacinto Reservoir, 554,000,000 gal.

Finished-water storage: Palos Verdes Reservoir, 326,000,000 gal; Orange County Reservoir 65,000,000 gal; Corona Del Mar Reservoir, 4,900,000 gal.

Constituent areas of Metropolitan Water District of Southern California: Anaheim, Beverly Hills, Burbank, Coastal Municipal Water District, Compton, Fullerton, Glendale, Long Beach, Los Angeles, Pasadena, San Diego County Water Authority, San Marino, Santa Ana, Santa Monica, Torrance, and West Basin Municipal Water District (new area in M. W. D. June 1949). The West Basin Municipal Water District comprises the cities of El Segundo, Gardena, Hermosa Beach, Manhattan Beach, Redondo Beach, Palos Verdes Estates, and industrially important unincorporated areas. (As of the end of 1952, constituents areas included Chino Basin, Pomona Valley, and Orange County Municipal Water Districts. The total number of cities included in the District totaled 48 in addition to numerous suburban communities and irrigated areas. The chief cities added to those mentioned above are Inglewood, Pomona, Ontario, and Fontana, each with considerable industrial development).

Water is delivered from Lake Havasu by main aqueduct to San Diego Aqueduct and to Lake Mathews. San Diego Aqueduct connects with the main aqueduct and extends to San Vicente Reservoir of the San Diego system, a distance of 71.1 miles. The main aqueduct is 242 miles long; the total distribution system is 215 miles long, making a total aqueduct length of 457 miles.

ANALYSES

(Analyses, in parts per millions, by Metropolitan Water District of Southern Calif.)

	Raw water[a]	Finished water[a]		Raw water[a]	Finished water[a]
Silica (SiO_2)	8.0	12	Hardness as $CaCO_3$:		
Iron (Fe)	--	--	Total	315	125
Manganese (Mn)	--	--	Noncarbonate	197	6
Calcium (Ca)	79	31			
Magnesium (Mg)	28	12	Color	--	--
Sodium (Na)	99	189	pH	8.4	8.8
Potassium (K)	4	3	Specific conductance (micromhos at 25 C.)	1,040	1,100
Carbonate (CO_3)	4	12	Turbidity	--	--
Bicarbonate (HCO_3)	137	121	Temperature (F.)	--	--
Sulfate (SO_4)	290	290	Date of collection	--	--
Chloride (Cl)	79	83			
Fluoride (F)	.4	.4			
Nitrate (NO_3)	.2	.2			
Dissolved solids	[b]661	[b]692			

Regular determinations at treatment plant, 1948-49

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$[c] (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	119	127	108	8.3	8.6	8.0	312	322	304	--	--	--
Finished water	111	151	63	8.8	9.3	8.4	125	131	114	--	--	--

[a] Colorado River. Average for 1950-51 fiscal year.
[b] Sum of determined constituents. [c] 1952.

LYNWOOD
(Population, 25,823)

Ownership: Municipal; supplies also about 500 people outside the city limits. Total population supplied, about 26,300.
Source: 11 wells (2 to 12) ranging in depth from 352 to 956 ft. The yield of the wells is reported to range from 550 to 1,700 gpm, and to average 1,158.
Treatment: None.
Storage: Elevated tanks, 300,000 gal.

ANALYSES

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

	Well 2	Well 3	Well 4	Well 7	Well 8
Silica (SiO_2)	18	22	20	23	20
Iron (Fe)	.05	--	.05	--	--
Manganese (Mn)	--	--	.1	--	--
Calcium (Ca)	112	77	62	58	54
Magnesium (Mg)	23	16	10	12	8.6
Sodium (Na)	52	49	39	31	37
Potassium (K)	4.4	4.1	3.2	2.4	4.0
Carbonate (CO_3)	--	--	7	2	2
Bicarbonate (HCO_3)	287	268	210	248	237
Sulfate (SO_4)	159	99	72	37	42
Chloride (Cl)	81	36	22	17	15
Fluoride (F)	.4	.3	.3	.3	.3
Nitrate (NO_3)	--	--	--	1.1	.3
Dissolved solids	660	448	352	310	306
Hardness as $CaCO_3$:					
Total	375	259	197	192	171
Noncarbonate	139	39	13	0	0
Color	0	0	0	0	0
pH	8.2	8.3	8.9	8.5	8.6
Specific conductance (micromhos at 25 C.)	910	656	517	471	454
Turbidity	0.6	0.5	0.5	0.05	0.3
Temperature (F.)	--	--	--	--	--
Date of collection	Apr. 27, 1951	Apr. 27, 1951	Apr. 27, 1951	Apr. 27, 1951	Apr. 27, 1951
Depth (feet)	352	436	790	610	864
Diameter (inches)	16	16	16	16	16
Date drilled	1930	1924	1946	1907	1948
Percent of supply	--	--	--	--	--

MANHATTAN BEACH
(Population, 17,330; in 1953, 26,000)

Ownership: Municipal; supplies also about 900 people outside the city limits. Total population supplied, about 26,900.

Source: 4 wells (9, 11, 13, 14) 390, 550, 550, and 550 ft deep, 60 percent of supply; Colorado River distributed by the Metropolitan District of Southern California (see Los Angeles), 40 percent of supply. The yield of each well is reported to be 600 gpm.

Treatment: The well water is not treated. The Colorado River water is softened and filtered by the Metropolitan Water District of Southern California, and rechlorinated by Manhattan Beach.

Raw-water storage: None.

Finished-water storage: 2,850,000 gal.

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

	Well 9	Well 11	Well 13	Well 14
Silica (SiO_2)	19	25	22	19
Iron (Fe)	--	--	.02	.02
Manganese (Mn)	0	0	0	0
Calcium (Ca)	65	42	67	65
Magnesium (Mg)	18	17	17	17
Sodium (Na)	76	86	80	68
Potassium (K)	--	--	--	--
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	287	378	298	306
Sulfate (SO_4)	28	1	35	32
Chloride (Cl)	98	37	93	65
Fluoride (F)	--	--	--	--
Nitrate (NO_3)	0	--	0	0
Dissolved solids	[a]445	[a]394	[a]461	[a]440
Hardness as $CaCO_3$:				
Total	236	175	237	232
Noncarbonate	0	0	0	0
Color	--	--	--	--
pH	7.8	7.7	7.7	7.7
Specific conductance (micromhos at 25 C.)	--	---	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	June 4, 1951	June 4, 1951	June 4, 1951	June 4, 1951
Depth (feet)	390	550	550	550
Diameter (inches)	16	16	16	16
Date drilled	1940	1943	1949	1949
Percent of supply	--	--	--	--

[a] Sum of determined conststuents.

MERCED
(Population, 15,278)

Ownership: Crocker-Huffman Land and Water Co.; supplies also about 300 people outside the city limits. Total population supplied, about 15,600.

Source: 10 wells (1 to 5, 8, 9, 11, and 12) ranging in depth from 112 to 270 ft. The yield of the wells is reported to be 1,000, 550, 2,700 (well 3: 2 wells), 1,850, 1,950, 1,900, 1,500, 1,550, and 2,200 gpm, respectively.

Treatment: None.

Storage: Elevated tanks, 600,000 gal.

MERCED--Continued
ANALYSES

(Analyses, in parts per million, by California State Department of Public Health)

	Well 1	Well 2	Well 3 (2 wells)
Silica (SiO_2)	--	--	--
Iron (Fe)	.0	.0	.0
Manganese (Mn)	.0	.0	.0
Calcium (Ca)	20	28	25
Magnesium (Mg)	9.6	13	12
Sodium (Na)	21	9.0	24
Potassium (K)	--	--	--
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	137	149	153
Sulfate (SO_4)	6.4	5.0	12
Chloride (Cl)	9.6	9.6	14
Fluoride (F)	.0	.0	.0
Nitrate (NO_3)	4.4	2.2	8.8
Dissolved solids	194	190	243
Hardness as $CaCO_3$:			
Total	89	122	110
Noncarbonate	0	0	0
Color	--	--	0
pH	7.2	7.6	7.2
Specific conductance (micromhos at 25 C.)	--	--	--
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	Apr. 27, 1950	Apr. 27, 1950	Apr. 27, 1950
Depth (feet)	118	230	185, 187
Diameter (inches)	12	12	20, 20
Date drilled	1910	1914	1950
Percent of supply	--	--	--

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	117	126	108	7.5	7.9	7.1	106	122	89	--	--	--
Finished water	--	--	--	--	--	--	--	--	--	--	--	--

MODESTO
(Population, 17,389)

Ownership: Municipal.
Source: 25 wells ranging in depth from 70 to 300 ft. There are 15 pumping stations, 4 of which pump water from 14 of the wells. The remaining pumping stations each pump water from a single well. The yield from the pumping stations is reported to be from 700 to 2,000 gpm.
Treatment: None.
Storage: 800,000 gal.

MODESTO--Continued

ANALYSES

(Analyses, in parts per million, by California State Department of Public Health)

	Well 5-1	Well 9-1	Well 10-1	Well 12-1	Well 14-1
Silica (SiO_2)	--	--	--	--	--
Iron (Fe)	.1	.0	.1	.0	.0
Manganese (Mn)	.0	.0	.0	.0	.0
Calcium (Ca)	58	39	46	15	18
Magnesium (Mg)	19	12	13	4.2	4.4
Sodium (Na)	121	25	104	12	24
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	169	184	165	95	104
Sulfate (SO_4)	.0	6.7	.0	.5	.0
Chloride (Cl)	248	31	183	1.2	19
Fluoride (F)	.0	.0	.0	.0	.0
Nitrate (NO_3)	2.7	1.3	3.5	1.3	2.2
Dissolved solids	[a] 532	[a] 206	[a] 431	[a] 81	[a] 119
Hardness as $CaCO_3$:					
Total	226	148	170	55	62
Noncarbonate	84	0	34	0	0
Color	--	--	--	--	--
pH	7.2	7.6	7.7	7.8	7.9
Specific conductance (micromhos at 25 C.)	--	--	--	--	--
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Dec. 27, 1951	Dec. 27, 1951	Dec. 27, 1951	Dec. 27, 1951	Dec. 27, 1951
Depth (feet)	200	136	110	107	125
Diameter (inches)	20	24	24	24	24
Date drilled	1918	1930	1939	1948	--
Percent of supply	--	--	--	--	--

[a] Sum of determined constituents.

MONROVIA
(Population, 20,186)

Ownership: Municipal.
Source: 6 wells (San Gabriel 1 to 4, Chapman 5 and 6), 476, 420, 500, 530, 387, and 424 ft deep, 94 percent of supply; 2 springs, 6 percent of supply. Auxiliary supply, surface water runoff from mountains when flow is adequate.
Treatment: Mountain and spring supplies are chlorinated. Well water is not treated.
Storage: 8,000,000 gal.

MONROVIA--Continued

ANALYSES

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

	San Gabriel Well 2	Chapman Well 6	Surface water run-off
Silica (SiO_2)	18	20	18
Iron (Fe)	--	.01	--
Manganese (Mn)	--	--	--
Calcium (Ca)	49	42	52
Magnesium (Mg)	15	11	15
Sodium (Na)	14	20	17
Potassium (K)	1.0	3.5	3.0
Carbonate (CO_3)	--	--	--
Bicarbonate (HCO_3)	193	204	244
Sulfate (SO_4)	14	10	20
Chloride (Cl)	12	9.5	8.5
Fluoride (F)	.4	1.0	.4
Nitrate (NO_3)	16	8.0	.4
Dissolved solids	[a]235	228	270
Hardness as $CaCO_3$:			
Total	185	151	190
Noncarbonate	26	0	0
Color	--	--	--
pH	7.5	7.7	8.2
Specific conductance (micromhos at 25 C.)	395	362	408
Turbidity	1.3	1.2	0.9
Temperature (F.)	--	--	--
Date of collection	May 4, 1951	May 4, 1951	May 4, 1951
Depth (feet)	420	424	--
Diameter (inches)	20	20	--
Date drilled	1924	1928	--
Percent of supply	--	--	--

[a]Sum of determined constituents.

MONTEBELLO

(Population, 21,735)

Ownership: Montebello Land & Water Co. supplies about 10,000 people in Montebello; South Montebello Irrigation District supplies about 7,000 people in Montebello; California Water Service Co. supplies the remainder of the population of the city.

Source: Montebello Land & Water Co., 4 wells (7, 8, 9, and 10) 900, 452, 302, and 280 ft deep, yield reported to be 1,500, 1,500, 1,500, and 2,000 gpm; South Montebello Irrigation District, 4 wells (1, 2, 3, and 4) 398, 395, 364, and 500 ft deep, yield reported to be 1,500, 1,000, 1,250, and 450 gpm; California Water Service Co., (data not furnished).

Treatment: Montebello Land & Water Co. supply, none; South Montebello Irrigation District supply, chlorination; California Water Service Co. supply, (data not furnished).

Raw-water storage: Montebello Land & Water Co., 1,500,000 gal; South Montebello Irrigation District, none; California Water Service Co., (data not furnished).

Finished-water storage: 250,000 gal (South Montebello Irrigation District).

MONTEBELLO--Continued

ANALYSES

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

	Well 7	Well 8	Well 9	Well 10
Silica (SiO_2)	15	19	22	19
Iron (Fe)	.03	.12	--	.06
Manganese (Mn)	--	--	--	--
Calcium (Ca)	75	100	82	21
Magnesium (Mg)	12	15	14	40
Sodium (Na)	38	32	36	42
Potassium (K)	4.8	4.0	6.6	4.0
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	239	242	254	228
Sulfate (SO_4)	35	33	37	40
Chloride (Cl)	62	100	68	60
Fluoride (F)	.3	.3	.3	.3
Nitrate (NO_3)	.1	.3	.4	.4
Dissolved solids	[a]360	[a]423	[a]392	[a]339
Hardness as $CaCO_3$:				
Total	236	310	262	219
Noncarbonate	40	112	54	32
Color	--	--	--	--
pH	8.5	8.3	8.5	8.5
Specific conductance (micromhos at 25 C.)	598	723	714	608
Turbidity	0.4	--	0.4	0.4
Temperature (F.)	--	--	--	--
Date of collection	Apr. 23, 1951	Apr. 23, 1951	Apr. 23, 1951	Apr. 23, 1951
Depth (feet)	900	452	302	280
Diameter (inches)	20	20	20	20
Date drilled	1926	1928	1944	1948
Percent of supply	--	--	--	--

	Well 1	Well 2	Well 3 [b]	Well 4 [b]
Silica (SiO_2)	19	18	15	12
Iron (Fe)	.01	.01	--	--
Manganese (Mn)	--	--	--	--
Calcium (Ca)	41	46	51	78
Magnesium (Mg)	10	4.6	10	16
Sodium (Na)	41	46	44	52
Potassium (K)	7.0	6.0	4.0	3.9
Carbonate (CO_3)	0	0	0	--
Bicarbonate (HCO_3)	195	210	210	265
Sulfate (SO_4)	34	34	46	71
Chloride (Cl)	22	23	32	61
Fluoride (F)	.8	.6	.4	.3
Nitrate (NO_3)	20	12	1.3	.3
Dissolved solids	318	308	[a]307	[a]425
Hardness as $CaCO_3$:				
Total	145	134	166	261
Noncarbonate	0	0	0	44

[a] Sum of determined constituents.

[b] Analyses by Pomeroy & Associates, Pasadena, California.

MONTEBELLO, Analyses--Continued

	Well 1	Well 2	Well 3 [b]	Well 4 [b]
Color	--	--	--	--
pH	7.3	7.6	7.4	--
Specific conductance (micromhos at 25 C.)	462	470	--	--
Turbidity	0.04	0.85	--	--
Temperature (F.)	--	--	64	61
Date of collection	May 2, 1951	May 2, 1951	Jan. 9, 1951	Jan. 9, 1951
Depth (feet)	398	395	364	500
Diameter (inches)	12	12	16	20
Date drilled	1920	1920	1938	1947
Percent of supply	--	--	--	--

[b] Analyses by Pomeroy & Associates, Pasadena, California.

MONTEREY
(Population, 16,205)

Ownership: California Water and Telephone Co.; supplies also Pacific Grove, Carmel, and about 30,000 people in other communities. Total population supplied, about 60,000.

Source: Carmel River (99 percent of supply) and 2 wells, 80 and 60 ft deep (1 percent of supply).

Treatment: Alum, lime, and activated carbon as needed, pressure filtration, and chlorination.

Rated capacity of treatment plant: 8,000,000 gpd.

Raw-water storage: 1,532,000,000 gal.

Finished-water storage: 170,000,000 gal.

ANALYSES
(Analyses, in parts per million, by California State Dept. of Public Health)

	Raw water [a]	Finished water [a]		Raw water [a]	Finished water [a]
Silica (SiO_2)	--	--	Hardness as $CaCO_3$:		
Iron (Fe)	0.10	0.04	Total	77	76
Manganese (Mn)	.0	.0	Noncarbonate	17	14
Calcium (Ca)	16	13			
Magnesium (Mg)	8.9	10	Color	--	--
Sodium (Na)	13	12	pH	7.8	7.8
Potassium (K)	--	--	Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	73	73	Temperature (F.)	--	--
Sulfate (SO_4)	18	15	Date of collection	May 8, 1951	May 8, 1951
Chloride (Cl)	9.5	9.0			
Fluoride (F)	.3	.2			
Nitrate (NO_3)	.0	.0			
Dissolved solids	154	148			

[a] Carmel River.

MONTEREY PARK
(Population, 20,395)

Ownership: Municipal.

Source: 4 wells (1 to 4), 410, 450, 1,110, and 480 ft deep. The yield of the wells is reported to be 900, 1,300, 2,000, and 900 gpm. Emergency supply from Southern California Water Co.

Treatment: None.

Storage: Reservoirs, 4,000,000 gal.

MONTEREY PARK--Continued

ANALYSES

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

	Well 1	Well 2	Well 3	Well 4
Silica (SiO_2)	22	19	20	12
Iron (Fe)	--	.02	--	.03
Manganese (Mn)	--	--	--	--
Calcium (Ca)	35	39	30	38
Magnesium (Mg)	11	10	5.3	12
Sodium (Na)	28	28	45	30
Potassium (K)	2.0	2.0	2.0	2.6
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	[a] 173	[a] 176	[a] 160	[a] 185
Sulfate (SO_4)	22	14	22	14
Chloride (Cl)	21	20	23	24
Fluoride (F)	.6	.6	.5	.5
Nitrate (NO_3)	7.5	12	4.9	14
Dissolved solids	272	262	280	284
Hardness as $CaCO_3$:				
Total	133	140	96	143
Noncarbonate	0	0	0	0
Color	0	0	0	0
pH	8.2	8.4	8.6	8.4
Specific conductance (micromhos at 25 C.)	361	367	364	374
Turbidity	1.0	0.8	0.8	0.9
Temperature (F.)	--	--	--	--
Date of collection	Apr. 18, 1951	Apr. 18, 1951	Apr. 18, 1951	Apr. 18, 1951
Depth (feet)	410	450	1,110	480
Diameter (inches)	12	16	30-16	12
Date drilled	1875	1924	1946	1945
Percent of supply	--	--	--	--

[a] Includes the equivalent of any carbonate (CO_3) present.

NATIONAL CITY
(Population, 21,199)

Ownership: California Water & Telephone Co.; supplies Chula Vista and also about 13,200 people outside the city limits. Total population supplied, about 61,200.

Source: Sweetwater River system (Loveland and Sweetwater Reservoirs); Colorado River, Metropolitan Water District of Southern California via San Diego Aqueduct (see Los Angeles); National City Well 1, 784 ft deep and reported to yield 1,100 gpm; and 6 wells 59 ft deep (average) in Sweetwater Valley. The quantity of water furnished from each source of supply varies annually depending entirely on runoff collected in the Sweetwater River system which at present (1953) is the main source of supply.

Treatment: Chlorination.

Raw-water storage: Sweetwater Reservoir, 9,976,900,000 gal; Loveland Reservoir, 8,420,700,000 gal.

Finished-water storage: 306,500,000 gal.

NATIONAL CITY--Continued

ANALYSES

(Analyses, in parts per million, by California Water & Telephone Co.)

	Sweetwater River[a]	National City Well 1		Sweetwater River[a]	National City Well 1
Silica (SiO_2)	18	20	Hardness as $CaCO_3$:		
Iron (Fe)	.3	.1	Total	136	180
Manganese (Mn)	.0	.0	Noncarbonate	31	0
Calcium (Ca)	30	34			
Magnesium (Mg)	15	23	Color	--	--
Sodium (Na)	39	156	pH	8.1	7.6
Potassium (K)	3	4.5	Specific conductance (micromhos at 25 C.)	460	990
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	128	129	Turbidity	--	--
Sulfate (SO_4)	35	56	Temperature (F.)	--	--
Chloride (Cl)	59	177	Date of collection	Apr. 18, 1953	Apr. 13, 1953
Fluoride (F)	.3	.4			
Nitrate (NO_3)	.0	.0			
Dissolved solids	[b] 265	[b] 600			

[a] At entrance into Sweetwater Reservoir.
[b] Sum of determined constituents.

OAKLAND
(Population, 384,575)

Ownership: East Bay Municipal Utility District; supplies also Alameda, Albany, Berkeley, El Cerrito, Richmond, San Leandro, Vallejo (part of supply), other smaller cities, and numerous unincorporated areas in Alameda and Contra Costa Counties. Total population supplied, about 900,000.

Source: Mokelumne River impounded in Pardee Reservoir (93 percent of supply); local runoff into San Pablo, Upper San Leandro, Chabot, and Lafayette Reservoirs (7 percent of supply).

Treatment: Orinda Plant (Mokelumne River): coagulation with alum, rapid sand filtration, chlorination, and lime for pH adjustment. San Pablo and Upper San Leandro Plants: aeration, coagulation with alum, sedimentation, rapid sand filtration, chlorination, and lime for pH adjustment. Chabot and Grant Miller (Lafayette Reservoir) Plants: coagulation with alum, sedimentation, pressure filtration, chlorination, lime for pH adjustment.

Rated capacity of treatment plants: 196,000,000 gpd.

Raw-water storage: Reservoirs: Pardee, San Pablo, Upper San Leandro, Chabot, and Lafayette, 102,759,000,000 gal.

Finished-water storage: About 100 distribution reservoirs, 387,900,000 gal.

Pardee Reservoir, with a storage capacity of 68,400,000,000 gal, is about 94 miles northeast of the East Bay area. Water is released through an outlet tower into the twin Mokelumne Aqueducts, together capable of delivering almost 100,000,000 gpd by gravity flow. By operating pumping plants the daily flow can be increased to more than 210,000,000 gpd. Most of this water is treated at the Orinda Filter Plant and transmitted into distribution mains; the remaining amounts are stored in the four terminal reservoirs.

The storage capacity of the terminal reservoirs is as follows: San Pablo, 14,000,000,000 gal; Upper San Leandro, 13,500,000,000 gal; Chabot, 4,100,000,000 gal; Lafayette, 1,700,000,000 gal.

Although much of the water is served by gravity, the district requires 67 pumping plants and over 100 distribution reservoirs to serve those at the higher elevations.

OAKLAND--Continued

ANALYSES

(Analyses, in parts per million, by East Bay Municipal Utility District)

	Finished water[a]	Finished water[b]	Finished water[c]	Finished water[d]
Silica (SiO_2)	7.2	1.3	5.6	.4
Iron (Fe)	[e].4	[e]2.6	[e].6	[e].9
Manganese (Mn)	.0	.0	.0	.0
Calcium (Ca)	6.0	23	36	48
Magnesium (Mg)	.7	5.6	13	22
Sodium (Na)	4.7	13	20	34
Potassium (K)	--	--	--	--
Carbonate (CO_3)	[f]24	--	--	--
Bicarbonate (HCO_3)		81	142	199
Sulfate (SO_4)	1.1	24	45	71
Chloride (Cl)	5.0	13	18	32
Fluoride (F)	.1	.1	.2	.2
Nitrate (NO_3)	--	--	--	--
Dissolved solids	[g]37	[g]122	220	316
Hardness as $CaCO_3$:				
Total	18	81	144	208
Noncarbonate	0	15	28	45
Color	--	--	--	--
pH	9.1	8.0	7.9	7.9
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	June 1950	June 1950	June 1950	June 1950

[a] Mokelumne River. [b] San Pablo Reservoir. [c] Upper San Leandro Reservoir.
[d] Chabot Reservoir. [e] Iron and aluminum oxides.
[f] Includes the equivalent of any carbonate (CO_3) as bicarbonate (HCO_3).
[g] Sum of determined constituents.

OILDALE
(Population, 16,615)

Ownership: Oildale Mutual Water Co.
Source: 13 wells ranging in depth from 466 to 722 ft. The yield of the wells is reported to range from 680 to 940 gpm.
Treatment: None.
Storage: 75,000 gal.

OILDALE--Continued

ANALYSES

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

	Well 5	Well 8	Well 10	Well 11
Silica (SiO_2)	27	36	33	32
Iron (Fe)	.0	.0	.0	.0
Manganese (Mn)	.0	.0	.0	.0
Calcium (Ca)	55	25	45	33
Magnesium (Mg)	8.3	3.2	7.9	5.3
Sodium (Na)	25	22	25	22
Potassium (K)	4.8	4.4	1.1	.8
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	116	92	155	102
Sulfate (SO_4)	61	28	16	31
Chloride (Cl)	48	16	39	24
Fluoride (F)	.0	.0	.0	.0
Nitrate (NO_3)	4.4	2.2	.0	2.2
Dissolved solids	326	179	272	216
Hardness as $CaCO_3$:				
Total	171	76	145	104
Noncarbonate	76	0	18	21
Color	--	--	--	--
pH	7.3	7.8	7.2	7.7
Specific conductance (micromhos at 25 C.)	479	258	404	321
Turbidity	<1	<1	<1	<1
Temperature (F.)	--	--	--	--
Date of collection	Sept. 18, 1951	Sept. 18, 1951	Sept. 18, 1951	Sept. 18, 1951
Depth (feet)	466	643	533	512
Diameter (inches)	16	16	16	16
Date drilled	1933	1939	1942	1945
Percent of supply	--	--	--	--

ONTARIO
(Population, 22,872)

Ownership: Municipal; supplies about 300 people outside the city limits. Total population supplied, about 23,200.

Source: 8 wells (1 to 8), 600, 600, 604, 507, 551, 496, and 536 ft deep. The yield of the wells is reported to be 945, 1,650, 1,500, 1,600, 2,400, 2,400, 1,420, and 450 gpm. Emergency supply from well and surface water of San Antonio Water Co.

Treatment: None.

Storage: 14,750,000 gal.

ONTARIO--Continued

ANALYSES

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

	Well 1	Well 6	Well 7
Silica (SiO_2)	27	29	34
Iron (Fe)	--	.02	--
Manganese (Mn)	--	--	--
Calcium (Ca)	53	47	46
Magnesium (Mg)	6.3	6.4	7.6
Sodium (Na)	15	16	18
Potassium (K)	3.0	2.0	--
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	200	187	172
Sulfate (SO_4)	9.5	8.0	14
Chloride (Cl)	7.0	6.0	9
Fluoride (F)	.4	.2	.4
Nitrate (NO_3)	1.9	2.5	2.6
Dissolved solids	236	208	238
Hardness as $CaCO_3$:			
Total	158	144	145
Noncarbonate	0	0	4
Color	0	0	0
pH	8.5	--	8.5
Specific conductance (micromhos at 25 C.)	352	327	343
Turbidity	1.6	2.2	1.7
Temperature (F.)	--	--	--
Date of collection	Apr. 12, 1951	Apr. 13, 1951	Apr. 13, 1951
Depth (feet)	600	551	496
Diameter (inches)	16	26	16
Date drilled	1910	1930	--
Percent of supply	--	--	--

OXNARD

(Population, 21,567; census 1952, 26,353)

Ownership: Municipal.
Source: 6 wells (1 to 6) 234, 234, 232, 252, 235, and 240 ft deep; yield reported to be 1,080, 1,120, 1,000, 1,440, 1,600, and 1,700 gpm.
Treatment: None.
Storage: 1,000,000 gal.

OXNARD--Continued

ANALYSES

(Analyses, in parts per million, by Smith-Emery Co., Los Angeles, Calif.)

	Wells (composite sample)	Well 1	Well 5
Silica (SiO_2)	7.5	--	--
Iron (Fe)	--	.25	0
Manganese (Mn)	--	--	.8
Calcium (Ca)	155	153	197
Magnesium (Mg)	42	51	61
Sodium (Na)	105	86	93
Potassium (K)	--	--	--
Carbonate (CO_3)	3	0	0
Bicarbonate (HCO_3)	262	230	248
Sulfate (SO_4)	471	501	625
Chloride (Cl)	55	58	61
Fluoride (F)	--	.6	.7
Nitrate (NO_3)	--	6.0	2.4
Dissolved solids	[a]968	[a]969	[a]1,160
Hardness as $CaCO_3$:			
Total	561	594	745
Noncarbonate	340	402	540
Color	--	--	--
pH	8.2	7.4	7.4
Specific conductance (micromhos at 25 C.)	1,500	--	--
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	Nov. 24, 1950	Dec. 8, 1950	Dec. 8, 1950
Depth (feet)	--	234	235
Diameter (inches)	--	14	14
Date drilled	--	1912	--
Percent of supply	--	--	--

[a] Sum of determined constituents.

PALO ALTO
(Population, 25,475)

Ownership: Municipal; supplies also about 9,750 people outside the city limits. Total population supplied, about 35,200.
Source: San Francisco city supply (see San Francisco, Bay Crossing lines) 60 percent of supply; 9 wells, 250 to 600 ft deep, 40 percent of supply.
Treatment: Chlorination.
Raw-water storage: --
Finished-water storage: 4,980,000 gal.

PALO ALTO--Continued

ANALYSES

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

	Main Station Well	Mayfield Well[a]	Middlefield Well	Oregon Well
Silica (SiO_2)	--	--	--	--
Iron (Fe)	.04	.6	0	.26
Manganese (Mn)	.0	0	0	.1
Calcium (Ca)	61	41	39	82
Magnesium (Mg)	14	12	11	22
Sodium (Na)	86	65	110	102
Potassium (K)	--	--	--	--
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	283	244	271	254
Sulfate (SO_4)	44	40	33	36
Chloride (Cl)	83	35	90	170
Fluoride (F)	.0	0	0	.1
Nitrate (NO_3)	.4	1.1	0	1.8
Dissolved solids	575	438	552	668
Hardness as $CaCO_3$:				
Total	211	151	142	291
Noncarbonate	0	0	0	87
Color	--	--	--	--
pH	7.7	7.9	7.9	8.1
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Feb. 6, 1951	Feb. 6, 1951	Feb. 6, 1951	Feb. 6, 1951
Depth (feet)	446	526	600	512
Diameter (inches)	14	14	14	14
Date drilled	1926	1931	1932	1930
Percent of supply	--	--	--	--

[a] Also known as Park Boulevard Well.

PASADENA
(Population, 104,577)

Ownership: Municipal.
Source: Colorado River distributed by Metropolitan Water District of Southern California, 62 percent of supply (see Los Angeles); 14 wells ranging in depth from 642 to 1,220 ft, 35 percent of supply; Arroyo Seco, Eaton Canyon, and Millard Streams, 3 percent of supply.
Treatment: Colorado River: softened and filtered by Metropolitan District of Southern California (see Los Angeles). Local supplies: chlorination and ammoniation.
Rated capacity of treatment plant: --
Raw-water storage: --
Finished-water storage: 103,000,000 gal.

PASADENA--Continued

ANALYSES

(Analyses, in parts per million, by City Of Pasadena)

	Jourdan Well[a]	Garfield Well[a]	Woodbury Well[a]	Sunset Well[a]	Copelin Well[a]
Silica (SiO_2)	30	30	26	30	30
Iron (Fe)	.03	.03	.06	.03	.03
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	42	20	24	37	47
Magnesium (Mg)	11	4.0	3.7	11	15
Sodium (Na) / Potassium (K)	17	25	33	23	26
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	178	99	123	159	216
Sulfate (SO_4)	13	13	21	18	28
Chloride (Cl)	10	10	12	14	13
Fluoride (F)	(b)	--	--	--	--
Nitrate (NO_3)	8.7	9.9	6.7	14	6.4
Dissolved solids	[c] 219	[c] 161	[c] 187	[c] 225	[c] 272
Hardness as $CaCO_3$:					
Total	151	65	74	139	179
Noncarbonate	5	0	0	9	2
Color	--	--	--	--	--
pH	7.4	7.7	7.8	7.4	7.3
Specific conductance (micromhos at 25 C.)	--	--	--	--	--
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	--	--	--	--	--
Depth (feet)	729	720	1220	751	700
Diameter (inches)	26	26	26	26	26
Date drilled	1926	1921	1930	1924	1921
Percent of supply	11	7	6	6	3

	Eaton Canyon Stream[a]	Arroyo Seco Stream[a]
Silica (SiO_2)	19	24
Iron (Fe)	.04	.07
Manganese (Mn)	--	--
Calcium (Ca)	45	56
Magnesium (Mg)	15	18
Sodium (Na) / Potassium (K)	14	26
Carbonate (CO_3)	0	0
Bicarbonate (HCO_3)	208	254
Sulfate (SO_4)	21	36
Chloride (Cl)	7.2	13
Fluoride (F)	--	--
Nitrate (NO_3)	.4	.4
Dissolved solids	[c] 224	[c] 299
Hardness as $CaCO_3$:		
Total	175	213
Noncarbonate	4	5
Color	--	--
pH	8.2	7.9
Specific conductance (micromhos at 25 C.)	--	--
Turbidity	--	--
Temperature (F.)	--	--
Date of collection	--	--

[a] Average for year 1950-51. [b] Weighted average fluoride content of sources of supply about 0.7 ppm. Annual Report 1952-53, Pasadena Water Dept.
[c] Sum of determined constituents.

POMONA
(Population, 35,405)

Ownership: Municipal.
Source: 12 wells (1 to 12) ranging in depth from 495 to 1,104 ft, and 2 tunnels (1 and 3). The yield of the wells is reported to range from 400 to 1,500 gpm, and to average 843 gpm.
Treatment: None.
Storage: Reservoirs, 15,000,000 gal.

ANALYSES

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

	Well 4	Well 5	Well 8	Well 11	Tunnel 3
Silica (SiO_2)	20	19	18	23	16
Iron (Fe)	--	--	--	--	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	72	52	68	52	37
Magnesium (Mg)	12	8.5	7.6	9.3	4.0
Sodium (Na)	12	20	32	12	31
Potassium (K)	11	4.6	4.4	3.8	3.0
Carbonate (CO_3)	--	--	--	--	--
Bicarbonate (HCO_3)	214	184	170	189	172
Sulfate (SO_4)	29	27	64	20	21
Chloride (Cl)	11	9	13	7.0	10
Fluoride (F)	.3	.4	.2	.3	.8
Nitrate (NO_3)	48	32	80	17	13
Dissolved solids	321	270	386	256	218
Hardness as $CaCO_3$:					
Total	231	166	202	169	108
Noncarbonate	56	15	62	14	0
Color	0	0	0	0	0
pH	7.0	7.3	7.1	7.3	7.3
Specific conductance (micromhos at 25 C.)	495	403	540	382	330
Turbidity	1.2	0.8	0.7	0.6	0.9
Temperature (F.)	--	--	--	--	--
Date of collection	May 9, 1951	May 9, 1951	May 9, 1951	May 9, 1951	May 9, 1951
Depth (feet)	537	575	960	566	
Diameter (inches)	20	20	16	20	
Date drilled	1940	1930	[a] 1926	1947	
Percent of supply	--	--	--	--	

[a] Drilled prior to 1926.

REDLANDS
(Population, 18,429)

Ownership: Municipal; supplies also Bryn Mawr, Loma Linda, and Mentone. Total population supplied, about 23,200.

Source: 11 wells (10 to 16, 30, 32, Maquet 1 and 2, and East Lugonia 3) ranging in depth from 88 to 687 ft (67 percent of supply); and Mill Creek (33 percent of supply). The yield of the wells is reported to range from 225 to 3,096 gpm, and to average 1,345 gpm.

Treatment: Water from the wells is not treated. Mill Creek: prechlorination, coagulation with alum of ferric chloride when the water is very turbid, rapid sand (pressure) filtration.

Rated capacity of treatment plant: 7,750,000 gpd.

Raw-water storage: --

Finished-water storage: Reservoirs, 14,360,000 gal.

ANALYSES

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

	Wells[a]	Mill Creek (raw water)		Wells[a]	Mill Creek (raw water)
Silica (SiO_2)	13	9	Hardness as $CaCO_3$:		
Iron (Fe)	.02	--	Total	191	123
Manganese (Mn)	--	--	Noncarbonate	11	13
Calcium (Ca)	54	38			
Magnesium (Mg)	14	6.7	Color	0	0
Sodium (Na)	40	8.9	pH	8.4	8.9
Potassium (K)	.2	.3	Specific conductance (micromhos at		
Carbonate (CO_3)	--	--	25 C.)	503	240
Bicarbonate (HCO_3)	220	134	Turbidity	2.7	3.5
Sulfate (SO_4)	43	15	Temperature (F.)	--	--
Chloride (Cl)	19	2.0	Date of collection	Apr. 18, 1951	Apr. 18, 1951
Fluoride (F)	.4	.8			
Nitrate (NO_3)	46	.9			
Dissolved solids	[b]338	172			

Depth (feet)	347 to 687
Diameter (inches)	18 to 20
Date drilled	1913, 1925
Percent of supply	

[a] Raw water from wells 10, 11, 12, 13, 14, and 16, Roosevelt Road Plant.
[b] Sum of determined constitents.

REDONDO BEACH
(Population, 25,226)

Ownership: California Water Service Co.; supplies also Hermosa Beach and about 3,000 people outside the city limits. Total population supplied, about 48,200.

Source: 13 wells ranging in depth from 286 to 600 ft (95 percent of supply); auxiliary supply from Colorado River distributed by the Metropolitan Water District of Southern California (5 percent of supply). (See Los Angeles.) The yield of the wells is reported to range from 180 to 1,052 gpm, and to average 557 gal.

Treatment: Chlorination of well water. Colorado River water is softened and filtered by the Metropolitan Water District of Southern California.

Storage: 3,450,000 gal.

REDONDO BEACH--Continued

ANALYSES

(Analyses, in parts per million, by California Water Service Co., San Jose, Calif.)

	Well 5-04	Well 21-01	Well 22-01	Well 25-01	Well 5-02
Silica (SiO_2)	21	28	18	33	21
Iron (Fe)	.01	.22	.01	.08	.22
Manganese (Mn)	.03	.10	.07	.0	.07
Calcium (Ca)	52	38	48	27	54
Magnesium (Mg)	15	24	15	12	16
Sodium (Na)	56	79	54	99	62
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	--	--	--	--	--
Bicarbonate (HCO_3)	252	305	263	305	254
Sulfate (SO_4)	44	5.3	23	12	43
Chloride (Cl)	44	77	44	50	56
Fluoride (F)	--	--	--	--	--
Nitrate (NO_3)	2.5	.6	.0	.0	1.8
Dissolved solids	[a]359	[a]403	[a]332	[a]384	[a]379
Hardness as $CaCO_3$:					
Total	191	194	182	117	200
Noncarbonate	0	0	0	0	0
Color	--	--	--	--	--
pH	7.9	7.7	7.8	7.9	8.0
Specific conductance (micromhos at 25 C.)	612	715	590	653	644
Turbidity	0	0	0	0	0
Temperature (F.)	74	74	72	75	72
Date of collection	Apr. 13, 1950	Feb. 19, 1951	Apr. 25, 1950	May 10, 1950	Apr. 11, 1950
Depth (feet)	520	456	600	504	349
Diameter (inches)	16	16	16	16	16
Date drilled	1949	1944	1948	1950	1908
Percent of supply	--	--	--	--	--

[a] Sum of determined constituents.

REDWOOD CITY
(Population, 25,544; census 1953, 34,005)

Ownership: Municipal; supplies also about 4,900 people outside the city limits. Total population supplied, about 30,400.
Source: Hetch Hetchy aqueduct is principal source of supply. (See San Francisco, Bay Crossing lines.) Emergency supply, small private wells, only.
Treatment: Chlorination by City of San Francisco.
Storage: 6,420,000 gal.

REDWOOD CITY--Continued

ANALYSIS

(Analysis, in parts per million, by City of San Francisco)

	Finished water[a]		Finished water[a]
Silica (SiO_2)	7	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	56
Manganese (Mn)	0	Noncarbonate	8
Calcium (Ca)	15		
Magnesium (Mg)	4.6	Color	--
Sodium (Na)	11	pH	7.5
Potassium (K)	--	Specific conductance (micromhos at 25 C.)	163
Carbonate (CO_3)	0	Turbidity	6
Bicarbonate (HCO_3)	59	Temperature (F.)	--
Sulfate (SO_4)	19	Date of collection	Mar. 1, 1950
Chloride (Cl)	9		
Fluoride (F)	.1		
Nitrate (NO_3)	.1		
Dissolved solids	95		

Regular determinations at treatment plant, 1950-51[b]

	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	--	--	--	9.0	--	--	36	164	12	2.3	9	.5

[a] Composite sample, Bay Crossing lines. The composition of the water supplied during a year may vary over a considerable range depending on the quantity of water taken from each of the various sources of supply.

[b] Fiscal year, San Francisco Water Dept.

RICHMOND
(Population, 99,545)

Ownership: East Bay Municipal Utility District. (See Oakland.)

RIVERSIDE
(Population, 46,764; census 1952, 56,000)

Ownership: Municipal; supplies also about 1,600 people outside the city limits. Total population supplied, about 57,600.

Source: 26 wells in the San Bernardino artesian basin. Well depths range from 300 to 1,192 ft. Most of these wells are flowing. Auxiliary supply from 5 wells in Riverside.

Treatment: None.

Storage: Reservoirs, 22,000,000 gal.

RIVERSIDE--Continued

ANALYSES

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

	Composite sample [a]	Warren Well 2	Raub Well 2	Hunt Wells (5 wells)	Cooley Wells (9 wells)
Silica (SiO_2)	16	17	15	18	18
Iron (Fe)	--	--	.01	--	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	27	33	28	26	35
Magnesium (Mg)	4	4.4	2.7	4.9	7.0
Sodium (Na)	50	16	57	51	31
Potassium (K)	--	3.2	5.6	3.6	4.4
Carbonate (CO_3)	0	--	--	--	--
Bicarbonate (HCO_3)	162	144	151	162	175
Sulfate (SO_4)	34	16	44	31	28
Chloride (Cl)	18	5.5	27	24	8.0
Fluoride (F)	.4	.5	.8	.4	.2
Nitrate (NO_3)	--	1.1	1.4	1.9	1.3
Dissolved solids	[b] 229	170	246	262	216
Hardness as $CaCO_3$:					
Total	84	102	80	85	116
Noncarbonate	0	0	0	0	0
Color	--	0	0	0	0
pH	--	7.2	7.4	7.7	7.4
Specific conductance (micromhos at 25 C.)	350	266	208	374	355
Turbidity	--	1.2	0.9	0.9	0.5
Temperature (F.)	--	--	--	--	--
Date of collection	Nov. 17, 1950	May 8, 1951	May 8, 1951	May 8, 1951	May 8, 1951
Depth (feet)		485	1,192	409-868	520-1,138
Diameter (inches)		20	20	10-20	10-20
Date drilled		1930	1931	1912-46	1899-1947
Percent of supply		--	--	--	--

[a] City tap.
[b] Sum of determined constituents.

SACRAMENTO
(Population, 137,572)

Ownership: Municipal; supplies about 132,700 people in the city; Southern California Water Co. supplies about 10,000 people; Jacinto Developers Inc. supplies 2,500 people. A number of people outside the city are also supplied. Total population supplied, about 146,200.

Source: Municipal: Sacramento River and 6 wells (standby); Southern California Water Co: 8 wells; Jacinto Developers, Inc.: 4 wells.

Treatment: Sacramento River: coagulation with alum, sedimentation, rapid sand filtration, and chlorination. Wells: none.

Rated capacity of treatment plant: 64,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 14,000,000 gal.

The intake in the Sacramento River is just below the mouth of the American River. Analytical data indicate that at times the water withdrawn represents chiefly American River water. The well systems and the system served with Sacramento River water are all separate.

SACRAMENTO--Continued

ANALYSES

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

	Raw water[a]	Finished water[a]		Raw water[a]	Finished water[a]
Silica (SiO_2)	9.2	9.1	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.0	Total	20	21
Manganese (Mn)	--	--	Noncarbonate	0	6
Calcium (Ca)	4.6	5.0			
Magnesium (Mg)	2.0	2.0	Color	15	0
Sodium (Na)	1.5	1.5	pH	7.2	6.7
Potassium (K)	.6	.9	Specific conductance (micromhos at 25 C.)	46.8	54.6
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	23	18			
Sulfate (SO_4)	1.7	7.6	Turbidity	--	--
Chloride (Cl)	.9	1.4	Temperature (F.)	54	58
Fluoride (F)	.0	.0	Date of collection	June 6, 1952	June 6, 1952
Nitrate (NO_3)	.6	.4			
Dissolved solids	36	37			

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	42	104	14	7.3	7.7	7.0	56	120	24	36	750	7
Finished water	33	90	6	6.7	7.2	6.2	56	120	24	0	0	0

[a] Sacramento River.

SAN BERNARDINO

(Population, 63,058; special census 1952, 73,827)

Ownership: Municipal.

Source: 30 wells ranging in depth from 40 to 1,408 ft (82 percent of supply), and Lytle Creek (18 percent of supply). The yield of the wells is reported to range from 125 to 2,900 gpm, and to average 1,298 gal (data on 21 wells).

Treatment: Chlorination of creek water; well water not treated.

Storage: Reservoirs, 37,690,000 gal.

SAN BERNARDINO--Continued

ANALYSES

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

	Antil Well 5	17th St. & Sierra Way Well	Hanford Well 1	Perris Hill Well 3	Lytle Creek [a]
Silica (SiO_2)	--	14	9	15	--
Iron (Fe)	--	.03	--	--	0
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	24	52	47	31	52
Magnesium (Mg)	1.8	9.5	7.7	6.1	6
Sodium (Na)	44	12	17	32	41
Potassium (K)	2.2	4.0	4.0	.3	--
Carbonate (CO_3)	--	--	--	--	--
Bicarbonate (HCO_3)	127	210	188	129	244
Sulfate (SO_4)	42	13	30	27	27
Chloride (Cl)	7.4	4.8	10	18	12
Fluoride (F)	.4	.4	.4	.8	--
Nitrate (NO_3)	1.3	5.3	3.7	3.5	--
Dissolved solids	232	244	240	[b] 197	[b] 258
Hardness as $CaCO_3$:					
Total	67	169	149	102	154
Noncarbonate	0	0	0	0	0
Color	0	0	0	0	--
pH	8.8	8.5	8.4	8.0	8.0
Specific conductance (micromhos at 25 C.)	319	339	325	352	--
Turbidity	1.1	1.1	1.0	3.5	--
Temperature (F.)	--	--	--	--	--
Date of collection	Apr. 18, 1951	Apr. 18, 1951	Apr. 18, 1951	Apr. 18, 1951	1940
Depth (feet)	1,408	700	752	265	
Diameter (inches)	--	20	16	20	
Date drilled	1929	1948	1920	1930	
Percent of supply	--	--	--	--	

[a] Special Bulletin No. 63, California Water Supply Statistics, California State Dept. of Health.

[b] Sum of determined constituents.

SAN DIEGO

(Population, 334,387; special census 1952, 434,924)

Ownership: Municipal; supplies San Dieguito Irrigation District, Santa Fe Irrigation District, Del Mar, and part of Coronado. Total population supplied, about 450,000.

Source: San Diego River system (47 percent of supply), Cottonwood-Otay system (43 percent of supply), and San Dieguito system (10 percent of supply). Imported supply, Colorado River through the Colorado River Aqueduct and San Diego Aqueduct of the Metropolitan Water District of Southern California, and the San Diego County Water Authority. (See Los Angeles.)

Treatment: Alvarado plant: prechlorination, coagulation with ferric sulfate, partial softening with lime, settling, polyphosphate, rapid sand filtration, and fluoridation; Lower Otay plant: pressure filtration, chlorination, and fluoridation; Torrey Pines plant: pressure filtration, chlorination, and fluoridation. There are 2 stations for chlorination only.

Rated capacity of treatment plant: Alvarado plant: 66,000,000 gpd; Lower Otay plant: 16,000,000 gpd; Torrey Pines plant: 3,000,000 gpd.

Raw-water storage (capacity): 130,085,000,000 gal.

Finished-water storage (capacity): 136,000,000 gal.

SAN DIEGO--Continued

The percentages of supply shown above are the "normal" percentages. Considerable quantities of Colorado River water have been used for the past few dry years, due to extremely low production of local supplies. For the year ending June 30, 1951, almost 90 percent of the supply came from the Colorado River, distributed through the San Dieguito system and San Vicente Reservoir, and for the year ending June 30, 1952, 75 percent. As of 1952, the city's entitlement to Colorado River water was approximately 53,000,000 gpd.

The San Diego River system includes water from the San Diego River and tributaries, and is stored in El Capitan and San Vicente Reservoirs. However, most of the water received at present in San Vicente Reservoir is Colorado River water through the San Diego Aqueduct. Water from the San Diego River system is treated at the Alvarado Plant.

The Cottonwood-Otay system includes water from Buckman and La Posta Creeks (tributaries of Cottonwood Creek) stored in Morena Reservoir, Cottonwood and Pine Valley Creeks stored in Barrett Reservoir, and Dulzura Creek stored in Lower Otay Reservoir. All Cottonwood-Otay sources eventually reach Lower Otay Reservoir, the water from which is treated at the Lower Otay Plant.

The San Dieguito River system stores water from the San Dieguito River in Lake Hodges and San Dieguito Reservoir. Water from this system is treated at Torrey Pines Plant.

ANALYSES

(Analyses, in parts per million, by City of San Diego)

	Alvarado finished water[a]	Reservoirs[a]			
		El Capitan	San Vicente	Lower Otay	San Dieguito
Silica (SiO_2)	11	18	10	12	12
Iron (Fe)	0	.05	.02	.13	.05
Manganese (Mn)	0	0	0	.03	0
Calcium (Ca)	60	44	75	34	64
Magnesium (Mg)	20	13	26	21	23
Sodium (Na)	81	43	107	82	88
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	9	0	5	0	0
Bicarbonate (HCO_3)	78	208	159	235	154
Sulfate (SO_4)	217	45	265	50	249
Chloride (Cl)	77	41	81	90	80
Fluoride (F)	[b].9	[b].3	[b].4	[b].5	[b].4
Nitrate (NO_3)	.8	.4	.3	0	0
Dissolved solids	514	307	648	406	592
Hardness as $CaCO_3$:					
Total	231	181	295	170	253
Noncarbonate	155	10	157	0	127
Color	--	--	--	--	--
pH	8.4	7.8	7.8	7.6	7.9
Specific conductance (micromhos at 25 C.)	959	500	970	750	980
Turbidity	<1	<1	<1	<1	<1
Temperature (F.)	--	--	--	--	--
Date of collection	1951-52	1951-52	1951-52	1951-52	1951-52

[a] All results are averages of monthly and quarterly analyses for 1951-52 fiscal year.

[b] Fluoride average 0.9 ppm after beginning of treatment (Dec. 1952).

SAN FRANCISCO
(Population, 775,357)

Ownership: Municipal; furnishes the entire supply for Belmont, Belmont Water District, Burlingame, Moffett Field, Redwood City, San Carlos, San Mateo, and Sunol; furnishes part of the supply for Alameda County Water District, Atherton, Daly City, Menlo Park, Millbrae, Palo Alto, and South San Francisco. Total population supplied, about 975,000.

Source: Hetch Hetchy system (60 percent of supply), Alameda system (approximately 30 percent of supply), Peninsula system (approximately 10 percent of supply). Emergency supplies from Sunset wells system and from Lake Merced, within San Francisco.

Treatment: Chlorination, copper sulfate for algae control in open reservoirs. Aeration of water from Calaveras Reservoir. Fluoridation authorized in November 1951.

Raw-water storage: Storage reservoirs, total capacity 187,630,000,000 gal.

Finished-water storage: Distribution reservoirs, total capacity 315,600,000 gal; elevated tanks, total capacity 2,780,000 gal.

The Hetch Hetchy system includes the Tuolumne River impounded in Hetch Hetchy Reservoir, Eleanor Creek impounded in Lake Eleanor, and Cherry River. These waters are combined at Early Intake, 155 miles east of San Francisco, where they enter the aqueduct leading to San Francisco.

Hetch Hetchy Reservoir has a storage capacity of 117,300,000,000 gal, Lake Eleanor a storage capacity of 9,000,000,000 gal, while the present capacity of the aqueduct is about 92,000,000 gpd. Under construction (1951) is a dam on Cherry River which will create a new reservoir with a capacity of 86,000,000,000 gal. Also under construction is a second section of aqueduct across San Joaquin Valley which will increase the capacity of the aqueduct to 140,000,000 gpd.

The Alameda sources lie on the east side of San Francisco Bay within the drainage area of Alameda Creek. The chief source is Calaveras Reservoir, which impounds Calaveras Creek and Arroyo Hondo, and water diverted from upper Alameda Creek through a tunnel. Calaveras Reservoir has a storage capacity of 31,550,000,000 gal, and its water flows by gravity to enter the Hetch Hetchy aqueduct. During dry years water is also obtained from two underground sources: Sunol filter galleries on Alameda Creek and wells in the vicinity of Pleasanton. When these sources are used, the water is pumped into the Hetch Hetchy aqueduct near the Bay Crossing Division.

The Peninsula system includes chiefly three reservoirs: Crystal Springs, Pilarcitos, and San Andres. These reservoirs catch and store the local runoff; also Crystal Springs is the terminal reservoir for the Hetch Hetchy aqueduct, which includes all of the Hetch Hetchy and Alameda sources. The storage capacity of each reservoir is as follows: Crystal Springs, 22,580,000,000 gal; San Andres, 6,190,000,000 gal; Pilarcitos, 1,010,000,000 gal. Water from Pilarcitos Reservoir is released to San Andres Reservoir. Water from Crystal Springs and San Andres Reservoirs is supplied to a number of distribution reservoirs throughout the city. Crystal Spring lines supply downtown, commercial, waterfront areas of the city, and peninsula communities as far south as San Carlos. San Andres lines furnish water to residential areas of San Francisco. Bay Crossing lines (Hetch Hetchy aqueduct) supply peninsula communities south of San Carlos and some communities in Alameda County.

SAN FRANCISCO--Continued

ANALYSES

(Analyses, in parts per million, by City of San Francisco)

	Hetch Hetchy Reservoir	Calaveras Reservoir	Pilarcitos Reservoir	Sunol Galleries	Pleasanton Wells
Silica (SiO_2)	3.8	5.0	3.7	14	11
Iron (Fe)	.02	.02	.02	.03	.02
Manganese (Mn)	0	0	0	0	0
Calcium (Ca)	1.1	25	15	52	63
Magnesium (Mg)	1.4	8.8	5.1	14	29
Sodium (Na)	.1	8.8	14	26	28
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	7	105	70	193	283
Sulfate (SO_4)	1.6	17	6.5	63	47
Chloride (Cl)	1	7	20	21	30
Fluoride (F)	.1	.1	.0	.1	.1
Nitrate (NO_3)	.1	.2	.1	.0	1.0
Dissolved solids	[a]13	[a]124	[a]99	[a]286	[a]348
Hardness as $CaCO_3$:					
Total	9	99	59	187	275
Noncarbonate	3	13	1	29	44
Color	--	--	--	--	--
pH	6.4	7.7	7.5	7.9	8.0
Specific conductance (micromhos at 25 C.)	19.7	225	175	466	606
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	June 1949	June 1949	June 1949	1948	January 1949

	Crystal Springs lines	San Andres lines	Bay Crossing lines
Silica (SiO_2)	7.5	7.0	3.0
Iron (Fe)	.02	.01	.05
Manganese (Mn)	0	0	0
Calcium (Ca)	13	14	7.5
Magnesium (Mg)	5.6	6.2	3.4
Sodium (Na)	11	12	5.3
Potassium (K)	--	--	--
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	66	71	34
Sulfate (SO_4)	13	12	8.7
Chloride (Cl)	10	15	5
Fluoride (F)	.1	.0	.0
Nitrate (NO_3)	.0	.1	.0
Dissolved solids	[a]93	[a]102	[a]50
Hardness as $CaCO_3$:			
Total	54	58	33
Noncarbonate	1	2	5
Color	--	--	--
pH	7.9	7.8	7.3
Specific conductance (micromhos at 25 C.)	152	170	85
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	Apr. 17, 1951	Apr. 17, 1951	Aug. 18, 1950

[a] Sum of determined constituents.

SAN GABRIEL
(Population, 20,343)

Ownership: San Gabriel County Water District; supplies about 15,000 people in San Gabriel and about 5,000 people outside the city limits. Total population supplied, about 20,000. California Water & Telephone Co.; supplies sections of San Gabriel, San Marino, and County Island No. 2 (north of San Marino). Total population supplied, about 21,000.

Source: San Gabriel County Water District, 5 wells (3, 4, 5, 6, 7) 437, 500, 340, 401, and 910 ft deep; yield reported to be 1,225, 1,332, 2,146, 1,991, and 2,034 gpm. California Water & Telephone Co., 8 wells ranging in depth from 300 to 785 ft; yield (capacity) reported to range from 900 to 2,100 gpm.

Treatment: None.

Storage: San Gabriel County Water District, 4,100,000 gal; California Water & Telephone Co., 7,490,000 gal.

ANALYSES

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

	Well 3	Well 4	Well 5	Well 6	Well 7
Silica (SiO_2)	23	19	37	25	34
Iron (Fe)	.01	.03	--	--	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	29	26	34	34	31
Magnesium (Mg)	3.7	3.9	8.5	11	8.9
Sodium (Na)	30	29	25	25	33
Potassium (K)	--	3.0	3.0	2.0	--
Carbonate (CO_3)	--	--	--	--	--
Bicarbonate (HCO_3)	132	130	158	149	134
Sulfate (SO_4)	15	27	9.3	16	33
Chloride (Cl)	10	9.0	12	16	15
Fluoride (F)	1.1	1.0	.8	.6	.9
Nitrate (NO_3)	12	7.1	16	20	20
Dissolved solids	[a] 189	[a] 189	[a] 224	[a] 223	[a] 242
Hardness as $CaCO_3$:					
Total	87	82	121	128	114
Noncarbonate	0	0	0	6	4
Color	--	--	--	--	--
pH	8.8	9.0	8.2	8.2	8.4
Specific conductance (micromhos at 25 C.)	275	277	319	343	331
Turbidity	6.0	1.5	0.9	1.3	1.1
Temperature (F.)	--	--	--	--	--
Date of collection	Apr. 17, 1951	Apr. 17, 1951	Apr. 17, 1951	Apr. 17, 1951	Apr. 17, 1951
Depth (feet)	437	500	340	401	910
Diameter (inches)	18	26	20	20	20
Date drilled	1931	1928	1915	1942	1947
Percent of supply	--	--	--	--	--

[a] Sum of determined constituents.

SAN GABRIEL--Continued

ANALYSES

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

	Well 1917	Well 1923	Well 1925	Well 1947
Silica (SiO_2)	--	--	--	--
Iron (Fe)	.27	.0	.0	.0
Manganese (Mn)	.0	.0	.0	.0
Calcium (Ca)	29	33	27	35
Magnesium (Mg)	7.4	8.2	8.6	8.5
Sodium (Na)	29	31	30	26
Potassium (K)	--	--	--	--
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	128	149	132	163
Sulfate (SO_4)	16	26	18	18
Chloride (Cl)	20	18	13	14
Fluoride (F)	1.0	.8	.9	.6
Nitrate (NO_3)	5.3	2.0	6.4	1.9
Dissolved solids	[a] 171	[a] 192	[a] 169	[a] 184
Hardness as $CaCO_3$:				
Total	104	115	102	122
Noncarbonate	0	0	0	0
Color	--	--	--	--
pH	7.9	7.0	7.4	7.4
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	June 11, 1952	June 11, 1952	June 11, 1952	June 11, 1952
Depth (feet)	385	501	785	690
Diameter (inches)	18	18	26	20
Date drilled	1917	1923	1925	1947
Percent of supply	--	--	--	--

[a] Sum of determined constituents.

SAN JOSE
(Population, 95,280)

Ownership: San Jose Water Works (private); supplies also Los Gatos and about 65,300 people outside the city limits. Total population supplied, about 165,500.
Source: 41 wells ranging in depth from 185 to 1,535 ft (60 percent of supply); Los Gatos and Saratoga Creeks (40 percent of supply).
Treatment: Wells: chlorination for some, others untreated. Creeks: chlorination, occasional use of chlorine dioxide and ammonia.
Rated capacity of treatment plant: --
Raw-water storage: Impounding reservoirs for streams, 2,485,000,000 gal.
Finished-water storage: Distribution reservoirs, 42,800,000 gal.

SAN JOSE--Continued

ANALYSIS

(Analysis, in parts per million, by California Water Service Co.)

	Composite water [a]		Composite water [a]
Silica (SiO_2)	21	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	194
Manganese (Mn)	.00	Noncarbonate	8
Calcium (Ca)	42		
Magnesium (Mg)	21	Color	--
Sodium (Na)	29	pH	8.2
Potassium (K)	1	Specific conductance (micromhos at 25 C.)	475
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	222	Temperature (F.)	--
Sulfate (SO_4)	41	Date of collection	1950
Chloride (Cl)	16		
Fluoride (F)	.1		
Nitrate (NO_3)	6.8		
Dissolved solids	[b] 288		
Depth (feet)			--
Diameter (inches)			--
Date drilled			--
Percent of supply			100

[a] Mean for 1950.
[b] Sum of determined constituents.

SAN LEANDRO
(Population, 27,542)

Ownership: East Bay Municipal Utility District. (See Oakland.)

SAN MATEO
(Population, 41,782)

Ownership: California Water Service Co.
Source: Crystal Springs Reservoir (see San Francisco). Emergency supply from 10 wells, ranging in depth from 237 to 445 ft.
Treatment: Chlorination of water from Crystal Springs Reservoir by City of San Francisco; softening by lime-soda process, and chlorination of well water, when used.
Finished-water storage: 5,540,000 gal.

SANTA ANA
(Population, 45,533; Oct. 23, 1952, 52,355)

Ownership: Municipal.
Source: Colorado River distributed by the Metropolitan Water District of Southern California, 83 percent of supply, 89 percent of supply in 1952. (See Los Angeles.) Six wells (7, 12 to 16) 960, 466, 960, 978, 1,140, and 1,050 ft deep, 17 percent of supply.
Treatment: Chlorination of well water; Colorado River water treated by Metropolitan Water District of Southern California. (See Los Angeles.)
Raw-water storage: --
Finished-water storage: 2,060,000 gal.

SANTA ANA--Continued

ANALYSES

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

	Well 13	Well 14	Well 15	Well 16
Silica (SiO_2)	18	16	18	15
Iron (Fe)	.05	.07	.00	.00
Manganese (Mn)	.00	.00	.00	.00
Calcium (Ca)	51	63	50	67
Magnesium (Mg)	18	16	19	20
Sodium (Na)	45	43	43	43
Potassium (K)	1.9	2.3	1.7	1.3
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	204	230	207	208
Sulfate (SO_4)	93	74	90	83
Chloride (Cl)	39	54	35	53
Fluoride (F)	.3	.5	.3	.4
Nitrate (NO_3)	16	12	4.4	21
Dissolved solids	[a]383	[a]394	[a]364	[a]406
Hardness as $CaCO_3$:				
Total	203	225	205	250
Noncarbonate	36	36	35	79
Color	--	--	--	--
pH	7.5	7.4	7.5	7.5
Specific conductance (micromhos at 25 C.)	645	708	625	685
Turbidity	< 1	< 1	< 1	< 1
Temperature (F.)	--	--	--	--
Date of collection	Sept. 25, 1951	Sept. 25, 1951	Sept. 26, 1951	Sept. 25, 1951
Depth (feet)	960	978	1,140	1,050
Diameter (inches)	18-16	20-16	26-16	20-12
Date drilled	1925	1927	1929	1932
Percent of supply	--	--	--	--

[a] Sum of determined constituents.

SANTA BARBARA
(Population, 44,913)

Ownership: Municipal; supplies also about 400 people outside the city limits. Total population supplied, about 45,300.

Source: Santa Inez River impounded in Gibraltar Reservoir, 60 percent of supply; 9 wells ranging in depth from 473 to 946 ft, 40 percent of supply. The yield of the wells is reported to range from 250 to 800 gpm. Auxiliary supply, 5 wells. There is an emergency connection with a private water company.

Treatment: Santa Inez River water: prechlorination, lime-soda softening, recarbonation, coagulation with alum, rapid sand filtration, and postchlorination. Well water: chlorination.

Rated capacity of treatment plant: 6,000,000 gpd.

Raw-water storage: Gibraltar Reservoir, approximately 4,700,000,000 gal.

Finished-water storage: Reservoirs, 64,000,000 gal.

Santa Inez River is supplemented when available by water from Tecolote Tunnel. When water from this source is used no softening is done. Sheffield Reservoir serves to distribute both Santa Inez River and Tecolote Tunnel water.

SANTA BARBARA--Continued

ANALYSES

(Analyses, in parts per million, by Pomeroy & Associates, Pasadena, Calif.)

	Yanonali Well 1	Soledad Well 1	De La Guerra Well 1	De La Guerra Well 3
Silica (SiO_2)	32	32	38	28
Iron (Fe)	.1	.0	.0	.0
Manganese (Mn)	--	--	--	--
Calcium (Ca)	70	88	103	81
Magnesium (Mg)	23	24	36	23
Sodium (Na)	53	75	54	42
Potassium (K)	1.7	2	2.0	1.4
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	251	301	249	252
Sulfate (SO_4)	134	135	106	125
Chloride (Cl)	27	65	131	30
Fluoride (F)	.4	.3	.4	.3
Nitrate (NO_3)	.6	2	40	4
Dissolved solids	[a] 465	[a] 572	[a] 633	[a] 459
Hardness as $CaCO_3$:				
Total	268	319	408	295
Noncarbonate	64	72	201	90
Color	--	--	--	--
pH	6.9	7.2	6.7	7.0
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Aug. 29, 1951	Aug. 29, 1951	Aug. 29, 1951	Aug. 29, 1951
Depth (feet)	946	635	529	698
Diameter (inches)	14	14	14	14
Date drilled	1950	1948	1948	1948
Percent of supply	--	--	--	--

	Finished water [b]	Tecolote Tunnel		Finished water [b]	Tecolote Tunnel
Silica (SiO_2)	24	28	Hardness as $CaCO_3$:		
Iron (Fe)	--	--	Total	220	52
Manganese (Mn)	--	--	Noncarbonate	42	0
Calcium (Ca)	46	14			
Magnesium (Mg)	25	4.0	Color	--	--
Sodium (Na)	99	117	pH	7.6	8.2
Potassium (K)	2.4	6.7	Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	--	--	Turbidity	--	--
Bicarbonate (HCO_3)	214	236	Temperature (F.)	--	--
Sulfate (SO_4)	224	98	Date of collection	Aug. 6, 1951	Aug. 6, 1951
Chloride (Cl)	19	11			
Fluoride (F)	.7	.8			
Nitrate (NO_3)	1.2	1.2			
Dissolved solids	[a] 547	[a] 397			

[a] Sum of determined constituents.
[b] Sheffield Reservoir.

SANTA CRUZ
(Population, 21,970)

Ownership: Municipal; supplies also about 11,000 people outside the city limits. Total population supplied, about 33,000.
Source: Coastal streams: Laguna Creek, Majors Creek, and Liddell Creek (57 percent of supply); San Lorenzo River (39 percent of supply); 3 wells each 100 ft deep (4 percent of supply).
Treatment: San Lorenzo River: prechlorination, activated carbon, pressure filtration, and postchlorination. Coastal streams: chlorination. Wells: chlorination, and addition of Calgon for stabilization.
Rated capacity of treatment plant: 6,750,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoirs and tanks, 45,800,000 gal.

Water from the coastal streams flows by gravity to Santa Cruz. San Lorenzo River water is first treated, then pumped to the system.

ANALYSES

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

	San Lorenzo River (raw water)	San Lorenzo River (finished water)	Bay Street Reservoir [a]
Silica (SiO_2)	--	--	--
Iron (Fe)	.1	--	--
Manganese (Mn)	.0	--	--
Calcium (Ca)	33	37	55
Magnesium (Mg)	11	6.8	5.1
Sodium (Na)	22	20	12
Potassium (K)	--	--	--
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	110	126	177
Sulfate (SO_4)	56	26	24
Chloride (Cl)	20	24	12
Fluoride (F)	.0	.2	.0
Nitrate (NO_3)	1.5	.0	.9
Dissolved solids	[b] 198	202	220
Hardness as $CaCO_3$:			
Total	128	123	160
Noncarbonate	37	20	15
Color	--	--	--
pH	7.6	7.9	7.6
Specific conductance (micromhos at 25 C.)	--	347	370
Turbidity	--	< 1.0	< 1.0
Temperature (F.)	--	--	--
Date of collection	Jan. 30, 1951	Oct. 16, 1951	Oct. 16, 1951

[a] Coastal streams (finished water).
[b] Sum of determined constituents.

SANTA MONICA
(Population, 71,595)

Ownership: Municipal.

Source: Colorado River distributed by the Metropolitan Water District of Southern California, 91 percent of supply; 95 percent in 1952 (see Los Angeles); 8 wells ranging in depth from 250 to 468 ft, 9 percent of supply. The reported yield of the wells is from 500 to 1,750 gpm. Emergency supply from Southern California Water Co.

Treatment: Colorado River water is softened and filtered by the Metropolitan Water District of Southern California. The well water is not treated.

Raw-water storage: --

Finished-water storage: 20,000,000 gal.

ANALYSES

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

	Well 1	Well 2		Well 1	Well 2
Silica (SiO_2)	14	--	Hardness as $CaCO_3$:		
Iron (Fe)	.00	.0	Total	291	295
Manganese (Mn)	.00	.0	Noncarbonate	109	136
Calcium (Ca)	64	66			
Magnesium (Mg)	32	33	Color	--	--
Sodium (Na)	49	44	pH	7.0	7.1
Potassium (K)	1.3	--	Specific conductance (micromhos at 25 C.)	725	--
Carbonate (CO_3)	--	0	Turbidity	< 1	--
Bicarbonate (HCO_3)	222	201	Temperature (F.)	--	--
Sulfate (SO_4)	119	138	Date of collection	Sept. 25, 1951	Sept. 25, 1951
Chloride (Cl)	53	42			
Fluoride (F)	.3	.4			
Nitrate (NO_3)	20	2.4			
Dissolved solids	485	493			
Depth (feet)				250	250
Diameter (inches)				16	16
Date drilled				1920	1940
Percent of supply				--	--

SANTA ROSA
(Population, 17,902)

Ownership: Municipal; supplies also about 12,000 people outside the city limits. Total population supplied, about 30,000.

Source: 7 wells (2 to 6, Peters Springs well, and Ralphine well) 900, 300, 1,000, 290, 915, 139, and 846 ft deep, 67 percent of supply; Santa Rosa Creek and MacRae Springs, 33 percent of supply. The yield of the wells is reported to be 380, 325, 950, 250, 1,500, 575, and 450 gpm. Water from Santa Rosa Creek and MacRae Springs is stored in Lake Ralphine. Water from Peters Springs and Ralphine wells is pumped into Lake Ralphine during the summer months.

Treatment: Wells 2 to 6: aeration and polyphosphate (Calgon) for iron and manganese control, chlorination, and dechlorination by sulfur dioxide. Lake Ralphine: chlorination after long storage.

Rated capacity of treatment plant: 6,500,000 gpd.

Raw-water storage: Lake Ralphine, 135,000,000 gal.

Finished-water storage: Reservoirs, 2,800,000 gal.

SANTA ROSA--Continued

(Analyses, in parts per million, by Brown and Caldwell, San Francisco)

	Well 4	Well 6	Peters Springs Well	Lake Ralphine	Finished water (city tap)
Silica (SiO_2)	93	89	95	38	84
Iron (Fe)	.33	.27	.33	.52	.27
Manganese (Mn)	.09	.07	.10	.03	.18
Calcium (Ca)	28	29	34	22	30
Magnesium (Mg)	18	18	21	19	18
Sodium (Na)	} 59	67	64	25	58
Potassium (K)					
Carbonate (CO_3)	0	0	0	14	0
Bicarbonate (HCO_3)	285	290	346	168	280
Sulfate (SO_4)	.9	9.9	2.9	7.0	8.8
Chloride (Cl)	27	28	16	11	25
Fluoride (F)	--	--	--	--	--
Nitrate (NO_3)	.0	7.0	1.0	3.1	1.5
Dissolved solids	366	391	405	222	364
Hardness as $CaCO_3$:					
Total	144	147	171	133	149
Noncarbonate	0	0	0	0	0
Color	0	--	0	5	--
pH	8.0	7.4	8.1	8.4	7.5
Specific conductance (micromhos at 25 C.)	550	479	610	334	486
Turbidity	2	--	0	7	--
Temperature (F.)	--	--	--	--	--
Date of collection	Jan. 19, 1948	Aug. 31, 1950	Jan. 22, 1948	Feb. 10, 1949	Sept. 19, 1950
Depth (feet)	1,000	915	139		
Diameter (inches)	16-10	16	8		
Date drilled	1940	1950	1923		
Percent of supply	--	--	--		

SOUTH GATE
(Population, 51,116)

Ownership: Municipal.
Source: 17 wells ranging in depth from 551 to 1,600 ft. The reported yield of the individual wells is from 400 to 1,900 gpm. There are emergency cross-connections with the Huntington Park and Walnut Park systems.
Treatment: None.
Storage: 1,300,000 gal.

Analyses of samples from the other wells show that they furnish water of about the same chemical composition as those for which analyses are given.

SOUTH GATE--Continued

ANALYSES

(Analyses, in parts per million, by Smith Emery Co., Los Angeles, Calif.)

	Well 5	Well 15	Well 17	Well 18	Well 20
Silica (SiO_2)	16	14	13	12	14
Iron (Fe)	--	--	--	--	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	55	68	60	63	62
Magnesium (Mg)	8.9	18	18	12	14
Sodium (Na)	47	46	46	29	34
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	213	238	244	238	219
Sulfate (SO_4)	59	103	64	37	73
Chloride (Cl)	28	32	41	26	23
Fluoride (F)	--	--	--	--	--
Nitrate (NO_3)	--	--	--	--	--
Dissolved solids	[a]319	[a]398	[a]362	[a]296	[a]328
Hardness as $CaCO_3$:					
Total	174	246	225	208	214
Noncarbonate	0	48	24	12	32
Color	--	--	--	--	--
pH	7.4	7.6	7.8	7.5	7.8
Specific conductance (micromhos at 25 C.)	500	600	570	450	520
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Nov. 2, 1950	Nov. 2, 1950	Nov. 2, 1950	Nov. 2, 1950	Nov. 2, 1950
Depth (feet)	1000	700	551	792	1,400
Diameter (inches)	12	12	16	18	18
Date drilled	1923	--	1931	1945	1949
Percent of supply	--	--	--	--	--

[a] Sum of determined constituents.

SOUTH PASADENA
(Population, 16,935)

Ownership: Municipal.
Source: 6 wells (Wilson 1 to 3, Graves 1 and 2, and Orange Grove) 500, 525, 984, 500, 738, and 232 ft deep, respectively; yield reported to be 900, 1,030, 3,000, 900, 3,000, and 300 gpm. Emergency supply from Pasadena. (See Pasadena.)
Treatment: None.
Storage: Reservoirs and tanks, 10,200,000 gal.

SOUTH PASADENA--Continued

ANALYSES

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

	Wilson well 1	Wilson well 2	Wilson well 3	Graves well 1	Graves well 2
Silica (SiO_2)	32	32	32	28	33
Iron (Fe)	.03	.04	.05	.02	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	40	39	38	48	42
Magnesium (Mg)	10	9.3	11	11	10
Sodium (Na)	29	28	29	25	24
Potassium (K)	3.2	2.4	3.0	--	3.5
Carbonate (CO_3)	--	--	--	--	--
Bicarbonate (HCO_3)	136	173	161	151	149
Sulfate (SO_4)	27	21	22	18	21
Chloride (Cl)	20	18	17	36	26
Fluoride (F)	.5	.5	.6	.5	.4
Nitrate (NO_3)	55	18	28	23	9.7
Dissolved solids	300	264	270	292	268
Hardness as $CaCO_3$:					
Total	141	136	141	166	146
Noncarbonate	29	0	9	42	24
Color	0	0	--	0	0
pH	7.8	8.1	7.9	8.1	8.2
Specific conductance (micromhos at 25 C.)	400	367	380	416	370
Turbidity	1.0	1.5	1.7	0.0	0.0
Temperature (F.)	--	--	--	--	--
Date of collection	Apr. 24, 1951	Apr. 24, 1951	Apr. 24, 1951	Apr. 19, 1951	Apr. 19, 1951
Depth (feet)	500	525	984	500	738
Diameter (inches)	16	26	24	16	20
Date drilled	1910	1924	1950	[a] 1890	1949
Percent of supply	--	--	--	--	--

[a] Drilled about 1890.

SOUTH SAN FRANCISCO
(Population, 19,351)

Ownership: California Water Service Co.; supplies also about 175 people outside the city limits. Total population supplied, about 19,500.

Source: Crystal Springs Reservoir, 52 percent of supply (see San Francisco); 9 wells (1-02, 1-04, 1-09, 1-14 to 1-19) 196, 271, 276, 547, 539, 589, 478, 575, and 528 ft deep; yield reported to be 140, 160, 140, 150, 475, 300, 400, 70, and 70 gpm. The wells furnish 48 percent of the supply.

Treatment: Chlorination.

Raw-water storage: --

Finished-water storage: Reservoirs and tanks, 4,640,000 gal.

SOUTH SAN FRANCISCO--Continued
ANALYSIS

(Analysis, in parts per million, by California Water Service Co., San Jose, Calif.)

	Composite sample (city tap)		Composite sample (city tap)
Silica (SiO_2)	22	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	128
Manganese (Mn)	--	Noncarbonate	20
Calcium (Ca)	16		
Magnesium (Mg)	21	Color	--
Sodium (Na)	42	pH	8.3
Potassium (K)	--	Specific conductance (micromhos at 25 C.)	448
Carbonate (CO_3)	2	Turbidity	0
Bicarbonate (HCO_3)	126	Temperature (F.)	--
Sulfate (SO_4)	37	Date of collection	1950
Chloride (Cl)	49		
Fluoride (F)	--		
Nitrate (NO_3)	6.8		
Dissolved solids	[a] 257		

[a] Sum of determined constituents.

STOCKTON
(Population, 70,853)

Ownership: California Water Service Co.; supplies also about 26,000 people outside the city limits. Total population supplied, about 96,900.
Source: 37 wells ranging in depth from 198 to 1,050 ft.
Treatment: 7 wells at Station 1: aeration, chlorination, and Calgon. Water from all but 5 wells is chlorinated.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoirs and tanks, 4,830,000 gal.

ANALYSES

(Analyses, in parts per million, by California Water Service Co., San Jose, Calif.)

	Well 1-09	Well 18-01	Well 22-01	Range of Constituents [a]	Mean [a]
Silica (SiO_2)	54	43	47	40 - 64	49
Iron (Fe)	.08	.04	.07	.00 - .34	.08
Manganese (Mn)	.14	.08	.14	.00 - .72	.09
Calcium (Ca)	38	10	22	4.0 - 93	20
Magnesium (Mg)	20	4.9	5.9	2.9 - 52	10
Sodium (Na)	71	31	71	15 - 227	65
Potassium (K)	--	--	--	-- --	--
Carbonate (CO_3)	--	--	--	-- --	--
Bicarbonate (HCO_3)	160	118	163	115 - 219	164
Sulfate (SO_4)	3.8	3.4	2.4	.5 - 12	4.0
Chloride (Cl)	134	6	67	6 - 410	63
Fluoride (F)	--	--	--	-- --	--
Nitrate (NO_3)	6.8	.1	.6	.0 - 14	2.6
Dissolved solids	[b] 408	[b] 158	[b] 298	158 - 828	296
Hardness as $CaCO_3$:					
Total	176	44	78	22 - 446	91
Noncarbonate	46	0	0	-- --	0

[a] Based on 37 analyses (1 analysis from each well) 1951.
[b] Sum of determined constituents.

STOCKTON, Analyses,-Continued

	Well 1-09	Well 18-01	Well 22-01	Range of Constituents[a]	Mean[a]
Color	--	--	--	-- --	--
pH	7.8	7.9	8.0	7.5 - 8.6	8.0
Specific conductance (micromhos at 25 C.)	715	211	475	211 - 1595	471
Turbidity	--	--	--	-- --	--
Temperature (F.)	--	--	--	-- --	--
Date of collection	Apr. 19, 1951	July 21, 1951	July 21, 1951	1951	1951
Depth (feet)	--	408	420		
Diameter (inches)	30	30-16	30-16		
Date drilled	--	1947	1949		
Percent of supply	--	--	--		

[a] Based on 37 analyses (1 analysis from each well) 1951.

TORRANCE

(Population, 22,241)

Ownership: Municipal; supplies also about 4,200 people outside the city limits. Total population supplied, about 26,400.

Source: 3 wells, 570, 540, and 492 ft deep (60 percent of supply); Colorado River distributed by the Metropolitan Water District of Southern California, 40 percent of supply; 58 percent in 1952. (See Los Angeles.) The yield of the wells is reported to be 1,350, 1,350, and 950 gpm.

Treatment: Well water is chlorinated. Colorado River water is softened and filtered by the Metropolitan Water District of Southern California.

Storage: 2,320,000 gal.

ANALYSES

(Analyses, in parts per million, by Montgomery & Pomeroy, Los Angeles, Calif.)

	Well 1	Well 2	Torrance District Well 1
Silica (SiO_2)	--	--	24
Iron (Fe)	.30	.25	.25
Manganese (Mn)	--	--	0
Calcium (Ca)	36	33	39
Magnesium (Mg)	15	14	14
Sodium (Na)	73	75	69
Potassium (K)	7.1	7.9	6.3
Carbonate (CO_3)	0	--	0
Bicarbonate (HCO_3)	267	272	242
Sulfate (SO_4)	.0	.0	7.3
Chloride (Cl)	68	63	78
Fluoride (F)	--	--	.0
Nitrate (NO_3)	.0	--	--
Dissolved solids	[a]331	[a]327	[a]357
Hardness as $CaCO_3$:			
Total	150	143	154
Noncarbonate	0	0	0
Color	--	--	--
pH	--	--	7.7
Specific conductance (micromhos at 25 C.)	--	--	--
Turbidity	0	0	0
Temperature (F.)	--	--	--
Date of collection	Feb. 15, 1947	Feb. 15, 1947	Nov. 12, 1948

[a] Sum of determined constituents.

TORRANCE, Analyses--Continued

	Well 1	Well 2	Torrance District Well 1
Depth (feet)	570	540	492
Diameter (inches)	16	16	14
Date drilled	1935	1935	1936
Percent of supply	--	--	--

VALLEJO
(Population, 26,038)

Ownership: Municipal; supplies also about 44,350 people outside the city limits. Total population supplied, about 70,400.

Source: 61 percent of the supply is obtained from East Bay Municipal Utility District (see Oakland). Surface waters impounded in reservoirs: Gordon Valley Creek (26 percent of supply), Green Valley Creek (13 percent of supply).

Treatment: Water from East Bay Municipal Utility District treated by the District (see Oakland). Local supply: prechlorination, coagulation with alum, sedimentation, activated carbon, postchlorination, and lime for pH control.

Rated capacity of treatment plant: 5,000,000 gpd.

Raw-water storage: Reservoirs, 6,053,600,000 gal.

Finished-water storage: 49,000,000 gal.

ANALYSES

(Analyses, in parts per million, by City of Vallejo, Calif.)

	Green Valley Creek[a]	Gordon Valley Creek[a]		Green Valley Creek[a]	Gordon Valley Creek[a]
Silica (SiO_2)	28	5.0	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.0	Total	29	170
Manganese (Mn)	.0	.0	Noncarbonate	0	22
Calcium (Ca)	6.0	41			
Magnesium (Mg)	3.0	17	Color	10	5
Sodium (Na)	10	27	pH	7.7	7.9
Potassium (K)			Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	0	0	Turbidity	10	25
Bicarbonate (HCO_3)	37	183	Temperature (F.)	--	--
Sulfate (SO_4)	10	65	Date of collection	June 1950	June 1950
Chloride (Cl)	8	11			
Fluoride (F)	.0	.0			
Nitrate (NO_3)	1.0	.0			
Dissolved solids	90	263			

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	--	--	--	7.0	8.2	5.6	80	110	60	20	400	10
Finished water	--	--	--	7.4	7.4	7.4	80	110	60	2	5	0

[a] Raw water.

VENTURA
(Population, 16,534)

Ownership: Municipal; supplies also about 4,000 people outside the city limits. Total population supplied, about 20,500.

Source: 6 wells: 3 wells (Pierpont 1 and 2, and Chrisman 2) within the city, 1,400, 1,574, and 1,632 ft deep. The yield of the wells is reported to be 1,300, 2,200, and 2,200 gpm; 3 wells (Casitas 1, Nye 1, and Nye 2) near the Ventura River, 75, 64, and 70 ft deep. The yield of these wells is reported to be 750, 600, and 400 gpm. Auxiliary supply from the Ventura River when there is a flow of water with low turbidity. This source is usually a very small part of the total. Emergency supplies from Mound Water Co., Saticoy Water Co., and Montalvo Mutual Water Co.

Treatment: Wells: aeration and zeolite softening. River: Zeolite softening and dual chlorination.

Rated capacity of treatment plant: 11,000,000 gpd.

Raw-water storage: 11,000,000 gal.

Finished-water storage: 16,000,000 gal.

ANALYSES

(Analyses, in parts per million, by Pomeroy and Associates, Pasadena, Calif.)

	Pierpont Well 2	Chrisman Well 2	Casitas Well 1
Silica (SiO_2)	42	39	16
Iron (Fe)	1.2	1.5	.2
Manganese (Mn)	--	--	--
Calcium (Ca)	159	165	109
Magnesium (Mg)	47	47	47
Sodium (Na)	155	147	46
Potassium (K)	6.1	6.0	2.0
Carbonate (CO_3)	--	--	--
Bicarbonate (HCO_3)	392	371	289
Sulfate (SO_4)	484	500	264
Chloride (Cl)	71	71	48
Fluoride (F)	.3	.3	--
Nitrate (NO_3)	--	--	--
Dissolved solids	[a] 1,160	[a] 1,160	[a] 675
Hardness as $CaCO_3$:			
Total	591	606	467
Noncarbonate	269	301	228
Color	--	--	--
pH	7.4	7.5	7.2
Specific conductance (micromhos at 25 C.)	--	--	--
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	Aug. 28, 1951	Aug. 28, 1951	Sept. 30, 1949
Depth (feet)	1,574	1,632	75
Diameter (inches)	16-12	16-12	18
Date drilled	1949	Mar. 1948	1924
Percent of supply	--	--	--

[a] Sum of determined constituents.

WHITTIER

(Population, 23,820; special census 1952, 29,265)

Ownership: Municipal.
Source: 8 wells (1, 5, 7, 8, 9, 10, 11, 12) 434, 680, 1,000, 302, 664, 808, 837, and 656 ft deep; yield reported to be 800, 1,800, 2,200, 2,800, 3,750, 2,500, 4,200, and 1,400 gpm.
Treatment: None.
Storage: Reservoirs, 18,400,000 gal.

ANALYSES

(Analyses, in parts per million, by Truesdail Laboratories Inc., Los Angeles)

	Well 5	Well 7	Well 8	Well 9	Well 11
Silica (SiO_2)	25	14	18	16	20
Iron (Fe)	--	--	--	--	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	83	61	63	44	33
Magnesium (Mg)	16	13	9.5	6.0	3.8
Sodium (Na)	34	20	13	12	22
Potassium (K)	--	--	--	--	--
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	257	219	206	159	144
Sulfate (SO_4)	101	40	24	1.9	.0
Chloride (Cl)	18	17	18	20	15
Fluoride (F)	--	--	--	--	--
Nitrate (NO_3)	1.4	4.5	8.2	.0	2.2
Dissolved solids	[a] 405	[a] 277	[a] 255	[a] 178	[a] 167
Hardness as $CaCO_3$:					
Total	275	205	196	134	97
Noncarbonate	62	26	27	4	0
Color	--	--	--	--	--
pH	7.2	7.2	8.0	7.9	8.1
Specific conductance (micromhos at 25 C.)	672	453	406	291	297
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	May 21, 1951	Jan. 18, 1951	Jan. 18, 1951	Jan. 18, 1951	Jan. 18, 1951
Depth (feet)	680	1,000	302	664	837
Diameter (inches)	26-18	18-14	24	24	20
Date drilled	1922	1930	1931	1933	1948
Percent of supply	--	--	--	--	--

[a] Sum of determined constituents.

AURORA, COLORADO
(Population, 11,421)

Ownership: Supplied by Denver; also supplies 50 people outside the city limits. Total population supplied, 11,471. (See Denver.)

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 pipeline 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	Turbidity	0.8
Bicarbonate (HCO_3)	14	Temperature (F.)	65
Sulfate (SO_4)	.5	Date of collection	May 23, 1951
Chloride (Cl)	.5		
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.

COLORADO SPRINGS--Continued
ANALYSES

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

	Regular supply Finished water	Raw water [a]	Finished water [a]
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	0.8
Temperature (F.)	--	56	60
Date of collection	Apr. 12, 1950	May 25, 1951	May 25, 1951

[a] 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.

DENVER--Continued

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, 3½ 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	June 4, 1951

Regular determinations at treatment plant, 1950 [a]

	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

[a] Marston Lake, north side.

DENVER--Continued

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[a]	92	95	90	8.0	8.5	7.7	145	150	140	5.9	12	2.3
Finished water[a]	--	--	--	7.7	8.0	7.3	--	--	--	1.3	4.0	1.0
Raw water[b]	93	104	68	7.6	8.1	7.4	147	169	102	13.6	28	4.0
Finished water[b]	85	107	66	7.7	8.0	7.0	133	171	88	1.0	1.0	1.0

[a] Marston Lake, south side.
[b] 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	May 23, 1951
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.

GRAND JUNCTION--Continued

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	Turbidity	30
Bicarbonate (HCO_3)	110	Temperature (F.)	--
Sulfate (SO_4)	9.1	Date of collection	Apr. 30, 1951
Chloride (Cl)	1.9		
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 25 C.)	99.1	121
Carbonate (CO_3)	0	0	Turbidity	3	0.4
Bicarbonate (HCO_3)	51	61	Temperature (F.)	--	--
Sulfate (SO_4)	4.0	1.0	Date of collection	May 23, 1951	May 22, 1951
Chloride (Cl)	1.5	4.0			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.3	.4			
Dissolved solids	71	80			

GREELEY--Continued

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	--	--

LONGMONT

(Population, 8.099)

Ownership: Municipal; also supplies about 2,000 people outside the city limits. Total population supplied, about 10,100.

Source: St. Vrain River.

Treatment: Slow sand filtration and chlorination.

Rated capacity of treatment plant: 6,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 9,000,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	9.8	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	32
Manganese (Mn)	.04	Noncarbonate	8
Calcium (Ca)	9.0		
Magnesium (Mg)	2.3	Color	33
Sodium (Na)	2.7	pH	7.1
Potassium (K)	.6	Specific conductance (micromhos at 25 C.).....	80.7
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	29	Temperature (F.).....	54
Sulfate (SO_4)	12	Date of collection	May 23, 1951
Chloride (Cl)	1.5		
Fluoride (F)	.2		
Nitrate (NO_3)	1.1		
Dissolved solids	72		

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.

PUEBLO--Continued

ANALYSES

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

	Raw water[a]	Finished water[a]		Raw water[a]	Finished water[a]
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	May 24, 1951	May 24, 1951
Chloride (Cl)	6.0	11			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	3.0	4.2			
Dissolved solids	269	329			

Regular determinations at District 1 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	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

[a] District 1.

TRINIDAD

(Population, 12,204)

Ownership: Municipal; also supplies a considerable area outside the city limits. Total population supplied, about 20,000.

Source: North Fork Las Animas River, approximately 40 miles east of Trinidad, impounded in reservoirs.

Treatment: None. (Filtration plant under construction in 1951).

Raw-water storage: 4 reservoirs: North Lake 326,000,000 gal; Monument Lake, 489,000,000 gal; concrete reservoir, Madrid Lake, a regulating reservoir 7 miles east of the city, 70,000,000 gal; reservoir 3 miles from the city, 3,000,000 gal. Total storage, 890,000,000 gal.

Finished-water storage: --

ANALYSIS

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

	Madrid Reservoir		Madrid Reservoir
Silica (SiO_2)	7.1	Hardness as $CaCO_3$:	
Iron (Fe)	.07	Total	76
Manganese (Mn)	--	Noncarbonate	2
Calcium (Ca)	24		
Magnesium (Mg)	4.0	Color	5
Sodium (Na)	3.3	pH	7.9
Potassium (K)	1.4	Specific conductance (micromhos at 25 C.)	160
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	91	Temperature (F.)	--
Sulfate (SO_4)	6.7	Date of collection	June 6, 1951
Chloride (Cl)	1.2		
Fluoride (F)	.2		
Nitrate (NO_3)	.6		
Dissolved solids	98		

ALAMEDA, IDAHO
(Population, 4,694)

Ownership: Municipal; supplies also about 750 people outside the city limits. Total population supplied, about 5,500.
Source: 3 closely spaced wells, each 104 ft deep; yield reported to be 350, 500, and 1,350 gpm. Wells 1 and 2 are used during the entire year, while well 3 is used mostly during the summer months.
Treatment: None.
Storage: Reservoir, 250,000 gal.

ANALYSIS

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

	Wells 1, 2 (composite)		Wells 1, 2 (composite)
Silica (SiO_2)	27	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	354
Manganese (Mn)	--	Noncarbonate	67
Calcium (Ca)	86		
Magnesium (Mg)	34	Color	7
Sodium (Na)	48	pH	7.2
Potassium (K)	9.2	Specific conductance (micromhos at 25 C.)	887
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	351	Temperature (F.)	47
Sulfate (SO_4)	60	Date of collection	Mar. 29, 1951
Chloride (Cl)	75		
Fluoride (F)	.0		
Nitrate (NO_3)	17		
Dissolved solids	537		

Depth (feet)	104, 104
Diameter (inches)	6, 10
Date drilled	about 1930
Percent of supply	--

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.

BLACKFOOT--Continued

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	Turbidity	--
Bicarbonate (HCO_3)	356	Temperature (F.)	--
Sulfate (SO_4)	45	Date of collection	Mar. 28, 1951
Chloride (Cl)	15		
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	Turbidity	--
Bicarbonate (HCO_3)	91	Temperature (F.)	58
Sulfate (SO_4)	34	Date of collection	June 4, 1951
Chloride (Cl)	3.1		
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 well[a]	Hoggan well[b]		Pumphouse well[a]	Hoggan well[b]
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	--			
Bicarbonate (HCO_3)	148	149			
Sulfate (SO_4)	26	23	Turbidity	--	--
Chloride (Cl)	45	33	Temperature (F.)	66	--
Fluoride (F)	.4	.6	Date of collection	Mar. 27, 1951	Jan. 8, 1951
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

[a] Chlorinated. [b] Analyzed by State Dept. of Public Health, Boise, Idaho.

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.

CALDWELL--Continued

ANALYSES

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

	Pump House 1 (6 wells)	Pump House 2 (5 wells)	Pump House 3 [a]	Pump House 4 [b]	City Hall Well [c]
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	--	--	--	--	6
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	June 24, 1949	June 24, 1949	June 24, 1949	June 24, 1949	June 4, 1951 [d]
Depth (feet)	--	--	--	--	--
Diameter (inches)	--	--	--	--	--
Date drilled	--	--	--	--	--
Percent of supply	38	48	4	10	--

[a] College Heights well.
[b] Cemetery well.
[c] Analyzed by U. S. Geological Survey
[d] 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.

COEUR D'ALENE--Continued

ANALYSES

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

	Finished water [a]	Finished water		Finished water [a]	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)	1.3	1.8	pH	7.0	--
Potassium (K)			Specific conductance (micromhos at 25 C.)	--	53
Carbonate (CO_3)	0	0	Turbidity	7	--
Bicarbonate (HCO_3)	24	25	Temperature (F.)	39	51
Sulfate (SO_4)	10	3.0	Date of collection	Apr. 29, 1948	Nov. 2, 1949
Chloride (Cl)	--	.2			
Fluoride (F)	--	.2			
Nitrate (NO_3)	--	.4			
Dissolved solids	58	--			

[a] Analyzed by State Dept. of Public Health, Boise, Idaho.

IDAHO FALLS
(Population, 19,218)

Ownership: Municipal. Total population supplied, about 19,250.

Source: 4 wells (Big Pump 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 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 3 well [a]	Wells [b] (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

[a] Analyzed by U. S. Geological Survey.

[b] Big Pump 3, Boulevard, and I Street wells.

IDAHO FALLS, Analyses--Continued

	Big Pump 3 well[a]	Wells[b] (composite)	Central Park well
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	Mar. 28, 1951	May 12, 1945[c]	Jan. 22, 1951
Depth (feet)	365	--	1,630
Diameter (inches)	22	--	20-16
Date drilled	1937	--	1946-7
Percent of supply	--	--	--

[a] Analysis by U. S. Geological Survey.
[b] Big Pump 3, Boulevard, and I Street wells.
[c] Date of analysis.

JEROME
(Population, 4,523)

Ownership: Jerome Water Co.; supplies also about 1,500 people outside the city limits. Total population supplied, about 6,000.
Source: 3 wells 400, 379, and 391 ft deep; yield reported to be 225, 700, and 275 gpm.
Treatment: Chlorination.
Raw-water storage: Reservoir, 100,000 gal.
Finished-water storage: Elevated tank, 50,000 gal.

ANALYSIS

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

	Finished water[a]		Finished water[a]
Silica (SiO_2)	34	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	167
Manganese (Mn)	--	Noncarbonate	26
Calcium (Ca)	39		
Magnesium (Mg)	17	Color	5
Sodium (Na)	20	pH	7.9
Potassium (K)	4.2	Specific conductance (micromhos at 25 C.)	409
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	172	Temperature (F.)	47
Sulfate (SO_4)	39	Date of collection	Mar. 27, 1951
Chloride (Cl)	24		
Fluoride (F)	.5		
Nitrate (NO_3)	1.6		
Dissolved solids	256		
Depth (feet)			400, 391
Diameter (inches)			8, 10
Date drilled			1909, 1910-11

[a] Composite; wells 1 and 3.

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		
Bicarbonate (HCO_3)	32	Turbidity	--
Sulfate (SO_4)	3.5	Temperature (F.)	46
Chloride (Cl)	1	Date of collection	Oct. 23, 1950
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.

LEWISTON--Continued

ANALYSES

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

	Raw water[a]	Finished water[b]	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	Oct. 16, 1950	Sept. 7, 1951	Sept. 27, 1948

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	--	--

[a] Clearwater River.

[b] Clearwater River. Analysis by U. S. Geological Survey.

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.

MOSCOW--Continued
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	Turbidity	--	21
Bicarbonate (HCO_3)	171	171	Temperature (F.)	51	51
Sulfate (SO_4)	25	23	Date of collection	Feb. 26, 1951	Feb. 26, 1951
Chloride (Cl)	3	2			
Fluoride (F)	.3	.3			
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)	53	54	51	49
Potassium (K)				
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

NAMPA, Analyses--Continued

	Wells 1 and 2	Well 3	Well 4	Well 5
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	Apr. 25, 1951	Apr. 25, 1951	Apr. 25, 1951	Apr. 25, 1951
Depth (feet)	452	503	575	452
Diameter (inches)	10, 8	16	16	16
Date drilled	1927-28	1949	1948	1947
Percent of supply	--	--	--	--

ORCHARDS

(Population, 4,494)

Ownership: Lewiston Orchards Irrigation District. Total population supplied, about 5,000.

Source: Sweetwater Creek, and Webb Creek impounded in Soldiers Meadows Reservoir; emergency supply from Lake Waha. Webb Creek water is diverted through a canal to East Fork Sweetwater Creek. Lake Waha water is pumped, when needed, into an upper tributary of Sweetwater Creek. All water used by the District leaves Sweetwater Creek through a canal to Reservoir A.

Treatment: Water for domestic use: prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and ammoniation. Irrigation water is in a separate pipe system and is not treated.

Rated capacity of treatment plant: 1,500,000 gpd.

Raw-water storage: Soldiers Meadows Reservoir, Lake Waha, and Reservoir A, about 3,000,000,000 gal.

Finished-water storage: Reservoir, 1,500,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	30	34	Hardness as $CaCO_3$:		
Iron (Fe)	.4	.02	Total	48	62
Manganese (Mn)	.0	.00	Noncarbonate	0	13
Calcium (Ca)	14	20			
Magnesium (Mg)	3.2	3.2	Color	50	--
Sodium (Na)	7.8	7.1	pH	7.4	7.7
Potassium (K)			Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	0	0	Turbidity	56	0
Bicarbonate (HCO_3)	73	61	Temperature (F.)	--	--
Sulfate (SO_4)	2.8	24	Date of analysis	May 16, 1951	May 16, 1951
Chloride (Cl)	1	2			
Fluoride (F)	.0	.0			
Nitrate (NO_3)	1.3	.9			
Dissolved solids	[a] 96	[a] 121			

Regular determinations at treatment plant, Feb.-May, 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	51	59	40	7.5	7.9	7.1	43	60	35	43	210	12
Finished water	46	59	32	7.3	8.6	6.8	60	78	51	0	0	0

[a] Sum of determined constituents.

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	Mar. 29, 1951	Mar. 29, 1951	Mar. 29, 1951
Depth (feet)		100	--
Diameter (inches)		18	--
Date drilled		--	--
Percent of supply		--	--

SANDPOINT
(Population, 4,265)

Ownership: Municipal; supplies also Kootenai, Pend Oreille, and about 500 people outside the city limits. Total population supplied, about 5,750.
Source: Sand Creek; auxiliary supply from Lake Pend Oreille. Only 1 percent of the supply was obtained from Lake Pend Oreille during 1950.
Treatment: Pressure filtration when water is turbid, and chlorination.
Rated capacity of treatment plant: Filter capacity, 2,000,000 gpd.
Raw-water storage: 1,400,000 gal.
Finished-water storage: --

The intake on Sand Creek is 4.5 miles northwest of Sandpoint.

SANDPOINT--Continued

ANALYSIS

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

	Sand Creek (finished water)		Sand Creek (finished water)
Silica (SiO_2)	8.9	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	8
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	2.7		
Magnesium (Mg)	.2	Color	5
Sodium (Na)	1.2	pH	7.0
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	16
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	10	Temperature (F.)	50
Sulfate (SO_4)	1.5	Date of collection	June 20, 1951
Chloride (Cl)	.5		
Fluoride (F)	.1		
Nitrate (NO_3)	.1		
Dissolved solids	20		

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	Turbidity	--	--
Bicarbonate (HCO_3)	200	186	Temperature (F.)	49	45
Sulfate (SO_4)	47	56	Date of collection	Mar. 26, 1951	Mar. 26, 1951
Chloride (Cl)	24	27			
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	--	--	--	--	--	--

AMES, IOWA
(Population, 22,898)

Ownership: Municipal.
Source: 4 wells (1, and 3 to 5), 109, 112, 120, and 127 ft deep. The yield of the wells is reported to be 500, 600, 1,000, and 1,600 gpm. Normally well 5 is used most of the time for the supply. The other wells are pumped as needed.
Treatment: Aeration, softening with lime and soda ash, sedimentation, recarbonation, chlorination, sodium hexametaphosphate, and rapid sand filtration.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,750,000 gal.

ANALYSES

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

	Well 5 (raw water)	Well 5 (finished water)		Well 5 (raw water)	Well 5 (finished water)
Silica (SiO_2)	24	15	Hardness as $CaCO_3$:		
Iron (Fe)	6.3	.13	Total	363	73
Manganese (Mn)	.20	.03	Noncarbonate	60	44
Calcium (Ca)	98	23			
Magnesium (Mg)	29	3.8	Color	4	4
Sodium (Na)	13	27	pH	7.5	8.5
Potassium (K)	3.2	3.5	Specific conductance (micromhos at 25 C.)	716	284
Carbonate (CO_3)	0	--	Turbidity	2	0.2
Bicarbonate (HCO_3)	369	[a] 36	Temperature (F.)	52	52
Sulfate (SO_4)	87	85	Date of collection	Feb. 23, 1951	Feb. 23, 1951
Chloride (Cl)	8.0	9.0			
Fluoride (F)	.4	.3			
Nitrate (NO_3)	.3	1.3			
Dissolved solids	464	190			

Depth (feet)	127
Diameter (inches)	30
Date drilled	1947
Percent of supply	--

[a] Includes the equivalent of less than 5 ppm of carbonate (CO_3).

BOONE
(Population, 12,164)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 12,400.
Source: 10 wells (11 to 20), 46, 67, 52, 54, 67, 51, 61, 55, 56, and 64 ft deep. The yield of the wells is reported to be (well 11 not reported) 900, 780, 600, 875, 900, 300, 300, 300, and 300 gpm, respectively.
Treatment: Chlorination.
Raw-water storage: 3,000,000 gal.
Finished-water storage: 1,100,000 gal.

BOONE--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	18	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	418
Manganese (Mn)	.57	Noncarbonate	126
Calcium (Ca)	103		
Magnesium (Mg)	39	Color	5
Sodium (Na)	27	pH	7.7
Potassium (K)	3.7	Specific conductance (micromhos at 25 C.)	844
Carbonate (CO_3)	0	Turbidity	0.7
Bicarbonate (HCO_3)	357	Temperature (F.)	54
Sulfate (SO_4)	141	Date of collection	Feb. 23, 1951
Chloride (Cl)	31		
Fluoride (F)	.2		
Nitrate (NO_3)	2.5		
Dissolved solids	564		

BURLINGTON

(Population, 30,613)

Ownership: Municipal; also supplies about 1,600 people outside the city limits. Total population supplied, about 32,200.

Source: Mississippi River.

Treatment: Prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 7,200,000 gpd.

Raw-water storage: None.

Finished-water storage: 3,500,000 gal.

The chemical composition of the raw water varies considerably throughout the year.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	8.8	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	154
Manganese (Mn)	.00	Noncarbonate	49
Calcium (Ca)	41		
Magnesium (Mg)	13	Color	12
Sodium (Na)	4.1	pH	7.8
Potassium (K)	2.1	Specific conductance (micromhos at 25 C.)	324
Carbonate (CO_3)	0	Turbidity	16
Bicarbonate (HCO_3)	128	Temperature (F.)	47
Sulfate (SO_4)	47	Date of collection	Apr. 11, 1951
Chloride (Cl)	8.0		
Fluoride (F)	.1		
Nitrate (NO_3)	3.6		
Dissolved solids	248		

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	--	178	92	7.9	8.4	6.6	180	200	90	60	1100	40
Finished water	152	158	90	7.3	7.7	7.1	180	200	122	.37	5.5	0

CEDAR FALLS
(Population, 14,334)

Ownership: Municipal; also supplies 25 people outside the city limits. Total population supplied, 14,359.
Source: 7 wells (1 to 7) each 125 ft deep.
Treatment: None.
Storage: 750,000 gal.

ANALYSIS

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

	Wells (composite) City tap		Wells (composite) City tap
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.06	Total	244
Manganese (Mn)	.00	Noncarbonate	24
Calcium (Ca)	65		
Magnesium (Mg)	20	Color	2
Sodium (Na)	4.6	pH	7.6
Potassium (K)	1.0	Specific conductance (micromhos at 25 C.)	475
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	268	Temperature (F.)	--
Sulfate (SO_4)	21	Date of collection	May 9, 1951
Chloride (Cl)	4.5		
Fluoride (F)	.2		
Nitrate (NO_3)	8.3		
Dissolved solids	278		

Depth (feet)	125
Diameter (inches)	8-16
Date drilled	1912-49
Percent of supply	100

CEDAR RAPIDS
(Population, 72,296)

Ownership: Municipal.
Source: Cedar River.
Treatment: Softening with lime and soda ash, coagulation with alum and ferric sulfate, activated carbon, recarbonation, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 24,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 8,200,000 gal.

There is considerable variation in the composition of the raw water throughout the year.

CEDAR RAPIDS--Continued
ANALYSES
(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water	Raw water [a]
Silica (SiO_2)	12	9.7	11
Iron (Fe)	.18	.11	.07
Manganese (Mn)	.00	.00	.00
Calcium (Ca)	64	30	58
Magnesium (Mg)	17	5.9	19
Sodium (Na)	6.9	12	11
Potassium (K)	1.8	1.9	2.4
Carbonate (CO_3)	0	--	0
Bicarbonate (HCO_3)	207	[b] 44	218
Sulfate (SO_4)	44	61	37
Chloride (Cl)	9.0	12	13
Fluoride (F)	.2	.3	.2
Nitrate (NO_3)	18	13	8.1
Dissolved solids	300	182	277
Hardness as $CaCO_3$:			
Total	228	99	224
Noncarbonate	58	63	--
Color	10	1	14
pH	7.7	9.0	7.7
Specific conductance (micromhos at 25 C.)	464	278	455
Turbidity	30	0.5	--
Temperature (F.)	--	--	54
Date of collection	May 12, 1951	May 12, 1951	1944-45

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	152	--	--	8.4	--	--	192	--	--	145	--	--
Finished water	43	--	--	9.5	--	--	88	--	--	0	--	--

[a] Average of 36 analyses of 10-day composites of daily samples of Cedar River at Cedar Rapids, 1944-45 (Water Supply Paper 1030, p. 148, 1949). Extremes:- Dissolved solids, maximum 370 ppm; minimum 193 ppm. Total hardness, maximum 300 ppm; minimum 151 ppm.

[b] Includes the equivalent of less than 5 ppm of carbonate (CO_3).

CENTERVILLE
(Population, 7,625)

Ownership: Municipal.
Source: 2 impounding reservoirs. Number 2 reservoir collects water from surface run-off and supplies it to No. 1 reservoir as it is needed.
Treatment: Aeration, coagulation with alum, activated carbon, addition of lime and chlorine, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 1,200,000 gpd.
Raw-water storage: Impounding reservoirs, 400,000,000 gal.
Finished-water storage: Elevated storage, 500,000 gal.

The treatment plant is near No. 1 Reservoir and water flows to it by gravity from that reservoir.

CENTERVILLE--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	6.0	Hardness as $CaCO_3$:	
Iron (Fe)	.10	Total	192
Manganese (Mn)	.22	Noncarbonate	126
Calcium (Ca)	59		
Magnesium (Mg)	11	Color	7
Sodium (Na)	10	pH	7.5
Potassium (K)	5.7	Specific conductance (micromhos at 25 C.)	444
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	80	Temperature (F.)	46
Sulfate (SO_4)	125	Date of collection	Apr. 10, 1951
Chloride (Cl)	13		
Fluoride (F)	.1		
Nitrate (NO_3)	4.4		
Dissolved solids	340		

CHARLES CITY

(Population, 10,309)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 10,500.

Source: 4 wells (1, and 3 to 5), 1,241, 1,260, 1,315, and 287 ft deep. The yield of the wells is reported to be 500, 580, 690, and 1,500 gpm. Well 5 is a flowing well, reported as yielding from Cedar Valley limestone.

Treatment: None.

Storage: 800,000 gal.

ANALYSIS

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

	Wells 1, 3, and 4 (composite)		Wells 1, 3, and 4 (composite)
Silica (SiO_2)	8.5	Hardness as $CaCO_3$:	
Iron (Fe)	.17	Total	244
Manganese (Mn)	.00	Noncarbonate	13
Calcium (Ca)	61		
Magnesium (Mg)	22	Color	3
Sodium (Na)	13	pH	7.8
Potassium (K)	5.8	Specific conductance (micromhos at 25 C.)	515
Carbonate (CO_3)	0	Turbidity	0.4
Bicarbonate (HCO_3)	282	Temperature (F.)	--
Sulfate (SO_4)	39	Date of collection	May 9, 1951
Chloride (Cl)	2.5		
Fluoride (F)	.8		
Nitrate (NO_3)	1.7		
Dissolved solids	294		

CHEROKEE

(Population, 7,705)

Ownership: Municipal; also supplies Illinois Central Railroad Co. Total population supplied, 7,705.

Source: 3 wells (1 to 3), 209, 201, and 210 ft deep. The wells are located in the same area.

Treatment: Chlorination.

Raw-water storage: 500,000 gal.

Finished-water storage: 500,000 gal.

CHEROKEE--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	28	Hardness as $CaCO_3$:	
Iron (Fe)	.45	Total	344
Manganese (Mn)	.03	Noncarbonate	50
Calcium (Ca)	94		
Magnesium (Mg)	27	Color	4
Sodium (Na)	26	pH	7.5
Potassium (K)	5.1	Specific conductance (micromhos at 25 C.)	704
Carbonate (CO_3)	0	Turbidity	3
Bicarbonate (HCO_3)	359	Temperature (F.)	53
Sulfate (SO_4)	106	Date of collection	Feb. 21, 1951
Chloride (Cl)	1.5		
Fluoride (F)	.6		
Nitrate (NO_3)	1.9		
Dissolved solids	486		

Depth (feet)	201-210
Diameter (inches)	8-15
Date drilled	1912-47
Percent of supply	100

CLINTON

(Population, 30,379)

Ownership: Clinton Water Works Co.

Source: 5 artesian wells (3, and 5 to 8), 1,685, 1,800, 2,101, 2,101, and 2,106 ft deep. The yield of the wells is reported to be 1,000, 800, 1,250, 2,000, and 1,348 gpm. Well 8 furnishes about one-third of the supply.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: 1,250,000 gal.

ANALYSES

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

	Finished water [a]	Well 8 (finished water)		Finished water [a]	Well 8 (finished water)
Silica (SiO_2)	10	9.8	Hardness as $CaCO_3$:		
Iron (Fe)	.14	.33	Total	277	258
Manganese (Mn)	.00	.00	Noncarbonate	8	8
Calcium (Ca)	64	54			
Magnesium (Mg)	29	30	Color	1	2
Sodium (Na)	36	13	pH	8.2	7.9
Potassium (K)	8.0	7.0	Specific conductance (micromhos at 25 C.)	670	535
Carbonate (CO_3)	0	0	Turbidity	0.6	1
Bicarbonate (HCO_3)	329	306	Temperature (F.)	68	--
Sulfate (SO_4)	47	23	Date of collection	May 11, 1951	May 11, 1951
Chloride (Cl)	29	11			
Fluoride (F)	.4	.3			
Nitrate (NO_3)	.9	1.0			
Dissolved solids	388	300			

Depth (feet)	2,106
Diameter (inches)	16-12
Date drilled	1944
Percent of supply	33

[a] Composite sample from well 3 (10 percent) and well 7 (90 percent).

COUNCIL BLUFFS
(Population, 45,429)

Ownership: Municipal.
Source: Missouri River.
Treatment: Prechlorination, coagulation with alum and lime, sedimentation, ammoniation and postchlorination.
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 13,000,000 gal.

There is considerable variation in the composition of the water throughout the year. The new treatment plant, now under construction, will have provisions for softening the supply.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	13	Hardness as $CaCO_3$:	
Iron (Fe)	.06	Total	262
Manganese (Mn)	.03	Noncarbonate	88
Calcium (Ca)	69		
Magnesium (Mg)	22	Color	4
Sodium (Na)	54	pH	8.3
Potassium (K)	5.0	Specific conductance (micromhos at 25 C.)	720
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	212	Turbidity	4
Sulfate (SO_4)	180	Temperature (F.)	34
Chloride (Cl)	16	Date of collection	Feb. 27, 1951
Fluoride (F)	.5		
Nitrate (NO_3)	2.0		
Dissolved solids	484		

CRESTON
(Population, 8,317)

Ownership: Municipal; also supplies about 100 people outside the city limits. Total population supplied, about 8,400.
Source: Artificial lake (impounded surface runoff).
Treatment: Coagulation with alum, lime, carbon, ammoniation (ammonium sulfate), sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: 461,900,000 gal in lake.
Finished-water storage: Elevated tank, 1,200,000 gal.

CRESTON--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	8.2	7.3	Hardness as $CaCO_3$:		
Iron (Fe)	.08	.03	Total	96	112
Manganese (Mn)	.04	.02	Noncarbonate	13	24
Calcium (Ca)	26	32			
Magnesium (Mg)	7.6	7.8	Color	20	4
Sodium (Na)	6.0	5.3	pH	7.4	7.8
Potassium (K)	5.9	4.8	Specific conductance (micromhos at 25 C.)	225	256
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	101	108			
Sulfate (SO_4)	23	31	Turbidity	45	2
Chloride (Cl)	3.0	6.5	Temperature (F.)	42	44
Fluoride (F)	.4	.3	Date of collection	Feb. 27, 1951	Feb. 27, 1951
Nitrate (NO_3)	2.8	1.2			
Dissolved solids	160	172			

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	--	92	60	--	8.0	7.2	--	103	86	--	--	--
Finished water	--	90	50	--	8.0	7.0	--	103	86	--	--	--

DAVENPORT
(Population, 74,549)

Ownership: Davenport Water Co.; also supplies about 500 people outside the city limits, and the city of Bettendorf. Total population supplied, about 80,200.
Source: Mississippi River.
Treatment: Coagulation with alum, sedimentation, carbon if necessary, lime for pH adjustment, rapid sand filtration, chlorination, and fluoridation (approved 1952).
Rated capacity of treatment plant: 14,000,000 gpd.
Raw-water storage: 5,000,000 gal.
Finished-water storage: 5,000,000 gal.

The water from the river flows by gravity into a raw-water well from which it is pumped at the beginning of the treatment process.

DAVENPORT--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	7.9	Hardness as $CaCO_3$:	
Iron (Fe)	.07	Total	128
Manganese (Mn)	.00	Noncarbonate	61
Calcium (Ca)	36		
Magnesium (Mg)	9.3	Color	5
Sodium (Na)	3.4	pH	7.2
Potassium (K)	2.2	Specific conductance (micromhos at 25 C.)	291
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	82	Temperature (F.)	55
Sulfate (SO_4)	56	Date of collection	May 11, 1951
Chloride (Cl)	5.0		
Fluoride (F)	.1		
Nitrate (NO_3)	5.4		
Dissolved solids	196		

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	125	139	108	7.6	8.1	7.2	140	162	112	130	570	35
Finished water	107	123	94	7.0	7.1	6.9	144	162	127	.20	.83	.11

DES MOINES
(Population, 177,965)

Ownership: Municipal; also supplies a population of about 17,600 in other communities outside the city limits. Total population supplied, about 195,000.

Source: Infiltration gallery along the Raccoon River, 50 to 75 percent of supply; Raccoon River impounded, 25 to 50 percent of the supply.

Treatment: Softening with lime and soda ash, coagulation with alum, recarbonation, rapid sand filtration and addition of polyphosphate for stabilization, and chlorination.

Rated capacity of treatment plant: 48,000,000 gpd.

Raw-water storage: Impounding reservoir, 1,570,000,000 gal.

Finished-water storage: Clear wells, 10,000,000 gal; tower, 2,000,000 gal.

The infiltration gallery is constructed of reinforced concrete rings 2 ft long and 4 and 5 ft inside diameter, placed in the sand and gravel 15 to 31 ft deep in one continuous line parallel with the river and from 150 to 300 ft back from the main channel. It is constructed to permit the entrance of water from the surrounding sand and gravel through openings between each ring, and serves the double purpose of collecting the water and carrying it by gravity to the pumping station. At the present time the gallery is approximately 3 miles long.

The impounding reservoir is located southwest of Commerce in the Raccoon River valley. Water from this source is used during drought periods or in emergencies.

DES MOINES--Continued

ANALYSES

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

	Raw water [a]	Finished water [a]		Raw water [a]	Finished water [a]
Silica (SiO_2)	16	11	Hardness as $CaCO_3$:		
Iron (Fe)	.10	.03	Total	342	78
Manganese (Mn)	.03	.02	Noncarbonate	71	31
Calcium (Ca)	88	12			
Magnesium (Mg)	30	12	Color	5	3
Sodium (Na)	16	38	pH	7.6	9.8
Potassium (K)	3.1	3.6	Specific conductance (micromhos at 25 C.)	677	341
Carbonate (CO_3)	0	26			
Bicarbonate (HCO_3)	330	4.0	Turbidity	2	0.4
Sulfate (SO_4)	87	90	Temperature (F.)	48	52
Chloride (Cl)	14	14	Date of collection	Feb. 26, 1951	Feb. 26, 1951
Fluoride (F)	.3	.2			
Nitrate (NO_3)	1.4	1.4			
Dissolved solids	432	212			

Regular determinations at treatment plant

	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	229	275	206	7.5	7.8	7.4	290	365	202	21	1000	0.30
Finished water	39	49	29	10.1	10.3	9.8	83	114	44	.18	.61	0

[a] Infiltration gallery.

DUBUQUE
(Population, 49,671)

Ownership: Municipal.
Source: 8 wells (1 to 8), 1,300, 1,300, 1,460, 1,460, 1,500, 1,504, 1,563, and 1,781 ft deep for regular supply; mine tunnel (known as the "Levels" Spring), auxiliary supply. The yield of the wells is reported to be 2,800 (wells 1 to 4, pumped as a unit), 900, 2,000, 2,400, and 2,430 gpm.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plant: 10,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoirs, elevated tanks, and standpipe, 12,000,000 gal.

DUBUQUE--Continued

ANALYSIS

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

	Wells (finished water)		Wells (finished water)
Silica (SiO_2)	12	Hardness as $CaCO_3$:	
Iron (Fe)	.24	Total	282
Manganese (Mn)	.00	Noncarbonate	18
Calcium (Ca)	57		
Magnesium (Mg)	34	Color	3
Sodium (Na)	3.4	pH	7.8
Potassium (K)	2.6	Specific conductance (micromhos at 25 C.)	525
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	322	Temperature (F.)	--
Sulfate (SO_4)	18	Date of collection	May 10, 1951
Chloride (Cl)	5.5		
Fluoride (F)	.2		
Nitrate (NO_3)	.4		
Dissolved solids	296		

Depth (feet)	1,300-1,781
Diameter (inches)	6-15
Date drilled	1899-1946
Percent of supply	100

ESTHERVILLE

(Population, 6,719)

Ownership: Municipal.

Source: 5 wells (1 to 5) 35, 25, 400, 395, and 395 ft deep; yield reported to be 500 (not reported for well 2), 2,045, 1,115, and 1,115 gpm, respectively.

Treatment: None.

Storage: Elevated tank and standpipe, 800,000 gal.

ANALYSIS

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

	Wells 3, 4, 5 (composite)		Wells 3, 4, 5 (composite)
Silica (SiO_2)	19	Hardness as $CaCO_3$:	
Iron (Fe)	1.7	Total	632
Manganese (Mn)	.00	Noncarbonate	360
Calcium (Ca)	156		
Magnesium (Mg)	59	Color	4
Sodium (Na)	63	pH	7.8
Potassium (K)	4.8	Specific conductance (micromhos at 25 C.)	1,370
Carbonate (CO_3)	0	Turbidity	20
Bicarbonate (HCO_3)	332	Temperature (F.)	54
Sulfate (SO_4)	483	Date of collection	May 31, 1951
Chloride (Cl)	3.5		
Fluoride (F)	.4		
Nitrate (NO_3)	5.6		
Dissolved solids	1,010		

FAIRFIELD

(Population, 7,299)

Ownership: Municipal.

Source: Reservoir (impounded runoff from the surrounding terrain) for regular supply; 3 wells for emergency use only.

Treatment: Prechlorination, coagulation with alum and lime, activated carbon (Nuchar) postchlorination, and rapid sand filtration.

Rated capacity of treatment plant: 900,000 gpd.

Raw-water storage: Reservoir.

Finished-water storage: 650,000 gal.

FAIRFIELD--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	2.6	Hardness as $CaCO_3$:	
Iron (Fe)	.07	Total	143
Manganese (Mn)	.00	Noncarbonate	79
Calcium (Ca)	43		
Magnesium (Mg)	8.7	Color	3
Sodium (Na)	3.6	pH	7.5
Potassium (K)	4.3	Specific conductance (micromhos at 25 C.)	316
Carbonate (CO_3)	0	Turbidity	0.8
Bicarbonate (HCO_3)	78	Temperature (F.)	48
Sulfate (SO_4)	75	Date of collection	Apr. 10, 1951
Chloride (Cl)	11		
Fluoride (F)	.1		
Nitrate (NO_3)	1.1		
Dissolved solids	236		

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	83	120	63	7.3	--	--	--	--	--	--	90	5
Finished water	--	--	--	7.8	7.8	7.5	--	--	--	--	.7	.1

FORT DODGE
(Population, 25,115)

Ownership: Municipal; also supplies about 3,500 people outside the city limits. Total population supplied, about 28,600.

Source: 5 artesian wells (8, 9, 12, 14, and 15), 1,040, 553, 507, 973, and 2,307 ft deep. The yield of the wells is reported to be 1,000, 1,500, 1,500, 2,800, and 2,800 gpm. The greater part of the supply is furnished by well 15.

Treatment: Aeration, chlorination, sedimentation, and rapid sand filtration.

Rated capacity of treatment plant: 9,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 2,000,000 gal.

FORT DODGE--Continued

ANALYSES

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

	Well 15 (raw water)[a]	Wells[b] 8, 9, 12, and 14		Well 15 (raw water)[a]	Wells[b] 8, 9, 12, and 14
Silica (SiO_2)	29	14	Hardness as $CaCO_3$:		
Iron (Fe)	.4	.16	Total	432	466
Manganese (Mn)	--	.03	Noncarbonate	172	99
Calcium (Ca)	104	115			
Magnesium (Mg)	42	44	Color	--	4
Sodium (Na)	175	60	pH	7.1	7.6
Potassium (K)		6.6	Specific conductance (micromhos at 25 C.)	--	1,050
Carbonate (CO_3)	0	0	Turbidity	--	2
Bicarbonate (HCO_3)	318	448	Temperature (F.)	--	52
Sulfate (SO_4)	223	170	Date of collection	Dec. 31, 1948	Feb. 23, 1951
Chloride (Cl)	227	40			
Fluoride (F)	.2	.7			
Nitrate (NO_3)	--	3.1			
Dissolved solids	1,073	692			

Depth (feet)	2,307
Diameter (inches)	12
Date drilled	1948
Percent of supply	--

[a] Analysis by Sanitary and Hydraulic Engineer, Ames, Iowa.
[b] Finished water.

FORT MADISON
(Population, 14,954)

Ownership: Municipal.
Source: Mississippi River.
Treatment: Coagulation with alum and lime, activated carbon, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 650,000 gal.
Finished-water storage: 130,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	9.2	Hardness as $CaCO_3$:	
Iron (Fe)	.18	Total	135
Manganese (Mn)	.00	Noncarbonate	83
Calcium (Ca)	38		
Magnesium (Mg)	9.8	Color	4
Sodium (Na)	4.0	pH	7.0
Potassium (K)	3.0	Specific conductance (micromhos at 25 C.)	304
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	64	Temperature (F.)	49
Sulfate (SO_4)	68	Date of collection	Apr. 11, 1951
Chloride (Cl)	13		
Fluoride (F)	.1		
Nitrate (NO_3)	7.9		
Dissolved solids	228		

FORT MADISON--Continued

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.....	100	150	90	7.4	7.8	7.0	100	150	--	200	3000	--
Finished water...	110	140	100	7.0	7.2	7.0	120	164	--	.5	.5	0.5

GRINNELL

(Population, 6,828)

Ownership: Municipal; also supplies a few people outside the city limits. Total population supplied, about 6,860.

Source: 2 wells (5 and 6) 2,260 and 2,498 ft deep. The yield of the wells is reported to be 520 and 800 gpm, respectively.

Treatment: Aeration (proposed), zeolite softening, adjustment of pH and chlorination.

Rated capacity of treatment plant: 800,000 gpd.

Raw-water storage: 1,000,000 gal.

Finished-water storage: 300,000 gal.

ANALYSES

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

	Well 5 (raw water)	Well 5 (finished water)		Well 5 (raw water)	Well 5 (finished water)
Silica (SiO_2)	12	15	**Hardness as $CaCO_3$:**		
Iron (Fe)	.58	.13	Total	399	103
Manganese (Mn)	.00	.00	Noncarbonate.....	112	0
Calcium (Ca)	89	25			
Magnesium (Mg).....	43	9.8	Color.....	2	2
Sodium (Na)	126	278	pH.....	7.5	8.3
Potassium (K)	16	8.2	Specific conductance (micromhos at 25 C.).....	1,230	1,400
Carbonate (CO_3)	0	6			
Bicarbonate (HCO_3)	351	362	Turbidity.....	1	1
Sulfate (SO_4)	345	343	Temperature (F.)...	--	50
Chloride (Cl)	23	34	Date of collection...	May 14, 1951	May 14, 1951
Fluoride (F)	1.2	1.2			
Nitrate (NO_3)	5.6	4.6			
Dissolved solids.....	834	914			

Depth (feet)	2,260	--
Diameter (inches).....	6	--
Date drilled	1920	--
Percent of supply	--	--

IOWA CITY

(Population, 27,212)

Ownership: Iowa Water Service Co.; also supplies University Heights and Coralville. Total population supplied, about 28,600.

Source: Iowa River.

Treatment: Aeration (spray), prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 2,000,000 gpd.

Raw-water storage: 500,000 gal.

Finished-water storage: 1,700,000 gal.

The composition of the raw water varies considerably throughout the year. Extremes for the year (Oct. 1, 1944 to Sept. 30, 1945, 36 analyses of 10-day composites), dissolved solids, 400-203 ppm; total hardness, 345-156 ppm (Geological Survey W. S. P. 1030, page 142, 1949).

IOWA CITY--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	11	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	238
Manganese (Mn)	.00	Noncarbonate	114
Calcium (Ca)	68		
Magnesium (Mg)	17	Color	5
Sodium (Na)	4.6	pH	7.2
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.)	491
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	151	Temperature (F.)	--
Sulfate (SO_4)	90	Date of collection	May 12, 1951
Chloride (Cl)	11		
Fluoride (F)	.1		
Nitrate (NO_3)	17		
Dissolved solids	332		

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	--	--	--	--	--	--	--	--	--	350	3200	3
Finished water	--	--	--	7.6	8.0	7.2	240	340	120	--	--	--

KEOKUK

(Population, 16,144)

Ownership: Municipal.

Source: Mississippi River.

Treatment: Prechlorination, coagulation with alum, softening with lime, sedimentation, activated carbon, ammoniation (ammonium sulfate), recarbonation, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 3,000,000 gpd.

Raw-water storage: None.

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

The composition of the raw water varies considerably throughout the year.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	8.4	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	170
Manganese (Mn)	.00	Noncarbonate	77
Calcium (Ca)	55		
Magnesium (Mg)	7.9	Color	3
Sodium (Na)	3.6	pH	7.8
Potassium (K)	3.0	Specific conductance (micromhos at 25 C.)	362
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	114	Temperature (F.)	--
Sulfate (SO_4)	64	Date of collection	Apr. 11, 1951
Chloride (Cl)	9.0		
Fluoride (F)	.0		
Nitrate (NO_3)	7.4		
Dissolved solids	246		

KEOKUK--Continued

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.....	160	198	40	7.7	8.6	6.8	198	230	62	80	1200	5
Finished water...	72	122	32	8.8	9.3	8.0	100	170	68	0	2	0

KNOXVILLE
(Population, 7,625)

Ownership: Municipal; also supplies 50 people outside the city limits. Total population supplied, 7,675.
Source: 5 wells (1, 2, 3, 5, and 6) 47, 46, 46, 52, and 47 ft deep. The yield of the wells is reported to be 390, 390, 500, 550, and 550 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 2,000,000 gal.

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	16	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	268
Manganese (Mn)	.00	Noncarbonate	58
Calcium (Ca)	74		
Magnesium (Mg)	20	Color	3
Sodium (Na)	7.4	pH	7.7
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.).....	530
Carbonate (CO_3)	0	Turbidity	0.7
Bicarbonate (HCO_3)	257	Temperature (F.).....	--
Sulfate (SO_4)	54	Date of collection	May 14, 1951
Chloride (Cl)	9.0		
Fluoride (F)	.2		
Nitrate (NO_3)	4.9		
Dissolved solids	340		

MARSHALLTOWN
(Population, 19,821)

Ownership: Municipal; also supplies Soldiers Home and about 150 people outside the city limits. Total population supplied, about 20,500.
Source: 4 wells, 50, 100, 170, and 225 ft deep for regular supply. Iowa River, auxiliary supply. The yield of the wells is reported to be 350, 2,000, 700, and 700 gpm, respectively.
Treatment: Aeration, softening with lime, recarbonation, sedimentation, and rapid sand filtration.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,500,000 gal.

MARSHALLTOWN--Continued

ANALYSES

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

	Wells (raw water)	Wells (finished water)		Wells (raw water)	Wells (finished water)
Silica (SiO_2)	16	9.1	Hardness as $CaCO_3$:		
Iron (Fe)	2.7	.08	Total	308	112
Manganese (Mn)	.46	.02	Noncarbonate	70	72
Calcium (Ca)	81	23			
Magnesium (Mg)	26	13	Color	5	4
Sodium (Na)	21	21	pH	7.7	7.5
Potassium (K)	2.3	2.3	Specific conductance (micromhos at 25 C.)	643	337
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	291	49			
Sulfate (SO_4)	105	105	Turbidity	15	0.5
Chloride (Cl)	5.0	5.5	Temperature (F.)	46	47
Fluoride (F)	.4	.3	Date of collection	Feb. 24, 1951	Feb. 24, 1951
Nitrate (NO_3)	1.8	3.5			
Dissolved solids	416	220			

MASON CITY

(Population, 27,980)

Ownership: Municipal.

Source: 6 wells (7 to 12), 1,230, 1,219, 1,200, 1,243, 1,306, and 1,585 ft deep. The yield of wells 7, 8, 9, and 10 is reported to be 1,000 gpm, each, and of wells 11 and 12, 1,200 gpm, each.

Treatment: None.

Storage: 6,000,000 gal.

ANALYSIS

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

	Wells (composite)		Wells (composite)
Silica (SiO_2)	8.3	Hardness as $CaCO_3$:	
Iron (Fe)	.19	Total	330
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	79		
Magnesium (Mg)	32	Color	1
Sodium (Na)	40	pH	7.5
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.)	760
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	407		
Sulfate (SO_4)	66	Turbidity	0.8
Chloride (Cl)	7.5	Temperature (F.)	50
Fluoride (F)	.6	Date of collection	May 9, 1951
Nitrate (NO_3)	2.2		
Dissolved solids	444		

MUSCATINE

(Population, 19,041)

Ownership: Municipal; also supplies about 600 people outside the city limits. Total population supplied, about 20,600.

Source: 12 wells, each 50 ft deep. Five 8-in. wells, and five 12-in. wells are pumped into a single suction line. The two 20-in. wells (1 and 2) are pumped separately. The yields are reported to be (not reported for the 8-in. wells) 900 gpm, each, for the 12-in. wells, and 1,100 gpm, each, for wells 1 and 2.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: 3,500,000 gal.

MUSCATINE--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	16	Hardness as $CaCO_3$:	
Iron (Fe)	.14	Total	162
Manganese (Mn)	.00	Noncarbonate	31
Calcium (Ca)	42		
Magnesium (Mg)	14	Color	1
Sodium (Na)	4.4	pH	8.0
Potassium (K)	.6	Specific conductance (micromhos at 25 C.)	334
Carbonate (CO_3)	0	Turbidity	0.7
Bicarbonate (HCO_3)	160	Temperature (F.)	--
Sulfate (SO_4)	20	Date of collection	May 11, 1951
Chloride (Cl)	7.0		
Fluoride (F)	.1		
Nitrate (NO_3)	11		
Dissolved solids	204		

NEWTON

(Population, 11,723)

Ownership: Municipal; also supplies about 1,500 people outside the city limits. Total population supplied, about 13,200.

Source: 11 wells 51 to 65 ft deep. The yield for most of the wells is reported to be 300 gpm.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: Reservoir, 3,200,000 gal; elevated tank, 600,000 gal.

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	22	Hardness as $CaCO_3$:	
Iron (Fe)	.68	Total	337
Manganese (Mn)	.31	Noncarbonate	96
Calcium (Ca)	86		
Magnesium (Mg)	30	Color	3
Sodium (Na)	7.7	pH	7.5
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.)	622
Carbonate (CO_3)	0	Turbidity	3
Bicarbonate (HCO_3)	294	Temperature (F.)	53
Sulfate (SO_4)	95	Date of collection	Feb. 26, 1951
Chloride (Cl)	5.5		
Fluoride (F)	.1		
Nitrate (NO_3)	1.3		
Dissolved solids	414		

OELWEIN

(Population, 7,858)

Ownership: Municipal.

Source: 2 wells (35 and 42), 119 and 1,328 ft deep. A third well (31), 122 ft deep, is to be put into service soon (1951). The yield of the wells is reported to be 520 and 750 gpm.

Treatment: None.

Storage: 780,000 gal.

OELWEIN--Continued

ANALYSIS

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

	Wells 35 and 42		Wells 35 and 42
Silica (SiO_2)	8.0	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	234
Manganese (Mn)	.00	Noncarbonate	3
Calcium (Ca)	44		
Magnesium (Mg)	30	Color	1
Sodium (Na)	20	pH	7.7
Potassium (K)	7.8	Specific conductance (micromhos at 25 C.)	526
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	282	Turbidity	0.6
Sulfate (SO_4)	45	Temperature (F.)	--
Chloride (Cl)	2.5	Date of collection	May 10, 1951
Fluoride (F)	.9		
Nitrate (NO_3)	2.9		
Dissolved solids	302		

OSKALOOSA
(Population, 11,124)

Ownership: Municipal; also supplies about 275 people outside the city limits. Total population supplied, about 11,400.

Source: Skunk River, 70 percent of supply; 4 wells (11 to 14) 52, 54, 44, and 44 ft deep, 30 percent of supply. The yield of the wells is reported to be 900, 975, 900, and 1,000 gpm.

Treatment: Softening with lime and soda ash, coagulation with alum, recarbonation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 3,000,000 gpd.

Raw-water storage: 7,000,000 gal.

Finished-water storage: 750,000 gal.

At the time of the collection of the sample for analysis in May 1951, the wells were furnishing the entire supply because of a special condition of the Skunk River which required a long detention period for clarification. There is a possibility that the river may be discontinued as a source of supply, although this was the principal source in 1950.

OSKALOOSA--Continued

ANALYSES

(Analyses, in parts per million, by State Hygienic Laboratory, Iowa City)

	Well 11	Well 12	Well 14	Wells [a]	Wells [b]
Silica (SiO_2)	--	--	--	--	12
Iron (Fe)	0.4	7.5	5.0	0.1	.08
Manganese (Mn)	.6	3.2	2.2	.0	.00
Calcium (Ca)	68	82	92	24	25
Magnesium (Mg)	21	24	26	4.9	5.5
Sodium (Na)	12	14	13	22	17
Potassium (K)					1.3
Carbonate (CO_3)	0	--	0	5	0
Bicarbonate (HCO_3)	251	303	361	46	58
Sulfate (SO_4)	57	71	59	66	59
Chloride (Cl)	10	6	6.0	7	8.0
Fluoride (F)	.3	.1	.2	.1	.2
Nitrate (NO_3)	2.1	1.8	1.8	3.5	2.9
Dissolved solids	325	372	411	167	166
Hardness as $CaCO_3$:					
Total	258	326	349	80	85
Noncarbonate	50	54	44	34	37
Color	--	--	--	--	2
pH	7.4	7.2	7.2	8.6	8.3
Specific conductance (micromhos at 25 C.)	492	562	621	241	264
Turbidity	--	--	--	--	0.5
Temperature (F.)	58	52	--	--	--
Date of collection	Dec. 5, 1950	Dec. 5, 1950	Dec. 16, 1950	Dec. 5, 1950	May 14, 1951
Depth (feet)	52	54	44		
Diameter (inches)	26	26	26		
Date drilled	1945	1947	1949		
Percent of supply	--	--	--		

[a] Finished water, composite.
[b] Finished water, composite. Analyzed by Geological Survey.

OTTUMWA
(Population, 33,631)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 34,100.
Source: Des Moines River.
Treatment: Aeration, softening with lime and soda ash, coagulation with alum or iron sulfate, activated carbon, recarbonation, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 11,000,000 gal.

There is considerable variation in the composition of the raw water throughout the year.

OTTUMWA--Continued

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	12	7.1	Hardness as $CaCO_3$:		
Iron (Fe)	.29	.12	Total	131	80
Manganese (Mn)	.13	.00	Noncarbonate	32	50
Calcium (Ca)	38	30			
Magnesium (Mg)	8.8	1.3	Color	40	2
Sodium (Na)	1.6	11	pH	7.4	7.8
Potassium (K)	3.3	3.2	Specific conductance (micromhos at 25 C.)	271	233
Carbonate (CO_3)	0	0	Turbidity	310	0.9
Bicarbonate (HCO_3)	119	36	Temperature (F.)	--	--
Sulfate (SO_4)	30	63	Date of collection	Apr. 10, 1951	Apr. 10, 1951
Chloride (Cl)	2.0	4.5			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	11	7.9			
Dissolved solids	186	162			

Regular determinations at treatment plant, 1949

	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	161	270	85	7.8	8.5	7.0	224	338	156	416	8000	20
Finished water	36	80	16	8.0	9.2	7.2	86	122	70	.20	1.5	0

SHENANDOAH
(Population, 6,938)

Ownership: Municipal; also supplies about 400 people outside the city limits. Total population supplied, about 7,300.

Source: 13 wells (3 to 15) ranging from 33 to 70 ft deep. The yield of the wells is reported to range from 125 to 250 gpm and to average 179 gal.

Treatment: Aeration, softening with lime and soda ash, coagulation, sedimentation, recarbonation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 1,500,000 gpd.

Raw-water storage: None.

Finished-water storage: Water tower, 400,000 gal; reservoir, 450,000 gal.

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

	6 Wells (composite)			6 Wells (composite)	
	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	20	20	Hardness as $CaCO_3$:		
Iron (Fe)	1.2	.08	Total	400	176
Manganese (Mn)	.46	.00	Noncarbonate	166	128
Calcium (Ca)	106	25			
Magnesium (Mg)	33	28	Color	4	3
Sodium (Na)	15	31	pH	7.2	9.1
Potassium (K)	2.1	1.9	Specific conductance (micromhos at 25 C.)	778	500
Carbonate (CO_3)	0	12	Turbidity	1	0.4
Bicarbonate (HCO_3)	286	34	Temperature (F.)	--	56
Sulfate (SO_4)	167	157	Date of collection	Apr. 9, 1951	Apr. 9, 1951
Chloride (Cl)	22	23			
Fluoride (F)	.3	.2			
Nitrate (NO_3)	1.1	1.1			
Dissolved solids	608	366			

SIOUX CITY
(Population, 83,991)

Ownership: Municipal; also supplies Morningside, Leeds, and Riverside. Total population supplied, about 91,000.
Source: 12 wells (2 to 7, 11, 14, and 16 to 19), 288 to 377 ft deep. The yield of the wells is reported to range from 1,110 to 1,750 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 24,000,000 gal.

ANALYSIS

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

	Finished water [a]		Finished water [a]
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	.40	Total	472
Manganese (Mn)	.12	Noncarbonate	141
Calcium (Ca)	125		
Magnesium (Mg)	39	Color	2
Sodium (Na)	37	pH	7.5
Potassium (K)	8.4	Specific conductance (micromhos at 25 C.)	982
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	404	Turbidity	1
Sulfate (SO_4)	183	Temperature (F.)	54
Chloride (Cl)	26	Date of collection	June 15, 1951
Fluoride (F)	.1		
Nitrate (NO_3)	1.2		
Dissolved solids	672		

Depth (feet)	323-374
Diameter (inches)	16-20
Date drilled	1940-48
Percent of supply	--

[a] Composite sample, wells 14, 17, 18, and 19, Main Street pumping station.

SPENCER
(Population, 7,446)

Ownership: Municipal.
Source: 4 wells (5 to 8) 46, 37, 34, and 31 ft deep.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 80,000 gal.

Iron content of the water is reported to average 3.5 ppm. It is proposed to aerate the supply for the removal of the iron.

SPENCER--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	1.7	Total	580
Manganese (Mn)	.34	Noncarbonate	328
Calcium (Ca)	176		
Magnesium (Mg)	34	Color	3
Sodium (Na)	10	pH	7.8
Potassium (K)	2.6	Specific conductance (micromhos at 25 C.)	1,090
Carbonate (CO_3)	0	Turbidity	12
Bicarbonate (HCO_3)	308	Temperature (F.)	--
Sulfate (SO_4)	330	Date of collection	May 31, 1951
Chloride (Cl)	14		
Fluoride (F)	.1		
Nitrate (NO_3)	1.0		
Dissolved solids	828		

Depth (feet)	31-46
Diameter (feet)	30
Date constructed	1948-50
Percent of supply	100

STORM LAKE
(Population, 6,954)

Ownership: Municipal; supplies also a few consumers outside the city limits. Total population supplied, about 6,970.
Source: 3 wells (1 to 3) 110, 115, and 210 ft deep. The yield of each well is reported to be 694 gpm. Storm Lake is used for auxiliary supply.
Treatment: Aeration, softening with lime, coagulation with alum, sedimentation, recarbonation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Clear well, 211,620 gal; standpipe, 290,000 gal.

STORM LAKE--Continued

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	32	29	Hardness as $CaCO_3$:		
Iron (Fe)	3.1	.13	Total	470	340
Manganese (Mn)	.06	.02	Noncarbonate	135	142
Calcium (Ca)	123	67			
Magnesium (Mg)	40	42	Color	5	4
Sodium (Na)	26	25	pH	7.4	7.7
Potassium (K)	4.4	4.9	Specific conductance (micromhos at 25 C.)	922	725
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	409	242	Turbidity	25	0.6
Sulfate (SO_4)	169	166	Temperature (F.)	54	55
Chloride (Cl)	14	15	Date of collection	Feb. 21, 1951	Feb. 21, 1951
Fluoride (F)	.3	.3			
Nitrate (NO_3)	3.7	.2			
Dissolved solids	638	500			

Depth (feet)	110-210
Diameter (inches)	72
Date drilled	1934-48
Percent of supply	100

WATERLOO
(Population, 65,198)

Ownership: Municipal.
Source: 7 wells (7 to 13), 84, 82, 87, 81, 82, 87, and 81 ft deep. The yield of each well is reported to be 2,000 gpm.
Treatment: Chlorination and ammoniation.
Raw-water storage: None.
Finished-water storage: 9,000,000 gal.

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	16	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	241
Manganese (Mn)	.00	Noncarbonate	48
Calcium (Ca)	67		
Magnesium (Mg)	18	Color	2
Sodium (Na)	6.6	pH	7.9
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	477
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	236	Turbidity	0.6
Sulfate (SO_4)	35	Temperature (F.)	--
Chloride (Cl)	10	Date of collection	May 9, 1951
Fluoride (F)	.2		
Nitrate (NO_3)	13		
Dissolved solids	294		

Depth (feet)	81-87
Diameter (inches)	16-24
Date drilled	1931-48
Percent of supply	100

WEBSTER CITY
(Population, 7,611)

Ownership: Municipal.
Source: 4 wells (1 to 4) 1,900, 110, 80, and 75 ft deep. The yield of the wells is reported to be 1,000, 700, 300, and 500 gpm.
Treatment: Softening with lime and soda ash, coagulation with alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,440,000 gpd.
Raw-water storage: None.
Finished-water storage: Clear well, 450,000 gal; elevated tank, 250,000 gal.

ANALYSES

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

	Raw water[a]	Finished water[a]		Raw water[a]	Finished water[a]
Silica (SiO_2)	19	6.6	Hardness as $CaCO_3$:		
Iron (Fe)	1.7	.14	Total	427	64
Manganese (Mn)	.35	.01	Noncarbonate	52	27
Calcium (Ca)	91	13			
Magnesium (Mg)	49	7.7	Color	4	3
Sodium (Na)	28	78	pH	7.6	9.8
Potassium (K)	5.2	7.3	Specific conductance (micromhos at 25 C.)	846	528
Carbonate (CO_3)	0	20			
Bicarbonate (HCO_3)	458	5.0	Turbidity	5	0.3
Sulfate (SO_4)	99	170	Temperature (F.)	50	50
Chloride (Cl)	10	20	Date of collection	Feb. 23, 1951	Feb. 23, 1951
Fluoride (F)	1.4	.7			
Nitrate (NO_3)	.3	.4			
Dissolved solids	530	328			

Depth (feet)	75-1,900
Diameter (inches)	12-18
Date drilled	1927-39
Percent of supply	100

[a] Composite.

ARKANSAS CITY
(Population, 12,903)

Ownership: Municipal.
Source: 8 wells.
Treatment: Chlorination (as the water leaves the storage reservoir).
Storage: 2,000,000 gal.

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	342
Manganese (Mn)	--	Noncarbonate	130
Calcium (Ca)	106		
Magnesium (Mg)	19	Color	5
Sodium (Na)	107	pH	7.5
Potassium (K)	2.8	Specific conductance (micromhos at 25 C.)	1,110
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	260	Temperature (F.)	--
Sulfate (SO_4)	119	Date of collection	May 25, 195-
Chloride (Cl)	162		
Fluoride (F)	.3		
Nitrate (NO_3)	5.0		
Dissolved solids	706		

ATCHISON
(Population, 12,792)

Ownership: Atchison City Water Works, Inc. (nonprofit company); also supplies about 1,500 people outside the city limits. Total population supplied, about 14,300.
Source: Missouri River.
Treatment: Plain sedimentation in two basins of 2,000,000 gal capacity, each, coagulation with lime and alum, sedimentation, break point chlorination, and rapid sand filtration.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 7,500,000 gal.
Finished-water storage: 1,500,000 gal.

The composition of the raw water varies throughout the year.

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

	Finished water		Finished water
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	286
Manganese (Mn)	.00	Noncarbonate	94
Calcium (Ca)	82		
Magnesium (Mg)	20	Color	2
Sodium (Na)	59	pH	8.0
Potassium (K)	5.6	Specific conductance (micromhos at 25 C.)	779
Carbonate (CO_3)	0	Turbidity	0.3
Bicarbonate (HCO_3)	234	Temperature (F.)	35
Sulfate (SO_4)	181	Date of collection	Mar. 23, 1951
Chloride (Cl)	27		
Fluoride (F)	.4		
Nitrate (NO_3)	2.7		
Dissolved solids	538		

ATCHISON--Continued

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.....	160	280	88	7.9	8.4	7.1	210	360	120	1500	2000	10
Finished water...	150	240	80	7.9	8.6	7.2	220	380	120	.1	.2	.05

CHANUTE
(Population, 10,109)

Ownership: Municipal.
Source: Neosho River.
Treatment: Coagulation with alum, softening with lime and soda ash, chlorination, activated carbon at times, copper sulfate at times, sedimentation, recarbonation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: --
Finished-water storage: 900,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	7.9	8.1	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.22	Total	183	81
Manganese (Mn)	--	--	Noncarbonate.....	69	13
Calcium (Ca)	57	26			
Magnesium (Mg).....	10	3.9	Color.....	5	--
Sodium (Na)	10	24	pH	6.7	7.9
Potassium (K)	2.8	2.8	Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.).....	407	282
Bicarbonate (HCO_3)	140	83	Turbidity	--	--
Sulfate (SO_4)	78	53	Temperature (F.)...	75	75
Chloride (Cl)	11	11	Date of collection...	May 31, 1951	May 31, 1951
Fluoride (F)	.1	.2			
Nitrate (NO_3)	2.5	2.4			
Dissolved solids.....	281	182			

COFFEYVILLE
(Population, 17,113)

Ownership: Municipal.
Source: Verdigris River.
Treatment: Coagulation with alum, softening with lime and soda ash, activated carbon at times, sedimentation, recarbonation, coagulation with alum, secondary sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: --
Finished-water storage: 6,000,000 gal.

COFFEYVILLE--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.0	7.9	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.00	Total	176	82
Manganese (Mn)	--	--	Noncarbonate	32	58
Calcium (Ca)	54	30			
Magnesium (Mg)	10	1.7	Color	50	5
Sodium (Na)	28	28	pH	7.9	9.4
Potassium (K)	2.2	2.1	Specific conductance (micromhos at 25 C.)	480	327
Carbonate (CO_3)	0	8			
Bicarbonate (HCO_3)	176	13	Turbidity	--	--
Sulfate (SO_4)	26	39	Temperature (F.)	74	57
Chloride (Cl)	51	57	Date of collection	May 31, 1951	May 31, 1951
Fluoride (F)	--	.1			
Nitrate (NO_3)	2.2	1.4			
Dissolved solids	297	215			

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	58	--	--	9.0	--	--	114	--	--	1	--	--

DODGE CITY

(Population, 11,262)

Ownership: Municipal.

Source: 6 wells. The yield of the wells is reported to range from 500 to 1,200 gpm. The water is pumped from the wells directly into the distribution system.

Treatment: None.

Storage: 1,000,000 gal.

ANALYSIS

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

	Wells (city tap)		Wells (city tap)
Silica (SiO_2)	29	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	248
Manganese (Mn)	--	Noncarbonate	56
Calcium (Ca)	63		
Magnesium (Mg)	22	Color	5
Sodium (Na)	17	pH	7.6
Potassium (K)	3.6	Specific conductance (micromhos at 25 C.)	528
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	234	Turbidity	--
Sulfate (SO_4)	54	Temperature (F.)	--
Chloride (Cl)	15	Date of collection	May 23, 1951
Fluoride (F)	1.6		
Nitrate (NO_3)	13		
Dissolved solids	368		

EL DORADO
(Population, 11,037)

Ownership: Municipal.
Source: Satchel Creek impounded in Lake El Dorado, 4.7 miles from the Courthouse in the city. Walnut River, emergency supply.
Treatment: Coagulation with alum and lime, sedimentation, activated carbon at times, rapid sand filtration, and chlorination. Copper sulfate is used for control of algae, when necessary.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: 1,000,000,000 gal.
Finished-water storage: 1,000,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	9.2	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	121
Manganese (Mn)	--	Noncarbonate	52
Calcium (Ca)	43		
Magnesium (Mg)	3.4	Color	10
Sodium (Na)	5.0	pH	7.8
Potassium (K)	2.8	Specific conductance (micromhos at 25 C.)	268
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	85	Turbidity	--
Sulfate (SO_4)	50	Temperature (F.)	--
Chloride (Cl)	7.8	Date of collection	May 24, 1951
Fluoride (F)	.0		
Nitrate (NO_3)	1.4		
Dissolved solids	179		

EMPORIA
(Population, 15,669)

Ownership: Municipal.
Source: Neosho River (impounded). Emergency supply, Kaholo Lake.
Treatment: Coagulation with alum and lime, carbon at times, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: (Not reported.)
Finished-water storage: 3,000,000 gal.

EMPORIA--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	10	10	Hardness as $CaCO_3$:		
Iron (Fe)	1.8	.01	Total	115	107
Manganese (Mn)	--	--	Noncarbonate	6	39
Calcium (Ca)	36	41			
Magnesium (Mg)	6.2	1.1	Color	100	5
Sodium (Na)	7.3	6.5	pH	7.5	10.5
Potassium (K)	2.9	2.6	Specific conductance (micromhos at 25 C.)	244	269
Carbonate (CO_3)	0	a 41	Turbidity	--	--
Bicarbonate (HCO_3)	133	0	Temperature (F.)	--	--
Sulfate (SO_4)	13	45	Date of collection	May 24, 1951	May 24, 1951
Chloride (Cl)	2.8	8.0			
Fluoride (F)	--	.1			
Nitrate (NO_3)	3.9	1.7			
Dissolved solids	192	168			

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	68	--	--	9.0	--	--	102	--	--	1	--	--

a Includes the equivalent of 1.0 ppm of hydroxide (OH).

FORT SCOTT

(Population, 10,335)

Ownership: Municipal; also supplies about 275 people outside the city limits. Total population supplied, about 26,400.

Source: Marmaton River for regular supply; Rock Creek Lake and Elm Creek Lake for auxiliary supply.

Treatment: Coagulation with alum, softening with lime, activated carbon, sedimentation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 3,000,000 gpd.

Raw-water storage: Rock Creek Lake and Elm Creek Lake.

Finished-water storage: 1,300,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	7.1	Hardness as $CaCO_3$:	
Iron (Fe)	--	Total	164
Manganese (Mn)	.00	Noncarbonate	79
Calcium (Ca)	59		
Magnesium (Mg)	4.1	Color	4
Sodium (Na)	3.4	pH	7.7
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.)	358
Carbonate (CO_3)	0	Turbidity	20
Bicarbonate (HCO_3)	104	Temperature (F.)	--
Sulfate (SO_4)	67	Date of collection	June 27, 1951
Chloride (Cl)	11		
Fluoride (F)	.1		
Nitrate (NO_3)	1.7		
Dissolved solids	236		

FORT SCOTT--Continued

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	185	250	54	7.6	8.1	7.4	200	266	66	200	4000	14
Finished water	95	156	44	7.8	8.3	7.6	130	200	84	--	--	--

GARDEN CITY
(Population, 10,905)

Ownership: Municipal.
Source: 4 wells each approximately 275 ft deep. The water from the wells is pumped directly into the distribution system.
Treatment: None.
Storage: 500,000 gal.

ANALYSES

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

	Wells (composite)	Gillespie Well	Boncraft Well	Second St. Well	Taylor St. Well
Silica (SiO_2)	20	--	--	--	--
Iron (Fe)	.00	--	--	--	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	58	--	--	--	--
Magnesium (Mg)	19	--	--	--	--
Sodium (Na)	44	--	--	--	--
Potassium (K)	3.5	--	--	--	--
Carbonate (CO_3)	0	--	--	--	--
Bicarbonate (HCO_3)	200	214	204	158	203
Sulfate (SO_4)	131	--	--	--	--
Chloride (Cl)	16	15	13	12	10
Fluoride (F)	.7	--	--	--	--
Nitrate (NO_3)	6.8	--	--	--	--
Dissolved solids	424	394	359	266	332
Hardness as $CaCO_3$:					
Total	222	220	214	180	200
Noncarbonate	58	--	--	--	--
Color	5	--	--	--	--
pH	7.6	--	--	--	--
Specific conductance (micromhos at 25 C.)	612	597	555	443	501
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	May 22, 1951	May 22, 1951	May 22, 1951	May 22, 1951	May 22, 1951

GREAT BEND
(Population, 12,665)

Ownership: Western Light and Telephone Co., Inc.
Source: 4 wells (1 to 4), 75, 117, 68, and 99 ft deep.
Treatment: Chlorination.
Finished-water storage: None.

Water from the wells is pumped directly into the distribution system.

GREAT BEND--Continued

ANALYSES

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

	Finished water (composite)	Well 2	Well 3	Well 4
Silica (SiO_2)	18	--	--	--
Iron (Fe)	.0	--	--	--
Manganese (Mn)	--	--	--	--
Calcium (Ca)	92	--	--	--
Magnesium (Mg)	18	--	--	--
Sodium (Na)	107	--	--	--
Potassium (K)	3.6	--	--	--
Carbonate (CO_3)	0	--	--	--
Bicarbonate (HCO_3)	202	212	204	204
Sulfate (SO_4)	156	--	--	--
Chloride (Cl)	135	170	145	140
Fluoride (F)	.6	--	--	--
Nitrate (NO_3)	3.0	--	--	--
Dissolved solids	678	688	660	713
Hardness as $CaCO_3$:				
Total	304	292	306	296
Noncarbonate	138	118	139	129
Color	0	--	--	--
pH	7.6	--	--	--
Specific conductance (micromhos at 25 C.)	1,040	1,080	1,030	1,030
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	May 23, 1951	May 23, 1951	May 23, 1951	May 23, 1951
Depth (feet)		117	68	99
Diameter (inches)		18	18	19
Date drilled		1937	1937	1946
Percent of supply		--	--	--

HUTCHINSON
(Population, 33,575)

Ownership: Glenn Dunn Co., Wichita, Kans.
Source: 8 wells (Adams Street, Main Street, Northwest, Northeast, Cleveland, Lorraine, North, and East), 65, 75, 60, 58, 80, 50, 65, and 59 ft deep, respectively; each 24 in. in diameter.
Treatment: Chlorination.
Finished-water storage: None.

Water from the wells is pumped directly into the distribution system. Partial analysis of a sample from each well indicates a range in dissolved solids from 479 to 1,070 ppm and hardness from 232 to 366 ppm.

HUTCHINSON--Continued

ANALYSES

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

	Finished water (composite)	Northeast well	Adams Street well
Silica (SiO_2)	16	--	--
Iron (Fe)	.0	--	--
Manganese (Mn)	--	--	--
Calcium (Ca)	110	--	--
Magnesium (Mg)	19	--	--
Sodium (Na)	144	--	--
Potassium (K)	3.4	--	--
Carbonate (CO_3)	0	--	--
Bicarbonate (HCO_3)	255	230	270
Sulfate (SO_4)	125	--	--
Chloride (Cl)	230	125	385
Fluoride (F)	.5	--	--
Nitrate (NO_3)	11	--	--
Dissolved solids	853	479	1,070
Hardness as $CaCO_3$:			
Total	352	232	364
Noncarbonate	144	44	143
Color	0	--	--
pH	7.3	--	--
Specific conductance (micromhos at 25 C.)	1,340	854	1,810
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	May 23, 1951	May 23, 1951	May 23, 1951

INDEPENDENCE

(Population, 11,335)

Ownership: Municipal.
Source: Verdigris River (impounded).
Treatment: Softening with excess lime, coagulation with alum, activated carbon at times, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: (Not reported.)
Finished-water storage: 2,000,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.4	7.0	Hardness as $CaCO_3$:		
Iron (Fe)	.12	.00	Total	186	143
Manganese (Mn)	--	--	Noncarbonate	29	82
Calcium (Ca)	58	42			
Magnesium (Mg)	10	9.2	Color	100	0
Sodium (Na)	29	29	pH	7.9	7.5
Potassium (K)	2.5	2.6	Specific conductance (micromhos at 25 C.)	501	432
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	191	74	Turbidity	--	--
Sulfate (SO_4)	27	69	Temperature (F.)	--	80
Chloride (Cl)	52	49	Date of collection	May 31, 1951	May 31, 1951
Fluoride (F)	.2	.1			
Nitrate (NO_3)	1.8	1.4			
Dissolved solids	322	281			

JUNCTION CITY
(Population, 13,462)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 14,000.
Source: 6 wells (2 to 7), 66, 59, 73, 67, 71, and 70 ft deep. The yield of well 2 is reported to be 950 gpm, and of remaining wells, each 1,000 gpm.
Treatment: Aeration, softening with lime and soda ash, coagulation with alum, sedimentation, rapid sand filtration, recarbonation, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,200,000 gal.

Water from several wells is mixed before entering treatment plant.

ANALYSES

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

	Raw water [a]	Finished water [b]		Raw water [a]	Finished water [b]
Silica (SiO_2)	23	20	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.01	Total	284	122
Manganese (Mn)	.00	.00	Noncarbonate	42	57
Calcium (Ca)	88	27			
Magnesium (Mg)	16	13	Color	3	2
Sodium (Na)	28	26	pH	7.5	8.1
Potassium (K)	7.3	7.4	Specific conductance (micromhos at 25 C.)	658	392
Carbonate (CO_3)	0	0	Turbidity	1.0	0
Bicarbonate (HCO_3)	295	79	Temperature (F.)	58	59
Sulfate (SO_4)	55	50	Date of collection	Mar. 20, 1951	Mar. 20, 1951
Chloride (Cl)	32	33			
Fluoride (F)	.4	.3			
Nitrate (NO_3)	15	26			
Dissolved solids	424	254			

[a] Composite of all wells.
[b] Three wells.

KANSAS CITY
(Population, 129,553)

Ownership: Municipal; also supplies about 35,000 people outside the city limits. Total population supplied, about 164,600.
Source: Missouri River. The raw water is obtained by means of either or both of two intake structures and equipment. It is first pumped to the electric power station where it is used for condensing purposes. When it leaves the condenser a sufficient amount is pumped to the settling basins at the water plant for the city supply. The remainder is wasted back into the river.
Treatment: Coagulation with alum, lime, silica, activated carbon, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 31,750,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoirs, 17,000,000 gal; elevated storage, 1,800,000 gal.

KANSAS CITY--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	276
Manganese (Mn)	.00	Noncarbonate	82
Calcium (Ca)	75		
Magnesium (Mg)	22	Color	3
Sodium (Na)	59	pH	7.9
Potassium (K)	5.6	Specific conductance (micromhos at 25 C.)	770
Carbonate (CO_3)	0	Turbidity	0.3
Bicarbonate (HCO_3)	237	Temperature (F.)	46
Sulfate (SO_4)	172	Date of collection	Mar. 23, 1951
Chloride (Cl)	29		
Fluoride (F)	.4		
Nitrate (NO_3)	2.8		
Dissolved solids	520		

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	153	253	102	8.2	8.6	7.9	220	368	136	1870	9830	26
Finished water	152	252	99	7.9	8.4	7.4	235	360	158	<1	<1	<1

LAWRENCE

(Population, 23,351)

Ownership: Municipal; supplies also the University of Kansas and about 3,000 people outside the city limits. Total population supplied, about 31,300.

Source: Kansas River (60-75 percent of suppiy); 3 wells (1 to 3), 50, 50, and 51 ft deep (25-40 percent of supply). The yield of the wells is reported to be 450, 450, and 400 gpm.

Treatment: Prechlorination, softening with lime and soda ash, coagulation with alum, copperas (part time only), chlorine dioxide when needed, carbon, recarbonation, addition of Calgon, sedimentation, rapid sand filtration, and ammoniation.

Rated capacity of treatment plant: 6,000,000 gpd.

Raw-water storage: 1,900,000 gal.

Finished-water storage: 1,373,000 gal.

LAWRENCE--Continued

ANALYSES

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

	Raw water[a]	Finished water		Raw water[a]	Finished water
Silica (SiO_2)	24	18	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.01	Total	368	109
Manganese (Mn)	.00	.00	Noncarbonate	54	52
Calcium (Ca)	118	32			
Magnesium (Mg)	18	7.1	Color	5	2
Sodium (Na)	53	55	pH	7.5	9.0
Potassium (K)	6.8	6.5	Specific conductance (micromhos at 25 C.)	890	506
Carbonate (CO_3)	0	17	Turbidity	95	0.3
Bicarbonate (HCO_3)	384	34	Temperature (F.)	46	47
Sulfate (SO_4)	82	80	Date of collection	Mar. 21, 1951	Mar. 21, 1951
Chloride (Cl)	64	70			
Fluoride (F)	.2	.2			
Nitrate (NO_3)	4.4	2.0			
Dissolved solids	568	324			

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	220	350	100	7.9	8.3	7.2	275	450	120	1800	15000	20
Finished water	50	80	36	9.1	9.6	8.7	112	152	84	<1	<1	<1

[a] Kansas River 75 percent, wells 25 percent.

LEAVENWORTH
(Population, 20,579)

Ownership: Municipal; also supplies about 600 people outside the city limits. Total population supplied, about 21,200.
Source: Missouri River.
Treatment: Plain sedimentation, softening with lime and soda ash, sedimentation, rapid sand filtration, recarbonation, and chlorination.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: 15,000,000 gal.
Finished-water storage: 5,000,000 gal.

The composition of the raw water varies throughout the year.

LEAVENWORTH--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	13	Hardness as $CaCO_3$:	
Iron (Fe)	.05	Total	130
Manganese (Mn)	.00	Noncarbonate	56
Calcium (Ca)	27		
Magnesium (Mg)	15	Color	2
Sodium (Na)	55	pH	8.9
Potassium (K)	5.3	Specific conductance (micromhos at 25 C.)	523
Carbonate (CO_3)	14	Turbidity	0.5
Bicarbonate (HCO_3)	62	Temperature (F.)	74
Sulfate (SO_4)	140	Date of collection	Mar. 23, 1951
Chloride (Cl)	24		
Fluoride (F)	.4		
Nitrate (NO_3)	2.9		
Dissolved solids	346		

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	60	112	42	8.2	9.6	7.2	110	118	100	<1	<1	<1

McPHERSON
(Population, 8,689)

Ownership: Municipal.
Source: 4 wells (2 to 5) 160, 158, 146, and 161 ft deep, all within the city limits.
Treatment: None.
Storage: 750,000.

ANALYSIS

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

	Wells (city tap)		Wells (city tap)
Silica (SiO_2)	36	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	359
Manganese (Mn)	--	Noncarbonate	86
Calcium (Ca)	124		
Magnesium (Mg)	12	Color	0
Sodium (Na)	32	pH	7.4
Potassium (K)	2.7	Specific conductance (micromhos at 25 C.)	820
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	333	Temperature (F.)	--
Sulfate (SO_4)	23	Date of collection	May 23, 1951
Chloride (Cl)	83		
Fluoride (F)	.0		
Nitrate (NO_3)	11		
Dissolved solids	[a]488		

[a] Sum of determined constituents.

MANHATTAN
(Population, 19,056)

Ownership: Municipal; also supplies about 2,000 people outside the city limits. Total population supplied, about 21,100.
Source: 5 wells (5 to 9), 68, 68, 63, 64, and 68 ft deep. The yield of the wells is reported to be 1,600, 1,200, 1,500, 800, and 1,700 gpm.
Treatment: Softening with lime and soda ash, and rapid sand filtration.
Rated capacity of treatment plant: 4,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,600,000 gal in reservoir and elevated tank.

A different well is pumped every half hour. Determinations made at the treatment plant show little or no difference in the chemical composition of water from each of the wells.

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

	Raw water [a]	Finished water [a]		Raw water [a]	Finished water [a]
Silica (SiO_2)	31	17	Hardness as $CaCO_3$:		
Iron (Fe)	6.9	.01	Total	370	54
Manganese (Mn)	1.4	.00	Noncarbonate	20	12
Calcium (Ca)	113	14			
Magnesium (Mg)	21	4.6	Color	2	2
Sodium (Na)	22	33	pH	7.3	8.3
Potassium (K)	5.1	5.5	Specific conductance (micromhos at 25 C.)	755	296
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	428	51			
Sulfate (SO_4)	52	55	Turbidity	0.9	0.2
Chloride (Cl)	18	25	Temperature (F.)	56	56
Fluoride (F)	.4	.1	Date of collection	Mar. 20, 1951	Mar. 20, 1951
Nitrate (NO_3)	.9	1.4			
Dissolved solids	488	196			

Depth (feet)	63-68
Diameter (inches)	18-26
Date drilled	1929-45
Percent of supply	100

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	424	430	400	6.9	7.5	5.3	450	463	425	100	120	90
Finished water	45	48	38	9.5	10.6	8.6	75	85	65	<1	<1	<1

[a] Composite.

NEWTON
(Population, 11,590)

Ownership: Municipal.
Source: 7 wells in use; four additional wells drilled but not in use at this time. The wells are located 7 to 10 miles from the city.
Treatment: Chlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: --
Finished-water storage: 4,200,000 gal.

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	26	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	167
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	53		
Magnesium (Mg)	8.4	Color	0
Sodium (Na)	27	pH	7.0
Potassium (K)	1.4	Specific conductance (micromhos at 25 C.)	416
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	211	Temperature (F.)	--
Sulfate (SO_4)	28	Date of collection	May 24, 1951
Chloride (Cl)	8.8		
Fluoride (F)	.0		
Nitrate (NO_3)	7.7		
Dissolved solids	264		

OTTAWA
(Population, 10,081)

Ownership: Municipal; also supplies about 800 people outside the city limits. Total population supplied, about 10,900.
Source: Osage River (impounded).
Treatment: Coagulation with alum, softening with lime and soda ash, activated carbon, alum, sedimentation, rapid sand filtration, fluoridation (sodium fluoride), ammoniation, and chlorination.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: Reservoirs, capacity unknown.
Finished-water storage: 1,250,000 gal.

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	7.4	5.8	Hardness as $CaCO_3$:		
Iron (Fe)	.21	.01	Total	307	126
Manganese (Mn)	.00	.00	Noncarbonate	78	82
Calcium (Ca)	93	32			
Magnesium (Mg)	18	11	Color	8	4
Sodium (Na)	22	25	pH	7.9	7.4
Potassium (K)	2.4	2.8	Specific conductance (micromhos at 25 C.)	637	383
Carbonate (CO_3)	0	0	Turbidity	15	2.0
Bicarbonate (HCO_3)	280	54	Temperature (F.)	43	43
Sulfate (SO_4)	110	117	Date of collection	Mar. 22, 1951	Mar. 22, 1951
Chloride (Cl)	11	13			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	1.7	2.2			
Dissolved solids	440	252			

OTTAWA--Continued

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.....	275	350	60	7.5	8.0	7.0	320	395	80	50	(a)	25
Finished water...	55	110	32	8.3	8.7	7.5	100	110	90	<1	<1	<1

(a) 10,000.

PARSONS
(Population, 14,750)

Ownership: Municipal.
Source: La Bette Creek. Auxiliary supply, Neosho River.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination. Copper sulfate is used for the control of algae when necessary.
Rated capacity of treatment plant: 5,180,000 gpd.
Raw-water storage: 10,000,000 gal.
Finished-water storage: 510,000 gal.

ANALYSIS

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

	La Bette Cr. (finished water)		La Bette Cr. (finished water)
Silica (SiO_2)	4.9	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	131
Manganese (Mn)	--	Noncarbonate	66
Calcium (Ca)	43		
Magnesium (Mg)	5.8	Color	25
Sodium (Na)	10	pH	7.2
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.).....	329
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	79	Turbidity	--
Sulfate (SO_4)	82	Temperature (F.).....	79
Chloride (Cl)	7.2	Date of collection	May 31, 1951
Fluoride (F)	.0		
Nitrate (NO_3)	1.1		
Dissolved solids	224		

PITTSBURG
(Population, 19,341)

Ownership: Municipal.
Source: 3 wells (1 to 3), about 1,400 ft deep.
Treatment: Softening with excess lime, coagulation with alum, sedimentation, recarbonation, and rapid sand filtration.
Rated capacity of treatment plant: 3,630,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,700,000 gal.

PITTSBURG--Continued

ANALYSES

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

	Well 1 (raw water)	Well 2 (raw water)	Well 3 (raw water)	Finished water (composite)
Silica (SiO_2)	10	9.7	8.9	4.7
Iron (Fe)	.02	.12	.25	.02
Manganese (Mn)	--	--	--	--
Calcium (Ca)	66	68	67	11
Magnesium (Mg)	31	33	34	14
Sodium (Na)	86	82	91	87
Potassium (K)	5.4	5.1	6.2	5.4
Carbonate (CO_3)	0	0	0	--
Bicarbonate (HCO_3)	333	334	355	[a]68
Sulfate (SO_4)	72	82	90	87
Chloride (Cl)	100	86	82	98
Fluoride (F)	.5	.5	.7	.3
Nitrate (NO_3)	.1	.9	.8	.7
Dissolved solids	535	531	556	342
Hardness as $CaCO_3$:				
Total	292	305	307	85
Noncarbonate	19	32	16	30
Color	5	5	10	5
pH	7.5	7.4	7.3	8.6
Specific conductance (micromhos at 25 C.)	929	929	933	615
Turbidity	--	--	--	--
Temperature (F.)	70	--	68	85
Date of collection	Nov. 29, 1951	Nov. 29, 1951	Nov. 29, 1951	Nov. 29, 1951

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	272	--	--	--	--	--	297	--	--	--	--	--
Finished water	60	--	--	--	--	--	85	--	--	--	--	--

[a] Includes the equivalent of less than 5 ppm of carbonate (CO_3).

SALINA

(Population, 26,176)

Ownership: Municipal.

Source: 10 wells (N-1, N-2, N-3, and 4 to 10), 62, 69, 86, 77, 62, 78, 70, 71, 64, and 75 ft deep. The yield of the wells is reported to be 1,040, 900, 800, 1,090, 1,040, 1,120, 1,090, 1,020, 900, and 1,200 gpm.

Treatment: Chlorination.

Rated capacity of treatment plant: 11,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 2,671,000 gal.

SALINA--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	24	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	552
Manganese (Mn)	.44	Noncarbonate	184
Calcium (Ca)	176		
Magnesium (Mg)	27	Color	3
Sodium (Na)	47	pH	7.3
Potassium (K)	8.5	Specific conductance (micromhos at 25 C.)	1,150
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	450	Temperature (F.)	58
Sulfate (SO_4)	188	Date of collection	Mar. 20, 1951
Chloride (Cl)	68		
Fluoride (F)	.2		
Nitrate (NO_3)	1.8		
Dissolved solids	800		

Depth (feet)	62-86
Diameter (inches)	24
Date drilled	1924-49
Percent of supply	100

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	368	414	334	7.0	7.2	6.9	548	734	442	1	1	1

TOPEKA
(Population, 78,791)

Ownership: Municipal; also supplies about 14,200 people outside the city limits and 1,000 at Forbes Air Base. Total population supplied, about 94,000.

Source: Kansas River, 90 percent of supply; 3 wells, 37, 50, and 50 ft deep, 10 percent of supply. Water from the river and wells is mixed before entering the sedimentation basin.

Treatment: Plain sedimentation, softening with excess lime and soda ash, coagulation with alum, sedimentation, recarbonation, chlorination, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 12,000,000 gpd (to be increased to 16,000,000 gpd).

Raw-water storage: None.

Finished-water storage: Reservoirs and elevated storage, 13,000,000 gal.

TOPEKA--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	20	14	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.01	Total	317	100
Manganese (Mn)	.00	.00	Noncarbonate	78	56
Calcium (Ca)	95	29			
Magnesium (Mg)	19	6.7	Color	7	3
Sodium (Na)	71	83	pH	7.9	8.3
Potassium (K)	7.9	7.6	Specific conductance (micromhos at 25 C.)	906	638
Carbonate (CO_3)	0	5			
Bicarbonate (HCO_3)	292	43	Turbidity	230	0.8
Sulfate (SO_4)	113	112	Temperature (F.)	37	41
Chloride (Cl)	88	93	Date of collection	Mar. 21, 1951	Mar. 21, 1951
Fluoride (F)	.3	.2			
Nitrate (NO_3)	4.9	3.6			
Dissolved solids	572	390			

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	204	327	77	8.3	8.7	8.0	253	418	90	1754	9040	100
Finished water	50	95	32	9.4	10.1	8.9	98	143	68	0	0	0

WICHITA
(Population, 168,279)

Ownership: The city owns the production facilities; The Wichita Water Co. (a subsidiary of the American Water Works Co., Inc.) owns the pumping station and water-distribution system.

Source: 35 wells (1 to 35) ranging in depth from 90 to 265 ft, with average of about 200 ft, located in the Equus Beds west and south of the city of Halstead 30 to 35 miles from Wichita, for regular supply. Seven local wells (1 to 7) near the treatment plant are used in case of an emergency. Two wells (16 and 17) belonging to the Wichita Water Co. are so connected to the system that the water from them can be treated at the treatment plant. Shallow wells of the Wichita Water Co. located in the vicinity of the treatment plant and which have a total capacity of 20,000,000 gpd are available but are never used except in case of emergency.

Treatment: Aeration, softening with lime, chlorination, ammoniation, sedimentation, rapid sand filtration, postchlorination, and polyphosphate (Calgon) for stabilization.

Rated capacity of treatment plant: 48,000,000 gpd.

Raw-water storage: None.

Finished-water storage: Clear wells, 1,000,000 gal; 2 reservoirs, 3,000,000 gal each. Wichita Water Co., 1 reservoir, 3,800,000 gal; 2 elevated tanks, 1,000,000 and 300,000 gal.

WICHITA--Continued

The regular supply wells are spaced at least half a mile apart in the well field and have an average yield of about 1,000 gpm. The wells, equipped with turbine pumps, pump into spur lines connected to the 48-in. supply line which conveys the water to the treatment plant located in the city. The control, the operation of which is manual, of the wells is centered at the treatment plant, so that individual wells may be cut in or out of the pumpage as desired. There is considerable variation in the chemical composition of the water from the individual wells. The hardness ranges from about 115 to 250 ppm.

ANALYSES

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

	Raw water [a]	Finished water [a]		Raw water [a]	Finished water [a]
Silica (SiO_2)	21	20	**Hardness as $CaCO_3$:**		
Iron (Fe)	1.6	.00	Total	200	86
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	62	19			
Magnesium (Mg)	11	9.4	Color	0	5
Sodium (Na)	56	56	pH	7.3	9.1
Potassium (K)	2.1	1.9	Specific conductance (micromhos at 25 C.)	595	418
Carbonate (CO_3)	0	13	Turbidity	--	--
Bicarbonate (HCO_3)	255	84	Temperature (F.)	--	--
Sulfate (SO_4)	54	54	Date of collection	May 24, 1951	May 24, 1951
Chloride (Cl)	36	43			
Fluoride (F)	.3	.5			
Nitrate (NO_3)	1.8	1.9			
Dissolved solids	370	260			

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 [b]	213	--	--	7.0	--	--	186	--	--	--	--	--
Finished water [c]	136	--	--	8.0	--	--	106	--	--	0	--	--

[a] Composite. [b] January. [c] June.

WINFIELD
(Population, 10,264)

Ownership: Municipal.
Source: 5 wells: East well 1 and West well 1, each 38 ft deep; 3 wells (2, 3, and 4) which are double wells (holes side by side) each pair being pumped simultaneously by one pump, 38, 38, and 48 ft deep. The wells are about 5 miles west of the city and are spaced about 3,000 ft apart.
Treatment: Addition of lime and polyphosphate (Calgon) and chlorination.
Rated capacity of treatment plant: 3,888,000 gpd.
Raw-water storage: None.
Finished-water storage: 3,000,000 gal.

ANALYSES

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

	East well 1	West well 1	Well 4	Finished water (composite)
Silica (SiO_2)	--	--	--	16
Iron (Fe)	--	--	--	.0
Manganese (Mn)	--	--	--	--
Calcium (Ca)	--	--	--	99
Magnesium (Mg)	--	--	--	21
Sodium (Na)	--	--	--	35
Potassium (K)	--	--	--	1.9
Carbonate (CO_3)	--	--	--	0
Bicarbonate (HCO_3)	414	388	230	333
Sulfate (SO_4)	--	--	--	81
Chloride (Cl)	8.5	15	28	26
Fluoride (F)	--	--	--	.7
Nitrate (NO_3)	--	--	--	1.4
Dissolved solids	412	383	489	464
Hardness as $CaCO_3$:				
Total	324	324	22	334
Noncarbonate	--	--	--	60
Color	--	--	--	0
pH	--	--	--	7.6
Specific conductance (micromhos at 25 C.)	733	732	713	707
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	May 25, 1951	May 25, 1951	May 25, 1951	May 25, 1951
Depth (feet)	38	38	48	
Diameter (inches)	--	--	--	
Date drilled	1923	1923	1940	
Percent of supply	--	--	--	

ALEXANDRIA
(Population, 34,913)

Ownership: Municipal; supplies about 1,500 people outside of city limits. Total population supplied, about 35,400.

Source: 18 wells (U. S. G. S. R-7, R-12, R-15 to R-18, R-20, R-404 to R-406, R-408 to R-410, and R-421 to R-426) ranging in depth from 253 to 1,202 ft; 1 well (R-458), 341 ft deep, used only in emergency. The yield of wells R-7, R-12, R-15, and R-405 is reported to be 400, 473, 400, and 400 gpm, respectively. (Data not available on other wells.)

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: 3,200,000 gal.

The wells are pumped individually. The wells at Madison St., 5th and Monroe Sts., N. 3rd and McNutt Sts. pump into the main reservoir at 5th and Monroe Sts. The wells at the City Park pump into the reservoir at that location. The wells at 4th and Casson Sts. and at Bolton and Rapides Ave. have small storage tanks into which they pump.

The water is chlorinated at the intake of each of the storage points. It is pumped from storage into the distribution system.

There is considerable difference in the chemical composition of the water from the individual wells. The greater number of the wells deliver water that is very soft. The analyses selected show approximately the range in dissolved solids and hardness of the waters from the wells.

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

	Well R-404	Well R-408	Well R-423	Well R-409	Well R-15
Silica (SiO_2)	28	30	47	28	49
Iron (Fe)	.51	9.0	.03	13	.15
Manganese (Mn)	.0	.3	--	.4	--
Calcium (Ca)	19	97	1.2	116	1.3
Magnesium (Mg)	4.4	50	.4	62	.5
Sodium (Na)	250	7.1	121	21	89
Potassium (K)					1.5
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	591	548	297	600	212
Sulfate (SO_4)	16	2.0	1.0	55	11
Chloride (Cl)	77	9.0	14	30	11
Fluoride (F)	--	--	1.2	--	.9
Nitrate (NO_3)	.0	.0	.0	.0	.1
Dissolved solids	689	458	335	626	270
Hardness as $CaCO_3$:					
Total	66	448	4	544	5
Noncarbonate	0	0	0	53	0
Color	--	--	--	--	0
pH	8.1	6.8	7.5	6.8	--
Specific conductance (micromhos at 25 C.)	1,130	817	--	1,050	--
Turbidity	--	--	--	--	--
Temperature (F.)	--	68	--	68	--
Date of collection	Aug. 25, 1949	May 13, 1948	Aug. 25, 1943	May 13, 1948	Oct. 22, 1938
Depth (feet)	253	326	786	1,027	1,202
Diameter (inches)	8	12-8	12-8	12-6	12
Date drilled	1941	1941	--	1941	1935
Percent of supply	--	--	--	--	--

BASTROP
(Population, 12,769)

Ownership: People Water Service,Inc.; supplies about 225 people outside city limits. Total population supplied, about 13,000.
Source: 3 wells (U. S. G. S. wells Mo-18, Mo-19, and Mo-65))-65) 800, 600, 630 ft deep, and reported to yield 250, 650, and 950 gpm, respectively.
Treatment: None.
Storage: 240,000 gal.

The analysis given is representative of the water served to the consumers.

ANALYSIS

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

	Well Mo-65 (city well 3)		Well Mo-65 (city well 3)
Silica (SiO_2)	11	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	6
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	1.7		
Magnesium (Mg)	.4	Color	35
Sodium (Na)	281	pH	8.0
Potassium (K)	1.2	Specific conductance (micromhos at 25 C.)	1,220
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	422	Temperature (F.)	74
Sulfate (SO_4)	1.9	Date of collection	Feb. 27, 1951
Chloride (Cl)	186		
Fluoride (F)	.6		
Nitrate (NO_3)	.5		
Dissolved solids	697		

Depth (feet)	630
Diameter (inches)	$12\frac{3}{4}$-8
Date drilled	1948
Percent of supply	--

BATON ROUGE
(Population, 125,629)

Ownership: The Baton Rouge Water Works Co., Istrouma Water Co., and Dixie Water Co.; supplying approximately 109,000, 11,000, and 6,000 people, respectively.
Source: 30 wells (The Baton Rouge Water Works Co., 19 wells; Istrouma Water Co., 8 wells; and Dixie Water Co., 3 wells). Three of the wells of the Baton Rouge Water Works Co. are 339, 338, and 343 ft deep; the remaining wells range in depth from 1,496 to 2,712 ft. The wells of the Istrouma Water Co. range in depth from 1,060 to 1,939 ft. The wells (EB-154, EB-447, and EB-514) of the Dixie Water Co. are 2,434, 1,626, and 2,865 ft deep, respectively.
Treatment: Chlorination of the water furnished by the Baton Rouge Water Works Co. and the Dixie Water Co. No treatment of water furnished by the Istrouma Water Co.
Storage: The Baton Rouge Water Works Co., 6,140,000 gal; the Istrouma Water Co., 30,000 gal; and the Dixie Water Co., 120,000 gal.

The wells are pumped individually by electric pumps. The water is pumped directly into the distribution system and to storage. All of the analyses are of water from the wells of the Baton Rouge Water Works Co. at different location or pumping stations, and are representative of the water served to the consumers.

BATON ROUGE--Continued

ANALYSES

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

	Well EB-100 [a]	Well EB-151 [b]	Well EB-413 [c]	Well EB-444 [d]	Well EB-456 [e]
Silica (SiO_2)	34	24	28	24	23
Iron (Fe)	1.3	.07	.10	.23	.13
Manganese (Mn)	.05	.00	--	.00	.00
Calcium (Ca)	62	1.4	3.6	1.0	1.3
Magnesium (Mg)	18	.2	1.7	.3	.2
Sodium (Na)	20	82	73	91	83
Potassium (K)	2.4	2.4	4.4	2.0	3.2
Carbonate (CO_3)	0	6	10	19	10
Bicarbonate (HCO_3)	314	191	165	190	186
Sulfate (SO_4)	1.0	11	13	11	9.0
Chloride (Cl)	7.2	6.2	8.0	5.0	3.8
Fluoride (F)	.1	.1	.2	.3	.3
Nitrate (NO_3)	2.5	.0	2.8	.2	1.0
Dissolved solids	300	219	228	241	223
Hardness as $CaCO_3$:					
Total	228	4	16	4	4
Noncarbonate	0	0	0	0	0
Color	--	--	--	--	--
pH	7.5	8.7	8.7	9.0	8.8
Specific conductance (micromhos at 25 C.)	505	344	322	383	347
Turbidity	--	--	--	--	--
Temperature (F.)	70	96	88	93	86
Date of collection	May 9, 1951	May 9, 1951	Sept. 26, 1949	May 9, 1951	May 9, 1951
Depth (feet)	343	2,664	1,732	2,253	1,895
Diameter (inches)	18-12	12-6	12-9 5/8	--	--
Date drilled	--	--	1946	1946	1947
Percent of supply	--	--	--	--	--

	Well EB-504 [f]	Well EB-510 [g]
Silica (SiO_2)	28	36
Iron (Fe)	--	.24
Manganese (Mn)	--	.00
Calcium (Ca)	.6	.4
Magnesium (Mg)	1.0	.3
Sodium (Na)	76	67
Potassium (K)		.4
Carbonate (CO_3)	10	--
Bicarbonate (HCO_3)	162	[h] 162
Sulfate (SO_4)	16	9.6
Chloride (Cl)	4.0	4.0
Fluoride (F)	--	.1
Nitrate (NO_3)	.2	1.2
Dissolved solids	226	202
Hardness as $CaCO_3$:		
Total	6	2
Noncarbonate	0	0
Color	--	--
pH	8.7	8.3
Specific conductance (micromhos at 25 C.)	326	279
Turbidity	--	--
Temperature (F.)	88	85
Date of collection	Sept. 26, 1949	May 9, 1951

[a] Front Street. [b] Government Street Station. [c] Baton Rouge Water Works, well 3. [d] First Street. [e] Scotlandville, La. [f] Government Street Station, well 4. [g] Lula Street. [h] Includes the equivalent of less than 5 ppm of carbonate (CO_3).

BATON ROUGE--Continued

	Well EB-504[f]	Well EB-510[g]
Depth (feet)	1,777	1,605
Diameter (inches)	--	12-9 5/8
Date drilled	1949	1951
Percent of supply	--	--

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	106	124	72	8.1	8.5	7.6	--	--	--	67	300	25
Finished water	99	120	72	7.9	8.1	7.7	--	--	--	--	--	--

[f] Government Street Station, well 4. [g] Lula Street.

BOGALUSA
(Population, 17,798)

Ownership: Municipal; supplies approximately 500 persons outside of city limits. Total population supplied, about 18,300.
Source: 6 wells (U. S. G. S. wells Wa-34, Wa-41, Wa-44 to Wa-47) 1,500, 1,442, 1,450, 1,500, 1,500, and 1,500 ft deep. Emergency supply can be furnished by the Gaylord Container Corp.
Treatment: None.
Storage: 2 elevated tanks, each 250,000 gal; 2 underground tanks, each 500,000 gal.

ANALYSIS

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

	Well Wa-41		Well Wa-41
Silica (SiO_2)	48	Hardness as $CaCO_3$:	
Iron (Fe)	.06	Total	2
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	.2		
Magnesium (Mg)	.3	Color	7
Sodium (Na)	44	pH	8.0
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	204
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	105	Turbidity	--
Sulfate (SO_4)	9.3	Temperature (F.)	--
Chloride (Cl)	4.5	Date of collection	June 21, 1950
Fluoride (F)	.2		
Nitrate (NO_3)	.0		
Dissolved solids	165		

Depth (feet)	1,442
Diameter (inches)	12-9 5/8
Date drilled	1950
Percent of supply	--

BOSSIER CITY
(Population, 15,470)

Ownership: City of Shreveport.
Source: Supplied by city of Shreveport (See Shreveport.)

CROWLEY
(Population, 12,784)

Ownership: Central-Louisiana Electric Co.
Source: 3 wells (U.S.G.S. wells Ac-169, Ac-170, and Ac-280), 280, 247, and 257 ft deep, and reported to yield 1,250, 900, and 1,400 gpm, respectively.
Treatment: Aeration (trays), softening with lime, coagulation with iron salts, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 5,100,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,060,000 gal.

ANALYSES

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

	Well Ac-280 [a]	Finished water		Well Ac-280 [a]	Finished water
Silica (SiO_2)	32	28	Hardness as $CaCO_3$:		
Iron (Fe)	1.7	.14	Total	216	81
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	54	7.7			
Magnesium (Mg)	20	15	Color	--	5
Sodium (Na)	65	69	pH	7.3	8.6
Potassium (K)	6.0	2.8	Specific conductance (micromhos at 25 C.)	691	432
Carbonate (CO_3)	0	10			
Bicarbonate (HCO_3)	396	205	Turbidity	--	--
Sulfate (SO_4)	.5	.8	Temperature (F.)	--	70
Chloride (Cl)	26	29	Date of collection	Sept. 16, 1950	Apr. 4, 1951
Fluoride (F)	.2	.2			
Nitrate (NO_3)	8.2	2.0			
Dissolved solids	405	259			

Depth (feet)	257
Diameter (inches)	12-10
Date drilled	1942
Percent of supply	--

[a] Raw water.

GRETNA
(Population, 13,813)

Ownership: Municipal.
Source: Mississippi River. Emergency supply may be obtained from nearby industrial supply wells.
Treatment: Plain sedimentation, softening with lime, coagulation with iron salts, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,250,000 gal.

GRETNA--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	8.4	9.8	Hardness as $CaCO_3$:		
Iron (Fe)	.06	.05	Total	127	65
Manganese (Mn)	.00	.00	Noncarbonate	34	35
Calcium (Ca)	35	21			
Magnesium (Mg)	9.7	3.0	Color	--	--
Sodium (Na)	13	13	pH	7.3	9.8
Potassium (K)	--	4.4	Specific conductance (micromhos at 25 C.)	317	237
Carbonate (CO_3)	0	15			
Bicarbonate (HCO_3)	114	6	Turbidity	--	--
Sulfate (SO_4)	38	42	Temperature (F.)	--	--
Chloride (Cl)	14	15	Date of collection	May 14, 1951	May 14, 1951
Fluoride (F)	.3	.3			
Nitrate (NO_3)	3.0	2.5			
Dissolved solids	193	133			

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	--	--	--	7.8	8.0	7.8	115	130	100	800	1200	700
Finished water	--	--	--	9.6	9.6	9.6	70	75	60	2	2	2

HOUMA

(Population, 11,505)

Ownership: Municipal.
Source: Intracoastal Canal (Bayou Black).
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: 30,000,000 gal.
Finished-water storage: 450,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	8.6	7.2	Hardness as $CaCO_3$:		
Iron (Fe)	.41	.18	Total	106	103
Manganese (Mn)	.00	.00	Noncarbonate	39	72
Calcium (Ca)	29	28			
Magnesium (Mg)	8.3	8.0	Color	--	--
Sodium (Na)	26	28	pH	7.5	7.1
Potassium (K)	3.6	2.8	Specific conductance (micromhos at 25 C.)	348	373
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	82	37	Turbidity	--	--
Sulfate (SO_4)	27	73	Temperature (F.)	--	--
Chloride (Cl)	42	44	Date of collection	May 14, 1951	May 14, 1951
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.8	1.2			
Dissolved solids	207	222			

HOUMA--Continued

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.....	65	116	52	7.5	7.8	6.7	80	120	75	70	450	40
Finished water...	40	72	32	8.6	9.0	8.0	90	160	70	--	--	--

JEFFERSON PARISH

Ownership: East Jefferson Water District 1; supplies Harahan, Kenner, Metairie, Shrewsbury, Southport, and other communities. Total population supplied, about 62,000.

Source: Mississippi River. Emergency supply can be obtained from the New Orleans public supply.

Treatment: Plain sedimentation, softening with lime, coagulation with lime and iron salts, ammoniation, sedimentation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 10,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 3,500,000 gal.

The treatment plant for East Jefferson Water District 1 is at Shrewsbury.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	10	12	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.03	Total	156	75
Manganese (Mn).....	--	.00	Noncarbonate.....	38	48
Calcium (Ca).....	41	21			
Magnesium (Mg).....	13	5.5	Color.....	--	--
Sodium (Na)	21	21	pH.....	7.7	8.9
Potassium (K)	--	2.0	Specific conductance (micromhos at		
Carbonate (CO_3).....	0	5	25 C.).....	400	279
Bicarbonate (HCO_3)	144	23	Turbidity.....	--	--
Sulfate (SO_4)	41	56	Temperature (F.)...	--	--
Chloride (Cl)	26	27	Date of collection...	Oct. 12, 1951	Oct. 12, 1951
Fluoride (F).....	.3	.2			
Nitrate (NO_3)	3.0	2.0			
Dissolved solids.....	234	163			

Regular determinations at treatment plant

	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.....	--	165	67	--	8.2	7.5	--	--	--	500	1600	45
Finished water...	--	43	23	--	10	9.8	--	116	79	0	0	0

LAFAYETTE
(Population, 33,541)

Ownership: Municipal.
Source: 5 wells (U. S. G. S. wells Lf-1, Lf-433, Lf-491, Lf-492, and Lf-503), 220, 204, 214, 213, and 212 ft deep. The total yield of the wells is reported to be from 1,500 to 2,000 gpm.
Treatment: Aeration (trays), coagulation with sodium aluminate, softening with lime, sedimentation, addition of polyphosphate (Calgon) for stabilization, rapid (anthrafilt) filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Surface storage, 1,000,000 gal; elevated tank, 500,000 gal.

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

	Well Lf-491	Finished water		Well Lf-491	Finished water
Silica (SiO_2)	46	37	Hardness as $CaCO_3$:		
Iron (Fe)	3.6	.15	Total	123	95
Manganese (Mn)	--	.1	Noncarbonate	0	6
Calcium (Ca)	36	27			
Magnesium (Mg)	8.0	6.8	Color	0	0
Sodium (Na)	9.8	9.7	pH	7.0	8.9
Potassium (K)	1.2	2.0	Specific conductance (micromhos at		
Carbonate (CO_3)	0	19			
Bicarbonate (HCO_3)	151	77	25 C.)	278	258
Sulfate (SO_4)	9.3	10	Turbidity	--	--
Chloride (Cl)	8.2	12	Temperature (F.)	--	--
Fluoride (F)	.5	.2	Date of collection	Oct. 25, 1949	Apr. 5, 1951
Nitrate (NO_3)	.0	.2			
Dissolved solids	195	161			

Depth (feet)	214
Diameter (inches)	24-16-10
Date drilled	1949
Percent of supply	--

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	123	--	--	6.9	--	--	133	--	--	0	--	--
Finished water	--	--	--	9.5	--	--	85	--	--	0	--	--

LAKE CHARLES
(Population, 41,272)

Ownership: Gulf States Utilities Co.
Source: 5 wells ("A", "K", "L", "M", and "N") for regular supply; Calcasieu Lake for auxiliary supply. The depths of the wells are reported to be 693, 680, 696, 690, and 676 ft, and the yields, 1,500, 1,500, 1,500, 1,760, and 1,500 gpm, respectively.
Treatment: Aeration (contact beds), softening, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None (except Calcasieu Lake).
Finished-water storage: 1,500,000 gal.

LAKE CHARLES--Continued

ANALYSES

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

	Well "L"	Finished water		Well "L"	Finished water
Silica (SiO_2)	50	48	Hardness as $CaCO_3$:		
Iron (Fe)	1.6	.04	Total	108	109
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	27	28			
Magnesium (Mg)	9.7	9.5	Color	10	--
Sodium (Na)	80	77	pH	7.1	7.7
Potassium (K)	6.4	5.6	Specific conductance (micromhos at 25 C.)	580	594
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	170	160	Turbidity	--	--
Sulfate (SO_4)	2.4	2.6	Temperature (F.)	73	74
Chloride (Cl)	99	105	Date of collection	Oct. 25, 1949	Apr. 6, 1951
Fluoride (F)	.4	.5			
Nitrate (NO_3)	.0	.2			
Dissolved solids	359	348			

Depth (feet)	696
Diameter (inches)	16-10
Date drilled	1946
Percent of supply	--

MONROE

(Population, 38,572)

Ownership: Municipal; supplies approximately 5,000 people outside of the city limits. Total population supplied, about 43,600.

Source: Bayou De Siard for regular supply; Ouachita River for auxiliary or emergency supply.

Treatment: Prechlorination, aeration (spray), coagulation with alum, sedimentation, addition of soda ash for pH control, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 9,000,000 gpd.

Raw-water storage: None.

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

At the time of the collection of the samples lime instead of soda ash was being used for pH control in the treatment process.

ANALYSES

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

	Bayou De Siard[a]	Finished water		Bayou De Siard[a]	Finished water
Silica (SiO_2)	0.8	0.5	Hardness as $CaCO_3$:		
Iron (Fe)	.25	.04	Total	19	36
Manganese (Mn)	.00	.00	Noncarbonate	0	20
Calcium (Ca)	4.3	11			
Magnesium (Mg)	1.9	2.1	Color	--	--
Sodium (Na)	7.6	7.7	pH	6.7	7.0
Potassium (K)	1.6	--	Specific conductance (micromhos at 25 C.)	81	130
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	27	20	Turbidity	--	--
Sulfate (SO_4)	3.1	16	Temperature (F.)	76	76
Chloride (Cl)	5.2	16	Date of collection	May 1, 1951	May 1, 1951
Fluoride (F)	.3	.2			
Nitrate (NO_3)	1.5	.5			
Dissolved solids	51	75			

[a]Raw water.

NEW IBERIA
(Population, 16,467)

Ownership: Central-Louisiana Electric Co.
Source: 4 wells (U. S. G. S. wells I-1, I-12, I-18, and I-63) for regular supply; Bayou Teche, auxiliary or emergency supply. The depths of the wells are reported to be 290, 250, 278, and 288 ft; and the yields (well I-1, not reported), 1,800, 1,000, and 1,760 gpm, respectively.
Treatment: Aeration (cascades), softening with lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,850,000 gpd.
Raw-water storage: None.
Finished-water storage: 500,000 gal.

ANALYSES

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

	Well I-1	Finished water		Well I-1	Finished water
Silica (SiO_2)	42	36	Hardness as $CaCO_3$:		
Iron (Fe)	1.7	.24	Total	395	151
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	99	16			
Magnesium (Mg)	36	27	Color	10	5
Sodium (Na)	20	26	pH	7.2	7.6
Potassium (K)	12	1.6	Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.)	785	391
Bicarbonate (HCO_3)	540	216	Turbidity	--	--
Sulfate (SO_4)	.5	.5	Temperature (F.)	74	--
Chloride (Cl)	8.5	13	Date of collection	Oct. 19, 1950	Mar. 19, 1951
Fluoride (F)	.8	.2			
Nitrate (NO_3)	.0	10			
Dissolved solids	476	231			

Depth (feet)	290
Diameter (inches)	12-10
Date drilled	--
Percent of supply	--

NEW ORLEANS
(Population, 570,445)

Ownership: Municipal.
Source: Mississippi River. Auxiliary and emergency supplies can be obtained from Jefferson Parish, East Jefferson Water District 1.
Treatment: Carrollton Plant, plain sedimentation, softening with lime, sedimentation, activated carbon at times for taste and odor control, coagulation with ferrous sulfate, sedimentation, ammoniation, polyphosphates for stabilization, chlorination, rapid sand filtration, postchlorination, and addition of activated carbon when required.
Algiers Plant, prechlorination, coagulation with ferrous sulfate, softening with lime, sedimentation, ammoniation, rapid sand filtration, postchlorination, and addition of activated carbon for taste and odor control when required.
Rated capacity of treatment plants: Carrollton Plant, 112,000,000 gpd; Algiers Plant, 7,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Carrollton Plant, 15,000,000 gal; Algiers Plant, 7,000,000 gal.

NEW ORLEANS--Continued
ANALYSES

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

	Raw water [a]	Finished water [a]	Raw water [b]	Finished water [b]
Silica (SiO_2)	10	12	10	10
Iron (Fe)	.36	.08	.17	.03
Manganese (Mn)	.00	.00	.00	.00
Calcium (Ca)	47	16	48	20
Magnesium (Mg)	14	8.1	14	8.3
Sodium (Na)	21	21	21	20
Potassium (K)	.8	.8	.8	.8
Carbonate (CO_3)	0	0	0	6
Bicarbonate (HCO_3)	161	37	162	24
Sulfate (SO_4)	51	52	51	58
Chloride (Cl)	24	26	24	27
Fluoride (F)	.3	.2	.3	.3
Nitrate (NO_3)	2.5	2.0	2.0	2.0
Dissolved solids	262	158	266	166
Hardness as $CaCO_3$:				
Total	175	73	177	84
Noncarbonate	43	43	45	54
Color	--	--	--	--
pH	7.5	7.1	7.5	8.8
Specific conductance (micromhos at 25 C.)	438	270	439	285
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Aug. 31, 1951	Aug. 31, 1951	Aug. 31, 1951	Aug. 31, 1951

Regular determinations at treatment plant, 1950 [a]

	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	95	135	61	8.1	8.5	7.9	133	200	88	535	1770	55
Finished water	35	52	27	10.1	10.6	9.5	75	109	54	.1	1.2	.0

[a] Carrollton Plant.
[b] Algiers Plant.

OPELOUSAS
(Population, 11,659)

Ownership: Municipal.
Source: 4 wells (U. S. G. S. S1-2, S1-89, S1-122, and S1-123) 326, 288, 326, and 326 ft deep. The yield of the wells is reported to be 1,800, 1,500, 2,000, and 2,300 gpm.
Treatment: Aeration (contact bed of coke), softening with lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 950,000 gal.

OPELOUSAS--Continued

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

	Well S1-122	Finished water		Well S1-122	Finished water
Silica (SiO_2)	41	34	Hardness as $CaCO_3$:		
Iron (Fe)	1.1	.06	Total	245	102
Manganese (Mn)	--	.00	Noncarbonate	0	0
Calcium (Ca)	62	13			
Magnesium (Mg)	22	17	Color	5	0
Sodium (Na)	22	26	pH	7.4	8.6
Potassium (K)	8.8	2.0	Specific conductance (micromhos at 25 C.)	552	292
Carbonate (CO_3)	0	7			
Bicarbonate (HCO_3)	339	154			
Sulfate (SO_4)	.5	2.9	Turbidity	--	--
Chloride (Cl)	13	12	Temperature (F.)	70	69
Fluoride (F)	.3	.1	Date of collection	June 15, 1950	Apr. 2, 1951
Nitrate (NO_3)	.2	.2			
Dissolved solids	326	178			

Depth (feet)	326
Diameter (inches)	10
Date drilled	1942
Percent of supply	--

RUSTON
(Population, 10,372)

Ownership: Municipal; also supplies about 250 people outside the city limits. Total population supplied, about 10,600.
Source: 2 wells (U. S. G. S. L-1 and L-2) each 637 ft deep, and each reported to yield 750 gpm. An emergency supply can be obtained from a well at Louisiana Polytechnic Institute.
Treatment: None.
Storage: 1,500,000 gal.

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

	Well L-1		Well L-1
Silica (SiO_2)	23	Hardness as $CaCO_3$:	
Iron (Fe)	.16	Total	6
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	1.6		
Magnesium (Mg)	.5	Color	--
Sodium (Na)	69	pH	8.0
Potassium (K)	3.2	Specific conductance (micromhos at 25 C.)	305
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	163		
Sulfate (SO_4)	13	Turbidity	--
Chloride (Cl)	8.0	Temperature (F.)	76
Fluoride (F)	.1	Date of collection	Apr. 4, 1951
Nitrate (NO_3)	.5		
Dissolved solids	198		

Depth (feet)	637
Diameter (inches)	16-10
Date drilled	1936
Percent of supply	--

SHREVEPORT
(Population, 127,206)

Ownership: Municipal; supplies Bossier City, and approximately 27,000 people outside of the city limits, including Barksdale Field. Total population supplied, about 169,700.
Source: Cross Lake.
Treatment: (Both plants) addition of lime, ammoniation, coagulation with alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plants: Cross Lake Plant, 15,000,000 gpd; McNeill St. Plant, 14,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 6,000,000 gal.

ANALYSES

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

	Raw water[a]	Finished water[a]		Raw water[a]	Finished water[a]
Silica (SiO_2)	7.8	7.4	Hardness as $CaCO_3$:		
Iron (Fe)	.19	.06	Total	48	68
Manganese (Mn)	.00	.00	Noncarbonate	24	35
Calcium (Ca)	10	18			
Magnesium (Mg)	5.7	5.6	Color	--	--
Sodium (Na)	23	23	pH	6.9	7.1
Potassium (K)	2.0	3.2	Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.)	230	270
Bicarbonate (HCO_3)	30	40	Turbidity	--	--
Sulfate (SO_4)	25	33	Temperature (F.)	73	74
Chloride (Cl)	36	41	Date of collection	May 3, 1951	May 3, 1951
Fluoride (F)	.3	.1			
Nitrate (NO_3)	1.0	.0			
Dissolved solids	133	162			

Regular determinations at treatment plant

	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	30	7	6.6	7.5	6.0	38	42	33	17	35	9
Finished water	32	38	27	9.0	9.5	8.5	63	68	60	0	0	0

[a]Cross Lake Plant.

WEST MONROE
(Population, 10,302)

Ownership: Municipal; also supplies about 2,500 people outside the city limits. Total population supplied, about 12,800.
Source: 3 wells (U. S. G. S. Ou-63, Ou-64, and Ou-135) 473, 473, and 480 ft deep; each reported to yield 800 gpm.
Treatment: None.
Storage: 100,000 gal.

ANALYSIS

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

	Well Ou-63		Well Ou-63
Silica (SiO_2)	12	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	2
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	.4		
Magnesium (Mg)	.2	Color	--
Sodium (Na)	123	pH	8.5
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.)	502
Carbonate (CO_3)	5	Turbidity	--
Bicarbonate (HCO_3)	283	Temperature (F.)	72
Sulfate (SO_4)	.2	Date of collection	Apr. 4, 1951
Chloride (Cl)	19		
Fluoride (F)	.2		
Nitrate (NO_3)	.5		
Dissolved solids	299		

Depth (feet)	473
Diameter (inches)	16-8
Date drilled	1932
Percent of supply	--

ALBERT LEA
(Population, 13,545)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 14,000.
Source: 2 wells, 400 and 600 ft deep; tie-in with Wilson Co. for auxiliary supply. The yield of the wells is reported to be 1,750 and 1,250 gpm.
Treatment: Chlorination, addition of sodium metaphosphate (Nalco-18) for water stabilization after the water leaves the storage reservoirs.
Raw-water storage: None.
Finished-water storage: Reservoirs, 2,500,000 gal.

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	1.0	Total	350
Manganese (Mn)	.01	Noncarbonate	5
Calcium (Ca)	92		
Magnesium (Mg)	29	Color	3
Sodium (Na)	12	pH	7.6
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.)	645
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	421	Temperature (F.)	48
Sulfate (SO_4)	20	Date of collection	May 8, 1951
Chloride (Cl)	5.5		
Fluoride (F)	.1		
Nitrate (NO_3)	2.1		
Dissolved solids	404		

Depth (feet)	400, 600
Diameter (inches)	12
Date drilled	--
Percent of supply	100

AUSTIN
(Population, 23,100)

Ownership: Municipal.
Source: Sargeant Springs, 50 percent of supply; 1 well, 112 ft deep, 50 percent of supply. The yield for Sargeant Springs is reported to be 2,200 gpm, and for the well, 1,940 gpm.
Treatment: Chlorination. Fluoridation of the supply has been proposed.
Raw-water storage: None.
Finished-water storage: Reservoir, 2,186,000 gal; elevated storage, 750,000 gal.

AUSTIN--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	236
Manganese (Mn)	.00	Noncarbonate	12
Calcium (Ca)	59		
Magnesium (Mg)	22	Color	1
Sodium (Na)	4.2	pH	7.8
Potassium (K)	1.0	Specific conductance (micromhos at 25 C.)	446
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	274	Turbidity	0.6
Sulfate (SO_4)	13	Temperature (F.)	--
Chloride (Cl)	3.0	Date of collection	May 8, 1951
Fluoride (F)	.2		
Nitrate (NO_3)	3.5		
Dissolved solids	256		

BEMIDJI

(Population, 10,001)

Ownership: Municipal; total population supplied, about 5,000. Only part of the population is supplied by the city; the remainder is supplied from private wells.
Source: 5 wells, (7, 9, 10, 12, and 14) 187, 87, 250, 108, and 98 ft deep. The yield of the wells is reported to be 550, 410, 600, 550, and 440 gpm.
Treatment: Chlorination when necessary.
Raw-water storage: None.
Finished-water storage: 500,000 gal.

ANALYSIS

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

	Finished water (composite)[a]		Finished water (composite)[a]
Silica (SiO_2)	21	Hardness as $CaCO_3$:	
Iron (Fe)	.25	Total	201
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	52		
Magnesium (Mg)	17	Color	1
Sodium (Na)	9.5	pH	7.7
Potassium (K)	.6	Specific conductance (micromhos at 25 C.)	389
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	263	Turbidity	1
Sulfate (SO_4)	2.0	Temperature (F.)	46
Chloride (Cl)	.5	Date of collection	May 2, 1951
Fluoride (F)	0		
Nitrate (NO_3)	6.5		
Dissolved solids	246		

[a] Wells 7, 10, and 12.

BRAINERD
(Population, 12,637)

Ownership: Municipal.
Source: 4 wells (3 to 6), 120, 120, 145, and 150 ft deep. The yield of the wells is reported to be 1,200, 1,200, 2,400, and 2,500 gpm. Two wells are pumped at one time into reservoir and tower storage and then into the mains.
Treatment: Iron and manganese removal by upward flow of water through beds of manganese ore, aeration and percolation through beds of coke, and rapid sand filtration.
Rated capacity of treatment plant: 3,300,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoir, 800,000 gal; tower, 300,000 gal.

ANALYSIS

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

	Wells 3 and 6 (finished water)		Wells 3 and 6 (finished water)
Silica (SiO_2)	20	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	229
Manganese (Mn)	.00	Noncarbonate	21
Calcium (Ca)	66		
Magnesium (Mg)	16	Color	3
Sodium (Na)	9.5	pH	7.6
Potassium (K)	.5	Specific conductance (micromhos at 25 C.)	439
Carbonate (CO_3)	0	Turbidity	0.2
Bicarbonate (HCO_3)	254	Temperature (F.)	47
Sulfate (SO_4)	29	Date of collection	May 2, 1951
Chloride (Cl)	5.5		
Fluoride (F)	.0		
Nitrate (NO_3)	4.4		
Dissolved solids	288		

Depth (feet)	120, 150
Diameter (inches)	16, 16
Date drilled	1939, 1947
Percent of supply	--

DULUTH
(Population, 104,511)

Ownership: Municipal; also supplies about 2,700 people in Proctor. Total population supplied, about 107,200.
Source: Lake Superior for regular supply; Fond du Lac wells for auxiliary supply.
Treatment: Prechlorination, detention 4 hours, postchlorination, and ammoniation.
Rated capacity of treatment plant: 30,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoirs, tanks, and standpipes, 55,380,000 gal.

DULUTH--Continued

ANALYSIS

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

	Lake Superior (finished water)		Lake Superior (finished water)
Silica (SiO_2)	3.3	Hardness as $CaCO_3$:	
Iron (Fe)	.15	Total	44
Manganese (Mn)	.00	Noncarbonate	3
Calcium (Ca)	14		
Magnesium (Mg)	2.2	Color	1
Sodium (Na)	1.1	pH	7.4
Potassium (K)	.4	Specific conductance (micromhos at 25 C.)	102
Carbonate (CO_3)	0	Turbidity	0.9
Bicarbonate (HCO_3)	50	Temperature (F.)	35
Sulfate (SO_4)	1.0	Date of collection	May 3, 1951
Chloride (Cl)	3.5		
Fluoride (F)	.1		
Nitrate (NO_3)	1.6		
Dissolved solids	54		

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	43	44	42	7.6	--	--	46	47	45	0.35	13	0

EDINA

(Population, 9,744)

Ownership: Municipal.

Source: 4 wells (1 to 4) 400, 450, 475, and 500 ft deep. The yield of the wells is reported to be 700, 1,000, 1,000, and 1,000 gpm.

Treatment: None.

Storage: Elevated tank, 75,000 gal.

ANALYSIS

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

	Wells (city tap)		Wells (city tap)
Silica (SiO_2)	18	Hardness as $CaCO_3$:	
Iron (Fe)	.52	Total	288
Manganese (Mn)	.00	Noncarbonate	14
Calcium (Ca)	70		
Magnesium (Mg)	28	Color	5
Sodium (Na)	3.9	pH	7.8
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.)	536
Carbonate (CO_3)	0	Turbidity	7
Bicarbonate (HCO_3)	335	Temperature (F.)	53
Sulfate (SO_4)	8.0	Date of collection	May 31, 1951
Chloride (Cl)	6.0		
Fluoride (F)	.1		
Nitrate (NO_3)	1.9		
Dissolved solids	310		

FARIBAULT
(Population, 16,028)

Ownership: Municipal.
Source: 3 wells (1 to 3), 750, 450, and 1,385 ft deep. The yield of the wells is reported to be 2,400, 2,400, and 1,360 gpm.
Treatment: Chlorination and aeration.
Raw-water storage: None.
Finished-water storage: 4,000,000 gal.

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.70	Total	348
Manganese (Mn)	.02	Noncarbonate	18
Calcium (Ca)	88		
Magnesium (Mg)	31	Color	2
Sodium (Na)	9.0	pH	7.7
Potassium (K)	2.0	Specific conductance (micromhos at 25 C.)	642
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	403	Temperature (F.)	48
Sulfate (SO_4)	33	Date of collection	May 7, 1951
Chloride (Cl)	4.0		
Fluoride (F)	.1		
Nitrate (NO_3)	4.4		
Dissolved solids	376		

FERGUS FALLS
(Population, 12,917)

Ownership: Municipal; also supplies 2,000 people outside the city limits. Total population supplied, about 14,900.
Source: Otter Tail River.
Treatment: Softening with lime, coagulation with ferric sulfate and sodium aluminate, slow mechanical mixing and sludge blanket clarification, recarbonation, carbon when needed, fluoridation with sodium silicofluoride, rapid sand filtration, ammoniation, chlorination, and stabilization with polyphosphate.
Rated capacity of treatment plant: 3,500,000 gpd.
Raw-water storage: Lake.
Finished-water storage: 700,000 gal.(additional storage of 1,500,000 gal is planned for in 1951).

FERGUS FALLS--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.8	7.1	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.05	Total	176	75
Manganese (Mn)	.00	.00	Noncarbonate	1	0
Calcium (Ca)	31	9.0			
Magnesium (Mg)	24	13	Color	4	2
Sodium (Na)	5.2	6.5	pH	7.9	9.2
Potassium (K)	3.1	2.9	Specific conductance (micromhos at 25 C.)	345	179
Carbonate (CO_3)	0	13			
Bicarbonate (HCO_3)	214	65	Turbidity	2	2
Sulfate (SO_4)	11	10	Temperature (F.)	68	68
Chloride (Cl)	1.5	3.5	Date of collection	May 25, 1951	May 25, 1951
Fluoride (F)	.1	1.2			
Nitrate (NO_3)	1.0	.4			
Dissolved solids	212	118			

Regular determinations at treatment plant, 1951 [a]

	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	205	220	170	8.0	8.1	7.9	213	220	180	2	5	0
Finished water	68	70	65	9.2	9.2	9.2	63	66	61	0	0	0

[a] Fiscal year (Apr. 1, 1950 to Mar. 31, 1951).

HIBBING
(Population, 16,276)

Ownership: Municipal; also supplies about 3,000 people outside the city limits. Total population supplied, about 19,300.

Source: Mine shaft, 50 percent of supply; 7 wells (1-A, 2-A, 3-A, 4, 8-A, 9, and 12), 112, 118, 148, 88, 135, 182, and 138 ft deep, 50 percent of supply. The yield of the wells is reported to be 700, 500, 700, 300, 700, 450, and 450 gpm. All the wells are connected to a 1,000,000 gal reservoir at the main pumping station.

Treatment: Chlorination of water from mine shaft.

Raw-water storage: None.

Finished-water storage: Underground storage, 4,000,000 gal; elevated tank, 650,000 gal.

HIBBING--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	132
Manganese (Mn)	.01	Noncarbonate	17
Calcium (Ca)	28		
Magnesium (Mg)	15	Color	2
Sodium (Na)	5.6	pH	7.0
Potassium (K)	.6	Specific conductance (micromhos at 25 C.)	274
Carbonate (CO_3)	0	Turbidity	0.8
Bicarbonate (HCO_3)	140	Temperature (F.)	45
Sulfate (SO_4)	19	Date of collection	May 3, 1951
Chloride (Cl)	8.0		
Fluoride (F)	.1		
Nitrate (NO_3)	.7		
Dissolved solids	168		

MANKATO
(Population, 18,809)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 19,000.

Source: 6 wells (5 to 10), 68, 325, 65, 68, and 67 ft deep (depth not reported for well 10). The yield of the wells is reported to be 600, 500 (flow), 700, 600, 1,500, and 1,700 gpm.

Treatment: Prechlorination, iron removal by aeration and contact beds of manganese ore and coke, and rapid sand filtration.

Rated capacity of treatment plant: 4,500,000 gpd.

Raw-water storage: None.

Finished-water storage: High tower, 250,000 gal; concrete reservoir, 3,500,000 gal.

ANALYSIS

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

	Finished water composite [a] [b]		Finished water composite [a] [b]
Silica (SiO_2)	20	Hardness as $CaCO_3$:	
Iron (Fe)	2.2	Total	324
Manganese (Mn)	.00	Noncarbonate	83
Calcium (Ca)	77		
Magnesium (Mg)	32	Color	5
Sodium (Na)	22	pH	8.0
Potassium (K)	4.7	Specific conductance (micromhos at 25 C.)	714
Carbonate (CO_3)	0	Turbidity	9
Bicarbonate (HCO_3)	294	Temperature (F.)	50
Sulfate (SO_4)	107	Date of collection	May 31, 1951
Chloride (Cl)	11		
Fluoride (F)	.1		
Nitrate (NO_3)	4.4		
Dissolved solids	462		

[a] Chlorination only. Treatment plant out of service for repairs at time of collection of sample.

[b] Wells 5, 8, and 9.

MINNEAPOLIS
(Population, 521,718)

Ownership: Municipal; also supplies about 11,000 people outside the city limits and about 3,700 at other places. Total population supplied, about 536,400.
Source: Mississippi River.
Treatment: Prechlorination, softening with lime and soda ash, coagulation with ferrous sulfate, and Ferrifloc as required, clarification stabilization with alum, carbon dioxide or Ferrifloc or a combination of these as required, rapid sand filtration, postchlorination, and ammoniation.
Rated capacity of treatment plants: Fridley softening plant, 100,000,000 gpd; Columbia Heights filtration plant, 78,000,000 gpd; Fridley filtration plant, 80,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 61,000,000 gal.

The public supply of Minneapolis is obtained from the Mississippi River at the Fridley pumping station No. 5 located north of the city proper. After the water is softened at the Fridley water-softening plant it is divided for filtration. Centrifugal pumps deliver part of the water to the Columbia Heights filtration plant from which (after filtration and sterilization) the finished water is supplied to the city by gravity from the covered finished-water reservoir. The other portion is pumped by low service pumps to the Fridley filtration plant from which the finished water is pumped directly into the mains from the covered reservoir. The western half of the city is supplied by direct pumping into the mains and the balance is served by gravity. The Columbia Heights plant generally serves the entire city from midnight to 5 o'clock in the morning.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	10	4.4	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.17	Total	148	68
Manganese (Mn)	.00	.00	Noncarbonate	13	43
Calcium (Ca)	40	20			
Magnesium (Mg)	12	4.4	Color	47	7
Sodium (Na)	3.6	4.2	pH	7.9	7.6
Potassium (K)	2.0	2.3	Specific conductance (micromhos at 25 C.)	296	182
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	165	30	Turbidity	5	0.9
Sulfate (SO_4)	18	44	Temperature (F.)	69	66
Chloride (Cl)	1.0	8.0	Date of collection	May 29, 1951	May 29, 1951
Fluoride (F)	.1	.1			
Nitrate (NO_3)	2.0	.9			
Dissolved solids	198	126			

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	151	196	95	8.1	8.7	7.5	163	194	142	9.6	90	2
Finished water	42	58	18	8.0	8.6	7.4	77	83	74	.3	2.2	0

MOORHEAD
(Population, 14,870)

Ownership: Municipal.
Source: 5 wells (5 to 9), 265, 265, 116, 116, and 116 ft deep. The yield of the wells is reported to be 500, 500, 200, 1,400, and 1,400 gpm.
Treatment: Softening with lime, coagulation with ferric sulfate, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,800,000 gal.

ANALYSES

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

	Well 5 (raw water)	Well 9 (raw water)	Wells 5 & 9 (finished water)
Silica (SiO_2)	28	27	20
Iron (Fe)	.63	.26	.14
Manganese (Mn)	.00	.04	.00
Calcium (Ca)	55	70	22
Magnesium (Mg)	13	26	8.3
Sodium (Na)	155	74	100
Potassium (K)	5.0	5.5	4.9
Carbonate (CO_3)	0	0	10
Bicarbonate (HCO_3)	329	380	142
Sulfate (SO_4)	144	104	121
Chloride (Cl)	74	14	32
Fluoride (F)	.2	.2	.2
Nitrate (NO_3)	3.8	3.3	3.4
Dissolved solids	644	518	396
Hardness as $CaCO_3$:			
Total	189	280	89
Noncarbonate	0	0	0
Color	4	3	2
pH	7.7	7.6	8.7
Specific conductance (micromhos at 25 C.)	1,010	801	616
Turbidity	2	1	1
Temperature (F.)	48	45	49
Date of collection	May 25, 1951	May 25, 1951	May 25, 1951
Depth (feet)	265	116	
Diameter (inches)	16	12	
Date drilled	1930	1947	
Percent of supply	--	--	

OWATONNA
(Population, 10,191)

Ownership: Municipal.
Source: 3 wells (1 to 3) each 710 ft deep. The yield of the wells is reported to be 1,300, 1,600, and 1,000 gpm.
Treatment: Aeration, and hand application of chlorine when necessary.
Raw-water storage: None.
Finished-water storage: 625,000 gal.

OWATONNA--Continued

ANALYSIS

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

	Well 2 (finished water)		Well 2 (finished water)
Silica (SiO_2)	12	Hardness as $CaCO_3$:	
Iron (Fe)	.33	Total	266
Manganese (Mn)	.00	Noncarbonate	24
Calcium (Ca)	70		
Magnesium (Mg)	22	Color	2
Sodium (Na)	6.2	pH	7.6
Potassium (K)	1.3	Specific conductance (micromhos at 25 C.)	492
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	296	Temperature (F.)	50
Sulfate (SO_4)	29	Date of collection	May 7, 1951
Chloride (Cl)	3.0		
Fluoride (F)	.1		
Nitrate (NO_3)	6.1		
Dissolved solids	298		
Depth (feet)			710
Diameter (inches)			16
Date drilled			1945
Percent of supply			--

RED WING
(Population, 10,645)

Ownership: Municipal.
Source: 4 wells (Sta. 1, well 3; Sta. 3, well 1; well 2; and well, East 8th St.) 460, 770, 480, and 620 ft deep. The yield of the wells is reported to be 1,150, 1,500, 1,300 and 1,050 gpm.
Treatment: Aeration.
Raw-water storage: None.
Finished-water storage: Elevated tank, 1,200,000 gal; 2 reservoirs, 750,000 and 1,000,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	11	Hardness as $CaCO_3$:	
Iron (Fe)	.39	Total	254
Manganese (Mn)	.00	Noncarbonate	6
Calcium (Ca)	56		
Magnesium (Mg)	28	Color	2
Sodium (Na)	52	pH	7.7
Potassium (K)	5.3	Specific conductance (micromhos at 25 C.)	711
Carbonate (CO_3)	0	Turbidity	3
Bicarbonate (HCO_3)	302	Temperature (F.)	48
Sulfate (SO_4)	25	Date of collection	May 4, 1951
Chloride (Cl)	72		
Fluoride (F)	.1		
Nitrate (NO_3)	4.1		
Dissolved solids	420		

ROBBINSDALE
(Population, 11,289)

Ownership: Municipal.
Source: 3 wells (1 to 3) about 630 ft deep, for main supply; broken connection to Minneapolis supply for auxiliary supply. The yield of the wells is reported to be 900, 1,050, and 1,200 gpm. One pump operates during the winter months; two pumps operate continuously and a third operates intermittently during the day in the summer months. The water is pumped directly into the mains.
Treatment: Chlorination and sodium phosphate for water stabilization.
Raw-water storage: None.
Finished-water storage: Auxiliary supply, elevated storage, 150,000 gal.

ANALYSES

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

	Well 2 (finished water)	Well 3 (finished water)		Well 2 (finished water)	Well 3 (finished water)
Silica (SiO_2)	21	20	**Hardness as $CaCO_3$:**		
Iron (Fe)	.22	.08	Total	366	360
Manganese (Mn)	.00	.00	Noncarbonate	11	11
Calcium (Ca)	75	76			
Magnesium (Mg)	44	41	Color	5	3
Sodium (Na)	5.8	4.8	pH	7.7	7.7
Potassium (K)	3.0	2.4	Specific conductance (micromhos at 25 C.)	680	653
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	433	426	Turbidity	3	2
Sulfate (SO_4)	16	12	Temperature (F.)	52	52
Chloride (Cl)	7.0	6.0	Date of collection	May 29, 1951	May 29, 1951
Fluoride (F)	.1	.1			
Nitrate (NO_3)	.9	.4			
Dissolved solids	[a]386	[a]373			
Depth (feet)				630	--
Diameter (inches)				18	24-20
Date drilled				--	1949
Percent of supply				--	--

[a] Sum of determined constituents.

ROCHESTER
(Population, 29,885)

Ownership: Municipal.
Source: 11 wells (2 to 11), 430 to 510 ft deep. The yield of the wells is reported to range from 190 to 1,100 gpm.
Treatment: None (chlorination planned to be started in June 1951).
Storage: 2,400,000 gal.

ROCHESTER--Continued

ANALYSIS

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

	Wells (composite)		Wells (composite)
Silica (SiO_2)	11	Hardness as $CaCO_3$:	
Iron (Fe)	.15	Total	260
Manganese (Mn)	.00	Noncarbonate	20
Calcium (Ca)	70		
Magnesium (Mg)	21	Color	1
Sodium (Na)	3.7	pH	7.7
Potassium (K)	1.6	Specific conductance (micromhos at 25 C.)	477
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	292	Temperature (F.)	52
Sulfate (SO_4)	23	Date of collection	May 7, 1951
Chloride (Cl)	5.0		
Fluoride (F)	.1		
Nitrate (NO_3)	4.1		
Dissolved solids	288		

ST. CLOUD
(Population, 28,410)

Ownership: Municipal.
Source: Mississippi River.
Treatment: Prechlorination, ammoniation, coagulation with alum, activated carbon, sedimentation, and rapid sand filtration.
Rated capacity of treatment plant: 3,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,500,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	6.0	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	134
Manganese (Mn)	.00	Noncarbonate	51
Calcium (Ca)	35		
Magnesium (Mg)	11	Color	4
Sodium (Na)	3.6	pH	7.0
Potassium (K)	2.1	Specific conductance (micromhos at 25 C.)	287
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	101	Temperature (F.)	55
Sulfate (SO_4)	53	Date of collection	May 1, 1951
Chloride (Cl)	4.5		
Fluoride (F)	.0		
Nitrate (NO_3)	.8		
Dissolved solids	190		

ST. LOUIS PARK
(Population, 22,644)

Ownership: Municipal.
Source: 6 wells (1 to 6). Wells 1, 2, and 3 are 290 ft deep; wells 4, 5, and 6 are 500 ft deep. The yield of the wells is reported to be as follows: Wells 1 and 2, 930 gpm, each; wells 3, 4, 5, and 6, 1,200 gpm, each.
Treatment: Chlorination, polyphosphate for stabilization, and aeration in surface storage tank.
Raw-water storage: None.
Finished-water storage: Elevated tank, 1,600,000 gal; steel surface tank, 1,500,000 gal.

Continuous problem with "Crenothrix". Water is pumped directly into mains. The iron content is reported to vary from 0.8 to 3.4 ppm.

ANALYSES

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

	Well 3 (finished water)	Well 4 (finished water)		Well 3 (finished water)	Well 4 (finished water)
Silica (SiO_2)	20	17	Hardness as $CaCO_3$:		
Iron (Fe)	.18	.65	Total	334	290
Manganese (Mn)	.00	.02	Noncarbonate	72	13
Calcium (Ca)	81	73			
Magnesium (Mg)	32	26	Color	5	4
Sodium (Na)	3.6	4.0	pH	8.0	8.1
Potassium (K)	1.7	1.7	Specific conductance (micromhos at 25 C.)	620	537
Carbonate (CO_3)	0	0	Turbidity	2	10
Bicarbonate (HCO_3)	320	338	Temperature (F.)	49	49
Sulfate (SO_4)	52	13	Date of collection	May 30, 1951	May 30, 1951
Chloride (Cl)	16	6.5			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	7.3	1.4			
Dissolved solids	432	308			

Depth (feet)	290	500
Diameter (inches)	24	18
Date drilled	1939	1946
Percent of supply	--	--

ST. PAUL
(Population, 311,349)

Ownership: Municipal; also supplies 10,000 people outside the city limits. Total population supplied, about 325,000.
Source: Mississippi River and watershed of impounding lakes for regular supply; Centerville Lakes System for auxiliary supply. The principal impounding reservoirs of the present water-supply system are lakes Vadnais, Pleasant, Otter, Charles, and Sucker. Water storage in the Vadnais impounding system may be augmented from two principal sources: water pumped from the Centerville Lake system, which consists of four principal lakes and lies 18 to 20 miles north of the city; water pumped from the Mississippi River to the Vadnais storage reservoir through Charles and Pleasant Lakes.
Treatment: Aeration, coagulation with alum, softening with lime, recarbonation, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 70,000,000 gpd.
Raw-water storage: 6,750,000,000 gal.
Finished-water storage: 70,000,000 gal.

ST. PAUL--Continued

Water from Otter Lake and the overflow from Bald Eagle Lake may be taken by gravity into the Vadnais system as a reserve source of supply. During low water stages, however, the water in Otter Lake is highly colored and is seldom used. Two artesian well fields are held in reserve. One field which has 28 wells with an average depth of 400 ft, is located along the shores of Centerville Lake. The other field which has 6 wells ranging in depth from 700 to 1,000 ft is located at McCarron Station.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	5.1	5.1	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.13	Total	149	58
Manganese (Mn)	.00	.00	Noncarbonate	6	10
Calcium (Ca)	39	21			
Magnesium (Mg)	13	1.4	Color	15	5
Sodium (Na)	4.2	4.4	pH	8.1	7.9
Potassium (K)	2.0	2.1	Specific conductance (micromhos at 25 C.)	301	148
Carbonate (CO_3)	0	0	Turbidity	3	1
Bicarbonate (HCO_3)	174	59	Temperature (F.)	64	67
Sulfate (SO_4)	12	15	Date of collection	May 29, 1951	May 30, 1951
Chloride (Cl)	1.0	4.5			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	1.3	.8			
Dissolved solids	180	92			

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	148	168	132	8.3	8.6	8.1	159	179	144	3	6	1
Finished water	57	70	42	8.6	8.8	8.5	72	86	56	Tr	Tr	Tr

SOUTH ST. PAUL
(Population, 15,909)

Ownership: Municipal.
Source: 3 wells (2 to 4), 982, 340, and 960 ft deep. The yield of the wells is reported to be 1,200, 1,900, and 2,000 gpm. The water is pumped directly to the mains and to storage.
Treatment: None.
Storage: 2,400,000 gal.

SOUTH ST. PAUL--Continued

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

	Well 2	Well 3		Well 2	Well 3
Silica (SiO_2)	18	19	Hardness as $CaCO_3$:		
Iron (Fe)	.25	.10	Total	306	337
Manganese (Mn)	.00	.00	Noncarbonate	48	77
Calcium (Ca)	76	84			
Magnesium (Mg)	28	31	Color	2	2
Sodium (Na)	6.8	25	pH	8.0	7.7
Potassium (K)	2.3	2.3	Specific conductance (micromhos at 25 C.)	578	735
Carbonate (CO_3)	0	0	Turbidity	2	0.8
Bicarbonate (HCO_3)	315	317	Temperature (F.)	52	51
Sulfate (SO_4)	42	53	Date of collection	May 29, 1951	May 29, 1951
Chloride (Cl)	7.5	39			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	13	23			
Dissolved solids	380	476			
Depth (feet)				982	340
Diameter (inches)				10	24
Date drilled				1923	1937
Percent of supply				--	--

VIRGINIA
(Population, 12,486)

Ownership: Municipal; also supplies about 800 people outside the city limits. Total population supplied, about 13,300.
Source: Mesabi pit shaft for regular supply; 1 well, 400 ft deep, for auxiliary supply.
Treatment: Softening with lime, coagulation with sodium aluminate, sedimentation, recarbonation, rapid sand (pressure) filtration, stabilization with polyphosphate, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 500,000 gal.
Finished-water storage: 1,200,000 gal.

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	14	14	Hardness as $CaCO_3$:		
Iron (Fe)	.08	.04	Total	197	75
Manganese (Mn)	.00	.00	Noncarbonate	31	42
Calcium (Ca)	47	30			
Magnesium (Mg)	19	.1	Color	2	1
Sodium (Na)	7.9	20	pH	7.6	10.6
Potassium (K)	1.4	1.3	Specific conductance (micromhos at 25 C.)	400	272
Carbonate (CO_3)	0	[a] 20	Turbidity	5	5
Bicarbonate (HCO_3)	203	0	Temperature (F.)	--	43
Sulfate (SO_4)	35	35	Date of collection	May 3, 1951	May 3, 1951
Chloride (Cl)	10	12			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	3.4	2.2			
Dissolved solids	248	148			

[a] Hydroxide (OH) 10 ppm.

WILLMAR
(Population, 9,410)

Ownership: Municipal.
Source: 1 well (3) 302 ft deep, for regular supply; 2 wells (1 and 2) 314 and 310 ft deep for auxiliary supply. The yield for well 3 is reported to be 1,500 gpm; well 2, 600 gpm; well 1, not reported.
Treatment: Chlorination, and polyphosphate for water stabilization.
Rated capacity of treatment plant: 1,400,000 gpd.
Raw-water storage: None.
Finished-water storage: Elevated tank, 150,000 gal.

ANALYSIS

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

	Well 3 (finished water)		Well 3 (finished water)
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	1.6	Total	464
Manganese (Mn)	.02	Noncarbonate	0
Calcium (Ca)	102		
Magnesium (Mg)	51	Color	6
Sodium (Na)	39	pH	7.7
Potassium (K)	2.9	Specific conductance (micromhos at 25 C.)	942
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	577	Temperature (F.)	50
Sulfate (SO_4)	77	Date of collection	May 1, 1951
Chloride (Cl)	6.0		
Fluoride (F)	.1		
Nitrate (NO_3)	.5		
Dissolved solids	590		

Depth (feet)	302
Diameter (inches)	24-20
Date drilled	1949
Percent of supply	--

WINONA
(Population, 25,031)

Ownership: Board of Municipal Water Works.
Source: 6 wells (5 to 10), 500, 486, 452, 150, 149, and 150 ft deep. The yield of the wells is reported to be 1,002, 1,110, 840, 900, 1,136, and 1,100 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: Underground reservoir, 2,000,000 gal; elevated tank, 500,000 gal.

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.59	Total	241
Manganese (Mn)	.05	Noncarbonate	0
Calcium (Ca)	58		
Magnesium (Mg)	23	Color	4
Sodium (Na)	57	pH	7.7
Potassium (K)	4.8	Specific conductance (micromhos at 25 C.)	696
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	306	Turbidity	1
Sulfate (SO_4)	52	Temperature (F.)	50
Chloride (Cl)	44	Date of collection	May 8, 1951
Fluoride (F)	.4		
Nitrate (NO_3)	.8		
Dissolved solids	412		

CAPE GIRARDEAU, MISSOURI
(Population, 21,578)

Ownership: Missouri Utilities Co.
Source: Mississippi River.
Treatment: Coagulation with lime and ferrous sulfate, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,200,000 gpd.
Raw-water storage: 1,000,000 gal.
Finished-water storage: 3,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by Div. of Health of Missouri, Jefferson City, Mo.)

	Finished water		Finished water
Silica (SiO_2)	8.0	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	240
Manganese (Mn)	--	Noncarbonate	98
Calcium (Ca)	63		
Magnesium (Mg)	20	Color	--
Sodium (Na)	17	pH	6.9
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	1.4
Bicarbonate (HCO_3)	173	Temperature (F.)	--
Sulfate (SO_4)	100	Date of collection	Feb. 4, 1952
Chloride (Cl)	20		
Fluoride (F)	--		
Nitrate (NO_3)	3.8		
Dissolved solids	364		

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	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	120	142	110	7.3	8.4	7.0	213	241	196	0.2	1.4	0.1

CARTHAGE
(Population, 11,188)

Ownership: Municipal. Total population supplied, about 12,000.
Source: 7 deep wells. The depths of wells 1, 2, 5, 6, and 7 are 1,006, 1,000, 1,008, 1,854, and 1,865 ft, respectively.
Treatment: Softening with lime, coagulation with alum, sedimentation, chlorination, and rapid sand filtration.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoir, 1,500,000 gal; elevated, 500,000 gal.

CARTHAGE--Continued
ANALYSIS

(Analysis, in parts per million, by the Division of Health, Jefferson City, Mo.)

	Finished water		Finished water
Silica (SiO_2)	6.0	Hardness as $CaCO_3$:	
Iron (Fe)	.4	Total	107
Manganese (Mn)	--	Noncarbonate	65
Calcium (Ca)	23		
Magnesium (Mg)	12	Color	--
Sodium (Na)	24	pH	8.4
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	6		
Bicarbonate (HCO_3)	38	Turbidity	0.6
Sulfate (SO_4)	57	Temperature (F.)	--
Chloride (Cl)	37	Date of collection	Feb. 11, 1952
Fluoride (F)	--		
Nitrate (NO_3)	7.5		
Dissolved solids	246		

CLAYTON
(Population, 16,035)

Ownership: Supplied by the St. Louis County Water Co. (See University City.)

COLUMBIA
(Population, 31,974)

Ownership: Municipal; also supplies approximately 150 people outside the city limits. Total population supplied, about 32,100.
Source: 4 wells, 1,100 to 1,500 ft deep for regular supply; connection with a limited number of wells at the University of Missouri for auxiliary or emergency supply.
Treatment: Chlorination.
Raw-water storage: 5,000,000 gal.
Finished-water storage: 1,000,000 gal.

ANALYSIS

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

	Wells 1, 5 (city tap)		Wells 1, 5 (city tap)
Silica (SiO_2)	9.0	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	270
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	58		
Magnesium (Mg)	31	Color	3
Sodium (Na)	44	pH	8.2
Potassium (K)	6.4	Specific conductance (micromhos at 25 C.)	668
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	368	Turbidity	0.7
Sulfate (SO_4)	35	Temperature (F.)	56
Chloride (Cl)	26	Date of collection	Apr. 16, 1951
Fluoride (F)	1.4		
Nitrate (NO_3)	1.0		
Dissolved solids	406		

FERGUSON
(Population, 11,593)

Ownership: St. Louis County Water Company. (See University City.)

FULTON
(Population, 10,052)

Ownership: Municipal; also supplies about 100 people outside the city limits. Total population supplied, about 10,150.
Source: 1 well 1,350 ft deep, for regular supply; 1 well at Missouri State Hospital for emergency or auxiliary supply.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 500,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	8.0	Hardness as $CaCO_3$:	
Iron (Fe)	.94	Total	294
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	65		
Magnesium (Mg)	32	Color	1
Sodium (Na)	37	pH	7.8
Potassium (K)	5.7	Specific conductance (micromhos at 25 C.)	684
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	364	Temperature (F.)	--
Sulfate (SO_4)	50	Date of collection	Apr. 17, 1951
Chloride (Cl)	20		
Fluoride (F)	.1		
Nitrate (NO_3)	.5		
Dissolved solids	408		

Depth (feet)	1,350
Diameter (inches)	10
Date drilled	1931
Percent of supply	100

HANNIBAL
(Population, 20,444)

Ownership: Municipal; also supplies about 1,000 people outside the city limits. Total population supplied, about 21,400.
Source: Mississippi River.
Treatment: Plain sedimentation, coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 7,500,000 gal.
Finished-water storage: 7,500,000 gal..

HANNIBAL--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	6.3	Hardness as $CaCO_3$:	
Iron (Fe)	.07	Total	157
Manganese (Mn)	.00	Noncarbonate	77
Calcium (Ca)	47		
Magnesium (Mg)	9.7	Color	8
Sodium (Na)	3.2	pH	7.5
Potassium (K)	2.7	Specific conductance (micromhos at 25 C.)	340
Carbonate (CO_3)	0	Turbidity	0.9
Bicarbonate (HCO_3)	98	Temperature (F.)	49
Sulfate (SO_4)	71	Date of collection	Apr. 12, 1951
Chloride (Cl)	6.5		
Fluoride (F)	.0		
Nitrate (NO_3)	7.9		
Dissolved solids	246		

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	164	76	7.8	8.2	7.2	161	198	122	315	2000	25
Finished water	119	150	72	7.4	7.9	6.9	176	204	142	.1	.3	0

INDEPENDENCE
(Population, 36,963)

Ownership: Missouri Water Co.--Independence Division; also supplies about 24,000 people outside the city limits. Total population supplied, about 61,000.
Source: Missouri River. (See Kansas City.)
Finished-water storage: Closed surface reservoir, 2,000,000 gal; elevated tank, 600,000 gal; and standpipe, 25,000 gal.

JEFFERSON CITY
(Population, 25,099)

Ownership: Capital City Water Company.
Source: Missouri River.
Treatment: Softening with lime, coagulation with iron salts, sedimentation, secondary coagulation with iron salts, activated carbon, chlorination, sedimentation, recarbonation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 2,000,000 gal.
Finished-water storage: 1,250,000 gal.

The composition of the raw water varies considerably throughout the year.

JEFFERSON CITY--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	8.4	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	109
Manganese (Mn)	.00	Noncarbonate	62
Calcium (Ca)	41		
Magnesium (Mg)	1.6	Color	4
Sodium (Na)	27	pH	7.8
Potassium (K)	3.5	Specific conductance (micromhos at 25 C.)	366
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	57	Temperature (F.)	46
Sulfate (SO_4)	99	Date of collection	Apr. 17, 1951
Chloride (Cl)	15		
Fluoride (F)	.2		
Nitrate (NO_3)	2.8		
Dissolved solids	248		

JENNINGS
(Population, 15,282)

Ownership: Supplied by the St. Louis County Water Co. (See University City.)

JOPLIN
(Population, 38,711)

Ownership: Joplin Water Works Co. (private). Total population supplied, about 40,000.
Source: Shoal Creek.
Treatment: Coagulation with alum and lime, carbon when required, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 2,100,000 gal.
Finished-water storage: 1,360,000 gal.

ANALYSIS

Analysis, in parts per million, by Div. of Health of Missouri, Jefferson City, Mo.

	Finished water		Finished water
Silica (SiO_2)	6.0	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	131
Manganese (Mn)	--	Noncarbonate	11
Calcium (Ca)	48		
Magnesium (Mg)	2.7	Color	--
Sodium (Na)	6.4	pH	7.4
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	0.1
Bicarbonate (HCO_3)	146	Temperature (F.)	--
Sulfate (SO_4)	9.9	Date of collection	June 18, 1951
Chloride (Cl)	7.6		
Fluoride (F)	--		
Nitrate (NO_3)	5.3		
Dissolved solids	167		

JOPLIN--Continued

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.....	114	120	108	7.5	7.6	7.2	--	--	--	30	3000	20
Finished water...	112	115	106	7.5	7.5	7.2	112	130	100	0	0	0

KANSAS CITY
(Population, 456,622)

Ownership: Municipal; also supplies Avondale, Grandview, Independence, Lees Summit, Sugar Creek, a number of water districts in Clay and Jackson Counties, and private water companies. Total population supplied, about 689,000.

Source: Missouri River. The intake is located about 4 miles upstream from the city.

Treatment: Plain sedimentation (clarifier-equipped basins), softening with lime and soda ash, clarification and coagulation with ferric sulfate and alum, recarbonation, ammoniation (ammonium sulfate), activated carbon (aqua Nuchar), sedimentation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 150,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 52,000,000 gal.

The raw water is pumped from the river to the purification works by the Low Lift Pumping Station. From the finished-water reservoirs at the purification site the water is pumped by the Secondary Pumping Station through a tunnel under the Missouri River to reservoirs at the sites of two pumping stations in the city, Turkey Creek and East Bottoms Pumping Stations. The water is delivered from these reservoirs by these two to pumping station into the city's main distribution system. Turkey Creek Pumping Station is steam operated and handles about two-thirds of the total demand on the distribution system. All others are electrically operated. Repumping is required, during hours of maximum demand in the summer months, in an area in the south and southwest part of the city and in an area to the south of the city limits.

KANSAS CITY--Continued

ANALYSES

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

	Finished water	Finished water average [a]	Raw water average [a]
Silica (SiO_2)	11	9.4	12
Iron (Fe)	.04	--	--
Manganese (Mn)	.00	--	--
Calcium (Ca)	21	23	61
Magnesium (Mg)	8.2	6.3	17
Sodium (Na)	66	51	41
Potassium (K)	5.2		
Carbonate (CO_3)	9	--	--
Bicarbonate (HCO_3)	24	[b] 49	[b] 192
Sulfate (SO_4)	159	126	120
Chloride (Cl)	27	19	19
Fluoride (F)	.3	--	--
Nitrate (NO_3)	2.6	--	--
Dissolved solids	346	297	[c] 365
Hardness as $CaCO_3$:			
Total	86	84	221
Noncarbonate	51	43	64
Color	3	--	--
pH	8.7	9.4	8.3
Specific conductance (micromhos at 25 C.)	520	--	--
Turbidity	0.3	.26	2,170
Temperature (F.)	45	54	54
Date of collection	Mar. 23, 1951	--	--

Regular determinations at treatment plant, 1951 [d]

	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	157	238	113	8.3	8.4	8.2	221	305	145	2170	5800	200
Finished water	40	47	37	9.4	9.5	9.3	84	91	66	.26	.6	.1

[a] Analyzed by Purification Division, Kansas City Water Dept. Composite analyses, May 1950 to Feb. 1951, inclusive.
[b] Includes the equivalent of any carbonate (CO_3).
[c] Sum of determined constituents. [d] May 1950 to February 1951.

KIRKSVILLE
(Population, 11,110)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 11,300.
Source: Chariton River.
Treatment: Softening with lime, coagulation with alum, sedimentation, recarbonation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: Reservoir, 5,000,000 gal.
Finished-water storage: 600,000 gal.

KIRKSVILLE--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	8.6	5.6	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.04	Total	119	134
Manganese (Mn)	.01	.00	Noncarbonate	55	82
Calcium (Ca)	35	51			
Magnesium (Mg)	7.7	1.6	Color	34	6
Sodium (Na)	8.5	6.6	pH	7.8	7.7
Potassium (K)	2.7	2.6	Specific conductance (micromhos at 25 C.)	283	317
Carbonate (CO_3)	0	0	Turbidity	320	0.5
Bicarbonate (HCO_3)	78	64	Temperature (F.)	--	47
Sulfate (SO_4)	66	83	Date of collection	Apr. 11, 1951	Apr. 11, 1951
Chloride (Cl)	2.0	8.5			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	6.2	4.2			
Dissolved solids	188	216			

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	150	250	80	7.0	7.6	--	190	220	160	300	450	200
Finished water	40	72	18	7.6	9.2	7.2	90	120	60	0.2	0.2	0.2

KIRKWOOD
(Population, 18,640)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 19,100.

Source: Ranney collector, 53 ft deep and 13 ft in diameter, with valve controlled lateral perforated infiltration pipes along Meramec River.

Treatment: Aeration, softening with quick lime, prechlorination, mechanical flocculation, sedimentation, rapid sand filtration, and postchlorination.

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

Raw-water storage: None.

Finished-water storage: 1,500,000 gal.

KIRKWOOD--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	11	9.2	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.02	Total	267	128
Manganese (Mn)	.00	.00	Noncarbonate	71	68
Calcium (Ca)	65	21			
Magnesium (Mg)	26	18	Color	2	2
Sodium (Na)	21	20	pH	7.2	9.5
Potassium (K)	1.8	1.0	Specific conductance (micromhos at 25 C.)	585	373
Carbonate (CO_3)	0	18	Turbidity	3	0.2
Bicarbonate (HCO_3)	239	36	Temperature (F.)	55	56
Sulfate (SO_4)	61	65	Date of collection	Apr. 14, 1951	Apr. 14, 1951
Chloride (Cl)	41	31			
Fluoride (F)	.0	.1			
Nitrate (NO_3)	1.3	1.0			
Dissolved solids	420	244			

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	213	217	197	6.6	6.6	6.5	279	328	256	1.9	8	0.9
Finished water	56	61	50	9.4	9.5	9.3	120	127	110	.1	.1	.1

MAPLEWOOD
(Population, 13,416)

Ownership: Supplied by the St. Louis County Water Co. (See University City.)

MEXICO
(Population, 11,623)

Ownership: Missouri Power and Light Company.
Source: 4 wells (1 to 4) 1,173, 1,208, 1,250, and 1,450 ft deep, 90 percent of supply; impounding reservoir, 10 percent of supply. The yield of the wells is reported to be 310, 1,000, 300, and 750 gpm. Water from the impounding reservoir is only used when the runoff is high.
Treatment: Aeration, addition of lime, alum, and chlorine, sedimentation, recarbonation, and rapid sand filtration.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: Impounding reservoir, 52,000,000 gal.
Finished-water storage: Covered reservoir, 600,000 gal.

MEXICO--Continued

ANALYSES

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

	Well 4 (raw water)	Well 4 (finished water)		Well 4 (raw water)	Well 4 (finished water)
Silica (SiO_2)	9.6	9.0	Hardness as $CaCO_3$:		
Iron (Fe)	.23	.04	Total	310	125
Manganese (Mn)	0	0	Noncarbonate	0	0
Calcium (Ca)	63	12			
Magnesium (Mg)	37	23	Color	4	3
Sodium (Na)	66	69	pH	7.4	8.5
Potassium (K)	9.6	10	Specific conductance (micromhos at 25 C.)	839	567
Carbonate (CO_3)	0	7	Turbidity	1	0.5
Bicarbonate (HCO_3)	420	179	Temperature (F.)	--	60
Sulfate (SO_4)	68	65	Date of collection	Apr. 16, 1951	Apr. 16, 1951
Chloride (Cl)	38	45			
Fluoride (F)	1.3	1.2			
Nitrate (NO_3)	2.2	.?			
Dissolved solids	526	330			

Depth (feet)	1,450	--
Diameter (inches)	12	--
Date drilled	1949	--
Percent of supply	--	--

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	334	--	--	7.0	--	--	317	--	--	--	--	--
Finished water	137	154	120	8.2	8.4	8.1	128	146	111	--	--	--

MOBERLY
(Population, 13,115)

Ownership: Municipal; also supplies Huntsville and about 300 consumers outside the city limits. Total population supplied, about 14,900.
Source: Sugar Creek (impounded) for regular supply; Old Water Works Lake for auxiliary or emergency supply.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,304,000 gpd.
Raw-water storage: Reservoir, 1,145,000,000 gal.
Finished-water storage: 817,000 gal.

MOBERLY--Continued

ANALYSIS

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

	Finished water[a]		Finished water[a]
Silica (SiO_2)	2.7	Hardness as $CaCO_3$:	
Iron (Fe)	.14	Total	137
Manganese (Mn)	.00	Noncarbonate	55
Calcium (Ca)	43		
Magnesium (Mg)	7.2	Color	9
Sodium (Na)	5.2	pH	7.9
Potassium (K)	2.8	Specific conductance (micromhos at 25 C.)	295
Carbonate (CO_3)	0	Turbidity	6
Bicarbonate (HCO_3)	100	Temperature (F.)	--
Sulfate (SO_4)	60	Date of collection	Apr. 16, 1951
Chloride (Cl)	5.0		
Fluoride (F)	.1		
Nitrate (NO_3)	2.1		
Dissolved solids	210		

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	--	98	65	--	--	--	--	151	111	20	80	6
Finished water	82	100	70	8.0	8.4	7.8	120	151	111	5	5	5

[a] Sugar Creek Reservoir.

OVERLAND
(Population, 11,566)

Ownership: St. Louis County Water Company. (See University City.)

POPLAR BLUFF
(Population, 15,064)

Ownership: Municipal; also supplies 75 people outside the city limits. Total population supplied, 15,139.
Source: Black River.
Treatment: Coagulation with lime and alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 336,000 gal.
Finished-water storage: 1,200,000 gal.

POPLAR BLUFF--Continued

ANALYSIS

Analysis, in parts per million, by Div. of Health of Missouri, Jefferson City, Mo.

	Finished water		Finished water
Silica (SiO_2)	5.0	Hardness as $CaCO_3$:	
Iron (Fe)	.10	Total	129
Manganese (Mn)	--	Noncarbonate	7
Calcium (Ca)	27		
Magnesium (Mg)	15	Color	--
Sodium (Na)	8.2	pH	7.8
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	0.4
Bicarbonate (HCO_3)	149	Temperature (F.)	--
Sulfate (SO_4)	15	Date of collection	Sept. 11, 1951
Chloride (Cl)	6.3		
Fluoride (F)	--		
Nitrate (NO_3)	.4		
Dissolved solids	150		

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	--	--	--	--	--	--	--	--	--	25	170	20
Finished water	122	129	122	8.1	8.3	8.0	130	134	128	.1	.1	.1

RICHMOND HEIGHTS
(Population, 15,045)

Ownership: Supplied by the St. Louis County Water Co. (See University City.)

ST. CHARLES
(Population, 14,314)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 14,500.
Source: Missouri River.
Treatment: Plain sedimentation, prechlorination, softening with lime, coagulation and clarification with alum, stabilization with Calgon, chloramine, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: 1,000,000 gal (fill and draw system).
Finished-water storage: Steel standpipe, 1,000,000 gal; concrete and steel standpipe, 250,000 gal.

ST. CHARLES--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	11	7.8	Hardness as $CaCO_3$:		
Iron (Fe)	.08	.08	Total	166	116
Manganese (Mn)	0	0	Noncarbonate	45	60
Calcium (Ca)	48	32			
Magnesium (Mg)	11	8.8	Color	15	12
Sodium (Na)	24	23	pH	7.8	9.2
Potassium (K)	4.3	3.6	Specific conductance (micromhos at 25 C.)	437	359
Carbonate (CO_3)	0	10			
Bicarbonate (HCO_3)	148	48	Turbidity	2,000	0.6
Sulfate (SO_4)	85	90	Temperature (F.)	46	46
Chloride (Cl)	9.0	12	Date of collection	Apr. 13, 1951	Apr. 13, 1951
Fluoride (F)	.1	.3			
Nitrate (NO_3)	5.4	4.6			
Dissolved solids	318	232			

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	250	75	7.9	8.2	7.8	200	350	80	2000	18000	50
Finished water	50	100	40	9.1	9.5	8.8	100	175	50	.1	1.0	.05

ST. JOSEPH

(Population, 78,588)

Ownership: St. Joseph Water Co.; also supplies 3,708 people outside the city limits. Total population supplied, about 82,300.

Source: Missouri River.

Treatment: Plain sedimentation, prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 14,800,000 gpd.

Raw-water storage: None.

Finished-water storage: 16,680,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	250
Manganese (Mn)	.00	Noncarbonate	73
Calcium (Ca)	71		
Magnesium (Mg)	18	Color	6
Sodium (Na)	49	pH	8.0
Potassium (K)	5.2	Specific conductance (micromhos at 25 C.)	678
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	216	Turbidity	0.9
Sulfate (SO_4)	153	Temperature (F.)	42
Chloride (Cl)	20	Date of collection	Mar. 26, 1951
Fluoride (F)	.3		
Nitrate (NO_3)	2.8		
Dissolved solids	462		

ST. JOSEPH--Continued

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.....	--	--	--	--	--	--	--	--	--	2570	19830	25
Finished water...	160	272	99	7.8	8.4	7.2	232	372	136	--	--	--

ST. LOUIS
(Population, 856,796)

Ownership: Municipal; also supplies about 2,000 people outside the city limits. Total population supplied, about 858,800.

Source: Mississippi River at the Chain of Rocks Plant, 5 miles below the confluence with the Missouri River, 67 percent of supply; Missouri River at the Howard Bend Plant, 37 miles above its confluence with the Mississippi River, 33 percent of supply.

Treatment (both plants): Plain sedimentation, softening with lime, coagulation with ferrous sulfate, sedimentation, secondary coagulation and sedimentation with alum, ammoniation (ammonium hydroxide), chlorination, rapid sand filtration, and postchlorination.

Rated capacity of treatment plants: Chain of Rocks Plant, 160,000,000 gpd; Howard Bend Plant, 80,000,000 gpd.

Raw-water storage: Plain sedimentation basin at Chain of Rocks Plant, 24,000,000 gal; plain sedimentation basin at Howard Bend Plant, 11,000,000 gal.

Finished-water storage: Mississippi River water--Baden basins, 20,000,000 gal; Bissell's Point basins, 54,000,000 gal; and Compton Hill Reservoir, 85,000,000 gal. Missouri River water--Howard Bend basin, 5,000,000 gal, and Stacy Park reservoir, 100,000,000 gal. Total, 264,000,000 gal.

The raw water from both sources of supply is pumped into the plain sedimentation basins at the respective treatment plants from which it flows by gravity through the treatment plants. The finished water from the Chain of Rocks Plant flows by gravity to storage basins at Baden, $3\frac{1}{2}$ miles south, and Bissell's Point basins, 7 miles south of Chain of Rocks. From these basins three-fourths of the output of the plant is pumped into the city mains connected with the Compton Hill Reservoir, which floats on the system, and supplies the lower part of the city. The remainder of the output is pumped from the Baden basins directly into the mains at a higher pressure and serves the higher sections of the city.

The finished water from the Howard Bend Plant is pumped into Stacy Park Reservoir, about 9 miles distant, at an elevation high enough to supply by gravity flow the highest sections of the city.

ST. LOUIS--Continued

ANALYSES

(Analyses, in parts per million, by the St. Louis Water Department)

	Mississippi River		Missouri River	
	Raw water average[a]	Fin. water average[a]	Raw water average[a]	Fin. water average[a]
Silica (SiO_2)	13	9.0	12	9.3
Iron (Fe)	--	.01	--	--
Manganese (Mn)	--	--	--	--
Calcium (Ca)	50	23	50	23
Magnesium (Mg)	14	9.7	13	9.4
Sodium (Na), Potassium (K)	35	33	34	33
Carbonate (CO_3)	1.2	13	0	12
Bicarbonate (HCO_3)	156	20	163	22
Sulfate (SO_4)	97	109	96	108
Chloride (Cl)	16	17	16	17
Fluoride (F)	--	--	--	--
Nitrate (NO_3)	4.6	5.4	4.9	5.4
Dissolved solids	326	236	326	241
Hardness as $CaCO_3$:				
Total	183	97	181	96
Noncarbonate	53	60	48	58
Color	19	7	21	8
pH	7.9	9.2	8.0	9.2
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	1,100	0.07	1,300	0.07
Temperature (F.)	58	--	57	62
Date of collection	--	--	--	--

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[b]	130	226	77	7.9	8.1	7.6	183	289	107	1100	6400	80
Finished water[b]	37	86	20	9.2	9.6	8.5	97	156	70	.07	.60	.02
Raw water[c]	133	232	77	8.0	8.3	7.6	181	296	102	1300	6600	105
Finished water[c]	38	85	23	9.2	9.9	7.9	96	150	66	.07	.30	.03

[a] Monthly composite analyses.
[b] Chain of Rocks (fiscal year ending April 1950).
[c] Howard Bend (fiscal year ending April 1950).

SEDALIA

(Population, 20,354)

Ownership: Sedalia Water Co.; also supplies about 400 people outside the city limits. Total population supplied, about 20,750.

Source: Spring Fork Lake and Lake Tebo. The two lakes are interconnected, and water from both is mixed before going into the mains.

Treatment: Prechlorination, coagulation with alum, lime for pH control, activated carbon as needed, and rapid sand filtration. Copper sulfate is used for algae control.

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

Raw-water storage: Spring Fork Lake, 560,000,000 gal; Lake Tebo, 175,000,000 gal; Reservoir (settling basin), 50,000,000 gal. Total, 785,000,000 gal.

Finished-water storage: 600,000 gal.

SEDALIA--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	4.3	Hardness as $CaCO_3$:	
Iron (Fe)	.10	Total	55
Manganese (Mn)	.00	Noncarbonate	37
Calcium (Ca)	13		
Magnesium (Mg)	5.5	Color	3
Sodium (Na)	2.7	pH	7.8
Potassium (K)	1.4	Specific conductance (micromhos at 25 C.)	140
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	22	Temperature (F.)	--
Sulfate (SO_4)	35	Date of collection	Apr. 17, 1951
Chloride (Cl)	4.0		
Fluoride (F)	.0		
Nitrate (NO_3)	2.8		
Dissolved solids	106		

SIKESTON

(Population, 11,640)

Ownership: Municipal.

Source: 3 wells (1 to 3) 392, 405, and 366 ft deep, and reported to yield 375, 800, and 920 gpm, respectively.

Treatment: Aeration (spray and contact beds), rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 3,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 700,000 gal.

ANALYSIS

(Analysis, in parts per million, by the Division of Health, Jefferson City, Mo.)

	Finished water (city tap)		Finished water (city tap)
Silica (SiO_2)	10	Hardness as $CaCO_3$:	
Iron (Fe)	.2	Total	120
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	34		
Magnesium (Mg)	8.5	Color	--
Sodium (Na)	11	pH	7.3
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	0.1
Bicarbonate (HCO_3)	158	Temperature (F.)	--
Sulfate (SO_4)	3.7	Date of collection	Oct. 2, 1951
Chloride (Cl)	7.6		
Fluoride (F)	--		
Nitrate (NO_3)	.5		
Dissolved solids	181		

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	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	124	129	116	7.3	7.3	7.3	116	120	97	--	--	--

SPRINGFIELD
(Population, 66,731)

Ownership: Springfield City Water Co. (private); also supplies about 10,000 people outside the city limits. Total population supplied, about 76,700.
Source: Springs, 70 percent of supply; lake, 20 percent of supply; 1 well, 1,404 ft deep, 10 percent of supply.
Treatment: Prechlorination, coagulation with alum, carbon, sedimentation, rapid sand filtration, postchlorination, and ammoniation.
Rated capacity of treatment plant: 12,000,000 gpd.
Raw-water storage: 1,300,000,000 gal.
Finished-water storage: 5,000,000 gal.

ANALYSIS

Analysis, in parts per million, by Div. of Health of Missouri, Jefferson City, Mo.

	Finished water (city tap)		Finished water (city tap)
Silica (SiO_2)	4.0	Hardness as $CaCO_3$:	
Iron (Fe)	.17	Total	178
Manganese (Mn)	--	Noncarbonate	18
Calcium (Ca)	62		
Magnesium (Mg)	5.7	Color	--
Sodium (Na)	6.4	pH	7.1
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	0.1
Bicarbonate (HCO_3)	196	Temperature (F.)	--
Sulfate (SO_4)	13	Date of collection	Oct. 2, 1951
Chloride (Cl)	9.7		
Fluoride (F)	--		
Nitrate (NO_3)	5.3		
Dissolved solids	247		

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	157	178	130	7.5	8.7	7.1	--	--	--	6	25	1
Finished water	157	184	130	7.4	7.8	7.2	--	--	--	0	0	0

UNIVERSITY CITY
(Population, 39,892)

Ownership: St. Louis County Water Co.; also supplies Berkeley, Brentwood, Clayton, Ferguson, Jennings, Kinlock, Ladue, Maplewood, Overland, Pine Lawn, Richmond Heights, Webster Groves, Wellston, and a large number of incorporated and unincorporated places in St. Louis County. Total population supplied, about 268,000.
Source: Missouri River for regular supply; connection to the supply of St. Louis for auxiliary or emergency use.
Treatment: Prechlorination, softening with lime, coagulation with ferric sulfate, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 45,000,000 gpd.
Raw-water storage: 50,000,000 gal.
Finished-water storage: 12,000,000 gal.

The treatment plant is located on the Missouri River near St. Louis' Howard Bend Plant.

UNIVERSITY CITY--Continued

ANALYSES

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

	Raw water average [a]	Finished water average
Silica (SiO_2)	13	12
Iron (Fe)	.03	.0
Manganese (Mn)	--	--
Calcium (Ca)	[b] 48	[b] 22
Magnesium (Mg)	[b] 16	[b] 8.6
Sodium (Na)	33	34
Potassium (K)		
Carbonate (CO_3)	[b] 1	[b] 8
Bicarbonate (HCO_3)	[b] 162	[b] 28
Sulfate (SO_4)	91	98
Chloride (Cl)	17	19
Fluoride (F)	.4	.4
Nitrate (NO_3)	2	2
Dissolved solids	[b] 214	[b] 224
Hardness as $CaCO_3$:		
Total	[b] 174	[b] 91
Noncarbonate	[b] 40	[b] 50
Color	[b] 17	[b] 9
pH	[b] 7.9	[b] 9.7
Specific conductance (micromhos at 25 C.)	--	--
Turbidity	[b] 1,700	[b] 0.1
Temperature (F.)	--	56
Date of collection	--	--

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	135	267	99	7.9	8.3	7.2	174	321	81	1700	10000	60
Finished water	40	74	25	9.7	10.2	8.6	91	134	51	.1	2	.1

[a] Monthly composite analyses of daily samples, except as indicated.
[b] Daily determinations.

WEBSTER GROVES
(Population, 23,390)

Ownership: Supplied by the St. Louis County Water Co. (See University City.)

ANACONDA, MONTANA
(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 Creek [a]		Hafner Wells	Warm Springs Creek [a]
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	Turbidity	--	--
Sulfate (SO_4)	25	8.1	Temperature (F.)	45	46
Chloride (Cl)	1.9	1.2	Date of collection	June 22, 1951	June 22, 1951
Fluoride (F)	.3	.3			
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 [b]

	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	--	--	--

[a] Finished water.
[b] 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.

BILLINGS--Continued

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			
Bicarbonate (HCO_3)	147	146	Turbidity	9	2
Sulfate (SO_4)	71	78	Temperature (F.)	56	57
Chloride (Cl)	6.5	7.5	Date of collection	Sept. 17, 1951	Sept. 17, 1951
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.

BOZEMAN--Continued

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	Sept. 22, 1951	Sept. 22, 1951	Sept. 22, 1951	Sept. 22, 1951

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.

BUTTE--Continued

ANALYSES

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

	City tap [a]	Big Hole River	Basin Creek	Mouiton supply [b]
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	[c] 91	[c] 105	[c] 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	Nov. 17, 1951	Dec. 12, 1944	Dec. 12, 1944	Dec. 12, 1944

[a] Analyzed by U. S. Geological Survey.
[b] From Yankee Doodle Creek.
[c] Sum of determined constituents.

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. pipelines 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.

GREAT FALLS--Continued

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			
Bicarbonate (HCO_3)	172	156	Turbidity	8	2
Sulfate (SO_4)	38	47	Temperature (F.)	--	62
Chloride (Cl)	11	15	Date of collection	Sept. 25, 1951	Sept. 25, 1951
Fluoride (F)	.8	.8			
Nitrate (NO_3)	2.4	.8			
Dissolved solids	234	241			

Regular determinations at treatment plant, 1951 [a]

	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

[a] Fiscal year.

HAVRE
(Population, 8,086)

Ownership: Municipal.
Source: 4 wells (1 to 4) 95, 90, 95, and 96 ft deep; yield reported to be 700,000, 1,000,000, 1,300,000, and 700,000 gpd. Construction is under way (1951) for using the Milk River as the source of supply.
Treatment: None.
Storage: 675,000 gal. (When the new plant and the change over to the Milk River as the source of the supply is completed, 200,000 gal additional storage will be available.

HAVRE--Continued

ANALYSES

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

	Wells (city tap)	Raw water [a]		Wells (city tap)	Raw water [a]
Silica (SiO_2)	19	6.0	Hardness as $CaCO_3$:		
Iron (Fe)	.15	.02	Total	404	138
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	83	33			
Magnesium (Mg)	48	14	Color	6	12
Sodium (Na)	231	39	pH	7.7	8.1
Potassium (K)	7.1	2.2	Specific conductance (micromhos at 25 C.)	1,640	422
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	522	208			
Sulfate (SO_4)	443	52	Turbidity	3	10
Chloride (Cl)	29	2.0	Temperature (F.)	51	--
Fluoride (F)	.6	.3	Date of collection	Nov. 6, 1951	Nov. 6, 1951
Nitrate (NO_3)	.8	1.2			
Dissolved solids	1,120	255			
Depth (feet)				90-96	--
Diameter (inches)				24	--
Date drilled				1929, 1946	--
Percent of supply				100	--

[a] Future supply, Milk River.

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 water [a]	Finished water [b]		Finished water [a]	Finished water [b]
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			
Sulfate (SO_4)	20	52	Turbidity	6	1
Chloride (Cl)	3.0	4.0	Temperature (F.)	63	52
Fluoride (F)	.2	.1	Date of collection	Sept. 24, 1951	Sept. 24, 1951
Nitrate (NO_3)	1.4	2.6			
Dissolved solids	76	259			

[a] Tenmile Creek system.

[b] 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	Turbidity	--
Bicarbonate (HCO_3)	180	Temperature (F.)	55
Sulfate (SO_4)	2.6	Date of collection	June 21, 1951
Chloride (Cl)	1.0		
Fluoride (F)	.0		
Nitrate (NO_3)	.1		
Dissolved solids	157		

LEWISTOWN
(Population, 6,573)

Ownership: Municipal; also supplies 50 people outside the city limits. Total population supplied, 6,623.
Source: Big Springs in Snowy Mountains 7,000,000 gpd. The water flows in a closed system to the city. That portion of the 7,000,000 gpd not used overflows to Big Spring Creek.
Treatment: None.
Storage: None. (Standpipes for emergency use only, 1,350,000 gal.).

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

	City tap		City tap
Silica (SiO_2)	7.0	Hardness as $CaCO_3$:	
Iron (Fe)	.11	Total	237
Manganese (Mn)	--	Noncarbonate	80
Calcium (Ca)	64		
Magnesium (Mg)	19	Color	2
Sodium (Na)	1.2	pH	8.2
Potassium (K)	.4	Specific conductance (micromhos at 25 C.)	442
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	192	Temperature (F.)	52
Sulfate (SO_4)	78	Date of collection	Sept. 26, 1951
Chloride (Cl)	2.0		
Fluoride (F)	.5		
Nitrate (NO_3)	.9		
Dissolved solids	283		

LIVINGSTON
(Population, 7,683)

Ownership: Municipal; also supplies about 300 people outside the city limits. Total population supplied, about 8,000.
Source: Yellowstone River.
Treatment: Coagulation with alum and sodium aluminate, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 3,000,000 gal.
Finished-water storage: 3,000,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	15	14	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.04	Total	67	70
Manganese (Mn)	--	--	Noncarbonate	0	2
Calcium (Ca)	17	19			
Magnesium (Mg)	6.0	5.5	Color	4	3
Sodium (Na)	14	14	pH	7.8	7.5
Potassium (K)	3.3	2.8	Specific conductance (micromhos at 25 C.)	208	214
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	84	83	Turbidity	2	1
Sulfate (SO_4)	20	24	Temperature (F.)	54	54
Chloride (Cl)	8.0	8.0	Date of collection	Sept. 17, 1951	Sept. 17, 1951
Fluoride (F)	.4	.4			
Nitrate (NO_3)	7	.3			
Dissolved solids	138	135			

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	Sept. 26, 1951	Sept. 26, 1951	Sept. 26, 1951

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	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	June 22, 1951
Fluoride (F)	.1		
Nitrate (NO_3)	.1		
Dissolved solids	22		

ALLIANCE, NEBRASKA
(Population, 7,891)

Ownership: Municipal.
Source: 8 wells (Plant, Warehouse, Black Hills, Emerson, Hospital, Box Butte, Mississippi, and Missouri) 110, 301, 304, 300, 110, 307, 340, and 291 ft deep. The yield of the wells is reported to be 600, 1,100, 2,050, 900, 450, 1,000, 750, and 1,100 gpm. The Mississippi and Missouri wells furnish the greater part of the domestic supply. The Black Hills well is used exclusively for industry.
Treatment: None.
Storage: 450,000 gal.

ANALYSES

(Analyses, in parts per million, by Infilco Inc., Chicago, Ill.)

	Black Hills Well	Missouri Well	Mississippi Well	Tap sample[a]
Silica (SiO_2)	60	60	60	55
Iron (Fe)	1.0	--	0.0	.01
Manganese (Mn)	--	--	--	.00
Calcium (Ca)	85	85	61	65
Magnesium (Mg)	23	25	19	17
Sodium (Na)	163	166	40	40
Potassium (K)				9.1
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	432	429	260	261
Sulfate (SO_4)	250	240	84	77
Chloride (Cl)	32	53	13	17
Fluoride (F)	--	--	--	.8
Nitrate (NO_3)	--	--	--	11
Dissolved solids	825	840	404	438
Hardness as $CaCO_3$:				
Total	306	317	232	230
Noncarbonate	0	0	19	16
Color	8	4	1	1
pH	7.5	7.6	8.0	7.8
Specific conductance (micromhos at 25 C.)	--	--	--	614
Turbidity	4.0	2.0	0.0	0.5
Temperature (F.)	--	--	--	--
Date of collection	Oct. 5, 1949	Oct. 5, 1949	Oct. 5, 1949	Apr. 30, 1951
Depth (feet)	304	291	340	--
Diameter (inches)	36	36	36	--
Date drilled	1949	1948	1938	--
Percent of supply	--	--	--	--

[a] Composite, Mississippi and Missouri wells. Analyzed by U. S. Geological Survey.

BEATRICE
(Population, 11,813)

Ownership: Municipal.
Source: 4 wells (1 to 4), 94, 95, 93, and 96 ft deep. The yield of the wells is reported to be 1,250, 820, 800, and 800 gpm.
Treatment: None.
Storage: 3,000,000 gal.

ANALYSIS

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

	Wells 1, 2, and 3 (composite)		Wells 1, 2, and 3 (composite)
Silica (SiO_2)	30	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	168
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	53		
Magnesium (Mg)	8.7	Color	2
Sodium (Na)	20	pH	7.4
Potassium (K)	3.5	Specific conductance (micromhos at 25 C.)	398
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	216	Turbidity	0.4
Sulfate (SO_4)	25	Temperature (F.)	63
Chloride (Cl)	10	Date of collection	Mar. 19, 1951
Fluoride (F)	.1		
Nitrate (NO_3)	2.9		
Dissolved solids	276		

COLUMBUS
(Population, 8,844)

Ownership: Municipal; also supplies 54 people outside the city limits. Total population supplied, 8,894.
Source: 6 wells (1 to 6) 98, 100, 126, 120, 100, and 68 ft deep. The yield of the wells is reported to be 300, 400, 840, 300, 600, and 300 gpm.
Treatment: Iron and manganese removal, prechlorination, partial softening with lime, stabilization with metaphosphate, coagulation with alum, and rapid sand filtration.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,100,000 gal.

COLUMBUS--Continued

ANALYSES

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

	Well 1 (raw water)	Well 1 (finished water)		Well 1 (raw water)	Well 1 (finished water)
Silica (SiO_2)	35	36	Hardness as $CaCO_3$:		
Iron (Fe)	.32	.12	Total	273	205
Manganese (Mn)	.11	.02	Noncarbonate	16	15
Calcium (Ca)	87	58			
Magnesium (Mg)	14	15	Color	4	4
Sodium (Na)	35	38	pH	7.4	8.0
Potassium (K)	17	16	Specific conductance (micromhos at 25 C.)	690	580
Carbonate (CO_3)	0	0	Turbidity	1	0.8
Bicarbonate (HCO_3)	314	232	Temperature (F.)	54	55
Sulfate (SO_4)	73	71	Date of collection	Feb. 20, 1951	Feb. 20, 1951
Chloride (Cl)	29	29			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.4	1.7			
Dissolved solids	474	392			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	270	--	--	7.4	--	--	284	--	--	53	--	--
Finished water	84	--	--	9.8	--	--	112	--	--	54	--	--

FREMONT

(Population, 14,762)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 15,000.

Source: 3 wells (Northwest, Northeast, and Southeast), 100, 102, and 105 ft deep; 4 condenser by-pass wells for use in emergency. The yield of the wells is reported to be 1,900 gpm, each. The water is pumped directly into the mains.

Treatment: None.

ANALYSIS

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

	Wells (tap sample)		Wells (tap sample)
Silica (SiO_2)	29	Hardness as $CaCO_3$:	
Iron (Fe)	.14	Total	313
Manganese (Mn)	.03	Noncarbonate	106
Calcium (Ca)	78		
Magnesium (Mg)	29	Color	4
Sodium (Na)	31	pH	7.4
Potassium (K)	10	Specific conductance (micromhos at 25 C.)	723
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	253	Temperature (F.)	54
Sulfate (SO_4)	146	Date of collection	Feb. 27, 1951
Chloride (Cl)	18		
Fluoride (F)	.3		
Nitrate (NO_3)	8.3		
Dissolved solids	490		

GRAND ISLAND
(Population, 22,682)

Ownership: Municipal.
Source: 12 wells, seven of which are standby for summer use. Five of the wells (Harrison St., Locust St., Park View 1 and 2, and Dodge Acres) are 84, 113, 81, 78, and 101 ft deep, respectively. The yield of these wells is reported to be 820, 1,300, 1,000, 890, and 910 gpm.
Treatment: None.
Storage: Reservoir, 4,000,000 gal.

The analysis given represents reasonably well the composition of the water served to the consumers.

ANALYSIS

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

	Wells (composite)[a]		Wells (composite)[a]
Silica (SiO_2)	27	Hardness as $CaCO_3$:	
Iron (Fe)	.06	Total	189
Manganese (Mn)	.00	Noncarbonate	53
Calcium (Ca)	62		
Magnesium (Mg)	8.3	Color	2
Sodium (Na)	19	pH	7.2
Potassium (K)	7.6	Specific conductance (micromhos at 25 C.)	465
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	166	Temperature (F.)	60
Sulfate (SO_4)	64	Date of collection	Apr. 27, 1951
Chloride (Cl)	13		
Fluoride (F)	.2		
Nitrate (NO_3)	20		
Dissolved solids	324		

[a] Clebum, Hart, Parkview 1 and 2, and Harrison St. wells.

HASTINGS
(Population, 20,211)

Ownership: Municipal; also supplies 54 people outside the city limits. Total population supplied, 20,265.
Source: 9 wells (1 to 9) 180, 215, 156, 180, 182, (not reported), 195, 195, and 190 ft deep. The yield of the wells is reported to be 980, 2,254, 1,012, (yield not reported for wells 4 and 5), 1,025, 1,000, 2,040, and 1,000 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 1,550,000 gal.

HASTINGS--Continued

ANALYSIS

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

	Wells 1, 2, and 5 (tap sample)		Wells 1, 2, and 5 (tap sample)
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	155
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	51		
Magnesium (Mg)	6.7	Color	1
Sodium (Na)	26	pH	7.5
Potassium (K)	5.7	Specific conductance (micromhos at 25 C.)	410
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	208	Turbidity	0.3
Sulfate (SO_4)	34	Temperature (F.)	55
Chloride (Cl)	8.0	Date of collection	May 1, 1951
Fluoride (F)	.3		
Nitrate (NO_3)	3.8		
Dissolved solids	266		

KEARNEY
(Population, 12,115)

Ownership: Municipal.
Source: 9 wells (2 to 10), 41, 42, 39, 50, 54, 50, 47, 50, and 44 ft deep. The yield of the wells is reported to be 500, 600, 500, 600, 900, 600, 600, 875, and 500 gpm.
Treatment: None.
Storage: 1,000,000 gal.

ANALYSIS

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

	Wells 2, 6, and 9 (tap sample)		Wells 2, 6, and 9 (tap sample)
Silica (SiO_2)	36	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	395
Manganese (Mn)	.00	Noncarbonate	122
Calcium (Ca)	116		
Magnesium (Mg)	26	Color	2
Sodium (Na)	98	pH	7.5
Potassium (K)	10	Specific conductance (micromhos at 25 C.)	1,110
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	333	Turbidity	1
Sulfate (SO_4)	272	Temperature (F.)	55
Chloride (Cl)	28	Date of collection	May 1, 1951
Fluoride (F)	.4		
Nitrate (NO_3)	21		
Dissolved solids	808		

LINCOLN
(Population, 98,884)

Ownership: Municipal; also supplies about 1,850 people outside the city limits and other places. Total population supplied, about 100,700.

Source: 13 wells (1, 1A, 2-2, 2A, 3, 3A-2, 4, 4A, 5, 6, 7, 8, and 9), 50, 92, 88, 85, 65, 49, 54, 53, 67, 85, 84, 83, and 87 ft deep, located 3 miles northeast of Ashland, Nebr. for regular supply; 18 wells, located within Lincoln city limits, 130 to 188 ft deep, for auxiliary supply. The yield of the wells of the regular supply is reported to range from 1,170 gpm (well 4) to 2,090 gpm (well 9).

Treatment: Prechlorination, aeration, postchlorination, ammoniation, sedimentation, and rapid sand filtration, for regular supply. Chlorination only for auxiliary supply.

Rated capacity of treatment plant: 27,000,000 gpd.

Raw-water storage: None.

Finished-water storage: Underground reservoirs, 30,100,000 gal; elevated storage, 385,000 gal; concrete tanks, 2,000,000 gal. Total, 32,485,000 gal.

A collecting pipeline carries the water from the wells to the treatment plant just east of Ashland. After treatment the water is pumped into a concrete reservoir and then into a 36 in. cast-iron pipeline to Lincoln, a distance of 25 miles.

ANALYSES

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

	Regular Supply		Auxiliary Supply	
	Well 2-2	Finished water[a]	Well 16	Finished water[a]
Silica (SiO_2)	24	34	25	39
Iron (Fe)	.09	.1	.07	.2
Manganese (Mn)	.32	.02	.00	.0
Calcium (Ca)	55	59	56	69
Magnesium (Mg)	10	15	14	18
Sodium (Na)	32	31	30	40
Potassium (K)	8.0		4.0	
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	202	212	239	239
Sulfate (SO_4)	83	76	42	55
Chloride (Cl)	8.0	16	14	55
Fluoride (F)	.4	.3	.1	.3
Nitrate (NO_3)	.5	.1	9.6	2.0
Dissolved solids	336	310	336	396
Hardness as $CaCO_3$:				
Total	180	206	196	247
Noncarbonate	14	32	0	51
Color	--	--	--	--
pH	7.5	7.8	7.0	7.3
Specific conductance (micromhos at 25 C.)	492	--	500	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	55	--
Date of collection	May 29, 1951	September, 1951	July 17, 1951	September, 1951
Depth (feet)	88	--	142	--
Diameter (inches)	24	--	12	--
Date drilled	1950	--	--	--
Percent of supply	--	--	--	--

[a] Analyzed by Lincoln Water Dept.

McCOOK
(Population, 7,678)

Ownership: Municipal; also supplies about 350 people outside the city limits. Total population supplied, about 8,050.
Source: 4 wells (1 to 4) 81, 83, 84, and 84 ft deep. The yield of the wells is reported to be 750, 750, (not reported), and 1,500 gpm. Well 1 is used in the winter; wells 3 and 4 are used in the summer; and well 2 is a standby.
Treatment: None. (Chlorination, to start in the autumn of 1951).
Storage: 2 Elevated tanks, 500,000 and 235,000 gal.

ANALYSIS

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

	Well 1		Well 1
Silica (SiO_2)	37	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	314
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	84		
Magnesium (Mg)	25	Color	4
Sodium (Na)	78	pH	7.6
Potassium (K)	16	Specific conductance (micromhos at 25 C.)	898
Carbonate (CO_3)	0	Turbidity	0.7
Bicarbonate (HCO_3)	402	Temperature (F.)	63
Sulfate (SO_4)	127	Date of collection	May 21, 1951
Chloride (Cl)	20		
Fluoride (F)	.9		
Nitrate (NO_3)	6.3		
Dissolved solids	605		

Depth (feet)	84
Diameter (inches)	26
Date drilled	1926
Percent of supply	--

NORFOLK
(Population, 11,335)

Ownership: Municipal; also supplies about 100 people outside the city limits. Total population supplied, about 11,400.
Source: 4 wells (1 to 4), each 110 ft deep. The yield of the wells is reported to be 900, 800, 500, and 700 gpm. One or two of the four wells are held in reserve.
Treatment: Aeration, sedimentation, and rapid sand filtration.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,500,000 gal in clear wells and under pressure.

The water from the different wells is mixed before it reaches the treatment plant. The analyses given of the raw and finished water do not represent water from the same 3 wells. The composition of the finished water varies to some extent depending on what wells are being pumped for the supply.

NORFOLK--Continued

ANALYSES

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

	3 wells (raw water) [a]	Finished water [a]		3 wells (raw water) [a]	Finished water [a]
Silica (SiO_2)	31	32	Hardness as $CaCO_3$:		
Iron (Fe)	1.4	.04	Total	284	310
Manganese (Mn)	.29	.03	Noncarbonate	34	55
Calcium (Ca)	85	94			
Magnesium (Mg)	18	18	Color	5	4
Sodium (Na)	15	16	pH	7.4	7.8
Potassium (K)	6.8	7.8	Specific conductance (micromhos at 25 C.)	585	633
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	306	311			
Sulfate (SO_4)	61	83	Turbidity	10	0.5
Chloride (Cl)	10	13	Temperature (F.)	55	55
Fluoride (F)	.3	.3	Date of collection	Feb. 20, 1951	Feb. 20, 1951
Nitrate (NO_3)	0	.5			
Dissolved solids	398	442			

[a] Composite.

NORTH PLATTE

(Population, 15,433)

Ownership: Municipal.

Source: 45 wells. Forty-one wells in one well field (field No. 1) with an average depth of 100 ft; in another well field 4 wells (2, 3, 4, and 5 or Dunlap well) 97, 92, 135, and 256 ft deep. The yield of the four wells is reported to be 1,750, 1,800, 500, and 800 gpm, respectively, and the combined yield of the 41 wells is 3,400 gpm.

Treatment: None.

Storage: None.

The wells in field No. 1 are operated as a unit, whereas the other four wells are pumped separately.

ANALYSIS

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

	Wells (tap sample) [a]		Wells (tap sample) [a]
Silica (SiO_2)	41	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	326
Manganese (Mn)	.00	Noncarbonate	120
Calcium (Ca)	99		
Magnesium (Mg)	19	Color	2
Sodium (Na)	112	pH	7.8
Potassium (K)	12	Specific condnctance (micromhos at 25 C.)	1,100
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	252		
Sulfate (SO_4)	268	Turbidity	0.6
Chloride (Cl)	64	Temperature (F.)	60
Fluoride (F)	.8	Date of collection	May 1, 1951
Nitrate (NO_3)	11		
Dissolved solids	798		

[a] Well field 1 and well 5 (Dunlap well).

OMAHA
(Population, 251,117)

Ownership: Metropolitan Utilities District; also supplies about 13,000 people outside the city limits. Total population supplied, about 264,100.
Source: Missouri River. The intake and treatment plant are located on the Missouri River at Florence.
Treatment: Plain sedimentation, prechlorination, coagulation with alum, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 90,000,000 gpd.
Raw-water storage: 86,000,000 gal.
Finished-water storage: 44,000,000 gal.

There is considerable variation in the chemical quality of the water throughout the year.

ANALYSES

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

	Raw water	Finished water	Finished water
Silica (SiO_2)	13	8.5	--
Iron (Fe)	.04	.02	0.11
Manganese (Mn)	.01	.00	.03
Calcium (Ca)	72	64	--
Magnesium (Mg)	6.4	20	--
Sodium (Na)	41	62	--
Potassium (K)	4.7	2.8	--
Carbonate (CO_3)	0	0	--
Bicarbonate (HCO_3)	174	170	175
Sulfate (SO_4)	138	221	158
Chloride (Cl)	9.5	14	--
Fluoride (F)	.4	.6	--
Nitrate (NO_3)	4.0	1.4	--
Dissolved solids	386	492	418
Hardness as $CaCO_3$:			
Total	206	242	230
Noncarbonate	64	102	86
Color	5	--	4
pH	7.7	8.0	7.8
Specific conductance (micromhos at 25 C.)	575	756	629
Turbidity	500	--	1
Temperature (F.)	34	--	34
Date of collection	Feb. 27, 1951	Oct. 12, 1947	Feb. 27, 1951

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	--	--	--	--	--	--	--	--	--	200	15000	25
Finished water	146	232	91	7.8	8.2	7.3	261	380	175	.2	6.0	0

SCOTTSBLUFF
(Population, 12,858)

Ownership: Municipal; also supplies about 100 people outside the city limits. Total population supplied, about 12,950.
Source: 4 wells (2 to 5), 105, 105, 100, and 100 ft deep, for regular supply; 3 standby wells for emergency use. Two additional wells 102 ft deep are under construction. The yield of wells 4 and 5 is reported as 1,361 and 1,380 gpm.
Treatment: None.
Storage: 2 elevated tanks, 300,000 and 100,000 gal.

Three of the wells used for the regular supply are located in the south part of the city and the other in the north part. The water from the wells is pumped directly into the mains, which are interconnected in the midcity area, and consumers in the area receive mixed water from the four wells, whereas in the other sections they receive water from three wells and one. The analysis given is of a sample collected in the midcity area.

ANALYSIS

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

	4 Wells (composite)		4 Wells (composite)
Silica (SiO_2)	48	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	290
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	76		
Magnesium (Mg)	24	Color	2
Sodium (Na)	104	pH	7.7
Potassium (K)	9.9	Specific conductance (micromhos at 25 C.)	952
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	364	Temperature (F.)	55
Sulfate (SO_4)	178	Date of collection	Apr. 30, 1951
Chloride (Cl)	22		
Fluoride (F)	.3		
Nitrate (NO_3)	14		
Dissolved solids	670		

Depth (feet)	100-105
Diameter (inches)	16-36
Date drilled	1935-48
Percent of supply	100

BOULDER CITY, NEVADA
(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 [a]

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

	Lake Mead[b]	Lake Mead[c]		Lake Mead[b]	Lake Mead[c]
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)	80	128	pH	8.0	8.7
Potassium (K)			Specific conductance (micromhos at 25 C.)	900	--
Carbonate (CO_3)	0	7	Turbidity	--	0
Bicarbonate (HCO_3)	151	65	Temperature (F.)	64	80
Sulfate (SO_4)	246	247	Date of collection	Oct. 22, 1948	Nov. 8, 1948
Chloride (Cl)	59	60			
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

[a] In parts per million.
[b] Raw water.
[c] Finished water.

CARSON CITY
(Population, 3,082)

Ownership: (a) Carson City Water Co.; supplies also about 100 people outside the city limits. Total population supplied, about 3,200.
(b) State of Nevada; supplies domestic water to about 525 people largely in the state penitentiary and orphans' home, and supplies water to several state buildings.
Source: (a) King Canyon Creek, Ash Canyon Creek, and springs. The creeks furnish about 80 percent and the springs about 20 percent of the supply.
(b) Springs (70 percent of supply). The remainder of the supply is purchased from the Virginia City Water Co. The source of this supply is Marlette Lake.
Treatment: (a) Chlorination. (b) Chlorination.
Rated capacity of treatment plant: (a) 3,000,000 gpd. (b) 250,000 gpd. (estimated).
Raw-water storage: (a) None. (b) None.
Finished-water storage: (a) 2,000,000 gal. (b) 350,000 gal.

CARSON CITY--Continued

ANALYSES

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

	Raw water [a]	Finished water [b]		Raw water [a]	Finished water [b]
Silica (SiO_2)	20	18	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.09	Total	40	21
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	12	7.3			
Magnesium (Mg)	2.4	.6	Color	5	8
Sodium (Na)	4.6	4.5	pH	7.4	7.2
Potassium (K)	2.6	2.1	Specific conductance (micromhos at 25 C.)	100	69
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	60	36			
Sulfate (SO_4)	1.6	.7	Turbidity	--	--
Chloride (Cl)	1.0	2.2	Temperature (F.)	60	60
Fluoride (F)	.2	.2	Date of collection	Aug. 7, 1951	Aug. 7, 1951
Nitrate (NO_3)	.6	.1			
Dissolved solids	75	58			

[a] Composite; Carson City Water Co. supply.

[b] Composite; State of Nevada supply.

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_2)	0		
Bicarbonate (HCO_3)	169		
Sulfate (SO_4)	45	Turbidity	--
Chloride (Cl)	23	Temperature (F.)	--
Fluoride (F)	.4	Date of collection	May 20, 1951
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	Dec. 11, 1951
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	Nov. 29, 1948
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	Nov. 2, 1951	Nov. 2, 1951	Nov. 2, 1951	Nov. 2, 1951
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.

NORTH LAS VEGAS--Continued

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	Mar. 29, 1951
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	Turbidity	--
Bicarbonate (HCO_3)	29	Temperature (F.)	--
Sulfate (SO_4)	27	Date of collection	May 20, 1951
Chloride (Cl)	1.2		
Fluoride (F)	.1		
Nitrate (NO_3)	.3		
Dissolved solids	91		

SPARKS
(Population, 8,203)

Ownership: Sierra Pacific Power Co. (See Reno.)

WINNEMUCCA
(Population, 2,847)

Ownership: California Pacific Utilities Co.; supplies also about 100 people outside the city limits. Total population supplied, about 2,950.
Source: 2 wells (1 and 2) and spring. The wells are 140 and 525 ft deep, and reported to yield 700 and 800 gpm. The spring is located about 4 miles south of town, and furnishes about 33 percent of the supply. Usually any two of the three sources of supply are sufficient to meet the water requirements during peak demands.
Treatment: Chlorination.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: --
Finished-water storage: 2 reservoirs with a combined capacity of 1,000,000 gal.

ANALYSES

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

	Composite sample (city tap)	Well 1	Well 2	Spring[a]
Silica (SiO_2)	52	34	44	24
Iron (Fe)	.04	.04	.03	--
Manganese (Mn)	--	--	--	--
Calcium (Ca)	60	72	59	38
Magnesium (Mg)	18	16	16	10
Sodium (Na)	77	55	78	16
Potassium (K)	12	2.8	4.6	
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	286	270	287	146
Sulfate (SO_4)	92	76	72	35
Chloride (Cl)	58	54	61	12
Fluoride (F)	.2	.3	.6	--
Nitrate (NO_3)	.4	1.3	.1	--
Dissolved solids	483	442	466	203
Hardness as $CaCO_3$:				
Total	224	246	213	136
Noncarbonate	0	24	0	16
Color	7	--	--	--
pH	7.7	7.6	7.7	--
Specific conductance (micromhos at 25 C.)	759	710	748	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	65	--
Date of collection	May 20, 1951	Nov. 17, 1950	Nov. 17, 1950	--
Depth (feet)	--	140	525	--
Diameter (inches)	--	16	16	--
Date drilled	--	1921	1937	--
Percent of supply	100	--	--	--

[a] Analysis by University of Nevada, published in 1944.

ALBUQUERQUE, NEW MEXICO
(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 station[a]	Atrisco pump station[b]		Main pump station[a]	Atrisco pump station[b]
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		
Carbonate (CO_3)	0	0	25 C.)	404	471
Bicarbonate (HCO_3)	161	163	Turbidity	--	--
Sulfate (SO_4)	54	82	Temperature (F.)	76	61
Chloride (Cl)	12	12	Date of collection	Oct. 12, 1951	Oct. 12, 1951
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

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

[b] Composite sample from wells 1, 2, and 4, in Atrisco well field.

ARTESIA
(Population, 8,244)

Ownership: Municipal.
Source: 5 wells (Roselawn, Standpipe, Hospital, N. 5th St., and E. Chisum St.) 955, 1,050, 1,050, 1,100, and 1,200 ft deep, respectively. A sixth well 200 ft deep, was under construction in 1951. The yield of the wells is reported to be 500, 1,100, 1,100, 1,200, and 1,100 gpm.
Treatment: None.
Storage: Steel standpipe, 500,000 gal.

Partial analyses of samples from the other 4 wells indicate that the water from these wells is similar in composition to that from the Chisum Street well, which has the lowest dissolved solids.

ANALYSIS

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

	Chisum St. well		Chisum St. well
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	581
Manganese (Mn)	--	Noncarbonate	384
Calcium (Ca)	162		
Magnesium (Mg)	43	Color	2
Sodium (Na)	16	pH	7.3
Potassium (K)	3.2	Specific conductance (micromhos at 25 C.)	1,090
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	240	Temperature (F.)	--
Sulfate (SO_4)	400	Date of collection	May 10, 1951
Chloride (Cl)	8.0		
Fluoride (F)	1.1		
Nitrate (NO_3)	2.0		
Dissolved solids	767		
Depth (feet)			1,200
Diameter (inches)			13 3/8
Date drilled			1949
Percent of supply			20

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.

CARLSBAD--Continued

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	May 10, 1951	May 10, 1951
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)				15½	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	Turbidity	--
Bicarbonate (HCO_3)	235	Temperature (F.)	--
Sulfate (SO_4)	23	Date of collection	May 8, 1951
Chloride (Cl)	13		
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) and Potassium (K)	166	167	pH	7.5	8.0
Carbonate (CO_3)	0	23	Specific conductance (micromhos at 25 C.)	1,230	974
Bicarbonate (HCO_3)	424	173	Turbidity	--	--
Sulfate (SO_4)	297	293	Temperature (F.)	--	--
Chloride (Cl)	26	25	Date of collection	Dec. 5, 1950	Dec. 5, 1950
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.

HOBBS--Continued

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	May 9, 1951
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.

LAS CRUCES--Continued

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	Turbidity	--	--
Sulfate (SO_4)	112	401	Temperature (F.)	70	65
Chloride (Cl)	78	153	Date of collection	Sept. 10, 1951	Sept. 10, 1951
Fluoride (F)	.4	.1			
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: Impounding reservoir, 30,000,000 gal; Bradner Reservoir, 103,000,000 gal; Peterson Reservoir, 68,000,000 gal; equalizing reservoir, 8,000,000 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.

LAS VEGAS--Continued

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	Turbidity	--	--
Sulfate (SO_4)	12	14	Temperature (F.)	--	--
Chloride (Cl)	2.0	3.0	Date of collection	June 5, 1951	June 5, 1951
Fluoride (F)	.2	.2			
Nitrate (NO_3)	.2	.2			
Dissolved solids	150	181			

PORTALES

(Population, 8,112)

Ownership: Municipal.

Source: 9 wells (1 to 9) all located in Portales. Two wells (1 and 2) at North Tower, 99 and 100 ft deep; one well (3) at Lindsey School, 132 ft deep; two wells (4 and 5) on Locust Street, 129 and 125 ft deep; three wells (6, 7, and 8) at South Tower, 117, 112, and 125 ft deep; one well (9) at City Park, 129 ft deep. The yield of the wells is reported to be from 450 to 2,000 gpm.

Treatment: Sedimentation and chlorination.

Rated capacity of treatment plant: --

Raw-water storage: Elevated tanks, 260,000 gal.

Finished-water storage: 305,000 gal.

Analyses show composition of water from Locust Street and South Tower well fields which have the lowest and highest dissolved solids concentrations respectively of the 5 fields.

ANALYSES

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

	2 wells[a]	3 wells[b]		2 wells[a]	3 wells[b]
Silica (SiO_2)	46	51	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.0	Total	304	492
Manganese (Mn)	--	--	Noncarbonate	104	320
Calcium (Ca)	84	123			
Magnesium (Mg)	23	45	Color	0	0
Sodium (Na)	56	103	pH	8.0	8.0
Potassium (K)	5.6	5.6	Specific conductance (micromhos at 25 C.)	827	1,330
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	244	209	Turbidity	--	--
Sulfate (SO_4)	157	358	Temperature (F.)	--	--
Chloride (Cl)	49	117	Date of collection	May 8, 1951	May 8, 1951
Fluoride (F)	1.8	1.7			
Nitrate (NO_3)	5.1	7.6			
Dissolved solids	557	952			

[a] Locust Street well field.

[b] South Tower well field.

RATON
(Population, 8,241)

Ownership: Municipal; also supplies a small area outside the city limits. Total population supplied, about 8,400.
Source: Chicorico Creek impounded in Lake Maloya 7 miles northeast of Raton.
Treatment: Coagulation with alum, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: Lake Maloya, 1,304,000,000 gal.
Finished-water storage: 2,750,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	13	12	Hardness as $CaCO_3$:		
Iron (Fe)	.30	.01	Total	93	93
Manganese (Mn)	--	--	Noncarbonate	0	12
Calcium (Ca)	24	24			
Magnesium (Mg)	8.0	8.0	Color	20	0
Sodium (Na)	7.3	5.7	pH	8.0	7.7
Potassium (K)	1.2	1.8	Specific conductance (micromhos at 25 C.)	204	212
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	120	99	Turbidity	--	--
Sulfate (SO_4)	6.9	20	Temperature (F.)	--	--
Chloride (Cl)	1.0	3.0	Date of collection	June 6, 1951	June 6, 1951
Fluoride (F)	.2	.1			
Nitrate (NO_3)	1.3	1.3			
Dissolved solids	132	131			

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.

ROSWELL--Continued

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			
Sulfate (SO_4)	486	421	Turbidity	--	--
Chloride (Cl)	185	58	Temperature (F.)	--	--
Fluoride (F)	.7	.7	Date of collection	May 11, 1951	May 11, 1951
Nitrate (NO_3)	6.7	7.5			
Dissolved solids	1,160	886			

Depth (feet)	330	586
Diameter (inches)	16	$13\frac{1}{2}$
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.

SANTA FE--Continued

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	June 9, 1943	June 7, 1951	June 7, 1951
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	May 7, 1951	May 7, 1951
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	--	--

BISMARCK
(Population, 18,640)

Ownership: Municipal; also supplies 800 people outside the city limits. Total population supplied, 19,440.
Source: Missouri River.
Treatment: Plain sedimentation, softening with lime and soda ash, coagulation with alum, activated carbon, sedimentation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 4,500,000 gpd.
Raw-water storage: 1,500,000 gal.
Finished-water storage: 4,100,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	6.6	3.4	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.05	Total	130	84
Manganese (Mn)	.00	.00	Noncarbonate	23	55
Calcium (Ca)	35	28			
Magnesium (Mg)	10	3.4	Color	33	5
Sodium (Na)	31	31	pH	7.9	8.3
Potassium (K)	3.4	3.5	Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.)	393	338
Bicarbonate (HCO_3)	131	35	Turbidity	330	2
Sulfate (SO_4)	85	114	Temperature (F.)	32	32
Chloride (Cl)	2.5	7.0	Date of collection	May 6, 1951	May 6, 1951
Fluoride (F)	.1	.1			
Nitrate (NO_3)	2.7	.5			
Dissolved solids	250	244			

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	151	232	74	8.0	8.5	7.1	208	338	104	1295	4600	25
Finished water	72	148	18	8.8	10.2	7.7	90	200	44	0	0	0

DICKINSON
(Population, 7,469)

Ownership: Municipal.
Source: 6 wells, 199, 214, 173, 175, 140, and 129 ft deep, about 59 percent of the supply; Heart River, about 41 percent of supply. During the 1950 calendar year the supply consisted of a mixture of river water and well water from May through September, and well water, exclusively, the remainder of the year. The use of well water will be discontinued as soon as the new treatment plant is ready for operation. The completion date for the plant is set for Mar. 1, 1952.
Treatment: Coagulation with alum and lime, activated carbon, sedimentation, filtration, chlorination, and ammoniation for river water. Addition of polyphosphate (Nalco) to both well water and river water for stabilization and corrosion control.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,400,000 gal.

DICKINSON--Continued

There is tremendous variation in the composition of the river water throughout the year. The analyses show approximately the range in composition of the raw river water.

The wells furnish water of similar composition. The analysis given represents water of the maximum concentration of dissolved solids.

ANALYSES

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

	Well (raw water)	Heart River		Finished water [a]
		Raw water	Raw water	
Silica (SiO_2)	12	4.2	6.0	10
Iron (Fe)	.05	.70	.25	.03
Manganese (Mn)	--	--	--	--
Calcium (Ca)	9.0	9.4	60	53
Magnesium (Mg)	7.0	3.6	19	21
Sodium (Na)	574	10	290	199
Potassium (K)	6.4	6.6		3.6
Carbonate (CO_3)	--	0	31	--
Bicarbonate (HCO_3)	[b] 911	68	500	388
Sulfate (SO_4)	528	9.0	376	316
Chloride (Cl)	7.0	2.5	2.0	10
Fluoride (F)	.2	.0	.5	.2
Nitrate (NO_3)	.5	.2	.5	.5
Dissolved solids	1,600	87	1,070	814
Hardness as $CaCO_3$:				
Total	51	38	228	219
Noncarbonate	0	0	0	0
Color	--	--	--	--
pH	8.4	7.5	8.2	8.5
Specific conductance (micromhos at 25 C.)	2,260	136	1,430	1,230
Turbidity	--	--	--	--
Temperature (F.)	--	--	52	--
Date of collection	July 18, 1947	Mar. 23, 1947	May 26, 1947	Aug. 3, 1947

[a] Composite of well and river water.

[b] Alkalinity as bicarbonate (HCO_3).

FARGO
(Population, 38,256)

Ownership: Municipal; also supplies about 600 people outside the city limits. Total population supplied, about 38,900.

Source: Red River of the North for regular supply; 1 well, 195 ft deep, for auxiliary supply. The auxiliary supply is used only during extremely dry periods. During 1950 a total of 6,100,000 gal of well water was used.

Treatment: Softening with lime and soda ash, sedimentation, recarbonation, chlorination, ammoniation, and rapid sand filtration.

Rated capacity of treatment plant: 10,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 1,600,000 gal.

FARGO--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	13	9.4	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.05	Total	314	155
Manganese (Mn)	.00	.00	Noncarbonate	129	74
Calcium (Ca)	66	30			
Magnesium (Mg)	36	19	Color	9	3
Sodium (Na)	23	49	pH	7.8	9.1
Potassium (K)	7.5	7.5	Specific conductance (micromhos at 25 C.)	669	536
Carbonate (CO_3)	0	15	Turbidity	40	1
Bicarbonate (HCO_3)	226	69	Temperature (F.)	67	68
Sulfate (SO_4)	167	165	Date of collection	May 25, 1951	May 25, 1951
Chloride (Cl)	5.5	8.5			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	1.8	.4			
Dissolved solids	464	360			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH [a]			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	250	350	70	8.0	8.4	7.6	273	431	155	50	1500	0
Finished water	85	178	60	9.0	9.8	8.8	129	226	89	0	0	0

[a] 1949.

GRAFTON

(Population, 4,901)

Ownership: Municipal.
Source: 4 artesian wells (1 to 4) 306, 306, 320, and 248 ft deep. The yield of the wells is reported to be 95, 180, 90, and 230 gpm.
Treatment: Addition of polyphosphates (918-Y balls) to prevent scaling.
Rated capacity of treatment plant: 250,000 gpd.
Raw-water storage: 100,000 gal.
Finished-water storage: 100,000 gal.

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	11	Hardness as $CaCO_3$:	
Iron (Fe)	.78	Total	238
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	49		
Magnesium (Mg)	28	Color	2
Sodium (Na)	1,760	pH	7.5
Potassium (K)	18	Specific conductance (micromhos at 25 C.)	7,980
Carbonate (CO_3)	0	Turbidity	4
Bicarbonate (HCO_3)	867	Temperature (F.)	71
Sulfate (SO_4)	618	Date of collection	May 23, 1951
Chloride (Cl)	1,940		
Fluoride (F)	2.8		
Nitrate (NO_3)	18		
Dissolved solids	4,880		

GRAND FORKS
(Population, 26,836)

Ownership: Municipal; also supplies 300 people outside the city limits. Total population supplied, 27,136.
Source: Red Lake River, 60 percent of supply; Red River of the North, 40 percent of supply. Water from both rivers is mixed before entering the treatment plant.
Treatment: Prechlorination, softening with lime and soda ash, coagulation with alum, occasionally sodium aluminate, sedimentation, recarbonation, ammoniation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,500,000 gal.

There is considerable variation in the composition of the river water throughout the year.

ANALYSES

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

	Red Lake River[a] (raw water)	Red River of the North[a] (raw water)	Raw water	Finished water
Silica (SiO_2)	10	2.0	9.8	3.8
Iron (Fe)	--	--	.03	.03
Manganese (Mn)	--	--	.00	.00
Calcium (Ca)	46	74	61	36
Magnesium (Mg)	20	40	23	1.5
Sodium (Na)	19	38	10	33
Potassium (K)			4.5	4.3
Carbonate (CO_3)	--	--	0	----
Bicarbonate (HCO_3)	244	348	216	[b] 50
Sulfate (SO_4)	31	111	88	114
Chloride (Cl)	2.0	20	4.0	9.0
Fluoride (F)	.0	.0	.1	.1
Nitrate (NO_3)	5.3	4.4	1.6	.8
Dissolved solids	245	464	338	248
Hardness as $CaCO_3$:				
Total	197	349	246	96
Noncarbonate	0	64	69	55
Color	--	--	23	3
pH	--	--	7.6	8.4
Specific conductance (micromhos at 25 C.)	--	--	508	363
Turbidity	--	--	55	3
Temperature (F.)	--	--	66	66
Date of collection	Nov. 6, 1950	Nov. 6, 1950	May 24, 1951	May 24, 1951

Regular determinations at treatment plant, 1950 [c]

	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	203	330	75	7.4	8.2	7.2	271	425	85	10	120	5
Finished water	67	120	30	9.4	9.8	8.8	81	170	44	1	5	0

[a] Analyzed by University of North Dakota.
[b] Includes the equivalent of less than 5 ppm of carbonate (CO_3).
[c] Fiscal year.

JAMESTOWN
(Population, 10,697)

Ownership: Municipal.
Source: 6 drilled wells (1 to 6) 80 to 87 ft deep; 1 dug well, 36 ft deep and 25 ft in diameter. The yield of the wells is reported to be 300, 300, 300, 300, 500, over 500, and 1,300 gpm.
Treatment: Aeration, softening with lime, coagulation with sodium aluminate, sedimentation, recarbonation, rapid sand filtration, chlorination, and addition of polyphosphate.
Rated capacity of treatment plant: 2,250,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,610,000 gal.

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

	Raw water[a]	Finished water[a]		Raw water[a]	Finished water[a]
Silica (SiO_2)	26	14	Hardness as $CaCO_3$:		
Iron (Fe)	2.8	.07	Total	432	116
Manganese (Mn)	1.0	.00	Noncarbonate	55	40
Calcium (Ca)	107	35			
Magnesium (Mg)	40	6.9	Color	2	1
Sodium (Na)	113	110	pH	7.8	9.5
Potassium (K)	6.7	6.7	Specific conductance (micromhos at 25 C.)	1,180	746
Carbonate (CO_3)	0	25	Turbidity	35	0.2
Bicarbonate (HCO_3)	460	42	Temperature (F.)	43	47
Sulfate (SO_4)	233	222	Date of collection	Apr. 11, 1951	Apr. 11, 1951
Chloride (Cl)	38	38			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	3.8	2.5			
Dissolved solids	810	510			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	392	--	--	--	--	--	445	--	--	43	--	--
Finished water	130	--	--	9.2	9.3	9.0	152	--	--	44	--	--

[a] Composite.

MANDAN
(Population, 7,298)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 7,800.
Source: Missouri River. The intake is about 5 miles north of Mandan.
Treatment: Plain sedimentation, aeration, softening with lime and soda ash, coagulation with alum and sodium aluminate, ammoniation, chlorination, sedimentation, recarbonation, polyphosphates (918-Y balls), and rapid sand filtration.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,500,000 gal.

MANDAN--Continued

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	11	9.4	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.03	Total	192	114
Manganese (Mn)	.00	.00	Noncarbonate	50	56
Calcium (Ca)	49	32			
Magnesium (Mg)	17	8.3	Color	7	2
Sodium (Na)	57	63	pH	7.7	9.1
Potassium (K)	4.6	4.7	Specific conductance (micromhos at 25 C.)	636	533
Carbonate (CO_3)	0	10			
Bicarbonate (HCO_3)	173	50	Turbidity	500	1
Sulfate (SO_4)	155	178	Temperature (F.)	63	62
Chloride (Cl)	7.5	12	Date of collection	May 17, 1951	May 21, 1951
Fluoride (F)	.4	.4			
Nitrate (NO_3)	1.7	.9			
Dissolved solids	408	348			

Regular determinations at treatment plant

	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	160	222	120	8.1	8.3	8.0	229	316	142	--	--	--
Finished water	87	125	64	9.1	9.2	8.9	112	133	89	--	--	--

MINOT
(Population, 22,032)

Ownership: Municipal.
Source: 7 wells (1, and 3 to 8) 131, 158, 158, 147, 139, 125, and 132 ft deep. The yield of the wells is reported to be 533, 350, 450, 800, 800, 860, and 860 gpm. In 1950 well 7 furnished 75 percent of the supply, and wells 3, 4, and 5, the remainder.
Treatment: Chlorination.
Raw-water storage: 4,100,000 gal.
Finished-water storage: 4,100,000 gal.

MINOT--Continued

ANALYSES

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

	Well 3 (finished water)	Well 5 (finished water)	Well 7 (finished water)
Silica (SiO_2)	26	26	23
Iron (Fe)	2.6	2.7	2.5
Manganese (Mn)	.04	.22	.02
Calcium (Ca)	86	112	84
Magnesium (Mg)	29	42	33
Sodium (Na)	359	180	233
Potassium (K)	5.8	6.7	4.9
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	789	558	748
Sulfate (SO_4)	120	153	70
Chloride (Cl)	240	156	128
Fluoride (F)	.2	.1	.2
Nitrate (NO_3)	3.0	2.2	.8
Dissolved solids	1,280	980	972
Hardness as $CaCO_3$:			
Total	334	454	347
Noncarbonate	0	0	0
Color	18	7	13
pH	7.6	7.5	7.7
Specific conductance (micromhos at 25 C.)	2,070	1,550	1,560
Turbidity	25	35	5
Temperature (F.)	51	49	48
Date of collection	May 17, 1951	May 17, 1951	May 17, 1951
Depth (feet)	158	158	125
Diameter (inches)	12	16	16
Date drilled	1931	1939	1948
Percent of supply	--	--	--

VALLEY CITY
(Population, 6,851)

Ownership: Municipal.

Source: 3 wells about 50 ft deep. The yield of each of the wells is reported to be 600 gpm. Water from the Sheyenne River is diverted each spring by a 24-in. pipeline to a gravel pit which is lower than the river. The water seeps from this gravel pit into the surrounding gravel, recharging the well supply.

Treatment: Chlorination. Water from the Sheyenne River is chlorinated as it is pumped into the gravel pit.

Raw-water storage: None.

Finished-water storage: Tank, 550,000 gal.

VALLEY CITY--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	27	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	406
Manganese (Mn)	.37	Noncarbonate	60
Calcium (Ca)	98		
Magnesium (Mg)	39	Color	3
Sodium (Na)	83	pH	8.0
Potassium (K)	5.9	Specific conductance (micromhos at 25 C.)	1,030
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	422	Temperature (F.)	46
Sulfate (SO_4)	187	Date of collection	Apr. 11, 1951
Chloride (Cl)	29		
Fluoride (F)	.1		
Nitrate (NO_3)	4.1		
Dissolved solids	694		

WILLISTON

(Population, 7,378)

Ownership: Municipal; also supplies about 650 people outside the city limits. Total population supplied, about 8,050.

Source: Missouri River for regular supply; 2 wells each 220 ft deep for auxiliary supply. The yield of the wells is reported to be 550 and 600 gpm.

Treatment: Plain sedimentation, softening with lime (soda ash in winter), coagulation with alum and sodium aluminate, sedimentation, rapid sand filtration, ammoniation, and chlorination.

Rated capacity of treatment plant: 1,200,000 gpd.

Raw-water storage: 1,000,000 gal.

Finished-water storage: 630,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	10	9.8	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.11	Total	191	151
Manganese (Mn)	.01	.00	Noncarbonate	56	52
Calcium (Ca)	50	41			
Magnesium (Mg)	16	12	Color	9	4
Sodium (Na)	55	57	pH	7.9	8.9
Potassium (K)	4.9	4.2	Specific conductance (micromhos at 25 C.)	599	553
Carbonate (CO_3)	0	16	Turbidity	95	20
Bicarbonate (HCO_3)	165	89	Temperature (F.)	60	64
Sulfate (SO_4)	161	158	Date of collection	May 17, 1951	May 17, 1951
Chloride (Cl)	8.5	9.5			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.5	.8			
Dissolved solids	394	374			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	145	170	120	--	--	--	257	340	205	40	54	32
Finished water	55	68	53	--	--	--	137	214	68	40	54	32

ADA
(Population, 15,995)

Ownership: Municipal.
Source: Byrd's Mill Spring, in watershed of Clear Boggy Creek, tributary to Muddy Boggy Creek. The water plant is located just south of the city limits at the spring.
Treatment: Chlorination.
Raw-water storage: --
Finished-water storage: Elevated storage, 1,000,000 gal.

The water plant is just south of the city limits at the spring. The water is pumped from the storage reservoir at the plant to the distribution mains.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	7.7	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	362
Manganese (Mn)	--	Noncarbonate	20
Calcium (Ca)	81		
Magnesium (Mg)	39	Color	5
Sodium (Na)	4.3	pH	7.9
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	608
Carbonate (CO_2)	0	Turbidity	--
Bicarbonate (HCO_3)	418	Temperature (F.)	--
Sulfate (SO_4)	8.6	Date of collection	May 3, 1951
Chloride (Cl)	5.5		
Fluoride (F)	.0		
Nitrate (NO_3)	4.0		
Dissolved solids	357		

ALTUS
(Population, 9,735)

Ownership: Municipal.
Source: North Fork of Red River impounded in Altus-Lugert Reservoir about 10 miles north of Altus. Water from the reservoir is fed into City Lake just north of the city limits.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: Altus-Lugert Reservoir, 49,399,000,000 gal; allocation to city of Altus, 1,564,084,000 gal.
Finished-water storage: 1,700,000 gal.

The treatment plant is located at north edge of the city limits at City Lake.

ALTUS--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	7.6	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	606
Manganese (Mn)	--	Noncarbonate	490
Calcium (Ca)	154		
Magnesium (Mg)	54	Color	0
Sodium (Na)	162	pH	7.5
Potassium (K)	7.2	Specific conductance (micromhos at 25 C.)	1,780
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	141	Temperature (F.)	--
Sulfate (SO_4)	522	Date of collection	Feb. 7, 1951
Chloride (Cl)	215		
Fluoride (F)	.4		
Nitrate (NO_3)	.2		
Dissolved solids	1,190		

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	130	150	80	8.0	8.4	7.8	480	600	240	--	--	--
Finished water	130	150	100	8.0	8.4	7.6	490	600	280	--	--	--

ARDMORE

(Population, 17,890)

Ownership: Municipal.

Source: Hickory Creek, impounded in Mountain Lake, and a small lake in a natural depression, both in watershed of Caddo Creek. Mountain Lake overflows into City Lake.

Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination. Copper sulfate is used for the control of algae.

Rated capacity of treatment plant: 5,500,000 gpd.

Raw-water storage: Mountain Lake and small natural lake, 750,760,700 gal.

Finished-water storage: 1,720,000 gal.

The treatment plant is about 5 miles south of the city at City Lake.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	3.4	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	148
Manganese (Mn)	--	Noncarbonate	15
Calcium (Ca)	49		
Magnesium (Mg)	6.3	Color	5
Sodium (Na)	7.9	pH	7.7
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.)	313
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	163	Temperature (F.)	--
Sulfate (SO_4)	22	Date of collection	May 3, 1951
Chloride (Cl)	8.2		
Fluoride (F)	.1		
Nitrate (NO_3)	.5		
Dissolved solids	181		

BARTLESVILLE
(Population, 19,228)

Ownership: Municipal.
Source: Butler Creek impounded in Lake Hudson, in watershed of Verdigris River. Auxiliary supply, Caney River.
Treatment: Coagulation with alum and lime, sedimentation, carbon at times, rapid sand filtration, and chlorination. Copper sulfate when needed for algae control.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 1,726,000,000 gal.
Finished-water storage: 1,400,000 gal.

The treatment plant is at the northern boundary of the city.

ANALYSES

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

	Finished water	Finished water		Finished water	Finished water
Silica (SiO_2)	0.6	2.0	Hardness as $CaCO_3$:		
Iron (Fe)	.10	.26	Total	69	69
Manganese (Mn)	--	--	Noncarbonate	19	18
Calcium (Ca)	21	22			
Magnesium (Mg)	4.1	3.5	Color	15	15
Sodium (Na)	4.7	4.7	pH	8.1	7.6
Potassium (K)	3.6	2.6	Specific conductance (micromhos at 25 C.)	171	170
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	61	62			
Sulfate (SO_4)	20	19	Turbidity	--	--
Chloride (Cl)	9.0	10	Temperature (F.)	--	--
Fluoride (F)	.0	.1	Date of collection	May 16, 1951	July 25, 1951
Nitrate (NO_3)	.7	.1			
Dissolved solids	105	103			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	51	54	45	7.3	7.5	7.1	45	48	40	50	54	45
Finished water	48	51	44	8.1	8.7	7.7	60	62	58	48	51	44

BLACKWELL
(Population, 9,199)

Ownership: Municipal.
Source: Chikaskia River. The water is taken directly from the River to the treatment plant located at south edge of city.
Treatment: Coagulation with alum and lime, sedimentation, carbon at times, rapid sand filtration, and chlorination. Copper sulfate when needed for algae control.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 500,000 gal.

BLACKWELL--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	4.0	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	256
Manganese (Mn)	--	Noncarbonate	77
Calcium (Ca)	70		
Magnesium (Mg)	20	Color	5
Sodium (Na)	39	pH	7.8
Potassium (K)	3.6	Specific conductance (micromhos at 25 C.)	644
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	219	Temperature (F.)	--
Sulfate (SO_4)	108	Date of collection	May 17, 1951
Chloride (Cl)	37		
Fluoride (F)	.3		
Nitrate (NO_3)	1.4		
Dissolved solids	402		

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	200	270	104	8.1	8.3	7.9	250	306	85	--	--	--
Finished water	210	250	145	7.9	8.2	7.6	250	310	92	--	--	--

CHICKASHA

(Population, 15,842)

Ownership: Municipal.

Source: Washita River. The water is taken directly from the river to the treatment plant at northeast edge of town at the river.

Treatment: Coagulation with alum and lime, sedimentation, carbon at times, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 3,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 2,250,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	748
Manganese (Mn)	--	Noncarbonate	484
Calcium (Ca)	196		
Magnesium (Mg)	63	Color	5
Sodium (Na)	78	pH	7.5
Potassium (K)	4.8	Specific conductance (micromhos at 25 C.)	1,520
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	322	Temperature (F.)	--
Sulfate (SO_4)	529	Date of collection	Nov. 10, 1950
Chloride (Cl)	79		
Fluoride (F)	.1		
Nitrate (NO_3)	.1		
Dissolved solids	1,120		

CHICKASHA--Continued

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.....	--	--	--	8.2	--	--	--	--	--	--	--	--
Finished water...	270	--	--	7.4	--	--	--	--	--	--	--	--

CUSHING
(Population, 8,414)

Ownership: Municipal.
Source: Big Creek impounded in Cushing Lake.
Treatment: Coagulation with alum and lime, sedimentation, carbon at times, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: 890,000,000 gal.
Finished-water storage: 1,000,000 gal.

The treatment plant is located 7.5 miles northwest of the city at the Lake.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	4.4	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	124
Manganese (Mn)	--	Noncarbonate	4
Calcium (Ca)	30		
Magnesium (Mg)	12	Color	5
Sodium (Na)	15	pH	8.4
Potassium (K)	4.0	Specific conductance (micromhos at 25 C.)	312
Carbonate (CO_3)	6	Turbidity	--
Bicarbonate (HCO_3)	134	Temperature (F.)	58
Sulfate (SO_4)	11	Date of collection	Jan. 23, 1951
Chloride (Cl)	24		
Fluoride (F)	.3		
Nitrate (NO_3)	1.4		
Dissolved solids	175		

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.....	--	--	--	7.5	8.5	7.1	--	--	--	200	800	40
Finished water...	--	--	--	7.4	7.9	6.9	--	--	--	25	25	25

DUNCAN
(Population, 15,325)

Ownership: Municipal.
Source: Clear Creek impounded in Clear Creek Lake (sometimes called Chisholm Trail Lake) 11 miles northeast of the city. Auxiliary supply, Fitzpatrick Creek impounded in Lake Duncan, 8 miles northeast of the city.
Treatment: Coagulation with alum and lime, sedimentation, carbon at times, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,750,000 gpd.
Raw-water storage: Clear Creek Lake, 3,128,000,000 gal; Lake Duncan, 1,629,000,000 gal.
Finished-water storage: 3,620,000 gal.

The treatment plant is about 5 miles east of the city.
At the time of sampling the entire supply was being taken from Clear Creek Lake. Lake Duncan is seldom used.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	1.2	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	222
Manganese (Mn)	--	Noncarbonate	89
Calcium (Ca)	61		
Magnesium (Mg)	17	Color	0
Sodium (Na)	6.5	pH	8.5
Potassium (K)	4.1	Specific conductance (micromhos at 25 C.)	443
Carbonate (CO_3)	--	Turbidity	--
Bicarbonate (HCO_3)	[a]162	Temperature (F.)	--
Sulfate (SO_4)	102	Date of collection	Feb. 8, 1951
Chloride (Cl)	6.5		
Fluoride (F)	.1		
Nitrate (NO_3)	1.1		
Dissolved solids	280		

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	--	--	--	8.0	8.2	7.6	--	--	--	--	--	--
Finished water	--	--	--	7.9	8.2	7.1	--	--	--	--	--	--

[a]Includes the equivalent of less than 5 ppm of carbonate (CO_3).

DURANT
(Population, 10,541)

Ownership: Municipal.
Source: Blue River.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, chlorination, and copper sulfate when needed.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: --
Finished-water storage: 640,000 gal.

The raw water intake and the treatment plant are located near the town of Armstrong about 5 miles from Durant.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	7.6	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	267
Manganese (Mn)	--	Noncarbonate	50
Calcium (Ca)	61		
Magnesium (Mg)	28	Color	5
Sodium (Na)	13	pH	7.6
Potassium (K)	1.7	Specific conductance (micromhos at 25 C.)	512
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	265	Temperature (F.)	--
Sulfate (SO_4)	55	Date of collection	May 3, 1951
Chloride (Cl)	10		
Fluoride (F)	.2		
Nitrate (NO_3)	1.4		
Dissolved solids	312		

EL RENO
(Population, 10,991)

Ownership: Municipal.
Source: 11 wells, 51 to 55 ft deep, all located in the same general area at the north edge of the city limits. The yield of the wells is reported to range from 100 to 530 gpm.
Treatment: Softening with lime and soda ash, sedimentation (upward flow cylindrical tanks), recarbonation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: --
Finished-water storage: 1,500,000 gal.

The treatment plant is near the wells.

EL RENO--Continued

ANALYSES

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

	Raw Water[a]	Finished water[a]		Raw Water[a]	Finished water[a]
Silica (SiO_2)	18	14	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.02	Total	370	127
Manganese (Mn)	--	--	Noncarbonate	146	63
Calcium (Ca)	94	26			
Magnesium (Mg)	33	15	Color	5	0
Sodium (Na)	96	131	pH	7.5	7.9
Potassium (K)	6.2	5.6	Specific conductance (micromhos at 25 C.)	1,080	878
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	273	77	Turbidity	--	--
Sulfate (SO_4)	185	188	Temperature (F.)	--	--
Chloride (Cl)	115	115	Date of collection	Feb. 8, 1951	Feb. 8, 1951
Fluoride (F)	.6	.7			
Nitrate (NO_3)	1.5	1.0			
Dissolved solids	688	534			

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	230	288	204	7.2	--	--	350	528	304	--	--	--
Finished water	65	75	55	8.8	--	--	138	150	120	--	--	--

[a]Wells 10, 13, 17, and 21 pumping at time of the collection of the samples.

ENID

(Population, 36,017)

Ownership: Municipal; also supplies Vance Air Force Base.

Source: Wells (6 well fields): Carrier Field, 16 wells (1 to 16, well 14 abandoned) 65 to 75 ft deep; Northwest Field, 10 wells (1 to 10, well 4 abandoned) approximately 60 ft deep; Van Buren Field, 8 wells (1 to 8, wells 4 and 7 abandoned) approximately 55 ft deep; 2 wells (1 and 2) back of Water Plant, 45 ft deep; 5 wells (1 to 5) Ames Terrace, Frisco-Right-of-Way, approximately 60 ft deep; 7 wells (1 to 7) Ames Terrace, between the towns of Ames and Drummond, approximately 120 ft deep. (The wells of the last named group are not being used because of litigation.) The yield of the wells being used is reported to range from 50 to 225 gpm, which is 60 percent of capacity.

Treatment: Chlorination.

Rated capacity of treatment plant: 7,000,000 gpd.

Raw-water storage: --

Finished-water storage: 16,000,000 gal.

The water from all the wells is mixed at the plant before being pumped to the city and distribution. The analysis given represents mixed water from 31 wells being pumped at the time of the collection of the sample.

ENID--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	23	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	172
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	51		
Magnesium (Mg)	11	Color	0
Sodium (Na)	58	pH	7.1
Potassium (K)	3.2	Specific conductance (micromhos at 25 C.)	575
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	266	Turbidity	--
Sulfate (SO_4)	21	Temperature (F.)	--
Chloride (Cl)	39	Date of collection	May 17, 1951
Fluoride (F)	.1		
Nitrate (NO_3)	9.1		
Dissolved solids	346		

GUTHRIE
(Population, 10,113)

Ownership: Municipal.
Source: Stream tributary to Cottonwood Creek impounded in Lake Guthrie.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: 1,226,000,000 gal.
Finished-water storage: 750,000 gal.

The treatment plant is located at the south edge of the city limits.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	1.6	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	199
Manganese (Mn)	--	Noncarbonate	9
Calcium (Ca)	45		
Magnesium (Mg)	21	Color	0
Sodium (Na)	11	pH	8.0
Potassium (K)	4.1	Specific conductance (micromhos at 25 C.)	417
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	232	Turbidity	--
Sulfate (SO_4)	18	Temperature (F.)	--
Chloride (Cl)	15	Date of collection	Apr. 24, 1951
Fluoride (F)	.0		
Nitrate (NO_3)	.1		
Dissolved solids	231		

HENRYETTA
(Population, 7,987)

Ownership: Municipal; also supplies Dewar. Total population supplied, about 9,000.
Source: Wolf Creek impounded in Lake Henryetta, about 3 miles east of the city.
Treatment: Coagulation with alum and lime, sedimentation, carbon at times, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 4,750,000 gpd.
Raw-water storage: 2,085,000,000 gal.
Finished-water storage: 2,000,000 gal.

The treatment plant is located at the lake.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	1.4	Hardness as $CaCO_3$:	
Iron (Fe)	.24	Total	67
Manganese (Mn)	--	Noncarbonate	43
Calcium (Ca)	22		
Magnesium (Mg)	3.0	Color	5
Sodium (Na)	5.6	pH	8.2
Potassium (K)	2.0	Specific conductance (micromhos at 25 C.)	157
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	30	Turbidity	--
Sulfate (SO_4)	39	Temperature (F.)	--
Chloride (Cl)	7.5	Date of collection	May 2, 1951
Fluoride (F)	.2		
Nitrate (NO_3)	1.3		
Dissolved solids	99		

LAWTON
(Population, 34,757)

Ownership: Municipal; also supplies Fort Sill and Medicine Park. Total population supplied, about 43,500.
Source: Medicine Bluff Creek impounded in Lake Lawtonka, about 15 miles northwest of Lawton at the town of Medicine Park.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 12,500,000 gpd.
Raw-water storage: 13,686,000,000 gal.
Finished-water storage: 6,500,000 gal.

The treatment plant is at Medicine Park.

LAWTON--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	2.4	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	144
Manganese (Mn)	--	Noncarbonate	12
Calcium (Ca)	44		
Magnesium (Mg)	8.2	Color	0
Sodium (Na)	9.1	pH	7.8
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.)	307
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	160	Turbidity	--
Sulfate (SO_4)	19	Temperature (F.)	--
Chloride (Cl)	10	Date of collection	Feb. 7, 1951
Fluoride (F)	.1		
Nitrate (NO_3)	.4		
Dissolved solids	175		

MCALESTER
(Population, 17,878)

Ownership: Municipal; also supplies a small population outside the city limits. Total population supplied, about 17,900.
Source: Bull, Bodark, and Lily Pad Creeks impounded in Lake McAlester, 6 to 8 miles northwest of the city.
Treatment: Coagulation with alum and lime, sedimentation, activated carbon at times, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 4,497,000,000 gal.
Finished-water storage: 3,400,000 gal.

The treatment plant is about 3 miles north of the State Penitentiary.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	1.4	Hardness as $CaCO_3$:	
Iron (Fe)	.05	Total	45
Manganese (Mn)	--	Noncarbonate	20
Calcium (Ca)	13		
Magnesium (Mg)	3.0	Color	5
Sodium (Na)	6.2	pH	7.9
Potassium (K)	2.0	Specific conductance (micromhos at 25 C.)	120
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	30	Turbidity	--
Sulfate (SO_4)	28	Temperature (F.)	--
Chloride (Cl)	5.5	Date of collection	May 2, 1951
Fluoride (F)	.1		
Nitrate (NO_3)	.2		
Dissolved solids	74		

MCALESTER--Continued

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	26	20	32	7.0	7.4	6.8	22	28	16	--	--	--
Finished water	32	24	36	8.5	8.8	8.0	50	60	30	--	--	--

MIAMI
(Population, 11,801)

Ownership: Municipal.
Source: 5 wells (1 to 5), 1,233, 1,000, 1,252, 1,116, and 1,345 ft deep. The yield of the wells is reported to be 300, 300, 350, 470, and 510 gpm.
Treatment: None.
Storage: 2,000,000 gal.

ANALYSES

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

	Wells 3, 4 [a] (composite)	Well 3	Well 4
Silica (SiO_2)	9.1	--	--
Iron (Fe)	.01	--	--
Manganese (Mn)	--	--	--
Calcium (Ca)	31	--	--
Magnesium (Mg)	14	--	--
Sodium (Na)	29	--	--
Potassium (K)	2.5	--	--
Carbonate (CO_3)	0	--	--
Bicarbonate (HCO_3)	149	152	148
Sulfate (SO_4)	15	--	--
Chloride (Cl)	42	120	16
Fluoride (F)	.3	--	--
Nitrate (NO_3)	1.4	--	--
Dissolved solids	217	326	169
Hardness as $CaCO_3$:			
Total	135	152	134
Noncarbonate	13	27	13
Color	5	--	--
pH	8.1	--	--
Specific conductance (micromhos at 25 C.)	386	663	305
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	May 15, 1951	May 15, 1951	May 15, 1951
Depth (feet)		1,252	1,116
Diameter (inches)		$10\frac{3}{4}$	15
Date drilled		1921	1946
Percent of supply		--	--

[a] Pumping at the time of the collection of the samples.

MIDWEST CITY
(Population, 10,166)

Ownership: Municipal.
Source: 6 wells (1 to 6) each about 750 ft deep. One connecting line between Midwest City and Tinker Field Air Force Base in case of emergency at either location. All wells pump directly to the distribution mains as well as to the storage reservoir.
Treatment: Chlorination (at each well).
Raw-water storage: None.
Finished-water storage: Reservoir, 1,000,000 gal.

Partial analysis of a sample from each well indicates that the wells yield water of about the same chemical composition. The partial analyses given represent water from wells with the maximum and minimum concentration of dissolved solids.

ANALYSES

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

	Well 4	Well 6	Finished water[a] (composite)
Silica (SiO_2)	--	--	12
Iron (Fe)	--	--	.0
Manganese (Mn)	--	--	--
Calcium (Ca)	--	--	21
Magnesium (Mg)	--	--	14
Sodium (Na)	--	--	36
Potassium (K)	--	--	1.4
Carbonate (CO_3)	--	--	0
Bicarbonate (HCO_3)	218	202	205
Sulfate (SO_4)	--	--	7.4
Chloride (Cl)	12	3.0	6.2
Fluoride (F)	--	--	.2
Nitrate (NO_3)	--	--	1.1
Dissolved solids	201	149	181
Hardness as $CaCO_3$:			
Total	150	102	110
Noncarbonate	0	0	0
Color	--	--	5
pH	--	--	8.2
Specific conductance (micromhos at 25 C.)	376	321	330
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	May 4, 1951	May 4, 1951	May 4, 1951
Depth (feet)	750	750	
Diameter (inches)	8	8	
Date drilled	1948	1950	
Percent of supply	--	--	

[a] Collected from storage reservoir.

MUSKOGEE
(Population, 37,289)

Ownership: Municipal.
Source: Neosho River.
Treatment: Prechlorination, coagulation with alum and lime, softening with excess lime, sedimentation, recarbonation, rapid sand filtration, and post-chlorination.
Rated capacity of treatment plant: 7,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 10,000,000 gal.

The water is taken directly from the river to the treatment plant northeast of Muskogee just above the confluence of the Neosho with the Arkansas River.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.1	7.1	Hardness as $CaCO_3$:		
Iron (Fe)	.14	.05	Total	120	88
Manganese (Mn)	--	--	Noncarbonate	35	50
Calcium (Ca)	37	24			
Magnesium (Mg)	6.8	6.9	Color	100	5
Sodium (Na)	8.8	8.6	pH	7.7	9.3
Potassium (K)	2.9	2.5	Specific conductance (micromhos at		
Carbonate (CO_3)	0	8	25 C.)	277	217
Bicarbonate (HCO_3)	104	30	Turbidity	--	--
Sulfate (SO_4)	42	48	Temperature (F.)	51	52
Chloride (Cl)	8.0	12	Date of collection	Nov. 29, 1951	Nov. 29, 1951
Fluoride (F)	.0	.1			
Nitrate (NO_3)	2.8	2.4			
Dissolved solids	180	137			

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	85	90	68	7.8	8.2	6.0	115	128	88	35	300	20
Finished water	30	40	23	8.7	9.4	8.4	75	90	56	--	--	--

NORMAN
(Population, 27,006)

Ownership: Municipal; University of Oklahoma. The University has its own wells and supply system and serves an estimated total population of 15,000.
Source: Municipal; 12 wells (1 to 12), 535 to 671 ft deep. Well 7 was not being pumped at the time of the collection of sample since it was being used as an observation well. Two additional wells were under construction. Several wells pump directly into the distribution mains.
Treatment: None.
Storage: 1,000,000 gal.

NORMAN--Continued

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

	Municipal wells (composite)		Municipal wells (composite)
Silica (SiO_2)	9.7	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	8
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	2.0		
Magnesium (Mg)	.7	Color	5
Sodium (Na)	207	pH	9.1
Potassium (K)	3.2	Specific conductance (micromhos at 25 C.)	877
Carbonate (CO_3)	34	Turbidity	--
Bicarbonate (HCO_3)	359	Temperature (F.)	--
Sulfate (SO_4)	96	Date of collection	May 21, 1951
Chloride (Cl)	13		
Fluoride (F)	.3		
Nitrate (NO_3)	.5		
Dissolved solids	550		

OKLAHOMA CITY
(Population, 243,504)

Ownership: Municipal.
Source: North Canadian River by diversion into two off-channel reservoirs, Lake Hefner and Lake Overholser, approximately 8 miles northwest of the center of the city.
Treatment: (Both plants) softening with excess lime, coagulation with alum, carbon at times for taste and odor control, sedimentation, recarbonation, rapid sand filtration, and chlorination.
Rated capacity of treatment plants: Lake Hefner Plant, 24,000,000 gpd; Lake Overholser Plant, 15,000,000 gpd.
Raw-water storage: Lake Hefner, 24,438,800,000 gal; Lake Overholser, 5,213,600,000 gal.
Finished-water storage: Elevated, 5,500,000 gal; other, 25,500,000 gal.

Lake Overholser treatment plant is in the city and water from this plant is generally served in the central and southern parts of the city.

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

	Raw water[a]	Finished water[a]		Raw water[a]	Finished water[a]
Silica (SiO_2)	1.7	1.7	Hardness as $CaCO_3$:		
Iron (Fe)	.12	.0	Total	183	90
Manganese (Mn)	--	--	Noncarbonate	39	49
Calcium (Ca)	47	18			
Magnesium (Mg)	16	11	Color	60	5
Sodium (Na)	50	49	pH	8.2	10.4
Potassium (K)	5.4	5.4	Specific conductance (micromhos at 25 C.)	596	479
Carbonate (CO_3)	0	[b]16	Turbidity	--	--
Bicarbonate (HCO_3)	176	0	Temperature (F.)	--	--
Sulfate (SO_4)	70	73	Date of collection	May 26, 1951	May 26, 1951
Chloride (Cl)	60	64			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.3	.5			
Dissolved solids	364	262			

[a] Lake Hefner.
[b] Sample contained 5 ppm of Hydroxide (OH).

OKLAHOMA CITY--Continued

Regular determinations at treatment plant, 1950[c]

	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.....	143	150	136	8.5	8.9	8.1	190	200	175	14	25	10
Finished water...	39	53	26	10.3	11.0	9.6	90	100	73	--	--	--

[c] Fiscal year, July 1949 to June 1950.

OKMULGEE
(Population, 18,317)

Ownership: Municipal.
Source: Salt Creek impounded in Lake Okmulgee.
Treatment: Coagulation with alum and lime, sedimentation, carbon when necessary, rapid sand filtration; and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 4,300,000,000 gal.
Finished-water storage: 2,150,000 gal.

The treatment plant is about 3 miles west of the city.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	5.0	Hardness as $CaCO_3$:	
Iron (Fe)	.20	Total	68
Manganese (Mn)	--	Noncarbonate	35
Calcium (Ca)	17		
Magnesium (Mg)	6.2	Color	25
Sodium (Na)	28	pH	8.1
Potassium (K)	2.1	Specific conductance (micromhos at 25 C.).....	289
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	40	Temperature (F.).....	52
Sulfate (SO_4)	16	Date of collection	Nov. 29, 1951
Chloride (Cl)	58		
Fluoride (F)	.0		
Nitrate (NO_3)	.2		
Dissolved solids	171		

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	22	20	7.0	7.0	6.8	--	--	--	75	140	50
Finished water...	32	36	28	8.6	9.0	8.0	66	70	60	17	20	15

PONCA CITY
(Population, 20,180)

Ownership: Municipal.
Source: Turkey Creek impounded in Lake Ponca, 50 percent of supply; 5 wells, all approximately 60 ft deep, 50 percent of supply.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: Lake Ponca, 4,865,000,000 gal.
Finished-water storage: 2,500,000 gal.

ANALYSES

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

	Lake Ponca (raw water)	Wells (raw water)[a]	Finished water[b]
Silica (SiO_2)	--	--	5.0
Iron (Fe)	--	--	.0
Manganese (Mn)	--	--	--
Calcium (Ca)	27	121	56
Magnesium (Mg)	6.0	97	9.8
Sodium (Na)	11	132	27
Potassium (K)			4.4
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	109	486	206
Sulfate (SO_4)	11	361	30
Chloride (Cl)	7.0	126	32
Fluoride (F)	--	--	.1
Nitrate (NO_3)	6.5	44	1.0
Dissolved solids	134	1,120	268
Hardness as $CaCO_3$:			
Total	92	701	180
Noncarbonate	3	303	11
Color	--	--	5
pH	--	--	7.9
Specific conductance (micromhos at 25 C.)	213	1,700	469
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	July 21, 1950	July 21, 1950	May 17, 1951

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[c]	136	140	130	8.0	8.2	7.9	125	130	120	15	20	10
Finished water	180	190	170	7.4	7.5	7.3	200	215	191	--	--	--

[a] Composite (wells 1 to 4).
[b] Lake Ponca 50 percent; wells (1, 2, and 4) 50 percent.
[c] Lake Ponca.

SAPULPA
(Population, 13,031)

Ownership: Municipal.
Source: Rock Creek impounded in Lake Sahoma.
Treatment: Coagulation with alum and lime, sedimentation, carbon at times, rapid sand filtration, and chlorination. Copper sulfate is used for algae control when needed.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: 977,500,000 gal.
Finished-water storage: 2,475,000 gal.

The treatment plant is at the east edge of the city limits.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	3.9	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	98
Manganese (Mn)	--	Noncarbonate	57
Calcium (Ca)	29		
Magnesium (Mg)	6.3	Color	20
Sodium (Na)	17	pH	7.5
Potassium (K)	2.8	Specific conductance (micromhos at 25 C.)	297
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	50	Turbidity	--
Sulfate (SO_4)	50	Temperature (F.)	--
Chloride (Cl)	31	Date of collection	May 15, 1951
Fluoride (F)	.1		
Nitrate (NO_3)	1.7		
Dissolved solids	181		

SEMINOLE
(Population, 11,863)

Ownership: Municipal.
Source: 15 wells (1 to 15), 525 to 763 ft deep, all within the city limits. The yield of the wells is reported to range from 40 to 240 gpm.
Treatment: Chlorination of water from 9 wells pumped through the main pumping station. Other wells pump directly into distribution system and are not chlorinated.
Rated capacity of treatment plant: 7,300,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,500,000 gal.

Wells 10 and 11 were not in use at time of collection of samples.

ANALYSES

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

	Wells 1 to 9 (composite)	Well 12	Well 13	Well 15	Finished water (city tap)
Silica (SiO_2)	--	--	--	--	9.8
Iron (Fe)	--	--	--	--	.02
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	--	--	--	--	36
Magnesium (Mg)	--	--	--	--	8.2
Sodium (Na)	--	--	--	--	40
Potassium (K)	--	--	--	--	2.5
Carbonate (CO_3)	--	--	--	--	0
Bicarbonate (HCO_3)	188	226	194	180	192
Sulfate (SO_4)	--	--	--	--	47
Chloride (Cl)	4.0	6.0	4.0	3.5	4.5
Fluoride (F)	--	--	--	--	.3
Nitrate (NO_3)	--	--	--	--	.2
Dissolved solids	201	214	202	230	244
Hardness as $CaCO_3$:					
Total	116	52	128	102	124
Noncarbonate	0	0	0	0	0
Color	--	--	--	--	0
pH	--	--	--	--	7.8
Specific conductance (micromhos at 25 C.)	394	411	396	408	390
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	May 1, 1951	May 1, 1951	May 1, 1951	May 1, 1951	May 1, 1951
Depth (feet)	620-763	638	750	732	
Diameter (inches)	8-10¾	10¾	10¾	10¾	
Date drilled	--	--	--	1950	
Percent of supply	--	--	--	--	

SHAWNEE
(Population, 22,948)

Ownership: Municipal.
Source: South Deer Creek impounded in Shawnee City Lake.
Treatment: Coagulation with alum and lime, sedimentation, carbon at times, rapid sand filtration, and chlorination. Copper sulfate is used for algae control when necessary.
Rated capacity of treatment plant: 4,500,000 gpd.
Raw-water storage: 7,700,000,000 gal.
Finished-water storage: 5,250,000 gal.

The treatment plant is at the southwest edge of the city limits.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	4.3	Hardness as $CaCO_3$:	
Iron (Fe)	.11	Total	74
Manganese (Mn)	--	Noncarbonate	24
Calcium (Ca)	19		
Magnesium (Mg)	6.5	Color	10
Sodium (Na)	9.0	pH	7.3
Potassium (K)	2.3	Specific conductance (micromhos at 25 C.)	185
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	61	Temperature (F.)	--
Sulfate (SO_4)	25	Date of collection	May 1, 1951
Chloride (Cl)	11		
Fluoride (F)	.4		
Nitrate (NO_3)	.8		
Dissolved solids	108		

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	--	--	--	--	--	--	--	--	--	140	175	120
Finished water	65	74	58	--	--	--	78	90	68	--	--	--

STILLWATER
(Population, 20,238)

Ownership: Oklahoma A. & M. College; supplies about 1,800 people outside the city limits. Total population supplied, about 22,000.
Source: Lake Carl Blackwell, approximately 10 miles west of Stillwater. Emergency supply, Boomer Lake, just north of the city limits.
Treatment: Coagulation with ferrous sulfate, softening with excess lime, sedimentation, recarbonation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: 17,968,000,000 gal.
Finished-water storage: 450,000 gal.

The treatment plant is approximately 1 mile west of the College.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	2.9	2.3	Hardness as $CaCO_3$:		
Iron (Fe)	.36	.02	Total	133	60
Manganese (Mn)	--	--	Noncarbonate	3	21
Calcium (Ca)	32	14			
Magnesium (Mg)	13	6.0	Color	--	5
Sodium (Na)	17	18	pH	8.0	9.8
Potassium (K)	4.7	4.3	Specific conductance (micromhos at 25 C.)	321	221
Carbonate (CO_3)	0	13			
Bicarbonate (HCO_3)	159	21	Turbidity	--	--
Sulfate (SO_4)	15	26	Temperature (F.)	54	47
Chloride (Cl)	20	26	Date of collection	Jan. 12, 1951	Dec. 20, 1950
Fluoride (F)	--	.3			
Nitrate (NO_3)	.8	.7			
Dissolved solids	199	121			

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	131	146	104	8.2	8.6	7.9	124	155	113	39	105	25
Finished water	128	150	90	8.5	9.6	6.2	75	142	36	--	--	--

TULSA
(Population, 182,740)

Ownership: Municipal; supplies Skiatook, Sperry, Turley, and other consumers outside the city limits. Total population supplied, about 220,000. The city also supplies raw water to Owasso and Spavinaw.
Source: Spavinaw Creek impounded in Spavinaw Lake about 70 miles northeast of Tulsa.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 40,000,000 gpd.
Raw-water storage: 10,326,000,000 gal.
Finished-water storage: 27,500,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	4.3	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	91
Manganese (Mn)	--	Noncarbonate	7
Calcium (Ca)	34		
Magnesium (Mg)	1.4	Color	5
Sodium (Na)	2.3	pH	7.7
Potassium (K)	1.1	Specific conductance (micromhos at 25 C.)	191
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	102	Temperature (F.)	--
Sulfate (SO_4)	6.1	Date of collection	May 26, 1951
Chloride (Cl)	5.8		
Fluoride (F)	.1		
Nitrate (NO_3)	1.4		
Dissolved solids	114		

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	88	92	85	8.0	8.2	7.8	--	--	--	16	61	6
Finished water	85	89	80	7.6	7.7	7.5	93	94	93	.2	1.3	.1

ALBANY
(Population, 10,115)

Ownership: Mountain States Power Co.; supplies also about 330 people outside the city limits. Total population supplied, about 10,450.
Source: South Santiam River (through power canal).
Treatment: Coagulation with alum and lime, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 890,000 gal.

ANALYSIS

(Analysis, in parts per million, by Elgin Water Softener Corp., Elgin, Ill.)

	Finished water		Finished water
Silica (SiO_2)	17	Hardness as $CaCO_3$:	
Iron (Fe)	--	Total	42
Manganese (Mn)	--	Noncarbonate	15
Calcium (Ca)	15		
Magnesium (Mg)	1.2	Color	--
Sodium (Na)	4.3	pH	--
Potassium (K)	--	Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	33	Temperature (F.)	--
Sulfate (SO_4)	19	Date of collection	Apr. 12, 1945
Chloride (Cl)	3.6		
Fluoride (F)	[a].2		
Nitrate (NO_3)	--		
Dissolved solids	[b]76		

[a] Determination by Oregon State Board of Health, November, 1950.
[b] Sum of determined constituents.

ALTAMONT
(Population, 9,419)

Ownership: Supplied by Klamath Falls. (See Klamath Falls.)

ASTORIA
(Population, 12,331)

Ownership: Municipal; supplies also Tongue Point Naval Station and some other consumers outside the city limits. Total population supplied, about 14,800.
Source: Bear Creek and tributaries impounded in 3 artificial lakes. Intake located about 11 miles east of Astoria.
Treatment: Chlorination and occasional use of copper sulfate for algae control.
Rated capacity of treatment plant: 5,200,000 gpd.
Raw water storage: 200,000,000 gal.
Finished water storage: 24,000,000 gal.

The color and turbidity of the water are variable, being highest from September through November.

ASTORIA--Continued

ANALYSIS

(Analysis, in parts per million, by 13th Naval Dist. Sanitation Engineering Lab.)

	Finished water		Finished water
Silica (SiO_2)	28	Hardness as $CaCO_3$:	
Iron (Fe)	.18	Total	27
Manganese (Mn)	0	Noncarbonate	0
Calcium (Ca)	6.1		
Magnesium (Mg)	2.8	Color	10
Sodium (Na)	7.6	pH	7.0
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	37	Temperature (F.)	--
Sulfate (SO_4)	3.2	Date of collection	June 7, 1950
Chloride (Cl)	6.8		
Fluoride (F)	[a].1		
Nitrate (NO_3)	--		
Dissolved solids	73		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	7.0	7.6	6.8	--	--	--	50	67	37
Finished water	--	--	--	6.9	7.0	6.8	--	--	--	49	62	35

[a] From other analyses.

BAKER

(Population, 9,471)

Ownership: Municipal; supplies also about 500 people outside the city limits. Total population supplied, about 10,000.

Source: Goodrich Lake, Marble Creek, Pine Creek, and Elk Creek. The main pipeline is from Goodrich Lake, with a feeder pipeline from each of the creeks.

Treatment: Chlorination and occasional ammoniation.

Rated capacity of treatment plant: 10,000,000 gpd.

Raw-water storage: 120,500,000 gal.

Finished-water storage: 2 reservoirs, 5,000,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	13	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	37
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	12		
Magnesium (Mg)	1.7	Color	3
Sodium (Na)	1.4	pH	7.4
Potassium (K)	1.0	Specific conductance (micromhos at 25 C.)	80
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	47	Temperature (F.)	49
Sulfate (SO_4)	2.4	Date of collection	June 19, 1951
Chloride (Cl)	.4		
Fluoride (F)	.0		
Nitrate (NO_3)	.2		
Dissolved solids	56		

BEND
(Population 11,409)

Ownership: Municipal; supplies also about 300 people outside the city limits. Total population supplied, about 11,700.
Source: Tumalo Creek.
Treatment: Chlorination.
Raw water storage: None.
Finished water storage: 1,635,000 gal.

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

	Finished water		Finished water
Silica (SiO_2)	19	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	11
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	3.5		
Magnesium (Mg)	.6	Color	7
Sodium (Na)	2.0	pH	6.7
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	31
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	8	Turbidity	--
Sulfate (SO_4)	.8	Temperature (F.)	46
Chloride (Cl)	.9	Date of collection	June 18, 1951
Fluoride (F)	.0		
Nitrate (NO_3)	.1		
Dissolved solids	37		

COOS BAY
(Population, 6,223)

Ownership: Municipal; supplies also North Bend, Eastside, and about 1,500 consumers outside the city limits. Total population supplied, about 15,200.
Source: Pony Creek.
Treatment: Prechlorination, color removal by coagulation with alum and lime, rapid sand filtration, and aeration (spray).
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: 658,000,000 gal.
Finished-water storage: 5,500,000 gal. Present construction program will provide an additional 4,500,000 gal.

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

	Raw water[a]	Finished water		Raw water[a]	Finished water
Silica (SiO_2)	7.1	6.6	Hardness as $CaCO_3$:		
Iron (Fe)	.08	.04	Total	9	37
Manganese (Mn)	--	--	Noncarbonate	0	18
Calcium (Ca)	1.8	12			
Magnesium (Mg)	1.0	1.8	Color	100	6
Sodium (Na)	5.9	8.3	pH	6.1	7.1
Potassium (K)	--	1.4	Specific conductance (micromhos at 25 C.)	--	116
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	16	23	Turbidity	5	--
Sulfate (SO_4)	2.1	13	Temperature (F.)	58	66
Chloride (Cl)	10	15	Date of collection	May 7, 1947	June 15, 1951
Fluoride (F)	.2	.0			
Nitrate (NO_3)	.4	.2			
Dissolved solids	57	73			

[a] Analyzed by the Charlton Laboratories, Portland, Oreg.

COOS BAY--Continued

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water.....	12	14	8	6.6	6.9	5.2	8	10	8	54	68	36
Finished water...	18	24	16	8.4	9.0	8.0	24	30	22	--	--	--

CORVALLIS

(Population, 16,207)

Ownership: Municipal; supplies also Philomath and about 800 consumers outside the city limits. Total population supplied, about 18,300.
Source: Rock Creek.
Treatment: Pressure filtration, chlorination and ammoniation.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: --
Finished-water storage: 7,000,000 gal.

A water treatment plant has been constructed to utilize water from the Willamette River although this source has not been used to date (June 1951). This plant has a rated capacity of 4,000,000 gpd. The treatment of the water will include coagulation, sedimentation, gravity filtration, and chlorination.

ANALYSES

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

	Finished water[a]	Raw water[b]		Finished water	Raw water
Silica (SiO_2)	24	19	Hardness as $CaCO_3$:		
Iron (Fe)	.02	--	Total	37	20
Manganese (Mn)	--	--	Noncarbonate.....	0	0
Calcium (Ca)	8.5	4.2			
Magnesium (Mg).....	3.9	2.4	Color.....	5	--
Sodium (Na)	5.1	5.8	pH.....	7.5	--
Potassium (K)	2.2		Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.).....	94	47.9
Bicarbonate (HCO_3)	51	28	Turbidity.....	--	--
Sulfate (SO_4)	1.8	4.9	Temperature (F.)...	64	--
Chloride (Cl)	4.8	3.0	Date of collection...	June 14, 1951	Nov. 27, 1950
Fluoride (F)	.2	--			
Nitrate (NO_3)	.2	.8			
Dissolved solids.....	76	[c]54			

[a]Rock Creek.
[b]Willamette River.
[c]Sum of determined constituents.

EUGENE

(Population, 35,879)

Ownership: Municipal; supplies also about 14,000 people outside the city limits. Total population supplied, approximately 50,000.
Source: McKenzie River. The intake is located near Hayden Bridge, 7 miles east of the city.
Treatment: Prechlorination, coagulation with alum and lime at times of high turbidity of water, and rapid sand filtration.
Rated capacity of treatment plant: 25,000,000 gpd.
Raw-water storage: None.
Finished water storage: 5 reservoirs, 21,100,000 gal; elevated tank, 100,000 gal.

EUGENE--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	20	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	17
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	3.6		
Magnesium (Mg)	2.0	Color	7
Sodium (Na)	3.6	pH	7.5
Potassium (K)	1.6	Specific conductance (micromhos at 25 C.)	51
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	27	Temperature (F.)	59
Sulfate (SO_4)	1.6	Date of collection	June 14, 1951
Chloride (Cl)	2.2		
Fluoride (F)	.0		
Nitrate (NO_3)	.1		
Dissolved solids	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	--	--	--	--	7.4	7.0	17	18	16	--	--	--
Finished water	--	--	--	--	7.4	6.6	17	18	16	--	--	--

KLAMATH FALLS

(Population, 15,875)

Ownership: Oregon Water Corporation (subsidiary of Boise Water Corporation, Boise, Idaho); supplies suburban Altamont District and also consumers outside the corporate limits of the city. Total population supplied, about 26,000.
Source: 4 flowing wells (3, 6, 7, and 8), 145, 147, 370, and 850 ft deep.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 3,700,000 gal.

ANALYSIS

(Analysis, in parts per million, by the University of California, Berkeley, Calif.)

	Wells (composite sample)		Wells (composite sample)
Silica (SiO_2)	24	Hardness as $CaCO_3$:	
Iron (Fe)	.15	Total	52
Manganese (Mn)	0	Noncarbonate	0
Calcium (Ca)	10		
Magnesium (Mg)	6.3	Color	--
Sodium (Na)	30	pH	8.2
Potassium (K)		Specific conductance (micromhos at 25 C.)	212
Carbonate (CO_3)	--	Turbidity	--
Bicarbonate (HCO_3)	108	Temperature (F.)	67
Sulfate (SO_4)	1.3	Date of collection	Mar. 22, 1949
Chloride (Cl)	19		
Fluoride (F)	.3		
Nitrate (NO_3)	--		
Dissolved solids	141		

LA GRANDE
(Population, 8,635)

Ownership: Municipal; supplies also about 1,000 people outside the city limits. Total population supplied, about 9,650.
Source: Beaver Creek and 3 tributaries (Cold Creek, West Fork, and Hidden Springs Creek). Emergency supply, 2 artesian (flowing) wells, 1,035 and 1,391 ft deep.
Treatment: Chlorination.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: 200,000,000 gal.
Finished-water storage: 4,900,000 gal.

ANALYSES

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

	Finished water[a]	Well 2		Finished water[a]	Well 2
Silica (SiO_2)	34	73	Hardness as $CaCO_3$:		
Iron (Fe)	.07	--	Total	21	24
Manganese (Mn)	--	--	Noncarbonate	1	0
Calcium (Ca)	5.5	--			
Magnesium (Mg)	1.7	--	Color	5	--
Sodium (Na)	2.4	--	pH	6.8	--
Potassium (K)	1.0	--	Specific conductance (micromhos at 25 C.)	50	147
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	24	85	Turbidity	--	--
Sulfate (SO_4)	1.4	4	Temperature (F.)	55	78
Chloride (Cl)	3.9	1	Date of collection	June 19, 1951	June 19, 1951
Fluoride (F)	.1	.5			
Nitrate (NO_3)	.0	.3			
Dissolved solids	68	--			
Depth (feet)				--	1,391
Diameter (inches)				--	10
Date drilled				--	1926
Percent of supply				--	--

[a] Beaver Creek.

MEDFORD
(Population, 17,305)

Ownership: Municipal; supplies also Central Point, Eagle Point, and about 3,500 people outside the city limits. Total population supplied, about 23,100.
Source: Big Butte Spring.
Treatment: None.
Storage: 12,400,000 gal.

MEDFORD--Continued

ANALYSIS

(Analysis, in parts per million, by Charlton Laboratories, Portland, Oreg.)

	Big Butte Springs		Big Butte Springs
Silica (SiO_2)	35	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	35
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	7.3		
Magnesium (Mg)	4.0	Color	--
Sodium (Na)	7.0	pH	6.9
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	56	Temperature (F.)	42
Sulfate (SO_4)	1.3	Date of collection	Apr. 21, 1947
Chloride (Cl)	2.0		
Fluoride (F)	.0		
Nitrate (NO_3)	.3		
Dissolved solids	99		

PENDLETON
(Population 11,774)

Ownership: Municipal; supplies also about 200 people outside the city limits. Total population supplied, about 12,000.
Source: Springs, 80 percent of supply; 2 wells 774 and 761 ft deep, 20 percent of supply. Emergency supply from privately owned well.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 3,500,000 gal.

ANALYSIS

(Analysis, in parts per million, by Charlton Laboratories, Portland, Oreg.)

	Springs and wells[a]		Springs and wells[a]
Silica (SiO_2)	44	Hardness as $CaCO_3$:	
Iron (Fe)	.2	Total	95
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	25		
Magnesium (Mg)	8.0	Color	--
Sodium (Na)	26	pH	7.2
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	< 1
Bicarbonate (HCO_3)	146	Temperature (F.)	--
Sulfate (SO_4)	15	Date of collection	January 1949
Chloride (Cl)	12		
Fluoride (F)	.2		
Nitrate (NO_3)	--		
Dissolved solids	[b] 203		

[a] Composite sample.
[b] Sum of determined constituents.

PORTLAND
(Population, 373,628)

Ownership: Municipal; supplies also about 107,000 people outside the city limits, including 60 water districts, water companies, and towns in areas adjacent to Portland. Total population supplied, about 480,000.
Source: Bull Run River impounded in Lake Ben Morrow Reservoir which extends $3\frac{1}{2}$ miles along the river, and Bull Run Lake, the source of the main branch of the river close to the summit of the Cascades.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plant: --
Raw-water storage: Storage reservoir on Bull Run River, 11,000,000,000 gal; Bull Run Lake, 3,000,000,000 gal.
Finished-water storage: 6 reservoirs, 192,000,000 gal.

The water from the river is diverted 5 miles downstream from the storage dam through 3 steel conduits to distribution reservoirs on Mount Tabor, a distance of 24 miles. Four distribution reservoirs are located on Mount Tabor and two in Washington Park. Distribution is mainly by gravity.

ANALYSIS

(Analysis, in parts per million, by Charlton Laboratories, Portland, Oreg.)

	Finished water		Finished water
Silica (SiO_2)	7.2	Hardness as $CaCO_3$:	
Iron (Fe)	.2	Total	9
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	2.3		
Magnesium (Mg)	.7	Color	15
Sodium (Na)	2.1	pH	7.0
Potassium (K)	.2	Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	--		
Bicarbonate (HCO_3)	15	Turbidity	< 1
Sulfate (SO_4)	.9	Temperature (F.)	59
Chloride (Cl)	2.4	Date of collection	Sept. 19, 1947
Fluoride (F)	.0		
Nitrate (NO_3)	.3		
Dissolved solids	30		

ROSEBURG
(Population, 8,390)

Ownership: Oregon Water Corporation (subsidiary of Boise Water Corporation, Boise, Idaho). Supplies also about 4,500 people outside the city limits. Total population supplied, about 12,900.
Source: North Umpqua River.
Treatment: Prechlorination, coagulation with alum and lime, sedimentation, and pressure filtration.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 3,100,000 gal.

ROSEBURG--Continued

ANALYSIS

(Analysis, in parts per million, by University of California, Berkeley, Calif.)

	Finished water		Finished water
Silica (SiO_2)	12	Hardness as $CaCO_3$:	
Iron (Fe)	.3	Total	43
Manganese (Mn)	--	Noncarbonate	16
Calcium (Ca)	15		
Magnesium (Mg)	1.3	Color	--
Sodium (Na)	7	pH	7.6
Potassium (K)	--	Specific conductance (micromhos at 25 C.)	97.3
Carbonate (CO_3)	--	Turbidity	--
Bicarbonate (HCO_3)	33	Temperature (F.)	53
Sulfate (SO_4)	12	Date of collection	Mar. 10, 1949
Chloride (Cl)	11		
Fluoride (F)	.1		
Nitrate (NO_3)	--		
Dissolved solids	80		

SALEM

(Population, 43,140)

Ownership: Municipal; supplies also about 10,000 people outside the city limits. Total population supplied, about 53,100.

Source: Infiltration system from North Santiam River about 17 miles southeast of Salem. Auxiliary or emergency supply from wells. The wells furnished 19 percent of the total supply in 1950.

Treatment: Chlorination and ammoniation.

Rated capacity of treatment plant: --

Raw-water storage: None.

Finished-water storage: 11,500,000 gal. A reservoir under construction will provide 100,000,000 gal of additional storage.

The infiltration system is on Stayton Island in the North Santiam River above Stayton and below the Little North Fork. On Stayton Island 3 wells each 25 ft deep and capable of delivering 2 mgd are used when necessary to augment the infiltration supply. Water from the infiltration system is conducted to Salem by gravity flow through a 36-in. pipeline.

Four wells, which are in Salem and connected to the distribution system and are used during peak loads, contributed about 7 percent of the supply in 1951. Contribution from all the wells probably exceeded 20 percent in 1951.

ANALYSIS

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

	Finished water (tap sample)		Finished water (tap sample)
Silica (SiO_2)	17	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	17
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	4.9		
Magnesium (Mg)	1.1	Color	5
Sodium (Na)	3.2	pH	7.3
Potassium (K)	2.6	Specific conductance (micromhos at 25 C.)	54
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	31	Temperature (F.)	64
Sulfate (SO_4)	1.7	Date of collection	June 14, 1951
Chloride (Cl)	1.0		
Fluoride (F)	.0		
Nitrate (NO_3)	.1		
Dissolved solids	45		

SPRINGFIELD
(Population, 10,807)

Ownership: Mountain States Power Company.
Source: Willamette River; Auxiliary supply, 8 contiguous wells (1 to 8) ranging in depth from 28 to 30 ft. The yield of the wells is reported to be 1,000, 400, 1,250, 1,000, 150, 500, 900, and 1,000 gpm respectively. The well water is supplied directly to the transmission line which in turn feeds into the distribution system.
Treatment: Willamette River: rapid sand filtration and chlorination. During peak periods of consumption a pressure filter is operated in parallel with the 2 sand filters. The well water is chlorinated.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,550,000 gal.

The well system has been developed during 1950 and 1951. Should this source prove entirely satisfactory, it is expected to replace the Willamette River supply.

ANALYSES

(Analyses, in parts per million)

	Raw water[a]	Well 3[b]		Raw water[a]	Well 3[b]
Silica (SiO_2)	17	11	Hardness as $CaCO_3$:		
Iron (Fe)	--	1.3	Total	36	37
Manganese (Mn)	--	--	Noncarbonate	16	5
Calcium (Ca)	11	11			
Magnesium (Mg)	2.1	2.3	Color	--	--
Sodium (Na)	1.4	3.9	pH	--	7.1
Potassium (K)	--	--	Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	0	--			
Bicarbonate (HCO_3)	25	39	Turbidity	--	--
Sulfate (SO_4)	15	2.5	Temperature (F.)	--	53
Chloride (Cl)	2.4	4.4	Date of collection	Apr. 12, 1951	Sept. 26, 1950
Fluoride (F)	--	--			
Nitrate (NO_3)	--	.9			
Dissolved solids	[c] 61	[c] 56			

Depth (feet)	29
Diameter (inches)	12
Date drilled	1950
Percent of supply	--

[a] Willamette River. Analyzed by Elgin Softener Corporation, Elgin, Illinois.
[b] Analyzed by Oregon State College, Corvallis, Oreg.
[c] Sum of determined constituents.

ABERDEEN
(Population, 21,051)

Ownership: Municipal; also supplies 175 people outside the city limits. Total population supplied, 21,226.

Source: Elm River (impounded) supplemented by Maple and Willow Creeks (impounded) for main supply; 2 gravel pits, located northeast of treatment plant, for auxiliary supply.

Treatment: Softening with lime and soda ash, sedimentation, activated carbon, recarbonation, addition of polyphosphates (918-Y balls), coagulation with alum and sodium aluminate, secondary sedimentation, rapid sand filtration, ammoniation, and chlorination.

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

Raw-water storage: No. 1 dam, 60,000,000 gal; No. 2 dam, 170,000,000 gal; No. 4 dam, 76,000,000 gal; Elm Lake, 5,000,000 gal.

Finished-water storage: 3,700,000 gal.

The treatment plant is located 8 miles northeast of Aberdeen. River was at high stage when samples were collected. Fluoridation of public supply will be started soon.

ANALYSES

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

	Elm River [a]	Elm River [b]		Elm River [a]	Elm River [b]
Silica (SiO_2)	9.8	6.0	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.06	Total	97	75
Manganese (Mn)	.00	.00	Noncarbonate	17	41
Calcium (Ca)	25	28			
Magnesium (Mg)	8.4	1.3	Color	33	5
Sodium (Na)	26	25	pH	7.1	8.8
Potassium (K)	7.0	6.8	Specific conductance (micromhos at 25 C.)	326	313
Carbonate (CO_3)	0	3	Turbidity	10	0.4
Bicarbonate (HCO_3)	98	35	Temperature (F.)	39	39
Sulfate (SO_4)	56	80	Date of collection	Apr. 11, 1951	Apr. 11, 1951
Chloride (Cl)	14	16			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	3.6	.5			
Dissolved solids	204	188			

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	--	400	40	--	8.6	7.2	--	500	40	--	400	20
Finished water	--	75	20	9.5	10	9	70	110	30	--	--	--

[a] Raw water.
[b] Finished water.

BROOKINGS
(Population, 7,764)

Ownership: Municipal; also supplies a few people outside the city limits. Total population supplied, about 7,800.
Source: 3 wells (1, 2, and 3), each 60 ft deep, and each reported to yield 1,000 gpm.
Treatment: Aeration (for iron removal), sedimentation, and chlorination.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 4,000,000 gal.

The treatment plant is 2 miles north of Brookings.

ANALYSES

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

	Well 1 (raw water)	Finished water		Well 1 (raw water)	Finished water
Silica (SiO_2)	24	25	Hardness as $CaCO_3$:		
Iron (Fe)	4.5	.19	Total	656	672
Manganese (Mn)	.75	.93	Noncarbonate	370	383
Calcium (Ca)	171	173			
Magnesium (Mg)	56	58	Color	2	3
Sodium (Na)	17	18	pH	8.0	8.3
Potassium (K)	2.5	2.4	Specific conductance (micromhos at		
Carbonate (CO_3)	0	10	25 C.)	1,160	1,160
Bicarbonate (HCO_3)	349	333	Turbidity	70	1
Sulfate (SO_4)	383	388	Temperature (F.)	48	48
Chloride (Cl)	5.0	9.5	Date of collection	Apr. 3, 1951	Apr. 3, 1951
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.6	1.4			
Dissolved solids	874	890			

Depth (feet)	60	
Diameter (inches)	18	
Date drilled	1930	
Percent of supply	--	

HURON
(Population, 12,788)

Ownership: Municipal.
Source: James River for regular supply; 3 wells for auxiliary supply.
Treatment: Prechlorination, activated carbon, softening with lime and soda ash, coagulation and clarification with sodium aluminate, recarbonation, sedimentation, charcoal, and rapid sand filtration.
Rated capacity of treatment plant: 4,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,600,000 gal.

There is considerable variation in the composition of the water throughout the year. The treatment varies throughout the year.

HURON--Continued

ANALYSES

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

	James River a	James River b		James River a	James River b
Silica (SiO_2)	9.0	8.2	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.05	Total	152	158
Manganese (Mn)	.00	.69	Noncarbonate	39	88
Calcium (Ca)	37	38			
Magnesium (Mg)	15	15	Color	45	7
Sodium (Na)	39	46	pH	7.5	7.3
Potassium (K)	11	11	Specific conductance (micromhos at 25 C.)	497	559
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	138	85			
Sulfate (SO_4)	97	149	Turbidity	15	0.3
Chloride (Cl)	21	30	Temperature (F.)	37	38
Fluoride (F)	.1	.1	Date of collection	Apr. 10, 1951	Apr. 10, 1951
Nitrate (NO_3)	5.6	1.4			
Dissolved solids	340	384			

[a] Raw water.
[b] Finished water.

LEAD
(Population, 6,422)

Ownership: Homestake Mining Co.; also supplies about 1,000 people in Deadwood and 500 in Central City and Terraville, and Pluma. Total population supplied, about 7,900.
Source: Springs in upper Spearfish Creek basin.
Treatment: Chlorination and ammoniation.
Raw-water storage: None.
Finished-water storage: Reservoirs, 2,165,000 gal.
The water is pumped from the springs as needed to keep the reservoirs full.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	12	11	Hardness as $CaCO_3$:		
Iron (Fe)	.07	.08	Total	250	255
Manganese (Mn)	.00	.00	Noncarbonate	1	2
Calcium (Ca)	62	60			
Magnesium (Mg)	23	26	Color	1	1
Sodium (Na)	.6	.6	pH	8.0	8.2
Potassium (K)	.3	.4	Specific conductance (micromhos at 25 C.)	444	446
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	304	308			
Sulfate (SO_4)	1.0	1.0	Turbidity	0.4	0.9
Chloride (Cl)	1.0	1.3	Temperature (F.)	--	--
Fluoride (F)	.1	.1	Date of collection	May 15, 1951	May 15, 1951
Nitrate (NO_3)	1.3	1.8			
Dissolved solids	251	255			

MADISON
(Population, 5,153)

Ownership: Municipal.
Source: 3 wells (East, South, and Plant) each about 30 ft deep. East well furnishes 90 percent of supply; South well, 5 percent; Plant well, 5 percent.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 400,000 gal.

ANALYSIS

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

	East well (finished water)		East well (finished water)
Silica (SiO_2)	22	Hardness as $CaCO_3$:	
Iron (Fe)	.49	Total	662
Manganese (Mn)	.79	Noncarbonate	413
Calcium (Ca)	161		
Magnesium (Mg)	63	Color	2
Sodium (Na)	64	pH	7.8
Potassium (K)	11	Specific conductance (micromhos at 25 C.)	1,400
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	304	Temperature (F.)	48
Sulfate (SO_4)	448	Date of collection	Apr. 3, 1951
Chloride (Cl)	70		
Fluoride (F)	.2		
Nitrate (NO_3)	.3		
Dissolved solids	1,060		
Depth (feet)			27
Diameter (inches)			23
Date drilled			1930
Percent of supply			90

MITCHELL
(Population, 12,123)

Ownership: Municipal; also supplies about 125 people outside the city limits, the air base, and the Hormel Packing Co. Total population supplied, about 12,250.
Source: Firesteel Creek impounded in Lake Mitchell.
Treatment: Softening with lime-soda ash, coagulation with sodium aluminate, carbon, sedimentation, rapid sand filtration, recarbonation, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 3,565,000,000 gal.
Finished-water storage: 1,550,000 gal.

There is considerable variation in the composition of the raw water throughout the year.

MITCHELL--Continued

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	5.4	5.1	Hardness as $CaCO_3$:		
Iron (Fe)	.14	.14	Total	392	126
Manganese (Mn)	.20	.03	Noncarbonate	214	20
Calcium (Ca)	82	31			
Magnesium (Mg)	46	12	Color	9	4
Sodium (Na)	66	144	pH	7.6	9.7
Potassium (K)	14	14	Specific conductance (micromhos at 25 C.)	1,010	960
Carbonate (CO_3)	0	37	Turbidity	--	--
Bicarbonate (HCO_3)	217	54	Temperature (F.)	36	36
Sulfate (SO_4)	323	311	Date of collection	Feb. 18, 1952	Feb. 18, 1952
Chloride (Cl)	24	24			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	2.3	2.0			
Dissolved solids	724	631			

Regular determinations at treatment plant

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	240	300	190	--	65	33
Finished water	--	--	--	9.5	--	--	85	--	--	--	65	33

PIERRE
(Population, 5,715)

Ownership: Municipal.
Source: 4 wells (1, 2, 3, and 4) 64, 63, 62, and 64 ft deep. The yield of the wells is reported to be 1,000, 700, 400, and 700 gpm. Wells 2 and 4 are used most of the time for the supply.
Treatment: Chlorination at wells.
Raw-water storage: None.
Finished-water storage: 2,750,000 gal.

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

	Finished water[a]		Finished water[a]
Silica (SiO_2)	23	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	261
Manganese (Mn)	1.9	Noncarbonate	83
Calcium (Ca)	68		
Magnesium (Mg)	22	Color	3
Sodium (Na)	87	pH	7.8
Potassium (K)	4.2	Specific conductance (micromhos at 25 C.)	844
Carbonate (CO_3)	0	Turbidity	0.7
Bicarbonate (HCO_3)	217	Temperature (F.)	57
Sulfate (SO_4)	232	Date of collection	Apr. 26, 1951
Chloride (Cl)	24		
Fluoride (F)	.8		
Nitrate (NO_3)	1.1		
Dissolved solids	586		

[a] Composite of wells 2 and 4.

RAPID CITY
(Population, 25,310)

Ownership: Municipal.
Source: Jackson Springs (82 percent of supply, 1950); 4 wells (1 to 4) 1,460, 902, 957, and 1,075 ft deep (18 percent of supply, 1950). The yield of the wells is reported to be 380 (flowing), 240 (flowing), 669, and 690 (flowing) gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 3,000,000 gal.

ANALYSES

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

	Jackson Springs [a]	Finished water [b]		Jackson Springs [a]	Finished water [b]
Silica (SiO_2)	13	11	Hardness as $CaCO_3$:		
Iron (Fe)	.05	.06	Total	185	193
Manganese (Mn)	.03	.00	Noncarbonate	21	20
Calcium (Ca)	41	43			
Magnesium (Mg)	20	21	Color	--	0
Sodium (Na)	1.8	5.2	pH	7.9	7.8
Potassium (K)		2.1	Specific conductance (micromhos at 25 C.)	369	376
Carbonate (CO_3)	0	0	Turbidity	--	0.7
Bicarbonate (HCO_3)	200	211	Temperature (F.)	--	--
Sulfate (SO_4)	20	28	Date of collection	July 27, 1949	May 23 1951
Chloride (Cl)	1.6	3.5			
Fluoride (F)	.2	.1			
Nitrate (NO_3)	1.1	1.4			
Dissolved solids	210	219			

[a] Raw water.
[b] Composite.

SIOUX FALLS
(Population, 52,696)

Ownership: Municipal; also supplies about 1,000 people outside the city limits. Total population supplied, about 53,700.
Source: 17 shallow wells 36 to 45 ft deep in the Big Sioux River bottoms. The yield of the wells ranges from 300 gpm (well 10) to 1,025 gpm (well 14), and averages 779 gal.
Treatment: Aeration, chlorination, sedimentation, rapid sand filtration, and stabilization with polyphosphate (Nalco).
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Elevated tanks, 1,905,000 gal; storage reservoirs, 5,200,000 gal. Total, 7,105,000 gal.

The quality of the water from the wells is affected by change in the stage of the Big Sioux River. There is considerable variation in the composition of the water throughout the year.

SIOUX FALLS--Continued

ANALYSES

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

	Raw water [a]	Finished water [b]		Raw water [a]	Finished water [b]
Silica (SiO_2)	18	20	Hardness as $CaCO_3$:		
Iron (Fe)	6.3	.42	Total	320	484
Manganese (Mn)	.71	1.6	Noncarbonate	129	227
Calcium (Ca)	85	122			
Magnesium (Mg)	26	44	Color	5	4
Sodium (Na)	7.6	17	pH	7.9	7.6
Potassium (K)	2.6	3.4	Specific conductance (micromhos at 25 C.)	624	921
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	233	314			
Sulfate (SO_4)	131	237	Turbidity	1	2
Chloride (Cl)	5.5	14	Temperature (F.)	45	50
Fluoride (F)	.3	.4	Date of collection	Mar. 3, 1951	Mar. 3, 1951
Nitrate (NO_3)	1.8	.6			
Dissolved solids	430	646			

[a] Composite, all wells except well 24.
[b] Composite, all wells.

VERMILLION
(Population, 5,337)

Ownership: Municipal.
Source: 2 wells (1 and 2) each 110 ft deep.
Treatment: Aeration, softening with lime and soda ash, coagulation with sodium aluminate, sedimentation, recarbonation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,150,000 gpd.
Raw-water storage: None.
Finished-water storage: Elevated tank, 500,000 gal.

ANALYSES

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

	Raw water [a]	Finished water [a]		Raw water [a]	Finished water [a]
Silica (SiO_2)	34	14	Hardness as $CaCO_3$:		
Iron (Fe)	2.6	.06	Total	673	143
Manganese (Mn)	.56	.02	Noncarbonate	159	38
Calcium (Ca)	182	46			
Magnesium (Mg)	53	6.8	Color	5	5
Sodium (Na)	80	147	pH	7.4	9.1
Potassium (K)	12	13	Specific conductance (micromhos at 25 C.)	1,410	927
Carbonate (CO_3)	0	14			
Bicarbonate (HCO_3)	627	100			
Sulfate (SO_4)	335	348	Turbidity	20	5
Chloride (Cl)	8.5	12	Temperature (F.)	52	53
Fluoride (F)	.6	.5	Date of collection	Feb. 20, 1951	Feb. 20, 1951
Nitrate (NO_3)	.2	.1			
Dissolved solids	1,040	668			

[a] Composite.

WATERTOWN
(Population, 12,699)

Ownership: Municipal.
Source: Lake Kampeska, 75 percent of supply; 3 wells (2 to 4), each 28 ft deep, 25 percent of supply. The yield of the wells is reported to be 104, 104, and 139 gpm.
Treatment: Lake water: coagulation with alum, sedimentation, rapid sand filtration, ammoniation, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: Lake Kampeska.
Finished-water storage: 2,400,000 gal.

The treatment plant is located near the lake. The finished lake water is mixed with the raw well water and the mixed water is delivered to the distribution system.

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	19	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	342
Manganese (Mn)	.00	Noncarbonate	124
Calcium (Ca)	81		
Magnesium (Mg)	34	Color	3
Sodium (Na)	53	pH	7.8
Potassium (K)	6.8	Specific conductance (micromhos at 25 C.)	901
Carbonate (CO_3)	0	Turbidity	0.8
Bicarbonate (HCO_3)	266	Temperature (F.)	43
Sulfate (SO_4)	115	Date of collection	Apr. 12, 1951
Chloride (Cl)	88		
Fluoride (F)	.1		
Nitrate (NO_3)	5.7		
Dissolved solids	586		

YANKTON
(Population, 7,709)

Ownership: Municipal; also supplies about 3,000 people outside the city limits. Total population supplied, about 10,700.
Source: Missouri River.
Treatment: Coagulation with alum and sodium aluminate, softening with lime, sedimentation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: None.
Finished-water storage: Clear well and tank, 1,250,000 gal.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	15	12	Hardness as $CaCO_3$:		
Iron (Fe)	.10	.05	Total	245	113
Manganese (Mn)	.03	.01	Noncarbonate	78	80
Calcium (Ca)	65	26			
Magnesium (Mg)	20	12	Color	5	4
Sodium (Na)	57	61	pH	8.0	9.8
Potassium (K)	5.1	4.0	Specific conductance (micromhos at 25 C.)	693	531
Carbonate (CO_3)	0	17			
Bicarbonate (HCO_3)	203	5.0	Turbidity	45	1
Sulfate (SO_4)	187	194	Temperature (F.)	35	37
Chloride (Cl)	11	12	Date of collection	Feb. 20, 1951	Feb. 20, 1951
Fluoride (F)	.5	.6			
Nitrate (NO_3)	1.6	1.6			
Dissolved solids	494	368			

ABILENE, TEXAS
(Population, 45,570)

Ownership: Municipal.

Source: 3 lakes. Lake Abilene, approximately 19½ miles southwest of Abilene on Elm Creek, about 25 percent of the supply; Lake Kirby, 4 miles south of Abilene on Cedar Creek, about 25 percent of the supply; Lake Fort Phantom Hill, 12 miles north of Abilene in Jones County, on Elm Creek, 50 percent of supply.

Treatment: Lake Abilene and North Second Street (Fort Phantom Hill) plants: prechlorination, coagulation with alum, sedimentation, rapid sand filtration, and postchlorination. Lake Kirby plant: prechlorination, coagulation with alum, sedimentation, and postchlorination.

Rated capacity of treatment plants: Lake Abilene, 4,000,000 gpd; Lake Kirby, 4,000,000 gpd; North Second Street, 8,000,000 gpd.

Raw-water storage: 1 earthen reservoir, 20,000,000 gal; Lake capacities: Abilene, 3,250,000,000 gal; Kirby, 3,000,000,000 gal; Fort Phantom Hill, 25,000,000,000 gal.

Finished-water storage: 2 elevated tanks, 500,000 gal each; 3 standpipes, 85,000, 250,000, and 250,000 gal; clear wells: Lake Abilene plant, 600,000 gal; Lake Kirby plant, 500,000 gal; and North Second Street plant, 2,000,000 gal.

Except in emergencies Lake Fort Phantom Hill supply is used throughout the year. Lake Abilene and Lake Kirby are used primarily in the summer months when demands are high.

Water from Lake Abilene flows by gravity to a 20,000,000 gal earthen tank, from whence it flows by gravity to the treatment plant, 7½ miles south of Abilene on Buffalo Gap Road. The finished water is pumped to the city and into the distribution system and elevated storage.

Water from Lake Kirby flows by gravity to the treatment plant, 1 mile south of Abilene. The finished water is pumped into the distribution system and elevated storage.

Water from Lake Fort Phantom Hill is pumped to the treatment plant on North Second Street and Cottonwood Street. The finished water is pumped into the distribution system and elevated storage.

ANALYSES

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

	L. Abilene (raw water)	L. Kirby (raw water)	Lake Fort Phantom Hill[a]	Lake Fort Phantom Hill[a]	Finished water (city tap)
Silica (SiO_2)	9.6	5.5	6.0	1.2	0.8
Iron (Fe)	--	--	--	.05	.09
Manganese (Mn)	--	--	--	.00	.00
Calcium (Ca)	51	44	46	40	40
Magnesium (Mg)	15	12	19	23	23
Sodium (Na)	9.3	13	52	57	61
Potassium (K)	5.1	4.9	8.5	8.0	6.8
Carbonate (CO_3)	9	12	12	0	0
Bicarbonate (HCO_3)	192	178	198	236	234
Sulfate (SO_4)	21	11	52	40	46
Chloride (Cl)	15	9.0	56	65	66
Fluoride (F)	.2	1.0	.2	.3	.3
Nitrate (NO_3)	.0	.5	.2	.2	.0
Dissolved solids	234	209	360	362	361
Hardness as $CaCO_3$:					
Total	189	159	193	194	194
Noncarbonate	17	0	10	1	3

[a] Raw water.

ABILENE, Analyses--Continued

	L. Abilene (raw water)	L. Kirby (raw water)	Lake Fort Phantom Hill [a]	Lake Fort Phantom Hill [a]	Finished water (city tap)
Color	--	--	--	15	10
pH	--	--	--	7.8	7.3
Specific conductance (micromhos at 25 C.)	407	390	622	642	640
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Apr. 18, 1946	Apr. 18, 1946	Apr. 19, 1946	Jan. 18, 1952	Jan. 18, 1952

Regular determinations at treatment plant, 1951 [b]

	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	230	165	--	--	--	--	--	--	--	--	--
Finished water	185	220	160	8.2	8.4	7.7	--	--	--	--	--	--

[a] Raw water. [b] Average of all three plants.

ALICE
(Population, 16,449)

Ownership: Municipal; supplies also about 300 people outside the city limits. Total population supplied, about 16,750.

Source: 7 wells (1 to 5, 11, and 12), 2,068 (plugged 992 ft), 622, 647, 550, 900, 864, and 889 ft deep. The yield of the wells is reported to range from 110 to 430 gpm. The wells are pumped individually.

Treatment: Periodic chlorination (for example, during floods in the area). Each well is equipped with a chlorinating unit.

Raw-water storage: None.

Finished-water storage: 2,500,000 gal.

ANALYSES

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

	Well 1 (raw water)	Well 2 (raw water)	Well 3 (raw water)	Well 4 (raw water)	Well 5 (raw water)
Silica (SiO_2)	29	22	18	25	18
Iron (Fe)	.02	.03	.05	.05	.04
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	23	20	43	42	30
Magnesium (Mg)	8.8	8.1	23	22	17
Sodium (Na)	333	290	398	313	317
Potassium (K)	11	9.9	12	11	10
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	345	353	315	362	358
Sulfate (SO_4)	196	117	165	115	128
Chloride (Cl)	237	214	448	325	289
Fluoride (F)	1.0	.9	.9	2.1	1.2
Nitrate (NO_3)	11	12	22	12	12
Dissolved solids	1,030	876	1,290	1,090	1,020
Hardness as $CaCO_3$:					
Total	94	84	202	196	145
Noncarbonate	0	0	0	0	0

ALICE, Analyses--Continued

	Well 1 (raw water)	Well 2 (raw water)	Well 3 (raw water)	Well 4 (raw water)	Well 5 (raw water)
Color	--	--	--	--	--
pH	7.2	7.4	7.4	7.4	7.8
Specific conductance (micromhos at 25 C.)	1,880	1,630	2,480	2,070	1,740
Turbidity	--	--	--	--	--
Temperature (F.)	86	85	82	81	--
Date of collection	Mar. 5, 1945	Mar. 5, 1945	Mar. 5, 1945	Mar. 5, 1945	Sept. 27, 1945
Depth (feet)	1,076	622	647	*550	900
Diameter (inches)	16-8	5	10	10	16-8
Date drilled	1928	1938	1940	1944	1945
Percent of supply	--	--	--	--	--

AMARILLO
(Population, 74,246)

Ownership: Municipal.

Source: 47 wells in several well fields southwest of the city of Amarillo in the northern section of Randall County. Palo Duro Field: 10 wells (1 to 10), each 200 ft deep, with a reported average yield of 657 gpm; Greely: 7 wells (1 to 7), 264 to 313 ft deep, with a reported average yield of 951 gpm; Bush: 6 wells (one unnumbered, and 1 to 5), 239 to 305 ft deep, with a reported average yield of 955 gpm; McDonald: 6 wells (1 to 6), 270 to 336 ft deep, and each reported to yield 750 gpm; Bassett: 2 wells (1 and 2), 265 and 280 ft deep, and each reported to yield 750 gpm; Brinkman: 1 well (1), 277 ft deep, and reported to yield 700 gpm; West-Tex: 6 wells (1 to 6), 260 to 300 ft deep, with a reported average yield of about 1,200 gpm; Sec. 98: 1 well (3), 273 ft deep, and reported to yield 980 gpm. (Data for the remaining 8 wells, not reported).

Treatment: Chlorination.

Rated capacity of transmission plant: 23,300,000 gpd.

Raw-water storage: None.

Finished-water storage: 3 ground storage reservoirs, 5,000,000 gal, each; 3 elevated tanks, 1,000,000 gal, each; 1 elevated tank, 500,000 gal.

The wells are pumped individually to the transmission plant. The water is chlorinated at the transmission plant prior to going into the distribution system.

The analyses selected are reasonably representative of the water furnished by the wells.

AMARILLO--Continued

ANALYSES

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

	Palo Duro Well 1	Palo Duro Well 6	Greeley Well 1	Bush Well 4	Bush Well 5
Silica (SiO_2)	61	65	80	67	66
Iron (Fe)	.02	.04	.0	.0	.07
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	58	32	32	58	36
Magnesium (Mg)	62	39	43	26	41
Sodium (Na)	36	37	25	24	14
Potassium (K)	4.2	4.0	8.0	6.0	3.8
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	440	320	328	288	294
Sulfate (SO_4)	84	35	34	50	29
Chloride (Cl)	16	12	7.0	9.0	10
Fluoride (F)	3.6	3.2	3.2	2.4	3.0
Nitrate (NO_3)	3.8	3.2	2.8	3.5	2.5
Dissolved solids	530	386	372	382	390
Hardness as $CaCO_3$:					
Total	400	240	257	252	258
Noncarbonate	39	0	0	16	18
Color	--	--	--	--	--
pH	7.6	7.8	7.6	7.4	7.6
Specific conductance (micromhos at 25 C.)	799	586	584	534	561
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Dec. 11, 1947	Dec. 11, 1947	June 23, 1948	June 23, 1948	Dec. 11, 1947

	McDonald Well 1	Bassett Well 2	Brinkman Well 1	West-Tex Well 1
Silica (SiO_2)	66	56	62	65
Iron (Fe)	.06	.06	.0	.08
Manganese (Mn)	--	--	--	--
Calcium (Ca)	35	54	48	39
Magnesium (Mg)	35	33	27	33
Sodium (Na)	28	7.1	16	26
Potassium (K)	3.8	3.4	9.2	4.8
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	298	300	294	296
Sulfate (SO_4)	26	23	25	37
Chloride (Cl)	10	8.0	4.1	7.0
Fluoride (F)	3.2	2.2	2.8	2.4
Nitrate (NO_3)	3.8	3.8	2.8	1.8
Dissolved solids	350	341	341	351
Hardness as $CaCO_3$:				
Total	232	270	231	233
Noncarbonate	0	24	0	0
Color	--	--	--	--
pH	7.7	7.6	7.4	7.8
Specific conductance (micromhos at 25 C.)	529	529	511	549
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	64
Date of collection	Dec. 11, 1947	Dec. 11, 1947	June 23, 1948	June 18, 1951

AUSTIN
(Population, 132,459)

Ownership: Municipal; the city furnishes about 18,000 people outside the city limits. Total population supplied, about 150,500.
Source: Colorado River.
Treatment: Coagulation with iron salts (ferrous sulfate), softening with lime, ammoniation, chlorination, sedimentation, and rapid sand filtration.
Rated capacity of treatment plant: 32,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1 ground reservoir, 10,000,000 gal; 1 ungerground reservoir, 2,000,000 gal; clear well, 4,000,000 gal.

The water is pumped from the river to the treatment plant, located nearby within the city limits. The finished water is pumped to the distribution system and storage.

ANALYSES

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

	Colorado River (raw water)[a]	Raw water	Finished water
Silica (SiO_2)	11	12	5.4
Iron (Fe)	--	.03	.00
Manganese (Mn)	--	.00	.00
Calcium (Ca)	41	40	11
Magnesium (Mg)	14	16	14
Sodium (Na)	34	44	47
Potassium (K)		3.6	.8
Carbonate (CO_3)	0	0	20
Bicarbonate (HCO_3)	162	154	17
Sulfate (SO_4)	30	39	41
Chloride (Cl)	48	67	68
Fluoride (F)	.2	.3	.3
Nitrate (NO_3)	1.4	.8	.2
Dissolved solids	270	297	220
Hardness as $CaCO_3$:			
Total	160	166	85
Noncarbonate	27	40	38
Color	--	0	5
pH	--	8.0	9.7
Specific conductance (micromhos at 25 C.)	464	529	412
Turbidity	--	0	--
Temperature (F.)	--	--	68
Date of collection	--	Sept. 4-30, 1951	Feb. 29, 1952

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	134	153	130	8.0	8.4	7.6	161	168	156	14	900	10
Finished water	46	51	41	9.9	10.3	9.7	71	78	68	2	2	2

[a] Weighted average of analyses of 10-day composites of daily samples for the water year October 1949 to September 1950.

BAYTOWN
(Population, 22,983)

Ownership: Municipal; also supplies the town of Cedar Bayou. Total population supplied, about 24,500.
Source: 6 wells (Baytown 1 to 6), 410, 448, 485, (depth not reported), 563, and 468 ft deep. The yield of the wells is reported to be 900, 1,000, 650, 750, 585, and 200 gpm. Emergency supplies can be obtained from the supply of the Humble Oil and Refining Co.
Treatment: Chlorination at the wells.
Raw-water storage: --
Finished-water: 880,000 gal.

The wells are pumped individually into ground storage tanks, from which the water is pumped into the distribution system. Overhead storage tanks for pressure equalization are "floated" on the distribution system.

ANALYSIS

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

	Baytown Well 1 (raw water)		Baytown Well 1 (raw water)
Silica (SiO_2)	26	Hardness as $CaCO_3$:	
Iron (Fe)	.29	Total	40
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	10		
Magnesium (Mg)	3.5	Color	10
Sodium (Na)	271	pH	7.6
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	1,270
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	461	Temperature (F.)	--
Sulfate (SO_4)	.2	Date of collection	Nov. 27, 1951
Chloride (Cl)	174		
Fluoride (F)	1.2		
Nitrate (NO_3)	.0		
Dissolved solids	733		

Depth (feet)	410
Diameter (inches)	13-6 5/8
Date drilled	1942
Percent of supply	--

BEAUMONT
(Population, 94,014)

Ownership: Municipal.
Source: Neches River. The water is diverted by open canal from 2 intakes. The lower intake (Bunn's Bluff) is 8 miles upstream from the turning basin in Beaumont; the upper intake (Weiss' Bluff) is 21 miles upstream. The upper intake is only used when salt water from Sabine Lake moves upstream to the Bunn's Bluff intake.
Treatment: Aeration, coagulation with alum, chlorination, sedimentation, rapid sand filtration, and final adjustment of pH with lime.
Rated capacity of treatment plant: 20,000,000 gpd.
Raw-water storage: --
Finished-water storage: Ground reservoir and elevated tanks, 7,500,000 gal.

There is some variation in the composition of the water throughout the year. The analyses of the raw water at Evadale about 20 miles upstream from Beaumont are essentially representative of the raw water diverted for the supply.

BEAUMONT--Continued

ANALYSES

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

	Neches River at Evadale (raw water)[a]	Neches River at Evadale (raw water)[b]	Finished water
Silica (SiO_2)	16	27	17
Iron (Fe)	--	.57	.06
Manganese (Mn)	--	--	.00
Calcium (Ca)	6.6	12	21
Magnesium (Mg)	3.6	4.6	3.3
Sodium (Na)	11	39	41
Potassium (K)		.4	1.6
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	20	66	46
Sulfate (SO_4)	12	8.8	35
Chloride (Cl)	18	50	60
Fluoride (F)	.0	.3	.1
Nitrate (NO_3)	.9	.8	.2
Dissolved solids	96	174	212
Hardness as $CaCO_3$:			
Total	31	49	66
Noncarbonate	15	0	28
Color	--	60	10
pH	--	7.0	7.0
Specific conductance (micromhos at 25 C.)	115	295	360
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	1950 water year	Sept. 1-13, 15-20, 1951	Nov. 27, 1951

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	25	60	7	6.7	7.8	6.3	40	60	20	35	350	14
Finished water	30	60	20	8.4	9.0	8.3	60	80	55	.35	1	0

[a] Weighted average of analyses of 10-day composites of daily samples for the water year October 1949 to September 1950.

[b] Composite of daily samples Sept. 1-13, 15-20, 1951.

BELLAIRE
(Population, 10,173)

Ownership: Municipal.
Source: 4 wells, ranging in depths from 1,102 to 1,649 ft in the Lissie-Willis water-bearing formation.
Treatment: Chlorination at the wells.
Rated capacity of treatment plant: --
Raw-water storage: --
Finished-water storage: 750,000 gal.

The wells are pumped individually into ground storage tanks. From the storage tanks the water is pumped into the distribution system.

BELLAIRE--Continued
ANALYSIS

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

	Well 4 (raw water)		Well 4 (raw water)
Silica (SiO_2)	18	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	25
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	9.2		
Magnesium (Mg)	2.7	Color	--
Sodium (Na)	114	pH	8.0
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	535
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	274	Temperature (F.)	--
Sulfate (SO_4)	9.8	Date of collection	Nov. 20, 1951
Chloride (Cl)	36		
Fluoride (F)	.6		
Nitrate (NO_3)	.2		
Dissolved solids	328		

Depth (feet)	1,634
Diameter (inches)	20-10¾
Date drilled	1950
Percent of supply	--

BIG SPRING
(Population, 17,286)

Ownership: Municipal; supplies also about 3,000 persons outside the city limits, and the Big Spring Air Force Base. Total population supplied, in excess of 20,300.

Source: 26 wells in 4 well fields, about 50 percent of supply; Powell Lake, capacity 1,461 acre-ft, on Powell Branch Creek 12 miles southwest of Big Spring, about 50 percent of the supply. Well fields: City Park: 2 wells, 273 and 283 ft deep, 2.8 miles south of the City Hall; O'Barr: 7 wells, 125 to 255 ft deep, 22 miles south of the city in Glasscock County; Section 17: 10 wells, 121 to 260 ft deep, about 3 miles southwest of the City Hall; Section 33: 7 wells, 223 to 316 ft deep, about 5.7 miles southeast of the City Hall. Auxiliary or emergency supply, Moss Lake on Moss Ranch Creek.

Treatment: Surface water: coagulation with alum, sedimentation, rapid sand filtration, and chlorination. Wells: chlorination.

Rated capacity of treatment plant: 1,500,000 gpd.

Raw-water storage: None.

Finished-water storage: 4 reservoirs, three, 1,000,000 gal each, and one, 200,000 gal; 1 elevated tank, 200,000 gal.

The water is pumped from Powell Lake to the treatment plant in Big Spring. The finished water from the treatment plant is pumped into one of the reservoirs. The wells pump as a unit in each well field to a chlorinator station at City Park, where the water is chlorinated. The water from the chlorinator station and the treatment plant is pumped into the reservoir containing the smallest amount of water at the time. The water is pumped from the reservoirs into the distribution system and elevated tank.

BIG SPRING--Continued
ANALYSES

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

	City Park Field well 4	O'Barr Field well 1	O'Barr Field well 4	Section 17 well 9	Section 33 well 54
Silica (SiO_2)	15	15	23	17	16
Iron (Fe)	.04	.04	.08	.04	.06
Manganese (Mn)	--	--	.00	--	--
Calcium (Ca)	100	94	70	94	88
Magnesium (Mg)	10	20	13	4.6	8.3
Sodium (Na)	28	11	33	6.2	19
Potassium (K)	5.8	4.8	.8	4.0	4.7
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	294	318	251	268	244
Sulfate (SO_4)	46	29	30	19	35
Chloride (Cl)	44	36	38	20	40
Fluoride (F)	1.0	.6	1.0	.0	1.2
Nitrate (NO_3)	5.7	5.0	6.6	5.3	5.8
Dissolved solids	409	369	358	302	326
Hardness as $CaCO_3$:					
Total	290	316	228	254	254
Noncarbonate	50	56	22	34	54
Color	--	--	0	--	--
pH	7.2	7.2	7.4	7.1	7.2
Specific conductance (micromhos at 25 C.)	690	644	604	506	558
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Aug. 21, 1947	Aug. 22, 1947	Apr. 29, 1952	Aug. 22, 1947	Aug. 22, 1947
Depth (feet)	283	129	255	121	303
Diameter (inches)	12	12	12	6	10-8
Date drilled	1926	1943	1944	1926	1944
Percent of supply	--	--	--	--	--

	Moss Lake (raw water)	Powell Lake (raw water)	Finished water[a]
Silica (SiO_2)	--	7.1	19
Iron (Fe)	--	.10	.0
Manganese (Mn)	--	--	--
Calcium (Ca)	30	32	78
Magnesium (Mg)	2.1	4.1	11
Sodium (Na)	3.5	12	30
Potassium (K)		3.5	.4
Carbonate (CO_3)	0	8	0
Bicarbonate (HCO_3)	105	116	275
Sulfate (SO_4)	2	3.8	31
Chloride (Cl)	2.0	10	30
Fluoride (F)	--	.2	.6
Nitrate (NO_3)	.2	.0	5.0
Dissolved solids	114	130	346
Hardness as $CaCO_3$:			
Total	84	97	240
Noncarbonate	0	0	14

[a] Reservoir, composite sample.

BIG SPRING, Analyses--Continued

	Moss Lake (raw water)	Powell Lake (raw water)	Finished water[a]
Color	--	--	0
pH	--	--	7.5
Specific conductance (micromhos at 25 C.)	--	225	587
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	Aug. 9, 1945	Aug. 21, 1947	Mar. 29, 1952

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	106	124	72	8.1	8.5	7.6	--	--	--	67	300	25
Finished water	99	120	72	7.9	8.1	7.7	--	--	--	--	--	--

[a] Reservoir, composite sample.

BORGER
(Population 18,059)

Ownership: Phillips Petroleum Co.
Source: 8 wells (1 to 8), 410, 384, 371, 376, 495, 535, 403, and 459 ft deep, at the Plains Water Station in Carson County 13 miles southwest of Borger. The yield of the wells is reported to range from 700 to 800 gpm.
Treatment: None.
Storage: 10,000 gal.

The Phillips Petroleum Co. pumps the water from the well field through two 12-in. lines to the city limits from which point it is distributed by the city.

ANALYSIS

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

	Wells (composite)		Wells (composite)
Silica (SiO_2)	28	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	197
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	46		
Magnesium (Mg)	20	Color	--
Sodium (Na)	24	pH	8.0
Potassium (K)	7.6	Specific conductance (micromhos at 25 C.)	444
Carbonate (CO_3)	22	Turbidity	--
Bicarbonate (HCO_3)	204	Temperature (F.)	--
Sulfate (SO_4)	24	Date of collection	Nov. 17, 1947
Chloride (Cl)	18		
Fluoride (F)	.4		
Nitrate (NO_3)	3.5		
Dissolved solids	294		

BROWNSVILLE
(Population, 36,066)

Ownership: Municipal; supplies also about 400 people outside the city limits. Total population supplied, about 36,500. City also supplies Port of Brownsville, Carthage Hydrocal Plant, and International Airport outside the city limits.
Source: Rio Grande.
Treatment: (Both plants) Plain sedimentation, aeration (spray), prechlorination, coagulation with alum and lime, sedimentation, activated carbon at times for odor and taste control, rapid sand filtration, and postchlorination. Use of copper sulfate at times in reservoir.
Rated capacity of treatment plants: Plant 1: 5,000,000 gpd; plant 2: 4,000,000 gpd.
Raw-water storage: Reservoir, 180 acres, average depth, 8 ft.
Finished-water storage: 3,150,000 gal.

The raw water source is the same for both treatment plants. The water for plant 2 flows through a concrete lined canal to the plant. There is considerable variation in the composition of the raw water throughout the year.

ANALYSIS

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

	Finished water (Plant 2)		Finished water (Plant 2)
Silica (SiO_2)	13	Hardness as $CaCO_3$:	
Iron (Fe)	.09	Total	266
Manganese (Mn)	.00	Noncarbonate	153
Calcium (Ca)	72		
Magnesium (Mg)	21	Color	10
Sodium (Na)	126	pH	7.4
Potassium (K)		Specific conductance (micromhos at 25 C.)	1,100
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	138	Temperature (F.)	--
Sulfate (SO_4)	184	Date of collection	Oct. 22, 1951
Chloride (Cl)	165		
Fluoride (F)	.6		
Nitrate (NO_3)	2.0		
Dissolved solids	652		

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 [a]	144	220	90	8.1	8.3	7.9	279	480	130	126	450	40
Finished water [a]	142	212	82	7.9	7.9	7.7	282	410	140	0	0	0
Raw water [b]	151	214	90	7.9	8.0	7.5	303	470	180	66	140	25
Finished water [b]	148	204	86	7.7	7.8	7.3	294	450	150	0	0	0

[a] Plant 1.
[b] Plant 2.

BROWNWOOD
(Population, 20,181)

Ownership: Municipal and Brown County Water Improvement District; supplies also about 5,000 persons outside the city limits. Total population supplied, about 25,200.
Source: Pecan Bayou and Jim Ned Creek impounded in Lake Brownwood (capacity 137,300 acre-ft to emergency spillway), 9 miles north of Brownwood.
Treatment: Coagulation with alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: 2 reservoirs, approximately 9,800,000 and 6,500,000 gal.
Finished-water storage: 4 ground storage tanks: two 1,000,000 gal each, 500,000, and 250,000 gal.

The water from Lake Brownwood flows approximately 7 miles through an open canal to the larger of the storage reservoirs; from this reservoir to the smaller one, and then to the treatment plant. The finished water is pumped to two 1,000,000 gal ground storage tanks. From this point the city is responsible for the distribution of the water. It flows by gravity from the two 1,000,000 gal tanks into the distribution system and the two smaller ground storage tanks.

ANALYSES

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

	Raw water	Raw water	Finished water
Silica (SiO_2)	7.0	--	3.0
Iron (Fe)	.0	--	.05
Manganese (Mn)	--	--	.00
Calcium (Ca)	38	--	40
Magnesium (Mg)	7.0	--	5.5
Sodium (Na)	20	--	11
Potassium (K)	11	--	1.2
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	132	127	130
Sulfate (SO_4)	17	--	12
Chloride (Cl)	37	21	23
Fluoride (F)	.1	--	.1
Nitrate (NO_3)	.2	--	.2
Dissolved solids	195	--	170
Hardness as $CaCO_3$:			
Total	124	113	122
Noncarbonate	15	9	16
Color	--	10	5
pH	8.0	8.2	7.8
Specific conductance (micromhos at 25 C.)	358	293	302
Turbidity	--	--	--
Temperature (F.)	--	70	--
Date of collection	Sept. 21, 1948	May 2, 1952	Jan. 17, 1952

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	102	110	98	8.1	8.4	8.0	134	150	120	25	170	12
Finished water	100	108	96	7.5	7.7	7.2	131	146	120	.3	2	.2

BRYAN
(Population, 18,102)

Ownership: Municipal; also supplies about 150 people outside the city limits. Total population supplied, about 18,250.
Source: 8 wells (1 to 8), about $3\frac{1}{2}$ miles northwest of the city limits. Auxiliary or emergency supply can be obtained from A & M College, College Station, Tex. The wells are 557, 523, 498, 677, 584, 499, 536, and 554 ft deep, respectively, and are reported to yield 261, 315, 346, 424, 582, 510, 402, and 402 gpm.
Treatment: Aeration (air diffusion) and chlorination.
Rated capacity of pumping plant: 3,600,000 gpd.
Raw-water storage: Underground reservoir, 500,000 gal.
Finished-water storage: Underground reservoir, 3,000,000 gal; elevated tank, 400,000 gal.

The wells are pumped individually into an underground reservoir at the well field, the water being aerated as it enters the reservoir, chlorinated as it leaves the reservoir to be pumped to a larger underground reservoir in the city where it is pumped into the distribution system and elevated tanks.

ANALYSES

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

	Well 3 (raw water)	Well 4 (raw water)	Well 5 (raw water)	Finished water (city tap)
Silica (SiO_2)	16	15	19	17
Iron (Fe)	.05	.25	.10	.12
Manganese (Mn)	--	--	--	.00
Calcium (Ca)	1.5	2.1	1.7	.4
Magnesium (Mg)	.2	.5	.2	.3
Sodium (Na)	71	192	69	71
Potassium (K)				.8
Carbonate (CO_3)	0	22	11	0
Bicarbonate (HCO_3)	163	392	137	152
Sulfate (SO_4)	2.4	1.6	1.5	.1
Chloride (Cl)	16	45	16	22
Fluoride (F)	.2	.3	.0	.0
Nitrate (NO_3)	.0	.2	.0	.2
Dissolved solids	188	474	184	181
Hardness as $CaCO_3$:				
Total	5	7	5	2
Noncarbonate	0	0	0	0
Color	--	--	--	20
pH	8.2	8.2	8.1	7.7
Specific conductance (micromhos at 25 C.)	--	--	280	298
Turbidity	--	--	--	--
Temperature (F.)	--	79	--	--
Date of collection	Nov. 10,1942	Nov. 10, 1942	Aug. 23,1943	Oct. 22, 1951
Depth (feet)	498	677	584	--
Diameter (inches)	16-8 5/8	16-8 5/8	16-8 5/8	--
Date drilled	1939	1939	1943	--
Percent of supply	--	--	--	--

CLEBURNE
(Population, 17,600)

Ownership: Municipal; supplies also about 800 persons outside the city limits. Total population supplied, about 18,400.

Source: 7 wells (1, and 3 to 8), 1,100, 950, 935, 1,274, 1,206, 1,250, and 1,258 ft deep. Wells 1, 3, 4, and 6 are at pumping plant, about 200 yd from the City Hall; well 5, on North Cranberry St; well 7, on West Henderson St; and well 8, on Huron and Ramsey Sts.

Treatment: Filtration through sand traps and chlorination.

Raw-water storage: None.

Finished-water storage: 1 underground reservoir, 1,250,000 gal; 2 elevated tanks, 500,000 and 110,000 gal.

The wells pump into sand traps; the water flows by gravity through the sand traps to clear wells where it is chlorinated, and from which it is pumped into the distribution system, elevated tanks, and underground reservoir. Wells 5, 7, and 8 operate individually; wells 1, 3, 4, and 6 operate as a unit, the water being pumped to a common sand trap and chlorinator.

ANALYSES

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

	Wells (raw water)[a]	Well 3 (raw water)	Well 4 (raw water)	Well 6 (raw water)
Silica (SiO_2)	17	13	14	14
Iron (Fe)	.01	.02	.01	.0
Manganese (Mn)	.00	--	.00	--
Calcium (Ca)	2.2	2.3	1.8	1.8
Magnesium (Mg)	1.1	1.2	1.2	1.1
Sodium (Na)	231	231	231	222
Potassium (K)	--	6.4	1.2	14
Carbonate (CO_3)	6	26	3	24
Bicarbonate (HCO_3)	400	361	410	370
Sulfate (SO_4)	106	102	109	104
Chloride (Cl)	39	52	34	39
Fluoride (F)	1.0	.3	1.1	1.2
Nitrate (NO_3)	1.8	.0	1.5	1.5
Dissolved solids	606	599	602	613
Hardness as $CaCO_3$:				
Total	10	10	10	9
Noncarbonate	0	0	0	0
Color	0	--	0	--
pH	8.5	8.8	8.3	8.6
Specific conductance (micromhos at 25 C.)	983	--	983	979
Turbidity	--	--	--	--
Temperature (F.)	80	--	80	79
Date of collection	Feb. 28, 1952	Feb. 11, 1943	Feb. 28, 1952	Mar. 7, 1949
Depth (feet)	--	950	935	1,206
Diameter (inches)	--	8	$8\frac{1}{4}$-6	22-8 5/8
Date drilled	--	1913	1940	1941
Percent of supply	--	--	--	--

[a]Composite sample, wells 1, 4, and 6.

CORPUS CHRISTI
(Population, 108,287)

Ownership: Municipal; supplies also about 15,000 persons outside the city limits, and the town of Clarkwood. Total population supplied, about 123,600.

Source: Nueces River impounded in Lake Corpus Christi near Mathis, Tex., about 35 miles from Corpus Christi. Water is fed from the storage reservoir to a low water reservoir at Calallen, Tex. by the Nueces River. Wells are used as an auxiliary or emergency supply. The wells are pumped individually into the Nueces River, the water flowing down the river into Lake Corpus Christi.

Treatment: Prechlorination, partial softening with lime, primary sedimentation, primary coagulation with alum, sedimentation, secondary coagulation with alum, sedimentation, fluoridation with sodium fluoride, aeration, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 45,000,000 gpd.

Raw-water storage: Lake Corpus Christi, 11,405,000,000 gal.

Finished-water storage: 2 underground reservoirs, 10,000,000 gal. each; elevated tanks, 18,750,000 gal.

The water is pumped from the low water reservoir to the treatment plant at Calallen which is 16 miles from Corpus Christi. The finished water is pumped, in part, directly to the distribution system and elevated tanks, and part to two underground reservoirs in Corpus Christi.

There is some variation in the chemical character of the water throughout the year. The dissolved solids for the period October 1947 to September 1950 ranged from a maximum of 548 ppm to a minimum of 175 ppm.

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

	Nueces R. near Mathis (raw water)[a]	Nueces R. near Mathis (raw water)	Finished water (city tap)	Well (raw water)[b]
Silica (SiO_2)	22	22	15	30
Iron (Fe)	--	.00	.00	.19
Manganese (Mn)	--	.00	.00	--
Calcium (Ca)	44	40	38	3.6
Magnesium (Mg)	5.3	3.6	4.5	.7
Sodium (Na)	42	35	58	244
Potassium (K)		7.6	9.2	2.0
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	168	142	94	504
Sulfate (SO_4)	31	34	70	35
Chloride (Cl)	39	30	69	44
Fluoride (F)	.2	.3	1.2	.6
Nitrate (NO_3)	1.3	3.0	.2	.0
Dissolved solids	280	251	319	675
Hardness as $CaCO_3$:				
Total	132	115	114	12
Noncarbonate	0	0	36	0
Color	--	25	10	--
pH	--	7.6	7.2	8.1
Specific conductance (micromhos at 25 C.)	452	383	530	1,010
Turbidity	--	0	--	--
Temperature (F.)	--	--	--	138
Date of collection	Oct. 1949 to Sept. 1950	Oct. 1-31, 1951	Nov. 21, 1951	Mar. 14, 1951

[a] Weighted average of analyses of 10-day composites of daily samples for the water year October 1949 to September 1950.

[b] At Campbellton (one of emergency wells) owned by Lower Nueces River Water Supply District. Depth of well, 4,130 ft.

CORPUS CHRISTI--Continued
Regular determinations at treatment plant, 1951[c]

	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.....	179	198	158	8.1	8.6	8.0	168	190	120	40	75	24
Finished water...	132	138	104	7.8	8.0	7.4	135	162	106	--	--	--

[c] Month of January.

CORSICANA

(Population, 19,211)

Ownership: Municipal; supplies also about 220 persons outside the city limits. Total population supplied, about 19,400.

Source: Elm Creek impounded in Lake Halbert, approximately 13½ miles southeast of Corsicana, about 63 percent of the supply; Chambers Creek, intake approximately 150 ft south of bridge on State Highway 31, about 37 percent of the supply.

Treatment; Aeration (cascades), prechlorination, coagulation with alum and lime and soda ash at times, sedimentation, rapid sand filtration, and postchlorination. Use at times of activated carbon for odor and taste control.

Rated capacity of treatment plant: 3,000,000 gpd.

Raw-water storage: Lake Halbert capacity, 2,281,000,000 gal.

Finished-water storage: 1 underground reservoir, 370,000 gal; 2 elevated tanks, 400,000 and 200,000 gal.

Water is pumped from Chambers Creek into Lake Halbert, and is used approximately 9 months of the year when demand is greatest. From Lake Halbert the water flows by gravity to the treatment plant, just below the dam. The finished water is pumped to the distribution system and to the elevated tanks.

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

	Lake Halbert (raw water)	Chambers Creek (raw water)	Finished water
Silica (SiO_2)	8.8	15	2.4
Iron (Fe)	.01	.12	.01
Manganese (Mn)	.00	.00	.00
Calcium (Ca)	60	43	62
Magnesium (Mg)	13	3.3	11
Sodium (Na)	46	64	47
Potassium (K)	.8	.4	2.8
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	141	133	121
Sulfate (SO_4)	141	88	150
Chloride (Cl)	29	41	36
Fluoride (F)	1.0	.7	1.0
Nitrate (NO_3)	2.0	3.0	.5
Dissolved solids	387	358	384
Hardness as $CaCO_3$:			
Total	203	121	200
Noncarbonate	88	12	100
Color	10	15	0
pH	7.6	7.4	7.6
Specific conductance (micromhos at 25 C.)	602	534	617
Turbidity	--	--	--
Temperature (F.)	53	53	53
Date of collection	Feb. 28, 1952	Feb. 28, 1952	Feb. 28, 1952

DALLAS
(Population, 434,462)

Ownership: Municipal; supplies also about 3,000 persons outside the city limits, Arcadia Park, and Cockrell Hill. Total population supplied, about 442,900.

Source: Lake Dallas, about 30 miles north-northwest of Dallas in Denton County on Elm Fork Trinity River, furnishes approximately 99 percent of the supply; 6 wells, 1,260 to 2,690 ft deep, located at various points within the city limits furnishes approximately 1 percent of supply. Auxiliary or emergency supplies can be obtained from White Rock Lake and Bachman Lake.

Treatment: Bachman Plant: softening with lime, addition of activated carbon for odor and taste control, coagulation with iron salts (ferric sulfate), sedimentation, rapid sand filtration, chlorination, and ammoniation. Elm Fork Plant: softening with lime, addition of activated carbon for odor and taste control, primary coagulation, primary sedimentation, secondary coagulation, secondary sedimentation, rapid sand filtration, chlorination, and ammoniation. Wells, chlorination.

Rated capacity of treatment plants: Bachman Plant, 100,000,000 gpd; Elm Fork Plant, 96,000,000 gpd.

Raw-water storage: Lake Dallas (capacity, 63,215,000,000 gal).

Finished-water storage: 2 ground storage tanks, 14,000,000 and 21,000,000 gal; elevated tanks, 4,000,000, 2,000,000, two 1,000,000 gal each, 500,000, 200,000, and 50,000 gal; clear wells: Elm Fork Plant, 14,000,000 gal; Bachman Plant, 10,000,000 gal.

Released water from Lake Dallas flows down the Elm Fork Trinity River through the city of Dallas. The intake to the Elm Fork plant is located on the river directly west of the treatment plant at Carrollton, Tex. The water is pumped to the treatment plant, flows through the treatment plant and is pumped to the north city limits of Dallas. At the city limits part of the water is diverted to the north section of Dallas, supplying that area. The water that is not diverted flows to, and enters, the distribution system from the Bachman Treatment Plant which supplies that area of Dallas south of the plant.

The intake to the Bachman Plant is located on the Elm Fork Trinity River southwest of the Bachman Treatment Plant. The water flows by gravity from the river to the treatment plant, through the plant, and is pumped into the distribution system and storage.

The wells are pumped individually. The water is chlorinated at the well and is pumped directly into the distribution system and elevated tanks. The well supply will be abandoned, except well 39, as soon as those areas now served by the wells can be connected to the Dallas system.

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

	Well 39 (raw water)	Raw water	Finished water	
			Bachman Plant	Elm Fork Plant
Silica (SiO_2)	22	6.0	6.4	4.8
Iron (Fe)	.02	.01	.01	.01
Manganese (Mn)	.00	.00	.00	.00
Calcium (Ca)	6.0	54	19	19
Magnesium (Mg)	2.2	6.3	4.4	4.4
Sodium (Na)	385	35	35	35
Potassium (K)	.8	.4	1.2	1.6
Carbonate (CO_3)	0	0	9	13
Bicarbonate (HCO_3)	542	169	20	14
Sulfate (SO_4)	259	35	49	47
Chloride (Cl)	95	43	46	45
Fluoride (F)	1.8	.3	.3	.3
Nitrate (NO_3)	.5	.8	.5	.5
Dissolved solids	1,040	277	186	183
Hardness as $CaCO_3$:				
Total	24	161	66	66
Noncarbonate	0	22	34	32

DALLAS, Analyses--Continued

	Well 39 (raw water)	Raw water	Finished water	
			Bachman Plant	Elm Fork Plant
Color	0	0	--	--
pH	8.2	7.9	9.3	9.6
Specific conductance (micromhos at 25 C.)	1,650	481	334	329
Turbidity	--	--	--	--
Temperature (F.)	112	54	53	52
Date of collection	Mar. 27, 1952	Mar. 29, 1952	Mar. 29, 1952	Mar. 29, 1952
Depth (feet)	2,690	--	--	--
Diameter (inches)	18-8	--	--	--
Date drilled	1938	--	--	--
Percent of supply	--	--	--	--

Regular determinations at treatment plant, 1951[a]

	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	143	197	78	8.1	8.5	7.2	159	232	78	118	2250	17
Finished water	39	63	25	10.4	10.8	10.0	67	137	44	.27	2.0	0.0

[a]Bachman Plant.

DEL RIO
(Population, 14,211)

Ownership: Municipal.
Source: San Felipe Spring, in northeastern Del Rio on municipal golf course grounds, 0.3 mile north of U. S. Highway 90.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 2 elevated tanks, 1,000,000 gal each.

The water is pumped directly from the spring into the distribution system and elevated tanks. It is chlorinated at the pumps.

ANALYSIS

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

	San Felipe Spring (raw water)		San Felipe Spring (raw water)
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	218
Manganese (Mn)	.00	Noncarbonate	12
Calcium (Ca)	74		
Magnesium (Mg)	8.1	Color	0
Sodium (Na)	6.0	pH	7.6
Potassium (K)	.0	Specific conductance (micromhos at 25 C.)	448
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	251	Temperature (F.)	--
Sulfate (SO_4)	5.8	Date of collection	Mar. 26, 1952
Chloride (Cl)	9.2		
Fluoride (F)	.2		
Nitrate (NO_3)	7.2		
Dissolved solids	254		

DENISON
(Population, 17,504)

Ownership: Municipal; supplies also about 3,500 persons outside the city limits. Total population supplied, about 21,000.
Source: Lake Randall, approximately 4½ miles northwest of Denison on Shawnee Creek, furnishes 100 percent of the supply except in emergencies. Auxiliary or emergency supply, Lake Texoma.
Treatment: Prechlorination, coagulation with ferric sulfate, softening with lime, ammoniation, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: Lake Randall, capacity 1,760,000,000 gal.
Finished-water storage: 1 elevated tank, 1,000,000 gal; clear well, 750,000 gal.

The water is pumped from Lake Randall to the treatment plant. The finished water from the plant is pumped into the distribution system and elevated storage tank at the north city limits.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	3.5	3.2	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.0	Total	144	68
Manganese (Mn)	.00	.00	Noncarbonate	24	10
Calcium (Ca)	47	19			
Magnesium (Mg)	6.5	4.9	Color	5	5
Sodium (Na)	13	14	pH	7.5	7.4
Potassium (K)	1.2	1.2	Specific conductance (micromhos at 25 C.)	333	217
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	146	70	Turbidity	--	--
Sulfate (SO_4)	23	29	Temperature (F.)	--	--
Chloride (Cl)	23	18	Date of collection	Feb. 15, 1952	Feb. 15, 1952
Fluoride (F)	.3	.2			
Nitrate (NO_3)	.2	.5			
Dissolved solids	193	123			

Regular determinations at treatment plant[a]

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature (°F)		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	7.4	--	--	82	--	--	--	72	38
Finished water	--	--	--	8.6	--	--	71	--	--	--	68	45

[a]Average of analyses made by State Health Department over a period of many years.

DENTON
(Population, 21,372)

Ownership: Municipal; supplies also about 200 persons outside the city limits. Total population supplied, about 21,600.

Source: 9 wells (3 to 11), 1,160, 1,134, 1,140, 1,027, 1,153, 1,209, 1,218, 1,202, and 1,009 ft deep. The yield of the wells is reported to range from 325 to 480 gpm. Wells 3 to 6 are at various points within the city limits. The remaining wells are 1 to 2 miles east of the city limits.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: 1 ground reservoir, 1,000,000 gal; 6 ground storage tanks: four, 100,000 gal each and two, 50,000 gal each; 3 elevated tanks, 2,000,000, 360,000, and 250,000 gal.

The wells are pumped individually, the water being chlorinated at each well except that from wells 3 and 4, which is chlorinated as the water is pumped into storage. The water from all of the wells is first pumped into storage from which it is pumped into the distribution system.

ANALYSES

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

	Well 3 (raw water)	Well 4 (raw water)	Well 5[a]	Well 7 (raw water)	Well 9 (raw water)
Silica (SiO_2)	13	12	21	10	12
Iron (Fe)	--	--	.01	--	--
Manganese (Mn)	--	--	.00	--	--
Calcium (Ca)	2.2	2.4	1.4	2.0	.8
Magnesium (Mg)	1.0	1.2	.9	.9	.7
Sodium (Na)	227	235	193	187	229
Potassium (K)			1.6		
Carbonate (CO_3)	31	35	14	20	41
Bicarbonate (HCO_3)	336	390	339	294	314
Sulfate (SO_4)	121	106	90	102	130
Chloride (Cl)	33	23	21	23	28
Fluoride (F)	--	--	.3	--	--
Nitrate (NO_3)	3.0	1.2	.0	1.2	1.8
Dissolved solids	610	635	518	506	604
Hardness as $CaCO_3$:					
Total	10	11	7	8	5
Noncarbonate	0	0	0	0	0
Color	--	--	0	--	--
pH	--	--	8.6	--	--
Specific conductance (micromhos at 25 C.)	956	989	830	804	954
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	78	--	--
Date of collection	Dec. 3, 1948	Dec. 3, 1948	Mar. 26, 1952	Dec. 3, 1948	Dec. 3, 1948
Depth (feet)	1,160	1,134	1,140	1,153	1,218
Diameter (inches)	$10\frac{3}{4}$-$8\frac{3}{4}$	13-10	$10\frac{3}{4}$-$8\frac{6}{4}$	13 5/8	13 3/8
Date drilled	1926	1934	1940	1945	1947
Percent of supply	--	--	--	--	--

[a] Chlorinated water.

EDINBURG
(Population, 12,383)

Ownership: Municipal.
Source: Rio Grande. The water is conducted from the river by canal, for a distance of 20 miles, to the city.
Treatment: Aeration (cascades), coagulation with alum and lime, chlorination, sedimentation, and rapid sand filtration. Activated carbon is used at times for odor and taste control.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: 8,000,000 gal.
Finished-water storage: 3 elevated tanks, 710,000 gal.

There is a considerable variation in the chemical composition of the raw water throughout the year. Extremes for the water year 1945-46, analyses of 10-day composites of daily samples collected near Mission, Texas: dissolved solids, 284 and 1,260 ppm; hardness, 153 and 498 ppm.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	--	15	Hardness as $CaCO_3$:		
Iron (Fe)	--	.11	Total	277	278
Manganese (Mn)	--	--	Noncarbonate	145	156
Calcium (Ca)	83	85			
Magnesium (Mg)	17	16	Color	--	--
Sodium (Na)	92	88	pH	--	7.4
Potassium (K)		7.4	Specific conductance (micromhos at 25 C.)	--	949
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	161	149	Temperature (F.)	--	--
Sulfate (SO_4)	186	193	Date of collection	Aug. 3, 1945	Aug. 3, 1945
Chloride (Cl)	106	108			
Fluoride (F)	--	.4			
Nitrate (NO_3)	1.2	1.8			
Dissolved solids	574	615			

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	157	235	80	8.0	8.3	7.6	--	--	--	160	290	25
Finished water	115	155	75	7.9	8.1	7.6	375	550	200	--	--	--

EL PASO
(Population, 130,485)

Ownership: Municipal; supplies also about 1,000 people in the Sunrise Acres addition outside the city limits, and Fort Bliss with standby fire line. Total population supplied, about 131,500.

Source: 19 wells in 4 well fields: Mesa (north of Fort Bliss), Montana (Central El Paso), Downtown (southwest El Paso, near the Rio Grande), shallow well field (at surface water treatment plant along canal); and the Rio Grande. The wells furnish approximately 46 percent of the total supply. The shallow wells are about 50 ft deep, and the deeper wells range in depth from 425 to 1,055 ft.

Treatment: Well water: chlorination at the wells; surface supply: screening, grit removal, prechlorination, aeration by forced air, primary settling, coagulation with alum or ferric sulfate, softening with lime (and soda ash at times), activated carbon for taste and odor control as required, settling, reflocculation, settling, recarbonation, chlorination, and rapid sand filtration.

Rated capacity of treatment plant: 19,700,000 gpd for well water; 15,000,000 gpd for river water.

Raw-water storage: --

Finished-water storage: 7 ground reservoirs, 70,000,000 gal; elevated tank, 50,000 gal.

The water from the Rio Grande is brought to the treatment plant by canal.

ANALYSES

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

	Mesa Well Field (composite)	Montana Field Well 4	Downtown Field Well 14	Rio Grande (finished water)
Silica (SiO_2)	39	34	34	21
Iron (Fe)	.0	--	--	.06
Manganese (Mn)	--	--	--	--
Calcium (Ca)	32	49	26	32
Magnesium (Mg)	13	18	10	16
Sodium (Na)	88	173	138	197
Potassium (K)			1.6	4.0
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	189	160	170	45
Sulfate (SO_4)	68	58	70	292
Chloride (Cl)	63	268	139	175
Fluoride (F)	1.1	.7	--	.5
Nitrate (NO_3)	7.5	1.0	.0	.0
Dissolved solids	405	688	503	788
Hardness as $CaCO_3$:				
Total	134	196	106	146
Noncarbonate	0	66	0	109
Color	5	--	--	--
pH	7.9	7.6	7.9	7.3
Specific conductance (micromhos at 25 C.)	665	1,250	867	1,270
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Apr. 9, 1951	May 31, 1950	June 13, 1951	June 13, 1951
Depth (feet)	--	882	703	--
Diameter (inches)	--	24	36	--
Date drilled	--	1924	1937	--
Percent of supply	--	--	--	--

EL PASO--Continued

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.....	216	258	182	--	--	--	345	414	290*	--	--	--
Finished water...	46	68	33	--	--	--	159	215	135	--	--	--

FORT WORTH
(Population, 278,778)

Ownership: Municipal; supplies about 500 people outside the city limits. Total population supplied, about 279,300. There are several private water companies which supply areas within the city and in the suburbs. The two largest suppliers are the Worth Water Co., which supplies a population of about 2,000, and the Texas Water Co.

Source: 3 lakes: Lake Worth, Eagle Mountain Lake, and Lake Bridgeport, on West Fork Trinity River, about 9 miles west of Fort Worth, about 18 miles northwest of Fort Worth, and about 4 miles northwest of Bridgeport, respectively.

Treatment: Aeration (spray), coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 79,000,000 gpd.

Raw-water storage: Lake Worth, capacity, 9,339,000,000 gal; Eagle Mountain Lake, capacity, 68,755,000,000 gal; Lake Bridgeport, capacity, 95,148,000,000 gal.

Finished-water storage: 2 underground reservoirs, 5,000,000 and 4,500,000 gal; 8 elevated tanks: two 1,000,000 gal each, three 500,000 gal each, one 2,000,000 gal, one 1,500,000 gal, and one 100,000 gal; 1 standpipe, 330,000 gal; and clear wells, 10,000,000 gal.

The three lakes are in series, Lake Bridgeport spilling into Eagle Mountain Lake and Eagle Mountain Lake spilling into Lake Worth. Valves are maintained at the dams of each of the upper lakes allowing water to flow when necessary down the West Fork Trinity River into Lake Worth. The intake is at Lake Worth dam, the water flowing by gravity to the treatment plant. The finished water is pumped from the clear wells into the distribution system, elevated tanks, and underground reservoirs.

FORT WORTH--Continued

ANALYSES

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

	Lake Worth (raw water)	Eagle Mt. Lake (raw water)	Finished water	Well a (chlorinated)
Silica (SiO_2)	5.6	5.6	4.4	13
Iron (Fe)	.05	.01	.01	.18
Manganese (Mn)	.00	.00	.00	--
Calcium (Ca)	43	40	45	2.0
Magnesium (Mg)	7.8	7.3	7.7	.9
Sodium (Na)	18	17	19	313
Potassium (K)	.8	1.2	1.6	8.4
Carbonate (CO_3)	0	0	0	14
Bicarbonate (HCO_3)	161	151	158	502
Sulfate (SO_4)	17	15	22	156
Chloride (Cl)	23	21	25	68
Fluoride (F)	.4	.3	.3	1.8
Nitrate (NO_3)	.2	.5	.5	1.8
Dissolved solids	197	182	203	817
Hardness as $CaCO_3$:				
Total	139	130	144	8
Noncarbonate	7	6	14	0
Color	--	5	--	--
pH	7.9	7.7	7.6	8.5
Specific conductance (micromhos at 25 C.)	363	335	374	1,350
Turbidity	--	--	--	--
Temperature (F.)	52	62	--	76
Date of collection	Mar. 31, 1952	Apr. 2, 1952	Mar. 27, 1952	June 9, 1949
Depth (feet)	--	--	--	1,000
Diameter (inches)	--	--	--	--
Date drilled	--	--	--	1947
Percent of supply	--	--	--	--

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	120	128	112	8.2	8.4	7.9	123	132	101	24	37	10
Finished water	117	123	113	7.8	8.2	7.5	130	136	107	0	0	0

[a]Texas Water Co.

GAINESVILLE
(Population, 11,246)

Ownership: Municipal.
Source: 4 wells (2 to 5) 864, 931, 1,025, and 953 ft deep.
Treatment: None.
Storage: 2 underground reservoirs, 500,000 gal each; 2 elevated tanks, 250, 000 and 100,000 gal; 1 ground reservoir, 50,000 gal.

ANALYSES

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

	Well 2	Well 2	Well 3	Well 4
Silica (SiO_2)	13	--	10	9.2
Iron (Fe)	.16	--	.02	.01
Manganese (Mn)	--	--	--	--
Calcium (Ca)	2.4	--	3.6	2.3
Magnesium (Mg)	1.0	--	1.0	.6
Sodium (Na)	196	--	194	170
Potassium (K)	1.9	--	3.0	3.1
Carbonate (CO_3)	48	28	26	32
Bicarbonate (HCO_3)	386	412	340	348
Sulfate (SO_4)	31	--	31	26
Chloride (Cl)	5.0	6	58	10
Fluoride (F)	.2	--	.2	.2
Nitrate (NO_3)	1.2	--	1.0	1.2
Dissolved solids	487	--	536	442
Hardness as $CaCO_3$:				
Total	10	6	13	8
Noncarbonate	0	0	0	0
Color	--	--	--	--
pH	8.6	8.9	7.8	7.9
Specific conductance (micromhos at 25 C.)	804	805	869	730
Turbidity	--	--	--	--
Temperature (F.)	--	65	69	--
Date of collection	March, 1944	June 4, 1952	Feb. 25, 1944	Feb. 25, 1944
Depth (feet)	864	864	931	1,025
Diameter (inches)	10-8	10-8	$15\frac{1}{2}$-$8\frac{1}{4}$	18 5/8-$10\frac{3}{4}$
Date drilled	1912	1912	1931	1937
Percent of supply	--	--	--	--

GALVESTON
(Population, 66,568)

Ownership: Municipal; supplies also about 5,300 persons outside the city limits. Total population supplied, about 71,900.

Source: 13 wells (1 to 13), in and extending north and south of Alta Loma, approximately 20 miles northwest of the city of Galveston. Well 14 has not been connected with the system. The depths of the wells range from 764 to 888 ft. Wells 9 to 13 are pumped continuously and wells 1, 2, 6, and 7 are usually pumped. Additional demand is met by placing wells 3, 4, 5, and 8 in service.

Treatment: Chlorination and addition of polyphosphate at the Alta Loma pumping plant for scaling and corrosion control. Rechlorination at 59th and 30th Streets pumping plants upon pumping into the distribution system.

Rated capacity of pumping plant (Alta Loma): 18,000,000 gpd.

Raw-water storage: --

Finished-water storage: 3 reservoirs, 1,763,000, 1,777,000, and 3,812,000 gal; 2 reservoirs, 2,994,000 gal each; 2 reservoirs, 2,752,000 gal each; 2 reservoirs, 3,416,000 gal each; and 1 standpipe, 625,000 gal.

The water is pumped from the wells, as a unit, to the pumping station at Alta Loma, where additional head is obtained to pump the water under Galveston Bay to Galveston Island to two pumping stations, at 59th Street and 30th Street, from which the water is pumped into the storage reservoirs, standpipe, and the distribution system.

ANALYSES

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

	Well 1 (raw water)	Well 8 (raw water)	Well 9 (raw water)	Well 13 (raw water)	Finished water
Silica (SiO_2)	--	--	28	--	31
Iron (Fe)	--	--	--	--	.00
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	22	54	17	17	30
Magnesium (Mg)	4.4	11	7.5	5.6	9.7
Sodium (Na) + Potassium (K)	308	545	257	245	351
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	338	338	339	348	336
Sulfate (SO_4)	2	2	2.1	2	1.0
Chloride (Cl)	328	770	250	220	422
Fluoride (F)	--	--	--	--	.9
Nitrate (NO_3)	--	--	.2	.5	3.5
Dissolved solids	853	1,550	729	659	1,010
Hardness as $CaCO_3$:					
Total	73	180	74	66	115
Noncarbonate	0	0	0	0	0
Color	--	--	--	--	--
pH	--	--	7.9	--	8.0
Specific conductance (micromhos at 25 C.)	1,570	2,870	1,320	1,170	1,830
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	July 11, 1947	July 11, 1947	May 9, 1949	Nov. 10, 1947	May 11, 1951
Depth (feet)	840	884	764	810	--
Diameter (inches)	12	20	18 5/8	18 5/8	--
Date drilled	1914	1935	1942	1942	--
Percent of supply	--	--	--	--	--

GARLAND
(Population, 10,571)

Ownership: Municipal.
Source: 4 wells (1 to 4) 2,303, 2,318, 3,633, and 3,680 ft deep, located at different points within the city limits. The yield of the wells is reported to be 173, 278, 500, and 1,060 gpm.
Treatment: Aeration (cascades) and chlorination.
Raw-water storage: None.
Finished-water storage: 2 elevated tanks, 150,000 and 75,000 gal; 2 ground reservoirs, 500,000 and 315,000 gal.

The wells are pumped individually, the water being chlorinated at each well. The water is aerated, primarily for cooling, as it flows into the ground reservoirs, from which it is pumped into the distribution system and elevated tanks.

ANALYSES

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

	Well 3 (raw water)	Finished water (city tap)		Well 3 (raw water)	Finished water (city tap)
Silica (SiO_2)	25	21	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.01	Total	13	9
Manganese (Mn)	--	.00	Noncarbonate	0	0
Calcium (Ca)	3.9	2.3			
Magnesium (Mg)	.9	.8	Color	--	0
Sodium (Na)	425	354	pH	8.6	8.4
Potassium (K)	12	6.0	Specific conductance (micromhos at 25 C.)	--	1,460
Carbonate (CO_3)	25	12			
Bicarbonate (HCO_3)	468	559	Turbidity	--	--
Sulfate (SO_4)	370	214	Temperature (F.)	127	74
Chloride (Cl)	97	48	Date of collection	Feb. 23, 1944	Mar. 28, 1952
Fluoride (F)	1.8	1.8			
Nitrate (NO_3)	.8	2.0			
Dissolved solids	1,170	947			

Depth (feet)	3,633	--
Diameter (inches)	--	--
Date drilled	1942	--
Percent of supply	--	--

GRAND PRAIRIE
(Population, 14,594)

Ownership: Municipal; supplies also about 200 persons outside the city limits. Total population supplied, about 14,800.

Source: 8 wells: 2 wells (5 and 14), Northwest Third Street, 345 and 2,077 ft deep; 3 wells (6, 7, and 12), Davis Street, 430, 2,065, and 412 ft deep; 3 wells (8, 10, and 13), Dallas Street, 2,026, 283, and 2,047 ft deep. The yield of the wells is reported to range from 50 to 600 gpm.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: 1 underground reservoir, 100,000 gal; 3 ground reservoirs, one, 300,000 gal and two, 100,000 gal each; 3 elevated tanks, 500,000, 100,000, and 50,000 gal.

The wells are pumped individually and chlorinated by groups. The water from wells 5 and 14 is chlorinated in the water line leading to the reservoirs; that from wells 6, 7, 8, 10, 12, and 13 is chlorinated as it discharges into the ground storage reservoirs. The water is pumped from the ground reservoirs into the distribution system and elevated tanks.

ANALYSES

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

	Well 6	Well 8	Well 13
Silica (SiO_2)	12	16	16
Iron (Fe)	.08	.11	.05
Manganese (Mn)	--	--	.00
Calcium (Ca)	1.0	3.7	2.2
Magnesium (Mg)	.5	.9	1.0
Sodium (Na)	247	319	318
Potassium (K)			2.0
Carbonate (CO_3)	7	29	10
Bicarbonate (HCO_3)	505	485	515
Sulfate (SO_4)	84	131	138
Chloride (Cl)	19	83	82
Fluoride (F)	--	1.9	1.8
Nitrate (NO_3)	2.5	2.0	1.8
Dissolved solids	637	816	836
Hardness as $CaCO_3$:			
Total	4	12	10
Noncarbonate	0	0	0
Color	--	--	0
pH	8.6	8.7	8.4
Specific conductance (micromhos at 25 C.)	1,020	1,350	1,350
Turbidity	--	--	--
Temperature (F.)	--	--	91
Date of collection	June 16, 1949	June 23, 1943	Mar. 28, 1952
Depth (feet)	430	2,026	2,047
Diameter (inches)	10-7	10	13 5/8-10
Date drilled	1942	1942	1946
Percent of supply	--	--	--

GREENVILLE
(Population, 14,727)

Ownership: Municipal; supplies also Aidis Heights, Mineral Heights, Peniel, and Reavilon. Total population supplied, about 17,400. The city also furnishes Major Airfield.
Source: 4 reservoirs, (1 to 4), north of city supplied with water from the Sabine River.
Treatment: Coagulation with alum and lime, sedimentation, and chlorination. Copper sulfate, at times, for algae control.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: Reservoirs (1 to 4), 36,000,000, 52,000,000, 136,000,000, and 1,076,539,000 gal, respectively.
Finished-water storage: Elevated tank, 172,000 gal.

Water is diverted from the Sabine River into a canal by means of a low water diversion dam, approximately 2 miles upstream from the reservoirs. The water flows by gravity through the canal into the system of reservoirs and into the treatment plant. The finished water is pumped into the distribution system and elevated tank.

ANALYSES

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

	Reservoir 2[a]	Finished water		Reservoir 2[a]	Finished water
Silica (SiO_2)	2.4	0.8	Hardness as $CaCO_3$:		
Iron (Fe)	.08	.03	Total	122	137
Manganese (Mn)	.00	.00	Noncarbonate	5	27
Calcium (Ca)	38	44			
Magnesium (Mg)	6.5	6.5	Color	10	10
Sodium (Na)	21	22	pH	7.9	7.4
Potassium (K)	.8	.4	Specific conductance (micromhos at 25 C.)	347	370
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	142	134	Temperature (F.)	55	56
Sulfate (SO_4)	32	49	Date of collection	Mar. 25, 1952	Mar. 25, 1952
Chloride (Cl)	13	15			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	.0	.0			
Dissolved solids	205	213			

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	--	--	--	8.2	8.2	8.0	--	--	--	--	--	--
Finished water	--	--	--	8.2	8.4	7.4	--	--	--	--	--	--

[a] Raw water.

HARLINGEN
(Population, 23,229)

Ownership: Municipal; supplies about 1,300 persons outside the city limits. Total population supplied, about 24,500.
Source: Rio Grande.
Treatment: Plain sedimentation, periodic use of activated carbon for taste and odor control, periodic use of copper sulfate (in reservoir) for control of algae, aeration (spray), prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination. The same treatment is used at both plants.
Rated capacity of treatment plants: City Plant, 4,000,000 gpd. Airport Plant, 2,700,000 gpd.
Raw-water storage: Reservoir, 55,000,000 gal.
Finished-water storage: 1,400,000 gal.

The water is pumped from the Rio Grande into a canal connected with the reservoir at the treatment plants. The finished water from the plants is pumped into a common reservoir from which it is pumped into the distribution system and elevated tanks. There is considerable variation in the composition of the water throughout the year.

ANALYSES

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

	Finished water	Reservoir (raw water)	Finished water
Silica (SiO_2)	10	11	9.0
Iron (Fe)	.07	.0	.0
Manganese (Mn)	--	.00	.00
Calcium (Ca)	64	92	95
Magnesium (Mg)	22	33	33
Sodium (Na)	122	202	203
Potassium (K)	4.0	2.8	2.8
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	122	149	138
Sulfate (SO_4)	186	274	289
Chloride (Cl)	158	284	286
Fluoride (F)	.5	.8	.8
Nitrate (NO_3)	.5	.5	.2
Dissolved solids	628	1,000	1,020
Hardness as $CaCO_3$:			
Total	250	365	372
Noncarbonate	150	243	260
Color	--	5	5
pH	7.4	8.0	8.0
Specific conductance (micromhos at 25 C.)	1,060	1,640	1,670
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	June 7, 1951	Feb. 11, 1952	Feb. 11, 1952

HIGHLAND PARK
(Population, 11,405)

Ownership: Dallas County Park Cities Water Control and Improvement District No. 2 (supplies Highland Park and University Park).
Source: Elm Fork Trinity River. The intake is approximately 2,000 ft southwest of the Park Cities treatment plant and approximately 100 ft below the intake to city of Dallas' Bachman treatment plant. Auxiliary or emergency supply can be obtained from the city of Dallas.
Treatment: Activated carbon for odor and taste control, coagulation with ferric sulfate, softening with lime, sedimentation through clarifiers, filtration through anthracite, and chlorination.
Rated capacity of treatment plant: 25,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 4 elevated tanks, 2,000,000, 850,000, 500,000, and 300,000 gal; clear well, 10,000,000 gal.

The water flows by gravity from the Elm Fork Trinity River to the treatment plant. The finished water is pumped from the plant to the two Park Cities (Highland Park and University Park) into the distribution system and elevated tanks.

ANALYSES

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

	Raw water	Finished water (city tap)		Raw water	Finished water (city tap)
Silica (SiO_2)	6.0	12	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.01	Total	161	64
Manganese (Mn)	.00	.00	Noncarbonate	22	27
Calcium (Ca)	54	20			
Magnesium (Mg)	6.3	3.5	Color	0	--
Sodium (Na)	35	35	pH	7.9	9.8
Potassium (K)	.4	2.4	Specific conductance (micromhos at 25 C.)	481	345
Carbonate (CO_3)	0	22	Turbidity	--	--
Bicarbonate (HCO_3)	169	1	Temperature (F.)	54	68
Sulfate (SO_4)	35	44	Date of collection	Mar. 29, 1952	Mar. 27, 1952
Chloride (Cl)	43	45			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	.8	.2			
Dissolved solids	277	189			

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	160	206	83	8.0	8.5	7.7	150	209	114	110	4000	20
Finished water	45	48	41	10.4	10.5	10.3	72	128	52	--	--	--

HOUSTON
(Population, 596,163)

Ownership: Municipal; supplies also about 3,800 persons outside the city limits. Total population supplied, about 600,000.

Source: 68 wells. Fifty-one wells are in seven well fields in the older section of the city. Seventeen wells are in ten areas recently annexed by the city; these wells supply only about 5,000,000 gpd. The depths of the wells range from 544 to 2,580 ft, and the reported yield from 125 to 2,360 gpm. The average yield (data on 61 wells) is 1,462 gpm.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: Total, 51,000,000 gal. Ground storage tanks at the following pumping plants: Central, 19,000,000 gal; East End, 3,200,000 gal; Heights, 3,750,000 gal; Northeast, 3,200,000 gal; Scott Street, 2,000,000 gal; South End, 2,000,000 gal; Southwest, 6,000,000 gal. Elevated tanks throughout the city, 11,850,000 gal.

The wells are pumped individually. The water is pumped to ground storage tanks (being chlorinated before entering the tanks) from which it is pumped into the distribution system and elevated tanks. Each field is a system within itself, however, all of the systems are interconnected.

ANALYSES

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

	South End well 7	Scott St. well 4	South Park well 2	Southwest well 5	Central well C-20
Silica (SiO_2)	16	17	21	22	16
Iron (Fe)	.0	.0	.05	--	.15
Manganese (Mn)	.00	.00	.00	--	--
Calcium (Ca)	7.2	12	37	18	12
Magnesium (Mg)	2.5	3.6	7.4	4.5	4.9
Sodium (Na)	147	139	64	113	152
Potassium (K)	.4	.4	1.6		2.4
Carbonate (CO_3)	0	0	0	18	0
Bicarbonate (HCO_3)	328	317	246	250	340
Sulfate (SO_4)	2.6	5.6	15	7.0	3.1
Chloride (Cl)	51	56	34	47	71
Fluoride (F)	.8	.8	.3	--	1.0
Nitrate (NO_3)	.0	.0	.5	.2	.0
Dissolved solids	392	388	298	346	433
Hardness as $CaCO_3$:					
Total	28	45	123	64	50
Noncarbonate	0	0	0	0	0
Color	10	10	10	--	--
pH	8.0	7.8	7.9	--	7.7
Specific conductance (micromhos at 25 C.)	651	660	509	597	734
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	84
Date of collection	Feb. 11, 1952	Feb. 11, 1952	Feb. 11, 1952	Feb. 8, 1949	Mar. 26, 1949
Depth (feet)	1,932	1,756	853	1,401	1,940
Diameter (inches)	24-12¾	24-12½	8	24-12¾	24-12¾
Date drilled	1944	1931	1949	1945	1949
Percent of supply	--	--	--	--	--

HOUSTON--Continued

ANALYSES

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

	East End well 4	Northeast well 9	Heights well 10	Irvington well	Garden Oaks well 3
Silica (SiO_2)	18	20	22	20	22
Iron (Fe)	.17	.15	.18	.0	.0
Manganese (Mn)	--	--	--	.00	.00
Calcium (Ca)	5.3	11	28	36	36
Magnesium (Mg)	1.5	3.0	8.0	10	8.9
Sodium (Na)	219	153	102	52	64
Potassium (K)	6.8	8.4	2.8	.4	.4
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	420	314	289	218	238
Sulfate (SO_4)	1.1	12	9.8	12	11
Chloride (Cl)	109	80	57	37	43
Fluoride (F)	1.8	.8	.6	.1	.3
Nitrate (NO_3)	.0	.0	.0	.0	.0
Dissolved solids	576	441	383	270	297
Hardness as $CaCO_3$:					
Total	19	40	103	131	126
Noncarbonate	0	0	0	0	0
Color	--	--	0	10	10
pH	8.0	7.9	7.5	7.7	7.6
Specific conductance (micromhos at 25 C.)	1,000	741	661	475	515
Turbidity	--	--	--	--	--
Temperature (F.)	96	85	80	--	--
Date of collection	June 27, 1949	Apr. 21, 1950	July 23, 1949	Feb. 11, 1952	Feb. 11, 1952
Depth (feet)	2,530	1,940	1,880	1,070	1,100
Diameter (inches)	24-12¾	24-12¾	24-12¾	10¾-7	--
Date drilled	1948	1949	1949	1947	1945
Percent of supply	--	--	--	--	--

KINGSVILLE
(Population, 16,898)

Ownership: Municipal; supplies also about 300 persons outside the city limits. Total population supplied, about 17,200.
Source: 6 wells. Wells 2 and 5 are at the City Hall, well 4 is 2 blocks east of City Hall, wells 6 and 7 are on 12th Street, and well 8 is on 14th Street. The wells pump directly into the distribution system and elevated tanks.
Treatment: Chlorination at each well. Batch chlorination on elevated tanks when filled.
Raw-water storage: None.
Finished-water storage: Elevated tanks, 2,000,000 gal.

ANALYSES

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

	Well 2	Well 4	Well 5
Silica (SiO_2)	14	11	17
Iron (Fe)	.02	.02	.03
Manganese (Mn)	--	--	--
Calcium (Ca)	22	24	21
Magnesium (Mg)	8.6	9.6	7.5
Sodium (Na)	305	317	308
Potassium (K)	14		12
Carbonate (CO_3)	15	0	6
Bicarbonate (HCO_3)	277	304	303
Sulfate (SO_4)	162	163	162
Chloride (Cl)	242	255	235
Fluoride (F)	.9	.4	.5
Nitrate (NO_3)	9.0	12	9.2
Dissolved solids	956	959	951
Hardness as $CaCO_3$:			
Total	90	100	84
Noncarbonate	0	0	0
Color	--	--	--
pH	--	8.2	--
Specific conductance (micromhos at 25 C.)	1,580	--	1,560
Turbidity	--	--	--
Temperature (F.)	85	--	85
Date of collection	Mar. 16, 1945	Feb. 5, 1943	Mar. 16, 1945
Depth (feet)	730	725	737
Diameter (inches)	12	8	16-8
Date drilled	1935	1939	1943
Percent of supply	--	--	--

LAMESA
(Population, 10,704)

Ownership: Municipal; also supplies about 2,000 people outside the city limits, and an estimated 1,000 people at labor camp 4 miles southeast of Lamesa. Total population supplied, about 13,700.
Source: 18 wells ranging in depth from 138 to 300 ft, all in one well field.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: Underground reservoirs and elevated tanks, 1,300,000 gal.

The wells are pumped individually, the water pumped being chlorinated at four points before entering the underground storage tanks, from which it is pumped to the distribution system.

ANALYSES

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

	Well 4 (raw water)	Well 12 (raw water)	Well 13 (raw water)	Well 17 (raw water)	Finished water [a]
Silica (SiO_2)	39	33	72	38	37
Iron (Fe)	6.0	.02	.06	18	.03
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	35	33	74	46	38
Magnesium (Mg)	55	54	75	70	57
Sodium (Na)	167	176	54	112	164
Potassium (K)	14	14	8.2	14	25
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	376	390	402	372	388
Sulfate (SO_4)	191	195	160	176	193
Chloride (Cl)	126	122	70	116	130
Fluoride (F)	3.2	3.2	4.4	5.2	5.6
Nitrate (NO_3)	3.2	3.0	18	.5	2.5
Dissolved solids	824	836	760	798	839
Hardness as $CaCO_3$:					
Total	314	304	493	403	330
Noncarbonate	6	0	164	98	12
Color	--	--	--	--	--
pH	7.7	7.7	7.5	7.5	7.6
Specific conductance (micromhos at 25 C.)	1,280	1,290	1,110	1,230	1,380
Turbidity	--	--	--	--	--
Temperature (F.)	67	67	65	--	--
Date of collection	Sept. 12, 1947	Sept. 12, 1947	Sept. 13, 1947	Sept. 13, 1947	Nov. 27, 1946
Depth (feet)	150	160	168	182	
Diameter (inches)	10-8	12	12-10	14	
Date drilled	1945	1945	1946	1947	
Percent of supply	--	--	--	--	

[a] Tap sample, Pumping Plant No. 1.

LAREDO
(Population, 51,910)

Ownership: Municipal.
Source: Rio Grande.
Treatment: Aeration (spray), prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 7,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 2 ground reservoirs, 2,000,000 and 2,200,000 gal; 1 underground reservoir, 375,000 gal.

The water is pumped from the Rio Grande to the treatment plant. The finished water is pumped into the three storage reservoirs, from which it is pumped into the distribution system.
There is considerable variation in the composition of the raw water throughout the year.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	13	9.6	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.01	Total	322	328
Manganese (Mn)	.00	.00	Noncarbonate	204	216
Calcium (Ca)	75	77			
Magnesium (Mg)	33	33	Color	0	0
Sodium (Na)	165	159	pH	8.0	7.7
Potassium (K)	.4	.8	Specific conductance (micromhos at 25 C.)	1,380	1,390
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	144	136			
Sulfate (SO_4)	248	256	Turbidity	--	--
Chloride (Cl)	215	218	Temperature (F.)	76	77
Fluoride (F)	.9	.8	Date of collection	Apr. 21, 1952	Apr. 21, 1952
Nitrate (NO_3)	.8	.8			
Dissolved solids	849	845			

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	127	152	59	8.1	8.3	7.7	270	390	96	700	10800	35
Finished water	114	144	47	7.7	8.2	7.3	270	400	105	0	2	0

LONGVIEW
(Population, 24,502)

Ownership: Municipal; supplies also about 400 persons outside the city limits, and community of Greggton. Total population supplied, about 27,100.
Source: Lake Cherokee, approximately 8 miles southeast of the city on Cherokee Bayou. Auxiliary or emergency supply, Big Sandy Creek (diversion dam near Big Sandy, Upshur County, Tex.).
Treatment: Prechlorination, aeration (spray), coagulation with alum, activated carbon for odor and taste control, sedimentation, addition of lime for pH control, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 10,000,000 gpd.
Raw-water storage: 2 surface reservoirs, 11,000,000 and 2,000,000 gal.
Finished-water storage: 2 surface reservoirs, 2,000,000 and 500,000 gal; 2 elevated tanks, 1,000,000 and 150,000 gal; 2 elevated tanks, 200,000 gal each.

The water is pumped, intake approximately $2\frac{1}{2}$ miles upstream from the impounding dam, to the treatment plant about 1 mile outside the city limits. The finished water is pumped into town to 1,000,000 gal elevated tank and then into the distribution system and storage.

ANALYSES

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

	Lake Cherokee (raw water)	Lake Cherokee (raw water)	Finished water
Silica (SiO_2)	6.0	7.8	8.2
Iron (Fe)	.48	.70	.03
Manganese (Mn)	.0	.00	.00
Calcium (Ca)	6.8	3.5	12
Magnesium (Mg)	3.3	2.3	3.7
Sodium (Na)	6.0	8.7	5.0
Potassium (K)	6.0		1.6
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	25	14	20
Sulfate (SO_4)	16	13	23
Chloride (Cl)	8.5	7.8	14
Fluoride (F)	.0	.2	.1
Nitrate (NO_3)	.0	.5	.5
Dissolved solids	68	73	92
Hardness as $CaCO_3$:			
Total	30	18	45
Noncarbonate	10	7	29
Color	30	20	15
pH	6.8	6.6	7.2
Specific conductance (micromhos at 25 C.)	109	81	134
Turbidity	--	--	--
Temperature (F.)	--	57	57
Date of collection	June 4, 1949	Feb. 27, 1952	Feb. 27, 1952

LUBBOCK
(Population, 71,747)

Ownership: Municipal.
Source: 64 wells. Wells 1 to 19 are located at separate points in the city and the remaining wells in 2 well fields: one field of 30 wells in an area directly northwest of the city; the other of 15 wells in an area directly northeast of the city. Wells 1 to 3 are 98, 300, and 210 ft deep; the remaining wells (depths reported for 56) range from 106 to 158 ft deep. The average yield of the wells (yields reported for 59) is 498 gpm.
Treatment: Chlorination.
Rated capacity of pumping plant: 40,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 19,000,000 gal.

The wells are pumped in groups to ground storage reservoirs; from these reservoirs the water is pumped to a booster station where it is pumped into the distribution system.

ANALYSES

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

	Well 1	Well 2	Well 3	Well 4	Well 10
Silica (SiO_2)	--	52	--	--	--
Iron (Fe)	--	.02	--	--	--
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	78	57	63	48	50
Magnesium (Mg)	96	65	63	57	56
Sodium (Na)	160	79	76	69	74
Potassium (K)		23			
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	423	318	316	331	325
Sulfate (SO_4)	379	169	165	139	121
Chloride (Cl)	126	110	98	62	79
Fluoride (F)	3.2	5.4	3.4	--	3.5
Nitrate (NO_3)	11	7.5	4.1	.8	3.2
Dissolved solids	1,200	746	738	628	629
Hardness as $CaCO_3$:					
Total	589	410	416	354	356
Noncarbonate	242	150	157	83	89
Color	--	--	--	--	--
pH	--	8.1	--	--	--
Specific conductance (micromhos at 25 C.)	--	1,130	--	--	--
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Sept. 22, 1944	Feb. 15, 1944	Sept. 22, 1944	Oct. 2, 1944	Sept. 22, 1944
Depth (feet)	98	300	210	156	151
Diameter (inches)	24	24	24	24	24-18
Date drilled	1925	1917	1925	1928	1938
Percent of supply	--	--	--	--	--

LUBBOCK--Continued

ANALYSES

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

	Well 13	Well 15	Well 16	Well 19	Well 31
Silica (SiO_2)	--	55	--	64	49
Iron (Fe)	--	.0	--	.06	.01
Manganese (Mn)	--	.00	--	--	.00
Calcium (Ca)	76	59	45	69	49
Magnesium (Mg)	94	57	58	80	40
Sodium (Na)	166	115	59	150	53
Potassium (K)		12			7.6
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	345	368	249	317	304
Sulfate (SO_4)	421	227	120	272	85
Chloride (Cl)	146	68	98	190	43
Fluoride (F)	3.2	2.8	3.5	4.1	2.0
Nitrate (NO_3)	1.5	2.5	2.8	5.1	4.5
Dissolved solids	1,200	780	619	1,030	494
Hardness as $CaCO_3$:					
Total	576	382	351	501	287
Noncarbonate	294	80	147	241	38
Color	--	--	--	--	--
pH	--	7.5	--	7.5	8.3
Specific conductance (micromhos at 25 C.)	--	1,180	--	1,580	766
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	--	--	--
Date of collection	Sept. 22, 1944	Nov. 10, 1951	Sept. 25, 1944	Feb. 15, 1945	Nov. 10, 1951
Depth (feet)	150	135	135	145	141
Diameter (inches)	22-18	22-18	22-18	22-18	18
Date drilled	1939	1940	1941	1945	1947
Percent of supply	--	--	--	--	--

LUFKIN
(Population, 15,135)

Ownership: Municipal.
Source: 3 wells (3, 5, and 6), 1,168, 1,175, and 1,175 ft deep, about 4½ miles north of the city limits; auxiliary supply, 1 well (4), 66 ft deep, and 650 acre-ft lake (small streams impounded), about 2 miles north of the city limits. The yield of the wells is reported to be 640, 850, and 900 gpm. The auxiliary well is reported to yield 375 gpm.
Treatment: Aeration (trays) and chlorination.
Rated capacity of pumping plant: 3,500,000 gpd.
Raw-water storage: --
Finished-water storage: 2 elevated tanks and surface reservoirs, 1,200,000 gal.

The wells are pumped individually or in groups as needed, aerated at the well, chlorinated before entering the station reservoirs about 2 miles from the city's north limits. The water is pumped from the station reservoirs into 2 elevated tanks located in the city, then to the distribution system.

ANALYSES

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

	Well 3 (raw water)	Well 5 (raw water)	Well 6 (raw water)	Well 4 (raw water)
Silica (SiO_2)	17	19	18	58
Iron (Fe)	.17	--	--	1.4
Manganese (Mn)	.00	--	--	--
Calcium (Ca)	.5	1.7	.2	7.9
Magnesium (Mg)	.2	.7	.5	3.7
Sodium (Na)	134	150	142	26
Potassium (K)	1.2			4.1
Carbonate (CO_3)	0	9	7	0
Bicarbonate (HCO_3)	244	260	244	55
Sulfate (SO_4)	68	79	79	6.5
Chloride (Cl)	13	17	13	32
Fluoride (F)	.2	--	--	.0
Nitrate (NO_3)	.2	.2	.0	.2
Dissolved solids	357	406	385	181
Hardness as $CaCO_3$:				
Total	2	7	2	35
Noncarbonate	0	0	0	0
Color	15	--	--	--
pH	8.3	8.8	8.7	6.2
Specific conductance (micromhos at 25 C.)	565	665	625	204
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	66
Date of collection	Nov. 28, 1951	June 23, 1949	June 23, 1949	Oct. 4, 1944
Depth (feet)	1,168	1,175	1,221	66
Diameter (inches)	16-10	18-10	18-10	24-16
Date drilled	1939	1946	1948	1944
Percent of supply	--	--	--	--

MCALLEN
(Population, 20,067)

Ownership: Municipal.
Source: Rio Grande.
Treatment: Chlorination, aeration (trays), coagulation with alum, addition of lime for pH control, sedimentation, rapid sand filtration. Copper sulfate is used at times for algae control.
Rated capacity of treatment plant: 4,200,000 gpd.
Raw-water storage: Earthen reservoir, 10,500,000 gal.
Finished-water storage: 1 underground reservoir, 500,000 gal; 3 above-ground storage tanks, 900,000 gal.

There is considerable variation in the composition of the raw water throughout the year.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	--	16	Hardness as $CaCO_3$:		
Iron (Fe)	--	.13	Total	288	290
Manganese (Mn)	--	--	Noncarbonate	158	180
Calcium (Ca)	86	88			
Magnesium (Mg)	18	17	Color	--	--
Sodium (Na)	88	88	pH	--	7.4
Potassium (K)		7.4	Specific conductance (micromhos at 25 C.)	--	971
Carbonate (CO_3)	16	0	Turbidity	--	--
Bicarbonate (HCO_3)	126	134	Temperature (F.)	--	--
Sulfate (SO_4)	190	212	Date of collection	Aug. 7, 1945	Aug. 7, 1945
Chloride (Cl)	106	111			
Fluoride (F)	--	.8			
Nitrate (NO_3)	2.5	2.2			
Dissolved solids	650	634			

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	143	160	130	8.3	8.4	8.2	315	410	180	150	230	120
Finished water	118	140	100	7.8	7.8	7.7	316	350	240	--	10	0

MCKINNEY
(Population, 10,560)

Ownership: Municipal; supplies also about 600 people outside the city limits and the Veterans Hospital. Total population supplied, about 11,200.
Source: 3 wells: well 1, Graves St; wells 5 and 6, Rockwell St. The wells are 3,360, 3,230, and 1,272 ft deep, and the yield is reported to be 868, 645, and 248 gpm.
Treatment: Aeration (cascades) and chlorination.
Rated capacity of treatment plant: --
Raw-water storage: 3 underground reservoirs: two, 200,000 gal each, and one 150,000 gal.
Finished-water storage: 1 standpipe, 235,000 gal.

The wells are pumped individually, the water being pumped into underground reservoirs. It is aerated as it enters the reservoirs and chlorinated as it is pumped from the reservoirs into the distribution system and standpipe.

ANALYSES

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

	Well 5 (raw water)	Well 6 (raw water)	Finished water (composite)
Silica (SiO_2)	20	18	19
Iron (Fe)	.09	.08	.17
Manganese (Mn)	.00	--	.00
Calcium (Ca)	15	2.7	11
Magnesium (Mg)	5.6	1.2	3.9
Sodium (Na)	440	414	466
Potassium (K)	3.6	4.4	2.0
Carbonate (CO_3)	0	38	0
Bicarbonate (HCO_3)	400	620	559
Sulfate (SO_4)	371	201	340
Chloride (Cl)	205	91	165
Fluoride (F)	.9	2.0	1.6
Nitrate (NO_3)	2.0	3.0	2.0
Dissolved solids	1,290	1,100	1,290
Hardness as $CaCO_3$:			
Total	60	12	44
Noncarbonate	0	0	0
Color	0	--	0
pH	8.0	--	8.2
Specific conductance (micromhos at 25 C.)	2,070	--	2,050
Turbidity	--	--	--
Temperature (F.)	99	--	84
Date of collection	Mar. 26, 1952	Feb. 17, 1943	Mar. 26, 1952
Depth (feet)	3,230	1,272	--
Diameter (inches)	13 3/8-6 5/8	13 3/8-7	--
Date drilled	1936	1938	--
Percent of supply	--	--	--

MARSHALL
(Population, 22,327)

Ownership: Municipal; supplies also about 100 persons outside the city limits. Total population supplied, about 22,400.

Source: Caddo Lake (Cypress Creek impounded). The intake is approximately 14 miles northeast of Marshall, in Grayson County. Fifteen wells previously used as municipal water supply could be used in an emergency (no pumping facilities at present at the well locations).

Treatment: Aeration (spray), prechlorination, coagulation with alum, fluoridation with sodium fluoride, activated carbon for odor and taste control, sedimentation, rapid sand filtration, postchlorination, and addition of lime for pH control.

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

Raw-water storage: 1 ground reservoir, 11,500,000 gal.

Finished-water storage: 2 ground steel tanks, 400,000 gal each; 3 elevated tanks, 500,000, 160,000, and 300,000 gal.

The water flows by gravity to the pumping station approximately 300 yd from the intake on Caddo Lake. The water is pumped to the ground reservoir, from which it flows by gravity to the treatment plant. The finished water flows from the treatment plant to two steel tanks, from which it is pumped to the distribution system and elevated tanks.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	15	15	Hardness as $CaCO_3$:		
Iron (Fe)	.76	.0	Total	31	57
Manganese (Mn)	.00	.00	Noncarbonate	18	42
Calcium (Ca)	6.9	18			
Magnesium (Mg)	3.4	3.0	Color	25	10
Sodium (Na)	17	19	pH	6.4	6.7
Potassium (K)	3.6	1.2	Specific conductance (micromhos at 25 C.)	168	239
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	16	18	Turbidity	--	--
Sulfate (SO_4)	20	33	Temperature (F.)	54	55
Chloride (Cl)	27	34	Date of collection	Feb. 26, 1952	Feb. 26, 1952
Fluoride (F)	.3	1.0			
Nitrate (NO_3)	.5	.0			
Dissolved solids	127	160			

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	25	48	8	7.0	8.5	6.6	--	--	--	--	--	--
Finished water	30	55	10	8.6	9.0	8.0	--	--	--	--	--	--

MERCEDES
(Population, 10,081)

Ownership: Municipal; supplies also about 200 people outside the city limits. Total population supplied, about 10,300.
Source: Rio Grande. The intake is approximately 8 miles south of the city.
Treatment: Aeration (trays), coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination. Activated carbon is added at times just as water comes on filter. Copper sulfate is used at times for algae control.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: Mercedes main canal.
Finished-water storage: Underground reservoir, 500,000 gal; overhead storage, 500,000 gal.

The water is pumped from the river into a canal leading to the city treatment plant. The finished water is pumped to the distribution system and elevated storage. There is considerable variation in the composition of the raw water throughout the year.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	--	13	Hardness as $CaCO_3$:		
Iron (Fe)	--	.09	Total	266	273
Manganese (Mn)	--	--	Noncarbonate	140	176
Calcium (Ca)	80	83			
Magnesium (Mg)	16	16	Color	--	--
Sodium (Na)	89	75	pH	--	7.6
Potassium (K)		9.3	Specific conductance (micromhos at 25 C.)	--	910
Carbonate (CO_3)	9	0	Turbidity	--	--
Bicarbonate (HCO_3)	134	119	Temperature (F.)	--	--
Sulfate (SO_4)	179	190	Date of collection	Aug. 4, 1945	Aug. 4, 1945
Chloride (Cl)	103	103			
Fluoride (F)	--	1.8			
Nitrate (NO_3)	2.5	2.8			
Dissolved solids	594	602			

MIDLAND
(Population, 21,713)

Ownership: Municipal.
Source: 35 wells in 3 well fields: Cole Park Field, 14 wells, 102 to 145 ft deep, 3 miles southeast of the city limits; Rosedale Field, 9 wells, 109 to 147 ft deep, 1½ miles southeast of the city limits; Wadley Field, 12 wells, 125 to 185 ft deep (depths for 7 wells reported), half a mile northeast of the city limits.
Treatment: Chlorination.
Rated capacity of pumping plants: 12,000,000 gpd.
Raw-water storage: 4 ground tanks, 1,000,000, 300,000 gal, and two 180,000 gal each.
Finished-water storage: 2 reservoirs, 2,225,000 and 500,000 gal; 1 elevated tank, 300,000 gal.

The wells are pumped individually. The water is pumped to ground storage tanks at the well fields. It is chlorinated as it is pumped from the storage tanks to the city into the distribution system and storage.

ANALYSES

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

	Cole Park Field Well 1	Rosedale Field Well 8	Rosedale Field[a] (composite)	Wadley Field Well 4	Wadley Field Well 8
Silica (SiO_2)	68	67	53	74	61
Iron (Fe)	.03	.02	.08	--	--
Manganese (Mn)	.00	.00	--	--	--
Calcium (Ca)	242	151	153	78	83
Magnesium (Mg)	156	108	94	59	28
Sodium (Na)	387	211	219	126	75
Potassium (K)	10	8.4	14		
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	255	235	244	208	230
Sulfate (SO_4)	814	610	540	272	97
Chloride (Cl)	698	300	344	178	135
Fluoride (F)	3.6	4.0	1.8	--	--
Nitrate (NO_3)	28	8.2	15	8.2	7.5
Dissolved solids	2,790	1,680	1,550	939	650
Hardness as $CaCO_3$:					
Total	1,250	820	768	437	322
Noncarbonate	1,040	628	568	266	134
Color	0	0	--	--	--
pH	7.3	7.5	7.4	7.8	7.9
Specific conductance (micromhos at 25 C.)	3,870	2,360	--	1,390	994
Turbidity	--	--	--	--	--
Temperature (F.)	69	70	--	--	--
Date of collection	Apr. 30, 1952	Apr. 30, 1952	Dec. 18, 1946	Sept. 20, 1949	Sept. 20, 1949
Depth (feet)	110	147	--	125	148
Diameter (inches)	20	16	--	12	12
Date drilled	1927	1941	--	1948	1948
Percent of supply	--	--	--	--	--

[a] Wells 1, 2, 3, 4, 7, and 8.

MISSION
(Population, 10,765)

Ownership: Municipal; also supplies about 750 people outside the city limits. Total population supplied, about 11,500.
Source: Rio Grande.
Treatment: Plain sedimentation, periodic addition of copper sulfate in the sedimentation basin, aeration (cascades), prechlorination, coagulation with alum and lime, pH control, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: Sedimentation basin, 10,000,000 gal.
Finished-water storage: 2,000,000 gal.

The water is pumped from the river to the sedimentation basin, flows through the treatment plant and is pumped to the distribution system and storage. There is considerable variation in the composition of the raw water throughout the year. For more recent analyses of the Rio Grande, see Harlingen.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	--	15	Hardness as $CaCO_3$:		
Iron (Fe)	--	.22	Total	284	251
Manganese (Mn)	--	--	Noncarbonate	160	144
Calcium (Ca)	84	76			
Magnesium (Mg)	18	15	Color	--	--
Sodium (Na)	82	102	pH	--	7.4
Potassium (K)		6.5	Specific conductance (micromhos at 25 C.)	--	952
Carbonate (CO_3)	7	0	Turbidity	--	--
Bicarbonate (HCO_3)	136	131	Temperature (F.)	--	--
Sulfate (SO_4)	183	212	Date of collection	Aug. 7, 1945	Aug. 7, 1945
Chloride (Cl)	104	106			
Fluoride (F)	--	.8			
Nitrate (NO_3)	2.5	2.8			
Dissolved solids	617	623			

Regular determinations at treatment plant [a]

	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	110	114	105	8.4	8.4	8.3	330	450	215	240	400	70
Finished water	105	125	90	7.9	8.2	7.7	--	--	--	--	--	--

[a] January to June, 1951.

NACOGDOCHES
(Population, 12,327)

Ownership: Municipal.
Source: 4 wells, (1 to 4) 485, 484, 521, and 548 ft deep, north of town. The yield of the wells is reported to be 536, 500, 756, and 883 gpm.
Treatment: Degasification and chlorination.
Rated capacity of pumping plant: 3,300,000 gpd.
Raw-water storage: --
Finished-water storage: Ground reservoir and elevated tanks, 750,000 gal.

The wells are pumped individually into a common pipeline leading to degasifier on top of ground storage tank, chlorine is added after water leaves the degasifier and before going into storage. The water is pumped from storage to the distribution system and the elevated tanks connected to the system.

ANALYSES

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

	Well 1 (raw water)	Well 2 (raw water)	Well 4 (raw water)
Silica (SiO_2)	13	12	13
Iron (Fe)	.42	.41	.71
Manganese (Mn)	--	--	.00
Calcium (Ca)	3.1	2.0	1.6
Magnesium (Mg)	1.0	.6	1.4
Sodium (Na)	55	53	50
Potassium (K)	4.3	3.7	.4
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	123	112	102
Sulfate (SO_4)	22	22	21
Chloride (Cl)	9.0	9.0	7.8
Fluoride (F)	.0	.2	.2
Nitrate (NO_3)	.2	.0	1.5
Dissolved solids	172	161	152
Hardness as $CaCO_3$:			
Total	12	7	10
Noncarbonate	0	0	0
Color	--	--	5
pH	6.1	6.1	6.8
Specific conductance (micromhos at 25 C.)	275	329	240
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	Feb. 7, 1945	Feb. 7, 1945	Nov. 11, 1951
Depth (feet)	485	484	548
Diameter (inches)	20-8	20-10	20-12¾-10¾
Date drilled	1929	1933	1949
Percent of supply	--	--	--

NEW BRAUNFELS
(Population, 12,210)

Ownership: Municipal.
Source: 4 wells (1 to 4) 116, 102, 110, and 160 ft deep. Wells 1 to 3 are in a group and are pumped daily. Well 4 is pumped only during the summer months.
Treatment: Chlorination of supply from wells 1 to 3; no treatment of water from well 4.
Rated capacity of pumping plant: 4,000,000 gpd.
Raw-water storage: --
Finished-water storage: 1,900,000 gal.
The water from wells 1 to 3 is chlorinated at the wells, pumped to storage tanks and then to the distribution system. The water from well 4 is pumped directly into the distribution system.

ANALYSES

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

	Well 1	Well 2	Finished water[a]
Silica (SiO_2)	11	11	13
Iron (Fe)	.08	.02	.02
Manganese (Mn)	--	--	.00
Calcium (Ca)	73	73	70
Magnesium (Mg)	17	17	17
Sodium (Na)	5.1	3.9	8.8
Potassium (K)	1.6	1.6	.4
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	263	261	266
Sulfate (SO_4)	24	24	23
Chloride (Cl)	14	13	12
Fluoride (F)	.2	.2	.1
Nitrate (NO_3)	5.8	5.5	4.5
Dissolved solids	281	283	315
Hardness as $CaCO_3$:			
Total	252	252	244
Noncarbonate	36	38	26
Color	--	--	5
pH	7.2	7.1	7.3
Specific conductance (micromhos at 25 C.)	433	419	504
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	Dec. 4, 1943	Dec. 4, 1943	Nov. 30, 1951
Depth (feet)	116	102	--
Diameter (inches)	12	8	--
Date drilled	1941	1941	--
Percent of supply	--	--	--

[a] Composite sample, wells 1 to 3.

ODESSA
(Population, 29,495)

Ownership: Municipal; supplies also about 2,000 persons outside the city limits. Total population supplied, about 31,500.

Source: 74 wells in one area extending from 1 mile north to 7 miles north of the city limits. The depth of the wells ranges from 120 to 207 ft and averages 164 ft. The yield of wells is reported to range from 35 to 300 gpm and averages 164 gpm.

Treatment: Chlorination.

Rated capacity of pumping plants: 19,950,000 gpd.

Raw-water storage: None.

Finished-water storage: 6 reservoirs, 440,000 gal each; 5 ground storage tanks, 500,000, 440,000, 300,000, 100,000, and 65,000 gal; 3 elevated tanks, two 500,000 gal each and one 100,000 gal.

The wells are pumped individually. The water flows from the wells to the North Pump Station, at the well field, into 6 reservoirs. It is chlorinated as it enters the reservoirs. The water is pumped from the field reservoirs to ground storage tanks in Odessa from which it is pumped into the distribution system and elevated tanks.

ANALYSES

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

	Well 2	Well 28	Well 44	Well 66	Finished water (city tap)
Silica (SiO_2)	38	32	44	37	33
Iron (Fe)	.10	.15	.05	--	.05
Manganese (Mn)	--	--	--	--	.00
Calcium (Ca)	132	72	66	68	74
Magnesium (Mg)	34	17	14	13	12
Sodium (Na)	81	37	25	27	52
Potassium (K)	4.8	1.6	3.6		2.4
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	186	214	220	229	213
Sulfate (SO_4)	255	72	44	46	70
Chloride (Cl)	155	42	26	24	57
Fluoride (F)	1.4	1.8	2.0	--	1.6
Nitrate (NO_3)	14	17	12	14	14
Dissolved solids	877	406	364	342	442
Hardness as $CaCO_3$:					
Total	470	250	222	223	234
Noncarbonate	317	74	42	36	60
Color	--	--	--	--	0
pH	7.5	7.7	7.7	8.0	7.8
Specific conductance (micromhos at 25 C.)	1,280	644	568	562	717
Turbidity	--	--	--	--	--
Temperature (F.)	--	--	69	--	73
Date of collection	Sept. 22, 1948	Sept. 22, 1948	Sept. 22, 1948	July 8, 1949	Apr. 29, 1952
Depth (feet)	150	150	175	196	--
Diameter (inches)	10	10	16-10¾	16-10¾	--
Date drilled	1944	1946	1948	1949	--
Percent of supply	--	--	--	--	--

ORANGE
(Population, 21,174)

Ownership: Gulf States Utilities Co.; also supplies approximately 5,800 persons outside the city limits. Total population supplied, about 27,000.

Source: 5 wells (1, 2, 4 to 6), 687, 688, 738, 749, and 745 ft deep, within the city limits. The yield of the wells is reported to be 550, 2,400, 750, 1,000, and 2,100 gpm.

Treatment: Chlorination and ammoniation at point of discharge of water from wells into ground reservoir.

Raw-water storage: None.

Finished-water storage: 680,000 gal. One elevated tank, 500,000 gal, floats on the system in form of a surge tank.

The wells are pumped by electric motors individually or in group as demand requires, the water flowing to 1 ground reservoir, from which it is pumped into the distribution system. Analyses made by the State Board of Health Laboratories show very small variation in the chemical composition of the water over a period of the last 25 years.

ANALYSES

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

	Well 5 (raw water)	Finished water		Well 5 (raw water)	Finished water
Silica (SiO_2)	48	42	Hardness as $CaCO_3$:		
Iron (Fe)	.34	.39	Total	30	28
Manganese (Mn)	--	.00	Noncarbonate	0	0
Calcium (Ca)	8.6	7.0			
Magnesium (Mg)	2.0	2.5	Color	--	15
Sodium (Na)	105	108	pH	--	7.3
Potassium (K)		.8	Specific conductance (micromhos at 25 C.)	--	532
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	198	193			
Sulfate (SO_4)	1.6	.5	Turbidity	--	--
Chloride (Cl)	67	71	Temperature (F.)	--	--
Fluoride (F)	--	.4	Date of collection	Apr. 12, 1941	Nov. 27, 1951
Nitrate (NO_3)	.3	1.5			
Dissolved solids	335	334			

Depth (feet)	749	--
Diameter (inches)	16-8½	--
Date drilled	1941	--
Percent of supply	--	--

PALESTINE
(Population, 12,503)

Ownership: Municipal.
Source: 2 wells (1 and 2) 1,617 and 1,600 ft deep, at the auxiliary or emergency supply treatment plant about 1½ miles west of the Municipal Building, 100 percent of the supply except in emergencies. Auxiliary or emergency supply from Water Works Lake and Upper Lake on Sabine (Wolf) Creek at the treatment plant.
Treatment: Wells: chlorination; surface water: aeration, prechlorination, coagulation with sodium aluminate, activated carbon, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: 2 ground reservoirs, 246,000 gal, each.
Finished-water storage: 1 ground reservoir, 547,000 gal; 1 elevated tank, 300,000 gal; clear well, 175,000 gal.

The wells are pumped individually into the clear well, from which the water is pumped, being chlorinated as it leaves the clear well, to the city and distribution system and elevated tanks. The auxiliary supply is pumped to the treatment plant. The finished water from the plant is pumped into the same line with the well water leading to the city. The auxiliary supply was used in 1951 for the first time in many years.

ANALYSES

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

	Well 1 (raw water)	Well 2 (raw water)	Finished water
Silica (SiO_2)	20	20	19
Iron (Fe)	.02	.06	.02
Manganese (Mn)	--	--	.00
Calcium (Ca)	3.4	3.6	1.8
Magnesium (Mg)	.8	.7	.7
Sodium (Na)	72	56	79
Potassium (K)	1.7	1.8	2.0
Carbonate (CO_3)	10	11	0
Bicarbonate (HCO_3)	175	129	201
Sulfate (SO_4)	3	5.2	6.3
Chloride (Cl)	5.0	3.0	6.5
Fluoride (F)	.4	.2	.0
Nitrate (NO_3)	.0	.8	.0
Dissolved solids	217	170	215
Hardness as $CaCO_3$:			
Total	12	12	7
Noncarbonate	0	0	0
Color	--	--	20
pH	8.2	8.1	8.0
Specific conductance (micromhos at 25 C.)	332	260	334
Turbidity	--	--	--
Temperature (F.)	89	88	86
Date of collection	June 14, 1944	June 14, 1944	Feb. 25 1952
Depth (feet)	1,617	1,600	--
Diameter (inches)	16-8 5/8	16-8	--
Date drilled	1940	1940	--
Percent of supply	--	--	--

PAMPA
(Population, 16,583)

Ownership: Municipal.
Source: 8 wells: 5 wells (1 to 5-south), 450, 450, 411, 412, and 411 ft deep, south of city; 3 wells (1-north, 3-north, and 4-north), 395, 412, and 414 ft deep, north of the city.
Treatment: Chlorination.
Raw-water storage: 630,000 gal.
Finished-water storage: 3,570,000 gal ground storage; 525,000 gal overhead storage.

The wells are pumped individually to 2 central collecting points, 1 north of the city and the other south. The water is chlorinated, and pumped by booster pumps into the distribution system and storage.

ANALYSES

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

	Raw water[a]	Finished water[b]		Raw water[a]	Finished water[b]
Silica (SiO_2)	12	31	Hardness as $CaCO_3$:		
Iron (Fe)	.16	.16	Total	258	196
Manganese (Mn)	--	--	Noncarbonate	70	0
Calcium (Ca)	59	42			
Magnesium (Mg)	27	22	Color	--	--
Sodium (Na)	117	30	pH	7.4	7.8
Potassium (K)	12	2.8	Specific conductance (micromhos at 25 C.)	1,060	526
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	230	254	Turbidity	--	--
Sulfate (SO_4)	141	21	Temperature (F.)	--	--
Chloride (Cl)	132	26	Date of collection	Nov. 20, 1947	June 6, 1951
Fluoride (F)	1.2	.9			
Nitrate (NO_3)	4.0	4.8			
Dissolved solids	638	293			

[a]Composite sample wells 1 and 2-south and wells 1, 3, and 4-north.
[b]Composite sample wells 3, 4, and 5-south.

PARIS
(Population, 21,643)

Ownership: Municipal; supplies also about 300 persons outside the city limits. Total population supplied, about 21,900.
Source: Pine Creek impounded in Lake Crook, about 4 miles north of Paris. Auxiliary or emergency supply, Lake Gibbons on Pine Creek, about 5 miles upstream from Lake Crook.
Treatment: Prechlorination, aeration (cascades), coagulation with alum, sedimentation, rapid sand filtration, postchlorination, and addition of lime for pH control. Use of activated carbon at times for odor and taste control.
Rated capacity of treatment plant: City treatment plant (formerly Camp Maxie), 4,000,000 gpd; Old treatment plant, 3,200,000 gpd.
Raw-water storage: Lake Crook, capacity, 3,519,000,000 gal.
Finished-water storage: 2 underground reservoirs, 600,000 and 300,000 gal; 1 elevated tank, 500,000 gal; 1 standpipe, 300,000 gal.

Since 1948, when the city acquired the treatment plant at Camp Maxie, only that treatment plant has been in use.
The water flows by gravity from the lake, intake at dam of Lake Crook approximately 500 ft from the treatment plant, to the treatment plant. The finished water from the plant is pumped into 2 underground storage tanks, from which it is pumped into town, into the distribution system and elevated tanks.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.6	2.2	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.05	Total	43	83
Manganese (Mn)	.00	.00	Noncarbonate	10	46
Calcium (Ca)	13	30			
Magnesium (Mg)	2.6	1.9	Color	60	0
Sodium (Na)	8.7	5.2	pH	6.8	7.5
Potassium (K)	1.6	2.4	Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.)	115	219
Bicarbonate (HCO_3)	41	45	Turbidity	--	--
Sulfate (SO_4)	15	48	Temperature (F.)	57	55
Chloride (Cl)	4.0	6.8	Date of collection	Mar. 25, 1952	Mar. 25, 1952
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.0	.5			
Dissolved solids	[a]77	140			

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	23	25	22	7.3	7.5	7.3	43	44	41	85	190	50
Finished water	36	40	33	7.9	8.1	7.7	81	84	80	.5	.5	.5

[a]Sum of determined constituents.

PASADENA
(Population, 22,483)

Ownership: Municipal; also supplies approximately 100 persons outside the city limits. Total population supplied, about 22,600.
Source: 5 wells (4 to 8), 1,203, 580, 1,565, 1,264, and 1,262 ft deep.
Treatment: Chlorination at the wells.
Raw-water storage: None.
Finished-water storage: Ground reservoir and elevated tank, 2,000,000 gal.

The wells are pumped individually into ground storage tanks. From the storage tanks the water is pumped into the distribution system. Overhead storage tanks, used also in controlling pressure, are "floated" on the distribution system.

ANALYSES

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

	Well 4[a]	Well 8[a]		Well 4[a]	Well 8[a]
Silica (SiO_2)	16	18	Hardness as $CaCO_3$:		
Iron (Fe)	.32	.01	Total	21	39
Manganese (Mn)	--	.00	Noncarbonate	0	0
Calcium (Ca)	6.3	11			
Magnesium (Mg)	1.3	2.8	Color	--	--
Sodium (Na)	134	121	pH	8.6	7.9
Potassium (K)		1.6	Specific conductance (micromhos at 25 C.)	595	576
Carbonate (CO_3)	28	0			
Bicarbonate (HCO_3)	240	276			
Sulfate (SO_4)	11	12	Turbidity	--	--
Chloride (Cl)	40	46	Temperature (F.)	--	--
Fluoride (F)	.8	.6	Date of collection	Sept. 10, 1943	Nov. 20, 1951
Nitrate (NO_3)	.0	.2			
Dissolved solids	349	348			

Depth (feet)	1,203	1,262
Diameter (inches)	$18\frac{3}{4}$-$11\frac{3}{4}$	12-8
Date drilled	1943	1950
Percent of supply	--	--

[a] Raw water.

PLAINVIEW
(Population, 14,044)

Ownership: Municipal; supplies also about 500 persons outside the city limits. Total population supplied, about 14,500.
Source: 5 wells (1 to 5), within the city limits. Wells 1 to 3 are each 301 ft deep; well 5, 305 ft; depth not reported for well 4.
Treatment: None.
Storage: Ground storage reservoir, 750,000 gal; 3 elevated storage tanks, 500,000 gal.

The wells are pumped individually and directly into the ground reservoir and elevated tanks from which the water is distributed.

ANALYSES

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

	Well 1	Well 5		Well 1	Well 5
Silica (SiO_2)	60	60	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.0	Total	262	235
Manganese (Mn)	--	.00	Noncarbonate	0	0
Calcium (Ca)	44	38			
Magnesium (Mg)	37	34	Color	--	--
Sodium (Na)	28	45	pH	7.4	7.8
Potassium (K)	8.5	4.0	Specific conductance (micromhos at 25 C.)	594	622
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	329	335	Temperature (F.)	64	64
Sulfate (SO_4)	28	26	Date of collection	Feb. 28, 1945	Nov. 13, 1951
Chloride (Cl)	18	22			
Fluoride (F)	3.6	2.8			
Nitrate (NO_3)	1.2	2.5			
Dissolved solids	379	394			

Depth (feet)	301	305
Diameter (inches)	18	16
Date drilled	1937	1948
Percent of supply	--	--

PORT ARTHUR
(Population, 57,530)

Ownership: Municipal; supplies also approximately 10,000 persons outside the city limits, in addition to the towns of Griffing Park, Lakeview, Pear Ridge, and Sabine Pass. Total population supplied, about 75,100.

Source: Neches River. The intake is about 15 miles upstream from Beaumont, Jefferson County, and the water is diverted by open canal to the treatment plant.

Treatment: Coagulation with alum, followed by addition of lime and soda ash for corrosion control, chlorination, sedimentation, and rapid sand filtration.

Rated capacity of treatment plant: 11,000,000 gpd.

Raw-water storage: Earthen reservoir, 200,000,000 gal.

Finished-water storage: Ground reservoir and elevated tanks, 4,100,000 gal.

There is some variation in the composition of the raw water throughout the year. For raw water analyses of Neches River, see Beaumont.

ANALYSIS

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

	Finished water (city tap)		Finished water (city tap)
Silica (SiO_2)	13	Hardness as $CaCO_3$:	
Iron (Fe)	1.1	Total	45
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	10		
Magnesium (Mg)	4.9	Color	10
Sodium (Na)	55	pH	7.3
Potassium (K)	1.2	Specific conductance (micromhos at 25 C.)	348
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	70	Temperature (F.)	--
Sulfate (SO_4)	44	Date of collection	Nov. 28, 1951
Chloride (Cl)	44		
Fluoride (F)	.1		
Nitrate (NO_3)	.2		
Dissolved solids	211		

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	20	30	10	7.5	8.3	6.0	45	51	35	20	200	10
Finished water	45	60	35	8.3	8.7	8.0	50	60	40	2	2	2

SAN ANGELO
(Population, 52,093)

Ownership: Municipal; supplies also Goodfellow Air Force Base.
Source: Lake Nasworthy on South Concho River, 6 miles southwest of the City Hall.
Treatment: Prechlorination, coagulation with alum, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 12,500,000 gpd.
Raw-water storage: Lake Nasworthy, capacity 3,584,360,000 gal.
Finished-water storage: 2 elevated tanks, 250,000 gal each; 1 ground reservoir, 650,000 gal; clear wells, 5,500,000 gal.

The water is released from Lake Nasworthy and flows down the Concho River to the treatment plant in San Angelo. The finished water from the plant is pumped into the distribution system and storage.

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	11	13	Hardness as $CaCO_3$:		
Iron (Fe)	.37	.10	Total	219	200
Manganese (Mn)	--	--	Noncarbonate	32	46
Calcium (Ca)	55	49			
Magnesium (Mg)	20	19	Color	--	--
Sodium (Na)	43	64	pH	7.5	7.6
Potassium (K)	7.0		Specific conductance (micromhos at 25 C.)	626	629
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	228	188	Temperature (F.)	--	--
Sulfate (SO_4)	29	36	Date of collection	Aug. 18, 1947	Oct. 17, 1951
Chloride (Cl)	74	104			
Fluoride (F)	.6	.3			
Nitrate (NO_3)	.0	.5			
Dissolved solids	348	350			

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	200	246	156	8.2	8.5	7.8	--	--	--	9	50	5
Finished water	190	236	132	7.9	8.1	7.0	230	266	190	.8	1.0	.5

SAN ANTONIO
(Population, 408,442)

Ownership: Municipal; supplies also Alamo Heights, Olmos Park, Terrell Hills, and Brooks Air Force Base. Total population supplied, about 420,000.

Source: 66 wells: 41 wells in 6 well fields, and 25 wells at various points throughout the city. Well stations (Fields): Brackenridge, 13 wells, 900 ft deep (average); Market Street, 12 wells, 880 to 936 ft deep; Mission, 10 wells, 1,400 ft deep (average); and the following stations: Artesia Road, Lady of the Lake Garden, and Woodlawn Hills, 2 wells each. The depth of the wells at the last named stations and the remaining wells ranges from 600 to 1,333 ft.

Treatment: Chlorination at the major stations and some of the scattered outlying stations. The outlying stations that are not chlorinated are pumped only when the demand requires.

Rated capacity of pumping plants: 247,500,000 gpd.

Raw-water storage: None.

Finished-water storage: 7 elevated tanks, one 2,500,000 gal, one 1,500,000 gal, two 1,000,000 gal each, one 250,000 gal, one 80,000 gal, and one 50,000 gal; standpipe, 37,500 gal.

The wells at the Market Street, Brackenridge, Mission, and Artesia Road stations pump as a unit; all other wells are pumped individually. The water is pumped directly into the distribution system and storage. The Artesia Road, Market Street, and Mission stations serve the southern part of the city. The Brackenridge station and most of the scattered outlying wells serve the northern part of the city.

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

	Market St. Station well	Mission Station well 9	Artesia Rd. Station well	Basse Road well	Brackenridge, 13 wells [a]
Silica (SiO_2)	16	17	24	16	14
Iron (Fe)	.25	.01	.00	.00	.00
Manganese (Mn)	--	.00	--	--	.00
Calcium (Ca)	59	65	50	50	62
Magnesium (Mg)	17	19	14	17	17
Sodium (Na)	6.8	10	13	5.2	7.1
Potassium (K)		1.6	.4	.8	1.2
Carbonate (CO_3)	12	0	0	0	0
Bicarbonate (HCO_3)	208	238	176	190	244
Sulfate (SO_4)	22	35	35	32	15
Chloride (Cl)	12	18	19	13	12
Fluoride (F)	.1	.3	.4	.3	.2
Nitrate (NO_3)	1.8	5.0	2.5	3.5	5.4
Dissolved solids	263	296	244	246	259
Hardness as $CaCO_3$:					
Total	217	240	182	195	225
Noncarbonate	27	45	38	39	25
Color	--	0	--	--	0
pH	8.3	7.6	7.9	7.8	7.6
Specific conductance (micromhos at 25 C.)	465	498	425	490	449
Turbidity	--	0	--	--	0
Temperature (F.)	--	81	--	--	78
Date of collection	June 14, 1948	May 14, 1952	Dec. 13, 1948	June 21, 1950	May 14, 1952
Depth (feet)	--	1,400	800	772	Avg. 900
Diameter (inches)	--	--	--	16	16, 12, 8
Date drilled	--	--	--	1950	1916-33
Percent of supply	--	--	--	--	--

[a] Finished water.

SAN ANTONIO--Continued

ANALYSES

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

	Market St. Station 12 wells	Wells [b]		Market St. Station 12 wells	Wells [b]
Silica (SiO_2)	14	12	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.01	Total	225	223
Manganese (Mn)	.00	.00	Noncarbonate	23	26
Calcium (Ca)	62	63			
Magnesium (Mg)	17	16	Color	0	0
Sodium (Na)	7.4	7.9	pH	7.7	7.5
Potassium (K)	.8	2.0	Specific conductance (micromhos at 25 C.)	450	453
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	246	240	Turbidity	0	--
Sulfate (SO_4)	14	17	Temperature (F.)	77	--
Chloride (Cl)	12	14	Date of collection	May 14, 1952	Mar. 14, 1952
Fluoride (F)	.3	.2			
Nitrate (NO_3)	5.2	3.0			
Dissolved solids	257	268			

[b] Composite sample, Market Street, Mission Park, and Artesia well fields.

SAN BENITO

(Population, 13,271)

Ownership: Municipal; supplies also about 400 people outside the city limits. Total population supplied, about 13,700.

Source: Rio Grande. Connecting canal to San Benito; 3 wells, (developed 1952-53).

Treatment: Prechlorination, aeration (spray), coagulation with alum and lime, pH control, sedimentation, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 2,250,000 gpd.

Raw-water storage: Raw water storage in Resaca de los Fresnos.

Finished-water storage: Clear wells 450,000 gal; elevated, 650,000 gal.

There is considerable variation in the composition of the raw water throughout the year.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	10	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	248
Manganese (Mn)	--	Noncarbonate	155
Calcium (Ca)	65		
Magnesium (Mg)	21	Color	--
Sodium (Na)	101	pH	7.7
Potassium (K)	4.0	Specific conductance (micromhos at 25 C.)	955
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	114	Turbidity	--
Sulfate (SO_4)	164	Temperature (F.)	--
Chloride (Cl)	132	Date of collection	June 7, 1951
Fluoride (F)	.5		
Nitrate (NO_3)	.5		
Dissolved solids	552		

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	125	137	113	8.0	8.1	7.9	--	--	--	134	183	112
Finished water	113	125	103	7.8	8.0	7.6	--	--	--	--	--	--

SHERMAN
(Population, 20,150)

Ownership: Municipal; supplies also about 3,500 persons outside the city limits. Total population supplied, about 23,650.

Source: 11 wells: 7 wells (1 to 4, 6 to 8), on West Birge Street; 2 wells (3 and 9), on West McGee Street, in the northwest section of Sherman; 2 wells, on South East Street, in southeast section of Sherman. Seven of the wells range in depth from 708 to 912 ft; four, from 2,140 to 2,257 ft. The yield of the wells (data for 8 wells) is reported to range from 175 to 543 gpm.

Treatment: Chlorination.

Raw-water storage: 2 underground reservoirs, 1,400,000 and 50,000 gal.

Finished-water storage: 1 underground reservoir, 50,000 gal; 1 elevated tank, 750,000 gal; 1 standpipe, 300,000 gal.

The wells are pumped individually into the underground reservoirs, from which the water is pumped into the distribution system and storage, being chlorinated as it leaves the reservoirs. The wells in the northwest section, Fairview Pump Station, Woodbine wells 3, 4, 6, 7, 8, and 9, and Fairview Pump Station Trinity wells 1, 2, and 3 are pumped into a 1,400,000 gal reservoir. The water from the wells in the southeast section, South Plant Woodbine well 1, and South Plant Trinity well 1, is pumped into a 50,000 gal reservoir.

ANALYSES

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

	Trinity well 1 (raw water)[a]	Trinity well 3 (raw water)[a]	Woodbine well 9 (raw water)[a]
Silica (SiO_2)	16	16	14
Iron (Fe)	.01	.01	.16
Manganese (Mn)	.00	.00	.00
Calcium (Ca)	2.6	2.8	.2
Magnesium (Mg)	1.2	1.8	.5
Sodium (Na)	337	365	109
Potassium (K)	.8	--	2.0
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	461	468	248
Sulfate (SO_4)	110	107	21
Chloride (Cl)	168	215	8.8
Fluoride (F)	.6	.7	.6
Nitrate (NO_3)	1.2	1.8	1.0
Dissolved solids	859	942	284
Hardness as $CaCO_3$:			
Total	12	14	3
Noncarbonate	0	0	0
Color	5	5	5
pH	8.3	8.3	7.8
Specific conductance (micromhos at 25 C.)	1,450	1,610	459
Turbidity	--	--	--
Temperature (F.)	91	91	78
Date of collection	Feb. 15, 1952	Feb. 15, 1952	Feb. 15, 1952
Depth (feet)	2,140	2,169	912
Diameter (inches)	10-8	$13\frac{1}{2}$-$6\frac{1}{2}$	--
Date drilled	1921	1944	1949
Percent of supply	--	--	--

[a] Fairview Pump Station.

SNYDER
(Population, 12,010)

Ownership: Municipal; supplies also about 700 people outside the city limits. Total population supplied, about 12,700.
Source: 24 wells. 16 wells are at various points within the city limits; 4 wells, about 6 blocks north of the city limits; and 4 wells, about 6 blocks south of the city limits. The depth of the wells ranges from 164 to 315 ft, and averages 220 ft.
Treatment: None.
Storage: 3 elevated tanks, 100,000 gal each; 3 ground reservoirs, 500,000, 300,000, and 150,000 gal.

The wells are pumped individually. The water from wells 3, 4, 14, and 19 to 26 is pumped directly into the distribution system; the water from wells 1, 2, 11 to 13, 15 to 18, and 27 to 30 is pumped into storage from which it is pumped into the distribution system.

ANALYSES

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

	Well 1	Well 2	Well 4
Silica (SiO_2)	27	27	28
Iron (Fe)	.04	.05	.03
Manganese (Mn)	--	--	.00
Calcium (Ca)	60	79	48
Magnesium (Mg)	23	28	18
Sodium (Na)	45	49	44
Potassium (K)	5.0	4.8	2.8
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	308	316	284
Sulfate (SO_4)	32	51	22
Chloride (Cl)	34	66	18
Fluoride (F)	1.6	1.6	1.6
Nitrate (NO_3)	12	20	5.0
Dissolved solids	391	496	335
Hardness as $CaCO_3$:			
Total	244	312	194
Noncarbonate	0	53	0
Color	--	--	0
pH	7.5	7.5	7.6
Specific conductance (micromhos at 25 C.)	661	835	561
Turbidity	--	--	--
Temperature (F.)	70	77	69
Date of collection	May 29, 1946	May 29, 1946	May 1, 1952
Depth (feet)	165	165	205
Diameter (inches)	17	17	17-12
Date drilled	1925	1926	1945
Percent of supply	--	--	--

SWEETWATER
(Population, 13,619)

Ownership: Municipal; also supplies Robe, Longworth, and about 500 persons outside the city limits. Total population supplied, about 15,300.

Source: Lake Sweetwater on Bitter Creek, about 8 miles southeast of the city, two-thirds of the supply; Lake Trammel on Sweetwater Creek, about 8 miles southwest of the city, one-third of the supply.

Treatment: Prechlorination, aeration (cascades), coagulation with alum, sedimentation, rapid sand filtration, postchlorination, and fluoridation with sodium fluoride.

Rated capacity of treatment plant: 3,000,000 gpd.

Raw-water storage: Lake Sweetwater, capacity 4,500,000,000 gal; Lake Trammel, capacity 1,800,000,000 gal.

Finished-water storage: 1 elevated tank, 750,000 gal; 1 standpipe, 280,000 gal; clear well, 250,000 gal.

The water from Lake Sweetwater is pumped to the treatment plant; that from Lake Trammel flows by gravity to the treatment plant. The finished water from the plant is pumped into the distribution system and elevated storage.

ANALYSES

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

	Lake Trammel (raw water)	Lake Sweetwater (raw water)	Finished water (composite)
Silica (SiO_2)	7.6	3.0	7.2
Iron (Fe)	.05	.07	.05
Manganese (Mn)	--	.00	.00
Calcium (Ca)	52	59	64
Magnesium (Mg)	6.8	13	14
Sodium (Na)	7.8	13	14
Potassium (K)		3.6	3.6
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	164	197	224
Sulfate (SO_4)	16	41	36
Chloride (Cl)	16	20	17
Fluoride (F)	.0	.0	.9
Nitrate (NO_3)	1.0	.0	.5
Dissolved solids	193	270	278
Hardness as $CaCO_3$:			
Total	158	201	217
Noncarbonate	23	39	34
Color	--	10	10
pH	7.6	7.7	7.6
Specific conductance (micromhos at 25 C.)	338	453	472
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	July 2, 1946	Jan. 18, 1952	Jan. 18, 1952

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	175	185	160	7.6	8.0	7.4	200	220	129	25	1000	20
Finished water	170	180	155	7.6	8.0	7.4	200	220	129	.0	.0	.0

TEMPLE
(Population, 25,467)

Ownership: Municipal; supplies also about 400 persons outside the city limits and McCloskey Hospital. Total population supplied, about 27,500.

Source: Lake on Leon River, below highway bridge on U. S. Highway 81; and 5 wells (1 to 5), 1,238, 1,260, 1,268, 2,136, and 1,460 ft deep. Wells 1, 2, and 3 are at the treatment plant; well 4 on Nugent Avenue, and well 5 at the city airport. The yield of the wells is reported to be 900, 900, 900, 1,000, and 150 gpm.

Treatment: Surface water and water from wells 1, 2, and 3: prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, postchlorination, and fluoridation with sodium fluoride. Water from well 4: aeration and chlorination. Water from well 5: chlorination.

Rated capacity of treatment plant: 7,000,000 gpd.

Raw-water storage: Lake, capacity 300,110,000 gal.

Finished-water storage: 2 underground reservoirs, 8,000,000 and 25,000 gal; 2 elevated tanks, 500,000 gal each.

The water from the lake and wells 1, 2, and 3 is pumped to the treatment plant. The finished water from the plant is pumped approximately 6 miles to the city to the underground reservoir, from which it is pumped into the distribution system and elevated tanks. The water from well 4 is pumped into an underground reservoir, being aerated as it enters the reservoir and chlorinated as it is pumped from the reservoir into the distribution system. Well 5 is a separate unit supplying only the city airport.

ANALYSES

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

	Lake (raw water)	Well 2 (raw water)	Lake (finished water)
Silica (SiO_2)	12	14	8.8
Iron (Fe)	.04	.01	.02
Manganese (Mn)	--	.00	.00
Calcium (Ca)	47	6.8	12
Magnesium (Mg)	12	4.0	5.2
Sodium (Na)	181	438	48
Potassium (K)	4.4	.4	1.2
Carbonate (CO_3)	0	0	6
Bicarbonate (HCO_3)	307	442	34
Sulfate (SO_4)	79	221	46
Chloride (Cl)	162	268	50
Fluoride (F)	.5	2.2	.3
Nitrate (NO_3)	2.0	3.5	1.0
Dissolved solids	681	1,180	197
Hardness as $CaCO_3$:			
Total	167	34	51
Noncarbonate	0	0	14
Color	--	0	5
pH	8.0	8.0	9.0
Specific conductance (micromhos at 25 C.)	--	1,970	348
Turbidity	--	--	--
Temperature (F.)	--	86	--
Date of collection	Apr. 23, 1943	Feb. 29, 1952	Oct. 22, 1951

TERRELL
(Population, 11,544)

Ownership: Municipal; supplies also about 80 people outside the city limits. Total population supplied, about 11,600.
Source: Impounding reservoir on a creek about 2 miles east of the city.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination. Addition of copper sulfate during summer months for algae control.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: Impounding reservoir.
Finished-water storage: 1 elevated tank, 285,000 gal; 1 ground reservoir, 160,000 gal; clear well, 30,000 gal.

The water is pumped from the lake to the treatment plant about 100 yards from lake. The finished water is pumped into the distribution system and elevated tank.
A new treatment plant of 1,000,000 gpd capacity adjacent to the plant in use is expected to be put in operation in the latter part of 1952. Treatment at both plants will be the same.

ANALYSES

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

	Raw water	Raw water	Finished water
Silica (SiO_2)	13	7.6	3.4
Iron (Fe)	--	.03	.05
Manganese (Mn)	--	.00	.00
Calcium (Ca)	16	19	28
Magnesium (Mg)	3.9	5.2	4.7
Sodium (Na)	4.0	13	16
Potassium (K)	3.6	--	2.0
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	63	87	93
Sulfate (SO_4)	10	15	37
Chloride (Cl)	4.0	7.2	8.2
Fluoride (F)	.4	.4	.3
Nitrate (NO_3)	.8	.2	.0
Dissolved solids	92	125	155
Hardness as $CaCO_3$:			
Total	56	69	89
Noncarbonate	4	0	13
Color	--	10	10
pH	--	7.6	8.1
Specific conductance (micromhos at 25 C.)	132	200	253
Turbidity	--	50	--
Temperature (F.)	--	50	56
Date of collection	July 30, 1943	Mar. 24, 1952	Mar. 24, 1952

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	50	90	40	7.8	7.8	7.6	--	--	--	--	--	--
Finished water	45	95	30	8.3	8.4	7.6	--	--	--	--	--	--

TEXARKANA
(Population, 40,628; 24,753 in Texas)

Ownership: Municipal; supplies also suburban areas. Total population supplied, about 42,628.

Source: 3 well fields and 1 impounding reservoir: Arkansas Station, 22 wells ranging in depth from 40 ft to 50 ft; Texas Station, 12 wells ranging in depth from 40 ft to 50 ft; Bringle Station (used for emergency), 6 wells each about 37 ft deep; and Bringle Lake (Clear Creek impounded).

Treatment: Wells: aeration, alkali for adjustment of pH, and chlorination. Lake: prechlorination, coagulation with lime and alum, sedimentation, rapid sand filtration, postchlorination, and carbonation at times.

Rated capacity of treatment plant: 3,075,000 gpd.

Raw-water storage: --

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

The Arkansas Station well field is near East 9th St. and Jefferson Ave.; Texas Station is about 1 mile west of Texarkana; Bringle Station, 6 miles northwest of Texarkana; and the impounding reservoir, at Bringle Station well field.

ANALYSES

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

	Bringle Lake[a]	Arkansas Station (raw water)	Arkansas Station (finished water)	Texas Station[b]	Bringle Station[b]
Silica (SiO_2)	5.1	38	36	26	36
Iron (Fe)	.03	.48	.19	.01	.11
Manganese (Mn)	--	.05	.01	--	--
Calcium (Ca)	9.3	7.6	17	2.4	16
Magnesium (Mg)	2.7	5.1	5.6	1.2	4.4
Sodium (Na)	5.5	19	20	7.4	19
Potassium (K)	4.2	2.5	2.6	2.5	2.8
Carbonate (CO_2)	0	0	16	0	0
Bicarbonate (HCO_3)	34	31	18	10	55
Sulfate (SO_4)	3.0	5.6	5.7	3.0	2.0
Chloride (Cl)	14	33	36	8.0	37
Fluoride (F)	.2	.1	.1	.0	.2
Nitrate (NO_3)	.5	12	13	9.4	2.5
Dissolved solids	68	151	176	71	149
Hardness as $CaCO_3$:					
Total	34	40	65	11	58
Noncarbonate	6	14	24	3	13
Color	--	5	8	--	--
pH	6.6	5.8	9.1	5.6	6.6
Specific conductance (micromhos at 25 C.)	115	199	235	64.0	220
Turbidity	--	2	4	--	--
Temperature (F.)	--	66	65	--	--
Date of collection	Sept. 22, 1943	Dec. 4, 1951	Dec. 4, 1951	Sept. 22, 1943	Sept. 22, 1943

[a] Raw water.
[b] Finished water.

TEXAS CITY
(Population, 16,620)

Ownership: Community Public Service Co.
Source: 5 wells (3 to 7), 783, 772, 764, 778, and 763 ft deep, in the city. The yield of the wells is reported to be 190, 440, 500, 350, and 500 gpm.
Treatment: Chlorination.
Raw-water storage: 1 underground reservoir, 620,000 gal.
Finished-water storage: 2 elevated tanks, 250,000 and 100,000 gal.

The wells are pumped individually into connecting lines to the reservoir at the pumping plant. The water is pumped from the reservoir to the distribution system and elevated tanks, being chlorinated immediately before entering the distribution system.

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

	Well 6 (raw water)	Finished water[a]		Well 6 (raw water)	Finished water[a]
Silica (SiO_2)	19	16	Hardness as $CaCO_3$:		
Iron (Fe)	.15	.19	Total	33	24
Manganese (Mn)	--	.00	Noncarbonate	0	0
Calcium (Ca)	8.0	5.9			
Magnesium (Mg)	3.1	2.3	Color	--	10
Sodium (Na)	310	307	pH	7.8	7.5
Potassium (K)		.4	Specific conductance (micromhos at 25 C.)	1,460	1,370
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	366	463	Temperature (F.)	--	--
Sulfate (SO_4)	2.0	.1	Date of collection	Oct. 8, 1944	Nov. 19, 1951
Chloride (Cl)	285	219			
Fluoride (F)	1.0	1.1			
Nitrate (NO_3)	.5	.0			
Dissolved solids	834	784			

Depth (feet)	778	--
Diameter (inches)	20-10¾	--
Date drilled	1944	--
Percent of supply	--	--

[a]City tap.

TYLER
(Population, 38,968)

Ownership: Municipal; supplies also about 180 persons outside the city limits. Total population supplied, about 39,150.
Source: Lake Tyler, approximately 12 miles southeast of the city, off U. S. Highway 64 on Prairie Creek. Auxiliary or emergency supply, Bellwood Lake approximately 4 miles southwest of the city on Indian Creek, and 7 wells (2 to 8) at various points within the city limits. The depth of wells is reported to be 1,064, 1,057, 1,026, 1,037, 1,036, 1,075, and 1,144 ft, and the average yield is 681 gpm. The city expects to use the auxiliary supply during summer months of each year.
Treatment: Surface-water supply: prechlorination, aeration, coagulation with alum and lime, sedimentation, rapid sand filtration, postchlorination, and addition of lime for pH control. Well 4: aeration, coagulation with lime, pressure filtration, and chlorination. Wells 2, 3, 5, 6, 7, and 8: chlorination at each well.
Rated capacity of treatment plant: Lake Tyler plant: 10,500,000 gpd. Lake Bellwood plant: 3,000,000 gpd.
Raw-water storage: Lake Tyler, capacity 13,849,000,000 gal; Lake Bellwood, --.
Finished-water storage: 1 underground reservoir, 2,500,000 gal; 2 standpipes, 1,500,000 and 750,000 gal; 1 elevated tank, 500,000 gal.

TYLER--Continued

The water is pumped from Lake Tyler, intake approximately $2\frac{1}{2}$ miles from Whitehouse Dam, to the treatment plant approximately $1\frac{1}{2}$ miles southeast of Tyler. The water is prechlorinated at the pumping plant before being pumped to the treatment plant. The water flows through the treatment plant into an underground reservoir from which it is pumped to the distribution system and elevated storage. Wells 2, 3, 5, 6, 7, and 8 are pumped directly into the distribution system. Well 4 is pumped to a small treatment plant at the well, from which the finished water is pumped into the distribution system. The flow pattern of the water from Bellwood Lake to the distribution system is similiar to that of Lake Tyler.

ANALYSES

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

	Bellwood Lake (raw water)	Lake Tyler (raw water)	Lake Tyler (finished water)
Silica (SiO_2)	8.6	4.0	3.5
Iron (Fe)	.04	.03	.05
Manganese (Mn)	--	.00	.00
Calcium (Ca)	5.2	9.0	21
Magnesium (Mg)	2.0	4.6	4.6
Sodium (Na)	4.5	10	11
Potassium (K)	2.8		1.2
Carbonate (CO_3)	0	0	2
Bicarbonate (HCO_3)	20	46	61
Sulfate (SO_4)	2	7.3	19
Chloride (Cl)	9.0	12	17
Fluoride (F)	1.0	.3	.1
Nitrate (NO_3)	.8	.5	.0
Dissolved solids	56	92	132
Hardness as $CaCO_3$:			
Total	21	41	71
Noncarbonate	5	4	18
Color	--	15	10
pH	7.0	6.8	8.6
Specific conductance (micromhos at 25 C.)	85	138	200
Turbidity	--	--	--
Temperature (F.)	92	56	58
Date of collection	July 26, 1943	Feb. 27, 1952	Feb. 27, 1952

Regular determinations at treatment plant [a]

	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	18	19	17	7.0	7.0	7.0	--	--	--	--	--	--
Finished water	28	33	24	8.5	8.9	8.2	--	--	--	--	--	--

[a] Bellwood Lake, Jan. 1 to Nov. 28, 1951.

TYLER--Continued

ANALYSES

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

	Well 2 (raw water)	Well 4 (raw water)	Well 6 (raw water)
Silica (SiO_2)	11	14	14
Iron (Fe)	.01	3.5	.28
Manganese (Mn)	--	--	--
Calcium (Ca)	8.4	28	68
Magnesium (Mg)	1.7	4.5	4.1
Sodium (Na)	29	53	131
Potassium (K)	4.0	6.8	8.7
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	94	93	110
Sulfate (SO_4)	8.3	61	176
Chloride (Cl)	6.0	50	148
Fluoride (F)	.4	1.0	.0
Nitrate (NO_3)	.0	.2	.0
Dissolved solids	115	276	610
Hardness as $CaCO_3$:			
Total	28	88	186
Noncarbonate	0	12	96
Color	--	--	--
pH	8.1	7.2	7.5
Specific conductance (micromhos at 25 C.)	187	482	1,050
Turbidity	--	--	--
Temperature (F.)	--	79	78
Date of collection	Aug. 3, 1943	July 27, 1943	Sept. 9, 1944
Depth (feet)	1,064	1,026	1,036
Diameter (inches)	16-8 5/8	13 3/8-6 5/8	--
Date drilled	1937	1938	1944
Percent of supply	--	--	--

UNIVERSITY PARK
(Population, 24,275)

Ownership: (See Highland Park.)

VICTORIA
(Population, 16,126)

Ownership: Municipal.
Source: 7 wells (5 to 10, 12), 612, 365, 412, 414, 604, 1,012, and 751 ft deep, within 400 ft of pumping station 1 and near west city limits on Pine Street. The yield of the wells is reported to be 402, 500, 731, 430, 603, 1,000, and 1,350 gpm.
Treatment: Aeration (by forced air at plant 1; sprays at plant 2).
Raw-water storage: --
Finished-water storage: 1 reservoir, 1,000,000 gal; 2 elevated tanks, 300,000 and 500,000 gal; 2 ground storage tanks, 300,000 gal.

The wells are pumped individually to one or the other of two central pumping plants (No. 1 plant at the end of West Station Street; No. 2 plant on Pine Street). The water at plant No. 1 flows through a sand trap to the aeration chamber before entering the ground storage tank, from which it is pumped into the distribution system. The water at plant No. 2 is aerated before entering the ground storage tank, from which it is pumped into the distribution system

ANALYSES

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

	Well 5 (raw water)	Well 6 (raw water)	Well 8 (raw water)	Well 10 (raw water)	Finished water (city tap)
Silica (SiO_2)	21	26	26	23	22
Iron (Fe)	4.7	3.0	7.9	.97	.03
Manganese (Mn)	--	--	--	--	.00
Calcium (Ca)	34	36	36	18	28
Magnesium (Mg)	11	11	12	6.9	10
Sodium (Na)	146	152	134	221	148
Potassium (K)	7.9	6.4	3.9	6.6	2.0
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	402	386	366	348	366
Sulfate (SO_4)	14	10	3.0	37	2.7
Chloride (Cl)	80	102	93	168	91
Fluoride (F)	.4	.6	.6	.6	.3
Nitrate (NO_3)	.0	.0	.0	.0	.0
Dissolved solids	505	527	495	656	488
Hardness as $CaCO_3$:					
Total	130	135	140	74	111
Noncarbonate	0	0	0	0	0
Color	--	--	--	--	10
pH	7.0	7.2	7.4	7.5	7.6
Specific conductance (micromhos at 25 C.)	868	900	836	1,130	816
Turbidity	--	--	--	--	--
Temperature (F.)	--	74	75	82	--
Date of collection	Apr. 20, 1945	Apr. 2, 1945	Apr. 20, 1945	Apr. 20, 1945	Dec. 12, 1951
Depth (feet)	612	365	414	1,012	--
Diameter (inches)	$12\frac{1}{2}$-10	16-$8\frac{1}{2}$	$10\frac{3}{4}$-8	16-8 5/8	--
Date drilled	1934	1938	1941	1942	--
Percent of supply	--	--	--	--	--

VERNON
(Population, 12,651)

Ownership: Municipal; supplies also about 20 people outside the city limits. Total population supplied, about 12,700.

Source: 34 wells in 5 well fields $\frac{1}{4}$ to $2\frac{1}{4}$ miles from the County Courthouse in Vernon. Field 1: 5 wells (1 to 5) 48 to 52 ft deep; Field 2: 8 wells (1 to 8) 40 to 44 ft deep; Field 3: 5 wells (1 to 5) 41 to 46 ft deep; Field 4: 8 wells (1 to 8) 37 to 42 ft deep; Field 5: 8 wells (1 to 8) 38 to 45 ft deep. The yield from each well field is reported to be 245, 570, 510, 660, and 635 gpm, respectively.

Treatment: Chlorination.

Rated capacity of pumping stations: 1,700,000 gpd.

Raw-water storage: 10 ground reservoirs, 258,000 gal.

Finished-water storage: Elevated tank, 500,000 gal.

The wells are pumped individually to a settling basin at each well field. The water is pumped from the settling basins into the distribution system and elevated tank, being chlorinated just prior to entering the distribution system.

ANALYSES

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

	Field 1 Well 5	Field 2 Well 1	Field 2 Well 2	Field 4 Well 1	Finished water (city tap)
Silica (SiO_2)	20	--	23	24	--
Iron (Fe)	.02	--	.05	.07	--
Manganese (Mn)	--	--	--	.00	--
Calcium (Ca)	79	83	75	56	70
Magnesium (Mg)	37	46	42	38	31
Sodium (Na)	75	79	46	68	79
Potassium (K)				.8	
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	324	314	306	335	321
Sulfate (SO_4)	60	67	59	49	54
Chloride (Cl)	65	74	58	41	72
Fluoride (F)	1.3	--	1.3	1.4	--
Nitrate (NO_3)	110	168	76	64	65
Dissolved solids	603	643	602	494	540
Hardness as $CaCO_3$:					
Total	349	396	360	296	302
Noncarbonate	84	138	108	21	39
Color	--	--	--	5	--
pH	8.2	--	8.3	7.7	--
Specific conductance (micromhos at 25 C.)	--	--	--	808	879
Turbidity	--	--	--	--	--
Temperature (F.)	--	66	--	65	--
Date of collection	Oct. 30, 1943	Oct. 11, 1943	Oct. 11, 1943	Feb. 20, 1952	Apr. 10, 1951
Depth (feet)	48	44	44	41	--
Diameter (inches)	18	18	18	18	--
Date drilled	1931	1933	1926	1940	--
Percent of supply	--	--	--	--	--

WACO
(Population, 84,706)

Ownership: Municipal; supplies also about 6,000 people outside the city limits, and Beverly Hills. Total population supplied, about 91,400. Texas Water Co.; supplies about 6,300 of the total population.

Source: Municipal: Lake Waco, approximately 7½ miles northwest of the city on the Bosque River; 2 wells (1 and 2), 1,600 and 1,540 ft deep, at the municipal airport used solely for the maintenance of the airport. Texas Water Co.: 2 wells (1 and 2), 2,160 and 2,200 ft deep, which pump directly into the distribution system.

Treatment: Lake water: prechlorination, coagulation with alum, activated carbon for odor and taste control, sedimentation, rapid sand filtration, and postchlorination. Well water: chlorination.

Rated capacity of treatment plant: 20,000,000 gpd.

Raw-water storage: 1 ground reservoir, 1,000,000 gal.

Finished-water storage: 2 ground reservoirs, 6,000,000 and 5,000,000 gal; clear well, 3,500,000 gal; 2 elevated tanks, 750,000 and 250,000 gal.

The water from Lake Waco flows by gravity, intake at the lake spillway, approximately 5½ miles to the ground reservoir at the treatment plant. The finished water from the treatment plant and clear well is pumped into the distribution system and storage.

ANALYSES

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

	Lake Waco (raw water)	Lake Waco (raw water)	Finished water	Airport well 1 (raw water)	Texas Water Co. well 1 (raw water)
Silica (SiO_2)	7.6	6.2	4.9	16	20
Iron (Fe)	.06	.04	.01	.05	.01
Manganese (Mn)	--	.00	.00	--	.00
Calcium (Ca)	70	50	52	2.0	3.2
Magnesium (Mg)	11	6.6	6.3	1.3	1.3
Sodium (Na)	30	15	15	240	248
Potassium (K)	.6	--	.4	4.8	2.8
Carbonate (CO_3)	39	0	0	26	0
Bicarbonate (HCO_3)	137	164	152	386	432
Sulfate (SO_4)	52	30	41	108	124
Chloride (Cl)	33	14	15	44	47
Fluoride (F)	.8	.3	.2	1.0	1.1
Nitrate (NO_3)	5.9	.5	.2	1.2	1.0
Dissolved solids	335	225	225	627	664
Hardness as $CaCO_3$:					
Total	220	152	156	10	14
Noncarbonate	42	18	31	0	0
Color	--	10	15	--	0
pH	--	7.6	7.3	8.5	8.2
Specific conductance (micromhos at 25 C.)	--	367	376	1,000	1,060
Turbidity	--	--	--	--	--
Temperature (F.)	--	56	61	94	91
Date of collection	Jan. 8, 1943	Feb. 29, 1952	Feb. 29, 1952	Mar. 31, 1949	Feb. 29, 1952
Depth (feet)				1,600	2,160
Diameter (inches)				8½-6½	10-7
Date drilled				1942	1945
Percent of supply				--	--

WAXAHACHIE
(Population, 11,204)

Ownership: Municipal; supplies also about 25 people outside the city limits. Total population supplied, 11,250.

Source: 4 wells (1 to 4), 2,950, 2,950, 2,950, and 2,800 ft deep at East Madison St., Main and Tuggle Sts., Exposition Grounds, and Getzendander Park.

Treatment: Wells 1, 2, and 3, chlorination. Well 4, aeration (cascades) and chlorination.

Raw-water storage: None.

Finished-water storage: 2 elevated tanks, 200,000 and 125,000 gal; 2 ground reservoirs, 400,000 and 200,000 gal.

The wells are pumped individually. Wells 1, 2, and 3 are chlorinated individually and pumped into a common reservoir from which the water is pumped into the distribution system and elevated tanks. The water from Well 4 is aerated, chlorinated, and pumped into a ground reservoir from which it is pumped into the distribution system and elevated tanks.

ANALYSES

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

	Well 1 (raw water)	Well 2 (raw water)	Well 3 (raw water)	Well 4 (raw water)
Silica (SiO_2)	20	22	20	23
Iron (Fe)	.10	.05	.15	.01
Manganese (Mn)	--	--	--	.00
Calcium (Ca)	4.8	4.0	5.0	3.3
Magnesium (Mg)	1.7	1.6	3.2	1.2
Sodium (Na)	427	462	414	348
Potassium (K)	4.8		4.8	.8
Carbonate (CO_3)	24	6	28	0
Bicarbonate (HCO_3)	492	520	480	563
Sulfate (SO_4)	112	167	113	109
Chloride (Cl)	275	288	262	132
Fluoride (F)	2.0	1.8	1.8	1.8
Nitrate (NO_3)	.8	.0	.8	.0
Dissolved solids	1,110	1,210	1,120	895
Hardness as $CaCO_3$:				
Total	19	16	26	13
Noncarbonate	0	0	0	0
Color	--	--	--	0
pH	8.1	8.2	8.5	8.2
Specific conductance (micromhos at 25 C.)	1,920	1,930	1,890	1,470
Turbidity	--	--	--	--
Temperature (F.)	--	121	120	112
Date of collection	July 6, 1948	Mar. 24, 1949	June 4, 1948	Feb. 28, 1952
Depth (feet)	2,950	2,950	2,950	2,800
Diameter (inches)	6	8	12	16-6
Date drilled	about 1913	1919	--	Sept. 1949
Percent of supply	--	--	--	--

WEST UNIVERSITY PLACE
(Population, 17,074)

Ownership: Municipal; supplies about 100 persons outside the city limits. Total population supplied, about 17,200.
Source: 4 wells (3 to 6), 768, 1,183, 1,673, and 2,026 ft deep.
Treatment: Chlorination at the wells.
Raw-water storage: None.
Finished-water storage: Ground storage tanks and elevated tanks, 1,000,000 gal.

The wells are pumped individually into separate ground storage tanks. From the storage tanks the water is pumped into the distribution system. Overhead storage tanks, for pressure equalization, float on the distribution system.

ANALYSES

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

	Well 3 (raw water)	Well 4 (raw water)	Well 5 (raw water)	Well 6 (finished water)
Silica (SiO_2)	18	18	--	20
Iron (Fe)	.04	.09	--	.08
Manganese (Mn)	--	--	--	.00
Calcium (Ca)	18	22	10	12
Magnesium (Mg)	5.1	6.2	3.3	3.8
Sodium (Na)	98	93	114	151
Potassium (K)				1.6
Carbonate (CO_3)	0	0	6	0
Bicarbonate (HCO_3)	265	265	268	326
Sulfate (SO_4)	9.8	6.0	8	7.7
Chloride (Cl)	36	41	34	66
Fluoride (F)	.4	.4	--	1.6
Nitrate (NO_3)	.0	.0	--	.2
Dissolved solids	317	324	[a]307	418
Hardness as $CaCO_3$:				
Total	66	80	38	46
Noncarbonate	0	0	0	0
Color	--	--	--	10
pH	8.1	8.0	--	7.7
Specific conductance (micromhos at 25 C.)	547	550	--	698
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Sept. 17, 1943	Sept. 16, 1943	Jan. 31, 1942	Nov. 20, 1951
Depth (feet)	768	1,183	1,673	2,026
Diameter (inches)	$13\frac{1}{2}$-$6\frac{3}{4}$	16-$8\frac{1}{2}$	20-$12\frac{1}{2}$	20-$12\frac{3}{4}$
Date drilled	1938	1939	1941	1949
Percent of supply	--	--	--	--

[a] Sum of determined constituents.

WHITE SETTLEMENT
(Population, 10,827)

Ownership: Municipal; supplies also about 200 people outside the city limits. Total population supplied, about 7,500. Liberator Village, a section of White Settlement, population about 3,500, has an independent system of supply.

Source: Municipal: 6 wells: 2 wells (1 and 2) 300 and 180 ft deep on Raymond Street; 2 wells (4 and 5) about 180 and about 280 ft deep on Hannan Street; 1 well (3) about 180 ft deep on Redford Street; 1 well (6) about 280 ft deep on Rumfield Road. The wells pump directly into the distribution system. Liberator Village: wells.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: 2 ground reservoirs, 200,000 and 100,000 gal; 1 elevated tank, 100,000 gal.

ANALYSES

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

	Municipal well 1	Trinity well, Liberator Village	Paluxy well, Liberator Village
Silica (SiO_2)	19	10	16
Iron (Fe)	.09	.10	.19
Manganese (Mn)	.00	--	--
Calcium (Ca)	55	14	23
Magnesium (Mg)	23	1.8	13
Sodium (Na)	37	207	98
Potassium (K)	2.0	7.6	7.2
Carbonate (CO_3)	0	--	0
Bicarbonate (HCO_3)	283	[a]456	306
Sulfate (SO_4)	60	79	50
Chloride (Cl)	12	31	16
Fluoride (F)	.3	1.4	.6
Nitrate (NO_3)	7.5	.5	9.0
Dissolved solids	388	574	381
Hardness as $CaCO_3$:			
Total	232	42	111
Noncarbonate	0	0	0
Color	0	--	--
pH	7.7	8.4	7.6
Specific conductance (micromhos at 25 C.)	580	925	630
Turbidity	--	--	--
Temperature (F.)	64	76	70
Date of collection	Mar. 31, 1952	Sept. 19, 1949	Sept. 19, 1949
Depth (feet)	300	1,352	282
Diameter (inches)	10	--	--
Date drilled	1943	--	--
Percent of supply	--	--	--

[a] Alkalinity as bicarbonate (HCO_3).

WICHITA FALLS
(Population, 68,042)

Ownership: Municipal; supplies also Holliday, and Sheppard Air Force Base. Total population supplied, about 98,000.

Source: Lake Kickapoo, maximum capacity 220,000 acre-ft, on North Fork Little Wichita River, 8.2 miles south of Mankins and 9.2 miles northwest of Archer City, Archer County. Auxiliary or emergency supply, Lake Wichita on Holiday Creek, 6 miles southwest of Wichita Falls.

Treatment: Prechlorination, coagulation with iron salts, softening with lime, sedimentation, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 21,000,000 gpd.

Raw-water storage: 45,000,000 gal.

Finished-water storage: 2 underground reservoirs, 2,500,000 gal each; 2 elevated tanks, 1,000,000 and 500,000 gal.

The water is pumped from Lake Kickapoo to the treatment plant. The finished water from the treatment plant is pumped into the distribution system and storage.

ANALYSES

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

	Lake Kickapoo (raw water)	Finished water	Lake Wichita (raw water)
Silica (SiO_2)	4.3	3.6	8.6
Iron (Fe)	.0	.0	.03
Manganese (Mn)	.00	.00	.00
Calcium (Ca)	33	13	120
Magnesium (Mg)	11	8.5	36
Sodium (Na)	25	26	304
Potassium (K)	.8		.8
Carbonate (CO_3)	0	8	0
Bicarbonate (HCO_3)	176	77	104
Sulfate (SO_4)	8.4	15	239
Chloride (Cl)	18	21	552
Fluoride (F)	.5	.6	.2
Nitrate (NO_3)	.5	.5	1.5
Dissolved solids	197	141	1,310
Hardness as $CaCO_3$:			
Total	128	67	448
Noncarbonate	0	0	362
Color	10	10	0
pH	7.9	9.0	7.4
Specific conductance (micromhos at 25 C.)	335	244	2,440
Turbidity	20	10	--
Temperature (F.)	--	--	--
Date of collection	Feb. 20, 1952	Jan. 11, 1952	Mar. 24, 1952

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	Well 1 [a]	Well 2 [a]
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	Mar. 30, 1951	April, 1950	Apr. 18, 1950
Depth (feet)		205	412
Diameter (inches)		12	16-12
Date drilled		1935	1946
Percent of supply		--	--

[a] Analyzed by Utah State Dept. of Health, Salt Lake City.

CEDAR CITY
(Population, 6,106)

Ownership: Municipal; supplies also about 150 people outside the city limits. Total population supplied, about 6,250.
Source: Springs located in Coal Creek and Shurtz Canyon drainage basins, and 1 well 300 ft deep. The yield of the well is reported to be 100 gpm. Emergency supply from Shale Hill Spring.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: Reservoirs, 5,000,000 gal.

CEDAR CITY--Continued

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	19	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	191
Manganese (Mn)	.00	Noncarbonate	14
Calcium (Ca)	52		
Magnesium (Mg)	15	Color	5
Sodium (Na)	4.5	pH	7.7
Potassium (K)	1.9	Specific conductance (micromhos at 25 C.)	369
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	216	Temperature (F.)	--
Sulfate (SO_4)	20	Date of collection	Dec. 4, 1951
Chloride (Cl)	3.1		
Fluoride (F)	.2		
Nitrate (NO_3)	2.0		
Dissolved solids	228		

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. Chiorination 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	Turbidity	--	--
Bicarbonate (HCO_3)	230	228	Temperature (F.)	47	45
Sulfate (SO_4)	8.1	14	Date of collection	Mar. 30, 1951	Mar. 30, 1951
Chloride (Cl)	1.8	5.5			
Fluoride (F)	.0	.1			
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	Mar. 9, 1951	Mar. 9, 1951	Mar. 9, 1951
Depth (feet)		44-290	--
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 is controlled and after the filling of Pine View Reservoir was 24 second-feet, which was 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 well 2[a] (West well)	Airport well 3[a] (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	[b] 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	Apr. 17, 1951	Sept. 11, 1950	Nov. 6, 1948	Mar. 23, 1949	Sept. 11, 1950
Depth (feet)	84-600	484	495	472	600
Diameter (inches)	4-12	14	14	10	18
Date drilled	--	1945	1945	1943	1944
Percent of supply	--	--	--	--	--

[a] Analyzed by Utah State Dept. of Health, Salt Lake City.
[b] 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	Aug. 28, 1951	Aug. 28, 1951	Aug. 28, 1951
Depth (feet)	--	--	468
Diameter (inches)	--	--	12-10-8
Date drilled	--	--	1946
Percent of supply	--	--	--

PRICE
(Population, 6,010)

Ownership: Municipal; supplies also Wellington and about 1,200 people outside the city limits. Total population supplied, about 8,300.
Source: 5 springs located about 27 miles northwest of Price.
Treatment: None.
Storage: 3 reservoirs, 16,500,000 gal.

PRICE--Continued

ANALYSIS

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

	Springs (city tap)		Springs (city tap)
Silica (SiO_2)	5.9	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	280
Manganese (Mn)	.00	Noncarbonate	18
Calcium (Ca)	58		
Magnesium (Mg)	33	Color	5
Sodium (Na)	5.8	pH	7.4
Potassium (K)	3.7	Specific conductance (micromhos at 25 C.)	522
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	320	Temperature (F.)	44
Sulfate (SO_4)	24	Date of collection	Feb. 15, 1951
Chloride (Cl)	10		
Fluoride (F)	.1		
Nitrate (NO_3)	1.6		
Dissolved solids	297		

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 123,200,000 gal.

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	Mar. 23, 1951
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 Creek	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	Mar. 24, 1949	Oct. 20, 1949	Apr. 22, 1949	Mar. 24, 1949	Nov. 25, 1949

SALT LAKE CITY--Continued

ANALYSES

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

	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	May 9, 1949	Aug. 8, 1949	Aug. 18, 1949
Depth (feet)	--	58-440	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, 4 to 8) 585, 932, 750, 631, 895, and 970 ft deep. Auxiliary water is purchased from Salt Lake City, supplied by pipeline 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 (14 percent of supply in 1950).

Treatment: None.

Storage: Elevated tank, 350,000 gal.

SOUTH SALT LAKE--Continued

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	Turbidity	--
Bicarbonate (HCO_3)	241	Temperature (F.)	62
Sulfate (SO_4)	233	Date of collection	Mar. 9, 1951
Chloride (Cl)	40		
Fluoride (F)	.2		
Nitrate (NO_3)	.9		
Dissolved solids	630		

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

SPRINGVILLE
(Population, 6,475)

Ownership: Municipal; supplies also about 325 people outside the city limits. Total population supplied, about 6,800.

Source: Spring Creek Springs (55 percent of supply), Burt Spring (40 percent of supply), Knowles Tunnel (5 percent of supply). It is planned to use Bartholomew Spring as an additional supply by late summer of 1951. These sources of supply are located in canyons east of Springville.

Treatment: None.

Storage: Reservoirs, 1,208,000 gal.

SPRINGVILLE--Continued

ANALYSES

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

	Spring [a]	Spring [b]	Burt Spring	Knowles Tunnel	Bartholomew Spring
Silica (SiO_2)	7.6	7.9	10	8.0	8.0
Iron (Fe)	.02	--	.01	.03	.02
Manganese (Mn)	--	--	--	--	--
Calcium (Ca)	50	49	66	51	48
Magnesium (Mg)	16	17	17	22	7.0
Sodium (Na)	2.9	9.1	6.4	4.5	2.3
Potassium (K)	2.7		2.2	3.0	2.9
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	217	224	249	240	176
Sulfate (SO_4)	11	12	34	22	5.2
Chloride (Cl)	2.8	9.0	8.5	5.0	1.9
Fluoride (F)	.1	--	.0	.1	.1
Nitrate (NO_3)	3.8	3.9	.7	2.2	2.4
Dissolved solids	196	218	261	231	159
Hardness as $CaCO_3$:					
Total	191	192	234	218	149
Noncarbonate	13	9	30	21	4
Color	5	--	5	5	5
pH	7.9	--	7.6	7.9	7.8
Specific conductance (micromhos at 25 C.)	356	364	445	415	286
Turbidity	--	--	--	--	--
Temperature (F.)	47	48	49	42	43
Date of collection	Mar. 23, 1951	Mar. 23, 1951	Mar. 23, 1951	Mar. 23, 1951	Mar. 23, 1951

[a] Upper Spring Creek.
[b] Lower Spring Creek.

TOOELE
(Population, 7,269)

Ownership: Municipal.
Source: Middle Canyon Springs located 2 miles southeast of Tooele, and Settlement Canyon Spring 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, 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.

TOOELE--Continued

ANALYSES

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

	Middle Canyon Springs	Settlement Canyon Spring	Well 1[a]
Silica (SiO_2)	12	13	13
Iron (Fe)	.02	.02	[b]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	Mar. 1, 1951	Mar. 1, 1951	Jan. 3, 1947
Depth (feet)	--	--	452
Diameter (inches)	--	--	12-10
Date drilled	--	--	1946
Percent of supply	--	--	--

[a] Analyzed by University of Utah, Salt Lake City, Utah.
[b] Iron and aluminum oxides.

ABERDEEN, WASHINGTON
(Population, 19,653)

Ownership: Municipal; supplies also about 1,000 people outside the city limits. Total population supplied, about 20,650.
Source: Wishka River impounded 21.7 miles northeast of Aberdeen. A separate industrial system, municipally owned, utilizes large quantities of raw water from the Wynooche River. Emergency supplies from Wynooche River and Lake Aberdeen.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plant: 10,000,000 gpd.
Raw-water storage: 120,000,000 gal.
Finished-water storage: 24,000,000 gal.

ANALYSIS

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

	Finished water[a]		Finished water[a]
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	25
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	5.6		
Magnesium (Mg)	2.6	Color	5
Sodium (Na)	3.2	pH	7.3
Potassium (K)	2.1	Specific conductance (micromhos at 25 C.)	60
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	34	Temperature (F.)	61
Sulfate (SO_4)	1.0	Date of collection	June 12, 1951
Chloride (Cl)	3.4		
Fluoride (F)	.3		
Nitrate (NO_3)	.2		
Dissolved solids	57		

[a] Wishka River.

BELLINGHAM
(Population, 34,112)

Ownership: Municipal; supplies also about 1,500 people outside the city limits. Total population supplied, about 35,600.
Source: Lake Whatcom (96 percent of supply) and Lake Padden (4 percent of supply).
Treatment: Chlorination and ammoniation. Lime added to water from Lake Whatcom for corrosion control.
Rated capacity of treatment plant: 100,000,000 gpd.
Raw-water storage: Lake Whatcom and Lake Padden (capacities not computed).
Finished-water storage: 4 reservoirs, 2,000,000 gal; elevated tank, 75,000 gal.

BELLINGHAM--Continued

ANALYSIS

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

	Finished water [a]		Finished water [a]
Silica (SiO_2)	1.3	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	16
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	4.8		
Magnesium (Mg)	.9	Color	5
Sodium (Na)	3.3	pH	7.2
Potassium (K)	1.6	Specific conductance (micromhos at 25 C.)	55
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	21	Temperature (F.)	69
Sulfate (SO_4)	4.0	Date of collection	Aug. 13, 1951
Chloride (Cl)	3.2		
Fluoride (F)	.2		
Nitrate (NO_3)	.2		
Dissolved solids	35		

[a] Lake Whatcom.

BREMERTON

(Population, 27,678)

Ownership: Municipal; supplies also Puget Sound Naval Shipyard and military personnel, and about 20,000 people outside the city limits. Total population supplied, about 63,000.

Source: Anderson Creek, Gorst Creek, and Union River (82 percent of supply); 7 artesian wells (1 to 7) ranging in depth from 245 to 627 ft (18 percent of supply). The yield of the wells is reported to range from 130 to 1,500 gpm.

Treatment: Anderson and Gorst Creek stations: sedimentation, chlorination, and ammoniation; chlorination of Union River supply and at main distribution reservoir.

Rated capacity of treatment plant: 15,000,000 gpd.

Raw-water storage: None.

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

ANALYSES

(Analyses, in parts per million, by Northwest Laboratories, Seattle, Wash.)

	Anderson Creek	Gorst Creek	Union River
Silica (SiO_2)	39	38	33
Iron (Fe)	.09	.15	.38
Manganese (Mn)	--	--	--
Calcium (Ca)	7.2	9.7	9.0
Magnesium (Mg)	4.2	4.9	2.7
Sodium (Na)	7.5	6.9	12
Potassium (K)	--	--	--
Carbonate (CO_3)	--	--	--
Bicarbonate (HCO_3)	50	58	56
Sulfate (SO_4)	.8	.8	2.3
Chloride (Cl)	6.8	7.7	7.4
Fluoride (F)	.0	.0	.0
Nitrate (NO_3)	.0	.0	.0
Dissolved solids	[a] 90	95	[a] 94
Hardness as $CaCO_3$:			
Total	35	44	34
Noncarbonate	0	0	0

[a] Sum of determined constituents.

BREMERTON, Analyses--Continued

	Anderson Creek	Gorst Creek	Union River
Color	2.5	0	6
pH	7.5	7.6	7.4
Specific conductance (micromhos at 25 C.)	--	--	--
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date reported	July 5, 1951	July 5, 1951	July 5, 1951

	Well 2	Well 6	Well 7
Silica (SiO_2)	31	41	30
Iron (Fe)	.14	.09	.05
Manganese (Mn)	--	--	--
Calcium (Ca)	12	15	19
Magnesium (Mg)	5.1	3.2	4.0
Sodium (Na)	13	9.9	12
Potassium (K)	--	--	--
Carbonate (CO_3)	--	--	--
Bicarbonate (HCO_3)	79	76	78
Sulfate (SO_4)	4.4	1.6	.8
Chloride (Cl)	7.1	6.4	17
Fluoride (F)	.0	.0	.0
Nitrate (NO_3)	.0	.0	.0
Dissolved solids	106	108	114
Hardness as $CaCO_3$:			
Total	51	52	64
Noncarbonate	0	0	0
Color	0	0	0
pH	8.2	8.2	8.1
Specific conductance (micromhos at 25 C.)	--	--	--
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date reported	July 5, 1951	July 5, 1951	July 5, 1951
Depth (feet)	245	535	627
Diameter (inches)	22	16	16
Date drilled	1941	1944	1945
Percent of supply	--	--	--

EVERETT
(Population, 33,849)

Ownership: Municipal; supplies also about 10,000 people outside the city limits. Total population supplied, about 43,800.
Source: Sultan River stored in Lake Chaplain.
Treatment: Chlorination.
Rated capacity of treatment plant: 110,000,000 gpd.
Raw-water storage: Lake Chaplain, 4,500,000,000 gal.
Finished-water storage: 30,000,000 gal.

EVERETT--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	6.1	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	12
Manganese (Mn)	--	Noncarbonate	1
Calcium (Ca)	3.6		
Magnesium (Mg)	.7	Color	5
Sodium (Na)	1.0	pH	7.2
Potassium (K)	1.0	Specific conductance (micromhos at 25 C.)	29
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	13	Temperature (F.)	60
Sulfate (SO_4)	2.5	Date of collection	June 9, 1951
Chloride (Cl)	1.2		
Fluoride (F)	.1		
Nitrate (NO_3)	.3		
Dissolved solids	22		

HOQUIAM

(Population, 11,123)

Ownership: Municipal; supplies also about 700 people outside the city limits. Total population supplied, about 11,800.

Source: Davis Creek (75 percent of supply) and headwaters of the Little Hoquiam River (25 percent of supply). There are 2 emergency connections with the supply of the city of Aberdeen.

Treatment: Aeration and chlorination.

Rated capacity of treatment plant: 6,500,000 gpd.

Raw-water storage: --

Finished-water storage: 11,000,000 gal.

ANALYSES

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

	Davis Creek (raw water)	Little Hoquiam River (raw water)	Finished water (composite)
Silica (SiO_2)	19	18	19
Iron (Fe)	.19	.21	.18
Manganese (Mn)	--	--	--
Calcium (Ca)	5.3	5.5	5.0
Magnesium (Mg)	1.5	1.7	1.9
Sodium (Na)	5.4	5.4	5.6
Potassium (K)	3.0	3.0	2.4
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	34	28	32
Sulfate (SO_4)	1.0	1.6	1.2
Chloride (Cl)	5.8	7.8	6.8
Fluoride (F)	.2	.2	.3
Nitrate (NO_3)	.2	.2	.1
Dissolved solids	57	58	57
Hardness as $CaCO_3$:			
Total	19	21	20
Noncarbonate	0	0	0
Color	10	10	5
pH	7.2	7.0	7.3
Specific conductance (micromhos at 25 C.)	74	71	76
Turbidity	--	--	--
Temperature (F.)	54	53	62
Date of collection	June 12, 1951	June 12, 1951	June 12, 1951

KENNEWICK
(Population, 10,106)

Ownership: Municipal; supplies also about 2,100 people outside the city limits. Total population supplied, about 12,200.
Source: Columbia River; auxiliary supply from a well 552 ft deep. The yield of the well is reported to be 600 gpm.
Treatment: Chlorination. (Fluoridation equipment is currently being installed, November 1951).
Rated capacity of treatment plant: 10,000,000 gpd.
Raw-water storage: --
Finished-water storage: 5,000,000 gal.

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

	Finished water		Finished water
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.07	Total	80
Manganese (Mn)	--	Noncarbonate	9
Calcium (Ca)	22		
Magnesium (Mg)	6.1	Color	7
Sodium (Na)	5.4	pH	7.6
Potassium (K)	2.1	Specific conductance (micromhos at 25 C.)	179
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	87	Temperature (F.)	59
Sulfate (SO_4)	16	Date of collection	June 7, 1951
Chloride (Cl)	2.5		
Fluoride (F)	.5		
Nitrate (NO_3)	.9		
Dissolved solids	113		

LONGVIEW
(Population, 20,339)

Ownership: Municipal; supplies also about 4,000 people outside the city limits. Total population supplied, about 24,300.
Source: Cowlitz River.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: 500,000 gal.
Finished-water storage: 7,000,000 gal.

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

	Finished water		Finished water
Silica (SiO_2)	12	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	22
Manganese (Mn)	--	Noncarbonate	5
Calcium (Ca)	7.3		
Magnesium (Mg)	.8	Color	5
Sodium (Na)	2.4	pH	7.8
Potassium (K)	1.9	Specific conductance (micromhos at 25 C.)	63
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	20	Temperature (F.)	--
Sulfate (SO_4)	8.0	Date of collection	June 13, 1951
Chloride (Cl)	1.9		
Fluoride (F)	.3		
Nitrate (NO_3)	.0		
Dissolved solids	45		

LONGVIEW--Continued

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.....	--	--	--	7.0	7.2	6.8	--	--	--	25	1000	25
Finished water...	18	--	--	7.2	7.4	7.0	--	--	--	0	0	0

OLYMPIA
(Population, 15,819)

Ownership: Municipal; supplies also about 300 people outside the city limits. Total population supplied, about 16,100.
Source: McAllister Springs.
Treatment: Chlorination.
Rated capacity of treatment plant: 20,000,000 gpd.
Raw-water storage: 2,000,000 gal.
Finished-water storage: 7,700,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	36	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	50
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	10		
Magnesium (Mg)	6.2	Color	3
Sodium (Na)	6.9	pH	7.4
Potassium (K)	2.9	Specific conductance (micromhos at 25 C.).....	133
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	72	Turbidity	--
Sulfate (SO_4)	3.6	Temperature (F.).....	62
Chloride (Cl)	4.4	Date of collection	June 11, 1951
Fluoride (F)	.0		
Nitrate (NO_3)	.8		
Dissolved solids	107		

PASCO
(Population, 10,228)

Ownership: Municipal.
Source: Columbia River.
Treatment: Coagulation with alum and lime, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: --
Finished-water storage: 600,000 gal.

PASCO--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	7.3	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	70
Manganese (Mn)	--	Noncarbonate	14
Calcium (Ca)	21		
Magnesium (Mg)	4.2	Color	5
Sodium (Na)	1.8	pH	7.7
Potassium (K)	1.0	Specific conductance (micromhos at 25 C.)	148
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	68	Temperature (F.)	71
Sulfate (SO_4)	17	Date of collection	June 7, 1951
Chloride (Cl)	1.5		
Fluoride (F)	.0		
Nitrate (NO_3)	.3		
Dissolved solids	89		

PORT ANGELES
(Population 11,233)

Ownership: Municipal; supplies also about 2,000 people outside the city limits. Total population supplied, about 13,200.
Source: Morse Creek.
Treatment: Chlorination.
Rated capacity of treatment plant: 11,000,000 gpd.
Raw-water storage: --
Finished-water storage: 7,000,000 gal.

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	6.8	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	56
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	18		
Magnesium (Mg)	2.6	Color	5
Sodium (Na)	3.2	pH	7.5
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.)	128
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	68	Temperature (F.)	--
Sulfate (SO_4)	7.7	Date of collection	Aug. 7, 1951
Chloride (Cl)	1.5		
Fluoride (F)	.2		
Nitrate (NO_3)	.1		
Dissolved solids	76		

PULLMAN
(Population 12,022)

Ownership: Municipal; supplies also about 100 people outside the city limits. Total population supplied, about 12,100.
Source: 3 wells (1 to 3) 150, 232, and 167 ft deep. The yield of the wells is reported to be 750, 650, and 900 gpm.
Treatment: Chlorination.
Rated capacity of treatment plant: 3,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,050,000 gal.

ANALYSIS

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

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	63	Hardness as $CaCO_3$:	
Iron (Fe)	.23	Total	115
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	23		
Magnesium (Mg)	14	Color	5
Sodium (Na)	22	pH	7.8
Potassium (K)	5.4	Specific conductance (micromhos at 25 C.)	308
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	199	Turbidity	--
Sulfate (SO_4)	1.8	Temperature (F.)	59
Chloride (Cl)	3.1	Date of collection	June 6, 1951
Fluoride (F)	.3		
Nitrate (NO_3)	.1		
Dissolved solids	220		

RENTON
(Population, 16,039)

Ownership: Municipal; supplies also about 1,000 people outside the city limits. Total population supplied, about 17,000.
Source: Springbrook Springs and 4 wells (1 and 2, and Liberty Park 1 and 2). The yield of the wells is reported to be 105, 260, 1,000 and 1,000 gpm. Emergency supply from city of Seattle.
Treatment: Chlorination (at source only).
Raw-water storage: 1,800,000 gal.
Finished-water storage: 1,000,000 gal.

A private residential development of 150 homes, supplied by a private water company, has been annexed by the city. The source of the supply is springs, with a 25,000 gal storage tank. The city of Renton may purchase this water system.

RENTON--Continued

ANALYSES

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

	Finished water [a]	Finished water [b]		Finished water [a]	Finished water [b]
Silica (SiO_2)	29	28	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.01	Total	66	64
Manganese (Mn)	--	--	Noncarbonate	2	5
Calcium (Ca)	13	12			
Magnesium (Mg)	8.2	8.2	Color	5	5
Sodium (Na)	5.3	5.5	pH	7.2	7.3
Potassium (K)	4.0	2.6	Specific conductance (micromhos at		
Carbonate (CO_3)	0	0	25 C.)	161	161
Bicarbonate (HCO_3)	78	72	Turbidity	--	--
Sulfate (SO_4)	9.6	9.8	Temperature (F.)	50	52
Chloride (Cl)	4.2	4.0	Date of collection	June 8, 1951	June 6, 1951
Fluoride (F)	.4	.2			
Nitrate (NO_3)	4.0	4.2			
Dissolved solids	109	109			

[a] Springbrook Springs.
[b] Liberty Park wells.

RICHLAND
(Population, 21, 809)

Ownership: U. S. Government. Operated by General Electric Co. Supplies also about 6, 000 people outside Richland. Total population supplied, about 27, 800.
Source: Domestic supply, 18 wells in four groups: Richland group of 8 wells (2, 4, 5, 12, 13, 14, 15, and 18) ranging in depth from 70 to 140 ft, and reported to yield 6, 000 gpm; North Richland group of 6 wells (A, B, C, D, E, and 5) ranging in depth from 100 to 120 ft and reported to yield 7, 000 gpm; Columbia group of 3 wells (A, B, and C) 80 to 110 ft deep, and reported to yield 2, 200 gpm; and 1 well (1100-8) 120 ft deep, and reported to yield 1, 000 gpm. The Columbia group of wells is used only during the summer months.
Treatment: Chlorination of domestic supply.
Raw-water storage: --
Finished-water storage: 5, 400, 000 gal.

A separate supplementary supply for lawn sprinkling during summer months is obtained from a canal from the Yakima River through a separate distribution system. The river water is used also to flood the percolation basin in the well field area in order to maintain the ground water level during the summer months.
The water delivered to the consumers varies in chemical composition according to the wells pumped and somewhat with the level of the ground water table.

RICHLAND--Continued

ANALYSES

(Analyses, in parts per million, by General Electric Co., Richland, Wash.)

	8 wells (Richland group)	6 wells (North Richland group)	Well 1100-8
Silica (SiO_2)	55	38	52
Iron (Fe)	.01	.02	.00
Manganese (Mn)	.00	.00	< .01
Calcium (Ca)	50	27	34
Magnesium (Mg)	16	5.8	7.5
Sodium (Na)	21	8.5	16
Potassium (K)	4	1.3	2.7
Carbonate (CO_3)	--	--	--
Bicarbonate (HCO_3)	206	100	139
Sulfate (SO_4)	44	12	18
Chloride (Cl)	8.5	4.0	5.5
Fluoride (F)	.2	.2	.2
Nitrate (NO_3)	.9	.8	.3
Dissolved solids	307	148	186
Hardness as $CaCO_3$:			
Total	191	91	116
Noncarbonate	22	9	2
Color	5	0	0
pH	7.7	7.8	7.8
Specific conductance (micromhos at 25 C.)	424	202	283
Turbidity	2	< 1	<0.1
Temperature (F.)	--	--	--
Date of collection	Apr. 24, 1951	Apr. 24, 1951	Apr. 24, 1951
Depth (feet)	70 to 140	100 to 120	120
Diameter (inches)	16 to 30	20 to 30	10
Date drilled	1943-44	1948	1948
Percent of supply	--	--	--

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	120	232	80	7.2	7.8	7.0	140	202	90	2.0	2.0	2.0

SEATTLE
(Population, 467,591)

Ownership: Municipal; supplies also about 110,000 people outside the city limits. Total population supplied, about 580,000.
Source: Cedar River impounded in Lake Youngs.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plant: Approximately 300,000,000 gpd.
Raw-water storage: Lake Youngs, 3,660,000,000 gal.
Finished-water storage: 365,000,000 gal.

SEATTLE--Continued

ANALYSIS

(Analysis, in parts per million, by Seattle Water Dept.)

	Cedar River		Cedar River
Silica (SiO_2)	4.0	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	18
Manganese (Mn)	.0	Noncarbonate	0
Calcium (Ca)	6.3		
Magnesium (Mg)	.6	Color	0
Sodium (Na)	.4	pH	7.3
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	0
Bicarbonate (HCO_3)	22	Temperature (F.)	43
Sulfate (SO_4)	2.1	Date of collection	Jan. 8, 1951
Chloride (Cl)	.6		
Fluoride (F)	.0		
Nitrate (NO_3)	.0		
Dissolved solids	37		

SPOKANE

(Population, 161,721)

Ownership: Municipal; supplies also about 400 people outside the city limits. Total population supplied, about 162,100.

Source: 13 wells in two groups (87 percent of supply) with two pumping stations: Well Pumping Station (5 wells of 45 ft mean depth) and Parkwater Pumping Station (8 wells of 140 ft mean depth). Seven auxiliary wells (13 percent of supply) with four pumping stations: Ray Street (2 wells of 76 ft mean depth); Grace Avenue (1 well); Hoffman Avenue (2 wells of 225 ft mean depth); and Baxter (2 wells of 130 ft mean depth). The auxiliary wells are used during the summer months.

Treatment: Chlorination.

Rated capacity of treatment plant: --

Raw-water storage: --

Finished-water storage: 70,100,000 gal.

ANALYSES

(Analyses, in parts per million, by City of Spokane Health Dept.)

	Well Station [a]	Parkwater Station [b]		Well Station [a]	Parkwater Station [b]
Silica (SiO_2)	20	11	Hardness as $CaCO_3$:		
Iron (Fe)	.0	.0	Total	153	161
Manganese (Mn)	.0	.0	Noncarbonate	10	17
Calcium (Ca)	35	38			
Magnesium (Mg)	16	16	Color	--	--
Sodium (Na)	4.0	4.9	pH	7.9	7.9
Potassium (K)	--	--	Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	175	175	Temperature (F.)	--	--
Sulfate (SO_4)	13	13	Date of collection	June 1951	June 1951
Chloride (Cl)	2.0	1.9			
Fluoride (F)	.0	.0			
Nitrate (NO_3)	2.2	2.2			
Dissolved solids	184	186			
Depth (feet)				45	140
Diameter (feet)				28 to 50	6
Date dug				1907-25	1948
Percent of supply				60	27

[a] Five wells. [b] Eight wells.

SPOKANE--Continued

ANALYSES

(Analyses, in parts per million, by City of Spokane Health Dept.)

	Ray Street Station (2 wells)	Hoffman Avenue Station (2 wells)	Baxter Station (2 wells)	Grace Avenue Well
Silica (SiO_2)	7.2	7.2	6.4	15
Iron (Fe)	.0	.0	.0	--
Manganese (Mn)	--	--	--	.0
Calcium (Ca)	39	32	37	29
Magnesium (Mg)	12	15	13	11
Sodium (Na)	14	1.0	4.1	3.0
Potassium (K)	--	--	--	--
Carbonate (CO_3)	0	0	0	0
Bicarbonate (HCO_3)	176	146	145	126
Sulfate (SO_4)	22	16	27	12
Chloride (Cl)	7.4	2.5	5.7	3.6
Fluoride (F)	--	--	--	.0
Nitrate (NO_3)	8.9	.9	.4	4.0
Dissolved solids	191	144	195	132
Hardness as $CaCO_3$:				
Total	147	142	146	118
Noncarbonate	2	22	27	14
Color	--	--	--	--
pH	7.6	8.1	8.2	7.9
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	Oct. 1945	Sept. 1944	Dec. 1944	July 1951
Depth (feet)	76	225	130	--
Diameter (feet)	20	5	2	--
Date dug	1937	1923	1943	--
Percent of supply	6	3	.3	4

TACOMA
(Population, 143,673)

Ownership: Municipal; supplies also about 12,000 people outside the city limits. Total population supplied, about 155,700.

Source: Green River (94 percent of supply); auxiliary supply from 13 wells ranging in depth from 74 to 788 ft, and an average yield (reported) of 3,490 gpm. The well supply is used when the Green River is turbid, during peak demand for sprinkling, and for emergencies.

Treatment: Chlorination and ammoniation.

Rated capacity of treatment plant: 72,000,000 gpd.

Finished-water storage: Reservoirs, 160,000,000 gal; standpipes, 2,574,000 gal.

The intake on Green River is near Palmer, about 35 miles east of Tacoma. The water is transmitted by pipeline to McMillin Reservoir, located 8 miles southeast of Tacoma. A second pipeline connects McMillin Reservoir and the distribution system in Tacoma.

TACOMA--Continued

ANALYSES

(Analyses, in parts per million, by Northwest Laboratories, Seattle, Wash.)

	Green River (raw water)	Finished water	Well 5-A
Silica (SiO_2)	23	26	27
Iron (Fe)	0	0	0
Manganese (Mn)	0	0	0
Calcium (Ca)	5.2	6.4	12
Magnesium (Mg)	1.2	1.3	7.7
Sodium (Na)	6.9	6.7	9.4
Potassium (K)	--	--	--
Carbonate (CO_3)	--	--	--
Bicarbonate (HCO_3)	29	30	56
Sulfate (SO_4)	2.0	2.1	8.9
Chloride (Cl)	6.3	6.3	9.5
Fluoride (F)	0	0	0
Nitrate (NO_3)	0	0	17
Dissolved solids	[a] 59	[a] 64	115
Hardness as $CaCO_3$:			
Total	18	21	61
Noncarbonate	0	0	16
Color	0	0	0
pH	7.4	7.8	7.1
Specific conductance (micromhos at 25 C.)	--	--	--
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date reported	Oct. 4, 1948	Oct. 4, 1948	Oct. 4, 1948
Depth (feet)			378
Diameter (inches)			26
Date drilled			1930
Percent of supply			--

Regular determinations at treatment plant

	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	--	--	--	7.8	7.8	7.1	21	61	18	0	150	0
Finished water	--	--	--	--	--	--	--	--	--	--	--	--

[a] Sum of determined constituents.

VANCOUVER
(Population, 41,664)

Ownership: Municipal; supplies also about 6,800 people outside the city limits. Total population supplied, about 48,500.
Source: 14 wells (72 percent of supply) and springs (28 percent of supply). The range in depth and reported yield of 5 wells (1, 3, 4, 5, and 6) represent about average conditions for the 14 wells. The depth and the yield of the 5 wells are as follows: well 1, 132 ft and 1,000 gpm; well 3, 128 ft and 1,000 gpm; well 4, 243 ft and 2,000 gpm; well 5, 240 ft and 1,200 gpm; well 6, 278 ft and 2,000 gpm.
Treatment: Chlorination.
Raw-water storage: --
Finished-water storage: 5,728,000 gal.

The analysis given is representative of the water furnished to the consumers.

ANALYSIS

(Analysis, in parts per million, by Charlton Laboratories, Portland, Oreg.)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	44	Hardness as $CaCO_3$:	
Iron (Fe)	.3	Total	55
Manganese (Mn)	.0	Noncarbonate	0
Calcium (Ca)	14		
Magnesium (Mg)	4.8	Color	--
Sodium (Na)	4.4	pH	6.9
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	--		
Bicarbonate (HCO_3)	73	Turbidity	--
Sulfate (SO_4)	5.7	Temperature (F.)	--
Chloride (Cl)	3.2	Date of analysis	Apr. 18, 1949
Fluoride (F)	.0		
Nitrate (NO_3)	--		
Dissolved solids	129		

WALLA WALLA
(Population, 24,102)

Ownership: Municipal; supplies also about 1,500 people outside the city limits. Total population supplied, about 25,600.
Source: Mill Creek (84 percent of supply); auxiliary supply from 3 wells (1 to 3), 810, 808, and 1,169 ft deep. The yield of the wells is reported to be 1,500, 1,200, and 2,000 gpm. The wells are pumped only during the summer months and furnish 16 percent of the annual supply.
Treatment: Chlorination of water from Mill Creek; well supply not treated.
Raw-water storage: 15,000,000 gal.
Finished-water storage: --

WALLA WALLA--Continued

ANALYSIS

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

	Finished water		Finished water
Silica (SiO_2)	39	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	38
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	9.4		
Magnesium (Mg)	3.6	Color	5
Sodium (Na)	4.2	pH	7.6
Potassium (K)	2.6	Specific conductance (micromhos at 25 C.)	102
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	60	Temperature (F.)	61
Sulfate (SO_4)	1.8	Date of collection	June 6, 1951
Chloride (Cl)	1.0		
Fluoride (F)	.2		
Nitrate (NO_3)	.2		
Dissolved solids	89		

WENATCHEE

(Population, 13,072)

Ownership: Municipal; supplies also about 2,000 people outside the city limits. Total population supplied, about 15,100.

Source: Columbia River.

Treatment: Sedimentation, coagulation with alum, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 14,000,000 gpd.

Raw-water storage: None.

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

ANALYSIS

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

	Columbia River (raw water)		Columbia River (raw water)
Silica (SiO_2)	9.6	Hardness as $CaCO_3$:	
Iron (Fe)	--	Total	65
Manganese (Mn)	--	Noncarbonate	6
Calcium (Ca)	20		
Magnesium (Mg)	3.6	Color	--
Sodium (Na) + Potassium (K)	8.6	pH	--
Carbonate (CO_3)	0	Specific conductance (micromhos at 25 C.)	143
Bicarbonate (HCO_3)	72	Turbidity	--
Sulfate (SO_4)	21	Temperature (F.)	53
Chloride (Cl)	1	Date of collection	May 12, 1949
Fluoride (F)	.2		
Nitrate (NO_3)	.6		
Dissolved solids	[a] 100		

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	45	51	39	7.7	8.1	7.3	45	60	30	2.3	3.5	1.0
Finished water	45	50	41	7.5	7.8	7.3	46	60	32	.2	.5	0

[a] Sum of determined constituents.

YAKIMA
(Population, 38,486)

Ownership: Municipal; supplies also about 3,800 people outside the city limits. Total population supplied, about 42,300.
Source: Naches River; emergency supply from 2 wells (1 and 2) 250 and 65 ft deep. (No well water was used during 1950.)
Treatment: Plain sedimentation, filtration through natural sand and gravel beds, and chlorination.
Rated capacity of treatment plant: --
Raw-water storage: --
Finished-water storage: 24,000,000 gal.

ANALYSIS

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

	Finished water[a]		Finished water[a]
Silica (SiO_2)	17	Hardness as $CaCO_3$:	
Iron (Fe)	.11	Total	21
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	6.1		
Magnesium (Mg)	1.4	Color	10
Sodium (Na)	3.0	pH	7.1
Potassium (K)	1.0	Specific conductance (micromhos at 25 C.)	57
Carbonate (CO_2)	0		
Bicarbonate (HCO_3)	30	Turbidity	--
Sulfate (SO_4)	2.5	Temperature (F.)	64
Chloride (Cl)	1.7	Date of collection	June 7, 1951
Fluoride (F)	.1		
Nitrate (NO_3)	.1		
Dissolved solids	50		

[a] Naches River.

CASPER, WYOMING
(Population, 23,673)

Ownership: Municipal; also supplies about 1,000 people outside the city limits. Total population supplied, about 24,700.
Source: Infiltration 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	Oct. 27, 1951
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.

CHEYENNE--Continued

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	0.9	2
Temperature (F.)	44	53	56
Date of collection	Oct. 22, 1951	Oct. 22, 1951	Oct. 22, 1951

CODY

(Population, 3,872)

Ownership: Municipal; also supplies about 400 people outside the city limits. Total population supplied, about 4,270.

Source: South Fork Shoshone River via Cody Canal, for regular supply. Water from Beckley Reservoir is used in extreme emergencies. The water is diverted into the Cody Canal 1 mile upstream from the Buffalo Bill Reservoir, and 9 miles southwest of the city.

Treatment: Coagulation with alum, sedimentation, chlorination, and filtration for regular supply. Slow sand filtration for auxiliary or emergency supply.

Rated capacity of treatment plant: 5,000,000 gpd.

Raw-water storage: City Reservoir 163,000,000 gal; Markham Reservoir, 49,200,000 gal. Auxiliary supply is stored in Beckley Reservoir, capacity not known.

Finished-water storage: 2,000,000 gal.

CODY--Continued

ANALYSES

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

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	15	14	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.02	Total	126	126
Manganese (Mn)	.08	.04	Noncarbonate	14	14
Calcium (Ca)	31	30			
Magnesium (Mg)	12	12	Color	4	4
Sodium (Na)	58	56	pH	8.5	8.4
Potassium (K)	1.4	1.4	Specific conductance (micromhos at 25 C.)	505	499
Carbonate (CO_3)	6	0			
Bicarbonate (HCO_3)	124	136	Turbidity	5	3
Sulfate (SO_4)	135	130	Temperature (F.)	--	--
Chloride (Cl)	3.5	4.5	Date of collection	Nov. 6, 1951	Nov. 6, 1951
Fluoride (F)	.3	.3			
Nitrate (NO_3)	.7	.3			
Dissolved solids	327	332			

EVANSTON
(Population, 3,863)

Ownership: Municipal; supplies also about 600 people at the Wyoming State Hospital. Total population supplied, about 4,500.

Source: Bear River. During the summer months 3 wells (1 to 3), 186, 65, and 76 ft deep, are pumped as needed. The yield of the wells is reported to be 710, 610, and 472 gpm.

Treatment: Chlorination.

Raw-water storage: None.

Finished-water storage: Reservoirs, 2,000,000 gal.

The intake on Bear River is 9 miles upstream from Evanston, and the pipeline capacity is 2.5 mgd. For about two months during the summer the maximum demand is about 3.5 mgd, and the additional water needed is pumped from the wells directly into the distribution system.

ANALYSES

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

	Finished water[a] (city tap)	Well 1[b]	Well 2[b]
Silica (SiO_2)	9.0	--	--
Iron (Fe)	.04	--	--
Manganese (Mn)	.00	--	--
Calcium (Ca)	48	--	--
Magnesium (Mg)	13	--	--
Sodium (Na)	3.0	--	--
Potassium (K)	2.1	--	--
Carbonate (CO_3)	0	--	--
Bicarbonate (HCO_3)	208	--	--
Sulfate (SO_4)	6.5	--	--
Chloride (Cl)	2.8	27	21
Fluoride (F)	.1	--	--
Nitrate (NO_3)	.5	5.3	14
Dissolved solids	188	315	380
Hardness as $CaCO_3$:			
Total	173	210	240
Noncarbonate	0	--	--

[a] Bear River. [b] Analysis by state chemist, Laramie, Wyoming.

EVANSTON, Analyses--Continued

	Finished water[a] (city tap)	Well 1[b]	Well 2[b]
Color	7	--	--
pH	8.0	--	--
Specific conductance (micromhos at 25 C.)	324	--	--
Turbidity	--	--	--
Temperature (F.)	42	--	--
Date of collection	Mar. 14, 1951	Apr. 25, 1938	Nov. 6, 1939

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	130	171	89	--	--	--	149	197	105	--	--	--
Finished water	--	--	--	--	--	--	--	--	--	--	--	--

[a] Bear River.
[b] Analysis by state chemist, Laramie, Wyoming.

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.

LARAMIE--Continued

ANALYSES

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

	Pope well 3 (raw water)	City Springs (raw water)	Finished water (composite)[a]
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	0.9	0.8
Temperature (F.)	46	46	49
Date of collection	Oct. 21, 1951	Oct. 22, 1951	Oct. 22, 1951
Depth (feet)	158	--	--
Diameter (inches)	15	--	--
Date drilled	1939	--	--
Percent of supply	--	--	--

[a] 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.

RAWLINS--Continued

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	Oct. 23, 1951
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	Turbidity	1	--
Bicarbonate (HCO_3)	192	191	Temperature (F.)	56	55
Sulfate (SO_4)	161	125	Date of collection	Oct. 27, 1951	Oct. 22, 1948
Chloride (Cl)	13	9.9			
Fluoride (F)	.4	.4			
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 Railroad 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	Mar. 13, 1951
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	Nov. 7, 1951	Nov. 7, 1951
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	Nov. 5, 1951	Nov. 5, 1951	Nov. 5, 1951

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