13.

TEXAS BOARD OF WATER ENGINEERS

H. A. Beckwith, Chairman
A. P. Rollins, Member
James S. Guleke, Member

BULLETIN 5204

GROUND-WATER RESOURCES IN THE VICINITY OF KENMORE FARMS, KENDALL COUNTY, TEXAS

By

William O. George and William W. Doyel

Prepared cooperatively by the Geological Survey,
United States Department of the Interior

June 1952

CONTENTS

TABLES

ILLUSTRATIONS

GROUND-WATER RESOURCES IN THE VICINITY OF KENMORE FARMS, KENDALL COUNTY, TEXAS

By

William O. George and William W. Doyel

June 1952

INTRODUCTION

In October 1951, a study was made of the water resources of the Kenmore Farms and adjacent territory about 5 miles east of Boerne, Kendall County, Texas. The study was made after a visit to the office of the Texas Board of Water Engineers by John A. Kirschke, rancher, and William Garrett, warden for the Texas Game and Fish Commission.

Mr. Kirschke stated that he had entered a suit against Clifford Mooers, owner of the Kenmore Farms, alleging illegal use of water. He reported that withdrawals of water from wells, pits, or springs to irrigate pasture grasses reduced the flow of water from springs on the Kenmore Farms and consequently prevented the ordinary flow in Postoak Creek from reaching the Kirschke Ranch a relatively short distance downstream. (See fig. 2.) Mr. Kirschke stated further that the suit was entered solely for the purpose of determining his legal rights and the rights of other water users but that no damages were claimed as a part of the suit.

Mr. Garrett stated that fish in Postoak Creek had died because of a lack of water.

PURPOSE AND SCOPE

This study was a part of the general investigations of the ground-water resources of Texas, which are being made by the United States Geological Survey in cooperation with the Texas Board of Water Engineers. Data resulting from such investigations are released to the public in accordance with the usual practice of the cooperating parties.

The field work included geologic and topographic studies; the inspection of wells and springs in the area; collection of records of ownership, names of drillers, date of construction, types of wells, and types of equipment; measurements of depths of wells and depths to water in wells; obtaining samples of water; boring three auger holes; and determining altitudes of each well site. The work required about 15 man-days and was completed on November 1, 1951. The study was made under the supervision of W. L. Broadhurst, district geologist, and under the general direction of A. N. Sayre, chief of the Ground Water Branch of the Geological Survey.

ACKNOWLEDGMENTS

The writers wish to express appreciation to John Kirschke and William Garrett, and to the employees of Clifford Mooers, for their complete cooperation during the investigation, particularly the assistance of Jack Kelly, ranch foreman, and that of Bruce Scrafford, consulting geologist of San Antonio.

Data used in the preparation of this report include the Boerne quadrangle, a topographic sheet prepared by the Corps of Engineers, U. S. Army, and areal photographs by the Department of Agriculture.

GEOLOGIC DATA

All the known water-bearing formations in the vicinity of Kenmore Farms belong to the Trinity group, which is a part of the Comanche series of the Cretaceous system. Alluvial and surficial deposits in the area are only a few inches thick and do not yield significant amounts of water. Formations that lie below the Trinity group are believed to contain water that is too highly mineralized for most purposes. The Trinity group is represented in this area by the Travis Peak formation and the lower and upper members of the Glen Rose limestone, in ascending order. (See fig. 1.)

The Travis Peak formation, the lowest formation of the Trinity group, is difficult to identify in the drillers' logs of the wells in this general area, but available data indicate that the top of it lies at depths between 450 and 550 feet in the vicinity of Kenmore Farms. The formation has been penetrated by a few wells in the surrounding area. In 1928 a well was drilled by the city of Boerne to a depth of 938 feet, was plugged back to 464 feet, and is now unused. A log and record of the well have been published by the Texas Board of Water Engineers (1940)[a/]; the record shows that the well yielded only a small amount of hard water. On the Ralph E. Fair (Fair Oaks) Ranch, about 3 miles south of the Kenmore Farms headquarters, one well was drilled to a depth of 874 feet and was plugged back to 353 feet; a second well was drilled to a depth of 613 feet and was abandoned (Livingston, 1947, pp. 47-48). Analyses of water from the deeper sands in the wells mentioned above are not available. At Camp Stanley, about 5 miles south of Kenmore Farms, a number of wells were drilled to depths ranging from 400 feet to 800 feet. The maximum yield reported by Livingston (1947, pp. 47-48) is 50 gallons a minute and water levels are 300 to 400 feet below the land surface. The water is hard and has a rather high content of bicarbonate. In general the wells drilled to the Travis Peak formation have been unsatisfactory because the cost of drilling and of lifting the water is excessive in proportion to the yields obtained.

---

a/ See references, page 9 .

Texas Board of Water Engineers in cooperation with U. S. Geological Survey Bulletin 5204

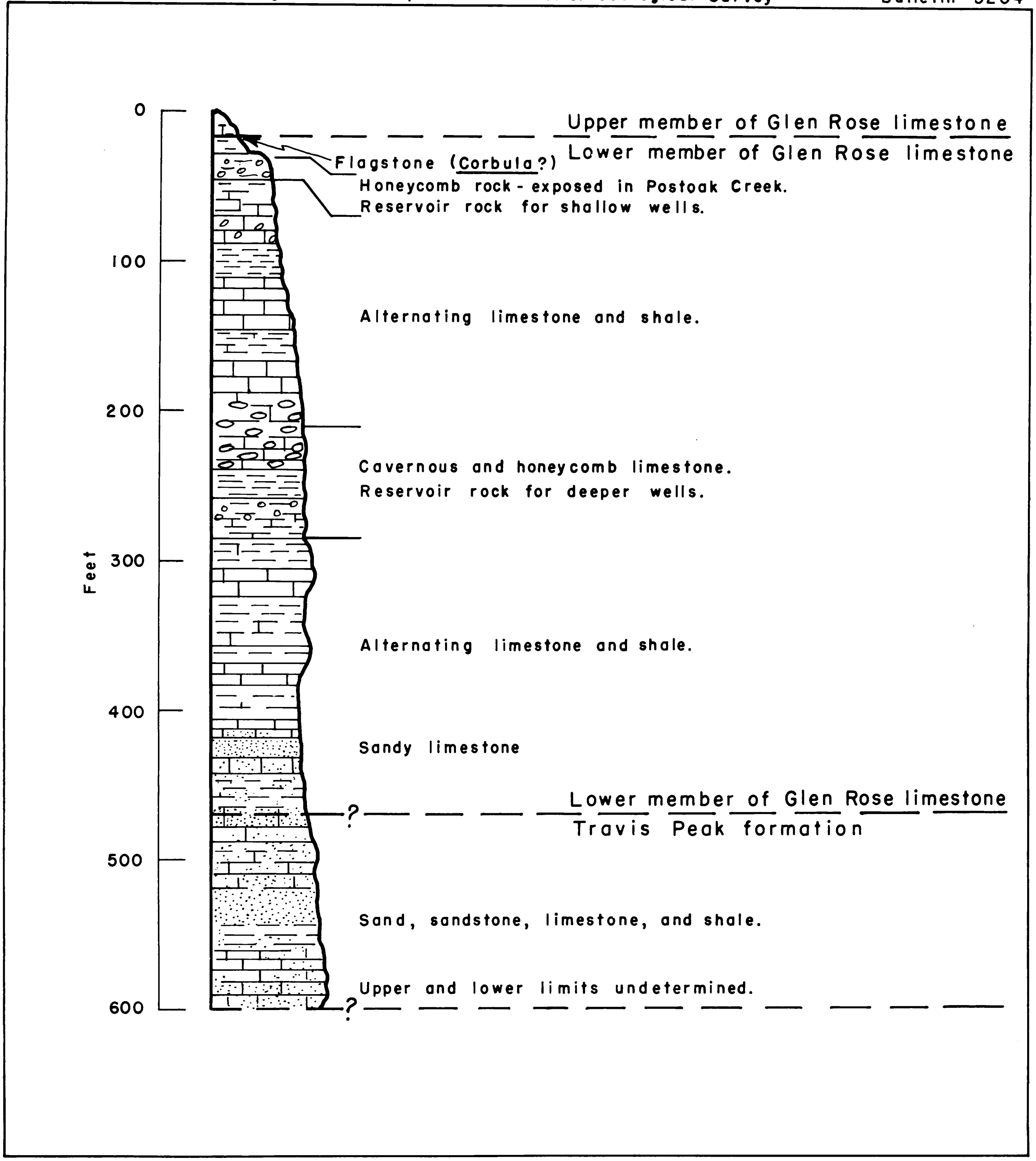

FIGURE 1.-Generalized section of rocks in vicinity of Kenmore Farms.

The Glen Rose limestone lies directly on the Travis Peak formation. The contact between the Travis Peak formation and the Glen Rose limestone is probably gradational and is not easily recognized in drillers' logs. In general the Glen Rose limestone consists of alternating limestone and marl. Some of the beds of marl are somewhat sandy. In Comal County the Glen Rose limestone has been divided into a lower limestone member and an upper limestone member (George, 1947, p. 17). The uppermost bed of the lower member is a hard flagstone containing many small fossils (Corbula?) about the size of wheat grains. These flagstones crop out in many places on and near Kenmore Farms at an altitude of about 1,390 feet.

The lower member of the Glen Rose limestone yields water to wells from several different levels, probably from porous or fractured limestones. The different levels probably are not interconnected in the vicinity of Kenmore Farms and, because the permeability of limestone is generally irregular, it is not possible to predict the amount of water that might be obtained at any given level. In most of the deeper wells for which drillers' logs are available, the water-bearing strata are reported at depths considerably below present water levels, indicating that some of the water is confined under artesian pressure. Wells 1, 12, 14, 19, 21, 22, and 23, which range in depth from 230 to 362 feet (see table 1 and fig. 2), draw water from the lower part of the lower member of the Glen Rose limestone. These wells have not been tested for yield but they appear to be adequate for domestic and stock use. Mr. Bergmann, who deepened well 2, reported an unlimited supply, which probably means that it was not possible to lower the water level with a bailer.

Shallow wells penetrating the upper part of the lower member in the broad valleys of the tributaries of Postoak Creek yield water from a honeycomb limestone that lies 2 to 15 feet below the land surface in the valleys. The limestone is well exposed in Postoak Creek on the Kirschke Ranch and it appears to be a fossil reef in which the shells have been removed by solution, leaving a coarse sponge-like rock that is generally known as honeycomb limestone. The top of the honeycomb limestone lies aboot 15 feet below the flagstone containing Corbula (?). This limestone supplies enough water to wells 3 and 4 for small-scale irrigation. A sprinkler system is used to apply the water. Well 6, which is west of wells 3 and 4 and about 25 feet above the valley floor, probably obtains water from the same honeycomb limestone.

The base of the upper member of the Glen Rose limestone, as indicated by the position of the fossiliferous flagstone previously mentioned, is 10 to 15 feet above the valley floor. It is believed that no water is obtained from the upper member in the area investigated because the divides are fairly sharp and water that percolates into the strata is quickly drained into the adjacent valleys.

In the broad valleys of the tributaries of Postoak Creek a deposit of clay or marl 2 to 15 feet thick overlies the honeycomb limestone. The clay is plastic and sticky when wet. It appears to have been reworked or leached because the texture does not resemble that of the clay and marl of the Glen Rose limestone.

Structural conditions are indicated by the position of the fossiliferous flagstone which crops out in a number of places on the Kenmore Farms and vicinity. The relative elevations of these outcrops as estimated from the topographic map indicate a regional dip or slope of the Glen Rose limestone southeastward at about 50 feet to the mile, and a slight flattening of the dip in the area investigated. There are probably no major faults in the area, but a small fault may be indicated by the linear arrangement of upturned or disturbed rocks about 400 feet east of well 14. The appearance of the land surface along the extension of this line, as shown in aerial photographs, also suggests faulting.

In general the topography of the area is characteristic of the outcrop of the Glen Rose limestone; alternating layers of hard limestone and less resistant marl cause "stair-steps" on the hillsides. The valleys on either side of the farm headquarters, however, appear to be somewhat broader than those typical of the outcrop of the Glen Rose limestone, and the gradient of the streams or drainage lines appears to be less than average. The gradient of the streams, however, is somewhat greater than the dip of the rocks, so that at the southern limit of Kenmore Farms the stream has cut through the clay that covers the broad valleys and has cut into the honeycomb limestone below. At the junction of the two streams, just above the Ammann road, the character of the topography changes abruptly. The broad valleys merge into a stream channel 10 to 20 feet wide having nearly vertical walls of honeycomb limestone 10 to 15 feet high.

HYDROLOGIC DATA

GENERAL HYDROLOGY

THE WATER CYCLE

Precipitation that falls as rain has been evaporated chiefly from the wet surfaces on the earth, including the oceans. Some of it evaporates while falling; some of it reaches the soil and is evaporated from the soil; and some soil moisture is transpired through the leaves of plants. A small part of the water moves down through the soil into underground reservoirs. The remainder runs off the land into streams that flow toward inland basins, lakes, or oceans.

GROUND WATER

The water that reaches the underground reservoirs is generally called ground water; the runoff, together with the water that falls on surface channels, is called surface water. This classification of water, however, leads to difficulties, particularly where the surface rocks are limestone. For example, the water that flows in a stream may sink through openings in the bed of the stream into an underground reservoir, and later appear as a spring farther down the same stream or in some other stream. The process may be repeated several times as the water moves downstream toward lower levels. Thus the water becomes alternately ground water and surface water.

Nearly all the normal flow or so-called ordinary flow of Texas streams comes from ground-water reservoirs through springs and seeps. Although the proportions vary considerably for different streams, less than 80 percent of all the water that flows in Texas streams is flood water which fills the stream beds immediately after rains, and more than 20 percent of the flow is water that emerges from underground reservoirs through seeps and springs.

Springs are points or areas of natural discharge from ground-water reservoirs. They may be classified as gravity springs or artesian springs. Gravity springs occur under water-table conditions The water emerges at the outcrop of the water-table either as seeps through small openings between grains of sand or as larger flows or streams from larger openings in rock formations. Most gravity springs occur at the contact of the water-bearing formation with the underlying impervious formation and are called contact springs.

Artesian springs flow from ground-water reservoirs under pressure. The reservoirs are confined by impervious layers of rocks and the water emerges through openings provided by ruptures in the overlying (confining) beds of the ground-water reservoir. The ruptures may result from faults or fractures or from local erosion of the overlying confining bed.

A well is defined by Meinzer (1923, p. 60) as: "* * * an artificial excavation that derives some fluid from the interstices of the rocks or soil which it penetrates, except that the term is not applied to ditches or tunnels that lead ground water to the surface by gravity * * *." A water well, therefore, is an artificial excavation in which the derived fluid is water.

According to this definition there may be some question as to the classification of wells 7 and 9, which are elongate ditch-like excavations made by means of a scraper or bulldozer. They are classified as wells because of the intention to obtain water, not to conduct it as is the ordinary purpose of ditches or tunnels.

RESERVOIR ROCKS

The rocks that compose our most important ground-water reservoirs, or "aquifers", are sand, gravel, sandstone, limestone, and volcanic rocks. No large supplies of ground water have been found in volcanic rocks in Texas. Where the reservoir rock is unconsolidated sand or gravel, water moves slowly between the grains of sand or gravel; in tightly cemented sandstone, water must move through fractures or cracks in the rock; in limestone, fractures and cracks are the initial passageways, but because limestone is slowly soluble in water the passageways may become enlarged by solution. In the Postoak Creek area, as indicated by drillers' logs, all the ground-water reservoirs now in use are composed of limestone.

As a result of decisions in certain ground-water cases brought before the courts of Texas, attempts have been made to distinguish "percolating waters" from waters that flow in "well-defined channels." Such a distinction is not based on the natural occurrence of ground water. In limestones "well-defined channels" may exist, but they are the main channels that are fed by water that percolates toward them through a network or "spongework" of small openings. Even if the large and small openings were to be considered collectively, the aggregate of openings could hardly be a well-defined channel because the occurrence of such openings is irregular and because such openings depend on the original character of the limestone and the fortuitous occurrence of cracks and crevices that are caused by earth movements.

MOVEMENT OF GROUND WATER

Nearly all ground water is in motion. Under artesian conditions it moves down gradient under cover of relatively impermeable formations so that, when the water-bearing stratum is penetrated by a water well, the water rises in the hole to a level comparable to the level at which it enters the formation, less the head lost by friction as the water moves from the outcrop to the well. Under water-table conditions there is no impermeable cover and the water infiltrates more or less vertically to the water table, which is the upper surface of the zone of saturation. In either case, the water moves in the direction of the slope of the water surface or pressure gradient. The slope of the water surface is ascertained by determining the relative altitudes of the land surface for a group of wells, and subtracting the depths to water. The slope may vary for each of the water-bearing formations.

The slope of the water surface in the shallow wells in the Kenmore Farms area is southeast, as indicated by the relative altitude of the water surface in wells 3, 4, 5, 6, 7, 8, 13, and 15, and spring 9, as shown in figure 2. The water in an elongated open pit, number 11, appears to be at least partially separated by a barrier of some sort from the ground-water reservoir that supplies the other shallow wells, because its water level is lower and the quality of its water is different. The reported great depth to water level in wells 1 and 14 and the measured depth to water in well 12 indicate that these wells are also separated from the shallow reservoir by some sort of barrier because they were drilled down through the level of the shallow-water horizon and no water was reported at this level. The drillers' logs of wells 1 and 12 show a number of honeycomb limestones in the upper parts of the logs that would probably yield water if the shallow reservoirs were continuous.

CHEMICAL CHARACTER OF THE WATER

The water obtained from wells and springs on Kenmore Farms and vicinity is typical of water obtained from limestone reservoirs and there is little difference among them (table 3). The water from no. 11, a large open pit, is considerably lower in mineral content than the others, which suggests that the water may be diluted by inflow of surface runoff.

CONCLUSIONS

The evidence obtained during the investigation indicates that the deeper water wells in the area probably yield water under artesian pressure, and that the shallow wells yield water from a perched water body occupying an isolated ground-water reservoir, which probably does not extend far beyond the Kenmore Farms in any direction. The intake areas of the deep ground-water reservoirs are probably more distant and more extensive than that of the shallow reservoir.

It is concluded that the Travis Peak formation would not yield sufficient water for profitable irrigation because of the probable low yield and the greater depth of the wells. Higher yields of water of better quality with less drawdown can probably be obtained from wells in the deeper aquifer in the lower member of the Glen Rose limestone, such as wells 1, 2, 12, and 14. The shallow aquifer, which yields water used to irrigate grass on Kenmore Farms, is believed to be limited to a relatively small area and, therefore, not capable of large yields for prolonged periods of time.

Pumping from the shallow wells must ultimately reduce the total flow of the springs by the amount of water pumped that is not returned to the aquifer. Because of the dense clay underlying the area now irrigated, it is doubtful that any of the water pumped now is returned to the aquifer.

REFERENCES

GEORGE, W. O., 1947, Geology and ground-water resources of Comal County, Tex.: Texas Board of Water Eng., 142 pp.

LIVINGSTON, P. P., 1947, Ground-water resources of Bexar County, Tex.: Texas Board of Water Eng., 234 pp., 2 maps, 2 figs.

MEINZER, O. E., 1923, Outline of ground-water hydrology, with definitions: U. S. Geol. Survey Water-Supply Paper 494, 71 pp.

TEXAS BOARD OF WATER ENGINEERS, 1940, Kendall County, Tex., Records of wells, drillers' logs, water analyses, and map showing location of wells, 47 pp.

Table 1.- Records of wells and springs on Kenmore Farms and vicinity in Kendall County, Tex.

Method of lift: C, cylinder; E, electric; G, gasoline; H, hand. Number indicates horsepower.
Use of water : D, domestic; Irr, irrigation; N, not used; S, stock.

Well	Distance from Kenmore Farms headquarters	Owner	Driller	Date completed	Type of well	Depth of well (ft.)	Altitude of land surface (ft.)	Diameter of well (in.)	Water level: Depth to which well is cased (ft.)	Water level: Below land surface (ft.)	Date of measurement	Altitude of water surface (ft.)	Method of lift	Use of water
1	150 feet northeast	Clifford Mooers	Louis Bergmann	1943	Drilled	346	1,400.6	6	75	a/200	1943	--	C, E, 2	D, S
2	100 feet northwest	do.	do.	Old	do.	336	1,397.1	5	--	--	--	--	C, E, 2	D, S
3	800 feet west	do.	--	--	Dug	12	1,380.2	60	12	7.3	Oct. 15, 1951	1,372.9	C, G, 4	S, Irr
4	1,850 feet northwest	do.	Arno Harz	1947	do.	7.5	1,383.6	95 x 204	7.5	7.5	Oct. 16, 1951	1,376.1	--	Irr
5	do.	do.	do.	--	do.	5	1,381.3	24 x 60	5	5.1	do.	1,376.2	None	N
6	2,850 feet west	do.	--	--	Drilled	55	1,408.5	8	--	31.6	do.	1,376.9	C, W	D, S
7	1,850 feet southwest	do.	--	--	b/Dug	11	--	--	--	--	do.	1,374.6	None	S
8	1,600 feet west	do.	--	--	do.	13	1,381.3	60	13	6.5	Oct. 25, 1951	1,374.8	None	N
9	1,400 feet west	do.	--	--	Spring	--	1,374.4	--	--	+	Oct. 16, 1951	1,374.4	Flows	S
10	--	--	--	--	Cistern	--	--	--	--	--	--	--	--	--
11	1,400 feet southwest	Clifford Mooers	--	--	b/Dug	15	--	--	--	--	Oct. 16, 1951	1,351.9	None	S
12	2,900 feet south	do.	Louis Bergmann	1947	Drilled	230	1,349.1	6	21	a/170 174.4	1947 Oct. 25, 1951	1,177.9	C, W	S
13	1,250 feet east	do.	--	--	Spring	--	1,377.5	84	6	5.0	Oct. 24, 1951	1,372.5	None	N
14	2,600 feet southwest	do.	Louis Bergmann	1947	Drilled	362	1,421.7	6	--	a/240	Dec. 1947	--	C, W	S
15	1,200 feet northwest	do.	--	1951	Bored	13.4	1,394.7	3	--	13.0	Oct. 25, 1951	1,381.7	None	N
16	1,500 feet northwest	do.	--	1951	do.	5.8	1,393.6	3	0	Dry	--	--	None	N
17	2,100 feet northwest	do.	--	1951	do.	9.8	1,391.8	3	0	Dry	--	--	None	N
18	3,900 feet northwest	A. Heileckmann	B. Leonard	1924	Drilled	75	--	8	16	41.8	Apr. 8, 1940	--	C, W	S
19	4,900 feet north	C. H. Rust	--	--	do.	250	--	8	30	151.7 112.8	Apr. 8, 1940 Nov. 1, 1951	--	C, W	D, S

a/ Reported by owner or driller.
b/ Open pit, land surface uneven.

Table 1.- Records of wells and springs on Kenmore Farms and vicinity in Kendall County--Continued

Well	Distance from Kenmore Farms headquarters	Owner	Driller	Date completed	Type of well	Depth of well (ft.)	Altitude of land surface (ft.)	Diameter of well (in.)	Depth to which well is cased (ft.)	Water level		Altitude of water surface (ft.)	Method of lift	Use of water
										Below land surface (ft.)	Date of measurement			
20	2,550 feet northeast	Bodo Ranzau	Bill Rust	--	Drilled	60	--	--	--	39.9	Nov. 1, 1951	--	C,H,G	D,S
21	6,600 feet southeast	Bar ? Ranch	Rust & Schwartz	1914	do.	285	--	--	--	a/200	--	--	C,W	D,S
22	5,700 feet southwest	John A. Kirschke	Louis Bergmann	1942	do.	280	--	6	20	227.7	Nov. 1, 1951	--	C,W	S
23	6,300 feet southwest	do.	B. Leonard	1924	do.	282	--	8	20	a/220	--	--	C,E	D,S

a/ Reported by owner or driller.

b/ Open pit, land surface uneven.

REMARKS

Well 1. The well was sealed at the surface and it was not possible to measure the depth to water without removing pump. Mr. Bergmann, the driller, reports that the depth to water was about 200 feet when the well was drilled. This is considerably lower than the level of the water in the shallow wells. The largest amount of water was obtained at a depth of 314 feet. The capacity of the well is not known but the yield is adequate for household and stock use. See log.

2. An "unlimited supply" of water was reported when the well was deepened from 294 to 336 feet in 1934. Pump set at 280 feet. See log of deepened portion of well.

3. Equipped for use with sprinkling system.

4. Main irrigation well. Equipped with 3¼-inch centrifugal pump. Reported maximum rated capacity of 400 gallons a minute. Volume of pumpage controlled by number of spray outlets on irrigation pipe, and limited by drawdown in well. Drawdown about 0.5 foot at estimated withdrawal of about 150 gallons a minute. A concrete pipe near the bottom of the well conducts the overflow from the well through well 5 to a natural drainage channel about 800 feet from well 4. Open well, rock curb. See log.

5. About 25 feet from well 4. Apparently designed to be used in case of failure of well 4. Rock curb covered with removable steel plate.

6. On west side of valley about 30 feet above valley floor. Elevated storage tank.

7. Open pit without curb or casing.

8. Rock curb. Material excavated from well is blue clay.

9. Head of small spring indicating level of water table. No measureable discharge on October 15, 1951, but enough water to fill small channel for distance of about 500 feet below head of spring.

10. Concrete subsurface cistern at edge of stream bed designed to be filled by stream at flood stage. Capacity about 5,000 gallons.

11. Open pit in stream channel. No curb or casing.

12. Six-inch casing to 21 feet. Main water-bearing rock at 208-220 feet. Reported drawdown 20 feet while bailing 12 gallons a minute.

13. This spring had been cleaned out and improved with rock curb. Reported to flow in wet weather but was not flowing on October 25, 1951.

14. Reported drawdown 10 feet while bailing 10 gallons a minute. See log.

15. Test hole made with hand auger. Struck water at 13 feet. See log.

16. Test hole made with hand auger. Struck hard rock without reaching water.

17. Test hole made with hand auger. Struck hard rock without reaching water. See log.

18. Reported as weak well.

20. Water reported from cave at 60 feet.

Table 2.- Drillers' logs of wells on Kenmore Farms and vicinity, Kendall County, Tex.

Well 1

Clifford Mooers, 150 feet northeast of Kenmore Farms headquarters. Driller: Louis Bergmann.

	Thickness (feet)	Depth (feet)
Surface, rock	18	18
Shale, blue	4	22
Honeycomb, yellow; dry	4	26
Shale, blue	14	40
Rock, hard, yellow	4	44
Rock, bluish-gray	21	65
Clay, blue and yellow	7	72
Honeycomb, light-yellow; dry	16	88
Rock, light-yellow	8	96
Rock, grayish-brown	20	116
Rock, light-yellow	8	124
Rock, bluish-gray	16	140
Rock, light-yellow	32	172
Honeycomb, light-yellow; dry	8	180
Honeycomb, bluish-gray	8	188
Honeycomb, light-yellow	37	225
Rock, bluish-gray; water at 260 feet	51	276
Clay, blue, slightly sticky	8	284
Rock, bluish-gray	8	292
Honeycomb, light-yellow; water	22	314
Honeycomb, dark-yellow; water	6	320
Shale, blue	21	341
Clay, blue, sticky	5	346

Well 2

Clifford Mooers, 100 feet northwest of Kenmore Farms headquarters. Driller: Louis Bergmann.

	Thickness (feet)	Depth (feet)
No record	294	294
Rock, gray	14	308
Clay, light-yellow	8	316
Honeycomb, bluish-brown	8	324
Rock, bluish-black	11	335
Clay, sticky blue	1	336

Well 4

Clifford Mooers, 1,850 feet northwest of Kenmore Farms headquarters. Driller: Arno Harz.

	Thickness (feet)	Depth (feet)
Clay, black	1.5	1.5
Gravel, pea	.8	2.3
Gravel and black dirt	1.7	4.0
Clay, brown to yellowish-blue, sticky; water	3.0	7.0
Limestone; water	.5	7.5

Table 2.- Drillers' logs of wells on Kenmore Farms and vicinity, Kendall County--Continued

Well 12

Clifford Mooers, 2,900 feet south of Kenmore Farms headquarters. Driller: Louis Bergmann.

	Thickness (feet)	Depth (feet)
Surface	4	4
Rock, brown	7	11
Rock, white, porous	38	49
Rock, yellow, porous	21	70
Clay, light-blue	12	82
Rock, white, soft	38	120
Rock, light-yellow	6	126
Rock, white	39	165
Shale, gray	20	185
Clay, light-blue	17	202
Clay, yellow and honeycomb rock	6	208
Cave; water	3	211
Rock, yellow; water	9	220
Rock, white	10	230

Well 14

Clifford Mooers, 2,600 feet southwest of Kenmore Farms headquarters. Driller: Louis Bergmann.

	Thickness (feet)	Depth (feet)
Surface, dirt and rock	1	1
Rock, white	6	7
Caliche	20	27
Clay, dark-blue	13	40
Clay, light-blue	28	68
Clay, sticky, blue	5	73
Rock, light-gray	13	86
Clay, yellow	4	90
Rock, white	48	138
Rock, light-yellow; water	12	150
Clay, light-blue	30	180
Rock, white	30	210
Rock, white, porous	18	228
Rock, light-yellow	23	251
Clay, light-blue	29	280
Rock, dark-gray	21	301
Rock, light-gray	9	310
Rock, white	24	334
Rock, light-yellow	8	342
Clay, light-blue	8	350
Clay, dark bluish-gray	10	360
Clay, light bluish-gray	2	362

Well 15

Clifford Mooers, 1,200 feet northwest of Kenmore Farms headquarters. Test hole.

	Thickness (feet)	Depth (feet)
Clay, black, silty; moist	1.5	1.5
Clay, dark-brown, silty; dry	3.5	5.0
Clay, light-brown, orange mottled, plastic; dry	2.5	7.5
Clay, light grayish-tan, orange mottled, plastic, silty; increasingly moist with depth	5.8	13.3
Rock	.1	13.4

Well 16

Clifford Mooers, 1,500 feet northwest of Kenmore Farms headquarters. Test hole.

	Thickness (feet)	Depth (feet)
Soil, black	1.5	1.5
Soil, brown	.5	2.0
Clay, yellow, sticky, with nodules of caliche	3.8	5.8

Well 17

Clifford Mooers, 2,100 feet northwest of Kenmore Farms headquarters. Test hole.

	Thickness (feet)	Depth (feet)
Soil, black	2.0	2.0
Clay, brown	2.0	4.0
Clay, brown to yellow; becomes gritty at 8 feet and grittiness increases with depth	5.8	9.8
Rock	9.8	

Table 3.- Analyses of water from wells and springs on Kenmore Farms and vicinity, Kendall County, Tex.
(Analyses given are in parts per million except specific conductance and pH)

Well	Aquifer in Glen Rose limestone	Depth of well (ft.)	Date of collection	Specific conductance (Micromhos at 25° C)	pH	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$
1	Deep	346	Nov. 1, 1951	554	7.4	12	86	19	4.4	325	16	11	4.5	318	292
4	Shallow	7.5	do.	561	7.6	11	96	15	1.6	332	15	10	4.0	323	301
6	do.	55	do.	626	7.3	13	114	11	4.6	366	13	11	13	371	330
9	do.	Spring	do.	608	7.6	12	110	12	12	362	33	11	4.0	359	324
11	do.	15	do.	402	7.8	9.8	44	13	14	160	19	30	.0	248	163
14	Deep	362	do.	557	7.5	12	75	25	6.7	319	15	16	6.3	319	290
20	Shallow	60	do.	586	7.3	11	92	18	5.8	334	16	15	6.1	333	304

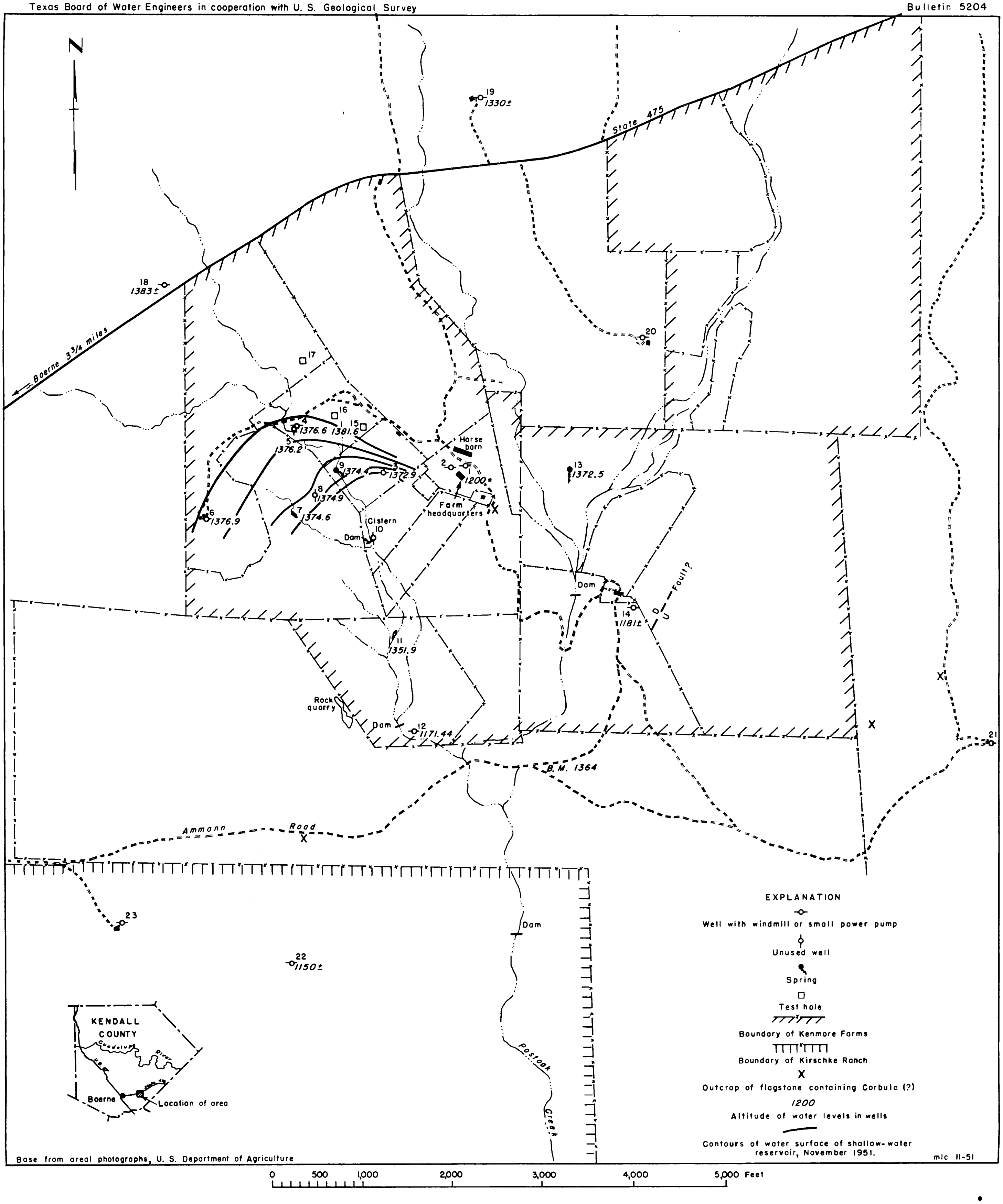

FIGURE 2.-Water resources of Kenmore Farms and vicinity, Kendall County, Tex.