TEXAS WATER DEVELOPMENT BOARD

REPORT 61

GROUND-WATER RESOURCES OF BROOKS COUNTY, TEXAS

By

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United States Geological Survey

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GROUND-WATER RESOURCES OF BROOKS COUNTY, TEXAS

ABSTRACT

The rock formations that contain fresh to slightly saline water (less than 3,000 parts per million dissolved solids) include, in order of decreasing age, the Oakville Sandstone, Lagarto Clay, Goliad Sand, Lissie Formation, Beaumont Clay, and windblown sand. All formations, except the Oakville and Lagarto, crop out in Brooks County. The formations consist principally of interbedded sand and clay deposits; the sand constitutes the principal aquifer in the county.

Precipitation on the outcrop of the formations is the primary source of recharge. The sandy soil which blankets most of the county facilitates the infiltration of rainfall, but extensive deposits of caliche near the surface prevent water from percolating deep into the ground. Consequently, much water is lost by evaporation. The ground water in the county moves eastward from areas of recharge to areas of discharge at about 35 feet per year.

A total of about 4,100 acre-feet per year, or about 3.7 mgd (million gallons per day), was pumped from wells in 1964 to supply the needs of Brooks County. The pumpage was about 1.2 mgd for public supply, 1.5 mgd for irrigation, 0.2 mgd for industrial use, and about 0.8 mgd for rural domestic and livestock needs.

Ground-water levels declined significantly from 1932-33 to 1964-65. The largest declines in water levels occurred in the north-central and northeastern parts of the county where the withdrawals for irrigation and public supply are large. At least 110 feet of decline occurred in the north-central part of the county in the 32-year period.

The chemical quality of the ground water is generally suitable for public supply, some industrial uses, supplemental irrigation, and rural domestic and livestock needs. Most of the water is hard, especially the relatively shallow water, but soft water may be obtained in places from the Oakville Sandstone in the southeastern part of the county. The dissolved-solids content of the water is rarely less than 500 ppm (parts per million), but water having less than 1,000 ppm dissolved solids is available in many places.

Additional ground water is available for development. At least 5 mgd, and probably several times more, of fresh to slightly saline water could be pumped perennially without depleting the supply. In addition to at least 5 mgd, about 11,000,000 acre-feet of water in transient storage is available for development at depths less than 400 feet below land surface. Withdrawals exceeding the

perennial yield could be made for several hundreds of years before the water in the upper 400 feet of sediments would be depleted.

Areas most favorable for development of additional supplies of ground water are from 3 to 10 miles southwest of Falfurrias where yields of more than 500 gpm (gallons per minute) are available. In much of the county, yields up to 500 gpm of water may be obtained. Ground water for rural domestic and livestock needs can be obtained in sufficient quantities almost everywhere in the county at depths ranging from about 100 feet on the west side of the county to about 400 feet on the east.

The use of unlined open surface pits for the disposal of oil-field salt water is a threat to the potable water supply, and contamination from this source is believed to be occurring. In 1961, slightly more than 1,200,000 barrels of salt water was placed in open surface pits in the county.

G R O U N D - W A T E R   R E S O U R C E S   O F

B R O O K S   C O U N T Y ,   T E X A S

INTRODUCTION

Purpose and Scope of Investigation

The purpose of the Brooks County investigation was to determine the occurrence, availability, dependability, quality, and quantity of the ground-water resources, particularly with reference to the sources of water suitable for public supply, irrigation, and industrial use. The results are presented in this report, which can be used as a guide in developing and obtaining maximum benefits from the available ground-water supplies.

The scope of the investigation included a determination of the location and extent of sand containing fresh to slightly saline water (less than 3,000 parts per million dissolved solids); the chemical quality of the water; the quantity of ground water being pumped and the effects these withdrawals have had on water levels and water quality; the hydraulic characteristics of the important water-bearing sands; and an estimate of the quantity of water available for development.

Methods of Investigation

To accomplish the main objectives of the investigation, the following detailed work was performed:

1. An inventory was made of 372 water wells and 17 oil tests (Table 5); locations of the wells are shown in Figure 14.

2. Drillers' logs of 24 wells were obtained (Table 6), and more than 640 electric logs were examined in order that the sand zones which comprise the aquifers could be defined.

3. An inventory was made of present and past ground-water pumpage (Table 4).

4. Pumping tests were made in six wells to determine the hydraulic characteristics of the aquifers.

5. Altitudes of wells were obtained from topographic maps and by instrumental leveling.

6. Measurements of water levels were made in wells, and previous measurements were compiled.

7. Climatological data were collected and compiled.

8. Samples of water from 81 water wells and 3 salt-water disposal pits were collected for chemical analysis. Previous analyses were compiled for comparison of quality-of-water changes (Table 7).

9. The hydrologic data were analyzed to determine the quality and quantity of water available for development.

10. Problems related to the development of the ground-water supplies in Brooks County were studied.

Previous Investigations

Prior to this investigation, few comprehensive studies had been made of the ground-water resources of Brooks County.

Taylor (1907, p. 7-9) briefly described wells in Hidalgo and Starr Counties, from which area Brooks County was later created. A report by Deussen (1926) describes the geology in general, but he had done no detailed work in Brooks County. An inventory of wells was made in 1932-33 by Turner and Cumley (1940); the report includes well data, chemical analyses of water, drillers' logs, and a map showing the locations of wells. Barnes (1940) discussed the water supply of Falfurrias. Ground-water conditions in the Premont-La Gloria-Falfurrias district were investigated by Cromack (1950); the report describes, in general, the source and quality of the ground water and the effects on water levels resulting from pumping. The public water supply of Falfurrias was included in an inventory of public water supplies in southern Texas by Broadhurst, Sundstrom, and Rowley (1950, p. 28-30). Wood (1956) determined the availability of ground water in the Gulf Coast region, which included a large part of Brooks County. A reconnaissance report on the ground-water resources of the Gulf Coast region, including Brooks County, was prepared by Wood, Gabrysch, and Marvin (1963).

Location and Physical Features

Brooks County, 904 square miles in area, is in the Gulf Coastal region of South Texas about 60 miles southwest of Corpus Christi (Figure 1). The surface is level to rolling, with a few small lakes and low sandy hills. The soil ranges in color from light to dark and is composed of sand and sandy loam. The vegetation consists of wild grasses, mesquite, catclaw, and prickly pear and other forms of cactus; this assemblage makes up what is known as chaparral brush. A few fairly large trees grow along the main streams; small live oak trees commonly grow in the area of sand dunes. Since 1950, extensive areas of brush have been cleared by means of chemical and mechanical processes. The principal physiographic feature in the area is the sand sheet that covers nearly the entire county. The sand sheet has a maximum thickness of about 60 feet and is made up of sand dunes and "blowouts." The dunes are not of great height, the maximum relief between the bottom of the "blowouts" and the top of the sand dunes being about 50 feet. In general, the dunes are fairly well stabilized by brush and vegetation except where cultivation keeps the topsoil loose.

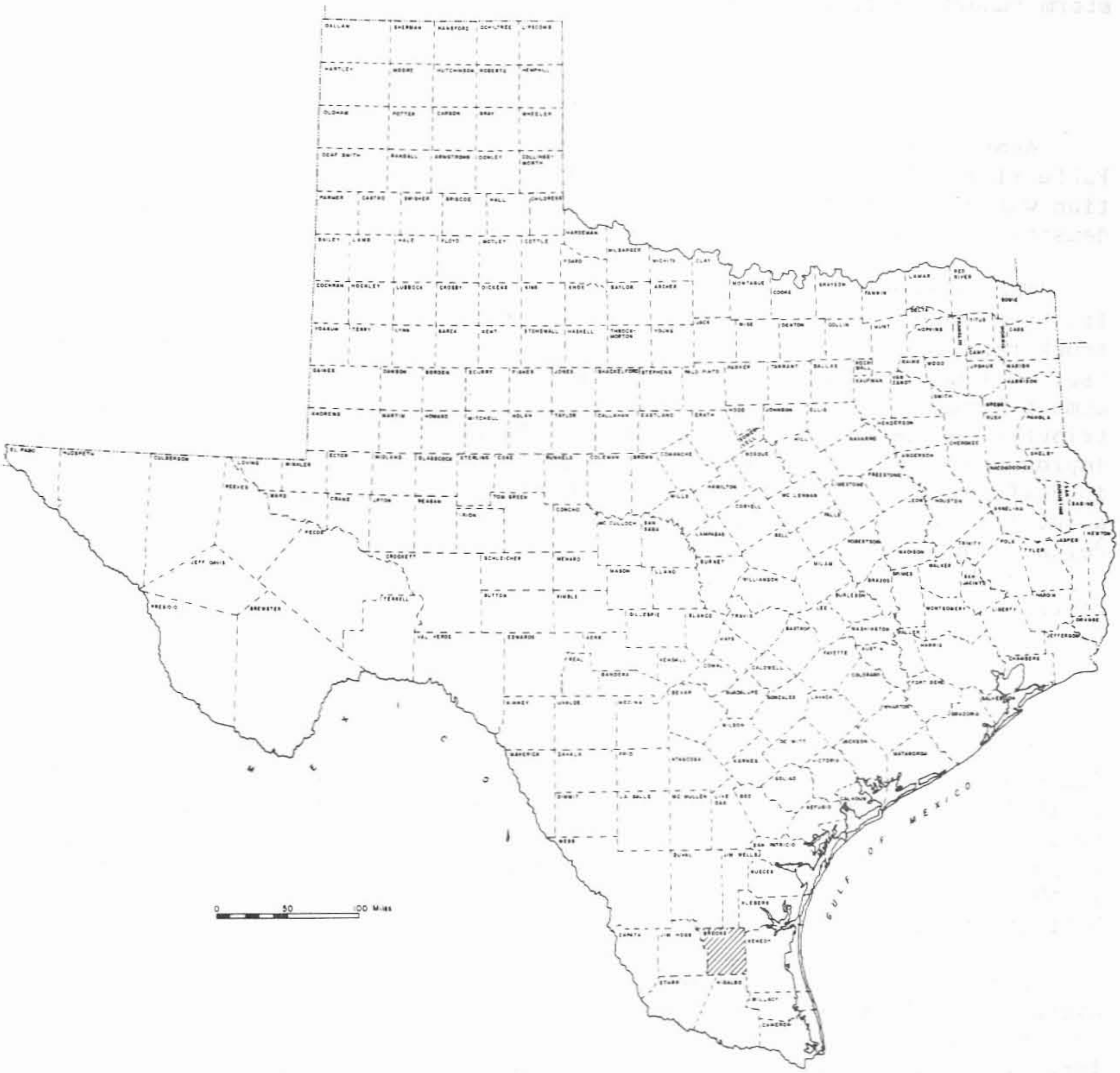


Figure 1

Index Map Showing Location of Brooks County

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

The county is drained principally by Palo Blanco Creek and Baluarte Creek, both of which empty into Laguna Salado, a shallow depression southeast of Falfurrias. Laguna Salado, in turn, is drained by a continuation of Palo Blanco Creek which crosses Kenedy County and empties into an arm of Baffin Bay, 15 miles east of Brooks County. The streams do not flow except during periods of storm runoff; and, as the topsoil is sandy, very little water runs off.

Population and Economy

Approximately 75 percent of the people in Brooks County reside in Falfurrias. The 1960 population of the county was 8,609, and the 1950 population was 9,195, a decrease of about 6.4 percent in this period. The population density in 1960 was 9.5 people per square mile.

The economy of the county depends on: the production of oil and gas, and its by-products; ranching; dairying, and the processing of milk products; and truck farming, including the raising of fruit. Grain sorghum is grown for local use. Oil has been produced since the early 1930's, and production had reached almost 4 million barrels per year by 1960. Large-scale ranching likewise contributes to the economy of the county. Residents of the area pioneered in the improvement and expansion of dairy herds and milk production. A large creamery in Falfurrias distributes dairy products throughout Texas. Falfurrias has about 100 business establishments, and their sales approximate 7-1/4 million dollars annually. Brooks County is served by one railroad and numerous highways which connect the county with large markets and afford excellent means for distribution of surplus produce.

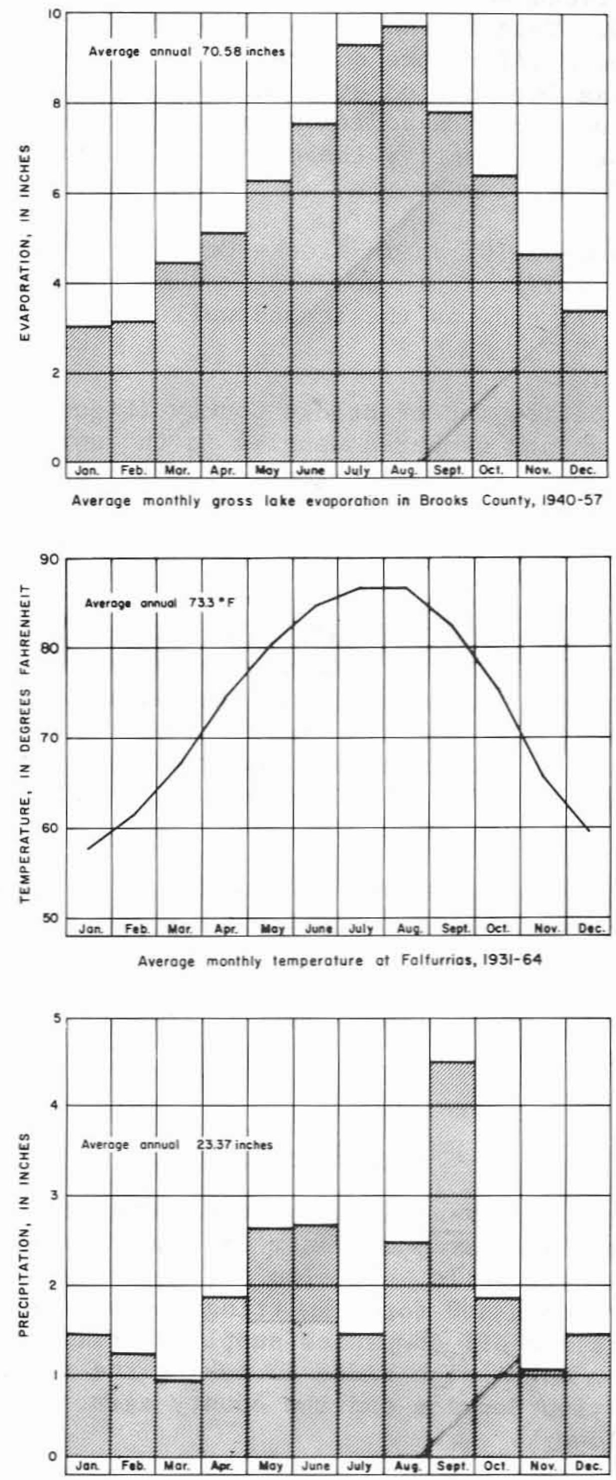
Climate

The climate in Brooks County is semiarid by Thornthwaite's (1941) classification. The average annual rainfall at Falfurrias was 23.37 inches from 1931 to 1964 (Figure 2). The rainfall was less than 20 inches during 9 of the 34 years of record and more than 30 inches during only 5 years. The average annual temperature at Falfurrias is 73.3°F (Figure 2). January, normally the coolest month, has an average temperature of 57.8°F; and July and August, normally the hottest, have an average temperature of 86.4°F.

Evaporation in Brooks County consumes a significant amount of water. The average annual gross lake evaporation of 70.58 inches is about three times more than the average annual precipitation. The average monthly evaporation is largest in one of the hottest months, August, and least in January and February (Figure 2).

Numbering Systems for Wells and Disposal Pits

The well-numbering system used in this report is one adopted by the Texas Water Development Board for use throughout the State and is based on longitude and latitude. Under this system, each 1-degree quadrangle in the State is given a number consisting of two digits. These are the first two digits appearing in the well number. Each 1-degree quadrangle is divided into 7-1/2 minute quadrangles which are also given 2-digit numbers from 01 to 64. These are the third and fourth digits of the well number. Each 7-1/2 minute



Average monthly gross lake evaporation in Brooks County, 1940-57

Average monthly temperature at Falfurrias, 1931-64

Average monthly precipitation at Falfurrias, 1931-64

Figure 2

Average Monthly Precipitation and Temperature at Falfurrias and Average Monthly Gross Lake Evaporation in Brooks County

(From records of U. S. Weather Bureau and Lowry, 1960)

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quadrangle is subdivided into 2-1/2 minute quadrangles and given single digit numbers from 1 to 9. This is the fifth digit of the well number. Finally, each well within the 2-1/2 minute quadrangle is given a 2-digit number in the order in which it was inventoried starting with 01. These are the last two digits of the well number. In addition to the 7-digit well number, a two-letter prefix is used to identify the county in which the well is located. The prefix for Brooks County is BP.

Thus, well BP-84-63-702 is in Brooks County in the 1-degree quadrangle numbered 84, in the 7-1/2 minute quadrangle numbered 63, in the 2-1/2 minute quadrangle numbered 7, and was the second well inventoried in the 2-1/2 minute quadrangle.

On the well-location map of Brooks County (Figure 14), the 7-1/2 minute quadrangles are shown and numbered usually in the northwest corner of each quadrangle. Also shown are the 1-degree quadrangles indicated by the large double-lined numbers 83, 84, 87, and 88. The 3-digit number shown with the well symbol contains the number of the 2-1/2 minute quadrangle and the well number within that quadrangle.

The numbering system for the salt-water disposal pits is an abbreviated form of the State well-numbering system, the pit numbers consisting of only five digits and an alphabetical prefix. The first four digits continue to signify the numbers of the 1-degree and the 7-1/2 minute quadrangles in the State. The fifth digit indicates the number of the pit in the order in which the pit was inventoried in the 7-1/2 minute quadrangle. The two-letter prefix, as in the well number, identifies the county.

For example, pit number BP-84-54-1 is in the 1-degree quadrangle number 84, in the 7-1/2 minute quadrangle 54, and was the first pit inventoried in that 7-1/2 minute quadrangle.

Table 1 shows the well numbers used in this report and the corresponding numbers previously published.

Acknowledgments

The authors gratefully acknowledge the cooperation of the many landowners and the city officials in Brooks County for their assistance in supplying information about their wells, and also for allowing access to their wells for water-level measurements and for permitting use of wells for pumping tests. Water well drillers and oil companies supplied drillers' logs, electric logs, and well-completion data which aided in making the report more complete. The U.S. Soil Conservation Service and the county agents gave supporting data which expedited the fieldwork.

GEOLOGY

The rock formations that contain fresh to slightly saline water are sedimentary deposits of Tertiary and Quaternary age. They include, in order of decreasing age, the Oakville Sandstone, Lagarto Clay, Goliad Sand, Lissie Formation, Beaumont Clay, and Recent windblown sand (Table 2). All formations, except the Oakville and the Lagarto, crop out in Brooks County.

Table 1.--Well numbers used in this report and corresponding numbers in report by Turner and Cumley (1940)

New number	Old number	New number	Old number	New number	Old number	New number	Old number
BP-84-45-801	1	BP-84-55-106	205	BP-84-56-106	457	BP-84-62-101	84
84-45-902	3	84-55-107	214	84-56-204	504	84-62-102	85
84-47-706	201	84-55-207	272	84-56-205	470	84-62-203	168
84-47-808	254	84-55-208	266	84-56-206	404	84-62-302	181
84-47-909	253	84-55-210	214	84-56-207	471	84-62-401	652
84-48-705	373	84-55-211	203	84-56-208	379	84-62-402	658
84-53-101	4	84-55-213	271	84-56-209	405	84-62-502	663
84-53-102	5	84-55-214	316	84-56-210	463	84-62-503	185
84-53-103	6	84-55-304	270	84-56-211	474	84-62-602	183
84-53-304	14	84-55-311	265	84-56-212	399	84-62-701	659
84-53-305	151	84-55-312	311	84-56-303	551	84-62-801	664
84-53-306	51	84-55-313	390	84-56-304	552	84-62-901	186
84-53-601	52	84-55-314	331	84-56-305	554	84-63-201	178
84-53-602	53	84-55-401	206	84-56-404	477	84-63-305	613
84-53-603	54	84-55-402	207	84-56-405	498	84-63-307	612
84-53-803	66	84-55-405	169	84-56-406	487	84-63-308	177
84-53-902	74	84-55-501	211	84-56-407	489	84-63-501	189
84-54-102	15	84-55-502	212	84-56-509	497	84-63-601	190
84-54-203	154	84-55-503	217	84-56-602	557	84-63-602	631
84-54-302	155	84-55-602	337-A	84-56-604	559	84-63-603	632
84-54-303	156	84-55-603	340	84-56-802	558	84-63-606	751
84-54-404	159	84-55-609	342	84-56-803	618	84-63-803	189
84-54-405	166	84-55-610	223	84-56-804	562	84-63-901	633
84-54-503	160	84-55-611	481	84-56-902	561	84-64-101	616
84-54-601	164	84-55-612	482	84-56-903	604	84-64-201	567
84-54-602	88	84-55-702	170	84-61-201	70	84-64-202	564
84-54-801	167	84-55-804	175	84-61-401	64	84-64-303	565
84-54-805	89	84-55-901	226	84-61-503	65	84-64-304	570
84-54-901	91	84-55-902	221	84-61-504	71	84-64-401	752
84-54-902	93	84-56-103	377	84-61-505	72	84-64-501	568
84-54-903	171	84-56-104	378	84-61-601	653	84-64-601	569
84-55-105	202	84-56-105	397	84-61-602	651	84-64-602	760

Table 1.--Well numbers used in this report and corresponding numbers in report by Turner and Cumley (1940)--Continued

New number	Old number	New number	Old number	New number	Old number	New number	Old number
BP-84-64-803	754	BP-87-06-606	832	BP-87-07-609	921	BP-87-14-602	971
84-64-901	761	87-06-701	668	87-07-702	865	87-14-603	973
87-05-301	657	87-06-702	667	87-07-705	882	87-14-703	955
87-05-302	654	87-06-703	666	87-07-801	885	87-14-801	956
87-05-601	662	87-06-704	670	87-07-904	715	87-15-101	879
87-05-602	811	87-06-802	672	87-08-301	762	87-15-102	981
87-05-901	812	87-06-805	839	87-08-502	766	87-15-401	983
87-05-902	813	87-07-202	705	87-08-503	765	87-15-501	982
87-06-101	660	87-07-301	755	87-08-601	768	87-15-601	992
87-06-201	827	87-07-403	707	87-13-602	954	87-16-102	991
87-06-301	704	87-07-404	856	87-14-101	670	87-16-401	994
87-06-401	661	87-07-405	858	87-14-202	951	87-16-501	997
87-06-502	828	87-07-503	708	87-14-203	952	87-16-601	996
87-06-604	835	87-07-605	918	87-14-301	874		
87-06-605	830	87-07-606	919	87-14-302	842		

All of the formations containing fresh to slightly saline water in Brooks County are considered to be part of the principal (Gulf Coast) aquifer. The formations are composed of non-marine sand and sandstone interbedded with clay. The sedimentary rocks become finer grained and some beds of sand grade into clay toward the coast. Correlation of individual sand or clay beds is difficult even over short distances because of the heterogenous character of the sedimentary rocks. Because the character of much of the sedimentary rocks comprising the Goliad Sand, Lissie Formation, Beaumont Clay, and windblown sand have similar electrical properties, the geologic sections (Figures 15, 16, and 17), which are based on electrical logs, show only the Oakville Sandstone, Lagarto Clay, and Goliad Sand and rocks younger than the Goliad Sand.

Structure

The regional dip of the formations in Brooks County is to the east and southeast toward the Gulf. A major fault zone crosses the county along a line from near the southwest corner to the vicinity of Falfurrias. The fault was not observed at the surface. An examination of electric logs of oil wells along and near the fault zone indicates that the displacement decreases toward the surface, and that at shallow depths of less than 1,500 to 2,000 feet, hardly a trace of the fault exists. Consequently, this structural feature does not affect the circulation of ground water in the county.

Table 2.--Rock formations and their water-bearing properties

System	Series	Rock formation	Approximate maximum thickness in feet	Character of rocks	Water-bearing properties
Quaternary	Recent	Windblown sand	60	Sand and small amounts of clay and caliche.	Not known to yield water to wells.
		Unconformity			
	Pleistocene	Beaumont Clay	100?	Clay, marl interbedded with clay, and layers of fine sand and gravel.	Yields small quantities of less than 50 gpm of mostly highly mineralized water to domestic and livestock wells.
		Lissie Formation	300?	Sand, lentils of clay and silt, and gravel near base.	Do.
		Unconformity			
Tertiary	Pliocene	Goliad Sand	1,000?	Sand and sandstone interbedded with clay and silt. Contains caliche in surface outcrop.	Yields moderate quantities of 50 to 500 gpm of fresh to slightly saline water.
		Unconformity			
	Miocene(?)	Lagarto Clay	700	Clay, silty clay, sandy clay, sand, and gravel.	Capable of yielding small quantities of less than 50 gpm of fresh to slightly saline water.
	Miocene	Oakville Sandstone	500	Fine sand, sandstone, and clay.	Capable of yielding moderate quantities of 50 to 500 gpm of fresh to slightly saline water.

Two known salt domes and several geologic structural features that may be deep-seated salt domes affect the circulation of the ground water. The salt core in the Gyp Hill dome, about 4 miles southeast of Falfurrias, is about 1,000 feet below the surface; and the ground-water movement at this depth is changed locally. The base of the fresh to slightly saline water above the Gyp Hill salt dome is slightly more than 300 feet below mean sea level; but within less than 2 miles in any direction from the dome, the base of fresh to slightly saline water is at least 800 feet below mean sea level (Figure 11). The Alta Verde salt dome, whose salt core is below the base of fresh to slightly saline water, has compressed the sediments above the dome, thus reducing the permeability and changing the direction of movement of ground water. The base of fresh to slightly saline water above the Alta Verde salt dome, about 15 miles west-southwest of Falfurrias, is less than 50 feet below mean sea level, whereas the base is more than 2,200 feet about 5 miles southeast of the dome. Faulting, in addition to the compression of the sediments above and around the sides of the domes, may occur either radially, across, or tangential to the salt dome, and further contribute to the complex ground-water circulation.

Rock Formations and Their Water-Bearing Properties

Oakville Sandstone

The Oakville Sandstone, the oldest water-bearing formation in the county, lies unconformably on the Miocene(?) Catahoula Tuff which consists of tuffaceous shale and clay. The Catahoula Tuff does not contain fresh or slightly saline water. The Oakville Sandstone crops out in north-central Duval County, about 35 miles north-northwest of Brooks County.

The Oakville Sandstone is a continental deposit consisting chiefly of sand, sandstone, and clay. At its type locality in Live Oak County, the formation is composed of medium- to coarse-grained, cross-bedded sand interbedded with bluish carbonaceous clay. In Duval County, the Oakville is composed of fine- to coarse-grained, dirty gray to buff sandstone, and considerable amounts of clay. The Oakville Sandstone in Brooks County consists of fine sand, sandy clay, and clay, according to available subsurface data, and has a maximum thickness of about 500 feet.

The Oakville is capable of yielding moderate quantities of water where the sand is sufficiently thick. The formation yields water to at least seven ranch wells for domestic and livestock purposes. Water from well BP-87-08-901 is used for cooling a small compressor station and for livestock. Much of the formation contains saline water in Brooks County (Figures 15 and 17).

Lagarto Clay

The Lagarto Clay overlies the Oakville Sandstone. West of Brooks County, the Lagarto pinches out updip, and the Oakville is overlain by the Goliad Sand. The Lagarto Clay is not exposed in Brooks County, but crops out in southern Live Oak County and in northeastern Duval County. The formation in Brooks County has a maximum thickness of about 700 feet and dips east-southeast toward the coast. The formation is predominantly clay but contains discontinuous beds of silty sand, sand, and gravel.

Although in nearly all of Brooks County sufficient quantities of water for most needs can be obtained from other formations, the Lagarto is capable of yielding small quantities of water to wells. Two known wells presently tap the Lagarto.

Goliad Sand

The Goliad Sand, which unconformably overlies the Lagarto Clay, crops out in northwestern Brooks County and in large areas of Duval and Jim Hogg Counties. The thickness of the formation has not been precisely determined because of the lithologic similarity of the formations above and below it, but the Goliad attains a maximum thickness of around 1,000 feet in other areas. The formation, where undisturbed by salt domes, dips to the east-southeast at about 20 feet per mile (Figure 3).

The Goliad Sand consists chiefly of sand or sandstone interbedded with layers of silt and clay. The sand ranges from fine to coarse on the outcrop; however, the sand is relatively fine grained in the subsurface, and wells penetrating the sand must be screened accordingly. Caliche deposited in the sand where it crops out imparts to the formation a white color which is one of the features distinguishing it from the other formations.

The Goliad Sand is the chief water-bearing formation in Brooks County and yields by far the largest quantities of water to wells. This water-bearing formation is capable of yielding small to moderate quantities of fresh to slightly saline water throughout most of the county. Properly constructed wells commonly produce as much as 500 gpm from the Goliad Sand.

Lissie Formation

The Lissie Formation, unconformably overlying the Goliad Sand, consists of coarse-grained, mottled reddish to chocolate-colored calcareous clayey sand, and some chert gravel near the base. The formation crops out in north-central Brooks County, but the remainder of its outcrop is covered by windblown sand. On the basis of thickness determinations in other areas, the Lissie probably thickens to a maximum of around 300 feet at the eastern edge of the county. The Lissie contains less sand than the underlying Goliad but more sand than the overlying Beaumont. The geologic map of Texas (Darton and others, 1937) does not show the outcrop of the Lissie Formation south of northern Brooks County, except for a small isolated area in south-central Starr County.

Small quantities of water sufficient for domestic and livestock needs may be obtained from the Lissie, but the water in many places is highly mineralized. The lentils of sand and gravel are not extensive but occur at different depths in the Lissie in Brooks County, and wells tapping these beds may vary in depth over short distances.

Beaumont Clay

The Beaumont Clay, overlying the Lissie Formation, consists of clay, marl interbedded with clay, and small sand and gravel lenses. The beds dip east-southeast and, on the basis of thickness determinations in other areas, the maximum thickness of the Beaumont Clay is probably around 100 feet at the Brooks-Kenedy County line. The formation crops out in a small area in northeastern Brooks County but underlies windblown coastal sands at shallow depths of 60 feet and less in the remainder of much of eastern Brooks County.

The low permeability of the clay retards the flushing action of rainfall entering the outcrop; consequently the water in the formation may be highly mineralized. The formation yields small quantities of mostly highly mineralized water to a few domestic and livestock wells.

Windblown Sand

The sheet of windblown sand in south Texas has been mapped over approximately 2,800 square miles in parts of Willacy, Kenedy, Brooks, Hidalgo, and Jim Hogg Counties (Cook, 1962). Bullard (1942), Loshe (1952, 1955), and others have shown that longshore-current drift is responsbile for sediment transport in a southerly direction along the north Texas coast and in a northerly direction along the south Texas coast. The opposing sediment-laden currents meet at approximately latitude 27° N and deposit large volumes of sand and detritus which is picked up by wind and carried inland to form the sand sheet.

The sand is white to pale tan, fine to very fine grained, well sorted, round to sub-angular, and unconsolidated. The thickness of the sheet ranges from 0 to 60 feet and covers large areas underlain by the Beaumont Clay, Lissie Formation, and Goliad Sand. Water in the sand is generally too saline for use. This may be explained by the fact that salt is transported from the beach by moisture-laden wind and is deposited over the sand sheet. Water collects where the sand rests in shallow depressions in the clay of the older formations. The salt is concentrated in the shallow ground water as water is removed by evapotranspiration and forms lenses of salt-water-bearing sand; for the water is generally too saline for use. Where the sand rests on the sand of older formations, the water percolates downward and flushes the salt from the sand.

A large part of the surface of the sand dunes has been stabilized by the growth of grass, brush, and live-oak vegetation. The sand is not stable, however, where it has been cultivated; and the wind velocity is strong enough occasionally for the blowing sand particles to damage crops.

The windblown sand is not an important source of water in Brooks County but it may contain usable water locally. No presently used wells are known to tap the sand.

HYDROLOGY

The Hydrologic Cycle

The movement of water as it relates to the earth is called the hydrologic cycle. A comprehensive diagram of the hydrologic cycle was published by Piper (1953, p. 9). A somewhat less complete but more readily visualized diagram is shown on Figure 4. The major elements of the hydrologic cycle are clearly indicated.

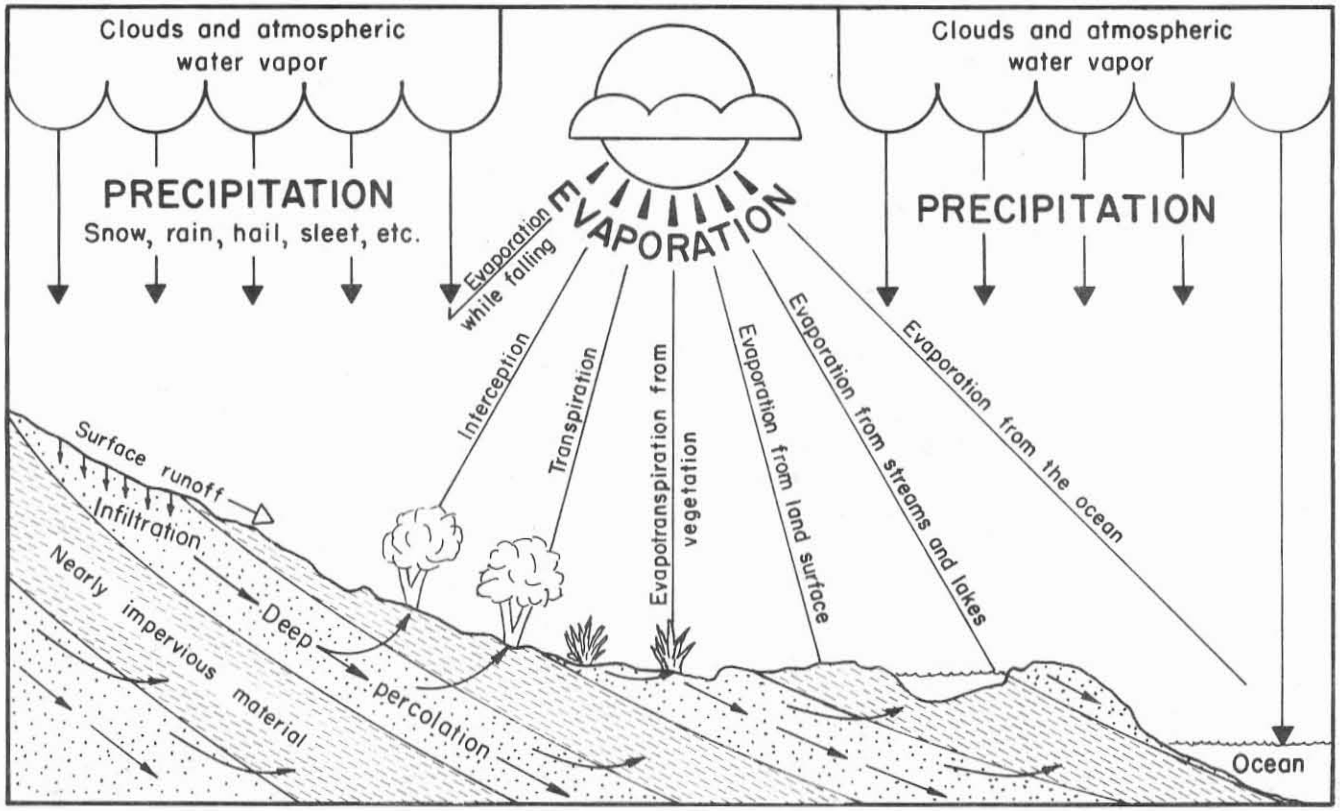

Figure 4

The Hydrologic Cycle

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

Water entering the ground is dispersed in several ways. Some of the water infiltrating the ground may reappear quickly and run off into streams or lakes, whereas the remainder seeps downward through the soil into the zone of aeration (that part of the rocks above the water table). Part of the water entering this zone may be returned to the atmosphere by evaporation, part will enter plants through their roots and be transpired through plant leaves, part will be used to make up deficiencies in the soil moisture, and the remainder will ultimately reach the zone of saturation below the water table where all pores in the rocks are filled with water. Water reaching the zone of saturation generally remains there until removed by natural or artificial discharge.

Source and Occurrence of Ground Water

Rainfall in Brooks County and adjoining areas is the source of all fresh ground water occurring in the county.

Ground water in Brooks County occurs under both water-table and artesian conditions, depending on whether the water is unconfined (under atmospheric pressure only) or confined. Water-table conditions usually prevail at shallow depths in the outcrop areas of the aquifers, whereas artesian conditions generally prevail downdip from the outcrop where the aquifers are overlain by less permeable material. Water in a well penetrating the artesian aquifers will rise to an altitude higher than the bottom of the confining layer. This rise is caused by the pressure from the weight of the water in the updip part of the aquifers and by the pressure from overlying rock formations.

Recharge, Movement, and Discharge of Ground Water

Recharge to ground-water reservoirs in Brooks County results from the infiltration of water from precipitation on the outcrops and on the sand overlying the outcrops of the formations and by infiltration from lakes, streams, or other bodies of surface water. Of these methods, infiltration from rainfall is the principal method. The windblown sand that covers most of the county and the sandy outcropping rocks of the Goliad Sand and Lissie Formation greatly facilitate the infiltration of water.

Ground water in Brooks County is in a state of transient storage--that is, moving slowly from places of recharge toward places of discharge. Where not affected by pumping, the movement of ground water is regulated by the amount of water reaching the water table. For example, during and shortly after a period of heavy rainfall, the water table or piezometric surface rises in areas of recharge and the hydraulic gradient increases; consequently, the rate of movement increases. Pumping also has the effect of increasing the hydraulic gradient and rate of movement and causes water to move from all directions toward the center of pumping. Generally, ground water in Brooks County moves in an easterly or southeasterly direction toward the Gulf of Mexico. The rate of movement averages around 35 feet per year.

Transpiration, evaporation, and interformational leakage are the principal means of natural discharge in Brooks County. Plants (such as mesquite and salt cedar), whose roots reach the water table, remove water by transpiration. Extensive deposits of caliche near the surface prevent water from percolating deep into the ground, and consequently, water is lost by evaporation. In

Brooks County, the annual gross lake evaportion is about three times the average annual rainfall. Therefore, losses of water by evaporation can be large. Interformational leakage--the transfer of water from one aquifer to another--is the principal means of subsurface discharge of ground water. As pressure in the aquifer is increased (from increased recharge), larger quantities of water are discharged by this means.

Ground water is discharged by pumping or flowing wells (artificial discharge). In 1964, about 4,100 acre-feet, or 3.7 mgd (million gallons per day), was removed in this manner.

Pumping Tests

Pumping tests on wells provide a source of information on the hydraulic characteristics of the aquifers. Hydraulic characteristics, the prime factors that determine to what extent ground water may be developed and the effects of development, are described by the terms "coefficient of transmissibility" and "coefficient of storage."

The coefficient of transmissibility is defined as the number of gallons of water that will move in one day through a vertical strip of the aquifer 1 foot wide and having a height equal to the thickness of the aquifer, under a hydraulic gradient of 100 percent (that is, 1 foot per foot).

The coefficient of storage is defined as the volume of water an aquifer will release or take into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface.

The hydraulic properties may be determined in the laboratory by testing rock samples collected in the field or by analyzing data obtained from pumping tests of wells that withdraw water from the aquifer. The latter method is more reliable than the former, because of the difficulty of obtaining rock samples that represent the undisturbed water-bearing material, and, too, rock samples yield data usually for only a small part of the aquifer.

The Theis nonequilibrium method as modified by Cooper and Jacob (1946, p. 526-534) and the Theis recovery method (Wenzel, 1942, p. 95-96) were used to analyze the test data from wells in Brooks County. Pumping test data were obtained on six wells in Brooks County (Table 3), all of which tap the Goliad Sand. The coefficients of transmissibility ranged from 10,700 gpd (gallons per day) per foot to 18,500 gpd per foot. The coefficients of storage obtained from two wells were 1.8×10^{-5} and 2×10^{-5}.

The results from the pumping tests may be used to predict the lowering of the water levels caused by pumping wells. The theoretical drawdown of water levels with relation to time and distance can be obtained from Figure 5.

To determine the drawdown at a constant time for variable distances: using Figure 5, draw a line parallel to the constant time-variable distance guideline through the point of intersection of the desired constant time and the index line. Points on the constructed line represent the drawdown for variable distances as indicated by the left-hand scale and top scale, respectively. For example, in Figure 5, the dotted line shows a drawdown of 31.8, 21.7, and 11.6 feet at distances of 10, 100, and 1,000 feet from the center of pumping,

Table 3.--Results of pumping tests

Well	Geologic formation	Screened interval (ft)	Average discharge during test (gpm)	Coefficient of transmissibility (gpd/ft)	Specific capacity (gpm/ft)	Coefficient of storage	Remarks
BP-84-55-308	Goliad Sand	675-705	334	12,200	10	--	Recovery of pumped well.
84-55-309	do	694-755	195	10,700	15.3	1.8×10^{-5}	Drawdown in observation well.
84-55-310	do	686-749	195	10,700	--	2×10^{-5}	Recovery of observation well.
84-56-203	do	654-680	350	18,500	--	--	Recovery of pumped well.
84-56-501	do	560-600	240	15,100	4.4	--	Drawdown in pumped well.
84-63-304	do	548-600	200	12,700	--	--	Recovery of pumped well.

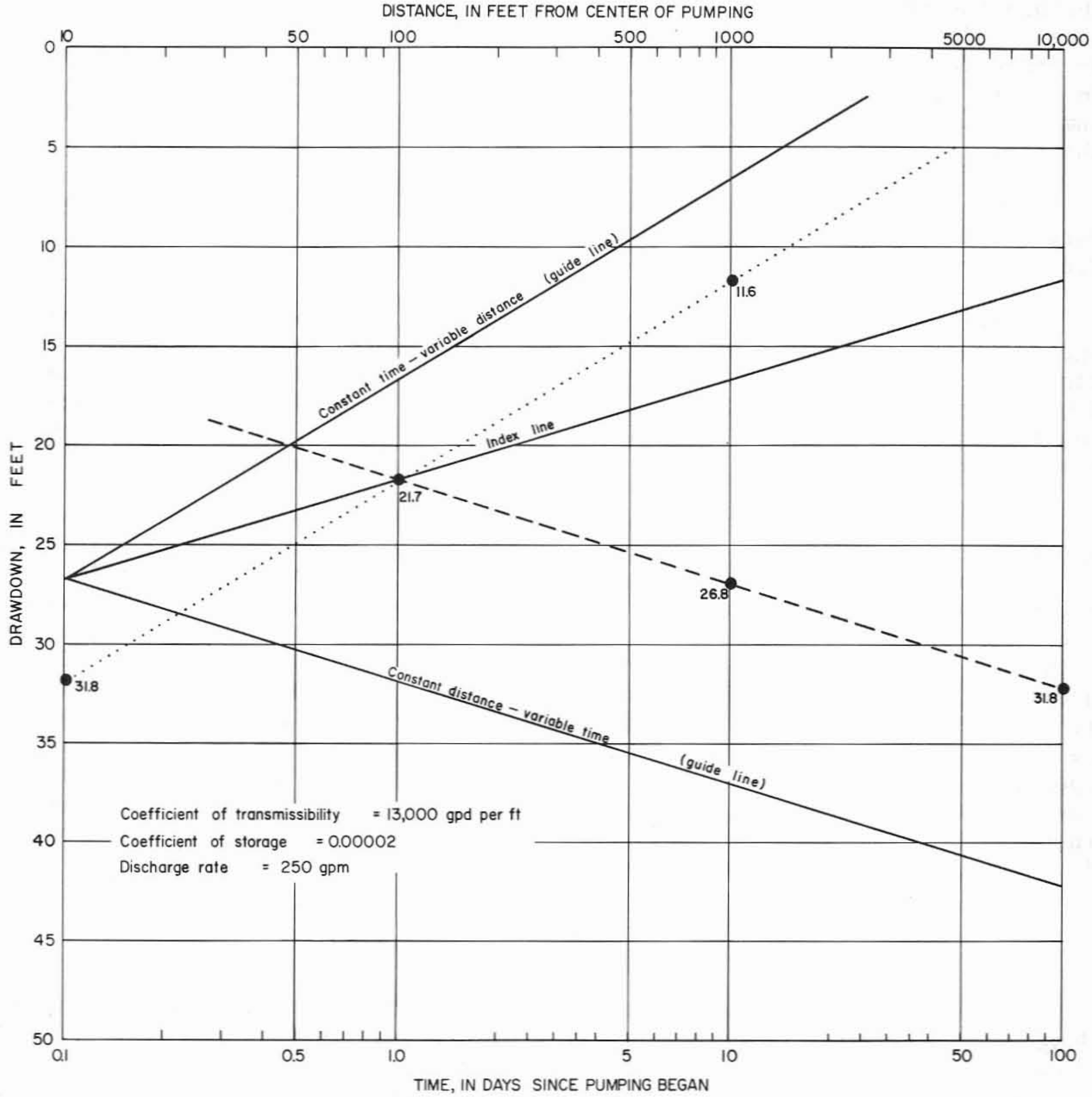

Figure 5

Theoretical Relationship of Drawdown of Water Levels to Distance and Time as a Result of Pumping from the Goliad Sand

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

respectively, after 1 day since pumping started. The constant time-variable distance guideline should not be used to determine a drawdown of less than about 3 feet.

To determine the drawdown at a constant distance for variable times: using Figure 5 draw a line parallel to the constant distance-variable time guideline through the point of intersection of the desired constant distance and the index line. Points on the constructed line represent the drawdown for variable times as indicated by the left-hand scale and bottom scale, respectively. For example in Figure 5, the dashed line shows a drawdown of 21.7, 26.8, and 31.8 feet after pumping for 1, 10, and 100 days, respectively, at a distance of 100 feet from the center of pumping.

The average coefficients of the pumping tests were used in computing the curves and are considered applicable to that part of the Goliad Sand in Brooks County containing fresh water.

Figure 5 is based on a discharge of 250 gpm (gallons per minute) and average coefficients of transmissibility and storage for the Goliad Sand as determined from the aquifer tests in Brooks County. If the discharge of 250 gpm is doubled, then the drawdown will be approximately doubled; for in a homogeneous aquifer under equilibrium conditions, the drawdown is directly proportional to the pumping rate.

The specific capacity of a well is expressed as the yield in gallons per minute per unit drawdown. The specific capacities for three wells are shown in Table 3. In the absence of detailed pumping-test data, the specific capacity of wells may be used to indicate the capacity of aquifers to yield water. The specific capacity of a well depends primarily on the hydraulic characteristics of the aquifer and indicates in a general way the permeability of the aquifer material. The specific capacity also depends on the well efficiency. If the wells in Brooks County are screened properly to keep the fine sand from being pumped and permit the maximum movement of water into the well, then the specific capacities of the wells represent true aquifer properties; if the wells are not properly screened, then the true specific capacities would be greater than the recorded values. The largest specific capacity recorded (Table 3) was 15.3 gpm per foot, and the smallest was 4.4 gpm per foot.

Ground-Water Development

The use of ground water in Brooks County about doubled from 1932 to 1964. Usage increased from about 2,250 acre-feet per year in 1932 and 1933 to 4,100 acre-feet in 1964. The water pumped for irrigation in 1964 was about 40 percent of the total quantity used that year. The quantity used for public supply has increased rapidly. Table 4 contains data on pumpage of ground water from 1955 to 1964.

About 95 percent of the water used in Brooks County is withdrawn from wells in the Goliad Sand, and the depths of the wells range from less than 100 feet on the outcrop to more than 900 feet in the eastern part of the county. Many wells drilled to supply water for oil-well drilling operations have been converted to rural domestic and livestock needs.

Table 4.--Pumpage of ground water, 1955-64

Year	Public supply		Irrigation		Industry		Rural domestic and livestock needs		Total*	
	ac-ft per yr	mgd	ac-ft per yr	mgd	ac-ft per yr	mgd	ac-ft per yr	mgd	ac-ft per yr	mgd
1955	841	0.75	--	--	--	--	841	0.75	1,700	1.5
1956	930	.83	--	--	--	--	852	.76	1,800	1.6
1957	964	.86	--	--	--	--	852	.76	1,800	1.6
1958	818	.73	173	0.15	--	--	852	.76	1,800	1.6
1959	829	.74	--	--	--	--	863	.77	1,700	1.5
1960	886	.79	--	--	--	--	863	.77	1,800	1.6
1961	986	.88	--	--	--	--	874	.78	1,900	1.7
1962	1,121	1.00	--	--	--	--	874	.78	2,000	1.8
1963	1,076	.96	--	--	--	--	874	.78	1,900	1.7
1964	1,345	1.20	1,675	1.49	224	0.20	874	.78	4,100	3.7

* Figures are approximate because some of the pumpage is estimated. Totals are rounded to two significant figures. Totals are incomplete for the period 1955-63 because data for industry and irrigation were not available.

Public Supply

The use of water for public supply has increased tenfold from about 0.12 mgd in 1932 and 1933 to about 1.2 mgd in 1964 (Table 4). Public supply usage represented about one-third of the total used in the county in 1964.

A total of 10 wells supply water for public use in Brooks County. Falfurrias, the only city in the county having a public-supply system, pumps most of the water used for public supply. The city uses three wells for supplying its needs and two others as standby wells. The only other public supply of any consequence, the public school at Encino, uses about 9,000 gpd. Other public-supply wells are at a church in Encino, a drive-in theater south of Encino, and the county airport southeast of Falfurrias. Water wells at oil-field camps generally are used for industrial and public-supply purposes, but the quantity of water used by residents in these camps is insignificant.

Irrigation

Irrigation has been practiced on a small scale in Brooks County since about 1910. By the winter and spring irrigation season of 1932-33, an estimated 500 to 600 acres of citrus orchards and truck gardens was irrigated with water from 85 to 90 wells, and by 1940, the irrigated acreage had been reduced to about 60 percent of the 1932-33 estimate (Turner and Cumley, 1940). The reduction was attributed to a decrease in truck farming. Some of the principal users of water for irrigation expressed the belief that, although a reduction had occurred in the number of acres irrigated, the quantity of water used in 1940 was virtually the same as in the 1932-33 season because the citrus trees had grown larger and required more water per acre.

In the early 1950's, freezing weather killed or severely damaged the citrus orchards in the county, and irrigation was curtailed for several years. Some of the orchards were not replanted, and the water was diverted from orchard irrigation to small grain, pasture, and truck farming.

An inventory of irrigation made in 1958 and again in 1964 (Gillett and Janca, 1965) indicated that 173 acre-feet of water was used in 1958, but the quantity had increased to 1,675 acre-feet in 1964. A large percentage of the 1964 figure was used for irrigating pastures and vegetables.

Industrial Use

Industrial use of water is insignificant. During the exploration for oil and the development of the oil industry, industrial water use increased, but the pumpage of water for industrial purposes in 1964 is small compared to the total quantity used for all purposes in the county. The estimated industrial use of ground water in the county in 1964 was 224 acre-feet, or 0.20 mgd. This is about 5 percent of the total.

Rural Domestic and Livestock Needs

The estimated withdrawal of ground water in 1964 for rural domestic and livestock needs was about 880 acre-feet, or about 0.8 mgd. This is about 22 percent of the total ground water used for all purposes. According to the population figures, the 1964 estimate has not changed materially since 1950. Most of the rural domestic and livestock wells are equipped with windmills or small gasoline-powered pumps and are not designed to yield more than a few gallons per minute.

Changes in Water Levels

Water levels in the aquifers in Brooks County rise or fall mainly in response to changes in the rates of recharge or discharge and rates of pumpage. During periods of drought, recharge to the aquifer is reduced and generally pumpage of water is increased, thereby reducing the quantity of ground water in storage--and the water levels decline. Conversely, during periods of above normal rainfall, the process is reversed--and the water levels rise.

The decline of the water level is large where wells are concentrated in relatively small areas or in areas where the coefficient of transmissibility of the aquifer is low. In these areas the cone of depression created by pumping one well will intersect that of a nearby well, and the composite cones result in deeper pumping levels than those where the wells are adequately spaced.

Water levels change especially in irrigation areas where wells are heavily pumped. When the seasonal irrigation period is over, water levels usually rise and may even reach their former levels.

The approximate altitude of the water levels in the Goliad Sand in 1932-33 is shown in Figure 6. Many of the wells having data that were used in the preparation of this map are now abandoned, but the well locations are shown.

The approximate altitude of water levels in the Goliad Sand in 1964-65 is shown in Figure 7. The 1964-65 water-level map may be used to estimate the altitude of the water level when drilling a well to the Goliad Sand in any part of the county.

A comparison of the two water-level maps, in conjunction with measured declines in water levels, shows the rises and declines of the water levels from 1932-33 to 1964-65 (Figure 8). Water levels have declined everywhere except in one area in the west-central part of the county where water levels rose as much as 30 feet. In that area, only a small amount of water was pumped from a few livestock and domestic wells. The largest decline in water levels occurred in the north-central and northeastern parts of the county where the withdrawals for irrigation and public supply are large. The water level declined at least 110 feet in the north-central part of the county in the 32-year period. Withdrawals in southern Jim Wells County for irrigation and for industrial use at the La Gloria refinery, which normally uses more water annually than Falfurrias, probably contributed considerably to the decline in Brooks County. As a result of the decline, pumps were lowered in many wells, and the cost of pumping increased.

In Figure 9 is shown the decline of the water level in four observation wells. The water level in all four of the wells shows a net decline for the entire period; a rise in the water level over a period of one or more years reflects above average rainfall.

If the present rate of pumpage is continued in northern Brooks and southern Jim Wells Counties, water levels will continue to decline, although at a slower rate, because more water will flow toward these centers of pumpage as the hydraulic gradient steepens.

Well Construction

Turner and Cumley (1940) described more than 900 wells in Brooks County at the time the records were made in 1932-33. Many of these wells are now abandoned or unused because of inferior construction. For example, some of the wells were completed with the iron casing in direct contact with shallow, saline water which is corrosive. The shallow water corroded the casing to such an extent that the saline water entered the well, and the quality of the water in the well deteriorated. Other wells had large slots in the casing which permitted sand to enter the well. This resulted in excessive wear on the pump and reduced the yield of the well. Many small-capacity domestic and livestock wells have casings that reach the bottom of the hole so that water can enter the well only through the end of the casing. These "open end" wells, though normally pumped at rates of less than 5 gpm, cannot prevent sand from entering the well and must be cleaned periodically.

The purpose and expected yield of a well generally determines the manner in which a well is constructed. If large-capacity wells are required, the initial cost of which is comparatively high, the most modern methods of well construction should be used in order for the owner to receive the best return on his investment.

Modern municipal wells generally are underreamed, screened, and gravel packed opposite the water-bearing sand. The gravel packing increases the effective diameter of the well, aids in preventing the entrance of sand into the well, and protects the casing from caving of the surrounding formation. The space between the hole and the blank casing is cemented off from the land surface to the top of the first screen. This prevents the entrance into the well of inferior quality water and prevents the corrosion of the casing by highly mineralized water.

Irrigation wells are designed to pump a large quantity of water at as low a cost as possible. The wells generally are finished with torch-slotted casing and some are underreamed and gravel packed. Care should be taken to relate the width of the slots to the diameter of the sand particles. If the slots are too large, considerable quantities of sand enter the well, resulting in wear of the pumps and casing. On the other hand, slots that are too small, or an insufficient number of slots, may cause excessive "entrance losses" in head, thereby reducing the specific capacity of the wells.

Modern rural domestic and livestock wells are equipped with jet pumps, submersible pumps, or windmills. The wells are cased with galvanized pipe down to the desired water-bearing sand and usually have torch-slotted or perforated pipe or screen set opposite the water-bearing sand.

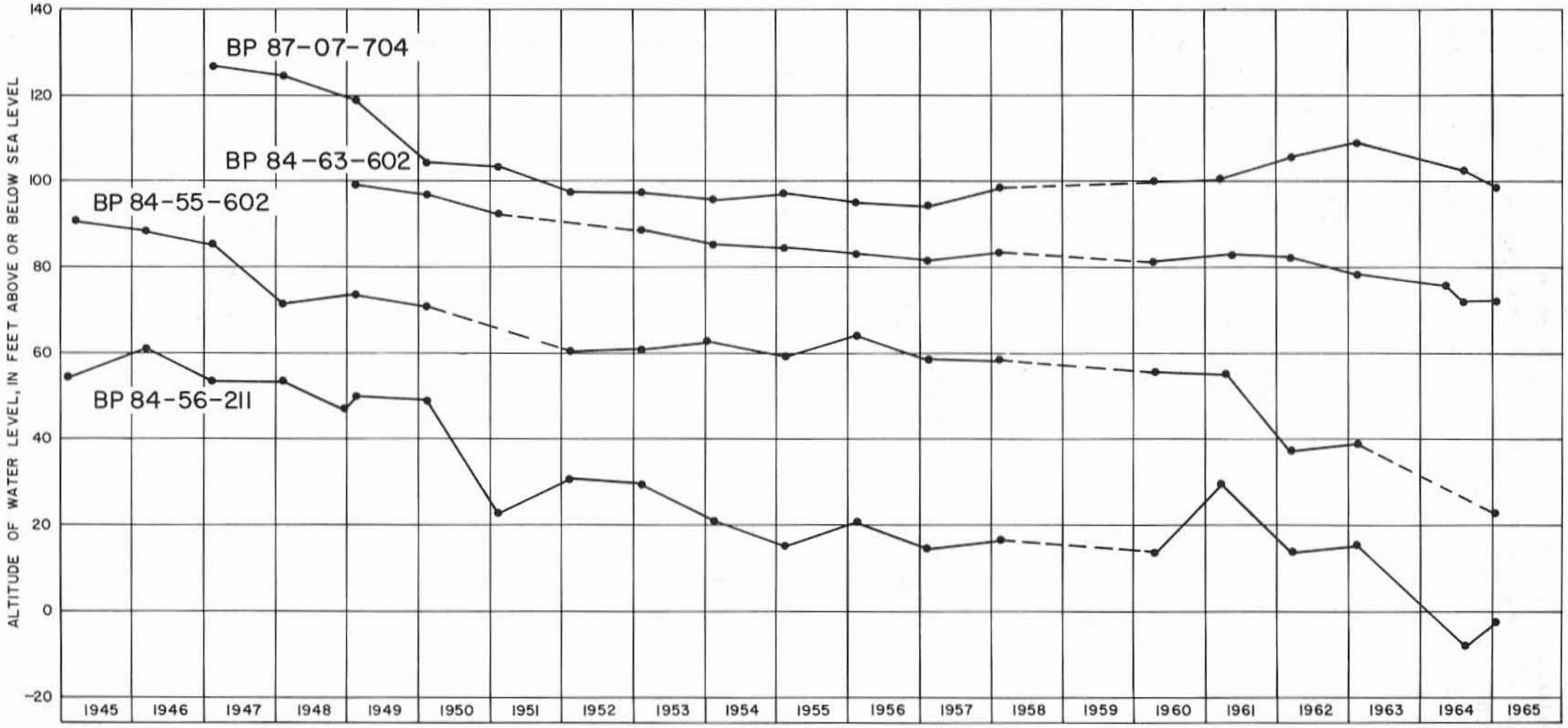

Figure 9

Hydrographs of Wells in the Goliad Sand

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QUALITY OF GROUND WATER

All ground water contains dissolved minerals. The amount and the kind of minerals found in solution in ground water depend to a large extent on the physical and chemical character of the rocks through which the water moves and the length of time the water has been in contact with these rocks. Usually, most deep ground water is free from contamination by organic matter; but, normally, the dissolved-solids content increases with depth.

General Quality-of-Water Tolerances for Different Uses

The suitability of a water supply depends upon the quality of the water and the limitations imposed by the use contemplated. Water-quality requirements have been based on various criteria including bacterial content, physical characteristics, and chemical constituents. The problems arising from adverse physical characteristics and bacterial content can generally be remedied rather economically, but removal or neutralization of unwanted chemical constituents may prove difficult and expensive.

Public Supply

The U.S. Public Health Service (1962) has set up the following standards for drinking water used by interstate carriers:

Substance	Concentration (parts per million)
Chloride (Cl)	250
Fluoride (F)	.8*
Iron (Fe)	.3
Manganese (Mn)	.05
Nitrate (NO_3)	45
Sulfate (SO_4)	250
Dissolved solids	500

*Upper limit for Brooks County based on an appropriate annual average of maximum daily air temperature of 85.7°F calculated over 51 years at Falfurrias.

Water having chemical substances in excess of the standards of the U.S. Public Health Service may be objectionable for various reasons. For example, concentrations of nitrate in excess of 45 ppm (parts per million) in water used for feeding infants has been related to the incidence of infant cyanosis (methemoglobinemia or "blue baby" disease), in which the oxygen content in the blood is reduced and a form of asphyxia results (Maxcy, 1950, p. 271). High nitrate concentration may be an indication of pollution from organic matter, commonly sewage. Excessive concentrations of iron and manganese in water cause reddish-brown or dark-gray precipitates that stain clothing and plumbing fixtures. Chloride content exceeding 250 ppm in water may have a salty taste, and sulfate in excess of 250 ppm in water may be laxative. Excessive fluoride concentration may cause mottling of teeth; however, about 1 ppm may reduce the incidence of tooth decay (Dean, Arnold, and Elvove, 1942, p. 1155-1179).

Water having a dissolved-solids content (degree of mineralization or "total salts") in excess of 500 ppm is not recommended for public supply if other less mineralized supplies are or can be made available at reasonable cost. Water having less than 500 ppm dissolved solids is not always available, and it is recognized that a considerable number of supplies with dissolved solids in excess of the established limit are used without any obvious ill effects. Because the dissolved-solids content of water is a major limitation on its practical use, a general classification of water based on dissolved-solids content, as used in this report, is shown in the following table (Winslow and Kister, 1956, p. 5):

Description	Dissolved-solids content (ppm)
Fresh	Less than 1,000
Slightly saline	1,000 to 3,000
Moderately saline	3,000 to 10,000
Very saline	10,000 to 35,000
Brine	More than 35,000

In water the principal constituents causing hardness are calcium and magnesium. Excessive hardness requires increased use of soap. Hardness also causes a formation of scale in hot-water heaters and water pipes. The commonly accepted standards and classification of water hardness are shown in the following table:

Hardness range (ppm)	Classification
60 or less	Soft
61 to 120	Moderately hard
121 to 180	Hard
More than 180	Very hard

Industrial Use

Water suitable for industrial use may not be acceptable for human consumption. Water for industrial use may be placed in three principal categories--cooling water, boiler water, and process water. Cooling water usually is selected for its low temperature, although its chemical quality also has significance because the chemical characteristics may adversely affect the heat-exchange surface.

The temperature of ground water near the land surface in Brooks County is generally very near the average annual air temperature of 73.3°F, but the temperature of the water increases with depth at the rate of about 1°F per 100 feet.

The quality of water for steam boilers must meet rigid standards. Corrosion and encrustation become a problem because of the increase in temperature and pressure. The constituents that make water corrosive are calcium and magnesium chloride, sodium chloride in the presence of magnesium, acids, dissolved oxygen, and carbon dioxide. Silica in boiler water forms a hard scale, and the scale-forming tendency increases as the boiler pressure increases. Treatment of water for boiler use may be necessary, therefore examination of the suitability of treatment of raw water is desirable.

Water used as process water in manufacturing is subject to a wide range of quality requirements which generally are rigidly controlled. For example, water used in textile manufacturing must be low in dissolved solids and free from the staining effects of precipitated iron and manganese. The beverage industry requires water free of iron, manganese, and organic substances. Water used in making high-grade paper may contain only exceedingly small concentrations of heavy metals. Whereas cooling and boiler water can often be reused, process water is usually not available or not practical for reuse.

Irrigation

The most important chemical characteristics pertinent to the evaluation of water for irrigation are: (1) total concentration of soluble salts or dissolved-solids content (an index of the salinity hazard); (2) proportion of sodium to total cations (an index of the sodium hazard); (3) the amount of residual sodium carbonate; and (4) the concentration of boron.

The U.S. Salinity Laboratory Staff has proposed a system of classification for irrigation waters (U.S. Salinity Laboratory Staff, 1954, p. 69-82). The classification is based on the salinity hazard as measured by the electrical conductivity of the water and the sodium hazard as measured by the SAR (sodium-adsorption ratio). Water to be used for irrigation may be evaluated by plotting the SAR and specific conductance of the water sample as shown on Figure 10. The importance of using the total soluble salts or dissolved-solids content of water as a criterion for the water's acceptability for irrigating is that it points out the damage which may be done to the soil by excessive accumulation of the salts. Kelly (1951, p. 95-99) cited areas having an average annual precipitation of about 18 inches in which the salts did not accumulate in the soil. Wilcox (1955, p. 15) believes that the system of classification proposed by the U.S. Salinity Laboratory Staff is not directly applicable to supplemental irrigation in areas of relatively high rainfall. In Brooks

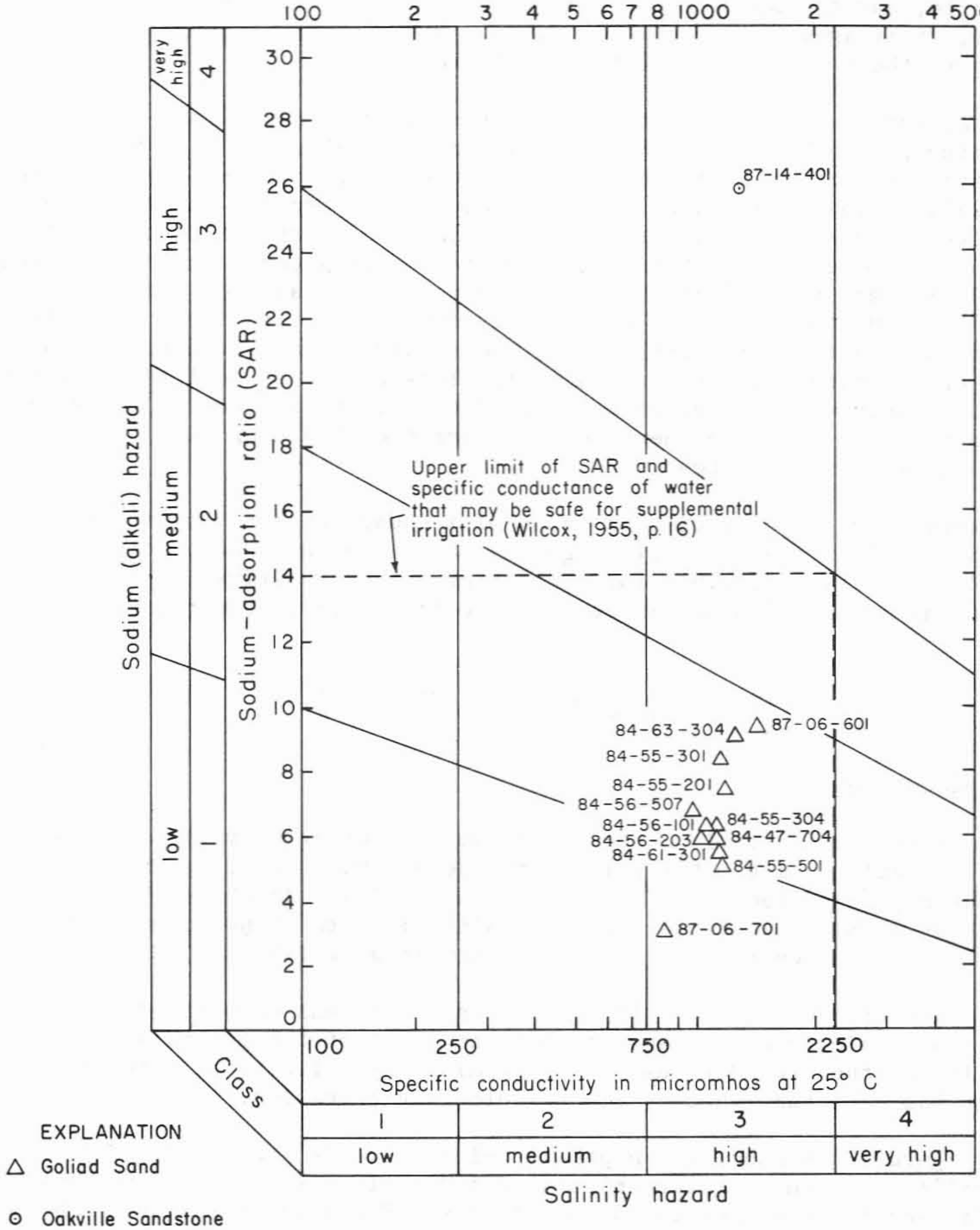

Figure 10

Classification of Irrigation Waters

(After U. S. Salinity Laboratory Staff, 1954, p. 80)

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County, where the average annual precipitation is 23.37 inches, the system of classification may not be fully applicable. Wilcox (1955, p. 16) indicates that water generally may be used safely for supplemental irrigation if its specific conductance is less than 2,250 micromhos per centimeter at 25°C, its SAR is less than 14, and the soil-drainage conditions are good. Care should be taken, therefore, if irrigation waters are near these limits or if the crops grown are sensitive to the hazards of sodium and salinity.

If carbonate and bicarbonate, in epm (equivalents per million), is more than calcium plus magnesium, RSC (residual sodium carbonate) will be present. The formation of RSC will accompany the increase in sodium and cause the soil to be alkaline; this alkalinity, in turn, causes the organic matter in the soil to dissolve. The soil may become grayish black and is referred to as "black alkali." From results of determinations made on irrigated noncalcareous soil, Wilcox, Blair, and Bower (1954, p. 265) report "...it has been concluded that waters containing more than 2.5 me/l [milliequivalents per liter] of residual Na_2CO_3 are not suitable for irrigation, those that contain between 1.25 and 2.5 me/l are marginal, and those containing less than 1.25 me/l are probably safe. These conclusions are, of course, tentative and subject to change as more data are obtained. Furthermore, the degree of leaching will modify permissible limits to some extent."

An excessive concentration of boron will cause water to be unsuitable for irrigation. Wilcox (1955, p. 11) suggests that a boron concentration of as much as 1.0 ppm is permissible for irrigating boron-sensitive crops; a concentration of as much as 3.0 ppm is permissible for boron-tolerant crops.

Quality of Water by Formations

General Discussion

All of Brooks County is underlain by water-bearing formations containing fresh to slightly saline water. The altitude of the base of fresh to slightly saline water ranges from about 50 feet below sea level in the Alta Verde oil field, about 15 miles west-southwest of Falfurrias, to about 2,300 feet below sea level near the central part of the county (Figure 11).

The base of the fresh to slightly saline water was determined through a combination of electric logs and chemical analyses of the ground water. An explanation of the procedure used to determine the salinity of water from electric logs has been published by electric-logging companies.

In Figure 12 is shown the depth of selected wells tapping the Goliad Sand and Oakville Sandstone and the chloride and dissolved-solids content of water from wells and three salt-water disposal pits. The samples for analysis were collected from wells selected for their differences in depth and are probably representative of the water in the same general areas and at comparable depths. The water from the three salt-water disposal pits was very saline, or brine.

In Table 7 are given the results of chemical analyses of samples from 81 water wells (68 of which are recent analyses) and from three salt-water disposal pits. Turner and Cumley (1940, p. 3-56) showed field determinations of chloride, hardness, and sulfate of many other wells--some of which have since been abandoned. The wells and pits sampled are identified on Figure 14 by means of lines over the well and pit numbers.

Because the mineral constituents in ground water originate principally from the soil and rocks through which the water has passed, the differences in the chemical character of the water indicate in a general way the nature of the geologic formations through which the water has moved. The quality of the water in the Oakville Sandstone, the Goliad Sand, and the Lissie Formation, Beaumont Clay, and windblown sand is discussed separately in the following report sections.

Oakville Sandstone

Quality-of-water data are available for only four wells that tap the Oakville, principally because ample supplies of water can be obtained from shallower formations. The water from well BP-87-14-401 contained 806 ppm dissolved solids, 270 ppm chloride, and 90 ppm sulfate. Well BP-84-63-701 contained 1,190 ppm dissolved solids, 290 ppm chloride, and 290 ppm sulfate. Well BP-87-08-101 contained 1,660 ppm dissolved solids, 400 ppm chloride, and 532 ppm sulfate. Well BP-87-08-901 contained 1,730 ppm dissolved solids, 255 ppm chloride, and 736 ppm sulfate. The fact that well BP-87-14-401, nearest the outcrop, yields the best quality water suggests that even shallower wells nearer the outcrop of the Oakville may yield even less mineralized water.

The chemical analyses show that the water from the four wells does not meet the drinking-water standards set by the U.S. Public Health Service. The high fluoride content of the water, ranging from 3.5 to 5.6 ppm in three of the deeper wells, may cause mottling of teeth in those who use it continually for drinking purposes, and the high sulfate content in three of the deeper wells may have a laxative effect.

The Oakville water has been used occasionally for supplemental irrigation, although the water is not recommended for this purpose because of the high SAR, high RSC, high dissolved-solids content, and high boron concentration. On well-drained soils that permit rainfall to leach the salts from the root zone of plants, water from the Oakville may be used for supplemental irrigation.

Most of the industries require water of better quality than that found in the Oakville Sandstone; however, the water may be used for cooling purposes. Soft water is generally available from the Oakville in the southeastern part of the county.

Goliad Sand

The Goliad Sand is tapped by more than 90 percent of the wells in the county, because the Goliad is the shallowest aquifer containing water of acceptable quality and adequate quantity. This water is being used for all purposes in Brooks County. The wells range in depth from about 50 feet at the outcrop on the western side of the county to more than 800 feet on the eastern side.

The quality of the water is generally suitable for public supply and some industrial uses. The dissolved solids in 71 samples ranged from 395 to 3,360 ppm, exceeding 500 ppm in all but one sample (well BP-87-14-501). In only 15 samples, however, did it exceed 1,000 ppm. Most of the water sampled was hard to very hard; the hardness in 71 samples ranged from 11 ppm in a well 700 feet deep to 1,060 ppm in a well 100 feet deep, and exceeded 120 ppm in all but 12 samples. The chloride content in 76 samples ranged from 51 to 1,450 ppm, exceeding 250 ppm in 25 samples. The sulfate content in 76 samples ranged from 7.6 to 4,341 ppm, exceeding 250 ppm in only 8 samples. The fluoride content in 61 samples ranged from 0.2 to 7.0 ppm, exceeding 0.8 ppm in only 8 samples.

Much of the water is suitable for supplemental irrigation. Analyses of water from 71 wells show that 14 of the samples had conductivities greater than 2,250 micromhos. The SAR ranged from 1.1 to 44 in 60 samples and in only 4 samples did it exceed 14. The RSC in 57 samples ranged from 0.00 to 5.63 epm, exceeding 2.5 epm in 12 samples. Boron ranged from 0.01 to 1.4 ppm in 20 samples and exceeded 1.0 ppm in only 2 samples. Sandy and well-drained soils in Brooks County may partially offset any detrimental effects of using water that is high in the salinity and sodium hazards. Twenty-six wells produce water from the Goliad Sand for irrigation.

Probably 95 percent of the domestic and livestock wells tap the Goliad Sand. As previously shown, in only a few wells are chemical substances generally present in excess of the standards set by the U.S. Public Health Service for human consumption. Livestock have greater tolerance for highly mineralized water than humans; therefore, practically all of the water available to wells is usable by livestock.

Lissie Formation, Beaumont Clay, and Windblown Sand

The Lissie Formation, Beaumont Clay, and windblown sand are treated as a unit for this discussion. Field tests by Turner and Cumley (1940) show that water containing chloride in excess of 2,000 ppm is found in these shallow formations in much of the county, but in local areas, shallow wells may tap water having chloride concentrations as low as 200 ppm.

Only a few wells are believed to obtain water from the Lissie Formation, Beaumont Clay, and windblown sand because of the usually high salinity, and test drilling is necessary to locate the local areas where water of acceptable quality can be found.

PROBLEMS

Salt-Water Disposal

In 1961 a statewide survey was made by the Texas Water Commission and the Texas Water Pollution Control Board (1963) to determine the amount of production and methods of disposal of oil-field salt water. The survey indicated that the total quantity of salt water produced in the county in 1961 was 1,974,757 barrels. Of this amount, 1,221,843 barrels, or 61.9 percent, was placed in open surface pits; 700,695 barrels, or 35.5 percent, was returned to subsurface formations through injection wells; 52,018 barrels, or 2.6 percent, was disposed by miscellaneous means; and the means of disposing of the remaining 201 barrels, or 0.01 percent, was unaccountable.

Theoretically, when oil-field waters are placed in an open surface pit for disposal, the water will evaporate and leave the salts as residue in the pits. This situation is true only if the pits are lined with impervious material and no water is allowed to escape through the bottom and sides of the pit or by overflow. Most of the disposal pits in Brooks County are unlined; they allow the seepage of water into the ground and the infiltrating salt water is free to contaminate the fresh water.

Because ground water moves slowly, the salt water may not reach the fresh water for years. Once the fresh water is contaminated and the quality of the water deteriorates, the damage cannot be rectified merely by eliminating the source, because a longer period will be required for purification and dilution than for the original pollution.

Results of chemical analyses of samples of water taken from three of the salt-water disposal pits in Brooks County are shown in Table 7. The dissolved solids range from 22,000 to 147,000 ppm and average 70,100 ppm. Expressed in tons of salt from the 1,221,843 barrels of salt water disposed in open surface pits in 1961, the residue would be 15,025 tons. Assuming 80 pounds per cubic foot for the residue in solid state, about 376,000 cubic feet of salt would have been left in open surface pits after evaporation, providing the pits were impervious. The accumulation of salt observed in the pits was very small, which indicates that much of the salt water seeps into the ground.

Injection of the salt water into formations well beneath the deepest beds containing fresh to slightly saline water is one of the safest methods to dispose of oil-field waste, if proper attention is given to the construction and operation of the injection wells.

No direct evidence of salt-water contamination from open surface pits was discovered from the wells sampled. Contamination is believed to be occurring, nevertheless, because of the many unlined pits and the porous nature of the soil in the vicinity of the pits. If the ground water is intensively developed, thus increasing the slope of the water table and the rate of movement of the water, the potential rate of contamination will increase.

Improperly Cased Wells

If the casing is not cemented opposite beds that contain saline water and overlie fresh water-bearing formations, the saline water may corrode the casing and enter the well. In Brooks County where saline water overlies fresh to slightly saline water, extra care should be taken in casing off the saline water.

The Texas Railroad Commission requires that all "fresh water strata" be protected against possible contamination by improperly cased oil wells. The Commission issues rules governing the depth of cemented surface casing required to protect such strata for many oil fields within the State.

A study of the field rules published by the Texas Railroad Commission reveals that only the Palo Blanco oil field, 16 miles west of Falfurrias, has inadequate surface-casing requirements for protecting the fresh to slightly saline water beds. Under present published rules, only 500 feet of surface casing is required by the Railroad Commission. Figure 11 indicates that in the area of the Palo Blanco field, the base of fresh to slightly saline water is about 1,000 feet below sea level.

POTENTIAL DEVELOPMENT OF GROUND WATER

The volume of ground water available in Brooks County on a long-term basis depends chiefly on the average rate of recharge. The long-term average rate of recharge can be estimated by determining the quantity of ground water moving through the county. This quantity is computed by using the formula $Q = TIW$, in which Q is the quantity of water in gallons per day moving through the county, T is the coefficient of transmissibility in gallons per day per foot, I is the hydraulic gradient of the water surface in feet per mile, and W is the average width of the county in miles normal to the hydraulic gradient. The average gradient of the water surface is about 12 feet per mile, the average coefficient of transmissibility based on six pumping tests is 13,000 gpd per foot, and the width of Brooks County along the Brooks-Kenedy County line is 33 miles. On the basis of these figures, the computed average recharge or quantity of water perennially available for development in Brooks County is approximately 5 mgd, or about 5,600 acre-feet per year. The average coefficient of transmissibility used in the computations is from pumping tests on wells that screen only a small fraction of the entire thickness of sand containing fresh to slightly saline water; therefore, the actual recharge or quantity of water perennially available for development is probably a few times larger than that computed.

In addition to at least 5 mgd perennially available for withdrawal, about 80 million acre-feet of fresh to slightly saline water is in transient storage in the county. Because most of this water is too deep in the ground to be withdrawn economically, only the water stored in the upper part of the aquifer will be considered for potential development.

With 400 feet assumed to be an economic depth below land surface for pumping water, the volume of saturated sediments in the upper 400 feet was computed and a storage coefficient (0.15) was estimated in order to evaluate the volume of water available for use. According to these assumptions, about 11,000,000 acre-feet of water in transient storage can be withdrawn. Withdrawals exceeding the perennial yield can be made for several hundred years before water in the upper 400 feet of sediments will be depleted. Many wells properly spaced would be needed to economically withdraw this water.

The areas most favorable for development of additional supplies of ground water are indicated by the sand-thickness map (Figure 13). Generally areas having relatively thick sand containing fresh to slightly saline water are the most favorable areas for future development. Beds of sand thicker than 700 feet underlie an elongated area about 2 miles wide and 8 miles long from 3 to 10 miles southwest of Falfurrias. Other areas, where the sand thickness is more than 600 feet thick, are shown on the sand-thickness map. In large areas throughout much of the county, sands as thick as 500 feet may yield as much as 500 gpm of water.

Unfavorable areas for future development are near and over salt domes, such as the Gyp Hill and Alta Verde domes, where the rising salt block has compressed and thinned the sediments and where the permeability of the water-bearing formations is low.

The most beneficial development of ground water depends on the proper spacing of wells. Moderate- to large-capacity wells should be widely spaced to prevent the overlapping of cones of depression which result in deeper water levels and higher pumping costs. Wells properly spaced may produce 500 gpm of water in much of the county where the sand is as thick as 500 feet if all of the beds of sand are screened; and, locally, more than 500 gpm can be produced from thicker sands.

Ground water for rural domestic and livestock needs can be obtained in sufficient quantities almost everywhere in the county at depths ranging from about 100 feet on the west side of the county to about 400 feet on the east.

CONCLUSIONS

Additional supplies of ground water are available for development in Brooks County. At least 5 mgd and probably several times more of fresh to slightly saline water is perennially available without depleting the ground-water supply. In addition to the 5 mgd, about 11,000,000 acre-feet of water above a depth of 400 feet is available from storage. This volume of water from storage insures an excess of many times the perennial yield for several hundreds of years before the 11,000,000 acre-feet will be depleted.

In any large scale development of ground water, wells should be properly spaced and large withdrawals should not be concentrated in small areas, in order to minimize the declining water levels. It should be emphasized that large quantities of water may be continuously withdrawn from storage provided that the user is able to withstand the declining water levels and the consequent increased cost of lifting the water to the surface. Intensive development will create steep water-level gradients, thus increasing the rate of ground-water movement and the potential danger of contamination from oil-field salt water in unlined open surface pits. Natural saline water at shallow depths may also contaminate the underlying fresh water if wells are not constructed properly.

The most favorable areas for future development of large quantities of water are those where the water-bearing sand is thickest. The thickest sand is in an area from 3 to 10 miles southwest of Falfurrias. Ground water in sufficient quantities for rural domestic and livestock needs can be obtained almost everywhere in the county at depths ranging from about 100 feet on the west side of the county to about 400 feet on the east. Local areas may contain small amounts of potable water at shallow depths.

The Goliad Sand is the chief water-bearing formation in the county and yields by far the largest quantities of water to wells. The quality of water from the Goliad is generally suitable for public supply, for some industrial uses, and for supplemental irrigation.

An observation-well program should be maintained in the county. Basic data on water levels can thus be kept up-to-date and any trends toward over-development of ground water can be foreseen. Periodic sampling of wells for chemical analysis of water is recommended in order that salt-water encroachment or contamination from improperly cased wells and salt-water disposal pits can be quickly detected.

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Table 5.--Records of wells

All wells are drilled unless otherwise noted in remarks column.
Water level : Reported water levels given in feet; measured water levels given in feet and tenths.
Method of lift and type of power: C, cylinder; E, electric; G, gasoline, butane, or diesel engine; H, hand; J, jet; N, none; Ng, natural gas; T, turbine; W, windmill. Number indicates horsepower.
Use of water : D, domestic; Ind, industrial; Irr, irrigation; N, none; P, public supply; S, stock.

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-45-701	San Antonio Loan & Trust Co.	--	--	67	4	Goliad Sand	--	41.2	Apr. 28, 1965	C,W	D,S	Cased to bottom. Old well.
801	A. Maldanado	--	--	60	5	do	328	56.7	Apr. 29, 1965	C,W	S	Do.
* 901	Daniel Quintanilla	--	--	100	4	do	--	47.9	do	C,W	S	Cased to 80 ft. Old well.
* 46-905	Mills Bennett Estate	--	--	400	4	do	--	125.6	Mar. 23, 1965	C,W	S	Cased to bottom. Slotted from 360 ft to bottom.
* 47-704	Clyde Burdett	Porter Drilling Co.	1963	607	12	do	170	--	--	T,E	Irr	Cased to bottom. Slotted from 507 ft to bottom.
705	Miller Ranch	do	1947	400	4	do	188	109	Feb. 1965	C,W	S	Cased to bottom. Slotted from 379 ft to bottom.[1]
706	do	Perry Downs	1911	470	5	do	175	21.0	Dec. 8, 1932	C,W	S	
808	E. G. Maun	Chester Downs	1909	500	--	do	135	--	--	J,E	D,S	
908	Church of the Bretheren Service Farm	--	1950	700	10	do	130	80	1960	T,E	Irr	Cased to bottom. Slotted from 620 ft to bottom.
909	Earl Young	Chester Downs	--	500?	5	do	132	11.0	Dec 2, 1932	C,W	D,S, Irr	Irrigates 2 acres of citrus fruit.
48-703	Frank Morales	Elmer Rupp	1954	600	8	do	120	--	--	T,E	Irr	Cased to bottom. Slotted from 579 ft to bottom.
704	Church of Bretheren	Magnolia Petroleum Co.	1945	10,005	9, 6	--	116	--	--	--	--	Oil test.
705	Lino Trevino	--	--	535	5	Goliad Sand	113	25	Dec. 1932	C,W	S	
* 801	W. P. Wright	Disbro Bros.	1952	446	4	do	105	--	--	C,W	S	Cased to bottom. Slotted from 426 ft to bottom.[1]
53-101	Trinidad Pena	--	--	76	4	do	--	32.0 38.0	Mar. 6, 1933 Apr. 28, 1965	C,W	S	Cased to bottom. Old well.
102	do	--	--	60	4	do	--	35.5	Apr. 28, 1965	C,W	D,S	Do.

See footnote at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-53-103	Trinidad Pena	--	--	35	5	Goliad Sand	359	21	Mar. 1933	C,W	S	
* 301	K. J. Alexander	House & Mason	1950	245	4	do	340	80	1965	--	D,S	Cased to bottom. Slotted from 224 ft to bottom.
302	do	--	1950	246	4	do	307	76.6	Apr. 29, 1965	Ng,J	Ind,S	Cased to bottom.
303	do	Alfred Morrison	1944	3,100	--	--	338	--	--	--	--	Oil test.[2]
304	Ed Pena	--	--	--	5	Goliad Sand	305	37.5	Feb. 24, 1933	C,W	S	Temp. 76°F.
305	J. D. Cage Estate	--	1913	135	5	do	--	51.5	Feb. 3, 1933	C,W	S	
306	Scott & Hopper	--	--	72	5	do	337	55.7	Feb. 26, 1933	C,W	S	
401	P. J. Boerjan	Porter Drilling Co.	1958	510	4	do	--	86	1958	C,W	S	Cased to bottom. Slotted from 488 ft to bottom.[1]
501	George Sanders	Renaldo Almoraz	1958	150	4	do	308	62	1958	C,W	S	Cased to bottom. Slotted from 140 ft to bottom.[1]
601	Scott & Hopper	--	1928	450	5	do	312	42.1	Feb. 26, 1933	C,W	D,S	
602	do	--	1915	350	5	do	365	13	Feb. 1933	C,W	S	
603	do	--	1915	350	4	do	330	14	do	C,W	S	
* 701	George Sanders	Elmer Rupp	1938	232	4	do	--	41.9	Mar. 24, 1965	C,W	S	Cased to bottom. Slotted from 211 ft to bottom.
801	do	Fritz Vollmer	1938	135	4	do	--	46.0	do	C,W	S	Cased to bottom. Slotted from 115 ft to bottom.
802	do	do	--	450	4	do	--	5	1965	C,W	S	Cased to bottom. Slotted from 410 ft to bottom.
803	do	do	--	250	4	do	--	45.0	Mar. 24, 1965	C,W	S	Cased to bottom. Slotted from 230 ft to bottom.
901	Mills Bennett Estate	Elmer Rupp	--	348	5	do	--	100	1965	C,W	S	Cased to bottom. Slotted from 328 ft to bottom.
902	James T. Maupin	--	--	2,357	--	do	352	4.0	Feb. 25, 1953	N	N	
54-101	Felix Barrera	Disbro Drilling Co.	1959	248	4	do	--	57	1960	C,W	S	Cased to bottom. Slotted from 227 ft to bottom.[1]
102	Ramos Bros.	--	1918	110	5	do	288	45.1	Feb. 3, 1933	C,W	S	

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-54-201	Mills Bennett Estate	Elmer Rupp	1942	400	5	Goliad Sand	--	113.1	Mar. 23, 1965	C,W	D,S	Cased to bottom. Slotted from 380 ft to bottom.
202	do	do	--	400	4	do	--	114.4	do	C,W	S	Do.
203	do	A. Calderon	1912	171	5	do	--	--	--	C,W	N	Cased to bottom. Open end at bottom.
204	do	--	1962	5,976	--	--	256	--	--	--	---	Oil test. 2/
301	San Antonio Loan & Trust Co.	Porter Drilling Co.	1958	275	6	Goliad Sand	--	47	1960	C,W	S	Cased to bottom. Slotted from 254 ft to bottom. 1/
302	Cage Estate	A. Calderon	1912	257	4	do	207	34.5	Dec. 15, 1932	C,W	S	Water level reported 30 ft below top of casing in April 1912.
303	do	--	1918	103	5	do	220	34.0	Feb. 3, 1933	C,W	S	
* 401	Mills Bennett Estate	Porter Drilling Co.	1957	395	7	do	--	103	1965	T,E	Ind	Cased to bottom. Slotted from 365 ft to bottom. 1/
402	do	--	--	300	5	do	--	105.2	Mar. 23, 1965	C,W	S	Cased to bottom. Open end at bottom. Old well.
403	do	--	--	350	5	do	--	100	1965	C,W	S	Cased to bottom. Old well.
404	J. D. Cage Estate	A. Calderon	1912	103	5	do	292	32.2	Feb. 3, 1933	C,W	S	
405	do	--	1908	300	5	do	280	24.6	do	C,W	S	
* 501	do	Porter Drilling Co.	1950	700	8	do	--	125	1965	T,E	D,S	Cased to bottom. Slotted from 660 ft to bottom.
502	do	Elmer Rupp	--	400	4	do	--	125	1965	J,E	D,S	Cased to bottom. Slotted from 380 ft to bottom.
503	do	--	1915	200	5	do	--	16.6 109.3	Feb. 3, 1933 Mar. 23, 1965	C,W	S	Cased to bottom. Open end at bottom.
* 601	do	--	1916	70	5	do	--	19.3 28.6	Feb. 3, 1933 Mar. 23, 1965	C,W	S	Do.
602	Lopez Bros.	--	1900	150	5	do	--	65.0 74.2	May 13, 1933 Mar. 24, 1965	C,W	S	Cased to bottom.
* 701	Luna Ranch	--	1900	100	5	do	--	89.5 96.0	Feb. 26, 1933 Mar. 24, 1965	C,W	S	
801	Mills Bennett Estate	-- Caldwell	1908	160	5	do	--	35.6 100	Feb. 3, 1933 1965	C,W	S	
802	do	Elmer Rupp	1953	406	7	do	--	100	1965	T,E	D	Cased to 385 ft. Slotted from 361 to 385 ft. 1/

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level		Method of lift	Use of water	Remarks
								Below land surface datum (ft)	Date of measurement			
BP-84-54-803	Mills Bennett Estate	Elmer Rupp	--	290	4	Goliad Sand	--	100	1965	C,W	S	Cased to bottom. Slotted from 270 ft to bottom.
804	do	do	1946	370	4	do	--	100	1965	C,W	S	Cased to bottom. Slotted from 350 ft to bottom.
805	Lopez Bros.	--	1903	175	6	do	--	32.1 70.0	Feb. 4, 1933 Mar. 24, 1965	C,W	S	Cased to bottom.
901	Domingo Garza	--	--	90	5	do	--	56.7	May 4, 1965	C,W	D,S	Old well.
902	Lazaro Lopez	--	--	80	5	do	--	53.2	do	C,W	S	Cased to bottom. Old well.
903	Cage Ranch	L. Calderon	1918	100	4	do	--	60.2	do	C,W	S	Cased to bottom.
55-101	Lasater Estate	--	--	112	5	do	--	42	Apr. 1960	N	--	Do.
102	Miller Ranch	Elmer Rupp	1940	510	5	do	179	101.7	Feb. 23, 1965	C,W	S	Cased to bottom. Slotted from 470 ft to bottom.
103	do	Domingo Navarez	1940	508	5	do	165	85.1	do	C,W	S	Cased to bottom. Slotted from 468 ft to bottom.[1]
104	do	Porter Drilling Co.	1951	550	--	do	170	107.5	do	C,W	S	Cased to bottom. Slotted from 529 ft to bottom.
105	Lasater Estate	--	--	112	5	do	170	30.4	Dec. 8, 1932	C,W	S	Temp. 72°F.
106	do	Perry Downs	1910	502	5	do	186	18.4	do	C,W	S	Reported water level in 1911 was 10 ft below top of casing.
107	do	Doug McGinnis	--	788	5	do	157	5	Dec. 1933	--	--	
* 201	W. I. Davis	Allee Porter	1956	618	8	do	140	75	1960	T,G	Irr	Cased to bottom. Estimated discharge 250 gpm. Pump set at 240 ft.
202	H. T. Hansen	Elmer Rupp	1950	600	8, 7	do	133	75	1960	T,G	Irr	Casing: 8-in. to 220 ft; 7-in. from 220 ft to bottom. Slotted from 580 ft to bottom.
203	George Frank Estate	Chester Downs	--	710	5	do	136	75.7	Apr. 19, 1960	C,W	D,S	Cased to bottom. Dry at 81 ft, Nov. 4, 1964.
204	J. E. McDonald	--	--	601	4	do	135	69.3 89.9	Apr. 19, 1960 Nov. 4, 1964	C,W	D,S	Cased to bottom.
205	Mobil Oil Co.	--	--	500?	4	do	134	73.4 72.7	Apr. 19, 1960 Nov. 3, 1964	J,Ng	Ind	Supplied water for oil field rig.
206	Miller Ranch	Elmer Rupp	--	500	4	do	148	110	1965	C,W	S	Cased to bottom. Slotted from 460 ft to bottom.
207	-- Oliver	Chester Downs	1915	730?	5	do	137	15.0	Oct. 23, 1932	C,W	D,S	Cased to bottom.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-55-208	Mrs. B. M. McCullar	Perry Downs	--	500	12	Goliad Sand	135	12.0	Oct. 23, 1932	C,W	D,S	Cased to bottom.
* 209	Miller Ranch	Rupp Drilling Co.	1938	500	4	do	151	105	Feb. 1965	C,W	S	Cased to bottom. Slotted from 479 ft to bottom.
* 210	do	Doug McGinnis	--	788	5	do	136	79	do	C,W	S	Cased to bottom.
211	do	Perry Downs	--	772	5	do	147	100	1965	C,W	D,S	Cased to bottom. Slotted from 520 ft to bottom.
212	do	Porter Drilling Co.	1961	615	7	do	140	75	1965	C,E	D	Cased to bottom. Slotted from 594 ft to bottom.1/
213	G. Trevino	Doug McGinnis	--	753	12	do	138	13.3	Nov. 30, 1932	C,W	D,S	
214	H. Obervetter	do	1907	812	5	do	132	18.7	Dec. 1, 1932	C,W	D,S	
* 301	Miller Ranch	Porter Drilling Co.	--	600	8	do	110	70	1960	T,G	Irr	Cased to bottom. Reported discharge 300 gpm. Slotted from 579 ft to bottom. Irrigates approximately 100 acres.
302	Batot Dairy	Elmer Rupp	1953	620	8	do	132	75	1960	T,G	Irr	Cased to bottom. Slotted from 599 ft to bottom. Reported irrigates approximately 50 acres.
303	Hopper Bros.	do	--	625	8	do	131	--	--	T,E, 40	Irr	Cased to bottom. Slotted from 604 ft to bottom. Reported irrigates approximately 100 acres.
* 304	R. E. Story	Porter & Rupp	1932	628	8	do	120	16.5 73.3 100.0	Oct. 21, 1932 Apr. 19, 1960 Jan. 6, 1965	T,E, 15	Irr	Cased to bottom. Reported irrigates approximately 10 acres.
305	City of Falfurrias	Carl Vickers	1958	600	12	do	120	--	--	T,E, 40	P	Cased to bottom. Reported discharge 500 gpm.
* 306	City of Falfurrias well 3	Layne-Texas Co.	1945	787	10, 5	do	116	--	--	T,E	P	Cased to 766 ft. Screen from 678 to 766 ft. Reported discharge 300 gpm.
307	City of Falfurrias well 5	Carl Vickers	1957	750	12, 8	do	120	75	1960	T,E	P	Cased to bottom. Screen from 709 ft to bottom.
* 308	City of Falfurrias well 4	Porter Drilling Co.	1954	705	12	do	112	86.6	Nov. 17, 1955	T,E	P	Cased to bottom. Slotted from 675 ft to bottom.
* 309	City of Falfurrias well 2	Layne-Texas Co.	1930	755	12, 8	do	120	20.2 29.1	Mar. 3, 1940 Nov. 3, 1943	T,E	P	Cased to bottom. Slotted from 694 ft to bottom. Screen from 676 to 737 ft.
* 310	City of Falfurrias well 1	Chester Downs	1922	749	5, 4	do	120	20.3 26.4	Apr. 3, 1940 Nov. 5, 1943	T,E	P	Cased to bottom. Slotted from 686 ft to bottom. Screen from 686 ft to bottom. Reported discharge 140 gpm.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-55-311	A. B. Watts	Perry Downs	--	770	5	Goliad Sand	117	16.7	July 31, 1933	C,W	D,S	Old well.
312	Chester Downs	do	1926	591	8	do	118	14.2	Oct. 22, 1932	C,W	D,S	
313	S.A. & A.P. RR.	-- Downing	--	810	6	do	110	11.5	Oct. 25, 1932	--	N	Reported flowed prior to 1907.
314	Mrs. Edith Bedell	--	--	18	5	do	115	6.2	Sept.25, 1933	N	N	
* 401	Miller Ranch	Chester Downs	1928	500	5	do	193	35.5 104.5	Dec. 8, 1932 Feb. 23, 1965	C,W	S	Cased to bottom.
402	do	Perry Downs	1911	487	5	do	173	32.2	Dec. 8, 1933	N	N	Cased to bottom. Slotted from 460 ft to bottom. Abandoned.
403	do	Porter Drilling Co.	1947	540	4	do	174	88.0	Feb. 23, 1965	C,W	S	Cased to bottom. Slotted from 520 ft to bottom.
404	do	Elmer Rupp	1939	570	--	do	148	41.9	do	C,W	S	Cased to bottom. Slotted from 549 ft to bottom. Screen from 549 ft to bottom.
405	Mills Bennett Estate	Perry Downs	1908	810	5	do	180	27.3 60	Feb. 3, 1933 1965	C,W	S	Cased to bottom.
* 501	Garland Lasater	Chester Downs	1913	752	5	do	145	9.0 70	Dec. 8, 1933 1965	T,E	D,S, Irr	Cased to bottom. Slotted from 712 ft to bottom.
502	do	Doug McGinnis	1901	775	8, 6	do	145	+ 70	Dec. 8, 1933 1965	Flows, C,W	S	Cased to bottom.
503	Miller Ranch	A. Calderon	--	232	5	do	133	31.2	Dec. 8, 1933	C,W	S	Cased to bottom. Slotted from 225 ft to bottom.
504	do	Porter Drilling Co.	1945	673	--	do	125	46.1	Feb. 23, 1965	C,W	S	Cased to bottom. Slotted from 642 ft to bottom.
505	do	do	1945	611	5, 4	do	123	45	1965	C,W	S	Cased to bottom. Slotted from 570 ft to bottom.1/
506	do	Domingo Navarez	1945	645	--	do	137	56.2	Feb. 3, 1965	C,W	S	Cased to bottom. Slotted from 595 ft to bottom.
601	Mobil Oil Co.	--	--	500	4	do	106	54.2	Apr. 4, 1960	N	Ind	Oil field supply well.
602	Mrs. J. S. Donahoe	--	1945	800	4	do	112	58.3	Apr. 19, 1960	J,E	D,S	
* 603	H. M. Bennett Estate	Rupp Drilling Co.	1927	742	6, 4	do	110	53.6	do	T,E	D,S	Cased to bottom.
* 604	Miller Ranch	Porter Drilling Co.	1958	807	7	do	105	55.0	Feb. 23, 1965	C,W	S	Cased to bottom. Slotted from 786 ft to bottom.1/

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-55-605	Miller Ranch	Porter Drilling Co.	1941	823	4	Goliad Sand	110	60	1965	C,W	S	Cased to bottom. Slotted from 783 ft to bottom.
606	do	do	1940	800	4	do	97	48.2	Feb. 23, 1965	C,W	S	Cased to 760 ft. Slotted from 760 ft to bottom.
607	do	do	1942	847	4	do	106	50.4	do	C,W	S	Cased to 807 ft. Slotted from 807 ft to bottom.
608	Luella Proctor	Magnolia Petroleum Co.	1948	10,500	--	--	106	--	--	--	--	Oil test.
609	George Franks	Chester Downs	--	807	6	Goliad Sand	112	.5	Oct. 23, 1932	C,W	D,S	
610	Lasater Estate	Elmer Rupp	1927	600	10	do	105	3.3	do	N	N	
611	S. B. Boykin	Chester Downs	--	720	10	do	109	4.7	July 27, 1933	C,W	D,S, Irr	
612	T. S. Proctor	Perry Downs	1909	846	5	do	100	8.4	Apr. 25, 1933	C,W	D,S	
701	Miller Ranch	Elmer Rupp	1944	550	5, 4	do	154	45	1965	C,W	S	Cased to 516 ft. Slotted from 510 ft to bottom.
702	Cage Ranch	--	1908	700	5	do	164	48.5 71.2	Feb. 4, 1933 Mar. 25, 1965	C,W	S	Cased to bottom.
703	do	Elmer Rupp	1948	520	4	do	170	55.1	Mar. 25, 1965	C,W	S	Cased to 500 ft. Slotted from 500 ft to bottom.
704	do	do	1946	600	4	do	145	52	1965	C,W	S	Cased to 580 ft. Slotted from 580 ft to bottom.
* 801	Miller Ranch	Porter Drilling Co.	1947	725	5, 4	do	144	90.0	Feb. 23, 1965	C,W	S	Cased to bottom. Slotted from 704 ft to bottom.
802	do	Elmer Rupp	1946	801	5, 4	do	127	51.2	do	C,W	S	Cased to 760 ft. Slotted from 760 ft to bottom.
803	do	do	1946	509	5, 4	do	143	54.6	Mar. 25, 1965	C,W	S	Cased to 488 ft. Slotted from 488 ft to bottom.
804	do	Chester Downs	1918	600	5	do	123	+ 50	Feb. 4, 1933 1965	Flows, C,W	S	Reported flowed 5 to 6 gpm in 1933. Cased to bottom.[1]
805	L. D. Miller well 1	Continental Oil Co.	1948	10,054	--	--	119	--	--	--	--	Oil test.[2]

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-55-901	Owen McKinney	Perry Downs	1910	647	5, 4	Goliad Sand	100	+	1933	Flows, J,E	D,S	Reported flowed 12 gpm in 1933; prior to 1907 reported flowed 75 gpm. Cased to bottom. Slotted from 614 ft to bottom. Temp. 85°F.
902	do	do	1909	909	5, 4	do	107	+	1933	C,W	S	Casing slotted from 610 to 865 ft. Reported flowed in 1933. Reported discharge 15 gpm. Temp. 87°F.
903	Cage Ranch	Elmer Rupp	1947	550	5	do	112	50	1965	C,W	S	Cased to 530 ft. Slotted from 530 ft to bottom.
* 56-101	A. L. Fitzhenry	Herb Freison	1959	637	16	do	115	78	1959	T,E	Irr	Cased to bottom. Slotted from 587 ft to bottom. Pump set at 128 ft. Reported irrigated 12 acres with 1 1/4-in. plastic hose.
* 102	Scott Farms	Elmer Rupp	--	707	5	do	95	65	1953	T,-	N	Reported well was once used for irrigation.
103	-- Longoria	--	--	--	--	?	108	15.4	Aug. 4, 1933	C,W	D,S	
104	R. B. Klump	Porter & Rupp	1929	670	10, 5	Goliad Sand	118	20.8	Dec. 6, 1932	C,W	D,S, Irr	
105	A. W. Dale	--	--	520	5	do	104	16.6	Dec. 7, 1932	C,W	N	
106	Chris Walters	M. Martinez	--	548	10	do	108	27.1	Nov. 30, 1932	C,W	S	Water became salty in 1930.
201	-- Askey	Elmer Rupp	1953	603	7	do	95	65	1953	T,-	N	Reported well was once used for irrigation.
202	C. H. Rupp	do	1950	650	10	do	100	--	--	T,E	N	Well not used in 1964 or 1965. Needs to be reworked.
* 203	do	Porter Drilling Co.	1960	680	12	do	90	75	1960	T,E, 40	Irr	Cased to bottom. Slotted from 645 ft to bottom. Measured discharge 352 gpm. Reported irrigates 120 acres of oats. Temp. 87°F.
* 204	Neil Rupp	Chester Downs	1920	488	8, 6	do	95	21.8 75	Oct. 21, 1932 1960	T,E, 40	D,S, Irr	Cased to bottom. Reported irrigates 100 acres. Reported discharge 250 gpm.
205	East Ward School	Elmer Rupp	--	478	5	do	100	11.2	May 19, 1965	N	N	
206	D. J. Gross	Chester Downs	1914	608	5	do	93	104.2	do	C,W	S	Formerly used to irrigate 5 acres of citrus trees.
207	J. H. Loving	Porter & Rupp	1928	621	5	do	91	10.0 106.1	May 30, 1933 May 19, 1965	C,W	D,S	Formerly used to irrigate 4 acres of citrus trees.
208	W. G. Schutz	Chester Downs	--	640	5	do	98	17.4 101.7	Dec. 8, 1932 May 19, 1965	C,W	D,S	
209	A. Rupp	Elmer Rupp	1923	612	5	do	100	19.1 76.3	Oct. 21, 1932 May 19, 1965	N	N	Formerly used to irrigate 10 acres of vegetables and citrus trees.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-56-210	Juan Garza	Chester Downs	--	518	4	Goliad Sand	100	89.1	May 19, 1965	C,W	D,S	Formerly irrigated 1 acre of citrus trees.
211	A. Rupp	do	1910	472	5	do	95	79.2	Feb. 11, 1957	C,W	D,S	Observation well.
212	J. B. Dekle	Porter & Rupp	1930	505	8	do	99	15.8	Dec. 7, 1932	C,W	D,S, Irr	
301	D. J. Sullivan	Porter Drilling Co.	1953	588	12	do	80	56	1953	T,E	Irr	Cased to 569 ft. Slotted from 548 to 569 ft. Reported irrigates 165 acres of grain.
* 302	do	do	1953	481	12	do	75	70	1960	T,E, 75	Irr	Cased to bottom. Slotted from 460 ft to bottom. Reported discharge 300 gpm. Reported irrigates 169 acres.
303	do	Schrock & Rupp	1927	565	4	do	80	1.0	Mar. 22, 1953	C,W	S	
304	do	Porter & Rupp	1930	640	5	do	82	10.0	do	C,W	S	
305	do	Perry Downs	--	600	4	do	75	12.0	do	C,W	D,S	
401	John F. Maher	--	1957	1,000	10	do	125	30	1960	T,G	Irr	Oil test; converted to water well. Cased to bottom. Slotted from 800 to bottom. Irrigates 80 acres.
402	Lois L. Maher	Disbro Drilling Co.	1959	840	4	do	115	27.5	June 29, 1960	C,W	S	Cased to bottom. Slotted from 819 ft to bottom.[1]
403	F. D. Orth	Porter Drilling Co.	1964	707	12, 8	do	96	60	1965	T,G	Irr	Cased to bottom. Slotted from 607 ft to bottom. Reported irrigates 130 acres.
404	Brooks County Airport	do	--	700	4	do	107	116	1965	T,E	P,D	Cased to 660 ft.
405	Robert Blumer	O. M. Boone	1929	535	6	do	98	8.2 97.3	Dec. 9, 1932 May 19, 1965	--	S	Cased to bottom.
406	Ysidro Villareal	Chester Downs	--	640	6	do	100	24.5	Dec. 21, 1932	C,W	D,S	Do.
407	John Riley	do	--	540	8	do	89	11.6	do	C,W	D,S	
501	J. M. Alinez	Elmer Rupp	1953	600	8, 7	do	104	80 86.6	1960 Apr. 20, 1965	T,E, 15	Irr	Cased to bottom. Slotted from 560 ft to bottom. Reported discharge 240 gpm in 1965. Irrigates about 70 acres.
502	N. W. Chamberlain	Porter Drilling Co.	1951	500	7	do	100	75	1960	T,E, 5	D,S, Irr	Cased to bottom. Slotted from 460 ft to bottom. Stopped irrigation in 1953.
503	do	Elmer Rupp	1950	600	6	do	98	83.4 104.8	June 22, 1960 May 19, 1965	C,W	S	Cased to bottom. Slotted from 560 ft to bottom. Not used for irrigation since 1951.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*BP-84-56-504	Garland Lasater	Porter Drilling Co.	--	500	4	Goliad Sand	85	80	1965	C,W	S	Cased to bottom. Slotted from 460 ft to bottom.
505	do	do	--	550	4	do	98	80	1965	C,W	S	Cased to bottom. Slotted from 510 ft to bottom.
506	do	--	--	500	4	do	90	80	1965	C,W	S	Cased to bottom. Slotted from 460 ft to bottom.
* 507	J. M. Alinez	Porter Drilling Co.	1964	500	8	do	90	78	1965	T,E	Irr	Cased to bottom. Slotted from 475 ft to bottom.
508	D. J. Sullivan	Carl Vickers	1959	505	7	do	84	70	1959	C,W	S	Cased to bottom. Slotted from 494 ft to bottom.1/
509	T. D. Chamberlain	W. Zimmerman	1929	660	10	do	97	96.6	May 19, 1965	C,W	S	Cased to bottom.
601	D. J. Sullivan	Porter Drilling Co.	1953	597	12	do	80	--	--	N	N	Abandoned. Reported water salty.
602	do	Porter & Rupp	1928	700	4	do	80	74.6	May 4, 1965	C,W	S	Cased to bottom. Slotted from 649 ft to bottom.
603	do	Friesan Drilling Co.	1963	543	--	do	90	--	--	C,W	S	Cased to bottom. Slotted from 510 ft to bottom.1/
604	do	--	--	630	5	do	97	10.5	May 4, 1965	C,W	S	Old well.
* 701	Garland Lasater	Porter Drilling Co.	1958	450	4	do	100	75	1965	C,W	S	Cased to bottom. Slotted from 408 ft to bottom.
702	O. P. Alinez	Rupp Drilling Co.	1956	477	4	do	110	84.2	Mar. 9, 1965	C,W	D,S	Cased to bottom. Slotted from 435 ft to bottom.
703	J. E. Henslty well 1	Sun Oil Co.	1948	7,493	--	--	98	--	--	--	--	Oil test.
* 801	D. J. Sullivan	--	1940	700	12	Goliad Sand	90	--	--	T,E	D,Ind	Cased to bottom.
802	do	Porter & Rupp	1932	540	5	do	95	9.5 70	Mar. 23, 1933 1965	J,E	D,S	Do.
803	Margarita Perez	do	1925	598	6	do	100	22.6	June 1, 1933	C,W	D,S	
804	D. J. Sullivan	Perry Downs	--	1,007	5	do	98	22.8	Mar. 22, 1933	C,W	D,S	
901	do	Elmer Rupp	--	535	4	do	80	74.9	May 4, 1965	C,W	S	Cased to bottom. Slotted from 495 ft to bottom.
* 902	do	Porter & Rupp	1930	671	5	do	85	3.7 71.1	Mar. 23, 1933 May 4, 1965	C,W	S	Cased to bottom. Slotted from 626 ft to bottom.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-56-903	Mrs. J. F. Dawson	Zimmerman Bros.	1909	697	5	do	80	16.5	Mar. 22, 1933	C,W	D,S	
61-101	Hopper Bros.	Porter Drilling Co.	1964	403	5	do	--	42	1965	C,W	S	Cased to bottom. Slotted from 183 ft to bottom.[1]
201	J. C. Saunders	--	--	--	--	do	315	28	Mar. 1933	C,W	S	
* 301	R. S. Mims	Porter Drilling Co.	1963	287	8	do	--	70	1965	T,E	Irr	Cased to bottom. Slotted from 251 ft to bottom. Reported discharge 175 gpm. Reported drawdown 80 ft.
302	Richard Myrick	--	--	150	--	do	325	120.4	May 4, 1965	C,W	S	Cased to bottom. Slotted from 130 ft to bottom.
303	K. J. Alexander	--	--	90	5	do	--	64.8	May 10, 1965	C,W	S	Cased to bottom; open end.
401	Hopper Bros.	--	--	90	5	do	--	81.8	May 18, 1965	C,W	D,S	Cased to bottom.
402	F. H. Knight	--	1955	60	5	do	312	21.9	May 13, 1933	C,W	S	
501	do	Porter Drilling Co.	1955	350	4	do	309	15	1965	C,W	S	Cased to bottom. Slotted from 330 ft to bottom.
502	Hopper Bros. well 1	Herd, Welch & Chizum	1955	6,005	--	do	309	--	--	--	--	Oil test.
503	F. H. Knight	--	1915	42	4	?	307	29.0	May 13, 1933	C,W	S	
504	J. C. Saunders	--	--	100	4	Goliad Sand	307	26	Mar. 1933	C,W	S	
505	do	--	--	79	4	do	307	32	do	C,W	S	
* 601	K. J. Alexander	Fritz Volmer	--	375	5	do	--	+	1933	Flows	S	Estimated flow 60 gpm in 1933. Estimated discharge 20 gpm. Slotted from 354 ft to bottom. Temp. 80°F.
602	W. W. Jones	--	--	90	5	do	306	35	Mar. 1933	C,W	S	
* 901	do	do	1953	375	4	do	--	10.6	May 10, 1965	C,W	S	Cased to bottom. Slotted from 354 ft to bottom.
62-101	Mary Powers	--	--	400	15	do	290	37.5	Apr. 4, 1933	C,W	S	Do.
102	Charles Hoffman	J. M. Calderon	1896	90	6	do	252	42.0	do	C,W	S	
201	Jack Casey	--	--	220	5	do	--	80.0	May 18, 1965	C,W	S	Cased to bottom.
202	do	--	--	200	4	do	--	77.5	do	C,W	S	Do.
203	Cage Estate	--	1910	75	5	do	245	52.5	Feb. 3, 1933	C,W	S	

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-62-301	Cage Ranch	Porter Drilling Co.	1937	510	5	Goliad Sand	--	60.3	May 17, 1965	C,W	S	Cased to bottom. Slotted from 489 ft to bottom.
302	Cage Estate	Doug McGinnis	1913	231	5	do	212	39.0	Mar. 4, 1933	C,W	S	
* 401	K. J. Alexander	--	--	100	5	do	--	60.0	May 10, 1965	C,W	S	Cased to bottom. Slotted from 80 ft to bottom.
* 402	do	--	--	300	5	do	--	41.1	do	C,W	S	Cased to bottom. Slotted from 260 ft to bottom.
501	do	Fritz Vollmer	1955	450	4	do	--	+	do	Flows	S	Cased to bottom. Slotted from 410 ft to bottom. Reported discharge 15 gpm.
502	W. W. Jones	--	--	150	6	do	255	52.3	May 18, 1965	C,W	S	
503	Cage Estate	Chester Downs	1918	550	5	do	230	32.6	Feb. 4, 1933	C,W	S	
601	Cage Ranch	Porter Drilling Co.	1938	529	5	do	--	55.7	May 17, 1965	C,W	S	Cased to bottom. Slotted from 501 ft to bottom.
602	Cage Estate	Chester Downs	1926	580	4	do	200	13	Feb. 4, 1933	C,W	S	
* 701	W. W. Jones II	--	--	370	4	do	--	+ +	May 18, 1933 Jan. 18, 1965	Flows	S	Cased to bottom. Reported flow 10 gpm. Old well. Temp. 79°F.
* 702	K. J. Alexander	Fritz Vollmer	1953	390	4	do	--	+	May 10, 1965	Flows	S	Cased to bottom. Slotted from 350 ft to bottom. Estimated flow 10 gpm.
703	Atlantic Refining Co.	--	--	3,600	--	--	244	--	--	--	--	Oil test.
801	K. J. Alexander	Cecil Albrecht	--	370	12	Goliad Sand	--	+	May 10, 1965	Flows	S	Cased to bottom. Estimated flow 25 gpm.
901	Cage Estate	--	1908	200	5	do	253	67.6	Feb. 4, 1933	C,W	S	
* 63-101	Cage Ranch	Porter Drilling Co.	1963	535	5	do	120	56	1965	T,E	D,S	Cased to bottom. Slotted from 495 ft to bottom.
102	do	Elmer Rupp	1947	550	7, 5	do	150	55.9	Mar. 25, 1965	C,W	D,S	Cased to bottom. Slotted from 510 ft to bottom.
103	do	Porter Drilling Co.	1961	640	5	do	157	61.3	Mar. 15, 1965	C,W	S	Cased to bottom. Slotted from 600 ft to bottom.
104	J. L. Cage well 1	Shell Oil Co.	1948	7,736	--	--	160	--	--	--	--	Oil test.
* 201	Cage Ranch	Chester Downs	--	672	5, 4	Goliad Sand	128	48.4	Mar. 25, 1965	C,W	S	Cased to bottom. Slotted from 632 ft to bottom.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-63-202	Cage Ranch	Porter Drilling Co.	1962	670	5	Goliad Sand	125	46.2	Mar. 25, 1965	C,W	S	Cased to bottom. Slotted from 630 ft to bottom.
301	do	--	1937	642	7	do	110	34.8 53.1	Apr. 19, 1960 Oct. 14, 1964	C,W	S	Cased to bottom.
302	United Carbon Co.	--	--	100	4	do	110	--	--	T,E	Ind	Cased to bottom. Plant shut down, well not used. Old well.
303	Texas Highway Dept.	Rupp Drilling Co.	1947	280	6	do	110	--	--	T,E, 5	Irr	Cased to bottom. Slotted from 240 ft to bottom. Reported irrigates grass on roadside park.
* 304	J. R. Murphy	-- Conroe	--	600	10	do	120	48	1965	T,E, 20	Irr	Oil test; converted to water well. Cased to bottom. Measured discharge 200 gpm. Pumping level after 8 hours 93.1 ft. Perforated from 548 ft to bottom.
* 305	J. M. Brooks	Perry Downs	1907	783	5	do	110	+	Feb. 27, 1933	Flows, C,W	S	Reported flowing Feb. 27, 1933. Cased to bottom. Slotted from 688 ft to bottom.
* 306	do	--	1950	350	4	do	115	--	--	C,W	S	Cased to bottom. Slotted from 330 ft to bottom.
307	J. W. Freeman	-- Rupp	1925	465	4	do	120	14.0	Jan. 17, 1933	C,W	D,S	
308	Cage Estate	--	--	188	5	do	113	6.4	Feb. 27, 1933	N	N	
501	Cage Ranch	Perry Downs	1903	526	5	do	152	36.2	Apr. 19, 1960	C,W	S	Reported flowed when first drilled.
502	do	Porter Drilling Co.	1963	514	5	do	154	52.1	Mar. 25, 1965	C,W	S	Cased to bottom. Slotted from 494 ft to bottom.
503	do	do	1961	550	5	do	144	55	1965	C,W	S	Cased to bottom. Slotted from 530 ft to bottom.
601	do	Chester Downs	--	502	4	do	123	7.1 40.4 51.7	Jan. 24, 1950 Apr. 14, 1960 Oct. 15, 1964	C,W	S	Cased to bottom. Old well.
* 602	King Ranch	--	--	640	6	do	122	39.1 50.0	Apr. 14, 1960 Nov. 4, 1964	C,W	S	Do.
603	C. F. Wagenschein	Porter & Rupp	1931	459	4	do	132	16.5 60.0	May 5, 1933 Mar. 4, 1965	C,W	D,S	Cased to bottom. Slotted from 419 ft to bottom.
* 604	do	--	1947	460	4	do	135	65	1965	J,E	D,S	Cased to bottom. Slotted from 420 ft to bottom.
605	do	--	1945	460	4	do	145	65	1965	C,W	S	Do.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date com-plet-ed	Depth of well (ft)	Diam-eter of well (in.)	Water-bear-ing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-63-606	R. J. Kleberg	Chester Downs	1917	840	5	Goliad Sand	130	12.0	Feb. 28, 1933	C,W	S	
* 701	Hopper Bros.	--	1940	1,380	4	Oakville Sand-stone	175	+	Mar. 9, 1965	Flows	S	Cased to bottom. Slotted from 1,340 ft to bottom.
702	do	--	--	1,300	4	do	164	+	do	Flows	S	Cased to bottom. Slotted from 1,260 ft to bottom.
801	Ed Rachal Estate	Elmer Rupp	--	610	5	Goliad Sand	146	66.9	May 17, 1965	C,W	S	Cased to bottom. Slotted from 570 ft to bottom.
802	do	--	--	650	4	do	154	69.2	do	C,W	S	Cased to bottom. Slotted from 610 ft to bottom.
803	Cage Estate	Perry Downs	1903	526	5	do	160	7.0	Feb. 14, 1933	C,W	S	Reported flowed when drilled.
901	W. T. Eldridge	Chester Downs	1917	480	4	do	141	24.0 66.8 76.1	Jan. 24, 1933 Apr. 19, 1960 Oct. 15, 1964	C,W	S,Ind	Cased to bottom. Reported used occasionally for highway construction. Not used in 1965.
902	Ed Rachal Estate	Elmer Rupp	--	560	5	do	152	62.7	May 17, 1965	C,W	S	Cased to bottom. Slotted from 520 ft to bottom.
903	do	--	--	600	5	do	153	67.1	do	C,W	S	Cased to bottom.
64-101	C. F. Wagenschein	--	--	46	4	?	100	11.2	June 1, 1933	C,W	S	
* 201	D. J. Sullivan	--	--	615	5	Goliad Sand	100	7.8 55.2	Mar. 23, 1965 May 4, 1965	C,W	S	Cased to bottom. Slotted from 575 ft to bottom.
202	do	Porter & Rupp	1930	580	5	do	91	11.1 65.6	Mar. 22, 1933 May 4, 1965	C,W	S	Cased to bottom. Slotted from 540 ft to bottom.
203	do	Freisan Drilling Co.	1962	492	4	do	93	44	1965	C,W	S	Cased to bottom. Slotted from 457 ft to bottom.[1]
* 301	do	Carl Vickers	1962	714	4	do	86	67.0	May 14, 1965	C,W	S	Cased to bottom. Slotted from 693 ft to bottom.[1]
* 302	do	--	--	650	5	do	80	60	1965	C,W	D,S	Cased to bottom. Slotted from 610 ft to bottom.
303	do	-- Hubble	1905	625	8	do	88	12.6 62.2	Mar. 23, 1933 May 4, 1965	C,W	S	Cased to bottom.
304	do	--	--	--	4	?	75	9.5	Mar. 23, 1933	C,W	S	
401	King Ranch	Chester Downs	1916	517	5	Goliad Sand	104	5.0 46.8	Feb. 8, 1933 Jan. 27, 1965	C,W	S	Cased to bottom. Reported flowed 3 gpm in January 1916.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-84-64-402	King Ranch	--	--	600	5	Goliad Sand	102	50	1965	C,W	S	Cased to bottom.
403	D. J. Sullivan	--	--	600	7	do	96	--	--	C,W	S	Cased to bottom. Slotted from 560 ft to bottom.
501	do	--	1908	--	7	?	98	10.7	Mar. 23, 1933	C,W	S	
* 601	do	--	--	700	4	Goliad Sand	80	60.1	May 4, 1965	C,W	S	Cased to bottom. Slotted from 660 ft to bottom.
602	King Ranch	Chester Downs	1928	829	5	do	71	3.5 41.2	Feb. 28, 1933 Jan. 27, 1965	C,W	S	Cased to bottom. Slotted from 800 ft to bottom.
603	D. J. Sullivan	Carl Vickers	1962	582	4	do	75	61.0	May 4, 1965	C,W	S	Cased to bottom. Slotted from 540 ft to bottom.
604	King Ranch	do	1962	571	5	do	79	40.7	Jan. 27, 1965	C,W	S	Cased to bottom. Slotted from 531 ft to bottom.
605	D. J. Sullivan	--	--	8,981	--	--	88	--	--	--	--	Oil test.
701	King Ranch	Porter Drilling Co.	1959	652	5	Goliad Sand	135	76.8	May 18, 1960	C,W	S	Cased to bottom. Slotted from 631 ft to bottom.
801	do	Elmer Rupp	1951	604	5	do	95	63.3	do	C,W	S	Cased to bottom. Slotted from 583 ft to bottom.
802	do	Carl Vickers	1962	582	5	do	85	--	--	C,W	S	Cased to bottom. Slotted from 542 ft to bottom.
803	R. J. Kleberg	Chester Downs	1914	684	5	do	110	12.8	Feb. 28, 1933	C,W	S	
901	do	do	1910	648	5	do	70	+	do	C,W	S	Cased to bottom. Slotted from 588 ft to bottom. Estimated flow in 1933, 5 gpm.
87-05-301	W. W. Jones II	--	--	150	5	do	270	36.0 41.1	May 18, 1933 Jan. 18, 1965	C,W	S	Cased to bottom.
302	do	--	--	150	5	do	281	40.0	May 18, 1933	C,W	S	
* 601	do	--	--	373	4	do	240	+ +	May 18, 1933 Jan. 18, 1965	Flows	S	Cased to bottom. Estimated flow 155 gpm in 1933, and 100 gpm in 1965.
602	Garcia Ramos	--	--	350	4	do	249	30.0	Mar. 17, 1933	C,W	D,S	Cased to bottom.
901	J. G. Garcia	Calderon Bros.	1925	107	5	do	284	26.5	do	C,W	D,S	
902	Garcia Ramos	do	1923	123	5	do	272	24.7	do	C,W	S	

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date com-plet-ed	Depth of well (ft)	Diam-eter of well (in.)	Water-bear-ing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-87-06-101	Garcia Ramos	--	--	370	4	Goliad Sand	252	+ +	May 18, 1933 Jan. 18, 1965	Flows	S	Estimated flow 6 gpm in 1933, and 5 to 8 gpm in 1965. Temp. 81°F.
201	Adolpho Garcia	Cecil Albright	--	238	--	do	270	66.7	Mar. 17, 1933	N	N	
* 301	Hopper Bros.	--	--	650	5	do	204	72.4	Mar. 9, 1965	C,W	S	Cased to bottom.
302	Amando Trad	Humble Oil & Refining Co.	--	6,991	--	--	225	--	--	--	--	Oil test.
303	Scott & Hopper well 3	do	1946	7,371	--	--	210	--	--	--	--	Do.
401	W. W. Jones II	--	--	150	4	Goliad Sand	262	58.5 58.8	May 18, 1933 Jan. 18, 1965	C,W	S	Cased to bottom.
402	do	--	--	150	5	do	262	86.0 79.5	May 18, 1933 Jan. 18, 1965	C,W	S	Do.
* 501	Elijio Garcia	--	--	100	5	do	280	76.2	May 5, 1965	C,W	S	Cased to bottom. Slotted from 80 ft to bottom. Old well.
502	Adolpho Garcia	Chester Downs, Jr.	1932	258	8	do	300	93.7	Mar. 17, 1933	J,G	D,S	
* 601	Estaban Garcia	Porter Drilling Co.	1953	458	10	do	270	70	1960	T,Ng	Irr	Cased to bottom. Slotted from 437 ft to bottom. Reported not used for irrigation in several years.
602	Hopper Bros.	do	1945	600	5	do	230	75.0	Mar. 9, 1965	C,W	S	Cased to bottom.
603	Estaban Garcia	Chester Downs	1913	470	5	do	265	100	1965	J,E	D,S	Do.
* 604	Elijio Garcia	Cecil Albrecht	1930	365	6	do	282	100	1965	T,E	D,S	Cased to bottom. Slotted from 350 ft to bottom.
605	Estaban Garcia	O. M. Boone	1926	550	5	do	265	96.3 115.0	Mar. 17, 1933 May 5, 1965	C,W	D,S	Cased to bottom.
606	Adalpho Garcia	Calderon Bros.	1910	120	8	do	250	69.5	Mar. 17, 1933	C,W	D,S	
* 701	W. W. Jones II	--	1921	150	5	do	270	69.0 72.8	May 18, 1933 Jan. 18, 1965	C,W	D,S, Irr	Cased to bottom.
702	do	--	1931	158	5	do	245	26.5	May 18, 1933	C,W	S	Do.
703	do	--	--	150	5	do	257	25.2	do	C,W	S	
704	A. C. Jones	--	--	150	5	do	248	54.0	do	C,W	S	
* 801	Elijio Garcia	Sea Cat Drilling Co.	1965	280	4	do	268	134.2	May 5, 1965	C,W	S	Cased to bottom. Slotted from 260 ft to bottom.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-87-06-802	W. W. Jones II	--	1931	147	5	Goliad Sand	270	35.0 52.0	May 18, 1933 Jan. 18, 1965	C,W	S	Cased to bottom.
803	Elijio Garcia	Humble Oil & Refining Co.	1942	200	4	do	298	109.8	May 5, 1965	C,W	S	Cased to bottom. Slotted from 180 ft to bottom.
804	Braulia D. Garcia	Standard Oil Co. of Texas	1963	6,999	--	--	269	--	--	--	--	Oil test.
805	do	Calderon Bros.	1908	100	5	Goliad Sand	330	54.7	Mar. 17, 1933	C,W	D,S	
* 901	Elijio Garcia	Stanley Haines	1963	320	5	do	255	114.1	May 5, 1965	C,W	S	Cased to bottom. Slotted from 268 ft to bottom.[1]
07-101	Hopper Bros.	Porter Drilling Co.	1962	300	4	do	183	72.1	Mar. 9, 1965	C,W	S	Cased to bottom. Slotted from 279 ft to bottom.[1]
102	do	Elmer Rupp	--	650	5	do	170	50	1965	C,W	S	Cased to bottom. Slotted from 610 ft to bottom.
* 201	do	Porter Drilling Co.	1946	650	6	do	165	75	1965	T,E	D,S	Cased to bottom. Slotted from 610 ft to bottom.
202	do	--	--	730	5	do	165	--	--	C,W	D,S	Cased to bottom. Slotted from 560 ft to bottom.
301	King Ranch	Chester Downs	--	600	5	do	130	32.3 60.7	Jan. 24, 1933 May 18, 1960	C,W	S	Cased to bottom. Old well.
302	Ed Rachal	--	1948	400	4	do	135	55.2 56.4	Apr. 19, 1960 Oct. 15, 1964	C,W	S,Ind	Cased to bottom. Reported has been used for highway construction.
* 401	Hopper Bros.	Porter Drilling Co.	1945	600	4	do	212	77.6	Mar. 9, 1965	C,W	S	Cased to bottom. Slotted from 560 ft to bottom.
402	J. P. Ruelas	Fabricio Barrera	1962	150	4	do	202	80.4	Mar. 10, 1965	C,W	S	Cased to bottom. Slotted from 130 ft to bottom.
403	Mrs. B. A. Skinner	--	--	600	5	do	187	--	--	C,W	S	Cased to bottom. Old well.
404	Longoria Estate	Calderon Bros.	1918	140	5	do	222	70.6	Mar. 14, 1933	C,W	S	
405	Felicita Lopez	do	1907	150	5	do	227	87.0	Mar. 13, 1933	C,W	D,S	
501	Hopper Bros.	Elmer Rupp	1931	650	--	do	151	50	1965	C,W	S	
502	B. A. Skipper well 3	Humble Oil & Refining Co.	1945	3,056	--	--	162	--	--	--	--	Oil test.
503	Scott & Hopper	--	--	602	5	Goliad Sand	165	50.0	Apr. 5, 1933	C,W	S	

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*BP-87-07-601	Humble Oil & Refining Co.	Layne-Texas Co.	1948	1,411	6	Goliad Sand	130	--	--	T,E	D,P, Ind	Drilled to 1,411 ft; plugged back to 550 ft. Screen from 339-361, 352-403, 446-506, and 528-549 ft.
602	do	do	1945	599	6, 4	do	132	--	--	N	N	Cased to bottom. Screen from 445 ft to bottom.
603	do	do	1953	1,567	6	Goliad Sand and Oakville Sandstone	133	+	1965	Flows	D,P	Cased to 1,505 ft. Screen from 337-350, 447-460, 517-530, and 1,485-1,505 ft.
* 604	Brooks County Independent School District	Elmer Rupp	1948	400	6	Goliad Sand	125	70	1960	T,E	P	Cased to bottom. Slotted from 305 ft to bottom. Supplies water for school.
605	Jose Ramos	Enero Abrigo	1921	50	4	?	125	40.9	Feb. 18, 1940	C,W	D,S	Cased to bottom.
606	J. R. Canales	--	--	42	4	?	125	37.5 39.7	Sept.22, 1933 Apr. 18, 1939	C,W	D,S	Do.
* 607	J. J. Hinojosa	Fritz Vollmer	1939	336	4	Goliad Sand	128	36.2	Feb. 18, 1949	J,E	D,S	Cased to bottom. Slotted from 300 ft to bottom.
608	P. Mangel, Jr.	--	1937	45	4	?	128	41.2	Feb. 7, 1941	C,W	S	Cased to bottom.
609	N. Santos	Enero Abrigo	1920	42	4	?	128	41.1	Feb. 18, 1940	C,W	D,S	Do.
610	Nicolas Cantu	--	1940	64	4	?	125	42.9	Feb. 5, 1943	C,W	D,S	Do.
* 611	Catholic Church of Encino	Moore Drilling Co.	1963	352	4	Goliad Sand	127	50.1	Mar. 25, 1965	J,E	P	Cased to 312 ft. Slotted from 312 ft to bottom.
701	Florencio Rodriquez	--	1947	340	3	do	207	89.7 90.0	Apr. 19, 1960 Oct. 15, 1964	C,W	D,S	Cased to bottom. Slotted from 319 ft to bottom.
702	do	Calderon Bros.	1924	130	5	do	205	84.2 86.9	Apr. 19, 1960 Oct. 15, 1964	N	N	Abandoned.
703	E. Villareal	--	--	324	4	do	213	90.0 95.3	Apr. 19, 1960 Oct. 15, 1964	C,W	D,S	Cased to bottom.
* 704	T. G. Mangel	--	--	600	5	do	229	131.4 132.8	Apr. 19, 1960 Oct. 15, 1964	C,W	D,S	Drilled as an oil field supply well.
705	E. Villareal	Calderon Bros.	1926	138	5	do	192	72.6 83.1	Mar. 14, 1933 Mar. 10, 1965	C,W	D,S	Cased to bottom.
801	Juan Longoria	do	1928	300	4	do	173	70 81.7	Apr. 1960 Oct. 15, 1965	C,W	D,S	Well has been reworked and deepened from 100 to 300 ft.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-87-07-901	B. A. Skipper	Porter Drilling Co.	1959	355	6	Goliad Sand	172	86	1959	C,W	S	Cased to bottom. Slotted from 334 ft to bottom.1/
902	Texas Drive-In	Pat Moore	1963	385	4	do	119	50	1965	J,E	P	Cased to bottom. Slotted from 345 ft to bottom.
903	Hopper Bros.	Elmer Rupp	--	350	4	do	113	50	1965	C,W	S	Cased to bottom. Slotted from 330 ft to bottom.
904	Mrs. B. A. Skipper	Porter & Rupp	1925	365	8, 5	do	122	25.0 56.0	Jan. 24, 1933 Mar. 9, 1965	C,W	S	Cased to bottom. Slotted from 345 ft to bottom.
905	do	Elmer Rupp	--	600	5	do	125	60	1965	C,W	S	Cased to bottom. Slotted from 580 ft to bottom.
* 08-101	King Ranch	do	1947	1,600	5	Oakville Sandstone	120	+	1960	Flows, T,E,5	D,S	Estimated flow 15 gpm in 1960. Supplies water for 4 families.
102	do	Carl Vickers	1963	585	7	Goliad Sand	123	25	1965	T,E	D,S	Cased to 545 ft. Slotted from 545 ft to bottom.
103	do	Elmer Rupp	--	571	5	do	125	41.1	Jan. 26, 1965	C,W	S	Cased to bottom. Slotted from 531 ft to bottom.
201	do	--	--	650	8	do	103	25	1965	C,W	S	Old well.
202	do	Elmer Rupp	1949	550	5	do	100	28.2	Jan. 26, 1965	C,W	S	Cased to bottom. Slotted from 530 ft to bottom.
203	do	Carl Vickers	1962	545	5	do	87	27.2	do	C,W	S	Cased to bottom. Slotted from 504 ft to bottom.
301	do	Chester Downs	1918	817	5	do	73	+ 20	Feb. 28, 1933 1965	C,W	S	Estimated flow 8 gpm in 1933. Well stopped flowing in 1960. Temp. 84°F.
302	do	Elmer Rupp	1949	550	5	do	63	25.6	Jan. 26, 1965	C,W	S	Cased to bottom. Slotted from 510 ft to bottom.
303	do	Carl Vickers	--	685	5	do	74	--	--	C,W	S	Cased to bottom. Slotted from 645 ft to bottom.
401	Victor Cantu	Friesen Well Service	1962	379	4	do	111	60	1965	C,W	S	Cased to bottom. Slotted from 358 ft to bottom.1/
* 501	King Ranch	Carl Vickers	1962	580	4	do	87	25.0	Jan. 26, 1965	C,W	S	Cased to bottom.
502	R. J. Kleberg	--	--	35	5	?	90	10.7	Feb. 2, 1933	N	N	
503	do	--	--	52	5	?	85	14.3	do	N	N	

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*BP-87-08-601	King Ranch	Chester Downs	1921	782	5	Goliad Sand	68	+ 20	Mar. 1, 1933 1965	Flows, C,W	S	Cased to bottom. Slotted from 702 ft to bottom.1/
* 801	do	Elmer Rupp	1955	660	6	do	73	24.8 32.6	May 18, 1960 Jan. 26, 1965	C,W	S	Cased to bottom. Slotted from 639 ft to bottom.
802	do	Humble Oil & Refining Co.	1957	9,477	9	--	79	--	--	--	--	Oil test.
* 901	do	Carl Vickers	1962	2,312	4	Oakville Sandstone	65	+	1965	Flows	S,Ind	Cased to 1,785 ft. Slotted from 1,785 ft to bottom.
13-301	Humble Oil & Refining Co.	--	--	300	4	Goliad Sand	245	90.8	May 24, 1960	N	Ind	Oil-field supply well. Not used.
* 601	McGill Bros.	Porter Drilling Co.	1961	350	4	Lagarto Clay	252	78.2	Apr. 29, 1965	C,W	S	Cased to 310 ft. Slotted from 310 ft to bottom.
602	do	--	--	350	5	do	255	--	--	C,W	N	Abandoned.
901	do	Humble Oil & Refining Co.	1947	6,820	--	--	234	--	--	--	--	Oil test.
14-101	W. W. Jones II	--	--	150	5	Goliad Sand	230	53.5 56.7	May 18, 1933 Jan. 18, 1965	C,W	S	Cased to bottom.
201	Elijio Garcia	Humble Oil & Refining Co.	1940	250	4	do	241	100	1965	C,W	S	Cased to bottom. Slotted from 230 ft to bottom.
202	Allen Land & Cattle Co.	--	--	100	5	do	251	32	Apr. 1933	C,W	S	
203	do	--	--	120	4	do	220	40	do	C,W	S	
301	Matilde Martinez Estate	--	--	80	96	do	216	43.0 65.2	Aug. 20, 1933 Apr. 19, 1960	C,W	D,S	Dug well; lined with stone partway to bottom.
302	J. G. Garcia	-- Dickens	1907	110	5	do	216	37.2	Mar. 16, 1933	C,W	S	
* 401	McGill Bros.	Elmer Rupp	1936	801	4	do	235	70	1965	T,E	D,S	Cased to bottom. Slotted from 760 ft bottom.
402	do	Humble Oil & Refining Co.	1958	8,690	9	--	229	--	--	--	--	Oil test.
* 501	do	Elmer Rupp	--	653	4	Goliad Sand	210	60.2	Apr. 29, 1965	C,W	S	Cased to bottom. Slotted from 611 ft to bottom.
* 601	W. W. Jones II	--	--	700	10	do	175	+	Jan. 18, 1965	Flows	S	Estimated flow 25 gpm. Temp. 91°F.

See footnotes at end of table.

Table 5.--Records of wells--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Diameter of well (in.)	Water-bearing unit	Altitude of land-surface (ft)	Water level: Below land surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
BP-87-14-602	W. W. Jones II	Milam Drilling Co.	--	150	6	Goliad Sand	201	61.0 78.2	May 18, 1933 Jan. 18, 1965	C,W	S	Cased to bottom.
603	do	--	--	150	4	do	177	41.0 67.9	May 18, 1933 Jan. 18, 1965	C,W	S	Do.
701	McGill Bros.	Elmer Rupp	1935	150	4	do	222	70.4	Apr. 29, 1965	C,W	S	
702	do	Humble Oil & Refining Co.	--	1,000	4	Oakville Sandstone	220	+	do	Flows	S	
703	Allen Land & Cattle Co.	--	--	60	5	Goliad Sand	222	45.0	Apr. 10, 1933	C,W	S	
801	do	--	--	120	6	do	212	25.0	do	C,W	S	
901	W. W. Jones II	--	--	700	5	do	162	+	Jan. 18, 1965	Flows	S	
15-101	E. G. de Esslinger	G. Hernandez	--	70	8	do	195	56.3	Mar. 16, 1933	H	D,S	
102	L. J. Lipps	--	--	1,100	10	do	155	45.0	Apr. 17, 1933	C,W	D,S	
401	Lipps Ranch	--	--	450	4	do	120	12	Apr. 1933	C,W	S	
501	do	--	--	100	4	do	128	33	do	C,W	S	
601	Santa Fe Ranch	--	1917	510	6	do	94	1.0 20	Apr. 21, 1933 1965	C,W	S	
* 16-101	do	Humble Oil & Refining Co.	1955	450	4	do	75	40	1965	C,W	S	Cased to 410 ft. Slotted from 410 ft to bottom.
102	do	Chester Downs	1921	670	4	do	87	20	1965	C,W	S	Cased to bottom. Slotted from 632 ft to bottom.
* 401	do	--	--	600	6	do	75	+ 10	Apr. 21, 1933 1965	Flows, C,W	S	
402	do	Humble Oil & Refining Co.	1958	450	4	do	77	51.1	May 6, 1965	C,W	S	Cased to bottom. Slotted from 410 ft to bottom.
501	do	H. L. Curry	1930	810	5	do	55	+ +	Apr. 21, 1933 1965	Flows	S	Estimated flow 19 gpm in 1933, and 10 gpm in 1965.
601	do	do	--	1,182	5	do	53	+ +	Mar. 1, 1933 1965	Flows	S	Estimated flow 5 gpm in 1933, and 10 gpm in 1965.
* 801	do	Chester Downs	--	691	5	do	56	+ +	Apr. 21, 1933 1965	Flows	S	Estimated flow 22 gpm in 1933, and 5 gpm in 1965.

* For chemical analyses of water from wells in Brooks County, see Table 7.
1/ For drillers' logs of wells in Brooks County, see Table 6.
2/ Electric logs in files of U.S. Geological Survey or Texas Water Development Board.

Table 6.--Drillers' logs of wells

Well BP-84-47-705

Owner: Miller Ranch. Driller: Porter Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface sand	9	9	Clay	85	320
Sand, red, and rock	13	22	Sand, hard	5	325
Sand, hard, and rock	34	56	Clay	25	350
Clay, colored	39	95	Clay, red	18	368
Sand	10	105	Sand	32	400
Clay and rock	130	235			

Well BP-84-48-801

Owner: W. P. Wright. Driller: Disbro Bros.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	15	15	Sand	8	360
Caliche	107	122	Shale, sticky	66	426
Sand	8	130	Sand	20	446
Shale, sticky	222	352			

Well BP-84-53-401

Owner: R. J. Boerjan. Driller: Porter Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	12	12	Shale and rock	57	267
Rock	85	97	Shale, red	45	312
Shale, red	83	180	Shale and rock	80	392
Sand, fine	10	190	Shale, red	96	488
Shale, red	20	210	Sand	22	510

Table 6.--Drillers' logs of wells--Continued

Well BP-84-53-501

Owner: George Sanders. Driller: Renaldo Almoraz.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Topsoil	3	3	Soaprock	53	127
Caliche	59	62	Shale, sandy	11	138
Shale, sandy	6	68	Sand, water	12	150
Sand, water	6	74			

Well BP-84-54-101

Owner: Felix Barrera. Driller: Disbro Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	5	5	Shale, soft	33	220
Caliche	105	110	Sand	28	248
Shale, hard	77	187			

Well BP-84-54-301

Owner: San Antonio Loan and Trust Co. Driller: Porter Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	14	14	Shale, red	19	240
Rock and sand	88	102	Sand	35	275
Shale and rock	119	221			

Well BP-84-54-401

Owner: Mills Bennett Estate. Driller: Porter Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	9	9	Sand, broken	23	358
Rock	186	195	Shale, red	5	363
Shale, red	140	335	Sand and gravel	32	395

Table 6.--Drillers' logs of wells--Continued

Well BP-84-54-802

Owner: Mills Bennett Estate. Driller: Elmer Rupp.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil -----------	6	6	Sand -------------------	10	195
Caliche and clay -------	12	18	Shale ------------------	10	205
Caliche ----------------	30	48	Sand -------------------	17	222
Sandrock ---------------	22	70	Shale ------------------	76	298
Rock -------------------	10	80	Sand -------------------	27	325
Sandrock ---------------	10	90	Shale ------------------	43	368
Sandrock, hard ---------	30	170	Sand -------------------	38	406
Shale ------------------	15	185			

Well BP-84-55-103

Owner: Miller Ranch. Driller: Domingo Navarez.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil -----------	12	12	Clay, white and pink ---	40	145
Caliche and clay -------	36	48	Sand, hard -------------	37	182
Rock and clay ----------	20	68	Clay, pink, and rock ---	128	310
Sand, hard -------------	20	88	Clay, red, and rock ----	110	420
Clay, pink, and rock ---	8	96	Clay, sticky, red ------	48	468
Rock, hard -------------	9	105	Sand and gravel --------	40	508

Well BP-84-55-212

Owner: Miller Ranch. Driller: Porter Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil -----------	12	12	Shale, red -------------	79	261
Caliche and rock -------	30	42	Shale and sand ---------	41	302
Rock and shale ---------	140	182	Shale, white -----------	45	347

(Continued on next page)

Table 6.--Drillers' logs of wells--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Well BP-84-55-212--Continued					
Shale and sand ---------	62	409	Sand, fine -------------	22	537
Shale, white -----------	31	440	Shale, red -------------	49	586
Sand, fine -------------	35	475	Sand -------------------	29	615
Shale, red -------------	40	515			

Well BP-84-55-505

Owner: Miller Ranch. Driller: Porter Drilling Co.

Surface soil -----------	10	10	Sand, white ------------	38	313
Caliche and clay -------	22	32	Clay, sticky -----------	27	340
Sandrock ---------------	16	48	Sand and sandy clay ----	60	400
Clay, white, and rock --	24	72	Clay, pink, sandy ------	85	485
Sand (salty) -----------	13	85	Sand, hard, and gravel -	22	507
Clay, white ------------	25	110	Clay, red --------------	27	534
Sand, hard -------------	30	140	Sand -------------------	12	546
Clay and rock ----------	135	275	Sand, hard, yellow -----	65	611

Well BP-84-55-604

Owner: Miller Ranch. Driller: Porter Drilling Co.

Surface soil -----------	13	13	Shale and sand ---------	222	541
Caliche, rock, and sand	48	61	Shale, red -------------	241	782
Shale, white -----------	121	182	Sand, water ------------	25	807
Shale, red -------------	137	319			

Well BP-84-55-804

Owner: Cage Ranch. Driller: Chester Downs.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Sand and clay ----------	40	40	Clay, white and blue ---	100	360
Clay, blue -------------	20	60	Sand, white ------------	10	370
Rock and sand ----------	20	80	Rock -------------------	12	382
Clay, blue and white ---	30	110	Clay and boulders ------	48	430
Sand, white ------------	10	120	Clay, red and blue -----	50	480
Rock -------------------	20	140	Clay, red --------------	90	570
Clay, brown ------------	120	260	Sand, white ------------	30	600

Well BP-84-56-402

Owner: Lois L. Maher. Driller: Disbro Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil -----------	5	5	Sand, broken, and Shale ----------------	84	766
Shale and caliche ------	57	62	Shale, red -------------	14	780
Shale, white, sandy ----	174	236	Sand -------------------	8	788
Shale, white -----------	84	320	Shale, red -------------	3	791
Sandrock and shale -----	142	462	Sand -------------------	17	808
Shale, white -----------	38	500	Shale, red -------------	4	812
Sand, red --------------	48	548	Sand -------------------	28	840
Sand, broken -----------	37	585			
Shale, red, and hard sand ----------------	97	682			

Table 6.--Drillers' logs of wells--Continued

Well BP-84-56-508

Owner: D. J. Sullivan. Driller: Carl Vickers.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Sand	13	13	Shale, blue	30	115
Shale	5	18	Shale	235	350
Sand	7	25	Sand	36	386
Shale	45	70	Shale	64	450
Sand	15	85	Sand	55	505

Well BP-84-56-603

Owner: D. J. Sullivan. Driller: Friesan Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Sand and clay	10	10	Shale	32	260
Caliche	10	20	Shale, sandy	202	280
Caliche and clay	10	30	Shale	35	315
Sand	15	45	Shells, hard, and sand	25	340
Shale	25	70	Shale, hard	63	403
Sand	15	85	Sand	34	437
Shale	45	130	Shale	21	458
Sand	18	148	Sand	19	477
Shale	22	170	Shale, sticky	33	510
Shale, red	28	198	Sand	33	543
Shells and sand	30	228			

Table 6.--Drillers' logs of wells--Continued

Well BP-84-61-101

Owner: Hopper Bros. Driller: Porter Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil -----------	14	14	Shale, red, and rock ---	49	135
Caliche, rock, and gravel	17	31	Shale, red -------------	249	384
Caliche and rock -------	55	86	Gravel -----------------	19	403

Well BP-84-64-203

Owner: D. J. Sullivan. Driller: Friesan Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil -----------	15	15	Sand -------------------	12	224
Caliche ----------------	5	20	Shale, sandy -----------	46	270
Sand -------------------	10	30	Shells, hard, and sand -	27	297
Caliche-----------------	5	35	Shale ------------------	23	320
Clay, sandy ------------	23	58	Sand and shale ---------	80	400
Caliche, hard ----------	37	95	Shale ------------------	35	435
Shale, white -----------	23	118	Sand -------------------	53	488
Sand -------------------	10	128	Shale and sand ---------	4	492
Shale ------------------	84	212			

Well BP-84-64-301

Owner: D. J. Sullivan. Driller: Carl Vickers.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Sand -------------------	12	12	Sand -------------------	11	528
Clay -------------------	4	16	Shale ------------------	147	675
Sand -------------------	6	22	Sand -------------------	36	711
Shale ------------------	495	517	Shale ------------------	3	714

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)

Well BP-87-06-901

Owner: Elijio Garcia. Driller: Stanley Haines.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Sand	15	15	Sand	30	298
Caliche and clay	135	150	Sand, broken	12	310
Sand, hard	55	205	Shale	10	320
Sand and shale, hard	63	268			

Well BP-87-07-101

Owner: Hopper Bros. Driller: Porter Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	12	12	Shale, red	59	280
Rock	59	71	Sand and gravel	20	300
Rock and shale	150	221			

Well BP-87-07-901

Owner: B. A. Skipper. Driller: Porter Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	12	12	Shale, colored	82	288
Caliche	96	108	Shale, red	37	325
Shale and rock	79	187	Sand	30	355
Shale, red	19	206			

Well BP-87-08-401

Owner: Victor Cantu. Driller: Frieson Well Service.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface sand and clay	12	12	Shale	21	265
Caliche	43	55	Sand	20	285
Shale	15	70	Shale, sandy	71	356
Shale, sandy	150	220	Sand	23	379
Sand	24	244			

Table 6.--Drillers' logs of wells--Continued

Well BP-87-08-601

Owner: King Ranch. Driller: Chester Downs.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Rock and clay ----------	20	20	Clay, red ----------------	30	550
Sand -------------------	5	25	Gravel -----------------	10	560
Clay, blue and white ---	125	150	Clay, red --------------	20	580
Clay, blue -------------	150	300	Clay, brown ------------	60	640
Rock, hard -------------	10	310	Rock -------------------	20	660
Clay, red, and boulders-	115	425	Sand, artesian ---------	50	710
Clay, red --------------	89	514	Clay, red --------------	20	730
Rock, hard -------------	6	520	Sand, artesian ---------	52	782

Table 7.--Chemical analyses of water from wells and salt-water disposal pits

(Analyses given are in parts per million except specific conductance, pH, percent sodium, sodium adsorption ratio, and residual sodium carbonate.)

Water-bearing unit: Tg, Goliad Sand; Tl, Lagarto Clay; and To, Oakville Sandstone.

Well	Depth of well (ft)	Date of collection	Water bearing unit	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3) a/	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (micromhos at 25°C)	pH
BP-84-45-901	100	Apr. 29, 1965	Tg	73	--	138	55	*423		300	211	720	0.9	6.8	--	1,780	570	62	7.7	0.00	2,940	7.9
46-905	400	Mar. 23, 1965	Tg	36	--	60	22	*184		270	59	240	.6	20	--	755	240	62	5.2	.00	1,270	8.1
47-704	607	Jan. 6, 1965	Tg	30	--	39	18	*175		286	29	202	1.1	.2	0.66	636	172	69	5.8	1.26	1,120	8.2
48-801	446	May 5, 1952	Tg	--	--	--	--	--	--	278	--	195	--	--	--	--	--	--	--	--	1,230	8.0
53-301	245	Apr. 29, 1965	Tg	70	--	172	93	*506		308	294	950	1.1	12	--	2,250	812	58	7.7	.00	3,700	7.0
701	232	Mar. 24, 1965	Tg	38	--	136	54	*386		250	164	720	7.0	8.8	--	1,630	562	60	7.1	.00	2,720	8.1
54-401	395	Mar. 23, 1965	Tg	46	--	67	20	178	7.8	272	56	250	.7	23	.54	783	250	60	4.9	.00	1,300	7.7
501	700	do	Tg	42	--	60	18	*174		286	60	203	.8	20	--	719	224	63	5.0	.22	1,180	8.3
601	70	do	Tg	63	--	188	80	*434		398	230	830	--	7.2	--	2,030	798	54	6.7	.00	3,240	7.1
701	100	May 8, 1933	Tg	--	--	88	19	*81		350	14	115	--	12	--	512	298	--	--	--	--	--
55-201	618	Jan. 26, 1965	Tg	31	--	46	17	*181		276	50	212	.7	.5	.64	675	185	68	5.8	.82	1,170	7.3
209	500	May 23, 1965	Tg	22	--	33	22	*187		236	63	225	.7	.8	--	670	173	70	6.2	.41	1,170	7.4
210	788	Feb. 23, 1965	Tg	30	--	52	33	*227		266	61	332	.7	8.9	--	876	265	65	6.1	.00	1,550	7.8
301	600	Mar. 24, 1965	Tg	6.1	--	14	19	*204		222	65	215	.6	1.2	.62	635	113	80	8.3	1.38	1,140	8.3
304	628	Jan. 5, 1965	Tg	30	--	40	17	*185		308	89	160	.6	.2	.86	674	170	70	6.2	1.65	1,110	8.0
306	787	Mar. 26, 1945	Tg	22	0.22	39	16	167	14	283	45	187	.6	0	--	638	164	--	--	--	1,130	8.0
308	705	Nov. 17, 1955	Tg	30	.02	35	15	169	8.6	285	43	172	.6	.0	.01	600	148	70	6.0	--	1,060	8.1
309	755	Apr. 17, 1933	Tg	--	--	38	18	*168		278	40	188	--	.5	--	589	169	--	--	--	--	--
309	755	Apr. 20, 1938	Tg	--	--	35	--	*176		290	36	192	--	.2	--	600	164	--	--	--	--	--
309	755	Apr. 5, 1940	Tg	--	--	39	18	*162		285	24	188	--	--	--	571	171	--	--	--	--	--
309	755	Mar. 10, 1945	Tg	23	.08	40	17	167	9.9	289	41	188	.6	0	--	615	170	--	--	--	1,150	7.8
310	749	do	Tg	23	1.1	42	17	*170		268	42	183	.6	0	--	608	175	--	--	--	1,120	8.1
401	500	Feb. 23, 1965	Tg	31	--	41	16	*178		314	104	132	.8	3.0	--	660	168	70	6.0	1.78	1,070	8.2
501	752	Mar. 8, 1965	Tg	30	--	45	20	*175		286	81	180	.7	2.0	.67	675	195	66	5.4	.79	1,120	8.2
603	742	Jan. 26, 1965	Tg	16	--	40	19	*716		396	336	750	--	1.2	--	2,070	178	90	23	2.93	3,380	7.6
604	807	Feb. 23, 1965	Tg	22	--	34	16	*171		310	70	135	.6	3.8	--	604	151	71	6.1	2.06	1,010	8.1

See footnotes at end of table.

Table 7.--Chemical analyses of water from wells and salt-water disposal pits--Continued

Well	Depth of well (ft)	Date of collection	Water bearing unit	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3) a/	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (micromhos at 25°C)	pH
BP-84-55-801	725	Feb. 23, 1965	Tg	27	--	45	17	*170		294	64	160	0.4	21	--	649	182	67	5.5	1.17	1,100	7.6
56-101	637	Jan. 25, 1965	Tg	13	--	40	16	*180		306	59	172	.6	.5	0.63	632	166	70	6.1	1.70	1,090	7.8
102	707	Mar. 10, 1965	Tg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,020	--
203	680	Mar. 25, 1965	Tg	30	--	37	15	*171		306	56	152	.6	.0	.69	612	154	71	6.0	1.94	1,040	7.8
204	488	Feb. 21, 1949	Tg	--	--	--	--	--	--	340	--	132	--	--	.78	--	--	--	--	--	1,020	--
302	481	Mar. 24, 1965	Tg	24	--	27	11	*196		328	64	142	.7	.8	.71	627	112	79	8.1	3.13	1,040	7.6
504	500	Mar. 9, 1965	Tg	12	--	29	16	*187		338	81	126	.5	5.6	--	623	138	75	6.9	2.77	1,040	8.0
507	500	Apr. 20, 1965	Tg	25	--	30	14	*174		328	69	118	.5	3.2	.61	595	132	74	6.6	2.73	973	8.0
701	450	Mar. 9, 1965	Tg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,370	--
801	700	May 4, 1965	Tg	18	--	15	6.0	*249		296	158	138	.6	.0	.78	731	62	90	14	3.61	1,190	8.1
902	671	do	Tg	23	--	10	8.8	*226		318	96	135	.6	.0	--	655	61	89	13	3.40	1,090	8.5
61-301	287	do	Tg	34	--	48	16	*174		284	65	180	.6	11	.78	669	186	67	5.6	.93	1,110	7.5
601	375	May 10, 1965	Tg	58	--	198	46	*242		214	126	625	.4	24	--	1,420	683	43	7.1	.00	2,410	7.1
901	375	do	Tg	59	--	170	40	*245		224	108	570	.5	25	--	1,330	588	48	4.4	.00	2,220	7.1
62-401	100	do	Tg	89	--	198	138	*827		436	434	1,450	--	7.0	--	3,360	1,060	63	11	.00	5,210	7.3
402	300	do	Tg	57	--	165	41	*249		198	89	595	.5	31	--	1,320	580	48	4.5	.00	2,290	7.5
701	370	Jan. 18, 1965	Tg	--	--	--	--	--	--	--	103	660	--	--	--	--	--	--	--	--	2,460	7.3
702	390	May 10, 1965	Tg	56	--	195	45	*254		206	112	648	.4	28	--	1,440	672	45	4.3	.00	2,480	7.1
63-101	535	May 25, 1965	Tg	24	--	46	19	*200		306	79	195	.5	22	--	736	193	69	6.3	1.16	1,230	7.4
201	672	Mar. 25, 1965	Tg	22	0.00	23	11	*263		342	136	178	.8	.0	--	802	102	85	11	3.56	1,310	8.2
304	600	Jan. 27, 1965	Tg	23	--	30	13	*234		314	117	178	.6	5.5	1.4	756	128	80	9.0	2.58	1,250	8.2
305	783	Apr. 7, 1933	Tg	--	.39	43	23	*220		292	192	170	--	1.2	--	793	202	--	--	--	--	--
306	350	Apr. 30, 1965	Tg	21	--	33	15	*176		276	85	145	.3	7.2	--	618	144	73	6.4	1.64	1,040	8.1
602	640	Jan. 26, 1965	Tg	23	--	47	17	*197		292	95	188	.4	13	--	724	188	70	6.2	1.04	1,210	7.4
604	460	Mar. 4, 1965	Tg	23	--	56	20	*177		312	65	200	.3	.8	--	695	222	63	5.2	.67	1,190	7.4
701	1,380	Mar. 9, 1965	To	17	--	10	2.2	*431		304	290	290	3.5	1.2	--	1,190	34	96	32	4.30	1,940	8.2
64-201	615	May 4, 1965	Tg	23	--	15	14	*214		286	97	157	.4	1.2	--	663	95	83	9.5	2.80	1,090	8.4
301	714	do	Tg	24	--	17	14	*199		284	106	132	.4	2.8	--	635	100	81	8.7	2.66	1,040	8.5

See footnotes at end of table.

Table 7.--Chemical analyses of water from wells and salt-water disposal pits--Continued

Well	Depth of well (ft)	Date of collection	Water bearing unit	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3) a/	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (micromhos at 25°C)	pH
BP-84-64-302	650	May 4, 1965	Tg	26	--	73	27	*273		228	312	265	0.3	0.2	--	1,090	293	67	6.9	0.00	1,710	8.1
601	700	do	Tg	25	--	50	16	*195		262	174	152	.3	3.8	--	745	191	69	6.1	.47	1,180	7.8
87-05-601	373	Jan. 18, 1965	Tg	--	--	--	--	--	--	122	600	--	--	--	--	--	--	--	--	--	2,370	7.5
06-301	650	Mar. 9, 1965	Tg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,000	--
501	100	Jan. 18, 1965	Tg	57	--	203	80	*795		376	548	1,190	--	7.5	--	3,070	836	67	12	.00	4,770	7.2
601	458	May 5, 1965	Tg	21	--	38	14	*262		274	174	222	.7	.8	1.1	869	152	79	9.2	1.44	1,410	8.0
604	365	do	Tg	22	--	91	32	*305		244	193	438	.5	1.2	--	1,200	358	65	7.0	.00	2,030	7.7
701	150	Jan. 18, 1965	Tg	79	--	51	20	*99		314	18	97	.8	13	.45	532	210	51	3.0	.96	815	8.0
801	280	May 5, 1965	Tg	28	--	38	15	*176		328	68	135	1.6	5.2	--	628	156	71	6.1	2.25	1,040	8.2
901	320	do	Tg	23	--	21	14	*297		280	130	275	.7	.5	--	899	110	85	12	2.39	1,510	8.2
07-201	650	Mar. 9, 1965	Tg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,640	--
401	600	do	Tg	16	--	122	46	*466		110	1,050	228	1.0	.8	--	1,980	494	67	9.1	.00	2,720	7.2
601	550	Aug. 3, 1960	Tg	35	--	68	16	*226		272	94	272	.4	27	.51	873	236	68	6.4	--	1,490	7.0
604	400	do	Tg	31	--	58	20	*249		283	97	288	.3	35	.55	918	226	71	7.2	--	1,550	7.1
607	336	Oct. 9, 1939	Tg	--	--	60	24	*234		288	104	280	.3	22	--	866	248	--	--	--	--	--
611	352	Mar. 25, 1965	Tg	19	0.02	52	23	207	9.9	292	60	255	.3	21	.55	792	224	66	6.0	.31	1,410	7.5
704	600	Mar. 22, 1946	Tg	--	--	--	--	--	--	242	240	239	--	1.8	--	--	138	--	--	--	--	--
704	600	Mar. 5, 1965	Tg	21	--	37	14	*273		250	202	230	.6	1.0	--	902	150	80	9.7	1.10	1,490	8.1
08-101	1,600	Jan. 26, 1965	To	19	--	13	1.8	*579		204	532	400	5.2	1.0	12	1,660	40	97	40	2.54	2,610	8.2
501	580	do	Tg	18	--	158	49	*424		122	1,080	205	.2	4.9	--	2,000	595	61	7.5	.00	2,650	7.2
601	782	Apr. 19, 1933	Tg	23	.28	35	15	*283		182	266	232	--	3.5	--	938	149	--	--	--	--	--
801	660	Jan. 26, 1965	Tg	22	--	62	26	*246		252	110	325	.2	19	--	934	262	67	6.6	.00	1,600	7.3
901	2,312	do	To	18	--	12	1.2	*586		204	736	255	5.6	.8	16	1,730	35	97	43	2.65	2,550	8.4
13-601	350	Apr. 29, 1965	Tl	69	--	93	72	*853		656	347	1,010	--	74	--	2,840	528	78	16	.19	4,490	7.4
14-401	801	do	To	21	--	6.0	2.4	*298		240	90	270	.8	.0	--	806	25	96	26	3.43	1,390	8.1
501	653	do	Tg	83	--	66	13	*39		266	7.6	51	.3	4.2	--	395	218	28	1.1	.00	578	7.6
601	700	Jan. 18, 1965	Tg	19	--	3.2	.7	*334		356	106	232	2.5	1.0	--	873	11	99	44	5.63	1,470	8.5

See footnotes at end of table.

Table 7.--Chemical analyses of water from wells and salt-water disposal pits--Continued

Well	Depth of well (ft)	Date of collection	Water bearing unit	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3) a/	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Boron (B)	Dis-solved solids	Hard-ness as $CaCO_3$	Per-cent so-dium	Sodium adsorp-tion ratio (SAR)	Residual sodium carbon-ate (RSC)	Specific conduct-ance (micromhos at 25°C)	pH
BP-87-16-101	450	May 4, 1965	Tg	19	--	28	20	*238		312	51	255	0.3	0.5	--	765	152	77	8.4	2.06	1,310	7.5
401	600	May 6, 1965	Tg	17	--	14	5.1	*305		248	138	262	.9	.8	--	865	56	92	18	2.94	1,470	7.8
801	691	Apr. 21, 1933	Tg	30	0.20	21	9.2	280	14	302	105	252	--	5.6	--	859	90	--	--	--	--	--
801	691	Apr. 4, 1965	Tg	17	--	20	6.1	*293		308	96	250	.4	7.4	--	841	75	89	15	3.55	1,430	7.7
Salt-Water Disposal Pits																						
BP-84-54-1	--	Apr. 28, 1965	--	14	--	10,900	1,310	*440,000		59	5.2	90,000	--	--	--	147,000	32,600	75	--	--	127,000	5.6
84-55-1	--	do	--	50	--	316	17	*8,280		637	9.0	13,000	--	--	--	22,000	858	95	--	--	32,100	7.1
87-13-1	--	Apr. 29, 1965	--	35	--	1,750	37	*14,300		665	11	24,800	--	--	--	41,300	4,520	87	--	--	52,200	6.5

* Sodium and potassium calculated as sodium (Na).
a/ Includes the equivalent of any carbonate (CO_3) present.