TEXAS WATER DEVELOPMENT BOARD

REPORT 71

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE COLORADO RIVER BASIN, TEXAS

By

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Prepared by the U.S. Geological Survey
in cooperation with the
Texas Water Development Board

March 1968

Published and distributed
by the
Texas Water Development Board
Post Office Box 12386
Austin, Texas 78711

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RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE COLORADO RIVER BASIN, TEXAS

ABSTRACT

The natural runoff in most of the Colorado River basin is of good chemical quality and is suitable for most municipal, industrial, and agricultural purposes.

The kinds and quantities of minerals dissolved in surface water of the basin are related to the geology of the area and to rainfall and streamflow characteristics, but the quality of the water in the Colorado River below Lake J. B. Thomas is influenced also by oil-field brines.

Most of the tributary streams yield surface water averaging less than 250 ppm (parts per million) in dissolved-solids content, but the saline inflow in the upper basin keeps the average concentration in the main stem above 250 ppm throughout its length. The discharge weighted-average concentrations of the Colorado River near San Saba and at Wharton for the period 1958-65 are 295 ppm and 255 ppm, respectively.

Surface water of the basin generally ranges from moderately hard (61 to 120 ppm) to very hard (over 180 ppm). From Lake J. B. Thomas to the mouth of Pecan Bayou, the Colorado River and most of its tributaries contain very hard water. Downstream from Pecan Bayou the water of the basin is hard.

The chloride concentration in surface water of the basin ranges from less than 50 ppm to several thousand ppm. In the upper basin where brines are reaching the streams, chloride concentrations of several thousand ppm are common. Most of the remainder of the basin yields water averaging less than 50 ppm, but the saline inflow in the upper basin keeps the average concentration in the main stem above 50 ppm all the way to Austin. Higher concentrations are found in the South Concho River and in the headwater reaches of Pecan Bayou probably because of oil-field operations.

All the major water-supply reservoirs contain water of acceptable quality for most uses. The quality of the water that will be stored in Robert Lee Reservoir will depend on the success of the upstream salt-water alleviation program. Water available for storage at potential reservoir sites is of good quality; the dissolved-solids concentration is usually less than 350 ppm.

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE COLORADO RIVER BASIN, TEXAS

INTRODUCTION

The investigation of the chemical quality of the surface waters of the Colorado River basin, Texas, is part of a statewide reconnaissance. Each major river basin in the State is being studied, and reports presenting the results of the studies and summaries of available chemical-quality data are being prepared. River basins on which reports have been completed and the area covered by this report are shown in Figure 1.

The purpose of this report is to present the available information on the water quality of the Colorado River basin that will further the proper development, control, and use of the water resources of the area. In the study, the following items were considered: the nature and amounts of mineral constituents in solution; the geologic, hydrologic, and cultural influences that determine the water quality; the amount and probable source of the salt discharged by the streams; and the suitability of the water for domestic supply, industrial use, and irrigation.

A network of daily chemical-quality stations on principal streams in Texas is operated by the U.S. Geological Survey in cooperation with the Texas Water Development Board and with other Federal and local agencies. This network has been inadequate to inventory completely the chemical quality of the surface waters of the State. To supplement the information being obtained by the network, a cooperative statewide reconnaissance by the U.S. Geological Survey and the Texas Water Development Board was begun in September 1961. In this study, samples for chemical analyses were collected periodically at numerous sites throughout Texas so that some quality-of-water information would be available where water-development projects are likely to be built. These data aid in the delineation of areas having water-quality problems and in the identification of probable sources of pollution, thus indicating areas where more detailed investigations are needed.

During the period September 1961 to September 1965, water-quality data were collected for the principal streams, the major reservoirs, a number of potential reservoir sites, and many tributaries in the Colorado River basin.

Agencies that have cooperated in the collection of chemical-quality and streamflow data include the U.S. Army Corps of Engineers, the Brown County Water Improvement District No. 1, the Colorado River Municipal Water District, the Lower Colorado River Authority, the Texas Electric Service Company, the Texas State Department of Health, and the cities of Austin, Brady, and San Angelo.

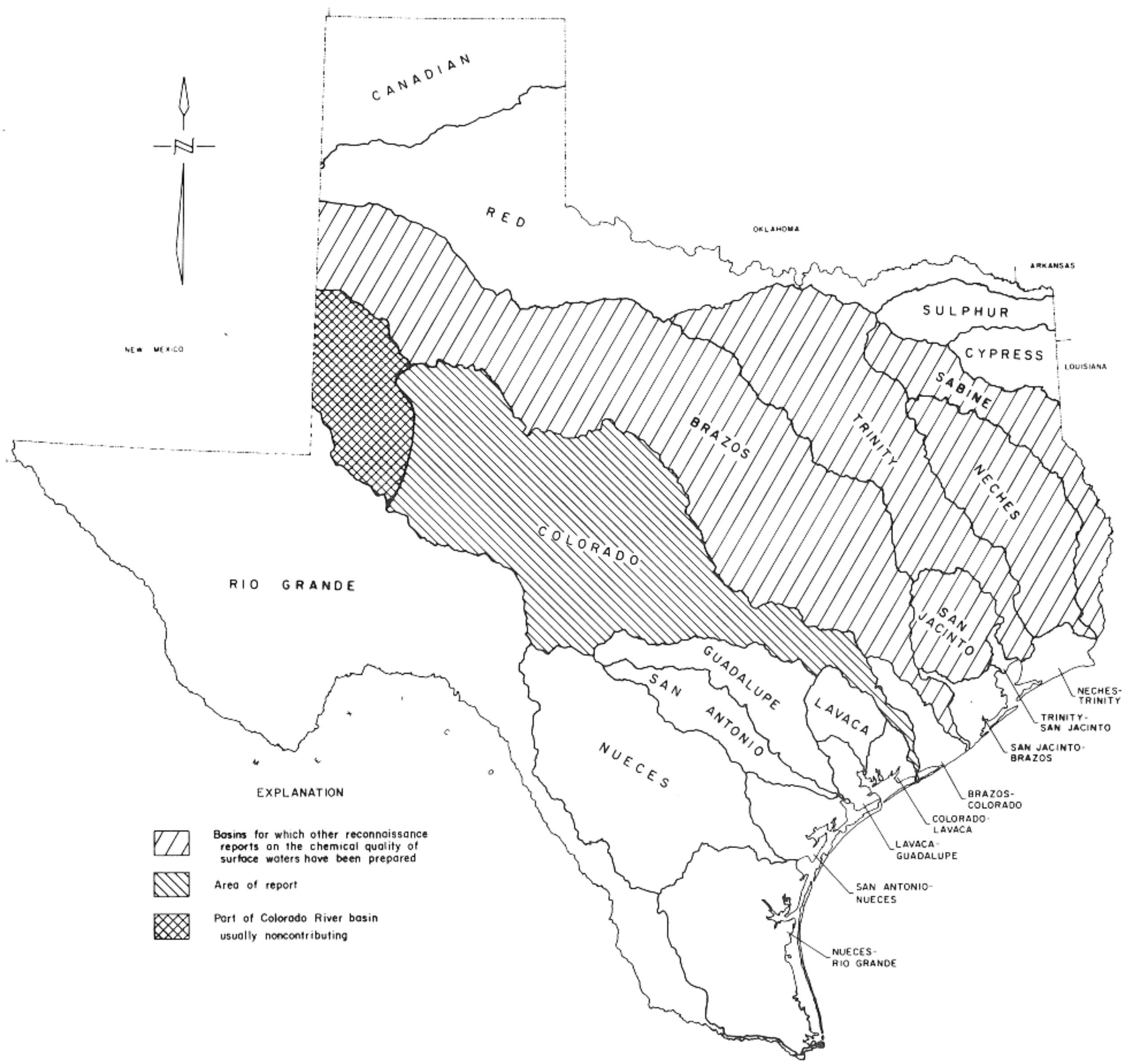

Figure I

Index Map of Texas Showing River Basins and Coastal Areas

U. S. Geological Survey in cooperation with the Texas Water Development Board

COLORADO RIVER DRAINAGE BASIN

General Description

As measured by length and drainage area, the Colorado is the largest river that is wholly in Texas. The basin extends into eastern New Mexico, but the part of the basin there does not contribute to the river flow. The Colorado River rises in north-central Dawson County near Lamesa, on the southern High Plains, and flows southeastward to Matagorda Bay, on the middle Gulf Coast. The Texas part of the basin, which includes all or part of 50 counties, is about 500 miles long and varies in width from 7 miles in southern Colorado County to 160 miles in the Brown-McCulloch County area. The average width is about 80 miles. The area of the basin in Texas is 39,890 square miles, or 15.2 percent of the area of Texas.

The elevation at the point of origin of the Colorado River is about 3,000 feet above mean sea level. The river flows through a rolling, generally prairie terrain to the vicinity of San Saba County where it enters the rugged Hill Country of Central Texas. It then flows through a series of canyons, crosses the Balcones Escarpment at Austin, and continues across the Coastal Plain to the Gulf.

The principal tributaries, in downstream order, are: The Concho River, Pecan Bayou, and the San Saba, Llano, and Pedernales Rivers. All except Pecan Bayou are spring-fed, perennial streams that begin in the Edwards Plateau.

The average annual precipitation ranges from a minimum of 13 inches in the upper part of the drainage area to a maximum of 43 inches at the mouth of the river. The average for the basin in Texas is 28 inches. Average monthly precipitation at three U.S. Weather Bureau stations and annual precipitation for the period 1931-65 at one station are shown in Figure 2.

Runoff is defined as that part of the precipitation appearing in surface streams, and is the same as streamflow unaffected by artificial storage or diversion (Langbein and Iseri, 1960, p. 17). Temperature, seasonal distribution of rainfall, storm intensity, infiltration rates, and types and density of vegetation affect the amount of runoff from a drainage basin.

The average annual runoff in the Colorado River basin ranges from a maximum of 6.6 inches (350 acre-feet per square mile) near the mouth of the river to less than 1.0 inch (53 acre-feet per square mile) west of an approximate north-south line through San Angelo. The runoff decreases more or less uniformly from east to west along with the decrease in rainfall. The runoff varies widely from year to year and between periods of wet and dry years.

Annual runoff, expressed as mean discharge in cubic feet per second and as inches per year, is shown in Figure 2 for the gaging station Colorado River at Columbus for the period 1940-65. The contributing drainage area at the station is 29,170 square miles. Runoff ranged from 0.44 to 3.86 inches per year and averaged 1.37 inches during the 26-year period of record.

Population and Municipalities

The population of the Colorado River basin in 1965 was about 850,000, which was about 8 percent of the total population of the State. Less than one-fourth of the people in the basin live on farms. Austin is the largest city in the basin, with a 1965 population of about 240,000. San Angelo, Midland, and Odessa are other cities that have more than 50,000 inhabitants. Twelve other cities had 1965 populations of more than 5,000.

Agricultural and Industrial Development

The basin's economic base is oil production and agriculture. The western part of the basin has a heavy concentration of oil fields and petrochemical industries. Ranching and farming throughout the basin support a wool industry, cottonseed oil plants, cattle marketing operations, textile plants, creameries, and other industries. Miscellaneous light manufacturing includes aircraft and boat fabrication. The chief crops are cotton, wheat, grain sorghum, vegetables, and sugar beets. State and Federal offices, The University of Texas, tourism, and recreation on the Highland Lakes contribute substantially to the Austin area's economy.

Development of Surface-Water Resources

The Colorado River basin contributes about 6 percent of the State's total runoff (Figure 3). Runoff increases from west to east with the increase in rainfall, and the quantity of surface water available for development differs widely between the upper and lower ends of the basin. In the High Plains the only surface water available is the small quantity periodically salvageable from playas.

The Texas Water Development Board reported that 1,258,000 acre-feet of water was used in the Colorado River basin in 1960. Of this amount only 173,300 acre-feet was from surface-water sources. Municipal and industrial use of surface water was 83,400 acre-feet. Surface water supplements ground-water supplies for some cities and provides the total supply for others. Cities using surface water impounded in the Colorado River basin include Colorado City, Big Spring, Odessa, Snyder, Sweetwater, San Angelo, Brady, Coleman, Brownwood, and Austin.

In 1964, 89,900 acre-feet of surface water was used for irrigation. In the middle part of the basin about 40,000 acre-feet of surface water was diverted from the Colorado and its tributaries to irrigate cotton, peanuts, pastures, hay, and feed crops. In the coastal rice area 40,000 acre-feet of surface water was diverted for irrigation.

The Colorado River basin has 21 major reservoirs existing or under construction as of December 31, 1966, with capacities ranging from 8,640 to 1,950,000 acre-feet. Table 1 lists these reservoirs and gives their capacities and uses. Several of the reservoirs in the upper part of the basin were built by cities or by water districts to supply water for local municipal and industrial use. Twin Buttes Reservoir was constructed by the U.S. Bureau of Reclamation for flood control, conservation storage, recreation, and irrigation. San Angelo Reservoir was constructed by the U.S. Army Corps of Engineers

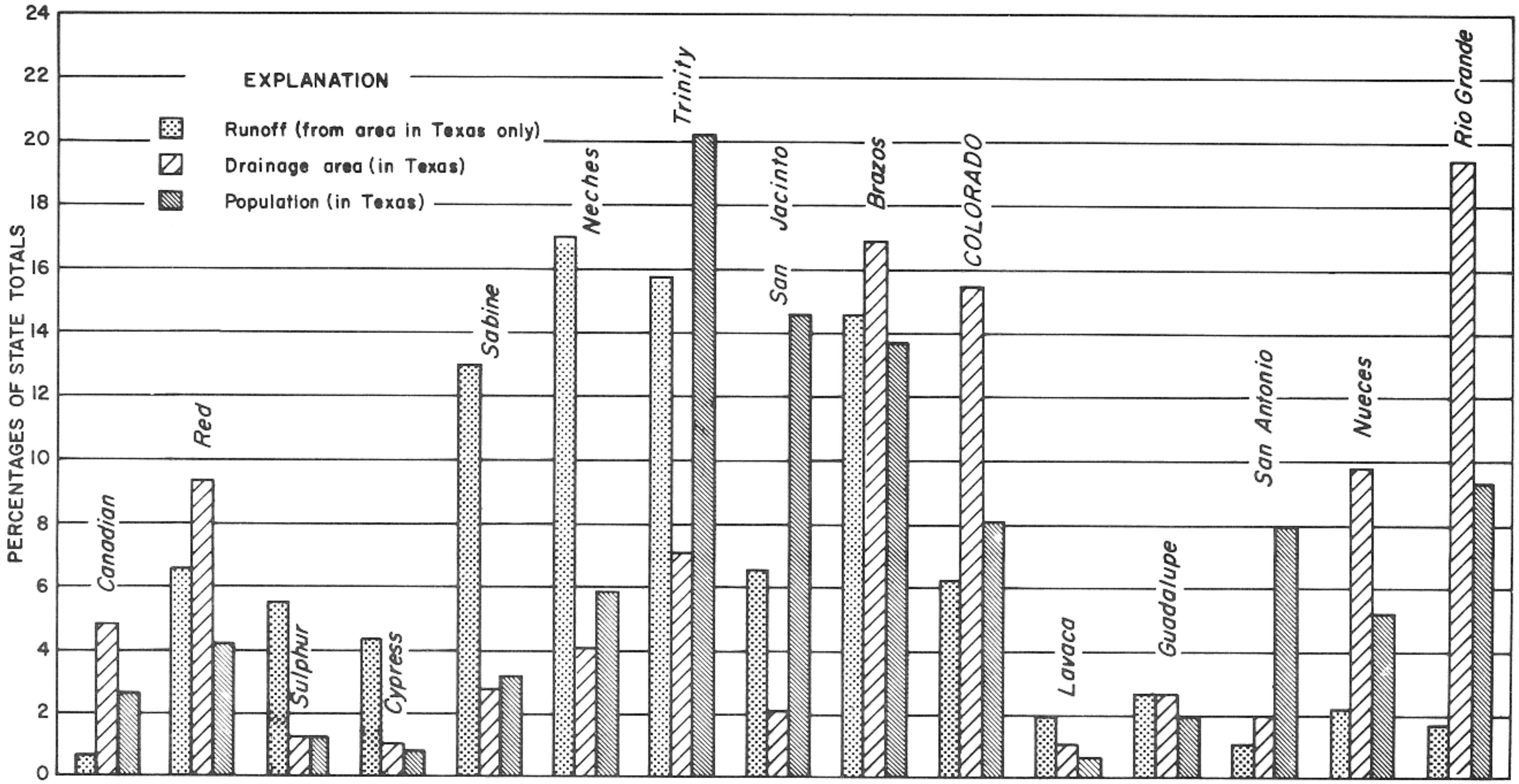

Figure 3

Graph Showing Average Annual Runoff, Drainage Area, and 1960 Population of Major River Basins in Texas, as Percentages of State Totals

Adjacent coastal areas have been included in basin totals.

(Data from Texas Water Development Board)

U. S. Geological Survey in cooperation with the Texas Water Development Board

Table 1.--Reservoirs with capacities of 5,000 acre-feet or more in the Colorado River basin

The purpose for which the impounded water is used is indicated by the following symbols: M, municipal; I, industrial; Ir, irrigation; Mi, mining; R, recreation; P, hydroelectric power; FC, flood control.

Reservoir	Year operation began	Stream	a/ Total storage capacity (acre-feet)	Owner	County	Use
Lake J. B. Thomas	1952	Colorado River	203,600	Colorado River Municipal Water District	Borden, Scurry	M, I, R
Lake Colorado City	1949	Morgan Creek	31,600	Texas Electric Service Company	Mitchell	M, I
Champion Creek	1959	Champion Creek	42,500	do	do	M, I
Robert Lee	*	Colorado River	520,000	Colorado River Municipal Water District	Coke	M, I
Oak Creek	1952	Oak Creek	39,360	City of Sweetwater	do	M, I
Twin Buttes	1962	Middle and South Concho Rivers	640,600	U.S. Government	Tom Green	M, I, Ir, R, FC
Lake Nasworthy	1948	South Concho River	12,390	City of San Angelo	do	M, I, Ir, R
San Angelo	1952	North Concho River	396,400	U.S. Government	do	M, I, Ir, R, FC
Hords Creek	1948	Hords Creek	8,640	do	Coleman	M, I, FC
Coleman	1966	Jim Ned Creek	40,000	do	do	M, I
Brownwood	1933	Pecan Bayou	143,400	Brown County Water Improvement District No. 1	Brown	M, I, Ir
Brady Creek	1963	Brady Creek	30,430	City of Brady	McCulloch	M, I
Lake Buchanan	1938	Colorado River	992,000	Lower Colorado River Authority	Llano, Burnet	M, I, Ir, P, R
Inks Lake	1938	do	17,500	do	do	P, R
Lake Lyndon B. Johnson	1951	do	145,200	do	do	P, R
Marble Falls Lake	1951	do	8,760	do	do	P, R
Lake Travis	1942	do	1,950,000	do	Travis	M, I, Ir, R, P, FC
Lake Austin	1939	do	21,000	do	do	M, R, P
Decker Lake	*	Decker Creek	33,940	City of Austin	do	I, R
Lake Bastrop	1964	Spicer Creek	16,590	Lower Colorado River Authority	Bastrop	Ir
Eagle Lake	1900	Colorado River (off channel)	9,600	Lakeside Irrigation Company	Colorado	Ir

* Under construction as of December 31, 1966.
a/ Total capacity is that capacity below the lowest uncontrolled outlet or spillway (in some cases top of gates) and is based on the most recent reservoir survey available.

primarily for flood control and municipal supply. The six Lower Colorado River Authority lakes--Buchanan, Inks, Lyndon B. Johnson, Marble Falls, Travis, and Austin--are operated as a unit for generating hydroelectric power. Buchanan provides conservation storage, and Travis provides both conservation storage and flood control. Lake Bastrop, owned by the Lower Colorado River Authority, provides cooling water for a steam-electric generating plant.

Projects under construction in the Colorado River basin include Robert Lee Reservoir for additional municipal and industrial supply for the cities of Big Spring, Odessa, Snyder, and Midland; and Decker Lake to provide cooling water for a new steam-electric generating plant near Austin.

Figure 4 shows locations of the existing reservoirs, the two reservoirs under construction, and a number of potential dam sites which have been considered by various agencies.

The Soil Conservation Service of the U.S. Department of Agriculture was authorized by the Flood Control Act of 1936 to investigate and prescribe measures for runoff and water-flow retardation and soil-erosion prevention. As of September 30, 1966, 207 upstream floodwater-retarding structures had been built under this program in the Colorado River basin. These structures partly control flow from 1,180 square miles. Nineteen of the reservoirs are in the Cummings Creek subbasin in Fayette and Lee Counties in the lower part of the basin. The remaining 188 structures are in Callahan, Coke, Runnels, Menard, Schleicher, McCulloch, Coleman, and Brown Counties in the northwestern and north-central part of the basin.

CHEMICAL QUALITY OF THE WATER

Chemical-Quality Records

The U.S. Geological Survey has been collecting quality-of-water data in the Colorado River basin since 1944 when a daily-sampling station was established on the Colorado River at Wharton. Currently (1966), eleven daily-sampling stations are in operation. In addition to collecting daily samples for chemical analyses, the Geological Survey has operated a continuously recording conductivity meter on the Colorado River near Cuthbert since March 1965.

Collection of chemical-quality data for this reconnaissance began in 1961 and continued through September 1965. Samples were collected periodically from most of the principal tributary streams and reservoirs. Numerous miscellaneous samples have been collected by the Geological Survey since 1941, and the results of the analyses of these samples have been included in this report. Most of the sampling for this study was done at gaging stations. When sampling was done at other sites, discharge measurements were usually made when the samples were collected.

The periods of record of all data-collection sites are shown on Table 4 and the locations are shown on Figure 10. The chemical-quality data for the daily stations are summarized in Table 5, and the complete records are published in an annual series of U.S. Geological Survey Water-Supply Papers and in reports of the Texas Water Development Board. (See table in the list of references.) Results of all the periodic and miscellaneous analyses are given in Table 6.

The Texas State Department of Health makes available to the U.S. Geological Survey the data collected in its statewide stream-sampling program, which includes the periodic determination of pH, biochemical oxygen demand, total solids, dissolved oxygen, chloride, chlorine demand, and sulfate at 26 locations in the Colorado River basin. The data-collection sites of the Texas State Department of Health are listed in the following table. Most of them are at Geological Survey gaging stations and the numbers refer to locations on Figure 10.

Location No.	State Department of Health data-collection site
9	Colorado River at Colorado City
--	Beals Creek at FR 821 near Big Spring
25	Colorado River at Robert Lee
30	Colorado River at Ballinger
36	South Concho River at Christoval
38	Middle Concho River near Tankersley
53	North Concho River near Carlsbad
58	Concho River near San Angelo
59	Concho River near Paint Rock
62	Colorado River at Winchell
80	Pecan Bayou at Brownwood
84	San Saba River at Menard
89	San Saba River at San Saba
91	Colorado River near San Saba
--	Colorado River near San Saba
96	Llano River near Junction
99	Llano River at Llano
103	Pedernales River near Johnson City
--	Colorado River below Mansfield Dam
114	Colorado River at Austin
122	Colorado River at Bastrop

(Continued on next page)

Location No.	State Department of Health data-collection site
125	Colorado River at Smithville
130	Colorado River at Columbus
133	Colorado River at Wharton
134	Colorado River near Bay City
--	Colorado River at Matagorda above Intracoastal Canal

Streamflow Records

Streamflow records in the Colorado River basin date from 1894, when the U.S. Geological Survey began collecting gage-height records of the Colorado River at the dam above Austin. The daily flow of the Colorado River at Austin has been measured continuously since 1898. More than 40 years of continuous discharge records are available for several stations on the main stem of the Colorado River, and records for more than 20 years are available for many of the principal tributaries. In 1966 the Geological Survey operated 57 streamflow stations, 12 reservoir-content stations, 13 low-flow partial-record stations, and 19 crest-stage partial-record stations. During this reconnaissance, discharge measurements were made at other sites where water samples were collected for chemical analysis.

The periods of record for all the streamflow stations are given in Table 4 and the locations are shown on Figure 10. Records of discharge and stage of streams and contents and stages of lakes or reservoirs from 1898 to 1960 have been published in the annual series of U.S. Geological Survey Water-Supply Papers. (See table in the list of references.) Beginning with the 1961 water year, streamflow records have been released by the Geological Survey in annual state reports (U.S. Geological Survey, 1961, 1962, 1963, 1964b, 1965, 1966). Summaries of discharge records giving monthly and annual totals have been published (Texas Board of Water Engineers, 1958; U.S. Geological Survey, 1960, 1964a).

Environmental Factors and Their Effects on the Chemical Quality of the Water

Many environmental factors determine the chemical quality of a water, the most important of which are geology, patterns and characteristics of streamflow, and the activities of man.

Geology

When industrial and municipal influences are small, the chemical character of a river water is dependent primarily upon the composition of the geologic formations that are traversed and the time that the water is in contact with the rocks.

The amount of soluble minerals in rocks and soils is decreased by leaching. In arid or semiarid regions, most soils and the rocks from which they originated are incompletely leached and still contain large quantities of readily soluble material. Conversely, in areas of high rainfall, the mantle rock and residual soil contain relatively small amounts of readily soluble minerals. In the Colorado River basin, where the average annual precipitation varies from less than 13 inches in the northwestern part to over 42 inches near the coast, the amount of leaching varies geographically. Partly because of this, the dissolved-solids content of surface runoff and of ground-water inflow to streams is greatest in the western part of the basin and decreases toward the coast.

Figure 5 shows the geochemical character and ionic concentration of some surface waters in the Colorado River basin. The total ionic concentration in equivalents per million is equal to twice the length of either the vertical or horizontal axis. If the major part of the quadrilateral is in the lower left quarter, sulfate or chloride predominate among the anions, and sodium or potassium among the cations. If the major part is in the upper right quarter, calcium or magnesium, and carbonate or bicarbonate, are predominant.

Headwaters of the Colorado River rise primarily on the Dockum Group of Triassic age, which is composed of sand and shale. Water from this area, represented by the water stored in Lake J. B. Thomas, is generally dilute, of a mixed type, and has sodium and bicarbonate as its principal ions. Downstream from Lake J. B. Thomas, the Colorado River traverses sediments of Permian age composed of sand, shale, limestone, anhydrite, and salt. This is an area of saline inflow that degrades much of the water of the upper basin.

Inflow from small tributaries dilutes the water in the main stem by the time it reaches Ballinger, but sodium and chloride are still the predominant ions. Salinity is further decreased between the chemical-quality stations at Ballinger and near San Saba due to inflow from three major tributaries. Two of these, the Concho and San Saba Rivers, rise on Cretaceous rocks composed mainly of limestone, shale, sand, and silt. Runoff from these formations is generally of the calcium bicarbonate type and is dilute. Pecan Bayou primarily drains rocks of Pennsylvanian age, which are composed of marine sand, shale, and limestone. The water contributed by Pecan Bayou is of a mixed type and is low in dissolved solids. The inflow from these tributaries dilutes the main stem to a dissolved-solids content less than 300 ppm (parts per million); calcium and bicarbonate are the predominant ions.

Downstream from San Saba the tributaries that influence the chemical quality of the Colorado River are the Llano and Pedernales Rivers, which enter the main stem in the chain of Highland Lakes above Austin. Both of these streams drain a limestone terrain and contribute water saturated or nearly saturated with calcium and bicarbonate.

No major tributaries enter the Colorado River downstream from Austin, and most of the flow in the river is maintained by releases from the Highland Lakes. The quality of the water is uniform from Austin to the mouth. The water usually contains about 250 ppm of dissolved solids and is calcium bicarbonate in type.

Streamflow

The patterns and characteristics of streamflow usually affect the chemical character of water in streams. In most streams where the flow is not regulated by upstream reservoirs, the concentrations of dissolved-mineral constituents vary inversely with the flow of the stream. The base flow, or sustained low flow, of a stream is predominantly water that has entered the stream from the ground-water reservoir. Usually this water has been in contact with rocks and soils for a sufficient time to dissolve part of their soluble minerals. At high stages most of the flow of a stream consists of surface runoff that has been in contact with rocks and soils for only a short time. Therefore, the dissolved-solids concentration of the stream is usually lowest during periods of high flow. This relationship is applicable in the upper Colorado River basin, but in the central portion of the basin where streams drain a limestone terrain, dissolved-solids concentrations vary only slightly with changes in discharge. In the lower part of the basin, streamflow is sustained by releases from the Highland Lakes, and tributary inflow is not sufficient to affect greatly the quality of the main stem.

Although the dissolved-solids concentration of the upper Colorado River is related in a general way to water discharge, the dissolved-solids concentration of the water cannot be estimated from streamflow data. The first increased streamflow resulting from a particular rain is usually more saline than an equal discharge that occurs later. Tributary inflow may also contribute significantly to streamflow but not be dilute enough to affect the concentration of the flow in the main stem. Figure 6 is a plot of electrical conductance of the water and discharge of the Colorado River near Cuthbert. Conductance is a measure of the total concentration of ions in water and can be directly related to dissolved-solids content. The general inverse relation of discharge to concentration of dissolved solids is well shown in Figure 6A, which shows a short duration rise following a period of no flow. Figure 6B shows a short duration rise following a period of low flow. The initial decrease in conductance is caused by local runoff; the sharp increase in conductance while the discharge was still increasing is the flushing out effect of the runoff from upstream. Figure 6C is a plot of an extended runoff event. The flushing out effect is again obvious. Discharge varies considerably during this rise but the conductance remains fairly uniform after the first 24 hours.

Duration curves of dissolved solids and water discharge for the Colorado River near San Saba and Colorado River at Wharton are given in Figure 7. The dissolved solids duration curve is a cumulative frequency curve that shows the percent of time during which specified dissolved-solids concentrations were equaled or exceeded during a specified period. The flow-duration curve is a cumulative frequency curve that shows the percent of time that water discharge was equal to or less than a specified discharge. The curves, therefore, show the inverse relation of dissolved-solids concentration to water discharge. For example, the Colorado River near San Saba had a dissolved-solids concentration of more than 285 ppm and flowed at a rate of less than 640 cfs (cubic feet per second) 80 percent of the time, and had a dissolved-solids concentration of more than 750 ppm and a discharge of less than 18 cfs 5 percent of the time, during the period 1948-65.

Activities of Man

The activities of man often have a deteriorative effect on the chemical quality of water. Oil-field brine, municipal and industrial wastes, and irrigation return flows increase the concentration of dissolved materials in streams. Evaporation from reservoirs increases the dissolved-solids concentration of the remaining water.

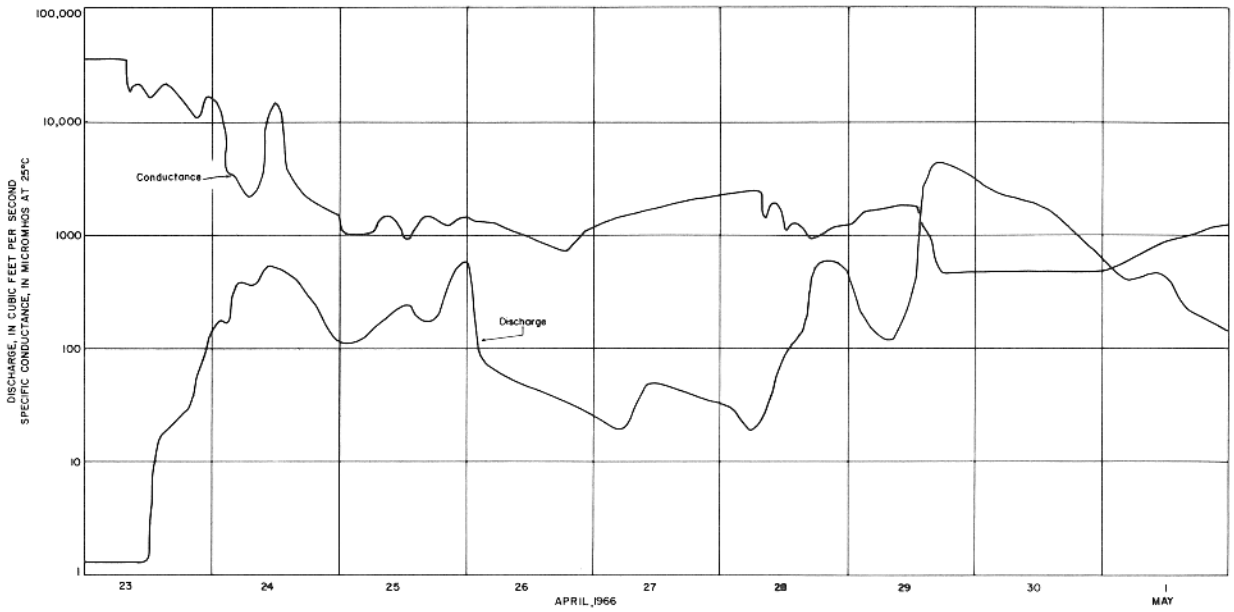

FIGURE 6 C

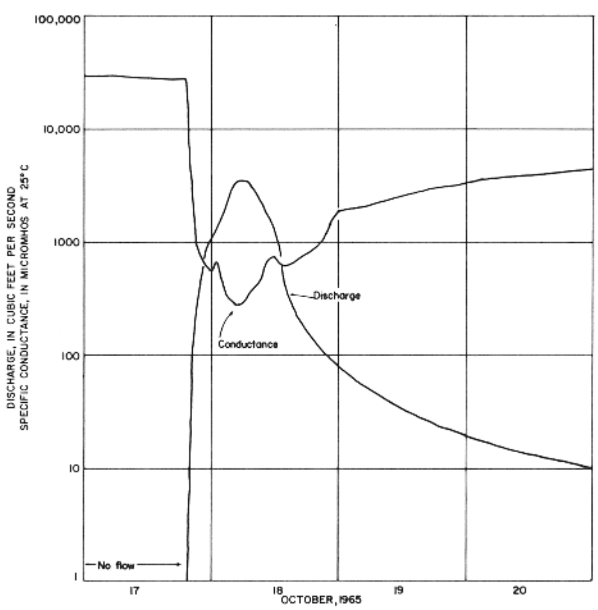

FIGURE 6 A

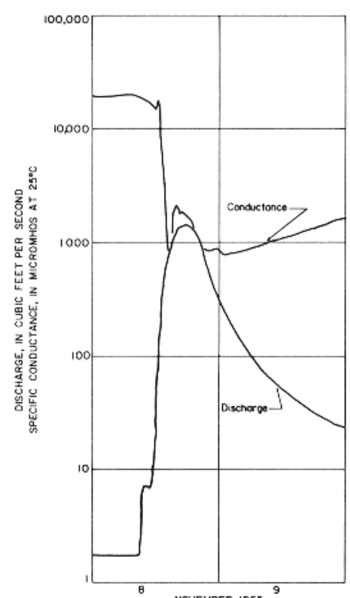

FIGURE 6 B

Figure 6

Specific Conductance - Discharge Hydrograph for Colorado River Near Cuthbert, October 17-21, November 8-9, 1965 and April 23-May 1, 1966

U. S. Geological Survey in cooperation with the Texas Water Development Board

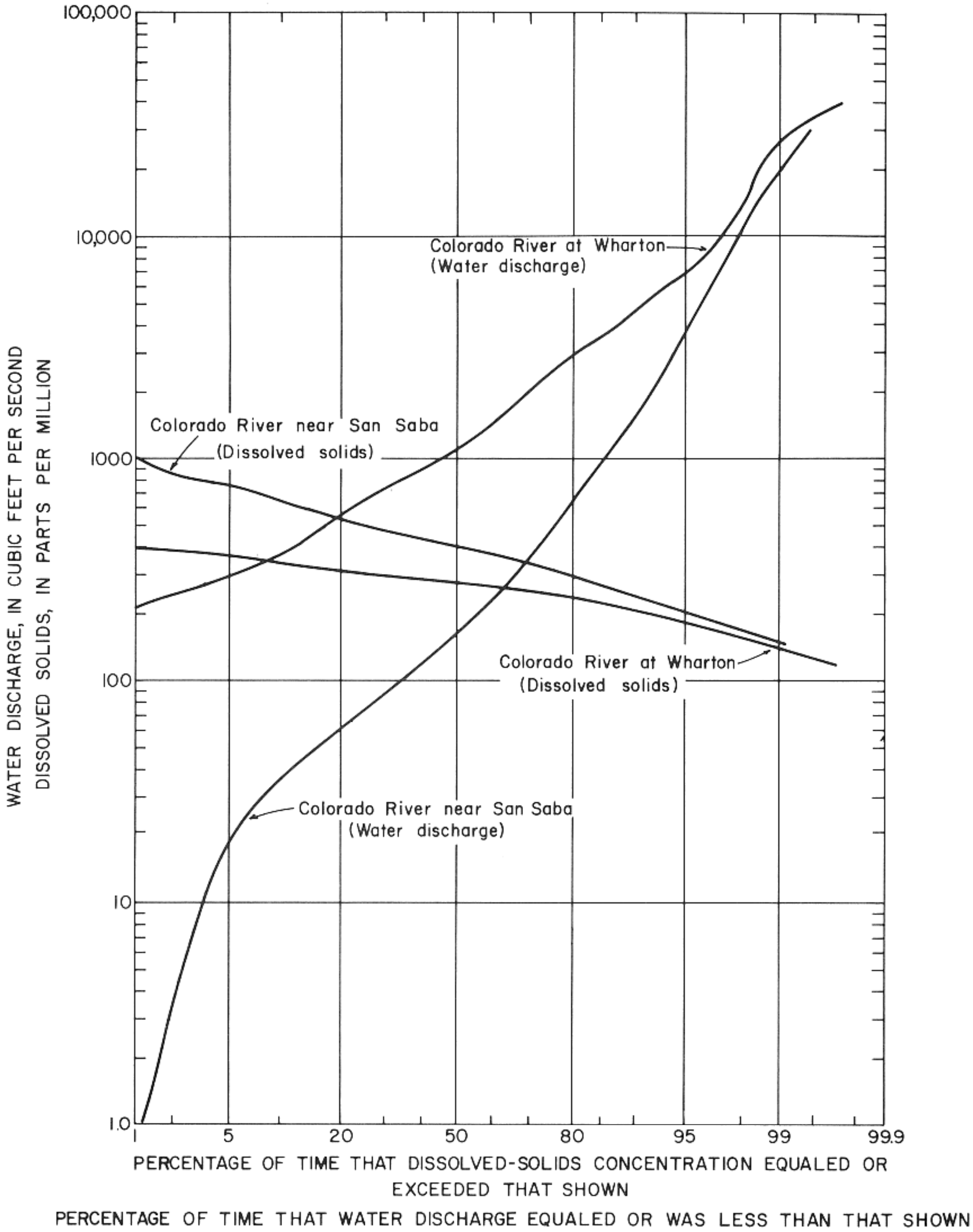

Figure 7

Duration Curves for Dissolved Solids and Water Discharge for Colorado River Near San Saba and Colorado River at Wharton, Water Years 1948-65

U. S. Geological Survey in cooperation with the Texas Water Development Board

Oil is produced in many areas in the Colorado River basin (Figure 8). Brine is produced in nearly all oil fields and it may, if improperly handled, eventually reach the streams. The composition of oil-field brine varies; but the principal chemical constituents in order of magnitude of their concentration (in ppm) are generally chloride, sodium, calcium, and sulfate. The quality of the water in the Colorado River and Beals Creek in Mitchell, Howard, and Scurry Counties is seriously affected by brines. Investigators in the past have disagreed as to the origin of the brine, but Reed (1961) in a consulting report to the Colorado River Municipal Water District presents convincing evidence that the brines entering the river are directly related to oil-field operations. The purpose of Reed's study was to determine the various sources of salt water present in the Colorado River principally in the area between Lake J. B. Thomas and Colorado City, a distance of about 24 river miles. The study was divided into three parts: first, a detailed study of the geology of the upper 1,000 feet of section with particular emphasis on the nature and structure of the surface beds which provide all the low flow of the Colorado River; second, a study of the ground water adjacent to the Colorado River and its tributaries, including chemical analyses and determinations of the altitude of the water table; and third, a study of U.S. Geological Survey quality and flow data of the Colorado River together with measurements of the thickness of underflow gravel in the river channel. As a result of his study, Reed concluded:

1. The probable maximum chloride ion concentration of the Colorado River prior to the development of the oil fields between the present site of Lake J. B. Thomas and Colorado City, Texas, was of the order of 300 to 500 parts per million during periods of maximum evaporation.

2. There is no known source of natural inflow of salt water to the river with chlorides significantly higher than 500 parts per million.

3. A great percentage of the total mineral content of brines produced with oil in the watershed of the Colorado River does eventually find its way into the Colorado River itself.

4. There are an unknown number of abandoned oil wells which were improperly plugged and which are now contributing salt water to the Colorado River and which must be controlled.

An indication of the magnitude of the man-made pollution problem is given by the tremendous volume of salt water produced with oil or gas in the area. The Texas Water Commission and Texas Water Pollution Control Board (1963) compiled an inventory conducted by the Railroad Commission of Texas which showed that approximately 222,400,000 barrels (28,680 acre-feet) of brine was produced in 1961 in the Colorado River basin in Texas. Of this amount, 63.2 percent or 140,650,000 barrels (18,130 acre-feet) was reinjected into the subsurface, with the remaining 10,550 acre-feet being placed in unlined surface pits or dumped directly into surface watercourses. Some of the salt water reinjected into the subsurface also contributed to the problem because of inadequately completed injection wells and improperly plugged abandoned wells and test holes.

Robert Lee Reservoir is being built (1966) on the Colorado River downstream from the area of saline inflow. The Colorado River Municipal Water District plans to divert the low flows of the river upstream from the reservoir, and impound only the storm runoff, thereby allowing only the better-quality water to enter the reservoir. Extensive cleanup measures in the oil fields will also be necessary to insure that the water impounded will be satisfactory for municipal use.

Oil-field brines are also causing some deterioration of water quality in the Concho River and Pecan Bayou subbasins.

Municipal use of water tends to increase the concentration of dissolved solids in a stream system. The depletion of flow by diversion and consumptive use, the loss of water because of increased evaporation, and the disposal of municipal wastes into a stream result in higher average concentrations of dissolved solids in the remaining water. The municipal use of water in the Colorado River basin has not caused significant changes in water quality, but the disposal of municipal and industrial wastes has degraded the quality of the water of the Colorado River immediately downstream from Austin.

The waste load carried by a stream can also have significant effects on the water impounded in downstream reservoirs. Connell (1964) was especially concerned about the increasing phosphate in Texas reservoirs and the potential phosphate loading of many of the projected reservoirs. He lists the principal source of phosphate as municipal and industrial waste water, but also says surface runoff may contribute significantly to the phosphate content of streams and reservoirs, from leaching and erosion of mineral phosphate from soil, decay of vegetation and animal wastes, and use of phosphate fertilizers and phosphorus-containing insecticides. Dr. Connell lists the following serious quality threats caused by phosphate loading of projected reservoirs:

> First, production of excessive biological activity and associated odors and tastes rendering the water difficult and expensive to purify for domestic use. Second, promotion of heavy algal bloom and subsequent oxygen-consuming decay of organic matter sufficient to kill fish and to render water undesirable for recreation activities. Third, production of sufficient organic matter--"slimy soupy growth"--to render water difficult and expensive to process, distribute and use for industrial purposes. Fourth, very objectionable calcium phosphate scaling in cooling and boiler water uses.

Algal blooms may be promoted by as small amounts as 0.05 to 0.1 ppm of inorganic phosphate, or 0.2 to 0.6 ppm of inorganic plus organic phosphate (phosphate expressed in equivalent PO_4). Other factors favoring development of algal bloom are presence of essential nutrients, quiescence, clear water, and abundant sunlight. These conditions will frequently be attained in many reservoirs.

Connell (1966) reports phosphate concentrations as high as 0.3 to 0.4 ppm in the Colorado River at Wharton and Bay City. He concludes that 90 percent of this total is attributable to the municipal and industrial waste water from the city of Austin. In reference to the proposed Columbus Bend Reservoir he makes the following statement.

The periodic production and deposition of organic matter through algal growth, and subsequent lifting and transport, have not been of sufficient proportions to produce seriously adverse effects on the current use of the water, i.e. for fishing, boating, and irrigation. But some curtailment of phosphate sources will probably be necessary for adequate protection of the quality of water in Columbus Bend Reservoir.

Relation of Quality of Water to Use

Quality-of-water studies are usually concerned with determining the suitability of water--judged by the chemical, physical, and biological characteristics--for its proposed use. In the Colorado River basin, surface water is used primarily for municipal and industrial supplies and for irrigation. This report considers only the chemical character of the water and its relationship to the principal uses.

All natural water contains dissolved-mineral matter. Most of this mineral matter in water is dissociated into charged particles, or ions. Principal cations (positive-charged ions) in natural water are calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), and iron (Fe). The principal anions (negative-charged ions) are carbonate (CO_3), bicarbonate (HCO_3), sulfate (SO_4), chloride (Cl), fluoride (F), and nitrate (NO_3). Other constituents and properties are often determined to help define the chemical and physical quality of water. Table 2 lists the constituents and properties commonly determined by the U.S. Geological Survey, and includes a résumé of their sources and significance.

Domestic Supply

Because of differences in individuals, varying amounts of water used, and other factors, the safe limits for mineral constituents in drinking water are difficult to define. The limits usually accepted in the United States are the drinking-water standards established by the United States Public Health Service. Originally established in 1914 to control the quality of water used on interstate carriers for drinking and culinary purposes, these standards have been revised several times. The latest revision was in 1962 (U.S. Public Health Service, 1962). These standards have been accepted by the American Water Works Association and by most of the state departments of public health as minimum standards for all public water supplies.

The maximum concentrations permitted by these standards are given for selected constituents in the table on page 28.

Table 2.--Source and significance of dissolved mineral constituents and properties of water

Constituent or property	Source or cause	Significance
Silica (SiO_2)	Dissolved from practically all rocks and soils, commonly less than 30 ppm. High concentrations, as much as 100 ppm, generally occur in highly alkaline waters.	Forms hard scale in pipes and boilers. Carried over in steam of high-pressure boilers to form deposits on blades of turbines. Inhibits deterioration of zeolite-type water softeners.
Iron (Fe)	Dissolved from practically all rocks and soils. May also be derived from iron pipes, pumps, and other equipment. More than 1 or 2 ppm of iron in surface waters generally indicate acid wastes from mine drainage or other sources.	On exposure to air, iron in ground water oxidizes to reddish-brown precipitate. More than about 0.3 ppm stain laundry and utensils reddish-brown. Objectionable for food processing, textile processing, beverages, ice manufacture, brewing, and other processes. U.S. Public Health Service (1962) drinking-water standards state that iron should not exceed 0.3 ppm. Larger quantities cause unpleasant taste and favor growth of iron bacteria.
Calcium (Ca) and Magnesium (Mg)	Dissolved from practically all soils and rocks, but especially from limestone, dolomite, and gypsum. Calcium and magnesium are found in large quantities in some brines. Magnesium is present in large quantities in sea water.	Cause most of the hardness and scale-forming properties of water; soap consuming (see hardness). Waters low in calcium and magnesium desired in electroplating, tanning, dyeing, and textile manufacturing.
Sodium (Na) and Potassium (K)	Dissolved from practically all rocks and soils. Found also in ancient brines, sea water, industrial brines, and sewage.	Large amounts, in combination with chloride, give a salty taste. Moderate quantities have little effect on the usefulness of water for most purposes. Sodium salts may cause foaming in steam boilers and a high sodium content may limit the use of water for irrigation.
Bicarbonate (HCO_3) and Carbonate (CO_3)	Action of carbon dioxide in water on carbonate rocks, such as limestone and dolomite.	Bicarbonate and carbonate produce alkalinity. Bicarbonates of calcium and magnesium decompose in steam boilers and hot-water facilities to form scale and release corrosive carbon dioxide gas. In combination with calcium and magnesium, cause carbonate hardness.
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Commonly present in mine waters and in some industrial wastes.	Sulfate in water containing calcium forms hard scale in steam boilers. In large amounts, sulfate in combination with other ions gives bitter taste to water. Some calcium sulfate is considered beneficial in the brewing process. U.S. Public Health Service (1962) drinking-water standards recommend that the sulfate content should not exceed 250 ppm.
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and found in large amounts in ancient brines, sea water, and industrial brines.	In large amounts in combination with sodium, gives salty taste to drinking water. In large quantities, increases the corrosiveness of water. U.S. Public Health Service (1962) drinking-water standards recommend that the chloride content should not exceed 250 ppm.
Fluoride (F)	Dissolved in small to minute quantities from most rocks and soils. Added to many waters by fluoridation of municipal supplies.	Fluoride in drinking water reduces the incidence of tooth decay when the water is consumed during the period of enamel calcification. However, it may cause mottling of the teeth, depending on the concentration of fluoride, the age of the child, amount of drinking water consumed, and susceptibility of the individual. (Maier, F. J., 1950.)
Nitrate (NO_3)	Decaying organic matter, sewage, fertilizers, and nitrates in soil.	Concentration much greater than the local average may suggest pollution, U.S. Public Health Service (1962) drinking-water standards suggest a limit of 45 ppm. Waters of high nitrate content have been reported to be the cause of methemoglobinemia (an often fatal disease in infants) and therefore should not be used in infant feeding. Nitrate has been shown to be helpful in reducing intercrystalline cracking of boiler steel. It encourages growth of algae and other organisms which produce undersirable tastes and odors.
Dissolved solids	Chiefly mineral constituents dissolved from rocks and soils. Includes some water of crystallization.	U.S. Public Health Service (1962) drinking-water standards recommend that waters containing more than 500 ppm dissolved solids not be used if other less mineralized supplies are available. Waters containing more than 1000 ppm dissolved solids are unsuitable for many purposes.
Hardness as $CaCO_3$	In most waters nearly all the hardness is due to calcium and magnesium. All the metallic cations other than the alkali metals also cause hardness.	Consumes soap before a lather will form. Deposits soap curd on bathtubs. Hard water forms scale in boilers, water heaters, and pipes. Hardness equivalent to the bicarbonate and carbonate is called carbonate hardness. Any hardness in excess of this is called noncarbonate hardness. Waters of hardness as much as 60 ppm are considered soft; 61 to 120 ppm, moderately hard; 121 to 180 ppm, hard; more than 180 ppm, very hard.
Specific conductance (micromhos at 25° C)	Mineral content of the water.	Indicates degree of mineralization. Specific conductance is a measure of the capacity of the water to conduct an electric current. Varies with concentration and degree of ionization of the constituents.
Hydrogen ion concentration (pH)	Acids, acid-generating salts, and free carbon dioxide lower the pH. Carbonates, bicarbonates, hydroxides, and phosphates, silicates, and borates raise the pH.	A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increasing alkalinity; values lower than 7.0 indicate increasing acidity. pH is a measure of the activity of the hydrogen ions. Corrosiveness of water generally increases with decreasing pH. However, excessively alkaline waters may also attack metals.

Constituents	Maximum concentration (ppm)
Sulfate	250
Chloride	250
Nitrate	45
Fluoride	a/ .9
Dissolved solids	500

a/ Based on temperature records for Austin.

In the Colorado River basin the concentrations of these constituents are generally lower than the maximum concentrations recommended by the U.S. Public Health Service. The exception is the area between Ira and Ballinger in the upper Colorado River basin, where concentrations frequently exceed these recommended limits.

Industrial Use

The industrial use of water in the Colorado River basin is primarily as cooling water for steam generators and for the generation of hydroelectric power, but additional industrial development in the basin is expected and surface water will probably be used to meet the demands. The quality requirements vary greatly for almost every industrial application, as indicated by the water-quality tolerances given in Table 3. One requirement of most industries is that concentrations of various constituents of the water remain relatively constant. When concentrations of undesirable substances in water vary, constant monitoring is required, and thus operating expenses are increased.

Hardness is one of the more important properties of water that affects its utility for industrial purposes. Excessive hardness is objectionable because it contributes to the formation of scale in steam boilers, pipes, water heaters, and various other equipment where water is heated, evaporated, or treated with alkaline materials. The accumulation of scale increases costs for fuel, labor, repairs and replacement, and lowers the quality of many wet-processed products. However, some calcium hardness may be desirable because calcium carbonate sometimes forms protective coatings on pipes and other equipment and reduces corrosion.

The corrosive property of water receives considerable attention in industrial water supplies. A high concentration of dissolved solids in a water may be closely associated with the corrosive property of the water, especially if chloride is present in appreciable quantities. Water that contains a large concentration of magnesium chloride may be highly corrosive because the hydrolysis of this salt yields hydrochloric acid.

The surface water of the Colorado River basin is hard and often sufficiently mineralized to require treatment for many industrial uses. However, it usually is satisfactory as cooling water.

Table 3.--Water-quality tolerances for industrial applications[1]

[Allowable limits in parts per million except as indicated]

Industry	Turbidity	Color	Color + O_2 consumed	Dissolved oxygen (ml/1)	Odor	Hardness	Alkalinity (as $CaCO_3$)	pH	Total solids	Ca	Fe	Mn	Fe + Mn	Al_2O_3	SiO_2	Cu	F	CO_3	HCO_3	OH	$CaSO_4$	Na_2SO_4 to Na_2SO_3 ratio	General [2]
Air conditioning [3]	--	--	--	--	--	--	--	--	--	--	0.5	0.5	0.5	--	--	--	--	--	--	--	--	--	A,B
Baking	10	10	--	--	--	(4)	--	--	--	--	.2	.2	.2	--	--	--	--	--	--	--	--	--	C
Boiler feed:																							
0-150 psi	20	80	100	2	--	75	--	8.0+	3,000-1,000	--	--	--	--	5	40	--	--	200	50	50	--	1 to 1	--
150-250 psi	10	40	50	.2	--	40	--	8.5+	2,500- 500	--	--	--	--	.5	20	--	--	100	30	40	--	2 to 1	--
250 psi and up	5	5	10	0	--	8	--	9.0+	1,500- 100	--	--	--	--	.05	5	--	--	40	5	30	--	3 to 1	--
Brewing: [5]																							
Light	10	--	--	--	Low	--	75	6.5-7.0	500	100-200	.1	.1	.1	--	--	--	1	--	--	--	100-200	--	C,D
Dark	10	--	--	--	Low	--	150	7.0→	1,000	200-500	.1	.1	.1	--	--	--	1	--	--	--	200-500	--	C,D
Canning:																							
Legumes	10	--	--	--	Low	25- 75	--	--	--	--	.2	.2	.2	--	--	--	--	--	--	--	--	--	C
General	10	--	--	--	Low	--	--	--	--	--	.2	.2	.2	--	--	--	1	--	--	--	--	--	C
Carbonated beverages [6]	2	10	10	--	0	250	50	--	850	--	.2	.2	.3	--	--	--	.2	--	--	--	--	--	C
Confectionary	--	--	--	--	Low	--	--	[7]	100	--	.2	.2	.2	--	--	--	--	--	--	--	--	--	--
Cooling [8]	50	--	--	--	--	50	--	--	--	--	.5	.5	.5	--	--	--	--	--	--	--	--	--	A,B
Food, general	10	--	--	--	Low	--	--	--	--	--	.2	.2	.2	--	--	--	--	--	--	--	--	--	C
Ice (raw water) [9]	1-5	5	--	--	--	--	30-50	--	300	--	.2	.2	.2	--	10	--	--	--	--	--	--	--	C
Laundering	--	--	--	--	--	50	--	--	--	--	.2	.2	.2	--	--	--	--	--	--	--	--	--	--
Plastics, clear, undercolored	2	2	--	--	--	--	--	--	200	--	.02	.02	.02	--	--	--	--	--	--	--	--	--	--
Paper and pulp: [10]																							
Groundwood	50	20	--	--	--	180	--	--	--	--	1.0	.5	1.0	--	--	--	--	--	--	--	--	--	A
Kraft pulp	25	15	--	--	--	100	--	--	300	--	.2	.1	.2	--	--	--	--	--	--	--	--	--	--
Soda and sulfite	15	10	--	--	--	100	--	--	200	--	.1	.05	.1	--	--	--	--	--	--	--	--	--	--
Light paper, HL-Grade	5	5	--	--	--	50	--	--	200	--	.1	.05	.1	--	--	--	--	--	--	--	--	--	B
Rayon (viscose) pulp:																							
Production	5	5	--	--	--	8	50	--	100	--	.05	.03	.05	<8.0	<25	<5	--	--	--	--	--	--	--
Manufacture	.3	--	--	--	--	55	--	7.8-8.3	--	--	.0	.0	.0	--	--	--	--	--	--	--	--	--	--
Tanning [11]	20	10-100	--	--	--	50-135	135	8.0	--	--	.2	.2	.2	--	--	--	--	--	--	--	--	--	--
Textiles:																							
General	5	20	--	--	--	20	--	--	--	--	.25	.25	--	--	--	--	--	--	--	--	--	--	--
Dyeing [12]	5	5- 20	--	--	--	20	--	--	--	--	.25	.25	.25	--	--	--	--	--	--	--	--	--	--
Wool scouring [13]	--	70	--	--	--	20	--	--	--	--	1.0	1.0	1.0	--	--	--	--	--	--	--	--	--	--
Cotton bandage [13]	5	5	--	--	Low	20	--	--	--	--	.2	.2	.2	--	--	--	--	--	--	--	--	--	--

[1] American Water Works Association, 1950.
[2] A--No corrosiveness; B--No slime formation; C--Conformance to Federal drinking-water standards necessary; D--NaCl, 275 ppm.
[3] Waters with algae and hydrogen sulfide odors are most unsuitable for air conditioning.
[4] Some hardness desirable.
[5] Water for distilling must meet the same general requirements as for brewing (gin and spirits mashing water of light-beer quality; whiskey mashing water of dark-beer quality).
[6] Clear, odorless, sterile water for syrup and carbonization. Water consistent in character. Most high quality filtered municipal water not satisfactory for beverages.
[7] Hard candy requires pH of 7.0 or greater, as low value favors inversion of sucrose, causing sticky product.
[8] Control of corrosiveness is necessary as is also control of organisms, such as sulfur and iron bacteria, which tend to form slimes.
[9] $Ca(HCO_3)_2$ particularly troublesome. $Mg(HCO_3)_2$ tends to greenish color. CO_2 assists to prevent cracking. Sulfates and chlorides of Ca, Mg, Na should each be less than 300 ppm (white butts).
[10] Uniformity of composition and temperature desirable. Iron objectionable as cellulose adsorbs iron from dilute solutions. Manganese very objectionable, clogs pipelines and is oxidized to permanganates by chlorine, causing reddish color.
[11] Excessive iron, manganese, or turbidity creates spots and discoloration in tanning of hides and leather goods.
[12] Constant composition; residual alumina 0.5 ppm.
[13] Calcium, magnesium, iron, manganese, suspended matter, and soluble organic matter may be objectionable.

Irrigation

The extent to which chemical quality limits the suitability of a water for irrigation depends on such factors as: the nature, composition, and drainage of the soil and subsoil; the amounts of water used and the methods of applying it; the kind of crops grown; and the climate of the region. Because these factors are highly variable, every method of classifying waters for irrigation is somewhat arbitrary.

The most important characteristics in determining the quality of irrigation water, according to the U.S. Salinity Laboratory Staff (1954, p. 69), are: (1) total concentration of soluble salts, (2) relative proportion of sodium to other cations, (3) concentration of boron or other elements that may be toxic, and (4) the excess of equivalents of bicarbonate over equivalents of calcium plus magnesium.

High concentrations of dissolved salts in irrigation water may cause a buildup of salts in the soil solution, and may make the soil saline. The increased salinity of the soil may drastically reduce crop yields by decreasing the ability of the plants to take up water and essential plant nutrients from the soil solution. The tendency of irrigation water to cause a high buildup of salts in the soil is called the salinity hazard of the water. The specific conductance of the water is used as an index of the salinity hazard.

High concentrations of sodium relative to the concentrations of calcium and magnesium in irrigation water can adversely affect soil structure. Cations in the soil solution become fixed on the surface of the soil particles; calcium and magnesium tend to flocculate the particles, whereas sodium tends to deflocculate them. This adverse effect on soil structure caused by high sodium concentrations in an irrigation water is called the sodium hazard of the water. An index used for predicting the sodium hazard is the sodium-adsorption ratio (SAR), which is defined by the equation:

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}},$$

where the concentrations are expressed in equivalents per million.

The U.S. Salinity Laboratory Staff has prepared a classification for irrigation waters in terms of salinity and sodium hazards. Empirical equations were used in developing a diagram, reproduced in modified form as Figure 9, which uses SAR and specific conductance in classifying irrigation waters. This classification, although embodying both research and field observations, should be used only for general guidance because many additional factors (such as availability of water for leaching, ratio of applied water to precipitation, and crops grown) also affect the suitability of water for irrigation. With respect to salinity and sodium hazards, waters are divided into four classes--low, medium, high, and very high. The classification range encompasses those waters which can be used for irrigation of most crops on most soils as well as those waters which are usually unsuitable for irrigation.

Representative data from analyses of water from Twin Buttes Reservoir and the percentage of time that the specific conductance exceeded the indicated

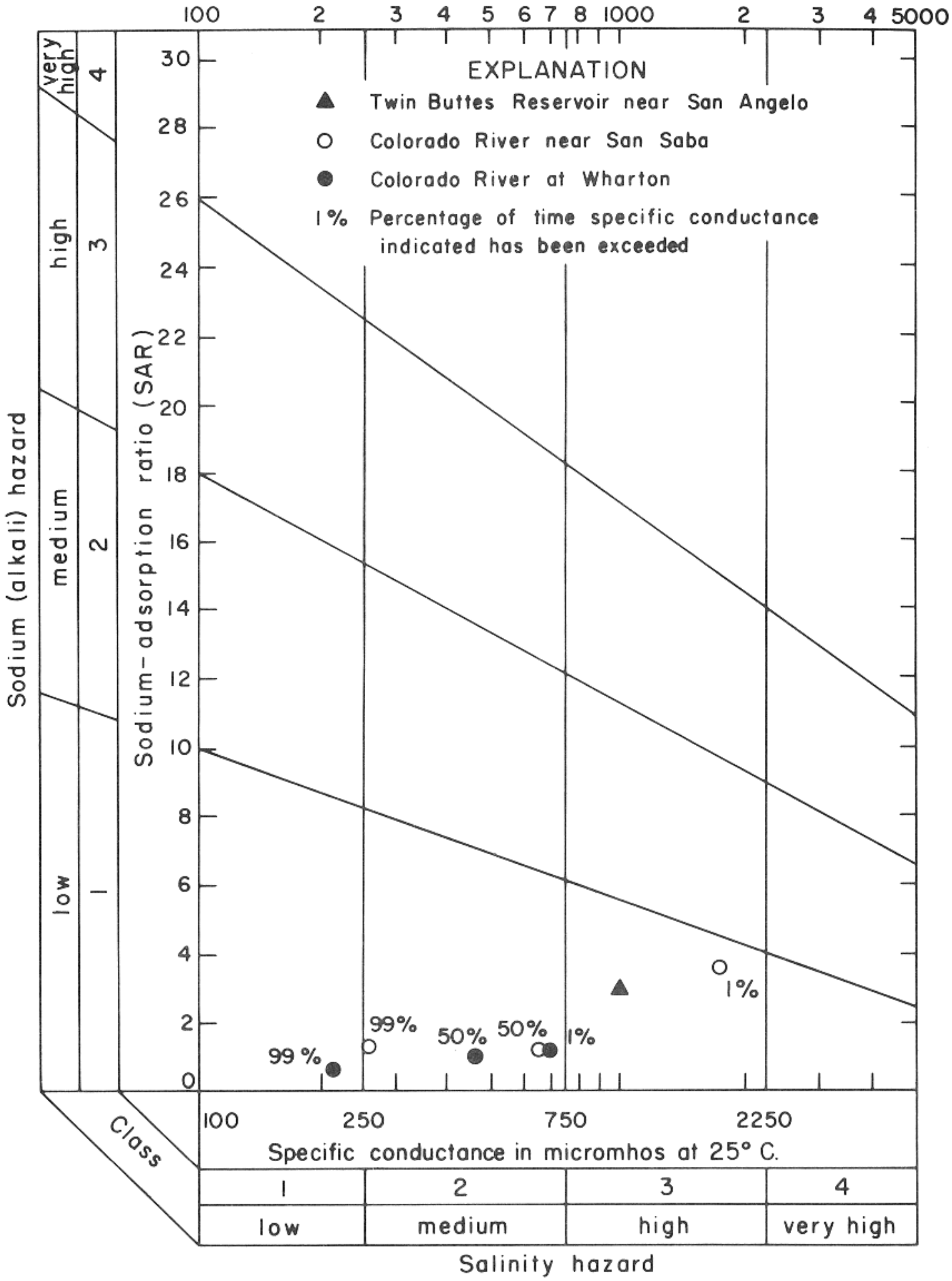

Figure 9

Classification of Irrigation Waters

U. S. Geological Survey in cooperation with the Texas Water Development Board

value for the Colorado River near San Saba and at Wharton are shown in Figure 9. The data show that the sodium hazard for water of the Colorado River basin is low and that the salinity hazard generally is medium.

In the lower Colorado River basin, great quantities of surface water are used for irrigation of rice and grain sorghums. Surface water of the lower basin is excellent for irrigation of these crops.

Geographic Variations in Water Quality

Variations of dissolved solids, hardness, and chloride in the streams in the Colorado River basin are shown in Figures 11, 12, and 13. These values are based on the discharge-weighted average concentrations, as calculated from chemical-quality data. The discharge-weighted average represents approximately the chemical character of the water if all the water passing a point in the stream were impounded in a reservoir, and mixed, with no adjustments for evaporation, rainfall, or chemical changes that might occur during storage. For many of the streams, chemical-quality data are limited, especially data on the chemical quality of flood flows. All the streams will at times have concentrations exceeding those shown, but the averages shown on the maps are indicative of the type of water that would be stored in a reservoir.

Dissolved Solids

The concentration of dissolved solids in surface water of the Colorado River basin is shown on Figure 11. Water of Lake J. B. Thomas in the upper part of the basin contains slightly more than 250 ppm dissolved solids. Below Lake J. B. Thomas is an area of saline inflow that badly degrades the water of much of the upper basin. Part of the inflow is definitely the result of oil-field operations. Most of the remainder of the basin yields surface water averaging less than 250 ppm in dissolved-solids content, but the effect of the saline inflow keeps the average concentration in the main stem above 250 ppm throughout its length (Figure 11). Higher concentrations are found in Beals Creek and Concho River subbasins because of oil-field operations.

The discharge-weighted average concentrations of dissolved solids of the Colorado River near San Saba and at Wharton for the period 1948-65 were 295 and 255 ppm, respectively. The analyses showing annual maximum and minimum dissolved-solids concentrations and the weighted averages for the stations are shown in Table 5.

Time-weighted averages are usually higher than discharge-weighted averages. The duration curves (Figure 7) for concentration of dissolved solids for the Colorado River near San Saba and at Wharton show that 400 ppm dissolved solids has been equaled or exceeded 50 percent of the time at San Saba and that 280 ppm was equaled or exceeded 50 percent of the time at Wharton.

Hardness

Surface water of the Colorado River basin generally is moderately hard (61 to 120 ppm) to very hard (over 180 ppm). Water in Lake J. B. Thomas is moderately hard. From Lake J. B. Thomas to the mouth of Pecan Bayou, the

Colorado River and its major tributaries contain very hard water (Figure 12). Pecan Bayou and most of the downstream tributaries contribute water that is hard (121 to 180 ppm), and the Colorado River contains hard water from the mouth of Pecan Bayou to the coast.

Chloride

The concentration of chloride in surface waters of the Colorado River basin ranges from less than 50 ppm to over 500 ppm (Figure 13). Water of Lake J. B. Thomas contains less than 50 ppm chloride. Below Lake J. B. Thomas, where oil-field brine and some natural saline flow is reaching the streams, chloride concentrations of several thousand ppm are common. Most of the remainder of the basin yields surface water averaging less than 50 ppm chloride, but the effects of the saline inflow in the upper basin keeps the average concentration in the main stem above 50 ppm all the way to Austin. Higher concentrations are found in the South Concho River and in the upstream portion of Pecan Bayou probably because of oil-field operations.

Other Constituents

Other constituents of importance in the evaluation of the quality of a water include silica, sodium, bicarbonate, sulfate, fluoride, and nitrate.

Most of the streams in the Colorado River basin contain less than 15 ppm silica, and the annual weighted-average concentration of the Colorado River has usually been less than 10 ppm.

Sodium concentrations are generally less than 50 ppm in most of the streams. In those waters having high chloride concentrations, sodium occurs in quantities approximately equivalent to the chloride. It is therefore present in highest concentrations in the Colorado River in the Ira-Colorado City area. The annual weighted-average concentration of the Colorado River at Austin and Wharton is usually less than 50 ppm.

Bicarbonate is the principal anion in water draining rocks of Cretaceous age. The water of the Concho, San Saba, Llano, and Pedernales Rivers has bicarbonate as the principal anion; concentrations generally range between 200 and 300 ppm. In the lower part of the basin, water draining the younger formations contains much smaller concentrations. The weighted-average concentrations of bicarbonate for the 18-year period 1948-65 for the daily sampling stations on the Colorado River near San Saba and at Wharton are 156 ppm and 164 ppm, respectively.

Sulfate concentrations are generally less than 50 ppm in most of the streams in the basin, although higher concentrations are found in the polluted streams. Although concentrations of over 3,000 ppm are not uncommon, the weighted-average concentration for the Colorado River at Colorado City has ranged from 42 to 456 ppm. The weighted-average concentration for the Colorado River has ranged from 16 to 70 ppm near San Saba and 18 to 45 ppm at Wharton. Fluoride concentrations seldom exceed 1.0 ppm and generally range from 0.2 to 0.4 ppm. Nitrate concentrations are generally less than 3.0 ppm in most of the streams in the basin.

Water Quality in Reservoirs

The principal reservoirs in the Colorado River basin were sampled during the reconnaissance and the chemical analyses are given in Table 6. Analyses are also available for some of the small reservoirs used for public supply (Sundstrom and others, 1949).

Lake J. B. Thomas.--Lake J. B. Thomas, in the upper Colorado River basin, contains water of good quality. Ten analyses during the period 1953-65 show that the water usually contains about 250 ppm dissolved solids, about 25 ppm chloride, and about 60 ppm sulfate.

Lake Colorado City and Champion Creek Reservoir.--Owned and operated by the Texas Electric Service Company, these reservoirs provide cooling water for a steam-electric plant and the municipal supply for Colorado City. The chemical quality of the water in the two reservoirs is similar, about 300 ppm dissolved solids and about 40 ppm chloride.

Robert Lee Reservoir.--Construction of the dam that will form Robert Lee Reservoir began late in 1966. The reservoir site is on the Colorado River downstream from an area of saline inflow in Mitchell and Scurry Counties. The Colorado River Municipal Water District is building the reservoir, and plans to catch the highly mineralized low flow of the river upstream from the reservoir for use in waterflooding projects in several oil fields in the area. This salt-water alleviation program will greatly improve the quality of the water stored in the reservoir, but the chloride content of the stored water probably will, at times, exceed the limits recommended by the U.S. Public Health Service.

Oak Creek Reservoir.--The quality of the water in Oak Creek Reservoir, though still good, has deteriorated slightly since 1953. An analysis in 1953 showed 1.5 ppm chloride and 127 ppm dissolved solids. The most recent analysis in 1965 showed 29 ppm chloride and 239 ppm dissolved solids.

Twin Buttes Reservoir.--Twin Buttes Reservoir was completed in 1962 but because of drought conditions had not impounded much water during this study. For the period that analyses are available (September 1964 to August 1965) the dissolved-solids content of the water has ranged from about 400 to 700 ppm. The quality of the water in Twin Buttes Reservoir is probably adversely affected by oil-field operations in the South Concho River and Spring Creek drainage areas, but the concentrations measured during this study are higher than can be expected when the reservoir is filled.

Lake Nasworthy.--Lake Nasworthy is just downstream from Twin Buttes Reservoir and most of its inflow is water released or pumped from Twin Buttes. Therefore, the water in Lake Nasworthy is similar in chemical quality to that stored in Twin Buttes Reservoir. Two analyses in 1965 showed 451 and 500 ppm dissolved solids.

San Angelo Reservoir.--San Angelo Reservoir, on the North Concho River, impounds water of very good quality; dissolved-solids content has usually been less than 200 ppm.

Coleman Reservoir.--Coleman Reservoir was not impounding water during this study but the probable quality can be inferred from chemical analyses of Jim Ned Creek (site 71, Table 6). Dissolved-solids content of Jim Ned Creek near Coleman has ranged from 130 to 433 ppm and averaged about 200 ppm.

Hords Creek Reservoir.--Hords Creek Reservoir contains water of excellent quality, averaging about 15 ppm chloride and 150 ppm dissolved solids.

Brownwood Reservoir.--The water in Brownwood Reservoir is always of good quality as shown by analyses of samples from the Brown County Water Improvement District No. 1 Canal (site 78, Table 6). The dissolved-solids concentration of water drawn from the lake has ranged from 166 to 241 ppm.

Brady Creek Reservoir.--Brady Creek Reservoir was built to provide a municipal water supply for the city of Brady. The water is of excellent quality, usually containing less than 200 ppm dissolved solids.

Lake Buchanan, Inks Lake, Lake Lyndon B. Johnson, Marble Falls Lake, Lake Travis, and Lake Austin.--As a result of the successive impoundment, the quality of the water in these reservoirs is very similar. The Texas State Department of Health has sampled the outflow from Lake Buchanan and Lake Travis since 1957, and the Geological Survey has sampled the outflow from Lake Austin on a daily basis since October 1947. The analyses show that the water is always of good quality. Calcium and bicarbonate are the predominant ions, and dissolved-solids content is usually between 250 and 350 ppm.

Decker Lake.--Construction of Decker Lake began in 1966 and no water was impounded during this study. The reservoir, when completed, will store water pumped from the Colorado River to be used for cooling at the city of Austin's Decker Creek steam-generating plant. The water will be diverted from the river downstream from the Austin sewage outfall. The dissolved-solids content of the water should range from 250 to 350 ppm, but the organic quality of the water may at times be poor.

Lake Bastrop.--Lake Bastrop is a Colorado River off-channel reservoir that stores cooling water for a Lower Colorado River Authority steam-generating plant. Chemical analyses are not available, but the water is similar to that of the Colorado River passing Austin, which usually contains from 250 to 350 ppm dissolved solids.

Eagle Lake.--Eagle Lake is a Colorado River off-channel reservoir owned by the Lakeside Irrigation Company. During flood flows, water is pumped from the Colorado River and stored until needed for irrigation. An analysis in 1959 showed the water to be of good quality; the dissolved-solids concentration was 176 ppm.

Water Quality at Potential Reservoir Sites

One of the purposes of the reconnaissance was to appraise the quality of the water which will be available for storage at potential reservoir sites. Many sites studied by various Federal, State, and local agencies are indicated on Figure 4.

Stacy.--A reservoir on the Colorado River at the Stacy site would impound water from the Colorado and Concho Rivers. The water of the Colorado River impounded at the Stacy site would contain slightly more than 500 ppm dissolved solids.

Upper Pecan Bayou.--A reservoir at the Upper Pecan Bayou site would impound water of good quality; the water would be hard and contain less than 250 ppm dissolved solids.

Brownwood Reservoir (Enlargement).--The enlargement of Brownwood Reservoir should not cause any change in the quality of the water stored. The water should still be hard and contain less than 250 ppm dissolved solids.

San Saba.--The quality of the water at the San Saba site can be determined from the chemical quality data for the San Saba River at San Saba. The water that would be stored will be very hard but contain less than 250 ppm dissolved solids.

Mason.--The quality of the water that could be impounded at the Mason site on the Llano River can be inferred from analyses of the Llano River at Junction and Llano. The water available for storage is calcium bicarbonate in type and is hard; the dissolved-solids concentration is usually less than 250 ppm.

Pedernales.--According to periodic chemical-quality data for the Pedernales River near Johnson City, water impounded at the Pedernales site would be hard and contain about 250 ppm dissolved solids.

Columbus Bend.--Water available at this site would be very similar in quality to the water sampled at the daily quality station at Wharton where the weighted-average dissolved-solids concentration has ranged from 198 to 328 ppm.

Matagorda.--Water available at the Matagorda site would also be very similar to the water sampled at the daily quality station at Wharton.

Problems Needing Additional Investigation

This reconnaissance of the chemical quality of the Colorado River basin has shown that the natural runoff of the basin is generally of good chemical quality.

However, saline inflow principally from oil-field operations makes the water in the upper part of the basin unfit for most uses and increases the salt load in the main stem throughout its length. Continuing study will be necessary to evaluate the salt-water alleviation program that is planned for the area above the Robert Lee Reservoir site. Small areas in the Concho River and Pecan Bayou subbasins are slightly polluted with salt water produced with oil or gas.

A potential water-quality hazard exists in the portion of the Colorado River basin that is usually considered noncontributing. In the drainage area of Beals Creek just upstream from Big Spring, natural and oil-field brines are impounded in a depression called Natural Dam Salt Lake (site 19, Table 6). The impounded water may contain more than a hundred thousand ppm of dissolved solids, and the lake bed is covered by a thick layer of deposited salts. Levees have been built as a precaution against overflow. If the lake should overflow the small amount of brine in storage would not cause serious pollution in downstream reservoirs, but many tons of the deposited salt in the lake would be dissolved and carried downstream, thereby greatly increasing the possibility of serious water-quality damage.

Organic quality is generally good throughout the basin; however, some concern is being expressed regarding bacterial contamination of the Highland Lakes by septic-tank effluent in areas of housing developments, and by waste discharges from pleasure boats.

Continued municipal and industrial growth in the basin will cause an increase in the waste-disposal burdens of the stream system. Meanwhile, the impoundment of water in upstream reservoirs will cause a reduction of streamflow now utilized for the assimilation of municipal wastes. Consequently, continued municipal and industrial growth will require that wastes be consistently treated to the maximum extent if gross pollution of streams is to be avoided in the future.

Impoundment of water will likewise result in some changes of water quality. Beneficial effects will include: the reduction in turbidity, silica, color, and coliform bacteria; the evening-out of sharp variations in chemical quality; the entrapment of sediment; and a reduction in temperature. On the other hand, detrimental effects of impoundment will include: an increase in the growth of algae; the reduction of dissolved oxygen; and an increase of dissolved solids as a result of evaporation. The continued extensive development of the water resources of the Colorado River basin will necessitate detailed study of the changes in water quality.

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Water year	U.S.G.S. Water-Supply Paper No.	T.W.D.B. Report No.	Water year	U.S.G.S. Water-Supply Paper No.	T.W.D.B. Report No.
1940-45	--	*1938-45	1955	1402	*1955
1946	1050	*1946	1956	1452	Bull. 5905
1947	1102	*1947	1957	1522	Bull. 5915
1948	1133	*1948	1958	1573	Bull. 6104
1949	1163	*1949	1959	1644	Bull. 6205
1950	1188	*1950	1960	1744	Bull. 6215
1951	1199	*1951	1961	1884	Bull. 6304
1952	1252	*1952	1962	1944	Bull. 6501
1953	1292	*1953	1963	1951	Rept. 7
1954	1352	*1954			

* "Chemical Composition of Texas Surface Waters" was designated only by water year from 1938 through 1955.

The following U.S. Geological Survey Water-Supply Papers contain results of stream measurements in the Colorado River basin, 1898-1960:

Year	Water-Supply Paper No.	Year	Water-Supply Paper No.	Year	Water-Supply Paper No.
1898	28	1919	508	1940	898
1899	37	1920	508	1941	928
1900	50	1921	528	1942	958
1901	75	1922	548	1943	978
1902	84	1923	568	1944	1008
1903	99	1924	588	1945	1038
1904	132	1925	608	1946	1058
1905	174	1926	628	1947	1088
1906	210	1927	648	1948	1118
1907	248	1928	668	1949	1148
1908	248	1929	688	1950	1178
1909	268	1930	703	1951	1212
1910	288	1931	718	1952	1242
1911	308	1932	733	1953	1282
1912	328	1933	748	1954	1342
1913	358	1934	763	1955	1392
1914	388	1935	788	1956	1442
1915	408	1936	808	1957	1512
1916	438	1937	828	1958	1562
1917	458	1938	858	1959	1632
1918	478	1939	878	1960	1712

Table 4.--Index of surface-water records in the Colorado River basin

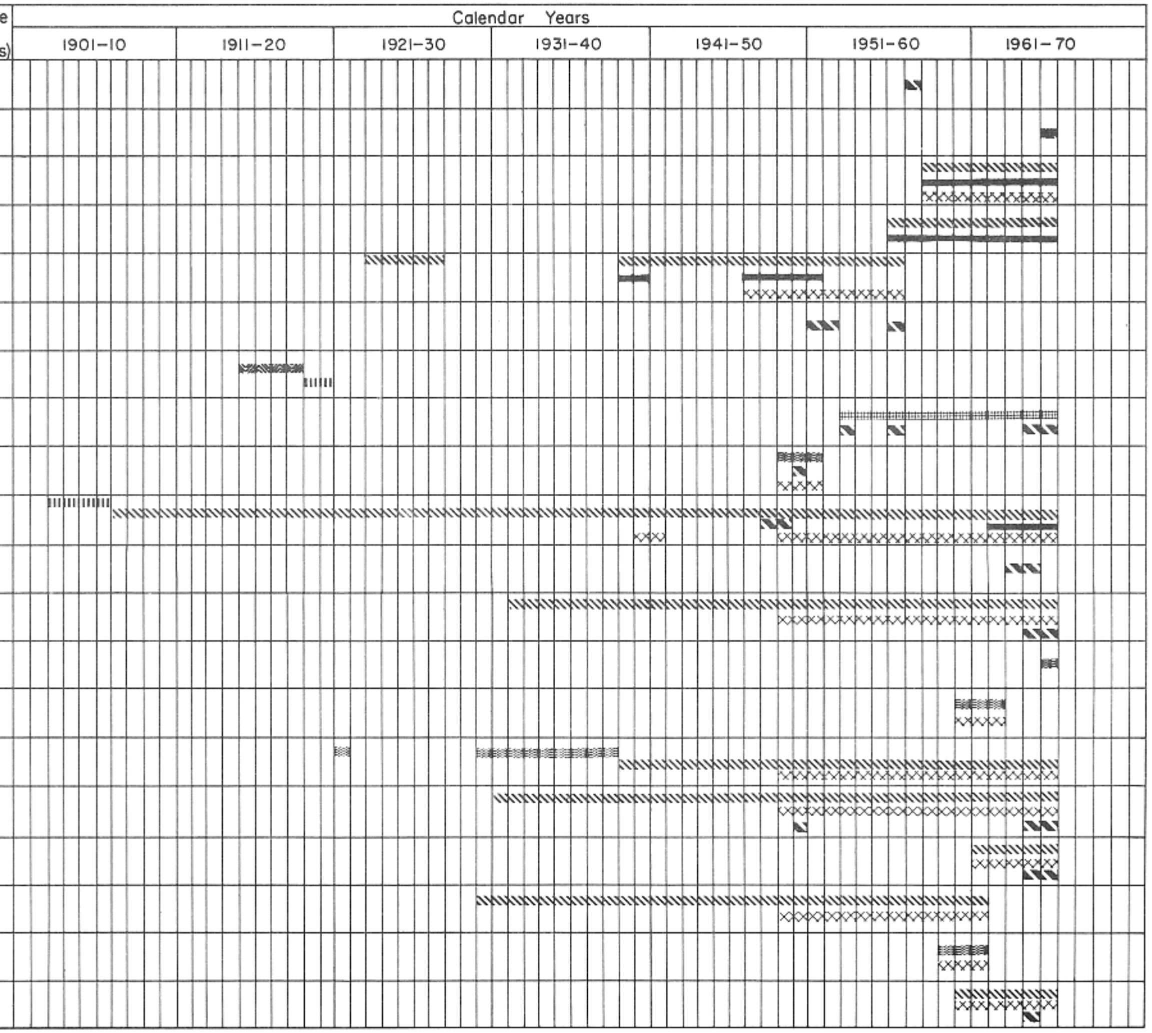
Reference no.	Stream and Location	Drainage Area (sq. miles)	Calendar Years 1901–10	1911–20	1921–30	1931–40	1941–50	1951–60	1961–70
1	Lake J. B. Thomas near Vincent	934							
2	Bull Creek near Ira	388							
3	Bluff Creek near Ira	42.6							
4	Colorado River near Ira	1027							
5	Deep Creek near Snyder								
6	Deep Creek near Dunn	188							
7	Sulphur Creek near Dunn								
8	Colorado River near Cuthbert	1428							
9	Colorado River at Colorado City	1482							
10	Morgan Creek near Westbrook	228							
11	Graze Creek near Westbrook	21.2							
12	Morgan Creek near Colorado City	262							
13	Lake Colorado City near Colorado City	267							
14	Champion Creek near Colorado City	158							
15	Champion Creek Reservoir near Colorado City	203							
16	Sulphur Springs Creek near Big Spring								
17	Calf Creek near Stanton								
18	Buzzard Creek at U.S. Highway 87 near Big Spring								
19	Natural Dam Salt Lake near Big Spring								
20	Beals Creek above Big Spring	494							

Discharge   Gage heights only   Gage heights and discharge measurements   Reservoir contents

Periodic discharge measurements   Daily chemical quality   Periodic chemical quality   Water temperature

Table 4.--Index of surface-water records in the Colorado River basin--Continued

Reference no.	Stream and Location	Drainage Area (sq. miles)	Calendar Years (1901–10, 1911–20, 1921–30, 1931–40, 1941–50, 1951–60, 1961–70)
21	Beals Creek at Big Spring	515	
22	Coahoma Draw Tributary near Big Spring		
23	Beals Creek near Westbrook	973	
24	Colorado River near Silver	3880	
25	Colorado River at Robert Lee	4170	
26	Mountain Creek Reservoir at Robert Lee		
27	Colorado River near Bronte		
28	Oak Creek Reservoir near Blackwell	222	
29	Oak Creek near Blackwell		
30	Colorado River at Ballinger	5240	
31	Lake Winters near Winters		
32	Elm Creek at Ballinger	471	
33	Dry Creek near Christoval		
34	Anson Springs near Christoval		
35	South Concho Irrigation Co.'s canal at Christoval		
36	South Concho River at Christoval	344	
37	Middle Concho River above Tankersley	1381	
38	Middle Concho River near Tankersley	1128	
39	Spring Creek Springs near Mertzon		
40	Spring Creek above Tankersley	396	



Discharge · Gage heights only · Gage heights and discharge measurements · Reservoir contents · Periodic discharge measurements · Daily chemical quality · Periodic chemical quality · Water temperature

Table 4.--Index of surface-water records in the Colorado River basin--Continued

Reference no.	Stream and Location	Drainage Area (sq. miles)	Calendar Years 1901-10	1911-20	1921-30	1931-40	1941-50	1951-60	1961-70
41	Dove Creek Springs near Knickerbocker								
42	Dove Creek near Knickerbocker								
43	Dove Creek at Knickerbocker	198							
44	Spring Creek near Tankersley	734							
45	Twin Buttes Reservoir near San Angelo	2546							
46	Pecan Creek near San Angelo	84.9							
47	Tom Green Co. WCID No. 1 Canal near San Angelo								
48	Lake Nasworthy near San Angelo	2507							
49	South Concho River at San Angelo	2535							
50	Quarry Creek near Sterling City								
51	North Concho River at Sterling City	539							
52	Broome Creek near Broome								
53	North Concho River near Carlsbad	1144							
54	Nolke Station Creek near San Angelo								
55	Gravel Pit Creek near San Angelo								
56	San Angelo Reservoir at San Angelo	1383							
57	North Concho River at San Angelo	1402							
58	Concho River near San Angelo	4097							
59	Concho River near Paint Rock	5132							
60	Mukewater Creek Subwatershed No. 9 near Trickham	4.02							

Discharge; Gage heights only; Gage heights and discharge measurements; Reservoir contents

Periodic discharge measurements; Daily chemical quality; Periodic chemical quality; Water temperature

Table 4.--Index of surface-water records in the Colorado River basin--Continued

Reference no.	Stream and Location	Drainage Area (sq. miles)	Calendar Years 1901–10	1911–20	1921–30	1931–40	1941–50	1951–60	1961–70
61	Mukewater Creek at Trickham	70.0							
62	Colorado River at Winchell (Milburn)	12680							
63	Deep Creek Subwatershed No. 1 near Placid								
64	Deep Creek Subwatershed No. 2 near Placid								
65	Deep Creek Subwatershed No. 3 near Placid	3.42							
66	Deep Creek Subwatershed No. 4 near Placid								
67	Deep Creek Subwatershed No. 5 near Placid								
68	Deep Creek near Mercury	43.9							
69	Deep Creek Subwatershed No. 8 (Dry Prong Deep Creek) near Mercury	4.32							
70	Dry Prong Deep Creek near Mercury	8.31							
71	Jim Ned Creek near Coleman	333							
72	Hords Creek Reservoir near Valera	48							
73	Hords Creek near Valera	53							
74	Hords Creek at Coleman	107							
75	North Fork Pecan Bayou near Clyde								
76	Pecan Bayou at Burkett								
77	Pecan Bayou at FM Road 2559 near Brownwood								
78	Brown Co. WID No. 1 Canal near Brownwood								
79	Brownwood Reservoir near Brownwood	1535							
80	Pecan Bayou at Brownwood	1614							

Discharge — Gage heights only — Gage heights and discharge measurements — Reservoir contents

Periodic discharge measurements — Daily chemical quality — Periodic chemical quality — Water temperature

Table 4.--Index of surface-water records in the Colorado River basin--Continued

Reference no.	Stream and Location	Drainage Area (sq. miles)	Calendar Years 1901-10	1911-20	1921-30	1931-40	1941-50	1951-60	1961-70
81	Pecan Bayou near Goldthwaite								
82	Springs at Fort McKavett								
83	Noyes Canal at Menard								
84	San Saba River at Menard	1151							
85	Brady Creek near Eden	97							
86	Hardin Creek at Eden								
87	Brady Creek Reservoir near Brady	513							
88	Brady Creek at Brady	575							
89	San Saba River at San Saba	3042							
90	San Saba Springs at San Saba								
91	Colorado River near San Saba	18700							
92	Buchanan Reservoir near Burnet	19350							
93	North Llano River near Junction	914							
94	South Llano River near Telegraph								
95	Seven Hundred Springs near Telegraph								
96	Llano River near Junction	1874							
97	Beaver Creek near Mason	218							
98	Llano River near Castell	3747							
99	Llano River at Llano	4233							
100	Colorado River at Marble Falls								

Discharge; Gage heights only; Gage heights and discharge measurements; Reservoir contents; Periodic discharge measurements; Daily chemical quality; Periodic chemical quality; Water temperature

Table 4.--Index of surface-water records in the Colorado River basin--Continued

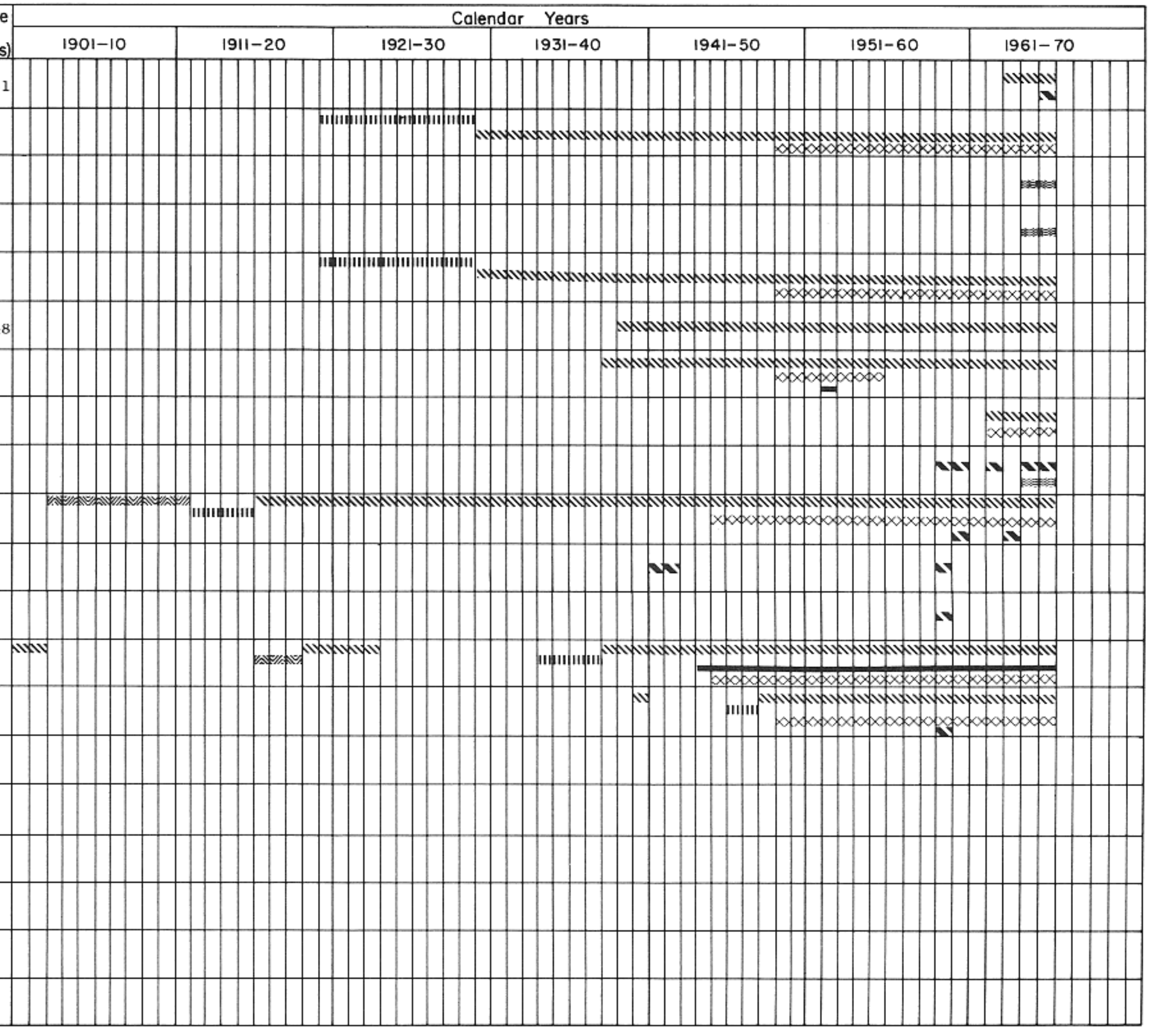
Reference no.	Stream and Location	Drainage Area (sq. miles)	Calendar Years 1901–10	1911–20	1921–30	1931–40	1941–50	1951–60	1961–70
101	Pedernales River at Stonewall	647							
102	Salt Branch at Stonewall								
103	Pedernales River near Johnson City	947							
104	Pedernales River near Spicewood	1294							
105	Lake Travis near Austin	26230							
106	Bull Creek at Doerntge Park near Austin								
107	Lake Austin at Austin								
108	Colorado River at Dam above Austin								
109	Barton Creek at Hays Co. line near Dripping Springs								
110	Barton Creek above Barton Springs at Austin								
111	Barton Springs at Austin								
112	Waller Creek at 38th Street at Austin	2.31							
113	Waller Creek at 23rd Street at Austin	4.13							
114	Colorado River at Austin	26500							
115	Little Walnut Creek near Austin								
116	Onion Creek near Driftwood								
117	Onion Creek at Buda								
118	Fox Branch near Oak Hill								
119	Onion Creek near Del Valle	337							
120	Onion Creek below Del Valle								

Discharge — Gage heights only — Gage heights and discharge measurements — Reservoir contents

Periodic discharge measurements — Daily chemical quality — Periodic chemical quality — Water temperature

Table 4.--Index of surface-water records in the Colorado River basin--Continued

Reference no.	Stream and Location	Drainage Area (sq. miles)
121	Wilbarger Creek near Pflugerville	4.61
122	Colorado River at Bastrop	27500
123	Cedar Creek near Bastrop	
124	Piney Creek near Bastrop	
125	Colorado River at Smithville	27980
126	Dry Creek at Buescher Lake near Smithville	1.48
127	Colorado River at LaGrange	28530
128	Redgate Creek near Columbus	173
129	Cummins Creek near Columbus	
130	Colorado River at Columbus	29170
131	Colorado River near Eagle Lake	29270
132	Eagle Lake at Eagle Lake	
133	Colorado River at Wharton	29480
134	Colorado River near Bay City	29750



Discharge   Gage heights only   Gage heights and discharge measurements   Reservoir contents

Periodic discharge measurements   Daily chemical quality   Periodic chemical quality   Water temperature

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin

(Analyses listed as maximum and minimum were classified on the basis of the values for dissolved solids only; values of other constituents may not be extremes.)

Results in parts per million except as indicated

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
2. BULL CREEK NEAR IRA																						
Apr. to Sept., 1950																						
Maximum, Aug. 16-20-----	0.36	11		111	39	1,000		69	317	1,580		5.0		3,100	4.22	3.0	438	381	83	--	5,510	7.6
Minimum, May 2---	110	12		24	4.6	23		114	17	11		4.0		152	.21	45	79	0	39	--	263	7.4
Weighted average-	30.3	15		32	6.4	47		134	37	40		3.6		256	.35	21	106	0	49	--	427	--
Water year 1951																						
Maximum, May 1-10, 1951-	.09	3.9		97	83	549		156	649	690		1.0		2,150	2.92	.5	584	456	67	--	3,500	7.8
Minimum, July 1-7-------	24.0	16		36	4.8	44		142	32	38		2.5		248	.34	16	110	0	47	--	413	7.8
Weighted average-	7.43	18		39	6.3	60		144	46	60		1.6		302	.42	6.2	124	6	51	--	513	--
Water year 1952																						
Maximum, August 1-31, 1952-----------	.01	--		--	--	--		--	--	980		--		--	--	--	--	--	--	--	4,450	--
Minimum, Sept. 22-28----------	13.8	--		--	--	--		--	--	11		--		--	--	--	--	--	--	--	236	--
Weighted average-	.08	7.0		98	67	598		122	593	780		3.2		2,210	3.01	48	520	420	71	--	--	--
Water year 1953																						
Maximum, Mar. 1-31. 1953	.15	6.2		98	38	286		207	304	378		3.5		1,220	1.66	.49	400	231	61	6.2	2,100	8.2
Minimum, Dec. 18-31,1952	1.01	11		26	5.2	37		108	24	36		4.0		210	.29	.57	86	0	49	1.7	354	8.1
Oct. 11, 1959------	a.01	5.2		211	62	2,370		92	489	3,790		--		6,970	9.51	--	782	706	87	37	11,500	7.5
Sept. 17, 1964-----	--	16		100	43	792		54	43	1,450		16		2,490	3.39	--	426	382	80	17	4,390	7.5
Dec. 21, 1964------	a.10	.5		225	94	2,100		235	334	3,520		--		6,390	8.69	--	948	756	83	30	10,300	7.3
Jan. 28, 1965------	a.06	.6		172	68	980		317	282	1,620		.0		3,280	4.46	--	708	448	75	16	5,460	7.3
May 11, 1965-------	a.72	6.6		42	8.5	145		81	67	204		4.0		537	.73	--	140	74	69	5.3	1,010	7.6
3. BLUFF CREEK NEAR IRA																						
Water year 1950																						
Maximum, Aug. 30, Sept. 1, 1950--	--	17		120	55	662		258	423	930	--	1.5		2,340	3.18		526	314	73	--	3,960	8.2
Minimum, May 11-13, -----------	--	13		33	4.7	26		116	26	22	0.3	5.4		209	.28		102	7	35	--	310	8.3
Mar. 24, 1964------	a0.06	15		232	88	297		346	478	570	.4	1.8		1,850	2.52		941	658	41	4.2	2,900	7.2
Apr. 27, 1964------	a.03	16		278	109	388		264	534	860	--	.5		2,320	3.16		1,140	926	42	5.0	3,720	7.1
May 30, 1964-------	8.65	7.5		56	4.5	65		145	21	110	.4	1.8		337	.46		158	39	47	2.2	632	7.0
June 2, 1964-------	a.1	12		152	42	179		233	211	375	.4	.0		1,090	1.48		552	360	41	3.3	1,880	7.1
Sept. 17, 1964-----	a.01	9.4		48	7.4	39		96	42	78	.3	1.0		272	.37		150	72	36	1.4	496	7.4
Nov. 17, 1964------	a.01	13		430	169	662		251	606	1,680	--	--		3,680	5.00		1,770	1,560	45	6.8	5,710	7.4
Jan. 28, 1965------	a.02	22		305	124	443		202	564	1,050	--	1.0		2,610	3.55		1,270	1,110	43	5.4	4,100	7.4
May 17, 1965-------	3.49	19		44	6.4	48		116	43	70	.4	1.2		289	.39		136	41	43	1.8	506	7.4

a Field estimate

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
4. COLORADO RIVER NEAR IRA																						
Water year 1959																						
Maximum, Mar. 14-25, 1959-------	0.18	3.4		955	353	13,500		129	3,020	21,200	--	--		39,100	54.6	19.0	3,830	3,730	88	95	49,900	7.7
Minimum, June 4-6, 1959--------	75.7	12		34	4.1	53		108	27	69	--	2.8		255	.35	52.1	102	13	53	2.3	467	7.1
Weighted average-	2.76	9.7		155	50	1,670		100	406	2,640	--	--		4,990	6.79	37.2	592	510	86	30	7,650	--
Water year 1960																						
Maximum, Apr. 16-30,1960	.02	4.8		1,200	500	18,400		98	4,080	28,900	--	--		53,100	74.9	2.87	5,050	4,970	89	113	64,000	6.4
Minimum, July 5-6-	268	16		47	10	159		144	58	230	--	1.5		592	.81	428	158	40	69	5.5	1,040	7.8
Weighted average-	2.47	13		124	40	1,320		127	310	2,060	--	--		3,930	5.34	26.2	474	370	86	26	5,900	--
Water year 1961																						
Maximum, May 1-6, 1961--	.07	4.9		1,440	583	19,800		172	4,750	31,200	--	--		57,900	82.1	10.9	5,990	5,850	88	111	69,100	7.0
Minimum, Oct. 19, 1960--	2910	8.2		23	2.8	60		99	23	65	--	2.5		234	.32	1,840	69	0	65	3.1	411	7.5
Weighted average-	43.5	8.1		37	8.4	198		136	74	260	--	--		660	.90	77.5	127	16	77	7.6	1,100	--
Water year 1962																						
Maximum, Apr. 12-25,1962	.2	3.3		944	389	13,600		92	3,380	21,200	--	--		39,600	55.3	21.4	3,960	3,880	88	94	50,300	6.8
Minimum, June 12-	131	6.0		28	7.5	53		105	23	74	--	2.0		246	.33	87.0	101	15	--	--	465	7.4
Weighted average-	41.1	8.2		40	10	220		146	80	292	--	1.3		725	.99	--	140	45	--	4.9	1,170	7.3
Water year 1963																						
Maximum, Apr. 19-23, 25-26,1963-	.1	1.8		1,120	475	15,100		130	3,840	23,700	--	--		44,300	62.2	12.0	4,750	4,640	87	95	53,400	7.0
Minimum, May 22-23, 1963	296	16		62	10	280		119	95	428	0.1	4.0		954	1.30	762	196	98	76	8.7	1,720	7.7
Weighted average-	4.1	12		125	37	--		121	314	1,740	--	--		3,400	4.62	--	464	365	--	18	5,340	7.5
Water year 1964																						
Maximum, May 1-2, 1964--	.1	7.8		1,510	664	22,600		119	5,190	35,600	--	--		65,600	93.3	--	6,500	6,400	88	--	74,600	7.4
Minimum, Aug. 27-	389	11		46	5.8	96		136	34	139	.4	4.0		403	.55	--	139	28	60	3.5	793	7.1
Weighted average-	4.1	9.6		152	49	1,520		112	397	2,390	--	--		4,570	6.22	--	581	489	78	21.7	7,140	6.9
Water year 1965																						
Maximum, May 1-6, 1965--	.1	1.2		1,320	573	20,000		69	4,360	31,600	--	--		57,900	82.3	--	5,650	5,590	89	--	80,200	6.6
Minimum, May 14,16	366	11		36	5.8	76		108	37	107	--	2.5		328	.45	--	114	26	59	3.1	663	7.8
Weighted average-	8.2	8.3		84	23	638		115	168	1,010	--	--		1,990	2.71	--	303	209	69	10.4	3,260	6.9

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
8. COLORADO RIVER NEAR CUTHBERT																						
Mar. to Sept. 1965																						
Maximum, Apr. 1-12, 25, 1965-	0.9	3.3		863	345	9,310	32	91	2,040	15,700		--		28,300	39.3		3,570	3,500	85	--	37,100	6.8
Minimum, May 16--	3,250	19		46	3.7	24		150	15	29		4.2		215	.29		130	7	29	0.9	358	8.0
Weighted average-	79.6	13		69	11	198		163	70	310		--		755	1.03		215	82	52	4.5	1,330	7.7
9. COLORADO RIVER AT COLORADO CITY																						
May to Sept. 1946																						
Maximum, May 9, 1946----	2.4	--		467	205	4,090		119	1,650	6,450		--		12,900	17.5	84	2,010	1,910	82	--	21,300	--
Minimum, June 27-	70	--		38	5.5	71		108	26	111		0.2		344	.47	65	118	29	57	--	601	--
Weighted average-	83.4	--		53	12	243		120	97	360		3.9		847	1.15	191	182	84	74	--	1,540	--
Water year 1947																						
Maximum, May 10, 1947---	1,450	--		441	192	4,370		110	1,500	6,900		4.0		13,500	18.4	52,900	1,890	1,800	83	--	20,700	--
Minimum, May 12-14,17, 1947-	6,532	--		27	4.9	35		112	26	30		1.8		206	.28	3,630	88	0	46	--	342	--
Weighted average-	147	--		47	12	201		115	85	298		2.7		738	.98	287	167	73	72	--	1,230	--
Water year 1948																						
Maximum, Apr. 23-28, May 1-15, 1948-	.95	5.9		425	145	3,720		108	1,220	5,940		3.0		11,500	15.6	29	1,660	1,570	83	--	18,300	--
Minimum, Oct. 26, 1947--	156	--		26	5.9	23		113	30	10		2.0		176	.24	74	89	0	36	--	274	--
Weighted average-	163	--		37	8.6	131		118	55	182		2.2		532	.70	228	128	32	69	--	916	--
Water year 1949																						
Maximum, Apr. 11-18, 1949	.25	8.4		477	195	4,450		121	1,500	7,100		.5		13,800	18.8	9.3	1,990	1,890	83	--	21,500	7.5
Minimum, Oct. 11, 1948--	570	11		23	3.4	70		116	39	60		2.8		286	.39	440	71	0	68	--	484	--
Weighted average-	63.6	12		52	14	279		120	114	408		2.2		948	1.29	163	188	89	76	--	1,670	--
Water year 1950																						
Maximum, Mar. 1-9, 11-19, Apr. 13-15, 1950-	1.09	9.2		562	237	5,550		93	1,790	8,860		--		17,100	23.3	50	2,380	2,300	84	--	26,100	6.9
Minimum, Sept. 5-9------	1,091	10		22	5.0	65		116	35	60		1.8		264	.36	778	75	0	65	--	482	7.8
Weighted average-	86.6	13		43	13	214		123	89	303		2.5		742	1.01	173	161	60	74	--	1,330	--
Water year 1951																						
Maximum, Apr. 1-30, May 1-7, 1951--	.72	7.4		609	266	6,000		105	2,000	9,570		--		18,500	25.1	36	2,610	2,530	83	--	28,300	7.7
Minimum, Aug. 23-25	1,576	17		35	8.0	71		167	49	58		5.5		332	.45	1,410	120	0	56	--	568	7.8
Weighted average-	47.9	15		89	30	634		130	222	982		--		2,040	2.77	264	346	239	80	--	3,570	--
Water year 1952																						
Maximum, Mar. 11, 1952--	.10	8.0		907	379	9,930		96	2,800	15,900		--		30,000	40.8	8.1	3,820	3,740	85	70	42,500	6.6
Minimum, July 16-17-----	210	16		50	5.7	152		125	62	217		6.9		571	.78	324	148	46	69	5.4	1,140	7.7
Weighted average-	4.47	11		177	56	1,500		104	456	2,390		--		4,640	6.31	56.0	672	587	83	25	7,620	--

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
9. COLORADO RIVER AT COLORADO CITY--Continued																						
Water year 1953																						
Maximum, Apr. 1-14, 1953-	0.21	5.4		735	348	9,020		58	2,290	14,500		--		26,900	36.6	15.3	3,260	3,220	86	69	38,800	7.2
Minimum, Aug. 19-22	692	9.8		39	5.5	104		123	33	147		--		443	.60	828	120	19	65	4.1	776	8.0
Weighted average-	14.9	9.0		100	29	795		111	213	1,260		--		2,490	3.39	100	368	278	82	18	4,090	--
Water year 1954																						
Maximum, Mar. 8-19, 1954	.01	3.9		735	288	8,150		127	2,070	13,100		--		24,400	33.2	.6	3,020	2,910	85	64	34,800	7.7
Minimum, May 12-13, 15, 19, 1954---	1,338	9.6		36	5.5	62		119	28	83		2.8		289	.39	1,040	112	14	54	2.5	528	7.5
Weighted average-	75.8	8.5		58	14	277		124	90	430		3.1		954	1.30	195	202	100	75	8.5	1,670	--
Water year 1957																						
Maximum, Jan. 24-31, Feb. 1-6, 1957-	2.85	4.5		569	235	6,670		122	1,500	10,800		--		19,800	26.9	152	2,390	2,290	86	59	28,800	7.6
Minimum, May 12-14, 17-18----------	1,919	12		30	3.3	35		99	16	46		3.0		208	.28	1,080	88	7	47	1.6	346	7.4
Weighted average-	163	12		40	7.4	151		102	42	235		--		555	.75	244	130	72	72	5.8	946	--
Water year 1958																						
Maximum, Feb. 1-10, 1958	2.04	3.8		414	169	4,080		136	1,100	6,620		--		12,500	17.0	68.8	1,730	1,620	84	43	19,600	7.6
Minimum, May 28-29, June 3-4-------	78.3	12		46	7.7	140		119	50	212		2.0		542	.74	115	146	49	67	5.0	972	8.0
Weighted average-	23.6	10		86	24	583		119	173	922		--		1,880	2.56	120	313	216	80	14	3,190	--
Water year 1959																						
Maximum Apr. 1-7, 1959-	2.31	4.4		598	260	6,330		87	1,680	10,100		--		19,000	26.2	144	2,560	2,490	84	54	27,300	7.3
Minimum, July 2-3, 13-14, 1959----	450	13		36	5.0	99		104	34	144		2.2		385	.52	468	110	26	56	4.1	687	7.5
Weighted average-	20.2	11		85	24	641		104	178	1,010		--		2,010	2.73	110	310	226	82	15	3,300	--
Water year 1960																						
Maximum, June 9-13, 1960	2.50	6.7		874	318	9,530		77	2,470	15,300		--		28,500	39.5	192	3,490	3,420	86	70	38,300	7.0
Minimum, July 7--	1,700	10		40	5.2	121		102	45	178		3.8		453	.62	2,080	122	38	68	4.8	728	7.9
Weighted average-	11.3	9.3		102	31	828		105	228	1,320		--		2,570	3.50	81.9	382	296	83	18	4,190	--
Water year 1961																						
Maximum, Apr. 1-15, 1961	.84	5.0		656	290	7,310		100	1,920	11,800		--		22,000	30.3	49.9	2,830	2,750	85	60	32,200	7.1
Minimum, June 15-17,----	977	13		36	5.8	66		120	30	90		2.2		302	.41	797	114	16	--	--	552	7.8
Weighted average-	71.9	10		54	14	305		135	102	453		--		1,010	1.37	196	192	82	78	9.6	1,760	--
Water year 1962																						
Maximum, Apr. 5-26, 1962	1.9	4.8		514	246	5,550		117	1,650	8,900		--		16,900	23.2	86.7	2,290	2,200	84	50	24,100	7.1
Minimum, Sept. 5-7-	3,607	--		--	--	--		92	18	27		--		150	.20	1,461	81	6	--	--	270	7.2
Weighted average-	85.5	7.3		42	11	187		125	74	270		--		662	.90	--	153	54	--	7.1	1,140	7.1

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids			Hardness as $CaCO_3$		Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
														Parts per million	Tons per acre-foot	Tons per day	Calcium, magnesium	Noncarbonate				
9. COLORADO RIVER AT COLORADO CITY--Continued																						
Water year 1963																						
Maximum, Apr. 1-26, 1963-	2.3	3.1		661	291	6,340		118	1,250	10,800	--	--		19,400	26.8	120	2,850	2,750	83	52	28,000	7.1
Minimum, May 23---	1,650	13		34	11	89		122	43	123	0.5	6.1		380	.52	1,690	131	31	60	3.4	714	7.6
Weighted average-	16.8	9.1		146	51	1,120		126	368	1,790	--	--		3,550	4.83	--	572	469	--	18	5,670	7.2
Water year 1964																						
Maximum, Apr. 1-18, 22-25, 1964----	.8	7.0		680	307	7,450	24	104	2,130	11,900	--	--		22,500	31.0	--	2,960	2,870	84	--	31,100	6.5
Minimum, Oct. 24, 1963--	182	11		40	9.7	108		120	67	144	.2	5.0		444	.60	--	140	42	63	4.0	805	7.6
Weighted average-	9.1	8.1		140	48	1,230		107	349	1,960	--	--		3,790	5.15	--	547	459	81	20.4	6,600	7.0
Water year 1965																						
Maximum, Apr. 1-21, 1965	.7	2.4		920	412	10,600	31	97	2,700	17,400	--	--		32,100	44.6	--	3,990	3,910	85	--	48,300	6.9
Minimum, May 16--	2,150	12		50	4.4	41		143	41	49	--	--		270	.37	--	143	26	38	1.5	481	7.4
Weighted average-	41.3	9.3		89	22	479		148	153	758	--	--		1,580	2.15	--	310	189	63	8.6	2,700	7.3
12. MORGAN CREEK NEAR COLORADO CITY																						
Water year 1947																						
Maximum, Sept. 10, 1947-	28.0	--		252	113	762		249	1,090	1,000		2.0		3,520	4.54	--	1,090	890	60		5,020	
Minimum, Sept. 11-13----	38.0	--		26	5.4	26		99	38	13		5.2		171	.23	--	87	6	39		276	
Weighted average-	31.2	--		35	6.8	36		104	47	40		3.3		238	.32	--	116	130	41		387	
Water year 1948																						
Maximum, May 25, 1948---	7.50	13		265	101	1,410		116	1,170	2,000		3.5		5,230	6.84	102	1,080	966	74		8,100	
Minimum, July 6--	6,043	4.0		14	.3	1.4		32	2	3.0		8.2		72	.10	1,170	36	10	7		100	
Weighted average-	34.8	--		29	4.9	26		103	33	20		3.8		188	.26	18	92	8	38		306	
23. BEALS CREEK NEAR WESTBROOK																						
Water year 1959																						
Maximum, Aug. 18-20, 27-28, 1959	1.34	5.7		253	488	2,090		118	2,030	3,520		--		8,440	11.6	30.5	2,640	2,540	63	18	12,400	6.5
Minimum, July 2, 12, 1959-------	164	10		24	5.9	33		96	22	37		1.5		180	.24	73.7	84	6	46	1.5	217	7.8
Weighted average-	15.9	8.9		48	29	153		117	138	233		2.3		680	.92	29.2	239	143	58	4.3	1,130	--
Water year 1960																						
Maximum, May 5-21, 1960-	5.02	6.9		395	978	3,520		231	3,810	6,030	1.3	--		14,900	20.5	202	5,010	4,820	60	22	20,200	7.4
Minimum, Nov. 4, 1959---	19.0	10		28	6.1	14		106	15	16		--		155	.21	7.95	95	8	--	--	258	7.9
Weighted average-	33.7	9.6		44	26	125		116	117	193		2.1		585	.80	53.2	217	122	56	3.7	942	--

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
23. BEALS CREEK NEAR WESTBROOK--Continued																						
Water year 1961																						
Maximum, Mar. 11-20,1961	0.23	7.0		220	364	1,690		212	1,740	2,650		--		6,780	9.22	4.21	2,050	1,870	64	16	9,970	7.4
Minimum,Oct.18,19	86.7	9.2		19	6.7	33		91	21	34		2.2		170	.23	39.8	75	0	49	1.7	303	7.3
Weighted average-	42.7	12		47	20	96		125	90	148		2.4		481	.65	55.5	200	97	51	2.9	830	--
Water year 1962																						
Maximum, May 1-11, 1962-	.4	5.5		150	330	1,670		241	1,570	2,500		--		6,340	8.62	6.85	1,730	1,530	68	18	9,580	7.4
Minimum, Sept. 1-2, 5-8-	1,545	10		30	7.3	37		104	32	45		3.2		216	.29	901	105	20	44	1.6	376	7.0
Weighted average-	35.0	10		46	25	123		112	118	188		--		569	.77	--	217	125	--	2.2	950	7.1
Water year 1963																						
Maximum. Mar. 1-31, 1963	1.4	11		225	323	1,500		236	1,520	2,400		--		6,100	9.52	23.1	1,890	1,700	63	15	8,920	7.3
Minimum, June 20-	362	7.0		33	8.4	48		114	31	65		4.4		253	.34	247	117	24	47	1.9	457	7.5
Weighted average-	10.6	11		70	49	30		140	238	403		3.5		1,100	1.50	--	378	264	--	4.8	1,800	7.2
Water year 1964																						
Maximum,Apr.7-30, 1964-----------	1.0	5.0		310	128	1,130		212	1,150	1,690		3.5		4,520	6.15	--	1,300	1,130	65	14	6,780	7.0
Minimum,Sept.12-13	41.5	8.0		26	6.4	17		126	12	7.8		2.0		141	.19	--	91	0	29	.8	219	8.2
Weighted average-	6.3	12		65	38	210		155	204	302		6.0		915	1.24	25.0	318	189	--	4.3	1,510	7.5
Water year 1965																						
Maximum, Apr. 1-2, 1965-	.7	4.6		192	277	1,340		238	1,420	2,020		--		5,370	7.30	--	1,620	1,420	64	14	7,610	8.1
Minimum,June 12--	1,520	.9		36	6.9	35		129	36	34		3.2		215	.29	--	118	12	39	1.4	393	8.0
Weighted average-	37.8	9.0		50	16	85		143	81	123		3.0		439	.60	--	192	75	44	2.3	770	7.3
24. COLORADO RIVER NEAR SILVER																						
Water year 1957																						
Maximum, Nov. 3-10, 1956	5.69	7.8		201	98	2,030		79	348	3,470	0.3	--		6,190	8.42	95.1	904	840	83	29	10,500	7.2
Minimum, June 1-4, 1957-	7,382	9.4		32	4.9	25		97	26	32	.4	2.5		180	.24	3,590	100	20	35	1.1	322	7.3
Weighted average-	496	11		41	6.9	64		117	46	88	.6	2.9		329	.45	441	131	35	51	2.4	565	--
Water year 1958																						
Maximum, Apr. 1-10, 1958	2.73	6.4		379	121	1,930		128	1,080	3,120	.4	2.0		6,700	9.11	49.4	1,440	1,340	74	22	10,600	7.8
Minimum, Oct. 8-9, 13-14, 1957----	1,525	11		42	5.3	19		128	29	20	.4	5.6		195	.27	803	127	22	25	.8	330	7.9
Weighted average-	61.0	12		82	18	291		129	166	446	.5	3.7		1,080	1.47	178	278	173	69	7.6	1,860	7.6

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
24. COLORADO RIVER NEAR SILVER--Continued																						
Water year 1959																						
Maximum, Apr. 21-30, May 1, 1959----	0.64	6.8		591	207	3,900		82	1,760	6,310	--	--		12,800	17.5	22.1	2,330	2,260	78	35	18,200	6.9
Minimum, June 3--	118	14		49	11	49		154	43	70	--	--		314	.43	100	166	40	39	1.6	568	8.2
Weighted average-	35.7	13		84	23	345		126	189	534	--	--		1,270	1.73	122	304	200	71	8.6	2,120	--
Water year 1960																						
Maximum, Apr. 15-25, 1960	.11	4.3		572	165	3,300		109	1,740	5,240	--	--		11,100	15.2	3.30	2,110	2,020	77	31	16,200	7.3
Minimum, Aug. 20-	335	14		54	10	24		189	25	32	--	1.2		253	.34	229	176	21	23	.8	414	7.0
Weighted average-	50.8	12		71	20	268		122	147	415	--	--		1,000	1.36	137	259	159	69	7.2	1,700	--
Water year 1961																						
Maximum, May 1-18, 1961-	.02	4.5		693	269	4,510		59	2,360	7,180	0.5	2.5		15,000	20.6	.81	2,840	2,790	78	36	22,200	6.4
Minimum, Oct. 17-18, 1960-	118	9.6		37	6.2	25		98	42	32	--	3.8		204	.28	65.0	118	38	32	1.0	348	7.8
Weighted average-	159	10		51	12	166		124	87	245	--	2.7		653	.89	280	176	75	67	5.4	1,130	--
Water year 1962																						
Maximum, Apr. 29, 1962--	93.0	5.0		591	174	4,370		139	1,510	7,090	--	--		13,800	18.9	3,470	2,190	2,080	--	--	20,300	7.1
Minimum, Sept. 5-9	8,356	8.6		32	6.2	37		105	33	45	--	2.0		228	.31	5,140	105	19	43	1.6	392	7.2
Weighted average-	190	9.0		43	11	201	--	118	75	162	--	--		486	.66	--	152	56	--	3.1	827	7.3
Water year 1963																						
Maximum, Apr. 7-17, 1963-	3.3	6.2		517	190	2,150	16	105	1,550	3,580	--	--		8,060	11.0	71.8	2,070	1,990	69	21	11,800	7.2
Minimum, Sept. 9-10, 12-13	9.3	12		36	5.9	26		93	36	38	.4	2.8		203	.28	5.10	114	38	33	1.1	354	7.6
Weighted average-	32.3	12		113	38	489	--	125	275	785	--	--		1,780	2.42	--	439	336	--	8.8	2,980	7.4
Water year 1964																						
Maximum, Mar. 1-18, 1964	.7	3.6		378	138	2,230		66	1,160	3,610	--	--		7,550	10.3	--	1,510	1,460	76	--	11,600	6.6
Minimum, Nov. 19, 1963--	16.0	7.1		34	6.6	24		107	27	32	.4	2.0		186	.25	--	112	24	32	1.0	329	7.4
Weighted average-	30.4	8.9		72	18	262		126	137	408	--	3.8		973	1.32	--	255	151	53	5.8	1,690	7.1
Water year 1965																						
Maximum, Apr. 6-10, 1965	14.6	1.6		466	174	2,290		78	1,430	3,760	--	--		8,160	11.1	--	1,880	1,810	73	--	12,000	7.1
Minimum, Nov. 18, 1964--	224	5.6		39	5.5	26		108	30	38	--	2.5		200	.27	--	120	31	32	1.0	364	7.5
Weighted average-	125	9.0		61	13	140		147	87	209	--	3.7		595	.81	--	205	84	52	3.6	1,060	7.4
25. COLORADO RIVER AT ROBERT LEE																						
Water year 1948																						
Maximum, Feb. 21-25, 1948	4.68	7.6		218	57	630		129	628	985		0.2		2,730	3.52	33	778	673	64		4,210	--
Minimum, July 6-10-----	11,510	21		30	6.2	39		111	42	34		2.8		228	.31	7,150	100	9	46		382	--
Weighted average	304	14		44	9.8	104		119	80	138		2.8		475	.63	--	150	53	60		796	--

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
25. COLORADO RIVER AT ROBERT LEE--Continued																						
Water year 1949																						
Maximum, Nov. 7-10, 1948	58.5	8.0		148	45	925		146	372	1,460		0.5		3,030	4.12	479	554	435	78		5,310	--
Minimum, June 8, 1949	5,467	21		34	6.8	16		100	36	17		4.4		186	.25	2,750	113	31	23		297	8.3
Weighted average	240	16		45	10	96		105	85	131		3.7		450	.61	292	154	68	58		772	--
Water year 1950																						
Maximum, May 5-8, 1950	88.5	23		192	59	1,100		138	568	1,700		.5		3,710	5.05	887	722	608	77		6,340	7.8
Minimum, Aug. 2-4, 18-22	206	13		31	7.3	23		91	37	31		1.8		202	.27	112	107	33	32		334	7.9
Weighted average	157	12		50	13	135		116	110	188		1.9		583	.79	247	178	84	62		1,000	--
Water year 1951																						
Maximum, Apr. 1-10, 1951	1.0	5.1		434	116	1,420		76	1,300	2,230		2.0		5,540	7.53	151	1,560	1,500	66		8,700	7.4
Minimum, June 3-4	1,548	17		38	6.8	49		107	41	66		6.5		294	.40	1,230	123	36	46		511	7.6
Weighted average	75.8	17		69	18	223		197	153	290		3.0		888	1.21	182	246	84	66		1,510	--
30. COLORADO RIVER AT BALLINGER																						
Water year 1962																						
Maximum, May 1-31, 1962	3.5	7.8		355	124	974		124	1,000	1,680		1.5		4,200	5.71	39.7	1,400	1,290	60	11	6,550	6.6
Minimum, Sept. 5-30	2,005	12		43	11	79		144	66	98		2.8		384	.52	2,080	152	34	53	2.8	668	--
Weighted average	177	12		54	15	110		142	96	154		2.9		517	.70	--	194	77	--	3.1	892	7.4
Water year 1963																						
Maximum, May 2-5, 1963	160	5.0		395	137	1,960		129	1,140	3,200		--		6,900	9.38	2,980	1,550	1,440	73	22	10,600	7.4
Minimum, Aug. 14	622	9.2		32	4.2	13		105	15	15		3.2		144	.20	242	97	11	23	.6	249	7.4
Weighted average	58.7	9.1		105	30	300		121	235	488		2.5		1,230	1.67	220	383	283	--	5.9	2,050	7.2
Water year 1964																						
Maximum, Sept. 15, 1964	167	3.3		165	80	922		110	396	1,590		1.0		3,210	4.37	--	740	650	73	15	5,500	6.9
Minimum, Sept. 19-30	432	6.9		44	11	36		114	49	62		3.0		268	.36	--	155	62	34	1.3	491	6.8
Weighted average	60.1	9.4		64	17	107		113	118	171		2.9		545	.74	--	228	135	45	2.8	939	7.0
Water year 1965																						
Maximum, Apr. 27, 1965	419	11		265	68	655		132	634	1,130		2.5		2,830	3.85	--	940	832	60	9.3	4,330	7.5
Minimum, Apr. 28-29	395	11		52	7.7	45		155	46	58		2.0		302	.41	--	161	34	38	1.7	521	8.2
Weighted average	198	8.0		61	14	88		146	79	138		3.1		463	.63	--	206	87	44	2.4	833	7.1

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
89. SAN SABA RIVER AT SAN SABA																						
Water year 1963																						
Maximum, Dec. 1-31, 1962	66.5	12		62	31	14		323	16	20	0.3	1.8		316	0.43	56.7	282	18	9	0.4	556	7.6
Minimum, May 8-16, 1963-	52.6	11		41	15	13		192	14	14	--	1.5		204	.28	29.0	164	7	15	.4	357	7.2
Weighted average-	52.7	12		51	28	15		276	16	20	.3	1.5		281	.38	42.0	241	15	--	.4	494	7.3
Water year 1964																						
Maximum, Aug. 2-6, 1964-	4.0	16		41	34	46		280	34	54	.3	.5		364	.50	3.93	242	13	29	1.3	636	7.3
Minimum, Sept. 20-29----	481	10		40	4.9	3.0	4.0	140	7.6	3.7		3.8		146	.20	190	120	5	5	.1	257	7.5
Weighted average-	180	10		51	20	12		245	15	14		2.0		246	.33	--	210	9	--	.3	441	7.5
Water year 1965																						
Maximum, Nov. 1-19, 1964-	135	13		71	26	21		336	20	20	.2	5.0		341	.46	--	284	8	14	.5	584	8.2
Minimum, Nov. 20-23-----	442	8.0		40	11	11		172	11	10	--	3.0		179	.24	--	145	4	14	.4	322	8.1
Weighted average-	249	12		54	21	14		256	18	17	.2	3.8		267	.36	180	224	14	12	.4	466	7.4
91. COLORADO RIVER NEAR SAN SABA																						
Water year 1948																						
Maximum, Oct. 15-19, 1947	302	--		138	43	356		169	354	558	--	1.5		1,670	2.08	1,250	522	383	60	--	2,570	--
Minimum, Sept. 11-15, 1948	1,474	11		35	5.9	13		126	11	15	--	4.5		176	.24	700	112	8	20	--	281	--
Weighted average-	832	--		49	11	47		161	43	64	--	2.9		324	.44	728	168	36	37	--	537	--
Water year 1949																						
Maximum, Sept. 10-13, 17, 1949---	277	15		108	31	242		167	231	385	--	2.8		1,100	1.50	823	397	260	57	--	1,920	7.8
Minimum, Apr. 21-23, 27-30, 1949----	18,880	11		38	5.7	17		126	16	22	--	5.4		189	.26	9,630	118	15	24	--	315	7.9
Weighted average-	1,309	12		45	9.4	34		147	31	48	--	3.5		270	.37	954	151	30	33	--	455	--
Water year 1950																						
Maximum, Aug. 2-3, 9, 1950--------	379	17		86	19	276		141	182	415	--	1.8		1,070	1.46	1,090	292	177	67	--	1,890	8.0
Minimum, Sept. 11, 21-23, 25, 27---	2,167	12		34	6.9	26		128	21	28	--	3.2		209	.28	1,220	113	8	33	--	345	7.7
Weighted average-	508	14		49	14	63		170	51	88	--	2.4		380	.52	521	180	40	43	--	642	--
Water year 1951																						
Maximum, July 9-10, 1951	528	14		89	21	286		139	154	463	--	3.0		1,220	1.50	1,570	308	194	67	--	2,030	7.8
Minimum, May 26--	17,800	14		33	4.2	8.6		118	9.1	7.0	--	3.0		137	.19	6,580	100	3	16	--	240	7.8
Weighted average-	585	15		43	9.4	39		142	32	56	--	2.8		280	.38	442	146	30	37	--	478	--

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
91. COLORADO RIVER NEAR SAN SABA--Continued																						
Water year 1952																						
Maximum, June 3, 1952---	3,640	19	--	86	17		137	145	142	223	--	1.2		732	1.00	7,190	284	166	51	3.5	1,220	8.1
Minimum, Sept. 11-13----	35,970	13	0.14	28	3.1		7.1	102	7.4	3.2	0.2	3.5		127	.17	12,330	83	0	10	.2	205	7.5
Weighted average-	651	15	--	36	6.4		16	129	16	19	--	3.0		184	.25	323	116	11	23	.7	311	--
Water year 1953																						
Maximum, July 19, 1953--	1,340	18	--	97	22		275	137	147	470	--	3.0		1,100	1.50	3,980	332	220	64	6.6	2,010	8.2
Minimum, Aug. 22-23, 25-27----------	7,550	12	--	39	6.4		15	129	24	16	--	4.0		189	.26	3,850	124	18	21	.6	310	7.8
Weighted average-	524	13	--	46	11		29	161	30	41	--	3.4		266	.36	376	160	28	28	1.0	446	--
Water year 1954																						
Maximum, Mar. 27-31, 1954	180	12	--	74	21		132	258	57	202	--	2.0		633	.86	308	271	60	51	3.5	1,130	8.2
Minimum, Oct. 5-12, 1953	7,264	12	--	38	5.6		20	127	17	25	--	4.2		190	.26	3,730	118	14	27	.8	317	7.9
Weighted average-	906	14	--	44	8.0		43	151	29	56	--	3.2		278	.38	680	143	20	40	1.6	481	--
Water year 1955																						
Maximum, Oct. 2-4, 1954-	198	15	--	108	40		264	188	233	432	--	2.2		1,190	1.62	636	434	280	57	5.5	2,060	7.9
Minimum, Sept. 23-25, 1955	22,030	8.8	--	26	3.2		6.0	94	4.0	5.5	--	2.5		102	.14	6,070	78	1	14	.3	174	7.6
Weighted average-	1,660	15	--	43	5.9		21	142	16	30	--	2.9		214	.29	959	132	15	26	.8	361	--
Water year 1956																						
Maximum, Aug. 21, 24-28, 1956----	161	13	--	88	39		425	180	188	680	--	2.0		1,520	2.07	661	380	232	71	9.5	2,710	8.1
Minimum, Oct. 1-5, 1955-	2,046	11	--	38	4.8		13	127	11	18	--	2.5		171	.23	945	114	10	20	.5	289	7.8
Weighted average-	772	10	--	44	6.6		32	145	21	43	--	2.6		242	.34	504	137	18	34	1.2	419	--
Water year 1957																						
Maximum, Aug. 28-31, Sept. 1-5, 1957	92.1	16	--	102	44		226	191	261	352	--	3.5		1,100	1.50	274	436	279	53	4.7	1,840	7.9
Minimum, July 20-31-----	16,020	11	--	36	3.7		13	120	9.4	16	--	2.0		149	.20	6,440	104	6	21	.6	253	7.6
Weighted average-	3,354	10	--	38	5.3		23	125	19	29	--	3.4		204	.28	1,850	117	14	30	.9	333	--
Water year 1958																						
Maximum, May 2, 1958----	1,800	7.8	--	100	27		245	156	190	400	--	3.8		1,050	1.43	5,100	360	232	60	5.6	1,820	8.1
Minimum, Oct. 14-18, 24-26, 1957----	25,570	8.0	--	29	4.6		14	110	11	12	--	3.0		148		10,220	91	1	25	.6	234	7.7
Weighted average-	1,503	9.9	--	49	12		40	160	38	57	--	4.3		304	.41	1,230	172	41	34	1.3	506	--
Water year 1959																						
Maximum, May 21-23, 30-31, 1959----	246	8.2	--	82	34		149	207	156	238	--	.8		818	1.11	543	344	175	48	3.5	1,350	7.7
Minimum, July 21-31	6,522	13	--	42	6.4		28	125	20	48	--	1.8		227	.31	4,000	131	29	32	1.1	380	7.4
Weighted average-	593	13	--	48	12		45	148	40	72	--	2.0		315	.43	504	170	48	37	1.5	536	--

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
91. COLORADO RIVER NEAR SAN SABA--Continued																						
Water year 1960																						
Maximum, Aug.13-14,1960-	204	18		78	35	354		176	167	560	--	1.5		1,300	1.77	716	338	194	69	8.4	2,310	7.8
Minimum, Oct. 4-8, 1959-	36,700	12		30	4.0	12		108	10	12	--	2.8		136	.18	13,480	91	3	23	.5	237	7.7
Weighted average-	1,253	12		50	13	40		158	43	63	--	4.2		316	.43	1,070	178	49	33	1.3	534	--
Water year 1961																						
Maximum, Sept. 6, 1961--	2,650	13		78	25	180		163	178	260	0.6	2.2		817	1.11	5,850	298	164	57	4.5	1,410	7.6
Minimum, Oct. 17, 1960--	5,700	14		37	9.0	6.2		147	6.0	11	--	.8		156	.21	2,400	129	9	9	.2	275	7.3
Weighted average-	1,073	10		53	16	51		170	46	84	--	2.4		357	.49	1,030	198	58	36	1.6	625	--
Water year 1962																						
Maximum, June 24-27,1962	160	11		202	82	564		162	500	1,000	--	4.0		2,440	3.32	1,050	842	708	59	8.5	4,120	7.2
Minimum, Oct.10-12, 1961	8,367	13		38	7.2	25		113	26	40	--	3.8		209	.28	4,720	124	32	30	1.0	365	7.4
Weighted average-	508	12		55	19	73		168	70	114	--	2.8		440	.59	--	215	77	--	2.0	755	7.6
Water year 1963																						
Maximum, May 7, 1963----	696	9.0		143	53	271		212	289	490	--	.2		1,360	1.85	2,560	576	402	--	--	2,320	6.9
Minimum, Oct. 9-16, 1962-----------	4,005	11		32	5.4	13	3.9	112	13	21	.3	.2		155	.21	1,680	102	10	21	.6	276	7.4
Weighted average-	446	9.8		59	14	59		165	54	101	--	1.0		384	.52	--	206	71	--	1.5	674	7.2
Water year 1964																						
Maximum, Aug. 23-24,1964	358	10		106	22	329		174	150	550	--	1.0		1,250	1.70	--	355	212	--	--	2,260	7.8
Minimum,Sept.22--	24,000	6.8		45	3.3	6.0		151	7.6	3.4	--	3.0		149	.20	9,660	126	2	9	.2	262	7.8
Weighted average-	595	8.6		55	9.9	29		174	31	45	--	2.0		267	.36	--	177	34	--	.8	475	7.4
Water year 1965																						
Maximum, Sept. 25, 1965-	1,670	6.2		127	28	267		176	100	540	--	2.2		1,160	1.58	--	432	288	57	5.6	2,320	7.7
Minimum,Jan.23-25	855	6.4		36	8.8	20		135	18	27	--	2.2		184	.25	--	126	15	26	.8	334	7.7
Weighted average-	1,122	8.4		57	12	33		184	34	54	--	2.1		291	.40	--	192	41	26	1.0	530	7.0
107. LAKE AUSTIN AT AUSTIN																						
Water year 1965																						
Maximum, Dec. 1-31, 1964		14		44	21	58		178	46	89	0.5	0.5		361	0.49		196	50	39	1.8	632	8.0
Minimum,July 1-31, 1965-----		9.1		44	14	25	3.7	169	27	44	.3	1.8		252	.34		167	29	24	.8	462	7.1

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) / Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
114. COLORADO RIVER AT AUSTIN																					
Water year 1948																					
Maximum, Oct. 1-31, 1947	1,136	8	0.02	35	21	36	186	33	50	0.0	0.8		322	0.44	988	174	22	32	--	493	8.4
Minimum, Sept. 1-30, 1948	1,193	10	--	39	14	27	149	27	45	--	1.2		254	.35	818	155	33	28	--	450	--
Weighted average-	1,319		--	40	19	39	174	35	57	--	.8		300	.41	1,070	178	36	32	--	526	--
Water year 1949																					
Maximum, Jan. 1-14, 17-31, 1949----	702	7.2	--	44	16	40	179	32	58	--	1.0		288	.39	546	176	30	33	--	515	--
Minimum, Oct. 1-4, 6-31, 1948-----	939	9.9	--	39	15	31	158	28	47	--	1.0		255	.35	647	159	30	30	--	447	--
Weighted average-	1,214	9.5	--	42	14	36	170	30	50	--	1.5		274	.37	898	162	23	33	--	487	--
Water year 1950																					
Maximum, Jan. 1 - Feb. 28, 1950--	914	15	--	44	14	34	169	31	49	.2	1.0		288	.39	711	167	29	31	--	480	7.7
Minimum, May 1-31-------	1,643	12	--	44	14	32	166	30	48	.2	1.8		251	.34	1,110	167	31	29	--	456	7.6
Weighted average-	1,263	11	--	41	14	34	162	30	48	.2	1.4		270	.37	921	160	27	32	--	464	--
Water year 1951																					
Maximum, Sept. 1-30, 1951	806	12	.03	40	16	48	154	39	67	.3	.8		299	.41	651	166	40	--	--	529	8.0
Minimum, Oct. 1-31, 1950	576	9.2	--	41	16	25	164	29	40	.2	1.2		260	.35	404	168	34	24	--	462	7.7
Weighted average-	1,056	11	--	39	17	37	161	35	55	.3	1.0		282	.38	804	167	35	32	--	497	--
Water year 1952																					
Maximum, Nov. 1-30, 1951	244	11	--	34	16	59	170	38	70	.2	1.5		340	.46	224	151	12	46	2.1	547	8.2
Minimum, Sept. 1-30, 1952	901	13	--	41	13	36	168	27	47	.3	1.8		262	.36	637	156	18	33	1.3	470	8.0
Weighted average-	754	11	--	40	14	44	160	35	61	.3	1.5		293	.40	596	158	26	38	1.5	522	--
Water year 1953																					
Maximum, Oct. 1-31, 1952	284	12	--	45	13	25	178	20	35	.3	3.0		250	.34	192	166	20	25	.8	431	8.2
Minimum, July 1-31, 1953	1893	10	--	42	11	18	161	17	26	.3	3.2		214	.29	1,090	150	18	21	.6	379	7.9
Weighted average-	921	11	--	43	11	19	164	17	27	.3	3.1		225	.31	560	152	18	21	.7	384	--
Water year 1954																					
Maximum, Jan. 1-31, 1954-	487	12	--	58	17	17	230	20	28	--	3.5		272	.37	358	214	26	15	.5	477	8.2
Minimum, May 1-31-	1,952	16	--	42	10	25	174	16	27	.4	2.0		224	.30	1,180	146	4	27	.9	389	8.2
Weighted average-	945	12	--	45	12	22	182	17	28	.3	1.9		235	.32	600	162	13	23	.8	408	--
Water year 1955																					
Maximum, Jan. 1-31, 1955-	287	9.4	.01	45	13	30	180	22	42	.3	1.2		262	.36	203	167	20	28	1.0	444	7.9
Minimum, July 1-31	2,805	7.2	--	42	11	29	162	21	40	.3	1.0		232	.32	1,760	149	16	30	1.0	428	8.2
Weighted average-	1,322	8.6	--	42	12	31	167	22	41	.3	1.0		243	.33	867	154	18	30	1.1	431	--

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
114. COLORADO RIVER AT AUSTIN--Continued																						
Water year 1956																						
Maximum, Oct. 1-31, 1955	2,243	7.4		42	10		33	157	23	46	0.2	0.7		249	0.34	1,510	146	18	33	1.2	425	7.8
Minimum, Apr. 1-30, 1956-	966	8.0		42	11		26	159	22	36	.4	1.2		225	.31	587	150	20	27	.9	423	8.1
Weighted average-	1,331	8.2		42	9.9		30	158	22	40	.3	1.1		234	.32	841	146	16	31	1.1	416	--
Water year 1957																						
Maximum, June 2-3, 1957-	12,360	14		49	9.2		31	168	29	39	.6	4.5		259	.35	8,640	161	24	29	1.0	433	8.1
Minimum, July 1-31, 1957-----------	4,899	11		39	6.4		13	131	13	19	.5	3.2		184	.25	2,430	124	16	18	.5	304	7.7
Weighted average-	4,900	9.1		38	7.1		23	137	17	30	.4	2.6		201	.27	2,660	124	12	28	.9	349	--
Water year 1958																						
Maximum, Feb. 1-28, 1958	4,359	9.4		46	9.9		20	164	19	28	.3	4.4		238	.32	2,800	156	21	22	.7	389	8.5
Minimum, Nov. 1-30, 1957-	6,268	9.2		40	7.6		18	146	17	22	.2	4.0		192	.26	3,250	132	12	23	.7	330	7.8
Weighted average-	4,353	9.2		45	9.8		18	163	19	24	.3	3.8		216	.29	2,540	153	20	20	.6	369	--
Water year 1959																						
Maximum, Aug. 5, 1959---	3,430	--		--	--		--	181	--	58	--	--		287	.39	2,660	175	26	--	--	501	7.9
Minimum, Oct. 1-31, 1958-	1,477	10		44	13		19	179	19	26	.1	2.0		221	.30	881	164	17	20	.6	387	8.2
Weighted average-	1,631	9.6		43	15		23	177	24	34	.2	2.3		249	.34	1,100	169	24	23	.8	428	--
Water year 1960																						
Maximum, Sept. 1-30, 1960	1,211	9.4		46	16		33	182	28	52	.3	.8		286	.39	935	181	32	28	1.1	488	7.6
Minimum, Oct. 8-31, 1959	9,247	12		32	9.8		23	126	19	31	.3	2.0		199	.27	4,970	120	17	29	.9	340	7.6
Weighted average-	246	10		40	14		27	160	25	41	.3	1.6		246	.33	2,340	158	26	27	.9	426	--
Water year 1961																						
Maximum, Jan. 1-31, 1961-	875	11		64	19		19	260	24	25	.2	5.6		297	.40	702	238	24	15	.5	517	7.6
Minimum, May 1-31, 1961-	2,440	9.2		45	18		25	190	25	41	.3	1.0		258	.35	1,700	186	31	23	.8	473	7.2
Weighted average-	2,502	10		46	18		27	193	26	41	.3	1.7		276	.38	1,860	189	31	24	.9	474	--
Water year 1962																						
Maximum, Mar. 1-31, 1962	175	9.5		48	18		37	193	37	54	.2	1.8		330	.45	156	194	36	29	1.2	540	7.5
Minimum, Nov. 1-30, 1961-	2,895	11		39	18		34	172	29	51	.3	.5		268	.36	2,090	172	30	30	1.1	464	7.2
Weighted average-	1,414	11		43	19	34	--	177	33	57	.3	1.6		293	.40	--	186	40	--	1.1	516	7.3
Water year 1963																						
Maximum, Sept. 1-30, 1963	1,462	11		44	22		52	175	45	87	.3	.2		348	.47	1,370	200	57	36	1.6	638	7.6
Minimum, Oct. 1-31, 1962	283	13		49	20		37	203	35	57	.4	1.2		313	.43	239	205	38	28	1.1	561	7.6
Weighted average-	1,056	11		47	21	46	--	182	42	78	.3	1.8		338	.46	964	204	56	--	1.4	603	7.2

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
114. COLORADO RIVER AT AUSTIN--Continued																						
Water year 1964																						
Maximum, Dec. 1-31, 1963-	43.9	9.7		62	24	49		245	47	75	0.4	2.2		389	0.53	46.1	253	52	30	1.3	685	7.9
Minimum, July 1-31, 1964-	1,568	8.1		42	22	47	4.1	174	45	82	.4	1.0		338	.46	1,430	196	53	34	1.5	610	7.5
Weighted average-	729	9.1		45	23	51		183	46	84	.4	.9		351	.48	--	207	56	--	1.6	632	7.6
Water year 1965																						
Maximum, Oct. 1-31, 1964-	132	9.2		48	22	46	3.4	196	45	79	.3	1.0		350	.48	--	210	50	32	1.4	628	8.1
Minimum, Aug. 2-31, 1965-	1,416	7.7		46	14	30		181	27	43	.2	1.2		258	.35	--	172	24	28	1.0	475	7.5
Weighted average-	1,475	9.8		47	17	32		180	32	53	.3	2.3		283	.38	--	187	39	28	1.0	513	7.2
133. COLORADO RIVER AT WHARTON																						
Water year 1944																						
Maximum, Apr. 21-30, 1944	1,430	--		54	17	36		211	36	51	--	2.0		300	0.41	1,250	205	32	28	--	531	--
Minimum, Sept. 1-10-----	4,220	--		40	12	17		149	23	28	--	1.5		229	.27	2,610	150	27	20	--	352	--
Weighted average-	2,649	--		47	15	26		175	32	41	--	2.4		279	.38	2,000	179	36	24	--	460	--
Water year 1945																						
Maximum, Mar. 1-10, 1945-	3,179	--		61	16	23		214	34	39	--	2.5		324	.44	2,780	218	42	19	--	502	--
Minimum, Jan. 19-24-----	14,700	--		41	7.6	4.3		121	22	14	--	1.5		180	.24	7,140	134	34	7	--	293	--
Weighted average-	3,766	--		47	13	18		168	27	32	--	1.9		255	.35	2,590	171	33	19	--	413	--
Water year 1946																						
Maximum, Nov. 21-30, 1945	2,299	--		48	19	24		174	27	43	--	1.0		358	.49	2,220	198	37	21	--	474	--
Minimum, July 3-6, 1946-	11,630	--		36	7.4	15		118	13	20	--	1.0		186	.25	5,840	120	10	21	--	286	--
Weighted average-	3,535	--		46	13	24		174	27	35	--	2.1		267	.36	2,550	168	26	24	--	427	--
Water year 1947																						
Maximum, Feb. 1-10, 1947-	3,617	--		63	18	32		216	35	49	--	2.0		337	.46	3,290	231	38	23	--	546	--
Minimum, Aug. 27-31	6,792	--		34	7.6	9.6		114	16	18	--	1.8		179	.24	3,280	116	23	15	--	271	--
Weighted average-	3,095	--		50	15	25		186	31	38	--	2.1		280	.38	2,340	186	34	23	--	454	--
Water year 1948																						
Maximum, Apr. 1-10, 1948	976	9.4		48	19	48		208	40	64	--	.8		386	.52	1,020	198	28	35	--	602	--
Minimum, May 26-31------	3,563	11		36	7.8	27		131	24	34	--	1.2		215	.29	2,070	122	15	33	--	365	--
Weighted average-	1,246	--		44	18	40		187	35	55	--	1.3		310	.42	1,040	184	30	32	--	530	--
Water year 1949																						
Maximum, Apr. 1-21, 1949	1,419	14		48	14	40		188	35	51	--	2.2		312	.42	1,200	178	24	33	--	524	7.8
Minimum, Feb. 24-28	12,030	8.4		28	4.1	19		104	12	20	--	1.5		144	.20	4,680	87	2	32	--	240	7.6
Weighted average-	1,804	12		39	11	27		148	27	36	--	2.0		237	.32	1,150	143	21	29	--	406	--

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
133. COLORADO RIVER AT WHARTON--Continued																						
Water year 1950																						
Maximum, Mar. 1-31, 1950-	1,052	9.0		55	15	35		201	36	50	0.2	1.8		314	0.43	892	198	34	28	--	531	8.0
Minimum, Jan. 1-6, 10-16, 20-------	1,637	13		32	6.6	14		108	21	18	.3	2.2		160	.22	707	107	18	23	--	278	7.8
Weighted average--	2,038	13		42	10	25		149	28	33	--	2.6		242	.33	1,330	146	24	27	--	402	--
Water year 1951																						
Maximum, Aug. 1-31, 1951-	757	15		43	16	44		168	37	66	.2	.5		329	.45	672	174	36	36	--	555	7.6
Minimum, June 1-5, 10, 13----------	1,419	17		40	6.7	16		130	28	17	.3	2.5		206	.28	789	127	21	21	--	325	7.9
Weighted average--	892	11		46	15	38		181	34	51	.3	1.3		286	.40	715	176	28	32	--	513	--
Water year 1952																						
Maximum, Nov. 1-30, 1951-	423	11		42	17	60		216	36	64	.2	.2		354	.48	404	175	0	43	2.0	598	8.1
Minimum, May 25-30, 1952------------	7,153	11		29	5.0	13		104	15	14	.2	2.0		154	.21	2,970	93	8	24	.6	250	7.5
Weighted average--	764	11		42	12	37		162	30	49	.3	1.5		263	.37	557	154	22	34	1.3	474	--
Water year 1953																						
Maximum, Oct. 1-31, 1952-	383	9.0		55	18	42	4.0	228	34	54	.4	1.0		331	.45	342	211	24	30	1.3	579	7.7
Minimum, Nov. 1-30-	659	8.4		31	5.9	10	3.5	101	19	11	.4	3.8		170	.23	302	102	19	18	.4	251	7.7
Weighted average--	1,345	11		38	8.6	19	3.8	142	22	25	.3	2.2		211	.29	766	130	14	23	.7	353	--
Water year 1954																						
Maximum, Feb. 1-28, 1954-	390	9.0		55	16	30	3.6	216	34	41	.3	1.0		306	.42	322	203	26	24	.9	532	8.0
Minimum, Nov. 1-6, 1953--	3,050	17		36	5.0	10	3.6	118	21	12	.4	2.5		167	.23	1,380	110	14	16	.4	270	8.0
Weighted average--	880	15		45	11	21	4.0	171	24	29	.3	2.1		239	.33	568	158	18	22	.7	406	--
Water year 1955																						
Maximum, Mar. 1-31, 1955-	360	8.6		54	14	36	4.8	223	29	47	.4	1.5		310	.42	301	192	10	28	1.1	539	8.0
Minimum, Feb. 6-15-	2,840	16		32	5.9	16	3.7	116	18	20	.5	4.5		182	.25	1,400	104	10	24	.7	298	7.9
Weighted average--	1,196	12		43	11	27	4.8	165	23	39	.2	1.9		244	.33	788	152	18	27	.9	431	--
Water year 1956																						
Maximum, Jan. 1-31, 1956-	461	5.2		56	11	32	4.8	212	26	44	.1	.5		288	.39	358	185	12	27	1.0	507	8.1
Minimum, Feb. 11-17	1,575	8.0		36	6.0	17	4.0	118	21	24	.2	2.4		178	.24	757	114	18	24	.7	313	7.7
Weighted average--	1,041	8.6		44	10	29	5.2	163	23	42	.4	1.2		246	.33	691	151	18	29	1.0	435	--
Water year 1957																						
Maximum, Dec. 1-25, 1956-	279	8.8		57	14	34	4.9	229	26	47	.4	.5		312	.42	235	199	12	26	1.0	544	8.2
Minimum, Sept. 27-29, 1957	24,360	10		24	1.2	7.0	5.2	77	11	9.5	1.4	1.0		108	.15	7,100	66	3	17	.4	169	7.7
Weighted average--	5,937	11		39	6.3	17	4.5	131	18	25	--	3.0		198	.27	3,170	124	16	22	.7	331	--

Table 5.--Summary of chemical analyses at daily stations on streams in the Colorado River basin--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Dissolved solids: Tons per day	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH
133. COLORADO RIVER AT WHARTON--Continued																						
Water year 1958																						
Maximum, Feb. 1-22, 1958	3,921	12		55	11	17	3.9	186	27	27	--	5.0		259	0.35	2,740	182	30	17	0.5	429	8.1
Minimum, Oct.15-19, 1957	37,620	8.4		29	3.0	5.8	3.6	94	13	6.8	--	2.5		118	.16	11,990	85	8	12	.3	199	7.9
Weighted average	6,128	11		45	8.4	14	3.7	153	22	22	--	4.4		211	.29	3,490	147	22	17	.5	354	--
Water year 1959																						
Maximum, Dec.1-31, 1959	876	6.4		58	16	25	3.3	218	36	37	--	3.0		302	.41	714	210	32	20	.8	522	8.0
Minimum, May 24-25, 1959	8,820	11		26	4.1	7.9	2.6	93	7.6	11	--	1.8		118	.16	2,810	82	6	17	.4	204	7.8
Weighted average	2,372	11		43	11	18	3.5	159	27	27	--	2.5		231	.31	1,480	152	22	20	.6	393	--
Water year 1960																						
Maximum, Sept.1-30, 1960	1,195	13		47	17	31		193	29	46	--	1.0		279	.38	900	188	30	26	1.0	491	7.5
Minimum, July 26-28	44,130	12		26	3.0	9.4		93	8.0	8.0	0.3	1.5		114	.16	13,580	78	2	21	.5	190	7.4
Weighted average	4,576	12		41	11	24		153	25	34	--	1.9		231	.31	2,850	148	22	26	.9	397	--
Water year 1961																						
Maximum, Jan. 16-31, 1961	2,030	14		70	14	32		253	40	34	.3	3.8		337	.46	1,850	232	24	23	.9	563	7.7
Minimum, Nov. 1-3, 1960	27,620	14		30	3.2	6.0	3.9	94	17	6.0	--	1.5		128	.17	9,550	88	11	12	.3	216	7.3
Weighted average	5,390	13		43	10	19		154	26	25	--	2.3		223	.30	3,250	148	22	22	.7	372	--
Water year 1962																						
Maximum, Apr. 16-27, 1962	705	14		60	18	42		216	50	60	--	1.2		368	.50	700	224	46	29	1.2	606	7.2
Minimum, Nov. 14-17, 1961	11,630	12		30	6.7	17		106	18	22	.3	1.8		160	.22	5,020	102	16	26	.7	278	7.1
Weighted average	1,716	13		49	16	35		190	35	49	.3	1.9		303	.41	--	187	31	--	1.1	511	7.4
Water year 1963																						
Maximum, Aug.1-31, 1963	841	12		49	21	53		183	45	89	.3	.8		360	.49	817	209	59	35	1.6	645	7.0
Minimum, Feb.20-25	4,610	10		42	7.0	19		108	42	28	--	5.4		206	.28	2,560	134	46	24	.7	365	7.1
Weighted average	997	12		52	17	40	--	182	45	62	.3	2.0		323	.44	869	199	50	--	1.2	563	7.3
Water year 1964																						
Maximum, May 1-31, 1964	848	13		55	23	58		200	51	98	.5	2.5		399	.54	--	232	68	35	1.7	667	7.9
Minimum, Mar. 1-15	836	6.2		44	9.0	26		156	29	30	.3	1.0		222	.30	--	147	19	27	.9	404	7.8
Weighted average	615	10		51	19	43		193	42	67	.4	1.2		328	.45	--	203	45	--	1.3	584	7.4
Water year 1965																						
Maximum, May 12, 1965	4,560	7.0		62	17	42		204	42	72	--	3.0		345	.47	--	224	57	29	1.2	653	7.9
Minimum, Feb. 14-21	11,270	8.4		41	4.7	11		132	21	10	--	2.2		163	.22	--	122	14	16	.4	280	8.0
Weighted average	2,378	8.9		49	11	24		165	32	35	--	1.9		243	.33	--	168	33	23	.7	437	7.1

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

(Results in parts per million except where indicated)

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
1. LAKE J. B. THOMAS NEAR VINCENT																						
May 28, 1953-----		10	0.18	22	5.3	70	3.2	147	61	29	0.6	4.0	0.16	277	--		77	0	65	--	472	7.6
Nov. 11----------		8.4	.00	16	3.6	46	2.2	103	40	18	.5	1.0	.22	A203	--		55	0	63	--	313	7.2
July 21, 1954----		8.2	.01	17	4.6	41	1.3	104	37	18	.7	3.0	.02	A189	--		61	0	59	--	324	7.9
Jan. 3, 1956-----		.6	.00	31	4.5	48		140	52	22	.7	.2	--	A225	0.31		97	0	52	2.1	388	8.0
Oct. 17----------		3.6	.00	32	6.1	53	3.6	173	45	22	.9	.4	--	252	.34		105	0	51	2.3	429	7.9
Feb. 6, 1957-----		3.4	.21	32	6.3	60		168	56	27	.8	.0	--	269	.37		105	0	56	2.6	468	7.7
Mar. 6, 1962-----		2.7	.04	34	7.3	63		176	62	29	.8	.0	--	A295	.40		115	0	54	2.6	494	7.2
Sept. 9, 1964----		5.1	--	27	7.9	72		184	62	28	1.0	.0	--	293	.40		100	0	61	3.1	503	7.2
Dec. 21----------		2.2	--	29	8.1	77		205	57	29	1.1	1.2	--	306	.42		106	0	61	3.2	516	8.0
Aug. 25, 1965----		4.0	--	28	8.3	77		194	63	31	1.0	.2	--	308	.42		104	0	62	3.3	537	7.0
6. DEEP CREEK NEAR DUNN																						
May 30, 1964-----	28.8	9.0		52	2.5	17		170	11	16	0.4	2.5		194	0.26		140	1	21	0.6	354	6.9
June 2-----------	1.03	6.0		36	4.4	28		108	21	41	.5	.2		190	.26		108	19	36	1.0	364	6.9
Sept. 17---------	.09	17		24	2.0	6.0	4.6	90	7.4	1.5	.5	4.0		111	.15		68	0	15	.3	166	8.0
May 11, 1965-----	7.80	8.7		32	4.7	15		126	14	9.3	.4	1.0		147	.20		99	0	25	.7	247	7.8
do---------------	20	8.6		60	3.0	17		208	14	8.5	.4	.2		214	.29		162	0	18	.6	375	7.2
May 12-----------	3.28	6.3		31	2.3	20		116	18	10	.4	.5		146	.20		87	0	33	.9	257	7.0
May 18-----------	11.1	14		30	2.7	32		C118	25	22	.3	.5		184	.25		86	6	45	1.5	314	8.6
June 11----------	917	9.0		61	4.9	57		218	28	61	.4	1.8		330	.45		172	0	42	1.9	591	6.9
7. SULPHUR CREEK NEAR DUNN																						
May 7, 1952-------	B.01	9.4		116	39	70		210	340	54	--	1.0		A771	1.05		450	278	25	1.4	1,090	7.2
Mar. 25, 1953-----		2.7		117	66	105		180	514	78	--	.2		A1,080	1.47		564	416	29	1.9	1,490	8.2
13. LAKE COLORADO CITY NEAR COLORADO CITY																						
Nov. 15, 1956-----		5.3	0.03	39	9.4	56	6.6	167	62	47	0.8	2.5		311	0.42		136	0	46	2.1	514	7.6
Nov. 6, 1958------		3.9		39	8.4	37		164	38	26	.5	.1		A241	.33		132	0	38	1.4	411	8.2
May 18, 1960------		1.2		38	11	49		172	52	37	--	.0		A296	.40		140	0	43	1.8	493	7.8
Dec. 22, 1964-----		4.3		42	12	63		185	64	50	.9	.8		328	.45		154	3	47	2.2	558	8.2

A Residue on evaporation at 180°C.
B Field estimate.
C Contains the equivalent of 10 ppm carbonate (CO_3).

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated)			Hardness as $CaCO_3$		Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
														Parts per million	Tons per acre-foot	Tons per day	Calcium, Magnesium	Non-carbonate				
14. CHAMPION CREEK NEAR COLORADO CITY																						
July 8, 1947				142	78	144		185	495	228		--		A1,280			675				1,890	
Nov. 3				98	33	68		183	235	94		1.8		620			380				960	
Oct. 7				112	73	137		127	466	205		.2		1,060			580				1,710	
15. CHAMPION CREEK RESERVOIR NEAR COLORADO CITY																						
May 17, 1960		1.1		50	18	34		154	97	32	--	0.0		A332	0.45		199	73	27	1.0	532	7.7
Mar. 25, 1964		.5		48	16	32		146	80	36	0.4	.2		285	.39		186	66	27	1.0	515	7.4
Sept. 10		.0		35	20	43		116	94	48	.5	.5		298	.41		170	75	35	1.4	536	7.0
Aug. 26, 1965		2.5		39	19	36		116	94	43	.4	.2		291	.40		176	80	31	1.2	526	6.7
16. SULPHUR SPRINGS CREEK NEAR BIG SPRING																						
May 15, 1965		12		20	2.5	8.8	7.2	94	7.2	1.2	0.2	0.8		106	0.14		60	0	22	0.5	167	7.2
17. CALF CREEK NEAR STANTON																						
May 15, 1965		12		28	2.7	4.5	7.4	100	8.0	6.5	0.2	0.5		119	0.16		81	0	10	0.2	201	7.1
18. BUZZARD CREEK AT U.S. HIGHWAY 87 NEAR BIG SPRING																						
May 15, 1965		4.6		158	252	1,500	59	89	2,020	1,850		3.0		5,890	8.01		1,430	1,360	68	17	8,260	6.8
19. NATURAL DAM SALT LAKE NEAR BIG SPRING																						
E Mar. 23, 1964		1.0	0.54	535	11,200	73,500	2,330	522	64,400	100,000	3.6	49	4.3	--			47,400	47,000	76		F130,000	6.8
Mar. 2, 1965		1.8		--	--	63,000	2,020	884	21,700	122,000				--			58,400	57,700	69		G196,000	7.0
Apr. 6		1.9		--	--	69,200	5,680	873	80,000	126,000				--			109,000	108,000	56		H153,000	6.7
May 17		.1		305	868	6,300		78	7,720	7,040				22,300			4,330	4,270	76		I 27,500	8.0
June 21, 1965		.2		707	2,540	16,700		218	16,800	21,800				58,700			12,200	12,000	75		J 69,300	6.9
Aug. 25		2.3		424	8,370	54,200		530	52,900	69,300				185,000			35,500	35,100	77		K153,000	6.9
20. BEALS CREEK ABOVE BIG SPRING																						
Sept. 13, 1962	36.1	4.5		88	213	765		64	838	1,300		1.5		3,240	4.41		1,100	1,040	60	10	5,090	6.3
21. BEALS CREEK AT BIG SPRING																						
Apr. 25, 1957		19		39	3.8	17		132	18	14		4.5		A192	0.26		113	5	25	0.7	298	8.1
May 11		18		30	2.3	11		98	9.4	10		4.5		133	.18		84	4	22	.5	226	8.0
May 18		14		58	22	119		83	111	218		3.0		A629	.86		235	167	52	3.4	1,060	8.0
May 25		12		61	30	150		91	131	275		2.5		A765	1.04		276	201	54	3.9	1,260	7.9

A Residue on evaporation at 180°C.
E Contains .95 ppm Aluminum (Al); .8 ppm Manganese (Mn); 116 ppm Lithium (Li); 372 ppm Bromine (Br); 2.7 ppm Iodine (I); 1.0 ppm Phosphate (PO_4).
F Density 1.218.
G Density 1.181.
H Density 1.280.
I Density 1.016.
J Density 1.046.
K Density 1.155.

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Dissolved solids Tons per acre-foot	Dissolved solids Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Hardness as $CaCO_3$ Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
26. MOUNTAIN CREEK RESERVOIR AT ROBERT LEE																						
June 19, 1951-----		7.2		26	4.7	11		92	24	3.4	0.1	1.5		A121			84	9	22		198	7.8
Nov. 14, 1956-----		5.2	0.08	36	3.4	1.8	4.7	111	16	2.0	0.3	2.3		127	0.18		103	12	3	0.1	214	7.4
28. OAK CREEK RESERVOIR NEAR BLACKWELL																						
Oct. 16, 1953-----		3.6	0.12	34	4.6	1.7	4.5	125	8.4	1.5	0.1	1.0	0.06	A127	0.17		104	1	3	0.1	222	7.8
Nov. 15, 1956-----		2.8	.03	36	6.9	3.2	7.4	133	15	6.5	.2	1.8		145	.20		119	10	5	.1	254	7.8
Nov. 6, 1958------		1.6	--	44	9.2	13		134	35	21	.1	.2		190	.26		148	38	16	.5	350	7.9
Apr. 28, 1964-----		1.5	--	49	13	26		122	76	37	.2	.0		263	.36		176	76	24	.9	474	6.8
May 11, 1965------		1.1	--	47	12	22		128	64	29	.3	.2		239	.33		167	62	22	.7	428	7.0
29. OAK CREEK NEAR BLACKWELL																						
Apr. 21, 1950-----		20		36	4.2	10		102	32	6.0		3.8		162	0.22		107	23	17		245	7.6
May 11------------		19		37	8.5	15		140	30	8.0		3.2		190	.26		127	13	20		290	7.6
June 5------------		20		26	5.6	14		104	26	3.0		2.2		A116	.16		88	3	26		170	7.6
July 7------------		9.5		--	--	20		99	54	6.0		1.0		A165	.22		102	21	30		255	7.0
31. LAKE WINTERS NEAR WINTERS																						
Aug. 16, 1963-----		9.0	0.43	44	11	23		176	22	26	0.5	1.0		224	0.30		155	11	25	0.8	377	7.5
Nov. 13, 1964-----		3.0	.02	34	9.0	18		155	13	13	.7	.2		167	.23		122	0	24	.7	302	7.1
32. ELM CREEK AT BALLINGER																						
Mar. 11, 1964-----	1.7	4.6		71	38	110		166	98	235	0.4	2.0		641	0.87		334	198	42	2.6	1,190	6.9
Aug. 25-----------	5.2	10		42	16	37		138	18	83	.4	3.0		277	.38		171	58	32	1.2	555	6.7
Sept. 1-----------	16.4	7.3		32	7.8	18		102	19	34	.3	.0		168	.23		112	28	26	.7	316	6.8
May 6, 1965-------	1,830	.4		107	73	246		220	150	540	.7	2.8		1,230	1.67		567	386	49	4.5	2,270	7.3
do----------------	1,910	7.8		107	51	98		162	227	226	.4	1.0		798	1.09		477	344	31	2.0	1,380	7.3
do----------------	1,730	8.8		60	13	36		192	36	60	.3	1.5		310	.42		203	46	28	1.1	568	7.5
May 7-------------	153	4.8		47	19	64		106	57	131	.3	2.2		377	.51		196	108	42	2.0	725	7.0
Sept. 23----------	14.8	5.3		42	15	58		86	52	119	.1	.2		334	.45		168	98	43	1.9	643	6.5
36. SOUTH CONCHO RIVER AT CHRISTOVAL																						
May 9, 1950-------	--	14		64	18	41		278	22	50	--	2.0		348	0.47		234	6	28	--	654	8.0
Sept. 23, 1964----	670	45		--	--	14		171	4.2	9.2	0.6	8.3		--	--		136	0	18	0.5	306	8.2
Apr. 2, 1965------	11.2	14		90	21	56		314	19	106	.4	4.8		465	.63		311	54	28	1.4	864	7.2
June 7------------	11.1	14		88	19	51		312	16	95	.4	2.2		439	.60		298	42	27	1.3	792	7.2
Aug. 17-----------	4.23	16		87	20	54		306	16	103	.4	2.8		449	.61		300	48	28	1.4	815	7.1
37. MIDDLE CONCHO RIVER ABOVE TANKERSLY																						
Aug. 17, 1964-----	5.30	5.9		28	2.2	1.0	4.1	93	4.6	2.0	0.1	2.5		96	0.13		79	3	3	0.0	170	6.6
do----------------	318	13		56	6.4	4.2	6.7	196	15	4.4	.3	2.5		204	.28		166	5	5	.1	347	6.9
do----------------	826	8.8		55	4.1	2.2	5.6	182	10	2.4	.2	4.5		182	.25		154	5	3	.1	316	6.9
Aug. 19-----------	5.09	9.6		36	3.5	1.8	5.6	126	8.0	1.7	.3	1.8		130	.18		104	1	3	.1	227	6.8
Sept. 22----------	1,690	9.1		56	4.4	1.9	5.2	190	4.8	3.0	.2	7.0		185	.25		158	2	2	.1	318	7.1
Sept. 23----------	122	9.1		46	3.5	2.5	4.4	158	6.4	3.1	.2	1.8		155	.21		129	0	4	.1	266	7.0
Sept. 25----------	485	7.5		57	4.3	1.8	3.8	198	6.0	1.4	.3	.0		179	.24		160	0	2	.1	312	7.1
Oct. 12-----------	.05	11		52	16	16		201	35	19	.2	1.8		250	.34		196	31	15	.5	434	7.4
May 18, 1965------	428	12		29	3.6	2.9	3.9	107	6.0	1.9	.2	3.8		116	.16		87	0	6	.1	192	7.5

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
40. SPRING CREEK ABOVE TANKERSLY																						
Sept. 22, 1964	385	8.3		44	3.5	3.8	4.3	147	9.0	5.6	0.2	1.5		152	0.21		124	4	6	0.1	265	7.1
Sept. 23	7.98	8.4		33	3.3	4.7	4.2	114	9.8	6.7	.3	.0		126	.17		96	2	9	.2	220	6.9
Sept. 24	4.14	8.7		29	4.8	5.3	4.1	104	11	8.5	.3	.0		123	.17		92	7	11	.2	212	6.8
Oct. 12	.06	15		57	17		53	189	68	71	.2	.2		374	.51		212	57	35	1.6	638	7.4
41. DOVE CREEK SPRINGS NEAR KNICKERBOCKER																						
Sept. 27, 1949	10.8	29		69	20		121	236	24	208		6.8		A596	0.81		254	60	51	3.3	1,180	7.9
Apr. 1, 1965	4.59	16		77	16		17	293	15	21	0.5	10		316	.43		258	18	12	.5	542	7.6
43. DOVE CREEK AT KNICKERBOCKER																						
Feb. 26, 1965	3.04	11		60	20		31	244	24	51	0.6	0.2		318	0.43		232	32	22	0.9	567	7.2
45. TWIN BUTTES RESERVOIR NEAR SAN ANGELO																						
L Sept. 23, 1964		17		47	33		182	M158	48	330	0.9	1.2		737	1.00		253	128	61	5.0	1,360	8.3
N do		14		42	20		91	126	73	142	.5	4.0		448	.61		188	84	51	2.9	754	8.2
L May 4, 1965		2.6		61	22		107	202	32	195	.3	.2		519	.71		242	77	49	3.0	1,010	7.0
N do		3.6		64	27		128	192	92	208	.5	.2		617	.84		270	113	51	3.4	1,130	7.2
L Aug. 16		1.3		50	20		110	174	33	190	.4	.2		491	.67		208	65	53	3.3	943	7.3
N do		7.5		49	19		78	173	47	126	.4	.2		412	.56		200	58	46	2.4	768	7.0
48. LAKE NASWORTHY NEAR SAN ANGELO																						
Nov. 6, 1958		7.6		56	14		39	210	27	56	0.3	1.0		A310	0.42		197	25	30	1.2	549	7.9
Mar. 9, 1964		4.8		133	71		350	162	318	650	.4	3.2		1,610	2.19		624	491	55	6.1	2,770	6.9
Apr. 2, 1965		.4		65	20		77	207	54	132	.3	.2		451	.61		244	75	41	2.1	835	7.3
May 4		2.3		55	25		96	172	71	165	.3	.5		500	.68		240	99	47	2.7	952	6.9
49. SOUTH CONCHO RIVER AT SAN ANGELO																						
Sept. 16, 1947				47	22		53	226	36	71		0.5		A362	0.49		208	23	36	1.6	628	
Mar. 3, 1952		13		68	25		63	260	57	94		1.2		A481	.65		272	60	33	1.7	785	8.0
51. NORTH CONCHO RIVER AT STERLING CITY																						
Aug. 10, 1945	1.3			82	28		36	322	45	61		1.5		A484	0.66		320	56	20	0.9		
Sept. 24, 1964	730	20		31	3.3	6.0	3.9	117	5.2	2.8	0.6	4.0		135	.18		91	0	12	.3	216	8.1

A Residue on evaporation at 180°C.
L South Concho Pool.
M Includes the equivalent of 3 ppm carbonate (CO_3).
N Middle Concho Pool.

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Non-carbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
53. NORTH CONCHO RIVER NEAR CARLSBAD																						
May 23, 1963	234	10		34	4.4	2.3	4.3	120	5.2	3.0	0.2	4.9		127	0.17		103	5	4	0.1	214	6.9
May 24	67.7	10		40	5.4	6.2	4.5	142	9.6	8.5	.3	3.0		158	.21		122	6	10	.2	266	6.8
May 27	1.90	11		37	8.9	11		136	21	12	.4	2.2		170	.23		129	17	16	.4	291	6.5
May 29	.09	--		--	--	13	4.5	178	17	--	--	.0		--	--		134	0	17	.5	409	6.7
Aug. 15	1.43	7.0		28	4.4	4.0	4.7	102	10	4.4	.3	1.2		114	.16		88	4	8	.2	194	7.1
Nov. 19	255	9.0		43	3.1	1.9	5.1	143	5.2	1.3	.2	4.2		143	.19		120	3	3	.1	248	7.7
do	75.5	6.6		53	2.1	.9	4.4	172	2.0	1.1	.2	1.8		157	.21		141	0	1	.0	283	7.4
Nov. 20	2.18	5.4		48	2.0	1.0	5.0	159	2.8	1.5	.1	.8		145	.20		128	0	2	.0	262	7.5
June 1, 1964	.68	9.1		44	9.3	7.3	6.0	143	14	26	.3	1.2		187	.25		148	31	9	.3	342	6.8
Aug. 18	115	11		56	6.4	3.7	5.8	196	12	5.2	.3	1.5		198	.27		166	5	4	.1	338	6.8
Sept. 24	3,220	24		32	3.0	4.2	4.4	116	4.6	1.5	.3	7.2		138	.19		92	0	9	.2	205	7.9
Sept. 25	661	32		--	--	11		132	5.6	3.9	.3	4.2		--	--		100	0	19	.5	230	8.2
Sept. 28	13.0	16		--	--	7.1	3.9	104	15	8.9	.3	.0		--	--		95	10	13	.3	224	8.0
Nov. 30	B.04	9.6		50	15	13		196	30	16	.2	.0		230	.31		186	26	13	.4	412	7.6
May 16, 1965	2,470	16		34	3.4	3.1	4.9	118	6.6	2.3	.3	5.3		134	.18		99	2	6	.1	218	7.5
Sept. 1,	68	5.5		42	1.8	1.0	3.7	138	3.0	.8	.1	3.2		129	.18		112	0	2	.0	231	7.1
56. SAN ANGELO RESERVOIR AT SAN ANGELO																						
Oct. 16, 1953		7.8	0.08	36	5.5	4.0	4.3	139	4.0	4.2	0.3	1.0		A138	0.19		112	0	7	0.2	240	7.9
Nov. 6, 1958		1.3		40	7.2	10		158	8.4	9.5	.1	.4		A162	.22		129	0	15	.4	290	8.0
May 19, 1960		1.8		38	9.0	13		159	12	12	--	.2		164	.22		132	2	18	.5	314	7.7
Sept. 23, 1961		--		--	--	--		151	12	13	--	--		--	--		122	0	--	--	304	7.1
Apr. 5, 1965		1.8		44	13	26		191	22	27	.2	.8		229	.31		163	7	25	.9	426	7.5
57. NORTH CONCHO RIVER AT SAN ANGELO																						
Sept. 16, 1947				75	40	180		261	100	300		1.8		A920	1.25		352	138	53	4.2	1,500	
Sept. 23, 1961	B3.4							348	98	190							355	70			1,280	7.4
59. CONCHO RIVER NEAR PAINT ROCK																						
Apr. 18, 1946	1.6	9.2	0.19	74	46	101	7.7	214	144	196	0.4	1.2		685	0.93		374	198	37	2.3	1,210	7.3
Apr. 28, 1948	--	7.5		53	24	48		127	88	99	--	1.2		383	.52		231	127	31	1.4	717	--
July 27	--	8.8		44	19	39		128	67	68	--	2.8		312	.41		188	83	31	1.2	568	--
Sept. 21	--	20		58	29	71		144	110	132	--	.0		491	.67		266	146	37	1.9	868	--
Nov. 22	19	9.8		66	29	61		191	106	106	--	.0		472	.64		284	127	32	1.6	824	--

A Residue on evaporation at 180°C.
B Field estimate.

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated): Parts per million	Dissolved solids (calculated): Tons per acre-foot	Dissolved solids (calculated): Tons per day	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
59. CONCHO RIVER NEAR PAINT ROCK--Continued																						
Oct. 26, 1949-----	--	20		33	9.1		16	120	15	27	--	2.5		182	0.25		120	21	22	0.6	309	--
Mar. 11, 1964-----	6.34	2.8		155	84		158	184	414	345	0.5	5.7		1,260	1.71		732	581	32	2.5	2,020	6.9
Apr. 16-----------	.24	.9		158	93		176	154	462	390	.5	1.8		1,360	1.85		776	650	33	2.7	2,160	7.0
Aug. 25-----------	4.43	13		73	28		102	97	80	250	.4	3.0		597	.81		298	218	43	2.6	1,120	6.4
Aug. 30-----------	2,850	16		50	11		25	138	50	38	.4	5.1		264	.36		170	57	24	.8	448	7.1
Dec. 16-----------	14.5	2.5		106	39		55	138	237	130	.4	1.2		639	.87		425	312	22	1.2	1,040	7.8
Mar. 1, 1965------	13.0	2.2		158	84		172	202	414	360	.6	8.7		1,300	1.77		740	574	34	2.8	2,150	7.5
Apr. 5------------	4.01	1.1		136	83		204	176	380	412	.5	2.0		1,310	1.78		681	537	39	3.4	2,180	6.9
June 9------------	92.1	16		38	4.9		19	M116	21	26	.3	1.2		183	.25		115	20	26	.8	310	8.5
60. MUKEWATER CREEK SUBWATERSHED NO. 9 NEAR TRICKHAM																						
Dec. 6, 1961------	--	0.0		27	4.3	4.3	5.8	106	3.0	7.0	0.3	0.0		104	0.14		85	0	9	0.2	196	7.1
Jan. 8, 1962------	--	.5		31	4.1	4.6	5.8	119	3.6	6.0	.2	.4		115	.16		94	0	9	.2	220	7.0
June 5------------	--	3.6		27	6.2	8.0	7.0	118	4.2	11	.3	1.2		126	.17		93	0	15	.4	234	7.4
June 13-----------	--	2.8		24	5.8	7.7	6.4	106	4.2	10	.3	.8		114	.16		84	0	15	.4	214	7.4
July 3------------	--	5.0		22	3.1	6.1	6.1	89	3.6	7.5	.3	.8		98	.13		68	0	15	.3	183	7.2
May 23, 1963------	2.2	4.8		18	2.7	3.8	5.8	68	4.0	6.0	.2	.0		78	.11		56	0	12	.2	137	6.2
Apr. 23, 1964-----	13.1	1.6		33	3.3	3.8	5.2	115	4.6	6.3	.2	.2		115	.16		96	2	7	.2	217	7.2
Apr. 24-----------	37	10		24	2.0		10	92	4.0	4.6	.3	3.8		104	.14		68	0	24	.5	165	6.7
61. MUKEWATER CREEK AT TRICKHAM																						
Sept. 18, 1962----	0.06	7.8		26	2.3	4.1	5.7	85	7.2	8.0	0.2	1.8		105	0.14		74	5	10	0.2	174	6.4
Oct. 18-----------	.10	11		27	2.5	3.9	4.9	95	5.2	4.0	.3	.2		106	.14		78	0	9	.2	173	6.7
May 21, 1963------	360	9.9		40	1.0	2.9	5.0	125	6.2	5.0	.2	.0		131	.18		104	1	5	.1	222	6.6
June 17-----------	290	10		30	2.0	6.5	4.6	94	4.2	14	.2	1.2		119	.16		83	6	14	.3	205	7.1
Apr. 23, 1964-----	145	9.7		45	2.4		15	128	6.2	29	.2	1.2		172	.23		122	17	21	.6	317	6.6
Nov. 17-----------	972	8.0		58	2.5	3.0	3.2	189	4.8	3.2	.3	2.8		179	.24		155	0	4	.1	314	7.4
63. DEEP CREEK SUBWATERSHED NO. 1 NEAR PLACID																						
Oct. 4, 1961------		5.9		40	7.2		12	128	19	21	0.4	1.0		170	0.23		129	24	17	0.5	297	7.3
64. DEEP CREEK SUBWATERSHED NO. 2 NEAR PLACID																						
Oct. 4, 1961------		3.7		34	3.6	6.0	3.8	102	16	12	0.5	0.8		A142	0.19		100	16	11	0.3	233	7.2

A Residue on evaporation at 180°C.
M Includes the equivalent of 7 ppm carbonate (CO_3).

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
65. DEEP CREEK SUBWATERSHED NO. 3 NEAR PLACID																						
Oct. 4, 1961		6.2		39	6.7		18	107	15	42	0.4	1.0		181	0.25		125	37	24	0.7	331	7.3
Oct. 10		5.3		36	6.0		15	100	14	35	.4	.8		162	.22		114	33	22	.6	304	6.7
Nov. 8		4.3		38	6.7		16	107	16	37	.4	.0		171	.23		122	35	22	.6	323	7.0
Dec. 6		3.3		41	6.9		16	114	17	38	.4	.8		179	.24		131	37	21	.6	335	7.0
Jan. 3, 1962		2.2		46	7.3		15	128	18	38	.4	.0		A208	.28		145	40	21	.5	364	7.2
Feb. 2		1.7		50	7.7		16	136	20	40	.4	.5		203	.28		156	45	18	.6	392	7.0
Feb. 19		1.6		51	7.4		18	137	21	44	.4	.8		211	.29		158	45	20	.6	401	6.7
66. DEEP CREEK SUBWATERSHED NO. 4 NEAR PLACID																						
Oct. 4, 1961		13		48	6.8		15	131	35	25	0.4	0.5		208	0.28		148	40	18	0.5	348	7.3
67. DEEP CREEK SUBWATERSHED NO. 5 NEAR PLACID																						
Oct. 4, 1961		6.7		40	6.9		14	121	27	22	0.3	0.2		A193	0.26		128	29	20	0.5	309	7.4
69. DEEP CREEK SUBWATERSHED NO. 8 (DRY PRONG DEEP CREEK) NEAR MERCURY																						
Oct. 13, 1961		6.6		22	1.9	4.3	5.1	71	6.8	5.0	0.3	3.0		90	0.12		63	4	12	0.2	153	6.5
71. JIM NED CREEK NEAR COLEMAN																						
Oct. 9, 1961	216	8.9		32	4.2	7.2	3.9	107	10	13	0.2	1.8		134	0.18		97	9	13	0.3	223	7.6
Oct. 10	36.2	9.5		37	4.7		16	123	12	22	.3	1.2		A172	.23		112	11	24	.7	271	7.3
Oct. 13	12.0	9.9		50	8.0		23	162	25	34	.3	1.0		A235	.32		158	25	24	.8	407	7.0
July 26, 1962	2,540	13		68	4.4	6.2	4.8	216	12	11	.2	.8		A239	.33		188	11	7	.2	379	6.7
do	2,080	11		64	3.6	4.7	4.4	201	8.8	8.7	.2	.0		A213	.29		174	10	5	.2	348	6.7
July 27	428	8.3		38	4.2		11	119	9.2	20	.2	.2		A163	.22		112	15	18	.5	265	6.4
Oct. 15	B7.2	9.8		47	9.1		37	160	36	46	.4	.0		A274	.37		155	24	34	1.3	458	6.8
May 23, 1963	117	8.1		44	4.9		15	146	13	20	.3	.5		178	.24		130	10	20	.6	310	6.5
May 30	B5.5	--		--	--		--	119	19	28	--	--		--	--		116	18	--	--	327	7.1
May 31	B1,470	--		--	--		--	102	8.2	14	--	--		--	--		91	7	--	--	236	7.3
Apr. 23, 1964	B30	1.5		52	12		57	140	46	98	.3	.5		336	.46		179	64	41	1.9	623	7.7
Apr. 24	27.4	5.2		56	11		91	140	42	158	.1	.5		433	.59		184	70	52	2.9	815	6.9
June 15	8.85	10		74	13		54	187	75	88	.4	.0		406	.55		238	85	33	1.5	719	6.8
Sept. 21	9.34	8.0		31	4.8	5.4	4.1	106	14	8.2	.3	1.8		130	.18		97	10	10	.2	228	6.8
Sept. 25	6.21	8.2		40	6.4		14	133	16	20	.4	2.0		172	.23		126	17	19	.5	311	7.0
May 13, 1965	1,650	20		36	3.5		13	121	12	12	.3	3.8		161	.22		104	5	21	.6	261	7.4
May 19	522	18		40	3.0		11	126	11	14	.3	2.2		162	.22		112	9	18	.5	268	7.7

A Residue on evaporation at 180°C.
B Field estimate.

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated): Parts per million	Dissolved solids (calculated): Tons per acre-foot	Dissolved solids (calculated): Tons per day	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
72. HORDS CREEK RESERVOIR NEAR VALERA																						
July 28, 1949-----		15	--	36	4.3		11	138	8.8	6.0	--	2.0		108	0.21		108	0	19	0.5	247	7.8
Jan. 14, 1954-----		6.4	0.09	38	5.8	3.4	5.4	146	3.4	3.8	0.3	.5		A146	.20		119	0	6	.1	242	8.1
Mar. 13, 1964-----		3.4	--	45	5.8		16	148	12	25	.4	.2		181	.25		136	15	20	.6	345	7.3
Oct. 6------------		6.0	--	35	5.0		14	124	8.4	20	.0	.8		150	.20		108	6	23	.6	284	7.2
July 19, 1965-----		2.8	.03	41	4.8		14	138	8.8	21	.2	.2		161	.22		122	9	20	.6	308	7.0
73. HORDS CREEK NEAR VALERA																						
May 19, 1965------	96.8	10		36	3.7		14	117	9.6	19	0.2	2.0		152	0.21		105	9	22	0.6	273	6.9
74. HORDS CREEK AT COLEMAN																						
Apr. 22, 1964-----	16.4	8.4		42	4.4		16	106	24	33	0.0	0.0		180	0.24		123	36	22	0.6	336	6.5
Oct. 6------------	.13	12		94	19		59	227	84	118	.3	.8		499	.68		312	126	29	1.5	855	7.7
May 19, 1965------	250	11		41	4.8		15	124	17	23	.3	2.5		176	.24		122	20	21	.6	313	7.6
75. NORTH FORK PECAN BAYOU NEAR CLYDE																						
May 19, 1965------	2.25	16							106	263	0.3	2.0										
Sept. 22----------	2.82	7.5		44	6.9		48	70	37	102	.3	1.8		282	0.38		138	81	43	1.8	543	6.4
76. PECAN BAYOU AT BURKETT																						
Apr. 21, 1964-----	2.5	5.8		56	7.2		66	128	35	120	0.2	0.2		353	0.48		169	64	46	2.2	661	6.8
77. PECAN BAYOU AT FARM ROAD 2559 NEAR BROWNWOOD																						
Apr. 21, 1964-----	2,320	6.8		56	3.5		22	161	7.6	43	0.3	0.8		219	0.30		154	22	24	0.8	415	6.7
78. BROWN COUNTY WID NO. 1 CANAL NEAR BROWNWOOD																						
Oct. 29, 1963-----	29.5	5.9		48	6.4		30	132	20	58	0.3	0.0		234	0.32		146	38	31	1.1	444	6.6
Mar. 18, 1964-----	11.0	5.8		50	6.6		31	142	21	56	.3	.5		241	.33		152	36	30	1.1	456	7.3
Apr. 24-----------	21.2	6.0		48	7.4		29	137	21	56	.2	.0		235	.32		150	38	30	1.0	447	7.0
Oct. 21-----------	21.7	7.0		40	6.1		24	126	16	40	.2	.0		195	.27		125	22	29	.9	356	7.4
Dec. 30-----------	16.5	4.0		42	5.4		21	131	14	36	.2	.0		187	.25		127	20	27	.8	349	7.4
May 19, 1965------	21.0	4.6		37	4.5		18	114	15	28	.2	2.2		166	.23		111	17	27	.7	314	6.8

A Residue on evaporation at 180°C.

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Mag-ne-sium (Mg)	Sodium (Na)	Po-tas-sium (K)	Bi-car-bon-ate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Bo-ron (B)	Dissolved solids (calculated) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Cal-cium, Mag-ne-sium	Non-car-bon-ate	Per-cent so-dium	So-dium ad-sorp-tion ratio	Specific con-duct-ance (micro-mhos at 25°C)	pH
80. PECAN BAYOU AT BROWNWOOD																						
Apr. 28, 1948	--	6.2		46	8.9	25		152	22	41		0.0		224	0.31		151	27	26		431	
July 27	--	15		88	15	37		293	51	49		.8		400	.54		281	41	22		697	
Sept. 21	--	22		70	11	23		230	29	37		.2		306	.42		220	31	19		548	
Nov. 23	0.1	5.5		51	7.2	23		159	26	35		.2		254	.35		157	27	24		412	
Feb. 10, 1949	.4	7.0		54	9.4	24		181	26	36		.0		254	.36		173	25	23		457	
Apr. 21, 1964	960	4.3		54	18	33		177	63	49	0.4	.0		309	.42		208	64	26	1.0	562	6.9
81. PECAN BAYOU NEAR GOLDTHWAITE																						
Sept. 23, 1964	477	8.3		53	6.7	12		186	12	13	0.3	2.2		198	0.27		160	7	14	0.4	350	7.1
Nov. 20	2,520	7.5		60	6.9	21		194	16	34	.3	.0		241	.33		178	19	21	.7	433	7.3
82. SPRINGS AT FORT McKAVETT																						
Jan. 12, 1965	12.2	15		77	20	13		322	11	17	0.4	3.8		315	0.43		274	10	10	0.3	541	7.5
84. SAN SABA RIVER AT MENARD																						
Nov. 3, 1964	4.02	16		61	20	16		274	19	17	0.3	0.0		284	0.39		234	10	13	0.5	480	7.7
Jan. 12, 1965	13.3	12		64	22	16		296	14	19	.4	.0		293	.40		250	8	12	.4	509	7.6
Mar. 23	29.1	7.9		58	21	15		273	13	18	.4	.5		267	.36		227	3	14	.5	476	7.6
May 26	5.14	15		62	25	21		302	20	24	.4	.2		317	.46		258	10	15	.6	556	7.4
86. HARDIN CREEK AT EDEN																						
June 27, 1958		0.9		31	7.7	26		153	10	20	0.8	0.2		A181	0.25		109	0	34	1.1	314	7.5
87. BRADY CREEK RESERVOIR NEAR BRADY																						
Sept. 30, 1964		6.8		29	2.8	13		105	7.6	12	0.2	0.5		124	0.17		84	0	25	0.6	222	6.8
Jan. 14, 1965		4.2		45	4.3	15		164	8.0	13	.2	.5		171	.23		130	0	20	.6	311	7.2
Mar. 24		.9		49	4.3	15		174	8.8	14	.2	.0		178	.24		140	0	19	.6	333	7.4
88. BRADY CREEK AT BRADY																						
July 27, 1948	--	19		55	14	14		237	9.1	13	--	3.5		244	0.33		194	0	13	--	429	--
Sept. 21	--	14		34	9.3	9.9		150	12	6.0	--	.8		160	.22		123	0	15	--	278	--
May 19, 1960	B2	4.6		65	38	147		168	146	248	--	.2		A802	1.09		318	181	50	3.6	1,330	7.3
Oct. 9, 1961	5,620	9.0		26	3.6	15		88	13	18	.2	2.0		130	.18		80	8	30	.7	210	7.4

A Residue on evaporation at 180°C.
B Field estimate.

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
88. BRADY CREEK AT BRADY--Continued																						
Oct. 10, 1961	2,430	10		31	4.0	11		92	13	19	0.2	0.8		A143	0.19		94	18	20	0.5	225	7.6
Oct. 11	186	10		30	6.1	25		98	18	38	.2	1.8		177	.27		100	20	35	1.1	308	7.4
Apr. 3, 1964	.28	7.8		65	9.0	30		205	37	40	.3	.5		291	.40		199	31	25	.9	528	7.1
May 6	.21	9.3		67	9.5	34		236	28	40	.3	.2		304	.41		206	12	26	1.0	546	7.1
June 9	B.04	10		57	9.2	31		216	20	34	.4	2.0		270	.37		180	3	28	1.0	491	6.9
Sept. 30	2.20	8.6		40	3.7	6.7	4.0	128	13	11	.2	3.5		154	.21		115	10	11	.3	266	7.0
Nov. 6	.90	11		54	5.9	18		190	16	17	.3	.2		215	.29		159	3	19	.6	365	8.0
Jan. 14, 1965	.19	8.6		83	12	44		256	50	63	.3	.0		387	.53		256	46	27	1.2	663	7.6
90. SAN SABA SPRINGS AT SAN SABA																						
Jan. 14, 1965	6.62	9.0		68	35	95		348	8.4	159	0.2	2.8		548	0.75		314	28	40	2.3	992	7.6
92. BUCHANAN RESERVOIR NEAR BURNET																						
Jan. 13, 1965		6.4		42	13	44		140	38	69	0.3	1.2		283	0.38		158	44	37	1.5	518	7.3
93. NORTH LLANO RIVER NEAR JUNCTION																						
Sept. 28, 1964	218	15		62	15	6.8	2.8	237	15	13	0.3	11		258	0.35		216	22	6	0.2	435	7.6
Nov. 3	47.9	15		63	20	15		269	19	19	.3	4.8		288	.39		240	19	12	.4	490	7.9
Jan. 12, 1965	28.9	12		54	20	16		247	18	19	.3	2.2		262	.36		217	14	14	.5	455	7.7
Mar. 23	28.5	11		58	19	14		257	15	17	.3	2.2		262	.36		223	12	12	.4	460	7.7
94. SOUTH LLANO RIVER NEAR TELEGRAPH																						
Jan. 12, 1965	17.5	13		68	15	5.8	1.4	273	6.4	9.9	0.3	5.2		259	0.35		231	8	5	0.2	455	7.6
95. SEVEN HUNDRED SPRINGS NEAR TELEGRAPH																						
Jan. 12, 1965	15.7	13		68	15	6.7	1.5	272	6.4	9.8	0.3	5.7		260	0.35		231	8	6	0.2	449	7.6
96. LLANO RIVER NEAR JUNCTION																						
Mar. 31, 1964	76.5	11		55	17	8.4	1.5	236	11	14	0.3	0.8		235	0.32		207	14	8	0.3	423	7.4
May 5	70.0	12		58	17	8.7	1.7	250	11	13	.3	.2		245	.33		215	10	8	.3	442	7.0
June 8	56.6	13		50	17	10		228	9.4	14	.3	.0		226	.31		195	8	10	.3	404	7.4
July 14	30.9	16		51	18	13		241	9.8	14	.5	.0		241	.33		201	4	12	.4	420	7.4
Sept. 28	533	14		58	12	5.3	2.6	220	12	10	.3	7.2		229	.31		194	14	6	.2	391	7.6
Nov. 3	138	14		61	18	12		262	13	14	.2	4.5		266	.36		226	12	10	.3	447	7.8
Jan. 13, 1965	120	13		26	18	10		154	12	14	.2	3.2		172	.23		139	13	14	.4	304	7.8
Mar. 23	106	12		55	19	8.7	.9	243	12	14	.2	2.0		243	.33		215	16	8	.3	441	7.6

A Residue on evaporation at 180°C.
B Field estimate.

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Dissolved solids (calculated) Tons per acre-foot	Dissolved solids (calculated) Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Hardness as $CaCO_3$ Non-carbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
97. BEAVER CREEK NEAR MASON																						
Sept. 29, 1964	36.6	13		61	16		14	234	19	24	0.4	3.5		266	0.36		218	26	13	0.4	463	7.4
Nov. 4	9.28	8.8		47	26		27	237	22	46	.3	.0		294	.40		224	30	21	.8	524	7.7
Jan. 13, 1965	2.24	6.4		48	33		31	262	28	56	.4	.0		332	.45		256	41	21	.8	603	8.0
Mar. 23	4.65	4.2		44	28		26	234	26	44	.3	.5		288	.39		225	33	20	.8	547	8.1
Apr. 26	1.42	9.7		48	29		33	256	24	54	.3	.2		324	.44		240	30	23	.9	598	7.3
July 8	.27	15		46	27		43	246	24	64	.5	.2		341	.46		226	24	29	1.2	615	7.7
99. LLANO RIVER AT LLANO																						
Apr. 28, 1948	233	11		33	17		14	177	9.5	19	--	0.8		A214	--		152	7	17	0.5	353	--
July 27	216	14		40	16		9.3	182	11	16	--	3.5		200	--		166	16	11	.3	355	--
Sept. 21	88	18		37	14		8.5	176	8.2	10	--	1.8		184	--		150	6	11	.3	311	--
Nov. 21	86	8.2		38	21		3.6	191	9.6	16	--	.0		A197	0.27		181	25	4	.1	362	--
Feb. 8, 1949	108	6.2		40	22		12	213	13	19	--	.8		A224	.30		190	16	12	.4	401	--
May 19, 1960	114	9.0		35	22		19	197	16	29	--	.0		A237	.32		178	16	19	.6	417	7.7
Jan. 18, 1961	532	12		44	19		18	207	17	26	0.3	3.0		241	.33		188	18	17	.6	417	7.6
Oct. 11	187	12		33	20		12	183	13	18	.4	.5		A209	.28		165	15	14	.4	366	7.7
Apr. 2, 1964	97.9	3.5		39	22		14	207	15	22	.3	.2		218	.30		188	18	14	.4	414	7.5
May 6	70.5	7.0		36	22		14	205	11	21	.3	.2		212	.29		180	12	14	.5	403	7.4
June 8	48.5	8.1		32	20		15	186	11	22	.3	.0		199	.27		162	10	17	.5	374	7.2
July 14	4.14	10		31	23		23	195	12	34	.4	.0		230	.31		172	12	22	.8	426	7.1
Sept. 29	1,710	15		45	8.2		11	165	12	12	.5	5.9		191	.26		146	11	14	.4	325	7.2
Oct. 7	432	23		32	17		15	168	16	17	.4	4.5		208	.28		150	12	18	.5	344	8.1
Nov. 4	1,020	11		37	15		16	178	15	18	.3	.2		200	.27		154	8	18	.6	350	7.3
Jan. 13, 1965	148	6.0		42	22		16	219	16	23	.3	.5		234	.32		195	16	15	.5	430	7.6
Mar. 24	187	3.3		43	23		19	218	23	28	.4	.0		247	.34		202	23	17	.6	475	7.6
May 11	304	11		38	22		21	209	19	27	.3	.2		242	.33		185	14	19	.7	436	7.2
July 8	106	17		35	20		17	196	16	20	.3	.2		222	.30		170	9	18	.6	391	7.2
103. PEDERNALES RIVER NEAR JOHNSON CITY																						
Apr. 28, 1948	--	12		41	20		20	210	13	29	--	1.2		A285	--		185	12	19	--	443	--
July 27	--	9.2		38	29		25	235	15	42	--	1.2		A294	--		214	22	20	--	522	--
Sept. 21	--	11		38	42		53	246	30	106	--	.8		402	--		268	66	30	--	764	--
Nov. 21	9.8	2.4		50	44		31	234	35	102	--	.8		A387	0.53		306	134	18	--	779	--
Oct. 11, 1961	56	9.1		34	42		50	242	38	89	0.4	1.0		A404	.55		258	59	30	1.4	699	7.8
Apr. 2, 1964	44.4	3.2		50	31		30	244	35	56	.3	1.0		326	.44		252	52	20	.8	610	7.3
May 9	22.8	3.7		38	32		48	218	31	84	.3	.2		344	.47		226	48	31	1.4	597	7.5
Aug. 20	.12	14		15	44		26	234	20	39	.4	7.5		281	.38		218	26	21	.8	496	7.9
Sept. 28	276	10		48	11		12	182	14	18	.2	1.8		204	.28		165	16	14	.4	357	7.0
Oct. 1	39.1	10		41	16		20	173	22	32	.1	1.2		227	.31		168	26	20	.7	404	7.3

A Residue on evaporation at 180°C.
C Contains the equivalent of 12 ppm carbonate (CO_3).

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
103. PEDERNALES RIVER NEAR JOHNSON CITY--Continued																						
Jan. 16, 1965-----	11.6	1.3		42	43	54		270	38	98	0.3	0.2		410	0.56		282	60	30	1.4	758	7.5
Feb. 27-----------	74.1	6.5		51	29	23		254	28	41	.3	1.0		305	.41		246	38	17	.6	574	7.5
June 9------------	102	8.6		40	32	27		232	31	47	.3	.8		301	.41		232	42	20	.8	559	7.1
June 23-----------	18,600	6.7		40	5.2	3.3	3.3	149	6.4	3.8	.3	.2		142	.19		121	0	5	.1	254	6.9
106. BULL CREEK AT DOERNTGE PARK NEAR AUSTIN																						
July 5, 1960------		16		40	16	10		166	22	20	0.2	0.0		A212	0.29		166	30	12	0.3	358	7.6
109. BARTON CREEK AT HAYS COUNTY LINE NEAR DRIPPING SPRINGS																						
Oct. 17, 1961-----				50	16			216		15							191	14			396	7.5
110. BARTON CREEK ABOVE BARTON SPRINGS AT AUSTIN																						
June 2, 1965------	159	9.3		55	18	6.8	0.6	233	18	12	0.2	4.5		239	0.33		211	20	7	0.2	434	7.7
111. BARTON SPRINGS AT AUSTIN																						
Aug. 18, 1965-----	75.1	11		86	21	15		322	22	22	0.2	7.8		348	0.47		301	29	10	0.4	618	6.9
112. WALLER CREEK AT 38TH STREET AT AUSTIN																						
Oct. 5, 1961------	0.30	16		128	5.5	54		349	45	61	0.4	49		531	0.72		342	56	26	1.3	841	7.0
Apr. 27, 1962-----	14.1	4.8		67	2.5	6.4	2.3	194	12	8.0	.2	12		210	.29		177	18	7	.2	371	6.6
June 3------------	830	5.8		40	1.8	2.0	3.2	131	3.8	1.8	.1	1.0		124	.17		107	0	4	.1	190	7.3
Sept. 6-----------	52.0	4.0		28	1.7	5.5	3.0	88	7.0	9.0	.1	.8		102	.14		77	5	13	.3	180	7.4
Sept. 26----------	26.1	3.3		38	1.9	4.5	2.8	116	7.2	7.0	.1	1.2		123	.17		103	8	8	.2	222	6.9
Nov. 6------------	.49	13		106	7.5	38		297	40	56	.4	17		424	.58		296	52	22	1.0	709	7.6
Dec. 20-----------	2.31	--		--	--	--		205	--	28	--	--		--	--		173	5	--	--	442	6.5
Dec. 20-----------	43.4	--		--	--	--		174	--	4.8	--	--		--	--		148	5	--	--	300	6.7
113. WALLER CREEK AT 23RD STREET AT AUSTIN																						
Oct. 5, 1961------	1.42	14		110	8.7	50		275	61	75	0.4	30		484	0.66		310	85	26	1.2	803	6.9
Apr. 27, 1962-----	14.7	5.3		65	2.9	8.2	2.7	190	14	12	.2	7.9		211	.29		174	18	9	.3	383	6.6
June 3------------	1,380	6.0		42	1.9	2.6	3.2	137	5.4	2.8	.1	.2		131	.18		113	0	5	.1	204	7.0
Sept. 6-----------	76.5	4.3		32	1.8	6.1	3.0	95	8.8	11	.1	.2		114	.16		87	9	13	.3	199	7.2
Sept. 26----------	41.3	4.6		41	2.4	7.1	3.4	124	11	12	.1	2.2		145	.20		112	11	12	.3	258	6.9
Nov. 6------------	.84	11		90	9.8	43		242	53	70	.4	8.0		404	.55		265	66	26	1.1	685	7.5
Dec. 20-----------	42.4	--		--	--	--		224	--	24	--	--		--	--		200	16	--	--	459	6.5
do----------------	85.8	--		--	--	--		168	--	5.5	--	--		--	--		142	4	--	--	292	6.6

A Residue on evaporation at 180°C.

Table 6.--Chemical analyses of streams and reservoirs in the Colorado River basin for locations other than daily stations.

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Noncarbonate	Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
120. ONION CREEK BELOW DEL VALLE																						
Mar. 7, 1964------	0.32	4.2		71	17	26		256	63	18	0.5	1.0		327	0.44		247	37	19	0.7	573	7.1
May 9-------------	.13	9.6		54	11	21		212	33	12	.3	.0		245	.33		180	6	20	.7	431	7.1
Dec. 20-----------	2.67	7.4		90	17	29		288	71	33	.4	.8		391	.53		294	58	18	.7	639	8.0
Mar. 13, 1965-----	68.2	5.7		71	14	15		229	39	21	.3	12		291	.40		234	47	12	.4	504	7.6
July 13-----------	26.5	11		64	16	16		220	42	21	.3	6.3		285	.39		226	45	13	.5	496	7.1
Aug. 27-----------	2.25	9.3		50	11	16		180	34	12	.3	3.8		225	.31		170	22	17	.5	394	7.3
121. WILBARGER CREEK NEAR PFLUGERVILLE																						
Feb. 20, 1965-----	6.40	5.7		90	2.6	12		253	24	12	0.4	13		284	0.39		235	28	10	0.3	477	7.8
127. COLORADO RIVER AT LA GRANGE																						
June 11, 1952-----	1,880	9.4	0.00	42	13	37	1.2	148	37	56	0.3	2.0		A285	0.39		158	37	33	1.3	493	7.6
129. CUMMINS CREEK NEAR COLUMBUS																						
Mar. 17, 1959-----	B100	16		68	4.3	25		211	20	34	0.3	0.0		A280	0.38		187	14	23	0.8	470	7.7
Apr. 9------------	--	9.0		30	1.4	8.2	3.2	92	6.0	12	--	2.5		117	.16		81	5	17	.4	212	7.5
Dec. 1, 1960------	B250	16		57	3.9	19		185	11	25	.2	.2		A238	.32		158	7	20	.7	382	7.3
Mar. 28, 1962-----	B5	22		80	5.5	42		250	20	61	.4	.0		A354	.48		222	17	29	1.2	618	7.0
Nov. 2, 1964------	16.4	10		40	2.5	7.2	3.1	130	5.8	12	.2	.2		145	.20		110	4	12	.3	259	7.0
Dec. 7------------	4.20	17		78	4.7	30		240	8.0	52	.3	.0		308	.42		214	18	23	.9	534	7.6
Feb. 17, 1965-----	1,520	7.0		37	1.4	8.3	2.5	116	5.2	13	.2	.2		132	.18		98	3	15	.4	237	6.8
May 3-------------	7.98	18		56	6.0	42		160	23	71	.3	.2		296	.40		164	33	36	1.4	529	7.2
130. COLORADO RIVER AT COLUMBUS																						
Oct. 31, 1960-----	54,600	9.0	0.00	42	3.9	4.8	4.8	128	19	4.0	0.2	0.0		A160	0.22		121	16	8	0.2	267	7.6
June 6, 1963------	1,810							176		81							182	38			598	6.9
131. COLORADO RIVER NEAR EAGLE LAKE																						
Aug. 29, 1941-----				--	--	--		223	32	34		0.5		A293			178				470	
Sept. 1-----------				--	--	--		220	30	33		1.0		A298			206				487	
Oct. 4------------				--	--	--		175	26	37		--		A261			165				441	
Oct. 19-----------				--	--	--		183	23	29		--		A220			144				445	
Oct. 30-----------				49	11	16		166	28	26		1.0		A235			168				420	
Mar. 19, 1942-----				58	16	27		224	31	38		.8		A288			210				509	
Apr. 26, 1959-----		12		61	12	20		207	32	28	0.3	2.8		270	0.37		202	32	18	0.6	478	7.8
132. EAGLE LAKE AT EAGLE LAKE																						
Apr. 26, 1959-----		17		40	7.2	12		153	10	14	0.2	0.2		176	0.24		129	4	17	0.5	314	6.7
134. COLORADO RIVER NEAR BAY CITY																						
Apr. 25, 1959-----	3,160	11		54	9.7	22		177	36	26	0.2	2.5		248	0.34		175	30	21	0.7	439	7.3

A Residue on evaporation at 180°C.
B Field estimate.