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Report 189

MAJOR AND HISTORICAL SPRINGS OF TEXAS

March 1975

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MAJOR AND HISTORICAL SPRINGS OF TEXAS

By

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MAJOR AND HISTORICAL SPRINGS OF TEXAS

ABSTRACT

Springs have been very important to Texas from the time of its first inhabitants. Many battles were fought between the pioneers and Indians for possession of springs. Many springs afforded important stops on stagecoach routes, power for mills, water for medicinal treatment, municipal water supplies, and recreational parks.

Texas originally had 281 major and historically significant springs, other than saline springs. Of these, four were originally very large springs (over 100 cubic feet per second flow); however, only two, Comal and San Marcos, remain in that class today. Sixty-three springs, many with important historical backgrounds, have completely failed. Of the 281 springs studied, 139 issue from 2 underground reservoirs, the Edwards (Balcones Fault Zone) and the Edwards-Trinity (Plateau) aquifers. San Saba County, with 19 major and significant springs, leads all other counties in the State. Val Verde and Kerr Counties follow closely.

Although total flow of the springs included in this report has declined, it still amounts to about 1,150,000 acre-feet per year, and if all the smaller springs are included, the total annual flow probably exceeds 3,000,000 acre-feet.

The underground reservoirs from which springs arise may be cavernous limestone or gypsum, sand, gravel, or other permeable formations. Often faults have played an important role in the location of springs by damming up an underground reservoir, blocking lateral flow so that the water under hydrostatic pressure can only move upward to overflow as springs. In other cases arching, doming, and cracking of rock strata have caused the formation of springs.

Although a large number of water analyses were obtained and studied, no progressive trend toward contamination of spring waters could be found. At many springs, higher discharges are accompanied by decidedly lower concentrations of dissolved solids.

The decline of spring flows probably began soon after the first colonization of Texas by Spain. Clearing of forest land and heavy grazing of pastures probably reduced recharge. In the middle 1800's the drilling of many flowing wells, some of which spouted 84 feet above the land surface, greatly reduced the artesian pressure on springs. The natural "fountains," as the springs were described by early explorers, were soon a thing of the past. Heavy well pumping of underground waters for irrigation, municipal, and industrial purposes has continued the decline and disappearance of Texas springs. Surface reservoirs have inundated some springs but have increased the flow of others.

Detailed information is given separately for each spring, including the location, geologic setting, historical background, and discharge.

MAJOR AND HISTORICAL SPRINGS OF TEXAS

INTRODUCTION

Purpose of Study

The study of springs is a borderline discipline, because springs are the transition from ground water to surface water. Hence they have been studied to some extent by ground-water specialists and to some extent by surface-water specialists. Overall, however, they have been neglected. The purpose of this publication is to pull together information on major and historically significant springs in Texas, from ground-water reports, surface-water reports, historical documents, and field investigations.

Saline Springs

Included in this report are fresh-water springs (less than 1,000 milligrams per liter of dissolved solids) and slightly saline springs (1,000 to 3,000 milligrams per liter). Saline springs, containing more than 3,000 mg/l (milligrams per liter) of dissolved solids, are not included. The more important saline springs include a number in Childress, Cottle, Hall, King, and Stonewall Counties in northwest Texas, which issue from the Whitehorse Group and Blaine Gypsum. In south Texas, saline springs arise from sands of the Gulf Coast aquifer in Starr and Webb Counties. In Lampasas County is Hannah Saline Spring, formerly a well-known medicinal spring, issuing from the Marble Falls Limestone. Some of these springs are exceedingly saline, such as the Little Red Springs in Hall County, which contain 220,000 mg/l of dissolved solids, primarily sodium chloride. Efforts are under way to dam up the more saline springs and to allow the water to evaporate, thus preventing the salt from damaging downstream surface-water supplies.

Method of Study

For most of the larger springs in Texas discharge is measured frequently, in some cases daily, and water samples are taken for chemical analysis at regular intervals. These measurement stations are operated by the Texas Water Development Board, U.S. Geological Survey, and International Boundary and Water Commission. The smaller springs, which have not been measured or sampled nearly as frequently, were the prime target of field investigations conducted in this study. About 90 of these smaller springs were located and visited. Also, the geologic structure was studied, samples were taken for chemical analysis, photographs were taken, historical information was collected, and an estimate of the flow was made if not regularly measured.

On springs where flow is frequently measured, a weir is usually built which facilitates accurate measurement of the flow. On other springs, the discharge was estimated from pipe or open-channel flow. In estimating open-channel flow, a flow meter or the float method was used whenever possible. In using the float method, a reach of channel with nearly uniform cross-section and grade for a distance of at least 100 feet was selected. The average cross-sectional area and length of the reach were measured, and a stop-watch was used to time the passage of a float through the reach. The measured surface float velocity was multiplied by one of the coefficients given in the following table to correct for a slower velocity at the channel bed than on the surface:

AVERAGE DEPTH IN FEET	COEFFICIENT
1	0.66
2	0.68
3	0.70
4	0.72
5	0.74
10	0.78

The corrected velocity in feet per second multiplied by the average cross-section in square feet yielded the estimated discharge in cubic feet per second (ft^3/s).

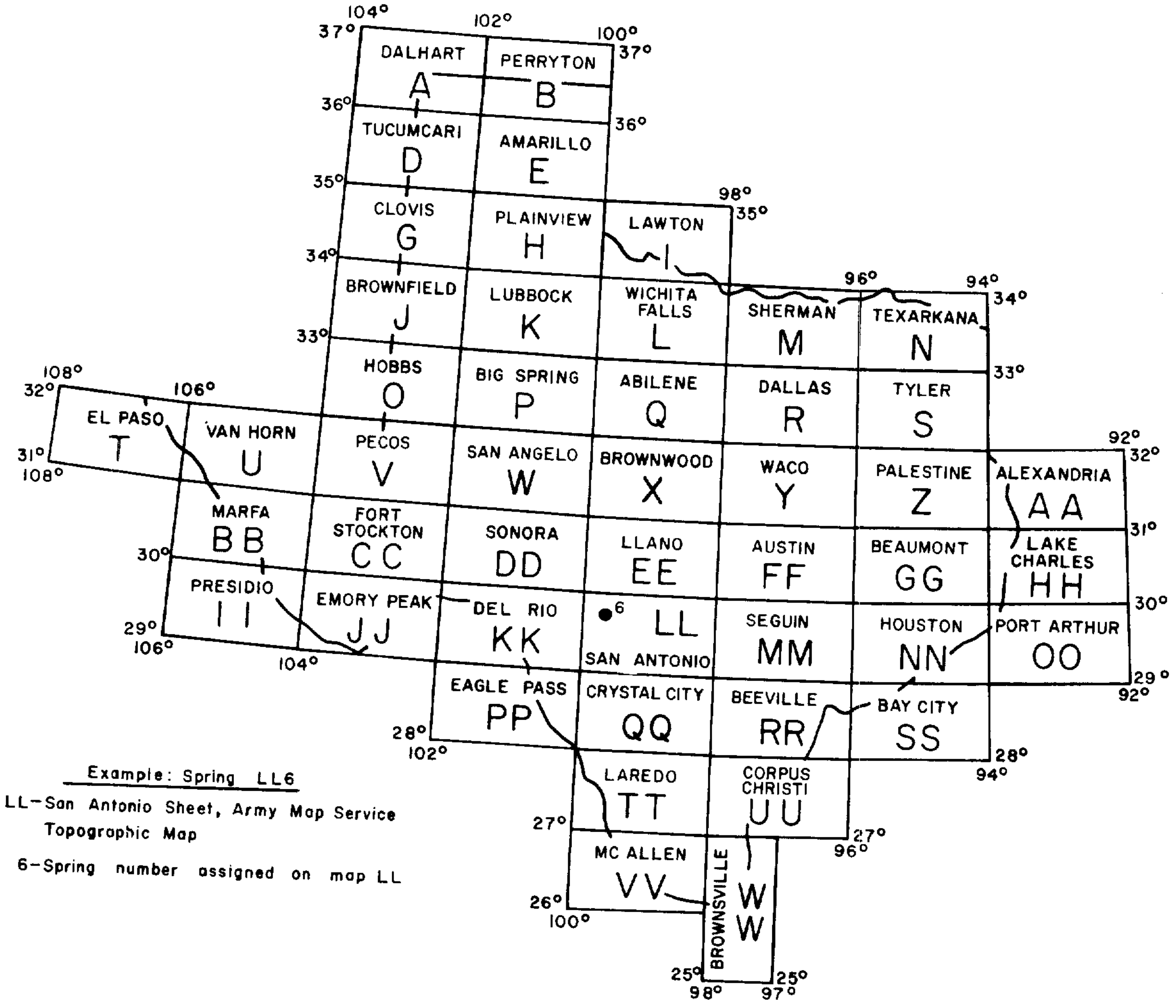

Figure 1.–Grid System Used for Spring-Numbering

Where practicable, discharge measurements have been summarized by water year, and an average of the available measurements is shown for the year. (A water year extends from October 1 to September 30 and is designated by the calendar year in which it ends.) For the larger springs more years of record are usually available. Generally, discharges less than 0.1 cubic foot per second have been converted to gallons per minute (gpm). One ft^3/s equals 449 gpm. Discharge measurements have generally been rounded to two significant figures.

In describing the location of a spring from the nearest town, the airline distance is always used. The road distance is usually much greater.

The author has relied heavily on information contained in the files of the Texas Water Development Board, most of which has been published previously in the Board's numerous reports pertaining to water availability. Many of these reports include county-wide well and spring inventories. Also used freely as source material were some 155 stream-measurement reports prepared by the U.S. Geological Survey and the International Boundary and Water Commission, United States and Mexico, which contain information on spring-sustained streamflow. Other sources of information used are numerous; the more significant of these are listed in the "References Cited."

Spring-Numbering System

Many common names, such as Buffalo, Bear, or Big Springs, are used for many different springs in Texas. Hence a numbering system is necessary to avoid ambiguity.

The numbering system used for this report is shown in Figure 1. All springs used in the study were plotted on the Army Map Service topographic maps having a scale of 1:250,000. Forty-seven of these sheets cover the entire State. Each sheet was assigned a letter or letters as shown, and each spring was assigned a number on the sheet. Thus each spring number is a composite of the topographic map letter or letters and the spring number on the map. For example, spring LL6 is on the San Antonio sheet and represents Eads Spring in Real County.

Acknowledgements

Special thanks are given to the U.S. Geological Survey and to the International Boundary and Water Commission, United States and Mexico. These agencies furnished numerous records of spring discharge measurements and chemical analyses of spring waters which have been included in this report. Others who furnished valuable records include the Reeves County Water Control and Improvement District and numerous city water departments. The Texas Historical Survey Committee provided important historical information on many springs.

Classification of Springs

The springs of Texas may be classified by size as follows:

MAGNITUDE	AVERAGE DISCHARGE FT³/S (CUBIC FEET PER SECOND)	GPM (GALLONS PER MINUTE)
Very large	Over 100	—
Large	10 to 100	—
Moderately large	1 to 10	—
Medium	0.1 to 1	45 to 449
Small	—	4.5 to 45
Very small	—	0.5 to 4.5
Seeps	—	Less than 0.5

This is similar to the classification used by Meinzer (1927), except that he used eight magnitudes, dividing the smaller springs and seeps into more classes.

Major springs as discussed in this report include springs which have or at some previous time did have 1 ft^3/s or more average flow, and also those smaller springs to which significant history is attached. In many cases the total discharge of a group of closely associated springs was used. In such cases the number of active springs in the group usually varies with the discharge. During high discharges they all flow, but at lower discharges only the lower ones flow.

Some springs which have been very infrequently measured are difficult to classify as to size. If the few measurements were made in periods of abundant rainfall, the flow would be higher and the spring might be classified as a larger spring than it really is. The reverse holds true if the measurement was made during a very dry period. Hence considerable judgement entered into the size classification of some springs.

IMPORTANCE OF TEXAS SPRINGS

Historical Significance

Springs were vital to the survival of Texas' earliest inhabitants, over 30,000 years ago. At an archeological site near Lewisville in Denton County, radiocarbon analysis has dated the remains of these early new-world men at 37,000+ years old, including crude sculptures, spears, and spear throwers (Newcomb, 1961). These early Americans always made their campgrounds near water, whether it was a spring, spring-fed stream, a river, or a lake. They preferred clear and pure water just as we do today.

Bedrock mortars or rock mills were worn into the rock by the Indians as they ground sotol, acorns and other nuts, mesquite beans, and grain. These mortars can still be seen at many Texas springs.

It is also noteworthy that the Pueblo Indians of west Texas used spring water for irrigation of crops long before the arrival of the Europeans (Taylor, 1902, and Hutson, 1898).

When European explorers entered the picture, Indians guided them over well-worn trails from one spring to another. The large number of springs on these old exploratory routes stands out plainly in Figure 2.

Because the springs were so vital to the life of both the Indians and the white men, it is not surprising that many battles were fought over their possession. In 1650 when Spanish explorers first visited Big Spring (P4) in Howard County, they found the Comanche and Pawnee Indians fighting for its possession. When a network of forts was strung across Texas, they were, in nearly all cases, located near springs in order to have a reliable supply of pure water. Later the covered-wagon and stagecoach routes came to rely heavily upon the springs. For example, the "Camino Real" or King's Highway, completed by the Spanish colonists about 1697 from Natchitoches, Louisiana, to San Antonio and Mexico, passed 13 major Texas springs (Figure 2) and many more minor ones. Most of the springs in far west Texas are very small in comparison with those in central and east Texas, because of the very low rainfall and recharge. Nevertheless, they often meant the difference between life and death to the early pioneers.

Nearly all of the larger springs were used for water power by the early settlers (Figure 3). At least 61 were

Figure 3.—Old Mill Dam at Hueco Springs in Comal County

used in this way. Gristmills, flour mills, sawmills, cotton gins, and later electric generating plants were powered by the flow of spring water.

In the late 1800's, many medicinal or health spas sprang up around the more mineralized springs (Figure 4). At least 25 springs, chiefly in east Texas, were believed to be beneficial in curing various ailments. Most of these waters are high in sulfate, chloride, iron, and manganese.

Many of the early settlements relied entirely on spring water. At least 200 towns were named for the springs at which they were located. About 40 still are shown on the official Texas State Highway Map, but many of the springs have dried up.

Many springs in Texas have acquired high recreational value (Figure 5). Among these are San Marcos (Hays County), Comal (Comal County) and Barton Springs (Travis County). Some recreational springs which have essentially ceased flowing much of the time, such as Gamel Spring (Mason County), Big Spring (Howard County), and San Antonio Springs (Bexar County), are now maintained by pumping water to the springs. The artificial spring water, however, usually lacks the cool clarity of natural spring water, and may be considered by some as an example of the decreasing quality of modern life.

Size of Springs

All known springs of over 1 ft^3/s average discharge are included in this report. Springs with less flow are included only if their unusual history warrants it.

Of the 281 major and historically significant springs described, only two springs at present, Comal (Comal County) and San Marcos (Hays County), are classified as very large. Of the remaining springs studied, 17 are classified as large, 79 as moderately large, 64 as medium, 31 as small, 21 as very small, 2 as seeps, and 65 as no longer existing (or inundated).

The area that is now Texas, when first explored by white men, had four very large springs. In order of size these were Comal, San Marcos, Goodenough (Val Verde County), and San Felipe (Val Verde County) Springs. Goodenough Spring is under 150 feet of water when International Amistad Reservoir is at conservation pool level. This head of water has probably greatly reduced or even stopped the flow of this spring. San Felipe Springs (Figure 6) have fallen below 100 ft^3/s discharge in

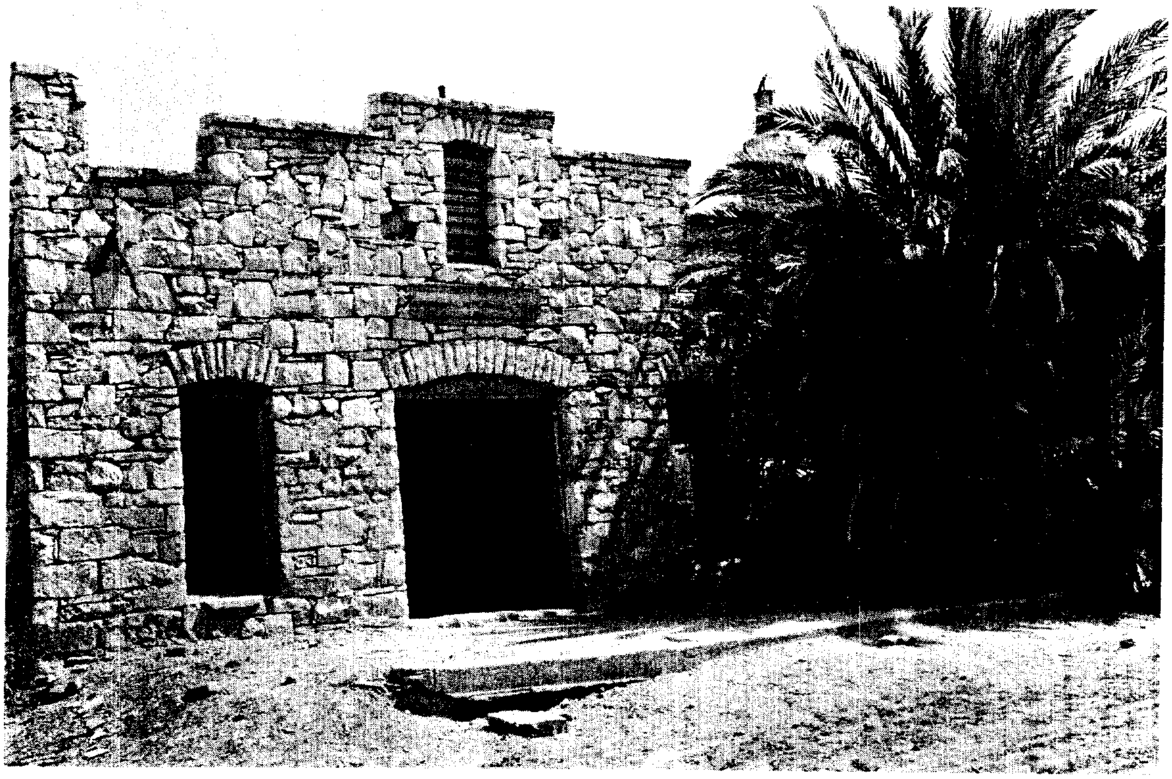

Figure 4.—Old Store and Bathhouse at Boquillas Warm Springs in Brewster County

Figure 5.—San Marcos Springs and Recreation Park

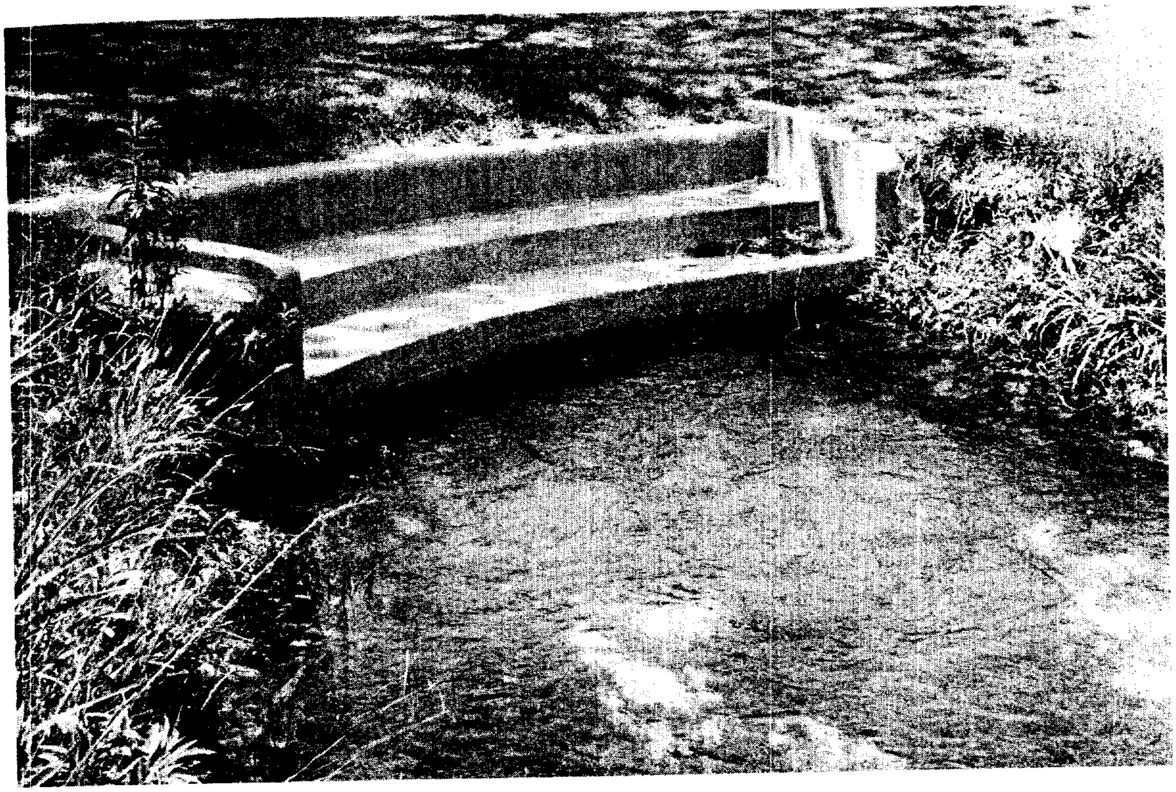

Figure 6.—One of the San Felipe Springs

recent years because of well pumping in the area. However, they may again become very large springs because of the recharge effects of the upstream International Amistad Reservoir.

Although the total flow of springs included in this report has declined considerably over the years, it still amounts to about 1,600 ft^3/s or 1,150,000 acre-feet per year. However, if the vast number of smaller springs are included, the total annual spring flow in Texas is probably in excess of 3 million acre-feet.

GEOLOGIC SETTING

Spring Aquifers

Figures 7 and 8 show the seven major and seven minor ground-water aquifers of Texas, and the number of springs described in this report which issue from each. It is noteworthy that 139 of the 281 springs issue from the Edwards-Trinity (Plateau) and Edwards (Balcones Fault Zone) aquifers. Note also that 49 springs issue from miscellaneous aquifers which are not shown in these figures. These include various rocks such as volcanic tuff, basalt, breccia, gypsum, and sandstone.

Figure 9 shows the distribution of the major springs by the type of rock from which they arise. The springs issuing from Comanchean limestones are by far the most common. These Lower Cretaceous limestones, including the Glen Rose, Edwards and associated limestones, Georgetown, and their equivalents, are found in the Edwards-Trinity (Plateau), Edwards (Balcones Fault Zone), Trinity Group, and Edwards-Trinity (High Plains) aquifers. A typical Edwards Limestone outcrop is shown in Figure 10. Certain parts of these limestones are filled with large interconnected caverns which form a tremendous underground reservoir. Recharge from streams and surface runoff enters the underground caverns through sinkholes, faults, and fissures in the surface rock. The flow of springs from cavernous rock underground reservoirs tends to fluctuate considerably, depending upon the amount of rainfall, recharge, and water in storage. As water levels decline, the spring flows fall off, but when recharge fills the reservoirs the springs begin flowing again.

The springs issuing from other Comanchean limestones arise primarily from the Ellenburger and San Saba Limestones aquifers which surround the uplifted Central Mineral Region.

Most of the springs issuing from sands and gravels flow under artesian pressure, from aquifers such as the

Figure 10.—Edwards Limestone Showing Fissures and Cavities Through Which Recharge Can Enter the Underground Reservoir (Courtesy of U.S. Department of Agriculture, Soil Conservation Service)

Each spring has its own individual geologic characteristics.

QUALITY OF SPRING WATERS

Chemical constituents in a water supply should preferably be limited to the concentrations shown in Table 1. However, the allowable concentration of the various constituents depends largely upon the use which is to be made of the water.

Selected chemical analyses of water from major springs in Texas are shown in Table 2, near the end of the report. No attempt has been made to list all of the available analyses. Usually the earliest known and the most recent analyses are given, to assist in determining whether there has been a change in quality of water from a particular spring.

Because underground water dissolves minerals from the rocks through which it moves, its chemical quality generally reflects the nature of the rock materials and also the length of time the water has been contained in the rocks. In the following paragraphs, the quality of spring water issuing from each aquifer is given in general terms based upon the analyses given in Table 2. It should be kept in mind, however, that the quality can vary greatly within one aquifer. For example, portions of the Edwards (Balcones Fault Zone) aquifer which are cut off from normal ground-water circulation are apt to have very high sulfate concentrations. Aquifers in West Texas are likely to have high total dissolved-solids concentrations, as the rock formations have been less completely leached of their soluble minerals in this region of lower rainfall and lower recharge rates.

Spring waters from the Edwards-Trinity (Plateau) and the Edwards (Balcones Fault Zone) aquifers are usually very hard, alkaline, and high in silica. They can be high in sulfate. The Comanchean limestone spring waters of Reeves and Pecos Counties are similar; however, they are higher in dissolved solids, more apt to contain high concentrations of sulfate and chloride, and may have high sodium-adsorption ratios (SAR).

Carrizo-Wilcox spring waters are alkaline, high to very high in silica, and sometimes high in sulfate and chloride. They may have an unsafe residual sodium carbonate (RSC) for irrigation.

Alluvium spring waters are usually very hard, alkaline, high in silica, and sometimes high in sulfate and chloride.

Spring waters arising from the Gulf Coast aquifer are usually low in fluoride and high in silica, may be very high in iron, and are sometimes high in sulfate and chloride.

Spring waters from the Ellenburger-San Saba and Marble Falls Limestones are normally very hard, alkaline, high in silica, low in fluoride and iron, and sometimes high in sulfate or chloride.

Ogallala Formation and Santa Rosa Sandstone spring waters are usually very hard, alkaline, high to very high in silica, and sometimes high in sulfate or chloride.

Sparta Sand spring waters are normally soft, acidic, high in silica, often high in iron and manganese, and low in fluoride.

Spring waters from the Queen City Sand are usually soft, high to very high in silica, and very high in iron.

Blaine Gypsum spring waters are normally very hard, alkaline, high in dissolved solids (but often less than 3,000 mg/l), high in silica, sometimes high in iron, high to very high in sulfate, and high in fluoride. They may have a marginal RSC.

Figure 11.—Lens of Gravel in Alluvium

Figure 12.—Sand Creek Springs, in Collingsworth County, Showing Interbedded Siltstone and Gypsum

Figure 13.—Example of Cavernous Gypsum

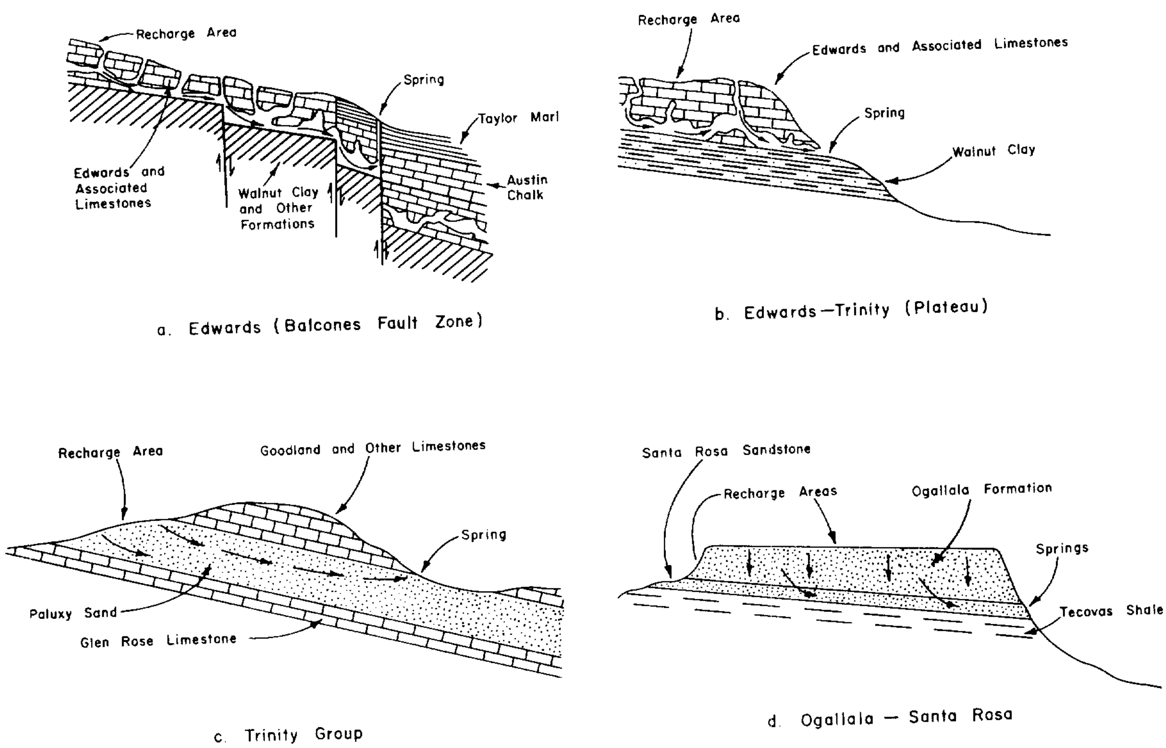

Figure 14.—Geologic Settings of Texas Springs

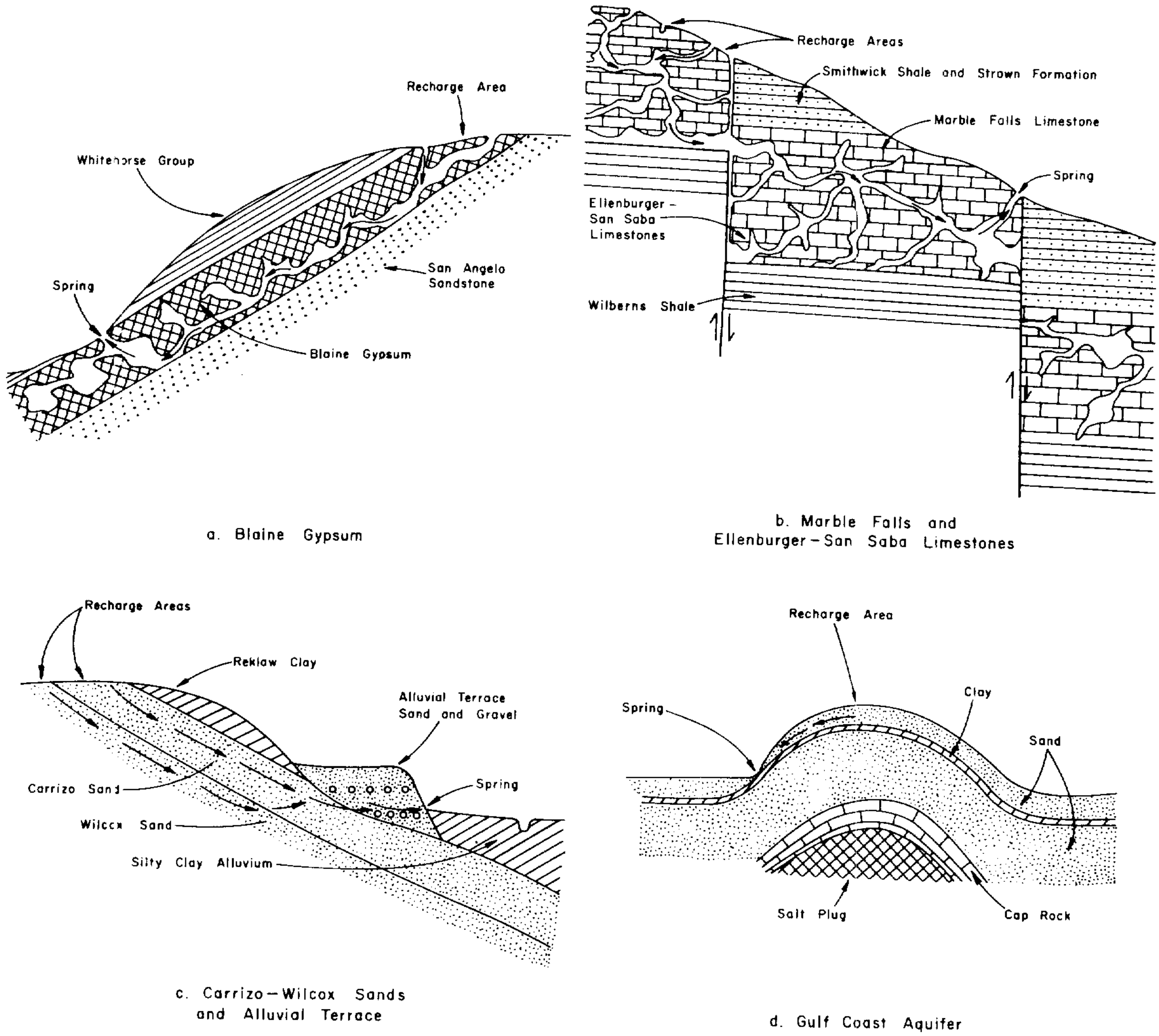

Figure 15.—Geologic Settings of Texas Springs

Hickory Sand spring waters, based upon only one analysis, are very hard but otherwise of high quality.

The only major warm springs in Texas are Boquillas Warm Springs in Brewster County. These springs range in temperature from 95 to 105 degrees Fahrenheit (35 to 41 degrees Celsius) which indicates that they originate from depths as great as 2,000 feet below the surface.

In addition to the standard chemical analysis parameters listed in Table 2, certain other parameters have been measured for some spring waters. These include total coliform organisms; fecal coliform organisms; streptococci; biochemical oxygen demand; detergents; dissolved oxygen; aluminum; copper; zinc; lithium; strontium; nickel; lead; iodide; mercury; arsenic; the insecticides aldrin, DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, and lindane; and the herbicides 2,4-D plus and 2,4,5-T plus. These tests have been made primarily on waters from the large springs of the Edwards and associated limestones in the Balcones Fault Zone. None of the tests showed dangerous concentrations of any of these parameters.

A study of the analyses listed in Table 2 does not reveal any case of progressively increasing concentrations of dissolved solids which might indicate spring-water contamination. Other factors such as variability of rainfall appear to have a much greater effect on dissolved-solids content and make the detection of contamination, if present, very difficult.

Phantom Lake Spring (Jeff Davis County) serves as an example. On October 7, 1932, following a rain in the recharge area, a discharge of 82 ft^3/s and a total dissolved-solids content of 144 mg/l were measured. On April 28, 1971, with a reduced flow of 5.7 ft^3/s, the

Figure 16.—Seven Springs, Irion County, Emerging From Jointed Limestone

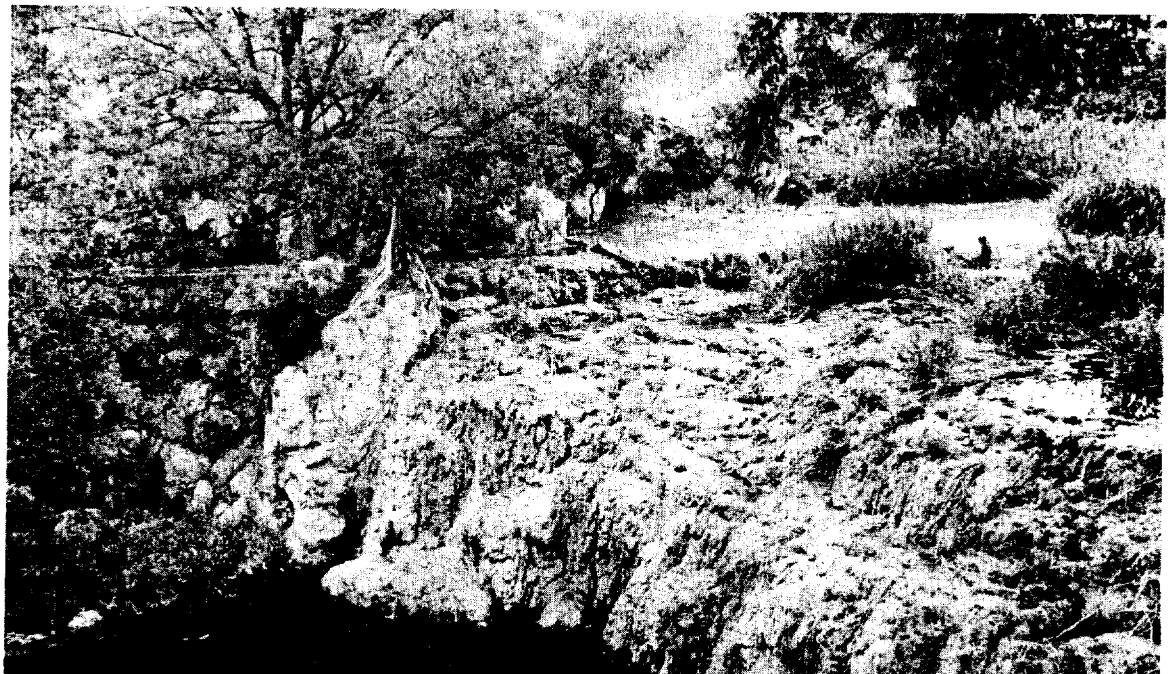

Figure 17.—Barnett Springs and Travertine Deposits

Table 1.—Source and Significance of Dissolved-Mineral Constituents and Properties of Water (From Doll and Others, 1963)

CONSTITUENT OR PROPERTY	SOURCE OR CAUSE	SIGNIFICANCE
Silica (SiO_2)	Dissolved from practically all rocks and soils, commonly less than 30 mg/l. High concentrations, as much as 100 mg/l, 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. In this report over 10 mg/l is considered high, and over 40 very high.
Iron (Fe)	Dissolved from practically all rocks and soils. May also be derived from iron pipes, pumps, and other equipment.	On exposure to air, iron in ground water oxidizes to a reddish-brown precipitate. More than about 0.3 mg/l stains 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 mg/l. Larger quantities cause unpleasant taste and favor growth of iron bacteria. In this report 0.3 mg/l is considered high, and 3 mg/l very high.
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 brimes. 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 are desired in electroplating, tanning, dyeing, and in textile manufacturing.
Sodium (Na) and potassium (K)	Dissolved from practically all rocks and soils. Found in ancient brimes, sea water, industrial brimes, 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 mg/l.
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 mg/l.
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, 1950).

Table 1.—Source and Significance of Dissolved-Mineral Constituents and Properties of Water—Continued

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 mg/l. 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 (Maxcy, 1950). Nitrate has been shown to be helpful in reducing inter-crystalline cracking of boiler steel. It encourages growth of algae and other organisms which produce undesirable tastes and odors.
Dissolved solids	Chiefly mineral constituents dissolved from rocks and soils.	U.S. Public Health Service (1962) drinking-water standards recommend that waters containing more than 500 mg/l dissolved solids not be used if other less mineralized supplies are available. Waters containing more than 1,000 mg/l 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 non-carbonate hardness. Waters of hardness as much as 60 mg/l are considered soft; 61 to 120 mg/l, moderately hard; 121 to 180 mg/l, hard; more than 180 mg/l, very hard.
Hydrogen ion concentration (pH)	Acids, acid-generating salts, and free carbon dioxide lower the pH. Carbonates, bicarbonates, hydroxides, 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. In this report a pH of less than 5.5 is considered very acid, 5.5 to 6.5 acid, 6.5 to 7.5 neutral, 7.5 to 8.5 alkaline, and over 8.5 very alkaline.
Boron (B)	Dissolved in small quantities from rocks and soils.	An essential plant micronutrient up to 0.5 mg/l. Concentrations between 0.5 and 4.0 mg/l can cause crop damage, depending upon the sensitivity of the particular crop.
Phosphorus (P)	Dissolved from most soils and rocks, and present in many detergents.	Concentrations of more than 0.2 mg/l can cause unpleasant algae and other plant growth in streams and lakes.
Sodium-adsorption ratio (SAR)	Sodium is dissolved from practically all soils and rocks, and may be derived from oil-field wastes.	Irrigation water with a high sodium-adsorption ratio can cause a breakdown of soils, making them impermeable. An SAR of 0 to 10 is considered low, 10 to 18 medium, 18 to 26 high, and over 26 very high.
Residual sodium carbonate (RSC)	Sodium is derived from all soils and rocks, and may stem from oil-field wastes.	Another method of measuring an irrigation water's sodium hazard to soils. An RSC of 1.25 is considered safe, 1.25 to 2.50 marginal, and over 2.50 unsafe.
Temperature	Ground-water temperature at a depth of 30 to 60 feet generally exceeds the mean annual air temperature at a given location by 2.5 degrees Fahrenheit. Below these depths the temperature increases about 1.8 degrees for each 100 feet of depth.	For public water supply a temperature above 85 degrees is considered undesirable.

total dissolved solids increased to 2,250 mg/l. Higher discharges tend to be associated with lower dissolved-solids concentration and higher suspended-solids or sediment concentration. This is especially true in limestone aquifers where sediment can easily enter the aquifer through sink holes along with recharge water.

Texas spring water, except for salt springs, has typically been noted for its purity. Available data indicate it has remained essentially as pure as it ever was. Where recharge water must percolate through sand beds for a considerable distance to reach an underground reservoir, many impurities such as bacteria and insecticides are naturally filtered out. In springs that issue from cavernous limestone or gypsum underground reservoirs, however, there is an increasing danger of pollution. These reservoirs receive recharge from surface water through open crevices and sink holes without filtering action. All types of pollutants can readily enter a limestone or gypsum underground reservoir. Therefore, it is especially important to protect the recharge areas of limestone and gypsum underground reservoirs and springs from pollution hazards.

DECLINE OF SPRINGS

Prehistoric Setting

Throughout the long period during which various Indian tribes occupied Texas, spring flow remained unchanged except as affected by wet and dry climatic cycles. At the time of Columbus' epic voyages Texas abounded with springs which acted as natural spillways to release the excess storage of underground reservoirs. Early explorers described them as gushing forth in great volume and numbers. The very early accounts usually describe not springs but "fountains." This is an indication of the tremendous force with which these springs spouted forth before they were altered by modern man. As an example, less than 100 years ago Big Boiling Spring, one of the Salado Springs (Bell County) was still described as a fountain rising 5 feet high. Such natural fountains ceased to exist in Texas many years ago. Probably in the year 1500, there were many times as many springs of all sizes in Texas as exist now.

Causes of Spring Decline

This was the situation which prevailed until Columbus' discoveries set off the widespread migration to the New World. Figure 18 is a comparison of probable sizes and locations of known springs existing in the year 1500 with those in 1973. Admittedly much judgement entered into the preparation of this figure, as accurate springflow measurements have been available only during the last 100 years or so.

Probably the first effect upon ground-water tables and spring flow was the result of deforestation by the early white settlers. Deforested land was placed in cultivation or pasture. The deep open structure of the forest soils was altered as the organic matter was consumed and the soils became more impervious. Heavy grazing by introduced stock animals was probably especially harmful. Soon the soils were so compacted that they could take in only a small fraction of the recharge which they formerly conveyed to the underground reservoir.

This reduction of recharge affected larger areas as more and more land was placed in pasture. However, the effect upon water tables and spring flow was probably relatively small in comparison with later developments. In the middle 1800's deep wells began to be drilled. It was found that flowing wells could be brought in nearly everywhere. The "Lunatic Asylum" well in Austin, drilled to the basal Trinity Sands, threw water 40 feet high. Water from a well south of San Antonio reaching the Edwards Limestone rose 84 feet above the surface of the ground (Hill and Vaughn, 1898). Nothing could have had a more disastrous effect upon spring flows than the release of these tremendous artesian pressures through flowing wells. Most of these wells were allowed to flow continuously, wasting great quantities of water, until the piezometric heads were exhausted and the wells stopped flowing. A few still flow to this day, as shown in Figure 19.

Although the effects of flowing wells upon spring flow were severe, there was more to come. When the wells ceased flowing, pumping began. Ground-water levels were systematically drawn down, as much as 700 feet in some areas. At first pumping for municipal and industrial use was primarily responsible. In recent years tremendous quantities of ground water have been withdrawn for irrigation, amounting to about 80 percent of the total ground water used in Texas. As a result, some streams which were formerly "gaining" streams, receiving additional water from streambed seeps and springs, are now "losing," and many streams have ceased flowing. Thousands of small springs have dried up, and the larger springs have generally suffered a decrease in flow.

Other factors have also affected spring flow. Paving of urban areas has reduced the amount of recharge to some spring aquifers. Many springs have been inundated by man-made reservoirs. The additional head of water is often sufficient to stop or greatly reduce the spring flow beneath it. However, in some instances man-made reservoirs have also increased the flow of springs located downstream through increased recharge. Since closure of the International Amistad Reservoir in 1968, there is evidence that San Felipe Springs, which supply municipal water to Del Rio downstream, are increasing in flow.

Some Examples

Texas has a very wide range in precipitation, averaging 8 inches annually in the west and 55 inches in the east. This also means that ground-water reservoirs receive much less natural recharge in the west than in the east. The western ground-water reservoirs are highly vulnerable to drawdown by heavy well pumping, because there is little natural recharge to replace the water that has been withdrawn. Figure 18 shows that nearly all of the springs which formerly existed in Pecos County are now gone. Heavy pumping for irrigation in this area lowered the water table so much that the springs ceased flowing.

A similar situation is now developing at the five springs in the Balmorhea area of Jeff Davis and Reeves Counties. These are Phantom Lake, shown on Figure 20, San Solomon, Giffin, Saragosa, and Sandia. Hydrographs for two of these springs are shown on Figure 21. The water for these springs comes from a reservoir in Comanchean limestones. Impervious upper Cretaceous rocks have been faulted down against the reservoir, forming an underground dam and causing the springs to flow. This is very similar to the situation in the Balcones Fault Zone of central Texas. Saragosa and Sandia Springs flow from gravel alluvium, but the water probably comes originally from Comanchean limestones.

Figure 19.—Large Well Flowing From the Edwards (Balcones Fault Zone) Aquifer at Fort Sam Houston in San Antonio
(Courtesy of U.S. Department of Agriculture, Soil Conservation Service)

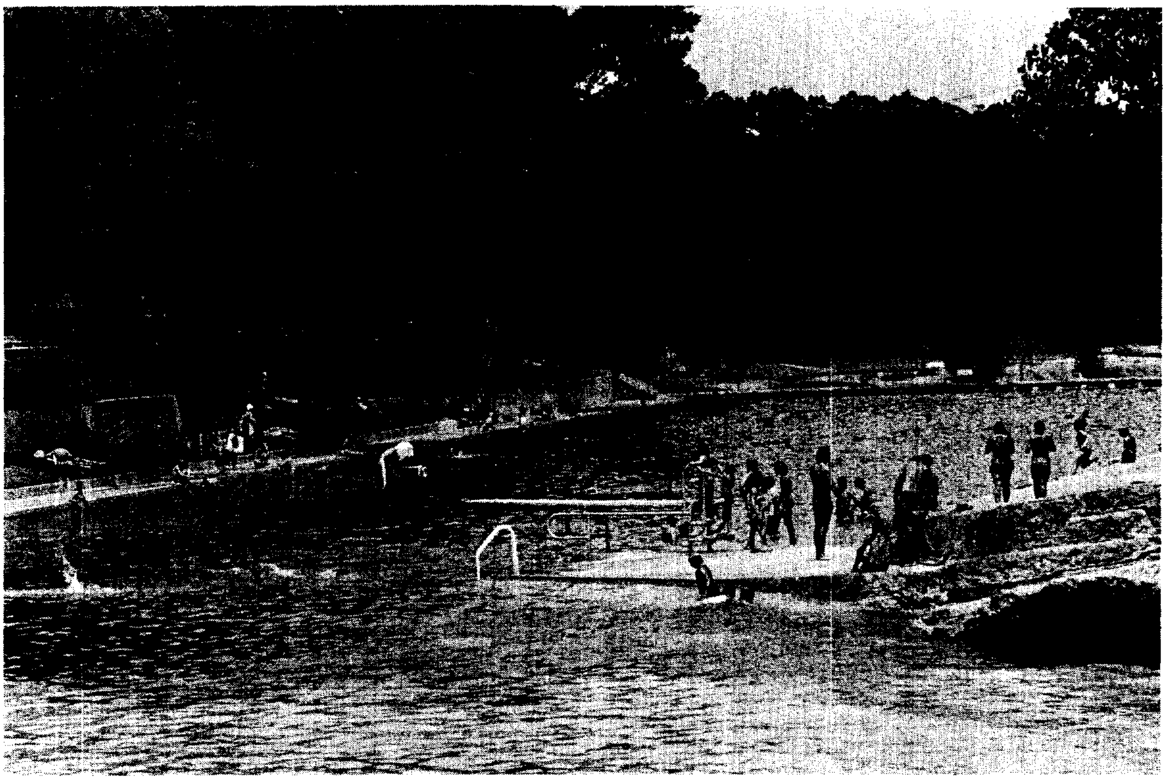

Figure 23.—Barton Springs Supplies a Swimming Pool in Austin

San Saba and Dove Creek Springs are located in rocky areas where little cultivation is possible. Consequently there has been little irrigation pumping of ground water and the springs have not been greatly affected. Roaring Springs have maintained their flow fairly well, despite large withdrawal of ground water for irrigation from the Ogallala Sand in the recharge area. Since the springs flow by gravity from the base of the Ogallala, no large reduction in flow can be expected until the ground water in the Ogallala aquifer is essentially exhausted. Some of the water for Roaring Springs may originate as recharge on the areas of Santa Rosa Sandstone outcrops in New Mexico. Ground-water pumping has been much less extensive from this formation than from the Ogallala.

Texas Water Law as Relating to Springs

Texas ground-water law affirms that the surface landowner owns the underground water unless it can be shown that the source is a subteranean stream or stream underflow (Yarbrough, 1968). This may be difficult to prove.

An example of stream underflow might be that along the east Nueces River near Montell. Here the river intermittently sinks into gravel beds and reappears as springs. This spring flow would probably be classed as originating from stream underflow and therefore subject to appropriation.

Natural spring waters if taken at their source are considered to be ground water and no permit is required for their use. Once they issue forth and flow in a watercourse, however, they become public surface waters. As such, a permit from the Texas Water Rights Commission is required for their use.

A spring is normally a spillway for an underground reservoir. This reservoir may be overlain by land belonging to a number of owners. If the landowners other than the spring owner choose to pump ground water heavily, lowering the water table and causing the spring to cease flowing, the spring owner has no recourse in the courts to prevent them.

An example is Comanche Springs at Fort Stockton (Pecos County). These artesian springs, reservoirs is the primary cause of their decline, it is obvious that if in the vicinity of springs such pumping continues or is increased, most of the springs will gradually disappear.

DETAILED INFORMATION ON INDIVIDUAL SPRINGS

The spring descriptions which follow are grouped by county. The counties appear alphabetically. The descriptions include: spring name; identification number; location; aquifer; historical information, where available; discharge, if known; and references to pertinent literature.

Spring locations are shown on Figure 58. Chemical quality of water data are given for many springs in Table 2.

Bandera County

Verde Springs (LL17). Latitude 29°52', longitude 99°10', 4 miles west of Camp Verde. Aquifer: Edwards and associated limestones in the Edwards-Trinity (Plateau) aquifer. History: Cabeza de Vaca may have passed here in 1535. Later the springs were a stop on the Chihuahua Road. In 1854 a Mormon settlement built a gristmill and sawmill downstream to use the spring water for power. The military Camp Verde used the springs as a water supply. Discharge: March 25, 1965–2.1 ft^3/s; February 2, 1971–13 gpm. Reference: Jackson, 1971.

Cold Springs (LL18). Latitude 29°41', longitude 98°59', 4 miles southwest of Pipe Creek. Aquifer: Glen Rose Limestone in the Edwards-Trinity (Plateau) aquifer. History: An Apache Indian village was located here. Cabeza de Vaca may have stopped here in 1535. Later the Chihuahua Road passed the springs. They were described by Bonnell in 1840 as "large fountains." Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1922	10	1926	7.7
1925	5.0	1930	7.5

Figure 25.—Site of Former Comanche Springs

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1933	11	1952	0.8
1935	10	1954	0.13
1948	3.5	1955	4.0
1951	2.2		

Reference: Bonnell, 1840.

Bastrop County

Burleson Springs (FF11). Numerous springs. Latitude 30°05′, longitude 97°21′, 3 miles southwest of Bastrop. Aquifer: Wilcox Formation of the Carrizo-Wilcox aquifer. The springs flow through alluvium. History: These springs were used by the Tonkawa Indians before the European settlers arrived. In 1691 the Spanish explorer Domingo Terán de los Rios is believed to have stopped here. Later the springs were a stop on the old Camino Real, or King's Highway, from Louisiana to Mexico. In 1840 they were described as "fine springs of crystal water bursting from the hills." A water-powered corn mill operated here in the 1840's. Discharge: March 1953–5 gpm; November 1964–25 gpm. Reference: Bonnell, 1840.

Baylor County

Buffalo Springs (L1). About 10 springs. Latitude 33°36′, longitude 99°18′, 3 miles west of Seymour. Aquifer: Contact of the Brazos River alluvium and Seymour Formation. History: Nomadic Indians who formerly camped here left hearths, crude grinding tools, and stone axes. The springs were frequented by thousands of buffalo and became a buffalo hunting camp in the 1870's. Discharge: June 22, 1969–25 gpm. References: Britton, 1955 and Malone and Briggs, 1970.

Bell County

Leon Springs (Y6). Near latitude 31°04′, longitude 97°27′, 2 miles northeast of Belton. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. The springs issue through a fault. History: They were known as medicinal springs in the 1800's, and were later a stop on the Chisholm Cattle Trail. Discharge: 1968–0. Reference: Atkinson, 1970.

Salado Springs (FF1). Many springs, including, from upstream to downstream, Robertson, Big Boiling, Elm, and Anderson Springs. Latitude 30°57′, longitude 97°32′, at Salado. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. The springs issue through faults. History: The Tehuacana Indians formerly lived here, leaving many flint implements, beads, pottery sherds, and metal ornaments. Big Boiling Spring (Figure 26) was formerly a fountain 5 feet high. After settlement in 1851 the springs were a well-known stage stand. From 1851 to 1868 there were 11 flour, grist, saw, cotton gin, and wool-carding mills using the spring water for power, one of which, the Davis Mill, is commemorated by a historical marker. From 1863 to 1878 one of the mill dams flooded the springs. The dam was finally lowered by court order. There were several swimming holes here. Sulphur Springs, 3 miles downstream, were used medicinally. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1902	13	1960	24
1903	13	1961	37
1934	7.6	1962	25
1948	10.6	1963	14
1950	6.3	1964	11
1951	5.5	1965	29
1952	7.6	1966	33
1954	6.8	1967	14
1955	5.5	1968	25
1956	4.6	1969	28
1957	8.0	1970	23
1958	24	1971	11
1959	13	1972	12

Maximum known discharge was 55 ft^3/s. References: Paddock, 1911; Atkinson, 1970; and Texas Historical Survey Committee, 1971.

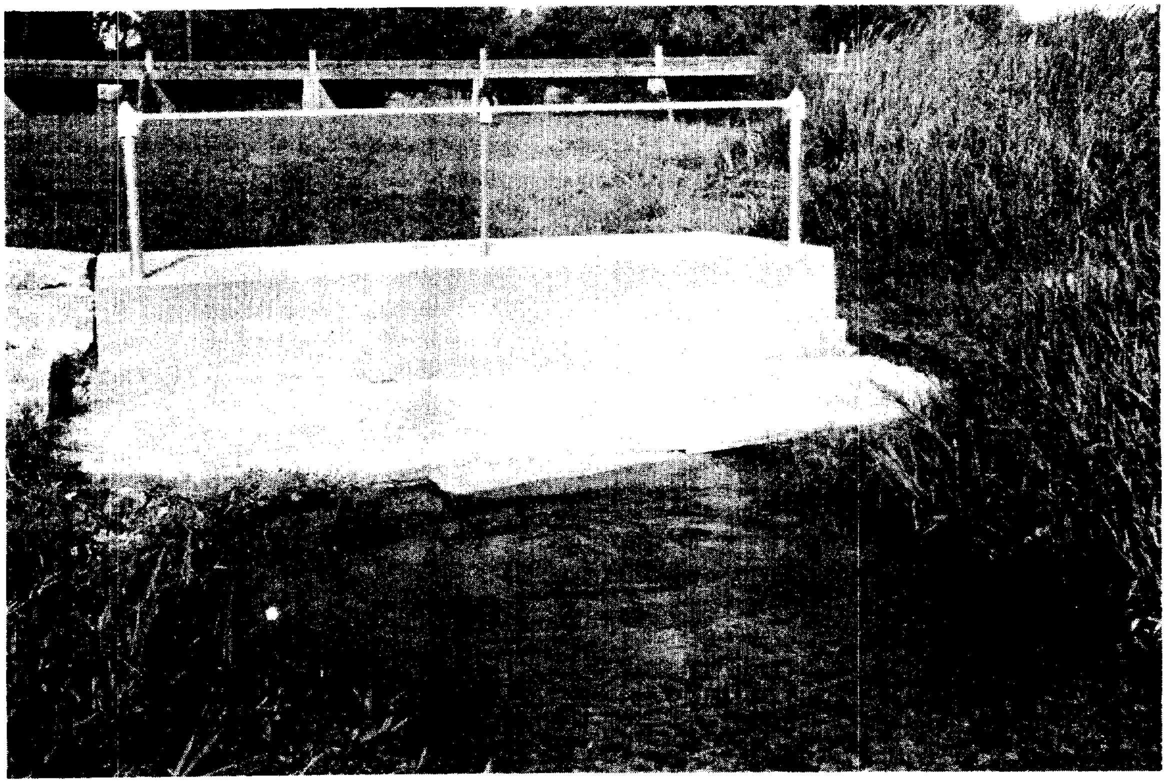

Figure 26.—Big Boiling Spring, One of the Salado Springs

Childers Springs (FF17). Several springs. Latitude 31°00′, longitude 97°29′, 5 miles northeast of Salado. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. The springs issue through a fault. History: Childers grist mill (also called Shanklin's mill later) used the spring water for power from 1847 to 1920. The mill race was later used for irrigation water. A historical marker is located here. Discharge: 1968—0. References: Atkinson, 1970 and Texas Historical Survey Committee, 1971.

Fort Little River Springs (FF18). Latitude 31°00′, longitude 97°23′, 2 miles west of Little River. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. The springs issue through a fault in the Austin Chalk. History: In 1836-37 these springs furnished water for Fort Little River. Discharge: 1965—0. Reference: Tyler, 1966.

Bexar County

Selma Spring (LL30). Latitude 29°34′, longitude 98°18′, 1 mile south of Selma. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. The spring issues through faults in the Austin Chalk. History: Bonnell in 1840 described this spring as "a white sulphur spring, the most beautiful in the world, with a large basin 20 feet in diameter." It was a stage stop on El Camino Real. Discharge: March 5, 1963—0; March 4, 1968—0.15 ft^3/s. Reference: Bonnell, 1840.

Salado Creek Springs (LL31). Several springs. Latitude 29°30′, longitude 98°26′, 7 miles northeast of San Antonio. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. Artesian water issues from a fault in the Anacacho Limestone. History: El Camino Real passed these springs. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1919	3.0	1948	0
1933	1.5	1951	0
1934	0.8	1952	0
1935	2.2	1970	1.2

San Antonio Springs (LL32). Many springs. Latitude 29°28′, longitude 98°29′, on the San Antonio River just above East Hildebrand Street in San Antonio. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. Artesian springs issue from a fault in the Austin Chalk. History: These springs were the site of an ancient Payayan Indian settlement. Cabeza de Vaca possibly visited them in 1535. El Camino Real passed them. Early Spanish missions used the water for irrigation. Bonnell (1840) estimated that about 100 springs formed the San Antonio River at that time. The San Jose Mission built the first corn grinding mill, the "Molino Blanco," in 1730 to utilize the water power of the springs. Many other mills used the site at later dates. They were temporarily abandoned in 1896 because of low spring flow, but in 1904 four hydroelectric powerplants were using the spring water. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1895	42	1934	36
1896	29	1935	82
1897	9	1936	120
1898	7	1937	98
1899	8	1938	83
1900	94	1939	7
1901	59	1940	2
1904	52	1941	75
1905	97	1942	75
1906	44	1943	36
1910	18	1944	29
1911	13	1945	63
1915	120	1946	38
1916	90	1947	40
1917	50	1948	2
1918	20	1949-50	0
1919	100	1951	5
1920	200	1952-57	0
1921	90	1958	40
1922	79	1959	35
1923	64	1960	12
1924	140	1961	67
925	45	1962	6.2
1926	54	1963	2
1927	29	1970	0
1928	18	1971	0
1929	19	1972	0
1932	76	1973	87
1933	54		

Maximum recorded discharge was 212 ft^3/s in 1920. As early as 1898, Hill and Vaughn recognized that the spring flow had been reduced by well pumping. They stated, "when the wells are allowed to flow the springs diminish in volume, and the San Antonio River is greatly lowered." The springs have now essentially ceased flowing much of the time. Water is pumped to the spring sites from several wells to maintain the recreational value of Brackenridge Park, in which the springs were located. References: Bonnell, 1840; Taylor, 1904; Hill and Vaughn, 1898; and Jackson, 1971.

San Pedro Springs (LL33). Several springs. Latitude 29°27′, longitude 98°30′, in San Pedro Park, San Antonio. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. Artesian springs issue through a fault in the Austin Chalk. History: These springs and their associated lakes were originally a focal point for several Coahuiltecan Indian bands known as Payayas. Excavations made in 1878 unearthed numerous pottery sherds, spearheads, knives, and tomahawks. The springs were called Yanaguana Springs by the Payayas. Cabeza de Vaca may have visited them in 1535. In 1718 the San Antonio de Valero mission (the Alamo) was founded nearby, and the spring water used for irrigation of corn, chilies, and beans. Numerous old roads radiated from this point. The springs were the site of an Army camp during the Mexican War, 1846-48, and the Civil War. The park in which the springs were located is one of Texas' oldest recreational areas. City water is now piped to the swimming pool formerly fed by the springs. A historical marker is located here. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1895	9	1922	9.3
1896	12	1923	7.5
1897	9	1924	13
1898	9	1925	7.6
1899	9	1926	9.5
1900	9	1927	7.2
1904	9	1928	5.6
1916	6.2	1929	4.9
1917	6.5	1930	4.1
1918	3.7	1932	7.6
1919	9.1	1933	6.8
1920	14	1934	5.6
1921	9.7	1935	20

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1936	30	1951	0.1
1937	24	1952-57	0
1938	21	1958	7.3
1939	2	1959	8.8
1940	1	1960	9.3
1941	18	1961	8.6
1942	18	1962	3.5
1943	9	1963	0
1944	7	1965	1.8
1945	15	1966	2.7
1946	10	1970	0.1
1947	10	1971	0
1948-50	0	1972	3.1

The springs have now essentially ceased flowing because of heavy municipal and industrial pumping. References: Newcomb, 1961; Texas Historical Survey Committee, 1971; Sturmberg, 1920; and Paddock, 1911.

Martinez Springs (LL34). Latitude 29°27', longitude 98°10', 3 miles northeast of Saint Hedwig. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. The springs appear as base flow in the gravel streambed. Discharge: March 5, 1963–1.6 ft^3/s.

Mitchell Lake Springs (LL35). Latitude 29°16', longitude 98°29', at Mitchell Lake Dam. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. Discharge: May 28, 1925–3.5 ft^3/s. The springs represent seepage from the reservoir.

Blanco County

Rocky Creek Spring (EE40). Latitude 30°15', longitude 98°32', 3 miles east of Hye. Aquifer: Ellenburger Limestone of the Ellenburger-San Saba aquifer. Discharge: May 17, 1962–1.5 ft^3/s.

Koch Springs (EE41). Latitude 30°06', longitude 98°25', 1 mile south of Blanco in Blanco State Park. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. History: An old Comanche Indian trial passed these springs. Discharge: June 22, 1938–30 gpm; August 20, 1941–15 gpm; September 8, 1952–270 gpm; March 7, 1962–430 gpm.

Buffalo Spring (EE44). Source of Buffalo Creek. Latitude 30°20', longitude 98°26', 5 miles northwest of Johnson City. Aquifer: Morgan Creek and Cap Mountain Limestones. Discharge: July 22, 1941–1.1 cfs; flowing in 1973.

Crofts Spring (EE45). Latitude 30°19', longitude 98°23', 4 miles northeast of Johnson City. Aquifer: Ellenburger-San Saba Limestones. Discharge: Reported to have failed in 1908; August 4, 1938–0.13 ft^3/s; May 28, 1968–3.7 ft^3/s.

Hobbs Spring (EE46). Latitude 30°18', longitude 98°25', 2 miles north of Johnson City. Aquifer: Ellenburger-San Saba Limestones. Discharge: May 27, 1969–1.0 ft^3/s.

Bosque County

El Flechazo or Love at First Sight Springs (Y1). Latitude about 31°43', longitude about 97°20', about 9 miles northeast of Valley Mills. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. History: "Eleven abundant springs" were used by the Tehuacana Indians, who had a village here. From 1867 to 1895 the Chisholm Cattle Trail passed the springs. Reference: Morfi, 1935.

Pierson Spring (Y5). Latitude 31°47', longitude 97°46', forming Gary Creek. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: Settled by Old Pierson of Norway in 1854. Discharge: In 1854 a 2-inch-diameter pipe could not carry the flow (about 0.15 ft^3/s). Reference: Pool, 1964.

Bowie County

DeKalb Spring (N2). Latitude 33°30', longitude 94°37', in DeKalb. Aquifer: Terrace Alluvium. The spring flows from a sand on top of a clay layer. Discharge: Flowing in 1911. Reference: Gordon, 1911.

Dalby Springs (N3). About four springs. Latitude 33°22', longitude 94°41', in Dalby Springs. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. History: Indians used these springs as far back as 30,000 years ago, as evidenced by projectile points, axes, scrapers, and pottery found here. In 1911 the springs were well known for their medicinal value. Discharge: 1892–27 gpm. References: Gordon, 1911; Peale, 1894; and Texas Historical Survey Committee and Texas Water Development Board, 1970.

Boston Chalybeate Spring (N4). Latitude 33°24', longitude 94°28', at Old Boston. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. History: From 1813 the spring was on Trammell's Trace, an underground slave route. In 1892 it was known as a mineral spring. Reference: Gordon, 1911.

Brewster County

Burgess, Kokernot, or San Lorenzo Spring (CC9). Latitude 30°22′, longitude 103°39′, in northeast Alpine. Aquifer: Alluvium. History: The spring was possibly visited by the early Spanish explorer Cabeza de Vaca in 1535. It was certainly used by Juan de Mendoza in 1684. It was on the Chihuahua Road from Chihuahua, Mexico to Indianola, Texas' chief port, in 1845. A historical marker is located here. Discharge: October 31, 1929—0.5 ft^3/s; 1957—none reported; April 28, 1971—0 ft^3/s. The spring is reported to have ceased flowing about 1940. References: Texas Historical Survey Committee, 1971; and Williams, 1969.

Pena Colorada or Colored Rock Spring (CC10). Latitude 30°10′, longitude 103°17′, 4 miles southwest of Marathon. Aquifer: Marathon Limestone. History: This spring was a rest stop on the Old Comanche Indian Trail from New Mexico. Fort Pena Colorada used the spring water around 1880. A historical marker is located here. Discharge: 1957—0.3 to 1.0 ft^3/s. Reference: Texas Historical Survey Committee, 1971.

Chilicotal Spring (JJ1). Latitude 29°15′, longitude 103°08′, 8 miles southeast of Panther Junction, Big Bend National Park. Aquifer: Alluvial sand and gravel. History: This was one of the Comanche Indian campgrounds on their trail from New Mexico to Mexico. References: Maxwell, 1968, and William, 1969.

Glenn Springs (JJ2). Latitude 29°11′, longitude 103°09′, 13 miles west of Boquillas Ranger Station, Big Bend National Park. Aquifer: Aguja Sandstone. History: This spring was the site of an Indian campground on the Comanche Trail from Mexico to New Mexico. Many spear and arrow points, grinding stones, and bedrock mortars have been found here. The spring was named for a Mr. Glenn who settled here in the 1870's and established a store. The settlement was raided by bandits from Mexico in 1916. Reference: Maxwell, 1968.

Boquillas Warm Springs (JJ3). Five artesian springs on the left bank of the Rio Grande. Latitude 29°11′, longitude 102°58′, near Boquillas Ranger Station, Big Bend National Park. Aquifer: Probably Edwards and associated limestones, through a fault in the Boquillas Limestone. The springs range in temperature from 95 to 105 degrees Fahrenheit, indicating that some of them originate about 2,000 feet below the surface. History: Used by the Mescalero Apache Indians. The springs were later on the Comanche Indian Trail to Mexico. Bedrock mortars ground by these people can still be seen at the springs. In recent times (1909), a store and bath house for medicinal bathing were built, as shown in Figure 4. A historical marker is located here. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1936	0.82	1965	0.61
1953	1.6	1966	0.78
1964	0.61	1971	0.32

The spring formerly used for medicinal bathing is now almost dry, but some of the others still flow. Reference: Williams, 1969.

Briscoe County

Hylsey Springs (H1). Many springs. Latitude 34°44′, longitude 101°23′, 9 miles northeast of Vigo Park, in Palo Duro Canyon. Aquifer: Santa Rosa Sandstone. History: The springs were possibly visited by Coronado in 1541. Discharge: September 9, 1946—2.1 ft^3/s; June 23, 1971—0.22 ft^3/s. Heavy pumping for irrigation to the west may have caused the reduction in flow.

Burleson County

Sour or Spring Lake Springs (FF14). Numerous openings. Latitude 30°33′, longitude 96°45′, 5 miles northwest of Caldwell. Aquifer: Sparta Sand. History: These springs were a stop on the old Spanish "Camino Real" from Louisiana to Mexico. In 1892 they were well known as mineral springs. In 1936 they supplied water for a swimming pool. Discharge: 1892—0.4 ft^3/s; 1936—0.4 ft^3/s. The flow varies considerably with precipitation. Reference: Peale, 1894.

Burnet County

Holland, Felps, and Horseshoe Springs (EE38). Several springs forming Hamilton Creek and Mormon Mill Falls. Latitude 30°42′, longitude 98°14′, 3 miles south of Burnet. Aquifer: Basal Hensell Sand of the Trinity Group aquifer. History: The springs were a favorite Indian watering place long before white men appeared. A Texas Ranger station was situated here from 1847 to 1849. In 1849 it was replaced by Fort Croghan, 3 miles north. From 1851 to 1853 a Mormon colony maintained a grist mill and shop for furniture making at

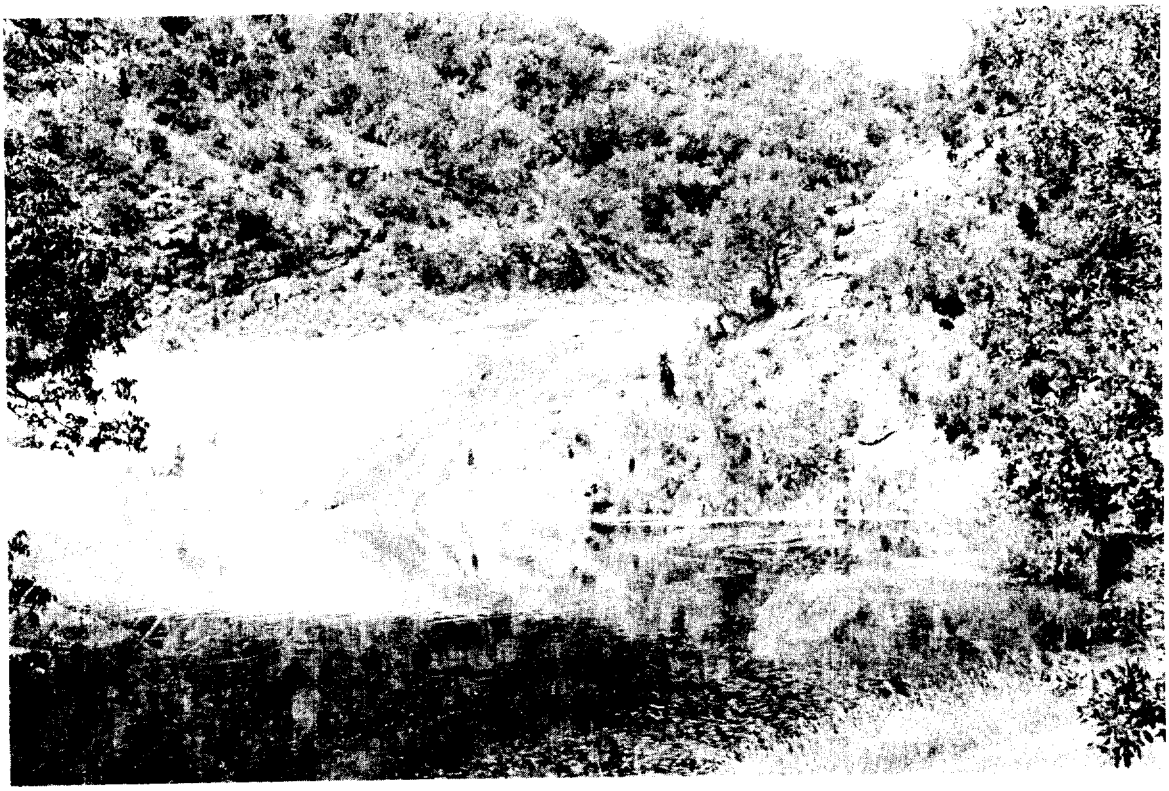

Figure 27.—Mormon Mill Falls Below Holland Springs

the picturesque Mormon Mill Falls, 5 miles downstream (Figure 27). Water from the springs provided the power. The mill, the remains of which can still be seen, was operated by others after the Mormons moved west. The springs are now used for irrigation. A historical marker is located here. Discharge: July 26, 1961—1.0 ft^3/s; September 17, 1971—1.3 ft^3/s (measured at the falls). References: Barkley, 1970; Texas Historical Survey Committee, 1971; and Jackson, 1971.

Ebeling Springs (EE39). Two openings. Latitude 30°28′, longitude 98°16′, 7 miles south of Marble Falls. Aquifer: The springs rise from a fault between the Ellenburger and Marble Falls Limestones. Discharge: July 25, 1940—1.7 ft^3/s; September 17, 1971—0.95 ft^3/s.

Cass County

Hughes or Chalybeate Springs (N5). Latitude 33°00′, longitude 94°38′, in Hughes Springs. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. History: A Caddo Indian village was located here in prehistoric times. The French explorer LaSalle may have passed here in 1686. From 1813 Trammell's Trace, an underground slave route, passed the springs. In 1847 the town of Hughes Springs was laid out at the springs. The springs were long known for medicinal qualities. A historical marker is located here. Discharge: None reported in 1942 or 1971. References: Gordon, 1911; Peale, 1894; and Texas Historical Survey Committee, 1971.

Thrasher Spring (N6). Latitude 33°01′, longitude 94°17′, 5 miles east of Linden. Aquifer: Queen City Sand. History: Known as a mineral spring in 1911. Discharge: None reported in 1942 and 1971. Reference: Gordon, 1911.

Cherokee County

Castalian or Chalybeate Springs (Z5). Latitude 31°50′, longitude 95°12′, 3 miles east of Dialville. Aquifer: Queen City Sand. History: The Cherokee Indians had a village here and raised orchards of peaches and plums. Remnants of their advanced pottery can still be found. For many years the springs were a resort for invalids afflicted with jaundice and other diseases. Discharge: July 12, 1936—5 gpm; flowing in 1971. Reference: Deussen, 1914.

Clay County

Buffalo Springs (L2). Latitude 33°33', longitude 98°08', at Buffalo Springs. Aquifer: Cisco Group limestones and sandstones. History: Moscoso may have stopped here in his 1542 expedition. The springs were a watering place for buffalo hunters as early as 1849. In 1857 the U.S. Cavalry camped here, finding "plenty of water in holes and fine grazing." An Army post was established here in 1867 but was soon abandoned because of a lack of water. The springs were also on the California Trail. Reference: Henderson, 1958.

Collingsworth County

Elm Creek Springs (E6). The springs form Elm Creek base flow. Latitude 35°07', longitude 100°17', 8 miles southeast of Shamrock. Aquifer: Blaine Formation (siltstone and gypsum), dipping northwest. The springs rise through alluvial sands. History: Indian artifacts have been found at the springs. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1947	2.3	1960	1.9
1948	2.3	1961	2.7
1949	2.8	1962	3.1
1950	2.4	1963	3.1
1951	2.7	1964	2.3
1952	1.9	1965	2.1
1953	1.6	1966	2.1
1954	1.4	1967	2.1
1955	1.7	1968	2.2
1956	1.2	1969	1.8
1957	1.6	1970	2.2
1958	1.4	1971	0.91
1959	1.4	1972	2.2

Wolf Creek Springs (E7). Numerous springs, forming Wolf Creek. Latitude 35°03', longitude 100°08', 5 miles northeast of Lutie. Aquifer: Blaine Formation (siltstone and gypsum), a dipping northwest. History: The springs have been used for irrigation. Discharge: September 9, 1938–1.0 ft^3/s; May 1, 1967–1.7 ft^3/s; June 24, 1971–2.5 ft^3/s.

Wischkaemper Springs (H3). Three springs. Latitude 34°59', longitude 100°21', 6 miles northeast of Quail. Aquifer: Alluvium. Discharge: May 18, 1967–1.7 ft^3/s; June 24, 1971–0.25 ft^3/s.

O'Hair Springs (H4). Several springs. Latitude 34°52', longitude 100°24', 3 miles south of Quail. Aquifer: Whitehorse Sandstone, dipping northwest. Discharge: October 20, 1938–0.02 ft^3/s; January 24, 1967–1.3 ft^3/s; June 24, 1971–0.12 ft^3/s. The flow is absorbed from the channel within one mile during summer.

Roscoe Springs (H5). Latitude 34°51', longitude 100°21', 8 miles west of Wellington. Aquifer: Whitehorse Sandstone, dipping northwest, and alluvium. History: A swamp that formerly existed here has been channelized and drained. Discharge: October 1, 1938–3 gpm; March 26, 1968–1.7 ft^3/s; June 24, 1971–0.10 ft^3/s. Wells pump water from alluvium nearby for irrigation. The spring flow is absorbed by the alluvium one mile downstream.

Sand Creek Springs (H6). Several springs, forming Sand Creek. Latitude 34°51', longitude 100°04', 8 miles east of Wellington. Aquifer: Whitehorse Sandstone, with much gypsum, dipping southeast (Figure 12). Discharge: October 5, 1938–trace; January 12, 1967–1.4 ft^3/s; June 24, 1971–0.08 ft^3/s.

Comal County

Spring Branch Springs (LL21). Two springs. Latitude 29°55', longitude 98°27', 3 miles northwest of Spring Branch. The springs supply water to the Spring Branch community and school. Aquifer: Glen Rose and Cow Creek Limestones of the Edwards-Trinity (Plateau) aquifer. Discharge (ft^3/s):

DATE		DIS-CHARGE (ft^3/s)	DATE		DIS-CHARGE (ft^3/s)
August	1924	3.5	March	1945	11
January	1928	1.5	October	1951	0.5
February	1929	0.9	January	1955	1.0
February	1930	1.0	March	1962	1.4
November	1936	1.8	August	1970	5.5

Honey Creek Spring (LL22). Latitude 29°50', longitude 98°30', 3 miles north of Honey Creek. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. The spring issues from a cavern. Discharge: July 20, 1944–2.8 ft^3/s; August 18, 1970–0.8 ft^3/s.

Rebecca Springs (LL23). Latitude 29°56', longitude 98°22', 4 miles northeast of Spring Branch.

The Springs supply water to Cypress Lake. Aquifer: Travis Peak Formation of the Edwards-Trinity (Plateau) aquifer. The springs issue from cavities in the Cow Creek Limestone. Discharge: October 1925—0.4 ft^3/s; October 1943—3.9 ft^3/s; August 1970—1.1 ft^3/s.

Wolle Springs (LL24). Five springs. Latitude 29°54', longitude 98°19', 5 miles northeast of Wesson. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Water was muddy during upriver rises, leading to the belief that the springs were fed by the Guadalupe River upstream. History: Inundated by Canyon Reservoir in 1964. Discharge: 1944—15 ft^3/s; January 26, 1955—22 ft^3/s.

Crane's Mill Springs (LL25). Two springs. Latitude 29°54', longitude 98°15', 6 miles west of Sattler. Aquifer: Lower Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. The springs flow from crevices along the Tom Creek Fault. History: Inundated by Canyon Reservoir in 1964. Discharge: September 18, 1944—14 ft^3/s; January 27, 1955—8.1 ft^3/s; March 7, 1962—9.1 ft^3/s.

Bear Springs (LL26). Latitude 29°48', longitude 98°13', 5 miles northeast of Valley View. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue through the Bear Creek Fault. Discharge: November 5, 1936—2 gpm; September 29, 1943—0.4 ft^3/s; March 28, 1945—5 ft^3/s; September 29, 1945—0.4 ft^3/s.

Hueco Springs (LL28). Two springs. Latitude 29°46', longitude 98°08', 4 miles north of New Braunfels. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. Artesian springs rise from two openings in gravel. History: The water was long used to run a mill. In 1950 a small water power plant was still in operation, but has now been abandoned (Figure 3). Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1924	37	1949	46
1928	0	1950	27
1929	0	1951	0.5
1937	1.5	1952	10
1944	60	1953	43
1945	58	1954	2.5
1946	54	1955	0
1947	57	1956	0
1948	7.0	1957	43

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1958	81	1966	72
1959	63	1967	23
1960	50	1968	82
1961	52	1969	50
1962	13	1970	48
1963	21	1971	20
1964	17	1972	72
1965	50		

Maximum recorded discharge was 131 ft^3/s in 1968. Temperature, turbidity, and discharge all fluctuate with rainfall, indicating that the recharge area is small and nearby.

Comal Springs (LL29). About six springs, forming the Comal River. Latitude 29°42', longitude 98°08', in Landa Park, New Braunfels. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. The springs issue through the Comal Springs Fault. The spring temperature of 74°F indicates that the artesian water circulate at least 500 feet below the surface. The water is never turbid and is believed to come from a large recharge area (Figure 28). History: The Tehuacana Indians formerly lived here, as evidenced by the many artifacts left in the vicinity. In 1764 the French explorer St. Denis visited the springs. They were later a stop on El Camino Real. In 1845 a group of German immigrants under Prince Carl Solms-Braunfels settled here, calling the springs "Las Fontanas." They purchased the 1,300 acres surrounding the springs for $1,111. Many mills and powerplants have used the water power of the springs. In the 1870's New Braunfels installed a water system, so that it was no longer necessary to carry the water from the springs. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1882	375	1904	375
1896	328	1905	390
1897	390	1906	386
1898	305	1910	299
1899	310	1911	267
1900	360	1915	407
1901	360	1921	320
1902	325	1924	370
1903	412	1925	320

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1926	300	1945	360
1927	320	1946	359
1928	288	1947	352
1929	290	1948	277
1930	273	1949	286
1931	320	1950	261
1932	321	1955	104
1933	311	1956	51
1934	315	1957	137
1935	326	1958	299
1936	359	1959	321
1937	347	1960	318
1938	343	1961	352
1939	301	1962	290
1940	279	1963	224
1941	343	1964	189
1942	349	1965	262
1943	341	1966	281
1944	346	1967	189

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1968	326	1971	313
1969	295	1972	358
1970	310		

Maximum recorded discharge was 534 ft^3/s on October 16, 1973. These are the largest springs in Texas and in the southwest. However, they failed completely for a time in 1956 after 7 years of drought. References: Tiling, 1913 and Taylor, 1904.

Bishop Spring (LL37). Also called Gumtree, Big, or Flugrath Spring. Latitude 29°55', longitude 98°18', 7 miles east of Spring Branch. Aquifer: Large cavities in the lower Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. History: Inundated by Canyon Reservoir in 1964. Discharge (ft^3/s):

DATE		DIS-CHARGE (ft^3/s)	DATE		DIS-CHARGE (ft^3/s)
August	1924	7.4	August	1951	0.1
January	1928	3.9	October	1951	0.3
February	1929	2.9	September	1952	0.8
November	1936	3.2	March	1962	9.1
January	1938	3.9			

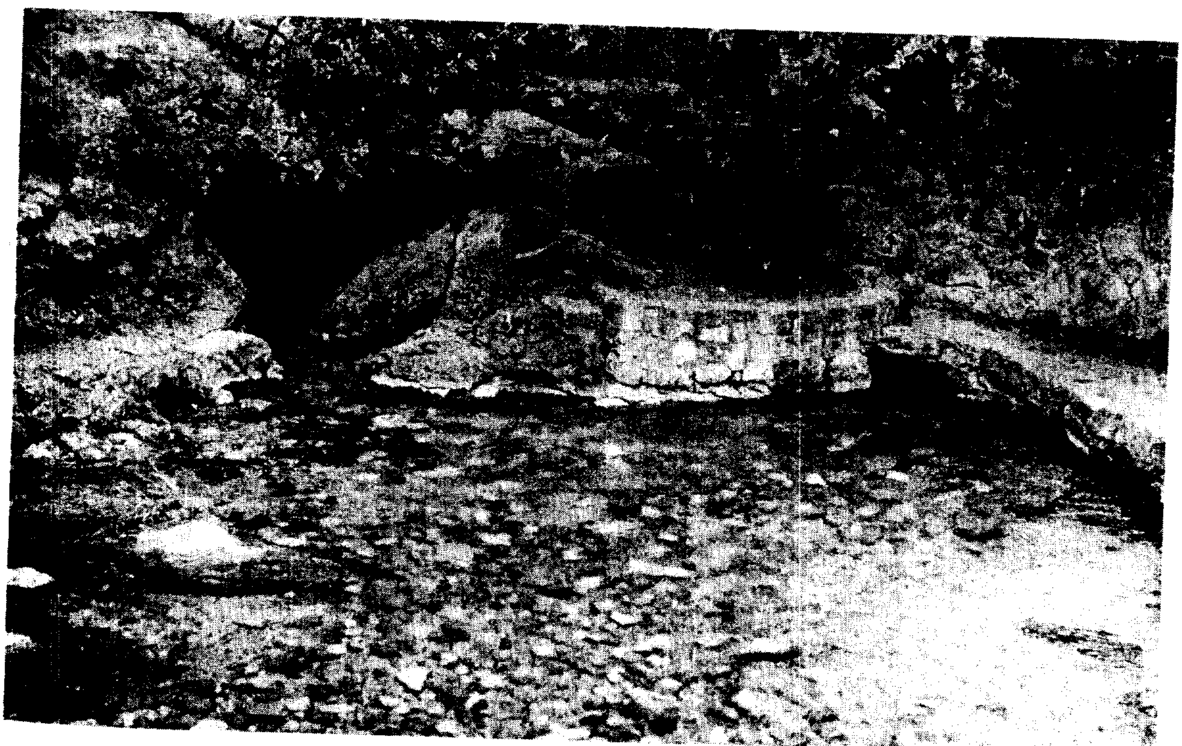

Figure 28.—Some of the Comal Springs (Courtesy of U.S. Department of Agriculture, Soil Conservation Service)

Crockett County

Live Oak Spring (DD2). Forms Live Oak Creek. Latitude 30°45′, longitude 101°41′, 10 miles northeast of Sheffield. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: Mendoza probably stopped here in 1683. The spring furnished water for Fort Lancaster in the 1880's. Discharge: July 4, 1917–5.0 ft^3/s; January 1962-"flows"; February 6, 1968–0.

Cedar Springs (DD4). Several springs. Latitude 30°30′, longitude 101°41′, 15 miles southeast of Sheffield. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: The springs were settled in 1882 by W. P. Hoover. They have been used for irrigation. Discharge: March 6, 1963–"flows"; February 6, 1968–18 ft^3/s (including several other nearby springs).

Crosby County

Couch Springs (K2). Latitude 33°39′, longitude 101°07′, 8 miles east of Crosbyton. Aquifer: Ogallala Formation. History: In 1874 General Mackenzie stopped here while pursuing Indians. Discharge: November 7, 1938–1.9 ft^3/s. Reference: Spikes and Ellis, 1952.

Culberson County

Bone Springs (U3). Latitude 31°53′, longitude 104°53′, 5 miles west of Pine Springs. Aquifer: Brushy Canyon Formation. The springs issue at the contact with the underlying Bone Spring Limestone. History: The springs were the basis for a Comanche Indian campground. References: King, 1948 and Williams, 1969.

Pine and Smith Springs (U4). Latitude 31°54′, longitude 104°49′, at Pine Springs. Aquifer: Cherry Canyon Formation. The springs issue through faults. History: The springs were the basis for a stage stand on the Butterfield Overland Mail route in 1857. A historical marker is located here. Discharge: 1971–68 gpm. References: King, 1948; Williams, 1969; and Texas Historical Survey Committee, 1971.

Independence Spring (U5). Latitude 31°54′, longitude 104°43′, 6 miles east of Pine Springs. Aquifer: Delaware Mountain Group sandstones. The spring issues through a fault and gravel alluvium. History: This spring was a Comanche Indian campground. In 1857 a stage stand on the Butterfield Overland Mail route was established here. Discharge: 1971–14 gpm. References: King, 1948 and Williams, 1969.

Delaware Springs (U6). Latitude 31°51′, longitude 104°33′, 15 miles east of Pine Springs. Aquifer: Bell Canyon Formation. History: The springs were used by the U.S. Cavalry in the early 1800's. In 1857 they were the basis for establishing a stage stop on the Butterfield Overland Mail route. References: King, 1948, and Williams, 1969.

Rattlesnake Spring (U8). Near latitude 31°21′, longitude 104°51′, 22 miles north of Van Horn. Aquifer: Hueco Limestone. The spring issues through a fault. History: In 1880 there was a battle between U.S. Cavalry troops and Apache Indians when Apache Chief Victorio and his band tried to get water at this spring. Reference: Utley, 1960.

Dallam County

Buffalo Springs (A1). Several springs. Latitude 36°29′, longitude 102°47′, 16 miles northeast of Texline. Aquifer: Purgatoire Formation, dipping east at about 20 feet per mile. History: Originally a watering place for buffalo herds, and later wild mustangs. It was an Indian settlement, as evidenced by numerous arrow and spear heads found nearby. Coronado may have drunk from these springs in 1542. In 1878 cattle ranching began, and in 1888 the XIT Ranch first division headquarters was established here. The stage line from Santa Fe to Kansas City stopped here. Presently the springs feed several large pools surrounded by cottonwood trees. A historical marker is located here. Discharge: August 7, 1924–1.2 ft^3/s; February 23, 1937–0.9 ft^3/s; July 26, 1957–1.2 ft^3/s; June 22, 1971–0.58 ft^3/s. In recent years municipal and irrigation pumping to the west have reduced the discharge. References: Haley, 1929; and Texas Historical Survey Committee, 1971.

Dallas County

Browder Springs (R7). Latitude 32°46′, longitude 96°47′, in City Park in Dallas. Aquifer: Austin Chalk and terrace alluvium. History: These springs were Dallas' principal source of water before wells were drilled. A historical marker is located here. Discharge: During the drought of 1909-1910, the springs supplied 1.6 ft^3/s of water to Dallas. No flow was reported in 1943. Reference: Texas Historical Survey Committee, 1971.

Figure 29.—Fish Pond and Pump House at Bitter Creek Springs

Dimmit County

Carrizo Springs (QQ1). Several springs. Latitude 28°30′, longitude 99°52′, 3 miles southwest of Carrizo Springs. Aquifer: Carrizo Sand of the Carrizo-Wilcox aquifer. History: The Spanish explorer Ponce de Leon is believed to have stopped here in 1689. After 1697 the springs were a stop on El Camino Real. In 1865 four hundred immigrants under Captain Levi English settled here. Discharge: 1892—0.26 ft^3/s. The springs ceased flowing in 1929 because of heavy well pumping and decline of ground-water levels in the area. Reference: Peale, 1894.

Donley County

Bitter Creek Springs (H2). Three springs. Latitude 34°49′, longitude 100°47′, 7 miles south of Lelia Lake. Aquifer: Ogallala Formation. The main spring emerges in the bottom of a fish pond and swimming pool (Figure 29). History: Early explorers described this area as "black with buffalo." The springs are surrounded by a large grove of cottonwoods. Discharge: March 5, 1968—1.7 ft^3/s; June 23, 1971—0.08 ft^3/s. Reference: Haley, 1929.

Eastland County

Shinoak Springs (Q1). Latitude 32°12′, longitude 98°42′, 2 miles southwest of Gorman. Aquifer: Basal Trinity Group Sands. History: The town of Old Shinoak Springs was laid out around these springs. Water was hauled from them for home and livestock use. The town was doomed when the railroad bypassed it in 1880. A lake was built in 1911 to catch the spring flow. A historical marker is located here. Discharge: No flow was recorded in 1937. Reference: Texas Historical Survey Committee, 1971.

Edwards County

Hackberry Springs (DD17). Many springs. Latitude 30°01′, longitude 100°03′, 8 miles east of Rocksprings. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. Discharge: 1939—2.5 ft^3/s; October 7, 1954—5.5 ft^3/s.

Big Paint Springs (EE8). Latitude 30°16′, longitude 99°53′, 4 miles south of Telegraph. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: The water has been used for irrigation. The springs supplied four fish ponds in 1938. Discharge: April 22, 1939—22 ft³/s; September 14, 1955—18 ft³/s; March 26, 1962—31 ft³/s.

Seven Hundred Springs (EE9). Many springs. Latitude 30°16′, longitude 99°55′, 4 miles south of Telegraph. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: Mendoza probably stopped here in 1683. The springs have been used for irrigation. Discharge (ft³/s by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1939	14	1965	16
1952	11	1966	15
1956	11	1967	17
1959	28	1968	15
1961	25	1969	15
1962	22	1970	20
1963	16	1971	18
1964	16	1972	21

Tanner Springs (EE10). Latitude 30°15′, longitude 99°56′, 5 miles south of Telegraph. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: A mill formerly used the spring water for power. The water has also been used for irrigation. Discharge: February 11, 1925—8.9 ft³/s; February 22, 1939—9.3 ft³/s.

Kickapoo Springs (KK15). At least three springs. Latitude 29°46′, longitude 100°24′, 21 miles southwest of Rocksprings. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. The springs probably issue through a fault. History: The explorer Bosque may have stopped here in 1675. In 1898 Hill and Vaughn wrote, "Enormous springs break forth, creating a wide, running stream of clear water that continues for four miles, and then disappears into sink holes," Discharge (ft³/s by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1931	2.0	1954	2.5
1939	3.5	1955	1.8
1952	1.5	1962	1.8
1953	1.3		

Reference: Hill and Vaughn, 1898.

Paint Bluff Springs (KK[illegible]). At least 14 openings. Latitude 29°47′, longitude 100°1[illegible]′, 10 miles northwest of Barksdale. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. The springs issue through faults. Discharge: January 23, 1939—2.2 ft³/s.

Roberts Springs (KK18). At least three springs. Latitude 29°48′, longitude 100°10′, 10 miles northwest of Barksdale. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. The springs issue through faults. History: The springs have been used for irrigation. Discharge: January 20, 1939—3.3 ft³/s; October 15, 1953—2.2 ft³/s.

Pulliam Springs (KK19). At least 10 springs. Latitude 29°51′, longitude 100°08′, 8 miles northwest of Vance. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. The springs issue through a fault. History: The springs have been used for irrigation. Discharge: January 18, 1939—2.5 ft³/s; October 15, 1953—2.0 ft³/s; February 1956—1.0 ft³/s.

McCurdy Springs (KK20). Latitude 29°54′, longitude 100°01′, 6 miles north of Vance. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: The springs have been used for irrigation. Discharge: March 10, 1924—11 ft³/s; 1939—3.7 ft³/s; August 16, 1955—14 ft³/s (after heavy rains).

Ellis County

Hawkins Spring (R5). Latitude 32°29′, longitude 96°59′, 1/2 mile east of Midlothian. Aquifer: Austin Chalk. History: The Peters Colony, including William Hawkins, settled here in 1848. During that summer log cabins were built from logs hauled from Dallas County cedar brakes. The spring supplied all water for the colony. A historical marker is located here. Discharge: None reported in 1967. Reference: Texas Historical Survey Committee, 1971.

Fayette County

Mount Maria Spring (MM4). Latitude 29°53′, longitude 96°53′, 2 miles south of La Grange. Aquifer: Oakville Sand of the Gulf Coast aquifer. History: Described by Bonnell (1840) as a spring on top of Mount Maria with a waterfall and much limestone spar (travertine). The spring was on the old Spanish Bahia Road from Nacogdoches to Corpus Christi. Discharge: No flow reported in 1967. Reference: Bonnell, 1840.

Galveston County

Smith Springs (NN1). Three springs. Latitude 29°34′, longitude 94°24′, on the northwest side of High Island. Aquifer: Gulf Coast aquifer. History: The Karankawa Indians had a campground at these springs. Discharge: In 1952 the flow had been reduced to "seepage in fine sand." Reference: Deussen, 1914.

Gillespie County

Lange Springs (EE18). At least two springs. Latitude 30°28′, longitude 99°08′, 2 miles north of Doss. Aquifer: Hensell Sand of the Edwards-Trinity (Plateau) aquifer. History: Pictographs in a nearby cave indicate that the Indians used these springs long before the coming of white men. Originally the springs were described as "deep, cold springs gushing from beneath shelving rock." In 1849 Lange's corn, feed, and saw mill was built here. The springs have also been used for irrigation. A historical marker is located here. Discharge: 1937–0.67 ft^3/s. References: Fredericksburg Chamber of Commerce, 1946, and Texas Historical Survey Committee, 1971.

Fall Springs (EE30). Latitude 30°10′, longitude 99°17′, 4 miles north of Camp Scenic. Aquifer: Comanche Peak Limestone of the Edwards-Trinity (Plateau) aquifer. History: Indians of the Archaic Period (400 to 3000 years ago) left burnt rock middens, projectile points, and stone axes at these springs. Discharge: March 1965–2.2 ft^3/s. Reference: Briggs, 1971.

Guenther Spring (EE33). Near latitude 30°16′, longitude 98°56′, about 4 miles west of Fredericksburg. Aquifer: Hensell Sand of the Edwards-Trinity (Plateau) aquifer. History: In 1851 the Guenther corn, feed, and saw mill was established, making use of the spring water power. Discharge: None reported in 1937. Reference: Fredericksburg Chamber of Commerce, 1946.

Grimes County

Kellum Springs (FF15). Latitude 30°37′, longitude 96°01′, 5 miles northeast of Carlos. Aquifer: Jackson Sand. History: The springs were the basis for a health and pleasure resort in the 1850's. Discharge: December 11, 1942–41 gpm; 1971–25 gpm.

Piedmont Springs (FF16). Eight springs originally, including White Sulphur, Middle, and Black Sulphur Springs. Latitude 30°31′, longitude 96°06′, at Piedmont. Aquifer: Jackson Sand. History: The springs were a stop on the old Bahia Road. In the 1850's three of these springs, varying in taste from mild to strong, were the basis for a famous health resort. They supplied a large hotel and bath house, which were used by the Confederate Army during the Civil War. A historical marker is located here. Discharge: December 11, 1942–36 gpm; November 9, 1970–13 gpm. Reference: Texas Historical Survey Committee, 1971.

Gibbons Spring (GG1). Latitude 30°36′, longitude 95°59′, 3 miles northwest of Roans Prairie. Aquifer: Jackson Sand. History: The Coushatta Indians had a village here with well-constructed houses and gardens. Later the spring was a stage stop on the old Spanish Bahia Road. In the 1850's a pleasure resort grew up around it. Discharge: None reported in 1971.

Guadalupe County

Ewing or Geronimo Springs (MM2). Latitude 29°39′, longitude 97°57′, 1 mile southeast of Geronimo. Aquifer: The springs flow from fissures in limestone, probably the Willis Point Formation. History: The Tehuacana Indians had a village at these springs until they were driven out by the white men in 1835. The springs were a favorite spot for barbecues and picnics in the 1850's. Discharge: August 20, 1926–0.44 ft^3/s; June 6, 1936–0.67 ft^3/s; June 23, 1964–0.58 ft^3/s. Reference: Moellering, 1938.

Walnut Springs (MM3). They include Elm Spring. Latitude 29°34′, longitude 97°57′, in Seguin. Aquifer: Leona Formation. History: Tonkawa and Hueco Indians lived at these springs. In prehistoric times they were also a favorite haunt of buffaloes, antelopes, bears, mountain lions, and jaguars. In 1834 the town of Walnut Springs was laid out around the springs and used the water. Later the town was renamed Seguin. Discharge: June 15, 1936–"flows"; 1966–No reported flow. Reference: Moellering, 1938.

Harrison County

Hynson, Marshall, Noonday Camp, and Iron Springs. Over 100 springs. Latitude 32°33′, longitude 94°35′, 4 miles north of Hallsville. Aquifer: Queen City Sand. History: The French explorer La Salle probably stopped here in 1686. The springs became very popular as a health resort about 1851. During the Civil War, water from the springs was used in a leather-tanning factory. Discharge: In 1943 the flow was described as "seeps." In 1964 they were reported to be flowing. References: Deussen, 1914, and Hackney, 1964.

Figure 30.—Site of the Original XIT Spring, Now Dry

Coushatta Spring (S9). Probably near latitude 32°35′, longitude 94°03′, 2 miles south of Latex. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. History: In 1841, a party mapping the boundary between the Republic of Texas and the United States "encamped at a spring of most delicious water on an old Caddo Indian trail leading from Caddo Prairie to the Coushatta Village." Discharge: No flow was reported in 1943 or 1966. Reference: Mugno, 1971.

Hartley County

XIT Springs (D2). Latitude 35°47′, longitude 102°30′, 9 miles southwest of Hartley, in a canyon on Rita Blanca Creek. Aquifer: Ogallala Formation. History: In 1890, when the Fort Worth and Denver Railroad came through, this became the general headquarters of the 3 million acre XIT Ranch. A lake was fed by this spring, and 40 acres of alfalfa, apples, peaches, plums, pears, and grapes were irrigated. The ruins of the old headquarters still stand. Discharge: February 1938—14 gpm; June 22, 1971—no spring flow, but 5 gpm from a flowing well. Many wells were drilled in the vicinity, causing the spring to dry up (Figure 30). Reference: Taylor, 1902.

Hays County

Dripping Springs (EE42). Latitude 30°12′, longitude 98°05′, in Dripping Springs. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. History: In 1849 the springs powered a cotton gin. For many years they provided water for the town and Dripping Springs Academy. In recent years a well has been drilled because of the unreliability of the springs. Discharge: 1938—None reported; November 20, 1950—"flows"; October 15, 1971—5 gpm. Reference: Dobie, 1948.

Jacob's Well (EE43). Source of Cypress Creek. Latitude 30°02′, longitude 98°08′, 3 miles north of Wimberly. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer, faulted against impermeable beds. The spring issues through a vertical shaft in the fault, 10 feet in diameter and 150 feet deep. Discharge: August 5, 1924—6.1 ft^3/s; October 28, 1937—6.0 ft^3/s; December 6, 1937—2.9 ft^3/s; January 26, 1955—2.4 ft^3/s; April 4, 1962—4.4 ft^3/s; July 10, 1974—3.6 ft^3/s.

Barton Creek Springs (EE47). Many springs and seeps. Latitude 30°15′, longitude 98°04′, 4 miles north of Dripping Springs. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge:

1938—None reported; July 6, 1970—2.9 ft³/s; October 1, 1970—0.31 ft³/s.

San Marcos Springs (MM1). Five large fissures and many small openings. Latitude 29°54′, longitude 97°56′, 2 miles northeast of San Marcos. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer, faulted against the Taylor Marl. The springs issue through the San Marcos Springs Fault. Since the chemical content varies much more than that of Comal Springs, the recharge area is believed to be smaller, probably within the Blanco River drainage area. History: When the Spanish explorers discovered these springs in 1743, they estimated that there were 200 springs. From 1755 to 1756 a mission was located here. The springs were an important stop on El Camino Real from Nacogdoches to Mexico. In 1840 Bonnell described them as "the most pleasant and delightful situation in the Republic." Power-plants, gins, corn mills, and an ice factory used the water power. A historical marker is located here. The springs were a stop on the Chisholm Cattle Trail from 1867 to 1895. In recent years an amusement park has developed around them (Figure 5). Discharge (ft³/s by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1895	150	1928	180
1896	89	1929	180
1897	186	1930	120
1898	51	1931	190
1900	150	1932	140
1903	153	1933	100
1906	145	1934	120
1910	95	1935	135
1915	280	1936	130
1916	150	1937	135
1917	108	1938	130
1918	97	1939	90
1919	127	1940	100
1920	190	1941	180
1921	170	1942	140
1922	220	1943	180
1923	150	1944	180
1924	220	1945	210
1925	160	1946	170
1926	180	1947	200
1927	130	1948	110

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1949	130	1961	209
1950	110	1962	134
1951	110	1963	124
1952	100	1964	92
1953	125	1965	156
1954	140	1966	164
1955	95	1967	103
1956	70	1968	194
1957	117	1969	162
1958	215	1970	190
1959	171	1971	138
1960	178	1972	158

These are the second largest springs in Texas. Maximum recorded discharge was 300 ft³/s on November 5, 1973. References: Bonnell, 1840; Hill and Vaughn, 1898; Taylor, 1904; and Texas Historical Survey Committee, 1971.

Hood County

Thorp or Sulphur Springs (R1). Latitude 32°28′, longitude 97°49′, at Thorp Spring. Aquifer: Comanche Peak Limestone of the Edwards-Trinity (Plateau) aquifer. History: During the Civil War the Confederate 20th Battalion was stationed at the spring. In 1871 a health resort and cotton gin opened to make use of the spring water. In 1873 Add-Ran College (TCU) began using the water. References: Ewell, 1895, and Paddock, 1911.

Hopkins County

Sulphur Springs (N1). Latitude 33°08′, longitude 95°37′. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. History: This was a campground of the Caddo Indians. When first settled, there were buffalo, bear, and wild mustangs in droves here. Wolves and panthers took a heavy toll of livestock. In 1892 the springs were well known for their mineral content. Discharge: None reported in 1943. Reference: Peale, 1894.

Houston County

Elkhart Creek Springs (Z1). The flow from these springs forms Elkhart Creek. Latitude 31°33′, longitude

95°31′, 2 miles southwest of Salmon. Aquifer: Sparta Sand. Discharge: September 15, 1965—3.4 ft^3/s.

Hays Branch Springs (Z2). Flow from these springs forms Hays Branch. Latitude 31°27′, longitude 95°32′, 5 miles southwest of Grapeland. Aquifer: Sparta Sand. History: A Kickapoo Indian village was formerly located at these springs. They were a stop on El Camino Real. Discharge: September 16, 1965—1.8 ft^3/s.

Caney Creek Springs (Z3). Flow from these springs forms Caney Creek. Latitude 31°27′, longitude 95°30′, 4 miles south of Grapeland. Aquifer: Sparta Sand. History: The springs were on El Camino Real. Discharge: September 16, 1965—1.7 ft^3/s.

Boiling Spring (Z4). Latitude 31°29′, longitude 95°23′, 6 miles east of Grapeland. Aquifer: Sparta Sand. History: The Tejas village of the Nabedache Indians was located here. A Spanish mission was established at the spring in 1690, and it became a stop on El Camino Real. The spring was used medicinally for many years. Discharge: 1963—5 gpm. Reference: Brune, 1970.

Howard County

Big Spring (P4). Originally seven springs. Latitude 32°13′, longitude 101°28′, 2 miles south of Big Spring. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer in a subsidence area. History: The spring was a favorite campground for Indians. The Spanish explorer Castillo is believed to have stopped here in 1650. When other Spaniards arrived in 1768, Comanche and Pawnee Indians were fighting for possession of the spring. Captain R. B. Marcy in 1849 described it as a "fine spring flowing from deep chasms in the limestone rock into an immense reservoir of some 50 feet in depth." The spring was used by the Texas and Pacific Railroad from 1881 to 1915. It was soon necessary to drill wells to supplement the spring flow. As a result the spring essentially dried up in 1925 (Figure 31). In 1967 well water was piped to the spring in an effort to restore the recreational value of the area. A historical marker is located here. Discharge: 1891—0.15 ft^3/s; 1925—0; 1937—"weak seep"; 1971—0. References: Fannin, 1968, and Texas Historical Survey Committee, 1971.

Hudspeth County

Alamo Springs or Ojos del Alamo (U1). Latitude 31°32′, longitude 105°43′, 17 miles north of Fort Hancock. Aquifer: Finlay Limestone (equivalent of Edwards Limestone). History: The Pueblo Indians were using well established systems of irrigation ditches here when the earliest Spanish explorers arrived. The springs became a stop for wagon trains heading west in 1850. References: Hutson, 1898; Taylor, 1902; and Williams, 1969.

Crow Spring or Ojo del Cuervo (U2). Latitude 32°00′, longitude 105°05′, in the Salt Basin 9 miles northeast of Dell City. Aquifer: Alluvium. History: Wagon trains stopped here for water in 1846. In 1857 it became a stop on the Butterfield Overland Mail route. Discharge: 1949—5 gpm. Reference: Williams, 1969.

Apache Spring (U7). Near latitude 31°27′, longitude 104°58′, at the head of Apache Canyon. Aquifer: Bone Spring Limestone. The spring issues through a fault. History: This spring was the scene of the last Indian fight in Texas. In 1881 a band of Apaches was annihilated here. The spring was reported to have run red with their blood. Reference: Utley, 1960.

Eagle Spring or Ojo del Aguila (BB1). Latitude 30°59′, longitude 105°06′, 5 miles west of Hot Wells. Aquifer: Yucca conglomerate, sandstones, and limestones. The spring issues through the Eagle Spring Fault. History: Because the Apache Indians as well as the white men relied on this spring for water, several skirmishes took place here. The Old Spanish Trail from San Antonio to El Paso passed here. From 1854 to 1882 the spring was the site of a stage stand. A historical marker is located here. References: Underwood, 1963, and Texas Historical Survey Committee, 1971.

Irion County

Seven, Spring Creek, Headwater, or Good Springs (W2). Several springs. Latitude 31°14′, longitude 100°49′, 3 miles south of Mertzon. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. Springs issue from joints in the limestone (Figure 16). History: The springs were used by Meserve man 9,000 years ago and later by Tonkawa Indians, who left several bedrock mortars, used for grinding corn and nuts, in the limestone, and many spear points. The Spanish explorer Mendoza passed here in 1683. The springs were used by the U.S. Cavalry in the late 1840's. This was the last fresh water spring on this route westward before encountering the gypseous water of the plains. The water is presently used for irrigation. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1918	8.0	1934	13
1925	12	1940	4.5

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1956	5.3	1964	6.1
1958	7.4	1965	6.0
1959	8.5	1966	5.7
1960	9.7	1969	5.7
1961	9.0	1970	7.9
1962	9.4	1972	12
1963	7.8		

Several small springs upstream have been dried up by pumping from wells.

Dove Creek Springs (W3). Latitude 31°11′, longitude 100°44′, 8 miles southeast of Mertzon. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: They were originally used by the Tonkawa Indians. In 1865 a force of 370 militiamen attacked 1,400 peaceful Kickapoos here and were defeated. A bedrock mortar used for grinding corn and acorns is still present. The springs are presently used for irrigation (Figure 32). A historical marker is located here. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1918	4.2	1965	5.5
1925	13	1966	7.6
1940	4.5	1967	5.5
1944	17	1968	5.4
1959	7.8	1969	5.1
1960	12	1970	4.9
1961	9.0	1971	9.8
1962	11	1972	13
1963	7.9	1973	12
1964	6.0		

Reference: Texas Historical Survey Committee, 1971.

Jeff Davis County

El Muerto or Dead Man's Hole (BB2). Near latitude 30°32′, longitude 104°20′, 5 miles northeast of Quebec Siding. Aquifer: Tertiary lava, ash, tuff, and agglomerate. History: This spring was a stop on the Old

Figure 31.—Site of Former Big Spring

Figure 32.—Dove Creek Springs

Spanish Trail from San Antonio to El Paso. Later it was the site of a stage stand, the ruins of which still exist. It is said that 29 bars of stolen gold were buried here in 1879. Discharge: 1963—"still flows enough to water cattle". Reference: Scobee, 1963.

Barrel Springs (BB3). Latitude 30°31′, longitude 104°14′, 8 miles northeast of Ryan Siding. Aquifer: Barrel Springs lava, tuff, and agglomerate. History: The springs were a water stop on the Old Spanish Trail from San Antonio to El Paso. After 1851 they were on a regular stagecoach route. Discharge: 1963—"slightly damp". Reference: Scobee, 1963.

Phantom Lake Spring (CC5). Latitude 30°55′, longitude 103°52′, in Madera Canyon, 5 miles west of Toyahvale. Aquifer: Comanchean limestones of the Edwards-Trinity (Plateau) aquifer. Artesian spring water issues from the base of a cliff, along a fault (Figure 20). Rainfall causes a large increase in flow and suspended sediment, and a large decrease in dissolved solids and temperature. For example, on April 28, 1971, with a flow of 5.7 cfs, the concentration of dissolved solids was 2,250 milligrams per liter. On October 7, 1932, following a rain, a flow of 82 cfs and dissolved-solids concentration of 144 mg/l were found. These relationships indicate that recharge is from a relatively small, nearby area. History: The Spanish explorer Espejo probably stopped here in 1582. The spring was used to power a cotton gin in early settlement days. It has been used for irrigation since 1853. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1900	46	1951	15
1904	46	1952	14
1932	16	1953	13
1933	23	1954	13
1934	16	1955	13
1941	17	1956	13
1942	17	1957	11
1943	14	1958	11
1944	14	1959	13
1945	19	1960	11
1946	16	1961	11
1947	15	1962	9.8
1948	14	1963	8.9
1949	14	1964	8.6
1950	15	1965	7.5

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1966	7.7	1969	8.0
1967	7.3	1970	6.1
1968	17	1971	5.7

As shown in Figure 21, the spring appears to be gradually failing. References: Taylor, 1904, and Scobee, 1963.

Barrila or Jug Spring (CC6). Latitude 30°46', longitude 103°35', close to the corner of Reeves, Pecos, and Jeff Davis Counties. Aquifer: Tertiary lava, tuff, ash, and agglomerate. History: This spring was a stop on the Old Spanish Trail from El Paso to San Antonio. Later it became a stagecoach station. In 1850 it was attacked by Apaches and 14 mules were stolen. The stone ruins of the station can still be seen. Discharge: 1877—"small but never failing." References: Utley, 1960, and Scobee, 1963.

Fort Davis Spring (CC7). Latitude 30°36', longitude 103°53', 1 mile north of the town of Fort Davis. Aquifer: Alluvium. History: The well-known Painted Comanche Camp was at this spring. The Indians made paintings on many trees here. The Spanish explorer Espejo probably stopped here in 1582. The Old Spanish Trail from San Antonio to El Paso used it as a water stop. From 1856 to 1875 Fort Davis hauled water from Limpia Creek, 2 miles north. From 1875 to 1883 the Fort Davis Spring was used for drinking water and irrigation of a garden at the fort, but caused much dysentery among the troops, probably because the spring was polluted by the fort and stock upstream. After 1883 water was pumped from Limpia Creek to the fort. Reference: Utley, 1960.

Templeton Springs (CC8). Two springs. Latitude 30°29', longitude 103°48', 10 miles southeast of Fort Davis. Aquifer: Duff Tuff. History: The springs were used in 1902 to irrigate fruit trees, alfalfa, and grass. Discharge: March 2, 1955—0.33 ft^3/s. Reference: Taylor, 1902.

Leoncita Springs (CC17). Latitude 30°29', longitude 103°41', 9 miles north of Alpine. Aquifer: Sheep Canyon and Cottonwood Springs Basalts. History: Juan Dominguez de Mendoza may have camped at these springs in 1684. They were the basis for a stage stand on the San Antonio to El Paso route through Musquiz Canyon. An Army camel train camped here in 1859. Discharge: April 12, 1930—0.11 ft^3/s; February 21, 1955—reported to be flowing. Reference: Texas Historical Survey Committee, 1971.

Johnson County

Cleburne Spring (R6). Latitude 32°21', longitude 97°23', at 304 West Henderson Street in Cleburne. Aquifer: Washita Group limestones. History: This brick-lined spring was the water supply for early Cleburne and Confederate Camp Henderson. At a nickel a bucket, boys carried water to the merchants. This was a stopping place on the Chisholm Cattle Trail. A historical marker is located here. Discharge: The pool was often dipped dry, but the spring always refilled it. Cleburne's first city well tapped its source and the spring dried up. In 1969 no flow was reported. Reference: Texas Historical Survey Committee, 1971.

Kendall County

Edge Falls Springs (LL20). About four springs. Latitude 29°55', longitude 98°31', 4 miles south of Kendalia. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: April 2, 1940—1.3 ft^3/s; September 8, 1952—0.4 ft^3/s; March 3, 1962—1.4 ft^3/s; November 20, 1964—2.5 ft^3/s.

Kerr County

Ellebracht Springs (EE19). Two springs. Latitude 30°10', longitude 99°20', 2 miles east of Mountain Home. Aquifer: Comanche Peak Limestone of the Edwards-Trinity (Plateau) aquifer. History: Indians of the Archaic period (400 to 3,000 years ago) left burnt-rock middens, projectile points, and stone axes at these springs. De Vaca may have passed them in 1534. Later they were on the Chihuahua Road from Mexico to Indianola. Discharge: March 16, 1965—11 ft^3/s; March 31, 1966—6.7 ft^3/s. They supply water for a fish hatchery. Reference: Briggs, 1971.

Fish and Wildlife Springs (EE20). Source of the North Fork Guadalupe River. Latitude 30°04', longitude 99°30', 10 miles west of Hunt. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. Discharge: June 30, 1938—16 ft^3/s; March 15, 1965—14 ft^3/s; April 13, 1967—0.33 ft^3/s. Reference: Bonnell, 1840.

Bear Springs (EE21). Latitude 30°04', longitude 99°25', 5 miles west of Hunt. Aquifer: Comanche Peak Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: March 16, 1965—3.0 ft^3/s; 1969—none reported.

Honey Springs (EE22). About five springs. Latitude 30°06', longitude 99°22', 3 miles northwest of

Hunt. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: March 16, 1965–1.6 ft^3/s; April 11, 1967–0.62 ft^3/s.

Mystic Springs (EE23). Source of Cypress Creek. Latitude 30°00′, longitude 99°22′, 5 miles south of Hunt. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue through cobbles and boulders. Discharge: March 16, 1965–3.6 ft^3/s; 1969–none reported.

Tegener Springs (EE24). Two springs. Latitude 30°02′, longitude 99°19′, 4 miles south of Hunt. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: March 16, 1965–1.4 ft^3/s; May 4, 1966–0.18 ft^3/s.

Kelly Springs (EE25). Latitude 30°03′, longitude 90°18′, 3 miles east of Hunt. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: March 16, 1965–2.0 ft^3/s; 1969–none reported.

Colbath Springs (EE26). Source of Bear Creek. Latitude 30°03′, longitude 99°13′, 5 miles west of Kerrville. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. History: Cabeza de Vaca probably stopped here in 1534. Later the springs were a stop on the Chihuahua Road. Discharge: March 24, 1965–1.1 ft^3/s; December 2, 1966–6 gpm.

Indian Springs (EE27). Latitude 30°02′, longitude 99°16′, 8 miles west of Kerrville. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: March 24, 1965–1.9 ft^3/s; December 1, 1966–0.20 ft^3/s.

Goat Springs (EE28). Latitude 30°06′, longitude 99°12′, 6 miles northwest of Kerrville. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. History: De Vaca possibly stopped here in 1534. Later the springs were a stop on the Chihuahua Road. Discharge: March 24, 1965–1.7 ft^3/s.

Henderson Springs (EE29). Latitude 30°06′, longitude 99°15′, 2 miles east of Camp Scenic. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. History: Indians of the Archaic period (400 to 3,000 years ago) left burnt-rock middens, projectile points, and stone axes at the springs. Cabeza de Vaca possibly stopped here in 1534. The springs were later a stop on the Chihuahua Road from Mexico to Indianola. Discharge: March 16, 1965–1.6 ft^3/s. Reference: Briggs, 1971.

Reid Springs (EE31). About five springs, forming Town Creek. Latitude 30°08′, longitude 99°07′, 7 miles north of Kerrville. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: March 24, 1965–2.4 ft^3/s; November 10, 1966–0.50 ft^3/s.

Cypress Springs (EE32). Latitude 30°02′, longitude 99°00′, 9 miles east of Kerrville. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: March 15, 1965–3.2 ft^3/s; June 15, 1966–2.2 ft^3/s.

Lynx Haven Springs (LL15). About two springs. The source of the South Fork Guadalupe River. Latitude 29°59′, longitude 99°27′, at Lynx Haven Lodge. Aquifer: Edwards and associated limestone of the Edwards-Trinity (Plateau) aquifer. Discharge: June 30, 1938–13 ft^3/s; March 15, 1965–10 ft^3/s; July 12, 1967–0.03 ft^3/s. Reference: Bonnell, 1840.

Buffalo Creek Springs (LL16). Latitude 30°00′, longitude 99°23′, 6 miles south of Hunt. Aquifer: Comanche Peak Limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue 40 feet above the channel bed. Discharge: March 16, 1965–1.3 ft^3/s; 1969–none reported.

Kimble County

Iona Springs (EE3). Many springs. Latitude 30°42′, longitude 99°41′, 7 miles west of London. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: These springs were the site of a Lipan Apache Indian campground. When settled in the 1850's they were described as "sparkling springs with 50-pound catfish and beaver." Discharge: July 13, 1966–1.3 ft^3/s. Reference: Fisher, 1937.

Gentry Spring (EE4). Latitude 30°39′, longitude 99°55′, 5 miles northwest of Cleo. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: Settled by Raleigh Gentry in the late 1850's, when it was described as a "lively spring." Discharge: September 25, 1965–0.28 ft^3/s. It is said to be affected very little by local rainfall. Reference: Fisher, 1937.

Scott Springs (EE5). Latitude 30°37′, longitude 99°39′, 6 miles southwest of London. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: A battle with the Lipan Apache Indians took place at these springs. Discharge: 1969—none reported. Reference: Fisher, 1937.

Coleman Springs (EE6). Two springs. Latitude 30°22', longitude 99°54', 4 miles north of Telegraph. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: De Vaca possibly drank from these springs in 1534. Discharge: March 22, 1966—1.9 ft^3/s. Flow varies with rainfall.

Christmas Canyon Springs (EE7). At least four springs originally, including House Canyon Spring. Latitude 30°19', longitude 99°55', 1 mile south of Telegraph. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. Discharge: March 24, 1966—16 ft^3/s.

Headquarters Springs (EE11). At least two springs. Latitude 30°22', longitude 99°37', 5 miles southeast of Segovia. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. Discharge: April 25, 1966—1.5 ft^3/s.

Rio Bonito Springs (EE12). At least three springs, including East, West, and Water Hole Springs. Latitude 30°19', longitude 99°38', 8 miles south of Segovia. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. Discharge: April 21, 1966—11 ft^3/s. The springs supply water to a lake.

KINNEY COUNTY

Mud Springs (KK11). Latitude 29°27', longitude 100°37', 8 miles north of Standart. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. History: The Spanish explorer Bosque probably stopped at these springs in 1675. They have been used for irrigation. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1939	4.0	1966	7.0
1940	2.5	1967	5.4
1941	1.0	1968	4.5
1952	0	1969	2.7
1953	0	1970	10
1962	10	1971	5.0
1965	14	1972	24

Pinto Springs (KK12). Latitude 29°24', longitude 100°29', 7 miles north of Brackettville. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. History: The springs have been used for irrigation. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1939	4.3	1966	3.7
1940	6.6	1967	2.0
1941	3.8	1968	2.5
1952	3.6	1969	0
1953	0	1970	2.4
1962	2.0	1971	2.1
1965	8.3	1972	16

Las Moras Springs (KK13). Latitude 29°18', longitude 100°25', at Brackettville. Aquifer: Edwards and associated limestones of the Edwards (Balcones Fault Zone) aquifer. The springs issue through a fault in the Eagle Ford and overlying formations. They quickly reflect rainfall in the area (Figure 33). History: The springs formed the site of a favorite campground for Comanche, Mescalero Apache, and other Indians. They were a stop on the Old Spanish Trail from El Paso to San Antonio, and later also on the military road running north from Eagle Pass. In 1840 Colonel Tom Howard led a U.S. Cavalry unit to surprise and massacre the Comanche Indian village here. Starting in 1852 the springs were used as a water supply for Brackettville. They have been much used for irrigation, and at one time supplied the power to run an ice manufacturing plant. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1896	21	1940	27
1899	60	1941	24
1900	51	1942	23
1902	11	1943	25
1904	28	1944	21
1905	14	1945	18
1906	18	1946	11
1910	14	1947	33
1912	8.4	1948	21
1925	9.3	1949	29
1928	5.8	1950	27
1939	27	1951	7.0

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1952	9.5	1963	11
1953	6.3	1964	5.7
1954	25	1965	30
1955	22	1966	21
1956	24	1967	20
1957	30	1968	25
1958	35	1969	7
1959	49	1970	17
1960	31	1971	3.5
1961	27	1972	28
1962	19		

References: Manny, 1947 and Hill and Vaugh, 1898.

Schwandner and Silver Lake Springs (KK14). Latitude 29°33′, longitude 100°15′, 16 miles northwest of Laguna. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: The springs were the basis for an Indian village in prehistoric times, as evidenced by pictographs, stone tools, and projectile points found in nearby caves. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1931	6.1	1954	3.0
1939	2.2	1955	5.1
1940	3.5	1962	3.3
1941	3.0		

Reference. Manny, 1947.

Lampasas County

Swimming Pool Spring (X15). Latitude 31°03′, longitude 98°11′, in Hancock Park, Lampasas. Aquifer: Marble Falls Limestone. History: The spring was used by the Comanche Indians as a campground, and later was a stage stop. It was known for its medicinal value in the 1890's. A historical marker is located here. The spring supplies the swimming pool in Hancock Park. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1900	1.6	1902	1.3
1901	1.7	1906	1.4

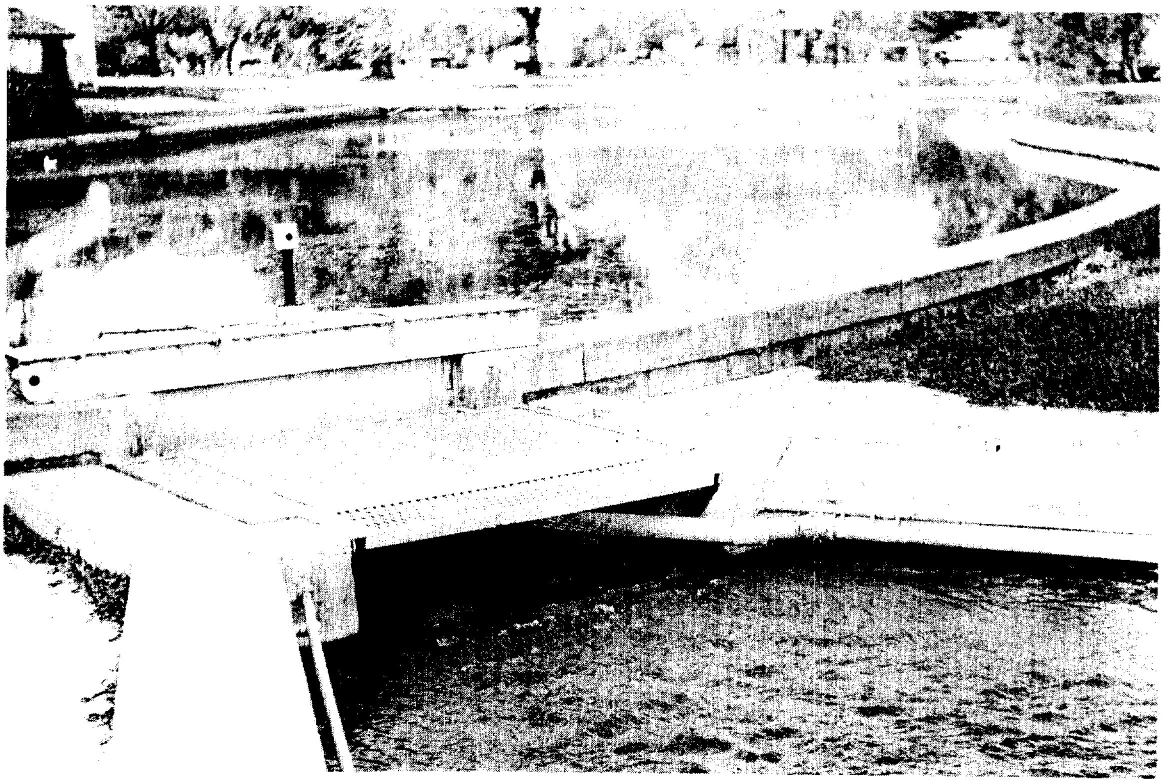

Figure 33.—Las Moras Springs

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1910	1.3	1957	1.3
1924	1.7	1962	1.7
1931	0.2	1971	1.5
1942	1.1		

Hancock, Gold, Rock, and many smaller springs (X22). Latitude 31°03′, longitude 98°11′, in Hancock Park, Lampasas. Aquifer: Marble Falls Limestone. History: The first white settlers found Indians using the curative waters of these springs. The town of Lampasas grew up around them. In 1882 they gained wide fame as a health resort. The springs still supply water to the city of Lampasas. A historical marker is located here. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1900	8.7	1959	7.9
1901	9.3	1960	13
1902	6.3	1961	15
1906	6.7	1962	11
1910	7.1	1963	11
1924	6.7	1964	7.4
1931	6.7	1965	12
1957	6.0	1971	7.3
1958	12		

References: Peale, 1894, and Texas Historical Survey Committee, 1971.

Limestone County

Tehuacana Springs (Y3). Latitude 31°45′, longitude 96°33′, at Tehuacana. Aquifer: Tehuacana Limestone. History: In 1825 Captain Coleman repulsed the Tehuacana Indians at these springs. In 1858 they became widely known as the Tehuacana Hills springs and parks. Reference: Williams, 1969.

Springfield Spring (Y4). Latitude 31°34′, longitude 96°33′, at Fort Parker. Aquifer: Kincaid sands and limestones. History: Explorers in 1833 saw the large council house built at this spring by the Tehuacana Indians. Here in 1836 Cynthia Ann Parker was captured by Comanche Indians at the age of 9. After 26 years with the Comanches she was recaptured. Reference: Williams, 1969.

Llano County

Castell Spring (EE34). Latitude 30°42′, longitude 98°58′, at Castell. Aquifer: Precambrian marble, gneiss, and schist. History: In 1847 a band of German settlers under the leadership of the Count of Castell laid out the town of Castell around this spring. Reference: Fry, 1943.

Valley Spring (EE35). Latitude 30°52′, longitude 98°49′, at Valley Spring. Aquifer: Hickory Sandstone. History: In 1854 O. C. Phillips erected a gin, grist mill, and saw mill at this "big spring." A historical marker is located here. References: Fry, 1943, and Texas Historical Survey Committee, 1971.

Lubbock County

Buffalo Springs (K1). Six springs. Latitude 33°32′, longitude 101°42′, 9 miles southeast of Lubbock. Aquifer: Comanchean limestones of the Edwards-Trinity (High Plains) aquifer. History: Coronado may have stopped here in 1541 while searching for the gold treasures of the Seven Cities of Cibolo. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1937	0.3	1969	3.4
1945	0.03	1970	3.3
1962	16		

In 1945 the springs supplied a swimming pool and bath house.

Martin County

Soda Springs (P1). Latitude 32°27′, longitude 101°53′, 5 miles south of Flower Grove. Aquifer: Ogallala Formation. History: These springs were on the old Comanche Indian trail from New Mexico to Mexico. Discharge: May 4, 1936—dry. Heavy well pumping for irrigation in the area probably dried up the springs.

Sulphur Springs (P2). Latitude 32°24′, longitude 101°52′, 8 miles north of Lenorah. Aquifer: Comanchean Limestone of the Edwards-Trinity (High Plains) aquifer. History: These springs were on the old Comanche Indian trail from New Mexico to Mexico. They were probably visited by Fray Juan de Salas in 1632 and Castillo in 1650. Several U.S. Army expeditions stopped here later. In 1891 the springs were described as "several springs of pure fresh water, one of them slightly tinged with sulphur." Discharge: May 4, 1936–10 gpm. Heavy well pumping for irrigation has greatly reduced the spring flow. Reference: Liles, 1953.

Mustang Spring or Mustang Fountain (P3). Latitude 32°08', longitude 101°56', at Mustang Pond 8 miles west of Stanton. Aquifer: Comanchean limestone of the Edwards-Trinity (High Plains) aquifer. History: When Capt. R. B. Marcy stopped here in 1849, he described the good grazing, numerous wild mustangs, and thousands of buffalo and antelope. The spring was on the Comanche Indian trail and later the California trail. This was the last water on the California trail until Willow Springs (Winkler County, spring V3) 100 miles west. In 1879 Thrall described it as "excellent stock water." A historical marker is located here. Discharge: April 17, 1936–"seep"; 1953–"dry for many years," Heavy well pumping in the area undoubtedly was an important factor in the failure of this spring. References: Thrall, 1879; Texas Historical Survey Committee, 1971; and Liles, 1953.

Mason County

Pluenneke Springs (EE13). Several springs. Latitude 30°46', longitude 99°25', 4 miles west of Streater. Aquifer: Ellenburger-San Saba Limestones. History: These springs were a stop on the old Chihuahua Road and later on the Western Cattle Trail. Discharge: February 16, 1925–0.7 ft^3/s; November 1939–20 gpm reported; January 20, 1962–2.0 ft^3/s.

Gamel Spring (EE14). Latitude 30°45', longitude 99°14', in Mason. Aquifer: Hickory Sandstone. The spring issued through a fault. History: The spring was at a favorite campground of the Comanche Indians. Bedrock mortars for grinding corn, nuts, and mesquite beans have been found here. In 1847 the German settler John Meusebach met with Indian chiefs here preparatory to his important treaty with the Comanches (See Sloan Springs, San Saba County). The spring supplied water to Fort Mason in 1851. Discharge: 1940–14 gpm; 1971–0. As recently as 1940 the spring supplied water to the Mason swimming pool. Water is now pumped to the pool. Reference: Polk 1966.

Kothmann Springs (EE15). Several springs. Latitude 30°42', longitude 99°19', 7 miles southwest of Mason. Aquifer: Ellenburger Limestone. The springs issue through a fault. Discharge: August 22, 1918–7.9 ft^3/s; December 1939–0.01 ft^3/s; January 20, 1962–3.0 ft^3/s.

Mill Springs (EE16). Several springs. Latitude 30°39', longitude 99°19', 10 miles southwest of Mason. Aquifer: Ellenburger Limestone. The springs probably issue through a fault. Discharge: December 1939–none reported; January 20, 1962–2.0 ft^3/s.

Anderegg Spring (EE17). Three springs. Latitude 30°31', longitude 99°08', 5 miles south of Hilda. Aquifer: Ellenburger Limestone. History: Johann Anderegg established a cheese factory at these springs in 1850. It was also a stop on the old Chihuahua Road to Mexico. Discharge: 1940–30 gpm. Reference: Gillespie County Historical Society, 1960.

McCulloch County

Soldiers' Water Hole (X18). Latitude 31°09', longitude 99°15', 6 miles east of Brady. Aquifer: Ellenburger and San Saba Limestones. History: This was an ancient Comanche Indian campground. Many U.S. Army units, including General Robert E. Lee's, used this spring. Early pioneers also camped here en route to the West. A historical marker is located here. Discharge: None reported in 1961. Reference: Texas Historical Survey Committee, 1971.

McLennan County

Waco Springs (Y2). Latitude 31°34', longitude 97°08', on Main Street several blocks northeast of the square in Waco. Another spring was located west of the Brazos River at First Street. Aquifer: Edwards and associated limestone of the Edwards (Balcones Fault Zone) aquifer. The springs apparently issued through a fault in the Austin Chalk and through the overlying terrace materials. History: The old Hueco Indian village was located here. In 1849 the town of Waco was laid out around the springs. A historical marker is located here. Discharge: 1964–none reported. References: Pool, 1964, and Texas Historical Survey Committee, 1971.

Medina County

Diversion Dam Springs (LL19). Latitude 29°30', longitude 98°54', just below Medina Diversion Dam, 6 miles north of Rio Medina. Aquifer: Edwards and associated limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue through the Haby Crossing Fault. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1921	50	1924	27
1923	25	1925	24

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1926	25	1953	2.9
1927	25	1954	1
1928	25	1955	4
1929	24	1956	0
1930	22	1957	3
1931	23	1960	36
1932	25	1962	29
1933	29	1963	26
1934	31	1964	25
1935	18	1965	20
1939	34	1966	18
1948	9	1967	18
1950	11	1968	23
1951	3	1969	20
1952	0		

The flow represents leakage from Medina Diversion Reservoir, and is related to reservoir stage.

Menard County

Wilkinson Springs (EE1). Latitude 30°56′, longitude 99°53′, forming Clear Creek, 6 miles west of Menard. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: The old San Saba Mission was located near these springs from 1756 to 1758. They were described then as "clear, sparkling, and deep." Later they provided irrigation water for 2,000 acres. They were a stop on the Chihuahua Road from the port of Indianola to Mexico. Discharge: (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1902	25	1948	15
1918	12	1949	13
1920	18	1951	10
1922	16	1952	7.6
1933	14	1955	8.2
1940	18	1956	7.3
1942	25		

References: Taylor, 1904; and Goodnight, Dubbs, and Hart, 1909.

Vaughn Spring (EE2). Near latitude 30°47′, longitude 99°46′, source of Elm Creek, 10 miles south of Menard. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: The Lipan Apaches left many mounds of burnt rock at these springs, where they had baked sotol bulbs. William Vaughn, the first settler, in 1886, irrigated 20 acres from the spring. Discharge: 1965—none reported. Reference: Pierce, 1946.

Milam County

Indian Springs (FF13). Several Springs. Latitude 30°53′, longitude 96°57′, 3 miles northeast of Cameron. Aquifer: Alluvium. History: In 1716 Domingo Ramon found a village of 2,000 Mayeya Indians at these springs. Later they were used by the Tonkawa Indians. Many middens, burial grounds, spear points, and corn grinders have been found here. The springs were formerly used to irrigate truck crops. Discharge: 1937—none reported; June 1971—0.10 ft^3/s. Reference: Taylor, 1902.

Sharp Springs (FF20). Two openings. Latitude 30°46′, longitude 97°11′, 1 mile northwest of Sharp. Aquifer: Probably Wolfe City Sand. History: The springs were on the old Comanche Indian Trail from Bandera to East Texas. They were well known in early days for their medicinal value. Discharge: March 19, 1936—5 gpm; 1971—none reported. Reference: Peale, 1894.

Montague County

Barrel Springs (M1). Latitude 33°44′, longitude 97°47′. Aquifer: Wichita Sandstone. History: A Taovayas Indian village was located here. Captain R. B. Marcy, exploring for the California Trail in 1854, camped here. He found that predecessors had sunk two barrels in the springs, and that the water was "delightfully pure and clear." Later the springs were on the Chisholm Cattle Trail. Discharge: 1857—The U.S. Cavalry found the flow weak; 1944—none reported; 1967—none reported. Reference: Henderson, 1958.

Motley County

Roaring Springs (K3). Latitude 33°51′, longitude 100°51′, 4 miles south of Roaring Springs. Aquifer: Santa Rosa Sandstone and Ogallala Formation. History: This and other large springs in the area were used for irrigation by the Wichita Indians long before the

European settlers arrived. Bedrock mortars used by the Wichitas can still be seen in sandstones at the springs. In 1876 a buffalo hunters' camp was located here. The springs were described at that time as supporting numerous cottonwood and walnut trees, grape vines, currants, and plums. Presently the water is used in a swimming pool and recreational area. A historical marker is located here. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1937	1.1	1957	1.2
1938	1.1	1958	1.4
1939	1.1	1959	1.3
1943	1.1	1960	1.1
1944	1.2	1961	1.4
1945	2.0	1962	1.5
1946	2.5	1963	1.4
1947	2.0	1964	1.4
1948	1.4	1965	1.2
1949	1.4	1966	1.0
1950	1.3	1967	0.9
1951	1.3	1968	1.2
1952	1.5	1969	1.3
1953	1.4	1970	1.1
1954	1.4	1971	1.3
1955	1.4	1972	1.3
1956	1.4	1973	1.3

Discharge is also shown on Figure 24. References: Morfi, 1935, and Texas Historical Survey Committee, 1971.

Nacogdoches County

Nacogdoches and Shawnee Springs (Z6). Latitude 31°37′, longitude 94°39′, between North Street and Banita Creek in Nacogdoches. Aquifer: Sparta Sand. History: These springs were originally on an old Tejas Indian trail. In 1686 Robert Sieur de La Salle became ill during his explorations and rested here for one month. Later the springs were a stop on El Camino Real. In 1716 the Mission Nuestra Senora de Guadalupe was established here. At that time some of the springs, on La Nana Creek, were called "Los Ojos de Padre Margil." They were formerly used as a water supply for the city of Nacogdoches and also as mineral springs. Discharge: In September 1936, there was essentially no flow; 1970—no flow reported. Reference: Deussen, 1914.

White and Red Springs (Z7). Latitude 31°49′, longitude 94°30′, in Garrison. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. History: La Salle may have drunk from these springs in 1686. They were formerly the basis for a health resort. The water of Red Spring is reddish in color and is more mineralized than the water of White Spring (Table 2). Discharge: October 1936—1 gpm; 1970—no flow reported.

Oldham County

Bravo or Bold Springs or Ojos Bravos (D1). Three springs. Latitude 35°37′, longitude 103°00′, 5 miles east of Nara Visa, New Mexico. Aquifer: Ogallala Formation. The springs flow from sand in spring boxes. History: A Comanche Indian settlement existed here. The explorer Onate may have passed here in 1601. Casimiro Romero, a sheep rancher, was the first settler in 1876. He was driven out by cattle ranchers, and XIT Ranch Division 3 headquarters was established here in 1888. The old XIT headquarters building, surrounded by large cottonwood trees, is still being used (Figure 34). Discharge: July 20, 1938—"weak"; June 22, 1971—18 gpm. The flow feeds a stock tank, with no overflow in June 1971. It reportedly overflows the tank in the winter, when cottonwood trees and evaporation do not draw so much water. Reference: Nordyke, 1949.

Parker County

Bear Creek Springs (R2). Latitude 32°40′, longitude 97°43′, 8 miles southeast of Weatherford. Aquifer: Paluxy Sand of the Trinity Group aquifer. The springs issue through the Goodland Limestone. History: In the 1870's three flourishing water-power mills used these springs. With increased grazing the springs dried up, probably because of compaction of the surface soil and reduction of natural recharge. Discharge: 1971—none reported. Reference: Taylor, 1904.

Pecos County

Santa Rosa Spring (V2). Latitude 31°16′, longitude 102°57′, 8 miles southwest of Grandfalls. Aquifer: Comanchean limestone of the Edwards-Trinity (Plateau) aquifer. The spring flowed from a limestone cavern in a ravine (Figure 35). History: The Jumano and Apache Indians who formerly frequented this spring left numerous artifacts. Taylor (1902) described the spring as an oasis in the desert, with cottonwood trees along the irrigation ditches which were used to irrigate alfalfa and peach trees. Runoff water now occasionally flows into the cavern, but spring flow from it has ceased.

Figure 34.—Bravo Springs Reservoir and Former XIT Ranch Division Headquarters

Discharge (ft^3/s):

DATE		DIS-CHARGE (ft^3/s)	DATE		DIS-CHARGE (ft^3/s)
July	1904	4.0	January	1959	0
January	1943	4.4	February	1962	0
December	1949	3.3	April	1971	0
December	1953	3.7			

Reference: Taylor, 1902.

Deep or Diamond Y Springs (V4). Several springs. Latitude 31°03′, longitude 102°54′, 12 miles north of Fort Stockton. Aquifer: Comanchean limestones of the Edwards-Trinity (Plateau) aquifer. History: These springs were on an old Comanche Indian trail. Mendoza probably stopped here in 1683. Later they were a stop on the Chihuahua Road. Discharge: May 10, 1943—0.4 ft^3/s; July 25, 1950—"flows"; 1971—0. Heavy well pumping for irrigation has dried up the springs.

Leon Springs (CC11). Several springs. Latitude 30°53′, longitude 103°01′, 8 miles west of Fort Stockton. Aquifer: Comanchean limestone and Trinity sand of the Edwards-Trinity (Plateau) aquifer. History: Juan de Mendoza in 1684 described the buffalo and the nut trees at the springs. Many pecan trees still grow here. The old Spanish Trail from San Antonio to El Paso passed through here. Later Lieutenant S. G. French of the U.S. Cavalry described them as springs 30 to 40 feet in diameter, that sank to great depths like large wells. He described salt deposits around the springs and an odor of sulfur. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1920	23	1948	15
1932	16	1949	11
1933	18	1950	12
1946	14	1958-71	0

Maximum recorded discharge was 28 ft^3/s on May 26, 1948. Some flowing wells were included in the discharge measurements. Heavy pumping of the aquifer caused the springs to cease flowing.

Comanche Springs (CC12). Six springs originally. Latitude 30°53′, longitude 102°52′, in southeast Fort Stockton. Aquifer: Comanchean limestone and Trinity sand of the Edwards-Trinity (Plateau) aquifer. The springs rose along a fault. History: The springs were used in prehistoric times by the Jumano Indians, probably for irrigation of corn. They were possibly visited by Cabeza

Figure 35.—Cavern From Which Santa Rosa Spring Formerly Flowed

de Vaca in 1536. Juan de Mendoza in 1684 described the 6 large beautiful springs gushing forth to form Comanche Creek. The Old Spanish Trail from San Antonio to El Paso passed through here. In 1849 Captain William Whiting of the U.S. Cavalry described them as "a clear gush of water which bursts from the plain, unperceived until the traveler is immediately upon it . . . abounding in fish and soft-shell turtles." In the same year many gold seekers traveling to California stopped here. In 1859 Camp Stockton was established and used the spring water as its supply. The water was used in 1904 to power a gin. A historical marker is located here. From 1875 on, the springs were the basis for an irrigation district which watered 6,200 acres of cropland. Heavy pumping of the aquifer, especially in the Belding area southwest of the springs, lowered the water table. The spring discharge began to fall off in May 1947, and by March 1961, the flow had ceased (Figure 25). Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1899	66	1919	45
1904	64	1922	46

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1923	42	1946	44
1924	47	1947	42
1925	49	1948	37
1932	42	1949	38
1933	47	1950	34
1934	46	1951	27
1935	44	1952	26
1936	42	1953	20
1937	44	1954	26
1938	43	1955	17
1939	42	1956	13
1940	42	1957	4
1941	43	1958	1.8
1942	44	1959	0.83
1943	43	1961	1.5
1944	43	1962-72	0
1945	43		

Maximum recorded discharge was 66 ft^3/s on June 23, 1899. References: Hutson, 1898; Taylor, 1904; Brune, 1969; and Texas Historical Survey Committee, 1971.

San Pedro Springs (CC13). Latitude 30°58', longitude 102°49', 7 miles northeast of Fort Stockton. Aquifer: Comanchean limestones of the Edwards-Trinity (Plateau) aquifer. History: The springs were on an old Comanche Indian trail. Mendoza possibly stopped here in 1683. Later they were a stop on the Chihuahua Road. The springs were used for irrigation. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1902	4.0	1952	2.7
1943	3.8	1953	2.4
1947	4.2	1954	1.8
1948	3.6	1956	1.9
1949	4.9	1957	0.7
1950	4.0	1958	0.2
1951	2.5	1959-71	0

Maximum recorded flow was 6.4 ft^3/s on January 18, 1949. Heavy well pumping for irrigation caused the springs to fail.

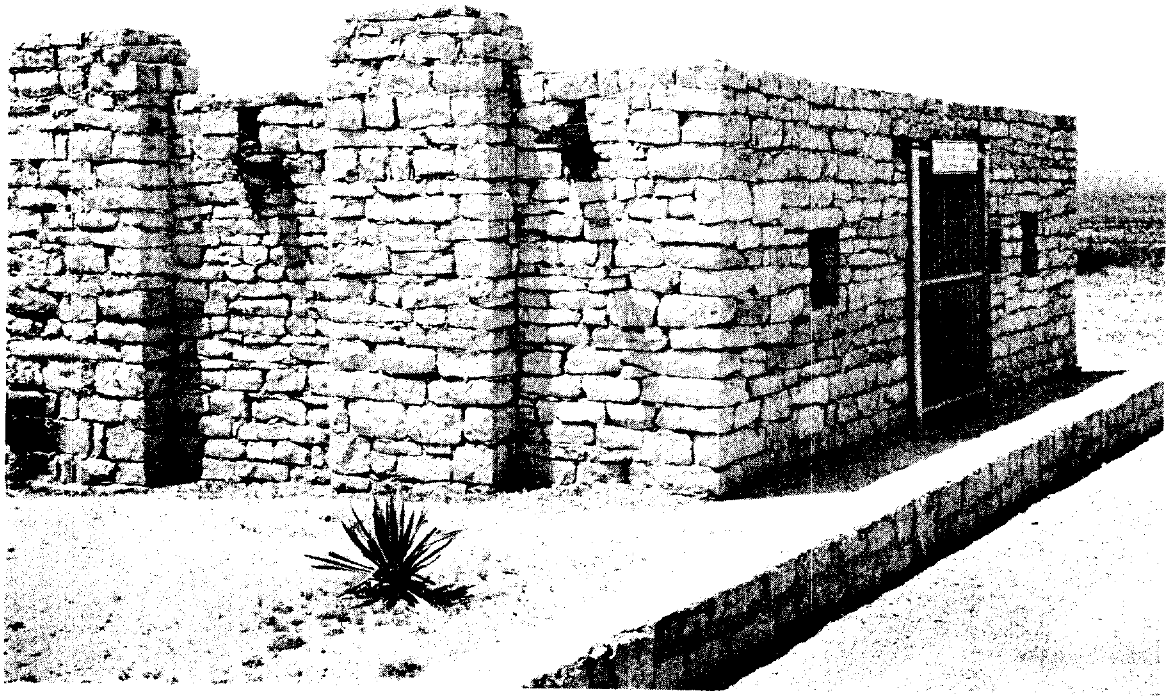

Figure 36.—Restored Stagecoach Station at Tunas Spring

Cold Springs (CC14). Several springs. Latitude 30°56′, longitude 102°48′, 6 miles northeast of Fort Stockton. Aquifer: Comanchean limestones of the Edwards-Trinity (Plateau) aquifer. History: The springs were on an old Comanche Indian trail. Later they were used for irrigation. Discharge: October 16, 1942–2.6 ft^3/s; April 1958–0; February 22, 1962–0. Heavy well pumping for irrigation caused the springs to fail.

Tunas (Prickly Pear Cactus) or West Escondido Spring (CC15). Latitude 30°51′, longitude 102°33′, 26 miles east of Fort Stockton. Aquifer: Comanchean limestones of the Edwards-Trinity (Plateau) aquifer. History: This was a favorite campground of the Comanche Indians. Cabeza de Vaca may have stopped here in 1534. It was described by Captain William Whiting of the U.S. Cavalry in 1849 as a clear, beautiful spring gushing from the limestone bluff on the north side of Tunas Creek. Experimental camel trains stopped here in the late 1800's. The stagecoach station on the Old Spanish Trail which passed the spring has now been restored (Figure 36). A historical marker is located here. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1924	1.2	1950	1.6
1933	1.9	1962	0.16
1943	2.0	1963-71	0

Pumping from nearby wells caused the spring to cease flowing. Reference: Williams, 1969.

Pecos Spring (DD1). Latitude 30°42′, longitude 101°48′, 1 mile east of Sheffield. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: The Comanche Indians used this spring as a campsite. In 1534 Cabeza de Vaca probably passed the spring. Later it became a regular stop on the Old Spanish Trail from San Antonio to El Paso. Discharge: March 7, 1924–0.7 ft^3/s; August 17, 1943–0.5 ft^3/s; 1961–none reported.

Potter County

Tecovas Springs (D3). Several springs. Latitude 35°15′, longitude 102°06′, 5 miles northwest of

Bushland. Aquifer: Ogallala and Santa Rosa sands. History: These springs supported a favorite campsite of plains Indians. Later they were a meeting place of traders, smugglers, and renegade peddlers called Comancheros. Since 1881 they have been at the headquarters of the Frying Pan Ranch, where barbed wire was first used. A historical marker concerning the spring is located 1 mile east of Bushland. Discharge: August 13, 1924–0.1 ft³/s; April 20, 1937–10 gpm. Reference: Texas Historical Survey Committee, 1971.

Reagan County

Grierson Springs (W1). Latitude 31°08′, longitude 101°37′, 6 miles south of Best. Aquifer: Edwards and associated limestones of the Edwards-Trinity (Plateau) aquifer. History: These springs were used by the Comanche Indians, who camped here. In 1683 Mendoza is believed to have stopped here. In 1879 the 10th U.S. Cavalry had an outpost at these springs. Discharge: 1972–none reported. Reference: Williams, 1969.

Real County

Camp Wood Spring (KK16). Latitude 29°41′, longitude 100°01′, 1 mile north of Camp Wood. Aquifer: Glen Rose Limestone of the Edwards-Trinity (Plateau) aquifer. The spring issues through alluvium. History: The spring has been used for irrigation. It is also the water supply for Camp Wood. Discharge: April 6, 1906–3 ft³/s; October 6, 1954–1.1 ft³/s; December 13, 1954–1.0 ft³/s; September 19, 1955–2.5 ft³/s. Reference: Taylor, 1902.

Morriss Spring (LL1). Latitude 29°57′, longitude 99°57′, 10 miles north of Vance. Aquifer: Edwards and associated limestones. The spring issues through a fault. Mendoza may have drunk from this spring in 1683. Discharge: April 17, 1955–1.6 ft³/s.

Chittim Springs (LL2). At least three springs. Latitude 29°57′, longitude 99°45′, 15 miles north of Leakey. Aquifer: Edwards and associated limestones. The springs issue through a fault. History: The Jumano Indians practiced agriculture here about 8,000 years ago and left paintings nearby. Discharge: April 19, 1956–1.6 ft³/s. Reference: Newcomb, 1961.

Prade Springs (LL3). Three springs. Latitude 29°55′, longitude 99°47′, 14 miles north of Leakey. Aquifer: Edwards and associated limestones. The springs probably issue through a fault. History: The Jumano Indians practiced agriculture here about 8,000 years ago. Discharge: June 23, 1955–1.2 ft³/s. Reference: Newcomb, 1961.

Big Springs (LL4). Latitude 29°52′, longitude 99°39′, 11 miles northeast of Leakey. Aquifer: Edwards and associated limestones. The springs issue through a fault. Much travertine has been deposited below the springs. History: The Jumano Indians practiced agriculture here about 8,000 years ago. Discharge (ft³/s by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1925	8.9	1956	4.5
1953	1.9	1962	2.2
1954	4.6		

Reference: Hill and Vaughn, 1898.

Vander Stucken Springs (LL5). Latitude 29°49′, longitude 99°55′, 7 miles east of Vance. Aquifer: Edwards and associated limestones. The springs probably issue through a fault. History: The springs have been used for irrigation. Discharge: July 25, 1955–1.1 ft³/s.

Eads Springs (LL6). At least two springs. Latitude 29°44′, longitude 99°56′, 11 miles west of Leakey. Aquifer: Edwards and associated limestones. History: The springs have been used for irrigation. Discharge: 1956–1.3 ft³/s.

Spring Branch Springs (LL7). Latitude 29°42′, longitude 99°46′, 1 mile south of Leakey. Aquifer: Alluvial gravel. The springs probably represent Frio River flow which sinks into gravel beds upstream and reappears here. Discharge: June 27, 1925–14 ft³/s; January 6, 1955–4 ft³/s; July 9, 1957–11 ft³/s.

Reeves County

Hackberry or Irving Springs (V1). Several springs. 6 miles south of Pecos at latitude 31°20′, longitude 103°29′. Aquifer: Alluvium. History: The California Trail and Butterfield Overland Mail route passed these springs in the 1850's. Taylor (1902) described them as several springs, the largest 20 feet in diameter, with a strong sulfur taste, but excellent for livestock. Discharge (ft³/s):

DATE		DIS-CHARGE (ft³/s)	DATE		DIS-CHARGE (ft³/s)
July	1904	2.2	April	1959	0
July	1924	1.0	March	1962	0
December	1949	0.1	April	1971	0

Reference: Taylor, 1902.

Figure 37.—Saragosa Springs

Saragosa Springs (CC1). They also include Toyah Creek Springs. Latitude 30°59′, longitude 103°46′, 1 mile southwest of Balmorhea (Figure 37). Aquifer: Alluvium (gravel). The original source of the water is probably Comanchean limestones which underlie the gravel. History: Espejo probably stopped here in 1582. The springs were once used to power a grain and flour mill. They are now used for irrigation in Reeves County Water Control and Improvement District No. 1. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1919	4.8	1963	2.1
1922	5.9	1964	2.1
1933	14	1965	1.7
1941	5.0	1966	1.9
1947	2.5	1967	1.4
1949	1.8	1968	1.1
1950	1.6	1969	1.4
1951	1.4	1970	0.8
1952	1.5	1971	0.3
1962	1.8		

Maximum recorded discharge was 30 ft^3/s in November 1932. Discharge is also shown on Figure 21. Reference: Taylor, 1904.

West and East Sandia Springs (CC2). Three springs. Latitude 30°59′, longitude 103°44′, at Balmorhea. Aquifer: Alluvium (gravel). Original source of the water is probably Comanchean limestone underlying the gravel. History: Espejo may have stopped at these springs in 1582. In 1911 another spring existed about 1 mile upstream. The springs are now used for irrigation in Reeves County Water Control and Improvement District No. 1. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1932	2.5	1949	1.8
1933	2.7	1950	2.1
1942	2.3	1951	1.9
1943	2.2	1952	1.6
1944	2.2	1953	1.8
1945	3.2	1962	0.53
1946	2.6	1963	0.59
1947	2.6	1964	0.50
1948	1.9	1965	0.51

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1966	0.51	1969	0.51
1967	0.50	1970	0.51
1968	0.51	1971	0.51

Maximum recorded discharge was 4.4 ft^3/s in August 1945.

Giffin Springs (CC3). Three springs. Latitude 30°57′, longitude 103°47′, at Toyahvale. Aquifer: Comanchean limestone of the Edwards-Trinity (Plateau) aquifer. Artesian springs issue through gravel from a fault (Figure 38). Impervious upper Cretaceous rocks have been faulted down against the lower Cretaceous underground reservoir, causing the springs to flow. Nearby rainfall results in a large increase in flow and suspended sediment and a large decrease in dissolved solids and temperature. History: The Spanish explorer Espejo possibly stopped here in 1582. The springs have been used for irrigation since 1853. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1919	3.9	1954	3.9
1922	4.7	1955	5.1
1923	3.6	1956	4.3
1925	3.2	1957	4.2
1932	4.5	1958	4.5
1933	5.2	1959	3.9
1941	5.6	1960	4.8
1942	5.0	1961	4.0
1943	5.4	1962	4.1
1944	4.0	1963	4.8
1945	6.0	1964	4.3
1946	5.3	1965	4.2
1947	4.7	1966	3.7
1948	4.5	1967	3.9
1949	4.6	1968	3.4
1950	4.1	1969	3.1
1951	5.0	1970	3.0
1952	4.8	1971	3.3
1953	4.4	1972	3.1

San Solomon or Mescalero Spring (CC4). Latitude 30°57′, longitude 103°47′, at Toyahvale. Aquifer: Comanchean limestone of the Edwards-Trinity (Plateau) aquifer. This artesian spring issues from caverns in the bottom of a [illegible] swimming pool (Figure 39). Impervious upper Cretaceous rocks have been faulted down against the lower Cretaceous underground reservoir, causing the springs to flow. Nearby rainfall results in a large increase in discharge and suspended solids and a large decrease in dissolved solids and temperature. History: The lines of prehistoric irrigation canals could still (1898) be traced in this area, where the Jumano Indians, and later the Mescalero Apaches, directed water to their corn and peaches. Many arrowheads and stone implements have been found nearby. The Spanish explorer Espejo possibly stopped at these springs in 1582. Irrigation by white men began at this and the other nearby springs in 1853. Fort Davis soldiers called this spring "Head Spring". The Reeves County Water Control and Improvement District No. 1 was formed in 1915, irrigating 12,200 acres. In 1971 11,000 acres were irrigated from the springs in the area. The town of Balmorhea also obtains its water from them. This spring is now in Balmorhea State Park. A historical marker is located here. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1900	46	1951	31
1904	46	1952	32
1919	35	1953	31
1922	37	1954	31
1923	34	1955	32
1924	34	1956	32
1925	36	1957	29
1932	35	1958	30
1933	45	1959	32
1934	41	1960	32
1935	32	1961	36
1936	30	1962	32
1941	43	1963	31
1942	49	1964	30
1943	40	1965	30
1944	35	1966	31
1945	41	1967	30
1946	36	1968	32
1947	37	1969	29
1948	32	1970	27
1949	31	1971	28
1950	31	1972	29

References: Hutson, 1898; Taylor, 1902; and Williams, 1969.

San Jacinto County

Gold Springs (GG2). Three springs. Latitude 30°36′, longitude 95°08′, northeast of Coldspring. Aquifer: Gulf Coast aquifer. History: The Alabama-Coushatta Indians formerly camped at these springs. They left many beads and silver ornaments made from coins. The springs originally supplied the town of Coldspring with its water, and in 1966 they still were used as an auxiliary source. One is a cypress-lined pit 8 by 15 feet and 30 feet deep. A historical marker is located here. Discharge: January 17, 1947–32 gpm; April 7, 1966–32 gpm. References: Hsu, 1969 and Texas Historical Survey Committee, 1971.

San Saba County

Hall or Big Springs (X2). Several springs. Latitude 31°17′, longitude 99°01′, 3 miles east of Hall. Aquifer: Marble Falls Limestone. Discharge: 1901–4.0 ft^3/s; October 24, 1938–2.5 ft^3/s; September 1952–0; February 7, 1957–0; March 19, 1962–0; September 14, 1971–1.6 ft^3/s. The springs supply a 23-acre lake.

Richland Springs (X3). Three springs. Latitude 31°17′, longitude 98°56′, at Richland Springs. Aquifer: Marble Falls Limestone. The springs rise through a fault

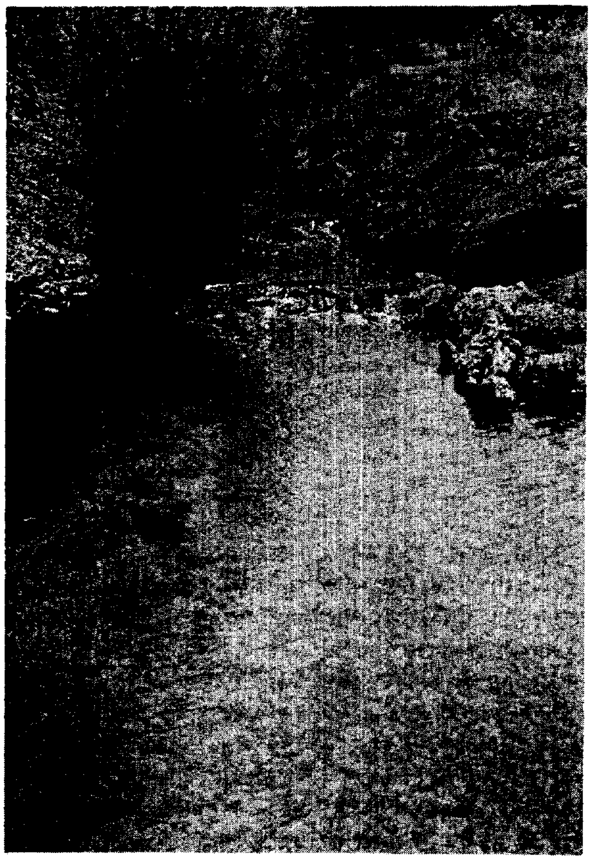

Figure 38.—One of the Giffin Springs

Figure 39.—Swimming Pool in Balmorhea State Park Into Which San Solomon Spring Flows

at which the aquifer is in contact with Strawn shales and sandstones. History: The springs were used by Fort Duncan in the 1850's. They have been used for irrigation and have always been the city of Richland Springs' primary water source. The city uses an average of 0.13 ft^3/s. Occasionally irrigation pumping in the area causes the springs to dry up. At these times the city relies on a well for water. Discharge: 1901–6.0 ft^3/s; October 10, 1938–3.4 ft^3/s; February 7, 1957–0; March 9, 1962–0.13 ft^3/s; September 14, 1971–4.8 ft^3/s.

Baker Springs (X4). One large and several small springs. Latitude 31°12', longitude 98°55', 5 miles southwest of Algerita. Aquifer: Ellenburger Limestone, dipping north. The springs are on the Sloan Fault (Figure 40). History: The Comanche Indians used these springs, leaving many projectile points and tools. The springs supply a 3-acre lake and are used for irrigation. Discharge: October 28, 1938–3.8 ft^3/s; September 8, 1952–1.7 ft^3/s; February 11, 1957–1.0 ft^3/s; April 25, 1962–2.4 ft^3/s; September 14, 1971–12 ft^3/s.

Fleming or King Springs (X5). Two springs. Latitude 31°08', longitude 98°56', 8 miles southwest of Algerita. Aquifer: The lower spring issues from the Ellenburger Limestone (Figure 41) and the upper from the Marble Falls Limestone. The springs are in the Algerita Syncline. History: The springs were used by the Comanche Indians, as evidenced by projectile points found there. Taylor reported that they were used to irrigate 40 acres in 1901. They are still used for irrigation. Discharge: November 5, 1921–3.0 ft^3/s; February 25, 1939–4.5 ft^3/s; September 8, 1952–0.3 ft^3/s; April 23, 1962–3.6 ft^3/s; September 14, 1971–10.2 ft^3/s. Reference: Taylor, 1902.

Hart, Berry, Mud, and Bogard Springs (X6). Latitude 31°11', longitude 98°55', 6 miles southwest of Algerita. Aquifer: Marble Falls Limestone in the Algerita Syncline. History: The springs formerly powered a grist mill. The old water wheel can still be seen. They are used to irrigate about 70 acres of pecan trees and other crops (Figure 42). Discharge: February 25, 1939–3.7 ft^3/s; February 11, 1957–1.4 ft^3/s; May 3, 1962–3.7 ft^3/s; September 14, 1971–4.1 ft^3/s.

Sloan or Walnut Springs (X7). Many openings. Latitude 31°09', longitude 98°55', 7 miles southwest of Algerita. Aquifer: Marble Falls Limestone in the Algerita Syncline. History: This was an important Indian settlement. In 1847 John Meusebach with a party of German immigrants made a treaty with the Indians at these springs. Rights to the San Saba valley were obtained in exchange for about $1,000 worth of presents. Comanche Chief Mope-tschokepe and representatives of the Hueco, Lipan, Qupaw, Tehuacana, and Caddo tribes participated. This was one of the most important Indian treaties ever made, and was never

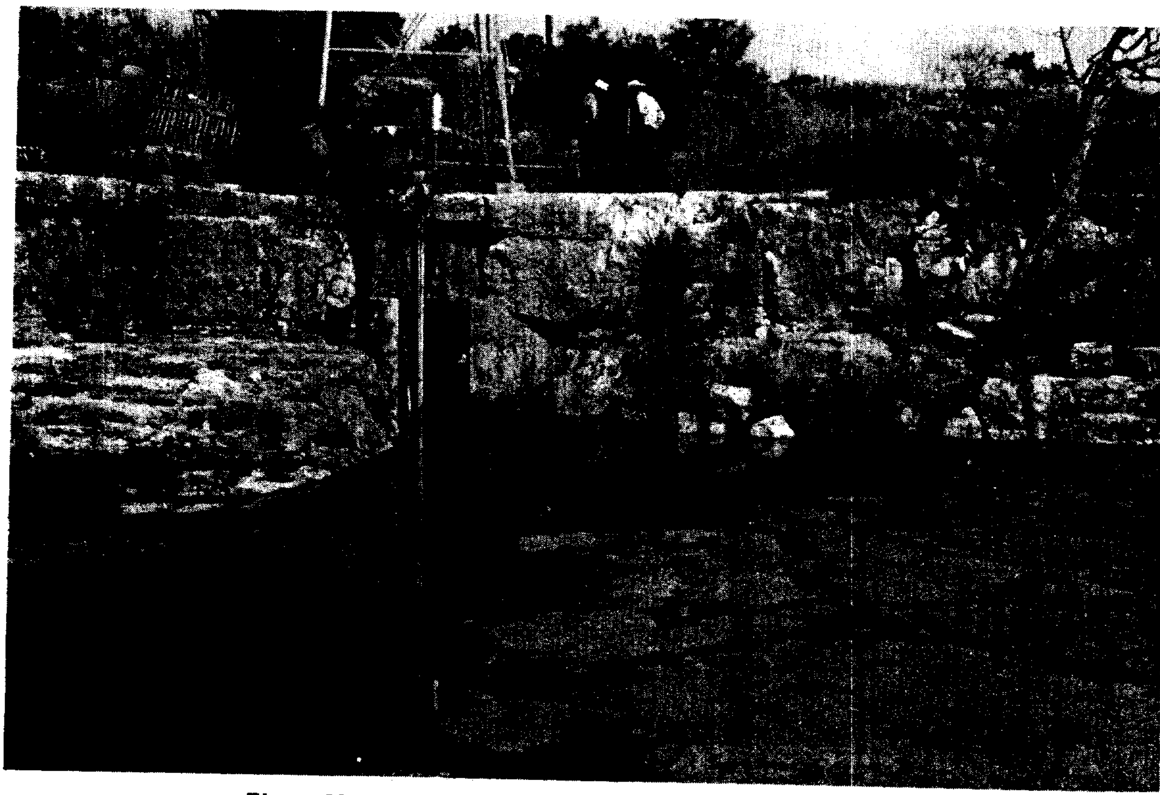

Figure 40.—Baker Springs Issuing From Ellenburger Limestone

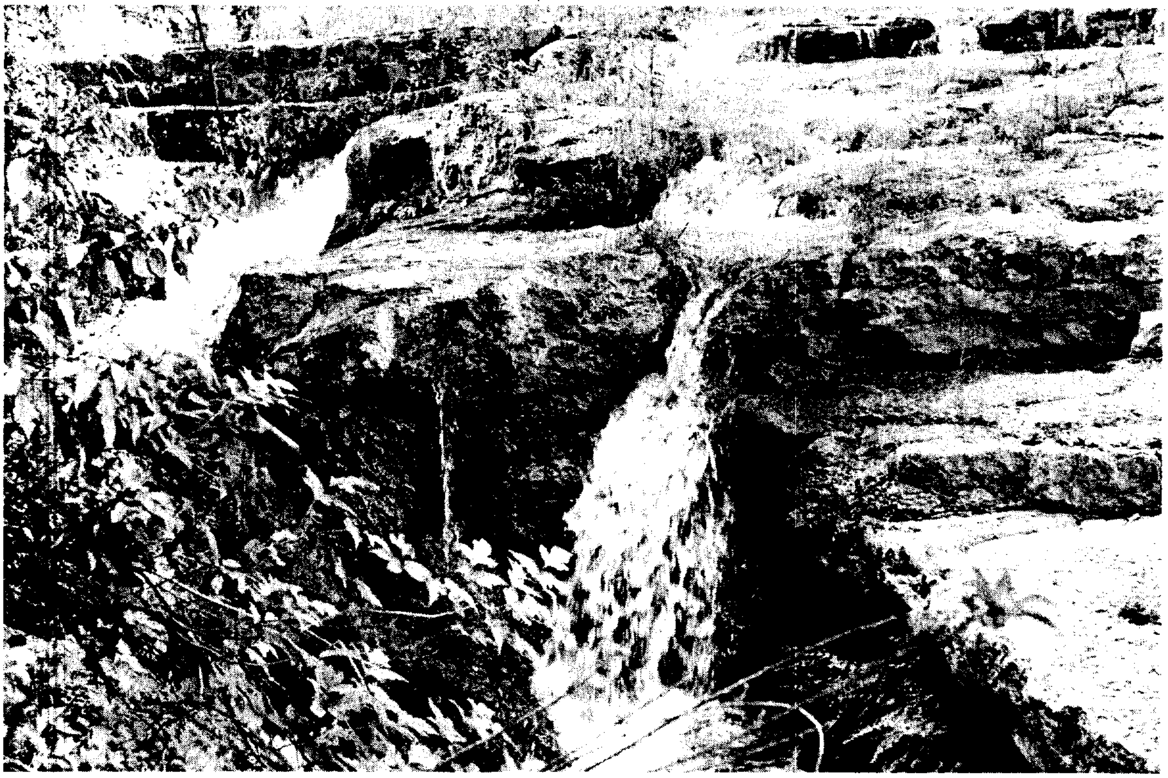

Figure 41.—Fleming Lower Spring

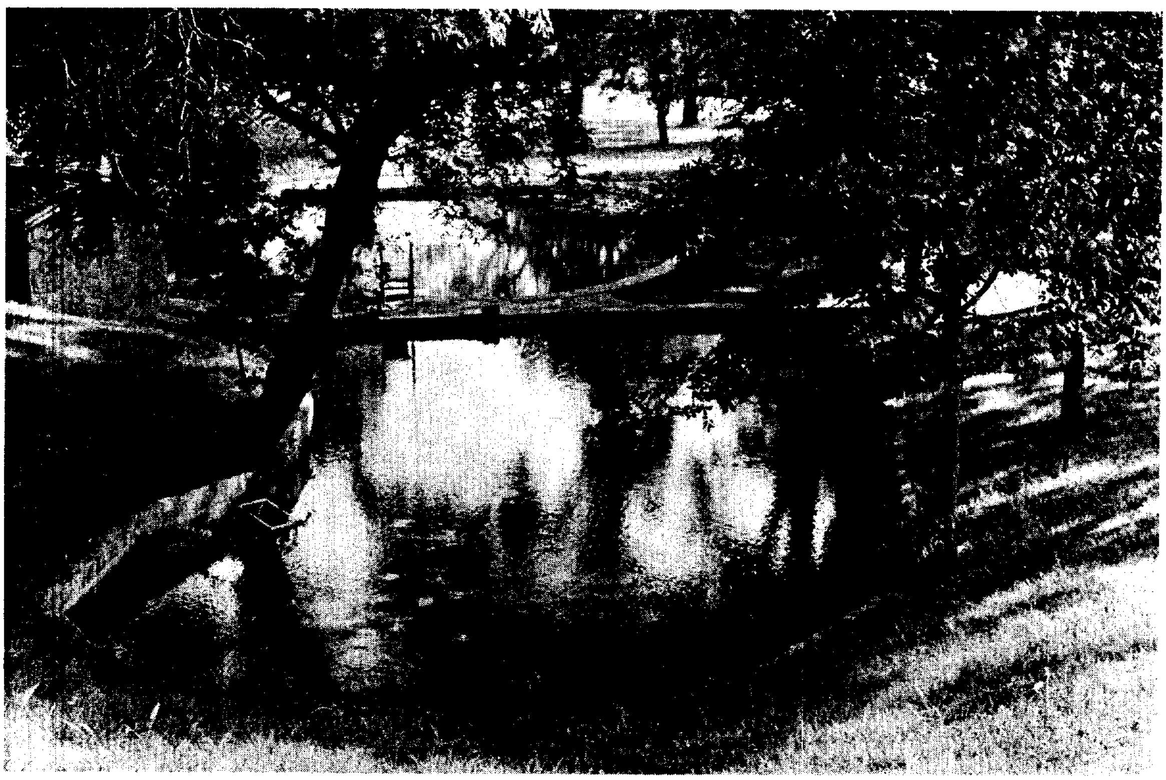

Figure 42.—Hart Spring

broken. In the 1880's a grist and saw mill was erected here. The dam and mill race still exist. The water has been used for many years to irrigate pecan trees, pasture, and crops. A historical marker is located here. Discharge: 1902–9.0 ft^3/s; March 30, 1918–4.7 ft^3/s; November 18, 1921–5.3 ft^3/s; October 28, 1938–6.2 ft^3/s; September 8, 1952–4.3 ft^3/s; February 7, 1957–3.1 ft^3/s; April 23, 1962–4.2 ft^3/s; September 14, 1971–9.0 ft^3/s.

Turkey Roost Springs (X8). Several springs. Latitude 31°08′, longitude 98°56′, 9 miles southwest of Algerita. Aquifer: Marble Falls Limestone in the Algerita Syncline. History: Used for a long period by the Comanche Indians, as evidenced by projectile points. Discharge: June 16, 1931–2.1 ft^3/s; December 19, 1938–0.33 ft^3/s; September 14, 1971–0.05 ft^3/s. The flow is usually lost before reaching the San Saba River.

Deep Creek Springs (X9). About seven springs, including Big Spring. Latitude 31°06′, longitude 98°59′, 12 miles south of Richland Springs. Aquifer: Ellenburger Limestone, dipping north. History: The springs supply a lake used for irrigation (Figure 43). Discharge: November 29, 1938–4.2 ft^3/s; February 25, 1969–3.1 ft^3/s; February 7, 1957–0.3 ft^3/s; March 19, 1962–2.5 ft^3/s; September 14, 1971–4.1 ft^3/s.

Sycamore, Cottonwood, and other springs (X10). Latitude 31°06′, longitude 99°01′, 13 miles south of Richland Springs, on both sides of the San Saba River. Aquifer: Ellenburger Limestone in a small anticline. History: They are used for irrigation. Discharge: February 25, 1939–1.3 ft^3/s; February 7, 1957–0; September 14, 1971–2.1 ft^3/s.

Wallace Springs (X11). Many openings in gravel and limestone. Latitude 31°06′, longitude 98°51′, 8 miles southwest of Harkeyville. A historical marker is located here. Aquifer: Ellenburger Limestone, dipping north. The springs issue at the contact of the aquifer and the Barnett Shale, in the Wallace Creek Syncline. Discharge: November 18, 1921–2.1 ft^3/s; October 3, 1938–3.6 ft^3/s; September 14, 1971–12 ft^3/s.

San Saba Springs (X12). About 18 springs. Latitude 31°12′, longitude 98°43′, at the southeast edge of San Saba. Aquifer: Marble Falls Limestone in the San Saba Anticline. History: Paddock (1911) stated that these "strong springs" were used as early as 1880 to power a flour mill, saw mill, and cotton gin, to irrigate 50 acres, and later to generate electric power. Remnants of the old mill dam are still in place (Figure 44). The springs now supply water to the city of San Saba. An average of 0.74 ft^3/s is used by the city. Discharge (ft^3/s

Figure 43.—Deep Creek Springs Reservoir

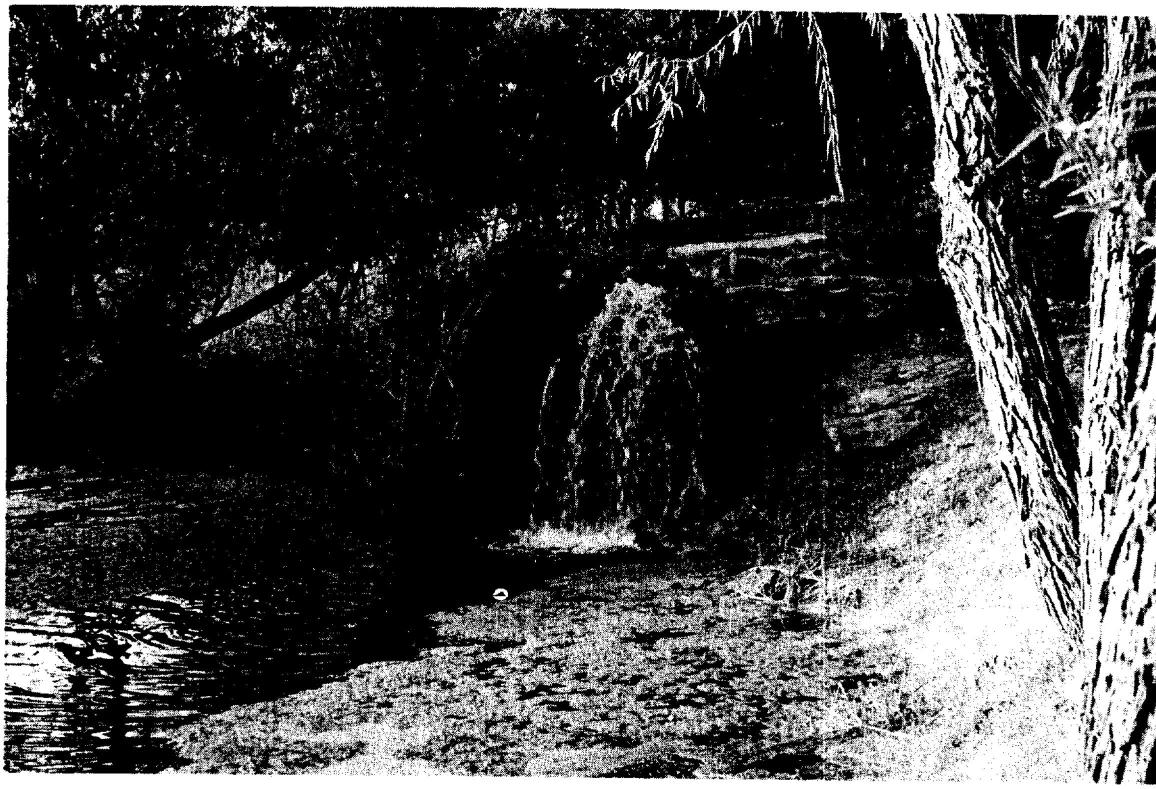

Figure 44.—Remains of Old Mill Dam at San Saba Springs

by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1939	9.7	1965	9.0
1952	7.3	1966	8.8
1957	5.5	1967	7.5
1959	7.5	1968	11
1960	11	1969	8.9
1961	12	1970	13
1962	16	1971	7.5
1963	5.3	1972	9.7
1964	8.4	1973	10.2

Discharge is also shown on Figure 24. Reference: Paddock, 1911.

Barnett or Dalton Springs (X13). Numerous springs. Latitude 31°11′, longitude 98°39′, 5 miles east of San Saba. Aquifer: Ellenburger Limestone, dipping northeast. Springs are on the Simpson Creek Fault Zone. Downstream from the springs, large travertine deposits have built up where the water passes over falls (See Figure 17). History: Much land was irrigated as early as 1867 from these springs. They are still used to irrigate a pecan grove. Little of the spring water reaches the San Saba River. Discharge: October 29, 1938—0.90 ft^3/s; February 12, 1957—0.5 ft^3/s; September 14, 1971—1.5 ft^3/s. Reference: Paddock, 1911.

Parker or Holland Springs (X14). Includes Brister Spring one-half mile west. Latitude 31°07′, longitude 98°34′, 5 miles northwest of Bend. Aquifer: Marble Falls Limestone. The springs issue through the Cherokee Fault Zone. History: They are used for irrigation. Discharge: October 29, 1938—1.9 ft^3/s; July 23, 1940—1.3 ft^3/s; February 12, 1957—0.2 ft^3/s; April 23, 1962—1.1 ft^3/s; September 14, 1971—2.2 ft^3/s.

Sulphur Springs (X16). Several springs, one in the Colorado River. Latitude 31°05′, longitude 98°28′, 3 miles east of Bend. Aquifer: Ellenburger Limestone, dipping northeast. History: The springs were used for medicinal bathing in the 1850's. They now supply the swimming pool at a hunting and fishing camp. Discharge: March 6, 1939—1.4 ft^3/s; September 14, 1971—0.54 ft^3/s.

Gorman Springs (X17). Several springs. Latitude 31°04′, longitude 98°29′, 4 miles southeast of Bend. Aquifer: Ellenburger Limestone, dipping northeast.

Much of the flow disappears into a sink, reappearing below Gorman Falls downstream. Large amounts of travertine have built up between the springs and the falls. Discharge: October 29, 1938–2.0 ft^3/s; February 12, 1957–2.5 ft^3/s; July 19, 1961–3.7 ft^3/s; September 1971–1.5 ft^3/s. The springs provide water for a fishing and hunting camp.

Post Oak Springs (X19). Many openings. Latitude 31°01′, longitude 98°28′, 7 miles southeast of Bend. Aquifer: Basal Ellenburger Limestone, in the Ellenburger Hills Fault Zone, dipping northeast. Post Oak Falls and much travertine are downstream. Discharge: February 26, 1939–1.1 ft^3/s; September 14, 1971–0.55 ft^3/s.

Jennings Springs (X20). At least three openings in gravel and limestone. Latitude 31°100′, longitude 98°28′, 8 miles southeast of Bend. Aquifer: Basal Ellenburger Limestone, dipping northeast, in the Ellenburger Hills Fault Zone (Figure 45). A small anticline is present. Discharge: February 26, 1939–1.5 ft^3/s; September 14, 1971–0.42 ft^3/s. Supplies water to a hunting and fishing lodge.

Heck Springs (EE36). Several openings at the base of a bluff. Latitude 30°59′, longitude 98°47′, 4 miles west of Cherokee. Aquifer: Ellenburger Limestone. The springs rise through a fault, with the Wilberns Limestone present on the other side of the fault at the surface (Figure 46). History: A Cherokee Indian village was at the site of the springs when Europeans first explored the area. The White mill was erected here in 1895. The springs were formerly used for irrigation. Although not used for irrigation now, there is much irrigation pumping in the vicinity. They now supply water to a swimming pool. Discharge: October 29, 1938–2.6 ft^3/s; July 24, 1940–1.7 ft^3/s; February 12, 1957–0.2 ft^3/s; 1962–2.0 ft^3/s; September 14, 1971–1.4 ft^3/s. Reference: Taylor, 1904.

Figure 45.—Jennings Springs

Boiling Springs (EE37). Three openings. Latitude 30°56′, longitude 98°29′, 3 miles north of Tow. Aquifer: Ellenburger Limestone, dipping northeast. Springs are in the Ellenburger Hills Fault Zone. Discharge: February 26, 1939–4.3 ft^3/s; April 25, 1962–3.5 ft^3/s; September 14, 1971–2.5 ft^3/s reported.

Schleicher County

Government or Main Springs (DD15). Latitude 30°50′, longitude 100°06′, 1 mile west of Fort McKavett. Aquifer: Edwards and associated limestones. History: As many as 3,000 Comanche Indians camped here at times. The lake formed by the springs formerly abounded with fish. The Chihuahua Road and Mackenzie Trail passed here. The springs were the water supply for Fort McKavett, established in 1852. Water was hauled in barrels by mule teams to the fort on a nearby hill. It was also used to irrigate a garden for the fort. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1902	26	1960	16
1905	15	1961	16
1918	8.6	1962	16
1922	12	1963	14
1933	2.0	1964	11
1942	6.1	1965	12
1948	11	1966	10
1951	9.3	1967	7.7
1952	3.8	1968	9.5
1955	6.7	1969	8.2
1956	6.2	1970	13
1958	16	1971	10
1959	16	1972	17

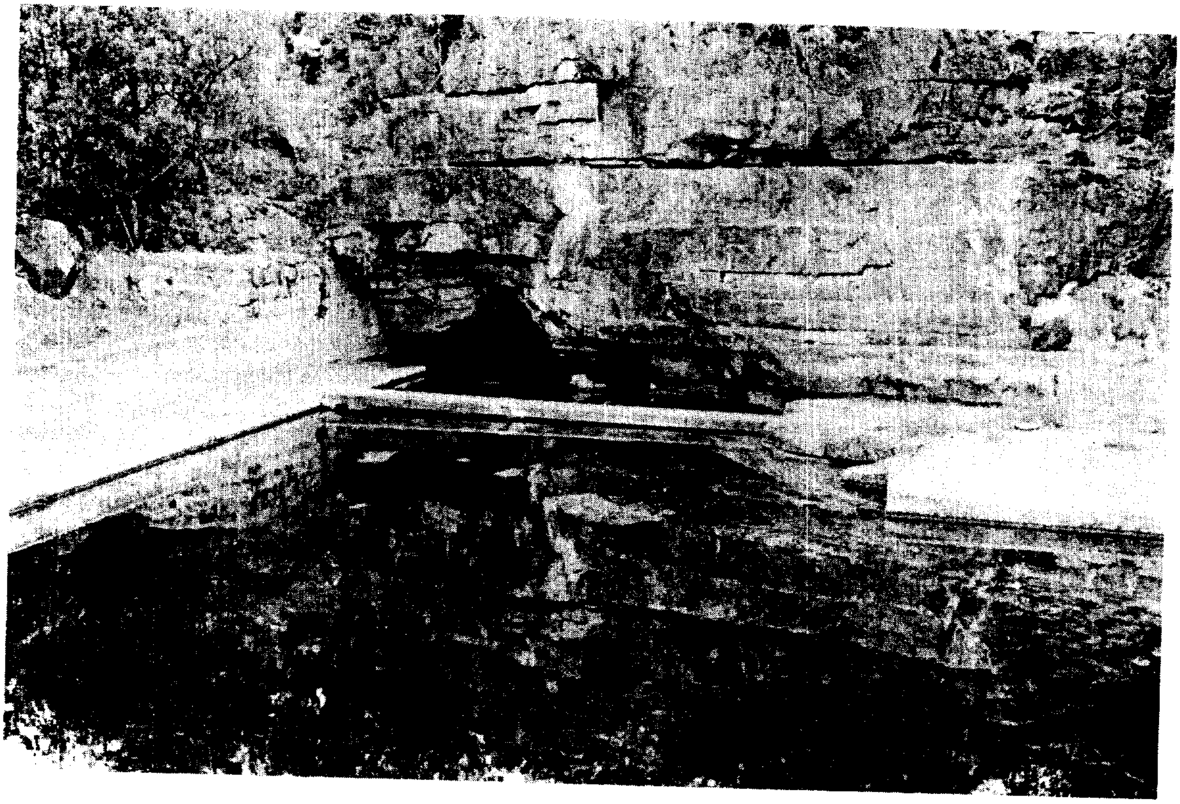

Figure 46.—Heck Springs Emerging From the Ellenburger Limestone Into a Swimming Pool

Scurry County

Camp Springs (P5). Several springs including Dripping Springs. Latitude 32°46′, longitude 100°42′, at Camp Springs. Aquifer: Santa Rosa Sandstone. History: The Comanche Indians often camped here, leaving many artifacts and pictographs in a nearby cave. Captain. R. B. Marcy and his troops camped here in 1849 while exploring routes to the west. Later the springs were a stop on the California Trail. The town of Camp Springs was thriving in 1900 but is now a ghost town. The nearby Deep Creek Springs, formerly strong, are now gone. A historical marker is located here. Discharge: April 8, 1924—2.0 ft^3/s; 1946—none reported. References: Boren, 1969, and Texas Historical Survey Committee, 1971.

Greene Springs (P6). Latitude 32°42′, longitude 100°43′, 3 miles southwest of Midway. Aquifer: Ogallala Formation and Santa Rosa Sandstone. History: The Comanche Indians left food-grinding holes and petroglyphs on the sandstone walls at these springs as evidence of their long use. Many stone knives, scrapers, arrow points, beads, and potsherds have also been found here. Captain R. B. Marcy camped here in 1849 and General Robert E. Lee in 1856. A historical marker is located 1.5 miles northeast of State Highway 180. Discharge: 1946—45 gpm; 1969—0. References: Boren, 1969, and Texas Historical Survey Committee, 1971.

Smith County

Cherokee Spring (S2). Latitude 32°10′, longitude 95°28′, 6 miles southwest of Noonday. Aquifer: Queen City Sand. The spring flowed from a limonite deposit. History: In 1839 there was a battle between Texas troops under General Rusk who were camped at the spring and the Cherokee Indians. A historical marker is located here. Discharge: No flow recorded in 1937 or 1963. Reference: Woldert, 1948.

Neff Springs (S3). Latitude 32°20′, longitude 95°19′, 450 feet south of the junction of West Houston and South Glenwood Boulevard in Tyler. Aquifer: Sparta Sand. History: The springs were formerly in Will Neff's swimming pool. Discharge: 1937—none reported; 1947—"moderately large" flow; 1963—none reported. Reference: Woldert, 1948.

Arms Factory Spring (S4). Latitude 32°20′, longitude 95°18′, 75 feet north of Mockingbird Lane and 50 feet west of South Robertson Avenue in Tyler. Aquifer: Sparta Sand. History: The spring was a campsite for the Caddo and Tejas Indians. When first discovered by white men it was a bold spring, one of the largest in the area. Discharge: None reported in 1937, 1947, or 1963. Reference: Woldert, 1948.

Tyler Springs (S5). Two springs. Latitude 32°21', longitude 95°18', on South Spring Street, 75 feet south of East Elm Street in Tyler. Aquifer: Sparta Sand. History: In the early days the spring had a large flow which was curbed in a 10- by 12-foot pool. It was frequently used for baptizing. Discharge: July 6, 1936—10 gpm; no flow recorded in 1937, 1948, or 1963. Reference: Woldert, 1948.

Camp Ford Spring (S6). Latitude 32°24', longitude 95°17', 3 miles north of Tyler. Aquifer: Sparta Sand. History: During the Civil War this spring supplied water for 6,000 men at Camp Ford, a prisoner-of-war camp. It is now submerged by Burns Lake. No flow was recorded in 1937, 1948, or 1963. Reference: Woldert, 1948.

Cousin Spring (S7). Latitude 32°23', longitude 95°15', 5 miles northeast of Tyler on the south side of Ray's Creek. Aquifer: Sparta Sand. History: It was described as one of the finest springs in the area when the county was first settled. Discharge: None reported in 1937, 1948, or 1963. Reference: Woldert, 1948.

Headache Springs (S11). Latitude 32°19, longitude 95°12', 6 miles east of Tyler. Aquifer: Queen City Sand. History: These springs were well known for their healing mineral waters. During the Civil War a medical laboratory here made medicines and whiskey for the government. The medicines were made from the mineral water and herbs such as poke root, snakeroot, mullein, jimson week, Jerusalem oak, nightshade, mistletoe, and cherry bark. Discharge: No flow reported in 1937 or 1963. Reference: Texas Historical Survey Committee, 1971.

Sutton County

Fort Terrett Springs (DD16). Source of the North Llano River. Latitude 30°28', longitude 100°11', 8 miles west of Roosevelt. Aquifer: Edwards and associated limestones. History: A number of early explorers passed this way, possibly including De Vaca in 1535, Bosque in 1675, and Mendoza in 1683. In 1852-53 the springs furnished water for Fort Terrett. Discharge: 1918—"large flow"; 1972—"reported to flow only after a rain." Reference: Fisher, 1937.

Tarrant County

Cold Springs (R3). Latitude 32°44', longitude 97°20', on the south side of the Trinity River 1/4 mile east of the North Main Street bridge in Fort Worth. Aquifer: Probably the Paluxy Sand of the Trinity Group aquifer. The springs issue through alluvium. History: The U.S. Army Dragoons arrived and camped here in 1849. The springs were then surrounded by a grove of giant oaks and pecan trees, and were a social center until the 1880's. They were used as a water supply for Fort Worth from 1849 to 1876, when artesian wells were drilled. They were on the Chisholm Cattle Trail from 1867 to 1895. Discharge: 1849—"gushed clear cold water"; 1942—none reported; 1949—"faintly bubbling"; 1957—none reported. References: Paddock, 1911, and Arlington Heights Junior Historians, 1949.

Mary Le Bone Springs (R4). Latitude 32°41', longitude 97°07', 3 miles south of Arlington. Aquifer: Woodbine Sand. History: This was an ancient Indian settlement, as evidenced by arrow points, bedrock mortars, and other relics. A trading post was established at the springs in 1845. From here the Texas Rangers set out in 1849 to locate a site for Fort Worth. Discharge: 1942—none reported; 1949—"several sluggish springs"; 1957—none reported. References: Paddock, 1911, and Arlington Heights Junior Historians, 1949.

Terrell County

Meyers Springs (CC16). Near latitude 30°09', longitude 102°01', about 9 miles northeast of Dryden. Aquifer: Edwards and associated limestones. History: These springs were an old Apache Indian watering place, as evidenced by pictographs on the cliffs. They make a beautiful 40-foot fall from a precipice into a large basin. In 1882 a military outpost was located here, the remains of which can still be seen. Reference: Williams, 1969.

T-5 Springs (DD3). Latitude 30°28', longitude 101°47', 16 miles south of Sheffield. Aquifer: Edwards and associated limestones. Discharge: 1917—5.5 ft^3/s; July 25, 1929—8.4 ft^3/s; March 29, 1962—13 ft^3/s; February 7, 1968—9.0 ft^3/s.

Richland Springs (DD5). Latitude 30°23', longitude 101°43', 16 miles northwest of Pandale. Aquifer: Edwards and associated limestones. Discharge: 1917—3.3 ft^3/s; July 25, 1929—2.8 ft^3/s; March 29, 1962—3.9 ft^3/s; February 7, 1968—1.9 ft^3/s.

Wolf Springs (DD6). Latitude 30°23', longitude 101°42', 16 miles northwest of Pandale. Aquifer: Edwards and associated limestones. Discharge:

1917–3.3 ft^3/s; July 25, 1929–6.2 ft^3/s; March 29, 1962–6.4 ft^3/s; February 7, 1968–6.3 ft^3/s.

Geddis Springs (DD7). Latitude 30°18′, longitude 101°46′, 15 miles northwest of Pandale. Aquifer: Edwards and associated limestones. Discharge: 1917–5.5 ft^3/s; April 29, 1943–2.6 ft^3/s; February 7, 1968–0.

Sweetwater Springs (DD8). Latitude 30°17′, longitude 101°46′, 14 miles northwest of Pandale. Aquifer: Edwards and associated limestones. Discharge: 1917–4.4 ft^3/s; April 29, 1943–3.2 ft^3/s; 1962–2.8 ft^3/s; 1968–2.4 ft^3/s.

Tom Green County

Mill Spring (W4). Latitude 31°11′, longitude 100°30′, 1 mile south of Christoval. Aquifer: Edwards and associated limestones. History: Meserve man of about 9,000 years ago left spear points here. Juan Dominguez de Mendoza possibly stopped here in 1683. The Bismarck gin used the spring for power in the 1800's. Discharge: March 12, 1925–2.4 ft^3/s; 1941 and 1954–none reported; July 20, 1970–dry.

Anson Springs (W5). Several springs. Latitude 31°08′, longitude 100°30′, 4 miles south of Christoval. Aquifer: Edwards and associated limestones (Figure 47). History: Bedrock mortars at the springs testify to their use by the Tonkawa Indians. Mendoza may have stopped here in 1683. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1925	11	1962	15
1940	4.5	1963	12
1950	9.0	1964	8.8
1958	12	1965	7.7
1959	11	1966	6.4
1960	16	1970	7.0
1961	15	1971	6.3

At least eight upstream springs, including Pecan, Cave, and McCarthy Springs, no longer flow because of well pumping. References: Taylor, 1904 and Newcomb, 1961.

Lipan Spring (W6). Latitude 31°15′, longitude 100°15′, 10 miles southeast of Wall. Aquifer: Edwards and associated limestones. History: This spring was a stop on the Chihuahua Road. Discharge (ft^3/s by water years):

Figure 47.—Anson Springs

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1905	1.0	1950	0.3
1940	0.30	1952	0.1
1948	0.1	1962	0.18

Kickapoo Spring (W7). Latitude 31°10', longitude 100°06', 12 miles south of Vancourt. Aquifer: Edwards and associated limestones. History: In 1873 a detachment from Fort Concho killed Kiowa Chief Lone Wolf here and recovered some stolen horses. The spring was used for irrigation in the early days of settlement. Discharge: December 20, 1904–4 ft^3/s; October 1940–1.3 ft^3/s; May 9, 1950–1.0 ft^3/s; April 12, 1962–1.4 ft^3/s; July 28, 1970–0.1 ft^3/s. Pumping of nearby wells causes the spring to stop flowing. Reference: Taylor, 1904.

Travis County

Mormon or Taylor and Mount Bonnell Springs (FF4). At least 50 springs. Latitude 30°19', longitude 97°46', 1 mile north of Tom Miller Dam in Austin. Aquifer: Edwards and associated limestones, on the Mount Bonnell Fault. History: A Mormon settlement used the springs to power a grist mill in 1846 and 1847. They have now nearly all been inundated by Lake Austin. Discharge: 1904–3 ft^3/s; 1918–1.0 ft^3/s; 1941 and 1957–none reported; February 6, 1973–22 ft^3/s. Reference: Hill and Vaughn, 1898.

Power House or Dam Spring (FF5). Latitude 30°18', longitude 97°47', at Tom Miller Dam in Austin. Aquifer: Edwards and associated limestones. The spring flows through Colorado River terrace deposits. History: The spring appeared in the east abutment during construction of Lake Austin Dam in 1893. The dam failed in 1900 and was later rebuilt. The spring still drains through several drainage pipes below the powerhouse. Discharge: December 18, 1895–4.3 ft^3/s; 1897–10 ft^3/s; 1899–8 ft^3/s; 1941 and 1957–none reported; March 1970–0.3 ft^3/s; February 5, 1973–0.05 ft^3/s. References: Hill and Vaughn, 1898, and Taylor, 1900.

Seiders Springs (FF6). At least two springs. Latitude 30°17', longitude 97°45', on Shoal Creek between 34th and 38th Streets in Austin. Aquifer: Edwards and associated limestones. The springs issue through a fault. History: In 1839 the springs were described as "a stream of limestone water which could be used as a water supply for the new capital." Between 1846 and 1865 many Army troops, including those under the command of General Custer and General Lee, camped at the springs. From 1871 to 1896 Ed Seiders operated a popular resort and bath house here. Bath tubs were cut out of the rock on the hillside and filled from the springs. Discharge: 1898–"small"; 1941 and 1957–none reported; 1971–0.32 ft^3/s; June 7, 1972–30 gpm. The downstream spring has a strange cyclic action. The flow practically ceases for several minutes and then gushes forth for a brief interval before subsiding again. On June 7, 1972, the range in flow was from 2 to 60 gpm during a 5-minute cycle. The phenomenon is probably caused by a siphoning action in the rock passageways from which it issues. When the rate of flow is lower, the cyclic period is longer. References: Hill and Vaughn, 1898; Barkley, 1963; and Texas Historical Survey Committee, 1971.

Cold and Deep Eddy Springs (FF7). At least seven springs. Latitude 30°16', longitude 97°46', near Valley Springs Road in Austin. Aquifer: Edwards and associated limestones. The springs issue through a fault. History: Many Indian projectile points and tools have been found at the springs and in Bat Cave downstream and Bee Cave just upstream. An old Comanche Indian trail from Bandera to Nacogdoches passed the springs. In the 1870's steamboats made excursions from Austin to these springs and the upstream Bee Springs. Only two springs are now above the level of Town Lake. Discharge: 1898–"large volume"; August 1917–4.2 ft^3/s; February 8, 1941–3.0 ft^3/s; 1955–none reported; May 1972–2.9 ft^3/s. References: Hill and Vaughn, 1898, and Sellards, Baker, and others, 1934.

Barton Springs (FF8). At least five groups of springs, including Upper, Main, Upper Left Bank, Lower Left Bank, and Old Mill or Walsh Spring; the farthest downstream. Latitude 30°16', longitude 97°47', 2 miles southwest of Austin. Aquifer: Edwards and associated limestones. The springs issue through a fault. History: This was a gathering place for the Caddo, Tonkawa, Apache, and Comanche Indians. An old Comanche Indian trail from Bandera County to Nacogdoches passed here. The early settlers had a trading post at the springs. Early Spanish explorers wrote that in 1714 wild horses were numerous. Three Spanish missions were located here from 1730 to 1731. In 1839 the five commissioners named to select a site for the Texas capital described the springs as "perhaps the greatest and most convenient water power to be found in the Republic." Bonnell (1840) described them as "large springs, many of which would afford 5 or 6 hundred barrels of water a minute, bursting out at the foot of the mountains." This flow is equivalent to 47 to 56 ft^3/s. Early in the 1880's a fort was located at the springs. A number of saw and grist mills and ice-making machines used the water power of the springs. This was also a stop on the Chisholm Cattle Trail from 1867 to 1895. A historical marker is located here. The springs have always been popular for swimming (See Figure 23). Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1895	17	1930	29
1896	25	1931	64
1897	48	1932	35
1898	25	1933	27
1899	19	1934	44
1900	69	1935	61
1901	33	1936	44
1902	23	1937	48
1903	69	1938	53
1904	43	1939	20
1905	65	1940	30
1906	24	1941	89
1910	19	1959	63
1916	30	1960	55
1917	17	1961	95
1918	18	1962	49
1919	52	1963	44
1920	95	1964	23
1921	82	1965	58
1922	58	1966	64
1923	36	1967	41
1924	64	1968	75
1925	36	1969	85
1926	62	1970	78
1927	37	1971	43
1928	33	1972	83
1929	50		

On February 6, 1973, the Upper Springs were not flowing, the Main Springs flowed an estimated 47 ft^3/s, the Upper Left Bank Springs flowed 5 ft^3/s, the Lower Left Bank Springs flowed 6 ft^3/s, and Walsh Springs flowed 9 ft^3/s. Discharge is also given on Figure 22. References: Bonnell, 1840; Hill and Vaughn, 1898; Meinzer, 1927; and Texas Historical Survey Committee, 1971.

Manchaca Springs (FF10). Several springs on a small tributary of Onion Creek. Latitude 30°06′, longitude 97°49′, 3 miles south of Manchaca. Aquifer: The springs rise through a fault in the Austin chalk and gravel, possibly from the Edwards Limestone. History: The springs were named for Colonel Jose Menchaca of the Army of the Texas Republic. They were described by Hill and Vaughn (1898) as having a large flow, but less than Barton Springs. They were on the Chisholm Cattle Trail from 1867 to 1895. A mill was once operated by the spring waters. The remains of the mill may still be seen (Figure 48). Discharge (gpm by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1941	18	1971	23
1955	5	1973	200

Reference: Hill and Vaughn, 1898.

Santa Monica or Sulphur Springs (FF19). Latitude 30°21′, longitude 97°54′, 4 miles south of Marshall Ford. Aquifer: Glen Rose Limestone. History: These springs were once the basis for Comanche and Tonkawa Indian campgrounds. In later periods the waters were bottled and highly valued for medicinal purposed. The springs were also a favorite resort for early Austinites (Figure 49). They are now beneath Lake Austin. References: Barkley, 1963, and Hart, 1973.

Tyler County

Enloe Spring (GG3). Latitude 30°56′, longitude 94°28′, 3 miles northwest of Colmesneil. Aquifer: Jasper Sand. History: The Cherokee Indian Peach Tree Village was formerly located here. In 1840 the Enloe gin, gristmill, and sawmill was built to use the spring water for power. A historical marker is located here. References: Bonnell, 1840; Taylor 1904; and Texas Historical Survey Committee, 1971.

Uvalde County

Spring Creek Springs (LL8). Latitude 29°33′, longitude 99°57′, 2 miles northeast of Montell. Aquifer: Gravel alluvium. The flow is believed to be chiefly Nueces River flow which sinks into gravels and reappears here as springs. History: The springs were the basis for an ancient Indian campground. Later a mission was located here. Discharge: March 22, 1924–0; August 11, 1924–0; December 14, 1954–10 ft^3/s; February 16, 1955–0; September 20, 1955–15 ft^3/s; July 10, 1957–30 ft^3/s.

Spring Branch Springs (LL9). Latitude 29°21′, longitude 99°57′, 6 miles southeast of Laguna. Aquifer: Edwards and associated limestones. Discharge: March 22, 1924–0; August 13, 1924–0; April 30, 1925–0;

Figure 48.—Remains of Old Mill at Manchaca Springs

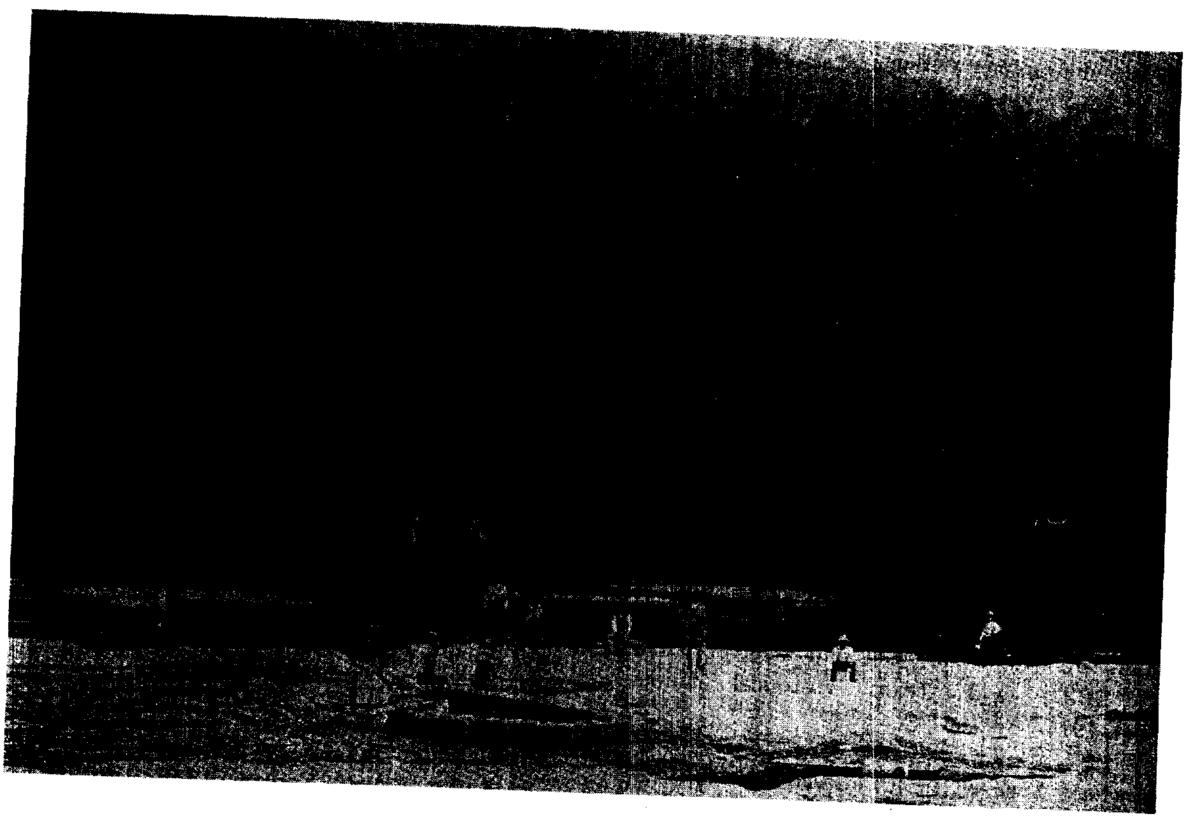

Figure 49.—Santa Monica Springs in 1890, Looking South
(From the Austin-Travis County Collection, Austin Public Library)

November 14, 1931–0; May 2, 1940–4.0 ft^3/s; July 9, 1940–3.1 ft^3/s; August 28, 1940–3.6 ft^3/s; September 26, 1940–3.2 ft^3/s.

Soldiers Camp Spring (LL10). Latitude 29°10′, longitude 99°54′, 8 miles west of Uvalde. Aquifer: Edwards and associated limestones. The spring issues through Austin Chalk and gravel. History: The spring was a stop on the Old Spanish Trail. Hill and Vaughn (1898) said "Water rushes out in a stream of considerable size, and is cool, clear, and pure, and surrounded by splendid growths of pecan trees." Discharge: November 15, 1931–0; August 19, 1939–1.5 ft^3/s; 1962–none reported. Reference: Hill and Vaughn, 1898.

Leona Springs, Group 1 (LL11). They include Mulberry Spring. Latitude 29°12′, longitude 99°47′, 1 mile southeast of Uvalde. Aquifer: Edwards and associated limestones. The springs issue through a fault and the Leona Gravel. The Leona River in this area is sometimes gaining and sometimes losing flow by means of interchange with underground water. Spring flow generally lags behind rainfall by several months. History: The springs afforded a stop on the Old Spanish Trail. In 1840 they were described as "the purest streams of crystal water." The Leona Springs were settled by Reading Black in 1853. At that time they were surrounded by large live oak, elm, pecan and hackberry trees. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1885	0	1931	3.1
1893	0	1933	19
1896	11	1934	6.8
1898	0	1935	1.4
1899	0	1939	7.1
1900	5	1940	7
1904	22	1941	6
1906	13	1942	7
1910	8.4	1943	8
1912	0	1944	4
1925	3.8	1945	1.0
1928	0.9	1946	0
1930	0	1947	3.5

See also the combined discharge measurements for Groups 1 to 3 of the Leona Springs, following Group 3. Reference: Bonnell, 1840.

Leona Springs, Group 2 (LL12). Latitude 29°11′, longitude 99°46′, 3 miles southeast of Uvalde. Aquifer: Edwards and associated limestones. The springs issue through a fault and the Leona Formation. Discharge: (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1925	5.3	1942	14
1931	4.9	1943	14
1934	7.6	1944	8
1935	5.2	1945	8
1939	6.9	1946	2.6
1940	13	1947	6.5
1941	12		

See also the combined discharge measurements for Groups 1 to 3 of the Leona Springs, following Group 3.

Leona Springs, Group 3 (LL13). Latitude 29°09′, longitude 99°44′, 6 miles southeast of Uvalde. Aquifer: Edwards and associated limestones. The springs probably issue through a fault beneath the Leona Formation. Discharge: (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1925	1.6	1939	6.5
1931	8.4	1946	4.7
1934	4.4	1947	7.0
1935	4.8		

See also the combined discharge measurements for Groups 1 to 3 of Leona Springs below.

Leona Springs, Groups 1 to 3 (LL11). In recent years the combined flow of Groups 1 through 3 of Leona Springs has been measured. These measurements follow (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft³/s)	WATER YEARS	DIS-CHARGE (ft³/s)
1934	14	1942	27
1935	14	1943	24
1936	33	1944	11
1937	34	1945	13
1938	29	1946	6
1939	20	1947	10
1940	20	1948	6.9
1941	17	1949	3.0

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1950	14	1962	28
1951	0.62	1963	7.1
1952	0	1964	0.11
1953	0	1965	0.07
1954	0	1966	0.3
1955	0	1967	0.5
1956	0	1968	5
1957	0	1969	9
1958	0	1970	21
1959	6.5	1971	12
1960	31	1972	25
1961	31		

The maximum recorded flow was 51 ft^3/s on December 4, 1973. It should be noted that in years in which both separate and combined discharge measurements were made, the separate measurements generally totaled a greater amount than the combined flow. This is because some of the flow of the upper springs (Group 1 and 2) was lost to the alluvial gravels before reaching the Group 3 springs where the combined flow was measured.

Leona Springs, Group 4 (LL14). Latitude 29°07′, longitude 99°41′, 9 miles southeast of Uvalde. Aquifer: Edwards and associated limestones. The springs probably issue through a fault beneath the Leona Formation. The Leona River in this area is sometimes losing and sometimes gaining flow. Spring flow lags behind rainfall by several months. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1925	12	1939	6.8
1931	12	1946	3.0
1934	5.2	1947	5.5
1935	5.6		

Reference: Taylor, 1902.

Val Verde County

Howard Springs (DD9). Latitude 30°09′, longitude 101°32′, 2 miles south of Pandale. Aquifer: Edwards and associated limestones. Discharge: May 18, 1939–2.6 ft^3/s; June 20, 1943–3.4 ft^3/s; March 29, 1962–0; February 8, 1968–0; May 20, 1969–4.0 ft^3/s.

Tardy Springs (DD10). Originally nine springs. Latitude 30°08′, longitude 101°32′, 4 miles south of Pandale. Aquifer: Edwards and associated limestones. Discharge: May 15, 1939–2.6 ft^3/s; 1962–1.1 ft^3/s; February 6, 1968–2.0 ft^3/s; May 29, 1969–1.9 ft^3/s.

Cox Springs (DD11). About 23 springs, including Evert Springs. Latitude 30°02′, longitude 101°32′, 11 miles south of Pandale. Aquifer: Edwards and associated limestones. History: The springs have been used for irrigation. Discharge: May 15, 1939–6.7 ft^3/s; July 21, 1943–17 ft^3/s; May 2, 1962–1.1 ft^3/s; 1968–0.89 ft^3/s.

Juno, Headwater, or Stein Springs (DD12). Originally two springs, at least. Latitude 30°09′, longitude 101°07′, at Juno. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. History: Many early settlers stopped here on their way west. The Old Spanish Trail from San Antonio to El Paso passed here. The Devil's River at this point was described in 1916 as a beautiful stream with large live oaks. The springs, Beaver Lake upstream, and the perennial flow of the Devil's River in this area have all disappeared. In May 1971, the first headwater springs were 15 miles downstream, at Pecan Springs. Discharge: August 8, 1925–5.8 ft^3/s; July 13, 1939–0.03 ft^3/s; May 25, 1971–0. Irrigation pumping from wells upstream probably contributed to the drying up of these springs. However, much of the reduction in discharge occurred before any pumping for irrigation took place. Bosworth (1964) believes that overgrazing compacted the surface soils and greatly reduced recharge to the aquifer. Reference: Bosworth, 1964.

Pecan Springs (DD13). Latitude 30°03′, longitude 101°10′, 7 miles southwest of Juno. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue through gravel on the right (west) bank of the Devil's River. History: Hill and Vaughn (1898) described them as a "sparkling spring of pure limpid water, and its taste is delicious." They are surrounded by a large grove of pecan trees (Figure 50), with beaver dams downstream. The Old Spanish Trail from San Antonio to El Paso passed here. Originally at least six springs were here, but in May 1971, only the fartherest downstream spring was still flowing. Discharge: 1892–0.8 ft^3/s; June 13, 1939–6.6 ft^3/s; May 25, 1971–0.1 ft^3/s. Reference: Hill and Vaughn, 1898.

Hudspeth Springs (DD14). Many springs. Latitude 30°01′, longitude 101°10′, 10 miles south of Juno. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue through gravel on the

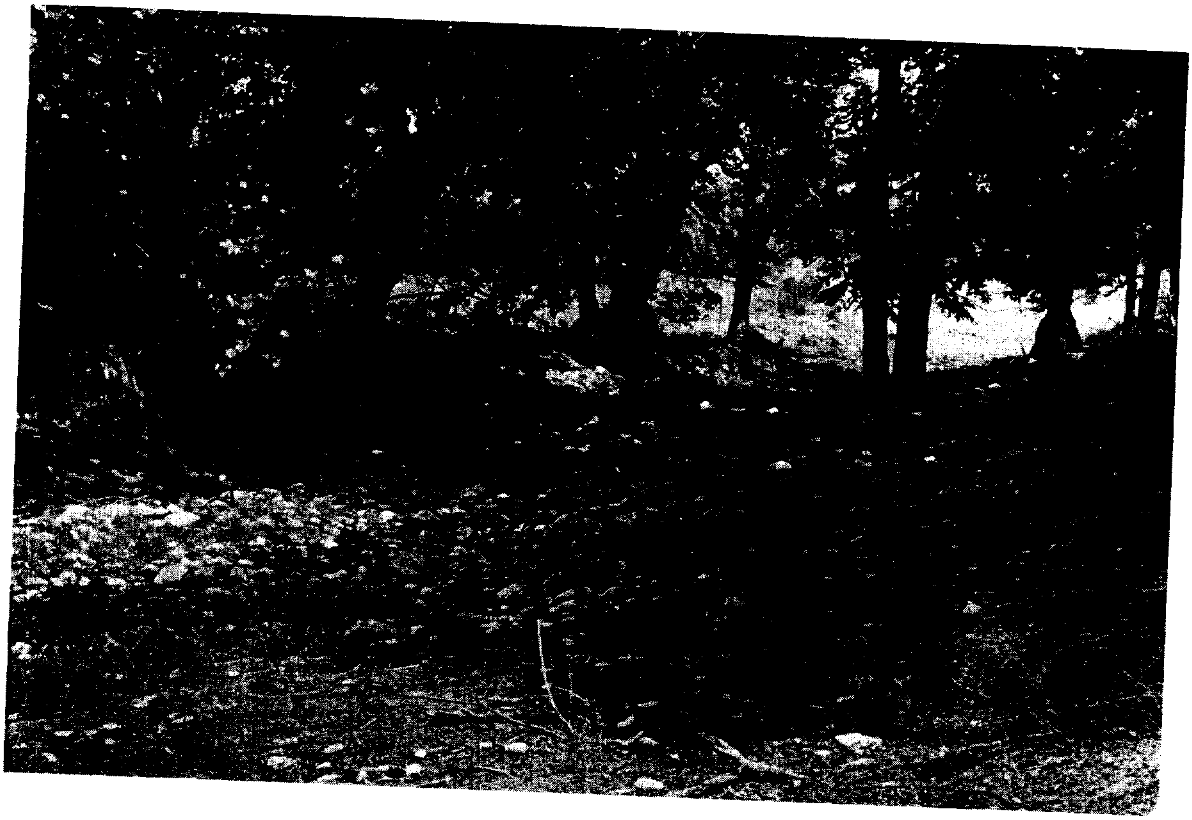

Figure 50.—Site of Former Pecan Springs

right (west) bank of the Devil's River (Figure 51). A beaver dam is located downstream. History: The Old Spanish Trail from San Antonio to El Paso passed here. The springs have been used for irrigation. Discharge: June 14, 1939–2.3 ft^3/s; February 1969–3.6 ft^3/s; May 25, 1971–5.8 ft^3/s.

Dead Man Springs (KK1). Four springs. Latitude 29°47′, longitude 101°21′, 3 miles east of Shumla. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer, on the left (east) bank of the Pecos River. History: In 1892 the Southern Pacific Railroad built the Pecos high bridge, 321 feet above the river. The southernmost of these springs was used as a water supply by the railroad at the bridge. The springs are under about 55 feet of water when International Amistad Reservoir is at conservation pool level. The International Boundary and Water Commission has drilled a well for the railroad, to replace the spring as a water supply. Discharge: May 25, 1939–4.2 ft^3/s: May 25, 1971–3.2 ft^3/s reported.

Huffstutter Springs (KK2). Two springs. Latitude 29°57′, longitude 101°08′, 19 miles north of Comstock. Aquifer: Georgetown Limestone. History: The Old Spanish Trail from San Antonio to El Paso passed these springs. Fort Hudson was established near them in 1854. Camel caravan experiments were carried out from here in 1856. Discharge: June 13, 1939–1.7 ft^3/s; May 25, 1971–0.8 ft^3/s reported. The small (east) spring has reportedly ceased flowing.

Finegan Springs (KK3). One large and eight smaller springs. Latitude 29°54′, longitude 101°00′, 13 miles west of Loma Alta. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue from the base of a bluff on the left (east) bank of the Devil's River, about 15 feet above the river (Figure 52). History: Artifacts indicate long use by the Apache Indians. Originally there were at least 25 springs. There was also a waterfall at a higher elevation during strong spring flows. Discharge: February 15, 1928–3.5 ft^3/s; July 1939–27 ft^3/s; September 17, 1966–4.0 ft^3/s; February 4, 1969–4.0 ft^3/s; May 25, 1971–20 ft^3/s. Reference: Bosworth, 1964.

Dolan Springs (KK5). Two main and about 20 smaller springs. Latitude 29°54′, longitude 100°59′, 12 miles west of Loma Alta. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer, on Dolan Creek. History: Indian middens with many stone tools indicate very ancient use of these springs. A dam and measuring weir have been built below the south springs (Figure 53). The north springs flow into a natural

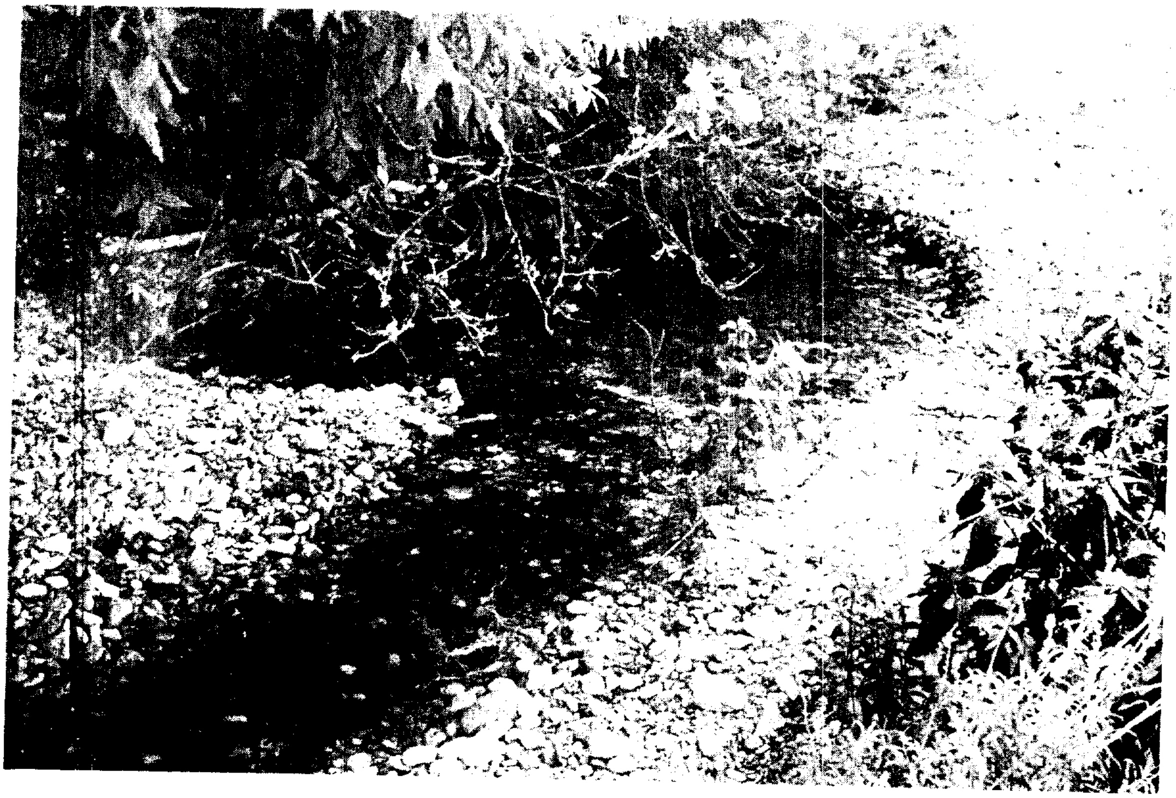

Figure 51.--Hudspeth Springs

Figure 52.—Finegan Springs

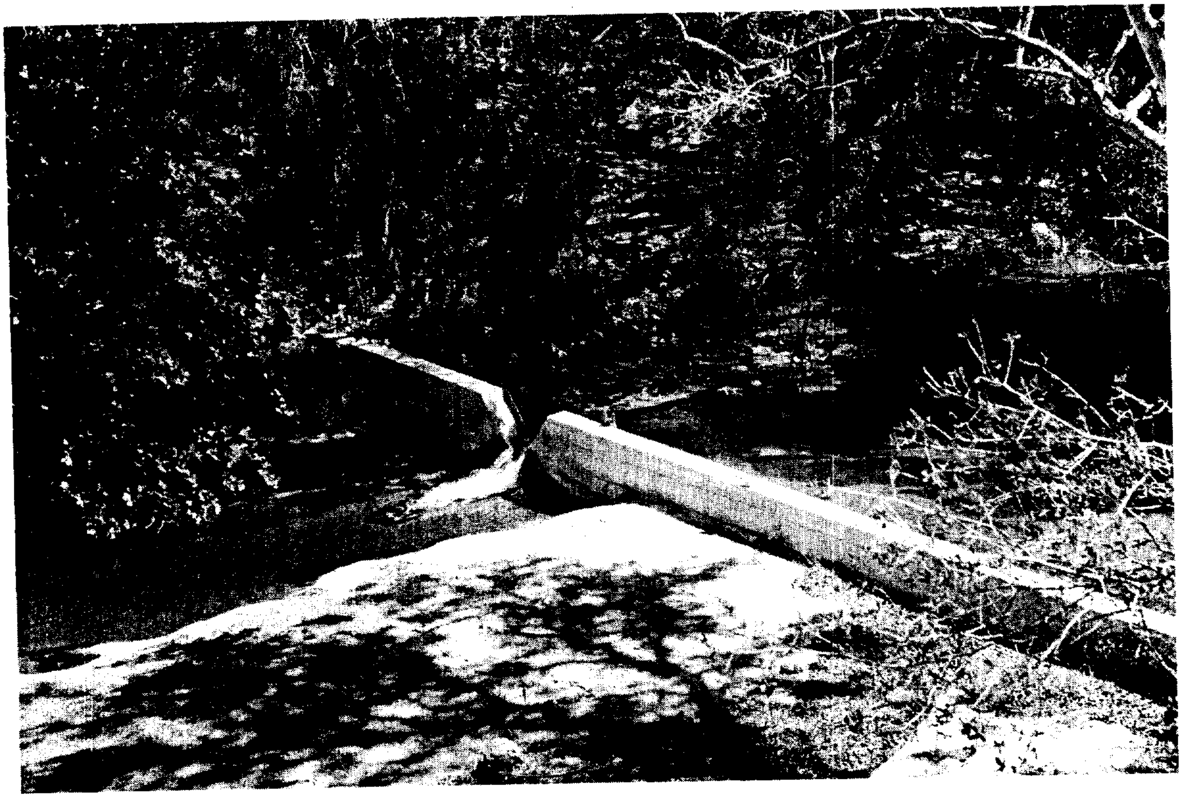

Figure 53.—Dam and Weir on Dolan South Spring

pool in the rock. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1928	2.0	1968	1.7
1939	33	1969	1.1
1966	5.6	1970	3.0
1967	2.4	1971	1.2

Gillis Springs (KK5). About 14 springs. Latitude 29°43′, longitude 101°02′, 9 miles east of Comstock. Aquifer: Georgetown Limestone of the Edward-Trinity (Plateau) aquifer. The springs issue from limestone on the right (west) bank of the Devil's River, some below river level (Figure 54). Discharge: February 14, 1928–6.3 ft^3/s; July 19, 1939–0.18 ft^3/s; October 4, 1967–0.22 ft^3/s; May 25, 1971–9.2 ft^3/s.

Slaughter Bend or Swann-Shelton Springs (KK6). About 18 springs. Latitude 29°40′, longitude 100°56′, 21 miles north of Del Rio. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue from the limestone at the base of a cliff on the left (east) bank of the Devil's River, about 10 feet above the river (Figure 55). A small anticline is present. History: Indian middens with numerous stone artifacts indicate long use of these springs. They are under about 50 feet of water when International Amistad Reservoir is at conservation pool level. Discharge: January 26, 1921–25 ft^3/s; August 12, 1925–50 ft^3/s; February 18, 1928–26 ft^3/s; May 25, 1971–11 ft^3/s.

Goodenough Spring (KK7). An artesian spring on the left (north) bank of the Rio Grande. Latitude 29°32′, longitude 101°15′, 12 miles southwest of Comstock. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. History: The Spanish explorer Castano de Sosa may have stopped here in 1590 during his exploration of the Rio Grande and Pecos River. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1922	190	1930	117
1923	240	1931	150
1924	210	1932	159
1925	169	1933	302
1926	160	1934	188
1927	140	1935	156
1928	120	1936	144
1929	130	1937	132

Figure 54.—Main Gillis Spring, in Devil's River

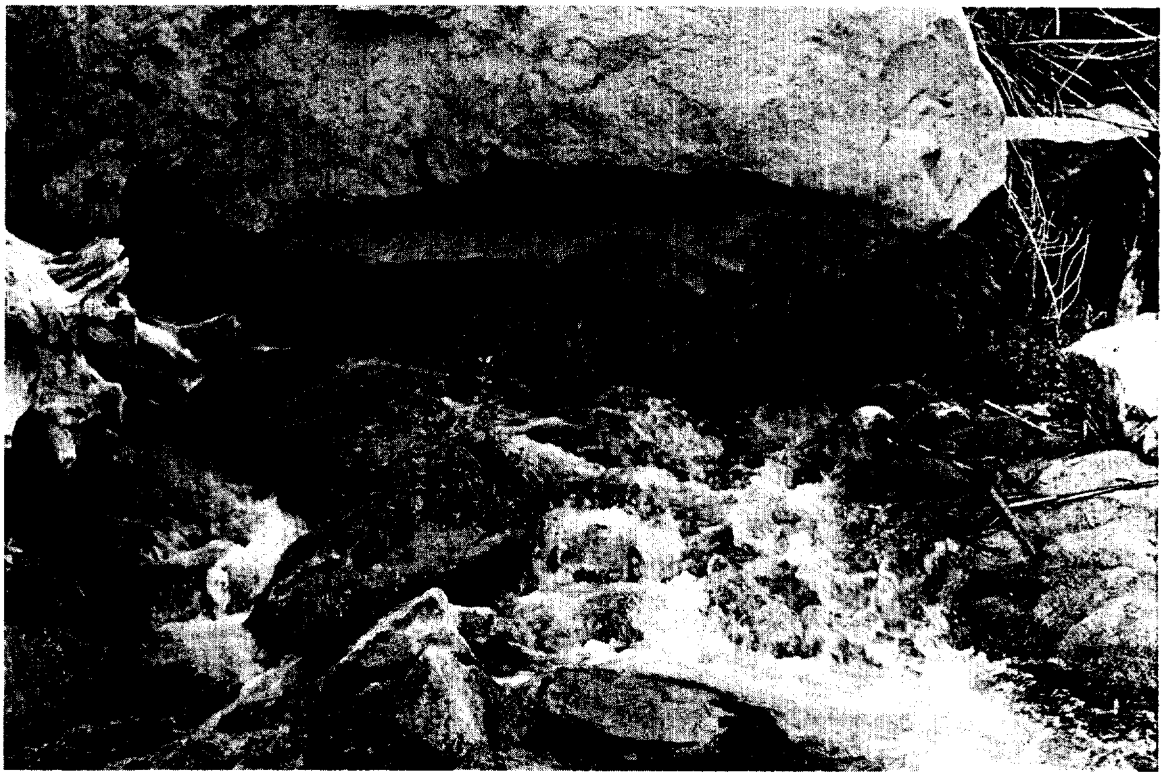

Figure 55.—One of the Slaughter Bend Springs

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1938	122	1954	103
1939	120	1955	105
1940	119	1956	91
1941	124	1957	102
1942	143	1958	113
1943	115	1959	219
1944	104	1960	156
1945	113	1961	149
1946	150	1962	116
1947	193	1963	102
1948	132	1964	128
1949	138	1965	120
1950	113	1966	124
1951	98	1967	107
1952	84	1968	137
1953	84		

The maximum momentary flow was 3,580 ft^3/s on September 23, 1964. This was the third largest spring in Texas until covered by water from International Amistad Reservoir in July 1968. The spring is under about 150 feet of water when the reservoir is at conservation pool level. This has probably greatly reduced the discharge and diverted it to other outlets such as San Felipe Springs.

McKee Springs (KK8). Latitude 29°25′, longitude 101°02′, 9 miles west of Del Rio. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. The springs issue from limestone on the left (east) bank of the Rio Grande (Figure 56). Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1939	1.0	1966	1.7
1961	2.1	1967	0.4
1962	1.7	1968	0.6
1963	0	1969	4.0
1964	1.5	1970	6.0
1965	4.3	1971	5.8

Discharge appears to have been increased by International Amistad Reservoir since its closure in July 1968.

San Felipe Springs (KK9). Three large and one small spring. Latitude 29°22′, longitude 100°53′, 1 mile

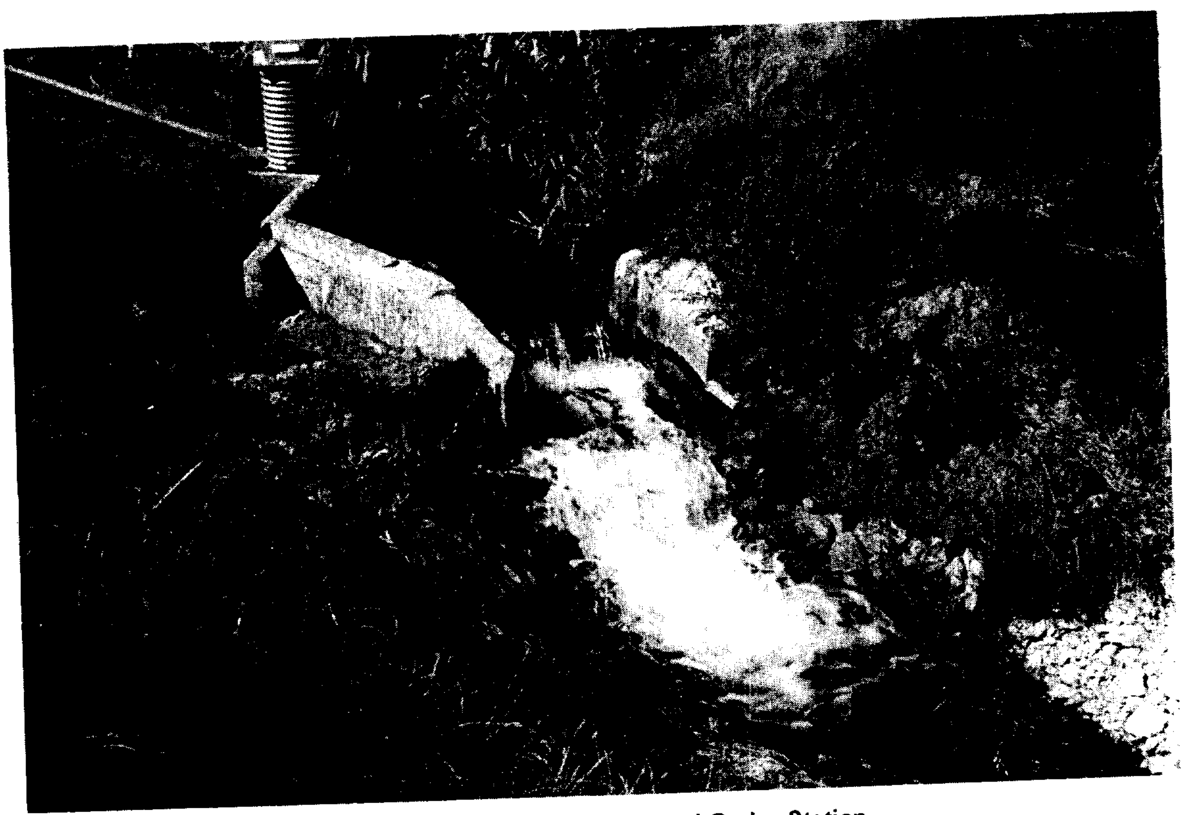

Figure 56.—McKee Spring and Gaging Station

north east of Del Rio. Figure 6 shows one of the springs. Aquifer: Georgetown Limestone, of the Edwards (Balcones Fault Zone) aquifer. The recharge area for these and other springs in the area is believed to cover about 6,500 square miles, extending into Pecos and Schleicher Counties. History: Bands of Apache and Pueblo Indians lived at these springs in the past, raising corn, beans, and squash, making baskets and clothing from sotol and yucca fibers, and eating prickly pears. When the springs were first discovered by white men, there were seven deep clear pools with many large fish, surrounded by hackberry trees, grape vines, and cattails. In 1657 a mass was held here by Franciscan Fathers and the springs named for the king of Spain. The old Spanish Trail from San Antonio to El Paso passed the springs. A mission was established in 1808 but was abandoned. The first settlement of San Felipe de Rio (now Del Rio) began in 1834. Irrigation dams and canals were built to irrigate grapes, plums, apples, and melons. The springs were much used by the cavalry and stage coaches in the late 1800's. Water from the springs was hauled to town for 5 cents a barrel. In 1882 two grist mills used the water for power. In 1884 a water company was formed. In 1901 an electric light and ice plant was built. The springs, the third largest in Texas, are still the sole water supply for the city of Del Rio. They also furnish irrigation water for the only winery in Texas. A historical marker is located here. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1889	113	1929	56
1896	99	1930	47
1897	89	1931	80
1899	113	1939	122
1900	149	1952	45
1902	128	1953	22
1904	118	1954	95
1905	103	1956	45
1906	72	1957	58
1910	69	1958	112
1912	71	1959	108
1922	85	1960	102
1923	92	1961	109
1924	89	1962	82
1925	65	1963	51
1926	85	1964	56
1927	80	1965	102
1928	65	1966	88

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1967	80	1970	104
1968	72	1971	82
1969	77		

International Amistad Reservoir appears to be increasing the flow of the springs by providing additional recharge and by diverting the flow of Goodenough Springs and other inundated springs to San Felipe Springs. Maximum recorded discharge was 150 ft^3/s in December 1901. References: Taylor, 1904; Manny, 1947; and Texas Historical Survey Committee, 1971.

Cantu or Cienaga (Bog) Spring (KK10). Latitude 29°22′, longitude 100°56′, 2 miles west of Del Rio. Aquifer: Georgetown Limestone of the Edwards-Trinity (Plateau) aquifer. The spring rises from a limestone cavern into a walled-up pool (Figure 57). History: Bosque and his men may have camped here in 1675. The spring has been used for irrigation. Discharge (ft^3/s by water years):

WATER YEARS	DIS-CHARGE (ft^3/s)	WATER YEARS	DIS-CHARGE (ft^3/s)
1939	0.3	1966	1.8
1961	2.9	1967	1.2
1962	1.2	1968	0.3
1963	0	1969	2.7
1964	0.7	1970	4.8
1965	3.0	1971	3.5

The discharge appears to have been increased by International Amistad Reservoir since closure of the reservoir in July 1968.

Van Zandt County

Roher Springs (S1). Latitude 32°21′, longitude 95°56′, 1 mile east of Big Rock. Aquifer: Carrizo Sand. History: When the springs were settled by Europeans in 1845, buffalo were common. Millions of passenger pigeons also stopped here until 1875. Roher's corn and wool-carding mill was powered by the springs. Discharge: In 1973 no flow was recorded. Reference: Taylor, 1904.

Riley Spring (S10). Latitude 32°30′, longitude 95°53′, 4 miles south of Canton. Aquifer: Wilcox Sand of the Carrizo-Wilcox aquifer. History: The Caddo Indians formerly lived here and farmed nearby. Many of their arrow heads, stone scrapers, grinders, sinker stones

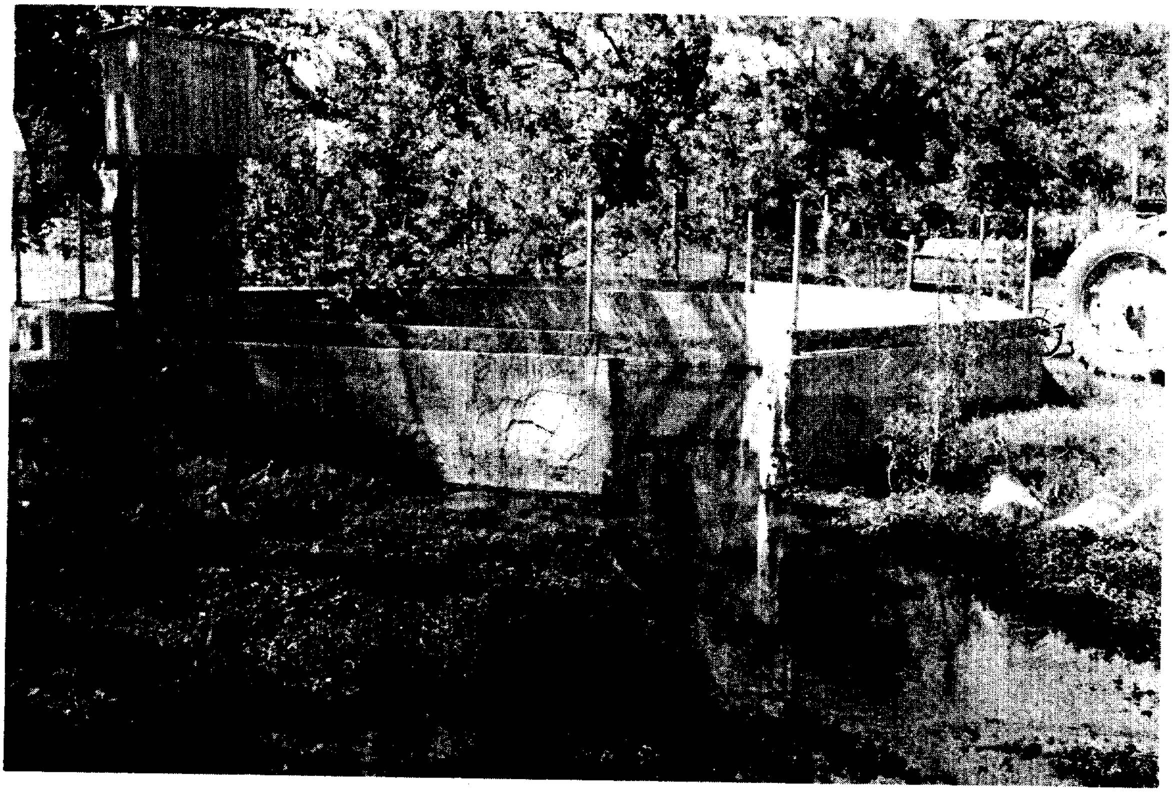

Figure 57.—Cantu Spring and Gaging Station

for fishing, mounds, pottery sherds, and old furnaces for making pottery have been found here. Several mills were powered by the spring water, including Riley's Mill, the first, in the 1850's. These included a grist mill, flour mill, cotton gin, and furniture factory. An old water wheel could still be seen in 1950. Discharge: 1973—none reported. A flowing well was reported just northeast from the same aquifer. Reference: Mills, 1950.

Wheeler County

Fort Elliott Springs (E1). Several springs forming Sweetwater Creek. Latitude 35°33′, longitude 100°28′, 2 miles west of New Mobeetie. Aquifer: Ogallala Formation. History: These springs were originally a watering place for buffalo, wild turkey, antelope, bear, and javelinas. Buffalo hunters established the town of Mobeetie near the springs in 1874, From 1875 to 1889 nearby Fort Elliott used the spring water to irrigate vegetables. The creek was reported originally to have had many more water holes and fish, perhaps because the springflow was greater and more uniform. Discharge: July 11, 1967—140 gpm; June 24, 1971—9 gpm. Much well pumping for irrigation in the vicinity has reduced the spring flow. Reference: Harris, 1968.

Rathjen Springs (E2). Five springs. Latitude 35°32′, longitude 100°07′, 11 miles northeast of Wheeler. Aquifer: Ogallala Formation. History: In 1879 Fred Rathjen arrived from Germany to establish the first white settlement here. He used the springs to irrigate 60 acres, the first irrigation in the Texas Panhandle. He sold vegetables, peaches, pears, and apples to nearby Fort Elliott. Discharge: July 14, 1967—180 gpm; June 24, 1971—110 gpm. In 1971 the springs supplied 10 stock tanks on Williams Creek. References: Taylor, 1902, and Harris, 1968.

Wheeler Springs, formerly Seed Springs (E3). Several springs. Latitude 34°24′, longitude 100°06′, 1 mile northeast of Kelton. Aquifer: Whitehorse Group (sandstone), dipping northwest. History: Used for irrigation. Discharge: July 27, 1967—1.4 ft^3/s; June 24, 1971—0.28 ft^3/s. Much well pumping has been done for irrigation in the surrounding area.

Bronco Springs (E4). Numerous small springs. Latitude 35°22′, longitude 100°16′, 6 miles south of Wheeler. Aquifer: Whitehorse Group (sandstone), dipping northwest. History: In the early 1900's these springs were a part of Shamrock's water supply. The water was hauled to town on wagons. Discharge:

1938—"very strong"; May 25, 1967—10 gpm; June 24, 1971—27 gpm. In 1971 they supplied eight stock tanks. References: Perkins, 1938, and Harvey, 1962.

Lehman Springs (E5). Several springs forming Crow Creek. Latitude 35°11′, longitude 100°11′, 5 miles southeast of Shamrock. Aquifer: Blaine Formation (siltstone and gypsum), dipping northwest. History: These springs were a part of Shamrock's first water supply in 1901. Water was hauled to town and sold, 6 barrels for $4. Discharge: June 16, 1967—0.56 ft³/s; June 24, 1971—0.60 ft³/s. Reference: Harvey, 1962.

Wichita County

China Springs (I3). Several springs. Latitude 34°05′, longitude 98°57′, 2 miles west of Haynesville. Aquifer: Wichita Formation (limestone and sandstone). Discharge: 1913—"considerable flow of slightly brackish water"; 1969—0.24 ft³/s; 1970—0.23 ft³/s. Reference: Gordon, 1913.

Wilbarger County

Doans Springs (I1). Several springs. Latitude 34°21′, longitude 99°16′, 1 mile northwest of Doans. Aquifer: Base of the Seymour Formation (alluvium). History: These springs were a stop on the Western Cattle Trail from 1876 on. The water is now impounded in a recreational lake. Discharge: In 1913 they were described as supporting a small stream which persisted throughout the year, sinking into sands about one mile from its source. Discharge: February 28, 1951 and November 10, 1970—reported to be flowing. Reference: Gordon 1913.

Condon Springs (I2). About 10 springs. Latitude 34°10′, longitude 99°19′, 3 miles northwest of Vernon. Aquifer: Base of the Seymour Formation (alluvium). History: The springs were on the Western Cattle Trail from 1876 on. Discharge: In 1913 they were described as "good water, with a good flow maintained through the year." October 1943—27 gpm; December 10, 1969—reported to be flowing. Reference: Gordon, 1913.

Williamson County

Berry Springs (FF2). Latitude 30°41′, longitude 97°39′, 5 miles north of Georgetown. Aquifer: Edwards and associated limestones. The springs issue through a fault. History: The Strange corn mill was operated at these springs for many years. Discharge: March 17, 1964—13 ft³/s. Reference: Taylor, 1904.

Manske Branch Springs (FF3). Latitude 30°38′, longitude 97°35′, 6 miles east of Georgetown. Aquifer: Edwards and associated limestones. The springs issue through a fault. Discharge: March 17, 1964—2.3 ft³/s.

Wilson Spring (FF9). Latitude 30°35′, longitude 97°28′, 4 miles northwest of Taylor. Aquifer: Wolfe City Sand. History: The spring was on an old Comanche Indian trail. From 1849 to 1887 the Gooch corn mill used the spring waters. Discharge: February 8, 1941—0.10 ft³/s. Reference: Norvell (no date).

Knight Springs (FF12). Several springs. Latitude 30°40′, longitude 97°45′, 5 miles northwest of Georgetown. Aquifer: Edwards and associated limestones. History: Knight's mill used the water power from the springs in the 1880's. They were a rest stop on the Chisholm Cattle Trail from 1867 to 1895. Discharge: July 1940—0.89 ft³/s; March 16, 1964—0.66 ft³/s. Reference: Norvell (no date).

Wilson County

Sutherland Springs (LL36). Many springs including White Sulphur, Cold, Sour, and Alligator Springs. Latitude 29°17′, longitude 98°03′, 1 mile northeast of Sutherland Springs. Aquifer: Carrizo Sand. History: These springs were much used by the Coahuiltecan Indians, who left many flint projectile points, choppers, scrapers, knives, and ceramic sherds. The springs were a stop on the Chihuahua Road, and the old town of Sutherland Springs was laid out around them. In the 1850's and 1860's the approximately 100 warm and cold springs, reportedly with 27 flavors, were known for their medicinal qualities. Bathing in the spring at the resort hotel was popular. A historical marker is located here. They will probably be inundated by the conservation pool waters of proposed Cibolo Reservoir. Discharge: August 18, 1936—"flows"; 1949—1.5 ft³/s; 1954—0.01 ft³/s; March 6, 1968—0.15 ft³/s. References: Wilson County Centenial Association, 1960; Hsu and Ralph, 1968; and Texas Historical Survey Committee, 1971.

Winkler County

Willow Springs (V3). Latitude 31°41′, longitude 102°55′, 7 miles north of Monahans. Aquifer: Cenozoic alluvium (dune sand). History: This water hole was vital to the Comanche Indians and to the white travelers heading for the gold rush in California. In 1901 the remains of a 40-wagon-party massacre were found here. A historical monument is located 12 miles south of Kermit on State Highway 18 and 6.6 miles west of the springs. Discharge: None reported in 1941 or 1959. Heavy pumping in this area has greatly drawn down water tables. Reference: Texas Historical Survey Committee, 1971.

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Table 2.--Selected Chemical Analyses of Spring Waters

Analyses by the Texas State Department of Health unless otherwise indicated. Results are in milligrams per liter except pH, sodium-adsorption ratio, residual sodium carbonate, and temperature.

Aquifer symbols: Alluvium, Al; Gulf Coast, GC; Ogallala, Og; Sparta, Sp; Queen City, QC; Carrizo-Wilcox, CW; Trinity Group, TR; Edwards-Trinity (High Plains), EH; Edwards-Trinity (Plateau), EP; Edwards (Balcones Fault Zone), Eb; Santa Rosa, SR; Ellenburger-San Saba, ES; Hickory, Hi; other aquifers, oth.

Spring	Name	Aquifer	Date of Collection	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Boron (B)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Total dissolved solids	Total hardness as $CaCO_3$	pH	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Temperature (°F)
1/ A1	Buffalo	oth	Feb. 23, 1937	--	59	29	* 13	--			329	12	10				285	268		0.4	0	
			June 22, 1971	19	48	22	20	<1	0.12	0.2	265	23	6	1.5	< 0.4	<0.2	270	212	8.0	.57	.58	70
D1	Bravo	Og	do.	41	46	20	22	2	--	<.2	240	23	11	1.5	6	< .2	291	197	7.9	.97	.48	60
1/ D2	XIT	Og	Feb. 14, 1938	--	42	33	* 13	--	--	--	256	33	17	--	<20	--	264	240	--	.4	0	--
D3	Tecovas	Og	Apr. 20, 1937	--	--	--	--	--	--	--	--	28	11	--	<20	--	--	--	--	--	--	--
E1	Fort Elliott	Og	July 12, 1967	--	--	--	--	--	--	--	236	8.0	5.4	--	--	--	--	192	7.7	--	.03	63
			June 23, 1971	29	66	9	8	<1	--	<.2	246	7	8	.5	< .4	< .2	249	202	7.4	.26	.01	63
E2	Rathjen	Og	do.	14	16	8	28	<1	--	<.2	112	16	8	.5	< .4	< .2	153	73	8.9	1.4	.62	72
E3	Wheeler	oth	Feb. 4, 1971	39	520	111	87	--	--	--	212	1,610	59	1.0	8.5	--	2.540	1,760	7.1	.90	0	49
E4	Bronco	oth	June 23, 1971	5	32	14	28	<1	--	<.2	178	30	10	.7	< .4	< .2	208	136	7.9	1.0	.2	68
E5	Lehman	oth	do.	12	630	71	57	3	.6	.5	115	1,710	60	1.0	< .4	< .2	2,600	1.870	7.6	.58	0	74
E6	Elm Creek	oth	June 24, 1971	19	520	70	76	4	--	.3	176	1,370	99	.8	< .4	< .2	2,250	1.580	7.5	.83	0	74
1/ E7	Wolf Creek	oth	Sept. 9, 1946	--	623	81	* 47	--	--	--	220	1,675	40	.4	<20	--	2,590	1,890	7.4	.5	0	65
			June 24, 1971	12	560	104	70	--	--	--	217	1,570	75	.9	10	--	2,510	1,820	7.8	.74	0	44
1/ H1	Hylsey	SR	Sept. 9, 1946	--	40	26	* 43	--	--	--	270	55	15	--	0	--	351	207	--	1.3	0	--
			Jan. 24, 1971	50	41	32	49	<1	--	.4	306	56	15	4.5	1.0	< .2	399	235	8.0	1.4	1.5	64
H2	Bitter Creek	Og	Mar. 5, 1968	27	75	5.8	26	2	--	--	242	21	17	.2	24	--	317	211	7.4	.8	0	--
			June 24, 1971	38	75	7	25	2	--	<.2	260	24	21	.3	4.2	< .2	324	216	7.9	.69	.44	70
H3	Wischkaemper	Al	Oct. 18, 1966	29	113	55	*137	--	--	--	443	252	121	.7	3.0	--	930	510	8.1	2.6	0	65
			Jan. 27, 1971	18	580	62	40	--	--	--	199	1,450	46	1.0	18	--	2,310	1,720	7.8	.41	0	44
H4	O'Hair	oth	Jan. 26, 1971	14	126	18	41	--	--	--	560	11	7	.1	< .4	--	492	389	7.6	.95	1.4	48
1/ H5	Roscoe	oth	Oct. 1, 1938	--	--	--	--	--	--	--	171	1,660	59	--	<20	--	2,590	--	--	--	--	--
			June 25, 1971	30	142	62	99	5	--	.5	317	408	88	1.0	< .4	< .2	990	610	8.0	1.7	1.5	73
I1	Doans	Al	Nov. 10, 1970	23	72	27	44	<1	--	.2	350	40	28	.6	27	--	434	294	7.3	1.1	0	--
1/ I2	Condon	Al	Oct. 14, 1943	--	--	--	--	--	--	--	404	56	80	--	--	--	--	--	--	--	--	68
1/ K1	Buffalo	Eh	May 11, 1937	--	50	39	* 58	--	--	--	366	41	48	--	--	--	416	284	--	1.5	.2	55
1/ K3	Roaring	SR, Og	Sept. 12, 1938	--	84	25	* 57	--	--	--	329	48	69	1.3	20	--	465	310	--	1.4	0	--
L1	Buffalo	Al	June 12, 1969	21	44	56	* 98	--	--	--	487	57	40	1.5	29	--	590	340	7.8	2.3	--	--
1/ N3	Dalby	CW	Sept. 9, 1907	78	7.1	3.8	38	2	9.1	--	41	31	39	--	--	--	230	34	--	2.7	0	--
1/ N5	Hughes	CW	Sept. 12, 1907	21	4.9	4.4	3	3	12	--	18	25	5.2	--	0	--	86	30	--	.2	0	--
1/ N6	Thrasher	QC	Nov. 15, 1907	23	11	8.5	13	--	12	--	41	1.9	5.5	--	1.0	--	112	63	--	0.8	0	--
1/ P1	Soda	Og	May 4, 1936	--	24	53	*506	--	--	--	690	393	285	--	--	--	1,607	286	--	13	5.7	--
1/ P2	Sulphur	Eh	do.	--	--	--	--	--	--	--	427	211	148	--	--	--	839	--	--	--	--	--
1/ P3	Mustang	Eh	Apr. 17, 1936	--	--	--	--	--	--	--	244	532	615	--	--	--	1,917	--	--	--	--	--
1/ P6	Greene	Og, SR	Dec. 20, 1943	--	63	21	* 16	--	--	--	253	29	25	--	6.9	--	244	--	--	.4	0	--
1/ S8	Hynson	QC	Feb. 3, 1908	78	9.8	16	11	5	40	--	--	239	14	--	.06	--	435	90	--	.6	--	56
1/ V2	Santa Rosa	Ep	Dec. 14, 1949	27	212	91	*452	--	--	0.50	285	894	510	--	3.0	--	2,330	903	7.4	13	0	--
1/ W2	Seven	Ep	May 21, 1940	--	71	21	* 16	--	--	--	238	51	30	--	<20	--	314	263	--	1.7	0	68

See footnotes at end of table.

Table 2.--Selected Chemical Analyses of Spring Waters--Continued

Spring	Name	Aquifer	Date of Collection	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Boron (B)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Total dissolved solids	Total hardness as $CaCO_3$	pH	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Temperature (°F)
1/ W3	Dove Creek	Ep	Aug. 7, 1940	--	70	14	* 11	--	--	--	268	12	18	0.4	<20	--	257	234	--	1.3	0	--
			Apr. 1, 1965	16	77	16	* 17	--	--	--	293	15	21	0.5	10	--	316	258	7.6	0.9	0	68
1/ W5	Anson	Ep	Aug. 20, 1940	--	60	17	* 31	--	--	--	287	<10	27	.4	<20	--	289	220	--	4.0	.2	--
			July 12, 1970	15	88	18	* 35	--	--	--	312	11	66	.3	7.5	--	394	297	7.3	1.0	0	--
1/ W6	Lipan	Ep	Oct. 15, 1940	--	80	20	* 13	--	--	--	293	31	28	.1	<20	--	316	283	--	.4	0	68
1/ W7	Kickapoo	Ep	Oct. 18, 1940	--	76	22	* 23	--	--	--	299	<10	21	.1	<20	--	292	278	--	1.9	0	69
1/ X2	Hall	oth	Oct. 24, 1938	--	--	--	--	--	--	--	275	11	13	--	<20	--	261	--	--	--	--	72
			Sept. 13, 1971	13	104	23	8	1	<.02	.1	405	9	11	.2	8.0	<1.0	376	353	7.6	.16	0	73
1/ X3	Richland	oth	Oct. 10, 1938	--	104	20	* 27	--	--	--	403	15	39	--	<20	--	403	343	--	.6	0	73
			May 3, 1971	--	108	21	* 44	--	<.02	--	405	15	57	.7	5.5	--	650	337	7.4	1.1	0	73
1/ X4	Baker	ES	Oct. 5, 1938	--	111	18	* 36	--	--	--	390	12	67	--	<20	--	440	351	--	.8	0	72
			Sept. 13, 1971	11	99	22	46	2	<.02	.02	387	10	70	.3	5.5	<1.0	456	339	7.7	1.1	0	72
1/ X5	Fleming	ES	Nov. 14, 1938	--	--	--	--	--	--	--	--	11	7	--	<20	--	--	--	--	--	--	71
			Sept. 12, 1971	11	92	37	4	1	<.02	<.1	426	8	6	<.1	7	<1.0	375	384	7.6	.1	0	72
1/ X6	Bogard	oth	Nov. 15, 1938	--	105	24	* 7	--	--	--	390	15	28	--	<20	--	371	360	--	.2	0	71
1/	Hart	oth	do.	--	--	--	--	--	--	--	427	15	14	--	<20	--	393	--	--	--	--	71
			Sept. 14, 1971	12	110	22	8	1	<.02	.1	423	9	11	.1	5.5	<1.0	387	368	7.5	.2	0	72
1/ X7	Sloan	oth	July 20, 1938	--	--	--	--	--	--	--	451	8	6	--	<20	--	391	--	--	--	--	72
			Sept. 14, 1971	11	97	30	5	1	<.02	<.1	423	6	6	.1	6.0	<1.0	370	365	7.6	.1	0	72
1/ X8	Turkey Roost	oth	Dec. 19, 1938	--	--	--	--	--	--	--	336	9	5	--	<20	--	296	--	--	--	--	69
			Sept. 12, 1971	17	65	28	8	2	.13	.1	276	42	15	.2	< .4	<1.0	313	280	7.9	.2	0	69
1/ X9	Deep Creek	ES	Nov. 29, 1938	--	--	--	--	--	--	--	445	11	8	--	<20	--	393	--	--	--	--	70
			Sept. 12, 1971	12	73	31	5	1	.04	<.1	362	6	7	<.1	3.0	<1.0	316	312	7.7	.1	0	73
1/ X10	Sycamore	ES	Nov. 29, 1938	--	67	32	* 3	--	--	--	329	19	10	--	<20	--	297	300	--	.1	0	71
			Sept. 14, 1971	17	46	32	13	2	.1	<.1	281	14	21	.2	1.5	<1.0	285	246	7.9	.3	0	73
1/ X11	Wallace Creek	ES	Sept. 29, 1938	--	94	--	* 38	--	--	--	451	8	10	--	<20	--	376	394	--	1.1	2.8	70
			Sept. 13, 1971	15	89	40	4	1	<.02	.1	448	5	6	.1	6.0	<1.0	386	387	7.9	.1	0	69
1/ X12	San Saba	oth	July 19, 1938	--	109	32	* 90	--	--	--	451	8	156	--	<20	--	619	405	--	2.0	--	71
			Jan. 8, 1971	--	110	32	* 85	--	.10	--	449	12	147	<.1	4.5	--	616	407	7.1	1.8	0	72
1/ X13	Barnett	ES	Oct. 7, 1938	--	--	--	--	--	--	--	479	8	10	--	<20	--	403	416	--	--	--	[illegible]
			Sept. 13, 1971	13	86	23	6	1	<.02	.1	353	9	9	.1	4.5	<1.0	326	310	7.6	.2	0	71
1/ X14	Parker	oth	July 20, 1938	--	114	31	--	--	--	--	476	12	10	--	<20	--	402	414	--	--	0	74
1/	Brister	oth	Aug. 29, 1938	--	68	30	--	--	--	--	317	11	14	--	<20	--	279	293	--	--	0	[illegible]
	Parker	oth	Sept. 13, 1971	12	107	34	6	1	--	.1	481	5	7	.1	3.0	<1.0	412	407	7.6	.1	0	[illegible]
1/ X15	Swimming Pool	oth	May 14, 1942	--	142	54	*447	--	--	--	359	32	865	--	0	--	1,870	576	--	7.5	0	71
			Sept. 17, 1971	10	124	45	253	9	--	.3	351	25	530	.2	< .4	<1.0	1,170	497	7.4	5.0	0	72
1/ X16	Sulfur	ES	Mar. 6, 1939	--	184	46	*812	--	--	--	451	27	1,430	--	<20	--	2,720	649	--	14.1	0	[illegible]
			Sept. 16, 1971	12	158	51	530	16	.04	.4	450	27	970	.2	< .4	<1.0	1,990	600	7.2	10	0	[illegible]
1/ X17	Gorman	ES	Oct. 29, 1938	--	--	--	--	--	--	--	366	7	9	--	<20	--	327	--	--	--	--	[illegible]
			Sept. 14, 1971	13	77	28	5	1	--	<.1	349	8	8	<.1	4	<1.0	316	307	7.6	.1	0	71
1/ X19	Post Oak	ES	Jan. 6, 1939	--	89	35	* 1	--	--	--	421	13	8	--	<20	--	353	367	--	0	0	69
			Sept. 14, 1971	13	60	37	4	1	--	<.1	350	6	6	<.1	2.5	<1.0	302	302	8.0	.1	0	70
1/ X20	Jennings	ES	Feb. 26, 1939	--	--	--	--	--	--	--	305	19	17	--	<20	--	306	--	--	--	--	69
			Sept. 14, 1971	10	80	41	4	<1	--	<.1	423	6	6	.1	4.0	<1.0	359	367	7.6	.1	0	70
X22	Hancock	oth	Jan. 15, 1971	--	25	15	* 48	--	<.02	--	88	17	98	.3	< .4	--	291	125	8.3	1.9	0	--
Z1	Elkhart Creek	Sp	Sept. 15, 1965	17	4.2	1.8	* 12	--	†.33	--	20	4.6	16	.1	1.0	--	67	20	6.2	1.2	0	76
Z2	Hays Branch	Sp	Sept. 16, 1965	--	--	--	--	--	--	--	--	--	--	--	--	--	42	--	--	--	--	80
Z3	Caney Creek	Sp	do.	15	3.0	1.1	5	2	.39	--	16	3.8	5.2	.1	1.8	--	45	12	6.4	.6	0	77
1/ Z5	Castalian	QC	Feb. 3, 1908	50	6.2	.3	32	6	8	--	46	50	14	--	.06	--	180	17	--	1.0	.5	--
1/			Apr. 21, 1936	--	--	--	* 15	--	--	--	18	--	12	--	--	--	36	--	--	--	--	--

See footnotes at end of table.

Table 2.--Selected Chemical Analyses of Spring Waters--Continued

Spring	Name	Aquifer	Date of Collection	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Boron (B)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Total dissolved solids	Total hardness as $CaCO_3$	pH	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Temperature (°F)
1/ 1/ Z6	Nacogdoches	Sp	Sept. 19, 1907 Sept. 22, 1936	21 --	3 4	1.4 6	* 12 --	-- --	0.7 --	-- --	16 12	1.5 <10	4.5 13	-- --	1.8 --	-- --	48 29	14 34	-- --	0.4 --	0 0	-- 74
1/ Z7	Red	CW	Sept. 19, 1907	64	126	96	273	9	11	--	0	564	443	--	0	--	1,620	700	--	1.2	0	--
1/	White	CW	Oct. 6, 1936	--	28	7	* 85	--	--	--	85	15	142	--	--	--	319	100	--	2.9	0	72
1/ CC1	Saragosa	Ep	Dec. 7, 1930 Apr. 28, 1971	-- 28	272 237	102 90	*584 560	-- 19	-- --	-- 0.6	332 322	868 840	842 760	-- 2.2	5.0 2.7	-- <0.2	2,840 2,700	1,100 960	-- 7.6	6.1 7.7	0 0	68 52
1/ CC2	Sandia	Ep	Nov. 13, 1931 Apr. 28, 1971	-- 25	200 202	81 88	*463 444	-- 23	-- --	-- .5	222 281	705 680	655 630	-- 2.1	-- 2.7	-- .3	2,215 2,240	832 870	-- 8.1	5.4 6.6	0 0	64 52
1/ CC3	Giffin	Ep	Dec. 6, 1930 Apr. 28, 1971	19 18	189 192	80 81	*437 430	-- 17	-- --	-- .5	284 276	635 650	608 610	-- 1.9	-- < .4	-- < .2	2,098 2,140	800 810	-- 7.3	6.8 6.8	0 0	78 79
1/ CC4	San Solomon	Ep	Oct. 28, 1930 Apr. 28, 1971	-- 19	190 196	80 87	*448 437	-- 19	.04 .04	-- .6	286 278	651 680	610 630	-- 2.0	.9 2	-- < .2	2,196 2,210	803 850	-- 7.4	14 6.6	0 0	78 76
1/ CC5	Phantom Lake	Ep	Oct. 28, 1930 Apr. 28, 1971	19 16	191 192	86 91	*473 467	-- 19	-- --	-- .5	285 278	691 680	655 650	-- 2.2	.55 < .4	-- < .2	2,309 2,250	830 850	-- 7.4	6.9 6.9	0 0	71 78
1/ CC10	Pena Colorado	oth	Mar. 12, 1957	10	60	48	* 92	--	--	--	374	166	42	2.2	1.8	--	606	347	8.1	2.1	0	57
1/ CC12	Comanche	Ep	Apr. 7, 1932 May 20, 1958	22 23	138 144	54 52	256 252	13 --	.05 --	-- .37	271 247	393 420	358 330	-- --	.8 6.5	-- --	1,370 1,350	566 574	-- --	21 21	0 0	-- 76
1/ 1/ CC15	Tunas	Ep	Feb. 1, 1941 Dec. 16, 1949	22 18	140 133	48 53	183 *186	8 --	.05 --	-- --	276 277	342 360	250 249	.8 --	2.0 2.2	-- --	1,130 1,140	547 550	-- 7.3	15 15	0 0	-- --
DD3	T-5	Ep	Feb. 7, 1968	16	86	27	82	4	--	.13	218	171	111	.9	3.2	--	608	473	7.8	2.0	0	54
DD4	Cedar	Ep	Mar. 6, 1963	20	49	22	* 13	--	--	--	216	22	24	1.4	10	--	267	216	7.5	.3	0	--
1/ DD5	Richland	Ep	Aug. 21, 1918	--	213	32	--	--	--	--	204	461	--	--	--	--	--	660	--	--	0	--
1/ DD6	Wolf	Ep	do.	--	153	41	--	--	--	--	127	21	129	--	8.0	--	--	550	--	--	0	--
1/ DD8	Sweetwater	Ep	Feb. 7, 1968	18	93	20	52	3	--	--	250	111	74	.7	6.9	--	502	424	7.6	1.3	0	68
1/ DD9	Howard	Ep	May 18, 1939	--	76	19	* 3	--	--	--	--	15	21	.6	<20	--	274	267	--	.4	0	72
1/ DD10	Tardy	Ep	May 15, 1939 Feb. 6, 1968	-- 19	60 81	21 20	* 12 111	-- 2	-- --	-- --	268 226	12 45	22 206	.4 .3	<20 13	-- --	259 608	238 384	-- 7.5	-- 2.9	-- --	-- 72
1/ DD11	Cox	Ep	Apr. 26, 1939	--	79	25	* 96	--	--	--	195	111	166	--	<20	--	573	300	--	11	0	73
1/ DD13	Pecan	Ep	June 13, 1939 May 27, 1971	-- 2	76 35	13 16	* 5 9	-- <1	-- .06	-- .1	281 172	10 8	10 15	.3 .4	<20 .4	-- .1	252 170	243 154	-- 7.5	.2 .34	0 0	71 72
1/ DD14	Hudspeth	Ep	Aug. 20, 1934 May 27, 1971	-- 16	75 72	13 15	* 9 8	-- <1	-- .06	.09 .1	286 270	13 10	15 12	-- .4	Trace 7.5	-- .2	268 274	241 243	-- 7.5	.3 .26	0 0	-- 72
DD15	Government	Ep	Jan. 12, 1965	15	77	20	* 13	--	--	--	322	11	17	.4	3.8	--	315	274	7.5	1.5	0	--
1/ DD17	Hackberry	Ep	Feb. 9, 1939	--	56	15	* 19	--	--	--	232	11	27	--	<20	--	242	199	--	2.3	0	--
1/ EE1	Wilkinson	Ep	Aug. 18, 1942	15	62	20	* 9	--	--	--	288	21	12	.2	.5	--	278	236	7.9	.2	0	--
EE6	Coleman	Ep	Aug. 25, 1966	14	72	16	6	1	--	--	278	7.6	11	.2	8.7	--	304	246	7.2	.2	0	--
1/ EE9	Seven Hundred	Ep	Dec. 29, 1938	--	74	15	* 5	--	--	--	275	15	11	0	<20	--	256	244	--	.1	0	--
1/ EE10	Tanner	Ep	do.	--	73	13	* 12	--	--	--	281	13	11	--	<20	--	267	238	--	.3	0	70
EE13	Pluenneke	ES	Jan. 20, 1962	--	--	--	--	--	--	--	284	--	36	--	--	--	314	272	7.6	--	--	45
1/ EE14	Gamel	Hi	Feb. 10, 1940	--	66	33	* 5	--	--	--	342	<10	13	--	<20	--	299	300	--	.1	0	--
EE15	Kothman	ES	Jan. 20, 1962	--	--	--	--	--	--	--	284	--	21	--	--	--	286	276	7.5	--	--	51
1/ EE18	Lange	Ep	Mar. 4, 1936	--	--	--	--	--	--	--	270	<10	50	--	--	--	303	--	--	--	--	--
EE19	Ellebracht	Ep	Mar. 15, 1965	--	--	--	--	--	--	--	268	--	19	--	--	--	265	240	7.8	--	--	73
EE20	Fish and Wildlife	Ep	do.	12	68	14	5	1	--	--	268	4.6	7.9	.2	4.2	--	248	235	7.2	.1	0	70
EE21	Bear Creek	Ep	Mar. 16, 1965	--	--	--	--	--	--	--	224	--	11	--	--	--	245	232	7.5	--	--	--

See footnotes at end of table.

Table 2.--Selected Chemical Analyses of Spring Waters--Continued

Spring	Name	Aquifer	Date of Collection	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Boron (B)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Total dissolved solids	Total hardness as $CaCO_3$	pH	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Temperature (°F)
EE22	Honey Creek	Ep	Mar. 16, 1965	--	--	--	--	--	--	--	276	--	13	--	--	--	260	250	7.8	--	--	68
EE23	Mystic	Ep	do.	--	--	--	--	--	--	--	282	--	8.5	--	--	--	250	241	7.8	--	--	--
EE24	Tegener Creek	Ep	do.	--	--	--	--	--	--	--	284	--	16	--	--	--	265	264	8.0	--	--	70
EE25	Kelly Creek	Ep	do.	--	--	--	--	--	--	--	318	--	15	--	--	--	290	292	7.8	--	--	--
EE26	Colbath	Ep	Mar. 24, 1965	--	--	--	--	--	--	--	267	--	19	--	--	--	265	317	7.6	--	--	70
EE27	Indian Creek	Ep	do.	--	--	--	--	--	--	--	281	--	16	--	--	--	275	266	7.6	--	--	--
EE28	Goat Creek	Ep	do.	--	--	--	--	--	--	--	272	--	22	--	--	--	275	269	8.0	--	--	--
EE29	Henderson Branch	Ep	Mar. 16, 1965	--	--	--	--	--	--	--	268	--	18	--	--	--	265	252	7.8	--	--	--
EE30	Fall	Ep	do.	--	--	--	--	--	--	--	250	--	26	--	--	--	260	251	7.9	--	--	--
EE31	Reid	Ep	Mar. 24, 1965	--	--	--	--	--	--	--	248	--	21	--	--	--	250	261	7.5	--	--	68
EE32	Cypress Creek	Ep	Mar. 25, 1965	--	--	--	--	--	--	--	280	--	26	--	--	--	300	310	7.7	--	--	54
1/ EE36	Heck	ES	Sept. 27, 1938	--	69	51	* 12	--	--	0.1	473	6	10	--	<20	--	390	381	--	.3	.1	70
			Sept. 16, 1971	8	83	46	5	1	--	0.1	453	9	7	.1	10	<1.0	392	398	7.4	.1	0	70
1/ EE37	Boiling	ES	Jan. 4, 1939	--	94	39	* 5	--	--	--	464	11	9	--	<20	--	386	394	--	.1	0	68
EE38	Holland	Tr	July 26, 1961	11	96	43	* 21	--	.12	--	454	15	30	.1	21	--	504	418	7.3	.5	0	--
			Sept. 15, 1971	2	38	41	19	2	--	.1	268	28	36	.2	.4	<1.0	298	265	8.3	.5	0	72
EE39	Ebeling	ES	Sept. 16, 1971	13	92	40	15	1	--	.1	437	17	27	.3	7.0	<1.0	427	395	7.6	.4	0	72
EE40	Rocky Creek	ES	May 17, 1962	13	53	34	* 18	--	--	--	240	64	31	.5	3.2	--	335	348	7.6	.5	0	78
1/ EE41	Kock	Ep	May 20, 1941	--	105	22	* 29	--	--	--	329	31	56	.3	46	--	451	354	--	1.2	0	--
1/ EE43	Jacob's Well	Ep	Oct. 28, 1937	--	94	17	--	--	--	--	329	11	15	<20	--	--	303	306	--	--	0	--
1/ EE44	Buffalo	oth	July 22, 1941	--	122	17	* 9	--	--	--	409	15	28	--	7.0	--	399	375	--	.2	0	--
1/ EE45	Crofts	ES	Aug. 4, 1938	--	105	41	* <5	--	--	--	470	12	19	2.5	.2	--	411	430	--	.1	0	--
			May 28, 1969	--	88	30	--	--	--	--	432	19	29	--	--	--	--	380	7.3	--	.2	69
EE46	Hobbs	ES	May 27, 1969	--	86	27	--	--	--	.05	368	16	14	--	--	--	--	322	8.3	--	0	--
FF2	Berry	Eb	Mar. 17, 1964	6.2	73	13	* 12	--	--	--	248	24	16	.4	11	--	278	268	7.6	.3	0	63
FF3	Manske Branch	Eb	do.	4.2	70	2.3	* 10	--	--	--	182	26	14	.5	11	--	227	220	7.5	.3	0	75
FF4	Mormon	Eb	Feb. 6, 1973	7	122	22	* 18	--	--	.2	375	48	40	.3	15	--	456	396	7.8	.4	0	72
2/ FF5	Power House	Eb	Mar. 14, 1896	--	--	--	--	--	--	--	--	--	28	--	.13	--	298	106	--	--	--	--
FF6	Seiders	Eb	Mar. 30, 1973	0	53	14	* 42	--	.04	.1	96	82	75	.7	7.0	--	330	191	8.5	1.5	0	[illegible]
2/ FF7	Cold	Eb	Mar. 21, 1896	--	--	--	--	--	--	--	--	--	34	--	1.75	--	330	180	--	--	--	
			June 16, 1972	12	73	38	* 34	--	--	--	339	45	58	.4	7.0	--	434	340	7.5	.8	0	
2/ FF8	Barton	Eb	Mar. 14, 1896	--	--	--	--	--	--	--	--	--	22	--	.67	--	325	94	--	--	--	
			June 14, 1941	10	80	20	* 4	--	.04	--	302	16	18	--	1.5	--	321	282	--	.4	0	
			Feb. 6, 1973	7	82	19	* 12	--	.02	.1	298	25	22	.2	5.5	--	319	282	7.8	.3	0	[illegible]
1/ FF9	Wilson	oth	Feb. 8, 1941	--	99	11	* 16	--	--	--	244	26	37	.2	59	--	368	292	--	.5	0	
1/ FF10	Manchaca	oth	Feb. 17, 1941	--	87	2	* 19	--	--	--	256	22	13	--	22	--	291	227	--	.5	0	[illegible]
			Sept. 3, 1971	18	94	11	74	2	1.0	.4	329	89	46	.7	12	<1.0	510	282	7.9	2.0	0	[illegible]
1/ FF11	Burleson	CW	Aug. 23, 1949	24	94	8.6	* 18	--	--	--	298	29	23	.0	3.8	--	348	270	8.2	.5	0	[illegible]
1/ FF12	Knight	Ep	July 3, 1940	--	66	17	* 56	--	--	--	354	12	36	--	<20	--	366	236	--	1.5	[illegible]	
			Mar. 16, 1964	--	--	--	--	--	--	--	316	--	14	--	--	--	303	284	7.1	--	--	
FF13	Indian	Al	June 8, 1971	22	95	5	* 22	--	--	--	282	17	15	.1	12	--	363	256	7.4	.4	0	70
1/ FF15	Kallum		Dec. 11, 1942	--	45	1.9	*140	--	--	--	92	179	116	--	0	--	527	121	--	5.5	0	--
1/ FF16	Piedmont	oth	Dec. 8, 1942	--	233	27	*213	--	--	--	305	340	390	0	0	--	1,353	691	--	3.6	0	--
			Nov. 5, 1970	89	230	25	200	25	0	.05	124	620	300	.1	0	--	1,500	680	6.7	3.3	0	72

See footnotes at end of table.

Table 2.--Selected Chemical Analyses of Spring Waters--Continued

Spring	Name	Aquifer	Date of Collection	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Boron (B)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Total dissolved solids	Total hardness as $CaCO_3$	pH	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Temperature (°F)
[2] FF19	Santa Monica	Ep	May 26, 1896	2	260	130	780	30	5.0	--	310	1,640	670	--	--	--	3,710	--	--	9.8	0	--
[1] GG2	Cold	GC	Oct. 23, 1941 Apr. 7, 1966	12 17	4.2 3.0	2.0 1.3	* 1 7	-- 1	.16 .19	-- .02	6 8	3 .4	8 9.0	.3 .1	5 9.6	-- --	39 52	22 13	-- --	.3 .8	0 0	68 68
[1] JJ3	Boquillas Warm	Ep	June 10, 1936 Apr. 29, 1971	-- 23	120 135	-- 39	85 95	-- 4	-- .24	-- .4	275 272	375 365	68 70	1.8 2.1	.7 <.4	-- <.2	868 870	532 499	-- 7.2	2.9 1.9	0 0	105 104
[1] KK1	Dead Man	Ep	Mar. 15, 1934	--	76	14	* 8	--	--	--	226	2.3	20	--	11	--	265	247	--	1.3	0	72
KK3	Finegan	Ep	Sept. 12, 1966 May 25, 1971	10 14	69 67	13 15	8 7	1 <1	-- --	-- .1	256 259	7.2 7	14 12	-- .3	11 8	-- .3	272 257	176 230	8.0 7.6	.2 .21	0 0	-- 73
[1] KK4	Dolan	Ep	June 22, 1939 May 25, 1971	-- 14	73 67	14 14	* 6 7	-- <1	-- .02	-- .1	281 256	<10 7	9 13	.4 .3	<20 7.6	-- .1	248 256	239 227	-- 7.7	.2 .21	0 0	72 72
[1] KK5	Gillis	Ep	July 18, 1939 May 26, 1971	-- 14	65 61	12 13	* 8 7	-- <1	-- --	-- .1	244 227	<10 8	11 10	.2 .4	<20 7	-- .1	231 232	213 206	-- 7.5	.2 .21	0 0	74 73
KK6	Slaughter Bend	Ep	do.	13	66	12	6	<1	--	.1	239	6	11	.3	8	.2	240	215	7.5	.19	0	73
[1] KK7	Goodenough	Ep	Nov. 2, 1933 Sept. 7, 1967	-- 13	69 74	21 13	13 10	7 2	-- --	.06 --	278 252	16 26	12 11	-- .5	1.1 6.4	-- --	279 280	258 238	-- 7.3	1.7 1.3	-- --	-- 72
[1] KK8	McKee	Ep	Apr. 10, 1939 Nov. 4, 1970	-- 14	88 120	9 9.2	* 9 12	-- 1	-- 0	-- .06	189 240	101 130	11 19	-- .4	20 7.1	-- --	311 431	255 340	-- 7.3	.2 .3	0 0	-- 66
[1] KK9	San Felipe	Ep	Apr. 27, 1933 Nov. 3, 1970	-- 12	88 75	11 6.8	6 5	14 1	-- .02	.08 .04	270 248	7.7 4.6	13 9.2	-- .2	11 7.5	-- --	286 244	265 220	-- 7.4	.4 .2	0 0	-- 64
[1] KK10	Cantu	Ep	Apr. 6, 1939 Nov. 3, 1970	-- 13	-- 94	-- 7.8	-- 18	-- 1	-- 0	-- .1	244 266	11 38	14 29	.1 .3	<20 8.0	-- --	244 340	-- 270	-- 7.4	-- .5	-- 0	75 65
[1] KK11	Mud	Ep	Nov. 8, 1939	16	80	7.2	* 1	--	--	--	253	4.4	8.0	--	10	--	257	230	--	.2	0	--
[1] KK12	Pinto	Ep	Oct. 4, 1939	22	85	3.6	* 4	--	--	--	261	6.3	9.0	--	3.6	--	271	227	--	.6	0	--
[1] KK13	Las Moras	Eb	Oct. 3, 1939 June 17, 1952	14 12	82 73	6.8 9.6	* 2 * 5	-- --	-- --	-- --	260 230	6.4 5.8	8.0 9.8	-- .2	8.2 17	-- --	263 253	233 222	-- --	.2 .1	0 0	-- --
[1] KK15	Kickapoo	Ep	Feb. 6, 1939	--	59	11	* 9	--	--	--	220	15	11	.1	<20	--	213	192	--	1.3	0	70
[1] KK16	Camp Wood	Ep	Oct. 6, 1954	15	56	14	6	1	0	.12	220	6.0	12	0	5.2	--	223	197	7.8	.3	0	75
[1] KK17	Paint Bluff	Ep	Jan. 23, 1939	--	52	6	* 7	--	--	--	183	9	7	.1	<20	--	171	154	--	.8	0	70
[1] KK18	Roberts	Ep	Jan. 20, 1939	--	54	10	* 4	--	--	--	201	11	7	0	<20	--	184	176	--	.4	0	70
[1] KK19	Pulliam	Ep	Jan. 16, 1939	--	46	7	* 13	--	--	--	177	11	12	--	<20	--	176	145	--	2.1	0	68
[1] KK20	McCurdy	Ep	Feb. 27, 1939	--	50	18	* 2	--	--	--	214	15	11	--	<20	--	201	201	--	.2	0	68
[1] LL3	Prade	Ep	Apr. 11, 1956	12	56	13	5	1	--	0	225	4.6	9.8	.2	4.8	--	220	192	8.0	.6	0	69
[1] LL4	Big	Ep	Apr. 3, 1956	13	66	20	5	1	--	--	302	3.7	7.5	--	1.4	--	266	246	7.7	.6	0	70
[1] LL11	Leona Group 1	Eb	Mar. 1, 1947	9.8	97	9.7	* 12	--	.06	--	298	29	19	.8	4.4	--	335	282	--	.3	0	--
[1] LL13	Leona Group 3	Eb	do.	--	100	11	* 8	--	--	--	304	30	20	--	3.5	--	331	294	--	.2	0	61
[1] LL14	Leona Group 4	Eb	do.	12	109	12	* 16	--	.01	--	334	32	33	0	1.2	--	388	322	--	.4	0	72
LL15	Lynx Haven	Ep	Mar. 15, 1965	11	72	20	5	1	--	--	314	4.6	8.4	.2	3.2	--	279	266	7.5	.1	0	68
LL16	Buffalo Creek	Ep	Mar. 16, 1965	--	--	--	--	--	--	--	247	--	8.4	--	--	--	220	218	7.9	--	--	--
LL17	Verde	Ep	Mar. 25, 1965	--	--	--	--	--	--	--	296	--	13	--	--	--	295	286	7.6	--	--	56
	Edge Falls	Ep	Aug. 3, 1965	14	102	16	9	1	.01	--	344	30	18	.1	8.8	--	368	320	7.0	.2	0	68
[1] LL21 [1]	Spring Branch	Ep	Nov. 20, 1936 Jan. 24, 1955	-- --	23 15	17 --	* 8 --	-- --	-- --	-- --	140 285	0 --	19 --	-- --	0 --	-- --	136 313	125 244	-- 8.1	1.3 --	0 --	70 52
[1] LL22	Honey Creek	Ep	July 19, 1944	--	107	7.8	* 9	--	--	--	352	4	16	--	4.5	--	322	299	--	1.0	0	69
[1] LL23	Rebecca	Ep	Oct. 7, 1943	--	84	24	* 11	--	--	--	352	17	16	--	3.8	--	329	308	--	1.3	0	70
[1] LL24	Wolle	Ep	Jan. 24, 1955	--	--	--	--	--	--	--	271	--	26	--	--	--	340	246	7.9	--	--	56

See footnotes at end of table.

Table 2.--Selected Chemical Analyses of Spring Waters--Continued

Spring	Name	Aquifer	Date of Collection	Silica (SiO_2)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Iron (Fe)	Boron (B)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Nitrate (NO_3)	Phos-phate (PO_4)	Total dis-solved solids	Total hardness as $CaCO_3$	pH	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Temper-ature (°F)
1/ LL25	Crane's Mill	Ep	Do.	--	--	--	--	--	--	--	292	--	23	--	--	--	360	268	7.6	--	--	--
1/ LL26	Bear	Ep	Sept. 29, 1943	--	80	21	* 6	--	--	--	325	8	14	--	5.2	--	294	286	--	.1	0	--
1/ LL28	Hueco	Eb	June 24, 1941	--	97	11	* 13	--	--	--	334	11	16	--	9.8	--	322	287	--	1.5	0	71
1/ LL29	Comal	Eb	May 25, 1934	--	--	--	--	--	--	--	268	30	12	--	--	--	--	264	--	--	--	74
			Aug. 7, 1951	13	74	17	7	0	.21	--	274	22	12	0	4.5	--	292	254	7.5	.8	0	74
LL30	Selma	Eb	Mar. 4, 1968	11	172	12	37	3	--	--	292	221	56	.5	6.2	--	633	717	7.4	.7	0	50
1/ LL36	Sutherland	CW	Aug. 13, 1936	--	60	12	* 69	--	--	--	18	219	74	--	--	--	443	197	--	1.5	0	--
			Mar. 6, 1968	16	14	2.1	200	4	--	--	468	33	46	.9	.2	--	546	44	7.9	13	6.8	63
1/ LL37	Bishop	Ep	Nov. 13, 1936	--	94	19	* 9	--	--	--	372	<10	18	--	--	--	323	312	--	.8	0	
1/ MM1	San Marcos	Eb	Oct. 4, 1937	--	90	15	* 17	--	--	--	268	22	51	--	--	--	335	284	--	1.9	0	72
1/			May 16, 1947	11	90	20	* 12	--	.05	--	234	19	22	.8	3.0	--	349	306	7.2	.3	0	72
MM2	Ewing	A1	May 5, 1964	21	102	7.2	* 39	--	--	--	308	20	33	.4	60	--	434	284	7.7	1.0	0	69
1/ MM3	Walnut	A1	June 15, 1936	--	105	17	* 32	--	--	--	299	28	88	--	--	--	417	330	--	.8	0	--
1/ NN1	Smith No. 2	GC	1906	12	98	84	416	Trace	5	--	651	76	640	--	--	--	2,008	590	--	7.2	0	--
1/	Smith No. 3	GC	do.	27	46	6.2	52	12	18	--	0	247	63	--	--	--	479	150	--	1.8	0	--
1/			June 17, 1941	--	51	25	* 97	--	--	--	79	18	248	.3	9	--	487	230	--	2.7	0	--

* Sodium and potassium calculated as sodium (Na).
† Includes 0.09 mg/l manganese.
1/ Analysis by U.S. Geological Survey.
2/ Analysis by The University of Texas.