TEXAS BOARD OF WATER ENGINEERS

BULLETIN 5803

GROUND-WATER GEOLOGY OF REAL COUNTY, TEXAS

By

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Texas Board of Water Engineers

Prepared in cooperation with the Geological Survey,
United States Department of the Interior
and the
City of San Antonio

October 1958

C O N T E N T S

ILLUSTRATIONS

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ABSTRACT

Real County is on the Edwards Plateau in southwest Texas. The county has an area of 625 square miles, and in 1950 had a population of 2,479. Ranching is the principal occupation. Most of the surface drainage is southward through the Nueces, Dry Frio, and Frio Rivers.

Sedimentary rocks of Early Cretaceous age underlie Real County and dip gently southward toward the Balcones fault zone. The Edwards and associated limestones, one of the principal aquifers in the county, consists of the Comanche Peak, Edwards, and Georgetown limestones, which act as a single hydrologic unit. The Glen Rose limestone, of lesser importance as an aquifer, underlies the Edwards and associated limestones. The Grayson shale and Buda limestone overlie the Edwards and associated limestones and crop out only on the higher divides; they do not yield water in Real County. The oldest Cretaceous strata in Real County, herein called "basement sands," have not been tested for their water-bearing properties; however, they yield water elsewhere on the Edwards Plateau. Quaternary alluvial deposits in the major stream valleys have a maximum thickness of about 40 feet. Public, domestic, and stock supplies are obtained from the alluvium in some places.

The map of the water table in the Edwards and associated limestones indicates that the main ground-water divide follows the topographic divide fairly closely. North of the divide ground water flows northward into the lower Colorado River basin; south of the divide it flows into the Nueces River basin. The average thickness of the saturated zone in the Edwards and associated limestones probably exceeds 150 feet. Water is under artesian pressure locally where it is confined beneath relatively impermeable materials, but generally it is unconfined.

The base flow of the streams is sustained by ground-water discharge, which in turn is dependent on recharge. The estimated base flow of the Frio River (60 cubic feet per second) was about two-thirds of the total flow near Concan, in Uvalde County, during the period 1924-56. On this basis the average annual recharge to ground water in the Frio River basin is estimated to be about 2 inches.

The average use of water from wells in Real County is estimated to be about half a million gallons per day. The principal uses are for domestic and stock supplies. Most wells are designed to produce only small quantities of water; larger yields could be obtained by tapping the full thickness of the aquifers.

The amount of ground water available for perennial development is estimated to be about 70,000 acre-feet per year (60 million gallons per day). Consumptive use of water obtained from wells, however, would result in reduced streamflow.

The Edwards and associated limestones and the alluvium both yield water that is very hard but is otherwise of good chemical quality. Water from the Glen Rose limestone varies greatly in dissolved-solids content. The more highly mineralized waters have a high sulfate content which probably is derived from gypsum beds in the Glen Rose.

INTRODUCTION

LOCATION AND EXTENT OF AREA

Real County is in southwest Texas on the southern edge of the Edwards Plateau. It is bounded on the north by Edwards and Kerr Counties, on the east by Kerr and Bandera Counties, on the south by Uvalde County, and on the west by Edwards County (fig. 1). The area of Real County is 625 square miles.

ECONOMIC DEVELOPMENT

The raising of livestock is the principal occupation in Real County; mohair and wool are the principal products. Other important products are small grains and forage sorghums, which are grown in the stream valleys south of Leakey and Camp Wood, and cedar posts. The scenic beauty of the area and excellent hunting provide natural attractions for tourists, and recreational facilities are offered by guest ranches.

Real County was created from Edwards, Kerr, and Bandera Counties in 1913, and named for Julius Real, a prominent businessman of the area. According to the U. S. Bureau of the Census, the population of the county in 1950 was 2,479. Leakey, the county seat, had a population of 550, and Camp Wood had a population of 785. Other communities in the county are Rio Frio and Vance.

PURPOSE AND SCOPE OF INVESTIGATION

The investigation in Real County was carried on simultaneously with an investigation in Edwards County as part of a cooperative program of the United States Geological Survey, the Texas Board of Water Engineers, and the city of San Antonio to obtain data on the occurrence of ground water at the southern edge of the Edwards Plateau. The work consisted principally of inventorying wells and springs, mapping the surface geology, determining the structural relations of rock units to ground-water hydrology, and contouring the water table.

Most of the field data were obtained in 1955. The report contains records of 212 wells and springs (table 4), drillers' logs of 6 wells (table 5), and chemical analyses of the water from 38 wells and springs (table 6).

The investigation was made under the direction of R. W. Sundstrom, district engineer of the U. S. Geological Survey in charge of cooperative ground-water investigations in Texas. J. L. Deviney, U. S. Geological Survey, ran instrumental level lines to establish the altitudes of wells and collected some of the well records. Frank A. Welder, U. S. Geological Survey, helped measure a geologic section in the Edwards and associated limestones.

ACKNOWLEDGMENTS

Appreciation is expressed for the cooperation and assistance of oil-company personnel, well drillers, and well owners who contributed field data.

TOPOGRAPHY

SURFACE FEATURES

The northern part of Real County has a rolling surface characteristic of the Edwards Plateau; however, it is relatively flat compared with the southern part of the county, where streams have cut through the resistant Edwards and associated limestones to form a dissected area of divides and canyons. The gentler slopes of the underlying Glen Rose limestone form rolling topography in the valleys of the Nueces, Dry Frio, Frio and Sabinal Rivers.

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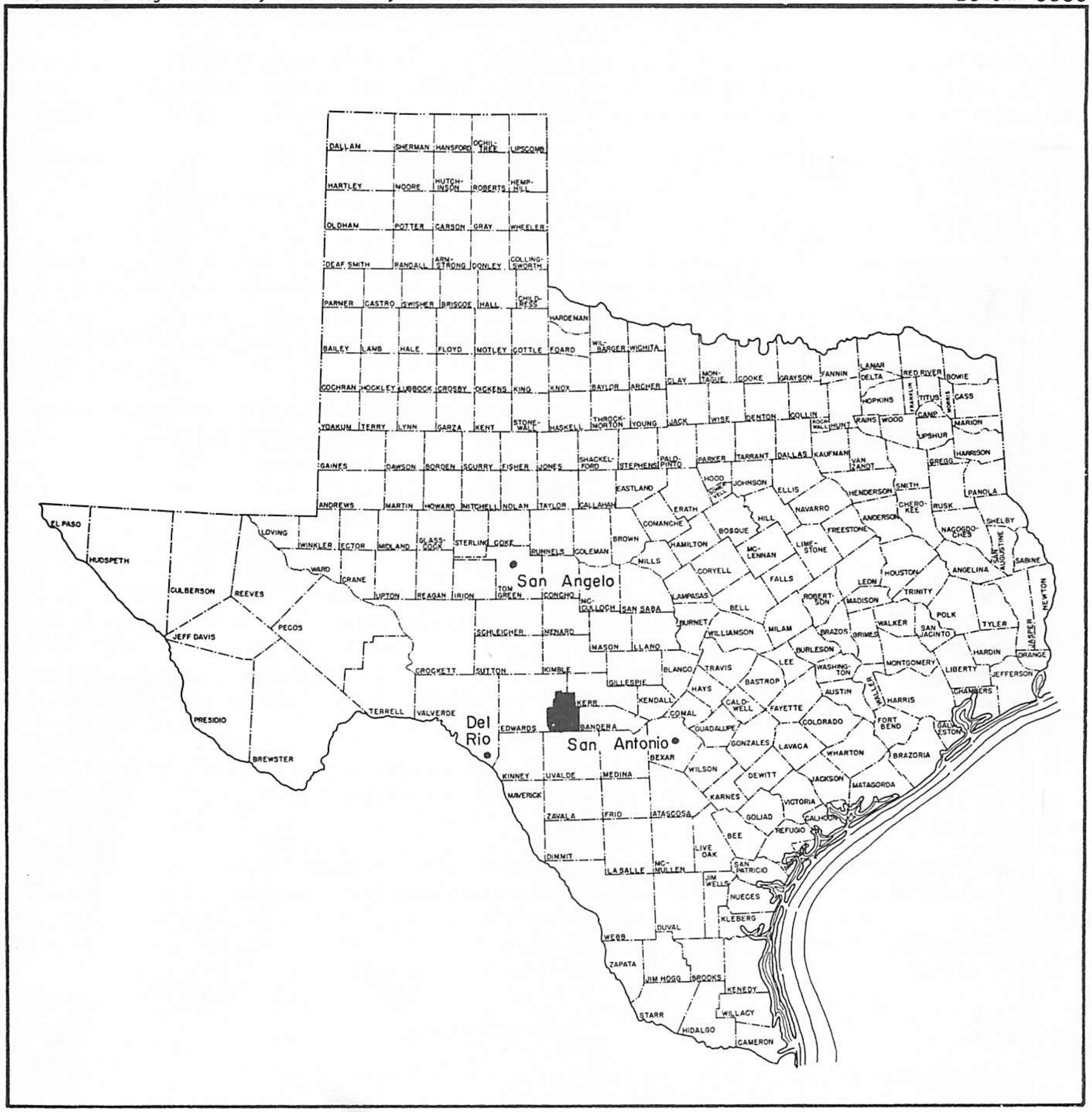

FIGURE I.— Map of Texas showing location of Real County.

The land surface ranges in altitude from about 1,400 feet above mean sea level in the beds of the Frio and Nueces Rivers in the extreme south to about 2,400 feet in the northern part of the county.

DRAINAGE

The principal drainage in Real County is to the south by way of the Nueces, Dry Frio, and Frio Rivers and tributaries of the Sabinal River. The extreme northern part of the county is drained by Paint Creek, which flows northward to the South Llano River.

Streams on the Edwards Plateau in the northern part of the county are ephemeral, carrying only storm runoff. The gradients are steep, probably averaging more than 50 feet per mile. Downstream from the plateau proper, the gradients average only about 20 to 25 feet per mile. Canyons are cut through the Edwards and associated limestones along the edge of the plateau, and gravity springs furnish a perennial supply of water to most of the major streams.

The average, minimum, and maximum flows of the principal streams in Real County for the period of record are shown in table 1. The estimated base flow of the Frio River near Concan is about two-thirds of the total flow.

Table 1.- Maximum, minimum, and average flow of the principal streams in Real County, Tex.

Station	Maximum flow (cfs)	Minimum flow (cfs)	Average annual flow (cfs)
Frio River at Concan (1924-56)	July 1, 1932 162,000	Aug. 5-Sept.30, 1956 No flow	86.2
Dry Frio River at Reagan Wells (1952-56)	Sept.24, 1932 23,200	Several periods of no flow	8.27
Nueces River at Laguna (1924-56)	Sept.24, 1955 307,000	Aug. 16-17, 1953 4.8	130

A comparison of the base flows of the Nueces and Frio Rivers near the Uvalde County line (pl. 2) with the base flows at the gaging stations near Laguna and Concan suggests that most of the base flow originates north of the Real County line.

CLIMATE

The climate of Real County is semiarid to subhumid. The mean annual precipitation at the Crider Ranch in extreme northern Real County was 22.15 inches during the 16-year period 1940-55. The months of heaviest rainfall are April through June and September through October (fig. 2).

Long-term records of temperature are not available in Real County. According to records of the U. S. Weather Bureau, the mean annual temperature at Kerrville, about 42 miles northeast of Leakey, during the period 1896-1955 was 64.8°F. At Uvalde, about 36 miles south of Leakey, the mean annual temperature during the period 1903-55 was 70.2°F.

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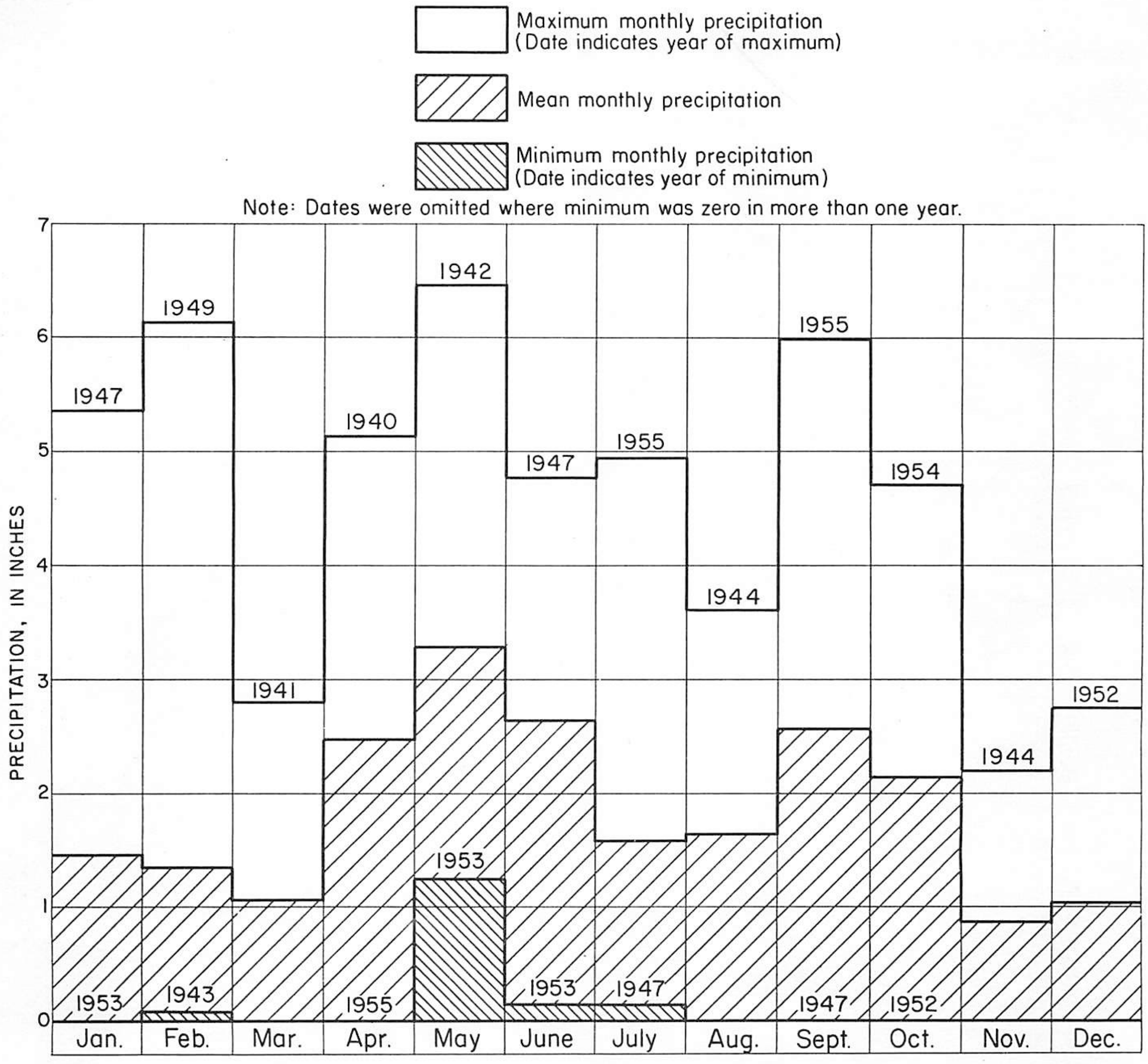

FIGURE 2.– Maximum, minimum, and mean monthly precipitation at Crider Ranch, Real County, Tex., 1940-55. From records of the U.S. Weather Bureau.

GEOLOGY

GENERAL

Real County is on the Edwards Plateau--a regionally uplifted and dissected plain capped by limestones of Early Cretaceous age. Beds dip gently southward toward the Balcones fault zone, where younger rocks of the Gulf Coastal Plain border the Edwards Plateau (fig. 3).

The Comanche Peak, Edwards, and Georgetown limestones collectively are called the Edwards and associated limestones (Petitt and George, 1956, p. 16). They underlie most of the county and are overlain locally by remnants of the Grayson shale and Buda limestone (pl. 3). Soft marly beds of the underlying Glen Rose limestone are exposed in the lower stream valleys but locally are covered by alluvium.

Figure 4 is a composite geologic section of the formations in Real County. The lithologic and water-supply characteristics of the formations are summarized in table 2.

ROCK FORMATIONS AND THEIR WATER-BEARING PROPERTIES

PRE-CRETACEOUS ROCKS

Rocks of pre-Cretaceous age are not exposed in Real County. Several oil tests drilled to the Ellenburger group of Ordovician age penetrate thick beds of shale, limestone, and sandstone of Pennsylvanian age. The shale is generally noncalcareous and is red or black. The Cretaceous beds are underlain by different Pennsylvanian formations in various parts of the county, owing to the structural relief of the Paleozoic beds and the extent of the unconformity between the Paleozoic and Cretaceous strata.

No fresh water has been reported in the Paleozoic rocks, and the base of the Cretaceous strata is considered to be the base of the fresh-water-bearing beds in Real County (fig. 5).

CRETACEOUS SYSTEM

Pre-Comanche and Comanche rocks, undifferentiated

The oldest Cretaceous rocks penetrated by the drill in Real County are sandstone, some of which is conglomeratic; shale; and limestone. Correlation of these beds is not certain, but they probably include the Pearsall formation of Comanche age and, where they thicken downdip, the Hosston and Sligo formations of Coahuila age (Imlay, 1945). None of these rocks crop out in Real County. For the purposes of this report it has not been necessary to differentiate these rocks, and they are all included under the following discussion of the "basement sands."

"Basement sands." - According to Cartwright (1932, p. 694), the Lower Cretaceous rocks were deposited upon a Paleozoic surface which was an upland plain having some relief. The first Cretaceous sediments were coarse clastics derived from the Paleozoic rocks and laid down in topographically low areas. The hills, which were islands in the Early Cretaceous seas, received the finer sediments of somewhat later age. Thus a basal conglomerate found in some wells is missing in others, and sand and clay may lie directly upon Paleozoic rocks.

The "basement sands" may be divided roughly into three parts in Real County. The lower part consists of varicolored calcareous shale alternating with poorly sorted sand which, in some places, is conglomeratic; the middle part contains limestone, dolomitic limestone, and some shale and marl; and the upper part consists of well-sorted sand which generally contains some calcareous shale and thin limestone (fig. 4). Chert gravel is reported at the base of the upper sand in some wells. The "basement sands" unit thickens southward from approximately 200 feet in the north to more than 500 feet in the southern part of the county (pl. 3).

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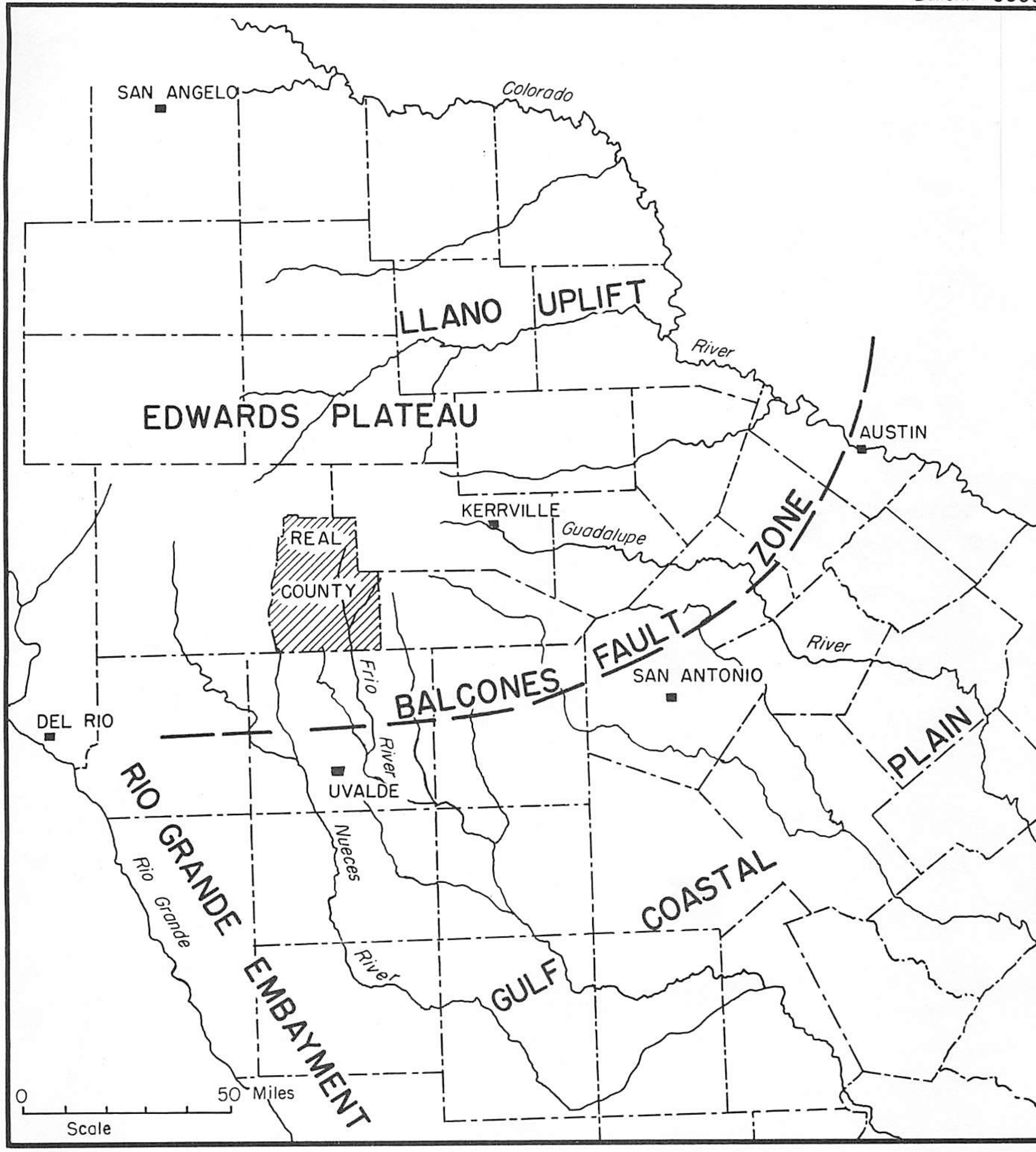

FIGURE 3.– Map of central Texas showing physiographic provinces

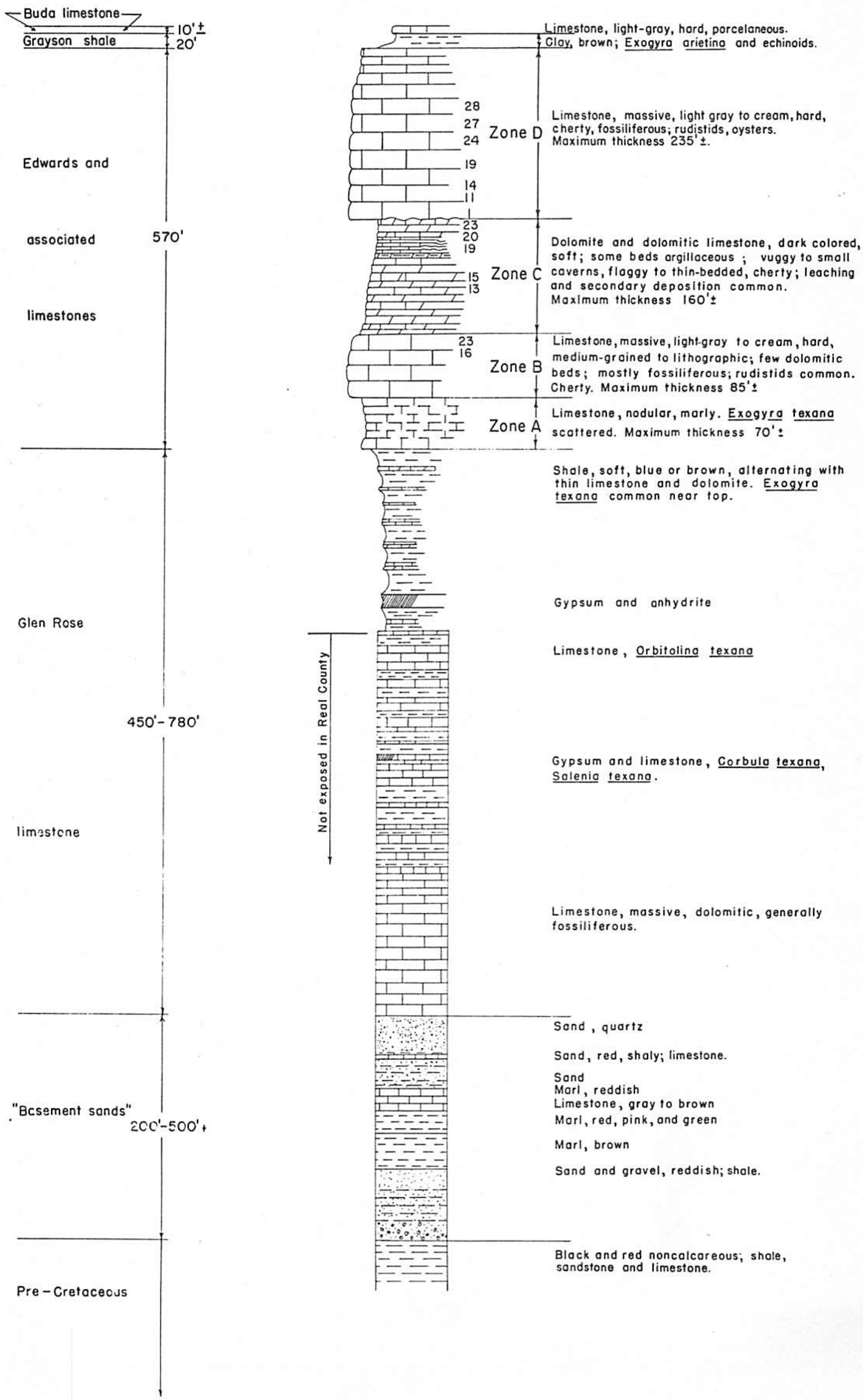

FIGURE 4.—Composite geologic section in Real County, Tex. Lithographic descriptions from measured section, well logs, and well samples at the Well Sample Library, Bureau of Economic Geology, University of Texas, Austin, Tex. Letters and numbers opposite beds correspond to those in description of measured section, p. 10.

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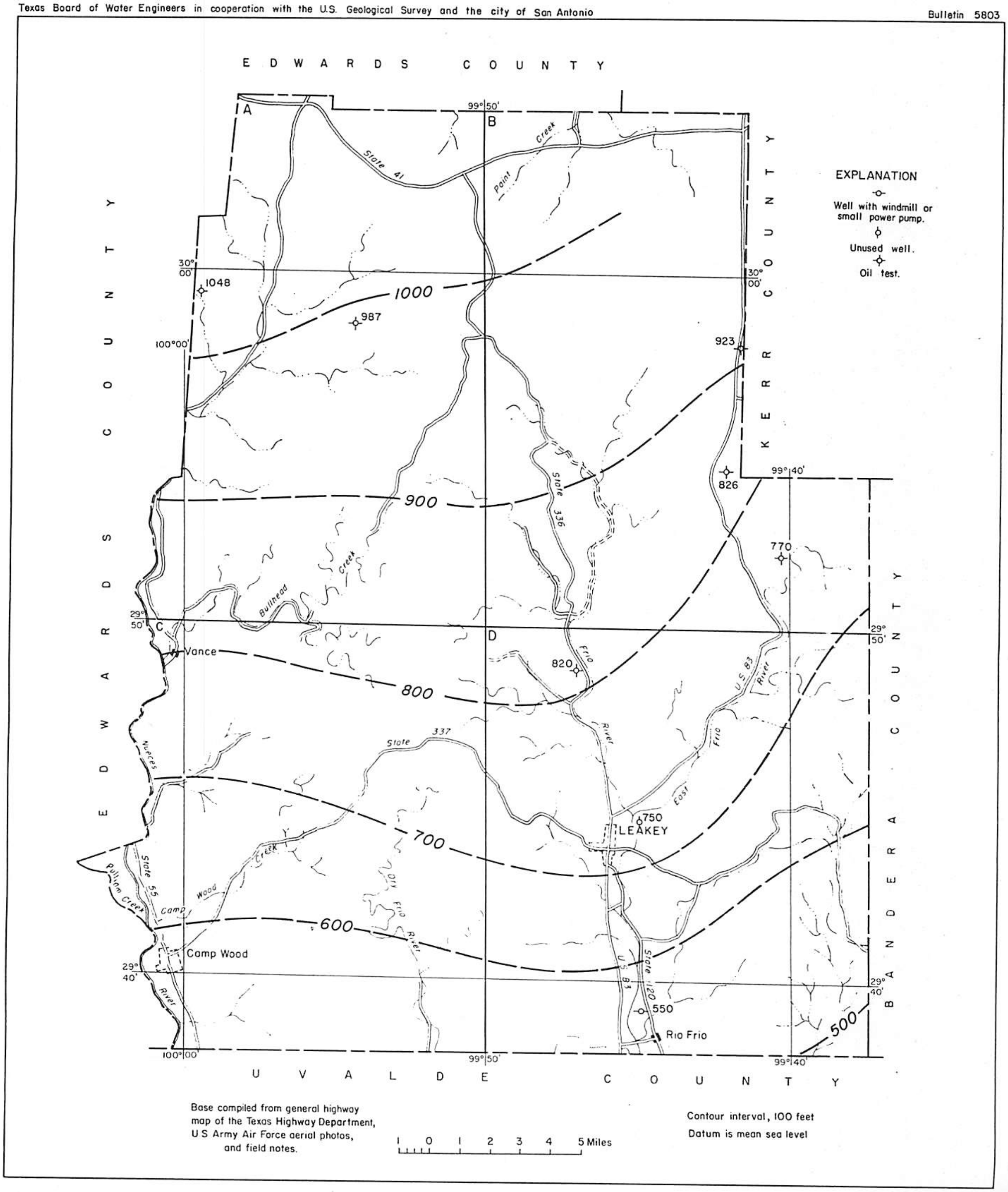

FIGURE 5.- Approximate altitude of the base of the Cretaceous rocks in Real County, Tex.

Table 2.- Geologic formations and their water-supply characteristics, Real County, Tex.

System	Series or group	Stratigraphic unit	Maximum thickness (feet)	Description of rocks	Surface expression	Water supply
Quaternary	Pleistocene and Recent	Alluvium	40±	Sand, silt, and gravel.	Flat terraces in stream valleys.	Yields potable water in some valleys.
Cretaceous	Comanche series: Washita group	Buda limestone	10±	Hard fine-grained porcellaneous light-gray limestone.	Caps divides; generally broken fragments or boulders.	Yields no water to wells in Real County.
	Comanche series: Washita group	Grayson shale	20±	Buff-brown clay or marl; some hard limestone.	Forms rolling topography.	Do.
	Comanche series: Washita group	Edwards and associated limestones: Georgetown limestone	200±	Hard massive limestone containing flint nodules.		Yields small to moderate supplies of potable water to domestic and stock wells.
	Comanche series: Fredericksburg group	Edwards and associated limestones: Edwards limestone	300±	Hard massive limestone and soft dolomite containing flint nodules; honeycombed and cavernous.	Forms canyon walls, steep rocky slopes.	
	Comanche series: Fredericksburg group	Edwards and associated limestones: Comanche Peak limestone	70	Nodular, marly limestone.	Forms gentle slopes and bluffs in cut banks.	
	Comanche series: Trinity group	Glen Rose limestone	780	Soft blue or brown marl alternating with beds of hard limestone and dolomite. Massive limestone at base contains gypsum and anhydrite.	Terraced topography, relatively gentle slopes.	Supplies stock wells. Yields are generally small, and most of the water is highly mineralized.
	Pre-Comanche	"Basement sands"	500+	Sandstone, gravel, calcareous shale, and limestone.	Not exposed in Real County.	Yields no water to wells in Real County.
Pre-Cretaceous		?	?	Dark non-calcareous shale, sandstone, and limestone.	do	Do.

Water has been reported from the "basement sands" in several oil test wells in Real County. In well A-12 "a hole full of water" was reported by the driller from a depth of 1,100 to 1,110 feet. A "hole full of water" was reported also in well B-36, from sands at depths of 1,025 feet and 1,225 feet. Although no wells are known to obtain water from the "basement sands" in Real County, and little is known regarding the quality of the water, small to moderate quantities of water might be obtained from the sand.

Glen Rose limestone. - The Glen Rose limestone of the Trinity group is exposed in the major stream valleys in southern Real County (pl. 1). The thickness of the formation ranges from about 450 feet in the northern part of the county to about 780 feet in the southern part (pl. 3).

In Comal County, Tex., George (1952, p. 17) divided the Glen Rose limestone into a lower member and an upper member. The division was arbitrarily made at the top of a thin limestone bed containing numerous individuals of the small pelecypod, Corbula texana Whitney, which is at the top of a well-known fossiliferous zone called the Salenia texana zone. This zone does not crop out in Real County; only the upper member of the Glen Rose limestone is exposed.

The lower member of the Glen Rose limestone consists of massive fossiliferous limestone, shaly limestone, and dolomite. The upper member of the Glen Rose limestone consists of alternating limestone and marl and at least two beds of gypsum and anhydrite. The alternating beds of limestone and marl form a rolling, somewhat terraced topography. The gentle slopes are in marked contrast to the plain developed on the overlying Edwards and associated limestones. The upper member of the Glen Rose is brown to buff where exposed to weathering but is generally gray blue in the subsurface. The beds are known locally as the "blue" or "blue mud." The top of the upper member is mapped in this report as the base of the Fredericksburg group (pl. 1).

The large foraminifer Orbitolina texana (Roemer), is found in the Glen Rose limestone and is particularly numerous in a zone approximately 100 feet thick, the top of which is about 250 feet below the top of the formation. The outcrop of the Orbitolina zone is probably limited in Real County to the Nueces River valley in the vicinity of Camp Wood.

The Glen Rose limestone is one of the principal aquifers in Real County. Several beds in the Glen Rose carry small supplies of water, generally not more than 10 gallons per minute to individual wells; the water is suitable for domestic or stock use. Two beds containing gypsum occur at depths of about 220 and 400 feet below the top of the Glen Rose. These beds yield highly mineralized water which should be cased off when seeking water of the best quality available as for domestic supplies. The limestones near the base of the Glen Rose yield small supplies of water for domestic use (wells D-52 and D-55, tables 4 and 6).

Numerous springs, which issue from beds in the upper 100 feet of the Glen Rose limestone, flow into the tributaries of the Frio River (pl. 1). The quality of the water from one of the springs (D-4) is similar to that of the water from the overlying Edwards and associated limestones, and the water may be moving down from the Edwards to the springs through small open fractures. In general, however, the Glen Rose limestone acts as a confining bed which retards the downward movement of water from the Edwards and associated limestones.

FREDERICKSBURG AND WASHITA GROUPS

The Fredericksburg group in Real County includes the Comanche Peak limestone and the Edwards limestone. The Walnut clay, which is the lowest member of the Fredericksburg group, is probably absent in Real County, or, if present, is represented only by a thin layer consisting almost entirely of Exogyra texana (Roemer). The Kiamichi formation, which is at the top of the Fredericksburg group, has not been recognized in Real County. The Washita group in Real County includes the Georgetown limestone, Grayson shale, and Buda limestone. The Comanche Peak, Edwards and Georgetown limestones act as a single hydrologic unit and constitute one of the three principal aquifers in Real County. To these three the term "Edwards and associated limestones" was applied by Petitt and George (1956, p. 16).

Edwards and associated limestones. - The Edwards and associated limestones crop out in most of Real County, except on the higher divides, which are capped by younger rocks, and in the stream valleys, in which the older Glen Rose limestone has been exposed by erosion. The total thickness of the Edwards and associated limestones in the county is about 570 feet.

The oldest formation in the Edwards and associated limestones is the Comanche Peak limestone. It is a marly, nodular buff-colored limestone in which bedding planes are generally absent or obscure. (See zone A in measured section and fig. 4.) The absence of bedding planes and the marly character of the limestone may be due to borings. In places where the softer marly material has been removed, the resultant honeycombed rock will transmit water readily.

The Comanche Peak limestone may be recognized in the field by the presence of the oyster Exogyra texana, which is scattered through the formation, and the fact that it weathers to relatively gentle slopes, except in bluffs or cut banks. The Comanche Peak is about 70 feet thick in Real County.

The upper 500 feet of the Edwards and associated limestones consists of the Edwards and Georgetown limestones. It has not been possible to differentiate these two limestones in Real County, but they may be broken down into three zones which are recognizable in the field. (See zones B, C, and D in the measured section and fig. 4.) Directly overlying the Comanche Peak limestone are massive, hard beds of relatively pure chert-bearing limestone and a few dolomitic beds. (See zone B in the measured section and fig. 4.) The massive limestones are light gray to cream colored and are medium grained to lithographic in texture. Some beds are mottled with darker areas of cherty material which may represent a stage in the development of pure chert. Shell fragments are common in a few beds and rudistids are abundant in some beds, Toucasia and Caprina being especially numerous. The zone of massive limestone is approximately 85 feet thick and is topographically prominent, forming bluffs which retain little soil; and, consequently, the vegetation on these rocks is sparse.

Overlying the massive limestones is a zone consisting largely of dolomite and dolomitic limestone and containing considerable chert, mostly as nodules but also in bedded form. (See zone C in measured section and fig. 4.) The dolomite and dolomitic limestone generally have a sugary texture, are relatively soft, and are dark in color, ranging from gray to dark brown. Soft argillaceous beds and flaggy limestone are interbedded with the dolomite.

Solution and secondary deposition have produced the dominant textural features of the dolomitic zone. Cavities ranging from several inches to a few feet in diameter are common. Secondary deposits of calcite, quartz, siliceous limestone, and chert occupy a considerable part of many of the beds. Much of the bedding has been destroyed or obscured by leaching. The upper beds of the dolomitic zone, approximately 230 to 260 feet above the top of the Glen Rose limestone, show an exceptionally high degree of leaching. Certain beds contain numerous rudistids or gastropods, but most beds are so highly altered by leaching that little or no evidence of fossils remains.

The relatively gentle slopes of the softer beds in the dolomitic zone retain more soil and support more vegetation than do the limestones of the zones above and below. The zone of dolomitic rocks is about 160 feet thick.

The uppermost zone of the Edwards and associated limestones consists of massive, highly fossiliferous light-gray to buff-colored limestone. (See zone D in measured section and fig. 4.) A few flaggy beds and some dolomite are interbedded with the limestone, and considerable chert is present as nodules and in beds. The texture of the limestone ranges from coarsely crystalline to lithographic.

Some of the beds in this zone are composed almost entirely of fossils. Rudistids, principally Caprina and Toucasia, are numerous in many beds, and gastropods are numerous in some beds. A brachiopod, Kingena wacoensis (Roemer), is numerous in the beds near the top of the zone.

Limestone containing pelletal material and shell fragments is common. Beds consisting mostly of specimens of Gryphaea sp. were observed in the northern part of the county. These beds may correlate with similar beds in northeastern Edwards County. [1]

The uppermost zone of the Edwards and associated limestones forms topographically prominent cliffs or steep slopes which retain little soil and support little vegetation along the drainage-ways. However in the interstream areas, it forms the slightly rolling surface which is so characteristic of the Edwards Plateau. The maximum thickness of this zone, determined from well logs, is approximately 235 feet.

The Edwards and associated limestones yield small to moderate supplies of potable water to domestic and stock wells in many parts of the county. Although the yields of wells are small, ranging from less than 1 gallon per minute to 130 gallons per minute, no attempt has been made to develop larger yields. The wells commonly are drilled only deep enough to obtain the desired quantity of water; deeper wells penetrating the full thickness of the aquifer may be capable of substantially larger yields.

The water generally is suitable for domestic, stock, and irrigation supplies, although it is hard.

The following geologic section in the Edwards and associated limestones was measured by Frank A. Welder and the writer in road cuts along State Highway 337 about 4 miles west of Leakey, Tex. Refer to figure 4 for corresponding lettered zones and numbered beds.

Zone and bed	Description	Thickness (feet)
	Edwards and associated limestones:	
D. 28	Limestone, hard, fossiliferous gray; Toucasia sp. abundant; large oysters, Pecten sp., and similar pelecypods abundant to common near top; small gastropods common	7.3
27	Limestone, hard, gray, siliceous	2.2
26	Limestone, powdery, gray, bored	1.3
25	Limestone, hard, gray, siliceous	5.5
24	Limestone, gray, fossiliferous; Caprina sp. common near bottom; Toucasia sp. abundant near top	9.3
23	Limestone, hard to powdery, gray; Foraminifera	3.9
22	Limestone, hard, fine-grained, cream-colored; Caprina sp. common to abundant	2.0
	Fault: correlated across	
21	Limestone, hard to powdery, fine- to medium-grained, gray to buff, cherty, poorly exposed	23.7
20	Limestone, flaggy, gray; nodules of chert and dark-gray siliceous limestone	3.1
19	Limestone, fine- to medium-grained, gray, mottled dark; disseminated chert nodules, small white pelecypod shells abundant	4.1
18	Limestone, hard, fine-grained, gray; thin beds of chert	3.2
17	Shale, laminated, buff	0.3
16	Limestone, hard, medium-grained, gray; Foraminifera, high-spired gastropods common; irregular to nodular; bedding massive to flaggy	9.0

1/ *Long, A. T., and Petitt, B. M., Geology and ground-water resources of Edwards County, Texas: U. S. Geol. Survey manuscript report.*

Zone and bed		Description	Thickness (feet)
D.	15	Limestone, hard, fine- to medium-grained, buff, highly bored ------------------	1.8
	14	Limestone, hard, fine- to medium-grained, gray; large _Caprina_ sp. very abundant, _Toucasia_ sp. abundant at top; several flaggy chert beds, other shell matter abundant ------------------	11.0
	13	Limestone and chert with alternating flaggy beds ------------------	3.1
	12	Limestone, powdery, buff, cherty ------------------	1.8
	11	Limestone, light-gray, irregular to nodular, highly bored with soft and shelly fillings; _Toucasia_ sp. and _Caprina_ sp. abundant, argillaceous ------------------	3.9
	10	Limestone, hard, fine-grained, light-gray, irregular to nodular; _Toucasia_ sp. and _Caprina_ sp. common, bored ------------------	2.4
	9	Limestone, hard, medium-grained, buff; contains small unidentifiable spots that may be Foraminifera. U. S. Coast and Geodetic Survey bench mark M462 about middle of bed ------------------	2.0
	8	Limestone, massive, fine-grained, light-gray, _Toucasia_ sp. abundant, _Caprina_ sp. scattered ------------------	3.6
	7	Limestone, laminated to flaggy, argillaceous, buff to tan ------------------	1.2
	6	Limestone, hard, massive, fine-grained, light-gray, fossiliferous; small _Toucasia_ sp. and shell fragments abundant but poorly exposed; small dark inclusions of limestone abundant--may be borings ------------------	5.1
	5	Limestone, hard, massive, medium-grained, buff, irregular to nodular, leached, vuggy; contains calcite ------------------	4.1
	4	Limestone, hard to friable, buff-gray, nodular to flaggy, argillaceous ------------------	5.3
	3	Limestone, crystalline, buff-gray; _Caprina_ sp. common at top, top boundary slightly undulating ------------------	3.2
	2	Limestone, slightly dolomitic, sugary, buff ------------------	2.3
	1	Limestone, hard, fine-grained to lithographic, massive, gray, geode holes scattered, white shell matter common in upper half ------------------	9.5
		Subtotal	135.2
C.	23	Limestone, hard, gray, iron-stained, nodular, bored; top surface undulating ----	5.3
	22	Limestone, hard, sugary, gray ------------------	3.7
	21	Limestone and dolomite, gray ------------------	3.0
	20	Limestone and dolomite, irregular bedding, highly leached, yellow and highly iron-stained in upper part, cherty ------------------	10.6
	19	Limestone, gray to buff, iron-stained in upper half, markedly flaggy and leached; very high calcite content, many holes, and other signs of leaching --	18.9
	18	Limestone, hard, irregularly massive, gray, leached; soft, yellow, and dolomitic at top ------------------	12.4
	17	Limestone, hard, fine-grained, dark-gray, irregularly bedded to massive, highly leached, slightly dolomitic; many holes of irregular size and shape, calcite veins abundant ------------------	13.6
	16	Limestone, dolomitized, soft, yellow, leached, flaggy at top; chert ------------------	13.4
	15	Limestone, dolomitized, leached, coquinal; numerous impressions of small gastropods and pelecypods ------------------	5.2
	14	Limestone, dolomitized ------------------	6.8
	13	Limestone, dolomitized, highly leached, cherty; _Caprina_ sp. and other fossil impressions common; yellow at top ------------------	6.6
	12	Limestone, dolomitized, flaggy in lower part, massive in upper; gastropod impressions common near top ------------------	7.5

Zone and bed	Description	Thickness (feet)
C. 11	Limestone, dolomitized; calcite crystals abundant	3.7
10	Limestone, hard, yellow, cherty	0.9
9	Limestone, dolomitized; large chert nodules at top	8.4
8	Limestone, hard, gray, partly dolomitized; cherty at top	5.3
7	Limestone, hard, gray	2.8
6	Limestone and dolomitized limestone, hard to soft, gray to olive drab, cherty; partly covered	15.9
5	Limestone, hard, gray, cherty	1.1
4	Dolomite, cherty	1.0
3	Limestone, hard, medium-grained, gray, pocked, cherty at top	5.3
2	Limestone, buff to gray, weathered, dolomitic at top	2.9
1	Dolomite and limestone, soft, poorly exposed	4.2
	Subtotal	158.5
B. 23	Limestone, hard, massive, gray, honeycombed; chert nodules common	4.7
22	Limestone, hard, massive, gray, highly bored; large oyster shells common to scattered; rosettes of milky quartz rare	4.1
21	Limestone, hard, gray, coquinal	1.2
20	Limestone, buff, bored, argillaceous	1.0
19	Limestone, gray, flaggy to thin-bedded, siliceous; U. S. Coast and Geodetic Survey bench mark N462 at base	2.5
18	Limestone, cream-colored, coquinal; nodules of gray, hard limestone which may be siliceous; Toucasia sp. common	4.8
17	Limestone, cream-colored, coquinal; small Nerinea sp.	1.2
16	Limestone, hard, matrix semi-lithographic, gray; numerous Caprina sp. and Toucasia sp., contains chert bed	4.0
15	Limestone, matrix lithographic to calcarenitic, cream-colored, pelletal; gastropods and Toucasia sp. scattered	2.3
14	Dolomite, soft, olive drab, leached	3.4
13	Limestone, buff, cherty; thin layer of dark gray siliceous limestone at top	1.2
12	Limestone, matrix fine-grained, cream-colored, coquinal	2.9
11	Chert, gray	0.2
10	Limestone, hard, cream-colored to gray, fine-grained to lithographic, mottled with siliceous spots; chert nodules abundant	9.5
9	Limestone, dolomitic, sugary texture, buff; small tubes in lower half, highly bored in upper half	2.6
8	Dolomite, soft, olive-drab, sugary texture; slightly calcareous, highly leached, nodular, bored	4.7
7	Limestone, hard, gray, massive, lithographic, bored; tubes filled with marl; two flaggy beds may be siliceous	11.6
6	Marl, yellow	0.4
5	Limestone, hard, gray, massive, lithographic; calcite specks, bored, tubes filled with yellow marl; small scattered clam molds, shell fragments common in lower part, irregular layer of brown satin-spar calcite in bedding plane	15.4

Zone and bed	Description	Thickness (feet)
B. 4	Limestone, hard, cream-colored, calcarenitic	1.6
3	Limestone, hard, massive, gray, lithographic, calcite specks, bored; tubes filled with dark marl	3.4
2	Limestone, hard, cream-colored, medium-grained; composed of small pieces of shell matter	1.6
1	Limestone, hard, gray, lithographic	1.2
	Subtotal	85.5
A. 2	Limestone, buff, harder and less argillaceous than below, fine-grained to lithographic, highly bored, nodular; bedding planes nearly indistinct, clam molds and shell fragments scattered, upper 10 feet somewhat leached	22.2
1	Limestone, hard, buff to gray, fine-grained to semi-lithographic, highly bored, very nodular; bedding planes partly obscured by borings, borings filled with buff marl; more argillaceous and pelletal in upper part; Exogyra texana scattered to common in lower part, few in upper part; pelecypod shells and molds, gastropod molds scattered to rare	36.9
	Subtotal	59.1
	TOTAL	438.3

Grayson shale.- The Grayson shale, formerly known as the Del Rio clay, consists of 10 to 20 feet of buff-brown clay or marl and thin lenses of limestone. It crops out only on the higher divides of the Edwards Plateau in the northern part of Real County (pl. 1). Inasmuch as the Grayson and overlying Buda limestone are not water bearing and are above the water table in Real County, they have been mapped together. Rolling topography and mesquite vegetation are typical of exposures of the Grayson.

Curry (1934, p. 1700) reported an unconformity at the top of the Georgetown limestone in the western part of the Edwards Plateau. In Real County, however, the Grayson shale appears to lie conformably on the Georgetown.

Exogyra arietina (Roemer), a small oyster having a shell shaped like a ram's horn, is a characteristic fossil in the Grayson shale. In Real County, however, it is common only in the northeastern part. Outcrops of the Grayson in the northwestern part of the county contain few speciments of Exogyra arietina but are characterized by echinoids.

The Grayson shale is relatively impermeable and does not yield water to wells in Real County. Many surface reservoirs for stock use are constructed in the outcrop area of the Grayson.

Buda limestone.- The Buda limestone in Real County is a fine-grained, dense, hard but brittle light-gray limestone. It has a porcelaneous texture, is easily broken, and breaks with a conchoidal fracture. Erosion of the underlying soft Grayson shale usually reduces the Buda to a layer of angular boulders which covers hilltops in the northern part of the county (pl. 1). The presence of the limestone generally can be recognized easily by a thick growth of live-oak trees.

The Buda has a maximum thickness of about 10 feet in Real County and is not known to yield water to wells in the county.

QUATERNARY SYSTEM

Pleistocene and Recent series, undifferentiated

Alluvium.- The alluvium in Real County consists of materials ranging in texture from gravel to silt which form terraces in the major stream valleys (pl. 1). These sediments are most extensive in the valleys of the Nueces and Frio Rivers, reaching a maximum thickness of about 40 feet. Practically all crops in Real County are cultivated on the alluvial terraces.

In places, particularly along the Nueces River, the streams lose part of their base flow to the alluvium. In these places wells obtain a moderately large supply of good quality water from the alluvium. Where the alluvium is recharged only by storm runoff, however, the ground-water supply varies seasonally and is not always dependable.

STRUCTURE

The Cretaceous rocks in Real County were deposited on an upland Paleozoic plain of low relief. The attitude of the beds was subsequently modified by movement in the Balcones fault zone (Cartwright, 1932, p. 699). (See also pl. 3). The regional dip of the Edwards and associated limestones in the northern part of Real County is approximately 10 to 12 feet per mile, but in the southern part of the county the dip increases to about 20 feet per mile. The trend of most faults and joints is northeastward, roughly parallel to the Balcones fault zone. The faults are normal and generally are downthrown to the southeast, but a few are downthrown to the northwest.

Slight domes, anticlines, and synclines were reported by Sellards and Baker (1934, p. 86) in Cretaceous beds of the Edwards Plateau. The linear trends of the structures, both folds and faults, may be noted in drainage patterns where streams are controlled locally by them.

Sinkholes are common on the outcrop of the upper part of the Edwards and associated limestones. The sinkholes are rounded depressions in the land surface which denote the presence of underlying collapse caverns. Some sinkholes--those probably plugged by the Grayson shale--were observed to hold rainwater. Others facilitate recharge to the ground-water reservoir.

GROUND WATER

OCCURRENCE AND MOVEMENT

The source of ground water in Real County is precipitation. A part of the water seeps downward through fractures and solution channels in the limestone and through permeable sandy materials in the alluvium. Figure 6 shows schematically the circulation of water in Real County. Seepage continues downward to the surface (the water table) of the ground-water body, or zone of saturation. Seepage detained by relatively impermeable materials at some point above the main ground-water body is called perched water. Well C-16 probably taps a perched zone.

The Edwards and associated limestones are recharged only by precipitation and overland runoff on their outcrop. The Glen Rose limestone and alluvium also are recharged in this manner, but the Glen Rose is further recharged by water from the overlying Edwards and associated limestones.

Water in the saturated zone moves by gravity toward the stream valleys, where it is discharged through springs, by effluent seepage not concentrated enough to form springs, and by evapotranspiration. Most of the important springs and other areas of discharge are shown on plate 1 and figure 6. Discharge from the ground-water body by evapotranspiration is confined to the stream valleys because elsewhere the water table is many feet below the land surface. The quantity of water discharged by wells is small compared to the natural discharge.

Texas Board of Water Engineers in cooperation with the U.S. Geological Survey and the city of San Antonio.

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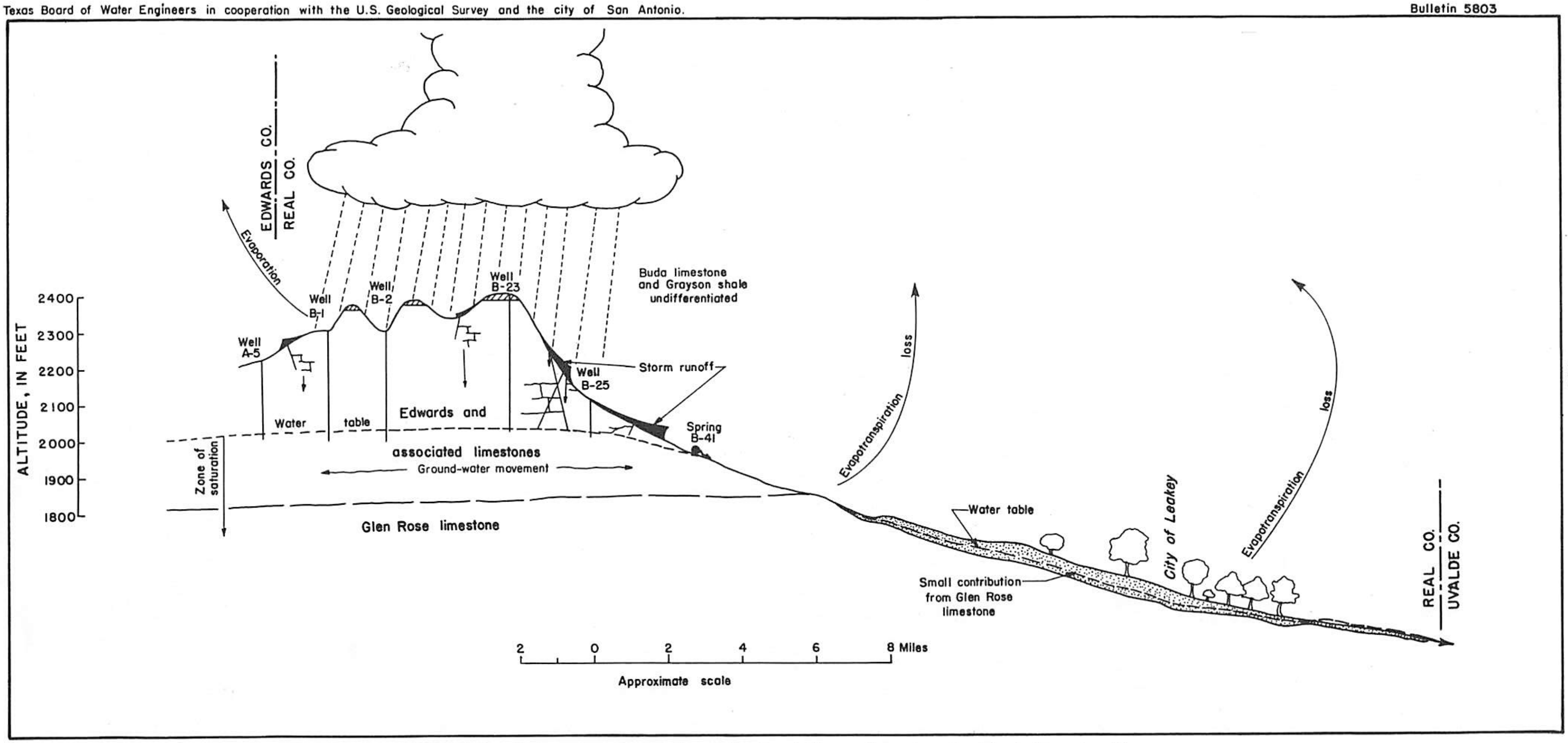

FIGURE 6.– Schematic illustration of circulation of water in Real County, Tex.

Ground water moving toward an area of discharge may pass between beds of impermeable material and thus become confined under artesian pressure. It will then rise above the bottom of the overlying confining layer in a well tapping the aquifer. Drillers report that in the Edwards and associated limestones water rises in many wells above the point where it is encountered by the drill bit, indicating local artesian conditions. It is believed, however, that water in this aquifer generally is unconfined. The water in all wells in the Glen Rose limestone is under artesian pressure. Water in the alluvium generally is unconfined (under water-table conditions).

Interchange of water probably occurs where the alluvium is in contact with permeable beds of the Glen Rose limestone, the movement generally being from the limestone to the alluvium. The low sulfate content of the ground water (table 6) from the alluvium as compared with that of the Glen Rose, however, suggests that the rate of discharge of water from the Glen Rose into the alluvium is low.

The configuration of the water table in the Edwards and associated limestones is shown on figure 7. Although the water-level measurements used for control were collected over a 1-year period (fall of 1954 to fall of 1955), the water-level changes shown in table 3 are small, suggesting that the contours are essentially correct. The map is useful in estimating the altitude at which water would stand in new wells. The depth to water level may be estimated if the surface altitude is known.

The general direction of movement of ground water in Real County is perpendicular to the contour lines shown on figure 7. The lack of adequate control and variations in geologic conditions prevent detailed analysis of the movement of water. The contours suggest the presence of a ground-water divide that approximates the topographic divide. The ground water north of the divide flows northward into the lower Colorado River basin, and the rest of the ground water in the county flows into the Nueces River basin.

A comparison of the altitudes of the base of the Edwards and associated limestones and the water-level contours (fig. 7) suggests that the saturated zone is at least 200 feet thick in places and that the average for the northern half of the county may exceed 150 feet. The volume of water in the saturated zone is unknown because no data on specific yield or porosity are available.

The depth to water generally is greater in wells tapping the Edwards and associated limestones than in wells tapping the Glen Rose limestone and the alluvium. In most of the wells tapping the Edwards and associated limestones the depth to water exceeds 200 feet, and in most of the wells tapping the Glen Rose and alluvium the depth to water is less than 100 feet.

RELATION BETWEEN GROUND WATER AND STREAMFLOW

The base flow of the streams in Real County is sustained by ground-water discharge and consequently is dependent on ground-water recharge; changes in base flow are related to changes in ground-water storage. The base flow during the winter probably closely represents the average rate of ground-water discharge because evapotranspiration is small and withdrawals from the streams are negligible. The average winter base flow for several years should approximate the average rate of recharge to the basin because the effect of any change in storage would be comparatively small. Accordingly, the average base flow for the period November through March was estimated for the Frio River at Concan in Uvalde County from 32 years of streamflow record. Figure 8 shows that the base flow during the period of record averaged about 60 cfs, or about 43,000 acre-feet per year. The drainage area above the gaging station is 405 square miles, or about 260,000 acres; hence, the indicated average annual recharge to the drainage basin is about 2 inches. This is probably a minimum figure because precipitation is less during the winter than during the summer (fig. 9), and discharge by evapotranspiration during the winter has not been considered even though small losses from evapotranspiration do occur then. However, the higher evapotranspiration rate during the warmer months may result in decreased recharge then despite the greater precipitation. Additional records of ground-water levels and more extensive meteorological data are needed to refine the estimate of recharge.

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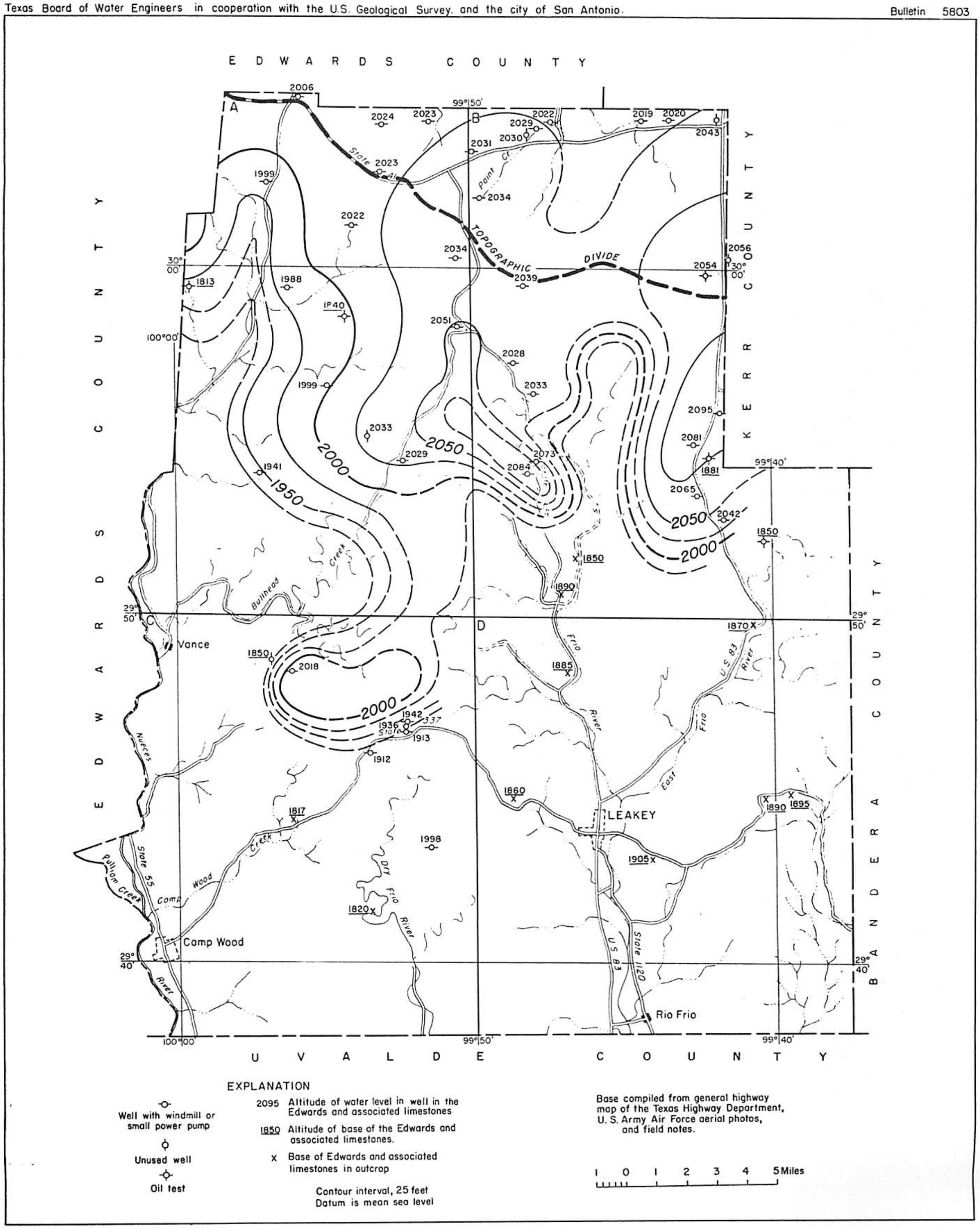
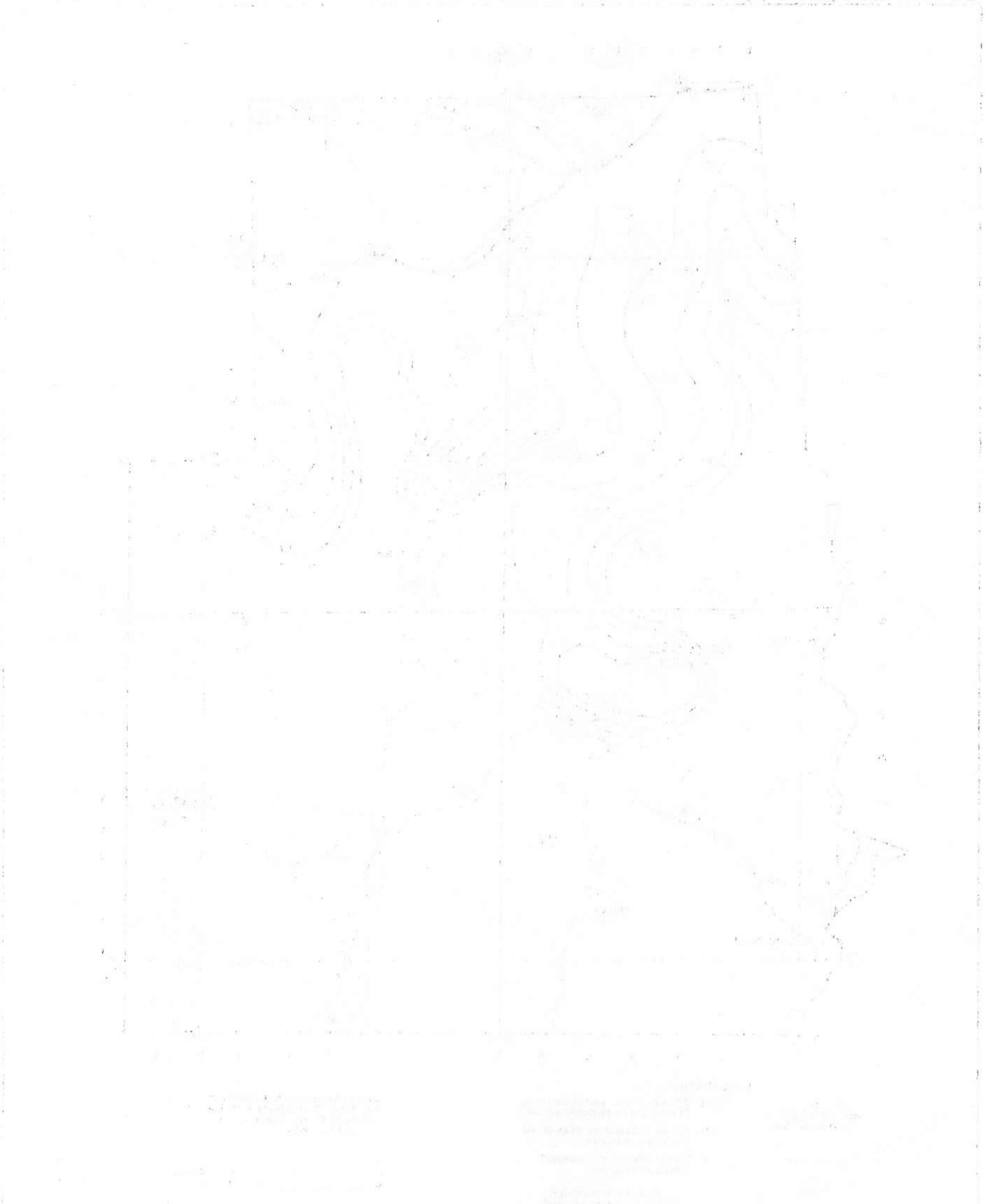


FIGURE 7.– Approximate altitude of water levels in wells in the Edwards and associated limestones, Real County, Tex. All measurements made during the period March–August 1955 except for wells A-17 and A-2 which were measured in October and November.



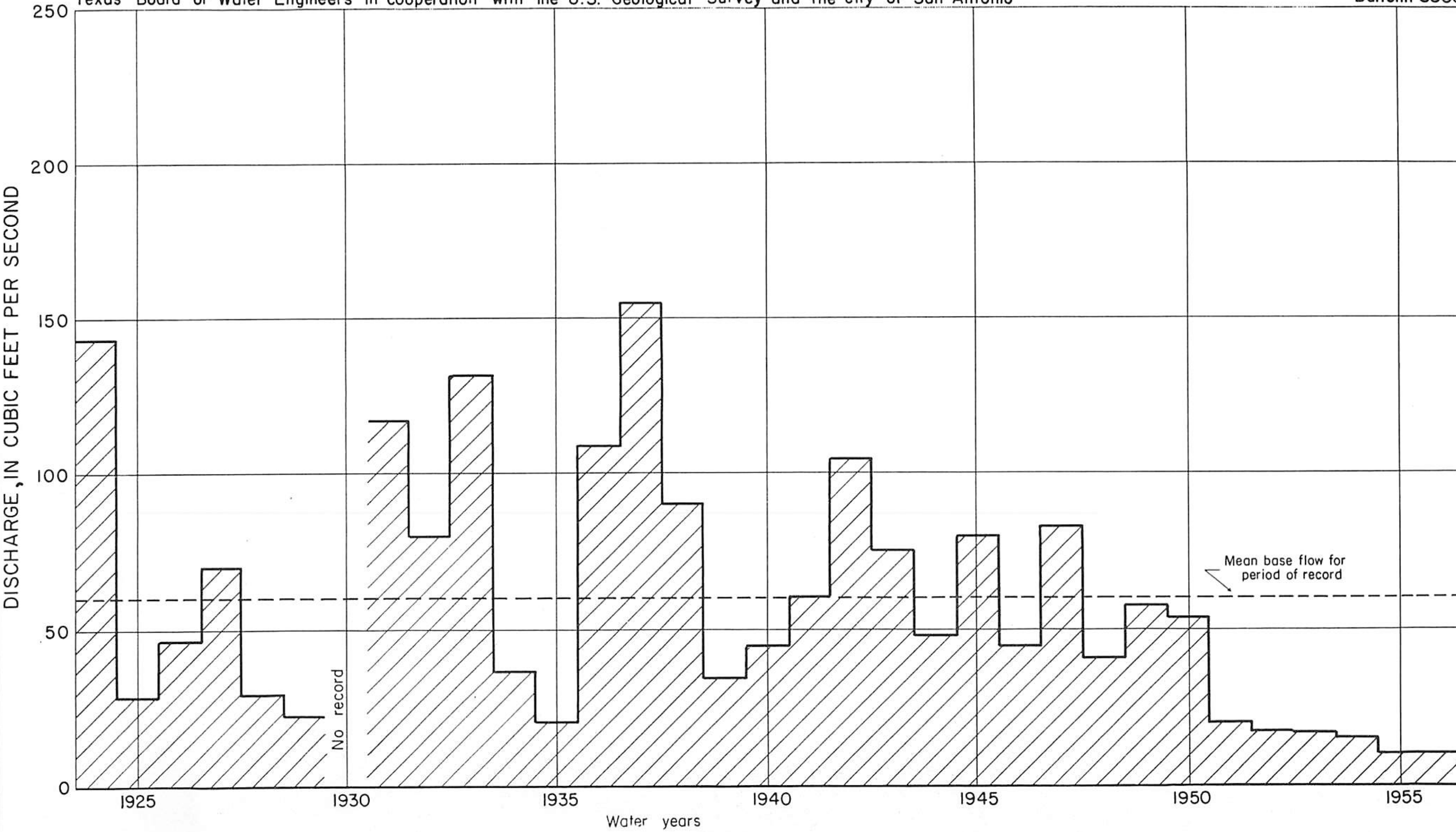


FIGURE 8.—Mean annual base flow of Frio River at Concan, Uvalde County, Tex., November—March.

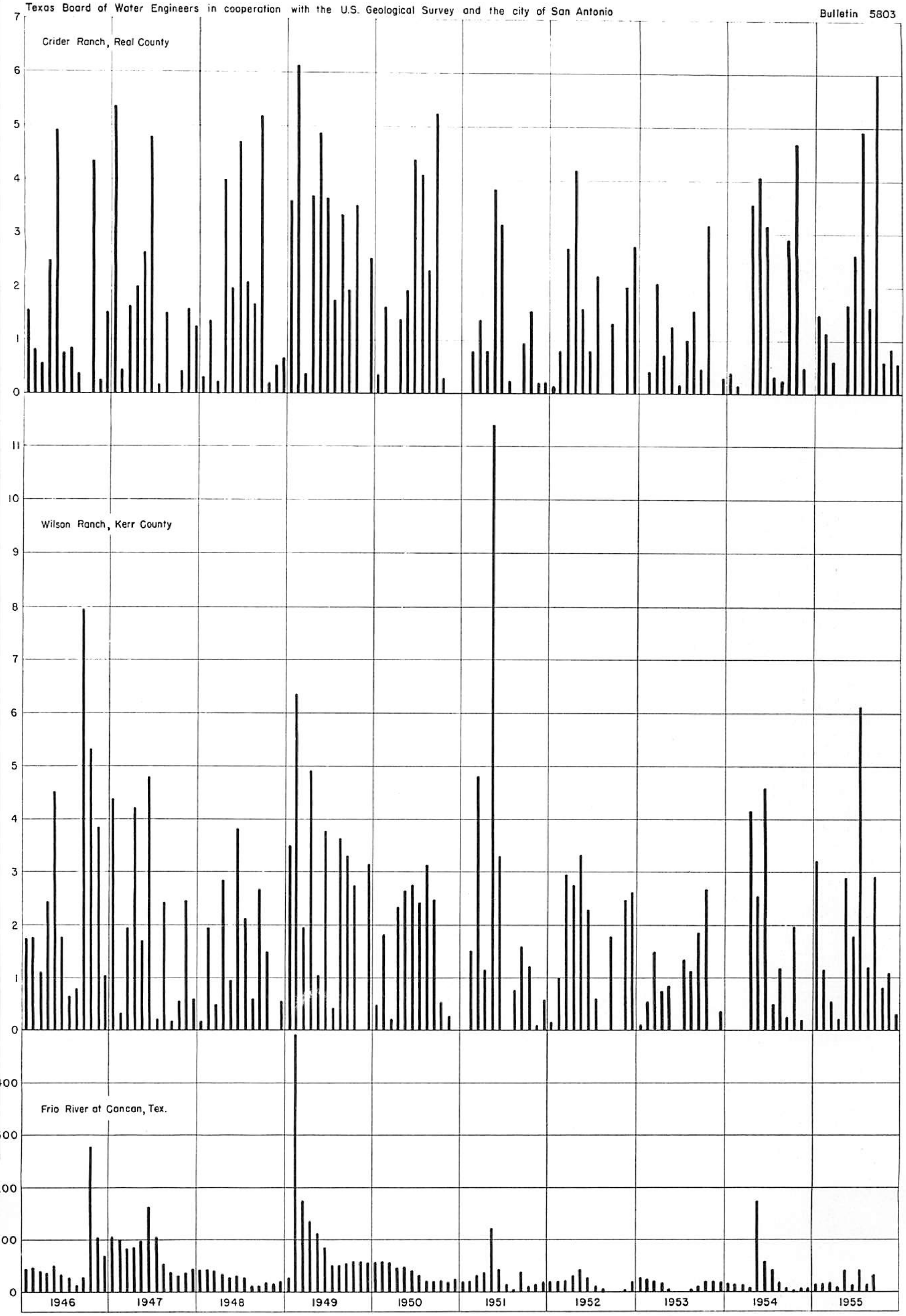


FIGURE 9.– Mean monthly precipitation at Crider and Wilson Ranch weather stations and mean monthly discharge of the Frio River at Concan, Tex.

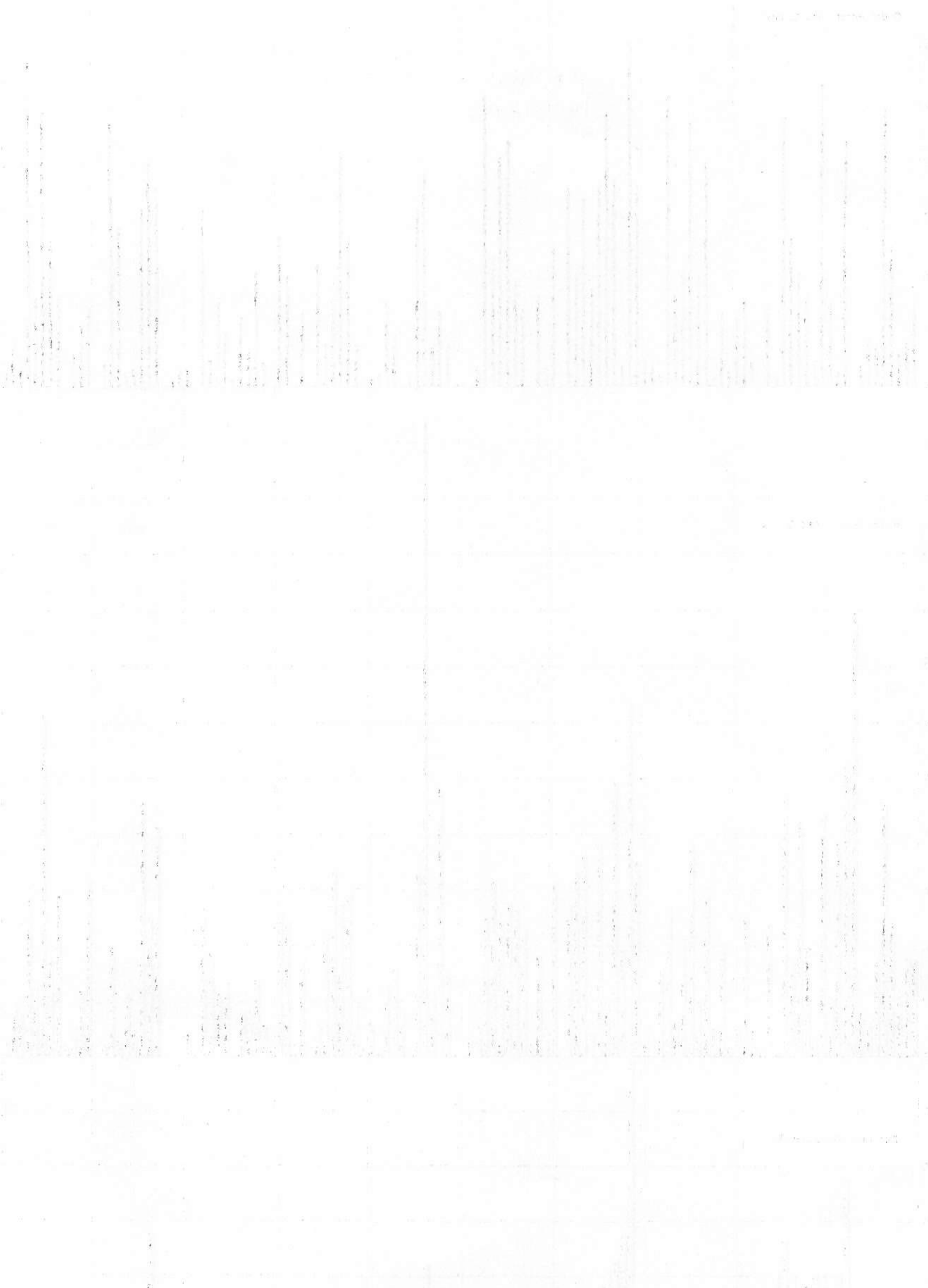


Table 3.- Water levels in wells in Real County, Tex., 1953-56

Well	Water-bearing formation	Date of measurement	Water level, in feet, below land-surface datum
A- 3	Edwards and associated limestones	Dec. 18, 1954	358.7
		June 22 1955	359.1
A-14	do	Oct. 11, 1954	243.0
		Apr. 27, 1955	245.1
B- 3	do	June 24, 1955	192.6 (pumping level)
		Sept. 15, 1955	192.0
B- 4	do	Feb. 11, 1953	175.2
		Mar. 23, 1955	176.4
B- 5	do	Feb. 12, 1953	169.5
		Mar. 23, 1955	170.3
B- 8	do	Feb. 11, 1953	180.2
		June 27 1955	180.0
B-10	do	Feb. 11, 1953	209.8
		June 27, 1955	210.1
B-15	do	Feb. 18, 1955	288.4
		June 24, 1955	288.4
B-25	do	June 22, 1955	100.3
		Jan. 13, 1956	100.3
		Mar. 16, 1956	100.4
		May 11, 1956	100.2
		July 12, 1956	100.3
		Sept. 7, 1956	100.6
		Nov. 15, 1956	100.4
B-38	do	Feb. 4, 1953	311.2
		June 24, 1955	311.9
B-39	do	Feb. 4, 1953	305.8
		June 24, 1955	305.9
B-43	do	Feb. 12, 1953	35.5
		June 23, 1955	35.6
		Jan. 13, 1956	35.7
		Mar. 16, 1956	35.5
		May 11, 1956	36.8
		July 12, 1956	37.2
		Sept. 7, 1956	36.8
		Nov. 15, 1956	36.2
B-44	do	Feb. 25, 1953	90.3
		June 23, 1955	68.8
B-52	do	Feb. 4, 1953	264.0
		June 25, 1955	266.1
B-53	do	Feb. 4, 1953	273.6
		Aug. 6, 1955	274.5
C-10	do	Aug. 2, 1955	378.2
		Jan. 13, 1956	382.2
		Mar. 16, 1956	384.0
		May 10, 1956	378.6
		July 12, 1956	379.2
		Sept. 6, 1956	378.3
D-52	Glen Rose limestone	July 26, 1955	23.2
		Jan. 16, 1956	25.1
		Mar. 16, 1956	48.5
		May 11, 1956	25.4
		Sept. 7, 1956	48.5
		Nov. 15, 1956	59.6

DEVELOPMENT

PRESENT DEVELOPMENT

The average use of water from wells in Real County is estimated to be about 500,000 gallons per day (gpd). The principal uses are for domestic and stock supplies. Municipal withdrawals are small and industrial withdrawals negligible by comparison. Wells D-27 and D-28, which draw water from the alluvium at Leakey, are the only municipal wells in the county. The average daily use at Leakey during 1955 was 80,000 gpd, which was supplied by well D-28 except during the summer and during emergencies when the supply was supplemented by well D-27. The principal use of water for industry is to supply oil drilling rigs and for highway construction.

Except for municipal withdrawals at Leakey, pumpage is rather evenly distributed throughout the county. Stock wells are generally spaced within 2 miles of each other, and rural domestic wells are rather widely spaced.

Most of the domestic and stock wells are equipped with windmills, although there is a trend toward supplementing or replacing the windmills with electric or gasoline motors. Electric power is used to pump and distribute Leakey's municipal supply.

Withdrawal rates from individual wells range from less than 1 gallon per minute (gpm) at well C-11 to about 150 gpm at well D-28. Most of the wells, however, are equipped with pumps capable of delivering 10 gpm or less. Well B-3 was pumped at the rate of 130 gpm continuously for highway construction during the summer of 1955; it had the largest reported yield of any well in the Edwards and associated limestones. Most wells are designed to produce small quantities of water; consequently, they are drilled deep enough only to obtain the desired yield. Larger yields could probably be obtained from deeper wells.

Specific capacities were calculated for 22 wells, of which 20 were in the Edwards and associated limestones and 2 were in the Glen Rose limestone. The specific capacity is a measure of a well's ability to yield water. It is calculated by dividing the pumping rate, in gallons per minute, by the drawdown, in feet. The specific capacities of 20 wells in the Edwards and associated limestones ranged from about 0.1 to about 20 gpm per foot. Only 7 of the 20 specific capacities were 5 gpm per foot or more and 10 were 1 gpm per foot or less. The two wells in the Glen Rose limestone had specific capacities of 0.25 and 1 gpm per foot while pumping 2 gpm and 10 gpm. Two of the wells tested, A-14 and B-26, were pumped at rates of 10 gpm and 20 gpm, and their specific capacities were 0.75 and 0.5 gpm per foot. The rest of the wells tested were pumped at less than 5 gpm. The tests are not representative of wells that penetrate to the base of the water-bearing formation and may not be representative of wells pumping larger quantities of water. The tests indicate, however, that many of the wells are not capable of large yields.

Many springs in Real County are used for domestic and stock supply, and the municipal supply for Camp Wood is taken from a spring (C-23). Although the average daily consumption at Camp Wood was not determined, it is probably about the same as that of Leakey. The total use of water from springs in the county is small in comparison with the total available springflow.

POTENTIAL DEVELOPMENT

The quantity of ground water available to wells and springs in Real County may average more than 100 times the quantity presently used. Assuming that the average annual recharge to Real County as a whole is the same as that estimated for the Frio River watershed above Concan (2 inches), about 70,000 acre-feet of water per year (60 mgd) is available for perennial development. The quantity of water available during any particular year may vary considerably from the average, however, depending upon changes in recharge rates and the amount of ground water in storage. The range is unpredictable because the quantity of ground water in storage is unknown.

The base flow of the streams is sustained by the natural ground-water discharge, which is reduced by the amount of withdrawals from wells. Thus, additional development from wells would result in reduced streamflow.

QUALITY OF WATER

The results of chemical analyses of water samples from 38 wells and springs in Real County are given in table 6, and representative analyses from the 3 principal aquifers are shown graphically in figure 10. A bar over the well or spring number on plate 1 indicates that an analysis is included in table 6. Most of the water samples were collected in 1955-56 and were analyzed in the laboratory of the U. S. Geological Survey at Austin, Tex.

State and municipal authorities have widely adopted the standards set by the U. S. Public Health Service (1946) for drinking water used on common carriers in interstate commerce. The maximum concentration of the more important dissolved minerals is listed below:

Iron (Fe) and manganese (Mn) together should not exceed 0.3 part per million.

Magnesium (Mg) should not exceed 125 parts per million.

Sulfate (SO_4) should not exceed 250 parts per million.

Chloride (Cl) should not exceed 250 parts per million.

Fluoride (F) must not exceed 1.5 parts per million.

Dissolved solids should not exceed 500 parts per million for a water of good chemical quality. However, if such water is not available, a dissolved-solids content of 1,000 parts per million may be permitted.

The hardness of water depends on the amount of calcium and magnesium in solution. Water having a hardness of 120 to 200 parts per million is classified as hard; water having a hardness of more than 200 ppm is classified as very hard.

The nitrate content in waters from limestones normally ranges considerably because surface water may move directly through open fractures and solution channels without being filtered. Organic material is considered to be one of the major sources of nitrate in water. Lohr and Love (1952, p. 10) state that "more than several parts per million of nitrate may indicate previous contamination by sewage or other organic matter." Nitrate is, however, one of the last products of organic decomposition. Hence the presence of more than usual amounts of nitrate is not, of itself, an indication that a water is bacterially unsafe.

The Glen Rose limestone in Real County yields water that has a considerable range in chemical quality (table 6). Analyses of 8 samples from wells in the Glen Rose show a range in dissolved solids from 340 to 3,550 ppm. The more highly mineralized waters have a high sulfate content, which probably results from the solution of gypsum in the Glen Rose. The sulfate content in the 8 samples ranged from 18 to 2,460 ppm. The water from wells in the Glen Rose is very hard, ranging from 307 to 2,680 ppm as shown by the analyses in table 6. The analysis of water from a spring (D-4) in the Glen Rose showed a much lower content of dissolved minerals than water from the wells. As previously suggested (p. 13), the water issuing from this spring may actually be coming from the overlying Edwards and associated limestones.

The Edwards and associated limestones yield water of rather uniform quality which, except for hardness, is suitable for domestic and stock use. Analyses of 24 samples show a range in dissolved solids from 186 to 269 ppm and a range in hardness from 154 to 246 ppm. The sulfate content was less than 10 ppm in all the samples from the Edwards.

The quality of the water from the alluvium is similar to that of the water from the Edwards and associated limestones. The sulfate content of the water from 3 of the 4 wells sampled exceeded 10 ppm, however, thus suggesting that part of the recharge to the alluvium may be from springs in the Glen Rose limestone.

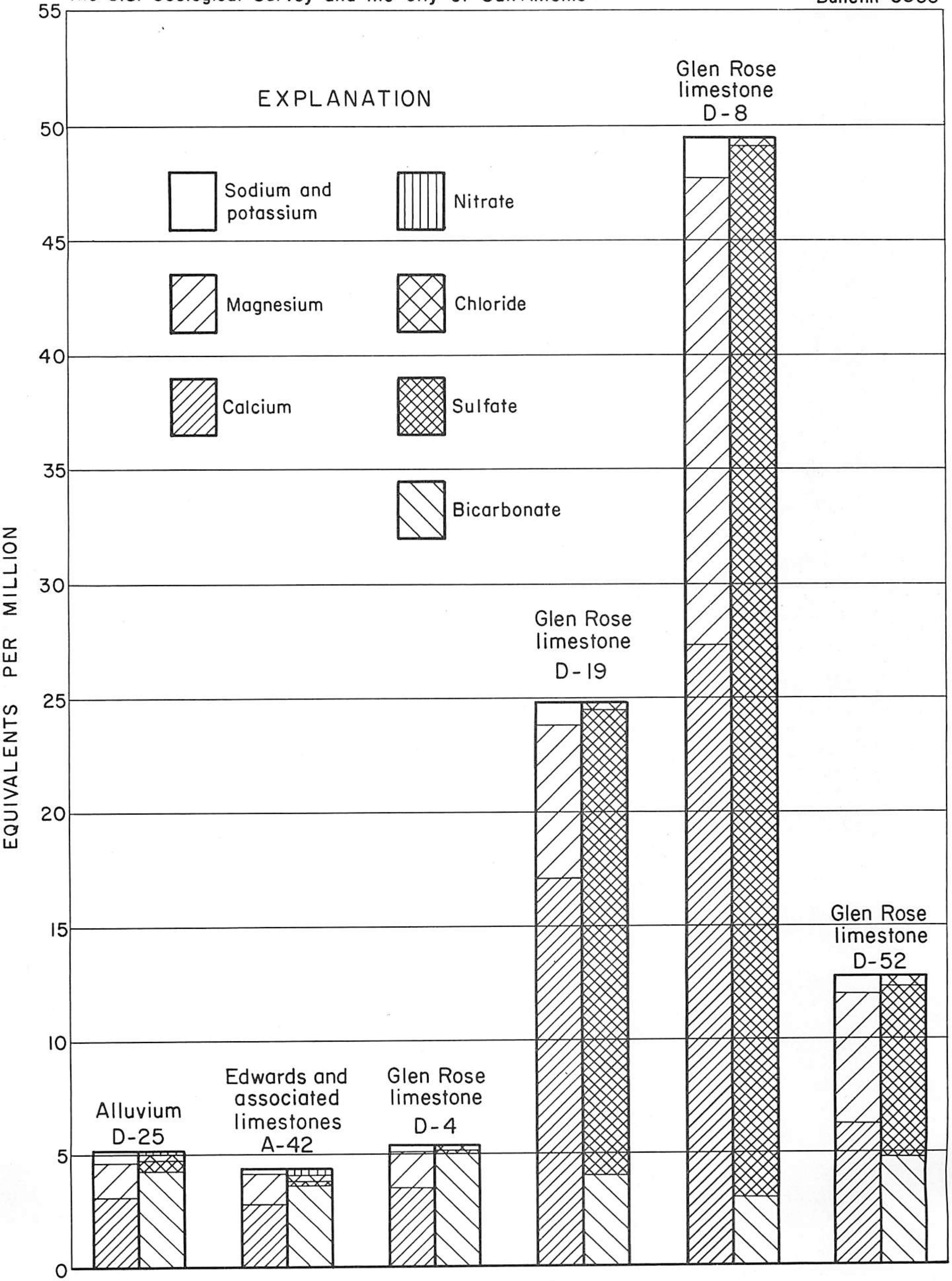


FIGURE 10.—Graphical representation of chemical analyses of ground water in Real County, Tex.

SUMMARY

The principal ground-water reservoirs in Real County are the Edwards and associated limestones and the Glen Rose limestone, both of Cretaceous age, and alluvium of Quaternary age. Little is known of the water-bearing properties of the older Cretaceous rocks, but they consist in part of sand which may be a potential source of ground water. The base of the Cretaceous is considered to be the base of the fresh water in Real County.

The source of ground water in Real County is precipitation. The water-bearing formations are recharged by precipitation and overland runoff. The Glen Rose limestone is recharged also by water from the overlying Edwards and associated limestones.

The altitude of the surface of the saturated zone in the Edwards and associated limestones indicates that the main ground-water divide approximately underlies the topographic divide. North of the divide ground water flows northward into the lower Colorado River basin; south of the divide it flows southward into the Nueces River basin. Ground water moves through solution channels and fractures, and along bedding planes in the limestones and through permeable sandy materials in the alluvium. Water in the saturated zone moves toward the stream valleys, where it is discharged through springs and by effluent seepage, and by evapotranspiration. The quantity of water discharged by wells is small compared to the natural discharge.

Water in the Edwards and associated limestones is under artesian pressure only locally, whereas water in the Glen Rose limestone generally is under artesian pressure. Water-table conditions prevail in the alluvium.

The base flow of the streams is sustained by ground-water discharge and consequently is dependent on ground-water recharge. The average annual recharge to the Frio River basin above Concan in Uvalde County is estimated to be about 2 inches.

The yields of wells in the Edwards and associated limestones range from less than 1 gpm to 130 gpm; however, the yield of some wells probably could be increased by extending their depths through the entire thickness of the Edwards and associated limestones. Several beds in the Glen Rose limestone carry small supplies of water; yields of individual wells generally are not more than 10 gpm. The yields of wells in the alluvium generally are adequate for domestic and stock uses.

The quantity of ground water available for perennial development from wells and springs in Real County is estimated to be about 70,000 acre-feet per year (60 mgd); this is more than 100 times the present use. Any additional development from wells, however, would result in reduced streamflow.

Water from the Edwards and associated limestones and from the alluvium is suitable for most uses although it is hard to very hard. The chemical character as well as the dissolved-solids content of the water from wells in the Glen Rose limestone differs considerably from well to well. The more highly mineralized water has a high sulfate content which probably results from the solution of gypsum in the Glen Rose.

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Table 4.- Records of wells and springs in Real County, Tex.

All wells are drilled unless otherwise noted in Remarks.

Water level : Reported water levels given in feet; measured water levels given in feet and tenths.

Method of lift and type of power : C, cylinder; E, electric; G, gasoline; H, hand; J, jet; N, none; T, turbine; W, windmill. Number indicates horsepower.

Use of water : D, domestic; Ind, industrial; Irr, irrigation; N, none; P, public supply; S, stock.

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
A-1	Florence Marshall	--	1933?	364	--	Edwards and associated limestones	2,353	348.8	Feb. 12, 1953	C,W	S	
A-2	do	-- Edmunds	1954	400	6	do	2,347	340.9	Nov. 10, 1954	T,E	D	Cased to 2 ft. Radioactivity log in files of Texas Board of Water Engineers.
*A-3	Myrtle A. Brown	--	Old	400	--	do	2,382	358.7 359.1	Dec. 18, 1954 June 22, 1955	C,W	D,S	Cylinders set at 370± ft. Reported yield 5 gpm. Drawdown 0.5 ft. after ¼ hour pumping 2 to 3 gpm on Dec. 18, 1954. Temp. 73°F.
A-4	Mrs. A. G. Morriss	--	1940	300	--	do	2,297	272.8	Mar. 22, 1955	C,W	S	Reported yield 5 gpm.
A-5	do	--	1948	225	--	do	2,222	198.2	do	C,W	S	Do.
A-6	W. S. Orr	-- Edmondson	1954	360	--	do	--	263.8	June 24, 1955	C,W	S	
A-7	do	-- Page	1940?	363	--	do	--	330.3	June 30, 1955	C,W	D	
A-8	do	A. Smith	1943	350	--	do	2,346	311.2	do	C,W	S	
A-9	-- Morgan	--	1930	--	--	do	2,338	286.7	do	C,W	D,S	
A-10	Farnsworth & Chambers	W. S. Seward	1954	250	--	do	--	215	Feb. 1954	C,W	S	Reported yield 4 gpm. 1/
A-11	do	do	1954	330	--	do	--	300	Jan. 1954	C,W	S	Reported yield 15 gpm. 1/
A-12	Oppenheimer & Dietert	Sun Oil Co.	1937	5,956	16, 5	--	2,370	--	--	--	--	Oil test. Cased to 743 ft. 1/
A-13	Farmsworth & Chambers	--	Old	94	--	Edwards and associated limestones	--	83.2	Apr. 27, 1955	N	N	
*A-14	do	--	1950	302	--	do	--	243.0 245.1	Oct. 11, 1954 Apr. 27, 1955	T,E	D	Pump set at 274 ft. Reported yield 20 gpm. Drawdown 29 to 30 ft. after pumping 1-hour at 20 gpm, on Apr. 27,1955. Pumping level 273 to 274 ft. Temp. 72°F.
A-15	do	--	1951	--	--	do	2,178	156.4	Apr. 27, 1955	C,W	S	
A-16	do	--	1954	--	--	do	--	317.6	do	C,W	S	Temp. 71°F.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level		Method of lift	Use of water	Remarks
								Below land-surface datum (ft.)	Date of measurement			
*A-17	O. Q. Marshall	L. A. Placker	1930	240	--	Edwards and associated limestones	2,192	192.7	Oct. 29, 1954	C,W	S	Temp. 69°F.
A-18	J. A. Clark	--	1930	125	--	do	--	46.7	do	C,W	D,S	Reported yield 2 gpm. Cylinder set at 90 ft.
A-19	H. Peterson	L. A. Placker	1950	311	--	do	2,277	288.8	Aug. 17, 1955	C,W	S	Drawdown 3 ft after pumping ¼-hour at 1 gpm on Aug. 17, 1955. Temp. 71°F.
A-20	do	--	--	Spring	--	do	--	+	do	Flows	S	Estimated flow, 100 gpm.
A-21	do	--	--	Spring	--	do	--	+	do	Flows	S	Estimated flow, 10 gpm.
A-22	do	--	--	Spring	--	do	--	+	do	Flows	S	Do.
A-23	do	L. A. Placker	1947	350	6	do	--	298.6	do	C,W	S	Drawdown 1.1 ft. after pumping ¼-hour at 2 to 3 gpm. Temp. 72°F.
A-24	H. & C. Peterson	Woodward & Co.	1951	6,015	11	--	2,237	--	--	--	--	Oil test. Cased to 450 ft. Electric log in files of Texas Board of Water Engineers.
A-25	do	A. B. Williams	1952	1,105	--	--	2,150	--	--	--	--	Oil test. 1/
A-26	Hal Peterson	L. A. Placker	1950	52	6	Edwards and associated limestones	--	44.9	Aug. 17, 1955	C,W	S	Temp. 71°F.
A-27	do	do	Old	400±	--	Edwards(?) and associated limestones	--	195.9	Aug. 16, 1955	C,W	S	Temp. 75°F.
A-28	Will Morriss	--	--	Spring	--	Edwards and associated limestones	--	+	Aug. 17, 1955	Flows	S	Estimated flow 600 to 800 gpm. Temp. 70°F.
A-29	T. J. Jacoby	--	1949	160	--	do	2,092	92.8	June 30, 1955	C,W	S	Reported yield 2 to 3 gpm.
A-30	Raymond Dietert	--	1951	300	--	do	--	262.0	do	C,W	S	Drawdown 0.4 ft. after pumping ½-hour at 2 gpm on June 30, 1955. Temp. 71°F.
A-31	do	--	Old	123	--	do	--	71.1	do	C,W	S	Drawdown 1.5 ft. after pumping ½-hour at ½ gpm on June 30, 1955. Temp. 75°F.
A-32	do	--	1933	275	--	do	2,364	226.6	June 23, 1955	C,W	D,S	
*A-33	Mrs. Jess Fryer	--	Old	400	--	do	--	--	--	C,W	D,S	Temp. 70°F.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
A-34	E. E. Bushong	Austin Smith	1951	300	--	Edwards and associated limestones	--	255.5	Aug. 8, 1955	C,W	S	
A-35	Longenbaugh & Sons	--	--	Spring	--	do	--	+	Mar. 16, 1956	Flows	S	Estimated flow 15 gpm.
A-36	Mrs. Jess Fryer	--	--	320	--	do	2,328	299.4	June 23, 1955	C,W	S	
A-37	T. J. Jacoby	--	1953	328	--	do	2,339	306.1	June 30, 1955	N	N	Abandoned. Insufficient supply.
A-38	Earl Jacoby	--	1929	477	--	do	--	400	June 1955	C,W	D,S	
A-39	D. H. Bierschwale	--	1940	200	6	do	1,973	31.9	July 26, 1955	C,W	S	Pump set at 180 ft. Reported yield 5 gpm.
A-40	Ed McCarson	--	Old	110	--	do	--	101.1	June 30, 1955	N	N	Abandoned. Insufficient supply.
A-41	H. F. Jacoby	--	1947	175	--	do	--	138.8	July 22, 1955	C,W,G	D,S	Reported yield 5 gpm.
A-42	do	--	Old	180	--	do	--	136.4	do	C,W	D,S	Reported yield 15 gpm. Temp. 70°F.
A-43	J. H. Massingill	--	1952	170	6	do	--	38.8	do	C,W	S	Cased to 3 ft.
A-44	Massingill & McCarson	--	--	Spring	--	do	--	+	do	Flows	S	Reported flow 40 to 50 gpm.
A-45	J. E. Robbins	--	1948	83	--	do	--	53.4	July 21, 1955	C,H	N	
A-46	A. M. Callison	--	Old	112	--	Glen Rose limestone	--	58.8	do	C,W,G	D,S	
A-47	M. R. O'Bryant	--	1928	31	--	Alluvium	--	23.9	do	C,W	D	
A-48	-- Bell	--	--	Spring	--	Edwards and associated limestones	--	+	July 22, 1955	Flows	S	Estimated flow 100 to 200 gpm.
A-49	Robert Sone	--	--	Spring	--	do	--	+	July 20, 1955	Flows	D,Irr	Estimated flow 50 gpm.
A-50	J. H. Massingill	--	1951	100	6	do	--	10.8	July 22, 1955	C,W	S	Reported yield 1 to 2 gpm.
A-51	J. M. Vander Stucken	--	--	Spring	--	do	--	+	July 25, 1955	Flows	D,Irr	Estimated flow 500 gpm. Temp. 70°F.
A-52	H. W. Lewis	--	Old	494	6	do	--	376.2	July 27, 1955	N	N	
B-1	W. S. Orr	--	1928	320	--	do	2,304	272.7	June 24, 1955	C,W	D,S	Estimated yield 5 gpm.
B-2	Roy Leinweber	--	Old	300?	--	do	2,303	269.0	June 30, 1955	C,W,G	D,S	Reported yield 10 gpm.
B-3	Rankin Linn	--	1955	218	6	do	2,222	192.6 192.0	June 24, 1955 Sept.15, 1955	N	N	Water-level measurement on June 24, 1955 made while pumping 130 gpm to supply water for highway construction. Abandoned prior to September 1955.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
B-4	Rankin Linn	--	1925	190	6	Edwards and associated limestones	2,206	175.2 176.4	Feb. 11, 1953 Mar. 23, 1955	C,W,E	D,S	Cased to 30 ft. Reported yield 10 gpm.
*B-5	J. B. Snodgrass	L. A. Placker	1933	175	--	do	2,192	169.5 170.2	Feb. 12, 1953 Mar. 23, 1955	C,W	D,S	Reported yield 10 gpm. Temp. 70°F.
B-6	Ross Snodgrass	--	--	192	--	do	--	176.5	Aug. 8, 1955	C,W	D,S	
B-7	Walter J. Merritt	--	--	--	8	do	--	--	--	C,W	D,S	
B-8	Byron Crider	--	1946	205	--	do	2,199	180.2 180.0	Feb. 11, 1953 June 27, 1955	C,G	S	
B-9	do	--	1880?	217	--	do	--	--	--	C,W	S	
*B-10	Mrs. -- Garuen	--	--	--	--	do	2,230	209.8 210.1	Feb. 11, 1953 June 27, 1955	C,W	S	Temp. 72°F.
B-11	do	--	1949	502	--	do	2,352	308.7	June 24, 1955	N	N	Abandoned. Formerly used to supply water for highway construction. Electric log in files of Texas Board of Water Engineers.
B-12	Ara Anderson	-- Barber	Old	191	--	do	--	177.7	Aug. 8, 1955	C,W	D	
B-13	Wm. Auld	--	1939	--	--	do	--	--	--	C,W	S	
B-14	do	--	--	--	--	do	--	--	--	C,W	S	
B-15	Texas Highway Department	--	1945	301	8	do	2,344	288.4 288.4	Feb. 18, 1955 June 24, 1955	N	N	Abandoned. Formerly used to supply water for highway construction. Reported yield 20 gpm.
B-16	O. L. Love	Gant Oil Co.	1938	--	--	do	--	--	--	C,W	S	Formerly used to supply drilling water for oil test.
B-17	do	do	1936	417	--	do	2,336	282.1	June 27, 1955	N	N	Oil test. Electric log in files of Texas Board of Water Engineers.
B-18	do	do	1938	--	--	--	--	--	--	N	N	Oil test.
B-19	Wm. Auld	--	Old	300?	--	Edwards and associated limestones	--	--	--	C,W	S	Estimated yield 2 to 3 gpm.
B-20	J. M. Chittim	L. A. Placker	1938	385	--	do	--	310	June 1955	C,W	S	
B-21	do	Paul Urban	1952	330	--	do	--	295	June 1955	C,W	S	

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
B-22	Carl Secrest	Austin Smith	1951	335	--	Edwards and associated limestones	--	269.5	Aug. 8, 1955	C,W	S	Reported yield 5 to 8 gpm when drilled.
*B-23	T. E. W. Dietert	--	Old	300	--	do	2,401	361.6	June 22, 1955	C,W	D,S	Temp. 70°F.
B-24	do	--	--	--	--	do	--	310.0	Aug. 8, 1955	C,W	S	
*B-25	Ernest Leinweber	--	1943	112	--	do	2,128	100.3 100.3 100.4 100.2 100.4	June 22, 1955 Jan. 3, 1956 Mar. 16, 1956 May 11, 1956 Nov. 15, 1956	C,W	S	Reported yield 5 gpm. Temp. 70°F.
B-26	do	-- Page	Old	280	---	do	---	200.6	June 22, 1955	C,W,G	D,S	Temp. 71°F.
B-27	Prade Ranch	do	1940	--	--	do	2,271	237.3	Aug. 8, 1955	C,W	S	
B-28	do	do	1940	--	--	do	--	277.5	do	C,W	S	
B-29	J. M. Chittim	--	--	Spring	--	do	--	+	Apr. 19, 1956	Flows	S	Estimated flow 25 gpm.
B-30	do	--	--	Spring	--	do	--	+	do	Flows	S	Do.
B-31	do	--	--	Spring	--	do	--	+	do	Flows	S	Estimated flow 600 gpm.
B-32	do	L. A. Placker	--	294	--	do	--	264	June 1955	C,W	S	
B-33	do	do	1948	303	8	do	--	268	July 1954	T,E,5	D	Reported yield 35 gpm.
B-34	do	do	--	288	--	do	--	264	June 1955	C,W,G	D	
B-35	Wm. Auld	-- Edmondson	1950	--	--	do	--	201.9	June 27, 1953	C,W	S	
B-36	O. L. Love	Gant & Evans	1931	4,180	--	--	--	--	--	--	--	Oil test. 1/
B-37	Wm. Auld	--	Old	180	--	Edwards and associated limestones	--	59.9	June 27, 1955	C,W	S	
*B-38	do	-- Boyce	1920	433	--	do	2,407	311.2 311.9	Feb. 4, 1953 June 24, 1955	C,W,E	D	Temp. 70°F.
B-39	Dan Auld	-- Edmondson	1951	371	--	do	2,387	305.8 305.9	Feb. 4, 1953 June 24, 1955	C,W	D,S	
B-40	Prade Ranch	--	--	Spring	--	do	--	+	Apr. 19, 1956	Flows	S	Estimated flow 25 gpm.
*B-41	do	--	--	Spring	--	do	--	+	June 23, 1955	Flows	S	Estimated flow 400 to 600 gpm. Temp. 69°F.
B-42	C. H. Godbold	--	--	Spring	--	do	--	+	do	Flows	S	Estimated flow 25 gpm.
B-43	do	Wee Hunt	1948	45	--	do	2,108	35.5 36.2	Feb. 12, 1953 Nov. 15, 1956	C,W	D,S	
B-44	do	do	1951	120	--	do	2,152	90.3 68.8	Feb. 25, 1953 June 23, 1955	C,W	S	Temp. 68°F.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County, Texas

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
B-45	Longenbaugh & Sons	--	--	Spring	--	Edwards and associated limestones	--	+	Mar. 16, 1956	Flows	D	Estimated flow 5 gpm.
*B-46	T. C. Evans	--	--	Spring	--	do	--	+	do	Flows	D,S	Estimated flow 50 gpm. Temp. 68°F.
B-47	Longenbaugh & Sons	--	--	Spring	--	do	--	+	Mar. 28, 1956	Flows	S	Estimated flow 50 gpm.
B-48	Mrs. -- McNutt	--	--	Spring	--	do	--	+	July 7, 1955	Flows	S	Estimated flow 25 gpm.
B-49	do	--	--	Spring	--	do	--	+	July 13, 1955	Flows	D,S	Estimated flow 50 gpm. Temp. 69°F.
B-50	do	--	--	Spring	--	do	--	+	do	Flows	S	Estimated flow 50 to 100 gpm. Temp. 69°F.
B-51	Dan Auld	-- Edmondson	1951	84	6	do	--	60.2	June 25, 1955	C,W	S	Cased to 84 ft. Casing perforated from 60 to 84 ft. Reported to yield 20 gpm when drilled.
B-52	J. W. Schneeman	--	1948	300	--	do	2,332	264.0 266.1	Feb. 4, 1953 June 25, 1955	C,W	D,S	
*B-53	Dan Auld	-- Edmondson	1942	300	--	do	2,317	273.6 274.5	Feb. 4, 1953 Aug. 6, 1955	C,W	S	Temp. 69°F.
B-54	Mrs. M. S. Perry	--	--	Spring	--	do	--	+	Apr. 3, 1956	Flows	S	
B-55	Claude Haby	--	--	Spring	--	do	--	+	do	Flows	D,S	
B-56	do	Moore Exploration Co.	1951	7,250	14	--	2,042	--	--	N	N	Oil test. Cased to 316 ft. Electric log in files of Texas Board of Water Engineers. 1/
B-57	do	do	--	135	8	Edwards and associated limestones	--	114.5	Apr. 3, 1956	C,W	S	Formerly used to supply water for drilling oil test. Temp. 71°F.
*B-58	do	L. A. Placker	1936	188	6	do	--	--	--	J,E, ¼	D,S	Reported yield 3 gpm. Temp. 71°F.
B-59	M. S. Perry	Hartwell & McGinley	1935	3,120	15, 12	--	--	--	--	N	--	Oil test. Cased to 1,176 ft.
*B-60	Mrs. M. S. Perry	--	--	Spring	--	Edwards and associated limestones	--	+	Apr. 3, 1956	Flows	D	Estimated flow 2,000 gpm. Known as Big Spring. Temp. 70°F.
B-61	A. D. Auld	Eastland Oil Co.	1931	4,010	--	--	2,361	--	--	N	N	Oil test.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
C-1	J. W. Cox	--	1920	36	--	Alluvium	--	26.2	July 21, 1955	C,W	D,S	Dug.
C-2	do	--	Old	35	--	do	--	29.7	July 22, 1955	C,W	D,S	Do.
C-3	Robert Sone	--	Old	27	--	do	--	15.8	July 21, 1955	C,W	D,S	Do.
C-4	Pierce Downer	--	--	114	6	Edwards and associated limestones	1,955	32.2	July 22, 1955	N	N	Originally drilled to about 500 ft., but caved back to 114 ft. Electric log in files of Texas Board of Water Engineers.
C-5	John Tom	Sid Wells	1953	62	--	do	2,063	45.2	do	C,W	D,S	
C-6	Sid Wells	do	Old	--	6	do	--	142.6	Aug. 5, 1955	C,W	S	Water level measured while pumping 1 to 2 gpm. Temp. 75°F.
C-7	do	do	Old	--	--	do	--	--	--	C,W	D,S	
°C-8	H. W. Lewis	--	--	415	6	do	--	374.5	Mar. 27, 1956	C,W	D,S	Cylinder set at 415 ft. Temp. 72°F.
C-9	Lent Wells	Sid Wells	1944	446	--	do	2,304	361.9	Aug. 2, 1955	C,W	D,S	Reported yield 2 to 3 gpm.
C-10	do	do	1954?	500	--	do	2,315	378.2 378.3	Aug. 2, 1955 Sept. 6, 1956	N	N	Abandoned. Insufficient supply. Owner intends to deepen.
C-11	do	do	1955	415	--	do	2,301	388.5	Aug. 2, 1955	C,W	D,S	
°C-12	A. G. Wells	Austin Smith	1948	515	--	do	2,289	436.2	June 23, 1955	C,W	S	Cylinder set at 480 ft. Temp. 70°F.
C-13	H. Ray	--	1948	400?	--	do	2,322	410.0	do	C,W	D,S	Reported yield 5 gpm.
C-14	R. A. Eads	--	--	Spring	--	do	--	+	May 28, 1956	Flows	D,S, Irr	Estimated flow 500 to 600 gpm. Temp. 69°F.
C-15	H. Ray	--	--	Spring	--	do	--	+	do	Flows	S,Irr	Estimated flow 25 to 50 gpm.
°C-16	Rex Phillips	--	--	209	--	do	2,327	187.1	July 22, 1955	C,W	S	Water level measured while pumping 1 to 2 gpm.
°C-17	B. Williams	--	--	Spring	--	do	--	+	do	Flows	D,S	Estimated flow 200 to 300 gpm. Temp. 69°F.
C-18	do	--	--	Spring	--	do	--	+	Apr. 17, 1956	Flows	S	Estimated flow 50 gpm. Temp. 69°F.
C-19	R. E. Prince	--	Old	45	--	Alluvium	--	41.8	July 22, 1955	N	D	Dug.
C-20	J. A. Blackman	--	Old	27	--	do	--	21.2	do	J,E, ½	D,S	Do.
C-21	C. C. Williams	--	Old	51	--	do	--	42.4	Aug. 2, 1955	C,J, W,E	D	Do.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date com-pleted	Depth of well (ft.)	Diam-eter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level		Method of lift	Use of water	Remarks
								Below land-surface datum (ft.)	Date of measurement			
C-22	Joe Sweeten	--	Old	38	--	Alluvium	--	34.5	Aug. 2, 1955	C,W	D	Dug.
*C-23	J. E. Bruce	--	--	Spring	--	do	--	+	Oct. 6, 1954	Flows	P,Irr	Reported flow 500 gpm. Supplies water to city of Camp Wood. Temp. 75°F.
C-24	Z. B. Grey	L. A. Placker	1948	45	6	Glen Rose limestone	--	36.2	July 25, 1955	C,W	S	Estimated yield 2 to 3 gpm.
C-25	do	--	Old	31	--	Alluvium	--	27.5	do	C,J, W,E	D	
C-26	-- Ellis	--	Old	141	10	Glen Rose limestone	--	77.8	do	C,W	S	Water level measured while pumping.
C-27	R. J. Vernon	--	--	110	--	do	1,627	97.6	July 20, 1955	C,W	S	
C-28	do	Fred Fuller	1928	110	8	do	--	97.3	Aug. 5, 1955	C,W	S	Estimated yield 2 to 3 gpm. Temp. 73°F.
C-29	C. R. Vernon	-- Crawford	1951	110	--	do	--	72	July 1955	N	N	Owner plans to install windmill.
C-30	O. H. Hope	A. M. Smith	1953	205	6	do	1,653	86.7	July 20, 1955	C,W	S	Cased to 105 ft.
C-31	C. Y. Smith	--	Old	23	--	Alluvium	--	19.0	Aug. 5, 1955	J,E	D	Dug.
C-32	W. A. Maley	--	--	Spring	--	Edwards and associated limestones	--	+	May 28, 1956	Flows	D,S, Irr	Estimated flow 300 gpm. Temp. 69°F.
C-33	do	--	--	Spring	--	do	--	+	do	Flows	D,S, Irr	Do.
C-34	Frank Powers	-- Johnson	Old	123	6	do	--	107.6	Aug. 2, 1955	C,W	S	
C-35	do	Austin Smith	1950	200	6	do	--	153.5	do	C,W	D,S	
*C-36	do	-- Johnson	1947	240	--	do	--	208.3	Aug. 10, 1955	C,W	S	Estimated yield 3 gpm. Temp. 71°F.
C-37	J. G. Rosson	Wee Hunt	1946	238	--	do	--	234.7	Aug. 3, 1955	C,W	S	
*C-38	do	--	Old	140	--	do	2,130	131.7	do	C,E	D,S	Estimated yield, 3 to 5 gpm.
*C-39	do	Wee Hunt	--	90	6	do	--	83.9	do	C,W	S	
C-40	Frank Powers	--	--	Spring	--	do	--	+	Apr. 18, 1956	Flows	S	Estimated flow 1,000 gpm. Known as "Trough Springs".
*C-41	Mrs. -- Gilliam	--	--	Spring	--	do	--	+	do	Flows	D,Irr	Estimated flow 25 to 50 gpm. Temp. 65°F.
C-42	-- Heine	--	--	Spring	--	do	--	+	do	Flows	D	Reported flow 25 gpm.
D-1	Joe Moffett	--	--	Spring	--	do	--	+	Mar. 27, 1956	Flows	D	Estimated flow 25 gpm.
D-2	Ross Powers	--	--	Spring	--	do	--	+	Mar. 28, 1956	Flows	D,S	Reported flow 25 gpm.
D-3	W. W. Wingfield	--	1919	25	--	Alluvium	--	20.1	Aug. 4, 1955	C,W	D	Dug.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
°D-4	H. W. Lewis	--	--	Spring	--	Glen Rose limestone	--	+	Mar. 27, 1956	Flows	S	Estimated flow 25 gpm. Temp. 63°F.
D-5	do	--	Old	38	--	Alluvium	--	31.3 28.9	Feb. 12, 1953 July 28, 1955	C,W	D,S	Dug.
D-6	Mrs. -- Samson	--	Old	50	--	do	--	40.9 43.1	Feb. 12, 1953 July 28, 1955	C,W	D,S	Do.
D-7	G. O. Knippa	Stanolind Oil & Gas Co.	1953	8,184	16, 11	--	1,730	--	--	N	N	Oil test. Cased to 1,501 ft.
°D-8	H. W. Lewis	--	1951	151	--	Glen Rose limestone	--	84.5	Mar. 27, 1956	C,W	S	Temp. 71°F.
D-9	do	--	Old	100	--	do	--	64.0	do	C,W	S	
D-10	Mrs. G. A. Bonner	--	Old	33	--	Alluvium	--	25.5	July 27, 1955	J,E	D	Dug.
D-11	John Mear	--	--	Spring	--	Edwards and associated limestones	--	+	Aug. 4, 1955	Flows	S	Estimated flow 25 gpm.
D-12	do	Sid Wells	1951	257	6	do	--	209.4	do	C,W	S	
D-13	-- Devaux	--	--	Spring	--	Glen Rose limestone	--	+	Apr. 3, 1956	Flows	S	Estimated flow 25 gpm.
D-14	L. E. Craig	--	New	27	--	Alluvium	--	21.6	July 29, 1955	J,E	D	Dug.
D-15	Mrs. E. I. Bradshaw	Sid Wells	1953	254	8	Edwards and associated limestones	--	237	Aug. 1955	C,W	D,S	
D-16	H. F. Heubner	Austin Smith	1952	235	--	do	--	230	Aug 1952	C,W	D,S	Reported yield 2 gpm.
D-17	Pat Bierschwale	--	--	560	6	Glen Rose limestone	--	354.3	Aug. 24, 1955	C,W	D,S	Cased to 440 ft. Estimated yield 2 to 3 gpm.
D-18	Charles Danner	Wee Hunt	1949	37	6	Alluvium	--	25.1	Aug. 4, 1953	J,E	D	
°D-19	Ross Powers	-- Smith	1950	100	--	Glen Rose limestone	1,713	--	--	J,E	S	Cased to 100 ft.
D-20	do	--	Old	36	--	Alluvium	1,713	30.6 32.0	Feb. 12, 1953 July 29, 1955	C,W	D	Dug.
D-21	do	Austin Smith	1951	122	8	Glen Rose limestone	1,681	46.9 45.7	Feb. 12, 1953 July 29, 1955	C,W	S	Cased to 65 ft.
D-22	do	-- Smith	--	63	4	Alluvium	1,682	37.1 36.1	Feb. 12, 1953 July 29, 1955	N	N	
D-23	Al C. Smith	-- Childress	1945	20	6	do	--	10.3	July 27, 1950	C,W	D	Bored.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*D-24	State Highway Department	Austin Smith	1952	640	6	Glen Rose limestone	--	280	1954	T, E, 3	Ind	Cased to 280 ft. Reported drawdown 40 ft. while pumping 10 gpm.
*D-25	Bill Burditt	--	Old	26	--	Alluvium	--	21.8	Aug. 6, 1955	J, E	D	Dug. Temp. 70°F.
D-26	R. E. Robinson	Austin Smith	1954	580	--	Glen Rose limestone	1,638	280	Mar. 1954	N	N	Electric log in files of Texas Board of Water Engineers.
*D-27	City of Leakey	--	1950	37	72	Alluvium	--	29.3	Apr. 3, 1956	J, E, 3	P	Dug. Cased to 30 ft. Estimated yield 50 gpm. Supplies water to city of Leakey. Temp. 71°F.
D-28	do	J. Roberts	1950	40	16	do	--	--	--	T, E, 3	P	Reported yield 150 gpm. Supplies water to city of Leakey.
D-29	R. DeWitt	--	Old	29	--	do	--	22.4	July 25, 1955	N	D	Dug.
D-30	Carroll S. Tom	--	Old	39	--	do	--	34.8	July 26, 1955	C, E	D	Do.
D-31	R. G. Bendele	Wee Hunt	1945	34	--	do	--	16.9	July 27, 1955	J, E, ½	D	Dug 18 ft.
D-32	S. P. Buchanan	do	1948	125	6	Glen Rose limestone	--	20.7	July 28, 1955	J, E	D	
D-33	John W. Buchanan	--	Old	41	--	Alluvium	--	26.0	July 29, 1955	C, W	D, S	Dug.
*D-34	J. H. Rose	--	--	Spring	--	Edwards and associated limestones	--	+	Mar. 28, 1956	Flows	D	Estimated flow 50 gpm. Temp. 69°F.
*D-35	Mrs. W. F. White	Austin Smith	1952	59	6	Alluvium	--	16.7	July 27, 1955	C, J, W, E	D, S	Temp. 73°F.
D-36	E. J. Tierce	--	Old	47	--	do	--	40.8	July 26, 1955	C, W	D, S	
D-37	Herbert Jones	--	Old	41	--	do	--	35.1	do	C, W	D, S	Dug.
*D-38	Red Chisum	Sid Wells	1952	96	6	Glen Rose limestone	--	88.1	do	C, W	S	Water level measured while recovering slowly.
D-39	do	--	Old	23	--	Alluvium	--	7.5	do	J, E	D, S	Dug.
D-40	R. L. Hubbard	--	1945	15	--	do	--	8.3	do	J, E	D	Do.
D-41	A. L. Cocke	--	Old	22	--	do	--	8.8	July 25, 1955	J, E	D, S	Do.
D-42	Lammar Hinnant	Sid Wells	1952	85	8	Glen Rose limestone	--	31.0	Aug. 3, 1955	J, E	D	
D-43	H. E. Wilson	--	--	Spring	--	Edwards and associated limestones	--	+	do	Flows	S	Estimated flow 25 gpm.

See footnotes at end of table.

Table 4.- Records of wells and springs in Real County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Diameter of well (in.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
D-44	H. E. Wilson	Austin Smith	1953	200	6	Edwards and associated limestones	--	152.1	Aug. 3, 1955	C,W	S	Cased to 8 ft. Estimated yield 2 gpm.
D-45	do	do	1950	325	6	do	--	106.7	do	N	N	Cased to 8 ft.
D-46	John Wennings	--	--	Spring	--	Glen Rose limestone	--	+	Aug. 12, 1955	Flows	S	Estimated flow 10 gpm.
D-47	do	--	1951	40	6	Alluvium	--	17.2	do	J,E, 1	D	Cased to 3 ft.
D-48	J. Ivy	Dug McCoy	1950	94	6	Glen Rose limestone	--	72.9	Aug. 3, 1955	C,W	D,S	Estimated yield 1 to 2 gpm.
D-49	J. W. Stormont	Austin Smith	1952	600	6	do	--	270	Aug. 1955	J,E, 1	S	Cased to 30 ft.
D-50	do	--	Old	30	--	Alluvium	--	27.1	Aug. 12, 1955	C,W	D	Dug.
D-51	R. L. Dudly	--	Old	27	--	do	--	12.5	Aug. 4, 1955	J,G	D,S	Do.
°D-52	J. W. Lumpkin	Austin Smith	1952	357	6	Glen Rose limestone	1,486	23.2 59.6	July 26, 1955 Nov. 15, 1956	J,E, ¼	D,S	Cased to 27 ft. Reported yield 5 gpm. Electric log in files of Texas Board of Water Engineers. Temp. 70°F.
°D-53	do	--	Old	31	--	Alluvium	--	23.2	July 26, 1955	N	N	Dug. Formerly used for domestic supply. Temp. 64°F.
°D-54	J. S. Boyles	--	Old	216	6	Glen Rose limestone	--	198.4	do	C,W	S	Reported yield ½ gpm. Temp. 84°F.
°D-55	do	Sid Wells	1955	317	6	do	--	48.6 47.3	Aug. 4, 1955 Mar. 28, 1956	C,W	S	Cased to 70 ft. Deepened from 70 ft in 1955. Temp. 72°F.
°D-56	J. H. Patterson	Wee Hunt	1949	440	6	do	--	217.8	July 26, 1955	C,W,E	D,S	
D-57	Carl Detering	Austin Smith	1953	610	6	do	--	266	do	N	N	Cased to 60 ft.

1/ See drillers logs, table 5.

° See analyses of water from wells and springs, table 6.

Table 5.- Drillers' logs of wells in Real County, Tex.

Well A-10

Owner: Farnsworth & Chambers. Driller: W. S. Seward.

	Thickness (feet)	Depth (feet)
Lime, shelly	38	38
Lime, yellow	25	63
Lime, white	29	92
Lime, gray, blind	80	172
Lime, brown, blind	40	212
Lime, yellow	28	240
Lime, white	5	245
Lime, yellow	5	250

Well A-11

Owner: Farnsworth & Chambers. Driller: W. S. Seward.

	Thickness (feet)	Depth (feet)
Lime, yellow	73	73
Rock, flint	7	80
Lime, gray	88	168
Lime, yellow, and flint rock	70	238
Lime, gray, blind	57	295
Lime, yellow	32	327
Lime, gray (water)	3	330

Well A-12, partial log

Owner: Oppenheimer & Dietert. Driller: Sun Oil Co.

	Thickness (feet)	Depth (feet)
Edwards and associated limestones:		
Lime	305	305
Lime and sand	45	350
Gravel (water)	35	385
Lime, sandy	20	405
Lime, gray	130	535
Shale, blue	10	545
Lime and shells	10	555
Lime, gray	5	560
Shale, blue	160	720
Lime	15	735
Shale, blue	5	740
Lime	55	795
Shale, blue, and lime	10	805
Shale and shells	25	830
Glen Rose limestone:		
Shale, gray	15	845
Shale, blue	50	895
Lime, gray	10	905
Shale, gray, and lime	20	925
Shale	45	970
Shale, gray, and lime shells	25	995
Lime, gray	10	1,005
Shale, gray	40	1,045
Lime	40	1,085
"Basement sands":		
Sand, (water)	50	1,135
Rock, red	15	1,150
"Basement sands"--Continued:		
Sand	20	1,170
Red bed, sticky	10	1,180
Shale, blue	35	1,215
Rock, red	5	1,220
Lime	10	1,230
Rock, red	15	1,245
Lime, broken	5	1,250
Shale, blue	12	1,262
Lime	3	1,265
Shale, blue	7	1,272
Lime	8	1,280
Shale, blue	5	1,285
Lime	3	1,288
Shale, blue	2	1,290
Rock, red	12	1,302
Lime, sandy	6	1,308
Rock, red	7	1,315
Sand	10	1,325
Lime, sandy	10	1,335
Rock, red, and broken shale	5	1,340
Rock, red, and sand	25	1,365
Rock, red	7	1,372
Lime	13	1,385
Lime, sandy	6	1,391
Shale, brown	29	1,420
Total depth		5,956

Table 5. - Drillers' logs of wells in Real County--Continued

Well A-25

Owner: H. & C. Peterson. Driller: A. B. Williams.

	Thickness (feet)	Depth (feet)
Lime	500	500
Shale and lime streaks	100	600
Lime and shale streaks (oil show)	368	968
Sand and streaks of lime	127	1,095
Sand, loose, and lime (oil show)	10	1,105

Well B-36, partial log

Owner: O. L. Love. Driller: Gant & Evans.

	Thickness (feet)	Depth (feet)
Lime	260	260
Lime (water)	17	277
Sand, and lime (water)	23	300
Lime	180	480
Shale, blue	3	483
Lime	27	510
Shale, gray	30	540
Lime	12	552
Shale, blue	38	590
Shale, sandy	10	600
Lime, sandy	20	620
Shale, gray	21	641
Lime	13	654
Shale, blue	16	670
Lime, sharp	17	687
Shale, blue	13	700
Limestone, broken (water)	50	750
Shale, blue	25	775
Lime	12	787
Shale, blue	58	845
Gypsum	25	870
Lime	125	995
Shale, blue	15	1,010
Lime	5	1,015
Sand (water)	10	1,025
Shale, blue	25	1,050
Rock, red	3	1,053
Sand	17	1,070
Lime	20	1,090
Shale, brown	20	1,110
Lime	10	1,120
Shale, blue	10	1,130
Lime	18	1,148
Shale, brown	13	1,161
Lime	6	1,167
Shale	18	1,185
Lime	5	1,190
Shale, blue	15	1,205
Sand (water)	20	1,225
Lime	5	1,230
Rock, red	13	1,243
Sand, red	5	1,248
Lime	4	1,252
Sand, red	23	1,275
Lime	25	1,300
Rock, red	10	1,310
Lime	33	1,343
Shale, brown	12	1,355
Shale, blue	50	1,405
Total depth		4,180

Table 5.- Drillers' logs of wells in Real County--Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Well B-56, partial log					
Owner: Claude Haby. Driller: Moore Exploration Co.					
Caliche	3	3	Shale, sandy	190	820
Lime, yellow, broken	34	37	Shale	30	850
Lime, yellow	15	52	Sand	40	890
Crevice, blind (water)	6	58	Coal	10	900
Sand (water)	4	62	Lime	20	920
Broken (water)	26	88	Sand and sandy shale	30	950
Lime, white	5	93	Shale, sand, and lime	84	1,034
Lime, yellow, honeycomb	45	138	Shale, gummy, and sand	186	1,220
Lime, broken, sandy (water)	36	174	Sand and lime	30	1,250
Lime, light-gray	21	195	Shale and sand	110	1,360
Lime, gray, broken, and shale	21	216	Shale, sandy, and sand	45	1,405
Shale, green	12	228	Shale, sandy	115	1,520
Lime, chalky, and lime	3	231	Shale and sandy lime	184	1,704
Shale and lime streaks	94	325	Shale, lime, and sand streaks	116	1,820
Shale and lime	204	529	Shale	107	1,927
Shale and gypsum	101	630	Total depth		7,250

Table 6.- Analyses of water from wells and springs in Real County, Texas

(Results are in parts per million, except specific conductance, pH, and percent sodium. Water-bearing unit: A, alluvium; E, Edwards and associated limestones; G, Glen Rose limestone.)

Well	Owner	Depth of well (ft.)	Water-bearing unit	Date of collection	Silica (SiO_2)	Iron (Fe) a/	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 $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
									Na	K												
A-3	Myrtle A. Brown	400	E	Mar. 22, 1956	12	-	57	17	7.0	0.5	242	6.6	12	0.2	2.4	-	235	212	7	0.2	417	7.9
A-14	Farnsworth & Chambers	302	E	Oct. 11, 1954	13	-	58	16	4.5	.8	243	5.9	9.0	.0	4.8	-	231	210	4	.1	420	7.9
A-17	O. Q. Marshall	240	E	Apr. 19, 1956	12	-	59	13	6.0	-	230	5.1	12	.2	4.5	-	232	200	6	.2	401	7.9
A-33	Mrs. Jess Fryer	400	E	Mar. 26, 1956	13	-	51	16	7.4	.6	224	7.4	12	.2	1.5	-	219	193	8	.2	381	7.8
A-42	H. F. Jacoby	180	E	do	12	-	58	15	5.4	.9	219	5.9	11	.0	20	-	244	206	5	.2	413	8.0
B-5	J. B. Snodgrass	175	E	do	13	-	66	12	5.9	1.1	245	5.4	11	.0	7.3	-	243	214	6	.2	429	7.7
B-10	Mrs. -- Garuen	-	E	do	13	-	62	14	5.5	.8	251	3.5	9.2	-	3.0	-	234	212	5	.2	414	7.9
B-23	T.E.W.Dietert	300	E	Mar. 22, 1956	12	-	56	15	7.5	.5	233	6.5	12	.2	3.6	-	229	201	7	.2	409	7.9
B-25	Ernest Leinweber	112	E	do	12	-	58	12	5.4	.6	224	4.8	10	-	5.7	-	222	194	6	.2	388	7.8
B-38	Wm. Auld	433	E	Mar. 26, 1956	13	-	56	21	8.7	.4	265	6.3	15	.4	.9	-	252	226	8	.3	446	7.9
B-41	Prade Ranch	Spring	E	Apr. --, 1956	12	-	56	13	4.7	.6	225	4.6	9.8	.2	4.8	0.00	220	192	5	.1	381	8.0
B-46	T. C. Evans	Spring	E	Mar. 16, 1956	11	-	62	13	5.2	.7	241	4.9	7.0	-	6.2	-	230	208	5	.2	413	7.8
B-53	Dan Auld	300	E	Mar. 26, 1956	12	-	62	14	4.7	.6	244	4.4	4.8	-	3.0	-	232	212	5	.1	401	7.9
B-58	Claude Haby	188	E	Apr. 3, 1956	12	-	64	18	4.7	.8	280	4.0	7.8	-	4.6	-	254	234	4	.1	446	7.6
B-60	Mrs. M. S. Perry	Spring	E	do	13	-	66	20	5.1	.8	302	3.7	7.5	-	1.4	-	266	246	4	.1	470	7.7
C-8	H. W. Lewis	415	E	Mar. 27, 1956	12	-	38	25	6.1	.6	229	6.8	10	.2	.8	-	212	198	6	.2	382	7.8
C-12	A. G. Wells	515	E	Mar. 19, 1956	15	-	32	18	10		183	8.4	12	-	1.0	-	186	154	13	.4	325	7.8
C-16	Rex Phillips	209	E	do	11	-	60	3.8	11		198	3.1	14	-	4.0	-	205	165	12	.4	352	7.9
C-17	B. Williams	Spring	E	Apr. 17, 1956	12	-	66	11	4.0	.5	237	4.8	9.2	.1	9.2	.09	248	210	4	.1	410	8.0

See footnotes at end of table.

Table 6.- Analyses of water from wells and springs in Real County--Continued

Well	Owner	Depth of well (ft.)	Water-bearing unit	Date of collection	Silica (SiO_2)	Iron (Fe) a/	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 $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
°C-23	J. E. Bruce	Spring	A	Oct. 6, 1954	15	0.00	56	14	6.0 0.7	220	6.0	12	0.0	5.2	0.12	223	197	6	0.2	392	7.8
C-36	Frank Powers	240	E	Mar. 19, 1956	11	-	64	16	4.7 .5	259	5.1	9.0	-	8.8	-	248	226	4	.1	438	7.9
C-38	J. G. Rosson	140	E	do	9.0	-	76	7.6	4.9 .6	232	8.2	10	-	27	-	257	221	5	.1	454	7.5
C-39	do	90	E	do	9.8	-	71	8.4	3.9 .6	253	3.5	6.8	-	5.2	-	233	212	4	.1	420	7.4
C-41	Mrs.-- Gilliam	Spring	E	Apr. 18, 1956	10	-	70	16	5.0 .3	271	6.3	9.8	.2	11	.00	269	240	4	.1	467	7.7
D-4	H. W. Lewis	Spring	G	Mar. 27, 1956	10	-	70	19	6.4 .6	304	6.9	11	-	.3	-	276	252	5	.2	502	7.3
D-8	do	151	G	do	12	-	548	248	41	183	2,220	11	-	.4	-	3,170	2,390	4	.4	3,240	7.1
D-19	Ross Powers	100	G	Mar. 28, 1956	13	.01	342	82	24	244	984	12	-	.2	-	1,580	1,190	4	.3	1,860	7.3
D-24	State Highway Dept.	640	G	do	11	.02	204	144	151	311	1,050	47	5.2	.0	-	1,770	1,100	23	2.0	2,210	7.6
D-25	Bill Burditt	26	A	do	13	-	62	19	12	262	22	12	-	4.0	-	275	232	10	.3	469	7.5
°D-27	City of Leakey	37	A	Apr. 3, 1956	13	.00	90	17	7.1 1.0	336	14	14	.1	4.5	.04	326	294	5	.2	567	7.5
D-34	J. H. Rose	Spring	E	Mar. 28, 1956	10	-	63	8.2	4.9	222	3.3	8.8	.1	5.8	-	221	192	5	.2	378	7.9
D-35	Mrs. W. F. White	59	A	do	11	-	88	12	5.9 -	306	12	13	-	3.0	-	298	268	5	.2	527	7.6
D-38	Red Chisum	96	G	Aug. 18, 1955	9.0	.00	318	196	83	335	1,410	26	-	1.2	-	2,210	1,600	10	.9	2,660	7.5
D-52	J. W. Lumpkin	357	G	Mar. 28, 1956	12	-	124	71	17	289	366	14	-	1.0	-	747	602	6	.3	1,100	7.3
D-53	do	31	A	do	11	-	69	18	7.0 1.1	285	9.7	14	.2	.8	-	274	245	6	.2	490	7.7
D-54	J. S. Boyles	216	G	do	9.6	-	534	328	63	273	2,460	22	-	3.4	-	3,550	2,680	5	.5	3,650	7.8
D-55	do	317	G	do	11	.02	80	26	12	356	18	14	-	3.2	-	340	307	8	.3	598	7.4
D-56	J. H. Patterson	440	G	Aug. 18, 1955	7.0	.00	412	295	133	277	2,150	37	4.4	1.8	-	3,180	2,240	11	1.2	3,430	7.4

° Well C-23, Manganese (Mn), 0.02; Phosphate (PO_4), 0.00. Well D-27, Phosphate (PO_4), 0.01.

a/ In solution at time of analysis.