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AVAILABILITY OF GROUND WATER FROM THE GOLIAD SAND IN THE ALICE AREA, TEXAS

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AVAILABILITY OF GROUND WATER FROM THE GOLIAD SAND IN THE ALICE AREA, TEXAS

ABSTRACT

The Alice area occupies parts of five counties in a subhumid to semiarid part of the Gulf Coastal Plain of south Texas. Alice, the principal city of the area, is about 45 miles west of Corpus Christi, and in 1960 had a population of 20,861. The economy of the Alice area depends chiefly upon diversified crop growing, livestock raising, and oil production.

The city of Alice is dependent entirely upon ground water for its present water supply. To provide for future water supplies for the Alice area, the city is searching for additional supplies, probably surface water, or an assurance that ground-water supplies are adequate to provide for future requirements.

The water-bearing formations in the Alice area are, in ascending order, the Oakville Sandstone, the Lagarto Clay, the Goliad Sand, and undifferentiated Pliocene(?) and Pleistocene formations. The formations crop out as bands roughly parallel with the coast, the older formations occurring farther inland. The formations dip toward the coast at rates ranging from 40 to 80 feet per mile so that their depth increases coastward.

The Oakville Sandstone of Miocene age, the oldest formation, consists chiefly of sand or sandstone and minor amounts of clay. The Oakville is capable of yielding moderate quantities of water probably throughout the Alice area; however, only one well is known to draw from the formation in the area. The Oakville probably contains slightly to moderately saline water throughout the area and it is overlain at a considerably shallower depth by a formation containing better water; therefore, it is unlikely that the Oakville will be widely used in the area.

The Lagarto Clay of Miocene(?) age, consisting chiefly of clay with minor amounts of fine-grained sand, overlies the Oakville Sandstone. No wells are known to draw from the Lagarto in the Alice area, and the formation probably contains saline water throughout.

The Goliad Sand of Pliocene age, the principal aquifer, overlies the Lagarto Clay. The Goliad consists chiefly of sand with minor amounts of clay and gravel, and in the outcrop it contains extensive deposits of caliche. The Goliad crops out in the northern, northwestern, and western parts of the area and dips toward the coast at about 40 feet per mile. The formation carries fresh to slightly saline water throughout the area, the altitude of the base of the fresh to slightly saline water ranging from about 200 feet above sea level in the northwestern part to more than 800 feet below sea level in the eastern part. The thickness of fresh to slightly saline water-bearing sands in the Goliad ranges from less than 100 to about 450 feet.

The Goliad Sand is overlain by a group of Pliocene(?) and Pleistocene formations that consist of alternating beds and lenses of sand and clay. The formations yield only small quantities of water and the quality ranges between wide limits--from fresh to moderately saline. Because of the extreme variability of quality and quantity of the water in the Pliocene(?) and Pleistocene formations, they should not be considered a major source of ground water.

Aquifer tests made to determine the hydraulic characteristics of the water-bearing formations indicate that the coefficient of transmissibility of the Goliad Sand ranges from about 2,500 to 8,700 gpd (gallons per day) per foot, and the average in the immediate vicinity of Alice is about 7,600 gpd per foot. The coefficient of storage is about 0.00025.

Only small quantities of water are used for irrigation and industry in the Alice area, the principal use being for municipal supply. In 1960, a total of 2,462,000 gpd was used for municipal supply of which 2,090,000 gpd was used by the city of Alice.

The Goliad Sand is recharged on the outcrop in the northern, northwestern, and western parts of the Alice area. The water moves from the recharge areas downdip generally in an east or southeast direction. Water-level measurements made in 1933-34 and in 1960-61 indicate that the water levels have declined seriously, particularly in the central and southeastern parts of the area, the maximum decline of about 127 feet being at Alice where the development has been centered. Water levels in the southeastern part have been influenced also by pumpage in the vicinity of Kingsville and in the southern part of Jim Wells County, and additional declines can be expected in these areas.

Problems of well construction in the Alice area are related primarily to the fine grain size of the sand in the Goliad and to the fact that throughout much of the area the Goliad is overlain by saline water-bearing sands of the Pliocene(?) and Pleistocene formations. The fine grain size requires that the large supply wells be gravel packed with gravel of a suitable size that will impede the entrance of sand into the wells by reducing the entrance velocity of the water entering the well. Wells drilled in many parts of the area must have the casings cemented for protection against corrosion from salt water-bearing sands overlying the Goliad.

Most of the water in the Goliad Sand contains more than 250 ppm (parts per million) of chloride and is slightly saline (contains more than 1,000 ppm of dissolved solids). The water from the Goliad is moderately hard to hard. The water is probably not suitable for continuous irrigation use, the water having high salinity and sodium hazards and high residual sodium carbonate content.

The recharge to the Goliad in the Alice area is estimated to be about 3 million gpd. The pumpage in 1960 nearly equaled that amount; therefore, additional large supplies of water for the area probably should be obtained from other sources, either distant ground-water or surface-water sources.

AVAILABILITY OF GROUND WATER FROM THE GOLIAD SAND IN THE ALICE AREA, TEXAS

INTRODUCTION

Purpose and Scope

Because of the rapid rate of growth during the 1950's, the city of Alice, Texas, has become concerned about its future water supply. In 1957, a consulting engineering report[1] prepared for the city made predictions of future population growth and water demand, and discussed the cost of supplying this demand with surface water from Lake Corpus Christi or ground water from the area near Alice. Another consulting engineering report[2] prepared in 1959 proposed the construction of a series of surface reservoirs to supply the city of Alice and other cities in the area. Supplying the water needs from surface-water sources was estimated to be more expensive than using ground-water supplies. Therefore, in 1960 the city of Alice entered into a cooperative agreement with the Texas Board of Water Engineers [since January 1962, the Texas Water Commission] and the U. S. Geological Survey to make a study of the water-bearing sands in the Alice area to determine if the sands were adequate to supply the future water needs.

Records from 407 selected wells (Table 5) and 107 electric logs and 35 drillers' logs (Table 6) were studied. Pumping tests were made on 11 large-capacity wells. Water samples from 60 wells were collected and analyzed in the laboratory of the U. S. Geological Survey in Austin, Texas. The results of the analyses are given in Table 8. Fieldwork on the project was started in September 1960 and continued through June 1961.

The investigation was made under the immediate supervision of R. W. Sundstrom, former district engineer, and A. G. Winslow, district geologist of the U. S. Geological Survey in charge of ground-water investigations in Texas, and under the administrative direction of P. E. LaMoreaux and O. M. Hackett, successive Chiefs of the Ground Water Branch of the Geological Survey.

Location and Physical Features

The Alice area, as used in this report, consists of approximately the northern two-thirds of Jim Wells County and small parts of Live Oak County on the north, Nueces County on the east, Kleberg County on the southeast, and Duval County on

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1/ Reagan, C. S., and McGaughan, F. A., 1957, Studies and investigations for feasibility of a water supply for the city of Alice, Texas: Unpublished engineering rept.

2/ Lockwood, M. G., Andrews, W. M., and Newnam, F. H., Jr., 1959, Surface water supply possibilities for the Alice area: Unpublished engineering rept., 2 vols.

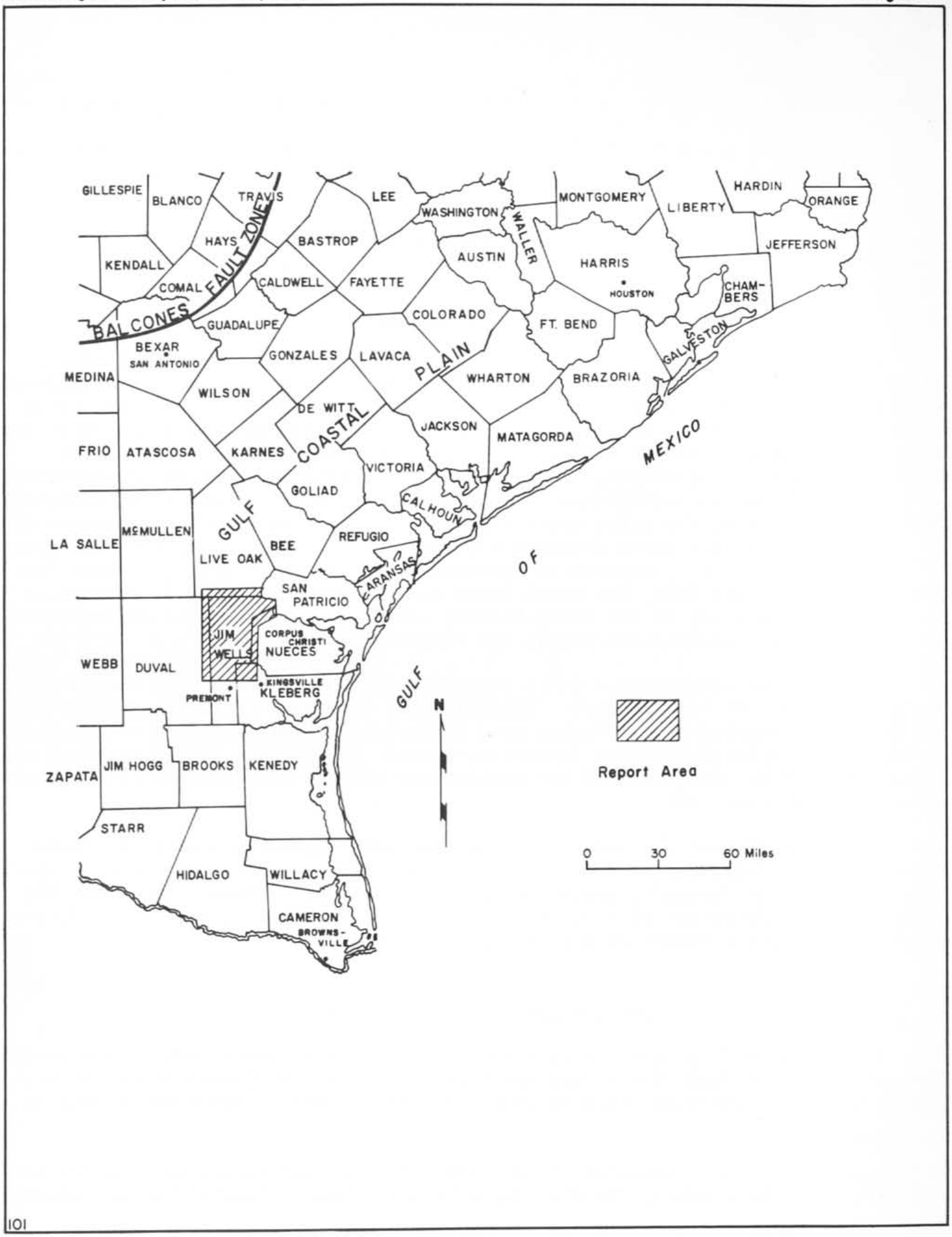

FIGURE 1.- Index map showing location of the Alice area

the west (Figure 1). The area is bounded by the parallel of 27°30' north latitude on the south. The Alice area is on the Gulf Coastal Plain in south Texas. Alice, the principal city, is 45 miles west of Corpus Christi and 120 miles south of San Antonio.

The topography is nearly flat in the southeastern part of the area, rolling in the central part, and broken in the northwest. The land surface slopes generally toward the east and southeast. The elevation ranges from a low of 43 feet in the valley of the Nueces River near the intersection of Jim Wells, San Patricio, and Nueces Counties in the northeast corner of the area to a high of approximately 400 feet in the west-central part.

The Nueces River and its tributaries drain the northern part. The central part is drained by Agua Dulce and San Diego Creeks and their tributaries, and the southern part is drained by Santa Gertrudis Creek. All the streams except the Nueces River are intermittent.

The brushy parts are covered with mesquite, huisache, black brush, small oak, cenizo, prickly pear, and other vegetation typical of the brush country of south Texas.

Alice, the county seat of Jim Wells County and the largest city in the area, had a population of 20,861 in 1960. Other communities are Orange Grove, Sandia, Agua Dulce, Palito Blanco, Ben Bolt, and San Diego, the county seat of Duval County.

Climate

The climate ranges from subhumid to semiarid and temperatures are usually mild. The average rainfall at Alice during the period 1931 to 1960, exclusive of 1946 and 1947, was 26.5 inches per year. During that period there have been 7 years with less than 20 inches of rainfall and 8 years with more than 30 inches (Figure 2). The mean annual temperature at Alice is about 72°F, the mean monthly temperature for January being about 56°F and for August about 86°F (Figure 3). The average length of the growing season is 294 days per year.

Evaporation records are not available in the Alice area, the nearest station having a long record being at Beeville, Texas, about 50 miles northeast of Alice. The monthly evaporation rate at Beeville ranges from about 7.7 inches in July to about 2.6 inches in January. The yearly average evaporation rate is about 60.5 inches (Figure 3).

Economic Development

The economy of the Alice area is dependent upon diversified crop growing, livestock raising, and oil production. Cotton, grain sorghum, redtop millet, and flax are the principal crops; however, peas, beans, onions, tomatoes, corn, and lettuce also are grown for both market and home consumption. During 1958 more than 10 million barrels of oil was produced in Jim Wells County. The total value of gas and oil production in 1958 was $51,133,014.

The area is served by numerous hard-surfaced roads and highways and two railroads. U. S. Highway 281 and State Highway 44 are the principal traffic arteries, both highways passing through Alice. The Texas and New Orleans and the Texas Mexican Railroads provide rail transportation.

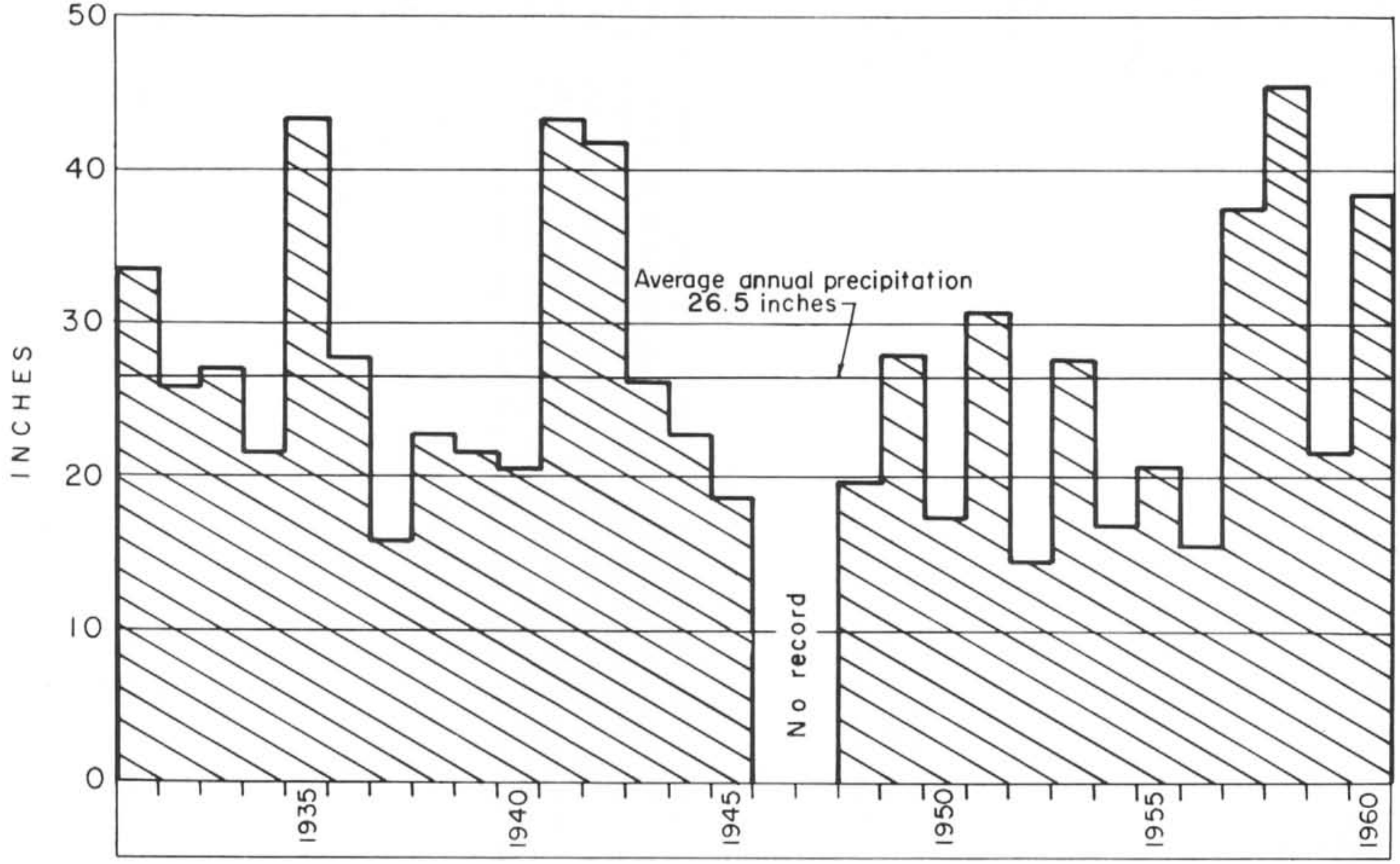

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FIGURE 2. - Annual precipitation at Alice
(From records of U.S. Weather Bureau)

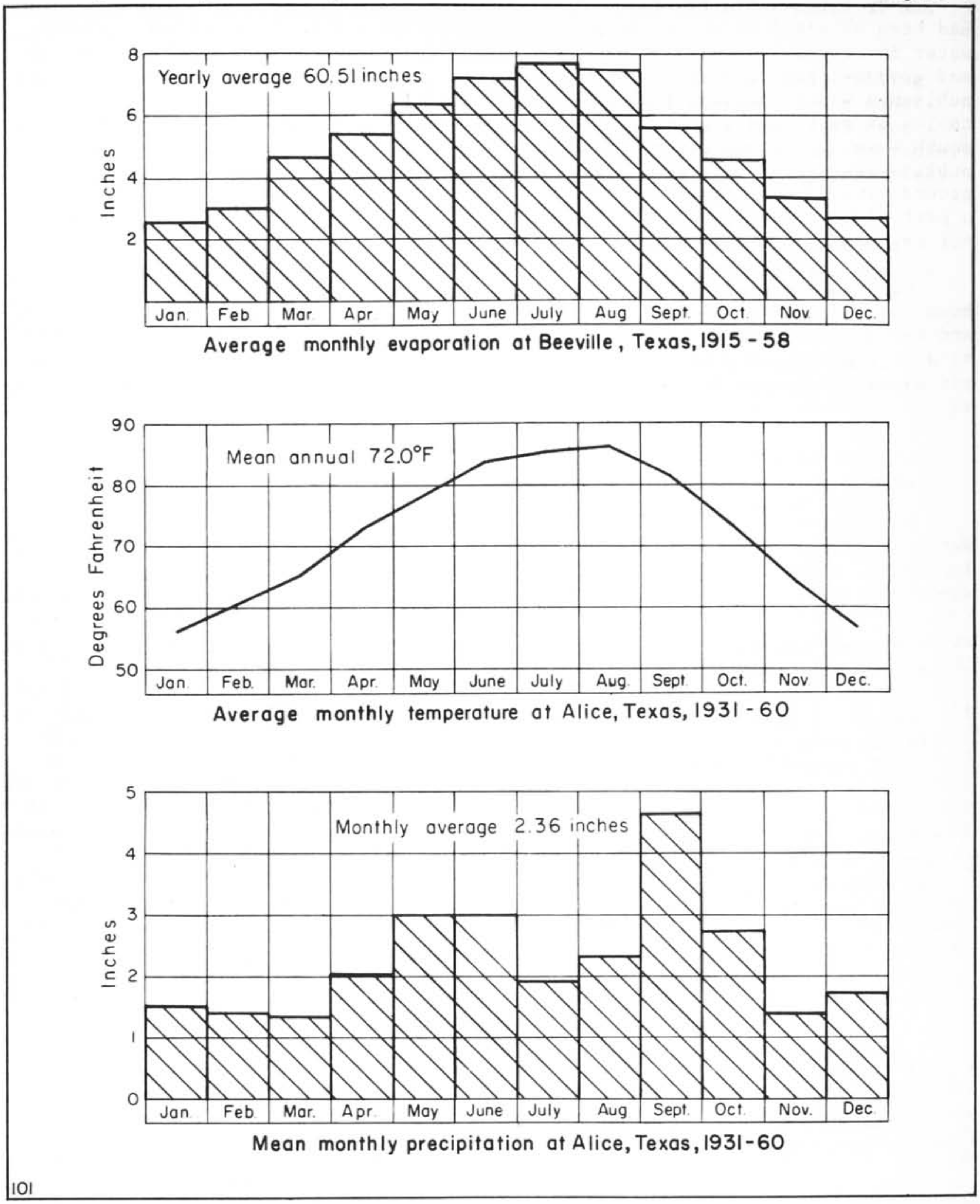

FIGURE 3.- Monthly precipitation and temperature at Alice, and evaporation at Beeville

(From records of the U.S. Weather Bureau and Bloodgood, Patterson, and Smith, 1954)

Previous Investigations

Very little detailed information concerning ground water in the Alice area had been obtained prior to the present study. The earliest significant ground-water investigation was made by Sayre (1937) during which he studied the geology and ground-water resources of Duval County. In 1940 a report by White (1940) was published which contains records of wells in Jim Wells County, together with tables of well logs and water analyses. A report on the public-water supplies of south Texas by Broadhurst, Sundstrom, and Rowley (1950) contained records of the public-water supply wells of Alice, Orange Grove, and San Diego. In 1960 the ground-water resources of the area were studied by the U. S. Geological Survey as a part of a reconnaissance of a much larger area. The results of this study have not yet been published.

No detailed reports on the geology of the Alice area have been published; however, the general geology was described by Sellards, Adkins, and Plummer (1932) and the geologic map of Texas (Darton and others, 1937) shows the geology of the area in a generalized manner. Doering (1956), in his paper on the Quaternary deposits of the Gulf Coast, has suggested changes that should be made on the geologic map of Texas, particularly in the mapping of the Pleistocene units.

Well-Numbering System

The well-numbering system used in this report is one adopted by the Texas Water Commission for use throughout the State and which is based on longitude and latitude. Under this system, each 1-degree quadrangle in the State is given a number consisting of 2 digits. These are the first 2 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 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 a 2-1/2 minute quadrangle is given a 2-digit number in the order in which it is inventoried starting with 01. These are the last 2 digits of the well number. Thus, well 83-01-402 is in the 1-degree quadrangle number 83, in the 7-1/2 minute quadrangle 01, the 2-1/2 minute quadrangle 4, and was the second well (02) inventoried in that 2-1/2 minute quadrangle. On the well-location map of this report (Plate 1), the 7-1/2 minute quadrangles are shown and numbered in the northwest corner of each quadrangle. The 3-digit number shown with the well symbol contains the number of the 2-1/2 minute quadrangle in which the well is located and the number of the well within that quadrangle. Tables 1 and 2 show the well numbers used in this report and corresponding numbers used in previously published reports.

Acknowledgments

The author is grateful to the former city manager of Alice, Mr. Elmo Drumb, and the acting city manager, Mr. W. W. Coym, both of whom have been very helpful in making provisions for performing pumping tests on the city wells. Mr. R. P. Cooper, consulting geologist; Mr. H. H. Presnall, oil operator; and Mr. R. C. Burnett of the Bridwell Oil Co., have been very liberal in allowing the use of their electric log libraries for subsurface studies of the Goliad Sand. The farmers and ranchers of the Alice area have been most cooperative in supplying information on their wells and allowing access to their land. Well drillers, Carl Vickers Water Wells and the Layne-Texas Co., Corpus Christi; W. J. Calaway, O'Neill Drilling Co., and Clyde Maley of Alice; Ben Welty and Martin Water Wells of

Table 1.--Well numbers used in this report and corresponding numbers used in Jim Wells County (White, 1940)

New number	Old number	New number	Old number	New number	Old number
78-63-501	12	84-07-201	21	84-24-201	156
502	13	301	27	210	159
601	16	401	24	211	154
701	6	402	23	212	155
803	70	501	62	213	162
804	19	502	25	407	146
901	20	601	64	510	175
78-64-701	31	604	28	603	172
79-58-703	49	84-08-101	30	703	184
83-01-103	40	705	81	801	189
303	50	706	82	804	191
705	406	907	407	84-31-202	206
83-09-405	93	84-15-801	115	205	232
406	94	802	123	206	214
503	95	84-16-303	88	501	221
504	97	304	89	502	222
702	167	604	92	84-32-102	213
83-17-404	178	810	153	104	236
84-07-101	18	901	409	401	242

Table 2.--Well numbers used in this report and corresponding numbers used in Live Oak County (Anders and Baker, 1961)

New number	Old number	New number	Old number	New number	Old number
78-63-101	L-41	78-64-101	M-13	79-57-201	N-28
201	L-39	301	M-31	202	N-29
202	M-15	404	M-25	203	N-27
604	M-18	79-57-101	N-24	204	N-26
605	M-16	102	N-38	601	N-33

Robstown; B. T. Sikes of San Patricio and Stanley Haynes of Agua Dulce, have given freely of their time and records in order that drillers' logs and completion records of the wells that they have drilled may be recorded.

GEOLOGY

General Geology

The water-bearing formations in the Alice area are the Oakville Sandstone of Miocene age, the Lagarto Clay of Miocene(?) age, the Goliad Sand of Pliocene age, and undifferentiated rocks of Pliocene(?) and Pleistocene age (Table 3). The rocks crop out in belts roughly parallel with the coast, the outcrop of the Goliad Sand, the principal aquifer, being shown in Plate 1. The older formations crop out farther from the coast so that the younger formations crop out at successively lower elevations. The rocks dip to the south and east toward the Gulf of Mexico at a greater rate than the slope of the land surface so that the formations are generally deeper toward the coast. The formations thicken downdip, and consequently the older beds dip more steeply than the younger. This is illustrated in the geologic section B-B' (Figure 5), which shows that the base of the Goliad Sand dips toward the coast at about 40 feet per mile, whereas the base of the Oakville Sandstone, an older formation, dips about 80 feet per mile. Although the regional structure is simple, faults have caused local reversals of dips and thinning of beds.

Because of their method of deposition, the geologic formations in the Alice area are not persistent in lithology or thickness. The rocks are nonmarine and consist chiefly of sand, clay, and gravel. In general, the material comprising the formations becomes finer downdip, the sand content becoming less in that direction. Predominantly sandy zones contain lenses of gravel, silt, or clay and predominantly clayey zones contain lenses of sand and silt. Sand beds may grade laterally into clay beds and clay beds into silt or sand within short distances. Thin beds may change lithology within a few hundred feet. These variations in lithology are illustrated on the geologic sections A-A', B-B', and C-C' (Figures 4, 5, and 6). Within any one formation, beds of sand interbedded with layers of clay are connected laterally and vertically with other beds of sand so that all of the sand beds within a formation may be considered a single aquifer.

Tertiary System

Miocene Series

Oakville Sandstone

The Oakville Sandstone, the oldest aquifer in the Alice area, lies unconformably on older undifferentiated rocks of Tertiary age, and is, in turn, overlain unconformably by the Lagarto Clay or Goliad Sand.

The outcrop area of the Oakville Sandstone is in Duval, McMullen, and Live Oak Counties beyond the limits of the area. Sayre (1937, pl. 1) shows the outcrop in Duval County as being irregularly shaped and about 1-1/2 miles wide at the northern edge of the county, the width of the outcrop increasing southward to about 7 miles near San Diego Creek, about 13 miles northwest of San Diego. The

Table 3.--Stratigraphy and water-bearing properties of geologic formations in the Alice area

System	Series	Formation	Approximate thickness (feet)	Lithology	Water-bearing properties
Quaternary and Tertiary(?)	Pleistocene and Pliocene(?)	Undifferentiated formations	500	Clay, silt, sand, and gravel.	Yields small quantities of good to poor quality water for domestic, livestock, and oil well drilling supply wells.
		Unconformity			
Tertiary	Pliocene	Goliad Sand	400-600	Chiefly sand or sandstone; contains minor beds of gravel and clay, and contains much caliche.	Yields moderate quantities of fresh to slightly saline water to domestic, livestock, industrial, and municipal wells. Principal aquifer.
		Unconformity			
	Miocene(?)	Lagarto Clay	520-1,400	Predominantly clay; contains a few beds of fine sand.	Contains saline water except in and near outcrop. Not known to yield water to wells.
		Unconformity			
	Miocene	Oakville Sandstone	240-500	Fine- to coarse-grained sand and sandstone, sandy clay, and clay.	Supplies moderate quantities of slightly saline water to one well.

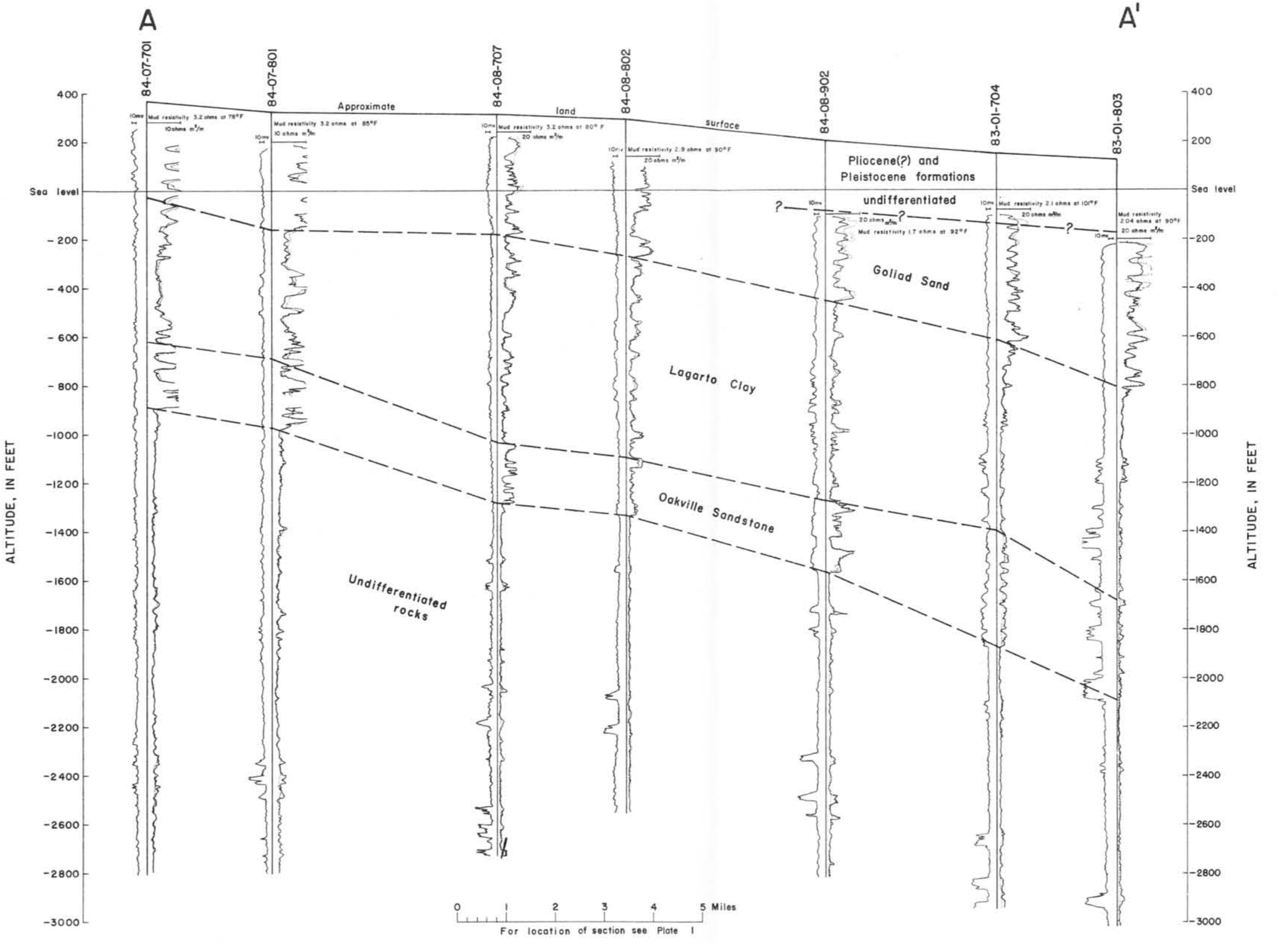

FIGURE 4. - Geologic section A-A', Alice area

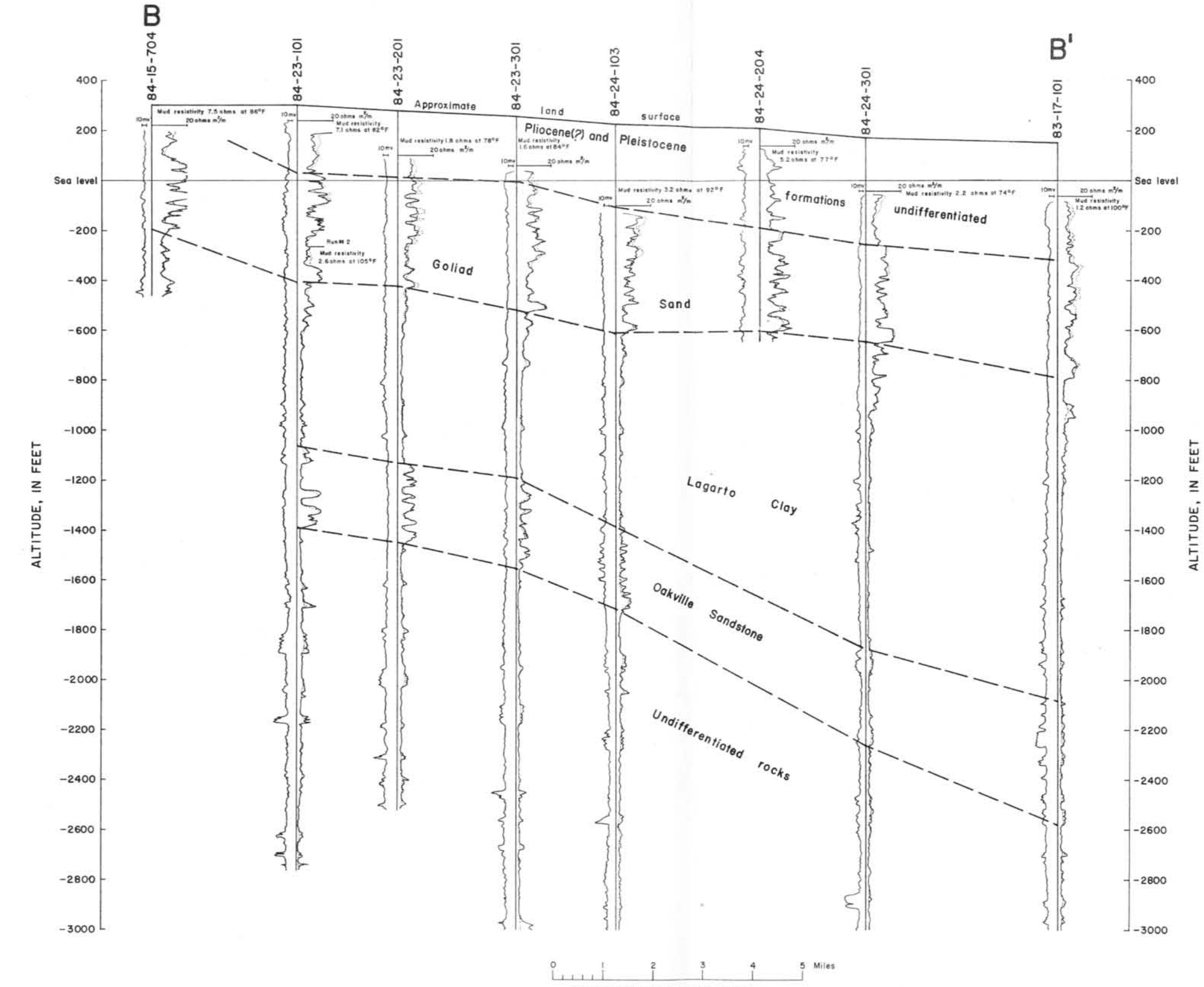

FIGURE 5. - Geologic section B-B', Alice area

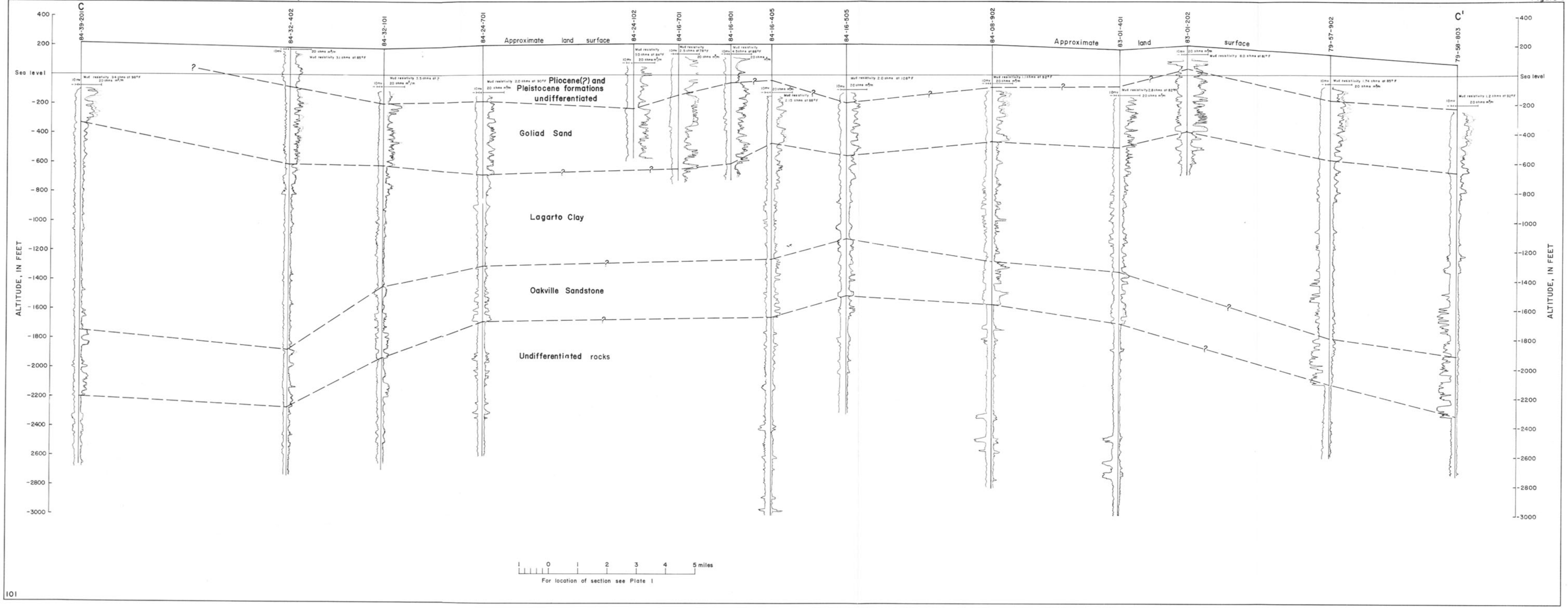

FIGURE 6.- Geologic section C-C', Alice area

The sediments of the Lagarto Clay are continental, similar to those of the Oakville Sandstone, except at the time of deposition of the Lagarto, the rivers were nearer base level and were carrying finer sediments. The Lagarto Clay is very similar in lithology not only to the Oakville Sandstone but also to the overlying Goliad Sand, the chief distinguishing characteristic being the greater proportion of clay in the Lagarto. The Lagarto ranges in thickness from about 520 to 1,400 feet where the full thickness of the formation is present.

The Lagarto Clay is not known to yield water to wells in the Alice area. Sands in the Lagarto may contain fresh to slightly saline water in and near the outcrop, but electric logs show that the water rapidly becomes highly mineralized downdip.

Pliocene Series

Goliad Sand

The Goliad Sand in the Alice area is overlain unconformably by undifferentiated deposits of Pliocene(?) and Pleistocene age and lies unconformably on the Lagarto Clay or on the Oakville Sandstone in places near the outcrop where the Lagarto is completely overlapped. The approximate outcrop area of the Goliad, as shown in Plate 1, occupies most of the northwestern part of the area and a belt near the western boundary. The thickness of the formation has not been precisely determined because of lithologic similarity to the overlapping and underlying formations. Based on determinations made from electric logs, however, the thickness ranges from less than 400 to more than 600 feet where the full thickness is present. The formation dips southeast at about 40 feet per mile. The top of the formation occurs at depths ranging from 0 at the outcrop to about 500 feet in the eastern part of the area.

The Goliad Sand consists chiefly of sand or sandstone, which is interbedded with layers of gravel and clay. On the outcrop, the sand ranges from fine to coarse; however, in the subsurface, most of the sand is fine grained and problems of well construction arise owing to the fine sand. The sand generally is gray or pinkish gray and much of it has a salt and pepper appearance due to the presence of many grains of black chert. In many places, especially on the outcrop, the formation is white because of extensive deposits of caliche. In fact, the presence of large quantities of caliche is one of the features used to distinguish the Goliad from the overlying formations.

The Goliad Sand is the principal aquifer in the Alice area. It is capable of yielding moderate quantities of fresh to slightly saline water throughout the area south and east of the outcrop. A detailed discussion of the occurrence of ground water in the Goliad is included in a later section of this report.

Tertiary(?) and Quaternary Systems

Pliocene(?) and Pleistocene Series

Undifferentiated Formations

The Goliad Sand in the Alice area is overlain unconformably by a unit that has been referred to by various geologists as the Willis Sand of Pliocene(?) age

(Weeks, 1945, p. 1694-1695) or the Citronelle Formation of Pliocene age, although it is considered of Pleistocene age by Doering (1956, p. 1822), and the Lissie Formation (Sayre, 1937, p. 64). This unit is, in turn, overlain by a younger Pleistocene formation that has been referred to by most geologists who have worked in the area as the Beaumont Clay. These units are of minor importance as aquifers in the Alice area, and no effort has been made in this report to differentiate them. They are referred to as Pliocene(?) and Pleistocene formations, undifferentiated.

The Pliocene(?) and Pleistocene formations, undifferentiated, crop out throughout the Alice area east and south of the outcrop of the Goliad Sand (Plate 1). The units dip gently toward the south and east and thicken in the same direction. The thickness ranges from 0 at the outcrop to about 500 feet in the eastern part of the area.

The Pliocene(?) and Pleistocene formations are largely continental, consisting of beds and lenses of sand, silt, clay, and marl, and minor amounts of gravel. The sands are extremely lenticular, grading rapidly both laterally and vertically into clays.

The Pliocene(?) and Pleistocene formations yield small quantities of fresh to saline water to domestic and livestock wells in the Alice area. Because of the rapid changes in lithology, both the quantity and quality of the water produced from the formations range widely from place to place. The Pliocene(?) and Pleistocene formations should not be considered a source of large supplies of ground water.

GROUND WATER

Occurrence

The following is a brief description of the principles of occurrence of ground water as they apply to the Alice area. For a comprehensive treatment of the general principles, the reader is referred to papers by Meinzer and others (1942) and Tolman (1937).

The source of all ground water is precipitation on the surface of the earth. A part of the precipitation runs off directly over the surface, another part infiltrates into the soil and is later largely removed by evaporation and transpiration. The remainder, generally not more than a few percent in the Alice area, moves downward to the water table, the top of the zone of saturation, and becomes part of the ground water in storage. Locally, some of the surface runoff may seep into the ground and also become part of the ground water in storage. Water in the area of recharge is unconfined and is said to be under water-table conditions. The water generally moves downdip from the recharge area, and as it passes beneath layers of less permeable material, the water is confined and is said to be under artesian conditions.

Water of good quality in the aquifers in the Alice area is in transient storage, moving slowly (tens to hundreds of feet per year) from places of recharge to places of discharge. Ground water may be discharged artificially through wells or naturally through seeps and springs in the outcrop of the aquifer (rejected recharge--believed to be non-existent in the Alice area), by transpiration where the water table is close enough to the surface that it may be reached by the roots of plants, and by seepage through semiconfining beds or along faults (either upward or downward) into another aquifer having a lower head or to the land surface.

Ground water in the Goliad Sand, the principal aquifer, occurs in the pore spaces between sand grains. The source of the water is chiefly precipitation on the outcrop in the western, northwestern, and northern parts of the area (Plate 1). The general direction of movement of the water in the Goliad is toward the south and east, the water leaving the area along its eastern edge except for that part discharged within the area.

The Goliad Sand underlies the entire Alice area and contains fresh to slightly saline water throughout the area. Figure 7 shows by contours the altitude of the base of the fresh to slightly saline water sands in the Goliad. The map reflects in a general way the dip of the formation toward the southeast. It also shows many irregularities, which probably are caused by facies changes.

Figure 8 shows the approximate thickness of fresh to slightly saline water-bearing sands in the Goliad Sand. The map shows that the thickness ranges from less than 100 feet on the outcrop in the northwestern part of the area to more than 400 feet. In the immediate vicinity of Alice, the thickness ranges from less than 200 to nearly 400 feet.

Aquifer Tests

Thirteen aquifer tests were made in 11 wells in the Alice area to determine the ability of the aquifers to transmit and store water. The data from the tests were analyzed by means of the Theis nonequilibrium method as modified by Cooper and Jacob (1946, p. 526-534) and the Theis recovery method (Wenzel, 1942, p. 94-97). The results of the tests are given in Table 4.

The ability of an aquifer to transmit water is expressed as its coefficient of transmissibility, which is defined as the amount of water in gallons per day that will pass through a vertical strip of aquifer having a width of 1 foot and a height equal to the saturated thickness of the aquifer under a hydraulic gradient of 1 foot per foot at the prevailing aquifer temperature. The coefficient of storage of an aquifer is defined as the volume of water it releases or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface.

Of the 13 aquifer tests made in the Alice area, all but 1 were made in the Goliad Sand, the other being a test in the Oakville Sandstone. The test in the Oakville was made on well 84-24-401, the only well that produces water from the Oakville. A recovery test on this well indicated a coefficient of transmissibility of 7,100 gpd (gallons per day) per foot. During the test, the well was pumped for 4 hours and 40 minutes at the rate of 325 gpm. The drawdown due to pumping was 40 feet, indicating a specific capacity of 8.1 gpm per foot.

An aquifer test of the Oakville Sandstone made near Premont in southern Jim Wells County, about 20 miles south of Ben Bolt, indicated a coefficient of transmissibility of 7,700 gpd per foot. This indicates that the characteristics of the Oakville may be fairly constant over considerable distances.

The 12 aquifer tests of the Goliad Sand were made in 10 wells, 6 of which are city of Alice municipal wells (Table 4). The highest coefficient of transmissibility of the Goliad tests was 8,700 gpd per foot obtained at the city of Orange Grove well (83-01-202). The lowest coefficient of transmissibility, 2,500 gpd per

Table 4.--Results of aquifer tests in the Alice area

Well number	Depth (ft.)	Average discharge during test (gpm)	Coefficient of transmissibility (gpd/ft.)	Specific capacity (gpm/ft.)	Coefficient of storage	Type of test	Remarks
83-01-202	817	495	8,700	5.2	--	Recovery	Pumped well
83-09-204	870	600	4,400	2.4	--	do	Do.
84-08-801	630	75	3,400	3.3	--	do	Do.
84-16-804	860	210	5,000	--	--	do	Do.
805	852	330	3,500	2.0	--	do	Do.
807	869	265	7,600	--	--	do	Do.
84-24-102	754	135	2,900	2.0	--	Drawdown	Do.
102	754	135	2,500	--	--	Recovery	Do.
101	850	200	3,400	--	--	do	Do.
203	785	--	6,700	1.7	$2.4\text{X}10^{-4}$	Drawdown	Observation well
203	785	--	7,700	--	$2.6\text{X}10^{-4}$	Recovery	Do.
204	820	340	3,200	--	--	do	Pumped well
401	1,910	325	7,100	8.1	--	do	Do.

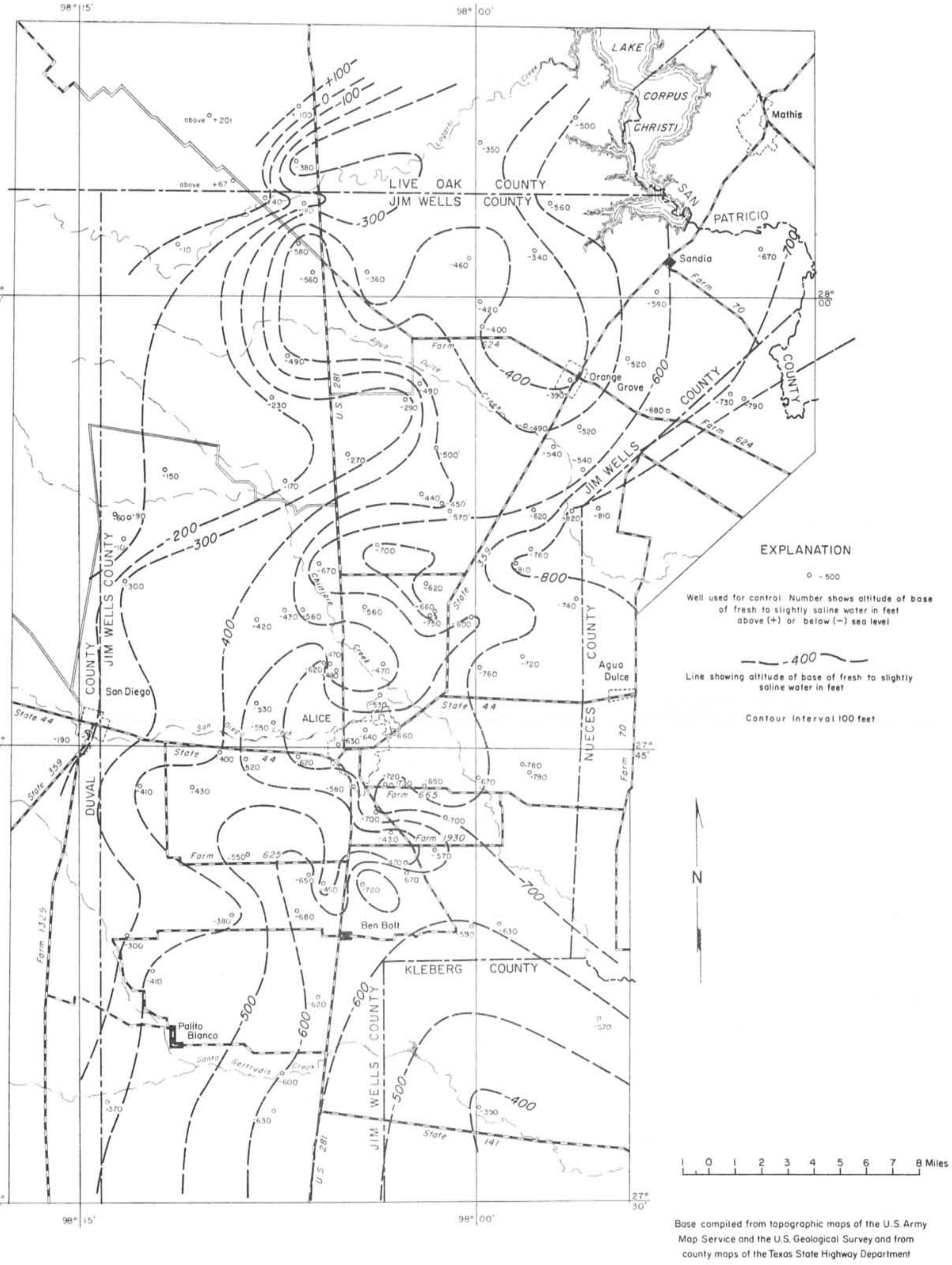

FIGURE 7.- Approximate altitude of the base of the fresh to slightly saline water in the Goliad Sand, Alice area

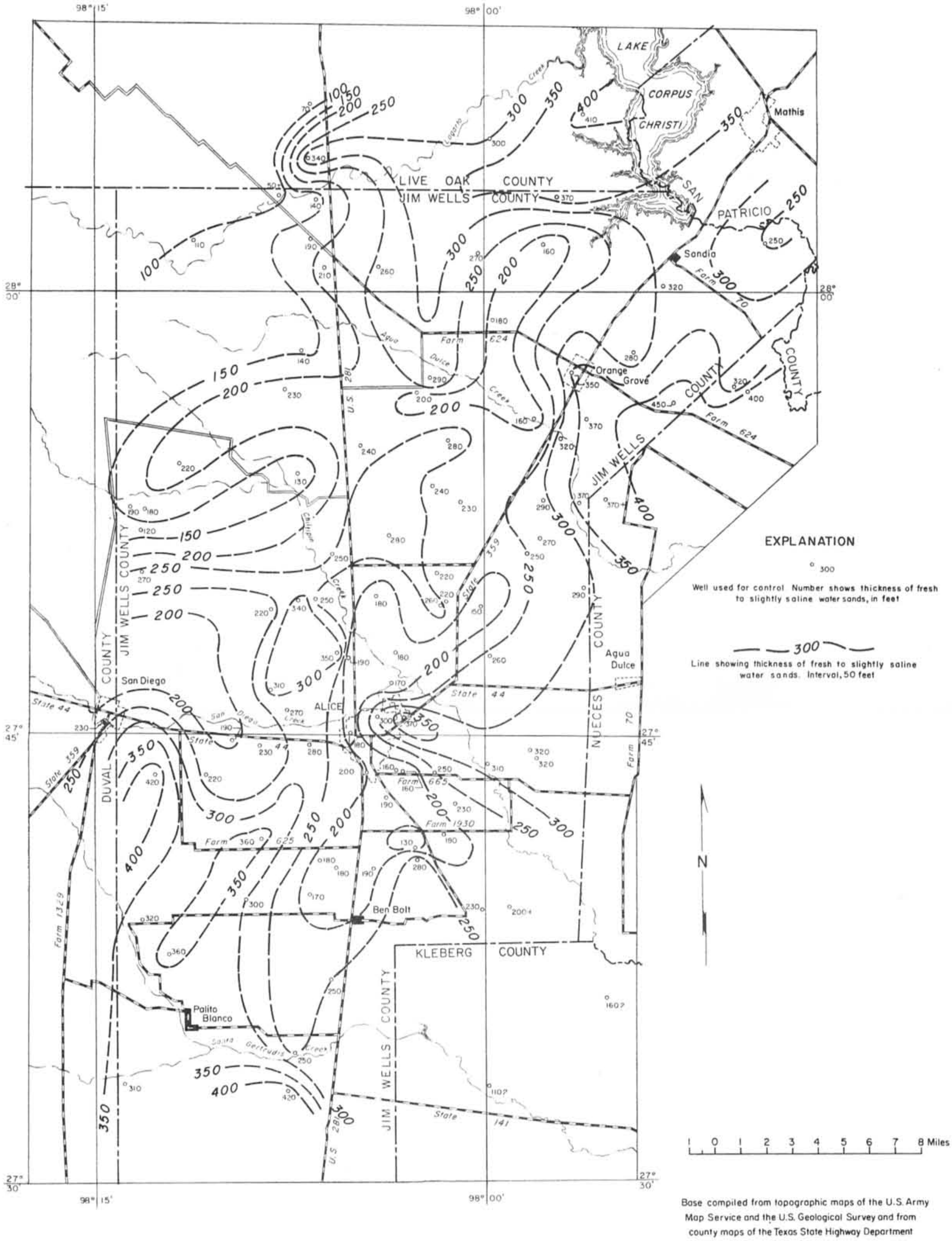

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FIGURE 8.-Approximate thickness of fresh to slightly saline water sands in the Goliad Sand, Alice area

outcrop disappears completely about 16 miles west of San Diego where the Oakville is overlapped by the Goliad Sand.

It is difficult to separate the Oakville Sandstone from the Lagarto Clay in the outcrop area in Live Oak County, according to Anders and Baker (1961, p. 17-18) because of a lack of good exposures and because of overlap by outliers of the Goliad Sand in some places. Anders and Baker (1961, pl. 1) mapped the outcrops of the Oakville Sandstone and the Lagarto Clay together, the combined outcrop occupying an irregularly shaped band trending northeast across the central part of Live Oak County.

The Oakville Sandstone is wholly continental, consisting chiefly of sand or sandstone and clay. At its type locality at the town of Oakville in Live Oak County, the formation consists of medium- to coarse-grained, cross-bedded sand interbedded with bluish, apparently carbonaceous clay. In Duval County, the Oakville consists of fine- to coarse-grained, dirty-gray to buff sandstone, containing considerable amounts of clay. In other areas the Oakville is a cross-bedded medium- to fine-grained sand or sandstone interbedded with sandy clay, some of which is slightly bentonitic.

The subsurface position of the Oakville Sandstone is shown on the geologic sections (Figures 4, 5, and 6). The contact of the Oakville with the Lagarto Clay is uncertain because of lithologic similarities between the lower part of the Lagarto and the upper part of the Oakville. The sections show that the thickness in the Alice area ranges from about 240 to 500 feet. The formation dips southeast at about 80 feet per mile, the depth to the top of the formation in the Alice area ranging from a few hundred feet in the northwestern part to more than 2,200 feet in the southeastern part.

The Oakville Sandstone is probably capable of supplying moderate quantities (300 to 400 gallons per minute) of slightly saline water (1,000 to 3,000 parts per million of dissolved solids) to wells within a few miles of the western and northern edges of the area. Only one well of record in the area draws water from the Oakville Sandstone. This well (84-24-401), which is perforated opposite sands between 1,850 and 1,900 feet, yields water having a dissolved-solids content of 2,030 ppm (parts per million), a sulfate content of 690 ppm, and a boron content of 9.2 ppm. The well has been pumped at 325 gpm (gallons per minute) with a drawdown of 40 feet. The Oakville Sandstone is one of the chief aquifers in much of Duval and Live Oak Counties. However, in the Alice area, the Oakville is about 1,000 feet below the Goliad Sand (a more productive aquifer) and it contains more highly mineralized water than does the Goliad. Therefore, the Oakville probably will not be important as an aquifer in the Alice area in the foreseeable future.

Miocene(?) Series

Lagarto Clay

The Lagarto Clay unconformably overlies the Oakville Sandstone and is overlain unconformably by the Goliad Sand. The Lagarto crops out in the central part of Live Oak County where the outcrop trends northeast. South of Live Oak County, the outcrop is obscured by the overlapping Goliad Sand. The formation dips to the southeast, the top of the formation occurring at depths ranging from 0 at the outcrop in the northwestern part of the area to more than 900 feet in the eastern part.

foot, was determined at the city of Alice well 84-24-102 where the sand is relatively thin. Furthermore, this well does not penetrate the full thickness of the Goliad Sand. The average of all the coefficients of transmissibility determined for the Goliad was 4,900 gpd per foot. However, based on considerations of the test data, the construction of the wells tested, and the distribution of sand thickness, a figure of 7,600 gpd per foot for the average coefficient of transmissibility is probably more representative for the Goliad in the Alice area. The coefficient of storage for the Goliad Sand was determined at well 84-24-203 to be about 0.00025, a typical artesian storage coefficient. Specific capacities measured at the time of the aquifer tests ranged from 1.7 gpm per foot (gallons per minute per foot of drawdown) at city of Alice well 84-24-203 to 5.2 gpm per foot at the Orange Grove well. The average specific capacity of all the city of Alice wells was about 2 gpm per foot.

The coefficients of transmissibility and storage as determined from the aquifer tests may be used to predict the drawdown of water levels caused by pumping. Figure 9 shows the theoretical effect that pumping from a well in the Alice area will have upon the water levels in the surrounding area. The curves in the illustration are based on the following assumptions: the coefficient of transmissibility is 7,600 gpd per foot; the coefficient of storage is 0.00025 and the constant discharge of the well is 270 gpm (the average of the city of Alice wells drilled before 1960); the outcrop of the aquifer is a straight line of infinite length 10 miles from the well; the formation is homogeneous; and there is sufficient recharge so that there is no drawdown in the outcrop area. The conditions in the Alice area do not meet the assumptions, but they probably are sufficiently close so that the use of the curves as an approximation is valid. The upper curve represents the drawdown caused by pumping the well continuously for one year. The lower curve represents the maximum drawdown reached when the cone of depression extends to the outcrop and assuming sufficient recharge to supply the water.

According to Figure 9, the drawdown 1 mile from the pumped well will be approximately 20 feet after 1 year. The drawdown 5 miles from the well will be more than 7 feet. From these figures it is evident that in order to avoid the harmful effects of mutual interference, wells in the Goliad Sand should be spaced as widely as possible consistent with the relative economics of greater pumping lifts compared with greater pipeline costs.

Ground-Water Development

Irrigation

Irrigation with ground water in the Alice area has been on a small scale due to the low yields of the wells and the rather high mineralization of the water. Probably not more than 250,000 gpd was pumped for irrigation during 1960-61. The first two irrigation wells (84-16-303 and 84-16-304) were drilled in 1927 and 1928; however, by 1934 the wells no longer were being used for irrigation.

During the period 1960-61, four large-capacity irrigation wells were being used and a few windmills in the area were used for the irrigation of small garden plots. Two of the large wells (79-58-801 and 83-02-201) in the northeastern part of Jim Wells County obtain water from the Goliad Sand and are used to irrigate 100 acres of feed and 50 acres of cabbage. A third well (79-58-802) in this same general area is equipped with a turbine pump, but during 1960-61 it had no source of power. The other two active irrigation wells in the Alice area are about 4-1/2 miles southwest of Alice where one well (84-24-101), obtaining water from the

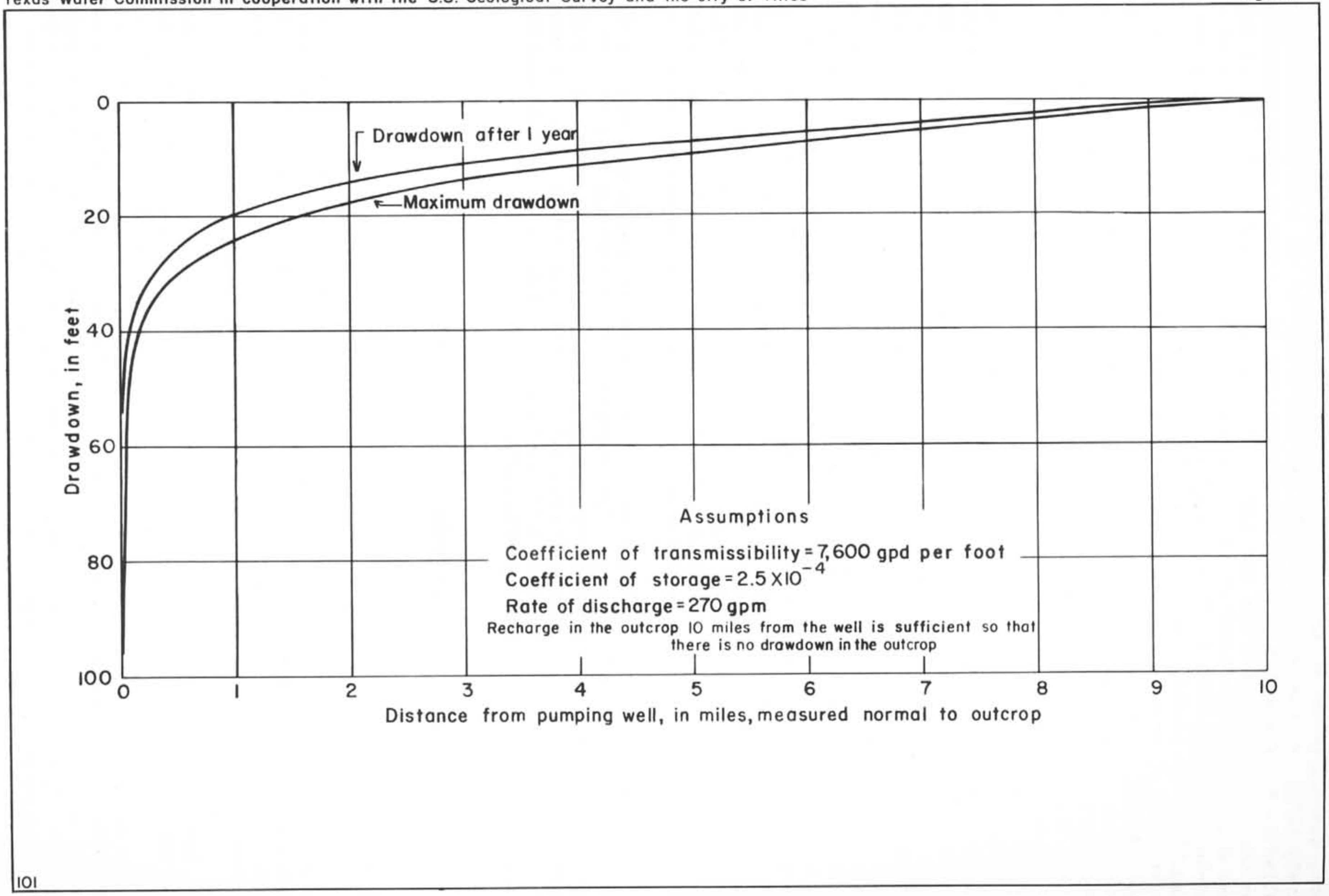

FIGURE 9.- Theoretical drawdown caused by pumping from the Goliad Sand in the Alice area

Goliad Sand, is used to irrigate 90 acres of pasture, and the other well (84-24-401), obtaining water from the Oakville Sandstone, is used to irrigate 35 acres of coastal bermuda grass. The owner of the Oakville well is experimenting with irrigation using water from this well; however, the water has a high boron content (9.2 ppm) and a high dissolved-solids content (2,030 ppm), and the water may be unsuitable for continued irrigation. Three other wells in the northern part of Jim Wells County are equipped to be used for irrigation but were not used in 1960-61. These are wells 83-09-204, which is used only during drought; 83-17-203, which is equipped with an electric motor and airlift pump but which has not been used since 1958; and 84-24-802, which was converted from an oil test but has been abandoned because it has become partly filled with sand.

Industrial

The use of ground water for industry in the Alice area is small. During 1960-61, only two large-capacity industrial wells (83-17-501 and 83-17-901) were in use. These wells pumped a total of about 500,000 gpd for cooling water for two gasoline plants. The only other industrial wells in the Alice area are of small capacity and are used to supply pumping stations or oil-well drilling rigs. Their aggregate use is small, probably not more than 100,000 gpd.

Municipal

The principal use of ground water in the Alice area is for municipal purposes. According to White (1940, p. 1), the average use of water by the city of Alice in 1938 was 364,100 gpd; by 1945, the average use of water had increased to about 1,000,000 gpd. Orange Grove was using 75,000 gpd by 1945; San Diego, 150,000 gpd; and Agua Dulce, 32,500 gpd (Broadhurst, Sundstrom, and Rowley, 1946, p. 52, 72-74, 87). The use of water by the city of Alice increased to a maximum of 2,280,000 gpd in 1957 and declined to 2,090,000 gpd in 1960. In 1960 Orange Grove used 93,000 gpd; San Diego, 220,000 gpd; and Agua Dulce, 59,000 gpd, making the total municipal use in the area 2,462,000 gpd in 1960.

Figure 10 shows, by months, the average daily pumpage of the city of Alice wells for the period August 1951 to December 1960. The figure illustrates the seasonal fluctuation in pumpage. During 1960, the pumpage ranged from about 1,200,000 gpd in October to more than 3,600,000 gpd in June, and averaged 2,090,000 gpd throughout the year.

Changes in Water Levels

The water levels in wells in the Alice area respond mainly to changes in withdrawal rates and changes in ground-water storage. However, a change in the physical condition of a well such as damage to the casing, deepening, or partial plugging also may cause a change in the water level in the well. These changes in water level occur because the well bore has gained or lost hydraulic connection with one or more sand zones containing water under different head. A change in chemical quality of water may occur in such wells because the quality of water commonly is somewhat different in each sand bed or sand zone.

Relatively rapid changes in water levels which occur in a few hours or several days are commonly due to local changes in the withdrawal rates of nearby wells and generally affect a rather small area. Substantial long-term changes in water levels over a period of weeks, months, or years, may be caused by changes in the

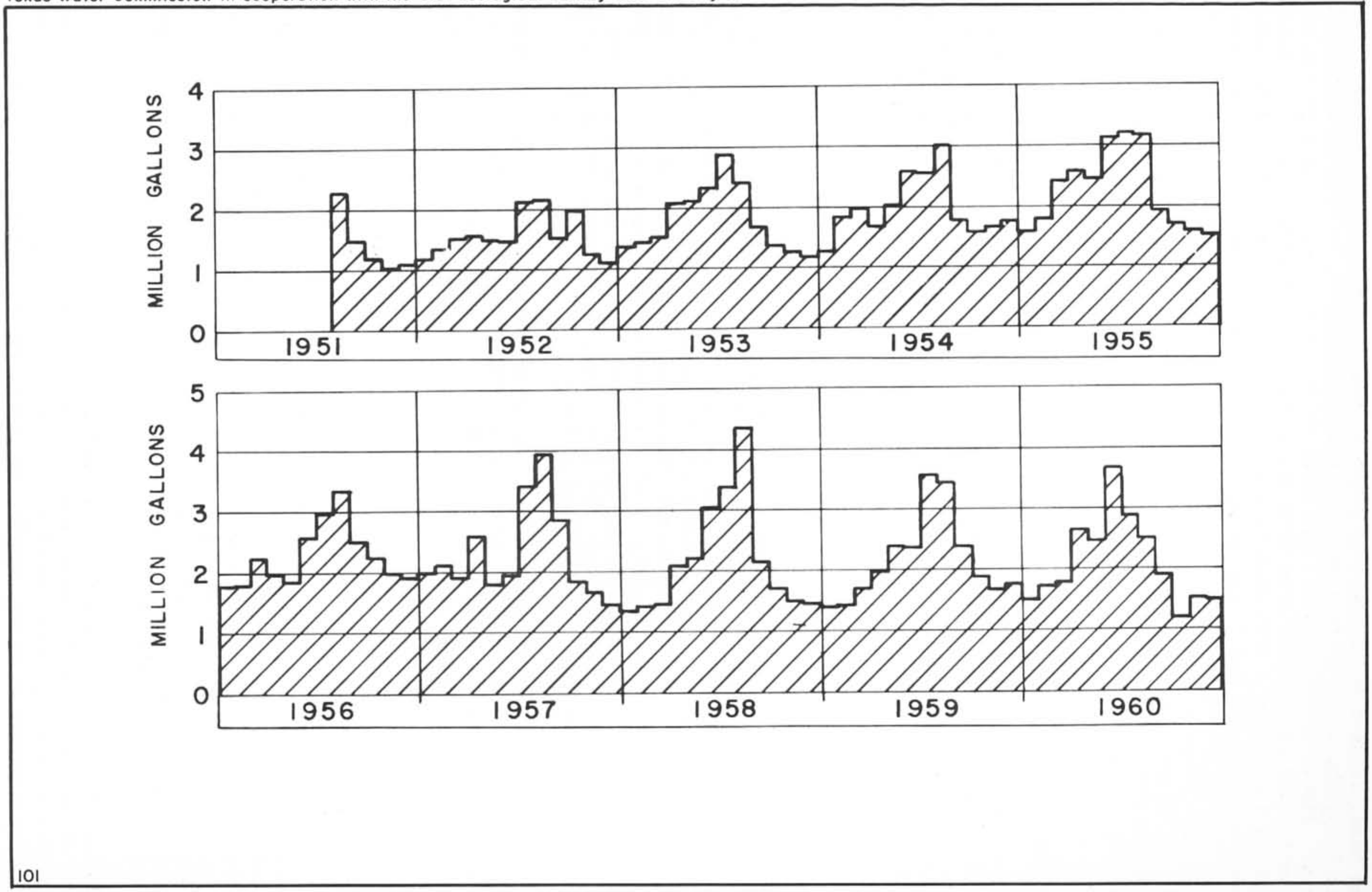

FIGURE 10.- Average daily pumpage from city of Alice wells
(From city of Alice records)

withdrawal rates of wells or by changes in ground-water recharge. Long-term changes in water levels generally affect a large area.

The principal cause of changes of water levels in the Alice area is change in pumping rate. The main center of pumping is at the city of Alice, and consequently the greatest changes in water levels have been in that general vicinity. Figure 11 shows the change in water levels in the Goliad Sand based on measurements in 1933-34 and 1960-61. The map shows the effect of the pumpage at Alice where the water levels have declined a maximum of 127 feet. The large declines in the southeastern part of the area reflect the pumpage at Alice and at Kingsville, about 20 miles southeast of Alice. Additional declines are to be expected in the southern part of the area caused by industrial pumping at the King Ranch Humble Oil and Refining Co. recycling plant, about 12 miles south of Ben Bolt, which presently uses 1,500,000 gpd.

Figure 11 shows that there has been very little change in water levels in the outcrop area of the Goliad Sand. In the northwestern part of the Alice area, the changes in water levels range from a decline of 6 feet to a rise of 5 feet, and northwest of Orange Grove the water level has risen 8 feet in one well.

The decline in water levels in the southern part of the Alice area also is illustrated by Figure 12, which shows hydrographs of three observation wells (84-32-401, 84-32-501, and 83-25-701), which have been measured periodically since 1932. Except for minor differences, the hydrographs all show similar patterns of fluctuations. The water levels declined slowly during the 1930's and rapidly during the 1940's and early 1950's. The water levels declined slowly from about 1954 to 1960; however, all three wells showed large declines during 1961. Records of water-level measurements made on these wells plus monthly measurements made on the city of Alice wells during 1960 and 1961 are given in Table 7.

Historical records of water levels in the Oakville Sandstone in the Alice area are not available; however, declines probably have been substantial, reflecting industrial pumpage in southern Jim Wells County. Records of an Oakville well at the Magnolia Petroleum Co. Seeligson plant about 17 miles south of Ben Bolt show a decline in water level of about 405 feet between 1947 and 1960.

Precise records of changes in water levels in the Pliocene(?) and Pleistocene undifferentiated formations are not available; however, the changes probably are small. The water level in well 84-24-207, which draws from the Pliocene(?) and Pleistocene sediments at a depth of 270 feet, was 53.8 feet below the land surface in February 1961. The water level in well 84-24-213, which is 154 feet deep and about 1 mile north of well 84-24-207, was 72.2 feet below the land surface in 1934. This, together with the fact that there is very little pumpage from the Pliocene(?) and Pleistocene sediments, would indicate that there has been no significant changes in the water levels in the Pliocene(?) and Pleistocene undifferentiated sediments at least in the vicinity of Alice.

The changes in water levels in wells in the Goliad Sand, resulting from changes in pumping rates, have caused changes in the direction of movement of the water. Figures 13 and 14, which show the altitude of the water level in wells in the Goliad in 1933-34 and in 1960-61, also show the direction of movement as the water moves in the direction of slope of the water surface. Figure 13 shows that in 1933-34 the movement of water was generally east and the effect of the pumping at Alice or Kingsville was not evident. The 1960-61 map shows the effect of pumping at Alice and Kingsville. The general direction of movement has shifted

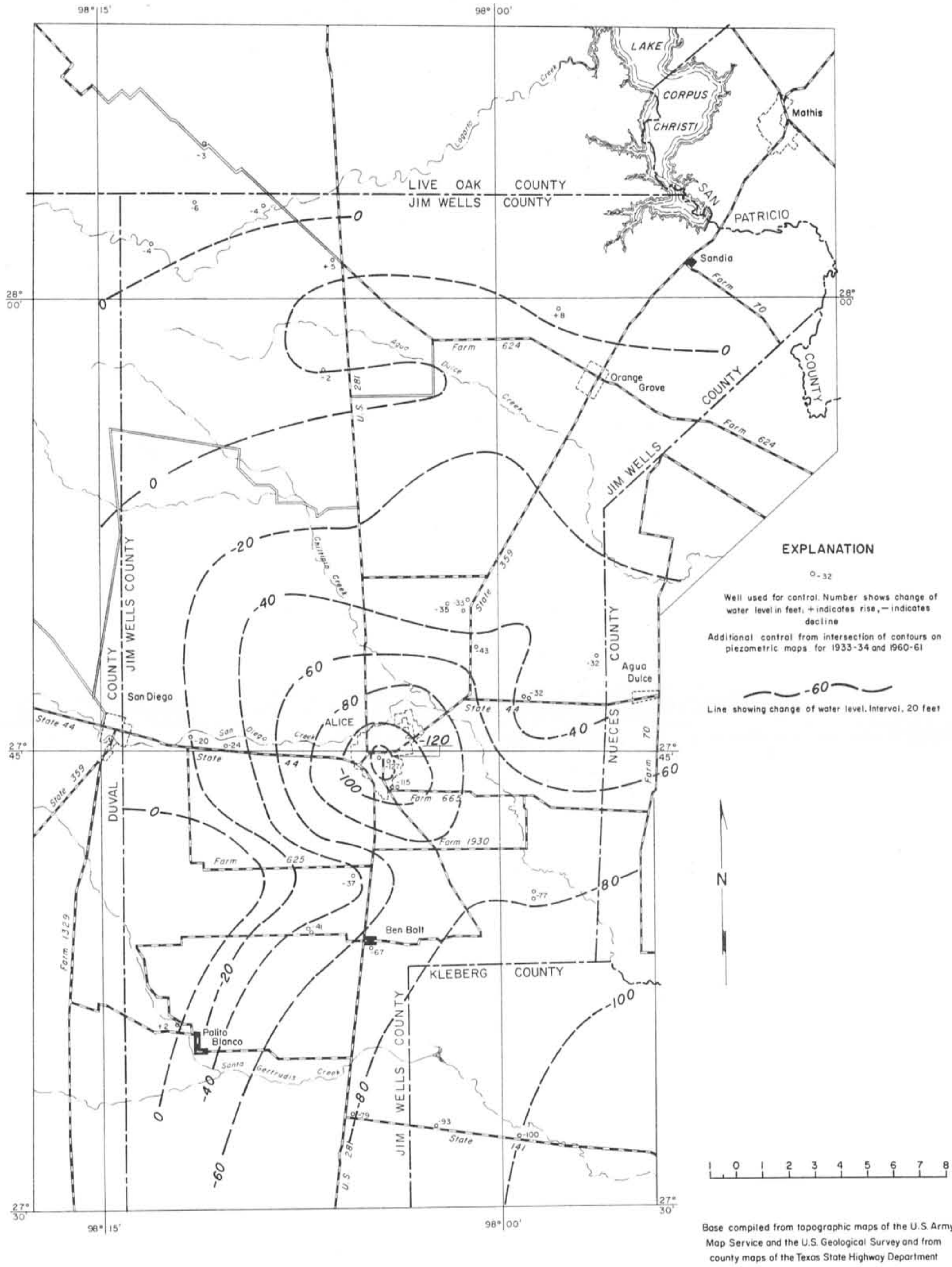

FIGURE 11. - Change of water levels in wells in the Goliad Sand, Alice area, 1933-34 to 1960-61

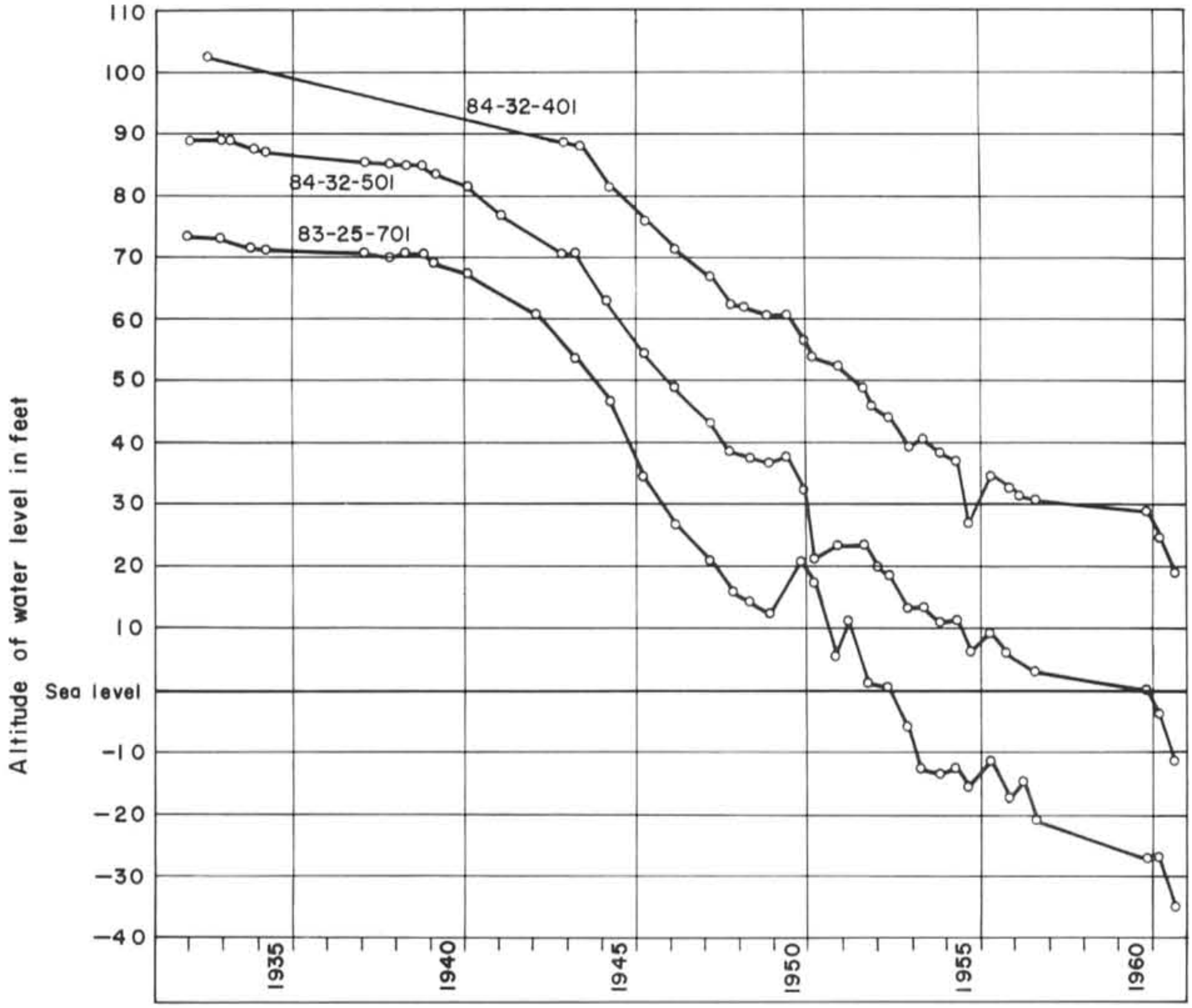

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FIGURE 12.- Hydrographs of wells in the Goliad Sand, southern part of Alice area

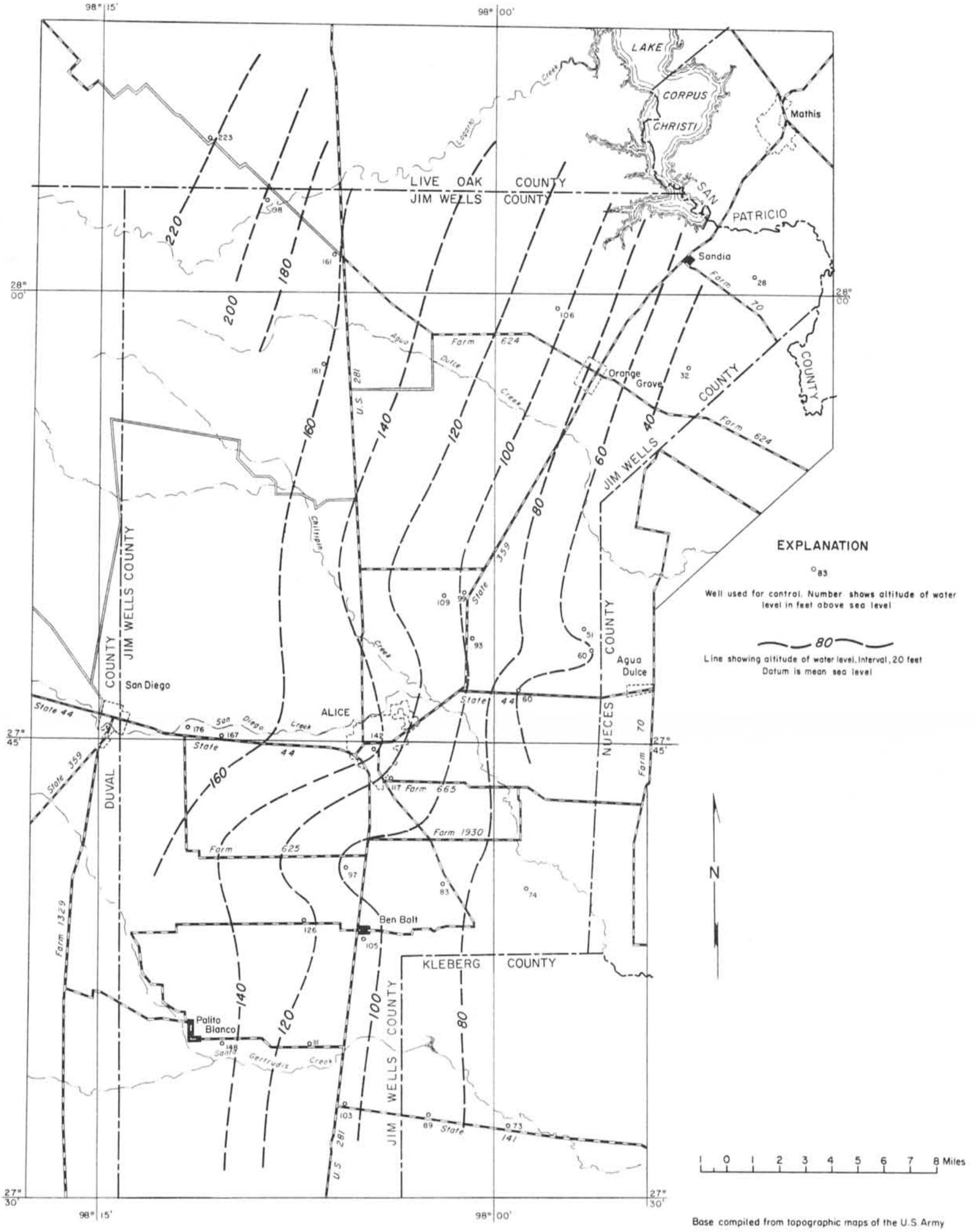

FIGURE 13.- Altitude of water levels in wells in the Goliad Sand, Alice area, 1933-34

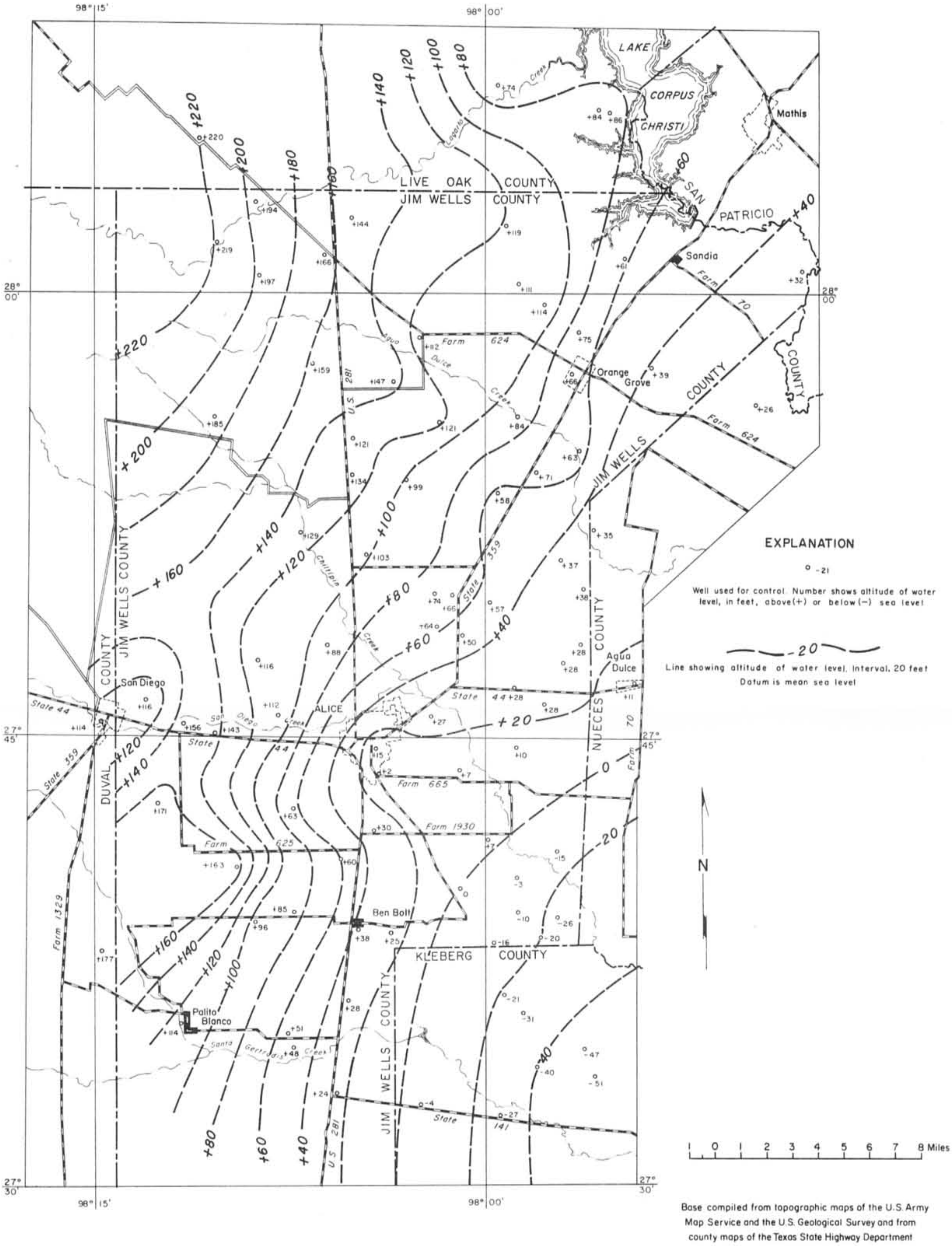

FIGURE 14.—Altitude of water levels in wells in the Goliad Sand, Alice area, 1960-61

slightly toward the southeast. The cone of depression in the water-level surface caused by pumping at Alice is not conspicuous because of the large contour interval of the map and because of the larger effect of the pumpage at Kingsville.

Problems of Well Construction

The problems of well construction in the Goliad Sand in the Alice area are related to two conditions. The more important of these is the grain size of the sand. The Goliad Sand in the subsurface in the Alice area contains much fine-grained sand. A sample taken from well 84-24-208 at a depth of 515 feet, as analyzed in the laboratory of the U. S. Geological Survey, contained 36.2 percent fine sand (one-fourth to one-eight millimeter in diameter), 35.6 percent very fine sand (one-eighth to one-sixteenth millimeter), and 28.2 percent silt and clay (less than one-sixteenth millimeter).

Because of the fine grain size of the Goliad, large-capacity wells completed in it should be underreamed and gravel packed. The gravel packing both increases the effective diameter of the well and aids in preventing the entrance of sand into the well. Recently drilled municipal wells of the city of Alice are packed with a gravel of which 60 percent is finer than 0.1 inch and 10 percent is finer than 0.06 inch. This practice has been at least partly successful in controlling the sand problem. A few of the earlier municipal wells were completed without gravel packing and have since been abandoned because of excessive sand pumping. The city of Agua Dulce has one well (83-17-901) that was converted from an oil-test well by perforating the surface casing; consequently, this well is not gravel packed. The well pumps much sand and has a relatively low yield. Well 84-24-101, an irrigation well converted from an oil-test well in a manner similar to the Agua Dulce well, also pumps a considerable amount of sand. Well 84-24-802, another irrigation well converted from an oil-test well, has been abandoned owing to a low yield and partial filling with sand. Even some of the gravel-packed wells pump too much sand. Wells 84-16-807 and 84-16-701 (city of Alice wells 11 and 13) have been pumping so much sand that they are equipped with sand traps to eliminate the sand before the water goes into the city mains.

Many of the domestic and livestock wells in the Alice area are finished by placing a joint or two of torch-slotted pipe at the bottom of the casing string. These wells are particularly vulnerable to sand troubles and must be cleaned periodically by jetting with air to remove the sand that has accumulated in the casing.

In the southeastern part of the Alice area, several strata of salt water-bearing sand occur in the Pliocene(?) and Pleistocene sediments overlying the Goliad Sand. Wells finished in the Goliad in this area should be cemented from the top of the fresh-water sands to the surface, thereby eliminating the threat of corrosion of the casing by the salt water. If the casing is not protected, the corrosion may cause holes in the casing and the wells may become contaminated by salt-water leakage from the overlying salt-water strata.

Quality of Water

All ground water contains dissolved minerals, the amount and kind of minerals largely determining the suitability of the water for different uses. The U. S. Public Health Service (1946, p. 371-384) has established standards for drinking water used on common carriers engaged in interstate commerce. The standards have been used widely in evaluating the suitability of water for drinking, although in many places water containing mineral content far in excess of that

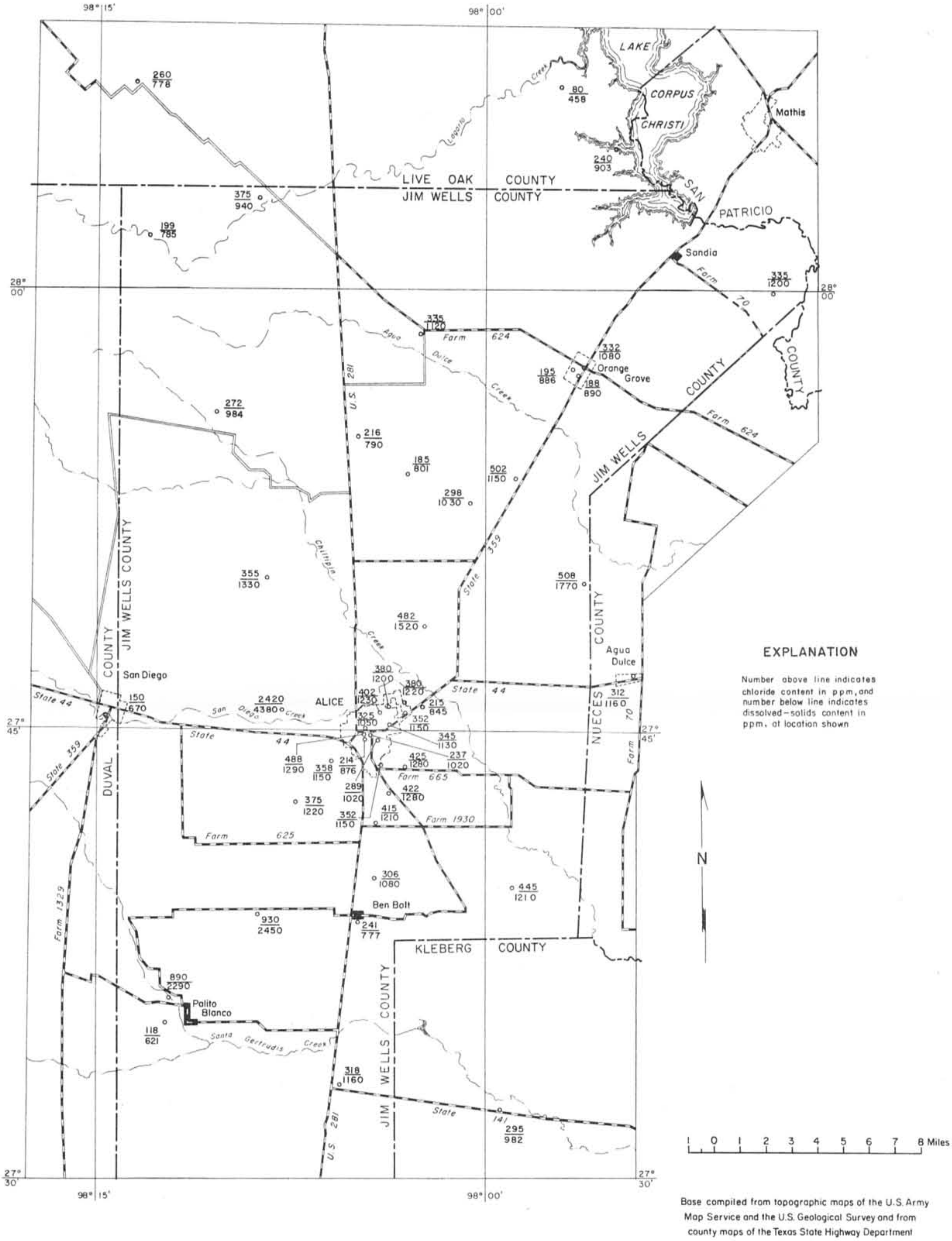

FIGURE 15.- Chloride and dissolved-solids content of water from selected wells in the Goliad Sand, Alice area

chloride content of 2,420 ppm and a dissolved-solids content of 4,380 ppm. This well probably is being contaminated by water from the Pleistocene(?) and Pliocene undifferentiated formations. In general, if a sample of water has a dissolved-solids content in excess of about 1,400 ppm, it probably is from a well that is not yielding water exclusively from the Goliad.

Calcium and magnesium are the principal constituents in water that give it the property called hardness. Hard water causes excessive soap consumption and creates incrustations in boilers, pipes, and hot water heaters. The hardness equivalent to the bicarbonate and carbonate content is called carbonate hardness; the remainder is called noncarbonate hardness. The figures given for the hardness of a water may be evaluated by comparing them with the commonly accepted standards of hardness for public and industrial supplies given in the following table (Lamar, 1942, p. 25-26).

Classification	Hardness range (ppm)
Soft	60 or less
Moderately hard	61 - 120
Hard	121 - 200
Very hard	More than 200

The hardness of the water from the Goliad Sand ranges between wide limits, but most of the water is hard or very hard. The city of Alice wells that draw only from the Goliad yield water ranging in hardness from 84 to 260 ppm; the average of 21 samples was 156 ppm. The three Orange Grove wells yielded water having 117, 170, and 286 ppm of hardness. The hardness of the water produced by the San Diego well was 151 ppm, whereas the Agua Dulce well produced relatively soft water, having only 58 ppm of hardness.

The presence of moderate amounts of silica in water is not harmful for most purposes; however, for some industrial uses it may be undesirable. Silica in boiler-feed water is objectionable because it forms a hard scale, the scale-forming process increasing with the pressure in the boiler. The following table shows the maximum allowable concentrations of silica for water used in boilers (Moore, 1940, p. 263). The silica content of the water from the Goliad Sand in the Alice area ranged from 10 to 39 ppm, and averaged 22 ppm in 37 samples.

Concentration (ppm)	Boiler pressure (pounds per square inch)
40	Less than 150
20	150 - 250
5	251 - 400
1	More than 400

In appraising the quality of water for irrigation, both the concentration and the composition of dissolved constituents should be considered. The chemical recommended in the standards has been used with no apparent ill effects. The maximum concentrations of some mineral substances recommended in the standards are as follows:

> Iron (Fe) and manganese (Mn) together should not exceed 0.3 ppm (parts per million).
>
> Magnesium (Mg) should not exceed 125 ppm.
>
> Chloride (Cl) should not exceed 250 ppm.
>
> Sulfate (SO_4) should not exceed 250 ppm.
>
> Fluoride (F) must not exceed 1.5 ppm.
>
> Dissolved solids should not exceed 500 ppm; however, 1,000 ppm may be permitted if water of better quality is not available.

These standards were set primarily as a protection against digestive or other disturbances and because they represent limits beyond which the taste of the water may become objectionable. Water containing magnesium and sulfate much in excess of the standards may have a laxative effect. Water high in fluoride content causes mottling of the teeth if used continuously by children (Dean, Dixon, and Cohen, 1935, p. 424-442); however, fluoride concentrations of about 1.0 ppm appear to reduce the incidence of tooth decay (Dean, Arnold, and Elvove, 1942, p. 1155-1179). High concentrations of iron may cause staining of plumbing fixtures and an undersirable taste. Water containing more than 44 ppm of nitrate should be regarded as unsafe for infant feeding because it may cause methemoglobinemia, or "blue baby" disease (Maxcy, 1950, p. 271). A high nitrate content may be an indication of pollution from organic matter, and water containing excessive nitrate should be tested for bacterial content.

Most of the water from the Goliad Sand in the Alice area meets the standards of the Public Health Service except those for chloride and dissolved-solids content. All the samples from the city of Alice wells contained chloride in excess of 250 ppm and all but one contained more than 1,000 ppm dissolved solids. Chemical analyses of water from wells in the Alice area are given in Table 8. Figure 15 is a map of the area showing the location of selected wells obtaining water from the Goliad Sand, and the chloride and dissolved-solids content of water from these wells. No clear pattern of distribution of either chloride or dissolved-solids content is evident from the map. Water of a quality as good or better than the water being used by the city of Alice is available in most parts of the area. The better quality water (water with less than 250 ppm chloride and less than 1,000 ppm dissolved solids) appears to be in the areas closer to and in the outcrop of the Goliad Sand. However, wells in many other parts of the area yield water of comparable quality. Changes of water quality probably are due more to a vertical variation of the quality of water in the individual sands in the Goliad than to a lateral variation. Thus, the quality of water produced by any given well will depend more upon how and in what sands the well is finished than on its location within the area.

The best quality of water, as shown in Table 8, from the Goliad Sand was from well 79-57-204 in Live Oak County, the water having a chloride contant of 80 ppm and a dissolved-solids content of 458 ppm. San Diego well 84-15-704 had a chloride content of 150 ppm and a dissolved-solids content of 670 ppm. The poorest quality of water from a well in the Goliad was from well 84-15-903 which had a

An excessive concentration of boron also will make water unsuitable for irrigation. Wilcox (1955, p. 11) has indicated that a boron concentration of as much as 1.0 ppm is permissible for irrigating sensitive crops; a concentration of as much as 3.0 ppm is permissible for tolerant crops. The boron content of 17 samples from the Goliad Sand in the Alice area ranged from 0.76 to 3.2 ppm. Most of the samples had less than 2 ppm and boron probably is not a serious problem for the irrigation of most crops in the Alice area.

Only one well (84-24-401) obtaining water from the Oakville Sandstone is being used in the northern part of the Alice area. An analysis of water from this well showed a dissolved-solids content of 2,030 ppm, chloride content of 452 ppm, sulfate content of 690 ppm, and boron content of 9.2 ppm. These constituents are well above the recommended limits for water for municipal or irrigation supplies.

FUTURE DEVELOPMENT

The future development of ground water from the Goliad Sand in the Alice area is dependent upon many factors; perhaps the most obvious of these is the amount of recharge which the aquifer receives. Studies to determine precisely the amount of recharge were not a part of the present investigation; however, estimates can be made based on available data. The water-level map for 1933-34 (Figure 13) represents conditions before large quantities of ground water were being used; consequently this map also represents nearly the original conditions of flow in the aquifer. Based on the slope of the water-level surface in the Goliad and the transmissibility of the water-bearing sands, computations can be made to show the amount of water moving through the aquifer. Such computations on the basis of the 1933-34 map indicate that approximately 3,000,000 gpd was flowing into the Alice area across the 120-foot contour. Only small supplies of ground water were being used in the area at that time; therefore, this figure can be considered an approximation of the amount of natural recharge to the Goliad. Although the effective area of recharge in the outcrop of the Goliad was not determined, the flow of 3,000,000 gpd through the aquifer indicates that the recharge was probably less than 0.1 inch per year.

Another important factor which controls the potential development of ground water is the transmissibility of the water-bearing sands. Under given conditions of pumping, the transmissibility is the major controlling factor affecting the decline of water levels which is needed to establish a gradient so that a given quantity of water will move toward areas of withdrawal. The effect of transmissibility on water levels can be demonstrated by a consideration of pumping in the immediate vicinity of Alice from municipal wells. In general, the shallowest water-bearing sands that supply the city of Alice wells are at a depth of about 300 feet below the land surface. When the water levels decline to this depth, further pumpage from the wells will start dewatering the sands. When this happens, the decline in water levels will be somewhat retarded because a larger proportion of the water pumped will be water that has been taken from storage. Although this retardation of decline will appear to be beneficial, as the decline continues the saturated thickness of the water-bearing sands will be reduced and the yields of the individual wells will decrease. Furthermore, as the water levels decline, the alternate wetting and drying of the exposed sections of screen in the wells will cause corrosion of the well screens. This will cause a further reduction in the yield of the wells.

Predictions of future water needs of the city of Alice have been made by consulting engineers (Figure 17). To demonstrate the effect of additional large-scale ground-water withdrawals in the Alice area, theoretical drawdowns in the characteristics that appear to be most important in evaluating the quality of water for irrigation in most areas, including the Alice area, are (1) relative proportion of sodium to other cations (an index of the sodium hazard), (2) total concentration of soluble salts (an index of the salinity hazard), (3) amount of residual sodium carbonate (RSC), and (4) concentration of boron.

A system of classification commonly used for judging the quality of a water for irrigation was proposed in 1954 by the U. S. Salinity Laboratory Staff (1954, p. 69-82). The classification is based primarily on the salinity hazard as measured by the electrical conductivity of the water and the sodium hazard as measured by the sodium-adsorption-ratio (SAR). On Figure 16, a diagram which can be used for evaluating water to be used for irrigation, are plotted the sodium-adsorption-ratio and specific conductance as determined from the analysis of 14 samples which may be considered as being representative of water from the Goliad Sand in the Alice area. The diagram shows that all the samples had a high or very high salinity hazard and medium to very high sodium hazard.

The relative importance of the dissolved constituents of water to be used for irrigation is dependent upon the degree to which the constituents accumulate in the soil. Kelley (1951, p. 95-99) cited areas having an average annual precipitation of about 18 inches in which salts did not accumulate in the irrigated soil. Wilcox (1955, p. 15) stated that the system of classification of irrigation water proposed by the Salinity Laboratory Staff "...is not directly applicable to the supplemental waters used in areas of relatively high rainfall." Thus, in the Alice area where the average annual precipitation is about 26 inches, the system of classification probably is not fully applicable. Wilcox (1955, p. 16) indicated that water generally may be used safely for supplemental irrigation if its conductivity is less than 2,250 micromhos per centimeter at 25°C and its SAR less than 14. Each individual situation should be appraised when consideration is being given to irrigating with water whose specific conductance and SAR exceed these limits or where soil or drainage are unfavorable or when the crop to be grown is especially sensitive to the hazards of sodium and salinity. On the basis of the above described classification, the water from the Goliad Sand probably is not suitable for continuous irrigation; however, under certain circumstances, the water probably can be used for supplemental irrigation.

When the content of carbonate and bicarbonate, in equivalents per million, exceeds that of calcium plus magnesium, residual sodium carbonate (RSC) will be present if the calcium and magnesium in the irrigation water are precipitated as carbonates. Thus, the formation of RSC will accompany the increase in percent sodium. The RSC will cause the water to be alkaline and the organic material of the soil to tend to dissolve. The soil may become a grayish black and the land areas affected are referred to as "black alkali." Wilcox, Blair, and Bower (1954, p. 265) report from results of determinations made on irrigated noncalcareous soils, "...it has been concluded that waters containing more than 2.5 me./1 of 'residual Na_2CO_3' are not suitable for irrigation, that those containing between 1.25 and 2.5 me./1 are marginal, and that those containing less than 1.25 me./1 are probably safe. These conclusions are, of course, tentative, and subject to change as more data are obtained. Furthermore, degree of leaching will modify permissible limit to some extent."

The RSC of ground waters in the Alice area ranges from 0 to 5.88 epm (equivalents per million) and water from most of the wells contains more than 2.5 epm. According to the conclusions of Wilcox, Blair, and Bower, extensive use of the water for irrigation might be harmful to the soil unless the soils are calcareous and provisions are made for ample leaching.

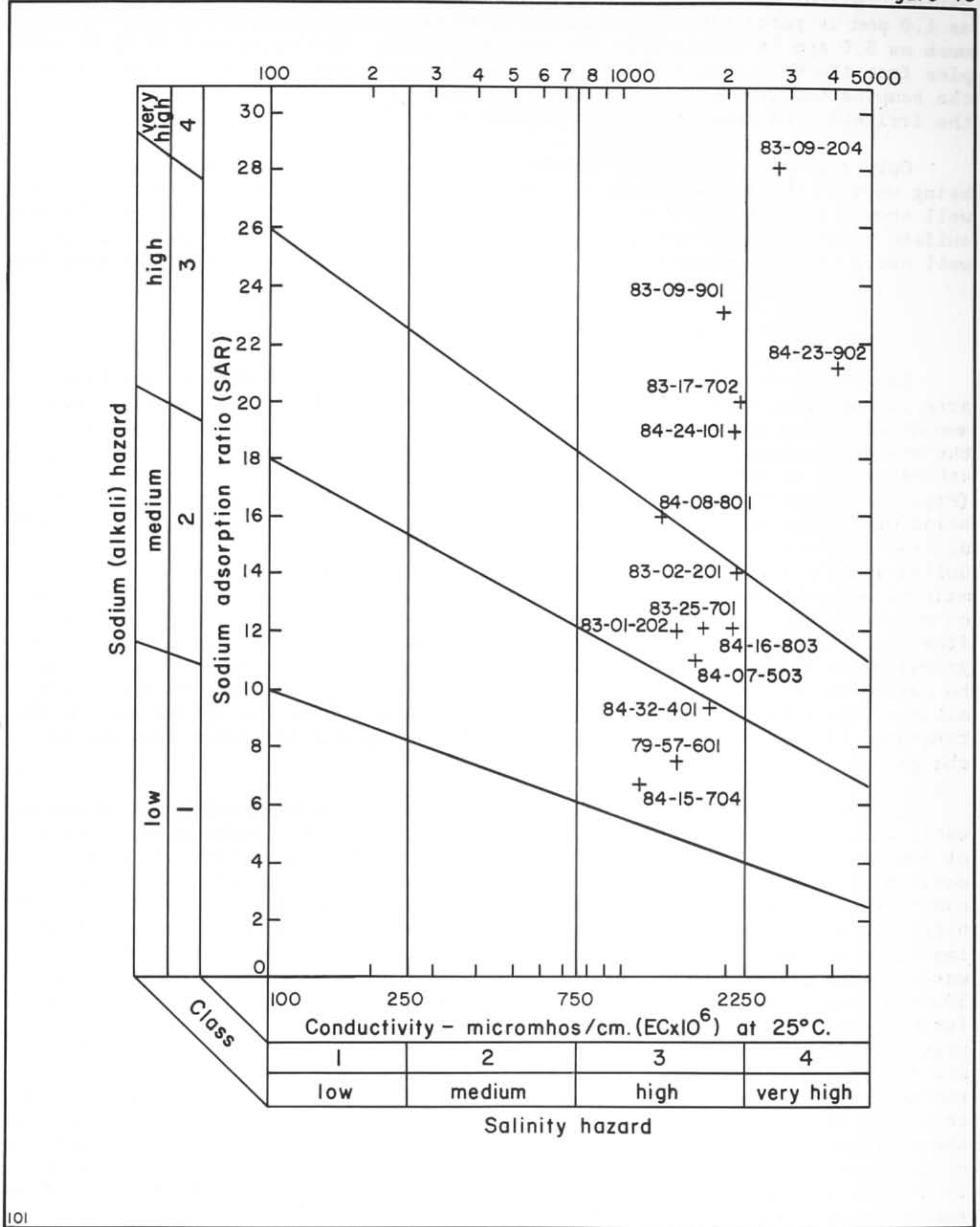

FIGURE 16.- Diagram for the classification of irrigation waters
(After U.S. Salinity Laboratory Staff, 1954, p.80)

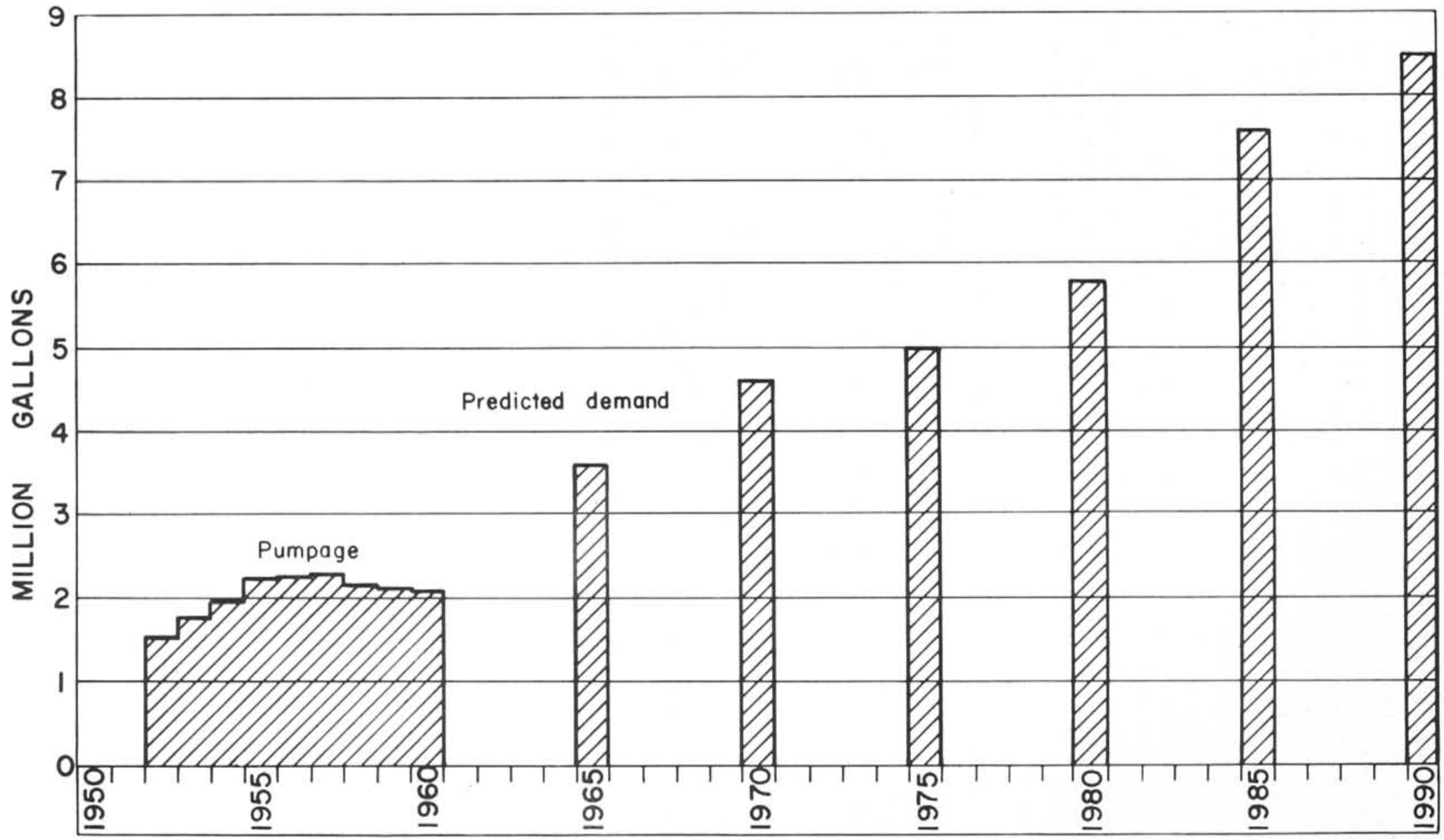

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FIGURE 17.- Average daily pumpage by the city of Alice, 1952-60, and predicted demand, 1965-90
(From city of Alice records)

wells at Alice were computed based on these figures. These computations indicate that when the pumpage by the city of Alice wells approaches the 4.6 mgd average daily use predicted for 1970, the pumping levels will have declined to approximately the 450-foot level and the upper sands in the Goliad will have begun to be dewatered. The computations of the theoretical pumping levels are based on the following assumptions: (1) the coefficient of transmissibility is 7,600 gpd per foot; (2) the coefficient of storage is 0.00025; (3) the pumpage will be supplied by wells pumping individually 270 gpm on a continuous basis; (4) new wells will be installed as necessary as the predicted demand increases; (5) the aquifer is homogeneous; (6) the outcrop of the aquifer is a straight line of infinite length 10 miles distant from the wells; and (7) there is no drawdown of water levels in the outcrop. The figure of 270 gpm yield of the wells is based on the approximate average yield of the city of Alice wells which were drilled before 1960. If larger pumps are installed in the wells, such as has been done in the wells drilled in 1960 and 1961, the theoretical pumping levels will be considerably deeper. Using a specific capacity figure of 2 gpm per foot of drawdown, the theoretical pumping level in 1970 at a well producing 500 gpm would be about 565 feet below land surface.

One of the factors usually considered important in the development of a ground-water supply is the amount of water in storage. Although the amount of water in storage in the Goliad Sand in the Alice area is very large, the actual amount is not of great importance because of the low permeability of the sands. This low permeability and lack of available drawdown limits the production of individual wells because of the great drawdown necessary to produce large quantities of water.

The fact that the present rate of pumping in the Alice area approaches the estimated recharge figure of 3,000,000 gpd indicates that the Goliad Sand in the area has nearly reached its optimum rate of development. The present rate of pumpage could be continued indefinitely and could even be increased slightly through widely spaced wells; however, any large additional development in the Alice area should be from other sources, either distant ground-water sources or surface supplies.

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*Name of agency changed to Texas Water Commission January 30, 1962.

Table 5.--Records of wells in the Alice area

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: A, airlift; B, bucket; C, cylinder; Cf, centrifugal; E, electric; G, gasoline, butane, or diesel; 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	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
						Jim Wells County					
78-63-501	Flora B. Patterson	--	1872	115	6	Goliad sand	75.3 79.7	Nov. 16, 1933 Oct. 7, 1960	C,W	S	
502	William and Beal Naumann	--	--	118	4	do	93.7	Nov. 16, 1933	N	N	
503	do	O'Neill Drilling Co.	1950	242	4	do	118.4	Oct. 7, 1960	C,W	S	
* 601	S. M. Freeborn	A. C. White	1926	275	4	do	68.5 72.5	Mar. 21, 1934 Oct. 7, 1960	C,W	D,S	Altitude of land surface 267 ft.
602	do	Al Herschap	1949	237	5	do	60.6	Oct. 7, 1960	J,E	D,S	
603	Bella S. Freeborn	S. H. Howell	1955	4,948	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 253 ft.
* 701	Sheeran School	Grogonio Cosa	1930	80	4	Goliad sand	49.2 52.9	Nov. 18, 1933 Dec. 5, 1960	C,H	P	
801	L. Broeter	Butler, Thomas, and Southern	1958	5,702	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 373 ft.
802	S. M. Freeborn	Brian Patterson	1946	240	4	Goliad sand	62.0	Dec. 2, 1960	C,W	S	Altitude of land surface 281 ft.
803	do	--	--	102	6	do	--	--	C,W	S	Old well.
804	do	--	--	200	6	do	104.0	Dec. 19, 1960	C,W	S	Do.
805	Doc Patterson	--	1916	112	4	do	--	--	C,W	D,S	
901	S. M. Freeborn	--	--	90?	6	do	127.4	Dec. 16, 1960	C,W	S	Altitude of land surface 324 ft. Old well.
902	do	W. J. Calaway	1955	250	4	do	--	--	C,W	S	Reported discharge 75 gpm. Open hole.1/

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*78-63-903	S. M. Freeborn	Patterson Drilling Co.	1951	228	4	Goliad sand	75 101.3	1960 Dec. 19, 1960	C,W	S	Open hole.
78-64-401	do	S. H. Howell	1955	5,368	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 243 ft.
402	do	A. L. Herschap	1949	311	4	Goliad sand	62.7	Dec. 19, 1960	C,W	S	[1]
403	S. T. Freeman	--	1954	400	4	do	152.9	Jan. 31, 1961	C,W	S	Altitude of land surface 297 ft.
501	Francis Daugherty Estate	--	--	--	--	do	156.8	Jan. 11, 1961	C,W	S	Old well.
701	D. Stehle Estate	--	--	400	4	do	163.3 159.1	Nov. 17, 1933 Oct. 7, 1960	C,W	D,S	Altitude of land surface 325 ft. Old well.
702	Herbert E. Hinze	Thomas Drilling Co.	1958	5,500	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 326 ft.
703	W. E. Langford	-- Patterson	1949	300	4	Goliad sand	169.6	Nov. 4, 1960	C,E, 3/4	D,S	
704	F. E. Dolan	Thomas Bros. and -- Shearer	1958	6,919	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 300 ft.
705	John Herschap	Ed Juergins	1939	320	4	Goliad sand	--	--	C,W	D,S	
801	Fritz Laudecke	Smith and Story Inc.	1954	3,010	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 319 ft.
802	S. T. Freeborn	O'Neill Drilling Co.	1959	365	4	Goliad sand	185	1959	C,E	D,S	
901	Willie Banker, Jr.	Max Pary	1953	3,904	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 257 ft.
902	Lena McElvaine	Martin Water Wells Co.	1958	382	4	Goliad sand	156.4	Dec. 2, 1960	C,W	S	Casing slotted from 358 ft. to bottom.[1]
903	Willie Banker, Jr.	--	--	300?	4	do	--	--	C,W	D,S	Old well.
904	do	--	--	300?	4	do	130.5	Feb. 2, 1961	C,W	S	Do.
79-57-501	-- Rozypal	Martin & Sunray	1955	5,054	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 218 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
79-57-701	-- Jennings	Daubert & Dolch	1957	5,122	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 193 ft.
702	Willie Banker, Jr.	--	--	300?	4	Goliad sand	113.7	Feb. 2, 1961	C,W	D,S	Altitude of land surface 225 ft. Old well.
703	do	--	1958	365	4	do	124.0	do	C,G	S	
704	do	--	--	300?	4	do	127.5	do	C,W	S	Altitude of land surface 247 ft. Old well.
705	do	--	--	300?	4	do	121.2	do	C,W	S	
901	Sandie Elementary School	--	1920	250?	4	do	--	--	J,E	P	Supplies water for school.
902	G. F. Vettern	H. R. Smith and Republic Co.	1956	5,820	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 149 ft.
903	Miguel Gaitan	--	1948	200	4	Goliad sand	118.5	Jan. 9, 1961	C,W	D,S	Altitude of land surface 180 ft.
904	Herman Nethal	-- Sikes	1943	296	4	do	--	--	C,W	D,S	Casing screened to bottom.
79-58-701	K. E. Slavik	Texas Water	1955	660	--	do	+	1960	Flows	N	Reported flowing in 1960.
702	Walter Brumme	-- White	1958	174	--	do	--	--	C,E	S	
703	Harry Cade	--	--	110	4	do	77.4	Feb. 6, 1934	N	N	Altitude of land surface 105 ft. Old well.
801	J. H. Machan	Parsley Bros.	1955	221	12	do	51	1950	T,G, 50	Irr	Casing slotted from 159 ft. to bottom. Reported to irrigate 100 acres of feed.
802	-- Evary	Burl Sikes	1952	200	10	do	32.6	Jan. 3, 1960	T,G, 85	N	Casing slotted from 155 ft. to bottom. Pump set at 120 ft. Altitude of land surface 65 ft.
803	-- Hubbert	Katy Oil Co.	1957	5,588	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 88 ft.
804	Knolle Jersey Farm	Ben Welty	1955	165	--	Goliad sand	--	--	T,E, 1-1/2	D,S	
83-01-101	Chas. Starke	O. W. Killam	1943	--	--	--	--	--	--	--	Oil test. Altitude of drill floor 208 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
83-01-102	Louis W. Haverlah	McCarrick, Gouger & Mitchell	1959	2,587	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 235 ft.
103	H. C. Fuhrken	David Usel	1913	125	4	Goliad(?) sand	105.5 97.7	Feb. 6, 1934 Mar. 14, 1961	C,W	D,S	Altitude of land surface 212 ft.
201	City of Orange Grove	Carl Vickers	1949	746	8, 5	Goliad sand	144.3	Jan. 27, 1961	T,E, 20	P	Casing: 8-in. to 680 ft., 5-in. to bottom. Measured discharge 350 gpm.1/
* 202	do	H & S Well Service	1959	817	12, 6	do	133.5	Mar. 23, 1961	T,E, 60	P	Casing: 12-in. to 410 ft., 6-in. to bottom. Screens from 550 to 590, 634 to 646, 696 to 724, and 792 ft. to bottom. Altitude of land surface 200 ft. Gravel-packed.1/
203	Willie Brand	Arkansas Fuel Co.	1942	450	10	do	101.9	Nov. 14, 1960	N	N	Supplied water for drilling rig. Altitude of land surface 177 ft.
204	Coastal States Gas Production Co.	Martin Water Wells	1956	300	--	do	131.6	do	T,E, 1	D,Ind	
* 205	City of Orange Grove	Ed Juergens	1942	520	8	do	--	--	N	N	Temp. 81°F.
* 206	do	-- Jackson	1936	288	8	do	--	--	N	N	Temp. 78°F.
301	R. Klosterman	H. R. Smith	1954	4,921	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 160 ft.
302	Emil Hinze	Ben Welty	1959	250	4	Goliad sand	112.2	Jan. 9, 1961	C,W	D,S	Altitude of land surface 151 ft.
303	Mrs. W. Wiechring	--	--	192	4	Goliad(?) sand	118.8	Feb. 6, 1934	C,W	S	Altitude of land surface 150 ft. Old well.
401	Gertrude Hoffhines	Tex Star Oil & Gas Corp.	1956	5,510	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 181 ft.
402	William Laake	--	1923	220	4	Goliad(?) sand	--	--	C,W	D,S	
403	Walter Schmidt	Ed Juergens	1933	292	6	Goliad(?) sand	37.4	Jan. 27, 1961	C,W	D,S	Casing: 60 ft. of slotted pipe.
404	do	B. T. Sikes	1956	272	4	Goliad sand	95.0	Jan. 31, 1961	C,W	S	Casing slotted from 252 ft. to bottom. Altitude of land surface 179 ft.1/

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
83-01-501	Orange Grove Gas & Oil Co.	Patterson Drilling Co.	1952	350	4	Goliad sand	--	--	C,E, 1-1/2	D,Ind	Casing slotted from 308 ft. to bottom.
502	A. Habrnal	Wiley P. Ballard	1955	5,450	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 168 ft.
503	R. C. Miller	H. H. Howell	1955	5,500	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 178 ft.
504	Paul Haverlah	John Schemercheuk	--	142	5	Goliad(?) sand	118.8	Nov. 14, 1960	C,W	D,S	Casing perforated. Old well.
505	Coastal States Gas Production Co.	Martin Water Wells	1953	300	--	Goliad sand	113.5	do	T,E, 1	D,Ind	
506	Richard Miller	Clyde Capp	1946	495	4	do	--	--	C,W	D,S	Casing: 20 ft. slotted pipe.
507	do	--	1946	512	7	do	--	--	T,E, 20	D,S	Casing: 40 ft. perforated. Estimated discharge 65 gpm.
601	Henry Mueller	Southwestern Oil & Refining Co.	1957	5,688	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 152 ft.
701	Ed C. Adams	O'Neill Drilling Co.	1959	324	4	Goliad sand	103.9	Jan. 30, 1961	C,W	S	Reported discharge 50 gpm. Altitude of land surface 175 ft.1/
702	J. W. Miles	Ed Juergens	1948	250	4	Goliad(?) sand	45.0	Nov. 9, 1960	C,E	D	
703	Coastal States Gas Production Co.	Martin Water Wells	1955	300	6	Goliad sand	111.8	Nov. 7, 1960	T,E, 1	D,Ind	Altitude of land surface 170 ft.
704	Rand Morgan	Rand Morgan	1951	3,565	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 163 ft.
* 705	Robert Adams	Rowan and Hope	1936	400	5	Goliad sand	--	--	N	N	
801	-- Fell	Rand Morgan	1955	3,647	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 171 ft.
802	Rand Morgan	do	1958	5,742	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 147 ft.
804	Richard Miller	Ed Juergens	1940	400	4	Goliad sand	90.4	Jan. 9, 1961	C,W	D,S	Altitude of land surface 153 ft.
83-02-101	Ed Knolle	Ben Welty	1957	165	--	Goliad(?) sand	67.6	Jan. 4, 1961	T,E, 1	D,S	

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
83-02-102	Ed Knolle	Ben Welty	1959	165	--	Goliad(?) sand	--	--	T,E, 1-1/2	S	
103	Knolle Jersey Farm	-- Sikes	1940	165	--	do	63.4	Jan. 4, 1961	T,E, 1-1/2	D,S	
* 201	Arthur Knolle	-- Fortran	1957	400	12	Goliad sand	--	--	T,E, 75	Irr	Reported to irrigate about 50 acres in 1961. Reported sands from 150 to 180 ft., and 320 to 350 ft.
83-09-101	A. A. Wright	Kirkwood & Morgan Inc.	1956	5,651	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 160 ft.
102	E. M. Brownlee	do	1957	5,100	---	--	--	--	--	--	Oil test. Altitude of kelly bushing 139 ft.
103	E. A. Kohler	--	1945?	380	4	Goliad sand	79.1	Nov. 21, 1960	C,E	D,S	
104	E. M. Brownlee	--	1940?	350	--	do	43.8	Nov. 9, 1960	C,W	S	
105	Rand Morgan	--	--	285	--	Goliad(?) sand	77.9	Jan. 30, 1961	C,W	S	Old well.
202	Richard King	--	1948	600	4	Goliad sand	90.7	do	C,W	S	Supplied water for drilling rig. Altitude of land surface 128 ft.
203	F. J. Hoelscher	Stanley Haynes	1956	630	4	do	60 91.5	1960 Jan. 30, 1961	C,W,E	D,S	
* 204	J. M. Dellinger	Carl Vickers	1957	870	12	do	96.6	Jan. 30, 1961	T,Ng	S,Irr	Supplies water for irrigation during dry seasons only. Gravel-packed from 280 ft. to bottom. Altitude of land surface 135 ft.
401	W. K. Hoffman	L. M. Lockhart	1955	5,210	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 183 ft.
402	J. W. Bird	Blanco Oil Co.	1955	5,150	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 161 ft.
403	John S. Ragland	--	1940?	720	10	Goliad sand	118.3	Jan. 30, 1961	C,W,E	D,S	Casing: 10-in. to 600 ft., open hole below 600 ft. Oil test converted to water well. Altitude of land surface 175 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
83-09-404	John A. True	Clyde Maley	--	470	4	Goliad sand	--	--	C,W	N	Reported contaminated with salt water.
405	Willie Taylor	Whitson Bros.	1925	314	6	Goliad(?) sand	105.2 119.1	Feb. 8, 1934 Apr. 11, 1961	C,W	D,S	Altitude of land surface 152 ft. Temp. 78°F.1/
406	John Bird	do	1925	348	6	do	107.3	Feb. 8, 1934	C,E	S	Altitude of land surface 154 ft.
502	Eddie Smith	Stanley Haynes	1960	580	4	Goliad sand	117.3	Jan. 30, 1961	C,W	D,S	Altitude of land surface 145 ft.
503	E. Whitley	--	1905	1,600	12	do	90.0	Feb. 8, 1934	C,W	D,S	Altitude of land surface 141 ft.
504	E. Sain	Frank Whitson	1932	521	4	do	81.6 113.5	Feb. 8, 1934 Mar. 21, 1961	C,W	D,S	Altitude of land surface 142 ft.
506	New Wells Pipeline Co.	Stanley Haynes	1954	580	4	do	--	--	T,E, 3	D,Ind	Reported discharge 200 gpm.
702	John A. True	-- Redner	--	340	5	Goliad(?) sand	99.9	Feb. 1, 1934	N	N	Altitude of land surface 160 ft.
703	do	Stanley Haynes	1953	640	5	Goliad sand	131.7	Feb. 3, 1961	C,E	D,S	Do.
704	Ed Louis	Bowen Well Service	1960	300	--	Goliad(?) sand	119.3	Oct. 5, 1960	A,G	N	Supplied water for drilling rig. Altitude of land surface 147 ft.
83-17-101	Louie Bennett	Katz, Fox, and Howell	1955	5,949	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 159 ft.
102	do	do	1955	5,949	--	--	--	--	--	--	Oil test. Altitude of ground level 145 ft.
103	Don Boggan	--	--	--	--	Goliad(?) sand	--	--	C,E	D,S	
104	J. A. Hill, Jr.	Frank Whitson	1945	346	4	do	146.1	Nov. 15, 1960	C,W	D,S	Altitude of land surface 156 ft.
105	J. P. Hill	--	1925	160	--	Pliocene(?) and Pleistocene formations, undifferentiated	--	--	C,E	D	
106	J. A. Hill, Jr.	Frank Whitson	1941	340	4	Goliad(?) sand	122.0	Nov. 15, 1960	C,W	D,S	
107	-- Lindeman	Cunningham and Dunn	1955	6,070	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 169 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level		Method of lift	Use of water	Remarks
							Below land surface datum (ft.)	Date of measurement			
83-17-201	G. A. Parr	W. J. Calaway	1946	574	6	Goliad sand	--	--	C,W	S	
203	do	--	1950?	855	10, 7	do	58.7	Nov. 15, 1960	A,E, 75	Irr	Casing: 10-in. to 240 ft., 7-in. to bottom. Reported discharge 450 gpm. Reported not used for irrigation since 1958.
204	do	-- Whichen	1935?	360	6	Goliad(?) sand	107.5	do	C,E, 2	D,S	
401	Jacob S. Floyd	W. J. Calaway	1945	650	--	Goliad sand	136.6	Nov. 28, 1960	C,E, 1	D,S	Casing cemented to bottom. Altitude of land surface 144 ft.
402	Allen Richardson	Ben Welty	1957	638	4	do	143.2	Mar. 15, 1961	C,E, 3/4	D,S	Altitude of land surface 140 ft.
403	Jacob S. Floyd	A. C. White	1936	450	4	do	--	--	C,E	D,S	
404	Allen Richardson	Tom Leary	1909	1,510	4	do	66.2	Feb. 5, 1934	N	N	Reported sand from 435 to 470 ft. and 880 to 918 ft. Altitude of land surface 140 ft.
502	King Ranch	A. H. Masiran	1942	585	5	do	142.7	Mar. 16, 1961	C,W	S	Cased to bottom. Altitude of land surface 128 ft.
701	J. S. Floyd	Swift and McBride	1951	6,528	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 146 ft.
* 702	do	Frank Whitson	1940	559	4	Goliad sand	--	--	C,W,E	D,S	Cased to bottom. Temp. 80°F.
703	do	W. J. Calaway	1949	550	--	do	156.0	Nov. 28, 1960	C,W,G	S	Cased to bottom. Altitude of land surface 146 ft.
704	do	Clyde Maley	1952	650	10	do	154.3	do	C,W	S	Oil test, converted to water well.
705	King Ranch	--	1944	589	7, 5	do	136.4	Mar. 16, 1961	C,W	S	Casing: 7-in. to 380 ft., 5-in. to bottom. Altitude of land surface 116 ft.
706	-- Chapa	W. J. Calaway	1960	450	5	Goliad sand	158.1	Apr. 28, 1961	N	N	Casing cemented to surface. Altitude of land surface 142 ft.[1]
801	King Ranch	--	--	436	7, 4	do	150.6	Nov. 16, 1961	C,W	S	Casing: 7-in. to 188 ft., 4-in. to bottom. Altitude of land surface 125 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date com-plet-ed	Depth of well (ft.)	Diam-eter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-07-101	S. M. Freeborn	--	1929	280	--	Goliad sand	--	--	C,W	S	
201	do	--	--	280	6	do	--	--	C,W	D,S	
301	do	--	--	280	--	do	--	--	C,W	S	Altitude of land surface 318 ft.
401	do	--	1928	380	--	do	228.1	Dec. 19, 1960	C,W	S	
402	do	--	1929	280	--	do	118.0	do	C,W	S	
501	do	--	1928	400	--	do	136.3	do	C,W	S	
502	do	--	--	180	--	do	104.0	do	C,W	S	
* 503	do	Lone Star Drilling Co.	1959	280	4	do	140.1	do	C,W	S	Oil test, converted to water well. Altitude of land surface 325 ft.
601	D. Sauseda	--	1908	126	4	do	59.3 28.7	Nov. 22, 1933 Dec. 5, 1960	C,W	D,S	
602	Smith and Story	--	1950	344	4	do	211.7	Nov. 3, 1960	C,W	S	
603	M. Dilworth	Smith, Storey, and Wood	1946	2,373	--	--	--	--	--	--	Oil test. Altitude of drill floor 343 ft.
604	S. M. Freeborn	--	--	190	--	Goliad sand	180.1	Dec. 20, 1960	C,W	S	
701	G. B. de Garcia	Miller and Fox	1958	5,754	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 380 ft.
702	J. M. Luby	Pyramid, Briggs, and Shelton	1957	5,640	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 376 ft.
801	Hawkins Ranch	Miller and Fox	1958	5,571	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 337 ft.
802	Ben W. Cox	Clyde Maley	1950	160	--	Goliad sand	--	--	C,W	S	
803	do	--	--	160	--	do	--	--	C,W	S	Old well.
804	do	--	--	160	--	do	--	--	C,W	S	Do.
805	do	--	--	160	--	do	--	--	C,W	S	Do.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-07-901	Alfredo and Minerva Perez	Clyde Maley	1949	350	4	Goliad sand	112.7	Oct. 21, 1960	C,W	S	
902	Dorotor Ramirez	Leon Rodrigez	1942	146	4	do	33.6	Dec. 5, 1960	C,W	D,S	
84-08-101	T. L. Delemater	L. Juergens	--	350	4	do	131.9 134.2	Jan. 25, 1934 Mar. 23, 1960	C,W	D,S	Altitude of land surface 293 ft.
102	Sam Taylor	--	1954	429	4	do	138.6	Nov. 28, 1960	C,W	S	
103	Stelzig and Zwernewman	Rupert Cox	1953	2,368	--	--	--	--	--	--	Oil test. Altitude of ground level 300 ft.
201	Leslie Jackson	--	1954	430	4	Goliad sand	111.8	Oct. 28, 1960	C,W	S	
202	Perry Klatt	--	1918?	200	--	Goliad(?) sand	--	--	C,E, 3/4	D,S	
* 301	-- Kerchoff	Burl Sikes Drilling Co.	1960	552	4	Goliad sand	135.6	Jan. 9, 1961	A,G	N	Casing slotted 20 ft. Altitude of land surface 248 ft.
302	Joe Reynolds	O. W. Kilam	1936	480	4	do	124.8	Feb. 15, 1961	C,W	D,S	Cased to bottom.
401	W. T. Wright	-- Cases	1950	300	4	do	127.4	Nov. 2, 1960	C,W	S	Casing slotted.
402	do	Brian Patterson	1952	500	4	do	193.5	do	C,W	D,S	Casing: 40 ft. of perforated pipe. Altitude of land surface 315 ft.
403	Alfred Errick	--	--	--	--	Goliad(?) sand	164.6	Nov. 3, 1960	C,W	D,S	Old well.
* 404	W. T. Wright	--	1946	491	--	Goliad sand	170	Dec. 1946	N	N	1/
405	J. E. Garrett	--	1920?	180	--	Goliad(?) sand	134.5	Nov. 14, 1960	C,W	D,S	
501	A. J. Baker Estate	H. R. Smith	1955	5,613	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 270 ft.
502	Edward Wastal	Ed Juergens	1938	240	3	Goliad sand	120	Sept. 1960	C,W	D,S	Casing: 30 ft. slotted pipe.
503	H. L. Baker	-- Schemechek	1928	198	--	Goliad(?) sand	140.7	Nov. 14, 1960	C,W	D,S	
504	Dan Migura	-- Juergens	1923	300	4	Goliad sand	147.5	Dec. 16, 1960	C,W	D,S	Altitude of land surface 295 ft.
601	Geo. W. Reynolds	Steinmetz and Barron Trustees	1954	4,688	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 246 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-08-602	S. T. McDaniel	H. R. Smith	1955	3,167	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 274 ft.
603	Coastal States Gas Production Co.	Martin Water Wells	1956	320	5	Goliad sand	--	--	T,E, 1	Ind	Altitude of land surface 233 ft.
604	S. Taylor McDaniel	Lee Hatton	1952	500	--	do	140.5	Nov. 16, 1960	C,W	D,S	Altitude of land surface 262 ft.
702	Antonio Gomez	--	--	200	4	do	137.5	Nov. 2, 1960	C,W	S	Old well.
703	W. T. Wright	Clyde Maley	1950	300	4	do	157.9	do	C,W	S	Casing: 2 joints slotted pipe.
704	do	do	1950	260	4	do	128.4	do	C,W	S	
705	Antonio Perez	--	--	226	--	do	134.4 144.7	Nov. 12, 1933 Oct. 21, 1960	C,W	S	Old well.
706	Clements Hinajoza	--	1909	200	6	do	84.5 54.1	Nov. 12, 1933 Oct. 21, 1960	C,W	S	
707	V. Gonzales	Smith & Story, Inc.	1943	4,015	--	--	--	--	--	--	Oil test. Altitude of drill floor 324 ft.
708	Mrs. Vicenta Garibey	O'Neill Drilling Co.	1959	250	4	Goliad sand	140.0	Oct. 28, 1960	C,E, 3/4	S	Altitude of land surface 274 ft.[1]
* 801	U. S. Navy	Carl Vickers	1956	630	10, 5	do	144.4	Oct. 7, 1960	T,E, 20	P	Casing: 10-in. to 580 ft., 5-in. to bottom. Pump set at 280 ft. Reported discharge 200 gpm. Gravel-packed. Altitude of land surface 243 ft.
802	Josephine Price	Tom Crews	1960	3,113	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 299 ft.
901	do	Calvert, Manley & McClain	1957	2,166	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 252 ft.
902	O. S. Adams	Calvert & Manley	1953	2,539	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 213 ft.
903	do	do	1957	2,513	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 150 ft.
904	J. D. Adams	O. B. Martin	1960	565	4	Goliad sand	86.0	Nov. 8, 1960	C,W	D,S	

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-08-905	O. S. Adams	--	1940	200	--	Goliad(?) sand	--	--	C,W	D,S	
906	J. D. Adams	Louie David	1917	200	4	do	89.3	Nov. 8, 1960	C,W	S	
* 907	Ed Adams	Ed Juergens	1936	411	4	Goliad sand	--	--	N	N	Open hole.
84-15-101	J. M. Luby	Pyramid, Briggs, and Shelton	1956	5,616	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 379 ft.
102	Dan Risinger	Bennett and Del Mar	1958	7,010	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 314 ft.
201	D. W. Risinger	--	--	500	4	Goliad sand	52.9	Dec. 21, 1960	C,W	S	Old well.
202	Joe Smithwick	--	1946	240	4	do	52.7	do	C,W	S	
203	Ben W. Cox	J. F. Dunn	1933	160	5	do	56.7	do	C,W	S	
* 301	Lamar Hinnant	W. J. Calaway	1952	525	4	do	--	--	T,E, 1-1/2	D,S	
302	do	do	1955	664	4	do	158.5	Dec. 16, 1960	C,W	D,S	Casing cemented. Altitude of land surface 264 ft.
303	do	Glen Menking	--	600	6	do	105.5	do	C,W	S	
304	D. W. Risinger	--	--	500	4	do	37.9	Dec. 21, 1960	C,W	S	
501	do	--	--	500	4	do	144.3	do	C,W	S	
502	do	--	--	500	--	do	96.8	do	C,W	S	
503	do	Henry Dunn	1933	500	6	do	97.5	do	C,W	S	
601	H. E. and H. A. Moss	S. H. Howell	1955	8,148	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 260 ft.
602	Henry Dunn	W. J. Calaway	1956	385	4	Goliad sand	144.8	Oct. 21, 1960	C,W	D,S	
603	Jack Dunn	Glen Menking	1950	492	4	do	151.7	do	C,W	S	Altitude of land surface 268 ft.
701	Dan Risinger	Stanley Haynes	1960	528	--	do	177.1	Oct. 5, 1960	A,G	N	Supplied water for oil test. Altitude of ground level 293 ft.
705	D. W. Risinger	--	--	500	6	do	114.0	Dec. 16, 1960	C,W	D,S	Old well.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date com-plet-ed	Depth of well (ft.)	Diam-eter of well (in.)	Water-bearing unit	Water level		Method of lift	Use of water	Remarks
							Below land surface datum (ft.)	Date of measurement			
84-15-706	D. W. Risinger	--	1955	500	4	Goliad sand	114.0	Dec. 16, 1960	C,W,E, 2	D,S	
801	A. L. Stokes	--	--	265	6	Goliad(?) sand	109.0 128.9	Jan. 8, 1934 Oct. 31, 1960	C,W	D,S	Altitude of land surface 285 ft. Old well.
802	J. S. Floyd	Joe Gonzales	1932	456	6	Goliad sand	101.8 126.3	Feb. 7, 1933 Oct. 31, 1960	C,W	D,S	Altitude of land surface 269 ft.
901	H. Hoffman	Miller, Fox and Carey	1958	5,032	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 271 ft.
902	J. M. Young	Tex-Kan Oil & T. W. Crews	1957	5,511	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 254 ft.
* 903	do	--	1953	358	4	Goliad(?) sand	144.2	Oct. 21, 1960	C,E, 3/4	S	Altitude of land surface 256 ft.1/
904	I. M. Singer	W. J. Calaway	1954	302	4	do	--	--	C,W	S	1/
84-16-101	Dee Pollard	-- Patterson	1950	439	4	Goliad sand	81.1	Nov. 2, 1960	C,W	S	
102	T. W. Crews	Page and Choate	1960	236	5	Goliad(?) sand	46.0	do	T,E, 2-1/2	D	
103	-- Seale	C. C. Winn	1957	6,127	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 252 ft.
104	Antonio Perez	Clyde Maley	1955	262	4	Goliad sand	134.8	Dec. 12, 1960	C,W	S	Casing slotted from 242 ft. to bottom. Altitude of land surface 264 ft.1/
105	Julian Perez	Louis Labbe	1958	235	6	do	135.8	do	C,W	S	Casing slotted 1 joint.
201	Ethel Bates	Coastal States Gas Production Co.	1957	5,420	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 200 ft.
202	Thomas W. Crews	W. J. Calaway	1954	371	4	Goliad sand	126.8	Nov. 2, 1960	C,W	S	Casing perforated from 302 to 326 ft., and 346 ft. to bottom. Altitude of land surface 230 ft.1/
203	do	--	--	--	4	Goliad(?) sand	138.3	do	C,E, 1	D	
204	do	--	--	--	4	do	133.3	do	C,W	S	

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-16-301	R. V. Embleton	W. Earl Rowe	1951	3,557	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 204 ft.
302	R. V. Embleton Estate	--	1958	420	--	Goliad sand	123.0	Nov. 9, 1960	C,E, 3/4	D,S	Altitude of land surface 189 ft.
303	do	--	1927	429	4	do	90.0	Feb. 1, 1934	N	N	Do.
304	do	--	1928	431	6	do	96.8 132.1	Feb. 10, 1934 Apr. 11, 1961	C,W	D,S	Altitude of land surface 206 ft.
401	L. Perez	Gulf Coast Minerals	1960	350	--	do	141.0	Sept.28, 1960	N	N	Supplied water for oil test. Altitude of land surface 229 ft.
402	E. A. Danford	Lundells Inc.	1955	5,205	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 239 ft.
403	H. D. Broggan	Lockhart and Collier	1956	5,064	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 254 ft.
404	Leonor Perez	Flamingo Ventures	1956	--	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 233 ft.
405	do	Earl Rowe	1951	4,806	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 217 ft.
406	Frank Bowman	Flamingo Ventures	1956	5,301	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 221 ft.
407	Ray Gonzales Estate	-- Gonzales	1942	326	6	Goliad sand	144.7	Oct. 28, 1960	C,W,G, 1-1/2	D,S	Casing slotted 20 ft.
408	Edwin A. Danford	O'Neill Drilling Co.	1954	460	5	do	149.0	do	C,W	S	Casing perforated from 396 ft. to bottom.[1]
409	Leonor Perez	Clyde Maley	1946	350	4	do	135.9	Nov. 2, 1960	C,W	S	
501	H. T. Sain	Argo Oil Corp.	1958	5,200	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 206 ft.
502	W. O. Meyer	--	1924	390	4	Goliad sand	95.8	Nov. 2, 1960	C,E, 3/4	D,S	
503	do	Fields Drilling Co.	1953	640	4	do	--	--	C,G	S	

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-16-504	Dee Pollard	Menking and Oeff	1947	449	4	Goliad(?) sand	32.8	Nov. 2, 1960	C,E, 1	D	
505	R. V. Embleton	W. Earl Rowe	1953	5,402	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 231 ft.
601	George Renken	Pontiac Refining Co.	1954	3,708	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 185 ft.
602	Sinclair Oil & Gas Co.	--	1945	360	4	Goliad(?) sand	70	Feb. 1957	C,E	D	
* 603	M. Word	-- Menking	1954	480	4	Goliad sand	147.9	Nov. 16, 1960	C,W	D,S	Casing slotted 25 ft.
604	W. C. Wedimeyer	Witson Bros.	1926	417	4	do	90.1 133.4	Jan. 26, 1934 Apr. 11, 1961	C,W	D,S	Altitude of land surface 183 ft.
605	J. D. Adams	A. B. Fuller	1913	450	4	do	134.2	Nov. 9, 1960	C,W	S	Altitude of land surface 198 ft.
606	do	Hamon and Coates	1958	5,473	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 200 ft.
607	do	do	1957	5,549	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 198 ft.
* 701	City of Alice	Carl Vickers	1952	844	20, 10	Pliocene(?) and Pleistocene formations, undifferentiated, and Goliad sand	--	--	T,E, 75	P	Casing: 20-in. to 153 ft., 10-in. to bottom. Screens from 153 to 260, 340 to 550, 700 to 750, and 800 to 840 ft. Gravel-packed.1/
702	-- Eggemeyer	W. J. Calaway	1952	146	--	Pliocene(?) and Pleistocene formations, undifferentiated	40	1952	J,E	D,Ind	
* 801	City of Alice	Carl Vickers	1960	896	18, 12	Goliad sand	--	--	T,E 100	P	Casing: 18-in. to 290 ft., 12-in. to bottom. Screens from 340 to 450, 470 to 500, 610 to 630, 670 to 740, 770 to 810, and 860 ft. to bottom. Gravel-packed. Observation well.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-16-802	City of Alice	Layne-Texas Co.	1949	820	16, 10, 8	Goliad sand	--	--	T,E, 60	P	Casing: 16-in. to 300 ft., 10-in. to 457, and 8-in. to bottom. Screens from 306 to 456, 471 to 511, 541 to 571, 621 to 651, 671 to 691, 701 to 731, and 751 to 816 ft. Test hole to 903 ft., plugged back to 820 ft. Gravel-packed. Altitude of ground level 200 ft. Observation well.[1]
* 803	do	do	1947	864	16, 10, 8	do	--	--	T,E, 60	P	Casing: 16-in. to 310 ft., 10-in. to 445 ft., and 8-in. to bottom. Screens from 323 to 403, 444 to 545, 577 to 613, 694 to 744, and 804 to 833 ft. Gravel-packed. Altitude of ground level 204 ft. Temp. 82°F.[1]
* 804	do	do	1947	860	16, 10, 8	do	206.3	Aug. 4, 1961	T,E, 60	P	Casing: 16-in. to 309 ft., 10-in. to 422 ft., 8-in. to bottom. Screens from 321 to 401, 422 to 480, 510 to 610, 630 to 670, 748 to 770, and 810 to 841 ft. Gravel-packed. Altitude of ground level 202 ft.[1]
* 805	do	do	1958	852	18, 12	do	229.4	Jan. 21, 1961	T,E, 100	P	Casing: 18-in. to 275 ft., 12-in. to bottom. Screens from 395 to 447, 473 to 527, 545 to 577, 620 to 667, 670 to 742, 781 to 820, and 840 to 850 ft. Gravel-packed. Altitude of ground level 198 ft.[1]
* 806	do	do	1945	896	16, 10, 8	do	--	--	T,E, 60	P	Casing: 16-in. to 322 ft., 10-in. to 387 ft., 8-in. to bottom. Screens from 388 to 410, 478 to 559, 578 to 613, 668 to 688, 708 to 764, 788 to 804, and 813 to 862 ft. Gravel-packed. Measured discharge 197 gpm. Altitude of ground level 197 ft. Observation well.[1]

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*84-16-807	City of Alice	Layne-Texas Co.	1948	869	10, 8	Goliad sand	196.6	Jan. 20, 1961	T,E, 60	P	Casing: 10-in. to 420 ft., 8-in. to bottom. Screens from 320 to 360, 370 to 400, 425 to 487, 528 to 559, 683 to 727, 739 to 779, and 834 to 856 ft. Gravel-packed. Altitude of ground level 190 ft.[1]
808	Frank Bowman	Carl Vickers	1960	465	7	do	--	--	T,E, 7-1/2	D	Casing cemented to 295. Estimated discharge 80 gpm. Gravel-packed.
809	Pablo Perez, Jr.	Clyde Maley	1946	350	4	do	152.2	Nov. 2, 1960	C,W	S	Casing perforated.
* 810	City of Alice	--	1938	622	5	do	--	--	N	N	
* 901	-- Adkinson	--	1930	900	10	do	--	--	C,W	S	Drilled as oil test, converted to water well.
902	Alice Country Club	H. Presnall et al.	1938	720	--	do	150.0	Feb. 8, 1961	T,E, 10	D	Drilled as oil test, converted to water well. Altitude of drill floor 187 ft.
84-23-101	Lundells Inc.	Lundells Inc.	1951	5,961	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 315 ft.
102	Harvey Hans	Brian Patterson	1952	324	4	do	130.4	Feb. 23, 1961	C,W	S	Altitude of land surface 301 ft.
201	W. G. Schuetz	Southwest Workover and G. Tsesmelis	1956	6,251	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 291 ft.
202	J. R. Leggett	Clyde Maley	1953	450	4	Goliad sand	--	--	C,E, 3/4	D,S	
203	A. E. Sandoval	do	1953	326	4	do	--	--	C,W	D,S	Casing cemented to 316 ft., open hole 10 ft.
301	Lula George	Appell Oil & Gas Corp.	1954	5,391	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 266 ft.
302	Warren Robertson	Page and Shoate	1958	324	4	Goliad sand	--	--	C,W	D,S	Casing: 16 ft. of perforated pipe.
303	Olga Schmidt	Mills, Bennett, and Del Mar	1958	6,255	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 271 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-23-402	J. T. Gladaney	--	1960	404	4	Goliad sand	125.4	Feb. 23, 1961	T,E, 1	S	
601	George A. Frank	Gust Tsesmelis	1956	5,431	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 240 ft.
602	R. L. Priest	Clyde Maley	1957	432	4	Goliad sand	83.0	Feb. 14, 1961	C,W	S	Casing cemented to surface.[1]
603	D. C. Holmes	Harry Mosser Oil Co.	1955	400	12	do	72.6	Feb. 13, 1961	C,W	S,Irr	Drilled as oil test, converted to water well. Reported irrigates 1/2-acre garden. Sands at 214, 360, and 400 ft. Altitude of land surface 236 ft.
604	do	Joe White	1924	214	4	Goliad(?) sand	89.5	Feb. 13, 1961	C,E, 1/2	D,S	
605	Geo. A. Frank	Ed Juergens	1940	352	4	Goliad sand	96.1	Feb. 28, 1961	C,W	D,S	Casing perforated.
702	M. L. Saenz	--	1958	315	4	do	--	--	J,E	D,S	
703	M. L. Garcia	--	1957	100	4	Goliad(?) sand	44.2	Oct. 31, 1960	N	N	
705	Chas. Muil	L. G. Shelly et al.	1957	5,227	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 290 ft.
801	Mary E. Lidwell	Thomas Bros. et al.	1957	5,265	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 260 ft.
802	Friendship Baptist Church Community	Woodrow Calaway	1940	580	--	Goliad sand	90	1956	C,E, 1	D,S	
901	Chas. Muil	Investors Syndicate	1958	6,025	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 260 ft.
* 902	Project Road Community	--	1945	580	5	Goliad sand	129.9	Mar. 3, 1961	C,E	D,S	Altitude of land surface 226 ft.
903	N. A. Hoffman	--	1938	370	4	do	96.2	Feb. 27, 1961	C,W	S	Reported water becomes salty if well sets idle.
904	do	--	1920	185	--	Pliocene(?) and Pleistocene formations, undifferentiated	100.7	Feb. 28, 1961	C,W	S	

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*84-24-101	Gerald English	--	1952	850	9	Goliad sand	171.7	Feb. 13, 1961	T,Ng	Irr	Drilled as oil test, converted to water well by shooting 400 ft. of sand in 600-700 ft. intervals, and 30 to 40 ft. in. 700 to 800 ft. intervals. Pump set at 270 ft. Reported irrigated 90 acres of pasture in 1961. Altitude of land surface 235 ft.
* 102	City of Alice	Carl Vickers	1954	754	16, 10	do	205.0	Jan. 19, 1961	T,E, 40	P	Casing: 16-in. to 320 ft., 10-in. to bottom. Screens from 320 to 333, 380 to 470, 510 to 540, 630 to 680, and 710 to 750 ft. Gravel-packed.1/
103	Edith Perkins	O. G. McClain	1957	4,609	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 238 ft.
104	City of Alice	Carl Vickers	1954	586	16, 10	Goliad sand	296.0	July 20, 1955	--	--	Screens from 320 to 334, and 395 ft. to bottom. Gravel-packed. Observation well.1/
105	Kyle Drake	--	1942	581	4	do	216.6	Feb. 9, 1961	C,W	D,S	
106	Joe Seiler	--	1940	500	--	do	--	--	C,W,E, 1	D,S	
107	R. L. Chiles, Sr.	-- Menking	1940	400	4	do	--	--	C,W,E	D,S	
108	do	Appel Corp.	1954	400	4	do	164.7	Feb. 9, 1961	C,W	S	
* 201	City of Alice	Layne-Texas Co.	1928	992	16, 8	do	58.5	Jan. 2, 1934	T,E, 40	P	Casing: 16-in. to 250 ft., 8-in. to bottom. Test hole drilled to 2,068 ft. plugged back to 992 ft. Used very little in 1960; water turns brackish. Altitude of land surface 201 ft.1/
* 202	do	--	--	647	--	do	185.9	Dec. 22, 1960	T,E, 40	P	Altitude of ground level 201 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*84-24-203	City of Alice	Carl Vickers	1957	822	16, 10	Goliad sand	196.0 204.3	Jan. 13, 1961 Aug. 4, 1961	T,E,	P	Casing: 16-in. to 396 ft., 10-in. to bottom. Screens from 390 to 430, 470 to 520, 560 to 590, 620 to 650, 665 to 700, and 730 to 780 ft. Gravel-packed. Altitude of ground level 201 ft.[1]
* 204	do	do	1956	820	16, 10	do	203.5	Jan. 16, 1961	T,E, 75	P	Casing: 16-in. to 383 ft., 10-in. to bottom. Screens from 400 to 450, 500 to 540, 588 to 600, 630 to 650, 700 to 730, and 750 to 810 ft. Gravel-packed. Altitude of ground-level 206 ft.
205	Alice Elevator Inc.	Glenn Menking	1950	485	7	do	--	--	C,E, 1	D,Ind	Casing slotted from 455 ft. to bottom.
206	E. H. Scheel	Ford and Hamilton	1960	5,810	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 197 ft.
207	Afroma Oil Co.	-- Casey	1961	270	4	Pliocene(?) and Pleistocene formations, undifferentiated	53.8	Feb. 13, 1961	N	N	
* 208	City of Alice	Carl Vickers	1961	944	18, 12	Goliad sand	174.4	Mar. 28, 1961	T,E, 100	P	Casing: 18-in. to 300 ft., 12-in. to bottom. Screens from 345 to 360, 425 to 445, 480 to 550, 570 to 650, 670 to 690, 720 to 750, 830 to 845, and 875 to 925 ft. Gravel-packed. Altitude of ground level 200 ft.[1]
* 209	do	do	1961	905	18, 12	do	166.3	Mar. 7, 1961	T,E, 100	P	Casing: 18-in. to 300 ft., 12-in. to bottom. Screens from 390 to 410, 440 to 460, 470 to 490, 500 to 510, 520 to 560, 590 to 640, 660 to 680, 720 to 780, 810 to 820, 840 to 870, and 880 to 900 ft. Gravel-packed. Altitude of ground level 200 ft.[1]

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-24-210	A. F. Blaschke	--	1927	540	4	Goliad sand	89.9	Jan. 27, 1933	N	N	Altitude of land surface 207 ft.
* 211	City of Alice	A. B. Fuller	1936	535	5	do	--	--	N	N	Casing slotted from 400 to 423 ft., and 510 ft. to bottom.
* 212	do	Whitson Bros.	1931	550	5	do	--	--	N	N	Open hole from 502 ft. to bottom.
213	F. A. Goldapp	A. C. White	1917	154	3	Pliocene(?) and Pleistocene formations, undifferentiated	72.2	Jan. 15, 1934	N	N	
301	I. R. Hobbs	Gust Tsesmelis	1953	5,808	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 177 ft.
302	Nina Adams Estate	Allen and McBride	1957	6,011	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 176 ft.
303	G. R. Valverde	Raul Barrera	1947	135	6	Pliocene(?) and Pleistocene formations, undifferentiated	65.3	Feb. 8, 1961	C,W	D,S	
304	B. R. Goldapp	-- Menking	1950	422	4	Goliad sand	153.3	Feb. 8, 1961	C,W,G	S	Altitude of land surface 160 ft.
* 401	H. E. Woolsey	E. T. Pierce	1958	1,910	12, 10	Oakville sandstone	50 58.6	1960 Feb. 13, 1961	T,Ng, 50	Irr	Casing: 12-in. to 265 ft., 10-in. to bottom. Casing slotted from 1,850 to 1,900 ft. Irrigates about 35 acres of grass in 1961.
402	Florence Ragland	S. H. Howell	1956	5,804	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 207 ft.
403	M. A. Wallis	Fletcher Oil & Gas Co.	1956	5,789	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 211 ft.
404	Delta Drilling Co.	Clyde Maley	1960	460	5	Goliad sand	--	--	T,E	D,S	
405	Lemon, Cummings, Smith & Gardner	O'Neill Drilling Co.	1959	235	4	Pliocene(?) and Pleistocene formations, undifferentiated	--	--	C,W	S	1/

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-24-406	M. L. Chiles	--	1945	600	4	Goliad sand	--	--	C,E	D,S	
407	B. J. Lynn	A. B. Fuller	--	521	5	do	107.6 144.8	Jan. 9, 1934 Mar. 16, 1961	C,W	S	Altitude of land surface 205 ft. Old well.
501	Chas. Muil	Coates, Daubert, and Dolch	1957	5,266	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 176 ft.
502	J. H. Reynolds	Southern Coast Corp.	--	5,204	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 182 ft.
503	W. F. Botard	S. H. Howell	1955	5,768	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 201 ft.
504	L. B. Hoelscher	Bradford Water Wells	1959	483	4	Goliad sand	149.5	Nov. 21, 1960	C,G	S	Casing perforated from 456 ft. to bottom.[1]
* 505	O. Z. Inglett	Clyde Maley	1949	654	5	do	166.1	Oct. 20, 1960	T,E, 1-1/2	D,S	Casing cemented to surface and shot from 510 to 528 ft., and 547 to 571 ft.; open hole from 639 ft. to bottom. Altitude of land surface 196 ft.
506	R. Huebner	Menking Drilling Co.	1943	639	6	do	--	--	C,W	D,S	
507	O. Z. Inglett	--	1935	460	4	do	--	--	N	N	Reported water became salty in 1948.
508	G. A. Pfeiffer	Slick Oil Corp.	1957	5,705	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 200 ft.
509	W. F. Botard	--	1948	450	5	Goliad sand	--	--	T,E, 1/2	D,S	Casing perforated from 20 to 30 ft.
* 510	do	John Riggins	1921	349	3	Goliad(?) sand	--	--	N	N	
601	Dillon and Bruns	L. H. La Rose et al.	1959	3,600	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 166 ft.
602	Coman Shear	W. J. Calaway	1955	500	4	Goliad sand	165.3	Feb. 9, 1961	C,E, 3/4	D,S	Casing cemented to surface. Altitude of land surface 165 ft.
603	August Doring	--	--	448	5	do	87.5	Jan. 27, 1933	C,E	D,S	Altitude of land surface 171 ft. Old well.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-24-701	-- Stacey	Delta Gulf Drilling Co.	1955	5,599	--	--	--	--	--	--	Oil test. Altitude of drill floor 202 ft.
702	C. E. Stacey	--	--	360	4	Goliad(?) sand	80.0	Feb. 27, 1961	C,E, 1	D,S	Old well.
703	L. D. White	A. C. White	1926	423	4	Goliad sand	80.7	Jan. 10, 1934	N	N	Altitude of land surface 207 ft.
704	do	--	1950	484	5	do	122.0	Apr. 6, 1961	C,W	D,S	Casing: 60 ft. perforated; cemented to top. Altitude of land surface 207 ft.
801	Ben Bolt Independent School District 7	A. C. White	1934	398	4	do	104.4	Feb. 1, 1934	C,E, 2	P	Casing perforated pipe.1/
802	Armando Garcia	H. R. Smith	1952	800	10	do	148.6	Sept.28, 1960	T,-	N	Drilled as oil test, converted to water well. Owner reported not enough water for irrigation. Not used in about 6 years. Altitude of land surface 174 ft.
803	do	--	--	450	4	do	--	--	C,W	D,S	
* 804	Romana V. de Garcia	Pete Christensen	1924	500	5	do	91.9 159.2	Mar. 20, 1934 Apr. 11, 1961	C,W	D	Altitude of land surface 197 ft.
901	Paula V. de Garcia	Smith, McBride, and Progress	1951	6,310	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 152 ft.
902	E. L. Kelley	W. J. Calaway	1960	150	4	Pliocene(?) and Pleistocene formations, undifferentiated	81.8	Feb. 9, 1961	N	N	
*84-31-201	Emilia Barrera	Emilia Barrera	--	75	48	Goliad(?) sand	52.1 50.4	June 30, 1933 Feb. 9, 1960	N	N	Old well.
202	Palito Blanco School	Luis Tamey	--	300	4	Goliad sand	109.2	Apr. 11, 1961	C,E	P	Pump set at 126 ft. Altitude of land surface 223 ft.
203	N. A. Hoffman	--	1950	450	4	do	118.2	Feb. 27, 1961	C,W	D,S	
204	do	--	1920	185	4	Goliad(?) sand	--	--	C,W	D,S	

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level		Method of lift	Use of water	Remarks
							Below land surface datum (ft.)	Date of measurement			
84-31-205	E. T. Floyd	--	1916	454	6	Goliad sand	74.2	June 22, 1933	C,W	D,S	Altitude of land surface 222 ft.
* 206	Miguel and Ignacio Cadena	Miguel Cadena	1908	98	--	Goliad(?) sand	46.0	July 1, 1933	H	D,S	
301	N. A. Hoffman	--	1951	375	4	Goliad sand	152.9	Nov. 1, 1960	C,W	S	
302	do	--	1937	450	4	do	134.8	Feb. 28, 1961	C,W	S	
303	do	--	1939	450	4	do	--	--	C,W	S	
304	A. C. Skinner, Jr.	O'Neill Drilling Co.	1955	415	4	do	133.3	Apr. 11, 1961	C,E, 3/4	S	Altitude of land surface 184 ft.
401	J. M. Valdez	La Gloria Corp.	1948	6,425	--	--	--	--	--	--	Oil test.
402	Gustavo Vella	--	--	80	84	Goliad(?) sand	52.6	Nov. 1, 1960	C,W	D,S	Dug. Old well.
501	P. P. Cadena	--	--	65	60	do	58.2 46.2	July 1, 1933 Feb. 9, 1960	C,W	D,S	Old well.
502	M. Cadena	--	--	60	60	do	54.7 48.7	do do	C,W	D,S	Do.
601	Clara Driscoll	Carrl Oil & Shore Exploration Co.	1957	6,386	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 184 ft.
602	N. A. Hoffman	--	1930	350	4	Goliad sand	94.0	Mar. 2, 1961	C,W	D,S	Altitude of land surface 196 ft.
801	Burton Dunn	--	1950	480	5	do	89.3	Mar. 7, 1961	C,W	S	
901	do	--	1950	480	6	do	102.1	do	C,W	S	
902	do	--	1950	480	4	do	130.3	do	C,W	S	
903	do	--	1950	480	4	do	--	--	C,W	S	
84-32-101	-- Kynette	Rowan and Hope	1941	3,772	--	--	--	--	--	--	Oil test.
102	N. A. Hoffman	--	1925	450	5	Goliad sand	86.2 102.6	June 29, 1933 Feb. 28, 1961	C,W	S	Altitude of land surface 188 ft.
103	King Ranch	A. H. Masiran	1941	443	6, 4	do	131.0	Dec. 9, 1960	C,W	S	Casing: 6-in. to 160 ft., 4-in. to bottom. Altitude of land surface 159 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
84-32-104	Mrs. F. M. Stewart	Benito L. Tames	1927	422	3	Goliad sand	64.2	Jan. 16, 1933	C,E	D,S	Altitude of land surface 175 ft.
* 401	King Ranch	Elmer Rupp	1955	500	6	do	125.2	Mar. 30, 1960	C,W	S	Casing slotted from 448 ft. to bottom. Altitude of land surface 158 ft. Observation well.
402	Dora Lee Blake	Stanolind Oil & Gas Co.	1943	6,276	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 195 ft.
403	Burton Dunn	--	1950	480	4	Goliad sand	91.8	Mar. 7, 1961	C,W	S	
404	A. C. Skinner, Jr.	O'Neill Drilling Co.	1959	415	4	do	134.1	Apr. 11, 1961	C,W	S	Casing perforated from 365 ft. to bottom. Altitude of land surface 182 ft.[1]
701	Burton Dunn	--	--	450	4	do	144.7	Mar. 7, 1961	C,W	D,S	Old well.
84-39-201	Clara Driscoll	H. R. Smith	1956	6,508	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 224 ft.
Live Oak County											
*78-63-101	Mrs. King Hinnant	--	1895	193	5	Goliad sand	139.8 136.5	Sept.12, 1956 Apr. 14, 1961	C,W	S	
201	--	--	--	188	4	do	129 133.2 131.9	Aug. 1934 Sept.16, 1957 Apr. 14, 1961	C,W	S	Altitude of land surface 352 ft.
202	George Weston	Chiles Drilling Co.	1958	4,826	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 292 ft.
604	Mike Davidson	A. C. White	1926	290	4	Goliad sand	111.1 93.4	Aug. 8, 1956 Apr. 13, 1961	T,E	D,S	
605	D. D. Hatch	L. M. Lockhart	1956	5,235	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 301 ft.
78-64-101	B. Allen	Sunray-Mid-Continent Oil Co.	1958	5,750	--	--	--	--	--	--	Oil test. Altitude of drill floor 314 ft.
301	William Hinnant	Doss Well Service	1952	246	7	Goliad sand	130.6 124.1	Aug. 15, 1956 Apr. 13, 1961	C,E, 1	S	Casing slotted from 225 ft. to bottom.
404	Mary A. Reynolds	Humble Oil & Refining Co.	1952	6,003	--	--	--	--	--	--	Oil test. Altitude of ground level 270 ft.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*79-57-101	Holman Cartwright	R. R. Lawson	1947	178	4	Goliad sand	98.8 88.7	Sept.27, 1956 Apr. 14, 1961	C,W	S	Casing slotted from 157 ft. to bottom. Altitude of land surface 163 ft.
102	do	A. O. Morgan	1955	4,510	--	--	--	--	--	--	Oil test. Altitude of ground level 194 ft.
201	H. D. Miller	--	1931	160	5	Goliad sand	84.5 69.9	Feb. 27, 1957 Apr. 13, 1961	C,E, 1	S	Altitude of land surface 155 ft.
202	do	--	--	270	10	do	101.6 87.3	Feb. 27, 1957 Apr. 13, 1961	T,G, 50	Irr	Casing perforated. Altitude of land surface 173 ft. Temp. 79°F.
203	C. F. Mangus	Kirkwood & Morgan	1955	6,724	--	--	--	--	--	--	Oil test. Altitude of drill floor 190 ft.
* 204	Lenora Rivera	A. L. Gooley	1908	106	4	Goliad sand	75.4	Sept.12, 1957	C,W	D,S	
* 601	H. D. Miller	--	1932	350	10	do	+	Feb. 27, 1957	Flows	N	Temp. 77°F.
						Nueces County					
83-01-602	Knolle Jersey Farm	Ben Welty	1956	200	--	Goliad sand	100.5	Jan. 4, 1960	T,E, 1-1/2	D,S	
803	Rand Morgan	Rand Morgan	1957	5,763	--	--	--	--	--	--	Oil test.
83-02-202	Knolle Jersey Farm	Burl Sikes	1941	110	--	Goliad(?) sand	37.9	Jan. 4, 1961	T,E, 1	D,S	
401	N. Erigan	Hunt Drilling Co.	1957	6,110	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 120 ft.
501	Levy Estate	Howell, Shelby, Walker and Donigan	1955	5,458	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 71 ft.
502	Walton Knolle	Ben Welty	1958	217	--	Goliad sand	36.9	Jan. 4, 1961	T,E, 1	D,S	Altitude of land surface 63 ft.
83-09-201	Rand Morgan	--	--	285	4	Goliad(?) sand	85.4	Jan. 30, 1961	C,W	S	Altitude of land surface 120 ft.
205	Southern Minerals Co.	-- Whitson	1943	540	--	Goliad sand	--	--	C,E, 3/4	D,Ind	

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
83-09-505	Southern Minerals Co.	Haynes and Whitson	1956	680	7, 5	Goliad sand	--	--	J,E, 1-1/2	D	Casing: 7-in. to 560 ft., 5-in. to bottom.
* 901	City of Agua Dulce	do	1954	809	7	do	114.4	Jan. 30, 1961	T,E, 20	P	Casing perforated from 692 to 732, 770 to 780, and 796 ft. to bottom. Estimated discharge 100 gpm. Altitude of land surface 125 ft.
83-17-202	G. A. Parr	W. J. Calaway	1959	404	6	do	100.4	Nov. 15, 1960	C,W	S	Casing perforated from 360 to 401 ft., cemented from 360 to surface. Altitude of land surface 122.[1]
* 501	Champlin Oil & Refining Co.	Carl Vickers	1956	768	12, 6	do	--	--	T,Ng	Ind	Casing: 12-in. to 530 ft., 6-in. to bottom. Sands from 540 to 575, 600 to 630, and 700 to 765 ft.
* 901	do	Layne-Texas Co.	1945	753	12, 6	do	--	--	T,E, 40	Ind	Casing: 12-in. to 568 ft., 6-in. to bottom. Sands from 579 to 619, and 649 ft. to bottom. Reported discharge 200 gpm.
						Kleberg County					
83-25-101	King Ranch	E. J. Rupp	1954	515	6, 4	Goliad sand	154.6	Mar. 16, 1961	C,W	S	Casing: 6-in. to 458 ft., 4-in. to bottom. Altitude of land surface 134 ft.
102	do	--	1952	--	--	do	154.6	do	C,W	S	Altitude of land surface 124 ft.
201	-- Wardner	The Chicago Corp.	1943	8,012	--	--	--	--	--	--	Oil test. Altitude of kelly bushing 107 ft.
401	King Ranch	A. H. Masiran	1941	503	6, 4	Goliad sand	145.6	Mar. 16, 1961	C,W	S	Altitude of land surface 106 ft.
402	do	Humble Oil & Refining Co.	1954	7,300	--	--	--	--	--	--	Oil test.
501	do	--	--	--	--	Goliad sand	153.4	Mar. 16, 1961	C,W	S	Altitude of land surface 106 ft. Old well.

See footnotes at end of table.

Table 5.--Records of wells in the Alice area--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Water level: Below land surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
83-25-502	King Ranch	Layne-Texas Co.	1952	645	20, 12	Goliad sand	146.0	Mar. 16, 1961	T,Ng	--	Casing: 20-in. to 339 ft., 12-in. to bottom. Gravel-packed from 460 ft. to bottom. Screens from 476 to 615 ft. and 635 ft. to bottom. Reported drawdown 137 to 272 ft. after 24 hours pumping at 770 gpm. Altitude of land surface 95 ft. Used as recharge well.
503	do	--	--	--	4	do	--	--	N	--	Observation well used for recharge project.
* 701	do	Elmer Rupp	1953	498	6, 4	do	--	--	C,W	S	Casing slotted from 388 ft. to bottom. Altitude of land surface 112 ft. Observation well.
84-32-501	do	do	1955	487	6, 4	do	--	--	C,W	S	Casing slotted from 427 ft. to bottom. Altitude of land surface 132 ft.
						Duval County					
84-15-401	Robert Hoffman	-- Berrera	1945	245	4	Goliad sand	103.2	Mar. 1, 1961	C,W	S	
702	City of San Diego	Layne-Texas Co.	1937	509	13, 6	do	--	--	T,E, 20	P	Drilled as test hole to 525 ft., plugged back to 509 ft. Screens from 402 to 468 and 484 to 505 ft.
703	do	do	1947	544	12	do	--	--	T,E, 50	P	Drilled as test hole to 700 ft., plugged back to 544 ft. Screen from 291 to 544 ft.
* 704	do	Louis Labbe	1959	749	10	do	184.2	Oct. 31, 1960	T,E, 50	P	Measured discharge 60 gpm. Screens from 210 to 370, 390 to 440, 460 to 510, and 660 to 740 ft. Gravel-packed. Altitude of land surface 298 ft.
84-23-401	Hart Mussey	--	1935?	175	7	Goliad(?) sand	94.5	Feb. 23, 1961	C,W	S	
704	M. L. Saenz	--	1959	400	4	Goliad sand	120.3	Oct. 31, 1960	A,G	N	Supplied water for oil test. Altitude of ground level 297 ft.

1/ See Table 6 for drillers' logs of wells in the Alice area.
* See Table 8 for analyses of water from wells in the Alice area.

Table 6.--Drillers' logs of wells in the Alice area

Well 78-63-902

Owner: S. M. Freeborn. Driller: W. J. Calaway.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface	60	60	Shale	80	200
Sand	20	80	Sand (water)	48	248
Shale, sandy	40	120	Shale	2	250

Well 78-64-402

Owner: S. M. Freeborn. Driller: A. L. Herschap.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Sand	10	10	Sand	23	311
Shale, brown and gray	278	288			

Well 78-64-902

Owner: Lena McElvaine. Driller: Martin Water Wells.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Soil, surface and clay	3	3	Shale	50	336
Caliche and shale, pink	196	199	Sand	6	342
Sand with shale streaks	48	247	Shale	11	353
Shale	23	270	Sand	29	382
Sand with shale streaks	16	286			

Well 83-01-201

Owner: City of Orange Grove. Driller: Carl Vickers.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Soil	6	6	Shale	7	224
Clay	8	14	Sand, firm	60	284
Clay and sand	8	22	Shale	9	293
Caliche	92	114	Sand	34	327
Shale	17	131	Shale	18	345
Sand, hard, broken	65	196	Sand	29	374
Sand	21	217	Shale	17	391

(Continued on next page)

Well 83-01-201--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Sand	27	418	Sand	23	579
Shale	8	426	Shale, hard	38	617
Sand	4	430	Sand, hard	15	632
Shale	12	442	Shale	18	650
Sand and shale	57	499	Sand	6	656
Shale	11	510	Shale	6	662
Sand, hard	11	521	Sand, hard	5	667
Shale	9	530	Shale, sticky	13	680
Sand, firm	21	551	Sand	63	743
Shale	5	556	Shale	3	746

Well 83-01-202

Owner: City of Orange Grove. Driller: H. & S. Well Service.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Clay	50	50	Shale	7	415
Caliche, soft	38	88	Sand with hard coarse streaks	20	435
Shale, red	20	108	Shale	10	445
Sand with shale streaks	22	130	Sand with thin coarse shale streaks	60	505
Shale with sand streaks	39	169	Sand, firm, coarse	25	530
Shale	34	203	Sand with shale streaks	15	545
Sand with shale streaks	17	220	Shale	18	563
Sand with thin shale streaks	28	248	Sand, firm, coarse	27	590
Shale, sandy	82	330	Shale	84	674
Sand	15	345	Sand, fine, with shale streaks	24	698
Shale, sandy	33	378	Sand, coarse, firm	26	724
Sand with thin shale streaks	30	408			

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

Well 83-01-202--Continued

Shale	44	768	Sand, fine, firm	23	818
Shale, sandy, with sand streaks	27	795	Shale	84	902

Well 83-01-404

Owner: Walter Schmidt. Driller: B. T. Sikes.

Topsoil	3	3	Clay	75	180
Clay	13	16	Clay, sandy	62	242
Caliche	26	42	Clay	2	244
Clay	6	48	Sand, water	29	271
Rock and caliche	37	85	Clay	1	272
Clay, sandy	20	105			

Well 83-01-701

Owner: Ed C. Adams. Driller: O'Neill Drilling Co.

Surface	5	5	Shale, sandy, and sand streaks	25	190
Caliche and clay	55	60	Sand	25	215
Shale	15	75	Shale	20	235
Sand	5	80	Shale, sandy and sand streaks	40	275
Shale	30	110	Shale, sticky	10	285
Shale, sandy, and sand	25	135	Sand	39	324
Shale	30	165			

Well 83-09-405

Owner: Willie Taylor. Driller: Whitson Bros.

Clay	20	20	Clay	40	80
Sand	20	40	Caliche and rock	18	98

(Continued on next page)

Table 6.--Drillers' logs of wells in the Alice area--Continued

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

Well 83-09-405--Continued

Clay ------------------	11	109	Sand (salt water) ------	10	169
Caliche ---------------	31	140	Clay ------------------	126	295
Clay ------------------	19	159	Sand (water) ----------	19	314

Well 83-17-706

Owner: -- Chapa. Driller: W. J. Calaway.

Caliche and shale, broken --------------	190	190	Sand (water) ----------	40	450
Shale -----------------	220	410			

Well 84-08-404

Owner: W. T. Wright. Driller: --

Caliche and other soils-	150	150	Clay, joint -----------	251	471
Clay, joint -----------	50	200	Sand (water) ----------	20	491
Sand (water) ----------	20	220			

Well 84-08-708

Owner: Mrs. Vicenta Garibey. Driller: O'Neill Drilling Co.

Surface ---------------	2	2	Shale ------------------	70	230
Caliche ---------------	33	35	Sand -------------------	20	250
Shale and sandy shale --	125	160			

Well 84-15-903

Owner: J. M. Young. Driller: --

Surface soil ----------	3	3	Shale, hard, pink ------	38	174
Sand ------------------	4	7	Clay, pink ------------	55	229
Caliche ---------------	77	84	Sand ------------------	4	233
Caliche, pink ---------	48	132	Shale, hard, pink ------	79	312
Sand (water) ----------	4	136	Sand ------------------	46	358

Table 6.--Drillers' logs of wells in the Alice area--Continued

Well 84-15-904

Owner: I. M. Singer. Driller: W. J. Calaway.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface ----------------	10	10	Shale, hard and sticky--	125	265
Caliche, very hard -----	140	150	Sand (water) ----------	35	300
Shale and boulders -----	20	170	Shale -----------------	2	302

Well 84-16-104

Owner: Antonio Perez. Driller: Clyde Maley.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface ---------------	4	4	Shale, and clay, pink --	125	195
Sand ------------------	4	8	Clay, pink ------------	52	247
Caliche and rock ------	62	70	Sand ------------------	15	262

Well 84-16-202

Owner: Thomas W. Crews. Driller: W. J. Calaway.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface ----------------	5	5	Sand ------------------	20	290
Caliche, hard ----------	115	120	Shale, very sticky -----	12	302
Shale, red -------------	50	170	Sand ------------------	18	320
Shale, very sticky -----	60	230	Shale, very sticky -----	20	340
Sand -------------------	10	240	Sand ------------------	25	365
Shale, very sticky -----	30	270	Shale -----------------	6	371

Well 84-16-408

Owner: Edwin A. Danford. Driller: O'Neill Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface ----------------	5	5	Shale with sandy shale streaks -------	200	395
Clay and sand ----------	15	20	Sand ------------------	60	455
Caliche, hard, and sand streaks ---------	145	165	Shale -----------------	5	460
Sand with hard streaks--	30	195			

Well 84-16-701

Owner: City of Alice. Driller: Carl Vickers.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	3	3	Sand, light	24	583
Clay	14	17	Shale	72	665
Sand	9	26	Sand, shaly	27	682
Clay and caliche, broken	68	94	Shale	14	696
Sand	31	125	Sand	64	760
Shale	20	145	Shale	35	795
Sand	195	340	Sand with shale streaks	7	802
Shale	207	547	Sand	40	842
Sand	12	559	Shale	2	844

Well 84-16-802

Owner: City of Alice. Driller: Layne-Texas Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	5	5	Shale, hard, fine, and shale breaks	39	420
Sand and caliche	29	34	Shale, sandy	10	430
Caliche, sandy	16	50	Shale, sticky	20	450
Caliche	14	64	Sand, hard, and shale	10	460
Caliche, sandy	11	75	Shale	10	470
Caliche	55	130	Shale, sandy	25	495
Clay and caliche	25	155	Sand	30	525
Clay	40	195	Shale, sandy	25	550
Clay, sticky	20	215	Sand, broken	35	585
Shale, red, and caliche	71	286	Shale	30	615
Shale, sandy	43	329	Sand	15	630
Shale and sandy shale	52	381			

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Table 6.--Drillers' logs of wells in the Alice area--Continued

Well 84-16-802--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Shale	10	640	Sand and shale, sandy	24	836
Shale, hard, sandy	40	680	Shale, sandy	5	841
Sand	20	700	Shale	10	851
Sand and shale, sandy	40	740	Shale, sandy	11	862
Shale	17	757	Sand	11	873
Shale and sand breaks	19	776	Shale	11	884
Sand	17	793	Shale, sandy	9	893
Shale, hard, and sand breaks	19	812	Shale	10	903

Well 84-16-803

Owner: City of Alice. Driller: Layne-Texas Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	3	3	Shale, broken	27	435
Caliche	25	28	Shale, hard	37	472
Clay	10	38	Shale	10	482
Caliche, broken	129	167	Sand	45	527
Clay	10	177	Sand, broken	14	541
Caliche	6	183	Shale, hard	10	551
Caliche and shale	23	206	Shale, with hard layers	14	565
Shale, red	66	272	Sand	26	591
Caliche and shale	24	296	Shale, sandy	8	599
Shale	25	321	Sand	8	607
Shale, broken	25	346	Shale, hard	88	695
Shale	12	358	Sand	39	734
Shale, sandy	16	374	Sand and shale	18	752
Shale, hard	42	408	Shale, sticky	13	765

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Table 6.--Drillers' logs of wells in the Alice area--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Well 84-16-803--Continued					
Shale, sandy -----------	13	778	Shale ------------------	4	840
Shale, hard ------------	22	800	Sand -------------------	3	843
Sand, hard -------------	36	836	Shale ------------------	21	864

Well 84-16-804

Owner: City of Alice. Driller: Layne-Texas Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Soil -------------------	2	2	Sand -------------------	70	480
Clay -------------------	3	5	Shale ------------------	29	509
Caliche and clay -------	13	18	Sand, good -------------	20	529
Caliche ----------------	32	50	Sand, broken -----------	43	572
Caliche and clay -------	23	73	Sand, good -------------	38	610
Clay -------------------	42	115	Shale, tough -----------	23	633
Caliche, hard ----------	34	149	Sand -------------------	42	675
Shale, red -------------	70	219	Shale ------------------	29	704
Shale ------------------	31	250	Sand -------------------	16	720
Caliche and shale ------	36	286	Shale, tough -----------	15	735
Clay, broken -----------	23	309	Sand -------------------	40	775
Sand -------------------	5	314	Shale, tough -----------	13	788
Sand, broken -----------	36	350	Shale, broken ----------	21	809
Shale ------------------	15	365	Sand -------------------	31	840
Sand -------------------	23	388	Shale, sandy -----------	6	846
Shale ------------------	22	410	Shale and sand breaks --	14	860

Table 6.--Drillers' logs of wells in the Alice area--Continued

Well 84-16-805

Owner: City of Alice. Driller: Layne-Texas Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Soil	3	3	Sand	10	537
Caliche and clay	50	53	Shale	3	540
Clay and caliche breaks	45	98	Sand and hard layers	38	578
Sand, and caliche	35	133	Shale, broken	30	608
Clay, white	39	172	Sand	5	613
Sand	4	176	Shale, sandy	30	643
Shale	93	269	Sand	25	668
Shale, broken	23	292	Sand, broken	25	693
Sand, fine	32	324	Sand and hard layers	49	742
Shale, sandy	18	342	Shale	23	765
Sand, broken	35	377	Shale, sandy	22	787
Sand	22	399	Sand	18	805
Shale	6	405	Shale	7	812
Shale, sandy	16	421	Sand, broken	21	833
Sand, broken	30	451	Shale	9	842
Shale and caliche	30	481	Sand	9	851
Sand, broken	31	512	Shale	1	852
Shale	15	527			

Well 84-16-806

Owner: City of Alice. Driller: Layne-Texas Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	3	3	Clay	6	28
Clay	12	15	Sand and clay, sandy	22	50
Sand	7	22	Caliche and clay	23	73

(Continued on next page)

Table 6.--Drillers' logs of wells in the Alice area--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Well 84-16-806--Continued					
Caliche	75	148	Rock	4	567
Clay and sand	22	170	Clay with hard layers	15	582
Sand with hard streaks	22	192	Sand	37	619
Caliche	17	209	Sand, broken	8	627
Caliche, sandy	17	226	Clay, hard	50	677
Caliche, hard	15	241	Clay, sandy	21	698
Clay, sandy	7	248	Shale, hard and lime	23	721
Caliche and clay	11	259	Sand and clay	22	743
Clay with hard layers	87	346	Sand with hard layers	57	800
Clay and sand, hard	21	367	Shale, hard	26	826
Sand	45	412	Sand	20	846
Clay and sand, hard	23	435	Shale and sand, hard	5	851
Clay and sand	45	480	Sand	10	861
Clay, sandy	22	502	Shale, hard, and sand breaks	35	896
Sand	22	524			
Sand, broken	39	563			

Well 84-16-807

Owner: City of Alice. Driller: Layne-Texas Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	4	4	Sand	20	313
Clay	17	21	Clay, sandy	14	327
Sand	36	57	Sand	35	362
Caliche	20	77	Clay, sandy	20	382
Caliche, sandy, and clay	70	147	Sand, broken	51	433
Clay, broken	146	293	Sand	69	502

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Well 84-16-807--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Shale, broken ----------	22	524	Sand ------------------	48	786
Sand ------------------	30	554	Shale, sandy ----------	41	827
Sand, broken ----------	74	628	Sand ------------------	9	836
Shale, tough ----------	23	651	Shale, sandy ----------	33	869
Sand, broken ----------	87	738			

Well 84-23-602

Owner: R. L. Priest. Driller: Clyde Maley.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil ----------	3	3	Sand, water, and shale--	15	245
Rock, surface, and sand-	5	8	Shale, hard, pink ------	80	325
Rock and caliche -------	68	76	Shale, soft, pink ------	45	370
Clay, pink ------------	19	95	Shale, hard -----------	25	395
Rock and caliche -------	45	140	Sand (water) ----------	37	432
Clay, pink ------------	90	230			

Well 84-24-102

Owner: City of Alice. Driller: Carl Vickers.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil ----------	2	2	Sand with shale streaks-	33	507
Clay and caliche -------	30	32	Shale -----------------	14	521
Caliche and shale ------	44	76	Sand, firm ------------	37	558
Shale -----------------	12	88	Sand ------------------	28	586
Sand ------------------	293	381	Shale with sand streaks-	41	627
Sand, light -----------	12	393	Sand with shale streaks-	58	685
Sand ------------------	29	422	Shale -----------------	25	710
Shale -----------------	16	438	Sand ------------------	43	753
Sand, firm ------------	36	474	Shale -----------------	1	754

Table 6.--Drillers' logs of wells in the Alice area--Continued

Well 84-24-104

Owner: City of Alice. Driller: Carl Vickers.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	2	2	Shale	10	445
Clay and caliche	51	53	Sand	11	456
Shale with sand streaks	81	134	Sand, shaly	17	473
Sand, hard	18	152	Sand with shale streaks	13	486
Shale	234	386	Shale	9	495
Sand	28	414	Sand	12	507
Shale	3	417	Shale	9	516
Sand	6	423	Sand	69	585
Shale	5	428	Shale	1	586
Sand	7	435			

Well 84-24-201

Owner: City of Alice. Driller: Layne-Texas Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Soil	4	4	Clay	73	496
Clay, white	6	10	Sand, fine, brown	39	535
Sand, packed	16	26	Gumbo	3	538
Clay, white, and gravel	58	84	Sand	15	553
Rock, hard	6	90	Rock	1	554
Caliche	66	156	Clay, hard	41	595
Clay, hard, and gravel	43	199	Sand	27	622
Clay, soft, yellow	194	393	Gumbo	4	626
Rock	1	394	Rock	1	627
Clay	9	403	Sand	18	645
Sand, fine, brown	20	423	Gumbo	14	659

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Table 6.--Drillers' logs of wells in the Alice area--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
		Well 84-24-201--Continued			
Sand ------------------	19	678	Gumbo -----------------	46	1,375
Shale -----------------	20	698	Sand, hard ------------	10	1,385
Gumbo -----------------	22	720	Gumbo -----------------	61	1,447
Shale -----------------	92	812	Gumbo and thin sand layers --------------	111	1,558
Gumbo -----------------	25	837	Sand, fine, blue -------	22	1,580
Sand ------------------	24	861	Gumbo -----------------	72	1,653
Shale, hard, and sand --	88	949	Sand ------------------	14	1,667
Sand, fine ------------	43	992	Gumbo -----------------	214	1,881
Gumbo -----------------	90	1,083	Shale -----------------	81	1,962
Sand, fine ------------	58	1,142	Sand, good, no breaks --	23	1,985
Gumbo -----------------	135	1,277	Sand and shale, very broken ---------	82	2,068
Sand, fine ------------	51	1,329			

Well 84-24-203

Owner: City of Alice. Driller: Carl Vickers.

Surface soil ----------	4	4	Sand ------------------	52	522
Clay and caliche, broken	82	86	Shale -----------------	71	593
Sand ------------------	34	120	Shale and sand streaks--	27	620
Shale -----------------	20	140	Sand ------------------	30	650
Sand ------------------	20	160	Shale -----------------	15	665
Shale, sandy ----------	145	305	Sand ------------------	40	705
Shale -----------------	25	330	Shale -----------------	25	730
Sand and shale streaks--	55	385	Sand ------------------	52	782
Sand ------------------	47	432	Shale -----------------	40	822
Shale -----------------	38	470			

Table 6.--Drillers' logs of wells in the Alice area--Continued

Well 84-24-208

Owner: City of Alice. Driller: Carl Vickers.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Soil	4	4	Sand	30	597
Shale	16	20	Shale	20	617
Caliche	84	104	Sand	43	660
Shale	315	419	Shale	72	732
Sand	21	440	Sand	103	835
Shale	30	470	Shale	42	877
Sand, hard	45	515	Sand	48	925
Sand	37	552	Shale	19	944
Shale	15	567			

Well 84-24-209

Owner: City of Alice. Driller: Carl Vickers.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil	2	2	Shale	18	578
Clay	19	21	Sand, tight, and shale streaks	117	695
Caliche and clay	111	132	Shale	20	715
Sand with hard streaks	48	180	Sand	25	740
Shale	136	316	Shale	15	755
Sand, tight, and shale streaks	44	360	Sand	25	780
Shale	25	385	Shale and sand streaks, hard	70	850
Sand and shale streaks	75	460	Sand	50	900
Shale	10	470	Shale	5	905
Sand and shale streaks	90	560			

Table 6.--Drillers' logs of wells in the Alice area--Continued

Well 84-24-405

Owner: Lemon, Cummings, Smith and Gardner. Driller: O'Neill Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface ----------------	5	5	Caliche, hard ----------	45	135
Caliche, sandy ---------	25	30	Shale, red -------------	75	210
Caliche, sandy, and shale streaks --------	60	90	Sand with shale streaks-	25	235

Well 84-24-504

Owner: L. B. Hoelscher. Driller: Bradford Water Wells.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Soil -------------------	3	3	Clay -------------------	47	136
Clay and caliche -------	15	18	Sand -------------------	2	138
Sand -------------------	9	27	Clay -------------------	334	472
Clay, red --------------	60	87	Sand with clay streaks--	11	483
Sand -------------------	2	89			

Well 84-24-801

Owner: Ben Bolt Independent School District 7. Driller: A. C. White.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface soil -----------	33	3	Clay, pink -------------	60	260
Caliche, reddish-sandy--	37	40	Sand -------------------	3	263
Caliche; very small water supply at 90 and 160 ft. ----------	160	200	Clay, pink -------------	82	345
			Sand (water) -----------	53	398

Well 84-32-404

Owner: A. C. Skinner, Jr. Driller: O'Neill Drilling Co.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface ----------------	5	5	Shale ------------------	40	110
Caliche, sandy ---------	35	40	Caliche ----------------	55	165
Sand -------------------	10	50	Shale, sandy, and sandy streaks --------------	40	205
Shale, sandy -----------	20	70			

(Continued on next page)

Table 6.--Drillers' logs of wells in the Alice area--Continued

Well 84-32-404--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Shale ------------------	45	250	Shale ------------------	85	355
Shale, sandy -----------	20	270	Sand with shale streaks-	60	415

Well 83-17-202

Owner: G. A. Parr. Driller: W. J. Calaway.

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Surface ----------------	10	10	Shale ------------------	67	262
Shale ------------------	160	170	Sand (water) -----------	140	402
Sand -------------------	25	195	Shale ------------------	2	404

Table 7.--Water levels in wells in the Alice area
(In feet below land-surface datum)

Jim Wells County

Well 84-16-701

Owner: City of Alice

Date	Water level	Date	Water level	Date	Water level
Oct. 6, 1960	149.77	Jan. 6, 1961	139.08	Aug. 4, 1961	144.47
Nov. 7	143.05	Feb. 7	136.19	Oct. 9	142.87
Dec. 7	140.70	Mar. 6	138.19		

Well 84-16-801

Owner: City of Alice

Date	Water level	Date	Water level	Date	Water level
Oct. 7, 1960	173.09	Jan. 6, 1961	161.99	Apr. 6, 1961	166.67
Nov. 7	165.80	Feb. 7	161.00	May 8	169.78
Dec. 7	162.58	Mar. 6	160.42		

Well 84-16-802

Owner: City of Alice

Date	Water level	Date	Water level	Date	Water level
Oct. 6, 1960	171.87	Feb. 7, 1961	159.84	June 8, 1961	168.68
Nov. 7	164.63	Mar. 6	178.47	Aug. 4	178.75
Dec. 8	160.75	Apr. 6	170.22		
Jan. 6, 1961	163.07	May 8	161.00		

Well 84-16-806

Owner: City of Alice

Date	Water level	Date	Water level	Date	Water level
Oct. 6, 1960	207.47	Jan. 6, 1961	194.40	May 8, 1961	203.88
Nov. 7	193.94	Feb. 7	190.46	Aug. 4	200.02
Dec. 8	192.39	Apr. 6	202.5	Oct. 9	201.75

Well 84-24-104

Owner: City of Alice

Date	Water level	Date	Water level	Date	Water level
Oct. 6, 1960	214.51	Nov. 7, 1960	211.42	Dec. 7, 1960	208.67

(Continued on next page)

Table 7.--Water levels in wells in the Alice area--Continued

Jim Wells County

Well 84-24-104--Continued

Date	Water level	Date	Water level	Date	Water level
Jan. 6, 1961	205.42	Apr. 6, 1961	196.67	July 5, 1961	204.74
Feb. 7	201.08	May 8	198.54	Aug. 4	202.22
Mar. 6	199.72	June 8	204.55	Oct. 9	194.30

Well 84-32-401

Owner: King Ranch

Date	Water level	Date	Water level	Date	Water level
June 13, 1933	54.4	Nov. 16, 1950	101.54	Oct. 7, 1953	118.60
Nov. 22, 1943	69.42	Feb. 26, 1951	104.12	Nov. 4	118.59
Mar. 7, 1944	70.09	Oct. 17	113.43	Dec. 3	118.77
Mar. 15, 1945	76.89	Nov. 22	105.47	Jan. 6, 1954	118.54
Mar. 13, 1946	82.19	July 29, 1952	109.32	Feb. 4	117.85
Feb. 21, 1947	86.75	Aug. 26	109.65	Mar. 8	118.29
Feb. 7, 1948	91.32	Sept.25	111.09	Apr. 7	117.20
Sept.28	95.91	Oct. 28	112.19	May 5	119.03
Dec. 11	95.50	Nov. 25	112.72	June 3	118.25
Feb. 17, 1949	96.14	Dec. 30	112.94	July 1	118.19
Apr. 25	96.06	Jan. 26, 1953	113.27	Aug. 10	119.40
July 20	96.64	Feb. 27	113.37	Oct. 1	119.70
Oct. 6	97.80	Mar. 26	113.63	Nov. 1	120.43
Nov. 17	97.90	Apr. 29	114.03	Dec. 3	119.50
Jan. 10, 1950	97.73	May 27	115.00	Jan. 7, 1955	119.37
Feb. 10	97.43	Aug. 6	117.64	Feb. 8	120.47
May 16	97.43	Sept. 2	118.14	Mar. 7	120.93

(Continued on next page)

Table 7.--Water levels in wells in the Alice area--Continued

Jim Wells County

Date	Water level	Date	Water level	Date	Water level
Well 84-32-401--Continued					
Apr. 4, 1955	120.77	June 26, 1956	123.50	Jan. 6, 1961	132.91
May 5	119.14	Aug. 24	124.66	Feb. 7	133.20
June 6	122.19	Oct. 16	125.34	Mar. 6	133.64
Aug. 22	131.27	Feb. 12, 1957	126.19	Apr. 6	134.73
Jan. 3, 1956	123.85	July 26	126.85	May 8	135.77
Feb. 7	124.32	Oct. 4, 1960	129.28	June 8	137.30
Apr. 5	123.30	Nov. 7	130.62	July 10	138.36
May 23	123.23	Dec. 9	132.19	Aug. 4	139.32

Table 7.--Water levels in wells in the Alice area--Continued

Kleberg County

Well 83-25-701

Owner: King Ranch

Date	Water level	Date	Water level	Date	Water level
Dec. 9, 1932	39.27	Oct. 6, 1949	100.70	Apr. 7, 1954	125.26
Dec. 13, 1933	39.48	Nov. 17	100.80	June 3	124.80
Feb. 6, 1934	39.09	Nov. 16, 1950	92.12	July 1	125.67
Nov. 9	41.00	Feb. 20, 1951	95.53	Aug. 10	126.05
Mar. 24, 1935	41.50	Oct. 17	107.10	Oct. 1	126.17
Jan. 31, 1938	42.45	Nov. 22	93.40	Dec. 3	125.93
Oct. 24	42.89	Feb. 8, 1952	101.66	Jan. 7, 1955	125.51
Apr. 11, 1939	42.25	July 29	103.20	Feb. 10	125.72
Oct. 10	42.71	Sept.25	111.10	Mar. 7	124.84
Feb. 15, 1940	43.45	Oct. 28	111.32	Apr. 4	125.22
Feb. 5, 1941	45.58	Nov. 25	111.45	May 5	124.58
Feb. 3, 1943	52.40	Dec. 30	111.90	June 6	125.16
Mar. 6, 1944	59.29	Feb. 27, 1953	111.60	Aug. 22	128.40
Mar. 15, 1945	66.79	Mar. 26	110.62	Jan. 3, 1956	128.62
Mar. 14, 1946	78.39	Apr. 29	112.30	Feb. 9	129.86
Feb. 21, 1947	86.18	May 27	113.95	Apr. 5	124.00
Feb. 8, 1948	91.68	Aug. 6	116.32	May 23	125.46
Sept.28	97.08	Oct. 7	118.78	June 26	125.59
Dec. 11	97.02	Dec. 3	124.64	Aug. 24	131.29
Feb. 17, 1949	99.58	Jan. 6, 1954	123.75	Oct. 16	130.45
Apr. 25	98.36	Feb. 4	122.89	Feb. 13, 1959	127.40
July 20	99.40	Mar. 8	123.71	July 26	133.15

(Continued on next page)

Table 7.--Water levels in wells in the Alice area--Continued

Kleberg County

Well 83-25-701--Continued

Date	Water level	Date	Water level	Date	Water level
Oct. 4, 1960	139.92	Feb. 7, 1961	140.26	June 8, 1961	145.35
Nov. 7	141.67	Mar. 6	139.59	July 10	147.70
Dec. 9	142.27	Apr. 6	141.70	Aug. 4	147.98
Jan. 6, 1961	141.65	May 8	144.34		

Well 84-32-501

Owner: King Ranch

Date	Water level	Date	Water level	Date	Water level
Dec. 9, 1932	43.66	Feb. 21, 1947	83.91	July 29, 1952	108.98
Dec. 13, 1933	43.50	Feb. 8, 1948	89.26	Aug. 26	109.82
Feb. 6, 1934	43.23	Sept.28	94.65	Sept.25	110.75
Nov. 9	44.80	Dec. 11	93.75	Oct. 28	111.76
Mar. 23, 1935	45.70	Feb. 17, 1949	94.44	Nov. 25	112.30
Jan. 31, 1938	46.87	Apr. 25	93.87	Dec. 30	112.68
Oct. 24	47.49	July 20	94.93	Jan. 26, 1953	112.21
Apr. 11, 1939	47.95	Oct. 6	96.20	Feb. 27	113.10
Oct. 10	48.12	Nov. 17	96.36	Mar. 26	113.40
Feb. 15, 1940	49.15	Jan. 10, 1950	95.65	Apr. 29	114.22
Feb. 5, 1941	51.37	Feb. 10	94.88	May 27	115.31
Feb. 3, 1943	55.86	May 16	94.95	Aug. 6	119.40
Nov. 13	62.48	Nov. 16	100.65	Sept. 3	120.26
Mar. 6, 1944	61.99	Feb. 20, 1951	111.46	Oct. 8	119.55
Mar. 15, 1945	69.85	Oct. 17	109.65	Nov. 4	119.84
Mar. 14, 1946	78.53	Nov. 22	109.57	Dec. 3	119.39

(Continued on next page)

Table 7.--Water levels in wells the Alice area--Continued

Kleberg County

Date	Water level	Date	Water level	Date	Water level
Well 84-32-501--Continued					
Jan. 6, 1954	118.76	Mar. 7, 1955	120.86	July 26, 1957	129.22
Feb. 4	118.38	Apr. 4	121.07	Oct. 4, 1960	132.59
Mar. 8	118.36	May 5	122.71	Nov. 7	134.46
Apr. 7	119.29	June 6	123.00	Dec. 9	136.60
May 5	119.50	Aug. 22	126.73	Jan. 6, 1961	136.87
June 3	119.83	Jan. 3, 1956	124.48	Feb. 7	136.90
July 1	119.89	Feb. 9	125.13	Mar. 6	136.53
Aug. 10	121.14	Apr. 5	123.74	Apr. 6	137.94
Oct. 1	121.45	May 23	124.06	May 8	139.89
Nov. 1	122.10	June 26	123.95	June 8	141.60
Dec. 3	120.94	Aug. 24	125.85	July 10	143.20
Jan. 7, 1955	120.56	Oct. 16	126.60	Aug. 4	143.90
Feb. 10	121.25	Feb. 13, 1957	128.45		

Table 8.--Chemical analyses of water from wells in the Alice area

(Results are in parts per million, except specific conductance, pH, residual sodium carbonate, percent sodium, and sodium adsorption ratio.)
Water-bearing unit: G, Goliad Sand; L, Lagarto Clay; O, Oakville Sandstone; P, Pliocene(?) and Pleistocene formations, undifferentiated.

Well	Owner	Depth of well (ft.)	Water-bearing unit	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Residual sodium carbonate (RSC)	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
Jim Wells County																						
78-63-601	S. M. Freeborn	275	G	Mar. 31, 1934	--	0.97	83	28	241	316	51	375	0.4	5.8	--	940	322	0	62	5.8	--	--
701	Sheeran School	80	G	Mar. 21, 1934	--	1.0	41	14	252	438	59	199	2.0	2.5	--	785	160	3.98	77	8.7	--	--
903	S. M. Freeborn	228	G	Jan. 12, 1961	39	--	235	72	369	230	132	950	--	24	--	1,930	882	0	48	5.4	3,480	7.2
83-01-202	City of Orange Grove	817	G	Mar. 23, 1961	25	.09	27	12	289 7.8	413	116	195	.6	8.9	1.5	886	117	4.43	83	12	1,490	7.6
205	do	520	G	June 2, 1945	22	2.0	40	17	259 9.3	423	121	188	.6	8.5	--	890	170	3.53	76	8.6	1,460	7.6
206	do	288	G	do	20	3.2	70	27	297	389	124	322	1.2	16	--	1,080	286	.67	69	7.6	1,850	7.6
705	Robert Adams	400	G	Apr. 9, 1940	--	--	94	32	307	318	62	502	--	--	--	1,150	366	0	65	7.0	--	--
83-02-201	Arthur Knolle	400	G	Mar. 17, 1961	24	--	36	14	391 8.1	382	201	335	.9	1.8	2.9	1,200	148	3.31	84	14	2,040	7.3
83-09-204	J. M. Dellinger	870	G	Mar. 28, 1961	19	--	24	7.8	608 7.2	314	434	508	.7	2.5	3.2	1,770	92	3.31	93	28	2,930	7.7
83-17-702	J. S Floyd	559	G	Jan. 13, 1961	15	--	20	8.3	427	248	168	445	--	7.4	--	1,210	84	2.38	92	20	2,130	7.8
84-07-503	S. M. Freeborn	280	G	Jan. 12, 1961	27	.04	36	16	313	397	109	272	1.9	12	--	984	156	3.39	81	11	1,690	7.4
84-08-301	-- Kerchoff	552	G	Jan. 3, 1961	29	.01	56	22	330	384	138	335	1.3	17	--	1,120	230	1.69	76	9.5	1,910	7.6
404	W. T. Wright	491	G	Nov. --, 1946	--	--	23	12	266	400	50	216	--	.0	--	790	107	4.43	84	11	--	--
801	U. S. Navy	630	G	Jan. 9, 1961	22	.02	14	6.1	286 6.8	432	66	185	1.1	.5	1.4	801	60	5.88	90	16	1,360	7.8
907	Ed Adams	411	G	Apr. 9, 1940	--	--	41	28	318	420	140	298	--	--	--	1,030	217	2.53	76	9.4	--	--
84-15-301	Lamar Hinnant	525	G	Jan. 11, 1961	30	--	57	38	376	420	242	355	--	24	--	1,330	298	.91	73	9.5	2,130	7.4
903	J. M. Young	358	G	Jan. 13, 1961	25	--	390	216	923	112	350	2,420	--	--	--	4,380	1,860	0	52	9.3	7,690	6.3
84-16-603	M. Word	480	G	Jan. 14, 1961	22	--	44	29	483	404	244	482	--	19	--	1,520	229	2.04	82	14	2,570	7.5
701	City of Alice	844	P,G	May 18, 1961	--	--	--	--	--	328	44	310	--	--	--	--	260	--	--	--	1,570	7.2
801	do	896	G	Apr. 27, 1961	--	--	--	--	--	322	376	418	--	--	--	--	223	--	--	--	2,550	7.3
803	do	864	G	Jan. 15, 1961	20	.03	40	23	376 10	352	168	402	1.1	13	1.8	1,230	194	1.88	80	12	2,130	7.5
804	do	860	G	do	20	.05	36	22	372 9.9	362	166	380	.9	13	1.8	1,200	180	2.32	81	12	2,080	7.6
805	do	852	G	do	18	.03	28	15	402 9.4	350	176	380	.8	15	1.9	1,220	132	3.11	86	15	2,090	7.6
806	do	896	G	Feb. 16, 1961	19	.28	31	18	363 9.4	352	158	345	.9	15	1.9	1,130	152	2.74	83	13	1,950	7.6
807	do	869	G	Feb. 15, 1961	19	.08	36	21	362 9.8	348	164	352	.9	14	1.9	1,150	176	2.17	81	12	2,000	7.4

Table 8.--Chemical analyses of water from wells in the Alice area--Continued

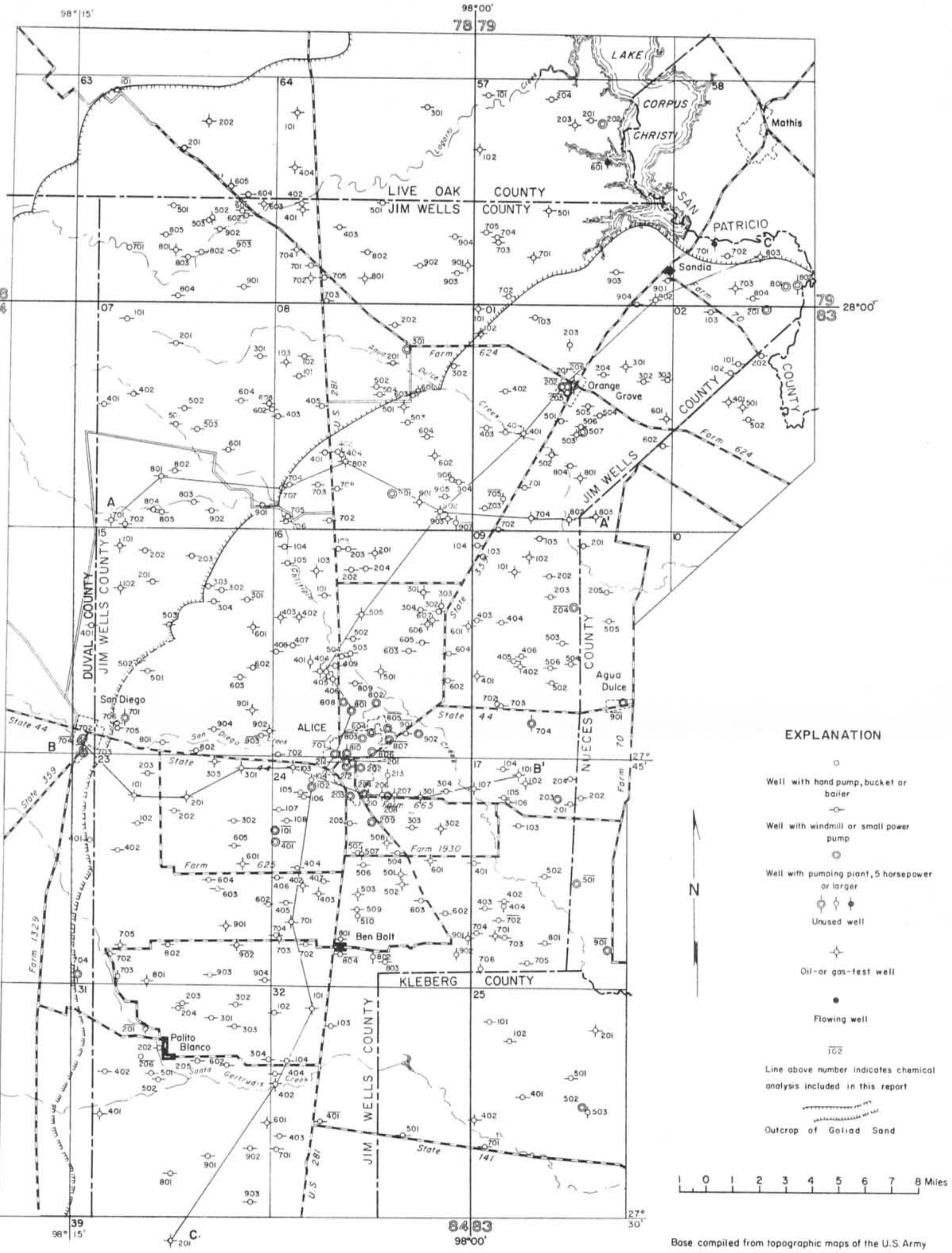
Well	Owner	Depth of well (ft.)	Water-bearing unit	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Residual sodium carbonate (RSC)	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
84-16-810	City of Alice	622	G	Apr. 8, 1940	--	--	--	--	287	342	115	220	--	--	--	798	87	3.87	88	13	--	--
810	do	622	G	Mar. 5, 1945	25	0.05	42	22	313 11	362	115	325	2.1	12	--	1,050	196	2.02	76	9.7	2,070	7.4
901	-- Adkinson	900	G	Apr. 8, 1940	--	--	--	--	316	374	135	215	--	--	--	845	63	4.88	92	17	--	--
84-23-902	Project Road Community	580	G	Mar. 13, 1961	18	--	48	40	816	396	392	930	2.1	12	--	2,450	284	.80	86	21	4,110	7.7
84-24-101	Gerald English	850	G	Mar. 14, 1961	17	--	20	10	416 8.8	277	208	375	.7	24	1.8	1,220	91	2.72	90	19	2,090	7.6
102	City of Alice	754	G	Jan. 20, 1961	21	.17	31	16	366 9.8	348	154	358	.8	18	1.7	1,150	144	2.83	84	13	1,970	7.7
* 201	do	992	G	do	--	--	246	31	1,650	223	3,190	579	--	--	--	5,810	742	0	83	26	--	--
* 201	do	992	G	Apr. 20, 1928	--	--	267	34	1,760	200	3,460	613	--	--	--	6,230	806	0	83	27	--	--
* 201	do	†1,327-837	G,L	May 1, 1928	--	--	104	24	841	274	1,330	409	--	--	--	2,840	358	0	84	19	--	--
* 201	do	†1,958-2,004	O	Jan. 10, 1928	--	--	46	9	1,370	209	1,950	660	--	--	--	4,140	152	.39	95	48	--	--
* 201	do	† 837-2,004	G,L,O	Jan. 20, 1928	--	--	155	17	1,420	211	2,350	657	--	--	--	4,700	456	0	87	29	--	--
* 201	do	† 837-867 † 945-986	G	Apr. 8, 1940	--	--	34	17	361	332	228	305	--	--	--	1,110	155	2.34	84	13	--	--
* 201	do	992	G	Mar. 5, 1945	29	.02	23	8.8	333 11	345	196	237	1.0	11	--	1,020	94	3.78	87	15	1,880	7.2
202	do	647	G	Sept.27, 1945	18	.04	30	17	317 10	358	128	289	1.2	12	--	1,020	145	2.97	81	11	1,740	7.8
203	do	785	G	May 18, 1961	--	--	--	--	--	304	178	398	--	--	--	--	116	--	--	--	2,130	7.4
204	do	820	G	Jan. 18, 1961	19	.06	26	12	377 9.4	328	166	352	.7	21	1.6	1,150	114	3.09	87	15	1,970	7.6
208	do	925	G	Mar. 26, 1961	19	.00	25	12	460 9.2	322	212	425	.9	21	2.0	1,340	112	3.04	89	19	2,280	7.7
209	do	900	G	Mar. 2, 1961	18	.03	22	9.8	442 8.7	294	187	422	.7	25	1.7	1,280	96	2.91	90	20	2,220	7.5
211	do	535	G	Apr. 8, 1940	--	--	43	29	363	340	149	412	--	--	--	1,160	226	1.05	78	10	--	--
211	do	535	G	Mar. 5, 1945	18	.05	43	23	398 12	315	165	448	.9	22	--	1,290	202	1.12	80	12	2,480	7.4
212	do	550	G	Mar. 5, 1928	25	.17	43	24	374 10	318	151	430	--	17	--	1,230	206	1.09	79	11	--	--
212	do	550	G	Apr. 8, 1940	--	--	50	28	330	354	113	390	--	--	--	1,080	240	1.00	75	9.3	--	--

See footnotes at end of table.

Table 8.--Chemical analyses of water from wells in the Alice area--Continued

Well	Owner	Depth of well (ft.)	Water-bearing unit	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Residual sodium carbonate (RSC)	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
84-24-212	City of Alice	550	G	Mar. 5, 1945	22	0.03	20	8.1	290 9.9	353	117	214	0.9	12	--	876	84	4.12	87	14	1,630	7.4
401	H. E. Woolsey	1,910	O	Mar. 22, 1961	22	--	17	1.6	704 3.8	260	690	452	3.5	.0	9.2	2,030	49	3.28	97	44	3,190	8.0
505	O. Z. Inglett	654	G	Jan. 13, 1961	16	--	20	11	420	288	170	415	--	13	--	1,210	95	2.82	91	19	2,130	7.9
510	W. F. Botard	349	G	May 29, 1934	--	.44	22	17	371	388	156	306	2.7	16	--	1,080	125	3.86	87	14	--	--
804	R. V. de Garcia	500	G	Mar. 21, 1934	--	2.0	16	12	271	306	74	241	.3	12	--	777	89	3.23	87	12	--	--
84-31-201	Emilia Barrera	75	G	Mar. 29, 1934	--	.26	220	107	462	360	399	890	.7	33	--	2,290	989	0	50	6.4	--	--
206	Miguel and Ignacio Cadena	98	G	do	--	3.6	73	56	85	436	45	118	1.8	27	--	621	412	0	31	1.8	--	--
84-32-401	King Ranch	500	G	Dec. --, 1948	--	--	--	--	--	--	--	318	--	--	.76	--	--	--	--	--	1,980	--
401	do	500	G	Jan. 12, 1961	39	.12	56	23	335	365	190	318	1.3	17	--	1,160	234	1.30	76	9.5	1,940	7.2
Kleberg County																						
83-25-701	King Ranch	498	G	Jan. 12, 1961	21	.08	30	16	315	284	155	295	.7	16	--	992	141	1.84	83	12	1,710	7.4
Duval County																						
84-15-704	City of San Diego	749	G	Mar. 27, 1961	22	.31	34	16	189 9.0	312	72	150	.9	23	.93	670	151	2.09	72	6.7	1,150	7.3
Nueces County																						
‡83-09-901	City of Agua Dulce	809	G	Aug. 9, 1960	10	.10	16	4.4	410 6.2	364	213	312	.7	9.3	2.0	1,160	58	4.81	93	23	1,970	7.6
83-17-501	Champlin Oil & Refining Co.	768	G	May 25, 1961	--	--	--	--	--	320	156	350	--	--	--	--	46	--	--	--	1,950	7.7
901	do	753	G	do	--	--	--	--	--	214	506	740	--	--	--	--	141	--	--	--	3,570	7.6
Live Oak County																						
78-63-101	Mrs. King Hinnant	193	G	Aug. 16, 1940	--	--	46	13	241	326	48	260	.8	8.4	--	778	168	1.97	76	8.1	--	--
79-57-101	Holman Cartwright	178	G	Sept.27, 1956	--	--	--	--	--	348	--	80	--	--	--	--	244	--	--	--	832	7.5
204	Lenora Rivera	106	G	Feb. 14, 1928	34	4.7	80	11	65 3.2	315	23	80	--	1.3	--	458	245	.27	36	1.8	--	--
601	H. D. Miller	350	G	July 16, 1948	26	--	51	23	258	422	87	240	--	10	--	903	222	2.48	72	7.5	1,550	--

*Curtis Laboratory analysis. Figure rounded and dissolved solids recomputed in accordance with Geological Survey usage.
†Interval sampled.
‡Phosphate (PO_4), 0.04.



Geology of the Goliad Sand after Geologic Map of Texas (Darton and others, 1937)

Base compiled from topographic maps of the U.S. Army Map Service and the U.S. Geological Survey and from county maps of the Texas State Highway Department

MAP SHOWING LOCATION OF WELLS AND OUTCROP OF GOLIAD SAND IN THE ALICE AREA

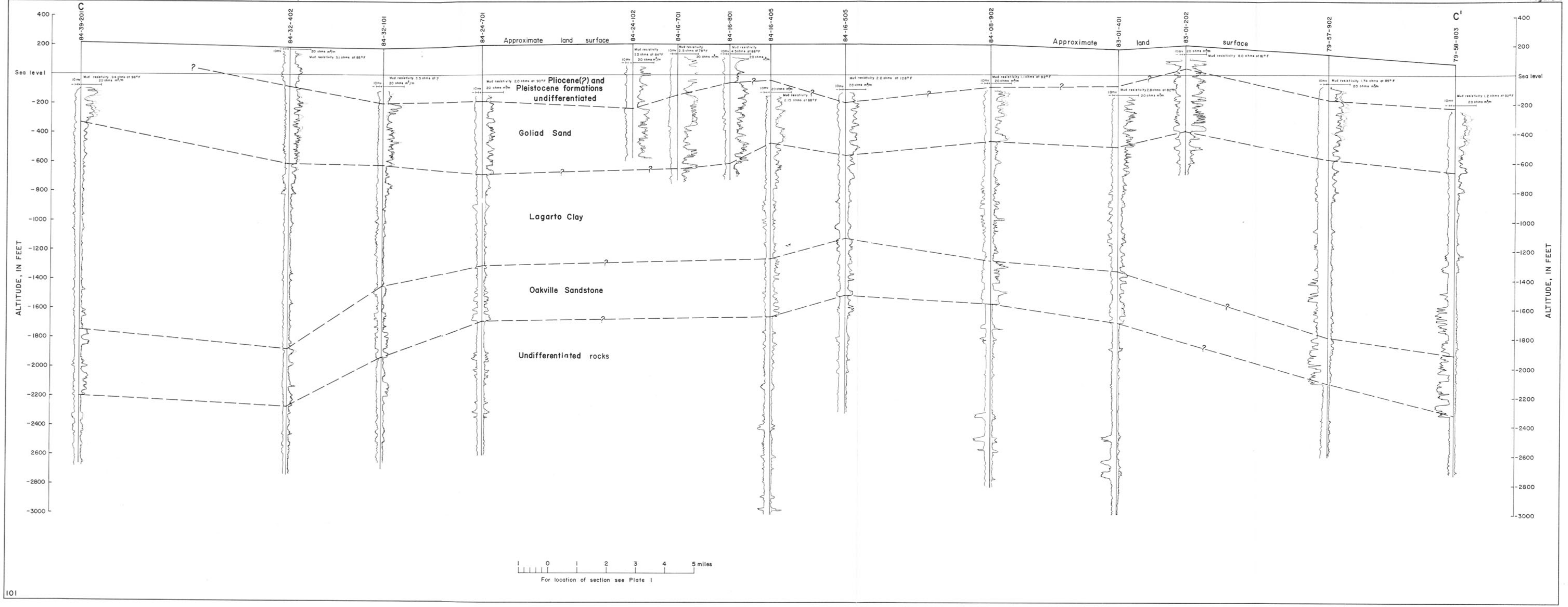


FIGURE 6.- Geologic section C-C', Alice area