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# GEOLOGY AND GROUND-WATER RESOURCES OF GRAYSON COUNTY, TEXAS

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Prepared in cooperation with
the United States Geological Survey
and the City of Sherman

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# GEOLOGY AND GROUND-WATER RESOURCES OF GRAYSON COUNTY, TEXAS


## ABSTRACT

Grayson County in north-central Texas is near the north edge of the Gulf Coastal Plain. The county has an area of 927 square miles and had an estimated population of 79,500 in 1957. The major town is Sherman, which has an estimated population of 31,000. The northern two-thirds of the county is drained by tributaries of the Red River; the southern third is drained by tributaries of the Trinity River.

Sedimentary rocks exposed at the surface in Grayson County are of Cretaceous and Quaternary age. Sand, clay, marl, and limestone of Cretaceous age, having a miximum thickness of about 3,600 feet, underlie the county, the beds dipping regionally to the southeast. Quaternary alluvium mantles part of the surface along the Red River and occurs in scattered patches elsewhere in the county.

The Trinity group and Woodbine formation of Cretaceous age are the principal water-bearing formations. Other stratigraphic units that yield water to wells are the Quaternary alluvium and the Pawpaw formation, Eagle Ford shale, and Austin chalk of Cretaceous age.

Ground water in Grayson County generally moves eastward and southward from areas of recharge to areas of discharge. Average rates of water movement in the Trinity group and Woodbine formation are estimated to be about 1.5 and 15 feet per year, respectively. The chief source of recharge to these aquifers is precipitation on the outcrop, although Lake Texoma contributes some recharge to the Trinity where it crops out in the lake. Ground-water discharges naturally by evapotranspiration, by vertical leakage, through springs, artificially through wells and by underflow out of the county to the southeast.

The withdrawal of ground water in Grayson County in 1957 was about 5 million gallons per day. Of this amount about 61 percent came from the Woodbine formation, about 36 percent from the Trinity group, and about 3 percent from the other water-bearing formations. Approximately 65 percent of the ground water pumped in Grayson County is withdrawn in the Sherman area.

Increased withdrawal of water since World War II has resulted in a rapid decline of the water levels in parts of Grayson County. The maximum decline in the Trinity group at Sherman from 1945 to 1958 was 113 feet, or about 8 feet per year. During the same period water levels in the Woodbine formation at Sherman declined as much as 156 feet, an average of 12 feet per year. Total declines since the early part of the 20th century were at least 180 feet in the Trinity group and about 240 feet in the Woodbine formation. Water levels in the area of outcrop of the principal aquifers, fluctuating chiefly in response to rainfall or changes in the natural rate of recharge, showed no appreciable decline from 1957 to 1959.

Coefficients of transmissibility, determined from pumping tests in Grayson County, averaged 2,800 gpd (gallons per day) per foot for the Trinity group and 3,200 gpd per foot for the Woodbine formation.

Results of chemical analyses of water samples indicate that the ground water in Grayson County is suitable for most purposes. The Trinity group generally yields soft water that is high in sodium-bicarbonate content and of questionable quality for irrigation. The water from the Woodbine formation ranges more widely in chemical composition than the water from the Trinity. It generally is soft but high in iron content; it is usually suitable for irrigation in the outcrop area but unsuitable in the downdip area. Water from the other water-bearing formations, though generally hard, is suitable for most purposes judging from the few analyses available.

The ground-water resources of Grayson County have been only partly developed. The volume of fresh water in transient storage in the Trinity group and Woodbine formation is estimated to be about 60 and 25 million acre-feet, respectively. Most of this water is not practicably recoverable because of the depth at which it occurs, but relatively high artesian heads and large available drawdowns in much of the county are favorable to future development within economic limits of pumping lift. In the Sherman area, however, concentrated pumping has caused large declines in the water levels, resulting in some dewatering of the Woodbine. Because of the large margin of safety before dewatering of the Trinity group begins, the Trinity is the most favorable source of additional ground water for Sherman. However, the higher lifting costs should be considered.

Large to moderate amounts of additional ground water can be obtained from the Trinity group and Woodbine formation in most presently undeveloped areas in the county. Water suitable for irrigation is available in moderate to large amounts from the Woodbine formation in places on its outcrop. A limiting factor to any major ground-water development, however, is the extent and thickness of saturated fresh-water sands available. The thickness of saturated fresh-water sand in the Trinity decreases northward; the thickness of the sands in the Woodbine is more erratic and has little definite pattern.

Additional supplies of water may be available from the alluvium near the Red River, but more information is needed before definite conclusions can be reached.

# INTRODUCTION

## Location and Extent of Area

Grayson County is in north-central Texas between latitudes 33°25' and 33°55' and longitudes 96°25' and 96°55'. The Red River and Lake Texoma (impounded by Denison dam on the Red River) form the northern county boundary and the boundary between Texas and Oklahoma. The Texas-Oklahoma State line has been determined as the south bank of the former course of the Red River. Grayson County is bordered on the east by Fannin County, on the south by Denton and Collin Counties, and on the west by Cooke County (fig. 1). Sherman, the county seat, is about 65 miles north of Dallas and about 15 miles south of Lake Texoma. The area of the county is 927 square miles. Lake Texoma covers approximately 143,000 acres, about 26,000 of which is in Texas.

## Purpose and Scope of the Investigation

Since 1945 the increase of population, expansion of industry, and modernization of both urban and rural homes have greatly increased the use of water in Grayson County. In the Sherman area, the accelerated withdrawals of ground water have emphasized the need for developing additional supplies; the city of Sherman and several small towns use only ground water for public supply.

Consequently, the current investigation was started as a cooperative project of the city of Sherman, the Texas Board of Water Engineers, and the U. S. Geological Survey. Its purpose was to obtain data on the geology, hydrology, and quality of ground water in Grayson County by which to appraise the county's ground-water resources. Specifically it was planned to: (1) study the geology of Grayson County with special emphasis on the Woodbine formation and Trinity group; (2) determine the quantity of water in storage in the principal aquifers; (3) study the effect of ground-water withdrawals on water levels in the aquifers; (4) determine the source and areas of recharge; (5) determine the chemical character of the ground water; and (6) estimate the over-all potential of the aquifers.

The investigation was made under the general supervision of A. N. Sayre and P. E. LaMoreaux, successive chiefs of the Ground Water Branch of the Geological Survey, and under the immediate supervision of R. W. Sundstrom, the Survey's district engineer in charge of ground-water investigations in Texas for the Survey.

## Methods of Investigation

The fieldwork, begun in the spring of 1957 and completed in the fall of 1959, included mapping the geology of the county and collecting hydrologic records pertaining to the occurrence of ground water. The geology was mapped on aerial photographs and the data transferred to a base map. Geologic sections, structure-contour maps showing altitudes of the top of the Woodbine formation and Trinity group, and maps showing thickness of fresh water sands in the Woodbine and Trinity were prepared from well logs.

The hydrologic records include an inventory of 333 wells (table 7), drillers' logs of 54 wells (table 9), electric logs of many wells, and chemical analyses of

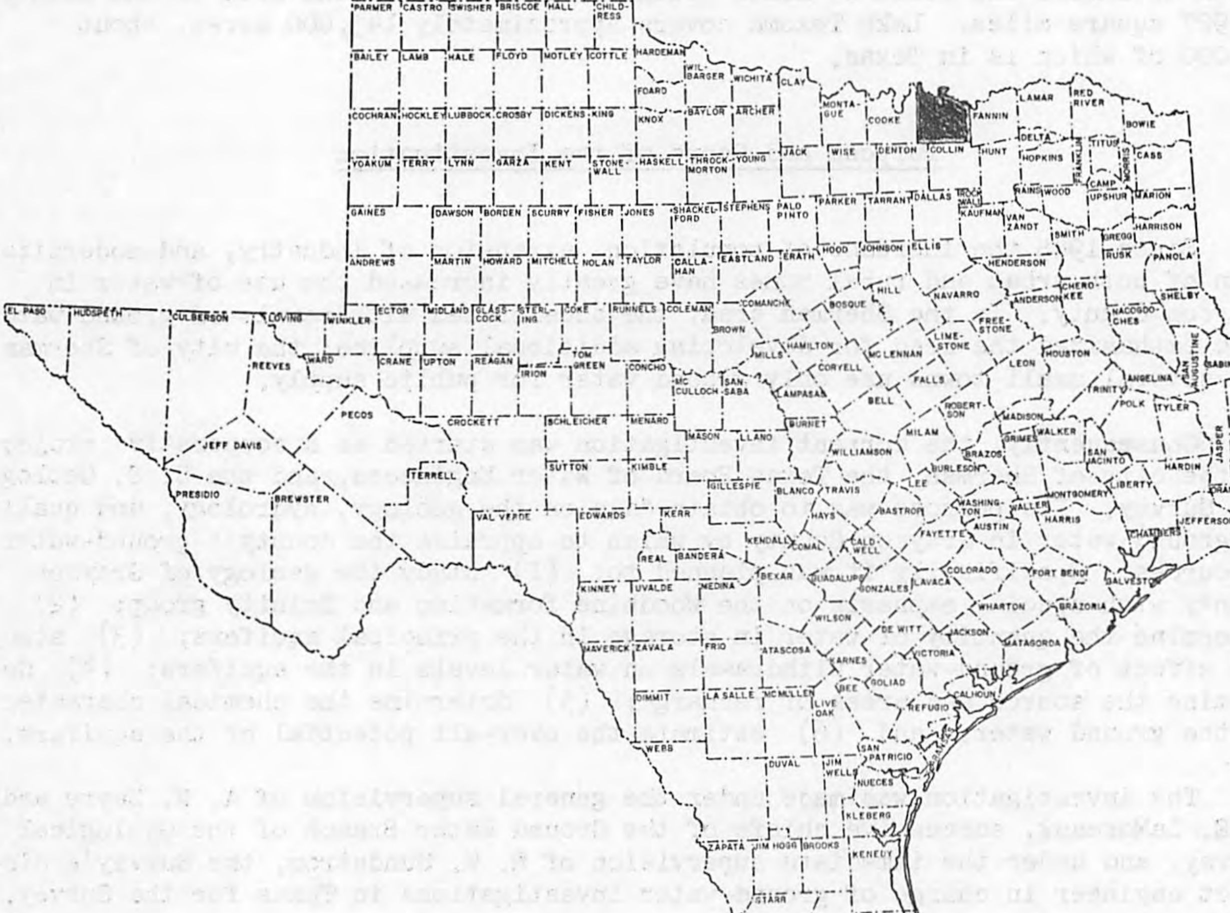


FIGURE 1. — Map of Texas showing location of Grayson County

water from 219 wells and 2 springs (table 10). The locations of the wells are shown on plate 1 and figure 2. For purposes of numbering the wells the county has been divided into 10-minute quadrangles, which are lettered alphabetically from the northwest corner of the county in a west-to-east, north-to-south progression. The wells are then numbered consecutively within each quadrangle. A line above the well number on the maps (pl. 1 and fig. 2) indicates that a chemical analysis of water from the well is given in table 10. Analyses of water samples from Lake Texoma and Lake Randell also are included in table 10. The chemical analyses, unless otherwise indicated, were made in the laboratory of the Geological Survey in Austin, Texas.

Periodic water-level measurements were made in 18 wells and hydrographs of selected wells were prepared to show the fluctuations of water level. A continuous water-level record of well B-2 was obtained with a recording gage, showing the fluctuations of water level caused by the rise and fall of Lake Texoma.

Pumping tests were made on 16 wells in Grayson County to determine the hydrologic characteristics of the principal aquifers. Pumpage was estimated according to the several uses of the water: public supply for cities, towns, and communities for which a record of water consumption was available; industrial for plants having their own wells; domestic; and stock. No estimate was made of pumpage for irrigation, as only about 150 acres was irrigated in Grayson County in 1959.

## Economic Development

The cities of Sherman and Denison are the industrial centers of Grayson County. Industrial plants in Sherman manufacture textiles, garments, milk products, cottonseed oil, cotton-oil refined products, iron and foundry products, steel and wire products, cotton-gin machinery, building materials, boats, pipes, and oil-well supplies. There are also meat-packing plants, railroad shops, and oil refineries. Denison has diversified industry, including the manufacture of textiles, garments, furniture, mattresses, air-conditioning equipment, dairy products, oleo-margarine, salad dressing, peanut butter, and livestock feed.

Farming, livestock raising, and dairying are successful in Grayson County because of good soils and favorable climate. The total farm income in 1954 was about $8,500,000, 59 percent of which was received from crops, 30 percent from dairy products, and 11 percent from livestock. Wheat, cotton, corn, oats, grain sorghums, and hay are the principal crops in the southern part of the county; peanuts and truck crops are grown extensively on the sandy soils in the western and northern parts.

The production of oil and gas from fields near Sherman and in the western part of the county is an important source of income. The total oil production in the county from the discovery date through 1958 was about 58,000,000 barrels. The production in 1958 was 6,790,201 barrels, according to records of the Texas Railroad Commission.

The county population, estimated to be 79,500 in 1957, is concentrated in urban areas, about 73 percent being in Sherman and Denison. The population of Sherman increased from 20,150 in 1950 to about 31,000 in 1957, and the population of Denison from 17,500 to 27,800. Ground water supplies the municipal and nearly all the industrial, domestic, and stock needs of the Sherman area, but Denison obtains its municipal supply from Lake Randell and Lake Texoma. The following towns use ground water for their public supplies: Whitesboro,

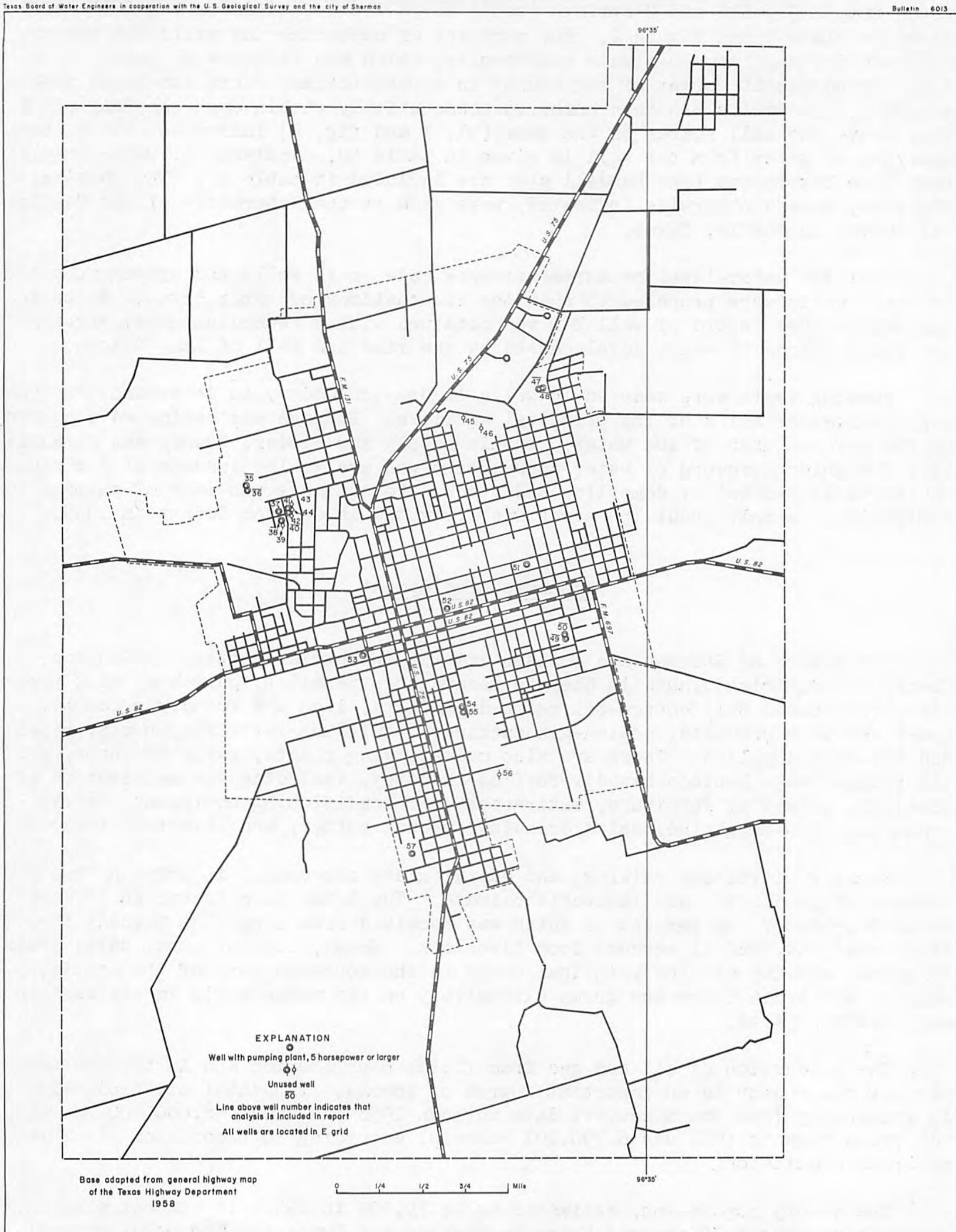


FIGURE 2.-Location of wells in Sherman, Grayson County, Texas

population 1,850; Van Alstyne, 1,649; Whitewright, 1,372; Bells, 614; Howe, 572; Collinsville, 561; Tioga, 529; Gunter, 463; Pottsboro, 383; and Tom Bean, 286.

Perrin Air Force Base, between Sherman and Denison, obtains its water supply from ground water obtained from wells at the base, and from surface water purchased from the city of Denison.

The tourist trade is an important factor in the economy of Grayson County. Millions of tourists visit Lake Texoma every year. Many motels and fishing and trailer camps in the area obtain their water supply from wells.

## Previous Investigations

Prior to this investigation very little study had been made of the ground-water resources of Grayson County. Hill (1901, p. 614-627) noted briefly the occurrence of artesian water in Grayson County in his report on the Black and Grand prairies of Texas. Bullard (1931) mapped and described in detail the geology of Grayson County; however, his report contained very little on the occurrence of ground water. Livingston (1945) reported in detail on the ground-water supplies in the immediate vicinity of Sherman. Sundstrom, Hastings, and Broadhurst (1948, p. 109-116) described the public water supplies of Sherman, Denison, Whitesboro, Whitewright, Van Alstyne, Bells, Collinsville, Howe, Gunter, and Tom Bean. Bergquist (1949) mapped and reported the geology of the Woodbine formation in Cooke, Grayson, and Fannin Counties.

## Acknowledgments

Appreciation is expressed to the landowners in Grayson County and the surrounding area who furnished information about their wells and gave permission for the periodic measurement of water levels in their wells. Well-drilling contractors, especially Messrs. E. C. Freeman and J. L. McClure of Denison, J. L. Myers & Sons of Denton, and the Layne-Texas Co., Ltd., of Dallas, supplied drillers' logs and electric logs. The collection of data on the use of water was greatly facilitated by the cooperation of well drillers, well owners, and city and company officials. The U. S. Corps of Engineers furnished logs of many test holes and topographic maps of the Lake Texoma area. The Standard Oil Co. of Texas aided the investigation by discussing subsurface correlation problems.

## Physiography and Drainage

Grayson County, near the north border of the Gulf Coastal Plain, is part of a dissected region whose topography is determined chiefly by the types of rock outcrops. On the basis of the outcrops, northern Texas has been divided into physiographic belts which generally coincide with geologic units. The various belts in Grayson County are shown on figure 3.

In the northwestern corner of the county the narrow belt known as the Western Cross Timbers occupies the outcrop area of the Trinity group. The belt parallels the shore of Lake Texoma and is characterized by rugged topography marked by deep, steep-walled ravines. The sandy soil supports a growth of post oak and blackjack oak.

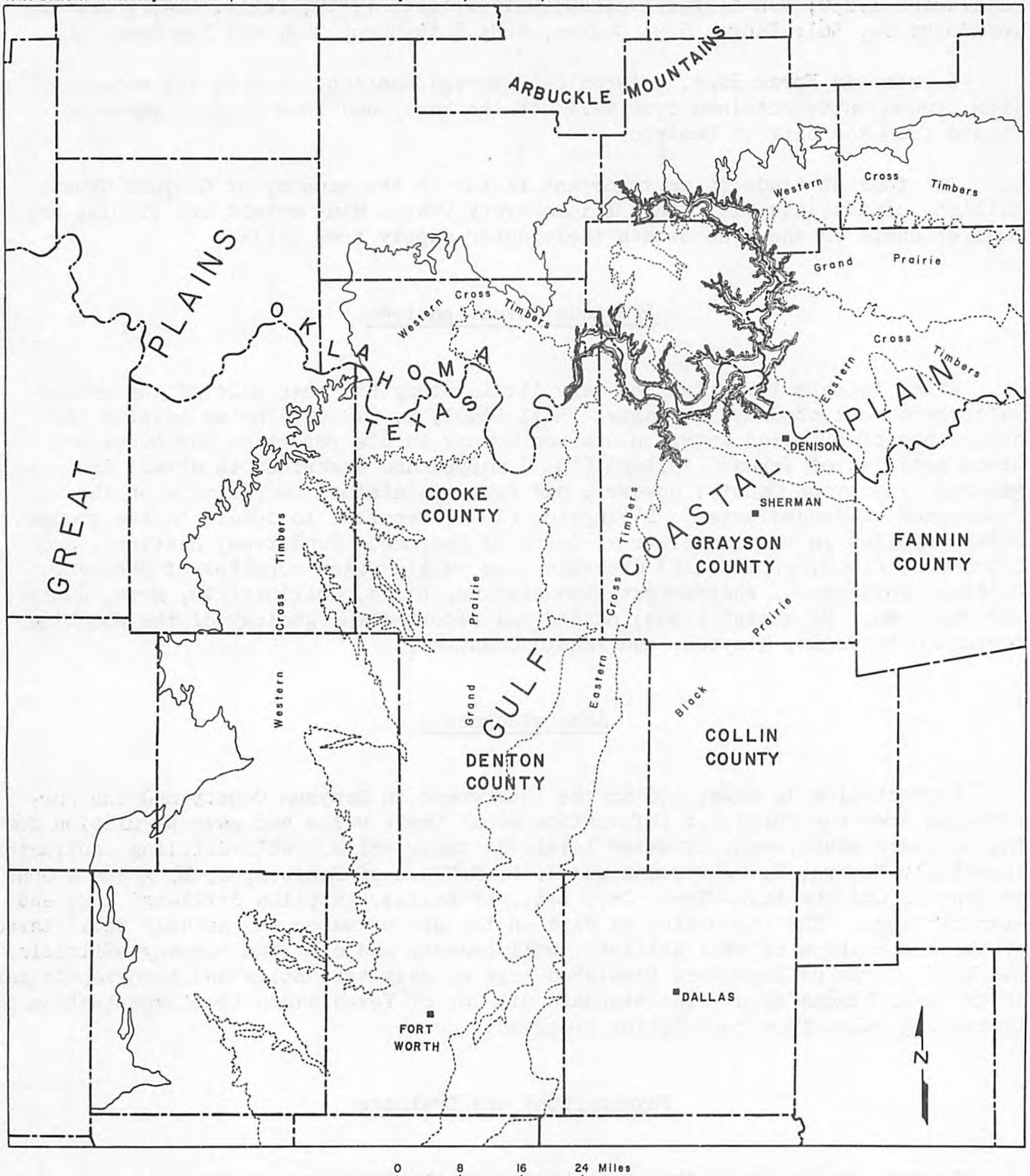


FIGURE 3. - Map of north-central Texas and south-central Oklahoma showing physiographic provinces

The Grand Prairie forms a rolling upland underlain by resistant limestone and softer marl of the Washita and Fredericksburg groups and extends in a narrow belt across the northernmost part of the county. The limestone forms the nearly flat upper surface of the prairie; the marl is exposed in the slopes.

The Eastern Cross Timbers forms a gently rolling sandy belt about 2 miles wide, generally coinciding with the outcrop of the Woodbine formation. The belt extends from the southwest corner of the county northward through the entire length of the county; thence it swings eastward across the extreme north-central and northeastern parts. The western part of the belt is devoted to farming; the northern part is forested with post oak and blackjack oak.

The Black Prairie occupies the outcrop area of the Eagle Ford shale and the Austin chalk. It forms a gently undulating to moderately rolling surface covering the southeastern three-fourths of Grayson County.

The altitude of Grayson County ranges from about 900 feet above sea level in an area about 5 miles west of Denison to about 500 feet along the Red River at the northeast edge of the county. The area of greatest relief is in the vicinity of Lake Texoma, where the erosion of the Trinity group (overlain by limestones and marls having greater resistance) has created a rugged topography.

The southern third of Grayson County is drained by the Trinity River; the central and northern parts are drained by the Red River. The divide separating the two drainage systems passes near the towns of Whitesboro, Howe, Tom Bean, and Whitewright. Choctaw Creek, which heads about 6 miles southwest of Sherman, drains the northeastern part of the county, joining the Red River near the Grayson-Fannin County line. Mineral Creek and other intermittent tributaries of the Red River drain the northwestern part of the county and empty into Lake Texoma. Pilot Grove and Sister Grove Creeks and the East Fork of the Trinity River, which drain the southeastern part of the county and the area west of Gunter, empty into Lake Lavon in Collin County. The southwestern part of Grayson County is drained by Range, Buck, and Little Elm Creeks, which empty into Lake Dallas in Denton County.

## Climate

Grayson County has a moist subhumid climate characterized by hot summers and mild winters. The mean annual temperature is 64.1°F, the mean July temperature being about 84°F and the mean January temperature about 43°F (fig. 4). Occasionally during the summer the temperature reaches 100°F. Freezing weather is not uncommon but generally does not last long. Several light snows fall during the winter, but the snow remains on the ground only a short time. The average dates for the last killing frost in spring and the first killing frost in winter are March 21 and November 17. The long growing season averages 238 days; the rich soils and adequate precipitation make Grayson County a productive agricultural area.

Figures 4 and 5 show graphically the annual and monthly precipitation for the period 1912-58. Precipitation averaging 38.89 inches annually is fairly well distributed throughout the year, being greatest from April to June and least from November to February. Doughts sometimes occur in the late summer, but generally they are not prolonged. Extended droughts, although infrequent, may result in loss of crops on many farms, as only a small part of the farm acreage is irrigated.

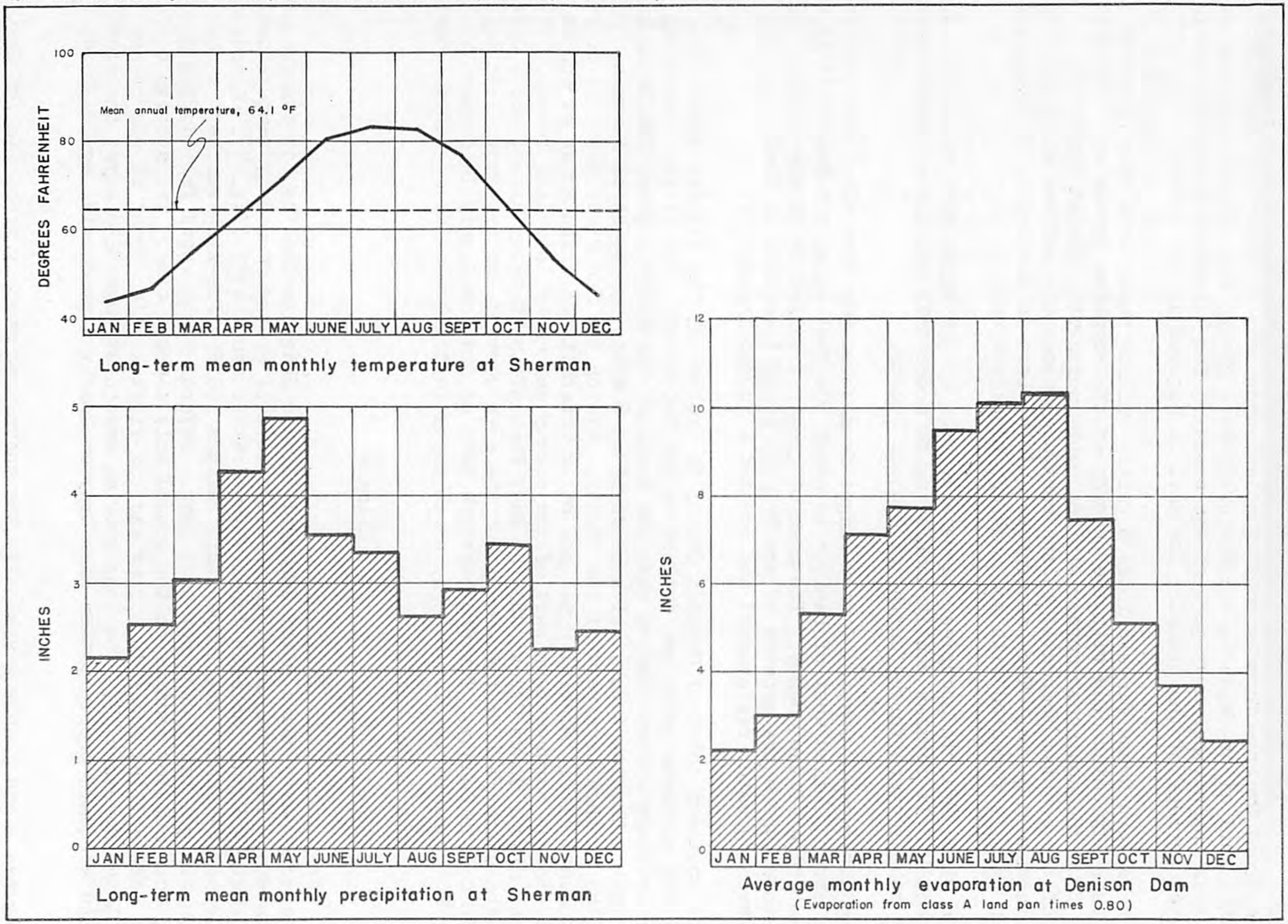


FIGURE 4.- Monthly precipitation and temperature at Sherman, 1912-58, and evaporation at Denison Dam, 1940-58
(From record of the U. S. Weather Bureau)

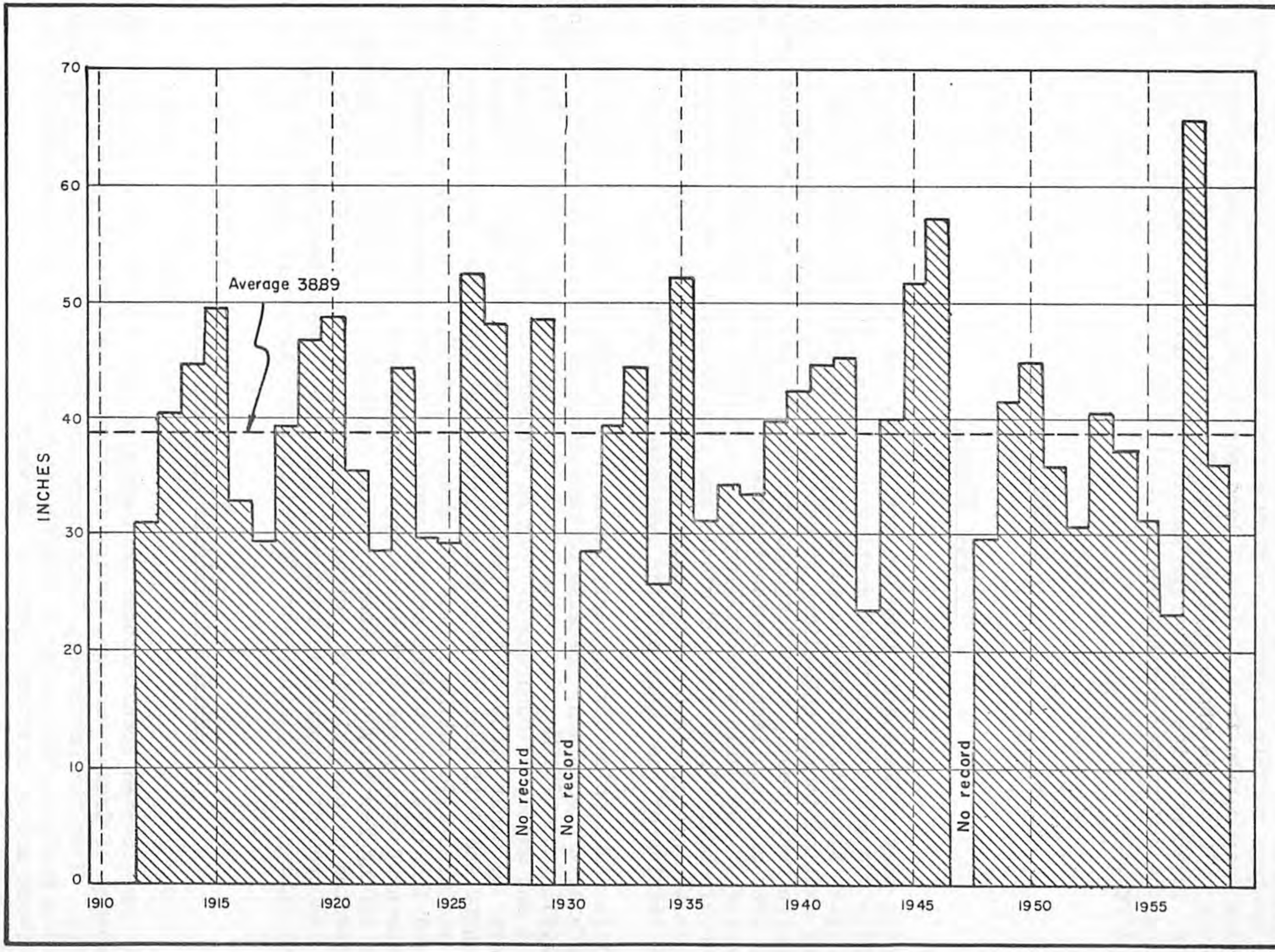


**FIGURE 5.- Annual precipitation at Sherman, Texas**

(From records of the U. S. Weather Bureau)

The average monthly evaporation from a free-water surface, as determined by multiplying evaporation from a class A land pan at the Denison Dam weather station by a factor of 0.80, is shown in figure 4. The average annual evaporation, about 74 inches, is about twice the average annual precipitation. Evaporation is greatest during the hot summer months when soil-moisture demand to sustain plant life also is large.

## GEOLOGY

### Geologic History

During most of Paleozoic time Grayson County was part of a large sedimentary basin which was receiving a thick section of marine deposits. Near the end of Mississippian time and during the early part of the Pennsylvanian period, structural deformation formed subsidiary troughs and arches within the basin. Parts of the basin subsequently were deepened and faulted and the basin received several thousand feet of early Pennsylvanian sediments. By middle Pennsylvanian time the deeper parts of the basin were filling with sediments and the seas were expanding. A maximum of about 10,000 feet of middle and late Pennsylvanian sediments were deposited in the basin. An orogeny during middle Pennsylvanian time caused a general westward tilting of the land, and the seas moved westward.

Uplift and erosion during early Mesozoic time reduced the area to a nearly flat surface, or peneplain. Because of subsidence in the Gulf Coast geosyncline during middle and late Mesozoic time, Cretaceous seas invaded the area from the southeast and deposited hundreds of feet of sediment in Grayson County, now represented by about 3,600 feet of sand, shale, marl, chalk, and limestone of the Comanche and Gulf series. The seas withdrew at the close of Cretaceous time. Later structural deformation formed the Preston anticline, Sherman syncline, and associated flexures now evident on the surface. Erosion began and probably continued during Tertiary and Quaternary time. Subsidence in the Gulf Coast geosyncline during Tertiary and Quaternary time caused tilting toward the southeast, as represented by the existing regional dip of the Cretaceous strata (fig. 6). Many of the present topographic features, including stream terraces now high above the valley flood plains, were formed during Pleistocene time.

### General Stratigraphy and Structure

The consolidated rocks exposed in Grayson County consist of sand, clay, marl, and limestone of Cretaceous age, having an estimated maximum thickness of about 3,600 feet. Near the Red River, Pleistocene and Recent sand, gravel, clay, and silt mantle parts of the surface. Pleistocene and Recent alluvium occurs also along streams and in scattered patches elsewhere in the county.

The Cretaceous system is represented in Grayson County by rocks of the Comanche series, which crop out only in the northern part of the county, and rocks of the Gulf series, which crop out in most of the remainder of the county. The Comanche series includes the Trinity group and rocks of the Fredericksburg and Washita groups. The Gulf series in Grayson County includes the Woodbine formation, Eagle Ford shale, and Austin chalk. The Trinity group and the Woodbine formation are the principal aquifers in the county. The stratigraphy and water-bearing properties of the formations are summarized in table 1.

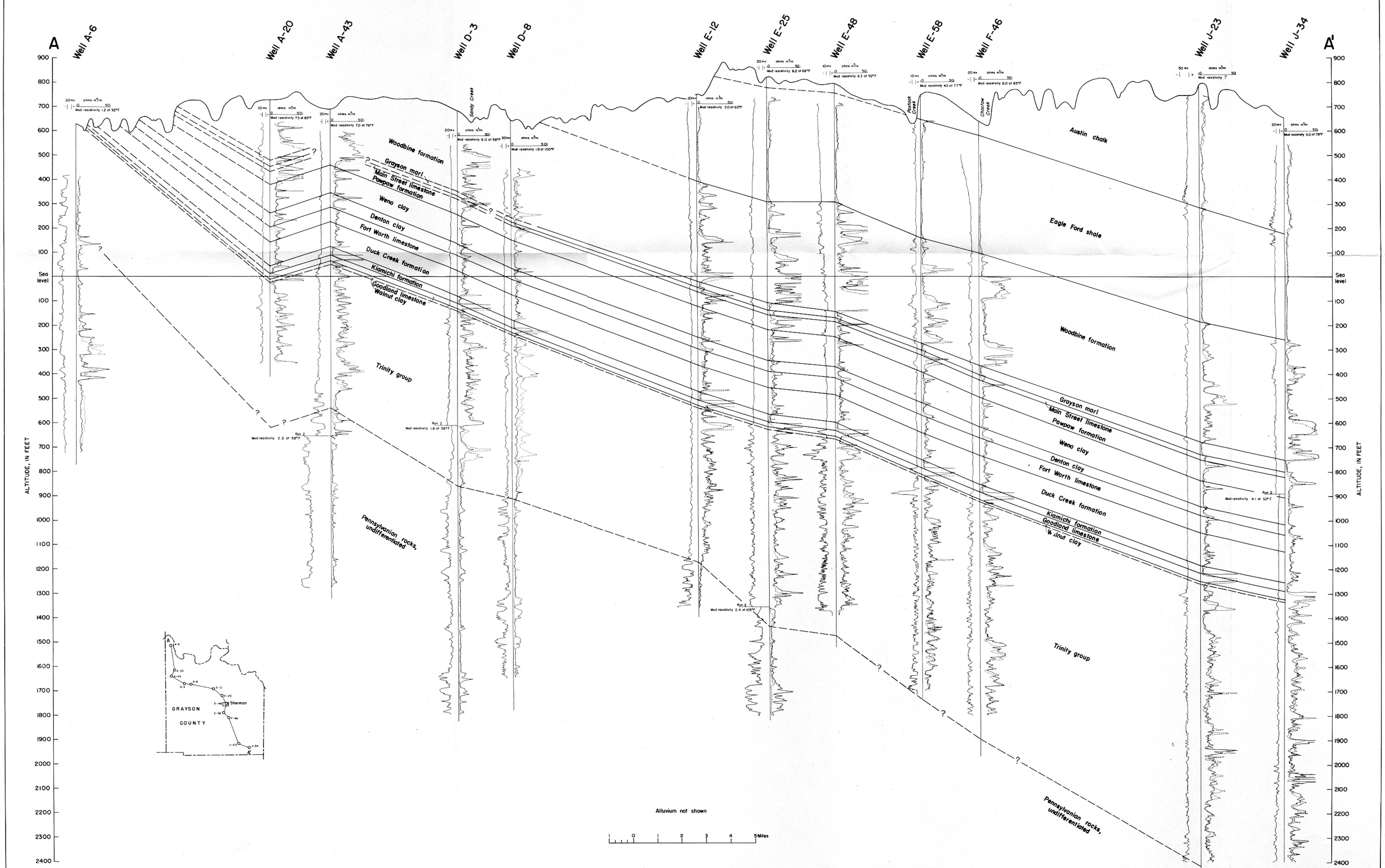


FIGURE 6.- Geologic section A-A', Grayson County, Texas

Table 1.--Stratigraphic units and their water-bearing properties, Grayson County, Texas

| System | Series and group | | Formation | Thickness (feet) | Character of rocks | Water-bearing properties |
|---|---|---|---|---|---|---|
| Quaternary | Recent and Pleistocene series | | Alluvium | 0 - 60 | Sand, gravel, clay, and silt. | Yields small to moderate quantities of water to domestic and industrial wells. |
| Cretaceous | Gulf series | | Austin chalk | 0 - 550 | White to buff chalk, marl, and limestone. | Yields small quantities of hard water to shallow domestic wells. |
| | | | Eagle Ford shale | 0 - 480 | Bluish-black gypsiferous shale; thin beds of shale and limestone. | Yields small quantities of water to domestic wells. |
| | | | Woodbine formation | 0 - 500 | Crossbedded ferruginous sand, laminated shaly clay, lignite, and gypsiferous clay. | Principal aquifer in Grayson County. Furnishes large supplies for municipal, industrial, irrigation, and domestic use. Water is typically high in iron. |
| | Comanche series | Washita group | Grayson marl | 0 - 50 | Yellowish-brown fossiliferous clay and thin limestone. | Not known to yield water to wells in Grayson County. |
| | | | Main Street limestone | 0 - 25 | Hard white- to brownish-white crystalline limestone alternating with layers of marl. | do |
| | | | Pawpaw formation | 0 - 80 | Reddish-brown calcareous clay and yellowish-brown ferruginous sand. | Yields small to moderate quantities of water to wells in outcrop area. |
| | | | Weno clay | 0 - 135 | Dark-gray to tan shaly clay and thin beds of sand and limestone, fossiliferous. | Not known to yield water to wells in Grayson County. |
| | | | Denton clay | 0 - 60 | Brownish-yellow clay, some hard sandstone beds, shell agglomerate in upper part. | do |
| | | | Fort Worth limestone | 0 - 70 | Alternating limestone and marl, fossiliferous. | do |
| | | | Duck Creek formation | 0 - 130 | Alternating limestone and marl, limestone predominating in lower part and marl in upper part, fossiliferous. | do |
| | | Fredericksburg group | Kiamichi formation | 0 - 35 | Greenish clay and thin limestone beds, fossils abundant in upper part. | do |
| | | | Goodland limestone | 0 - 40 | White fossiliferous limestone. | do |
| | | | Walnut clay | 0 - 22 | Black gypsiferous fissile shale; ledges of shell breccia. | do |
| | | Trinity group | Undifferentiated rocks | 500 - 1,200 | Fine to medium sand and beds of red, purple, and gray clay. | Yields large supplies of water for municipal, industrial, and domestic uses. Water is saline in northern part of county. |
| Pennsylvanian | Undifferentiated | | | 15,000± | Gray to red sandy shale, sandstone, and limestone. | Do not contain fresh water in Grayson County. |

The Cretaceous formations, deposited on the uneven erosional surface of the Pennsylvanian rocks, have a regional southeastward dip of about 33 feet per mile. Two prominent folds in Grayson County--the Preston anticline and the Sherman syncline--interrupt the general monoclinal dip of the strata. These structural features have a profound effect on the pattern of outcrop of the strata, which have been deflected to the south-east from their typical northerly and easterly strike (pl. 1). The position and magnitude of the structures are illustrated on figure 8 which shows by contours the altitude of the top of the Trinity group.

The Preston anticline, representing an upwarp of about 1,000 feet, begins in western Marchall County, Oklahoma, and plunges southeastward across Grayson County, becoming indistinct in southern Fannin County. From southern Marshall County the axis of the anticline enters Grayson County, crossing the Preston peninsula and passing just north of Denison and Ambrose (pl. 1). The position of the axis is represented in the Preston area by an outcrop of the Trinity group, between outcrops of the rocks of the Fredericksburg and Washita groups. The dip of the rocks on the south limb of the anticline ranges from a few feet to more than 300 feet per mile, being steepest in an area 1 to 2 miles northeast of Pottsboro. Most of the north limb of the anticline lies in Oklahoma and was not studied during this investigation; however, according to Bullard (1931, p. 62) the dip of the north limb is less steep than that of the south limb.

The Sherman syncline lies immediately to the south of and roughly parallel to the Preston anticline. The axis of the syncline trends southeastward, passing through Gordonville and Sherman (pl. 1). The syncline is a broad, shallow assymetrical fold having a steep limb on the north and a gently dipping limb on the south. Numerous subordinate flexures such as noses and terraces are present along the north limb of the syncline. A prominent anticlinal nose just east of Sherman is represented on the surface by an inlier of the Eagle Ford shale along a tributary to Choctaw Creek.

According to Harrington (1957, p. 74), the surface expression of the Sherman syncline and Preston anticline is a consequence of subsidence in the Tyler basin of east Texas and seems to reflect a wrinkling of incompetent Pennsylvanian and Cretaceous strata over the flexed Arbuckle limestone, which, when bending to join the corner of the Tyler basin, compressed the less competent beds above.

No major faults were seen at the surface in Grayson County. The narrow outcrop of the Eagle Ford shale between Sherman and Denison suggests a fault, in view of the fact that no steep dips of strata were noted at the surface in that area. This is the area of the so-called Cook Springs fault postulated by Hill (1901, p. 384).

There are several small-scale faults in widely scattered parts of the county. In a railroad cut 6 miles northeast of Whitesboro, a fault having a 6-foot throw was observed in the Woodbine formation and Eagle Ford shale. Other faults having small displacements were noted on the outcrop of the Austin chalk.

## Rock Units and Their Water-Bearing Properties

### PENNSYLVANIAN ROCKS, UNDIFFERENTIATED

Rocks of Pennsylvanian age do not crop out in Grayson County, but are found in most places directly below the Trinity group, although oil tests in a few places in the eastern part of the county penetrated overthrust rocks of possible

Mississippian age directly under the Cretaceous cover. Pennsylvanian rocks are found at depths ranging from about 3,500 feet in the southeastern part of the county to 600 feet in the north-western part. The Pennsylvanian rocks consist of a maximum thickness of about 15,000 feet of gray to red sandy shale, limestone, and sandstone. The rocks have a regional westward dip, in contrast to the overlying Cretaceous beds which dip regionally to the southeast. The Pennsylvanian rocks in Grayson County do not contain fresh water.

## CRETACEOUS SYSTEM

### Comanche Series

The Comanche series, the lowermost diversion of the Cretaceous system, includes the Trinity, Fredericksburg, and Washita groups. The oldest, the Trinity group, was deposited by an encroaching sea or an erosional land surface. The overlying Fredericksburg and Washita groups are distinguished by their cyclical type of deposition, indicated by an alternating sequence of limestone, clay, and marl, which is characteristic of sediments laid down during transgressions and regressions of the sea. In Grayson County the Comanche series ranges from about 500 to more than 800 feet in thickness.

## TRINITY GROUP, UNDIFFERENTIATED

The Trinity group is not differentiated in Grayson County. Throughout Trinity time, Grayson County was near the shore of a sea which had encroached upon the land from the southeast. In Grayson County and vicinity the deposits laid down in the Trinity sea consisted chiefly of sand and minor amounts of clay and gravel. To the south the Trinity sea deposited limestone as well. In Tarrant County, for example, the Trinity group includes, in ascending order: the Travis Peak formation (chiefly sand), Glen Rose limestone, and Paluxy sand. A facies change (representing a difference in the type of deposition) in Denton and Jack Counties south and west of Grayson County caused the Glen Rose limestone to grade into sand, so that in the area north of the facies change the Trinity group consists chiefly of sand, the Glen Rose limestone being absent.

The Trinity group crops out in massive beds in a narrow belt in the northwestern part of Grayson County, extending along the south shore of Lake Texoma for several miles in the region known as the Western Cross Timbers. Uplift and erosion associated with the Preston anticline have exposed the Trinity in this region; elsewhere in the county it is buried beneath younger rocks. The principal outcrop areas of the Trinity are to the west in Cooke and Montague Counties and to the north in Oklahoma (fig. 7). The Trinity is eroded readily and, where capped by the Walnut Clay and resistant Goodland limestone, forms steep bluffs and deep ravines. The outcrop of the Trinity in Grayson County in most places is covered by a loose mantle of alluvium deposited by Red River floods.

In its typical development in Grayson County the Trinity group begins with a basal conglomerate overlain by a fine white to gray poorly consolidated sand in massive beds. Beds of red, purple, or gray clay are scattered throughout the formation, generally in the form of lenses which are not continuous or extensive over large areas. These lenses are not effective barriers to the movement of ground water except locally. Because of the lenticular structure, individual clay beds generally cannot be correlated from place to place. The massive beds near the base and top of the Trinity probably correspond to the Travis Peak

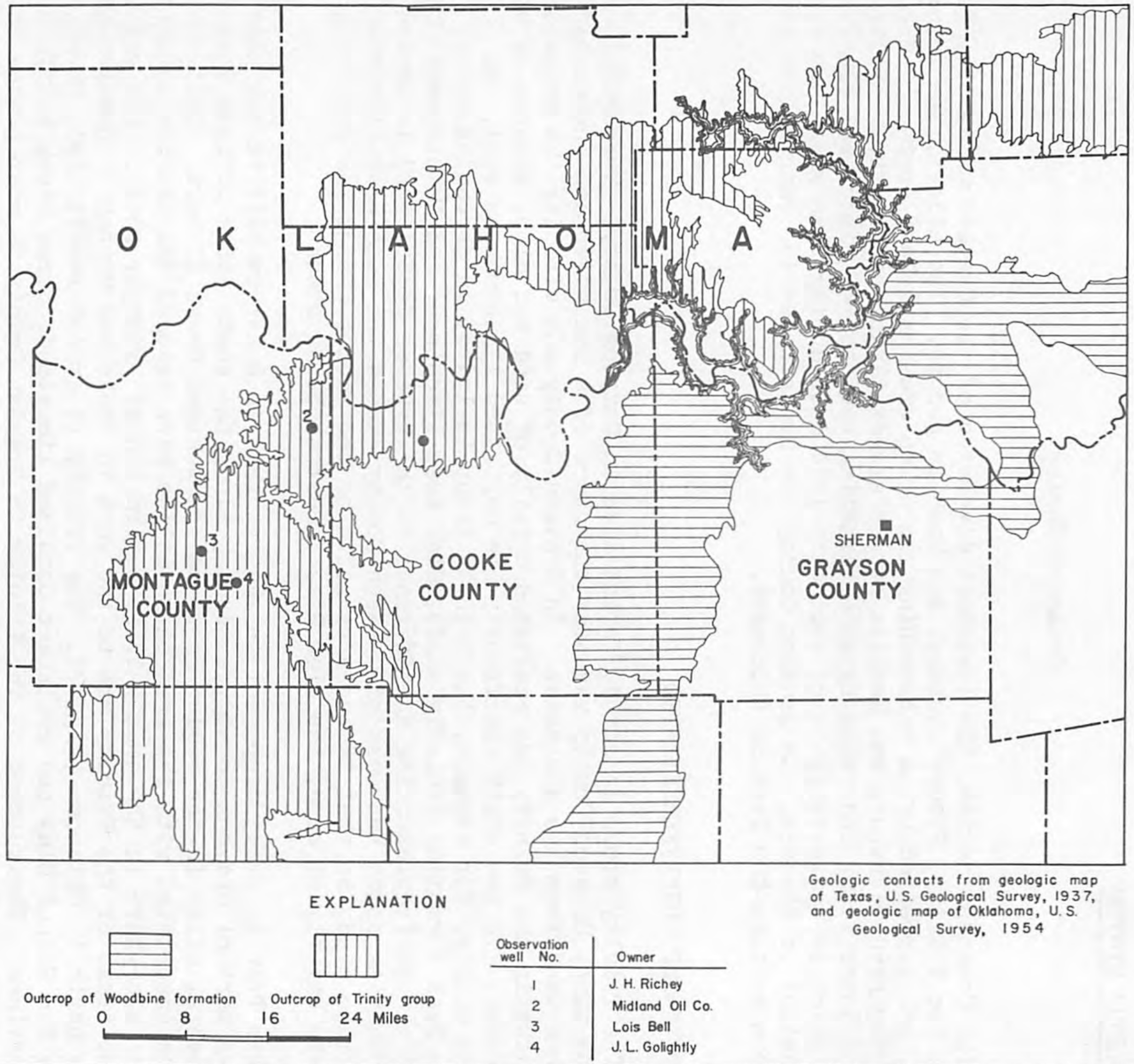


FIGURE 7.- Geologic map showing outcrop of Woodbine formation and Trinity group in Grayson County and surrounding area, and location of observation wells in Cook and Montague Counties, Texas

formation and Paluxy sand of north-central Texas. The middle part of the Trinity contains more thin sand beds than either the upper or lower part. Electric logs show some evidence of limestone beds in the middle part of the Trinity in southern Grayson County; these may correspond, in part, to the Glen Rose limestone of central Texas.

Southeast of its outcrop the Trinity group becomes deeply buried. At Sherman the Trinity is encountered at a depth of about 1,500 to 1,600 feet, and in the southeast corner of the county, at about 2,000 feet (fig. 6). The southeastward dip of the Trinity, averaging 48 feet per mile, is greatest on the south limb of the Preston anticline in the northern part of the county. The thickness of the Trinity ranges from about 500 to more than 1,200 feet, increasing in the direction of dip. The extent of the Trinity in the county and the altitude of the top are shown in figure 8.

A zone of saline water is present in the Trinity group in northern Grayson County along a narrow belt having a northwest-southeast trend parallel to the Preston anticline. South of the axis of this zone, the salinity gradually decreases until at Sherman most of the Trinity yields fresh water.

The Trinity group is second in importance to the Woodbine formation as an aquifer in Grayson County, supplying about one-third of the county's ground-water needs. In the northern part of the county, where the Woodbine formation is absent, the Trinity supplies most of the water for municipal, domestic, and stock use. Few wells penetrate the Trinity in southern Grayson County, owing to its depth and to the accessibility of the shallower Woodbine formation.

The following composite section, which includes the Goodland limestone, Walnut clay, and the upper part of the Trinity group, was measured at a road cut 7.8 miles northwest of Denison, and in a bluff overlooking Lake Texoma, 6.5 miles northwest of Denison.

| | Feet |
|---|---|
| Goodland limestone | |
| Limestone, fossiliferous, very hard, massive, white; contains _Gryphaea_ sp.; weathers to thin plates | 8.6 |
| Limestone, very fossiliferous, chalky, massive, white; contains _Turritella_ sp., _Gryphaea_, and _Pecten_ | 4.0 |
| Walnut clay | |
| Clay, fissile, black; contains streaks of yellow sericite and plates of selenite | 1.0 |
| Limestone, very fossiliferous, hard, yellowish-brown; 1 to 2-inch layer of fibrous impure calcite; contains _Exogyra_ and _Gryphaea_ | 2.2 |
| Shale, fissile, black; contains streaks of sericite and incrustations of selenite | 4.3 |
| Sandstone, very fossiliferous, calcareous, nodular, hard, brownish-gray; _Exogyra_ and _Gryphaea_ abundant | .9 |

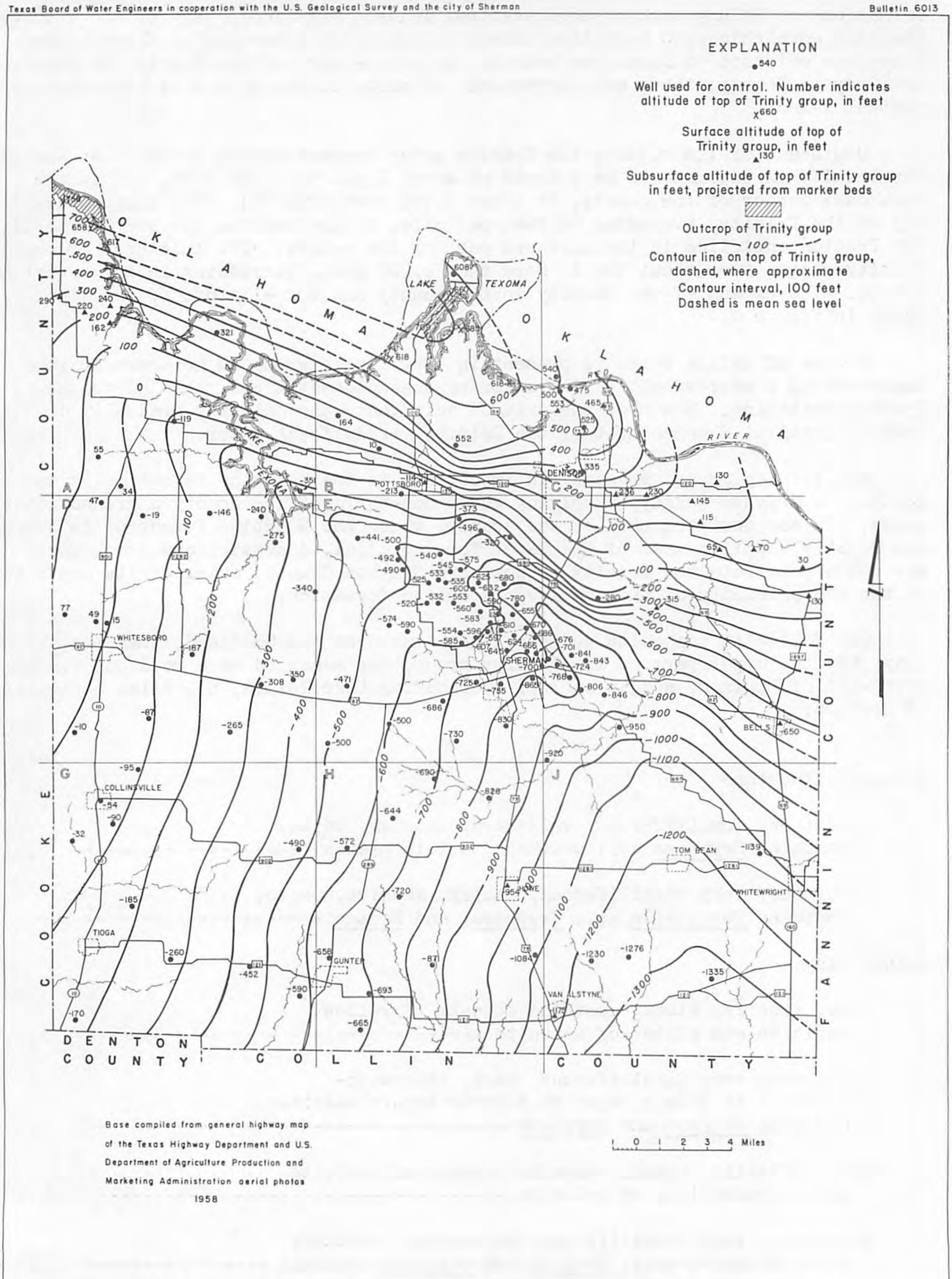


FIGURE 8.-Altitude of the top of the Trinity group, Grayson County, Texas

| | Feet |
|---|---|
| Trinity group | |
| Shale, sandy, ferruginous, light-gray; contains carbonized wood fragments | 3.0 |
| Sand, coarse to very coarse, light-gray. Grains composed of quartz. Top 3 inches is indurated fine-grained sandstone | 3.3 |
| Sand, medium to coarse, light-gray, crossbedded, locally ferruginous; contains pebbles and granules | 6.0 |
| Sand, fine, light-gray, slightly indurated; ferruginous near top | 3.4 |
| Sand, loose, light-gray. Grades upward into light-brown ferruginous indurated 3-inch sandstone bed containing small pebbles | 5.0 |
| Sand, medium, yellowish-brown, corssbedded; contains nodules of pyrite. Grades upward into 3-inch bed of light-gray hard sandstone | 1.3 |
| Sand, clayey, light-gray. Grades upward into 2-inch bed of white hard pebbly sandstone | 1.7 |
| Total Trinity group measured | 23.7 |
| Total section measured | 44.7 |

## FREDERICKSBURG GROUP

The Fredericksburg group overlies the Trinity group in Grayson County and includes, in ascending order, the Walnut clay, Goodland limestone, and Kiamichi formation. The thickness of the group, chiefly clay and limestone, ranges from 0 to about 100 feet, increasing southward and southeastward. The dip of the rocks averages about 40 feet per mile to the southeast.

The formations of the Fredericksburg group are not differentiated on the geologic map; however, their stratigraphic and structural relationships are shown in the geologic cross sections (fig. 6, 9, and 10).

### Walnut Clay

The Walnut clay unconformably overlies the Trinity group and crops out along Lake Texoma in the northwestern part of Grayson County. It consists of black gypsiferous fissile shale and layers of shell breccia containing an abundance of *Exogyra texana* Roemer and *Gryphaea marcoui* Hill and Vaughan. The thickness of the Walnut clay ranges from 8 feet where the section is complete near the outcrop to about 22 feet in southwestern Grayson County. Bybee and Bullard (1927, p. 15-16) assign a figure of 25 feet to the thickness of the Walnut clay in southern Cooke County. The Walnut is not known to yield water to wells in Grayson County.

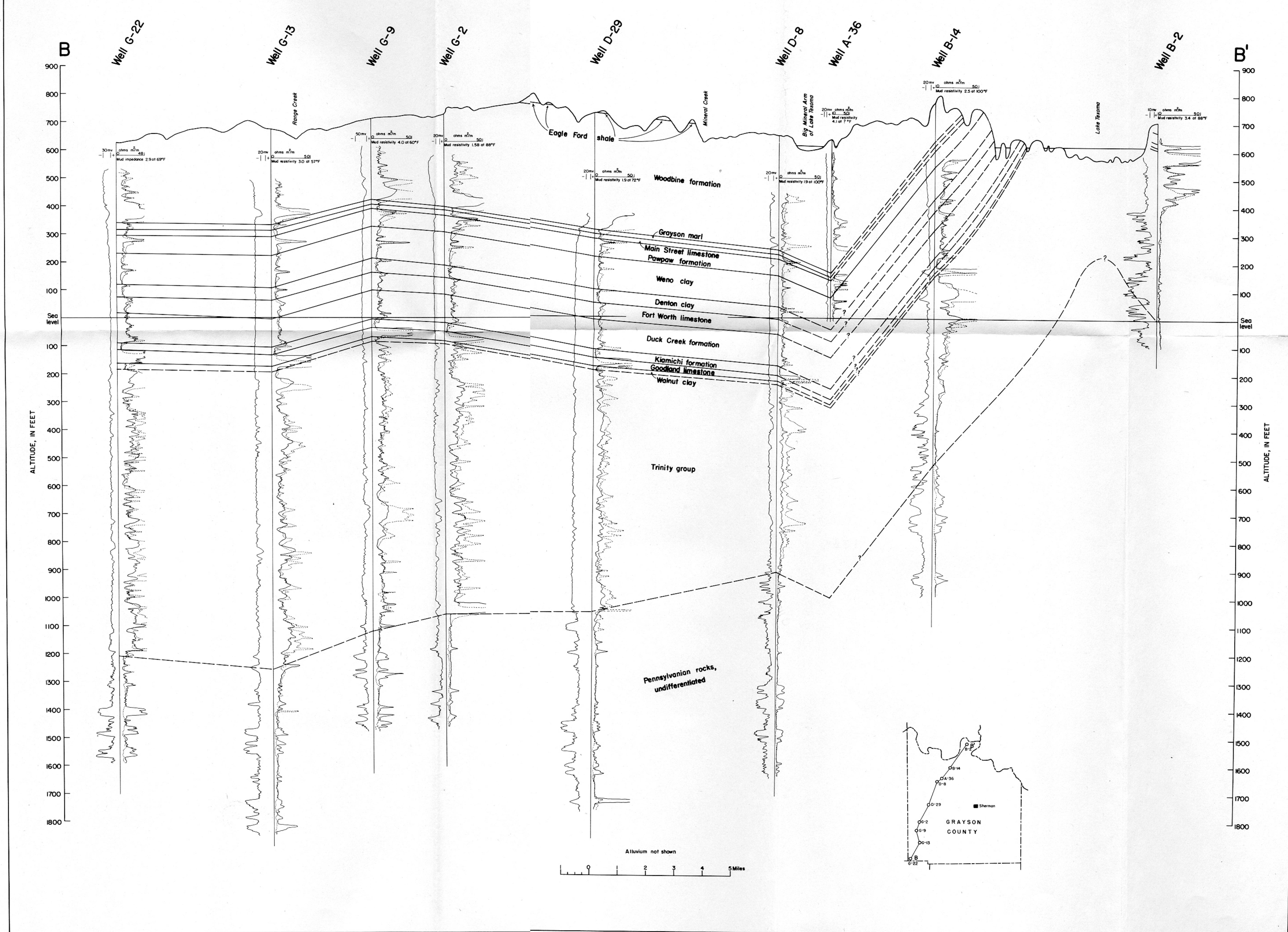


FIGURE 9.-Geologic section B-B', Grayson County, Texas

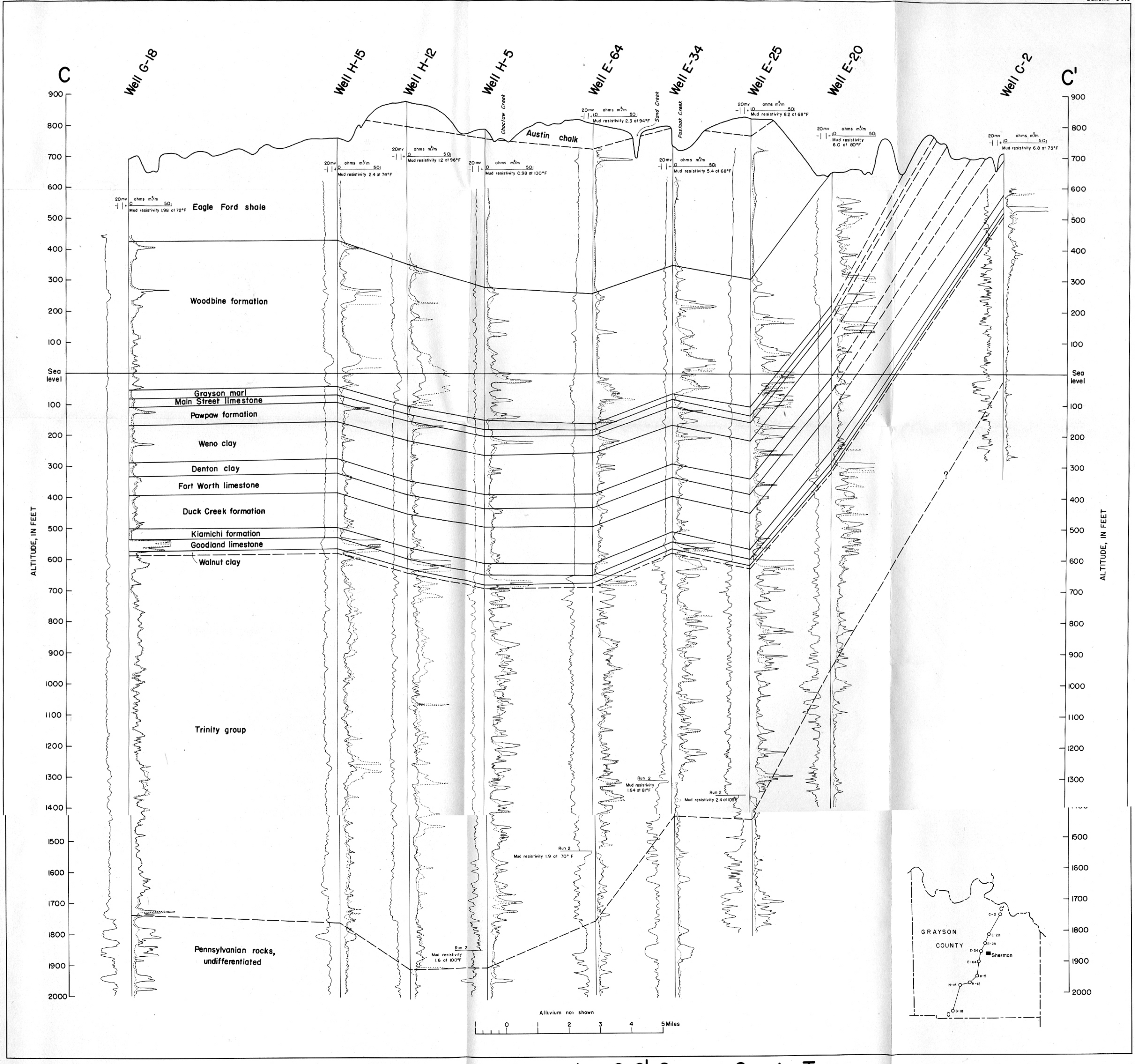


FIGURE 10.-Geologic section C-C', Grayson County, Texas

## Goodland Limestone

The Goodland limestone, named for the town of Goodland in Choctaw County, Oklahoma, conformably overlies the Walnut clay. The Goodland crops out in a sinuous, steep, northward-facing escarpment extending along Lake Texoma from the Cooke County line almost to Denison. Bullard (1931, p. 22) noted a small inlier of the Goodland limestone on Shawnee Creek east of Lake Randell, about 3½ miles northwest of Denison. The Goodland ranges in thickness from 12 feet where the section is complete near the outcrop to about 40 feet in the southern part of the county. The increase in thickness to the south and downdip is due to the presence of intervening clay and marl beds in the lower half of the formation. Winton (1925, p. 18) reports that the Goodland thickens from 42 feet in northwestern Denton County to 75 feet in the southwestern part. In southeastern Tarrant County the Goodland reaches a maximum thickness of 130 feet (Leggat, 1957, p. 24). At an outcrop northwest of Denison near Lake Texoma, the upper 8 feet of the formation is extremely hard crystalline limestone, which weathers into thin platy fragments; the lower 4 feet is chalky limestone. The upper part is sparsely fossiliferous; the lower part contains Pecten, Turritella sp., and Gryphaea sp. (See measured section, p. 30.) Throughout Grayson County the Goodland is easily identifiable on electric logs and is a valuable marker for structural mapping. The Goodland limestone is not known to yield water to wells in Grayson County.

## Kiamichi Formation

The Kiamichi, named for a river in Choctaw County, Oklahoma, conformably overlies the Goodland limestone in Grayson County. It crops out in benches or terraces between the resistant Goodland limestone and the overlying Duck Creek formation. The Kiamichi, averaging 30 to 35 feet in thickness, consists predominantly of greenish clay. Near the upper part, ledges of hard limestone 4 to 6 inches thick contain an abundance of the typical oyster Gryphaea navia Hall. These fossiliferous ledges, which are persistent across the county, constitute one of the most prominent stratigraphic horizons in the Comanche series. The Kiamichi is not known to yield water to wells in Grayson County.

## WASHITA GROUP

The Washita group, which overlies the Fredericksburg group with apparent conformity, was named for Fort Washita in Bryan County, Oklahoma. Included in this group, in ascending order, are the Duck Creek formation, Fort Worth limestone, Denton clay, Weno clay, Pawpaw formation, Main Street limestone, and Grayson marl. The Washita group ranges in thickness from 435 to about 550 feet, thickening downdip but thinning along strike to the south. The group, chiefly alternating beds of limestone and marl but containing some sand near the top, forms a large part of the Grand Prairie, an area of gently rolling hills, which extends across the northern part of the county. The formations of the Washita group are not differentiated on the geologic map and are mapped together with the formations of the Fredericksburg group (pl. 1). The stratigraphic and structural relationships are shown on the geologic cross sections (figs. 6, 9, and 10). The Washita group is not an important source of water in Grayson County. The Pawpaw formation, however, supplies small to moderate quantities of water to shallow domestic wells near its outcrop in the northern part of the county.

## Duck Creek Formation

The Duck Creek formation, named for a creek about 3 miles north of Denison, overlies the Kiamichi with apparent conformity in Grayson County. However, near Fort Worth the presence of rounded pebbles and transported debris at the contact suggests a lack of conformity (Adkins, 1932, p. 349). The outcrop extends across much of the northern part of Grayson County, crossing the Red River northeast of Denison. The formation ranges in thickness from about 90 to 130 feet; the thickness is rather uniform in the downdip direction but decreases along the strike toward the south. The Duck Creek consists chiefly of interbedded nodular limestone and marl; the limestone weathers to form prominent ledges. In the lower 40 to 50 feet, the limestone and marl alternate in thin beds; however, the limestone is predominant, the limestone beds being thicker. The marl beds greatly predominate in the upper 60 to 70 feet, where the limestone beds are thinner and are separated by increasingly greater thicknesses of marl. The contact with the overlying Fort Worth limestone is gradational from marl to limestone.

The lower part of the Duck Creek formation is very fossiliferous. The large ammonite Desmoceras brazoense (Shumard), abundant in a narrow zone from 30 to 40 feet above the base of the formation, is valuable for structural mapping because of its limited range. Other fossils in the Duck Creek formation include the ammonites Hamites sp. and Pervinquieria trinodosa (Böse), several species of the echinoid Hemiaster, and the pelecypod Inoceramus comancheanus Cragin.

The Duck Creek formation is not known to yield water to wells in Grayson County.

## Fort Worth Limestone

The Fort Worth limestone, named for excellent exposures in the city of Fort Worth, overlies the Duck Creek formation conformably and crops out in northern Grayson County on the south flank of the Preston anticline. The area of outcrop is characterized by cuestas which result in a rough topography. The Fort Worth is about 60 feet thick near the outcrop, thickening downdip to about 70 feet in the southeastern part of the county. The formation thins along the strike toward the south and is about 50 feet thick in the southwestern part of the county.

The Fort Worth consists of limestone and marl in alternating beds which may be separated into three distinct lithologic units. The lower unit consists of about 15 to 20 feet of limestone and minor beds of marl; the middle unit, about 20 feet thick, is predominantly marl; the upper unit is chiefly limestone and is about 15 to 20 feet thick. The Fort Worth limestone is easily confused with the underlying Duck Creek formation but may be distinguished from it on the basis of fossils. Characteristic fossils in the Fort Worth include the abundant echinoid Hemiaster elegans Shumard and the ammonite Pervinquieria leonensis (Conrad).

The Fort Worth limestone is not known to yield water to wells in Grayson County.

## Denton Clay

The Denton clay, which conformably overlies the Fort Worth limestone, crops out in a narrow band across most of northern Grayson County, the most prominent exposures being northwest of Pottsboro along Lake Texoma. Near the area of outcrop, the formation is about 60 feet thick, but it thins downdip to about 40 feet in the southeastern part of the county. Winton (1925, p. 25) reports a thickness of 25 to 35 feet of the clay in Denton County. The Denton consists of brownish-yellow clay and thick beds of hard light-colored sandstone. A bed of sandy shell agglomerate, containing an abundance of Gryphaea washitaensis Hill and Ostrea carinata Lamarck, marks the top of the formation.

The Denton clay is not known to yield water to wells in Grayson County.

### Weno Clay

The Weno clay, named for the small village of Weno (now abandoned) on the Red River northeast of Denison, is apparently conformable with the underlying Denton clay and the overlying Pawpaw formation. The outcrop of the Weno extends in a narrow belt across the northern part of the county. The formation ranges in thickness from about 110 to about 135 feet. Bullard (1926, p. 38) reports a thickness of 135 feet in northern Marshall County, Oklahoma. The formation consists of dark-gray to tan shaly clay, thin beds of sand, clay-ironstone concretions, and in the upper part some hard sandstone and limestone beds. The fossils Ostrea quadriplicata Shumard and Turritella sp. are characteristic of the Weno.

The Weno clay is not known to yield water to wells in Grayson County.

### Pawpaw Formation

The Pawpaw formation, named for the outcrop on Pawpaw Creek north of Denison, conformably overlies the Weno clay. The outcrop lies in a narrow belt in the northern part of the county. Locally the Pawpaw forms a topography very similar to that of the Eastern Cross Timbers belt, and the formation may be mistaken for the Woodbine formation. The Pawpaw is about 60 feet thick near the outcrop, thickening downdip to about 80 feet in the southeastern part of the county. The formation thins slightly along strike to the south; near the Denton County line the thickness is about 50 feet. The Pawpaw consists of reddish-brown calcareous clay in the lower part and poorly cemented yellowish-brown ferruginous sand at the top. The sand at the top of the formation generally is in a massive bed 20 to 30 feet thick. Nodules and pebbles of ironstone are characteristically abundant on the outcrop. Pelecypods, many of them in a good state of preservation, are abundant in the clay.

The sand in the Pawpaw formation yields small to moderate quantities of water to shallow wells in the area of outcrop in Grayson County. South of the outcrop, wells generally do not penetrate the Pawpaw but produce exclusively from the Woodbine formation. However, a few large-capactiy wells in the Woodbine, notably at Sherman, include the sand of the Pawpaw in the screened section.

The following section, which includes all the Pawpaw formation, Main Street limestone, and Grayson marl and the basal part of the Woodbine formation was measured at the railroad cut of the Pottsboro cutoff of the Missouri, Kansas, and Texas Railroad, about 5½ miles west of Denison.

| | Feet |
|---|---|
| **Pawpaw formation** | |
| Sandstone, brittle, platy, ferruginous, fine-grained | 1.0 |
| Shale, slightly sand, light-gray; surface covered with irregularly shaped limestone nodules; ironstone concretions containing impressions of pelecypods are abundant in upper part | 11.0 |
| Sand, platy, very fine, light-brown | .7 |
| Shale, light-gray; contains clay-ironstone concretions, small limestone nodules, and thin beds of sand; weathers red | 21.0 |
| Sand, ferruginous, massive, brownish-yellow; contains thin lenses of ironstone having impressions of small pelecypods; upper 5 feet clayey and highly fossiliferous | 22.0 |
| Subtotal | 55.7 |
| **Main Street limestone** | |
| Limestone, hard, grayish-white | 1.2 |
| Marl, gray; contains Exogyra arietina Roemer | .5 |
| Limestone, gray; contains Exogyra arietina Roemer | 1.5 |
| Marl, dark-gray, fossiliferous | .3 |
| Limestone, gray, fossiliferous | .5 |
| Marl, gray; contains Exogyra arietina Roemer | .3 |
| Limestone, hard, grayish-white; contains Pecten sp. | .5 |
| Marl, yellowish-gray; contains Kingena wacoensis (Roemer) | .3 |
| Limestone, hard, white; contains Kingena wacoensis (Roemer) | 1.5 |
| Marl, fossiliferous, gray | .8 |
| Limestone, light-gray; contains Exogyra arietina Roemer and Kingena wacoensis (Roemer) | .9 |
| Marl, light-gray; contains nodules of limestone | 3.0 |
| Subtotal | 11.3 |

| | Feet |
|---|---|
| Grayson marl | |
| Marl, light-gray; contains thin beds and nodules of limestone, Exogyra arietina Roemer, and Gryphaea mucronata Gabb | 11.0 |
| Covered by soil | 11.0 |
| Subtotal | 22.0 |
| Woodbine formation | |
| Covered by sandy soil; surface shows fragments of ferruginous pebbles | 6.0 |
| Sandstone, indurated, fine-grained, white | 9.0 |
| Clay, plastic, dark-red and light-gray; contains thin sand beds | 14.0 |
| Sandstone, ferruginous, slightly indurated, light-brown | 12.0 |
| Sandstone, indurated, dark-red, crossbedded; contains beds of conglomeratic ironstone and fragments of petrified wood | 14.0 |
| Subtotal | 55.0 |
| Total section measured | 144.0 |

Main Street Limestone

The Main Street limestone, named for exposures on the main street of Denison, conformably overlies the Pawpaw formation. The hard limestone crops out in conspicuous ledges along the Red River in northern Grayson County and is easily mapped. Likewise, the Main Street is easily identified on electric logs and serves as a useful stratigraphic marker. The thickness of the Main Street ranges from 11 to 15 feet in the outcrop area. Unlike most of the other formations in the area, the Main Street thickens along the strike toward the south, reaching a thickness of about 25 feet in the southwestern part of the county. The Main Street consists of beds 1 to 2 feet thick of hard white to brownish-white crystalline limestone alternating with marl layers 1 to 6 inches thick. Generally, the limestone is massive at the base, becoming thinner near the top where the marl beds are prominent. Oxidation of pyrite in the limestone causes an iron-stained appearance. Exogyra arietina Roemer and Kingena wacoensis Roemer occur in the upper part of the limestone and Turrilites brazoensis Roemer near the base.

The Main Street is not known to yield water to wells in Grayson County.

Grayson Marl

The Grayson marl, uppermost member of the Washita group and Comanche series, crops out in a narrow belt extending across the northern part of the county. Bergquist (1949) described about 17 feet of "unnamed shale and sandy clay (post-Grayson)" directly above the Grayson shale and below the Woodbine formation. These rocks are included with the Washita and Fredericksburg groups on the geologic map (pl. 1) and with the Grayson marl on the cross sections (figs. 6, 9, and 10). Ferruginous debris and slope wash from the overlying Woodbine generally cover the Grayson's outcrop and good exposures are rare. The thickness of the formation averages about 15 to 20 feet near the outcrop, thickening to about 25 feet along strike to the south. Downdip in the southeastern part of the county, the Grayson marl thickens to nearly 50 feet. It consists of yellowish-brown fossiliferous calcareous clay and bluish-gray marl containing many nodules of limestone and thin layers of grayish limestone. The more prominent limestone beds near the base represent the gradation from the underlying Main Street limestone. The lower part of the Grayson contains an abundance of Exogyra arietina Roemer. Other characteristic fossils include Gryphaea mucronata Gabb and Turrilites brazoensis Roemer.

The Grayson marl is not known to yield water to wells in Grayson County.

## Gulf Series

Rocks of the Gulf series overlie rocks of the Comanche series unconformably and are represented in Grayson County by the Woodbine formation, Eagle Ford shale, and Austin chalk. These sedimentary rocks have an average dip of 35 feet per mile to the southeast and reach a maximum thickness of about 1,500 feet. Cropping out in more than three-fourths of Grayson County, the rocks of the Gulf series form the surface of the Eastern Cross Timbers and Black Prairie belts.

### WOODBINE FORMATION

The Woodbine formation, named for the village of Woodbine in eastern Cooke County, is the basal formation of the Gulf series in north Texas. The relation of the Woodbine to the underlying rocks of the Comanche series has not been determined in Grayson County. However, the Woodbine apparently rests unconformably on the underlying Grayson marl, although the contact is obscured in many places by overwash. Bergquist (1949) reported that in the vicinity of Cedar Mills about 9.5 miles northwest of Pottsboro the Woodbine formation, containing reworked shells of Gryphaea mucronata Gabb at the base, is channeled through the Grayson marl and rests on Main Street limestone. Electric logs of wells in the Gordonville-Sandusky area, about 8 miles north of Whitesboro, show abnormal relationships at the contact zone. (See wells A-20, A-43, D-3, and D-8 in fig. 6) The contact of the rocks of the Comanche and Gulf series in that area is obscure; the Woodbine appears to overlie rocks that are not lighologically typical of the upper Washita group. It is not known whether erosion removed much of the upper rocks of the Washita in this area prior to deposition of the Woodbine or whether a local facies change altered the typical composition of the rocks.

The Woodbine outcrop, forming the Eastern Cross Timbers belt in Grayson County, averages 6 miles in width along the Cooke County line, but narrows to 3 miles across the northern part of the county. The outcrop begins to narrow a few miles east of Pottsboro because of steeply dipping beds. The Woodbine weathers to a loose soil which supports a growth of post oak and blackjack on the hilly northern outcrop. The surface is gently rolling near the Cooke County line where the proportion of clay is greater, and prairies predominate in that area. The Woodbine formation thickens downdip, increasing from 410 feet near the outcrop to 500 feet in the southeast corner of the county. The Woodbine consists of medium to coarse crossbedded ferruginous sand, much of which is unconsolidated, and laminated shaly clay interbedded with layers of lignite and gypsiferous clay. Beds of hard siliceous sandstone are scattered throughout the Woodbine; locally, the outcrop is covered with residual boulders of siliceous sandstone. Massive reddish sand beds are found in some places; however, the individual beds are highly lenticular and grade into clay within short lateral distances. In most places in Grayson County the thickest sand beds are found at or near the base and in the upper third of the Woodbine. The presence of alunite nodules marks the contact of the Woodbine with the overlying Eagle Ford shale (Stephenson, 1946, p. 1765).

Figure 11 shows by contours the altitude of the top of the Woodbine in Grayson County. If the altitude of the land surface is known, the depth to the top of the sand can be computed for any locality in the county. For example, the map shows the altitude of the top of the formation at Sherman to be about 200 feet. The altitude of the land surface is about 750 feet, consequently the depth to the formation is about 550 feet.

The Woodbine is the principal source of ground water for public supply, industrial, irrigation, and domestic use in Grayson County. It supplies water to all the industrial wells in the Sherman area. Water from the Woodbine is typically high in iron content but otherwise is satisfactory for nearly all purposes. Locally it may be highly mineralized where the water-producing sands contain lignite.

## EAGLE FORD SHALE

The Eagle Ford shale, named for the village of Eagle Ford 6 miles west of Dallas, conformably overlies the Woodbine formation. The outcrop pattern approximates that of the Woodbine, having two distinctly different directions of strike. The 8-mile-wide north-south outcrop turns abruptly to the east near Pottsboro and continues in a narrow belt, half a mile to 3 miles in width, leaving the county near the town of Bells. The outcrop of the Eagle Ford shale, forming a part of the Black Prairie belt, is a treeless prairie in most places in Grayson County; locally, near Bells, sandy layers in the upper part of the shale become prominent enough to produce a wooded sandhill topography. The Eagle Ford ranges in total thickness from 440 to about 480 feet in uneroded sections in Grayson County.

The formation consists chiefly of bluish-black gypsiferous shale and some thin lenses and bands of hard limestone. Calcareous concretions are found in the upper and lower parts. Near the top of the Eagle Ford, sand layers--in places hard fossiliferous sandstone--total about 15 to 20 feet in thickness, becoming thicker eastward. The hard fossiliferous sandstone layers contain an abundance of *Ostrea lugubris* Conrad.

The following section, which includes the upper part of the Eagle Ford shale and the basal Austin chalk, was measured along the county road and Choctaw Creek, 5½ miles southwest of Sherman.

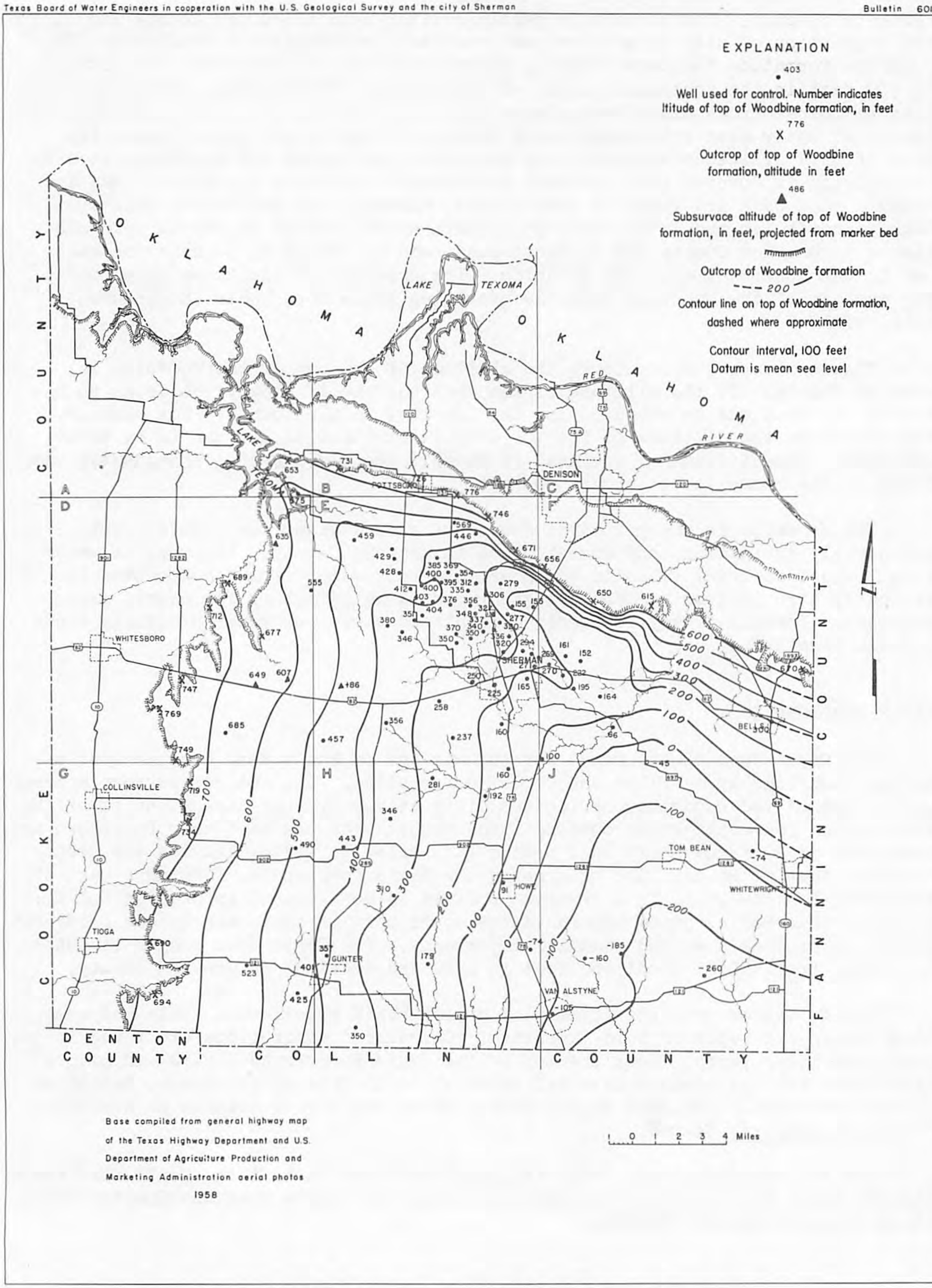


FIGURE 11.- Altitude of the top of the Woodbine formation, Grayson County, Texas

| | Feet |
|---|---|
| Austin chalk | |
| Chalk, hard, white, platy | 6.0 |
| Marl, soft, light-brown, sandy near bottom, indurated and layered near top, grading into overlying chalk; contains limestone pebbles | 22.0 |
| Conglomerate, slightly cemented; pebbles of crystalline limestone, sandstone, phosphate, and reworked *Ostrea lugubris* Conrad average 2 to 3 inches in size | 1.5 |
| Eagle Ford shale | |
| Sandstone, hard; cemented with calcium carbonate; *Ostrea lugubris* Conrad abundant | 1.5 |
| Sand, clayey, light-gray to yellow-brown; few hard thin sandstone layers; sparse pelecypod fauna | 7.0 |
| Shale, fissile, dark-gray; veins of yellow sericite | 15.5 |
| Sandstone, very fossiliferous, hard, light-gray, lenticular; small pebbles of dark-colored jasper; changes in places to a sandy shale with large septarian concretions. *Ostrea* sp. Upper 6 inches contains gastropod fauna | 1.0 |
| Shale, sandy, fissile, dark-gray; contains local lenses of hard sandstone | 3.0 |
| Total Eagle Ford shale measured | 28.0 |
| Total section measured | 57.5 |

The Eagle Ford shale supplies small quantities of water to shallow wells in Grayson County.

## AUSTIN CHALK

The Austin chalk, unconformably overlying the Eagle Ford shale, is the youngest formation of Cretaceous age in Grayson County. Underlying about one-third of the county, the Austin chalk forms a west-facing white escarpment overlooking the broad plain formed by the Eagle Ford shale. The outcrop of the Austin chalk, mainly in the central and southeastern parts of the county, weathers to a black residual soil forming a part of the Black Prairie belt. The maximum thickness of the formation in Grayson County is about 550 feet.

The Austin consists of chalk and limestone interbedded with layers of marl. The deeply buried rocks are bluish; those near the surface in the zone of weathering are chalky white. *Inoceramus* sp. and segregations of pyrite, which alter into marcasite, are commonly associated with the limestone beds. The base of the Austin chalk is marked by the presence of a conglomerate containing an abundance of Ostrea lugubris Conrad and fish teeth. The basal conglomerate, in part, is the so-called "fish-bed" conglomerate of Taff and Leverett (1893, p. 303).

The Austin chalk supplies small quantities of hard water to shallow dug wells in Grayson County. Many of the wells are dry during extended periods of drought.

## QUATERNARY SYSTEM

### Pleistocene and Recent series, undifferentiated

#### ALLUVIUM

Alluvial deposits forming flood plains and terraces are Pleistocene and Recent in age, but are undifferentiated on the geologic map (pl. 1). Generally, the older alluvial deposits, which are represented by terraces high above the present stream valleys, are dissected and show effects of erosion. In some areas the high-level terraces coalesce near junctions of streams and cap interstream divides. Associated with the high-level terraces are the younger, lower lying deposits, which form benches or broad terraces adjacent to the streams. The lowermost surface is the flood plain which includes the present stream bed.

The alluvium along each stream consists of sediments derived from rocks that crop out within the drainage basin of the stream. Streams draining shaly areas deposit alluvium that consists chiefly of tight, impermeable material; conversely, streams that drain sandy areas deposit alluvium that consists chiefly of permeable material. In some places in Grayson County the alluvium consists almost entirely of relatively impermeable clay or silt. In other places, especially along the Red River where meanders are common, it includes layers of sand, or possibly buried channels of gravel, that may yield water freely. The thickness of the alluvial deposits in Grayson County ranges from 0 to about 60 feet.

The most extensively developed terrace and flood-plain deposits in Grayson County are associated with the Red River. Many of the low-level deposits west of Denison Dam are now covered by Lake Texoma. In the northeastern part of the county, alluvium forms about 17 square miles of flood-plain and terrace deposits along the Red River. The highest deposits, about 200 feet above the river, are poorly exposed and deeply eroded; the younger terrace deposits, nearer the river, are more distinct. A measured section of the deposits of the lower terrace, which is about 40 feet above the river, disclosed about 30 feet of sand, silt, and clay, with gravel at the base. North of Denison in an area of about 4 square miles, the alluvium is reported to be as much as 60 feet thick.

Less extensive deposits of alluvium are found in other parts of the county, notably along the upper reaches of Choctaw Creek and along Isle du Bois, Range, and Buck Creeks (pl. 1). The alluvium in these areas is probably thin and unimportant hydrologically.

The alluvial deposits in Grayson County yield small to moderate quantities of water, chiefly to domestic wells. Only those deposits north of Denison and in the northeastern part of the county are known to be water bearing. The water in the alluvium is hard but otherwise suitable for most uses.

# GROUND WATER

## Occurrence and Movement

Open spaces in rocks, called "voids" or "interstices", contain the water that is found in the zone of saturation below the land surface. This water may be recovered through wells and springs. The capacity of a rock to hold water is determined by its porosity, but its capacity to yield water is determined by its permeability. Some deposits, such as silt or clay, may have a high porosity but because of the minute size of the interstices transmit water very slowly. Other deposits, such as well-sorted gravel, contain large interconnected openings which transmit water rapidly. Part of the water in any deposit does not drain into wells by gravity because it is held against the force of gravity by molecular attraction. Below a certain level the permeable rocks are saturated with water under hydrostatic pressure. The upper surface of this zone of saturation is called the water table. Wells dug or drilled into the zone of saturation become filled with ground water to the level of the water table.

Artesian conditions exist where permeable strata lie between less permeable strata, and ground water is confined under pressure. Water enters the aquifer in recharge areas, percolates slowly down to the water table, and then laterally down the dip of the water-bearing formation beneath the overlying confining bed. The water exerts pressure against the confining bed, so that when a well is drilled through the confining bed the pressure is released and water rises above the level at which it is found. If the elevation of the land surface is much below the general level of the area of outcrop, the pressure may be sufficient to cause the water to flow naturally from the well. Artesian conditions prevail in the Trinity group and Woodbine formation where they are overlain by impermeable beds downdip from the outcrop.

The rate of movement of water through an aquifer depends upon the porosity, permeability, and hydraulic gradient. Ground water moves from areas of recharge to areas of discharge under the influence of gravity; however, the movement is generally very slow, especially in sand bodies such as the Trinity group and Woodbine formation. The time necessary for water to move from the areas of recharge of the Trinity and Woodbine to, for instance, the city of Sherman, would be measured in centuries. Present average rates of movement of water in the Trinity group and Woodbine formation are estimated to be about 1 to 2 and 10 to 20 feet per year, respectively.

The presence of large quantities of salt water in the Trinity group along the crest and southern flank of the Preston anticline in the northern part of Grayson County is probably related to the natural movement of water. Much of the salt water in the aquifer is probably sea water which moved into the aquifer during the deposition of younger Cretaceous rock strata under marine conditions. Prior to the development of ground water from the Trinity group, the natural movement of water in the aquifer was from the areas of outcrop or recharge to the areas of natural discharge. Although some of the water in the artesian parts of the aquifer was discharged by vertical movement upward through less permeable rock strata, much of the water moved to other natural outlets. At the exposure of the Trinity along parts of the Preston anticline in the Red River valley altitudes of 530 feet or less are common compared to altitudes of 700 to 1,100 feet in the recharge areas of Cooke and Montague Counties and adjacent parts of Oklahoma. As a result, this was an area of natural discharge through seepage and possible spring flow into the Red River. The water-level altitude of 535 feet in well B-2 on Preston peninsula in 1943, 8 feet higher than the altitude of the Red River before the impounding of Lake Texoma, is evidence of movement of water toward the river. Water movement toward the river from the southeast near the turn of the century also is indicated by a 650-foot water-level altitude in a well in the Trinity a mile south of Denison, as reported by Hill (1901, p. 620). This natural discharge area around the Preston anticline served a large part of the aquifer. Salt water moving from the surrounding area converged on the discharge area resulting in an accumulation of salt water, part of which was not effectively removed by discharge.

After the development of wells in the Trinity group, accompanied by a general decline in water levels and the impounding of water in Lake Texoma, the gradient or direction of movement of water was reversed. Water is now moving away from the Preston anticline which has become an area of recharge. Much of the present water movement in the Trinity in Grayson County is probably toward Sherman, where heavy withdrawals have brought about a large decline in the water levels.

Sufficient data are not available to show in detail the direction of movement of water in the Woodbine formation in Grayson County. In general, however, the water is moving downdip in a southeastward direction from the outcrop in the western and northern parts of the county. Locally in areas of heavy pumping, for example at Sherman, water moves from the surrounding areas toward these discharge areas.

Water in the alluvial deposits north of Denison and in the northeastern part of the county probably moves toward points of discharge in the Red River.

## Recharge

Recharge to ground-water reservoirs results from the infiltration of water from precipitation on the outcrop of the formations, by seepage from lakes or other bodies of surface water, or by vertical and lateral movement of water from one underground reservoir to another. The latter process is not a primary source of recharge but only an incident to underground water movement.

Ground water in Grayson County is derived chiefly from precipitation on the outcrop of the formations. The Woodbine crops out in Grayson County and to the west in Cooke County. The Trinity group crops out in places in Grayson County along Lake Texoma; the major outcrop, however, is to the west in Cooke and Montague Counties and north of the Red River in parts of Oklahoma (fig. 7).

The soil mantle and outcropping rocks of the Trinity group and Woodbine formation provide an excellent facility for recharge of ground water. During some periods of rainfall a part of the water runs off directly into streams, part is evaporated, part is transpired by vegetation, and the remainder percolates downward to the water table. Recharge is most effective during periods of long, heavy rainfall when the requirements of evaporation and transpiration are quickly satisfied, allowing the excess water to escape these consumptive processes and to run off or penetrate to the water table. Recharge from precipitation may occur in any month of abundant rainfall, but it is least likely in the latter part of the growing season in July, August, and September, because of the usual soil-moisture deficiency during those months. A substantial rise of water levels in wells in the recharge area of the Trinity group and Woodbine formation in Grayson, Cooke, and Montague Counties indicates that there was considerable recharge during May 1959 (fig. 12).

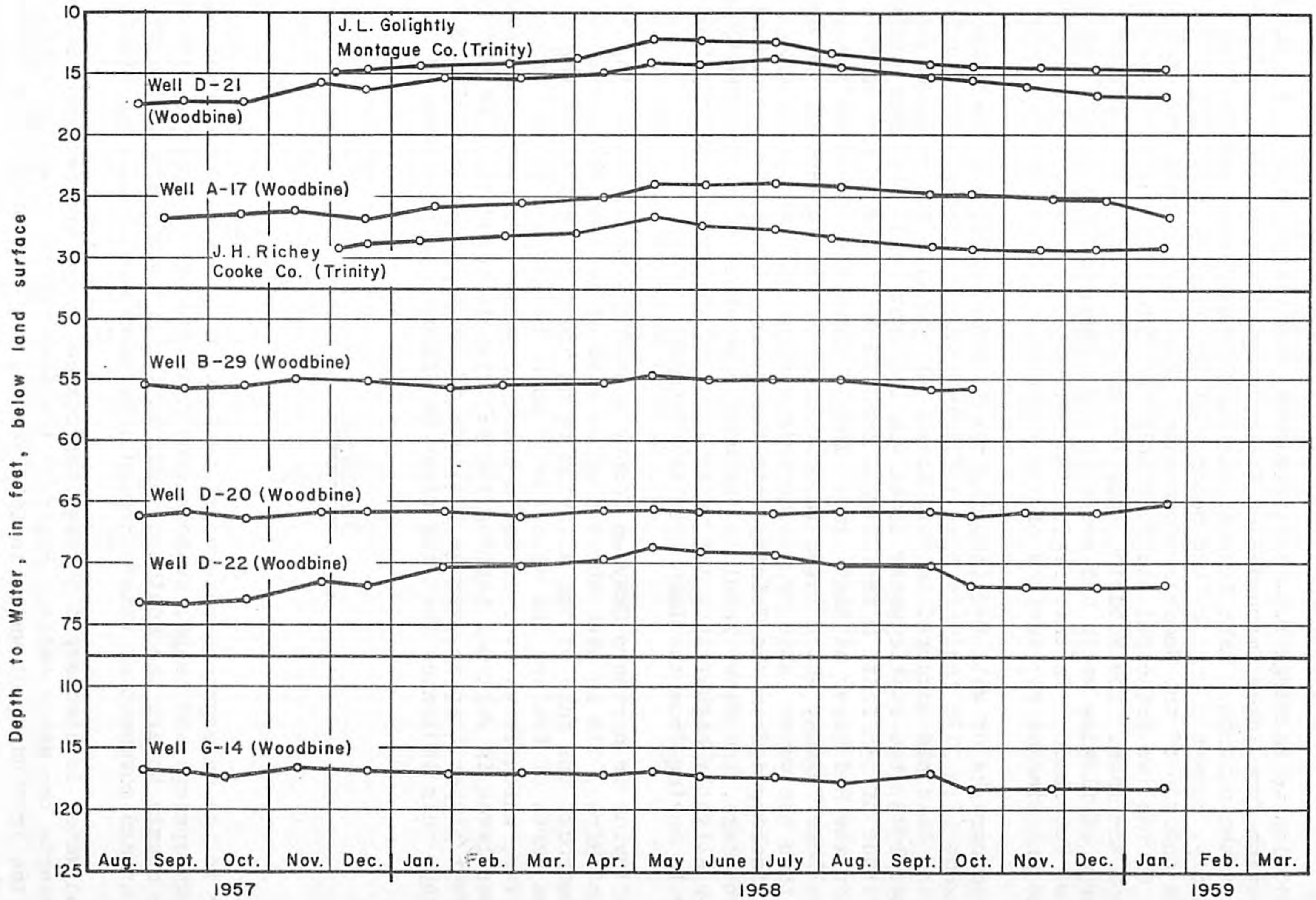


FIGURE 12.- Fluctuation of water levels in wells in the outcrop of the Woodbine formation and Trinity group, Grayson, Cooke and Montague Counties, Texas

Recharge to the alluvial deposits near the Red River is derived chiefly from precipitation on their sandy surface and to a lesser extent from runoff from adjacent slopes.

In addition to recharge from precipitation, water may enter the formations by infiltration from lakes impounded on the outcrop of the aquifers or by streams flowing over the outcrop. Lake Texoma, the largest surface-water reservoir in Grayson County, covers a part of the outcrop of the Trinity group and a smaller part of the outcrop of the Woodbine formation. The lake is both influent and effluent. Of the two principal aquifers only the Trinity group receives water by seepage from the lake. The Woodbine supplies ground water to Lake Texoma through the discharge of flowing wells and seeps in and around the Big Mineral Arm of the lake west of Pottsboro. In this region the surface of the lake is lower than the water table and piezometric surface of the Woodbine.

The hydrographs of well B-2 (tapping the Trinity group) and the water level in Lake Texoma (fig. 13) indicate that infiltration, or recharge, to the Trinity sand from the lake has occurred in this area. At the time the well was drilled in September 1943, the static water level was 173 feet below the land surface and had an altitude of 535 feet, 8 feet higher than the altitude of the surface of the water in the Red River at that time. Thus, before the regulated impounding of water in Lake Texoma, which began in October 1943, the surface of the Red River was lower than the water table or piezometric surface of the Trinity group and water was discharged from the Trinity into the river. After the impounding of water in the lake, the water level in the well rose about 80 feet. The lake surface is now slightly higher than the water level of the Trinity group, indicating that water is moving from the lake into the Trinity.

The alluvium in northern Grayson County apparently is not receiving recharge from the Red River. In an area about 8 miles east of Denison the river is flowing over bedrock, the base of the alluvium being about 10 feet above the stream. In the area north of Denison the alluvium is much thicker and is in contact with the Red River, which flows over it for a short distance. However, the altitude of the water level in well C-1 tapping the alluvium is reported to be 515 feet, about 10 feet higher than an average altitude of the water surface of the Red River nearby; this indicates that the river is effluent in this area.

## Discharge

### NATURAL

Water in the underground reservoirs in Grayson County is discharged naturally through springs and seeps, evaporation, transpiration by plants, underflow out of the county toward the southeast and, in the artesian part of the reservoirs, by upward movement of water through less permeable, confining strata.

Ground water is discharged through springs and seeps wherever the land surface intersects the water table. Prior to the development of wells in the Trinity group and the impounding of water in Lake Texoma, the area around the Preston anticline where the Trinity is exposed was a natural discharge point for water in the Trinity, and water undoubtedly was discharged through seeps and springs in that area. Some water is discharged through seeps and springs in the area of outcrop of the Woodbine between Sherman and Denison along tributaries to Choctaw Creek. This discharge can be considered rejected recharge that is, water that enters the outcrop but cannot move down the dip under present hydraulic gradients

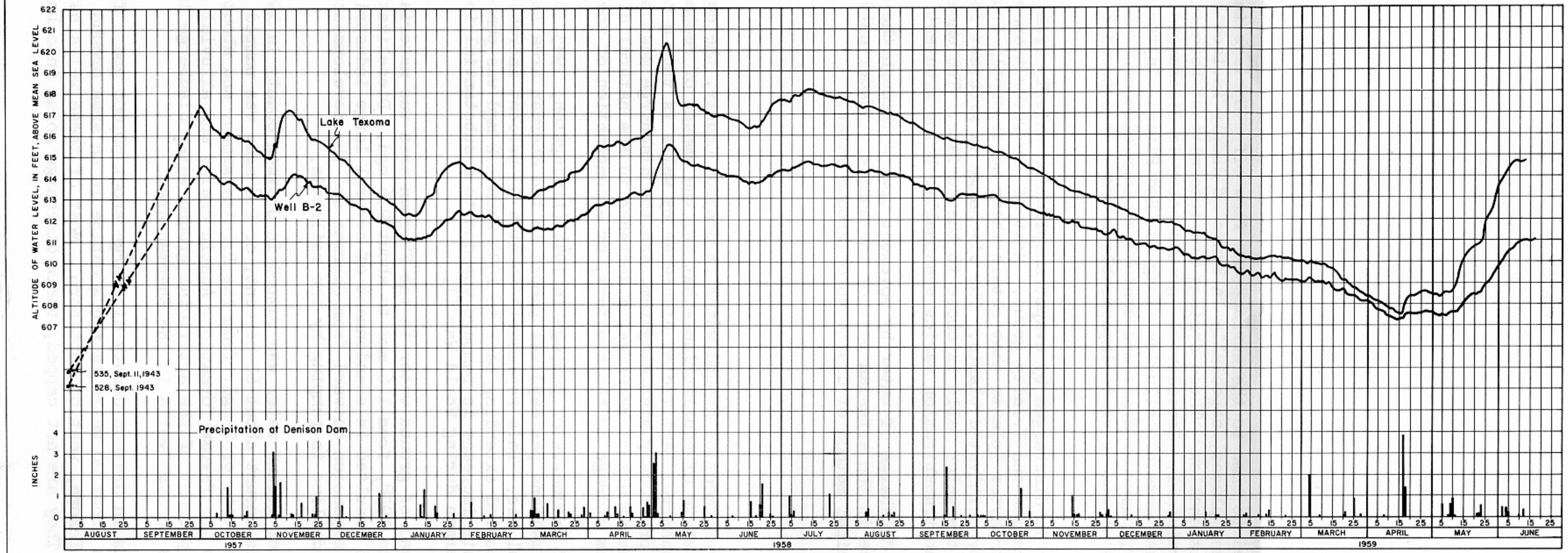


FIGURE 13.- Fluctuation of water levels in well B-2 and in Lake Texoma and precipitation at Denison Dam, Grayson County, Texas

and thus is forced to come to the surface and flow off. Springs in the Austin chalk occur in many places, especially in banks of deeply incised creeks where the water table is shallow. These springs are intermittent becoming dry in periods of insufficient rainfall. Considerable ground water is discharged through seeps and springs in the permeable alluvium along the Red River. In the northeastern part of the county numerous seeps and contact springs discharge along the bank of the Red River and at places where impermeable bedrock is exposed between terrace levels.

Ground water is discharged by evapotranspiration chiefly from the outcrop of the Woodbine formation and Trinity group. Most of the water transpired is discharged by phreatophytes (plants that obtain their water supply from the zone of saturation) and by cultivated plants. The discharge is greatest in areas of dense vegetation where the water table is close to the surface. The amount of water discharged by evapotranspiration varies seasonally, being greatest in the summer.

The natural discharge of water by movement upward through the overlying rock strata takes place in the artesian part of the aquifer. Under natural conditions this is the principal method of discharge of ground water.

ARTIFICIAL

Prior to development of ground water in Grayson County, the aquifers were essentially in a state of equilibrium--that is, the amount of recharge equaled the amount of discharge. Artificial discharge by wells is thus a new condition imposed upon the previously stable system, and the discharge must be balanced by an increase in the amount of recharge, a decrease in the natural discharge, a loss of water from storage in the aquifers, or a combination of these methods.

Estimates of ground-water pumpage in 1944 (Livingston, 1945, p. 3) show that 1.6 mgd (million gallons per day) was pumped in the Sherman area for public supply and industrial use. This represents about a 33 percent increase in pumpage over an 11-year period extending back to 1933 when 1.2 mgd was pumped. The larger part of this increase in pumpage was due to a substantial increase in the population of Sherman during World War II.

The withdrawal of ground water in the Sherman area was materially increased again from 1944 to 1958, from 1.6 mgd to about 2.6 mgd. Dieselization of the railroads in 1955 resulted in abandonment of several large industrial wells; however, industrial expansion outward from Sherman and the development of additional wells offset any decline in pumping by the railroads.

About 5 mgd of ground water was pumped in Grayson County in 1957 for all purposes. Of this amount about 61 percent, or 2.8 mgd, was pumped from the Woodbine; about 36 percent, or 2 mgd, from the Trinity group, and about 3 percent, or 0.15 mgd, from the Pawpaw formation, Austin chalk, and alluvial deposits. Approximately 65 percent of the artificial ground-water discharge in Grayson County take place through wells in the Sherman area.

Flowing wells in Grayson County discharge about 50,000 gpd. The production comes mostly from about 20 wells in the Woodbine in an area around the Big Mineral Arm of Lake Texoma, west of Pottsboro. Most of these wells have been flowing since 1900. They are not capped, their discharge going into Lake Texoma.

## Fluctuations of Water Levels

Water levels in aquifers fluctuate almost continually from artificial and natural causes. In general, the major factors that control the changes of water levels are the rates of recharge to and discharge from the aquifer. Changes of water level are caused also by variations in atmospheric pressure, tidal fluctuations, earthquakes, and other disturbances. The fluctuations are usually gradual, but it is not uncommon in some wells for the water level to rise or fall several inches or feet in a few minutes.

Fluctuations due to natural processes generally occur in cycles -- daily, annual, or other periods. Cyclic fluctuations during a day are caused chiefly by tidal and barometric effects and by changes in the rate of evapotranspiration. Annual fluctuations are generally the result of changes in the rate of precipitation and evapotranspiration throughout the year and consequently the amount of water available for recharge.

Fluctuations of considerable magnitude, especially in artesian aquifers, result chiefly from artificial processes. Withdrawals of ground water cause cones of depression to form in the water table or the piezometric surface, the cones being centered at centers of pumpage. The amount of influence of the cone of depression decreases with distance from the point of discharge. Water levels in the artesian reservoirs in Grayson County usually begin a period of decline in June, reaching a low in August when pumping is generally greatest. Recovery of the water levels takes place chiefly during the period from about September to May.

### TRINITY GROUP

Little information is available regarding the artesian pressure in the Trinity group in Grayson County prior to development of wells in the county. A comparison of early reported levels in the Woodbine formation at Sherman and in the Trinity group at Denison indicates that the water level in the Trinity at Sherman in the early part of the 20th century was probably about 100 feet below the land surface. The water levels declined steadily after wells were drilled in Grayson County and in areas to the west, where many flowing wells in Cooke and Denton Counties have ceased to flow and are now equipped with pumps. A rapid decline of artesian pressure took place in the Sherman area during and after World War II because of increased withdrawals of water for public supply and industrial use.

During the period 1909 to 1958, water levels in wells in the Trinity at the Fairview municipal pumping station in Sherman declined at least 180 feet; however, 63 percent of this decline, or 113 feet, took place after 1945. At other places in the city the wells in the Trinity are more widely spaced and the declines have been less. For example, in well E-55 the water level declined 65 feet during the period 1947 to 1958 and in well E-36 the water level declined 78 feet from 1944 to 1958. Hydrographs of short-term water levels in the Sherman area (fig. 14) show that artesian pressures in the Trinity group are at their lowest in August, generally the month of greatest water pumping.

Water levels in the Trinity group have declined considerably also in the western part of Grayson County in the vicinity of Collinsville and Whitesboro, where water is pumped for public supply from the Trinity. During the period 1935 to 1957 the water level in well E-26 at Whitesboro declined 72 feet, an average

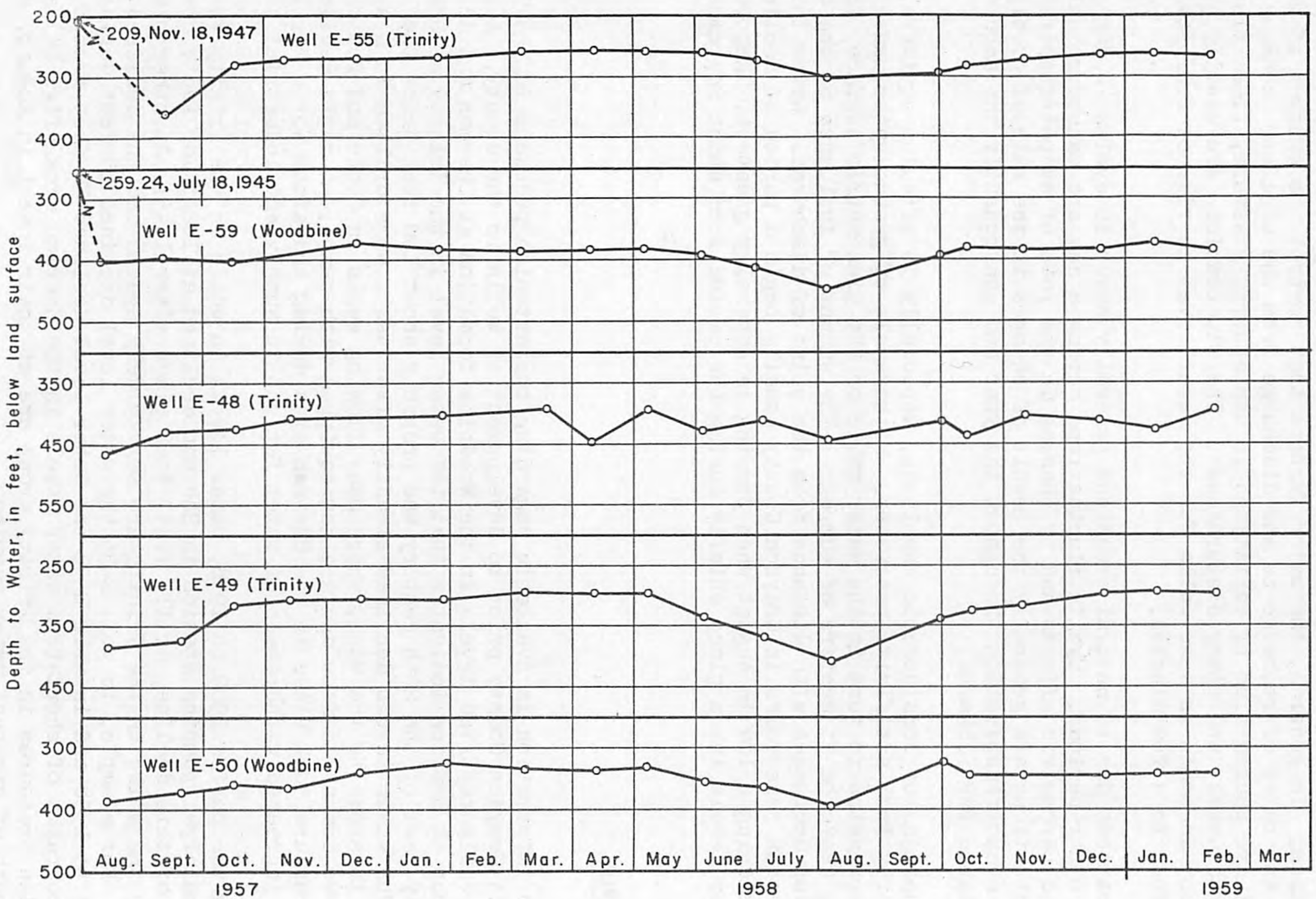


FIGURE 14.- Fluctuation of water levels in wells in the Woodbine formation and Trinity group at Sherman, Grayson County, Texas

of almost 3.5 feet per year. This area is midway between Sherman and Gainesville, both centers of heavy pumping, and the water levels here may be affected slightly by pumping in those cities.

Hydrographs of wells in the outcrop of the Trinity group in Cooke and Montague Counties (fig. 12) show fluctuations of water levels in response to recharge from rainfall on the outcrop of the aquifer. During 1958 the water levels in the J. L. Golightly well in Montague County and the J. H. Richey well in Cooke County fluctuated about 3 feet, the former showing no net decline for the year, the latter showing a net decline of 0.5 foot.

Figure 13 shows the fluctuations of the water level in well B-2, tapping the Trinity group in the vicinity of the outcrop in Lake Texoma, compared with fluctuations of water levels in the lake. Prior to October 1943, when water was first impounded in Lake Texoma, the water level in the well fluctuated independently of the water level in the Red River. After the formation of Lake Texoma, the water level rose nearly 80 feet in the well during the 14-year period from 1943 to 1957, indicating recharge from the lake into the sand. The water level, controlled almost entirely by the lake, fluctuates several feet below the level of the lake. Figure 13 shows also that changes in the lake level are reflected almost instantaneously at the well, indicating a pressure change followed by a slow transfer of water. Low permeability of the Trinity does not permit rapid movement of water in the aquifer; consequently, infiltration from the lake is a slow process.

## WOODBINE FORMATION

Water levels in the Woodbine in the Sherman area have shown large declines since the drilling of the first municipal wells early in the 20th century. During the 49 year period 1909-58, the water levels in wells at the Fairview pumping station in Sherman declined about 240 feet; however, 65 percent of this decline, or 156 feet, occurred during the 13-year period 1945-58. In well E-26 in the north-central part of Sherman, the water level declined 166 feet from 1933 to 1958, an average of about 6.5 feet per year. Water levels have declined rapidly since 1945 owing to the increased withdrawals of ground water during the postwar period. Water levels in some of the municipal wells during pumping are at or below the top of the Woodbine indicating at least local overdraft. The short-term hydrographs of wells E-50 and E-59 (fig. 14) show the decline in water levels and fluctuations due to seasonal pumping at Sherman.

Although the decline of artesian pressure has been widespread in Grayson County, the magnitude of decline diminishes with distance from the centers of heavy pumping. Since the drilling of the first well in the heavily pumped Perrin Air Force Base well field, 6 miles northwest of Sherman, the water level declined 72 feet in well E-9 during the period 1941 to 1957, an average of 4.5 feet per year. In well E-14, also in the Perrin Air Force Base well field, the water level declined 35 feet from 1953 to 1957, an average of 9 feet per year. Three miles north of Perrin Air Force Base at Pottsboro, the water level in well B-27 declined an average of 6.5 feet per year from 1952 to 1958.

Water levels in and near the outcrop of the Woodbine formation in Grayson County probably have not been seriously affected by the large withdrawals of water downdip. Hill (1901, p. 624) reports a number of flowing wells at altitudes of 650 feet or less in an area 6 miles west of Pottsboro. The majority of these wells are still flowing with little apparent loss of head. Furthermore, recharge is probably still being rejected in the outcrop area along Choctaw Creek between Sherman and Denison. The hydrographs of wells on the outcrop of the Woodbine (fig. 12) show, for the most part, fluctuations in response to recharge from rainfall -- the highest water levels usually coinciding with the months of greatest rainfall. The effect of evapotranspiration, greatest in late summer, causes a decline of water levels during that period.

## Water-Bearing Formations

The principal water-bearing formations in Grayson County are the Trinity group and Woodbine formation, which supply more than 95 percent of the ground water used in the county. Other water-bearing formations of lesser regional importance which yield small to moderate amounts of water include the alluvial deposits, Pawpaw formation, Austin chalk, and Eagle Ford shale.

### TRINITY GROUP

#### Hydraulic characteristics

The yield of a well is usually measured in gallons per minute or cubic feet per second. Yield depends upon the ability of the aquifer to transmit water, the thickness of the water-bearing material, the efficiency of the well, and the allowable drawdown.

Very few wells in Grayson County penetrate and are screened through the entire thickness of the water-bearing sands; therefore, the yields of the wells in general are less than the maximum that could be developed if the wells penetrated to the bottom of the aquifer and were screened through the entire saturated thickness.

The yields from the Trinity group range from less than 1 gpm to 700 gpm, the largest yields being from the Sherman city wells. Most of the Sherman wells penetrate the full thickness of the fresh-water-bearing part of the aquifer and are screened opposite all the water-bearing sands. Most of the wells having low yields are in the western and northwestern parts of the county and are windmill wells constructed to furnish only enough water for stock and domestic use on farms. The potential yield of wells in the Trinity group increases across the county from northwest to southeast because of an increase in thickness of the formation in that direction.

The specific capacity of a well is expressed as a ratio of the discharge to the drawdown, generally expressed in gallons per minute per foot of drawdown, and it is assumed to be a direct proportion. For instance, if the discharge of a well is doubled, the drawdown will be doubled. The specific capacity of 11 wells in the Trinity group in Grayson County ranged from 0.57 to 4.2 gpm per foot, averaging about 2.25 gpm per foot (table 2).

Table 2.--Yields and specific capacities of selected wells in the Trinity group in Grayson County, Texas

| Well No. | Diameter of screen (in) | Yield (gpm) | Drawdown (ft) | Time since pumping stopped (hrs) | Specific capacity (gpm/ft) |
|---|---|---|---|---|---|
| A-21 | 7 | 25 | 43.9 | 1 | 0.57 |
| B-2 | 10-3/4 | 112 | 65.0 | - | 1.7 |
| D-25 | 5-1/2 | 330 | 104 | 1 | 3.2 |
| E-12 | 8-5/8, 6-5/8 | 100 | 156 | 24 | .6 |
| E-36 | 6-5/8 | 543 | 260 | 24 | 2.1 |
| E-48 | 8-5/8 | 400 | 173 | 2-3/4 | 2.3 |
| E-49 | 8-5/8 | 600 | 203 | 3 | 2.9 |
| E-55 | 7 | 354 | 160 | 1/2 | 2.2 |
| E-58 | 10-3/4 | 560 | 366 | 24 | 1.5 |
| E-61 | 10-3/4 | 602 | 170 | 24 | 3.7 |
| G-1 | 5-1/2 | 110 | 26 | 3 | 4.2 |

Pumping tests were made on 5 wells in the Trinity group to determine the coefficients of transmissibility and storage, which govern the ability of the aquifer to transmit and yield water. The coefficient of transmissibility is defined as the rate of flow of water, in gallons per day, through a vertical strip of the aquifer that is 1 foot wide and extends the vertical thickness of the aquifer under a hydraulic gradient of 1 foot per foot and at the prevailing temperature of the water. Thus, the volume of water that will flow each day through each foot of the water-bearing material is the product of the coefficient of transmissibility and the existing hydraulic gradient. Therefore, the smaller the coefficient of transmissibility, the greater the hydraulic gradient required for the water to move through the aquifer at a given rate. Many of the wells tested penetrate only thin sections of the formation, and the coefficients obtained are not representative of the full thickness. Therefore, the field coefficient of permeability is used for expressing the ability of the aquifer to transmit water per unit of thickness. The coefficient is determined by dividing the field coefficient of transmissibility by the thickness, in feet.

The coefficient of storage is defined as the volume of water the aquifer releases from or takes into storage per unit surface area per unit change in the component of head normal to that surface. Under artesian conditions, the coefficient of storage is a measure of the ability of the formation to yield water from storage by the compression of the formation and the expansion of the water as the head is lowered. The coefficient of storage for an artesian aquifer, like the Trinity group and most of the Woodbine formation in Grayson County, is small; consequently, after pumping starts, a cone of depression is developed over a wide area in a short time. Under water-table conditions the coefficient of storage reflects gravity drainage of the aquifer and is very much larger.

The coefficients of transmissibility determined from the pumping tests ranged from a low of 300 gpd per foot at well A-21 to a high of 4,700 gpd per foot at well E-61 (table 3). The increase in the coefficient of transmissibility southward and southeastward can be attributed to an increase in thickness of the formation in those directions. Average values of the coefficients of transmissibility and storage of the Trinity group are approximately 2,800 gpd per foot and 0.0003, respectively.

Table 3.--Coefficients of transmissibility, permeability, and storage determined from pumping tests on selected wells in the Trinity group, Grayson County, Texas

| Date | Well No. | Coefficient of transmissibility (gpd/ft) | Coefficient of permeability (gpd/ft$^2$) | Coefficient of storage | Remarks |
|---|---|---|---|---|---|
| 8-13-58 | A-21 | 400 | 13 | - | Well is screened for 30 feet only. Not used in computing average. |
| | A-21 | 300 | 10 | - | Not representative and not used in computing average. |
| 1-30-59 | E-61 | 4,700 | 11 | | |
| 7-18,19-45 | E-38 | 2,200 | | 0.00008 | |
| do | E-36 | 3,200 | 10 | 0.00002 | |
| 7-19,20-45 | E-38 | 3,700 | - | 0.00002 | |
| 7-20,21-45 | E-38 | 2,800 | - | 0.00002 | |
| do | E-36 | 2,500 | 8 | - | |
| 3-19,20-59 | E-58 | 2,000 | 4 | | |
| 3-20,21-59 | E-58 | 1,600 | 3 | | |
| Average * | | 2,800 | | 0.00003 | |

*Excluding Well A-21

The coefficients of transmissibility and storage can be used to predict the general order of magnitude of the future drawdown in water levels caused by pumping a well or by a general increase in the pumping in an area. Theoretical drawdown curves in figure 15 were computed from the average coefficients determined for the Trinity group in the artesian part of the aquifer. The curves show the theoretical drawdown caused by pumping 100 gpm continuously for periods of 1 day, 1 month, 1 year, and 10 years at distances of 1 foot to 10,000 feet from the pumped well. The drawdown caused by pumping is proportional to the rate of pumping. As an example, if the drawdown 1 foot from a well is 10 feet while 100 gpm is being pumped, the drawdown would be 20 feet at 200 gpm. The total drawdown at any one place within the cone of influence of several wells would be the sum of the influences of all wells.

Drawdowns in wells may be reduced by reducing the pumping and/ (or) spacing the wells farther apart. Records should be kept of pumpage and water levels and new wells should be pump tested when completed. These records afford a basis for controlling the pumping so as to keep drawdown to a minimum.

As long as the pumping level is not below the top of an artesian aquifer from which it draws water, the aquifer is still full of water and the decline in water level represents only a decline in pressure. However, when the pumping level declines below the top of the aquifer, dewatering begins, resulting in a decrease in the saturated thickness of the aquifer, which in turn causes a decrease in the coefficient of transmissibility and consequently, a decrease in the yield of the well. On the other hand, when the water level declines into the aquifer, water-table conditions are set up and the rate of expansion of the cone of depression is greatly retarded.

## Future development

The volume of fresh water in transient storage in the Trinity group in Grayson County is estimated to be about 60 million acre-feet. Only a fraction of this water is available for recovery through wells, however, because of the great depth at which it occurs in much of the county and because much of the water would be held in the sand by forces of capillarity, against the pull of gravity.

The Trinity group is the most favorable source of additional ground water in the heavily pumped Sherman area. Even though water levels in the Trinity in Sherman have declined more than 100 feet since 1945, pumping levels presently are more than 800 feet above the top of the aquifer. In well E-48 at Old Settler's Park, the pumping level in August 1957 was 648 feet below the land surface, or 812 feet above the top of the Trinity; in well E-49 at Cherry Park, the pumping level in August 1958 was 615 feet below the land surface, or 885 feet above the top of the formation in well E-58 at Roscoe Russell station, the pumping level in March 1959 was 718 feet below the land surface, or 872 feet above the top of the formation; and in well E-61 at Tuck station, 6 miles south of Sherman, the pumping level in August 1959 was 480 feet below the land surface, or 1,100 feet above the top of the formation. Although a large margin of safety presently exists before dewatering of the aquifer begins, the economics of higher lifting costs from declining pumping levels probably will be an important factor limiting the full development of water from the Trinity sand in the Sherman area. If additional declines in the water levels are to be minimized, future wells of large capacity drilled to the Trinity group will have to be spaced as far apart as economically possible.

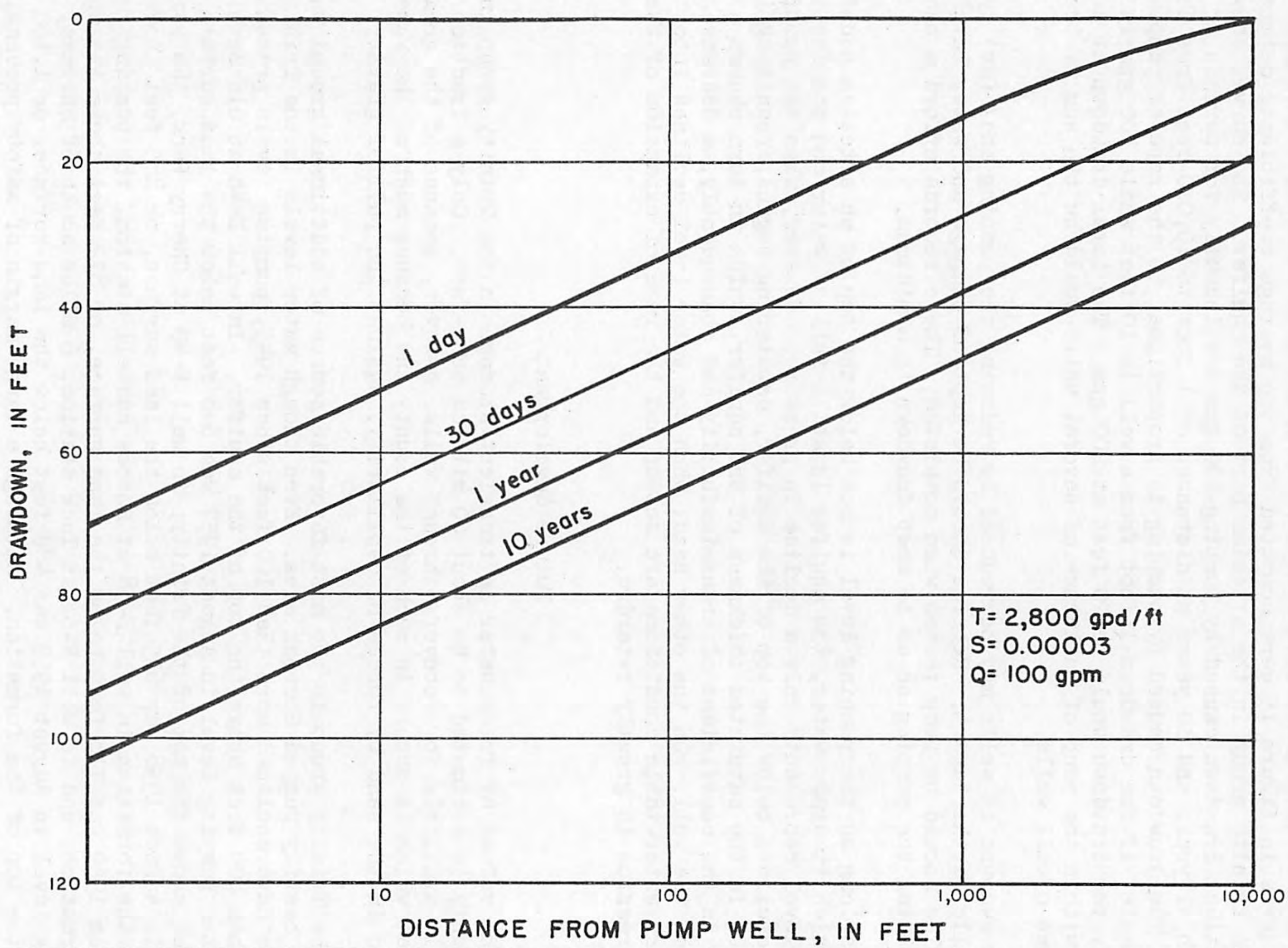


FIGURE 15.-Theoretical drawdown due to pumping 100 gpm from an infinite aquifer (Trinity group)

The threat of salt-water encroachment in the Trinity group should also be considered. Large quantities of salt water in the Trinity group on the Preston anticline in northern Grayson County are moving southward toward the heavily pumped Sherman area. However, this movement poses little threat in the foreseeable future because of its slow rate. Increased withdrawal of water at Sherman could cause a coning-up of the basal salt water, possibly resulting in some salt-water contamination in wells and an increase in the salinity of the fresh water being pumped. This situation should not discourage future development of the Trinity, however, because the amount of fresh water in the Trinity in the Sherman area is large in proportion to the amount of salt water.

Large quantities of additional ground water can be developed from the Trinity group in other parts of Grayson County. High artesian pressures and large available drawdowns prevail throughout most of the county because of the altitudes of the outcrop area and the deep position of the aquifer. However, the factor limiting any large ground-water development in the Trinity group is the amount of saturated fresh-water sand available in the area. Figure 16 shows saturated-sand thicknesses in various parts of Grayson County. The amount of sand increases southward from the outcrop in the northern part of the county, reaching a maximum in the southern part. The increase is due not only to the thinning of the Trinity group section toward the outcrop but also to the inclusion of progressively greater amounts of salt-water-bearing sand northward to the Preston anticline. The thickness of saturated sand exceeds 600 feet about 3 miles east of Tioga. The thickness is in excess of 500 feet in a large area from Tioga to Gunter; other smaller areas of similar thickness are about 2 miles northeast of Collinsville, 3 miles north of Howe, and 2 miles south of Sherman. Large developments of ground water from the sections of thick sands are possible, whereas the thin sections of fresh-water sand and low transmissibilities in the northern part of the county preclude the development of large-capacity wells in that area.

## WOODBINE FORMATION

### Hydraulic characteristics

The yields of wells in the Woodbine formation range over wide limits, from less than 1 gpm in windmill wells on the outcrop to about 600 gpm at Sherman. The extreme range is caused largely by the type of well construction. Many of the wells are constructed so as to produce only sufficient quantities of water for domestic or stock use. In most places much larger yields could be obtained from properly constructed wells.

The specific capacities of wells in the Woodbine ranged from 0.36 to 6.0 gpm per foot. Here again the range is largely the result of differences in well location and construction. The wells having the highest specific capacities are those in the thicker sand sections downdip from the outcrop. The average of the specific capacities in 12 wells tested is about 2.9 gpd per foot (table 4).

Pumping tests made on 9 wells in the Woodbine indicate that the average coefficient of transmissibility is about 3,200 gpd per foot; the average coefficient of storage in 5 of the wells was 0.00001 (table 5). Theoretical drawdown curves in figure 17 were computed from an average of the coefficients determined for the Woodbine in the artesian part of the aquifer. The curves show the theoretical drawdown caused by pumping 100 gpm continuously for periods of 1 day, 1 month, 1 year, and 10 years and at distances of 1 foot to 10,000 feet from the pumped well.

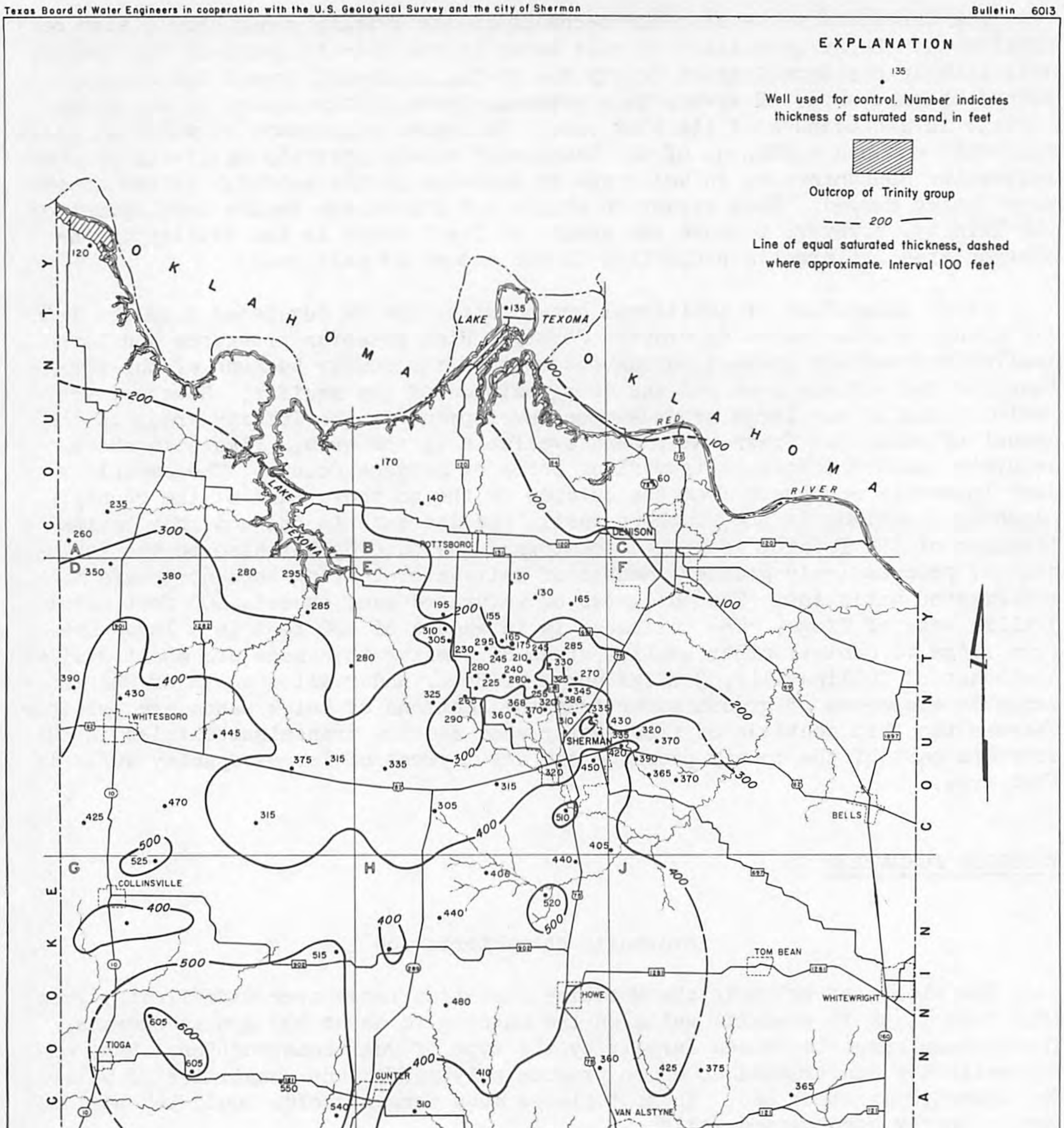


FIGURE 16.- Thickness of fresh-water-bearing sand in the Trinity group, Grayson County, Texas

Table 4.--Yields and specific capacities of selected wells in the Woodbine formation in Grayson County, Texas

| Well No. | Diameter of screen (in) | Yield in (gpm) | Drawdown (ft) | Time since pumping stopped (hrs) | Specific capacity (gpm/ft) |
|---|---|---|---|---|---|
| B-27 | 4-1/2 | 73 | 32.5 | 1 | 2.2 |
| E-9 | 6 | 60 | 167 | 9-1/2 | .36 |
| E-10 | 7 | 120 | 161 | - | .75 |
| E-14 | 8-5/8 | 77 | 166 | 1 | .46 |
| E-35 | 8-5/8 | 350 | 110 | 48 | 3.2 |
| E-47 | 8-5/8 | 500 | 83 | 2-3/4 | 6.0 |
| E-50 | 8-5/8 | 350 | 134 | 3 | 2.6 |
| E-62 | 10-3/4 | 602 | 132 | 36 | 4.5 |
| E-67 | 8-5/8 | 145 | 26 | 6 | 5.6 |
| H-21 | 4-1/2 | 100 | 54 | 1-1/2 | 2.0 |
| H-28 | 4-1/2 | 52 | 10 | 10 | 5.2 |
| J-11 | 6 | 69 | 35 | 1-1/2 | 2.0 |

Table 5.--Coefficients of transmissibility, permeability, and storage determined from pumping tests on selected wells in the Woodbine formation, Grayson County, Texas

| Date | Well No. | Coefficient of transmissibility (gpd/ft) | Coefficient of permeability ($gpd/ft^2$) | Coefficient of storage | Remarks |
|---|---|---|---|---|---|
| 8-20-58 | A-10 | 16,700 | | - | Short test under water-table conditions; results may be considerably in error. Not used in average. |
| 7-15-58 | A-25 | 7,900 | 190 | - | Short test under water-table conditions; results may be considerably in error. Not used in average. |

(Continued on next page)

Table 5.--Coefficients of transmissibility, permeability, and storage determined from pumping tests on selected wells in the Woodbine formation, Grayson County, Texas--Continued

| Date | Well No. | Coefficient of transmissibility (gpd/ft) | Coefficient of permeability (gpd/ft$^2$) | Coefficient of storage | Remarks |
|---|---|---|---|---|---|
| 3-24-58 | B-27 | 2,700 | 17 | | |
| do | B-27 | 2,200 | 14 | | |
| 7-13,15-45 | E-37 | 2,100 | 37 | 0.00006 | |
| do | E-39 | 2,200 | 44 | .00009 | |
| do | E-42 | 2,400 | 21 | .0002 | |
| do | E-43 | 2,300 | 37 | .0002 | |
| do | E-44 | 2,300 | 38 | .0002 | |
| 7-15,16-45 | E-37 | 2,400 | 42 | .00004 | |
| do | E-39 | 2,400 | 48 | .00009 | |
| do | E-42 | 2,500 | 22 | .0002 | |
| do | E-43 | 2,600 | 41 | 0.0001 | |
| do | E-44 | 2,500 | 41 | .00002 | |
| 3-24-58 | H-28 | 12,500 | 110 | - | |
| 3-26-58 | J-11 | 1,400 | 20 | - | |
| 1-30-59 | E-62 | 6,000 | 26 | - | |
| Average * | | 3,200 | | 0.0001 | |

*Excluding wells A-10 and A-25

## Future development

The volume of water in transient storage in the Woodbine formation in Grayson County is estimated to be about 25 million acre-feet. Only a fraction of this water is recoverable through wells because of the great depth at which much of it occurs and because much of the water would be retained in the "sand" by capillarity.

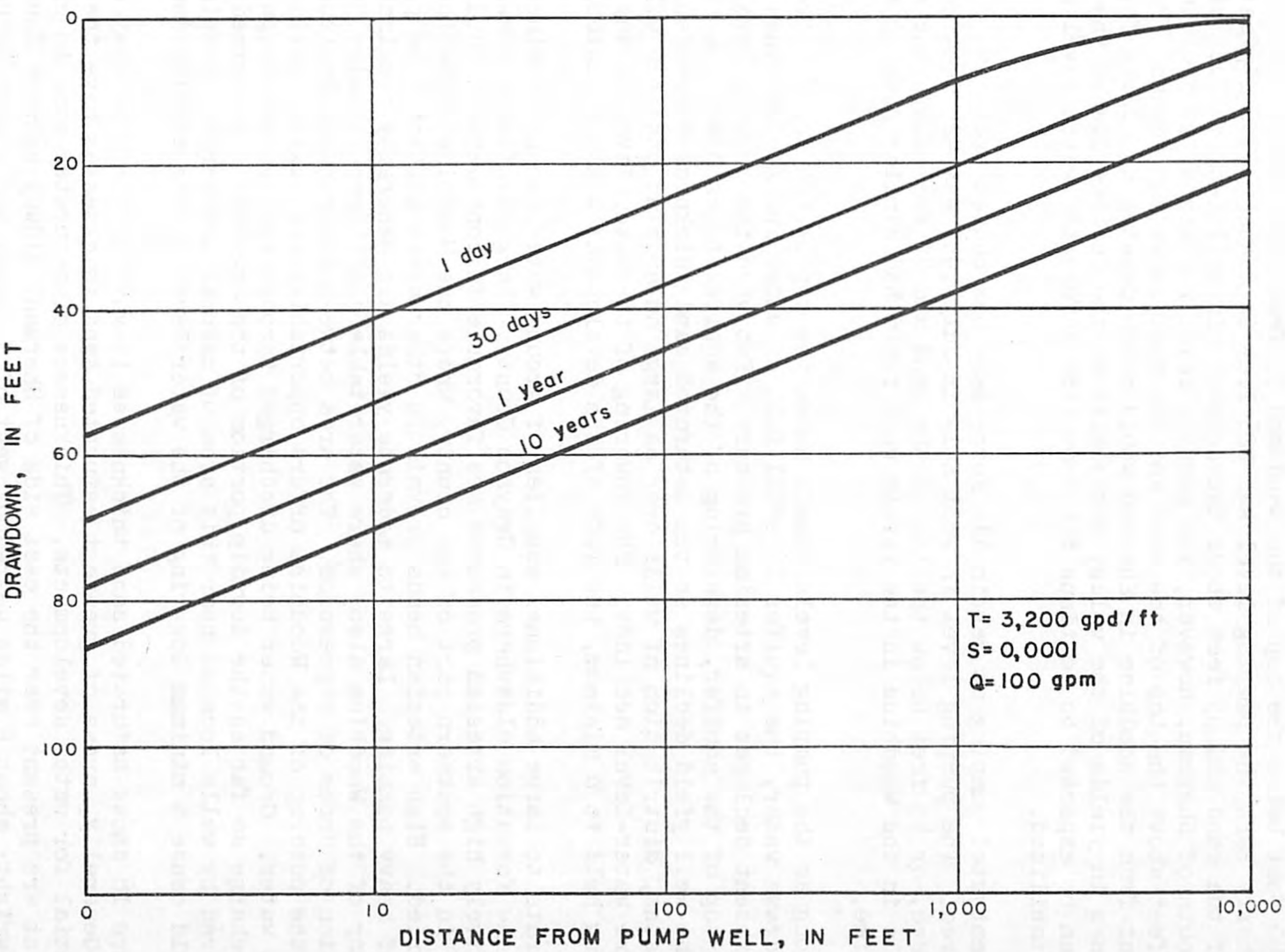


FIGURE 17.- Theoretical drawdown due to pumping 100 gpm from an infinite aquifer. (Woodbine formation)

It does not seem practical to develop large additional amounts of ground water from the Woodbine in Sherman. Increased withdrawals of ground water in Sherman since 1945 have caused large water-level declines. The pumping level in well E-47 at Old Settler's Park in August 1958 was 525 feet below the land surface, or 40 feet below the top of the sand and 55 feet above the screen. In well E-50 at Cherry Park the pumping level was 528 feet in August 1958, 25 feet below the top of the sand and 95 feet above the screen. In well E-62 at Tuck station, 4 miles south of Sherman, however, the pumping level was about 500 feet in October 1959, 70 feet above the top of the sand and 300 feet above the screen. Further development from the Woodbine in Sherman would cause dewatering of the formation and declines in yields of the wells, especially as the decline due to the present pumping can be expected to continue for some time before the water level gradually becomes stabilized.

Concentrated pumping at Perrin Air Force Base has caused excessive drawdowns in that area. The pumping level in well E-14 in July 1957 was 425 feet below the land surface, or 43 feet below the top of the sand and 45 feet above the screen. Other wells in the Woodbine in the Perrin well field had similar pumping levels at that time.

As long as the pumping levels remain above the top of the aquifer from which the well draws water, the aquifer is still full of water and any declines in water level represent declines in artesian pressure. But when the pumping levels drop below the top of the aquifer, dewatering of the aquifer takes place. As a consequence, the well yield declines as the saturated sand thickness decreases. For these reasons, distribution of wells over as large an area as possible will minimize future water-level declines. The lowering of the water level at any one place being held to a minimum, the life of the development would be extended.

Moderate to large additional supplies of ground water can be obtained from the Woodbine formation elsewhere in Grayson County. Large available drawdowns and relatively high artesian pressures are favorable to considerable future development in the southern part of the county, where the Woodbine formation is deeply buried. High artesian heads prevail in other areas distant from present centers of heavy pumping. Large to moderate yields are generally obtainable on the outcrop of the Woodbine also, where water-table conditions minimize the rate of expansion of cones of depression. The area between Sherman and Denison, in and near the outcrop of the Woodbine offers opportunity for maximum utilization of ground water. Ground water being discharged through springs and seeps (rejected recharge so far as the downdip portion of the aquifer is concerned) could be recovered by wells located near this area of natural discharge. Pumping this water would cause a minimum lowering of the water level in the aquifer downdip.

Figure 18 shows saturated sand thicknesses in various parts of Grayson County. Generally, areas of greatest saturated sand thicknesses have the greatest potential for water developments. Thicknesses of saturated sand in excess of 250 feet are present near the east side of Sherman; midway between Sherman and Whitewright; about 6 miles west-southwest of Sherman; and midway between Van Alstyne and Gunter. Thicknesses of saturated sand in excess of 150 feet are present in the outcrop of the Woodbine formation from Whitesboro northward to Big Mineral Arm of Lake Texoma about 6.5 miles west of Pottsboro. Water-table conditions, in addition to thick deposits of sand, are favorable to large future developments of ground water in this area.

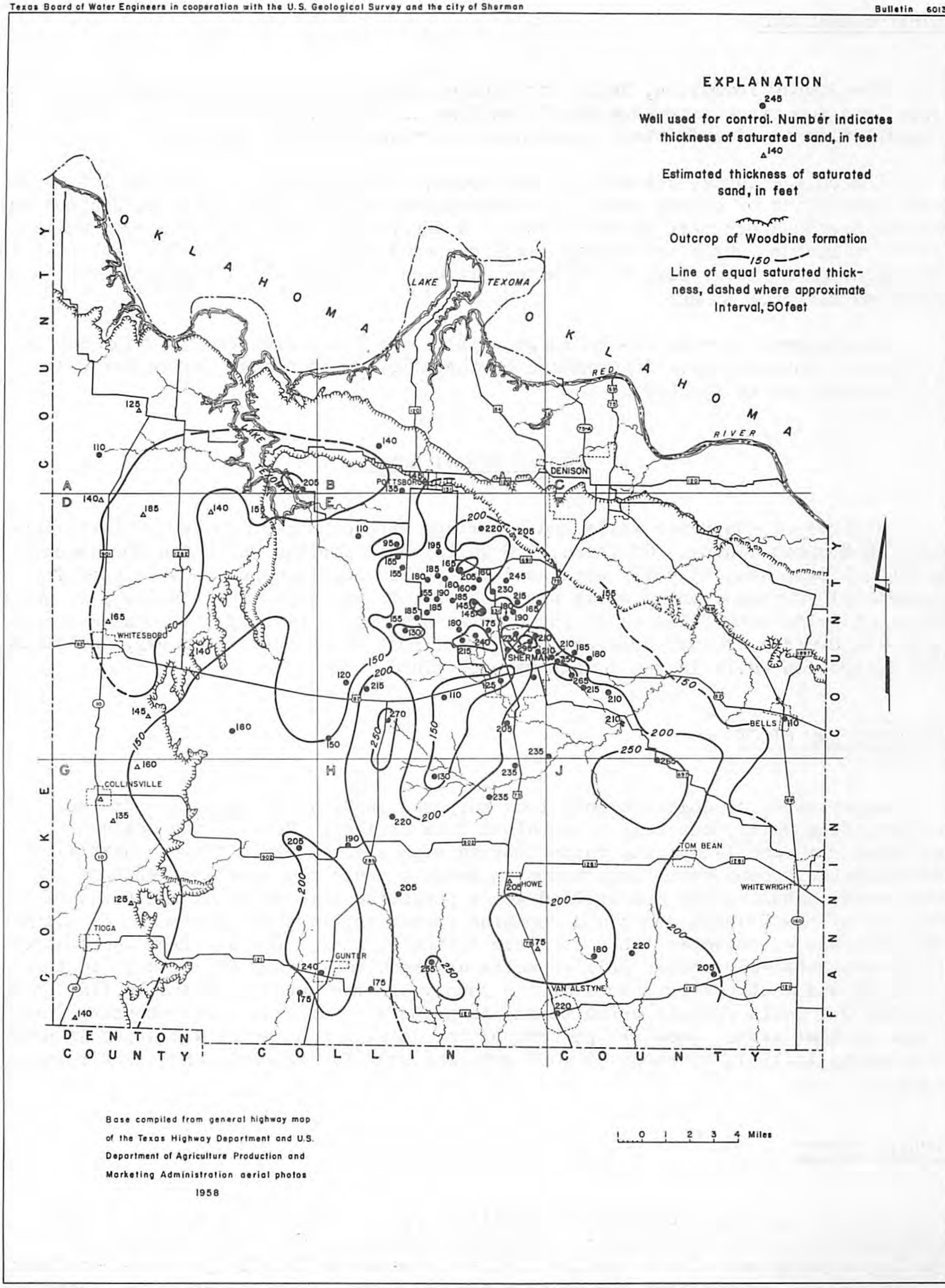


FIGURE 18.- Thickness of fresh-water-bearing sand in the Woodbine formation, Grayson County, Texas

OTHER FORMATIONS

The Pawpaw formation, Eagle Ford shale, Austin chalk, and alluvium constitute less important water-bearing formations in Grayson County. Of these, only the alluvium is of sufficient importance to warrant further mention.

The only alluvial deposits in the county that are known to contain considerable quantities of ground water are those along the Red River north of Denison and in the northeastern part of the county. A few records are available from wells in the alluvium, which are mostly small and used for domestic supply. Well C-1 in the alluvium north of Denison, however, is used for industrial supply and has a reported yield of 35 gpm.

Development of moderate to large supplies of water from the alluvium may be possible. However, more information on the alluvium is needed before definite conclusions can be reached.

## Use of Ground Water

Records of 305 water wells and 4 springs were obtained during the investigation in Grayson County. Of these, 200 wells and 2 springs were used for domestic and stock purposes, 43 wells were used for public supply, 9 wells were used for industrial purposes, and 6 wells were used for irrigation. The remaining 47 wells were not being used. The wells inventoried are only a part of the total number of wells in Grayson County; however, records of most of the public-supply, industrial, and irrigation wells in the county were obtained.

DOMESTIC AND STOCK

Water used for domestic and stock purposes in Grayson County is obtained chiefly from wells, but some is obtained from springs. Most of the wells are equipped with small-capacity pumps powered with electricity. The accessibility of available ground water determines in large measure the type and depth of the well used. Shallow dug and drilled wells predominate in and near the areas of outcrop of the Trinity group and Woodbine formation, Pawpaw formation, and alluvial deposits where the water table is close to the surface. Downdip from the outcrop areas progressively deeper drilled wells are required to tap the water. In the southern and southeastern parts of the county, in the outcrop of the Austin chalk, shallow dug wells prevail owing to the deep position of other water-bearing formations in that area. About 15 percent of the total ground water withdrawn in Grayson County in 1957, or about 750,000 gpd, was used for domestic and stock requirements.

PUBLIC SUPPLY

Public supplies accounted for about 3.3 mgd, or two-thirds of the ground water withdrawn for all purposes in Grayson County in 1957. The pumpage for public supplies was almost equally divided between the Trinity group and Woodbine formation, 53 percent from the Trinity and 47 percent from the Woodbine. Sherman, the largest user of ground water in the county, accounts for about 70 percent of the total ground water used for public supply. Water in Sherman is pumped from 14 wells, 8 in the Trinity and 6 in the Woodbine, having a total potential of about 8.6 mgd. Whitesboro, Collinsville, and the community of Gordonville about 10 miles north of Whitesboro are the only towns depending entirely on ground water from the Trinity group. Other towns in the county pump only from the Woodbine formation. Numerous resorts near Lake Texoma, having wells in either the Trinity or the Woodbine, use comparatively small amounts of water. Perrin Air Force Base supplements ground water from wells in the Woodbine with surface water obtained from the Denison municipal supply.

### INDUSTRY

Withdrawal of ground water for industrial use in Grayson County in 1957 was about 900,000 gpd, or 20 percent of the water pumped for all purposes. About 92 percent of the industrial pumpage, or 828,000 gpd, came from the Woodbine formation, and about 8 percent, or 72,000 gpd from the Trinity group. A relatively small amount of water for industrial use, probably less than 1 percent, is pumped from the alluvium north of Denison. Most of the industrial use of ground water prior to 1950 was by industries in Sherman. Since 1950 withdrawals of ground water by industry in the county have more than doubled. Most of the increase was for new industry in rural areas, the largest individual consumer being the Line Material Co., 6 miles west of Sherman, which pumps about 570,000 gpd. Dieselization of the railroads caused an abandonment of railroad wells in Sherman in about 1955 and resulted in a slight decrease in pumping at that time.

### IRRIGATION

Irrigation is relatively new in Grayson County. The first large irrigation well of record, D-24, was drilled in 1955 near Whitesboro in the western part of the county. From then until 1958 five more irrigation wells were drilled, A-10 and B-15 in 1956, A-19 and A-24 in 1957, and A-25 in 1958. All the irrigation wells, except well B-15 which produces from the Trinity group, produce from the Woodbine formation in its outcrop in the western part of the county. The principal irrigated crops include peanuts and grain sorghums, a total of about 110 acres being irrigated in 1958. The water is applied with sprinklers. The wells, 8 to 10 inches in diameter, are equipped with turbine pumps powered with electricity. The wells have yields ranging from about 30 to 260 gpm. The amount of water withdrawn for irrigation varies with soil-moisture requirements, the wells being used primarily to supplement rainfall; when rainfall is above normal or well distributed the irrigation requirement decreases. Well A-10, which may be considered a representative irrigation well, pumped about 14 acre-feet of water during 1957, a year of above-normal rainfall. The total pumpage for irrigation in 1957 averaged about 70,000 gpd.

## QUALITY OF WATER

The suitability of water for various uses is determined largely by the kind and amount of dissolved mineral matter that the water contains. The mineral matter is dissolved principally from the soil and rocks through which the water passes; consequently, the differences in the chemical character of the ground water reflect in a general way the differences in the geologic formations with which the water has had contact. The concentrations of the chemical constituents commonly are expressed in parts per million. A part per million (ppm) is 1 unit weight of constituent in 1 million unit weights of sample.

Samples of water were obtained from 219 wells, 2 springs, and 2 lakes in Grayson County. The wells and springs sampled are shown by bars over the location numbers on plate 1 and figure 2, and the results of the analyses of the samples are given in table 10. Figure 19 shows graphically the composition of representative samples from the principal aquifers in Grayson County. Table 6 shows a comparison of the quality of the ground water in the county with standards proposed for various uses. Most of the samples were collected during the present investigation; however, a few were collected at various times previously. Except as indicated in the table, the analyses were made in the laboratory of the Geological Survey at Austin, Texas.

The United States Public Health Service (1946, p. 382-383) has established standards for drinking water used on common carriers engaged in interstate commerce. These standards are widely used in evaluating water for drinking. The recommended maximum concentrations for certain of the chemical constituents according to the standards are listed below.

Iron (Fe) and Manganese (Mn) together should not exceed 0.3 ppm.

Magnesium (Mg) should not exceed 125 ppm.

Chloride (Cl) should not exceed 250 ppm.

Sulfate ($SO_4$) should not exceed 250 ppm.

Fluoride (F) must not exceed 1.5 ppm.

Dissolved solids should not exceed 500 ppm in water of good chemical quality; however, if such water is not available, a dissolved-solids content of 1,000 ppm may be permitted.

These tolerances were set primarily as a protection against digestive disturbances and because they represent limits beyond which taste may become objectionable. Water having a chloride content exceeding 250 ppm may have a salty taste. Water having a magnesium and sulfate content exceeding the standards may have a laxative effect. Water having a fluoride content exceeding 1.5 ppm may cause teeth of children to become mottled (Dean, Dixon, and Cohen, 1935, p. 424-442); however, fluoride concentrations of about 1.0 ppm appear to reduce the incidence of tooth decay (Dean, Arnold, and Elvove, 1942, p. 1155-1179). Water that contains more than 45 ppm of nitrate has been related to the incidence of infant cyanosis (methemoglobinemia, or "blue baby" disease) (Maxcy, 1950, p. 271), and may be dangerous for infant feeding. High nitrate content may be an indication of pollution from organic matter, and water containing excessive nitrate should be tested for bacterial content if it is to be used for domestic purposes.

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

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

The presence of moderate amounts of silica in water is not objectionable for most purposes; however, for some industrial uses it may be undesirable. Silica in boiler-feed water is undesirable because it forms a hard scale, the scale-forming tendency increasing with the pressure in the boiler. The following table shows the maximum suggested concentrations of silica for water used in boilers (Moore, 1940, p. 263).

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

Excessive iron and manganese concentrations cause reddish-brown or dark-gray precipitates that stain clothes and plumbing fixtures. The staining properties are especially objectionable in certain manufacturing processes. Water containing more than 0.3 ppm of iron and manganese together will probably cause noticeable staining. The concentration of manganese in the ground water in Grayson County was not determined; however, generally the manganese concentrations are small and for the most part negligible. Many water analyses include two values for iron, total iron and iron in solution at the time of analysis. The value for total iron includes iron precipitated from the sample during transportation and storage and redissolved with acid, and it represents the maximum value of iron present in water in place in the aquifer. Where iron in solution alone is given on the analytical report, it can generally be assumed that the water was stable and iron did not precipitate between the times of collection and analysis; otherwise, the chemist would have made a total-iron determination.

In appraising the quality of water for irrigation, both the concentration and the composition of dissolved constituents should be considered. The chemical characteristics that appear to be most important in evaluating the quality of water for irrigation in Grayson County are, in order of their importance (1) proportion of sodium to total cations (an index to the sodium hazard), (2) total concentration of soluble salts (an index to the salinity hazard), and (3) concentration of boron. A system of classification commonly used for judging the quality of a water for irrigation was proposed in 1954 by the U. S. Salinity Laboratory Staff (1954, p. 69-82). The classification is based primarily on the salainity hazard as measured by the electrical conductivity of the water and the sodium hazard as measured by the sodium-adsorption-ratio (SAR).

The relative importance of the dissolved constituents is dependent upon the degree to which they accumulate in the soil. Kelley (1951, p. 95-99) cited areas

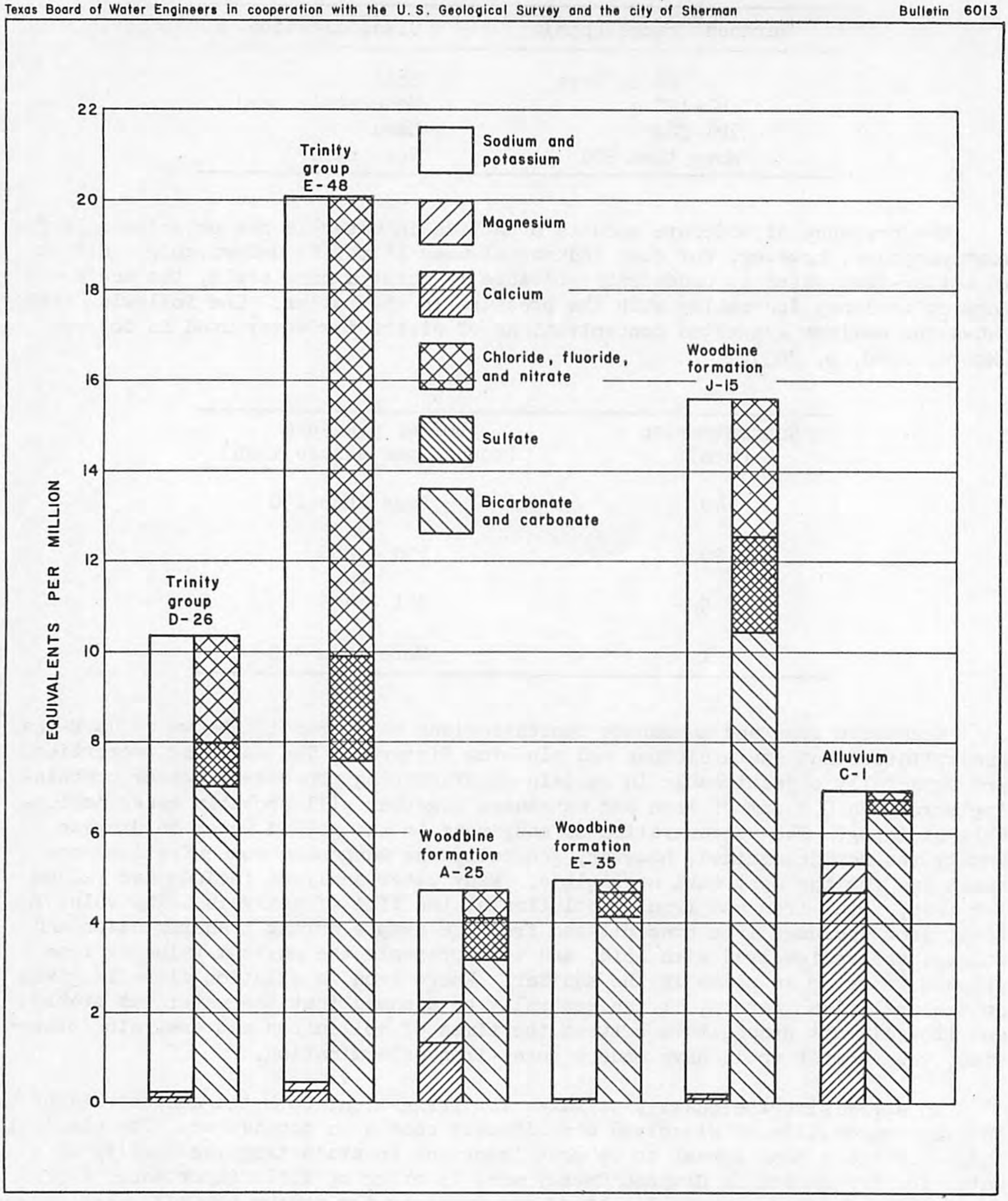


FIGURE 19.- Composition of ground water, Grayson County, Texas

Table 6.--Comparison of quality of ground water in Grayson County with standards recommended by U. S. Public Health Service and with others

Chemical constituents (in parts per million)

| | Silica a/ $SiO_2$ | | Iron, total (Fe) and Manganese (Mn) | | Magnesium (Mg) | | Sulfate ($SO_4$) | | Chloride (Cl) | | Fluoride (F) | | Nitrate b/ ($NO_3$) | | Boron c/ (B) | | Dissolved solids | | | Hardness | | Sodium adsorption ratio d/ | | Specific conductance d/ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maximum recommended | 20 | | 0.3 | | 125 | | 250 | | 250 | | 1.5 | | 45 | | 1.0 | | 500e/ | | | 60f/ | | 14 | | 2,250 | |
| Geologic formation | Number of determinations | Number exceeding 20 | Number of determinations | Number exceeding 0.3 | Number of determinations | Number exceeding 125 | Number of determinations | Number exceeding 250 | Number of determinations | Number exceeding 250 | Number of determinations | Number exceeding 1.5 | Number of determinations | Number exceeding 45 | Number of determinations | Number exceeding 1.0 | Number of determinations | Number exceeding 500 | Number exceeding 1,000 | Number of determinations | Number exceeding 60 | Number of determinations | Number exceeding 14 | Number of determinations | Number exceeding 2,250 |
| All wells | 47 | 1 | 47 | 19 | 49 | 0 | 70 | 7 | 223 | 16 | 43 | 5 | 44 | 0 | 32 | 4 | 48 | 26 | 5 | 223 | 106 | 43 | 30 | 209 | 16 |
| Trinity group | 14 | 0 | 14 | 4 | 14 | 0 | 14 | 0 | 25 | 2 | 12 | 2 | 12 | 0 | 11 | 2 | 14 | 14 | 2 | 35 | 6 | 11 | 11 | 24 | 1 |
| Woodbine formation | 27 | 0 | 30 | 14 | 32 | 0 | 42 | 7 | 134 | 9 | 28 | 3 | 29 | 0 | 21 | 2 | 31 | 10 | 3 | 134 | 51 | 31 | 19 | 131 | 13 |
| Pawpaw formation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 7 | 0 | 0 | 8 | 0 |
| Eagle Ford shale | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 0 | 0 | 3 | 0 |
| Austin chalk | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 30 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 | 0 | 0 | 21 | 1 |
| Alluvium | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 2 | 1 | 0 | 2 | 0 |

a/ Moore (1940, p. 263).
b/ Maxcy (1950, p. 271).
c/ Wilcox (1955, p. 11).
d/ Wilcox (1955, p. 16).
e/ 1,000 ppm permitted.
f/ Upper limit of soft water.

having an average annual precipitation of about 18 inches in which salts did not accumulate in the irrigated soil. Wilcox (1955, p. 15) stated that the system of classification of irrigation waters proposed by the Salinity Laboratory Staff "... is not directly applicable to supplemental waters used in areas of relatively high rainfall." Thus in Grayson County, where the average annual precipitation is about 39 inches, the system of classification is probably not directly applicable. Wilcox (1955, p. 16) indicated that water generally may be used safely for supplemental irrigation if its conductivity is less than 2,250 micromhos per centimeter at 25°C and its SAR is less than 14. Each individual situation should be appraised when consideration is being given to irrigating with water in which the specific conductance and SAR values exceed these limits, where soil or drainage conditions are unfavorable, or when the crop to be grown is especially sensitive to the hazards of sodium and salinity.

An excessive concentration of boron will make a water unsuitable for irrigation. Wilcox (1955, p. 11) has indicated that boron concentration up to 1.0 ppm is permissible for irrigating boron-sensitive crops; concentration up to 3.0 ppm is permissible for boron-tolerant crops.

## Trinity Group

The Trinity group in Grayson County generally yields water that is suitable for most purposes except in the northern part of the county, in the vicinity of the Preston anticline, where the lower part contains saline water. Most of the fresh water is high in sodium bicarbonate content and is very soft. The hardness of 35 samples ranged from 1 to 426 ppm; however, it exceeded 60 ppm in only 6 samples. The dissolved-solids content in 14 samples ranged from 516 to 1,180 ppm. In all the 14 samples it exceeded 500 ppm; however, only in 2, did it exceed 1,000 ppm. The iron content in 14 samples ranged from 0.02 to 2.1 ppm. In 4 of the samples the content exceeded 0.3 ppm.

The water from the Trinity group is of questionable quality for irrigation. In only 1 sample of 24 did the specific conductance exceed 2,250 micromhos; however, of 11 values of the sodium-adsorption-ratio (SAR) all exceeded the safe limit of 14. Of 11 determinations of boron 2 exceeded the permissible limit of 1.0 ppm for boron-sensitive crops.

## Woodbine Formation

The water from the Woodbine formation ranges more widely in chemical composition than does the water in the Trinity group. However, in general, the water of the Woodbine is suitable for most purposes. The iron content in water from the Woodbine poses the most serious problem so far as public supply is concerned. Of 30 determinations of iron content, 14 exceeded 0.3 ppm. The dissolved-solids content of 31 samples from the Woodbine ranged from 114 to 2,620 ppm; in 10 of the samples it exceeded 500 ppm and in 3 it exceeded 1,000 ppm. The hardness of the water ranged from 0 to 1,070 ppm in 134 samples; however, most of the water is soft, the hardness exceeding 60 ppm in only 51 of the samples. In general, the water from the Woodbine is hardest in and near the area of outcrop, the hardness decreasing with depth.

The water from the Woodbine in the outcrop area generally is suitable for irrigation. However, at depth the sodium content increases and the water becomes questionable for irrigation. Of 131 determinations of specific conductance only 13 exceeded 2,250 micromhos; however, of 31 values of SAR, 19 exceeded the limit of 14. In only 2 of 21 samples did the boron content exceed 1 ppm.

### Other Formations

The quality of water from the other formations in Grayson County ranges widely. Water from the Pawpaw formation appears to be of excellent chemical quality except that most of it is hard. Hardness of 7 of 8 samples exceeded 60 ppm. The water from the Austin chalk is probably suitable for most purposes except that it is hard. Of 30 determinations of hardness all 30 exceeded 60 ppm. Only 4 samples of water were obtained from the Eagle Ford shale and 2 from the alluvium. The small number of samples cannot be considered representative and generalizations concerning the quality of water in the two formations should not be made.

## SUMMARY AND CONCLUSIONS

The principal ground-water reservoirs in Grayson County are the Trinity group and Woodbine formation, supplying more than 95 percent of the ground water used in the county. Other water-bearing formations supplying small to moderate amounts of water include the alluvial deposits, Pawpaw formation, Austin chalk, and Eagle Ford shale.

Recharge to the Trinity group and Woodbine formation is derived chiefly from precipitation on the outcrop, although a small amount is contributed to the outcrop in Lake Texoma.

The ground-water resources of Grayson County are only partly developed. The amount of fresh water in transient storage in the Woodbine formation and Trinity group is estimated to be about 25 million and 60 million acre-feet, respectively. Most of the water is not recoverable because of the depth at which it occurs. However, relatively high artesian heads and large available drawdowns, prevailing over much of the county in both the Trinity group and Woodbine formation, are favorable to future development. A factor limiting any large well development, however, is the volume of saturated fresh-water sand available in the area. The amount of fresh-water sand in the Trinity decreases northward, chiefly as a result of an increase in the amount of salt water in the northern part of the county. Consequently, in much of northern Grayson County, large developments of fresh ground water from the Trinity are not feasible. Large to moderate amounts of fresh water may be obtained from the Woodbine in most of Grayson County, especially in the outcrop area and in areas where the amounts of saturated sand are greatest. Withdrawal of moderate to large amounts of water from the alluvial deposits north of Denison and in the northeastern part of the county may be possible, but more information is needed before definite conclusions can be reached.

Large withdrawals of ground water from the Trinity group and Woodbine formation have resulted in large declines of water levels in the heavily pumped Sherman area. Concentrated pumping in Sherman has resulted in some dewatering of the Woodbine in that area. Distribution of pumping over a larger area, will be necessary if further declines in water level in the Woodbine in the Sherman area are to be minimized. The Trinity group is the most favorable source of additional ground water in the Sherman area. Pumping levels in the Trinity, still several hundred feet above the top of the aquifer, have a large margin of safety before dewatering of the sand begins. However, the economics of higher pumping lifts caused by declining pumping levels will tend to limit the full development of the aquifer. In order to minimize additional declines in water levels in either the Trinity or the Woodbine, the pumping would have to be distributed evenly among the wells, and future wells spaced as far apart as possible.

The ground water in Grayson County is suitable for most purposes. The Trinity group generally yields soft water that is high in bicarbonate content but is questionable for irrigation because of high sodium content. Water from the Woodbine formation is generally soft but may be high in iron content. The water of the Woodbine is generally suitable for irrigation in the outcrop area but unsuitable downdip because of high sodium content. The other water-bearing formations yield water that is apparently acceptable for most purposes.

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Table 7.--Records of wells and springs in Grayson County, Texas

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 : A, airlift; B, bucket; C, cylinder; Cf, centrifugal; G, gasoline, butane, or Diesel engine; H, hand; J, jet; N, none; T, turbine; W, windmill. Number indicates horsepower.
Use of water : Ind, industrial; Irr, irrigation; N, none; P, public supply; S, stock.

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *A-1 | R. L. Cathey | L. O. McMillan | 1948 | 200 | 5 | Trinity group | 153.1 | July 25, 1958 | C,G | D | |
| A-2 | W. P. Luce | -- Whittington | 1937 | 460 | 13 | do | 75 | 1937 | C,W | S | Originally drilled as oil test. Perforated at 360 and 460 ft. Plugged at 460 ft. In Cooke County. |
| *A-3 | do | -- | 1924 | 328 | 4 | do | 196.7 | Sept.10, 1957 | C,W | D,S | In Cooke County. |
| A-4 | do | -- | 1924 | 24 | 48 | Pawpaw(?) formation | 22.3 | do | C,W | S | Dug. Reported never to have gone dry. |
| *A-5 | Omar B. Milligan | -- | -- | 325 | 6 | Trinity group | -- | -- | C,E | D | |
| A-6 | L. G. Handy well 4 | The Texas Co. | 1956 | 2,407 | -- | -- | -- | -- | -- | -- | Oil test. |
| *A-7 | Rock Creek Camp | Leech Bros. | 1948 | 502 | 5 | Trinity group | 18 | 1957 | C,E | D,P | Supplies tourist court and bath house. |
| *A-8 | Mrs. Anna Potts | J. L. McClure | 1955 | 51 | 6 | Pawpaw formation | 18.5 | June 5, 1958 | J,E 1/3 | D,S | Reported discharge 350 gph when drilled. |
| *A-9 | Mrs. L. E. McCormick | -- | -- | 18 | 48 | Woodbine formation | 11 | June 1958 | J,E 1 | D,S | Dug. |
| *A-10 | F. W. Holder | Hal Douglas | 1956 | 180 | 8 | do | 74.9 | Oct. 17, 1957 | T,E, 7½ | Irr | Pump set at 140 ft. Reported drawdown 22 ft. after 48 hrs. pumping 132 gpm November 1956. Irrigated 20 acres in 1957. |
| *A-11 | do | J. L. McClure | 1950 | 802 | 7, 4 | Trinity group | 75 | Sept. 1957 | C,E, 3/4 | D | Perforated from 722 ft. to bottom. Gas and lignite reported at 600 ft. |
| *A-12 | Cedar Bayou Resort | do | 1946 | 130? | 6 | Woodbine formation | 100 | Dec. 1957 | J,E, 1 | D,P | Supplies water for tourist court. |
| *A-13 | John Pitts | do | 1934 | 432 | 5 | Trinity group | 60 | July 1958 | C,E | D | |
| *A-14 | Cedar Mills Resort | -- | 1953 | 575 | 4 | do | 48.3 | July 22, 1958 | T,E | D,P | Supplies water for tourist court. |
| *A-15 | Walnut Creek Resort | -- | 1947 | 308 | 6 | Woodbine formation | 18.3 | Dec. 18, 1957 | J,E 1½ | D,P | Supplies water for 30 families during summer. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level | | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Below land surface datum (ft.) | Date of measurement | | | |
| *A-16 | C. Bates | -- | -- | 345 | -- | Woodbine formation | -- | -- | -- | D | Reported discharge 10 gpm in August 1953. |
| *A-17 | Hugh Bean | -- | 1910 | 50 | 5 | do | 26.8<br>26.6 | Sept. 9, 1957<br>Jan. 22, 1959 | B,H | D | Water reported very hard. 1/ |
| *A-18 | Mark Smith | -- | 1937 | 27 | 48 | do | 18.9 | July 25, 1958 | B,H | D,S | Dug. Temp. 68°F. |
| *A-19 | O. B. Rich | Hal Douglas | 1957 | 180 | 8 | do | 20.3 | Sept. 9, 1957 | T,E, 10 | Irr | Pump set at 65 ft. Perforated from 20 ft. to bottom. Drawdown 30 ft. after many hrs. pumping 260 gpm, Sept. 9,1957. Irrigated 20 acres in 1957. |
| A-20 | Mark Williams well 1 | Humble Oil & Refining Co. | 1953 | 14,345 | -- | -- | -- | -- | -- | -- | Oil test. |
| *A-21 | Gordonville Water Association | J. L. Myers & Sons | 1958 | 1,021 | 7 | Trinity group | 144.3 | Apr. 25, 1958 | T,E, 2 | P | Pump set at 300 ft. Perforated from 991 ft. to bottom. Measured drawdown 47 ft. after 100 min. pumping 25 gpm Apr. 25, 1958. Temp. 72°F. 2/ |
| *A-22 | E. W. McAden | -- | 1955 | 355 | -- | Woodbine formation | -- | -- | -- | D | |
| *A-23 | J. B. Thorn | -- | -- | 204 | 6 | do | 90.2 | Sept.11, 1957 | J,E, 1½ | D,Irr | Reported yield 20 gpm in 1957. Irrigates 1½ acres. |
| *A-24 | W. C. Garner | Hal Douglas | 1957 | 338 | 10, 8 | do | 35 | June 1958 | T,E, 5 | D,Irr | Casing: 10-in. to 300 ft., 8-in to bottom. Reported discharge 100 gpm in 1958. Reported irrigates 6 acres. Temp. 67°F. |
| *A-25 | J. C. Brady | do | 1958 | 345 | 10 | do | -- | -- | T,E | Irr | Pump set at 135 ft. Perforated from 189 to 229, 291 to 303, and 303 to 345 ft. Measured discharge 110 gpm in July 1958. Temp. 67°F. 2/ |
| *A-26 | Big Mineral Camp | -- | 1951 | 285 | 5 | do | 15 | Dec. 1957 | J,E, ½ | D,P | Supplies water for trailer camp. Flows when Lake Texoma is high. |
| A-27 | U. S. Army | -- | 1920? | 71 | 5 | do | 4.2 | Nov. 8, 1958 | C,H | N | |
| A-28 | Flowing Wells Camp | -- | 1860 | 480 | 12, 8 | do | + | -- | Flows | N | Well now covered by Lake Texoma. |
| *A-29 | do | J. L. McClure | 1946 | 354 | 5 | do | 35 | 1956 | J,E, 3 | P | Supplies water for tourist court. 1/ |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-30 | U. S. Army | -- | -- | 125 | 4 | Woodbine formation | + | -- | Flows | N | Water reported to have good taste. Lake Texoma covers well most of the time. |
| A-31 | do | -- | -- | 125 | 4 | do | + | -- | Flows | N | do |
| *A-32 | Stanley Franko | -- Townsend | 1946 | 175 | -- | do | 12 | Mar. 1958 | J,E | P | Perforated from 145 ft. to bottom. Supplies small tourist court. |
| *A-33 | Earl Baker | J. L. McClure | 1945 | 257 | 5 | do | 18 | Mar. 1958 | C,E | P | Perforated from 237 ft. to bottom. Supplies small tourist court. |
| *A-34 | E. Gaitis | Townsend & Barrett | 1937 | 265 | 7, 4 | do | 50 | Aug. 1957 | C,W | D | Perforated from 230 ft. to bottom. |
| A-35 | do | Townsend & Freeman | 1917 | 180 | 4 | do | 52.1 | Aug. 29, 1957 | C,H | N | 2/ |
| A-36 | Hagerman National Wildlife Refuge | Layne-Texas Co. Ltd. | -- | 654 | -- | do | -- | -- | N | N | Abandoned. 2/ |
| A-37 | do | -- | -- | 65 | 6 | do | + | -- | Flows | N | Well now covered by Lake Texoma. |
| A-38 | do | -- | 1920 | 65 | 6 | do | + | -- | Flows | N | Water reported very soft and to have good taste. Estimated flow 1 to 2 gpm. Lake Texoma covers well at times. Temp. 65°F. |
| *A-39 | Dale Dickey | -- | 1908 | 200 | 3 | do | 70 | July 1958 | C,W | D | Temp. 69°F. |
| *A-40 | Louise Kurr | E. C. Freeman | 1957 | 235 | 5 | do | -- | -- | J,E | D | |
| *A-41 | Texas Natural Gasoline Corp. | -- | 1955 | 940 | 6 | Trinity group | 125 | June 1958 | T,E, 20 | Ind | Reported yield 50 gpm. Perforated from 880 ft. to bottom. Temp. 77°F. |
| *A-42 | H. O. Reast | -- | 1898 | 56 | 42 | Woodbine formation | 36.0 | Apr. 15, 1958 | B,H | D,S | Dug. |
| A-43 | Suddath Bros. well 1 | L. O. McMillan | 1952 | 8,780 | -- | -- | -- | -- | -- | -- | Oil test. |
| *A-44 | J. F. Bullard | J. K. Hunter | 1948 | 160 | 6, 4 | Woodbine formation | -- | -- | C,W | D | Casing: 6-in. to 50 ft., 4-in. to bottom |
| B-1 | U. S. Army | -- | 1956 | 130 | 4 | Trinity group | 20 | Sept. 1957 | J,E | D | |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level | | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Below land surface datum (ft.) | Date of measurement | | | |
| B-2 | U. S. Army | Layne-Texas Co. Ltd. | 1943 | 290 | 24, 10 | Trinity group | 95.5 | Sept.17, 1957 | N | N | Casing: 24-in. to 65 ft., 10-in. to 290 ft.; screened from 132 to 143, 146 to 165, 191 to 226, 241 to 264, and 279 to 290 ft. Originally drilled to 805 ft., plugged back to 290 ft. because of salt water. 2/ 3/ |
| *B-3 | E. W. Terrell | -- | 1914 | 49 | 24 | -- | 42.9 | Oct. 3, 1957 | B,H | D,S | Dug. |
| B-4 | Jack Burrough | J. L. McClure | 1951 | 204 | 4 | Trinity group | 60 | Oct. 1957 | C,E | D | |
| *B-5 | R. J. Byrd | do | 1933 | 190 | 4 | do | 80.1 | Oct. 11, 1957 | C,E | D | |
| *B-6 | E. W. Miller | -- | 1956 | 228 | 4 | do | 81.5 | do | J,E, 1 | D,P | Supplies water for tourist court. |
| *B-7 | U. S. Army | -- | -- | 35 | 12 | do | 20.2 | Sept.17, 1957 | B,H | D | Dug. |
| *B-8 | W. L. Shires | -- | -- | 500 | 5 | do | 159.5 | do | C,W | D,S | Originally drilled to 500 ft., plugged back to 250 ft. because of salt water. Temp. 67°F. |
| B-9 | do | -- | -- | 43 | 48 | -- | 25.5 | do | N | N | Dug. |
| B-10 | -- | J. L. McClure | 1957 | 123 | 4 | Trinity group | 54.4 | do | N | D | |
| *B-11 | R. X. Allen | do | 1945 | 235 | 5 | do | 90 | May 1958 | J,E | D | Supplies water for small tourist court. |
| *B-12 | Jack Dophied | -- | 1918 | 240 | 4 | do | 80 | do | C,W | D,S | |
| *B-13 | L. A. Whitfield | J. L. McClure | 1955 | 300 | -- | do | 126.2 | Oct. 21, 1957 | C,E, 1 | D,S | Pump set at 170 ft. Perforated from 240 to 280 ft. |
| B-14 | Texas Nursery Co. well 1 | The Texas Co. | 1952 | 5,011 | -- | -- | -- | -- | -- | -- | Oil test. |
| B-15 | Texas Nursery Co. | M. Y. Myers | -- | 626 | -- | Trinity group | 100 | May 1957 | T,E, 5 | Irr | |
| B-16 | Tanglewood Hills Country Club, Inc. | -- | 1956 | 500 | 8 | do | -- | -- | T,E, 15 | P | Drilled to 800 ft., plugged back to 500 ft. Pump set at 410 ft. |
| *B-17 | B. V. Atnip | J. L. McClure | 1954 | 65 | 8 | Pawpaw formation | 30 | Oct. 1957 | J,E, ½ | D | |
| *B-18 | A. H. Sharp | do | 1952 | 349 | 5 | Trinity group | 134 | Oct. 1957 | C,E, 1 | D,S | Perforated from 309 ft. to bottom. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *B-19 | J. F. Allen | J. L. McClure | 1900 | 317 | 4 | Trinity group | 134 | Oct. 1957 | C,E, 1 | D | |
| B-20 | W. G. Wright | Denison Oil & Gas Co. | -- | 348 | 8 | do | 199.2 | July 10, 1958 | C,W | S | Originally drilled as oil test. |
| *B-21 | Aubrey E. Thomas | J. L. McClure | 1952 | 295 | 4 | do | 110 | July 1958 | J,E, 2 | D,S | |
| *B-22 | W. L. Cole | -- | 1958 | 300 | 4 | do | 80 | Jan. 1958 | C,E, 1½ | D | Gravel-packed. |
| *B-23 | J. D. Atkins | J. L. McClure | 1941 | 240 | 6 | Pawpaw formation | 40 | 1956 | J,E, 3/4 | D | |
| *B-24 | T. F. Staggers | -- | -- | 145 | 3 | do | -- | -- | C,E, ¼ | D | Water reported hard. |
| B-25 | R. C. Dalton well 1 | Sherman Oil & Gas Co. | 1929 | 892 | -- | -- | -- | -- | -- | -- | Oil test. 2/ |
| *B-26 | J. F. Wall | G. W. Wall | 1910 | 320 | 4 | Trinity group | -- | -- | C,E, 1 | D,S | Temp. 69°F. |
| *B-27 | City of Pottsboro | Layne-Texas Co. Ltd. | 1952 | 443 | 6, 4, 2 | Woodbine formation | 135 | Mar. 1958 | T,E, 7½ | P | Casing: 6-in. to 240 ft., 4-in. from 221 to 343 ft., 2-in. from 343 to bottom, screened from 241 to 282 ft., and from 330 to 341 ft. Pump set at 270 ft. Measured drawdown 33.5 ft. after 100 min. pumping 73 gpm. Temp. 68°F. 2/ |
| *B-28 | T. C. Gattis | -- | Old | 50 | 48 | do | 40 | July 1958 | J,E | D,S | |
| *B-29 | Willow Springs School | E. C. Freeman | 1957 | 192 | 6 | do | 55.4<br>55.9 | Aug. 30, 1957<br>Oct. 15, 1958 | J,E, 1 | P | 1/ 2/ |
| *C-1 | The Austin Co. | J. L. McClure | 1958 | 58 | 16 | Alluvium | 25 | 1958 | T,E, 5 | Ind | Pump set at 40 ft. Perforated from 38 to 58 ft. Reported discharge 35 gpm Mar. 27, 1958. Temp. 67°F. |
| C-2 | Perry well 1 | Aljon Oil Co. | 1955 | 991 | -- | -- | -- | -- | -- | -- | Oil test. |
| *C-3 | Speed-Cast Sporting Goods Co. | -- Smith | 1951 | 250 | 6 | Trinity group | 16.4 | July 10, 1958 | C,E | D | |
| C-4 | Table Products Co. | -- | -- | 558 | -- | do | -- | -- | N | N | 2/ |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *C-5 | Mrs. M. J. Brady | -- | 1880 | 35 | 144 | Pawpaw formation | 15 | July 1958 | J,E | D | Dug. |
| *C-6 | R. B. Derebery | -- | 1950 | 98 | -- | do | -- | -- | J,E | D | |
| *C-7 | C. Y. Gough | J. L. McClure | 1955 | 135 | 5 | do | 58.6 | July 17, 1958 | B,H | D | Temp. 73°F. |
| *C-8 | Luther Cherry | E. C. Freeman | 1955 | 110 | 5 | do | 90 | Nov. 1957 | C,W | D,S | 2/ |
| *C-9 | J. H. Nichols | -- | -- | 23 | -- | Alluvium | 21 | do | C,H | D | Bored. Temp. 70°F. |
| C-10 | -- | -- | -- | Spring | -- | do | -- | -- | -- | S | Estimated flow 2 gpm in June 1959. Temp. 65°F. |
| D-1 | Jim Scott | J. L. McClure | 1948 | 140 | 5 | -- | -- | -- | T,E, 2 | S | Reported water turns red upon standing. |
| *D-2 | A. H. McNairn | C. Moore | 1954 | 365 | 4 | Woodbine formation | 75 | Apr. 1954 | C,E, 1 3/4 | S | |
| D-3 | Mulder well 1 | Howell & Howell | 1950 | 7,887 | -- | -- | -- | -- | -- | -- | Oil test. |
| *D-4 | A. F. Siebman | -- Smith | 1948 | 160 | 4 | Woodbine formation | -- | -- | C,E | D,S | |
| D-5 | Hagerman National Wildlife Refuge | -- | -- | 105 | 3 | do | 1.1 | July 22, 1958 | C,W | S | |
| *D-6 | E. Gaitis | P. Townsend | 1947 | 91 | -- | do | 48.8 | Aug. 30, 1957 | C,W | D | |
| *D-7 | Dave Bennett | -- | 1911 | 183 | 3 | do | 33.9 | July 22, 1958 | C,E | D | |
| D-8 | Q. Little well 1 | Snuggs & Neal, Inc. | 1951 | 3,623 | -- | -- | -- | -- | -- | -- | Oil test. |
| *D-9 | Hagerman National Wildlife Refuge | -- | 1918 | 140 | -- | Woodbine formation | + | -- | N | N | Reported flow ½ gpm Apr. 18, 1958. Temp. 66°F. |
| D-10 | do | -- | 1918 | 140 | 4 | do | -- | -- | N | N | Well capped. Would flow if not capped. |
| D-11 | do | -- | 1918 | 140 | 3 | do | + | -- | N | N | Flows into Lake Texoma. Temp. 66°F. |
| D-12 | do | -- | 1918 | 149 | 3 | do | + | -- | N | N | do |
| *D-13 | do | E. L. Gill | 1920 | 165 | 5 | do | + | -- | N, Flows | N | Flows into Lake Texoma. Flow measured 1½ gpm Apr. 18, 1958. Temp. 67°F. |
| *D-14 | do | -- | 1918 | 165 | 6 | do | + | -- | N, Flows | N | do |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *D-15 | D. R. Bennett | P. Duncan | 1916 | 270 | 4 | Woodbine formation | -- | -- | C,E, 3/4 | D | |
| *D-16 | J. L. Metcalf | -- | -- | 250 | 4 | do | -- | -- | C,E | D,S | Pump set at 200 ft. |
| *D-17 | Hobert Shadden | P. Duncan | 1916 | 280 | 4 | do | -- | -- | C,E | D | |
| *D-18 | J. T. Crow | Jess Darr | 1904 | 180 | 6 | do | 65.4 | Apr. 15, 1958 | C,W | D,S | |
| D-19 | Hagerman National Wildlife Refuge | -- | Old | 109 | 4 | do | + | Nov. 10, 1958 | N, Flows | S | Reported flow 3 gpm Nov. 10, 1958. Temp. 65°F. |
| *D-20 | C. L. Sellers | Hal Douglas | 1956 | 95 | 7, 5 | do | 66.3<br>65.1 | Aug. 27, 1957<br>Jan. 20, 1959 | J,E, 3/4 | D,S | Casing slotted from 69 ft. to bottom. |
| D-21 | do | -- | Old | 31 | 48 | do | 17.3<br>16.7 | Aug. 27, 1957<br>Jan. 20, 1959 | N | D | Dug. 1/ |
| D-22 | do | Fleet Drilling Co. | 1944 | 285 | 7 | do | 72.2<br>71.8 | Aug. 27, 1957<br>Jan. 20, 1959 | C,W | N | Originally drilled as supply well for oil test. 1/ |
| *D-23 | G. Hodges | -- | 1948 | 69 | 6 | do | 38.6 | July 25, 1958 | J,E | D | Water reported hard. |
| D-24 | T. S. Tidwell | Howell, Hollaway, & Howell | 1953 | 705 | 10 | do | 95 | 1955 | T,E, 15 | Irr | Pump set at 230 ft. Perforated from 250 to 260 ft. Reported yield 125 gpm May 1958. Irrigates 35 acres. |
| D-25 | City of Whitesboro well 3 | Layne-Texas Co. Ltd. | 1946 | 1,520 | 10, 5 | Trinity group | 248.5 | May 9, 1957 | T,E, 50 | P | Casing: 10-in. to 1,404 ft., 5-in. to 1,520 ft., screened from 1,388 to 1,519 ft. Drawdown 107 ft. after 100 min. pumping 330 gpm. May 9, 1957. Gravel-packed. 2/ |
| *D-26 | City of Whitesboro well 2 | do | 1935 | 1,518 | 10, 5 | do | 242.5 | do | T,E, 40 | P | Casing: 10-in. to 1,399 ft., 5-in. to 1,512 ft. screened from 1,384 to 1,426 ft., and from 1,445 to 1,508 ft. Gravel-packed. Temp. 80°F. 2/ |
| *D-27 | Mrs. Iva Huff | Andrew Miller | 1939 | 49 | 48 | Woodbine formation | 10.1 | Dec. 5, 1957 | C,W | D | Dug. Water reported hard. |
| *D-28 | Annie Knight | -- Bass | 1940 | 145 | 6 | do | 80 | June 1958 | J,E | D | |
| D-29 | E. F. Allen well 1 | Ada Oil Co. | 1954 | 6,452 | -- | -- | -- | -- | -- | -- | Oil test. |
| *D-30 | J. G. Barrett | -- | 1908 | 230 | 6 | Woodbine formation | 82.5 | July 16, 1958 | C,W | D,S | Temp. 75°F. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date com-plet-ed | Depth of well (ft.) | Diam-eter of well (in.) | Water-bearing unit | Water level | | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Below land surface datum (ft.) | Date of measurement | | | |
| *D-31 | S. R. Hazelwood | J. L. Myers & Sons | 1942 | 210 | 66 | Woodbine formation | 35 | June 1958 | C,W | D | |
| *D-32 | Mrs. S. D. Ferguson | -- | -- | 210 | 4 | do | 150 | do | C,E | D | Pump set at 175 ft. |
| *D-33 | Southmayd High School | J. L. Myers & Sons | -- | 410 | 4 | do | 200 | do | C,E | P | Supplies water for two houses and a school. |
| *D-34 | Fred Tesar | E. J. Ray | 1948 | 380 | 5 | do | 170 | Dec. 1957 | C,E | D,S | |
| *D-35 | Ed Hurley | -- | 1935 | 200 | 4 | do | -- | -- | C,W | D | |
| *D-36 | W. B. Holland | J. L. McClure | 1926 | 190 | 6 | do | 68 | May 1958 | J,E | D | |
| *D-37 | L. C. Brookshire | -- Bass | 1930 | 200 | 6 | do | 68.3 | May 29, 1958 | C,W | D | |
| *D-38 | R. M. McConnell | -- | 1930 | 160 | 6 | do | 140 | 1957 | J,E, 1 | D,S | |
| *D-39 | S. Varley | Hal Douglas | 1950 | 57 | 6 | do | 25.2 | May 29, 1958 | C,H | N | Perforated from 37 ft. to bottom. |
| *D-40 | Ray Prestage | -- | 1944 | 140 | 7 | do | 65 | 1956 | C,E | D | |
| D-41 | S. Varley | -- Thompson | 1925 | 63 | 5 | do | 30 | May 1958 | C,E | D | |
| *D-42 | J. E. Anderson | -- | 1949 | 11 | 48 | do | 4.9 | Oct. 8, 1957 | B,H | D | Dug. Water reported hard. Temp. 73°F. |
| *D-43 | M. D. Widtfeldt | Ray Westbrook | 1956 | 178 | 4 | do | 79.0 | do | J,E, 1 | D | Perforated from 153 ft. to bottom. Reported to irrigate garden. |
| *E-1 | Hagerman National Wildlife Refuge | -- | 1918 | 165 | 5 | do | + | Apr. 18, 1958 | Flows, N | N | Flows into Lake Texoma. Measured flow 1½ gpm Apr. 18, 1958. Temp. 66°F. |
| *E-2 | do | J. L. Myers & Sons | 1946 | 300 | 6 | do | 34.5 | Apr. 15, 1958 | T,E, 1¼ | D | Reported discharge 8.2 gpm April 1958.2/ |
| *E-3 | do | -- | 1918 | 182 | 3 | do | + | Apr. 18, 1958 | Flows, N | -- | Measured flow 1 gpm Apr. 18, 1958. Temp. 68°F. |
| *E-4 | do | -- | -- | 56 | 3 | do | 38.2 | May 30, 1958 | C,W | N | Temp. 68°F. |
| E-5 | do | E. L. Gill | 1912 | 233 | 5 | do | + | Apr. 17, 1958 | Flows, N | N | |
| *E-6 | do | do | 1920 | 228 | 5 | do | + | do | Flows, N | N | Measured flow 1½ gpm Apr. 17, 1958. Temp. 67°F. |

*** See footnotes at end of table.**

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *E-7 | Hagerman National Wildlife Refuge | -- | 1912 | 235 | 6 | Woodbine formation | + | Apr. 17, 1958 | N | S | Measured flow 2½ gpm Apr. 17, 1958. Temp. 68°F. |
| *E-8 | J. W. Wilson | Perle Townsend | 1938 | 375 | 3 | do | 71.2 | July 11, 1958 | C,W | D | |
| *E-9 | Perrin Air Force Base well 1 | O. T. Myers | 1941 | 620 | 8, 6 | do | 211.1 | July 30, 1957 | T,E, 20 | P | Pump set at 450 ft. Casing: 8-in. to 510 ft., 6-in. to bottom. Slotted from 510 to 620 ft. opposite water-bearing sands. Drawdown 167 ft. after 9½ hrs. pumping 60 gpm July 30, 1957. Temp. 76°F. 2/ |
| *E-10 | Perrin Air Force Base well 2 | do | 1941 | 688 | 10, 8, 7 | do | 157 | Nov. 1941 | T,E, 40 | N | Casing: 10-in. to 30 ft., 8-in. to 504 ft., and 7-in. to bottom. Pump set at 450 ft. Screened from 504 to 524 ft. and 634 to 688 ft. Reported discharge 70 gpm November 1957. Temp. 77°F. 2/ |
| E-11 | Perrin Air Force Base well 3 | do | 1941 | 700 | 10, 8, 7 | do | -- | -- | -- | N | Casing: 10-in. to 40 ft., 8-in. to 585 ft., and 7-in. to 685 ft. Perforated from 585 to 685 ft. opposite water-bearing sands. Abandoned. 2/ |
| *E-12 | Perrin Air Force Base well 4 | Layne-Texas Co. Ltd. | 1942 | 1,570 | 10, 8, 6 | Trinity group | 242 | May 1945 | T,E, 30 | N | Casing: 10-in. to 1,280 ft., 8-in. to 1,589 ft., and 6-in. to 1,888 ft. Originally drilled to 2,131 ft., plugged back to 1,570 ft. because of salt water. 2/ |
| *E-13 | Perrin Air Force Base well 5 | do | 1943 | 801 | 8, 7, 5 | Woodbine formation | -- | -- | T,E, 25 | P | Casing: 8-in. to 660 ft., 7-in. to 697 ft., and 5-in. to bottom. Perforated from 660 to 801 ft. opposite water-bearing sands. Reported discharge 60 gpm November 1957. 2/ |
| *E-14 | Perrin Air Force Base well 7-A | do | 1953 | 642 | 14, 8 | do | 238 | May 1953 | T,E | P | Casing: 14-in. to 463 ft., 8-in. to bottom. Pump set at 450 ft. Screened from 470 to 490, 514 to 524, and 612 to 632 ft. Drawdown 166 ft. after 1 hr. pumping 77 gpm July 30, 1957. Gravel-packed. 2/ |
| E-15 | K. M. Mack | -- Witherspoon | 1958 | 125 | 6 | do | 50 | Oct. 1958 | J,E | D | |
| *E-16 | B. W. Rubarts | -- | Old | 213 | 5 | do | 135 | Nov. 1958 | C,W | D | |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E-17 | Mrs. S. A. Booth | -- Witherspoon | -- | 215 | 4 | Woodbine formation | -- | -- | J,E | D | Water becomes red when drawn from well. |
| *E-18 | Vincent McKeon | J. L. McClure | 1946 | 230 | 4 | do | 15 | May 1958 | J,E, 1 | D,S | Temp. 67°F. |
| *E-19 | D. H. Hamilton | -- | -- | 630 | 4 | do | 123.1 | May 13, 1958 | C,E, ½ | D | |
| E-20 | D. Blankenship well 1 | O. P. Leonard & Star Oil Co. | 1953 | 6,538 | -- | -- | -- | -- | -- | -- | Oil test. |
| *E-21 | O. G. Blankenship | Perle Townsend | 1930 | 100 | 3 | Woodbine formation | + | -- | Flows | -- | Estimated flow 5 gpm May 1958. Temp. 66°F. |
| *E-22 | E. F. Knight | E. C. Freeman | 1946 | 327 | 16, 4 | Pawpaw formation | 16 | July 1958 | J,E, 3/4 | D | Casing: 16-in. to 16 ft., 4-in. to bottom. |
| *E-23 | Jewel Franklin | Don Speaker | 1953 | 150 | 5 | Eagle Ford shale | -- | -- | C,E | D | |
| *E-24 | H. P. Craft | -- McBride | 1947 | 730 | 7 | Woodbine formation | 250 | July 1958 | C,E, 2 | D | |
| E-25 | Tom H. Smith Tract No. 1 | Standard Oil Co. of Texas | 1955 | 11,308 | -- | -- | -- | -- | -- | -- | Oil test. |
| *E-26 | W. E. Stephens | E. C. Freeman | 1930 | 520 | 4 | Woodbine formation | 100 | May 1958 | C,W | D | |
| *E-27 | W. J. Thompson | -- Reeves | 1918 | 380 | 5 | do | 50 | do | C,W | D,S | Pump set at 84 ft. Temp. 71°F. |
| E-28 | C. L. Gibbons | J. L. McClure | 1928 | 400 | 4 | do | -- | -- | C,W | D,S | |
| *E-29 | G. G. Fallon | E. C. Freeman | 1948 | 598 | 5 | do | 210 | Dec. 1597 | C,E, 1 | D,S | Pump set at 431 ft. |
| *E-30 | do | -- | 1955 | 1,600 | 10 | Trinity group | 252.5 | May 16, 1958 | T,E | N | Temp. 68°F. |
| *E-31 | Harry Hudgens | -- | 1943 | 800 | 5 | Woodbine formation | -- | -- | C,E | D,S | Pump set at 600 ft. Temp. 72°F. |
| E-32 | L. H. Jeans | J. L. Myers & Sons | 1958 | 765 | 4, 3 | do | 318 | June 1958 | C,E | D,S | Casing: 4-in. to 692 ft., 3-in. to 735 ft. Perforated from 692 to 710 ft., and 745 ft. to bottom. 2/ |
| *E-33 | E. C. Morris | Perle Townsend | 1939 | 560 | 5 | do | 300 | May 1958 | C,E | D | Pump set at 460 ft. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E-34 | O'Hanlon well 1 | Robert P. Karll | 1955 | 9,034 | -- | -- | -- | -- | -- | -- | Oil test. |
| *E-35 | City of Sherman | Layne-Texas Co. Ltd | 1949 | 789 | 14, 8 | Woodbine formation | 403.4<br>389.4<br>419.0<br>350.2 | Aug. 15, 1957<br>Sept.12, 1957<br>Oct. 17, 1957<br>Nov. 12, 1957 | T,E, 100 | P | Casing: 14-in. to 713 ft., 8-in. from 604 to 785 ft. Screened from 718 to 773 ft. Gravel-packed. Reported discharge 325 gpm August 1958. Drawdown 100 ft. after 48 hrs. pumping 350 gpm April 1949. Temp. 76°F. 2/ |
| *E-36 | do | do | 1944 | 2,169 | 14, 13, 8, 6 | Trinity group | 349.9 | Jan. 27, 1958 | T,E, 100 | P | Casing: 14-in. to 630 ft., 13-in. from 630 to 1,376 ft., 8-in. from 1,180 to 1,712 ft., 6-in. from 1,712 to 2,086 ft. Screened from 1,382 to 1,427, 1,559 to 1,580, 1,599 to 1,621, 1,644 to 1,712, 1,757 to 1,779, and 1,934 to 2,084 ft. Drawdown 260 ft. after 36 hr. pumping 543 gpm Oct. 27, 1944. Reported discharge 350 gpm June 1957. Gravel-packed. Temp. 90°F. 1/ 2/ |
| E-37 | do | Green-Deep Well Co. | 1913 | 778 | 8 | Woodbine formation | 418.7 | Dec. 18, 1958 | N | N | Casing: 8-in. to 721 ft., open hole from 721 ft. to bottom. 2/ |
| *E-38 | do | B. J. Harper | 1921 | 2,140 | 12 | Trinity group | 339.5<br>513.0 | Sept.20, 1957<br>Feb. 13, 1959 | T,E | P | Pump set at 600 ft. Originally drilled to 2,366 ft., plugged back to 2,140 ft. because of salt water. 1/ 2/ |
| E-39 | City of Sherman | W. E. Tomerlin | 1916 | 776 | 8 | Woodbine formation | 376.5<br>388.4 | Dec. 17, 1957<br>Feb. 13, 1959 | N | N | Casing: 8-in. to 725 ft., open hole from 725 ft. to bottom. Abandoned.1/ 2/ |
| *E-40 | do | do | 1917 | 786 | 8 | do | -- | -- | T,E | P | Casing: 8-in. to 724 ft., open hole from 724 ft. to botton. Measured discharge 239 gpm Nov. 13, 1958. Temp. 79°F. 2/ |
| *E-41 | do | Texas Tong & Tool Co., Inc. | 1921 | 2,146 | 12, 8 | Trinity group | -- | -- | T,E | P | Open hole opposite water-bearing sands. 2/ |
| E-42 | do | -- | 1911 | 778 | 8 | Woodbine formation | 443 | July 1945 | A | N | Perforated from 541 to 580 ft. Abandoned 2/ |
| E-43 | do | W. E. Tomerlin | 1917 | 786 | 8 | do | 444 | July 1945 | A | N | Casing: 8-in. to 724 ft., open hole to bottom. Abandoned. 2/ |
| E-44 | do | do | 1917 | 785 | 8 | do | 444 | July 1945 | A | N | Casing: 8-in. to 726 ft., open hole to bottom. Abandoned. 2/ |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E-45 | St.Louis, San Francisco & Texas Ry. Co. | Layne-Texas Co. Ltd. | 1943 | 805 | 10, 6 | Woodbine formation | 273 | Jan. 1944 | N | N | Casing: 10-in. to 735 ft., 6-in. from 645 to bottom. Screened from 747 to 792 ft. Gravel-packed. Well plugged at surface in 1954. 2/ |
| E-46 | do | do | 1916 | 814 | 8 | do | 418.2 | Nov. 6, 1958 | N | N | Casing: 8-in. to 766 ft., open hole from 766 ft. to bottom. 2/ |
| *E-47 | City of Sherman | do | 1956 | 955 | 26, 20, 12, 8 | do | 421.1<br>442.0 | Aug. 13, 1957<br>Feb. 13, 1959 | T,E, 100 | P | Casing: 26-in. to 35 ft., 20-in. from 0 to 574, 12-in. from 0 to 580, 8-in. from 841 ft. to bottom. Screened from 580 to 610, 628 to 668, 676 to 696, 755 to 765, 780 to 820, 830 to 835, and 850 to 940 ft. Gravel-packed. Pump set at 620 ft. Reported discharge 500 gpm August 1958. Temp. 79°F. 1/ 2/ |
| *E-48 | do | do | 1956 | 2,176 | 22, 16, 8 | Trinity group | 648.5<br>391.5 | Aug. 12, 1957<br>Feb. 13, 1959 | T,E, 150 | P | Casing: 22-in. from 0 to 52 ft., 16-in. from 0 to 1,470 ft., 8-in. from 1,270 to 2,140 ft. Screened from 1,480 to 1,550, 1,592 to 1,607, 1,630 to 1,660, 1,685 to 1,730, 1,735 to 1,795, 1,815 to 1,830, 1,852 to 1,887, 1,902 to 1,927, 1,962 to 1,977, 2,010 to 2,020, 2,042 to 2,092, and 2,100 to 2,130 ft. Pump set at 720 ft. Reported discharge 400 gpm August 1958. Drilled to 2,176 ft. plugged back to 2,140 ft. Gravel-packed. Temp. 90°F. 1/ 2/ |
| *E-49 | do | do | 1953 | 2,295 | 14, 8 | do | 385.3<br>298.5 | Aug. 13, 1957<br>Feb. 13, 1959 | T,E, 150 | P | Casing: 14-in. 0 to 1,495, 8-in. 1,255 to 2,295, Screened from 1,501 to 1,591, 1,661 to 1,746, 1,953 to 1,958, 2,001 to 2,031, 2,051 to 2,136, and 2,155 to 2,265 ft. Pump set at 700 ft. Reported discharge 600 gpm August 1958. Gravel-packed. Temp. 91°F. 1/ 2/ |
| *E-50 | do | do | 1953 | 736 | 14, 10, 8 | Woodbine formation | 386.3<br>342.3 | Aug. 13, 1957<br>Feb. 13, 1959 | T,E, 100 | P | Casing: 14-in. 0 to 605, 10-in. 446 to 600, 8-in. from 600 to 736 ft. Screened from 626 ft. to 726 ft. Pump set at 630 ft. Reported discharge 350 gpm August 1958. Gravel-packed Temp. 79°F. 1/ 2/ |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E-51 | Anderson & Clayton Co. | J. L. Myers & Sons | 1939 | 680 | 8, 6 | Woodbine formation | 250 | 1939 | T,E, 50 | Ind | Casing: 8-in. to 615 ft., 6-in. from 575 to 680 ft. Perforated from 615 ft. to 680 ft. Originally drilled to 1,000 ft., plugged back to 680 ft. Pump set at 559 ft. Reported discharge 120 gpm Nov. 1958. Temp. 76°F. 2/ |
| E-52 | Southern Ice Co. | -- | 1910 | 700 | 8 | do | 400 | 1955 | T,E, 20 | Ind | Pump set at 450 ft. Reported discharge 30 gpm in November 1958. |
| E-53 | Sherman Steam Laundry | Layne-Texas Co.Ltd. | 1914 | 791 | 8, 6 | do | 351 | Sept. 1955 | T,E, 18 | Ind | Casing: 8-in. to 620 ft., 6-in. from 638 to 791 ft., open hole from 791 to bottom. Pump set at 540 ft. Reported discharge 100 gpm November 1958. 2/ |
| E-54 | City of Sherman | do | -- | 915 | 10, 8, 4 | do | -- | -- | T,E, 75 | P | Casing: 10-in. to 520 ft., 8-in. from 0 to 654 ft., 4-in. from 578 ft. to bottom Screened from 652 to 706, and 748 to 768 ft. Pump set at 550 ft. Reported discharge 200 gpm Sept. 1947. Gravel-packed. |
| E-55 | do | do | 1947 | 2,256 | 10, 7 | Trinity group | 268.3 | Feb. 13, 1959 | T,E, 100 | P | Casing: 10-in. to 1,603 ft., 7-in. from 1,573 ft. to bottom. Screened from 1,688 to 1,729, 1,748 to 1,848, 1,898 to 1,918, 1,947 to 1,999, 2,048 to 2,068, 2,088 to 2,128, and 2,144 to 2,255 ft. Pump set at 520 ft. Drawdown 160 ft. after 30 min. pumping 354 gpm Nov. 18, 1947. 1/ 2/ |
| E-56 | Southern Pacific Ry. | do | 1949 | 730 | 6 | Woodbine formation | -- | -- | N | N | Well plugged and abandoned in 1955. 2/ |
| E-57 | Sherman Manufacturing Co. | W. E. Tomerlin | 1916 | 776 | 8 | do | 260 | July 1958 | T,E, 15 | Ind | Perforated from 735 ft. to bottom. Pump set at 368 ft. Reported discharge 100 gpm Nov. 1958. 2/ |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *E-58 | City of Sherman | Layne-Texas Co. Ltd. | 1958 | 2,380 | 22, 16, 10 | Trinity group | 312 | Mar. 1959 | T,E, 200 | P | Casing: 22-in. to 31 ft., 16-in. from 0 to 1,580 ft., 10-in. from 1,380 to 2,380 ft. Screened from 1,585 to 1,615, 1,625 to 1,645, 1,660 to 1,700, 1,710 to 1,720, 1,740 to 1,845, 1,870 to 1,880, 1,905 to 1,945, 1,960 to 1,975, 2,005 to 2,025, 2,040 to 2,060, 2,080 to 2,140, 2,150 to 2,250, 2,265 to 2,285, and 2,300 to 2,370 ft. Pump set at 810 ft. Originally drilled to 2,452 ft., plugged back to 2,380 ft. Gravel-walled. Drawdown 406 ft. after 36 hrs. pumping 602 gpm Mar. 20, 1959. Originally drilled to 2,452 ft., but plugged back to 2,380 ft. because of salt water. Temp. 90°F. 2/ |
| *E-59 | P. J. Johnson, Sr. | E. C. Freeman | 1948 | 725 | 4 | Woodbine formation | 190 | Nov. 1957 | C,E | D | Perforated from 714 ft. to bottom. |
| *E-60 | Leon Bloomer | do | 1948 | 720 | 4 | do | 300 | Nov. 1957 | C,E, 1 | D | Pump set at 347 ft. |
| *E-61 | City of Sherman | Layne-Texas Co. Ltd. | 1958 | 2,460 | 22, 16, 10 | Trinity group | 249 | Jan. 1959 | T,E, 200 | P | Casing: 22-in. 0 to 30 ft., 16-in. from 0 to 1,580 ft., 10-in. from 1,380 to 2,460 ft. Screened from 1,590 to 1,610, 1,635 to 1,650, 1,700 to 1,710, 1,730 to 1,765, 1,795 to 1,825, 1,850 to 1,870, 1,895 to 1,925, 1,950 to 1,970, 2,005 to 2,020, 2,115 to 2,155, 2,175 to 2,190, and 2,230 to 2,420 ft. Pump set at 600 ft. Reported discharge 722 gpm Aug. 17, 1959. Drawdown 170 ft. after 35 hrs. pumping 602 gpm Jan. 28, 1959. Gravel-packed. 2/ |
| *E-62 | do | do | 1958 | 1,023 | 26, 20, 12, 10 | Woodbine formation | 301 | Jan. 1959 | T,E, 150 | P | Casing: 26-in. from 0 to 31 ft., 20-in. 0 to 820, 12-in. 0 to 832, 10-in. 832 to 1,023. Screened from 832 to 912, and 942 to 1,012 ft. Pump set at 600 ft. Reported discharge 650 gpm October 1959. Reported drawdown 132 ft. after 37½ hrs. pumping 602 gpm Jan. 29, 1959. Gravel-packed. 2/ |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *E-63 | Chas. F. Burns | J. L. Myers & Sons | 1953 | 773 | 4 | Woodbine formation | 300 | May 1958 | C,E, 2 | D,S | 2/ |
| E-64 | Tyree Vawter well 1 | J. J. Lynn | -- | 9,629 | -- | Woodbine formation and Trinity group | -- | -- | -- | -- | Oil test. Temp. 67°F. |
| *E-65 | R. C. Counts | -- | 1936 | 1,100 | 8 | Woodbine formation | 300 | Dec. 1957 | C,E, 3 | D,S | Supplies water for 3 houses. Temp. 73°F. |
| *E-66 | Franklin Wible | J. L. McClure | 1957 | 140 | 4 | Eagle Ford shale | 30 | Dec. 1957 | C,W | D,S | Perforated from 30 ft. to bottom. Temp. 67°F. |
| E-67 | Line Material Co. | Layne-Texas Co. Ltd. | 1951 | 772 | 16, 8 | Woodbine formation | 279.4 | June 14, 1951 | T,E | Ind | Casing: 16-in. to 610 ft., 8-in. from 623 ft. to bottom. Screened from 623 to 639, 646 to 658, and 670 to 750 ft. Gravel-packed. 1/ |
| E-68 | do | do | 1953 | 773 | 16, 8 | do | 315.0 | July 11, 1953 | T,E, 75 | Ind | Casing: 16-in. to 650 ft., 8-in. from 548 to bottom. Screened from 655 to 728 ft. Pump set at 520 ft. Gravel-packed. 1/ |
| *E-69 | J. W. Bell | -- | 1927 | 370 | 4 | do | 220 | Dec. 1957 | C,W | D | |
| F-1 | Denison Cotton Mill | -- | -- | 50 | 72 | do | 25 | Mar. 1958 | T,E, $7\frac{1}{2}$ | Ind | Dug. Reported pumped 30 gpm Mar. 27, 1958. |
| *F-2 | Alice Sockwell | -- | -- | 70 | 8 | do | 47.8 | Mar. 21, 1958 | B,H | D,S | |
| *F-3 | C. L. Trice | -- | Old | 28 | 60 | do | 8.3 | Dec. 10, 1957 | C,E,1 | D,S | Dug. |
| *F-4 | E. C. Sweeney | -- | -- | 29 | 6 | do | 2.7 | July 16, 1958 | J,E, $\frac{1}{4}$ | D | Water unfit for human consumption. |
| *F-5 | W. S. Knox | J. L. McClure | 1951 | 100 | 4 | do | 40 | Dec. 1957 | C,E, $\frac{1}{2}$ | D,S | Perforated from 84 ft. to bottom. |
| *F-6 | C. W. Stripling | Perle Townsend | 1956 | 95 | 4 | do | 56.0<br>60.8 | Sept.12, 1957<br>Nov. 21, 1958 | J,E, 1 | D | Reported pumped 12 gpm Sept. 1957. 1/ |
| *F-7 | Mrs. H. E. Pierce | -- | -- | 100 | 6 | Pawpaw formation | -- | -- | C,E | D | Temp. 73°F. |
| *F-8 | Paul Wrenn | -- | Old | 42 | 48 | Woodbine formation | 35.6 | July 17, 1958 | J,E | D,S | Dug. |
| *F-9 | C. R. Crabtree | -- | -- | 35 | 48 | Pawpaw formation | 17.4 | do | J,E | D | Dug. Reported hard water. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level | | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Below land surface datum (ft.) | Date of measurement | | | |
| *F-10 | C. D. Mitchell | J. L. McClure | 1953 | 470 | 4 | Trinity group | 10 | Nov. 1957 | C,E, 3/4 | D,Irr | Irrigates small garden. |
| F-11 | Mrs. W. C. King | -- | -- | Spring | -- | Alluvium | + | -- | Flows | N | |
| *F-12 | Federal Communications Commission | Otis Engineering Co. | -- | 45 | 7 | Pawpaw formation | 4.7 | May 14, 1958 | J,E | D | |
| *F-13 | O. W. Price | J. L. McClure | 1953 | 195 | 5, 4 | do | 25.7 | Nov. 15, 1957 | J,E | D | Casing: 5-in. to 30 ft., 4-in from 30 ft to bottom. Perforated from 165 to 185 ft |
| F-14 | H. A. Dunn | -- | 1955 | 23 | -- | Alluvium | 10 | Nov. 1957 | C,E | D | |
| *F-15 | John T. Black | -- | -- | 34 | 48 | Woodbine formation | 20 | July 1958 | J,E, 1 | D | Dug. |
| *F-16 | D. D. Whiting | -- | 1955 | 75 | 4 | do | 10 | July 1958 | J,E, 1 | D,S | Perforated from 55 ft. to bottom. |
| F-17 | Joe Washburn | E. C. Freeman | 1954 | 200 | 5 | do | 90 | May 1954 | C,E, 3/4 | D | Reported pumped 7 gpm in May 1957. |
| *F-18 | Claude Arthur | -- | -- | 25 | 36 | do | 15.9 | July 18, 1958 | J,E | D | Dug. Reported hard water. |
| *F-19 | J. P. Armstrong | J. L. McClure | 1939 | 170 | 6 | do | 112 | Sept. 1957 | C,E, 3/4 | D,S | |
| *F-20 | G. S. Penn | do | 1951 | 460 | 4, 3 | do | 170 | June 1958 | T,E | D | Casing: 4-in. to 215 ft., 3-in. liner from 215 ft. to bottom. |
| *F-21 | R. C. Francis | do | 1957 | 893 | 4 | Trinity group | 75 | July 1958 | C,E, 3 | D | Perforated from 853 ft. to bottom. |
| *F-22 | D. H. James | do | 1941 | 152 | 4 | Woodbine formation | 80 | Sept. 1957 | C,E, 3/8 | S | Water reported to turn red on standing. |
| *F-23 | Jack Adkins | do | 1948 | 455 | 8 | do | 70 | May 1956 | J,E, 2 | D | Pump set at 180 ft. Reported discharge 60 gpm May 1958. |
| *F-24 | A. C. Poole | Perle Townsend | 1948 | 359 | 4 | do | 40 | July 1958 | C,E | D,S | |
| *F-25 | Elmer Mitchell | -- | 1923 | 45 | 60 | Austin chalk | 9.6 | June 6, 1958 | B,H | S | Dug. |
| *F-26 | R. O. Griffin | -- | 1880 | 45 | 72 | do | 20.4 | do | C,E | D | do |
| *F-27 | Jimmy Fant | J. L. McClure | -- | 497 | -- | Woodbine formation | -- | -- | J,E | D,S | |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *F-28 | W. C. Durham | J. L. McClure | 1938 | 70 | 6 | Eagle Ford shale | -- | -- | J,E, ½ | D | Reported hard water. |
| *F-29 | Ray Kraft | E. C. Freeman | 1946 | 365 | 4 | Woodbine formation | 70 | May 1958 | C,E, ½ | D,S | |
| *F-30 | Tom Connor | do | 1956 | 157 | 4 | do | 79.8 | May 14, 1958 | J,E, 1 | D | |
| *F-31 | D. Z. Reynolds | J. L. McClure | 1947 | 50 | 6 | do | 30 | July 1958 | J,E | D,S | |
| *F-32 | J. H. Whiting | E. C. Freeman | 1945 | 153 | 5 | do | 50 | May 1958 | J,E | D,S | Perforated from 138 ft. to bottom. Reported discharge 4 gpm May 1958. |
| *F-33 | Claude Smith | -- | 1948 | 150 | 4 | do | 40 | July 1958 | J,E | D | |
| *F-34 | N. D. Gilliam | E. C. Freeman | 1957 | 140 | 4 | do | -- | -- | C,E, ½ | D | In Fannin County. |
| *F-35 | City of Bells | Layne-Texas Co. Ltd. | 1936 | 709 | 7, 4 | do | 252.0 | May 2, 1957 | T,E, 30 | P | Casing: 7-in. to 672 ft., 4-in. from 665 ft. to bottom. Pump set at 400 ft. Measured discharge 47 gpm Mar. 25,1958. Reported drawdown 80 ft. after 17 hrs. pumping 75 gpm. 2/ |
| *F-36 | do | do | 1959 | 902 | 14 | do | 172 | Sept. 1959 | -- | N | Screened from 463 to 483 ft. About 100 ft. of screen opposite water-bearing sands Oct. 1959. Drawdown 76 ft. after 8½ hrs. pumping 40 gpm Sept. 2, 1959. Temp. 79°F. 2/ |
| F-37 | Dugan Estate | O. W. Witherspoon | 1947 | 538 | 6 | do | 90 | 1947 | J,E, 2 | D,S | Pump set at 230 ft. Perforated from 526 ft. to bottom. Reported discharge 7 gpm June 1957. |
| *F-38 | W. H. Brown | Perle Townsend | 1955 | 460 | 4 | do | 90 | 1955 | T,E, 1 | D,S | Perforated from 450 ft. to bottom. |
| F-39 | J. B. Washburn | -- | Old | 51 | 36 | Austin chalk | 5.3 | Apr. 11, 1958 | N | N | Dug. |
| *F-40 | C. B. Ball | J. L. Myers & Sons | 1956 | 878 | 6, 4 | Woodbine formation | 277.4 | June 10, 1958 | C,E, ½ | D,S | Casing: 6-in. to 20 ft., 4-in. from 20 ft. to bottom. Perforated from 843 ft. to bottom. 2/ |
| *F-41 | O. B. Pierce | -- | -- | 45 | 48 | Austin chalk | .7 | May 16, 1958 | C,E, ½ | D,S | Dug. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *F-42 | J. H. Washburn | J. L. Myers & Sons | 1957 | 745 | 6, 4 | Woodbine formation | 189.0 | May 16, 1958 | C,E, 2 | D | Casing: 6-in. to 10 ft., 4-in. from 10 to 745 ft. Pump set at 400 ft. Perforated from 700 ft. to bottom. 2/ |
| F-43 | Claude Odom | -- | -- | 36 | 48 | Austin chalk | 23.7 | do | B,H | N | Dug. |
| *F-44 | do | J. L. Myers & Sons | 1940 | 700 | 6 | Woodbine formation | 160 | May 1957 | C,E | D | Perforated from 680 ft. to bottom. |
| *F-45 | W. A. Presley | -- | 1880 | 15 | 36 | Austin chalk | -- | -- | Cf,E, 3/4 | D,S | Dug. Reported never fails. |
| F-46 | O. W. Kinnard | R. M. Laurence | -- | 2,481 | -- | -- | -- | -- | -- | -- | Oil test. |
| *G-1 | City of Collinsville | J. L. Myers & Sons | 1949 | 1,522 | 12, 8, 6 | Trinity group | 188.8 | May 7, 1957 | T,E | P | Measured drawdown 26 ft. after 3 hrs. pumping 110 gpm May 7, 1957. Temp. 77°F. |
| G-2 | O. E. Dawkins well 2 | Nortex Oil & Gas Corp. | 1955 | 4,359 | -- | -- | -- | -- | -- | -- | Oil test. |
| *G-3 | A. Hughes | E. C. Freeman | 1947 | 108 | 5 | Woodbine formation | 45 | Oct. 1957 | J,E, ½ | D | |
| *G-4 | Fred J. Price | -- | 1937 | 250 | 4 | do | 200 | Dec. 1957 | C,W | D | |
| *G-5 | Mrs. A. I. Whitt | J. L. McClure | 1954 | 400 | 4 | do | 200 | Dec. 1957 | C,W | S | Reported mineralized water. |
| *G-6 | W. D. Hunter | -- | 1900 | 216 | 5 | do | 165 | Oct. 1957 | C,E | D,S | |
| *G-7 | L. G. Vannoy | -- | 1920 | 35 | 36 | Austin chalk | 29 | Oct. 1957 | J,E | D | Dug. Reported hard water. |
| *G-8 | E. C. McMurrey | -- | -- | 125 | 6 | Woodbine formation | 60 | June 1958 | C,E, 1/6 | D | Reported hard water. |
| G-9 | Graham well 1 | F. H. E. Oil Co. | -- | 3,881 | -- | -- | -- | -- | -- | -- | Oil test. |
| *G-10 | J. L. Varley | -- | 1904 | 32 | 48 | Woodbine formation | 15.7 | Oct. 8, 1957 | C,E | D | Dug. |
| *G-11 | J. J. Tamplin | J. A. Ray | 1956 | 212 | 6 | do | -- | -- | J,E 1½ | D,S | |
| *G-12 | City of Tioga | J. L. Myers & Sons | 1936 | 215 | 8 | do | 65 | Feb. 1936 | T,E | P | Temp. 68°F. 2/ |
| G-13 | Milton Pearce well 1 | Howell, Holloway & Howell | 1953 | 4,327 | -- | -- | -- | -- | -- | -- | Oil test. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level | | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Below land surface datum (ft.) | Date of measurement | | | |
| *G-14 | Fred Reynolds | J. A. Ray | 1920 | 160 | 5 | Woodbine formation | 116.8<br>118.3 | Aug. 28, 1957<br>Jan. 20, 1959 | C,W | D,S | Temp. 69°F. 1/ |
| *G-15 | T. E. Hestand | -- Little | 1918 | 145 | 6 | do | 99.2 | May 29, 1958 | C,E | D,S | |
| *G-16 | Louie Meinen | -- | -- | 104 | 4 | do | 88.6 | do | J,E, 1 | D | |
| *G-17 | S. E. Bartlett | -- Bass | -- | 224 | -- | do | 111.5 | Dec. 18, 1957 | C,W | D,S | |
| G-18 | Murphy Bounds well 1 | Leland Fikes | 1956 | 5,247 | -- | -- | -- | -- | -- | -- | Oil test. |
| *G-19 | Albert Scharff | -- Bass | 1928 | 387 | 6, 5 | Woodbine formation | 72.2 | Oct. 4, 1957 | C,W | S | Reported mineralized water from 200 to 250 ft. |
| *G-20 | Cliff Davis | -- | -- | 146 | 4 | do | 71.7 | Oct. 10, 1957 | C,W | D,S | |
| *G-21 | L. Heitzman | J. A. Ray | 1948 | 230 | 8, 3 | do | 35.0 | Oct. 8, 1957 | C,E, 3/4 | D,S | Casing: 8-in. to 35 ft., 3-in. from 35 ft. to bottom. |
| G-22 | Schindler well 1 | R. B. Farrif | 1947 | 2,720 | -- | -- | -- | -- | -- | -- | Oil test. |
| H-1 | Sperry School Site | J. L. McClure | -- | 380 | 6 | Woodbine formation | -- | -- | C,W | N | |
| H-2 | O. M. Scoggins | J. A. Ray | 1937 | 412 | 6 | do | 250 | Aug. 1956 | C,E, 3/4 | D,S | |
| H-3 | W. H. Higgins | -- | -- | 480 | -- | do | 265 | Oct. 1957 | C,W | D | |
| H-4 | G. A. Umphries | J. L. Myers & Sons | 1956 | 661 | 5 | do | 120 | Aug. 1956 | T,E, 1½ | D,S | Pump set at 320 ft. Perforated from 611 ft. to bottom. |
| H-5 | C. E. Shenke well 1 | Sohio Petroleum Co. | 1955 | 8,362 | -- | -- | -- | -- | -- | -- | Oil test. |
| *H-6 | J. L. Bradley | Lee Wilson | 1918 | 700 | -- | Woodbine formation | 300 | May 1958 | C,E | D | Pump set at 400 ft. Perforated 200 ft. |
| *H-7 | Jake McDonald | -- | -- | 25 | 48 | Austin chalk | 10.3 | May 21, 1958 | Cf,E | D | Dug. |
| *H-8 | R. O. Barham | -- | 1918 | 40 | 36 | do | -- | -- | C,E | D | Reported to never fail. |
| *H-9 | C. E. Teague | -- Smith | 1955 | 750 | 5 | Woodbine formation | -- | -- | C,E, 3 | D,S | |
| *H-10 | C. V. Bowden | -- | -- | 20 | 36 | Austin chalk | .5 | May 21, 1958 | C,E | D | Dug. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H-11 | G. B. Lankford | J. L. Myers & Sons | 1955 | 702 | 4 | Woodbine formation | 290 | 1955 | T,E, 2 | D,S | Pump set at 400 ft. Perforated from 660 ft. to bottom. Temp. 68°F. |
| H-12 | Privette well 1 | The Superior Oil Co. | 1952 | 8,158 | -- | -- | -- | -- | -- | -- | Oil test. |
| *H-13 | W. H. Higgins | J. L. Myers & Sons | 1955 | 604 | 4 | Woodbine formation | 338 | Oct. 1957 | T,E, 2 | D | Perforated from 564 ft. to bottom. 2/ |
| H-14 | do | -- | 1954 | 102 | 5 | Eagle Ford shale | 26.6 | Oct. 9, 1957 | N | N | Perforated from 82 ft. to bottom. |
| H-15 | T. P. Roach well 1 | Sher-Tex Drilling Co. | 1956 | 5,905 | -- | -- | -- | -- | -- | -- | Oil test. |
| *H-16 | A. Dieterich | -- | 1937 | 780 | 8 | Woodbine formation | 240 | Oct. 1957 | C,E, 2 | D,S | |
| H-17 | W. J. Harris | -- | -- | 385 | -- | do | 304.2 | June 12, 1957 | C,W | D | |
| H-18 | E. B. Strawn | J. L. McClure | 1945 | 835 | 4 | do | 190 | 1945 | C,E, 3/4 | D,S | Pump set at 235 ft. Perforated from 658 ft. to bottom. |
| H-19 | J. P. Norman | do | 1953 | 690 | 4 | do | 336.0 | June 12, 1957 | C,E, 2 | D,S | Pump set at 420 ft. Perforated from 641 ft. to bottom. |
| *H-20 | C. E. Davis | -- | 1911 | 18 | 24 | Austin chalk | 1.5 | May 21, 1958 | C,W | D | Dug. |
| *H-21 | City of Howe | J. L. Myers & Sons | 1954 | 1,069 | 6, 4 | Woodbine formation | 371 | Apr. 1954 | T,E, 25 | P | Casing: 6-in. to 902 ft., 4-in. from 798 ft. to bottom. |
| H-22 | do | Deering & Sons | 1911 | 1,050 | 4 | do | 416.3 | May 1, 1957 | A,E, 30 | N | |
| H-23 | N. R. Lankford | J. L. Myers & Sons | 1956 | 1,220 | 4 | do | 200 | July 1956 | C,E, 2½ | D,S | Perforated from 1,188 ft. to bottom. |
| *H-24 | J. H. Blythe | -- | Old | 34 | 36 | Austin chalk | 1.6 | May 20, 1958 | J,E | D,S | Dug. |
| *H-25 | Leroy Wheeler | -- | -- | 32 | 48 | do | -- | -- | Cf,E | D | Dug. |
| *H-26 | L. L. Morrison | -- | -- | 25 | 72 | do | 11.5 | May 21, 1958 | Cf,E, 2 | D | do |
| H-27 | G. A. Umphries | J. L. Myers & Sons | 1953 | 503 | -- | Woodbine formation | 135.7 | June 13, 1957 | T,E, 1½ | D,S | |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *H-28 | City of Gunter | J. L. Myers & Sons | 1956 | 730 | 7, 4 | Woodbine formation | 206 | Mar. 1956 | T,E, 10 | P | Casing: 7-in. to 655 ft. Pump set at 320 ft. Screened from 655 to 730 ft. Drawdown 10 ft. after 10 hrs. pumping 52 gpm. 2/ 3/ |
| *H-29 | R. J. Block | -- Gill | 1947 | 545 | 4 | do | 224.8 | June 6, 1958 | C,W | D | |
| *H-30 | Mrs. J. W. Ladd | -- | Old | 30 | 60 | Austin chalk | 18.2 | May 20, 1958 | B,H | D | Dug. |
| *H-31 | State of Texas | -- | -- | 22 | 60 | do | -- | -- | C,E, 1/4 | D | Supplies water for 3 houses and a store. Temp. 64°F. |
| J-1 | Elwood Thompson | J. L. Myers & Sons | 1956 | 858 | 6 | Woodbine formation | 250 | 1956 | C,E, 2 | D,S | |
| J-2 | Southwestern Bell Telephone Co. | -- | 1938 | 400 | -- | -- | -- | -- | C,E, 5 | D,Ind | Pump set at 300 ft. Reported water highly mineralized. |
| J-3 | R. B. Graves | J. L. Myers & Sons | 1955 | 908 | 6, 4 | Woodbine formation | 280 | Dec. 1955 | C,E, 2 | D,S | Casing: 6-in. to 126 ft., 4-in. from 126 ft. to bottom. Pump set at 378 ft. Perforated from 874 ft. to bottom. 2/ |
| *J-4 | Oscar Wetzel | -- | Old | 26 | 24 | Austin chalk | 2.7 | June 10, 1958 | J,E | D | Dug. Reported to go dry during drought. |
| *J-5 | F. N. Rogers | -- | -- | Spring | -- | do | + | Apr. 11, 1958 | Cf,E, Flows | D,S | Temp. 65°F. |
| J-6 | L. T. Milligan | O. W. Witherspoon | 1949 | 516 | 6 | Eagle Ford shale | 115.3 | June 7, 1957 | C,E, 3/4 | D,S | Perforated from 504 ft. to bottom. |
| *J-7 | Roscoe Gillett | -- | -- | 34 | 48 | Austin chalk | 15.4 | June 10, 1958 | B,H | N | Dug. |
| J-8 | N. R. Stillwell | O. W. Witherspoon | 1940 | 241 | 6 | -- | 165 | 1940 | C,W | D,S | Pump set at 200 ft. Reported soft water. Temp. 68°F. |
| J-9 | Homer Sears | do | 1940 | 340 | 6 | -- | 149.8 | June 6, 1957 | C,E, 1 | D,S | Pump set at 275 ft. Reported soft water. Temp. 67°F. |
| J-10 | City of Whitewright | -- Johnson | 1900 | 1,160 | 6 | Woodbine formation | -- | -- | T,E, 25 | P | |
| *J-11 | do | J. L. Myers & Sons | 1938 | 1,189 | 10, 8, 6 | do | 367.5 | Mar. 26, 1958 | T,E, 25 | P | Casing: 10-in. to 40 ft., 8-in. to 1,109 ft., 6-in. to bottom. Perforated to 130 ft. Drawdown 35½ ft. after 100 min. pumping 698 gpm March 1958. Temp. 84°F. 2/ |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| J-12 | J. C. Bryant | O. W. Witherspoon | 1946 | 360 | 6 | Eagle Ford shale | 150 | June 1957 | C,E, 3/4 | D,S | Pump set at 190 ft. Reported soft water. |
| J-13 | C. L. Holland | do | 1949 | 508 | 5 | do | 160 | 1949 | C,E | S | Pump set at 260 ft. |
| J-14 | do | -- | Old | 34 | 48 | Austin chalk | 5.0 | June 6, 1957 | B,H | D | Dug. Reported hard water. Dry during drought. |
| *J-15 | City of Tom Bean | J. L. Myers & Sons | 1936 | 1,180 | 6 | Woodbine formation | -- | -- | T,E, 15 | P | Pump set at 500 ft. Reported discharge 60 gpm May 1957. Temp. 82°F. |
| *J-16 | Paul H. Franklin | do | 1955 | 1,067 | 6, 4 | do | 300 | Nov. 1955 | C,E, 2 | D,S | Casing: 6-in. to 10 ft., 4-in. to bottom. Perforated from 1,035 ft. to bottom. Pump set at 399 ft. Reported soft water. 2/ |
| *J-17 | Alvie Casada | -- | -- | 28 | 60 | Austin chalk | 10.8 | May 20, 1958 | J,E | D | Dug. |
| *J-18 | R. S. Nicholson | -- | 1900 | 30 | 36 | do | 4.6 | do | B,H | D | do |
| *J-19 | Morris M. Franklin | -- | 1896 | 24 | 36 | do | 2.1 | June 11, 1958 | J,E | D,S | Dug. Reported to never fail. |
| *J-20 | J. M. Purdom | -- | -- | 25 | 36 | do | 16.5 | do | B,H | D | do |
| *J-21 | I. L. Smith | -- | -- | 30 | 24 | do | 6.5 | May 20, 1958 | B,H | D | Dug. |
| *J-22 | W. H. Byers | -- | -- | 22 | 48 | do | .8 | do | J,E | D,S | do |
| J-23 | Mollie Williams well 1 | W. J. Rutledge, Jr. | -- | 5,296 | -- | -- | -- | -- | -- | -- | Oil test. |
| *J-24 | J. B. Edwards, Jr. | -- | Old | 40 | 36 | Austin chalk | 2.6 | May 20, 1958 | Cf,E | D,S | Dug. |
| *J-25 | Burl Shields | -- | 1938 | 20 | 48 | do | 7.2 | June 10, 1958 | Cf,E | D | Dug. Reported to never fail. |
| *J-26 | M. B. Jones | -- | -- | 32 | 72 | do | 9.0 | June 10, 1958 | B,H | S | Dug. Reported to go dry during drought. |
| *J-27 | L. H. Darwin | -- | -- | 39 | 36 | do | 19.7 | do | C,E | D | Dug. |
| *J-28 | Jack Biggerstaff | -- | -- | 42 | 48 | do | 9.4 | do | B,H | N | do |
| *J-29 | E. H. Hickland | -- | -- | Spring | -- | do | -- | -- | N | N | Temp. 65°F. |
| *J-30 | Tom Stephens | -- | Old | 25 | 36 | do | -- | -- | Cf,E, 1/3 | D | Dug. |

* See footnotes at end of table.

Table 7.--Records of wells and springs in Grayson County--Continued

| Well | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing unit | Water level: Below land surface datum (ft.) | Water level: Date of measurement | Method of lift | Use of water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| J-31 | J. D. Clower | O. W. Witherspoon | 1947? | 150 | 10 | Austin chalk | -- | -- | N | N | Abandoned. |
| J-32 | do | do | 1947? | 125 | 10 | do | 6.1 | June 1, 1957 | N | N | |
| J-33 | Calvin Linson | -- | 1935 | 28 | 48 | do | 1.3 | June 7, 1957 | B,H | D | Dug. Supplies water for several houses. Reported hard water. Dry during drought. |
| J-34 | J. Umphries well 1 | Pan American Production Co. | 1952 | 7,012 | -- | -- | -- | -- | -- | -- | Oil test. |
| *J-35 | J. D. Hix | -- | -- | 18 | 72 | Austin chalk | 7.2 | May 20, 1958 | C,E | D | Dug. |
| J-36 | C. B. Bell | -- | 1942 | 17 | 36 | do | 5.2 | June 11, 1957 | J,E, ½ | D,S | Dug. Dry during drought. |
| J-37 | J. B. McCollums | -- | Old | 40 | 36 | do | 26.4 | do | J,E, 1/3 | D,S | Dug. Reported to never fail. |
| J-38 | City of Van Alstyne | J. L. Myers & Sons | 1945 | 1,400 | -- | Woodbine formation | -- | -- | T,E | P | |
| *J-39 | do | do | 1955 | 1,401 | 20, 13, 6 | do | 458 | Aug. 1955 | T,E | P | Casing: 20-in. to 23 ft., 13-in. to 1,165 ft., and 6-in. to bottom. 80 ft. of screen opposite water-bearing sand. Reported discharge 250 gpm May 1957. |

1/ See table 8 for water level measurements of wells in Grayson County, Tex.
2/ See table 9 for drillers' logs of wells in Grayson County.
3/ Electric logs in files of Texas Board of Water Engineers.
* See table 10 for analyses of water from wells and springs in Grayson County.

Table 8.--Water levels in wells in Grayson County, Texas
(in feet below land-surface datum)

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| | | Well A-17 | | | |
| Owner: Hugh Bean | | | | | |
| Sept. 9, 1957 | 26.78 | Apr. 15, 1958 | 25.10 | Sept. 25, 1958 | 24.74 |
| Oct. 17 | 26.34 | May 9 | 24.09 | Oct. 15 | 24.84 |
| Nov. 13 | 26.18 | June 5 | 24.00 | Nov. 24 | 25.13 |
| Dec. 18 | 26.86 | July 8 | 23.98 | Dec. 22 | 25.16 |
| Jan. 22, 1958 | 25.91 | Aug. 12 | 24.14 | Jan. 22, 1959 | 26.62 |
| Mar. 4 | 25.68 | | | | |
| | | Well B-29 | | | |
| Owner: Willow Springs School | | | | | |
| Aug. 30, 1957 | 55.42 | Jan. 29, 1958 | 55.80 | July 8, 1958 | 55.14 |
| Sept.19 | 55.70 | Feb. 25 | 55.61 | Aug. 12 | 55.21 |
| Oct. 18 | 55.50 | Apr. 15 | 55.35 | Sept.25 | 55.82 |
| Nov. 13 | 55.00 | May 8 | 54.95 | Oct. 15 | 55.88 |
| Dec. 19 | 55.24 | June 6 | 55.03 | | |
| | | Well D-20 | | | |
| Owner: C. L. Sellers | | | | | |
| Aug. 27, 1957 | 66.28 | Mar. 4, 1958 | 66.15 | Sept.25, 1958 | 65.83 |
| Sept.19 | 65.94 | Apr. 15 | 65.98 | Oct. 15 | 66.03 |
| Oct. 18 | 66.48 | May 8 | 65.55 | Nov. 12 | 65.88 |
| Nov. 26 | 66.01 | June 2 | 65.82 | Dec. 17 | 65.98 |
| Dec. 18 | 65.80 | July 8 | 66.00 | Jan. 20, 1959 | 65.09 |
| Jan. 27, 1958 | 65.90 | Aug. 12 | 65.87 | | |

Table 8.--Water levels in wells in Grayson County--Continued

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| | | Well D-21 | | | |
| Owner: C. L. Sellers | | | | | |
| Aug. 27, 1957 | 17.33 | Mar. 4, 1958 | 15.33 | Sept.25, 1958 | 15.15 |
| Sept.19 | 17.17 | Apr. 15 | 14.98 | Oct. 15 | 15.50 |
| Oct. 18 | 17.47 | May 8 | 14.14 | Nov. 12 | 15.90 |
| Nov. 26 | 15.72 | June 2 | 14.26 | Dec. 17 | 16.54 |
| Dec. 18 | 16.32 | July 8 | 13.95 | Jan. 20, 1959 | 16.65 |
| Jan. 27, 1958 | 15.40 | Aug. 12 | 14.41 | | |
| | | Well D-22 | | | |
| Owner: C. L. Sellers | | | | | |
| Aug. 27, 1957 | 72.20 | Mar. 4, 1958 | 70.30 | Sept.25, 1958 | 70.18 |
| Sept.19 | 73.42 | Apr. 15 | 69.74 | Oct. 15 | 71.73 |
| Oct. 18 | 73.03 | May 8 | 68.75 | Nov. 12 | 72.00 |
| Nov. 26 | 71.50 | June 2 | 69.13 | Dec. 17 | 72.01 |
| Dec. 18 | 71.96 | July 8 | 69.42 | Jan. 20, 1959 | 71.77 |
| Jan. 27, 1958 | 70.40 | Aug. 12 | 70.23 | | |
| | | Well E-38 | | | |
| Owner: City of Sherman | | | | | |
| Aug. 12, 1957 | a458.00 | May 7, 1958 | a440.0 | Oct. 14, 1958 | a457.0 |
| Nov. 4 | a420.00 | June 4 | a452.0 | Nov. 12 | a457.0 |
| Dec. 17 | a503.0 | July 2 | 355.0 | Dec. 19 | a442.0 |
| Jan. 27, 1958 | a482.0 | Aug. 6 | a533.0 | Jan. 15, 1959 | a496.0 |
| Mar. 7 | a430.0 | Oct. 1 | a452.0 | Feb. 13 | a513.0 |
| Apr. 10 | 345.0 | | | | |

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Table 8.--Water levels in wells in Grayson County--Continued

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| | | Well E-39 | | | |
| Owner: City of Sherman | | | | | |
| Aug. 12, 1957 | 405.30 | Apr. 10, 1958 | 383.50 | Oct. 14, 1958 | 381.40 |
| Sept. 11 | 399.10 | May 7 | 385.90 | Nov. 12 | 384.20 |
| Oct. 15 | 404.70 | June 4 | 394.10 | Dec. 18 | 384.40 |
| Dec. 17 | 376.50 | July 2 | 418.40 | Jan. 15, 1959 | 375.40 |
| Jan. 27, 1958 | 382.50 | Aug. 6 | 451.90 | Feb. 13 | 388.40 |
| Mar. 7 | 388.50 | Oct. 1 | 396.10 | | |
| | | Well E-47 | | | |
| Owner: City of Sherman | | | | | |
| Aug. 13, 1957 | 421.06 | Mar. 19, 1958 | 442.40 | Oct. 1, 1958 | 446.22 |
| Sept. 13 | 431.08 | Apr. 11 | 412.70 | Oct. 14 | 454.70 |
| Oct. 17 | 443.06 | May 8 | 420.30 | Nov. 12 | 451.43 |
| Nov. 13 | 436.74 | June 4 | 441.05 | Dec. 18 | 450.99 |
| Dec. 17 | 371.40 | July 3 | 433.75 | Jan. 15, 1959 | 451.56 |
| Jan. 27, 1958 | 511.70 | Aug. 6 | 440.60 | Feb. 13 | 442.04 |
| Jan. 28 | 417.30 | | | | |
| | | Well E-48 | | | |
| Owner: City of Sherman | | | | | |
| Aug. 12, 1957 | 648.50 | Mar. 19, 1958 | 392.30 | Oct. 1, 1958 | 410.68 |
| Aug. 13 | 469.16 | Apr. 11 | 446.6 | Oct. 14 | 438.23 |
| Sept. 13 | 432.95 | May 8 | 392.00 | Nov. 12 | 403.62 |
| Oct. 17 | 428.50 | June 4 | 429.50 | Dec. 18 | 411.12 |
| Nov. 13 | 410.24 | July 3 | 412.10 | Jan. 15, 1959 | 426.85 |
| Jan. 28, 1958 | 404.17 | Aug. 6 | 442.20 | Feb. 13 | 391.50 |

Table 8.--Water levels in wells in Grayson County--Continued

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| | | Well E-49 | | | |
| Owner: City of Sherman | | | | | |
| Aug. 13, 1957 | 385.30 | Mar. 7, 1958 | 295.55 | Oct. 1, 1958 | 341.50 |
| Sept. 19 | 371.64 | Apr. 11 | 296.57 | Oct. 14 | 326.40 |
| Oct. 16 | 318.85 | May 7 | 295.33 | Nov. 10 | 318.35 |
| Nov. 12 | 307.65 | June 4 | 336.50 | Dec. 18 | 297.25 |
| Dec. 17 | 306.00 | July 3 | 371.40 | Jan. 15, 1959 | 295.15 |
| Jan. 27, 1958 | 306.58 | Aug. 6 | 410.38 | Feb. 13 | 298.50 |
| | | Well E-50 | | | |
| Owner: City of Sherman | | | | | |
| Aug. 13, 1957 | 386.25 | Mar. 7, 1958 | 333.18 | Oct. 1, 1958 | 326.30 |
| Sept. 19 | 371.10 | Apr. 11 | 333.86 | Oct. 14 | 343.00 |
| Oct. 16 | 357.50 | May 7 | 330.83 | Nov. 10 | 346.00 |
| Nov. 12 | 365.20 | June 4 | 353.30 | Dec. 18 | 343.90 |
| Dec. 17 | 340.80 | July 3 | 365.04 | Jan. 15, 1959 | 343.37 |
| Jan. 27, 1958 | 329.12 | Aug. 6 | 394.20 | Feb. 13 | 342.34 |
| | | Well E-55 | | | |
| Owner: City of Sherman | | | | | |
| Sept. 13, 1957 | 366.30 | Apr. 11, 1958 | 260.15 | Oct. 14, 1958 | 285.20 |
| Oct. 16 | 284.65 | May 7 | 260.18 | Nov. 12 | 275.36 |
| Nov. 12 | 274.49 | June 4 | 261.55 | Dec. 18 | 264.00 |
| Dec. 17 | 272.70 | July 2 | 276.74 | Jan. 15, 1959 | 262.49 |
| Jan. 27, 1958 | 271.25 | Aug. 6 | 304.73 | Feb. 13 | 268.29 |
| Mar. 7 | 261.70 | Oct. 1 | 294.21 | | |

Table 8.--Water levels in wells in Grayson County--Continued

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| | | Well F-6 | | | |
| Owner: C. W. Stripling | | | | | |
| Sept.12, 1957 | 56.02 | Feb. 25, 1958 | 41.73 | Aug. 19, 1958 | 60.60 |
| Oct. 23 | 52.44 | Apr. 17 | 38.40 | Sept.25 | 49.16 |
| Nov. 26 | 50.24 | May 8 | 4.75 | Oct. 15 | 50.19 |
| Dec. 20 | 50.10 | June 6 | 40.15 | Nov. 21 | 60.76 |
| Jan. 29, 1958 | 42.32 | July 8 | 46.40 | | |
| | | Well G-14 | | | |
| Owner: Fred Reynolds | | | | | |
| Aug. 28, 1957 | 116.76 | Mar. 4, 1958 | 116.97 | Aug. 12, 1958 | 117.70 |
| Sept.19 | 116.91 | Apr. 15 | 117.07 | Sept.25 | 117.09 |
| Oct. 8 | 117.39 | May 8 | 116.90 | Oct. 15 | 118.23 |
| Nov. 13 | 116.56 | June 2 | 117.21 | Nov. 24 | 118.39 |
| Dec. 18 | 116.77 | July 8 | 117.34 | Jan. 20, 1959 | 118.31 |
| Jan. 29, 1958 | 117.02 | | | | |

The well in Cooke County and the wells in Montague County listed below were selected as observation wells because of their location in the outcrop of the Trinity group. Figure 7 shows the location of the wells.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| | | Cooke County | | | |
| Owner: J. H. Richey. Town of Marysville, $9\frac{1}{2}$ miles north of Muenster. Drilled unused well; diameter, 4 inches; depth, 58 feet. | | | | | |
| Dec. 5, 1957 | 29.18 | May 9, 1958 | 26.60 | Oct. 16, 1958 | 29.14 |
| Dec. 19 | 28.85 | June 3 | 27.39 | Nov. 19 | 29.43 |
| Jan. 15, 1958 | 28.55 | July 9 | 27.70 | Dec. 16 | 29.22 |
| Feb. 27 | 28.16 | Aug. 7 | 28.45 | Jan. 19, 1959 | 29.09 |
| Apr. 2 | 27.99 | Sept. 26 | 29.05 | | |
| | | Montague County | | | |
| Owner: J. L. Golightly. 8.6 miles southeast of Montague. Drilled unused well; diameter, 6 inches; depth, 165 feet. | | | | | |
| Dec. 3, 1957 | 14.83 | May 9, 1958 | 12.10 | Oct. 16, 1958 | 14.30 |
| Dec. 19 | 14.54 | June 3 | 12.45 | Nov. 19 | 14.38 |
| Jan. 15, 1958 | 14.38 | July 9 | 12.47 | Dec. 16 | 14.50 |
| Feb. 27 | 14.19 | Aug. 7 | 13.25 | Jan. 19, 1959 | 14.38 |
| Apr. 2 | 13.78 | Sept. 26 | 14.09 | | |
| Owner: Midland Oil Co. 6.7 miles north of Saint Jo. Drilled domestic well; diameter, 5 inches; depth, 112 feet. | | | | | |
| Dec. 3, 1957 | 76.37 | May 9, 1958 | 74.92 | Oct. 16, 1958 | 75.25 |
| Dec. 19 | 75.38 | June 3 | 75.34 | Nov. 19 | 75.12 |
| Jan. 15, 1958 | 75.96 | July 9 | 75.32 | Dec. 16 | 76.00 |
| Feb. 27 | 75.08 | Aug. 7 | 77.15 | Jan. 19, 1959 | 75.10 |
| Apr. 2 | 75.48 | Sept. 26 | 72.37 | | |

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|

Montague County--Continued

Owner: Lois Bell. 3.0 miles southeast of Montague. Drilled domestic well; diameter, 6 inches; depth, 225 feet.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 14, 1957 | 58.99 | Feb. 27, 1958 | 58.90 | Dec. 16, 1958 | 58.88 |
| Dec. 19 | 59.96 | Oct. 16 | 58.62 | Jan. 19, 1959 | 58.70 |
| Jan. 15, 1958 | 59.30 | Nov. 19 | 58.81 | | |

Table 9.--Drillers' logs of wells in Grayson County, Texas 1/

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| | | Well A-21 | | | |
| Owner: Gordonville Water Association. Driller: J. L. Myers & Sons. | | | | | |
| Surface | 6 | 6 | Shale | 28 | 690 |
| Clay | 24 | 30 | Shale, sandy | 6 | 696 |
| Shale | 46 | 76 | Shale and sand | 30 | 726 |
| Sand | 12 | 88 | Shale | 11 | 737 |
| Shale | 48 | 136 | Shale, limy | 28 | 765 |
| Sand | 6 | 142 | Shale | 32 | 797 |
| Shale | 57 | 199 | Lime | 21 | 818 |
| Sand | 6 | 205 | Shale, limy | 20 | 838 |
| Shale | 57 | 262 | Sand | 8 | 846 |
| Sand | 4 | 266 | Shale | 21 | 867 |
| Shale | 36 | 302 | Sand | 16 | 883 |
| Shale, sandy | 10 | 312 | Shale | 4 | 887 |
| Sand | 43 | 355 | Sand | 19 | 906 |
| Shale | 6 | 361 | Shale | 81 | 987 |
| Shale, limy | 214 | 575 | Sand | 21 | 1,008 |
| Shale | 18 | 593 | Sandrock | 2 | 1,010 |
| Lime | 35 | 628 | Sand | 8 | 1,018 |
| Shale | 20 | 648 | Shale | 3 | 1,021 |
| Shale, sandy | 14 | 662 | | | |

1/ Wording rearranged for uniformity.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well A-25 | | | | | |
| Owner: J. C. Brady. Driller: Hal Douglas. | | | | | |
| Red bed | 20 | 20 | Sand | 13 | 145 |
| Shale | 30 | 50 | Shale and rock | 35 | 180 |
| Sand | 6 | 56 | Sand and shale | 9 | 189 |
| Shale | 12 | 68 | Sand | 40 | 229 |
| Sandrock | 12 | 80 | Rock, hard | 1 | 230 |
| Shale | 31 | 111 | Shale | 61 | 291 |
| Sand | 12 | 123 | Sand | 54 | 345 |
| Shale | 9 | 132 | | | |
| Well A-35 | | | | | |
| Owner: E. Gaitis. Driller: Townsend & Freeman. | | | | | |
| Clay | 25 | 25 | Clay, varicolored | 40 | 160 |
| Clay, varicolored | 85 | 110 | Sand, blue | 20 | 180 |
| Sand | 10 | 120 | | | |
| Well A-36 | | | | | |
| Owner: Hagerman National Wildlife Refuge. Driller: Layne-Texas Co., Ltd. | | | | | |
| Soil | 1 | 1 | Shale, sandy | 26 | 164 |
| Clay | 23 | 24 | Rock | 2 | 166 |
| Clay and some sand | 17 | 41 | Shale and hard layers | 37 | 203 |
| Shale, black | 31 | 72 | Rock | 1 | 204 |
| Shale, sticky | 65 | 137 | Sand | 12 | 216 |
| Rock | 1 | 138 | Shale and hard layers | 10 | 226 |

(Continued on next page)

Well A-36--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Sand, hard | 7 | 233 | Shale and sand | 9 | 487 |
| Shale, sandy | 19 | 252 | Rock | 1 | 488 |
| Shale and hard layers | 28 | 280 | Shale | 7 | 495 |
| Sand | 6 | 286 | Lime and shale | 19 | 514 |
| Rock | 1 | 287 | Rock | 1 | 515 |
| Gumbo | 4 | 291 | Lime and shale | 4 | 519 |
| Shale, tough | 6 | 297 | Sand and shale | 11 | 530 |
| Sand and hard layers | 16 | 313 | Gumbo | 4 | 534 |
| Shale, sandy | 79 | 392 | Shale | 47 | 581 |
| Sand, gray | 30 | 422 | Sand | 9 | 590 |
| Sand, white | 31 | 453 | Shale and sand | 13 | 603 |
| Shale, sandy, and hard layers | 15 | 468 | Shale, hard | 6 | 609 |
| Rock | 2 | 470 | Sand and shale | 30 | 639 |
| Shale, sandy | 8 | 478 | Shale, sandy | 15 | 654 |

Well B-2

Owner: U. S. Army. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Sand and clay | 25 | 25 | Sand | 18 | 115 |
| Rock | 2 | 27 | Sand, coarse | 29 | 144 |
| Clay | 5 | 32 | Limerock and sand | 10 | 154 |
| Rock | 1 | 33 | Shale and lime | 11 | 165 |
| Clay, tough, and rock | 35 | 68 | Sand, hard, broken | 14 | 179 |
| Lime, hard | 15 | 83 | Shale and lime | 6 | 185 |
| Clay and sand | 14 | 97 | Lime, hard, and shale | 17 | 202 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well B-2--Continued** | | | | | |
| Gumbo and shale------------ | 13 | 215 | Shale and sand------------- | 12 | 495 |
| Shale---------------------- | 46 | 261 | Shale, soft, green--------- | 5 | 500 |
| Shale, sandy--------------- | 9 | 270 | Shale, sandy, blue--------- | 60 | 560 |
| Rock----------------------- | 1 | 271 | Rock----------------------- | 1 | 561 |
| Sand and shale------------- | 9 | 280 | Shale, sandy--------------- | 12 | 573 |
| Gumbo and shale------------ | 15 | 295 | Sand, fine, white---------- | 12 | 585 |
| Rock----------------------- | 2 | 297 | Shale, sandy--------------- | 21 | 606 |
| Lime, hard----------------- | 12 | 309 | Sand, fine, white---------- | 10 | 616 |
| Shale, soft, green--------- | 7 | 316 | Shale and hard lime-------- | 24 | 640 |
| Shale and fine sand layers------------------ | 16 | 332 | Sand, and shaly lime------- | 45 | 685 |
| Lime----------------------- | 15 | 347 | Limerock------------------- | 1 | 686 |
| Rock----------------------- | 1 | 348 | Shale, sticky-------------- | 20 | 706 |
| Shale and lime layers------ | 30 | 378 | Gumbo, red----------------- | 25 | 731 |
| Lime----------------------- | 4 | 382 | Sand, gravel, and shale---- | 13 | 744 |
| Shale and sand breaks------ | 19 | 401 | Shale and some sand-------- | 23 | 767 |
| Gumbo---------------------- | 4 | 405 | Rock----------------------- | 1 | 768 |
| Shale---------------------- | 39 | 444 | Shale and lime------------- | 8 | 776 |
| Shale and hard layers------ | 19 | 463 | Shale, sticky-------------- | 8 | 784 |
| Sand, broken--------------- | 20 | 483 | Gumbo---------------------- | 21 | 805 |

Well B-25

Owner: R. C. Dalton Well 1. Driller: Sherman Oil & Gas Co.

| | | | | | |
|---|---|---|---|---|---|
| Soil----------------------- | 3 | 3 | Shale, blue---------------- | 45 | 85 |
| Clay, yellow--------------- | 37 | 40 | Shale, sticky, blue-------- | 18 | 103 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well B-25--Continued | | | | | |
| Shale, blue | 5 | 108 | Sand, white | 17 | 447 |
| Lime shell | 2 | 110 | Shale, brown | 13 | 460 |
| Shale, blue | 15 | 125 | Shale, sticky | 5 | 465 |
| Shale, sandy, blue | 8 | 133 | Shale, sandy | 20 | 485 |
| Shale, sandy | 7 | 140 | Shale, red | 15 | 500 |
| Shale, blue | 38 | 178 | Shale, blue | 10 | 510 |
| Limestone | 22 | 200 | Shale, sandy, gray | 15 | 525 |
| Shale, sandy, blue | 8 | 208 | Shale, sandy, red | 8 | 533 |
| Sand, white | 4 | 212 | Red bed | 12 | 545 |
| Lime, sandy | 10 | 222 | Shale, sticky | 5 | 550 |
| Sand, white | 38 | 260 | Shale, sandy, red | 20 | 570 |
| Sand, white, water | 20 | 280 | Sand, white, water | 20 | 590 |
| Sand, white | 40 | 320 | Shale, red | 10 | 600 |
| Sand, water | 15 | 335 | Sand, white | 12 | 612 |
| Sand, hard | 12 | 347 | Shale, red | 13 | 625 |
| Sand, white | 3 | 350 | Red bed | 15 | 640 |
| Shale, red | 10 | 360 | Shale, red | 30 | 670 |
| Shale, sandy | 20 | 380 | Shale, sandy, gray | 18 | 688 |
| Red bed | 3 | 383 | Quicksand | 9 | 697 |
| Shale, sticky | 10 | 393 | Red bed | 38 | 735 |
| Shale, sandy, red | 17 | 410 | Lime shell | 3 | 738 |
| Shale, blue | 10 | 420 | Sand, white, water | 17 | 755 |
| Sand, red | 7 | 427 | Shale, sticky, blue | 10 | 765 |
| Shale, brown | 3 | 430 | Red bed | 20 | 785 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well B-25--Continued | | | | | |
| Shale, sandy | 27 | 812 | Shale, blue | 27 | 867 |
| Shale, sandy, blue | 8 | 820 | Sand, gray | 5 | 872 |
| Lime, sandy | 6 | 826 | Gas sand | 3 | 875 |
| Shale, blue | 1 | 827 | Shale, blue | 7 | 882 |
| Lime, sandy | 13 | 840 | Gas sand | 10 | 892 |

Well B-27

Owner: City of Pottsboro. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Soil | 3 | 3 | Sand, fine, gray, and hard layers | 10 | 259 |
| Clay | 7 | 10 | Sand, fine, gray | 6 | 265 |
| Clay, sandy | 6 | 16 | Shale, sandy | 10 | 275 |
| Sandrock, yellow | 7 | 23 | Sand and shale layers | 13 | 288 |
| Shale, blue | 22 | 45 | Shale and sticky shale | 47 | 335 |
| Sand, fine, gray, and shale layers | 29 | 74 | Rock, hard | 2 | 337 |
| Shale, sandy, blue | 69 | 143 | Lime, sandy, and shale | 23 | 360 |
| Shale | 31 | 174 | Shale, sandy | 22 | 382 |
| Shale, sticky, and hard layers | 75 | 249 | Lime, hard, and shale | 36 | 418 |
| | | | Shale, sandy | 25 | 443 |

Well B-29

Owner: Willow Springs School. Driller: E. C. Freeman

| | | | | | |
|---|---|---|---|---|---|
| Soil and clay | 2 | 2 | Clay, varicolored | 60 | 160 |
| Shale, blue | 88 | 90 | Sand, coarse, white | 32 | 192 |
| Sand, blue, water | 10 | 100 | | | |

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| | | Well C-4 | | | |
| Owner: Table Products Co. Driller: -- | | | | | |
| Soil | 6 | 6 | Slate, gray | 20 | 305 |
| Sand, yellow | 16 | 22 | Lime | 10 | 315 |
| Lime shell | 6 | 28 | Slate | 3 | 318 |
| Shale, blue | 7 | 35 | Lime | 5 | 323 |
| Lime shell | 3 | 38 | Slate | 7 | 330 |
| Shale, sandy | 10 | 48 | Shale, sandy | 5 | 335 |
| Shale, blue | 12 | 60 | Slate, blue | 20 | 355 |
| Shale, sandy, gray | 40 | 100 | Lime | 16 | 371 |
| Slate, blue | 37 | 137 | Slate, brown | 11 | 382 |
| Lime | 8 | 145 | Limestone | 21 | 403 |
| Slate, gray | 15 | 160 | Shale | 4 | 407 |
| Slate, brown | 10 | 170 | Sand | 21 | 428 |
| Slate, gray | 20 | 190 | Sand, coarse | 8 | 436 |
| Lime | 8 | 198 | Shale, light-colored | 1 | 437 |
| Slate, gray | 5 | 203 | Marl, hard | 3 | 440 |
| Lime | 9 | 212 | Marl, red | 6 | 446 |
| Slate, gray | 8 | 220 | Sand, broken | 4 | 450 |
| Lime | 5 | 225 | Sand, brown and white | 10 | 460 |
| Slate, gray | 50 | 275 | Sand, water | 98 | 558 |
| Sand | 10 | 285 | | | |

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|

Well C-8

Owner: Luther Cherry. Driller: E. C. Freeman

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Soil, sandy | 10 | 10 | Hardpan | 20 | 100 |
| Clay | 70 | 80 | Sand, hard, yellow | 10 | 110 |

Well D-25

Owner: City of Whitesboro Well 3. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Surface soil | 2 | 2 | Sand, shale, and lime layers | 120 | 1,103 |
| Clay | 13 | 15 | Shale | 38 | 1,141 |
| Shale, sandy, and shale | 130 | 145 | Shale, hard | 17 | 1,158 |
| Shale, hard, lime, and sandy shale layers | 100 | 245 | Sand | 30 | 1,188 |
| Shale, hard | 62 | 307 | Shale, hard, and lime | 19 | 1,207 |
| Sand and shale | 52 | 359 | Shale, hard, lime, and sand breaks | 31 | 1,238 |
| Lime | 9 | 368 | Shale, sandy, and shale | 21 | 1,259 |
| Shale, hard, lime, and sand | 87 | 455 | Sand | 24 | 1,283 |
| Lime and shale | 99 | 554 | Sand and shale | 15 | 1,298 |
| Shale, sticky, and lime layers | 31 | 585 | Shale | 32 | 1,330 |
| Lime and shale | 233 | 818 | Sand and shale | 15 | 1,345 |
| Shale, sandy, and hard rock layers | 77 | 895 | Shale, hard, varicolored | 15 | 1,360 |
| Shale, sandy | 29 | 924 | Sand and shale | 18 | 1,378 |
| Shale and lime | 27 | 951 | Shale | 13 | 1,391 |
| Shale, sandy | 22 | 973 | Sand | 36 | 1,427 |
| Shale and lime | 10 | 983 | Shale, hard | 8 | 1,435 |
| | | | Sand and shale | 64 | 1,499 |
| | | | Shale, hard | 21 | 1,520 |

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| | | Well D-26 | | | |
| Owner: City of Whitesboro Well 2. Driller: Layne-Texas Co., Ltd. | | | | | |
| Surface soil | 5 | 5 | Rock | 2 | 551 |
| Clay | 5 | 10 | Shale and hard lime | 29 | 580 |
| Clay, sandy | 15 | 25 | Rock | 1 | 581 |
| Shale, hard | 26 | 51 | Shale and hard lime | 5 | 586 |
| Shale and boulders | 27 | 78 | Rock | 2 | 588 |
| Shale, sandy, and boulders | 40 | 118 | Shale and limerock | 2 | 590 |
| Shale, hard | 45 | 163 | Shale and hard lime | 35 | 625 |
| Rock | 1 | 164 | Rock | 1 | 626 |
| Gravel | 21 | 185 | Shale and hard lime | 21 | 647 |
| Rock | 2 | 187 | Rock | 1 | 648 |
| Shale, hard | 11 | 198 | Shale and lime | 26 | 674 |
| Shale, sand, and gravel | 153 | 351 | Lime, blue | 8 | 682 |
| Limerock | 6 | 357 | Shale and lime | 30 | 712 |
| Lime, sandy | 46 | 403 | Lime, hard | 4 | 716 |
| Limerock | 2 | 405 | Limerock | 6 | 722 |
| Shale, lime, and sand | 37 | 442 | Shale and hard lime | 43 | 765 |
| Limerock | 2 | 444 | Shale, sticky | 6 | 771 |
| Shale, lime, and sand | 7 | 451 | Limerock | 37 | 808 |
| Shale, sticky | 12 | 463 | Shale and lime | 3 | 811 |
| Rock | 7 | 470 | Shale, sticky | 30 | 841 |
| Shale and hard lime | 68 | 538 | Shale, sandy | 35 | 876 |
| Rock | 1 | 539 | Shale, hard | 4 | 880 |
| Shale and hard lime | 10 | 549 | Shale, sandy | 25 | 905 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well D-26--Continued | | | | | |
| Shale, hard---------------- | 6 | 911 | Lime----------------------- | 12 | 1,210 |
| Shale, sandy, and boulders- | 7 | 918 | Limerock------------------- | 7 | 1,217 |
| Shale and shells----------- | 7 | 925 | Sand----------------------- | 10 | 1,227 |
| Shale, sandy--------------- | 2 | 927 | Lime, hard----------------- | 12 | 1,239 |
| Shale and lime------------- | 8 | 935 | Packsand------------------- | 10 | 1,249 |
| Lime and limerock---------- | 8 | 943 | Lime and sand-------------- | 30 | 1,279 |
| Shale and lime------------- | 27 | 970 | Sand----------------------- | 10 | 1,289 |
| Shale, sticky-------------- | 11 | 981 | Red bed and lime----------- | 10 | 1,299 |
| Sand----------------------- | 10 | 991 | Sand----------------------- | 5 | 1,304 |
| Shale, hard---------------- | 9 | 1,000 | Red bed and lime----------- | 10 | 1,314 |
| Shale and sand------------- | 18 | 1,018 | Packsand, hard------------- | 13 | 1,327 |
| Shale and lime------------- | 19 | 1,037 | Lime and sand-------------- | 8 | 1,335 |
| Shale and lime sand-------- | 3 | 1,040 | Rock----------------------- | 1 | 1,336 |
| Sand and lignite----------- | 10 | 1,050 | Sand----------------------- | 3 | 1,339 |
| Lime, hard----------------- | 8 | 1,058 | Shale---------------------- | 4 | 1,343 |
| Shale, lime, and sand------ | 12 | 1,070 | Sand----------------------- | 6 | 1,349 |
| Shale and lime------------- | 13 | 1,083 | Lime, shale, and sand------ | 9 | 1,358 |
| Lime, sandy---------------- | 7 | 1,090 | Lime, hard----------------- | 2 | 1,360 |
| Lime, hard----------------- | 9 | 1,099 | Lime, sandy---------------- | 6 | 1,366 |
| Shale, hard---------------- | 27 | 1,126 | Lime, hard----------------- | 4 | 1,370 |
| Sand----------------------- | 7 | 1,133 | Lime, sandy---------------- | 15 | 1,385 |
| Shale, hard---------------- | 5 | 1,138 | Lime, sticky--------------- | 4 | 1,389 |
| Shale and slate------------ | 8 | 1,146 | Sand----------------------- | 26 | 1,415 |
| Red bed-------------------- | 52 | 1,198 | Sand and shale------------- | 12 | 1,427 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well D-26--Continued | | | | | |
| Limerock | 8 | 1,435 | Rock | 1 | 1,480 |
| Limerock and shale | 9 | 1,444 | Sand | 28 | 1,508 |
| Lime, sandy | 11 | 1,455 | Red bed | 1 | 1,509 |
| Sand | 24 | 1,479 | Lime and shale | 9 | 1,518 |

Well E-2

Owner: Hagerman National Wildlife Refuge. Driller: J. L. Myers & Sons.

| | | | | | |
|---|---|---|---|---|---|
| Soil | 1 | 1 | Sand, water | 14 | 224 |
| Clay | 26 | 27 | Shale, blue | 34 | 258 |
| Shale, blue | 113 | 140 | Sand, water | 4 | 262 |
| Rock, gray | 2 | 142 | Shale, sandy | 3 | 265 |
| Sand, blue | 13 | 155 | Shale, blue | 7 | 272 |
| Shale, blue | 30 | 185 | Limerock, blue | 3 | 275 |
| Sand, blue | 7 | 192 | Shale, blue | 10 | 285 |
| Shale, blue | 12 | 204 | Lime, blue | 1 | 286 |
| Sandrock | 6 | 210 | Shale | 14 | 300 |

Well E-9

Owner: Perrin Air Force Base Well 1. Driller: O. T. Myers.

| | | | | | |
|---|---|---|---|---|---|
| Soil, brown | 2 | 2 | Shale, gray | 35 | 145 |
| Clay, yellow | 15 | 17 | Shale, brown | 35 | 180 |
| Clay, sand, yellow | 3 | 20 | Shale, blue | 65 | 245 |
| Shale, yellow and blue | 8 | 28 | Shale, gray | 120 | 365 |
| Shale, blue | 54 | 82 | Shale, sandy, gray | 32 | 397 |
| Shale, brown | 28 | 110 | Sand, water | 15 | 412 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well E-9--Continued | | | | | |
| Shale, blue---------------- | 34 | 446 | Shale, green--------------- | 10 | 545 |
| First Woodbine sand-------- | 23 | 469 | Shale, sandy, light-brown-- | 20 | 565 |
| Gumbo, blue---------------- | 23 | 492 | Shale, varicolored--------- | 7 | 572 |
| Sand, fine, brown---------- | 5 | 497 | Shale, hard, gray---------- | 6 | 578 |
| Shale, gray---------------- | 2 | 499 | Lime, hard, brown---------- | 10 | 588 |
| Shale, blue---------------- | 5 | 504 | Shale, gray and green------ | 4 | 592 |
| Shell, sandy, light-colored----------------- | 6 | 510 | Sand, white, water--------- | 25 | 617 |
| Sand, fine, white, water--- | 25 | 535 | Shale, blue and brown------ | 3 | 620 |

Well E-10

Owner: Perrin Air Force Base Well 2. Driller: O. T. Myers.

| | | | | | |
|---|---|---|---|---|---|
| Soil, brown---------------- | 2 | 2 | Shale, blue---------------- | 25 | 450 |
| Clay, red-yellow----------- | 12 | 14 | Shale, sandy, white-------- | 5 | 455 |
| Shale, blue---------------- | 76 | 90 | Sand, gray, water---------- | 25 | 480 |
| Shale, brown--------------- | 27 | 117 | Gumbo, blue---------------- | 20 | 500 |
| Shale, gray---------------- | 35 | 152 | Rock, sandy, blue---------- | 5 | 505 |
| Shale, brown--------------- | 38 | 190 | Second Woodbine sand------- | 20 | 525 |
| Shale, blue---------------- | 63 | 253 | Shale, sandy, gray--------- | 5 | 530 |
| Shale, gray---------------- | 102 | 355 | Gumbo, green--------------- | 8 | 538 |
| Shale, brown--------------- | 20 | 375 | Shale, brown--------------- | 10 | 548 |
| Shale, sandy, gray--------- | 27 | 402 | Shale, varicolored--------- | 14 | 562 |
| Shale, blue---------------- | 12 | 414 | Shale, hard, gray---------- | 28 | 590 |
| Sand, white, soft---------- | 3 | 417 | Gumbo, sticky, gray-------- | 3 | 593 |
| Sand, green, and pyrite---- | 8 | 425 | Lime, hard, brown---------- | 9 | 602 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-10--Continued** | | | | | |
| Shale, gray | 4 | 606 | Shale, sandy, white | 19 | 634 |
| Shale, brown | 9 | 615 | Third Woodbine sand | 54 | 688 |

Well E-11

Owner: Perrin Air Force Base Well 3. Driller: O. T. Myers.

| | | | | | |
|---|---|---|---|---|---|
| Soil, brown | 2 | 2 | Shale, blue | 33 | 550 |
| Clay, yellow | 4 | 6 | Shale, white | 20 | 570 |
| Rock, brown | 3 | 9 | Shale, green | 7 | 577 |
| Clay, yellow-red | 18 | 27 | Lime, gray | 2 | 579 |
| Shale, blue | 123 | 150 | Gumbo, varicolored | 6 | 585 |
| Shale, brown | 60 | 210 | Sand, white | 25 | 610 |
| Shale, gray | 90 | 300 | Shale, pink | 9 | 619 |
| Shale, brown | 70 | 370 | Lime, gray | 2 | 621 |
| Shell and rock | 2 | 372 | Sand, white | 17 | 638 |
| Shale, sandy, gray | 63 | 435 | Shale, red | 10 | 648 |
| Shale, blue | 28 | 463 | Sand, white | 10 | 658 |
| Sand, gray | 27 | 490 | Lime, gray | 2 | 660 |
| Shale, blue | 13 | 503 | Shale, red | 3 | 663 |
| Shale, sandy, gray | 14 | 517 | Sand, hard, white | 37 | 700 |

Well E-12

Owner: Perrin Air Force Base Well 4. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Surface clay | 10 | 10 | Shale and chalk | 41 | 110 |
| Shale, blue | 59 | 69 | Sand, shale, and shells | 185 | 295 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well E-12--Continued | | | | | |
| Shale and shells | 62 | 357 | Shale and lime shells | 6 | 1,296 |
| Shale and lime shells | 51 | 408 | Sand | 5 | 1,301 |
| Sand and lime shells | 30 | 438 | Shale, sandy, and lime shale | 17 | 1,318 |
| Sand, broken, shale, and shells | 130 | 568 | Sand | 8 | 1,326 |
| Shale | 17 | 585 | Shale, sandy | 76 | 1,402 |
| Sand | 25 | 610 | Sand | 14 | 1,416 |
| Shale | 41 | 651 | Shale, sandy | 9 | 1,425 |
| Shale, blue and brown | 24 | 675 | Sand | 2 | 1,427 |
| Shale and lime streaks | 7 | 682 | Sand and shale, broken | 13 | 1,440 |
| Sand and lime streaks | 23 | 705 | Sand, hard, and shale | 32 | 1,472 |
| Shale | 12 | 717 | Sand | 3 | 1,475 |
| Sand and lime, broken | 28 | 745 | Shale, sand, and hard lime | 35 | 1,510 |
| Shale and lime shells | 63 | 808 | Shale, sandy | 8 | 1,518 |
| Shale and lime streaks | 22 | 830 | Shale, sandy, and lime shells | 82 | 1,600 |
| Lime | 5 | 835 | Shale | 2 | 1,602 |
| Sand and lime streaks | 67 | 902 | Sand, shale, and lime shells | 65 | 1,667 |
| Lime and shale, broken | 44 | 946 | Lime | 9 | 1,676 |
| Shale and lime | 44 | 990 | Shale, sandy | 9 | 1,685 |
| Lime and shale, broken | 57 | 1,047 | Lime, hard | 53 | 1,738 |
| Shale and lime streaks | 52 | 1,099 | Shale | 27 | 1,765 |
| Lime and shale, broken | 131 | 1,230 | Sand | 10 | 1,775 |
| Sand, shale, and shells | 28 | 1,258 | Lime and broken shale | 23 | 1,798 |
| Lime | 32 | 1,290 | | | |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-12--Continued** | | | | | |
| Sand, shale, and shells---- | 9 | 1,807 | Sand and shale, broken----- | 5 | 1,981 |
| Shale and shells----------- | 27 | 1,834 | Shale, sandy--------------- | 8 | 1,989 |
| Lime, broken--------------- | 8 | 1,842 | Sand, soft----------------- | 26 | 2,015 |
| Shale, sandy, and shells--- | 30 | 1,872 | Sand, medium soft---------- | 16 | 2,031 |
| Sand and shale------------- | 12 | 1,884 | Sand, soft----------------- | 13 | 2,044 |
| Sand----------------------- | 5 | 1,889 | Sand, hard, and medium lime-------------------- | 23 | 2,067 |
| Lime, sandy, hard---------- | 12 | 1,901 | Sand, hard----------------- | 15 | 2,082 |
| Sand, shale, and shells---- | 19 | 1,920 | Shale, sandy--------------- | 9 | 2,091 |
| Lime, sandy, hard, and shale------------------- | 9 | 1,929 | Sand, hard, and brown sticky shale------------ | 12 | 2,103 |
| Sand and lime, hard, broken------------------ | 6 | 1,935 | Sand, and brown shale------ | 7 | 2,110 |
| Shale, sandy, and shells--- | 25 | 1,960 | Shale, red, and sand------- | 8 | 2,118 |
| Sand, hard----------------- | 9 | 1,969 | Sand, hard, and red shale-- | 13 | 2,131 |
| Sand, medium soft---------- | 7 | 1,976 | | | |

Well E-13

Owner: Perrin Air Force Base Well 5. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Soil, brown---------------- | 2 | 2 | First Woodbine sand-------- | 25 | 505 |
| Clay, yellow--------------- | 25 | 27 | Shale, blue---------------- | 21 | 526 |
| Shale, blue and brown------ | 388 | 415 | Sand, gray----------------- | 12 | 538 |
| Sand, dry, brown----------- | 5 | 420 | Lime, gray----------------- | 1 | 539 |
| Shale, sandy, blue--------- | 32 | 452 | Shale, sandy, dark-blue---- | 9 | 548 |
| Sand, white, water--------- | 16 | 468 | Shale, gray---------------- | 8 | 556 |
| Shale, brown--------------- | 12 | 480 | Asphalt, fossiliferous, black------------------ | 1 | 557 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| | | Well E-13--Continued | | | |
| Shale, green---------------- | 6 | 563 | Gumbo, red------------------ | 6 | 676 |
| Shale, brown---------------- | 12 | 575 | Sand, white, water---------- | 10 | 686 |
| Shale, varicolored---------- | 11 | 586 | Sand, gray------------------ | 5 | 691 |
| Shale, sandy, hard, gray--- | 24 | 610 | Gumbo, red------------------ | 2 | 693 |
| Shale, gray----------------- | 2 | 612 | Gumbo, dark-green----------- | 3 | 696 |
| Lime, brown----------------- | 2 | 614 | Lime, brown----------------- | 3 | 699 |
| Shale, brown---------------- | 4 | 618 | Sand, white, water---------- | 35 | 734 |
| Lime, brown----------------- | 4 | 622 | Gumbo, varicolored---------- | 4 | 738 |
| Sand, white, water---------- | 13 | 635 | Sand, white, water---------- | 11 | 749 |
| Lime, hard, brown----------- | 6 | 641 | Gumbo, varicolored---------- | 12 | 761 |
| Gumbo, white---------------- | 8 | 649 | Lime, hard, brown----------- | 2 | 763 |
| Gumbo, red------------------ | 4 | 653 | Second Woodbine sand-------- | 25 | 788 |
| Gumbo, green---------------- | 5 | 658 | Lime, white----------------- | 8 | 796 |
| Sand, white, water---------- | 12 | 670 | Shale, blue----------------- | 5 | 801 |

Well E-14

Owner: Perrin Air Force Base Well 7-A. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Soil------------------------ | 2 | 2 | Shale, sandy---------------- | 36 | 163 |
| Clay------------------------ | 6 | 8 | Shale, blue----------------- | 215 | 378 |
| Sand, black----------------- | 4 | 12 | Shale, sandy---------------- | 22 | 400 |
| Clay------------------------ | 28 | 40 | Shale----------------------- | 24 | 424 |
| Shale, blue----------------- | 58 | 98 | Shale, sandy---------------- | 12 | 436 |
| Shale, sandy---------------- | 18 | 116 | Shale----------------------- | 28 | 464 |
| Shale, blue----------------- | 11 | 127 | Sand------------------------ | 24 | 488 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-14--Continued** | | | | | |
| Shale, sandy | 23 | 511 | Sand, broken | 34 | 632 |
| Sand | 4 | 515 | Shale | 6 | 638 |
| Shale, sandy | 29 | 544 | Not logged | 4 | 642 |
| Shale | 54 | 598 | | | |

Well E-32

Owner: L. H. Jeans. Driller: J. L. Myers & Sons.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Clay | 18 | 18 | Shale, sandy | 20 | 594 |
| Shale | 433 | 451 | Shale | 87 | 681 |
| Sand and shale, broken | 63 | 514 | Shale, sandy | 8 | 689 |
| Shale | 4 | 518 | Sand | 16 | 705 |
| Sand | 7 | 525 | Sand and shale | 5 | 710 |
| Shale, sandy | 23 | 548 | Shale | 31 | 741 |
| Sand | 9 | 557 | Sand | 23 | 764 |
| Shale | 3 | 560 | Shale | 1 | 765 |
| Sand | 14 | 574 | | | |

Well E-35

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Surface soil | 3 | 3 | Shale | 19 | 473 |
| Clay | 8 | 11 | Shale, sandy | 17 | 490 |
| Sand | 10 | 21 | Shale | 51 | 541 |
| Shale, blue | 413 | 434 | Sand and sandy shale | 30 | 571 |
| Shale, sandy, and sand | 20 | 454 | Shale | 9 | 580 |

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| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-35--Continued** | | | | | |
| Sand and sandy shale------- | 20 | 600 | Shale and sandy shale------ | 17 | 699 |
| Shale---------------------- | 28 | 628 | Shale, sandy, and shale---- | 21 | 720 |
| Shale and sandy shale------ | 42 | 670 | Sand----------------------- | 59 | 779 |
| Shale, red and blue-------- | 12 | 682 | Shale, blue, and streaks of red shale--------------- | 10 | 789 |

Well E-36

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Surface soil--------------- | 3 | 3 | Lime and shale------------- | 43 | 954 |
| Clay----------------------- | 7 | 10 | Shale, hard---------------- | 425 | 1,379 |
| Sand----------------------- | 10 | 20 | Sand, shale breaks, and lime-------------------- | 50 | 1,429 |
| Shale, blue---------------- | 440 | 460 | Shale, hard---------------- | 13 | 1,442 |
| Shale, sandy, and sand----- | 18 | 478 | Sand and sandy shale------- | 45 | 1,487 |
| Shale---------------------- | 63 | 541 | Shale, white and blue------ | 59 | 1,546 |
| Sand and sandy shale------- | 28 | 569 | Shale, sandy, and shale---- | 25 | 1,571 |
| Shale---------------------- | 10 | 579 | Shale, hard---------------- | 17 | 1,588 |
| Shale and sandy shale------ | 68 | 647 | Shale and breaks of hard sand-------------------- | 31 | 1,619 |
| Sand----------------------- | 14 | 661 | Shale---------------------- | 28 | 1,647 |
| Shale and some sand breaks- | 34 | 695 | Shale, sandy, and sand----- | 28 | 1,675 |
| Shale, sandy--------------- | 40 | 735 | Shale---------------------- | 10 | 1,685 |
| Sand----------------------- | 41 | 776 | Sand and sandy shale------- | 20 | 1,705 |
| Shale, blue and red-------- | 77 | 853 | Shale, red and blue-------- | 12 | 1,717 |
| Shale, hard, sticky-------- | 6 | 859 | Shale and hard lime-------- | 15 | 1,732 |
| Shale, hard---------------- | 52 | 911 | | | |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-36--Continued** | | | | | |
| Shale | 31 | 1,763 | Sand | 35 | 2,015 |
| Shale, sandy, and shale | 32 | 1,795 | Sand and shale | 16 | 2,031 |
| Shale, tough | 16 | 1,811 | Sand | 24 | 2,055 |
| Shale, hard, red and blue | 39 | 1,850 | Sand and shale breaks | 61 | 2,116 |
| Shale, sandy | 10 | 1,860 | Shale, hard | 13 | 2,129 |
| Shale, hard, red and blue | 58 | 1,918 | Sand | 13 | 2,142 |
| Lime, hard | 2 | 1,920 | Sand and shale layers | 13 | 2,155 |
| Shale, hard, red and blue | 19 | 1,939 | Sand | 12 | 2,167 |
| Shale, sandy, and sand | 23 | 1,962 | Shale, hard | 2 | 2,169 |
| Shale, sandy, hard | 18 | 1,980 | | | |

Well E-37

Owner: City of Sherman. Driller: Green Deep Well Co.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Soil, sandy | 6 | 6 | Sandrock | 3 | 226 |
| Clay, yellow | 14 | 20 | Mussel shells | 19 | 245 |
| Sand and gravel | 14 | 34 | Sandrock | 2 | 247 |
| Soapstone and shale | 13 | 47 | Shale, blue | 63 | 310 |
| Gumbo, hard, tough | 16 | 63 | Gumbo, black | 13 | 323 |
| Sandrock | 1 | 64 | Shale, light-colored | 89 | 412 |
| Shale, blue | 19 | 83 | Sandrock | 3 | 415 |
| Shale and streaks of gumbo | 57 | 140 | Shale, blue | 46 | 461 |
| Shale, blue | 60 | 200 | Gumbo, black | 9 | 470 |
| Gumbo, very tough | 23 | 223 | Soapstone, light-colored | 15 | 485 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-37--Continued** | | | | | |
| Sandrock------------------- | 3 | 488 | Soapstone, light-colored--- | 8 | 626 |
| Shale, light-colored------- | 52 | 540 | Soapstone and shale-------- | 14 | 640 |
| Gumbo, black--------------- | 14 | 554 | Gumbo, very sticky, blue--- | 25 | 665 |
| Soapstone, light-colored--- | 21 | 575 | Shale---------------------- | 18 | 683 |
| Sand, hard----------------- | 9 | 584 | Sandrock------------------- | 2 | 685 |
| Sandrock, very hard-------- | 4 | 588 | Gumbo---------------------- | 17 | 702 |
| First Woodbine sand, hard, fine-------------------- | 26 | 614 | Soapstone and streaks of shale------------------- | 19 | 721 |
| Sandrock------------------- | 4 | 618 | Second Woodbine sand, white------------------- | 57 | 778 |

Well E-38

Owner: City of Sherman. Driller: B. J. Harper.

| | | | | | |
|---|---|---|---|---|---|
| Clay----------------------- | 28 | 28 | Limerock and shale--------- | 75 | 1,094 |
| Rock, hard----------------- | 4 | 32 | Limerock and blue marl----- | 43 | 1,137 |
| Sand, yellow, water-------- | 2 | 34 | Lime, hard----------------- | 41 | 1,178 |
| Shale, blue---------------- | 457 | 491 | Limerock and shale--------- | 186 | 1,364 |
| Sandrock------------------- | 2 | 493 | Limerock, hard------------- | 38 | 1,402 |
| Sand, water---------------- | 18 | 511 | Sandrock------------------- | 6 | 1,408 |
| Shale, blue---------------- | 218 | 729 | Shale, sandy--------------- | 10 | 1,418 |
| Sand, water---------------- | 23 | 752 | Sand, fine----------------- | 39 | 1,457 |
| Shale---------------------- | 67 | 819 | Sand and marl-------------- | 59 | 1,516 |
| Shale, blue---------------- | 93 | 912 | Limerock, hard------------- | 1 | 1,517 |
| Limerock and shale--------- | 50 | 962 | Sand, fine, and streaks of marl-------------------- | 29 | 1,546 |
| Shale, blue---------------- | 57 | 1,019 | | | |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-38--Continued** | | | | | |
| Marl, white---------------- | 4 | 1,550 | Sand, hard, water---------- | 8 | 1,922 |
| Sand, fine, and red rock--- | 18 | 1,568 | Marl, varicolored---------- | 7 | 1,929 |
| Sand and marl, water------- | 19 | 1,587 | Marl, sandy, varicolored--- | 37 | 1,966 |
| Sand, hard----------------- | 8 | 1,595 | Sandrock and sand---------- | 14 | 1,980 |
| Marl, red, blue, and white- | 34 | 1,629 | Sand----------------------- | 20 | 2,000 |
| Marl, red, blue, and white, and streaks of sand----- | 24 | 1,653 | Rock, hard----------------- | 2 | 2,002 |
| Marl, red, blue, and white- | 25 | 1,678 | Sandrock, water------------ | 17 | 2,019 |
| Sand and limerock---------- | 28 | 1,706 | Sand, fine, soft, water---- | 8 | 2,027 |
| Sand and red and blue marl- | 21 | 1,727 | Sand, fine, hard, water---- | 27 | 2,054 |
| Sandrock, hard------------- | 8 | 1,735 | Sand, water---------------- | 14 | 2,068 |
| Sand, fine----------------- | 28 | 1,763 | Rock, sand, and layers of blue and red marl------- | 26 | 2,094 |
| Sandrock------------------- | 9 | 1,772 | Sand, hard, and rock------- | 4 | 2,098 |
| Sand, fine, and marl layers------------------ | 23 | 1,795 | Sandrock, sand, and marl--- | 13 | 2,111 |
| Sandrock------------------- | 4 | 1,799 | Marl, red, and streaks of sand-------------------- | 22 | 2,133 |
| Marl----------------------- | 10 | 1,809 | Sand, water---------------- | 10 | 2,143 |
| Sand----------------------- | 9 | 1,818 | Sandrock, hard------------- | 3 | 2,146 |
| Sand and streaks of marl--- | 22 | 1,840 | Gumbo, red----------------- | 4 | 2,150 |
| Rock, red------------------ | 13 | 1,853 | Marl, red------------------ | 2 | 2,152 |
| Sand, hard----------------- | 7 | 1,860 | Sandrock and red marl------ | 13 | 2,165 |
| Sand and streaks of red rock-------------------- | 25 | 1,885 | Marl, red------------------ | 2 | 2,167 |
| Marl, sandy, red----------- | 3 | 1,888 | Sandrock, broken----------- | 8 | 2,175 |
| Sand, fine, hard----------- | 26 | 1,914 | Shale, sandy, red and blue-------------------- | 14 | 2,189 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well E-38--Continued | | | | | |
| Marl, red | 7 | 2,196 | Shale, sandy | 4 | 2,305 |
| Sandrock, soft | 4 | 2,200 | Sandrock, hard | 3 | 2,308 |
| Rock, hard | 2 | 2,202 | Marl, red | 2 | 2,310 |
| Limerock, hard | 2 | 2,204 | Rock and red shale | 8 | 2,318 |
| Shale, hard, red | 2 | 2,206 | Sandrock and red shale | 8 | 2,326 |
| Shale, red, blue, and white | 9 | 2,215 | Shale, red | 3 | 2,329 |
| Lime, hard | 1 | 2,216 | Shale, hard, varicolored | 3 | 2,332 |
| Sandrock, hard | 3 | 2,219 | Sandrock | 4 | 2,336 |
| Shale, red | 1 | 2,220 | Sandrock and shale | 8 | 2,344 |
| Shale, red and blue | 28 | 2,248 | Sandrock, red shale, and hard rock | 11 | 2,355 |
| Shale, red | 18 | 2,266 | Sandrock, hard | 1 | 2,356 |
| Sandrock | 4 | 2,270 | Shale, hard | 2 | 2,358 |
| Shale, red | 26 | 2,296 | Sandrock, hard, sharp | 3 | 2,361 |
| Sandrock | 1 | 2,297 | Sandrock, hard | 5 | 2,366 |
| Shale, red | 4 | 2,301 | | | |

Well E-39

Owner: City of Sherman. Driller: W. E. Tomerlin.

| | | | | | |
|---|---|---|---|---|---|
| Soil, sandy | 3 | 3 | Marl, white | 14 | 555 |
| Clay, yellow | 9 | 12 | First Woodbine sand, water- | 32 | 587 |
| Clay, white, and sand | 3 | 15 | Sandrock, hard | 2 | 589 |
| Sand, yellow | 19 | 34 | Gumbo | 19 | 608 |
| Marl, blue, and streaks of shale | 507 | 541 | Shale, blue, and boulders | 43 | 651 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-39--Continued** | | | | | |
| Rock and gumbo | 34 | 685 | Sandrock | 2 | 726 |
| Gumbo, yellow and red | 39 | 724 | Second Woodbine sand, water | 50 | 776 |

Well E-40

Owner: City of Sherman. Driller: W. E. Tomerlin.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Soil, sandy | 3 | 3 | Sandrock, hard | 7 | 594 |
| Clay, yellow | 9 | 12 | Gumbo | 14 | 608 |
| Clay, white | 3 | 15 | Shale, blue | 43 | 651 |
| Sand, yellow | 19 | 34 | Gumbo and boulders | 30 | 681 |
| Marl, blue, and shale streaks | 507 | 541 | Sand | 15 | 696 |
| Marl, white | 14 | 555 | Gumbo, yellow and red | 27 | 723 |
| First Woodbine sand | 32 | 587 | Sandrock | 2 | 725 |
| | | | Second Woodbine sand | 61 | 786 |

Well E-41

Owner: City of Sherman. Driller: The Texas Tong & Tool Co., Inc.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Surface clay | 15 | 15 | Shale | 58 | 152 |
| Sand, water | 25 | 40 | Shale, sandy | 10 | 162 |
| Shale, sandy | 22 | 62 | Gumbo, blue | 20 | 182 |
| Rock | 1 | 63 | Rock and sand | 20 | 202 |
| Sand, water | 10 | 73 | Shale | 10 | 212 |
| Sandrock | 1 | 74 | Marl | 28 | 240 |
| Shale | 16 | 90 | Marl and sand | 12 | 252 |
| Sandrock | 4 | 94 | Marl, blue | 48 | 300 |

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| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Well E-41--Continued | | |
| Marl | 30 | 330 |
| Sandrock, hard | 4 | 334 |
| Marl | 8 | 342 |
| Gumbo and shale | 40 | 382 |
| Marl, tough | 20 | 402 |
| Marl | 40 | 442 |
| Limerock, hard | 2 | 444 |
| Marl and sandrock | 18 | 462 |
| Limerock, hard | 2 | 464 |
| Marl, hard, and sandrock | 32 | 496 |
| Limerock, hard | 13 | 509 |
| Sandrock, hard | 15 | 524 |
| Sandrock | 4 | 528 |
| Gumbo, blue | 11 | 539 |
| Gumbo, tough | 40 | 579 |
| Sandrock | 16 | 595 |
| Gumbo blue | 45 | 640 |
| Sandrock, hard | 10 | 650 |
| Gumbo | 10 | 660 |
| Sandrock | 30 | 690 |
| Sandrock and boulders | 30 | 720 |
| Sandrock, hard | 10 | 730 |
| Sandrock and boulders | 16 | 746 |
| Sandrock | 10 | 756 |
| Sandrock and boulders | 4 | 760 |
| Sandrock | 20 | 780 |
| Sand, water | 60 | 840 |
| Sandrock | 20 | 860 |
| Sandrock and boulders | 15 | 875 |
| Sand, water | 25 | 900 |
| Sandrock | 10 | 910 |
| Sandrock, hard, and boulders | 20 | 930 |
| Sandrock | 8 | 938 |
| Chalk | 10 | 948 |
| Limerock, hard | 6 | 954 |
| Chalk, hard | 2 | 956 |
| Sandrock, hard | 26 | 982 |
| Sandrock | 7 | 989 |
| Shale, hard | 11 | 1,000 |
| Sandrock | 19 | 1,019 |
| Sandrock, hard | 15 | 1,034 |
| Rock, hard, and boulders | 2 | 1,036 |
| Limerock, hard | 2 | 1,038 |
| Rock | 2 | 1,040 |
| Rock, hard | 2 | 1,042 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-41--Continued** | | | | | |
| Sandrock | 4 | 1,046 | Limerock and boulders | 10 | 1,325 |
| Gumbo | 20 | 1,066 | Limerock, hard | 5 | 1,330 |
| Sandrock | 12 | 1,078 | Marl, red and blue | 22 | 1,352 |
| Sandrock and boulders | 42 | 1,120 | Limerock, hard | 14 | 1,366 |
| Sandrock | 30 | 1,150 | Rock, hard | 1 | 1,367 |
| Rock, hard | 2 | 1,152 | Limerock, hard | 32 | 1,399 |
| Limerock, hard | 4 | 1,156 | Sandrock and marl | 3 | 1,402 |
| Limerock, hard, and boulders | 4 | 1,160 | Sandrock, hard | 3 | 1,405 |
| Limerock and boulders | 12 | 1,172 | Sandrock and marl | 90 | 1,495 |
| Limerock, hard | 6 | 1,178 | Sand, fine, water | 15 | 1,510 |
| Limerock and boulders | 12 | 1,190 | Gumbo, blue | 10 | 1,520 |
| Gumbo and boulders | 12 | 1,202 | Sandrock and marl | 25 | 1,545 |
| Limerock, hard | 10 | 1,212 | Sandrock, hard | 10 | 1,555 |
| Gumbo and boulders | 8 | 1,220 | Sandrock, soft | 10 | 1,565 |
| Limerock, hard | 4 | 1,224 | Sandrock and boulders | 20 | 1,585 |
| Limerock and boulders | 14 | 1,238 | Shale, limy | 4 | 1,589 |
| Limerock, hard | 12 | 1,250 | Sandrock and marl | 13 | 1,602 |
| Marl and boulders | 25 | 1,275 | Sandrock, hard | 8 | 1,610 |
| Gumbo and boulders | 10 | 1,285 | Limerock, hard | 2 | 1,612 |
| Limerock, hard | 6 | 1,291 | Shale, blue, and boulders | 33 | 1,645 |
| Limerock, hard, and boulders | 2 | 1,293 | Shale, blue | 15 | 1,660 |
| Rock, hard, and boulders | 3 | 1,296 | Sandrock and marl | 35 | 1,695 |
| Limerock, hard | 19 | 1,315 | Sand, limy, water | 20 | 1,715 |
| | | | Marl, red, blue, and white | 20 | 1,735 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-41--Continued** | | | | | |
| Sandrock, hard | 3 | 1,738 | Sandrock, hard | 2 | 1,999 |
| Marl, red | 10 | 1,748 | Sandrock, water | 6 | 2,005 |
| Sandrock and boulders | 17 | 1,765 | Gumbo, tough, blue | 10 | 2,015 |
| Lime boulders | 5 | 1,770 | Sand, water | 2 | 2,017 |
| Marl, red, blue, and white | 15 | 1,785 | Sandrock, hard, and sand, water | 18 | 2,035 |
| Sand, limy, water | 15 | 1,800 | Gumbo, tough, blue | 10 | 2,045 |
| Sandrock, hard, and boulders | 72 | 1,872 | Sand, water | 5 | 2,050 |
| Sandrock, hard | 20 | 1,892 | Sandrock and boulders | 5 | 2,055 |
| Marl, red | 10 | 1,902 | Sand, water, and boulders | 50 | 2,105 |
| Sandrock | 10 | 1,912 | Sand, water | 25 | 2,130 |
| Marl, red and blue | 33 | 1,945 | Sandrock, hard | 2 | 2,132 |
| Sand, fine, soft | 2 | 1,947 | Sand, water | 11 | 2,143 |
| Marl, red, and sand | 25 | 1,972 | Sandrock | 3 | 2,146 |
| Sandrock | 25 | 1,997 | | | |

Well E-42

Owner: City of Sherman. Driller: --

| | | | | | |
|---|---|---|---|---|---|
| Clay, yellow | 25 | 25 | Sand, water | 27 | 516 |
| Rock | 1 | 26 | Shale and hard shells | 26 | 542 |
| Shale, blue | 422 | 448 | First Woodbine sand | 40 | 582 |
| Sandrock, very hard | 5 | 453 | Shale and hard shells | 118 | 700 |
| Sand, dark | 10 | 463 | Second Woodbine sand | 72 | 772 |
| Shale, blue | 23 | 486 | Soapstone | 6 | 778 |
| Caprock | 3 | 489 | | | |

Well E-43

Owner: City of Sherman. Driller: W. E. Tomerlin.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Soil, sandy | 3 | 3 | Sandrock, hard | 7 | 594 |
| Clay, yellow | 9 | 12 | Gumbo | 14 | 608 |
| Clay, white | 3 | 15 | Shale, blue | 43 | 651 |
| Sand, yellow | 19 | 34 | Gumbo and boulders | 30 | 681 |
| Marl, blue, and shale streaks | 507 | 541 | Sand | 15 | 696 |
| Marl, white | 14 | 555 | Gumbo, yellow and red | 27 | 723 |
| First Woodbine sand | 32 | 587 | Sandrock | 2 | 725 |
| | | | Second Woodbine sand | 61 | 786 |

Well E-44

Owner: City of Sherman. Driller: W. E. Tomerlin.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Soil, sandy | 3 | 3 | Sandrock, hard | 7 | 594 |
| Clay, yellow | 9 | 12 | Gumbo | 14 | 608 |
| Clay, white | 3 | 15 | Shale, blue | 43 | 651 |
| Sand, yellow | 19 | 34 | Gumbo and boulders | 30 | 681 |
| Marl, blue, and shale streaks | 507 | 541 | Sand | 15 | 696 |
| Marl, white | 14 | 555 | Gumbo, yellow and red | 29 | 725 |
| | | | Sandrock, hard | 2 | 727 |
| First Woodbine sand, water | 32 | 587 | Second Woodbine sand | 58 | 785 |

Well E-45

Owner: St. Louis, San Francisco & Texas Ry. Co. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Clay | 14 | 14 | Shale, soft, sticky | 52 | 79 |
| Shale and sand | 13 | 27 | Rock | 1 | 80 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well E-45--Continued | | | | | |
| Shale | 28 | 108 | Shale | 83 | 450 |
| Rock | 1 | 109 | Sand and hard layers | 10 | 460 |
| Shale | 25 | 134 | Shale, sandy | 24 | 484 |
| Shale, soft, sticky | 11 | 145 | Rock, broken | 5 | 489 |
| Shale | 13 | 158 | Sand | 4 | 493 |
| Lime, broken | 1 | 159 | Shale | 35 | 528 |
| Shale | 55 | 214 | Shale, sandy, and shale | 22 | 550 |
| Shale and sandy shale | 25 | 239 | Sand, shale, and shells | 23 | 573 |
| Shale | 61 | 300 | Sand, hard | 4 | 577 |
| Shale, sandy | 8 | 308 | Sand and hard layers | 43 | 620 |
| Shale, sticky | 8 | 316 | Shale | 32 | 652 |
| Sand, hard | 4 | 320 | Sand, hard, and shale | 26 | 678 |
| Shale | 19 | 339 | Shale and red bed | 55 | 733 |
| Lime, broken | 2 | 341 | Sand | 57 | 790 |
| Shale | 22 | 363 | Shale and shells | 15 | 805 |
| Shale, sandy | 4 | 367 | | | |

Well E-46

Owner: St. Louis, San Francisco, & Texas Ry. Co. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Soil, black | 5 | 5 | Limerock, hard | 2 | 87 |
| Clay, yellow | 15 | 20 | Shale, tough, blue | 28 | 115 |
| Sand, gray | 10 | 30 | Sandrock, hard, thin | 1 | 116 |
| Sandrock, hard | 1 | 31 | Shale, blue | 39 | 155 |
| Shale, blue | 54 | 85 | Shale, blue, and lime shells | 315 | 470 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-46--Continued** | | | | | |
| Rock, hard---------------- | 5 | 475 | Gumbo, blue---------------- | 15 | 675 |
| Sand, hard----------------- | 21 | 496 | Marl, white---------------- | 22 | 697 |
| Sand, medium hard---------- | 12 | 508 | Sand, white, hard---------- | 20 | 717 |
| Gumbo, blue, and lime shells------------------ | 37 | 545 | Shale, red----------------- | 10 | 727 |
| Marl, sandy, blue---------- | 42 | 587 | Gumbo, red----------------- | 18 | 745 |
| Sandrock, hard------------- | 5 | 592 | Limerock, sandy------------ | 3 | 748 |
| Sand, coarse, loose, white, water------------ | 47 | 639 | Shale, sandy, varicolored-- | 16 | 764 |
| Marl, sandy, hard, blue---- | 21 | 660 | Sand, soft, white---------- | 50 | 814 |

Well E-47

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Shale and chalk------------ | 60 | 60 | Shale---------------------- | 32 | 762 |
| Shale---------------------- | 431 | 491 | Sand----------------------- | 5 | 767 |
| Shale and sand breaks------ | 35 | 526 | Shale and streaks of sand-- | 20 | 787 |
| Sand and shale breaks------ | 56 | 582 | Sand----------------------- | 38 | 825 |
| Sand----------------------- | 19 | 601 | Shale, sandy--------------- | 10 | 835 |
| Sand and shale breaks------ | 35 | 636 | Sand----------------------- | 8 | 843 |
| Rock----------------------- | 5 | 641 | Shale---------------------- | 10 | 853 |
| Sand----------------------- | 17 | 658 | Sand----------------------- | 85 | 938 |
| Shale and sand breaks------ | 72 | 730 | Shale---------------------- | 17 | 955 |

Well E-48

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Shale and chalk | 60 | 60 | Shale, hard | 24 | 1,652 |
| Shale | 459 | 519 | Shale, sandy, and lime | 72 | 1,724 |
| Shale and sandy shale | 39 | 558 | Shale and lime | 10 | 1,734 |
| Sand, shaly | 157 | 715 | Sand, shaly | 11 | 1,745 |
| Shale | 7 | 722 | Shale, sandy, and lime | 12 | 1,757 |
| Shale and sandy clay | 53 | 775 | Sand | 15 | 1,772 |
| Clay, sticky | 45 | 820 | Shale, sandy | 41 | 1,813 |
| Sand and streaks of shale | 130 | 950 | Shale, red and blue | 36 | 1,849 |
| Shale and lime | 495 | 1,445 | Shale and sand | 92 | 1,941 |
| Sand and shale | 22 | 1,467 | Shale, sandy, lime, and sand | 129 | 2,070 |
| Shale | 18 | 1,485 | Sand and streaks of shale | 97 | 2,167 |
| Sand | 63 | 1,548 | Shale and lime | 3 | 2,170 |
| Shale and sand breaks | 30 | 1,578 | Shale | 6 | 2,176 |
| Sand and shale breaks | 50 | 1,628 | | | |

Well E-49

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Surface soil | 2 | 2 | Shale, blue | 22 | 711 |
| Rock and blue shale | 84 | 86 | Sand | 6 | 717 |
| Rock, white, and blue shale | 43 | 129 | Sand and shale breaks | 61 | 778 |
| Shale, blue | 500 | 629 | Shale and sandy shale | 12 | 790 |
| Sand and rock | 10 | 639 | Shale, blue | 64 | 854 |
| Sand | 50 | 689 | Shale, blue and red | 20 | 874 |

(Continued on next page)

Well E-49--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Shale and thin sandy shale breaks | 50 | 924 | Shale, red | 9 | 1,901 |
| Shale, sandy, blue | 95 | 1,019 | Shale, sandy, hard, blue, gray and red | 63 | 1,964 |
| Shale, blue, and lime | 78 | 1,097 | Sand | 46 | 2,010 |
| Shale, blue, lime, and few sandy shale layers | 71 | 1,168 | Sand and shale breaks | 14 | 2,024 |
| Shale, hard, and sand | 85 | 1,253 | Shale, sandy, hard, blue, gray and red | 44 | 2,068 |
| Shale, hard, blue and red, and lime | 22 | 1,275 | Shale, hard, gray, blue, and red, and sandy shale layers | 85 | 2,153 |
| Shale, hard, blue and lime | 223 | 1,498 | Sand and shale breaks | 24 | 2,177 |
| Shale, blue and gray, some sand breaks | 90 | 1,588 | Sand, hard, blue and red shale breaks | 19 | 2,196 |
| Sand | 94 | 1,682 | Shale, sandy, hard, blue and red | 19 | 2,215 |
| Sand and shale breaks | 12 | 1,694 | Sand | 26 | 2,241 |
| Shale, sandy, hard, sand breaks and blue and black shale | 57 | 1,751 | Shale, hard, and sandy shale | 16 | 2,257 |
| Sand, hard, and shale breaks | 96 | 1,847 | Sand | 8 | 2,265 |
| Shale, sandy, hard, blue and red | 45 | 1,892 | Shale, hard, blue and red | 30 | 2,295 |

Well E-50

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Surface soil | 3 | 3 | Shale, blue | 444 | 547 |
| Rock and blue shale | 31 | 34 | Shale, sandy | 3 | 550 |
| Shale, blue, and rock layers | 69 | 103 | Sand | 10 | 560 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-50--Continued** | | | | | |
| Shale, sandy--------------- | 20 | 580 | Sand and shale breaks------ | 13 | 628 |
| Shale--------------------- | 20 | 600 | Sand---------------------- | 78 | 706 |
| Shale, sandy--------------- | 8 | 608 | Shale, sandy--------------- | 30 | 736 |
| Rock---------------------- | 7 | 615 | | | |

Well E-51

Owner: Anderson Clayton & Co. Driller: J. L. Myers & Sons.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Surface soil--------------- | 6 | 6 | Sandrock, hard------------- | 8 | 755 |
| Rock, white---------------- | 24 | 30 | Shale, red----------------- | 15 | 770 |
| Rock, soft, blue----------- | 32 | 62 | Limerock, hard------------- | 5 | 775 |
| Rock and shale, broken----- | 28 | 90 | Shale, sandy, gray and green------------------ | 21 | 796 |
| Shale, gray---------------- | 330 | 420 | Limerock------------------- | 4 | 800 |
| Shale, brown--------------- | 15 | 435 | Sand, dry------------------ | 6 | 806 |
| Shale, gray---------------- | 135 | 570 | Limerock------------------- | 4 | 810 |
| Shale, sandy--------------- | 15 | 585 | Shale, sandy, gray--------- | 15 | 825 |
| Sand, coarse, water-------- | 10 | 595 | Limerock------------------- | 3 | 828 |
| Limerock, hard------------- | 4 | 599 | Rock, sandy, hard---------- | 10 | 838 |
| Shale, dark gray----------- | 5 | 604 | Sand, medium hard, dry----- | 27 | 865 |
| Shale, sandy--------------- | 8 | 612 | Sandrock, hard------------- | 10 | 875 |
| Sand, fine----------------- | 76 | 688 | Sandrock, coarse, hard----- | 4 | 879 |
| Shale, blue---------------- | 24 | 712 | Limerock------------------- | 19 | 898 |
| Shale, sandy--------------- | 18 | 730 | Sandrock------------------- | 2 | 900 |
| Sand, putty, green--------- | 4 | 734 | Sand, putty, brown--------- | 3 | 903 |
| Shale, sandy--------------- | 13 | 747 | | | |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-51--Continued** | | | | | |
| Limerock------------------- | 2 | 905 | Limerock, hard------------- | 10 | 934 |
| Sandrock------------------- | 10 | 915 | Sandrock, medium hard------ | 9 | 943 |
| Shale, black--------------- | 6 | 921 | Shale, gray---------------- | 57 | 1,000 |
| Shale, pink---------------- | 3 | 924 | | | |

Well E-53

Owner: Sherman Steam Laundry. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Soil and clay-------------- | 23 | 23 | Rock, hard----------------- | 4 | 556 |
| Rock----------------------- | 2 | 25 | Rock, water---------------- | 4 | 560 |
| Gumbo---------------------- | 26 | 51 | Shale, blue---------------- | 30 | 590 |
| Sandrock, hard------------- | 5 | 56 | Rock, very hard------------ | 2 | 592 |
| Shale and gumbo------------ | 20 | 76 | Shale---------------------- | 26 | 618 |
| Rock, hard----------------- | 3 | 79 | Rock----------------------- | 2 | 620 |
| Shale and rock, stratified-------------- | 436 | 515 | First Woodbine sand-------- | 38 | 658 |
| Rock----------------------- | 2 | 517 | Shale, red and blue, and rock-------------------- | 131 | 789 |
| Shale, blue---------------- | 35 | 552 | Rock, hard----------------- | 2 | 791 |

Well E-55

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Surface soil--------------- | 3 | 3 | Shale, sandy--------------- | 41 | 152 |
| Clay and sandy soil-------- | 20 | 23 | Shale and hard streaks----- | 5 | 157 |
| Shale and hard streaks----- | 19 | 42 | Shale and sandy shale------ | 31 | 188 |
| Shale and sandy shale------ | 57 | 99 | Shale, sticky-------------- | 31 | 219 |
| Shale and hard streaks----- | 12 | 111 | Shale---------------------- | 148 | 367 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well E-55--Continued | | | | | |
| Shale, sticky | 97 | 464 | Shale, soft shale, and lime | 11 | 950 |
| Shale | 111 | 575 | Shale and lime streaks | 31 | 981 |
| Sand and sandy shale | 26 | 601 | Shale, tough | 44 | 1,025 |
| Shale, hard | 1 | 602 | Shale, hard, and lime | 23 | 1,048 |
| Shale | 53 | 655 | Lime, shale, and sandy shale | 26 | 1,074 |
| Sand and sandy shale | 21 | 676 | Shale and lime | 8 | 1,082 |
| Rock | 2 | 678 | Shale and lime, sandy | 15 | 1,097 |
| Sand | 15 | 693 | Shale | 4 | 1,101 |
| Shale and lime | 2 | 695 | Shale and sandy shale | 16 | 1,117 |
| Sand | 13 | 708 | Shale, hard, and limerock | 3 | 1,120 |
| Shale | 1 | 709 | Shale | 13 | 1,133 |
| Shale and shells | 29 | 738 | Shale, lime, and sandy shale | 14 | 1,147 |
| Shale | 14 | 752 | Shale, hard | 21 | 1,168 |
| Sand and sandy shale | 15 | 767 | Sand and sandy shale | 4 | 1,172 |
| Shale | 61 | 828 | Shale, hard | 82 | 1,254 |
| Shale and lime, hard | 12 | 840 | Shale and sandy shale | 16 | 1,270 |
| Shale, hard, blue and red | 5 | 845 | Shale and layers of lime | 50 | 1,320 |
| Shale and shale streaks | 15 | 860 | Lime, hard | 5 | 1,325 |
| Shale, hard, and lime streaks | 30 | 890 | Shale and lime | 20 | 1,345 |
| Shale, hard | 14 | 904 | Shale, sandy | 5 | 1,350 |
| Shale and lime streaks | 32 | 936 | Shale and lime | 30 | 1,380 |
| Sand, hard | 3 | 939 | | | |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well E-55--Continued | | | | | |
| Shale---------------------- | 20 | 1,400 | Shale and lime------------- | 50 | 1,757 |
| Shale and lime------------- | 10 | 1,410 | Shale, sandy, and lime----- | 14 | 1,771 |
| Limerock and shale--------- | 6 | 1,416 | Shale and lime------------- | 13 | 1,784 |
| Shale, hard, and lime------ | 27 | 1,443 | Shale, sandy, and lime----- | 25 | 1,809 |
| Shale---------------------- | 11 | 1,454 | Shale and lime------------- | 4 | 1,813 |
| Shale, soft---------------- | 6 | 1,460 | Shale, sandy, and lime----- | 12 | 1,825 |
| Shale, hard, tough--------- | 21 | 1,481 | Sand, sandy shale, and lime-------------------- | 10 | 1,835 |
| Shale---------------------- | 6 | 1,487 | Shale, lime, and sandy shale layers------------ | 12 | 1,847 |
| Lime and shale------------- | 19 | 1,506 | Sand and shale layers------ | 21 | 1,868 |
| Lime, sandy, hard, and shale------------------- | 2 | 1,508 | Shale---------------------- | 32 | 1,900 |
| Lime and shale------------- | 22 | 1,530 | Sand, shale, and lime breaks------------------ | 16 | 1,916 |
| Shale, sandy, and lime----- | 38 | 1,568 | Shale---------------------- | 16 | 1,932 |
| Shale and lime------------- | 16 | 1,584 | Shale and lime------------- | 6 | 1,938 |
| Shale, hard, varicolored--- | 18 | 1,602 | Sand and shale------------- | 14 | 1,952 |
| Shale and sandy shale------ | 5 | 1,607 | Shale---------------------- | 6 | 1,958 |
| Sand and sandy shale------- | 13 | 1,620 | Sand, shale, and lime breaks------------------ | 35 | 1,993 |
| Shale and layers of sandy shale------------------- | 25 | 1,645 | Shale and lime------------- | 15 | 2,008 |
| Shale and lime------------- | 5 | 1,650 | Sand, hard----------------- | 20 | 2,028 |
| Sand and varicolored shale- | 15 | 1,665 | Shale, sandy, hard, and lime-------------------- | 3 | 2,031 |
| Shale, tough--------------- | 11 | 1,676 | Shale, sandy, hard--------- | 11 | 2,042 |
| Shale and lime------------- | 20 | 1,696 | | | |
| Shale, sandy, and lime----- | 11 | 1,707 | | | |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-55--Continued** | | | | | |
| Shale, sandy | 15 | 2,057 | Sand and sandy shale | 7 | 2,128 |
| Shale | 5 | 2,062 | Shale | 16 | 2,144 |
| Lime, hard, and shale | 6 | 2,068 | Sand and shale layers | 8 | 2,152 |
| Shale | 5 | 2,073 | Shale | 30 | 2,182 |
| Shale, hard, tough | 3 | 2,076 | Shale, red and blue, and lime and sand layers | 8 | 2,190 |
| Shale, hard, and lime | 3 | 2,079 | Sand and shale and sand layers | 10 | 2,200 |
| Shale, hard, tough | 18 | 2,097 | Limerock and shale | 14 | 2,214 |
| Sand, hard | 7 | 2,104 | Sand, lime, and shale layers | 2 | 2,216 |
| Shale, sandy, hard, and sand layers | 3 | 2,107 | Sand, shale and lime | 7 | 2,223 |
| Sand, fine, hard, white | 8 | 2,115 | Sand and shale layers | 4 | 2,227 |
| Lime, sandy, hard, and shale | 3 | 2,118 | Shale | 29 | 2,256 |
| Shale, hard, and lime and shale breaks | 3 | 2,121 | | | |

Well E-56

Owner: Southern Pacific Ry. Co. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Clay | 14 | 14 | Rock, hard | 2 | 251 |
| Chalk | 38 | 52 | Soapstone | 341 | 592 |
| Shale | 16 | 68 | Packsand | 7 | 599 |
| Chalk | 44 | 112 | Rock, hard | 8 | 607 |
| Packsand, hard | 26 | 138 | Soapstone | 13 | 620 |
| Gumbo, tough | 27 | 165 | Rock, hard | 7 | 627 |
| Soapstone | 84 | 249 | Soapstone | 30 | 657 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-56--Continued** | | | | | |
| Rock, hard | 4 | 661 | Sand, hard | 51 | 722 |
| Soapstone | 10 | 671 | Soapstone | 8 | 730 |

Well E-57

Owner: Sherman Manufacturing Co. Driller: W. E. Tomerlin.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Sand, yellow | 32 | 32 | Gumbo, hard, blue | 30 | 567 |
| Rock, hard, white | 39 | 71 | Sandrock, hard | 3 | 570 |
| Shale, blue | 140 | 211 | Shale, hard, blue | 63 | 633 |
| Rock, blue | 9 | 220 | Sand, soft, white, water | 25 | 658 |
| Marl, blue | 140 | 360 | Shale, sandy | 12 | 670 |
| Marl, blue, and shells | 143 | 503 | Sandrock, hard | 2 | 672 |
| Gumbo, blue | 14 | 517 | Shale, hard | 8 | 680 |
| Rock, hard | 3 | 520 | Gumbo, hard, blue | 49 | 729 |
| Gumbo, blue | 16 | 536 | Sand, soft, white, water | 47 | 776 |
| Rock, hard | 1 | 537 | | | |

Well E-58

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Rock, white | 15 | 15 | Shale, hard | 76 | 361 |
| Shale, black | 5 | 20 | Shale, sticky | 103 | 464 |
| Shale, hard, gray | 31 | 51 | Shale, black | 141 | 605 |
| Shale, hard | 12 | 63 | Shale, sandy | 15 | 620 |
| Shale, hard, and a few sandy lime streaks | 93 | 156 | Shale, sandy shale, and streaks of sand | 94 | 714 |
| Shale, black | 129 | 285 | Rock | 12 | 726 |

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| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well E-58--Continued | | | | | |
| Shale and sandy shale------ | 52 | 778 | Shale---------------------- | 12 | 1,655 |
| Shale, sandy, and shale breaks------------------ | 47 | 825 | Sand----------------------- | 13 | 1,668 |
| Sand----------------------- | 36 | 861 | Shale---------------------- | 5 | 1,673 |
| Shale, hard---------------- | 7 | 868 | Sand----------------------- | 26 | 1,699 |
| Shale, sandy, and sand breaks------------------ | 66 | 934 | Sand, layers of shale, and sandy shale------------- | 71 | 1,770 |
| Sand and streaks of shale-- | 26 | 960 | Sand, hard----------------- | 13 | 1,783 |
| Shale---------------------- | 20 | 980 | Shale, lime, and streaks of sand----------------- | 20 | 1,803 |
| Sand, sandy shale, and shale streaks----------- | 45 | 1,025 | Shale, hard, and lime------ | 62 | 1,865 |
| Shale---------------------- | 56 | 1,081 | Shale, hard, and lime streaks----------------- | 75 | 1,940 |
| Shale and streaks of sand-- | 41 | 1,122 | Lime, hard, sandy---------- | 20 | 1,960 |
| Shale and layers of lime--- | 63 | 1,185 | Sand, hard----------------- | 16 | 1,976 |
| Shale and sandy shale------ | 47 | 1,232 | Lime, hard----------------- | 37 | 2,013 |
| Shale, sandy shale, and a few lime streaks-------- | 38 | 1,270 | Sand, hard, shale, and lime streaks------------ | 30 | 2,043 |
| Shale, hard, and lime------ | 30 | 1,300 | Shale, lime, and layers of sand----------------- | 39 | 2,082 |
| Lime, hard, and shale breaks------------------ | 114 | 1,414 | Shale, hard, and sand breaks------------------ | 93 | 2,175 |
| Shale, hard, and layers of lime----------------- | 76 | 1,490 | Sand and shale breaks------ | 16 | 2,191 |
| Shale, hard, and lime breaks------------------ | 90 | 1,580 | Lime,hard, and shale------- | 15 | 2,206 |
| Sand----------------------- | 33 | 1,613 | Shale and sand streaks----- | 11 | 2,217 |
| Shale---------------------- | 7 | 1,620 | Shale, sandy, blue, and red shale--------------- | 9 | 2,226 |
| Sand----------------------- | 23 | 1,643 | Sand----------------------- | 20 | 2,246 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-58--Continued** | | | | | |
| Shale and a few sand streaks | 15 | 2,261 | Sand | 16 | 2,355 |
| Shale | 4 | 2,265 | Shale and sandstone layers | 17 | 2,372 |
| Sand | 20 | 2,285 | Shale, hard | 9 | 2,381 |
| Sand and hard red shale | 10 | 2,295 | Shale and sandstone streaks | 8 | 2,389 |
| Shale, hard | 6 | 2,301 | Sand and shale breaks | 33 | 2,422 |
| Sand and lime | 14 | 2,315 | Sand, shale, and shale breaks | 23 | 2,445 |
| Shale, lime, and sand streaks | 20 | 2,335 | Shale, hard | 7 | 2,452 |
| Shale | 4 | 2,339 | | | |

Well E-61

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Soil, black | 4 | 4 | Shale and sand breaks | 25 | 1,006 |
| Clay | 26 | 30 | Sand and shale breaks | 25 | 1,031 |
| Chalk | 55 | 85 | Shale | 31 | 1,062 |
| Shale, sandy | 621 | 706 | Lime and shale | 494 | 1,556 |
| Sand and rock | 7 | 713 | Shale and lime | 9 | 1,565 |
| Shale | 61 | 774 | Shale | 24 | 1,589 |
| Sand | 12 | 786 | Sand | 23 | 1,612 |
| Shale | 35 | 821 | Shale and sandy shale | 88 | 1,700 |
| Shale, sandy | 18 | 839 | Sand | 10 | 1,710 |
| Sand and shale | 73 | 912 | Lime, sandy | 15 | 1,725 |
| Shale | 28 | 940 | Sand and shale breaks | 135 | 1,860 |
| Sand | 41 | 981 | Shale, sandy, and sand | 45 | 1,905 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-61--Continued** | | | | | |
| Lime and shale | 7 | 1,912 | Lime, shale and streaks of sand | 38 | 2,169 |
| Shale, sandy | 17 | 1,929 | Sand | 5 | 2,174 |
| Shale and lime | 9 | 1,938 | Shale, red and blue, and sand breaks | 17 | 2,191 |
| Shale, sandy | 10 | 1,948 | Sand, hard | 15 | 2,206 |
| Shale, blue and red | 14 | 1,962 | Shale, sandy, and sand | 152 | 2,358 |
| Lime | 3 | 1,965 | Shale | 13 | 2,371 |
| Shale and sand breaks | 73 | 2,038 | Sand and shale breaks | 27 | 2,398 |
| Sand | 13 | 2,051 | Shale and streaks of hard sand | 19 | 2,417 |
| Shale, sandy, sand, and lime | 66 | 2,117 | Sand, hard | 12 | 2,429 |
| Shale, sandy | 10 | 2,127 | Sand and shale breaks | 20 | 2,449 |
| Sand, hard | 4 | 2,131 | Shale | 11 | 2,460 |

Well E-62

Owner: City of Sherman. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Surface soil | 3 | 3 | Shale, sticky | 157 | 558 |
| Clay | 32 | 35 | Shale, hard, and lime streaks | 30 | 588 |
| Clay and chalk layers | 25 | 60 | Shale, hard | 22 | 610 |
| Clay, shale, and a few chalk streaks | 12 | 72 | Shale, hard, and sandy lime | 20 | 630 |
| Shale and chalk streaks | 34 | 106 | Shale, hard | 52 | 682 |
| Shale and a few lime streaks | 103 | 209 | Sand and a few shale streaks | 29 | 711 |
| Shale, sticky, and sandy lime streaks | 192 | 401 | Shale, sandy, and shale | 30 | 741 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well E-62--Continued** | | | | | |
| Shale, sandy, and lime----- | 32 | 773 | Shale, sandy and lime------ | 24 | 935 |
| Shale, sandy, and sand----- | 47 | 820 | Sand and shale layers------ | 72 | 1,007 |
| Shale---------------------- | 20 | 840 | Sand and shale, broken----- | 3 | 1,010 |
| Sand----------------------- | 71 | 911 | Shale---------------------- | 13 | 1,023 |

Well E-63

Owner: Charles F. Burns. Driller: J. L. Myers & Sons.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Soil----------------------- | 2 | 2 | Rock, hard----------------- | 3 | 723 |
| Clay----------------------- | 7 | 9 | Sand----------------------- | 9 | 732 |
| Rock----------------------- | 82 | 91 | Shale---------------------- | 6 | 738 |
| Shale---------------------- | 619 | 710 | Sand----------------------- | 9 | 747 |
| Shell and rock------------- | 10 | 720 | Shale---------------------- | 26 | 773 |

Well F-35

Owner: City of Bells. Driller: Layne-Texas Co., Ltd.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Clay----------------------- | 27 | 27 | Boulders and hard shale---- | 20 | 421 |
| Sand----------------------- | 4 | 31 | Shale and boulders--------- | 11 | 432 |
| Shale, sticky, blue-------- | 19 | 50 | Sand----------------------- | 5 | 437 |
| Shale, hard---------------- | 184 | 234 | Shale---------------------- | 20 | 457 |
| Shale, tough, hard--------- | 18 | 252 | Sand, hard----------------- | 5 | 462 |
| Shale, hard---------------- | 117 | 369 | Shale---------------------- | 11 | 473 |
| Rock----------------------- | 1 | 370 | Rock----------------------- | 1 | 474 |
| Shale, hard, and boulders-- | 7 | 377 | Shale and boulders--------- | 46 | 520 |
| Shale, hard---------------- | 24 | 401 | Rock----------------------- | 2 | 522 |

(Continued on next page)

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well F-35--Continued** | | | | | |
| Shale and sandy boulders--- | 48 | 570 | Shale and lime, sandy, hard-------------------- | 30 | 651 |
| Shalē, tough, sticky------- | 20 | 590 | Shale, hard---------------- | 23 | 674 |
| Shale, hard, brown--------- | 16 | 606 | Sand, hard----------------- | 31 | 705 |
| Shale, hard---------------- | 15 | 621 | Shale, hard---------------- | 4 | 709 |

Well F-36

Owner: City of Bells. Driller: Layne-Texas Co., Ltd.

| | | | | | |
|---|---|---|---|---|---|
| Soil----------------------- | 3 | 3 | Rock----------------------- | 2 | 485 |
| Clay and sand streaks------ | 25 | 28 | Shale---------------------- | 18 | 503 |
| Shale, hard, and rock streaks---------------- | 42 | 70 | Sand----------------------- | 6 | 509 |
| Shale and sandy shale------ | 60 | 130 | Shale---------------------- | 185 | 694 |
| Shale---------------------- | 269 | 399 | Sand and shale streaks----- | 16 | 710 |
| Rock----------------------- | 2 | 401 | Shale and sandy shale------ | 82 | 792 |
| Shale---------------------- | 59 | 460 | Sand, fine (powdered)------ | 9 | 801 |
| Sand, fine, gray----------- | 23 | 483 | Shale and hard streaks----- | 66 | 867 |
| | | | Lime and shale streaks----- | 35 | 902 |

Well F-40

Owner: C. B. Ball. Driller: J. L. Myers & Sons.

| | | | | | |
|---|---|---|---|---|---|
| Soil----------------------- | 6 | 6 | Sand----------------------- | 13 | 776 |
| Clay----------------------- | 10 | 16 | Shale---------------------- | 62 | 838 |
| Chalk---------------------- | 245 | 261 | Sand----------------------- | 40 | 878 |
| Shale---------------------- | 502 | 763 | | | |

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| **Well F-42** | | | | | |
| Owner: J. H. Washburn. Driller: J. L. Myers & Sons. | | | | | |
| Soil | 6 | 6 | Sand | 12 | 596 |
| Clay | 44 | 50 | Shale | 35 | 631 |
| Chalk | 26 | 76 | Sand | 51 | 682 |
| Shale | 482 | 558 | Shale | 16 | 698 |
| Sand | 10 | 568 | Sand | 46 | 744 |
| Shale | 16 | 584 | Shale | 1 | 745 |
| **Well G-12** | | | | | |
| Owner: City of Tioga. Driller: J. L. Myers & Sons. | | | | | |
| Surface soil | 25 | 25 | Shale, blue and red | 90 | 160 |
| Shale, blue and red | 35 | 60 | Sand, water | 40 | 200 |
| Sand and shale, water | 10 | 70 | Shale, sandy, hard | 15 | 215 |
| **Well H-13** | | | | | |
| Owner: W. H. Higgins. Driller: J. L. Myers & Sons. | | | | | |
| Soil | 2 | 2 | Sand and rock | 8 | 590 |
| Chalk | 16 | 18 | Sand | 14 | 604 |
| Sand | 564 | 582 | | | |
| **Well H-28** | | | | | |
| Owner: City of Gunter. Driller: J. L. Myers & Sons. | | | | | |
| Soil | 8 | 8 | Sand | 46 | 350 |
| Clay | 18 | 26 | Shale | 102 | 452 |
| Shale | 278 | 304 | Sand | 12 | 464 |

(Continued on next page)

Table 9.--Drillers' logs of wells in Grayson County--Continued

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Well H-28--Continued | | | | | |
| Rock---------------------- | 5 | 469 | Shale--------------------- | 178 | 652 |
| Sand---------------------- | 5 | 474 | Sand---------------------- | 78 | 730 |

Well J-3

Owner: R. B. Graves. Driller: J. L. Myers & Sons.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Surface------------------- | 8 | 8 | Shale--------------------- | 18 | 822 |
| Chalk--------------------- | 267 | 275 | Sand---------------------- | 4 | 826 |
| Shale--------------------- | 515 | 790 | Shale--------------------- | 40 | 866 |
| Sand---------------------- | 14 | 804 | Sand---------------------- | 42 | 908 |

Well J-11

Owner: City of Whitewright. Driller: J. L. Myers & Sons.

| | Thickness (feet) | Depth (feet) | | Thickness (feet) | Depth (feet) |
|---|---|---|---|---|---|
| Shale and chalk----------- | 420 | 420 | Shale--------------------- | 59 | 1,109 |
| Sand---------------------- | 20 | 440 | Sand---------------------- | 71 | 1,180 |
| Shale--------------------- | 550 | 990 | Shale--------------------- | 9 | 1,189 |
| Sand, broken-------------- | 60 | 1,050 | | | |

Table 10.--Analyses of water from wells and springs in Grayson County, Texas

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

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe) | | Calcium (Ca) | Magnesium (Mg) | Sodium and potassium (Na + K) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Boron (B) | Dissolved solids | Hardness as $CaCO_3$ | | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | In solution | Total | | | | | | | | | | | Total | Non-carbonate | | | | |
| A-1 | R. L. Cathey | 200 | July 25, 1958 | Trinity group | - | - | - | - | - | - | 480 | - | 16 | - | - | - | - | 138 | 0 | - | - | 843 | 7.5 |
| A-3 | W. P. Luce | 328 | Sept.10, 1957 | do | - | - | - | - | - | - | 563 | - | 24 | - | - | - | - | 1 | 0 | - | - | 1,040 | 8.8 |
| A-5 | Omar B. Milligan | 325 | July 25, 1958 | do | - | - | - | - | - | - | 520 | - | 206 | - | - | - | - | 12 | 0 | - | - | 1,600 | 8.1 |
| A-7 | Rock Creek Camp | 502 | June 5, 1958 | do | - | - | - | - | - | - | 724 | - | 39 | - | - | - | - | 8 | 0 | - | - | 1,390 | 8.6 |
| A-8 | Mrs. Anna Potts | 51 | do | Pawpaw formation | - | - | - | - | - | - | 392 | - | 110 | - | - | - | - | 426 | 105 | - | - | 1,070 | 7.2 |
| A-9 | Mrs. L. E. McCormick | 18 | do | Woodbine formation | - | - | - | - | - | - | 113 | - | 14 | - | - | - | - | 86 | 0 | - | - | 263 | 7.2 |
| A-10 | F. W. Holder | 180 | Sept.11, 1957 | do | 17 | 0.01 | 2.2 | 42 | 18 | 14 1.4 | 189 | 40 | 7.5 | 0.2 | 0.0 | 0.00 | 233 | 179 | 24 | 14 | 0.5 | 389 | 6.9 |
| A-11 | do | 802 | do | Trinity group | - | - | - | - | - | - | 667 | - | 33 | - | - | - | - | 5 | 0 | - | - | 1,280 | 8.5 |
| A-12 | Cedar Bayou Resort | 130? | Dec. 18, 1957 | Woodbine formation | - | - | - | - | - | - | 210 | - | 22 | - | - | - | - | 149 | 0 | - | - | 455 | 7.9 |
| A-13 | John Pitts | 432 | July 22, 1958 | Trinity group | - | - | - | - | - | - | 540 | - | 174 | - | - | - | - | 16 | 0 | - | - | 1,540 | 8.0 |
| A-14 | Cedar Mills Resort | 575 | do | do | - | - | - | - | - | - | 456 | - | 560 | - | - | - | - | 44 | 0 | - | - | 2,530 | 7.7 |
| A-15 | Walnut Creek Resort | 308 | Dec. 18, 1957 | Woodbine formation | - | - | - | - | - | - | 256 | - | 12 | - | - | - | - | 35 | 0 | - | - | 458 | 8.2 |
| A-16 | C. Bates | 345 | Aug. 23, 1953 | do | 8.0 | 0.04 | 6.2 | 128 | 71 | 334 | 193 | 1,050 | 60 | 0.4 | 0.2 | - | 1,750 | 612 | 454 | - | - | 2,360 | 7.5 |
| A-17 | Hugh Bean | 50 | Sept. 9, 1957 | do | - | - | - | - | - | - | 241 | - | 87 | - | - | - | - | 626 | 428 | - | - | 1,500 | 7.2 |
| A-18 | Mark Smith | 27 | July 25, 1958 | do | - | - | - | - | - | - | 18 | - | 18 | - | - | - | - | 46 | 31 | - | - | 173 | 6.2 |
| A-19 | O. B. Rich | 180 | Sept. 9, 1957 | do | 13 | .01 | 7.2 | 23 | 8.7 | 25 1.8 | 115 | 27 | 18 | .2 | .0 | 0.04 | 174 | 93 | 0 | 36 | 1.1 | 298 | 6.5 |
| A-21 | Gordonville Water Association | 1,021 | Apr. 25, 1958 | Trinity group | 10 | .02 | .45 | 3.0 | .0 | 290 1.8 | 522 | 93 | 74 | 1.2 | .0 | .64 | 733 | 8 | 0 | 98 | 46 | 1,170 | 8.7 |
| A-22 | E. W. McAden | 355 | Apr. 14, 1956 | Woodbine formation | 13 | .04 | 3.8 | 34 | 5.7 | 36 | 172 | 15 | 20 | .2 | .1 | - | 209 | 108 | 0 | 42 | 1.5 | 344 | 6.9 |
| A-23 | J. B. Thorn | 204 | Sept.11, 1957 | do | - | - | - | - | - | - | 144 | - | 23 | - | - | - | - | 124 | 6 | - | - | 384 | 6.7 |
| A-24 | W. C. Garner | 338 | June 5, 1958 | do | 13 | .00 | 5.7 | 25 | 9.4 | 27 2.1 | 137 | 21 | 19 | .2 | .0 | .08 | 184 | 101 | 0 | 36 | 1.2 | 323 | 6.9 |
| A-25 | J. C. Brady | 345 | Aug. 14, 1958 | do | 12 | .00 | 2.5 | 26 | 11 | 55 2.9 | 193 | 43 | 22 | .4 | .2 | .03 | 276 | 110 | 0 | 51 | 2.3 | 468 | 6.9 |
| A-26 | Big Mineral Camp | 285 | Dec. 18, 1957 | do | - | - | - | - | - | - | 207 | - | 23 | - | - | - | - | 65 | 0 | - | - | 462 | 8.0 |
| A-29 | Flowing Wells Camp | 354 | Mar. 20, 1958 | do | - | - | - | - | - | - | 134 | - | 14 | - | - | - | - | 80 | 0 | - | - | 314 | 8.0 |
| A-32 | Stanley Franko | 175 | do | do | - | - | - | - | - | - | 276 | - | 32 | - | - | - | - | 262 | 36 | - | - | 660 | 8.3 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe)a/ In solution | Iron (Fe)a/ Total | 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 $CaCO_3$ Total | Hardness as $CaCO_3$ Non-carbonate | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A-33 | Earl Baker | 257 | Mar. 20, 1958 | Woodbine formation | - | - | - | - | - | - | 236 | - | 10 | - | - | - | - | 8 | 0 | - | - | 446 | 8.2 |
| A-34 | E. Gaitis | 265 | Aug. 29, 1957 | do | - | - | - | - | - | - | 242 | - | 15 | - | - | - | - | 0 | 0 | - | - | 512 | 8.7 |
| A-39 | Dale Dickey | 200 | July 22, 1958 | do | - | - | - | - | - | - | 394 | - | 24 | - | - | - | - | 8 | 0 | - | - | 961 | 8.0 |
| A-40 | Louise Kurr | 235 | do | do | - | - | - | - | - | - | 56 | - | 95 | - | - | - | - | 22 | 0 | - | - | 120 | 6.3 |
| A-41 | Texas Natural Gasoline Corp. | 940 | June 5, 1958 | Trinity group | 13 | 0.02 | 0.20 | 1.4 | 0.5 | 279 1.0 | 600 | 93 | 22 | 1.2 | 2.0 | 1.2 | 709 | 6 | 0 | 99 | 52 | 1,130 | 8.7 |
| A-42 | H. O. Reast | 56 | Apr. 15, 1958 | Woodbine formation | - | - | - | - | - | - | 218 | - | 84 | - | - | - | - | 296 | 118 | - | - | 935 | 8.1 |
| A-44 | J. F. Bullard | 160 | July 25, 1958 | do | - | - | - | - | - | - | 96 | - | 112 | - | - | - | - | 60 | 0 | - | - | 1,740 | 7.0 |
| B-3 | E. W. Terrell | 49 | Oct. 3, 1957 | Washita group | - | - | - | - | - | - | 235 | - | 11 | - | - | - | - | 199 | 6 | - | - | 454 | 7.9 |
| B-5 | R. J. Byrd | 190 | Oct. 11, 1957 | Trinity group | - | - | - | - | - | - | 507 | - | 48 | - | - | - | - | 9 | 0 | - | - | 994 | 8.2 |
| B-6 | E. W. Miller | 228 | Mar. 20, 1958 | do | - | - | - | - | - | - | 532 | - | 64 | - | - | - | - | 12 | 0 | - | - | 1,030 | 8.7 |
| B-7 | U. S. Army | 35 | Sept.17, 1957 | do | - | - | - | - | - | - | 95 | - | 12 | - | - | - | - | 90 | 12 | - | - | 257 | 7.0 |
| B-8 | W. L. Shires | 500 | Oct. 3, 1957 | do | - | - | - | - | - | - | 442 | - | 119 | - | - | - | - | 274 | 0 | - | - | 1,230 | 8.0 |
| B-11 | R. X. Allen | 235 | May 13, 1958 | do | - | - | - | - | - | - | - | 63 | 97 | - | - | - | - | 426 | - | - | - | - | - |
| B-12 | Jack Dophied | 240 | May 13, 1958 | do | - | - | - | - | - | - | - | 44 | 35 | - | - | - | - | 208 | - | - | - | 706 | - |
| B-13 | L. A. Whitfield | 300 | Oct. 21, 1957 | do | - | - | - | - | - | - | 540 | - | 304 | - | - | - | - | 27 | 0 | - | - | 1,880 | 8.4 |
| B-17 | B. V. Atnip | 65 | do | Pawpaw formation | - | - | - | - | - | - | 318 | - | 20 | - | - | - | - | 260 | 0 | - | - | 559 | 7.1 |
| B-18 | A. H. Sharp | 349 | do | Trinity group | - | - | - | - | - | - | 580 | - | 140 | - | - | - | - | 38 | 0 | - | - | 1,850 | 8.4 |
| B-19 | J. F. Allen | 317 | do | do | - | - | - | - | - | - | 650 | - | 54 | - | - | - | - | 10 | 0 | - | - | 1,300 | 8.3 |
| B-21 | Aubrey E. Thomas | 295 | July 10, 1958 | do | - | - | - | - | - | - | 560 | - | 438 | - | - | - | - | 42 | 0 | - | - | 2,340 | 7.9 |
| B-22 | W. L. Cole | 300 | May 13, 1958 | do | - | - | - | - | - | - | 712 | - | 245 | - | - | - | - | 26 | 0 | - | - | 2,060 | 8.4 |
| B-23 | J. D. Atkins | 240 | July 11, 1958 | Pawpaw formation | - | - | - | - | - | - | 80 | - | 90 | - | - | - | - | 630 | 564 | - | - | 1,280 | 6.4 |
| B-24 | T. F. Staggers | 145 | July 10, 1958 | do | - | - | - | - | - | - | 404 | - | 12 | - | - | - | - | 312 | 0 | - | - | 656 | 7.2 |
| B-26 | J. F. Wall | 320 | do | Trinity group | - | - | - | - | - | - | 638 | - | 127 | - | - | - | - | 15 | 0 | - | - | 1,510 | 8.0 |
| B-27 | City of Pottsboro | 443 | Aug. 22, 1958 | Woodbine formation | 14 | 0.00 | 1.1 | 12 | 4.1 | 72 2.4 | 188 | 31 | 12 | 0.4 | 0.5 | 0.22 | 243 | 47 | 0 | 76 | 4.6 | 401 | 7.7 |
| B-28 | T. C. Gattis | 50 | July 11, 1958 | do | - | - | - | - | - | - | 39 | - | 14 | - | - | - | - | 57 | 25 | - | - | 176 | 6.5 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe)a/ In solution | Iron (Fe)a/ Total | 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 $CaCO_3$ Total | Hardness as $CaCO_3$ Non-carbonate | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-29 | Willow Springs School | 192 | Nov. 13, 1957 | Woodbine formation | 12 | 0.00 | 1.0 | 15 | 7.5 | 20 2.1 | 155 | 3.8 | 9.5 | 0.2 | 0.2 | 0.13 | b/152 | 68 | 0 | 31 | 1.1 | 267 | 6.9 |
| C-1 | The Austin Co. | 58 | Mar. 27, 1958 | Alluvium | 23 | .10 | - | 94 | 8.0 | 37 | 393 | 16 | 3.5 | .4 | 4.3 | - | 389 | 268 | 0 | 23 | 1.0 | 628 | 7.7 |
| C-3 | Speed-Cast Sporting Goods Co. | 250 | July 10, 1958 | Trinity group | - | - | - | - | - | - | 392 | - | 14 | - | - | - | - | 196 | 0 | - | - | 707 | 7.4 |
| C-5 | Mrs. M. J. Brady | 35 | July 16, 1958 | Pawpaw formation | - | - | - | - | - | - | 358 | - | 8.2 | - | - | - | - | 336 | 42 | - | - | 673 | 7.4 |
| C-6 | R. B. Derebery | 98 | Nov. 15, 1957 | do | - | - | - | - | - | - | 512 | - | 24 | - | - | - | - | 185 | 0 | - | - | 1,000 | 7.6 |
| C-7 | C. Y. Gough | 135 | July 17, 1958 | do | - | - | - | - | - | - | 608 | - | 43 | - | - | - | - | 140 | 0 | - | - | 1,760 | 7.7 |
| C-8 | Luther Cherry | 110 | Nov. 15, 1957 | do | - | - | - | - | - | - | 226 | - | 14 | - | - | - | - | 158 | 0 | - | - | 463 | 7.0 |
| C-9 | J. H. Nichols | 23 | Nov. 13, 1957 | Alluvium | - | - | - | - | - | - | 225 | - | 33 | - | - | - | - | 251 | 66 | - | - | 648 | 7.7 |
| D-2 | A. H. McNairn | 365 | Apr. 15, 1958 | Woodbine formation | - | - | - | - | - | - | 360 | - | 18 | - | - | - | - | 4 | 0 | - | - | 661 | 8.6 |
| D-4 | A. F. Siebman | 160 | Aug. 1, 1958 | do | - | - | - | - | - | - | 244 | - | 42 | - | - | - | - | 230 | 30 | - | - | 1,260 | 7.4 |
| D-6 | E. Gaitis | 91 | Aug. 30, 1957 | do | - | - | - | - | - | - | 247 | - | 45 | - | - | - | - | 21 | 0 | - | - | 617 | 8.4 |
| D-7 | Dave Bennett | 183 | Aug. 8, 1958 | do | - | - | - | - | - | - | 536 | - | 14 | - | - | - | - | 7 | 0 | - | - | 982 | 8.2 |
| D-9 | Hagerman National Wildlife Refuge | 140 | May 7, 1958 | do | - | - | - | - | - | - | 566 | - | 18 | - | - | - | - | 8 | 0 | - | - | 1,110 | 8.5 |
| D-13 | do | 165 | May 22, 1958 | do | - | - | - | - | - | - | 478 | - | 12 | - | - | - | - | 6 | 0 | - | - | 807 | 8.6 |
| D-14 | do | 165 | May 7, 1958 | do | - | - | - | - | - | - | 424 | - | 9.8 | - | - | - | - | 7 | 0 | - | - | 700 | 8.8 |
| D-15 | D. R. Bennett | 270 | Apr. 15, 1958 | do | - | - | - | - | - | - | 472 | - | 25 | - | - | - | - | 6 | 0 | - | - | 1,100 | 8.5 |
| D-16 | J. L. Metcalf | 250 | June 5, 1958 | do | - | - | - | - | - | - | 878 | - | 32 | - | - | - | - | 6 | 0 | - | - | 1,350 | 8.6 |
| D-17 | Hobert Shadden | 280 | Apr. 15, 1958 | do | - | - | - | - | - | - | 452 | - | 36 | - | - | - | - | 8 | 0 | - | - | 1,230 | 8.5 |
| D-18 | J. T. Crow | 180 | do | do | - | - | - | - | - | - | 648 | - | 47 | - | - | - | - | 26 | 0 | - | - | 1,420 | 8.6 |
| D-20 | C. L. Sellers | 95 | Aug. 27, 1957 | do | - | - | - | - | - | - | - | 116 | 26 | - | - | - | - | 294 | - | - | - | 562 | - |
| D-23 | G. Hodges | 69 | July 25, 1958 | do | - | - | - | - | - | - | 268 | - | 51 | - | - | - | - | 318 | 98 | - | - | 700 | 7.5 |
| D-26 | City of Whitesboro well 2 | 1,518 | Aug. 21, 1958 | Trinity group | 13 | 0.01 | 0.08 | 1.9 | 1.0 | 232 1.3 | 426 | 46 | 82 | 0.3 | 1.8 | 0.03 | b/588 | 8 | 0 | 98 | 35 | 994 | 8.3 |
| D-27 | Mrs. Iva Huff | 49 | Dec. 5, 1957 | Woodbine formation | - | - | - | - | - | - | 36 | - | 38 | - | - | - | - | 468 | 438 | - | - | 1,000 | 6.7 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe)a/ In solution | Iron (Fe)a/ Total | 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 $CaCO_3$ Total | Hardness as $CaCO_3$ Non-carbonate | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D-28 | Annie Knight | 145 | June 2, 1958 | Woodbine formation | - | - | - | - | - | - | 196 | - | 139 | - | - | - | - | 1,120 | 960 | - | - | 2,130 | 6.7 |
| D-30 | J. G. Barrett | 230 | July 16, 1958 | do | - | - | - | - | - | - | 900 | - | 195 | - | - | - | - | 27 | 0 | - | - | 2,180 | 8.1 |
| D-31 | S. R. Hazelwood | 210 | June 5, 1958 | do | - | - | - | - | - | - | 980 | - | 60 | - | - | - | - | 6 | 0 | - | - | 1,590 | 8.5 |
| D-32 | Mrs. S. D. Ferguson | 210 | do | do | - | - | - | - | - | - | 694 | - | 60 | - | - | - | - | 7 | 0 | - | - | 1,400 | 8.5 |
| D-33 | Southmayd High School | 410 | do | do | 11 | 0.1 | 0.9 | 0.9 | 0.4 | 292 1.0 | 686 | 50 | 20 | 1.2 | 1.0 | 1.4 | 716 | 4 | 0 | 99 | 68 | 1,150 | 8.6 |
| D-34 | Fred Tesar | 380 | Dec. 18, 1957 | do | - | - | - | - | - | - | 400 | - | 29 | - | - | - | - | 2 | 0 | - | - | 1,040 | 8.5 |
| D-35 | Ed Hurley | 200 | May 29, 1958 | do | - | - | - | - | - | - | 264 | - | 11 | - | - | - | - | 8 | 0 | - | - | 608 | 8.2 |
| D-36 | W. B. Holland | 190 | do | do | - | - | - | - | - | - | 262 | - | 39 | - | - | - | - | 250 | 36 | - | - | 1,420 | 8.1 |
| D-37 | L. C. Brookshire | 200 | do | do | - | - | - | - | - | - | 280 | - | 34 | - | - | - | - | 276 | 46 | - | - | 1,240 | 8.2 |
| D-38 | R. M. McConnell | 160 | do | do | - | - | - | - | - | - | 198 | - | 31 | - | - | - | - | 370 | 208 | - | - | 982 | 7.9 |
| D-39 | S. Varley | 57 | do | do | - | - | - | - | - | - | 220 | - | 33 | - | - | - | - | 210 | 30 | - | - | 524 | 6.9 |
| D-40 | Ray Prestage | 140 | do | do | - | - | - | - | - | - | 250 | - | 20 | - | - | - | - | 446 | 241 | - | - | 950 | 7.0 |
| D-42 | J. E. Anderson | 11 | Oct. 8, 1957 | do | - | - | - | - | - | - | 120 | - | 41 | - | - | - | - | 606 | 508 | - | - | 1,450 | 6.9 |
| D-43 | M. D. Widtfeldt | 178 | do | do | - | - | - | - | - | - | 356 | - | 286 | - | - | - | - | 950 | 658 | - | - | 2,240 | 7.2 |
| E-1 | Hagerman National Wildlife Refuge | 165 | May 7, 1958 | do | - | - | - | - | - | - | 450 | - | 11 | - | - | - | - | 6 | 0 | - | - | 747 | 8.7 |
| E-2 | do | 300 | Apr. 15, 1958 | do | 13 | 0.04 | 0.36 | 1.8 | 0.2 | 302 1.2 | 667 | 85 | 16 | 2.4 | 0.0 | 1.7 | 775 | 6 | 0 | 99 | 56 | 1,180 | 8.8 |
| E-3 | do | 182 | May 6, 1958 | do | - | - | - | - | - | - | 390 | - | 98 | - | - | - | - | 8 | 0 | - | - | 652 | 8.6 |
| E-4 | do | 56 | May 30, 1958 | Eagle Ford shale | - | - | - | - | - | - | 444 | - | 355 | - | - | - | - | 16 | 0 | - | - | 2,140 | 8.4 |
| E-6 | do | 228 | Apr. 17, 1958 | Woodbine formation | - | - | - | - | - | - | 206 | - | 98 | - | - | - | - | 10 | 0 | - | - | 485 | 8.2 |
| E-7 | do | 235 | May 7, 1958 | do | - | - | - | - | - | - | 240 | - | 28 | - | - | - | - | 10 | 0 | - | - | 858 | 8.1 |
| E-8 | J. W. Wilson | 375 | July 11, 1958 | do | - | - | - | - | - | - | 250 | - | 48 | - | - | - | - | 8 | 0 | - | - | 1,360 | 8.4 |
| E-9 | Perrin Air Force Base well 1 | 620 | Nov. 18, 1957 | do | 14 | .02 | - | 1.7 | .2 | 139 | 209 | 104 | 18 | .6 | .2 | - | 381 | 5 | 0 | 98 | 27 | 605 | 8.4 |
| E-10 | Perrin Air Force Base well 2 | 688 | Nov. 19, 1957 | do | 13 | .08 | - | 1.1 | .3 | 122 | 200 | 69 | 21 | .7 | 1.5 | - | 343 | 4 | 0 | 99 | 28 | 535 | 8.2 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe)a/ In solution | Iron (Fe)a/ Total | 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 $CaCO_3$ Total | Hardness as $CaCO_3$ Non-carbonate | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-12 | Perrin Air Force Base well 4 | 1,570 | Oct. --, 1953 | Trinity group | 15 | .01 | .18 | .2 | .1 | 307 | 652 | 86 | 27 | 1.8 | 2.2 | - | 761 | 1 | 0 | - | - | 1,200 | 8.6 |
| E-13 | Perrin Air Force Base well 5 | 801 | Nov. 18, 1957 | Woodbine formation | 12 | 0.26 | - | 0.0 | 0.1 | 89 | 197 | 15 | 11 | 0.5 | 0.2 | - | 230 | 0 | 0 | 100 | 55 | 359 | 7.8 |
| E-14 | Perrin Air Force Base well 7-A | 642 | Nov. 20, 1957 | do | 15 | .10 | - | .5 | .0 | 159 | 326 | 48 | 18 | .8 | 2.0 | - | 403 | 1 | 0 | 100 | 69 | 648 | 9.1 |
| E-16 | B. W. Rubarts | 213 | Nov. 13, 1958 | do | 12 | .02 | 2.3 | 27 | 3.1 | 8.2 .6 | 94 | 7.0 | 98 | .1 | .2 | 0.00 | 114 | 80 | 3 | 18 | 0.4 | 201 | 6.5 |
| E-18 | Vincent McKeon | 230 | May 13, 1958 | do | - | - | - | - | - | - | 172 | - | 21 | - | - | - | - | 230 | 89 | - | - | 510 | 8.0 |
| E-19 | D. H. Hamilton | 630 | do | do | - | - | - | - | - | - | 266 | - | 38 | - | - | - | - | 37 | 0 | - | - | 577 | 8.3 |
| E-21 | O. G. Blankenship | 100 | do | do | - | - | - | - | - | - | 422 | - | 9.8 | - | - | - | - | 32 | 0 | - | - | 700 | 8.6 |
| E-22 | E. F. Knight | 327 | July 11, 1958 | Washita group | - | - | - | - | - | - | 426 | - | 14 | - | - | - | - | 14 | 0 | - | - | 789 | 8.1 |
| E-23 | Jewel Franklin | 150 | July 15, 1958 | Eagle Ford shale | - | - | - | - | - | - | 648 | - | 77 | - | - | - | - | 24 | 0 | - | - | 1,970 | 8.2 |
| E-24 | H. P. Craft | 730 | do | Woodbine formation | - | - | - | - | - | - | 152 | - | 26 | - | - | - | - | 18 | 0 | - | - | 503 | 7.7 |
| E-26 | W. E. Stephens | 520 | May 22, 1958 | do | - | - | - | - | - | 546 - | - | 580 | 275 | - | - | - | - | 252 | - | - | - | - | - |
| E-27 | W. J. Thompson | 380 | do | do | - | - | - | - | - | - | 534 | - | 36 | - | - | - | - | 6 | 0 | - | - | 1,010 | 8.5 |
| E-29 | G. G. Fallon | 598 | May 16, 1958 | do | - | - | - | - | - | - | 1,320 | - | 203 | - | - | - | - | 12 | 0 | - | - | 2,420 | 8.2 |
| E-30 | G. G. Fallon | 1,600 | do | Trinity group | 3.2 | 0.03 | 0.53 | 1.0 | 0.0 | 292 1.3 | 718 | 11 | 21 | 1.4 | 0.0 | 0.83 | 685 | 2 | 0 | 99 | 80 | 1,160 | 9.5 |
| E-31 | Harry Hudgens | 800 | May 22, 1958 | Woodbine formation | - | - | - | - | - | - | 386 | - | 20 | - | - | - | - | 6 | 0 | - | - | 821 | 8.4 |
| E-33 | E. C. Morris | 560 | do | do | - | - | - | - | - | - | 706 | - | 700 | - | - | - | - | 18 | 0 | - | - | 3,140 | 8.3 |
| E-35 | City of Sherman | 789 | Aug. 26, 1958 | do | 14 | .03 | .14 | .5 | .0 | 113 .5 | 251 | 24 | 85 | .5 | .8 | .28 | 285 | 1 | 0 | 99 | 49 | 460 | 7.7 |
| E-36 | do | 2,169 | do | Trinity group | 15 | .01 | .05 | 2.6 | 1.2 | 358 2.1 | 462 | 102 | 225 | 1.0 | .5 | .46 | 937 | 12 | 0 | 98 | 46 | 1,610 | 8.2 |
| E-38 | do | 2,140 | Oct. 6, 1958 | do | 14 | .02 | .36 | 3.5 | .9 | 361 2.6 | 461 | 113 | 220 | .7 | 2.2 | .51 | 946 | 12 | 0 | 98 | 45 | 1,600 | 8.4 |
| E-40 | do | 786 | Nov. 13, 1958 | Woodbine formation | 13 | .05 | .15 | 1.0 | .1 | 196 1.0 | 327 | 72 | 66 | .6 | .5 | .38 | 512 | 3 | 0 | 99 | 49 | 852 | 8.4 |
| E-41 | do | 2,146 | Jan. 19, 1959 | Trinity group | 16 | .03 | - | 1.9 | .8 | 315 1.8 | 548 | 95 | 96 | .9 | .0 | .74 | 797 | 8 | 0 | 98 | 48 | 1,300 | 8.7 |
| E-47 | do | 955 | Aug. 26, 1958 | Woodbine formation | 14 | .07 | .30 | .9 | .1 | 94 .8 | 199 | 32 | 10 | .5 | .0 | .23 | 253 | 3 | 0 | 98 | 26 | 414 | 7.7 |
| E-48 | do | 2,176 | do | Trinity group | 16 | .02 | .04 | 4.8 | 2.0 | 446 3.0 | 466 | 111 | 362 | 1.0 | .0 | .59 | 1,180 | 20 | 0 | 98 | 43 | 2,020 | 8.2 |
| E-49 | do | 2,295 | do | do | 16 | .02 | .05 | 2.1 | .8 | 308 1.5 | 515 | 93 | 105 | 1.0 | .0 | .50 | 781 | 8 | 0 | 98 | 46 | 1,290 | 8.4 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe) a/ In solution | Iron (Fe) a/ Total | 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 $CaCO_3$ Total | Hardness as $CaCO_3$ Non-carbonate | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-50 | City of Sherman | 736 | Aug. 26, 1958 | Woodbine formation | 15 | .02 | .03 | 1.0 | .3 | 152 .5 | 270 | 67 | 34 | .5 | .0 | .32 | 404 | 4 | 0 | 99 | 35 | 668 | 8.8 |
| *E-58 | do | 2,380 | Mar. 20, 1959 | Trinity group | 18 | .1 | - | 1.6 | .4 | 315 | 596 | 86 | 76 | - | - | - | 815 | 6 | 0 | - | - | 1,280 | 8.6 |
| E-59 | P. J. Johnson, Sr. | 725 | Dec. 6, 1956 | Woodbine formation | 8.8 | 0.01 | - | 7.3 | 3.5 | 1,040 | 607 | 25 | 1260 | 2.4 | 0.5 | - | 2,620 | 32 | 0 | 99 | 79 | 4,680 | 8.5 |
| E-60 | Leon Bloomer | 720 | May 22, 1958 | do | - | - | - | - | - | - | 718 | - | 123 | - | - | - | - | 10 | 0 | - | - | 1,980 | 8.6 |
| *E-61 | City of Sherman | 2,460 | Jan. 29, 1959 | Trinity group | 20 | .07 | - | 1.8 | .4 | 285 | 554 | 87 | 56 | - | - | - | 740 | 6 | 0 | - | - | 1,140 | 8.5 |
| *E-62 | do | 1,023 | do | Woodbine formation | 18 | .07 | - | 1.0 | .3 | 174 | 354 | 62 | 18 | - | - | - | 461 | 4 | 0 | - | - | 686 | 8.1 |
| E-63 | Charles F. Burns | 773 | May 21, 1958 | do | - | - | - | - | - | - | 852 | - | 46 | - | - | - | - | 12 | 0 | - | - | 1,690 | 8.5 |
| E-65 | R. C. Counts | 1,100 | Dec. 9, 1957 | do | - | - | - | - | - | - | 842 | - | 100 | - | - | - | - | 8 | 0 | - | - | 1,840 | 8.8 |
| E-66 | Franklin Wible | 140 | do | Eagle Ford shale | - | - | - | - | - | - | 262 | - | 78 | - | - | - | - | 84 | 0 | - | - | 1,120 | 7.6 |
| E-69 | J. W. Bell | 370 | do | Woodbine formation | - | - | - | - | - | - | 1,060 | - | 258 | - | - | - | - | 6 | 0 | - | - | 2,210 | 8.7 |
| F-2 | Alice Sockwell | 70 | Mar. 21, 1958 | do | - | - | - | - | - | - | - | 199 | 770 | - | - | - | - | 1,070 | - | - | - | 3,160 | - |
| F-3 | C. L. Trice | 28 | do | do | 12 | .02 | 1.8 | 72 | 18 | 32 3.6 | 258 | 34 | 53 | .5 | 6.3 | 0.10 | 359 | 254 | 42 | 21 | .9 | 638 | 7.7 |
| F-4 | E. C. Sweeney | 29 | July 16, 1958 | do | - | - | - | - | - | - | 52 | - | 6.2 | - | - | - | - | 28 | 0 | - | - | 107 | 6.6 |
| F-5 | W. S. Knox | 100 | Sept.12, 1957 | do | - | - | - | - | - | - | 42 | - | 23 | - | - | - | - | 36 | 2 | - | - | 184 | 6.1 |
| F-6 | C. W. Stripling | 95 | do | do | - | - | - | - | - | - | 480 | - | 29 | - | - | - | - | 88 | 0 | - | - | 1,040 | 7.8 |
| F-7 | Mrs. H. E. Pierce | 100 | July 17, 1958 | Pawpaw formation | - | - | - | - | - | - | 382 | - | 18 | - | - | - | - | 92 | 0 | - | - | 682 | 7.6 |
| F-8 | Paul Wrenn | 42 | do | Woodbine formation | - | - | - | - | - | - | 226 | - | 88 | - | - | - | - | 171 | 0 | - | - | 720 | 7.1 |
| F-9 | C. R. Crabtree | 35 | do | Pawpaw formation | - | - | - | - | - | - | 270 | - | 68 | - | - | - | - | 322 | 100 | - | - | 799 | 7.4 |
| F-10 | C. D. Mitchell | 470 | Nov. 13, 1957 | Trinity group | - | - | - | - | - | - | 642 | - | 725 | - | - | - | - | 48 | 0 | - | - | 3,590 | 8.3 |
| F-12 | Federal Communications Comm. | 45 | May 14, 1958 | Pawpaw formation | - | - | - | - | - | - | 178 | - | 7.2 | - | - | - | - | 148 | 2 | - | - | 365 | 8.0 |
| F-13 | O. W. Price | 195 | Nov. 15, 1957 | do | - | - | - | - | - | - | 248 | - | 22 | - | - | - | - | 12 | 0 | - | - | 519 | 8.2 |
| F-15 | John T. Black | 34 | July 17, 1958 | Woodbine formation | - | - | - | - | - | - | 88 | - | 30 | - | - | - | - | 160 | 88 | - | - | 578 | 6.7 |
| F-16 | D. D. Whiting | 75 | do | do | - | - | - | - | - | - | 242 | - | 41 | - | - | - | - | 204 | 6 | - | - | 667 | 7.0 |
| F-18 | Claude Arthur | 25 | Aug. 1, 1958 | do | - | - | - | 55 | 14 | - | 2 | 198 | 11 | - | - | - | - | 196 | 194 | - | - | 459 | 4.7 |
| F-19 | J. P. Armstrong | 170 | Sept.17, 1957 | do | - | - | - | - | - | - | 131 | - | 16 | - | - | - | - | 88 | 0 | - | - | 661 | 7.5 |
| F-20 | G. S. Penn | 460 | June 6, 1958 | do | - | - | - | - | - | - | 192 | - | 13 | - | - | - | - | 7 | 0 | - | - | 472 | 7.5 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe)a/ In solution | Iron (Fe)a/ Total | 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 $CaCO_3$ Total | Hardness as $CaCO_3$ Non-carbonate | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F-21 | R. C. Francis | 893 | July 17, 1958 | Trinity group | 9.4 | 0.01 | 2.1 | 2.0 | 1.1 | 466 2.1 | 887 | 201 | 46 | 4.0 | 3.5 | 2.5 | 1,170 | 10 | 0 | 98 | 66 | 1,830 | 8.2 |
| F-22 | D. H. James | 152 | Sept.12, 1957 | Woodbine formation | - | - | - | - | - | - | 67 | - | 55 | - | - | - | - | 236 | 181 | - | - | 596 | 6.4 |
| F-23 | Jack Adkins | 455 | Jan. --, 1949 | do | 19 | - | - | 126 | 7.2 | 48 | 510 | 11 | 14 | - | 0.2 | 0.05 | 493 | 344 | 0 | 23 | 1.1 | 798 | - |
| F-24 | A. C. Poole | 359 | July 11, 1958 | do | - | - | - | - | - | - | 246 | - | 126 | - | - | - | - | 128 | 0 | - | - | 855 | 7.8 |
| F-25 | Elmer Mitchell | 45 | June 6, 1958 | Austin chalk | - | - | - | - | - | 53 | - | 94 | 232 | - | - | - | - | 594 | - | - | - | - | - |
| F-26 | R. O. Griffin | 45 | do | do | - | - | - | - | - | - | 308 | - | 63 | - | - | - | - | 388 | 136 | - | - | 925 | 7.7 |
| F-27 | Jimmy Fant | 497 | May 14, 1958 | Woodbine formation | - | - | - | - | - | - | 742 | - | 750 | - | - | - | - | 19 | 0 | - | - | 3,310 | 8.3 |
| F-28 | W. C. Durham | 70 | June 6, 1958 | Eagle Ford shale | - | - | - | - | - | 32 | - | 11 | 11 | - | - | - | - | 347 | - | - | - | - | - |
| F-29 | Ray Kraft | 365 | May 14, 1958 | Woodbine formation | - | - | - | - | - | - | 506 | - | 56 | - | - | - | - | 6 | 0 | - | - | 927 | 8.6 |
| F-30 | Tom Conner | 157 | do | do | - | - | - | - | - | - | 492 | - | 35 | - | - | - | - | 6 | 0 | - | - | 907 | 8.5 |
| F-31 | D. Z. Reynolds | 50 | July 17, 1958 | do | - | - | - | - | - | - | 478 | - | 13 | - | - | - | - | 310 | 0 | - | - | 799 | 7.3 |
| F-32 | J. H. Whiting | 153 | May 14, 1958 | do | - | - | - | - | - | - | 597 | - | 17 | - | - | - | - | 730 | - | - | - | - | - |
| F-33 | Claude Smith | 150 | July 17, 1958 | do | - | - | - | - | - | - | 280 | - | 51 | - | - | - | - | 58 | 0 | - | - | 3,510 | 7.9 |
| F-34 | M. D. Gilliam | 140 | July 17, 1958 | do | - | - | - | - | - | - | 528 | - | 23 | - | - | - | - | 14 | 0 | - | - | 1,470 | 8.0 |
| F-35 | City of Bells | 709 | Aug. 19, 1958 | do | 12 | 0.01 | 0.05 | 0.4 | 0.2 | 153 0.6 | 327 | 39 | 14 | 0.7 | 1.2 | 0.09 | 388 | 2 | 0 | 99 | 47 | 634 | 8.1 |
| *F-36 | do | 902 | Sept. 2, 1959 | do | - | .2 | 1 | 3.6 | 1.0 | 571 | 768 | 446 | 112 | - | - | - | 1,560 | 13 | 0 | 99 | 69 | 2,300 | 8.4 |
| F-38 | W. H. Brown | 460 | May 14, 1958 | do | - | - | - | - | - | - | 730 | - | 93 | - | - | - | - | 6 | 0 | - | - | 957 | 8.5 |
| F-40 | C. B. Ball | 878 | June 10, 1958 | do | - | - | - | - | - | - | 452 | - | 24 | - | - | - | - | 4 | 0 | - | - | 782 | 8.6 |
| F-41 | O. B. Pierce | 45 | May 16, 1958 | Austin chalk | - | - | - | - | - | - | - | 218 | 64 | - | - | - | - | 708 | - | - | - | - | - |
| F-42 | J. H. Washburn | 745 | do | Woodbine formation | - | - | - | - | - | - | 330 | - | 7.0 | - | - | - | - | 4 | 0 | - | - | 555 | 8.5 |
| F-44 | Claude Odom | 700 | do | do | - | - | - | - | - | - | 390 | - | 58 | - | - | - | - | 3 | 0 | - | - | 783 | 8.7 |
| F-45 | W. A. Presley | 15 | May 15, 1958 | do | - | - | - | - | - | - | - | 27 | 12 | - | - | - | - | 326 | - | - | - | 688 | - |
| G-1 | City of Collinsville | 1,522 | Aug. 28, 1958 | Trinity group | 15 | .01 | .02 | 1.0 | .4 | 208 .5 | 443 | 40 | 32 | .3 | 1.0 | .24 | 516 | 4 | 0 | 99 | 45 | 837 | 8.7 |
| G-3 | A. Hughes | 108 | Oct. 9, 1957 | Woodbine formation | - | - | - | - | - | - | 203 | - | 9.0 | - | - | - | - | 142 | 0 | - | - | 371 | 7.8 |
| G-4 | Fred J. Price | 250 | Dec. 18, 1957 | do | - | - | - | - | - | - | 514 | - | 16 | - | - | - | - | 2 | 0 | - | - | 991 | 8.7 |
| G-5 | Mrs. A. I. White | 400 | do | do | - | - | - | - | - | 808 | 514 | 1,220 | 68 | - | - | - | - | 30 | 0 | 98 | 64 | 3,390 | 8.5 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe)a/ In solution | Iron (Fe)a/ Total | 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 $CaCO_3$ Total | Hardness as $CaCO_3$ Non-carbonate | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G-6 | W. D. Hunter | 216 | Oct. 10, 1957 | Woodbine formation | - | - | - | - | - | | - | 426 | 782 | 60 | - | - | - | - | 92 | 0 | - | - | 2,310 | 7.9 |
| G-7 | L. G. Vannoy | 35 | Oct. 9, 1957 | Austin chalk | - | - | - | - | - | | - | 326 | - | 266 | - | - | - | - | 686 | 419 | - | - | 2,050 | 7.3 |
| G-8 | E. C. McMurrey | 125 | June 2, 1958 | Woodbine formation | - | - | - | - | - | | - | 234 | - | 24 | - | - | - | - | 362 | 170 | - | - | 958 | 7.9 |
| G-10 | J. L. Varley | 32 | Oct. 8, 1957 | do | - | - | - | - | - | | - | 247 | - | 11 | - | - | - | - | 196 | 0 | - | - | 485 | 7.3 |
| G-11 | J. J. Tamplin | 212 | May 29, 1958 | do | - | - | - | - | - | | - | 186 | - | 12 | - | - | - | - | 2 | 0 | - | - | 384 | 7.8 |
| G-12 | City of Tioga | 215 | Aug. 21, 1958 | do | 12 | 0.00 | 23 | 16 | 7.0 | 50 | 2.7 | 160 | 24 | 16 | 0.4 | 0.0 | 0.22 | 207 | 69 | 0 | 60 | 2.6 | 354 | 6.9 |
| G-14 | Fred Reynolds | 160 | Aug. 28, 1957 | do | - | - | - | - | - | | - | 230 | - | 47 | - | - | - | - | 84 | 0 | - | - | 761 | 8.2 |
| G-15 | T. E. Hestand | 145 | May 29, 1958 | do | - | - | - | - | - | | - | 520 | - | 169 | - | - | - | - | 18 | 0 | - | - | 2,070 | 8.4 |
| G-16 | Louie Meinen | 104 | do | do | - | - | - | - | - | | - | 496 | - | 48 | - | - | - | - | 44 | 0 | - | - | 2,080 | 8.4 |
| G-17 | S. E. Bartlett | 224 | Dec. 18, 1957 | do | - | - | - | - | - | 715 | | 584 | 950 | 80 | - | - | - | - | 26 | 0 | 98 | 61 | 3,000 | 8.6 |
| G-19 | Albert Scharff | 387 | Oct. 4, 1957 | do | - | - | - | - | - | | - | 136 | - | 292 | - | - | - | - | 39 | 0 | - | - | 4,480 | 8.2 |
| G-20 | Cliff Davis | 146 | Oct. 10, 1957 | do | - | - | - | - | - | | - | 476 | - | 36 | - | - | - | - | 6 | 0 | - | - | 1,180 | 8.9 |
| G-21 | L. Heitzman | 230 | Oct. 8, 1957 | do | - | - | - | - | - | | - | 163 | - | 28 | - | - | - | - | 81 | 0 | - | - | 493 | 7.0 |
| H-6 | J. L. Bradley | 700 | May 21, 1958 | do | - | - | - | - | - | | - | 356 | - | 20 | - | - | - | - | 3 | 0 | - | - | 761 | 8.4 |
| H-7 | Jake McDonald | 25 | do | Austin chalk | - | - | - | - | - | | - | 192 | - | 36 | - | - | - | - | 480 | 322 | - | - | 1,030 | 8.0 |
| H-8 | R. O. Barham | 40 | June 11, 1958 | do | - | - | - | - | - | 13 | - | - | 92 | 13 | - | - | - | - | 342 | - | - | - | - | - |
| H-9 | C. E. Teague | 750 | May 20, 1958 | Woodbine formation | - | - | - | - | - | 272 | - | - | 76 | 275 | - | - | - | - | 200 | - | - | - | - | - |
| H-10 | C. V. Bowden | 20 | May 21, 1958 | Austin chalk | - | - | - | - | - | | - | 294 | - | 6.0 | - | - | - | - | 278 | 37 | - | - | 539 | 7.7 |
| H-13 | W. H. Higgins | 604 | Oct. 8, 1957 | Woodbine formation | - | - | - | - | - | | - | 585 | - | 56 | - | - | - | - | 8 | 0 | - | - | 2,010 | 8.7 |
| H-16 | A. Dieterich | 780 | Oct. 9, 1957 | do | - | - | - | - | - | | - | 476 | - | 15 | - | - | - | - | 4 | 0 | - | - | 1,210 | 8.9 |
| H-20 | C. E. Davis | 18 | May 21, 1958 | Austin chalk | - | - | - | - | - | | - | 230 | - | 6.0 | - | - | - | - | 234 | 46 | - | - | 491 | 7.7 |
| H-21 | City of Howe | 1,069 | Aug. 20, 1958 | Woodbine formation | 13 | 0.00 | 0.05 | 1.2 | 0.7 | 367 | 1.5 | 751 | 118 | 33 | 1.4 | 3.0 | 0.20 | 909 | 6 | 0 | 99 | 65 | 1,450 | 8.6 |
| H-24 | J. H. Blythe | 34 | May 20, 1958 | Austin chalk | - | - | - | - | - | | - | 236 | - | 4.2 | - | - | - | - | 242 | 48 | - | - | 482 | 7.6 |
| H-25 | Leroy Wheeler | 32 | May 21, 1958 | do | - | - | - | - | - | | - | 286 | - | 5.0 | - | - | - | - | 252 | 18 | - | - | 526 | 7.9 |
| H-26 | L. L. Morrison | 25 | do | do | - | - | - | - | - | | - | 252 | - | 9.2 | - | - | - | - | 270 | 64 | - | - | 557 | 7.9 |
| H-28 | City of Gunter | 730 | Aug. 21, 1958 | Woodbine formation | 13 | 0.01 | 1.4 | 3.4 | 1.8 | 103 | 2.2 | 204 | 42 | 19 | 0.4 | 0.0 | 0.00 | 285 | 16 | 0 | 92 | 11 | 469 | 7.4 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

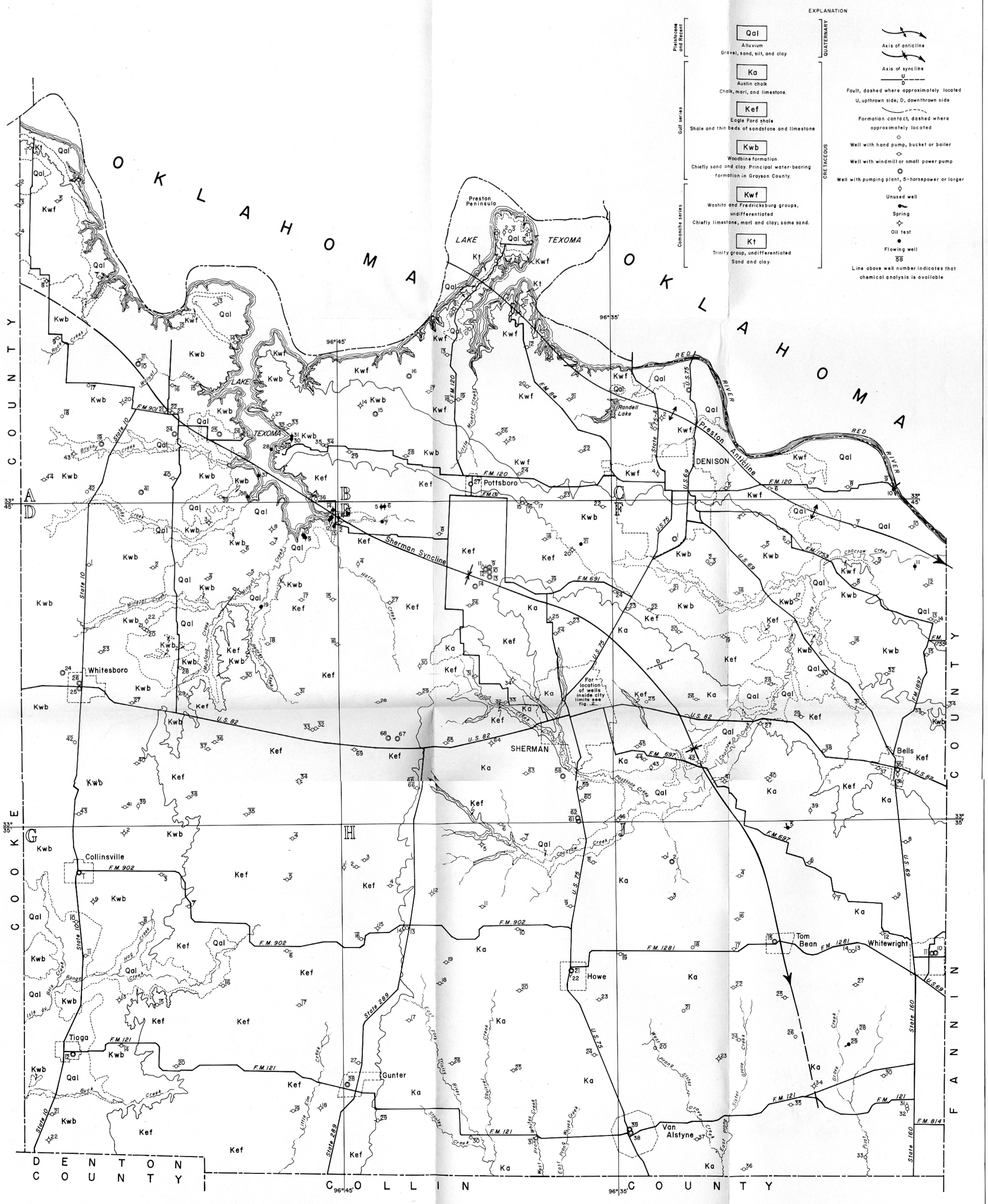
| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe)a/ In solution | Iron (Fe)a/ Total | Calcium (Ca) | Magnesium (Mg) | Sodium and potassium (Na + K) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Boron (B) | Dissolved solids | Hardness as $CaCO_3$ Total | Hardness as $CaCO_3$ Non-carbonate | Percent sodium | Sodium adsorption ratio (SAR) | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H-29 | R. J. Block | 545 | June 6, 1958 | Woodbine formation | - | - | - | - | - | - | 562 | 1,800 | 420 | - | - | - | - | 58 | 0 | - | - | 5,420 | 8.2 |
| H-30 | Mrs. J. W. Ladd | 30 | May 20, 1958 | Austin chalk | - | - | - | - | - | - | 168 | - | 53 | - | - | - | - | 256 | 118 | - | - | 642 | 7.8 |
| H-31 | State of Texas | 22 | do | do | - | - | - | - | - | 22 - | - | 70 | 21 | - | - | - | - | 350 | - | - | - | - | - |
| J-4 | Oscar Wetzel | 26 | June 10, 1958 | do | - | - | - | - | - | - | 368 | - | 7.8 | - | - | - | - | 310 | 8 | - | - | 595 | 7.2 |
| J-5 | F. N. Rogers | Spring | Apr. 11, 1958 | do | - | - | - | - | - | - | - | 36 | 12 | - | - | - | - | 370 | - | - | - | - | - |
| J-7 | Roscoe Gillett | 34 | June 10, 1958 | do | - | - | - | - | - | - | 270 | - | 124 | - | - | - | - | 78 | 0 | - | - | 1,380 | 7.9 |
| J-11 | City of Whitewright | 1,189 | Mar. 26, 1958 | Woodbine formation | 15 | .01 | - | 1.3 | .2 | 279 | 505 | 108 | 56 | 1.4 | 2.0 | - | 743 | 4 | 0 | 99 | 61 | 1,160 | 8.4 |
| J-15 | City of Tom Bean | 1,180 | Aug. 22, 1958 | do | 14 | .02 | .04 | 1.1 | .5 | 359 1.2 | 632 | 99 | 104 | 1.6 | 1.0 | .24 | 888 | 4 | 0 | 99 | 74 | 1,470 | 8.5 |
| J-16 | Paul H. Franklin | 1,067 | May 20, 1958 | do | - | - | - | - | - | - | 490 | - | 115 | - | - | - | - | 6 | 0 | - | - | 1,590 | 8.5 |
| J-17 | Alvie Casada | 28 | do | Austin chalk | - | - | - | - | - | - | 308 | - | 9.8 | - | - | - | - | 314 | 62 | - | - | 589 | 7.9 |
| J-18 | R. S. Nicholson | 30 | do | do | - | - | - | - | - | 26 - | - | 95 | 57 | - | - | - | - | 414 | - | - | - | - | - |
| J-19 | Morris M. Franklin | 24 | June 11, 1958 | do | - | - | - | - | - | - | 342 | - | 6.8 | - | - | - | - | 310 | 30 | - | - | 618 | 7.6 |
| J-20 | J. M. Purdom | 25 | do | do | - | - | - | - | - | 29 | - | 51 | 28 | - | - | - | - | 426 | - | - | - | - | - |
| J-21 | I. L. Smith | 30 | June 20, 1958 | do | - | - | - | - | - | - | 146 | - | 48 | - | - | - | - | 224 | 104 | - | - | 658 | 7.7 |
| J-22 | W. H. Byers | 22 | do | do | - | - | - | - | - | - | 228 | - | 4.2 | - | - | - | - | 224 | 37 | - | - | 455 | 7.6 |
| J-24 | J. B. Edwards, Jr. | 40 | May 20, 1958 | do | - | - | - | - | - | - | 286 | - | 12 | - | - | - | - | 264 | 30 | - | - | 527 | 7.7 |
| J-25 | Burl Shields | 20 | June 10, 1958 | do | - | - | - | - | - | - | 314 | - | 3.5 | - | - | - | - | 276 | 18 | - | - | 527 | 7.2 |
| J-26 | M. B. Jones | 32 | do | do | - | - | - | - | - | - | 282 | - | 46 | - | - | - | - | 486 | 255 | - | - | 1,160 | 7.5 |
| J-27 | L. H. Darwin | 39 | do | do | - | - | - | - | - | - | 288 | - | 12 | - | - | - | - | 222 | 0 | - | - | 524 | 7.7 |
| J-28 | Jack Biggerstaff | 42 | do | do | - | - | - | - | - | - | 266 | - | 187 | - | - | - | - | 1,090 | 872 | - | - | 2,460 | 7.4 |
| J-29 | E. H. Hichland | Spring | do | do | - | - | - | - | - | 46 | - | 29 | 20 | - | - | - | - | 304 | - | - | - | - | - |
| J-30 | Tom Stephens | 25 | May 15, 1958 | do | - | - | - | - | - | - | - | 18 | 9 | - | - | - | - | 310 | - | - | - | - | - |
| J-35 | J. D. Hix | 18 | May 22, 1958 | do | - | - | - | - | - | - | 284 | - | 10 | - | - | - | - | 290 | 58 | - | - | 580 | 7.9 |
| J-39 | City of Van Alstyne | 1,401 | Aug. 20, 1958 | Woodbine formation | 13 | 0.01 | 0.06 | 0.2 | 0.0 | 203 1.0 | 403 | 74 | 19 | 0.8 | 0.0 | 0.11 | 511 | 0 | 0 | 100 | 25 | 860 | 8.2 |

See footnotes at end of table.

Table 10.--Analyses of water from wells and springs in Grayson County--Continued

| Well | Owner | Depth of well (ft.) | Date of collection | Water-bearing unit | Silica ($SiO_2$) | Iron (Fe)a/ | | Cal-cium (Ca) | Magne-sium (Mg) | Sodium and potassium (Na + K) | Bicar-bonate ($HCO_3$) | Sul-fate ($SO_4$) | Chlo-ride (Cl) | Fluo-ride (F) | Ni-trate ($NO_3$) | Boron (B) | Dis-solved solids | Hardness as $CaCO_3$ | | Per-cent so-dium | Sodium adsorp-tion ratio (SAR) | Specific conduct-ance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | In solu-tion | Total | | | | | | | | | | | Total | Non-carbonate | | | | |
| | Lake Texoma | | Nov. 4, 1955 | -- | 7.8 | .02 | .08 | 94 | 19 | 186 | 106 | 222 | 282 | .3 | 1.5 | - | 901 | 312 | 226 | - | - | 1,520 | 7.5 |
| | Lake Randel | | Feb. --, 1955 | -- | 3.8 | .00 | .07 | 73 | 18 | 129 | 122 | 141 | 205 | .3 | .2 | - | 682 | 256 | 156 | - | - | 1,130 | 7.7 |

a/ Iron values listed are "In solution when analyzed" and "Total iron in sample at time of collection".
b/ Includes 4.9 parts per million of aluminum (Al), and 0.45 part per million manganese (Mn).
* Analyses by Curtis Laboratories.




Base compiled from general highway map of the Texas Highway Department and U.S. Department of Agriculture Production and Marketing Administration aerial photos 1958

Geology by E.T. Baker, Jr. U.S. Geological Survey Geology of Woodbine formation and alluvium modified from Bergquist (1949)

GEOLOGIC MAP SHOWING LOCATION OF WELLS AND SPRINGS, GRAYSON COUNTY, TEXAS