Ground-Water Resources of the Ladder Creek Area in Kansas

By

EDWARD BRADLEY and CARLTON R. JOHNSON

WITH A SECTION ON THE CHEMICAL QUALITY OF WATER

By

ROBERT A. KRIEGER

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BULLETIN 126

GROUND-WATER RESOURCES OF THE LADDER CREEK AREA IN KANSAS

By EDWARD BRADLEY and CARLTON R. JOHNSON
(U. S. Geological Survey)

With a section on the Chemical Quality of Water

By ROBERT A. KRIEGER
(U. S. Geological Survey)

Prepared as a part of the program of the Department of Interior for development of the Missouri River basin. The investigation was integrated with the cooperative ground-water program of the United States Geological Survey, the State Geological Survey of Kansas, the Division of Sanitation of the Kansas State Board of Health, and the Division of Water Resources of the Kansas State Board of Agriculture.

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ABSTRACT

This report describes the geology and hydrology of the drainage basin of Ladder Creek in western Kansas. The area investigated includes approximately 1,930 square miles and lies almost entirely within the High Plains section of the Great Plains physiographic province. The easternmost part is in the Plains Border section. Broad upland areas constitute the greatest part of the region under investigation. These upland areas are flat loess-covered plains sloping approximately 10 feet to the mile from west to east and containing many undrained depressions.

The outcropping rocks are sedimentary and range in age from Cretaceous to Quaternary. The Niobrara formation and Pierre shale form a nearly impervious floor beneath the Ladder Creek area, over which have been deposited the Ogallala formation of the Tertiary, and in places, younger deposits of the Quaternary. The principal water-bearing formation is the Ogallala.

The major stream in the area is South Fork of Smoky Hill River, which rises about 35 miles west of the Kansas-Colorado line and flows eastward through most of the area. Ladder Creek is the principal tributary entering this stretch of Smoky Hill River from the south. The flow of Ladder Creek is maintained principally by ground-water discharge from the Ogallala formation through the alluvial valley fill.

Measured depths to water in wells in the Ladder Creek area range from less than 1 foot to 246 feet. In most of the upland area the depth to water ranges from 80 to 150 feet. Transmissibility values obtained from two aquifer tests of the Ogallala formation are 15,000 and 40,000 gpd per foot. An aquifer test of the Sanborn and Meade formations gives a value for transmissibility of about 130,000 gpd per foot.

Deep-well irrigation is in the initial phase despite the great increase in the acreage of irrigated lands in the area in the last few years. The U. S. Bureau of Reclamation has estimated that 435,000 acres of land can be irrigated economically in the area. At the time of this investigation in 1951 about 26,000 acres, or about 6 percent, was developed, of which about 18,000 acres was irrigated annually by about 18,000 acre-feet of ground water.

The ground water in the Ogallala formation, though generally hard, is suitable for most purposes. Calcium and bicarbonate in the water range in concentration from 33 to 84 ppm and 170 to 248 ppm, respectively. The water from the Niobrara formation contains more dissolved solids than water from the Ogallala formation.

INTRODUCTION

Purpose of the Investigation

In the Ladder Creek drainage basin in Kansas, in the Smoky Hill River basin above Cedar Bluff reservoir, there is heavy pumping of ground water for irrigation, and probably the use of ground water for that purpose will increase greatly in the future. This investigation was made to further the understanding of the quantity and quality of the available ground water.

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The data upon which this report is based were collected at the request of the United States Bureau of Reclamation as a part of the Interior Department program in the Missouri Basin.

Location and Extent of the Area

The area discussed in this report includes the Kansas part of the Ladder Creek drainage basin and those parts of northeastern Scott County and northwestern Lane County that lie directly east of the Ladder Creek drainage. This eastern section has been included in the report because it is physiographically, geologically, and hydrologically similar to the Ladder Creek drainage basin and because some ground water is used for irrigation in this eastern section.

The approximate boundaries of the area are: on the north, Smoky Hill River and its South Fork; on the east, the line between R. 28 W. and R. 29 W.; on the south, the ground-water divide between the Arkansas and Smoky Hill River basins, which runs approximately

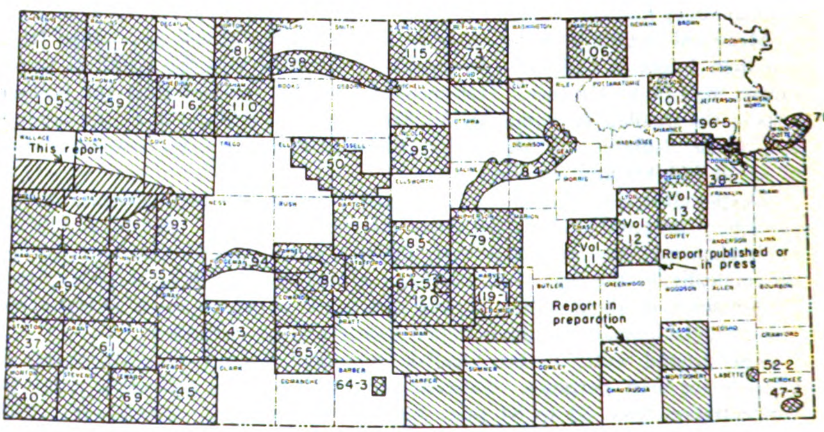

Fig. 1.—Map of Kansas showing area covered by this report and areas that have been covered under cooperative ground-water program and under Missouri Basin program of the Department of Interior.

through Shields, Healy, Manning, Scott City, and Leoti, and then slightly north of west to a point on the Kansas-Colorado line about 5 miles south of the Wallace-Greeley County line; and on the west, the Kansas-Colorado line (Fig. 1). The area investigated includes approximately 1,930 square miles.

Previous Investigations

Several studies concerning the geology and ground water of parts of the area have been published. In 1897, Haworth discussed the physiography of western Kansas and the physical properties of the Tertiary deposits in western Kansas. The 1895 and 1896 Report of the Board of Irrigation Survey and Experiment (Haworth, 1897a) summarized the possibilities of irrigation in western Kansas, described experiments with windmills and gasoline-driven pumps, and discussed the geology of ground water in western Kansas in some detail. Darton (1905) reported on the geology and ground water in much of the Great Plains area including western Kansas. Haworth (1913) included a brief chapter on water in the Tertiary of western Kansas in which he summarized the principal references pertaining to ground water and discussed the occurrence of ground water generally. Elias (1931) described the Ogallala formation, the principal water-bearing formation in the Ladder Creek area, and the Pierre shale and Niobrara formation of Cretaceous age.

The geology and ground-water resources of Scott and Lane Counties were described by Waite (1947) and Prescott (1951), respectively. Prescott, Branch, and Wilson (1954) described the geology and ground-water resources of Wichita and Greeley Counties. These reports have maps showing water-table contours, depth to water, and saturated thickness of the water-bearing materials, and they contain water-level measurements and logs of test holes and wells. Irrigation-well development and fluctuations of the water levels are discussed.

Methods of Investigation

Field work for the investigation on which this report is based was begun in March 1951. An inventory of existing irrigation wells and of some domestic and stock wells was made to determine the configuration of the water table. Water levels in representative wells were measured periodically to determine water-table fluctuations.

Test holes were drilled by W. T. Connor and N. W. Biegler using the hydraulic-rotary drilling machine of the State Geological Survey of Kansas. The test holes were drilled to determine the thickness and character of the water-bearing materials and the configuration of the surface of the Cretaceous rocks that represent the base of the ground-water reservoir. Also, some test holes were jetted in the

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Smoky Hill River valley to determine the thickness and character of the alluvium.

The discharges of Ladder Creek and Smoky Hill River were measured during this study, by use of a pygmy current meter and standard measurement procedure. When runoff consisted principally of effluent seepage, the discharges at eight sites on Ladder Creek and three sites on Smoky Hill River were measured periodically. The discharge at other sites also was measured occasionally. Observation wells were installed near the gaging sites to study the relation between local water-table fluctuations and stream discharge.

To determine the permeability and transmissibility of the water-bearing formations in the area, several aquifer tests were made by J. J. Schmidt on irrigation wells. The methods used in computing the results of the tests are discussed in the section on ground water.

The geologic map was prepared by mapping the area south of Smoky Hill River in Wallace and Logan Counties and southwestern Gove County and combining the resulting map with the maps of Lane, Scott, Wichita, and Greeley Counties that had previously been made as a part of the cooperative ground-water program in Kansas. K. L. Parish mapped the geology of most of Logan County, and N. W. Biegler mapped the geology of most of Wallace County. Biegler and Parish collaborated on the rest of those counties and southwestern Gove County. Altitudes of wells, of several points along Ladder Creek, and of some rock exposures were determined by C. K. Bayne and W. W. Wilson, using an alidade.

As a part of the ground-water investigation in the Ladder Creek area, quality of the water from selected wells and from streams was studied. Water samples for chemical-quality studies were obtained in Wallace, Logan, Greeley, Wichita, and Scott Counties in September 1951. In all, 36 samples from wells and 8 samples from surface sources were obtained. The analyses were made by C. J. Zabel of the U. S. Geological Survey.

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The writers wish to express their appreciation to many persons who contributed information for this report. Special thanks are due Weishaar & Son and Ben Hasz of Scott City, who provided well logs. Residents in the area cooperated in giving information regarding their wells.

The writers are grateful also to personnel of the United States Bureau of Reclamation for their cooperation and assistance in the

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study. Ed Kramer, H. R. McDonald, Marion Ball, and R. E. Glover were consulted frequently during the course of the investigation.

Well-Numbering System

The well numbers used in this report show the location of each well according to General Land Office surveys of the area. These numbers are assigned in accordance with the following formula: township, range, section, quarter section, and 40-acre tract within the quarter section. When two or more wells are within a 40-acre

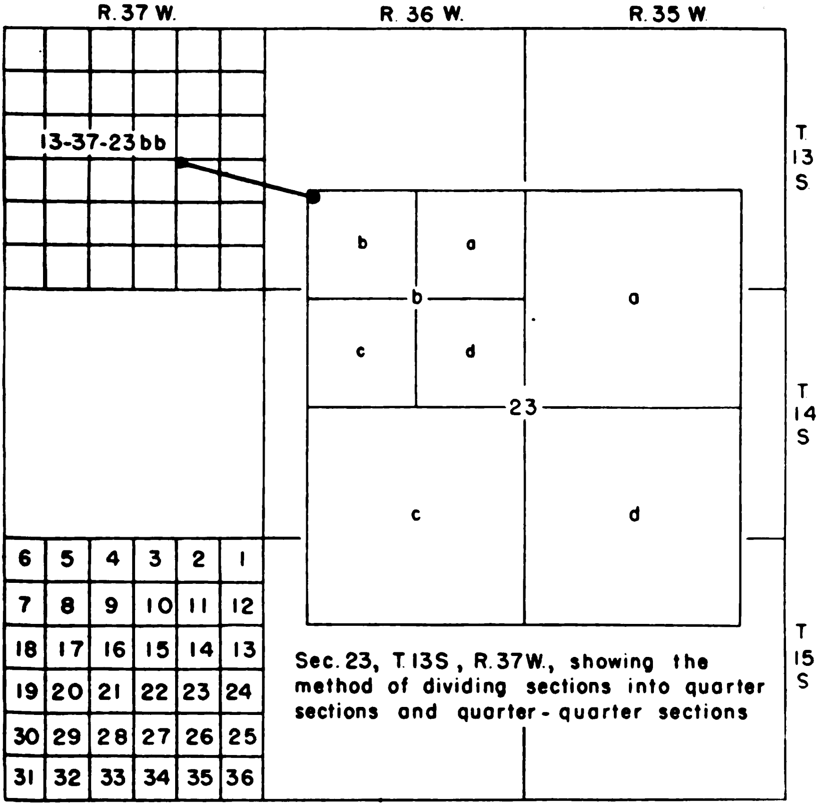

Fig. 2.—Sketch illustrating well-numbering system used in this report.

tract, the wells are numbered serially according to the order in which they were inventoried. The quarter section and 40-acre tracts are designated a, b, c, and d in a counterclockwise direction, beginning in the northeast quarter (Fig. 2).

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GEOGRAPHY

Topography and Drainage

The Ladder Creek project area lies almost entirely within the High Plains section of the Great Plains physiographic province. The east end of the area is in the Plains Border section (Fenneman, 1930). Broad upland areas constitute the greatest part of the region under investigation. These areas are loess-covered plains sloping eastward approximately 10 feet to the mile. Many undrained depressions on these surfaces indicate the flatness of the area. These depressions are circular or oval and about 100 to 2,000 feet in diameter.

The fringes of the upland areas are dissected by streams and dry gulches. Major valleys are broad, whereas the tributary valleys are narrow, steep walled, and short.

The major stream in the area is South Fork of Smoky Hill River, which rises about 35 miles west of the Kansas-Colorado line and flows eastward through the area. The flood plain increases from only 2 or 3 miles in western Wallace County to nearly 6 miles in eastern Logan County and western Gove County. Ladder Creek is the principal tributary entering this part of Smoky Hill River from the south. Ladder Creek originates within a mile of the source of South Fork of Smoky Hill River in Colorado and flows eastward, swinging southeastward in Wallace County into western Wichita County and then eastward in eastern Wichita County into western Scott County. In central Scott County, Ladder Creek turns northward, and it joins Smoky Hill River near Elkader in southeastern Logan County. Ladder Creek has a narrow valley and poorly developed terraces in its lower reaches. Other streams in the area flow in a general easterly direction. All the streams have short, narrow tributaries, generally normal to the main valley.

Population

The distribution of population in the Ladder Creek area in recent years has been affected by a general migration from rural areas to the towns. Table 1 gives the population in two northern townships in Scott County and in Scott City.

Table 1.—*Population of Scott City and Beaver and Michigan Townships, Scott County.*

Township or City	1930	1940	1950
Beaver Township	300	240	220
Michigan Township	430	268	215
Scott City	1,544	1,848	3,204

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The population in Wichita and Greeley Counties has been redistributed similarly. The population of Leoti increased from 618 in 1930 to 816 in 1940 and to 1,250 in 1950, and the population of Tribune increased from 436 in 1930 to 607 in 1940 and to 1,010 in 1950. Sharon Springs in Wallace County declined in population from 792 in 1930 to 760 in 1940. In 1950 the population of Sharon Springs was 994. Many residents left Wallace County during the drought years between 1930 and 1940. The population of the Ladder Creek area probably averages about 1 person per square mile.

Agriculture

The principal industry and source of income in the area is agriculture. In terms of cash income the largest single crop is wheat. The raising of grain sorghums and cattle has increased in recent years. Other crops include barley, corn, alfalfa, oats, sugar beets, potatoes, beans, and various grasses. In previous years climate was a dominant consideration in crop selection, but use of irrigation has stimulated a tendency toward experimentation with crops whose water requirements are not met by precipitation alone.

Climate

The High Plains region has a semiarid continental climate characterized by wide extremes in temperature, variable precipitation, and relatively high winds. The relative humidity is low, averaging between 40 and 50 percent.

According to the United States Weather Bureau, the normal annual precipitation is 18.61 inches at Scott City. The annual precipitation and cumulative departure from normal precipitation at Scott City are shown in Figure 3; the normal monthly precipitation is shown in Figure 4. Furthermore, Figure 4 indicates that the months of greatest rainfall are May and June.

During the late spring and early summer, local showers may be so erratic in areal distribution that one township receives 2 or 3 inches of rainfall while adjacent townships have no rain. Many of these showers are accompanied by electrical storms of considerable violence associated with unstable air masses. Records from 200 first-order Weather Bureau stations from 1899 to 1938 show that in western Kansas, thunderstorms occur on 30 to 50 days per year. Hailstorms frequently accompany thundershowers in western Kansas. Hail is more frequent in wet years than in dry years and results in considerable crop damage. Dust storms are common in

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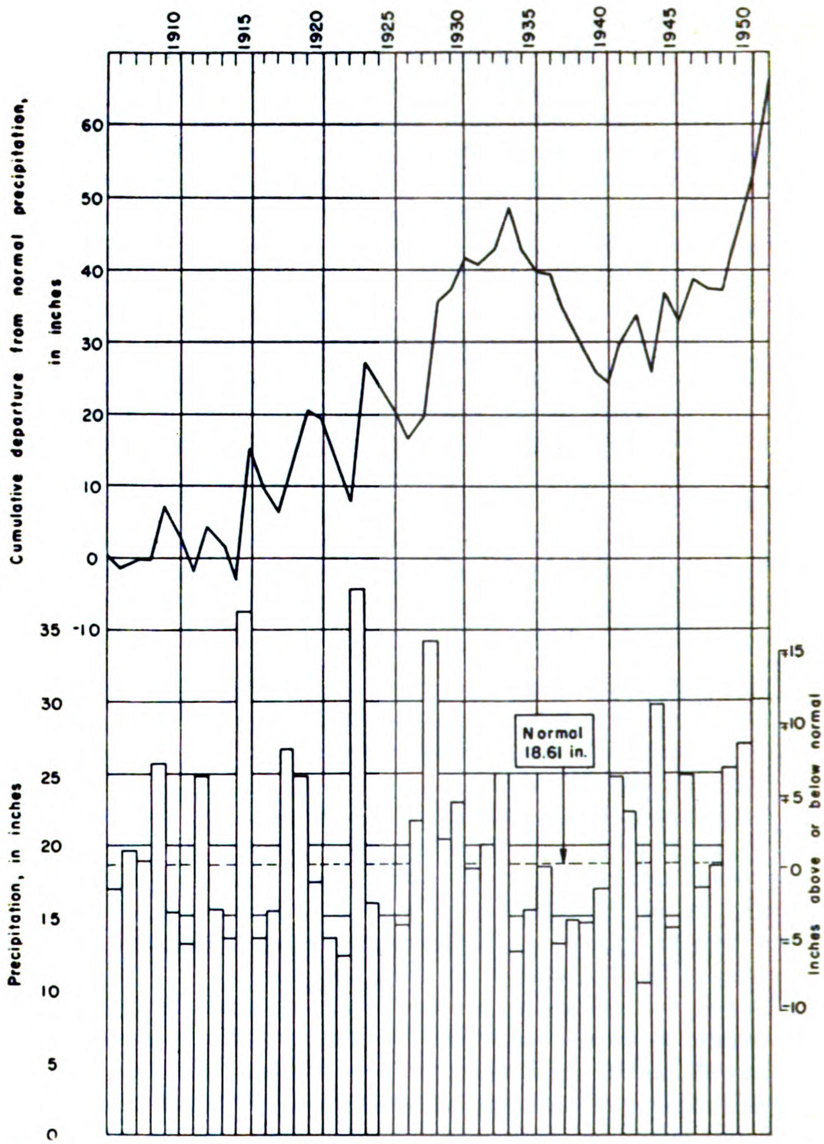

FIG. 3.—Graphs showing annual precipitation and cumulative departure from normal precipitation at Scott City.

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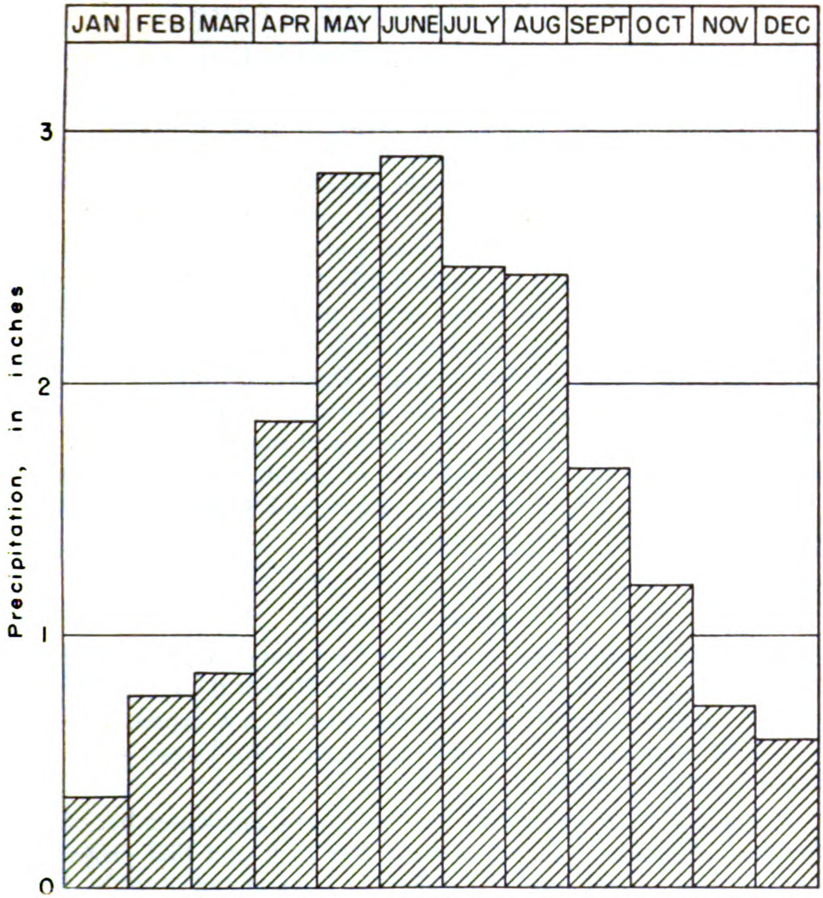

FIG. 4.—Graph showing normal monthly precipitation at Scott City.

parts of the High Plains, especially during prolonged periods of drought.

Much of the snowfall in western Kansas accompanies cold fronts. Not infrequently, strong winds and cold temperatures with accompanying precipitation result in blizzards. Normally, however, these are of short duration, and warmer temperatures follow in a few days. These storms may occur as early as the first of November and as late as the first of May. The snow usually drifts into road ditches and the lee of buildings, while open fields remain bare.

Evaporation is recorded by the United States Weather Bureau by a class A pan at Tribune.

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Geology in Relation to Ground Water *

The rocks that are exposed in the Ladder Creek area range in age from Cretaceous to Quaternary (Pl. 1). The oldest outcropping rocks are those of the Smoky Hill chalk member of the Niobrara formation. The youngest deposits are clays and silt on the floors of the upland lagoons, alluvium in the stream valleys, and dune sand on the upland.

The physical character and ground-water supply of the geologic formations are described briefly in Table 2. The stratigraphic relations of the formations are shown in the geologic sections in Plate 3.

The Niobrara formation and Pierre shale form a nearly impervious floor overlain by permeable Tertiary Ogallala formation and, in places, Quaternary deposits. The principal water-bearing formation is the Ogallala formation. In the buried stream valleys, Quaternary deposits are the principal source of ground water. In an area just north of Scott City both Quaternary and Tertiary (Ogallala) deposits consist of water-bearing materials.

Cretaceous System—Gulfian Series

Niobrara Formation

Fort Hays limestone member.—The Fort Hays limestone member is a massive gray marine limestone, about 60 feet thick, at the base of the Niobrara formation. The member is not exposed in the Ladder Creek area, and no wells in the area are known to derive water from the member.

Smoky Hill chalk member.—The Smoky Hill chalk member of the Niobrara formation (Pl. 6) is the oldest rock unit that crops out in the Ladder Creek area. The member is composed of shaly chalk containing concretions of limonite and pyrite. It is generally gray but weathers to bright hues of yellow, red, and white. The member is about 700 feet thick in Logan County (Moore and others, 1951, p. 24) and is exposed along most of the major streams and their tributaries in the Ladder Creek area.

The following section measured by A. R. Leonard and K. L. Parish in Logan County is typical of this member in the Ladder Creek area.

* The geologic classification and nomenclature of this report follow the usage of the State Geological Survey of Kansas and differ somewhat from those used by the U. S. Geological Survey.

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TABLE 2.—*Generalized section of geologic formations in Ladder Creek area*

System	Series	Formation	Thickness, feet	Physical Character	Water Supply
Quaternary	Pleistocene	Alluvium	0–65	Gravel, sand, silt, and clay deposits in major stream valleys.	Yields small amounts of very hard water to wells in the area.
		— unconformity —			
		Dune sand	0–40	Well-sorted fine- to medium-grained eolian sand. Mantles small area on the valley sides and upland divides.	Probably does not supply water directly to wells, but is important as a catchment area for ground-water recharge to adjacent and underlying formations.
		— unconformity —			
		Sanborn and Meade formations, undifferentiated	0–150	Predominantly tan to brownish loess underlain by clay, silt, volcanic ash, and thick sand and gravel in buried valleys, terraces, and slope deposits.	Generally occurs above the water table and is relatively impermeable. Gravel terrace deposits yield small quantities of water to a few wells, and where thick, as in buried valleys, the formation is highly productive.
		— unconformity —			
Tertiary	Pliocene	Ogallala formation	0–250	Arkosic gravel, sand, and silt locally cemented with calcium carbonate to form resistant "mortar beds", massive to cross-bedded bentonitic clay, fresh-water limestone. Individual beds generally lenticular. Underlies most upland areas.	Yields moderate to abundant supplies of good-quality but hard water to most wells in the upland area. Constitutes the principal source for most of the irrigation wells in the area.
		— unconformity —			
Cretaceous	Gulfian	Pierre shale	0–600	Thin-bedded, fissile clayey shale, black to dark gray, weathering yellowish brown to gray; contains concretions of selenite, thin beds of bentonite, and local calcareous lenses. Marine fossils common.	Relatively impermeable; not known to yield water to wells in area.
		Niobrara formation: Smoky Hill chalk member	100–700	Interbedded soft chalk and chalky shale; thin local limestones, marine vertebrate and invertebrate fossils; gray, weathering to yellow and red, thick weatherd zone present near top in most places.	Yields small supplies of very hard water to a few wells in areas where younger, more permeable water-bearing rocks are absent.
		Niobrara formation: Fort Hays limestone member	50–60	Massive chalky limestone; thin shale partings and abundant invertebrate fossils. Not exposed in area.	Not known to yield water to wells in area.

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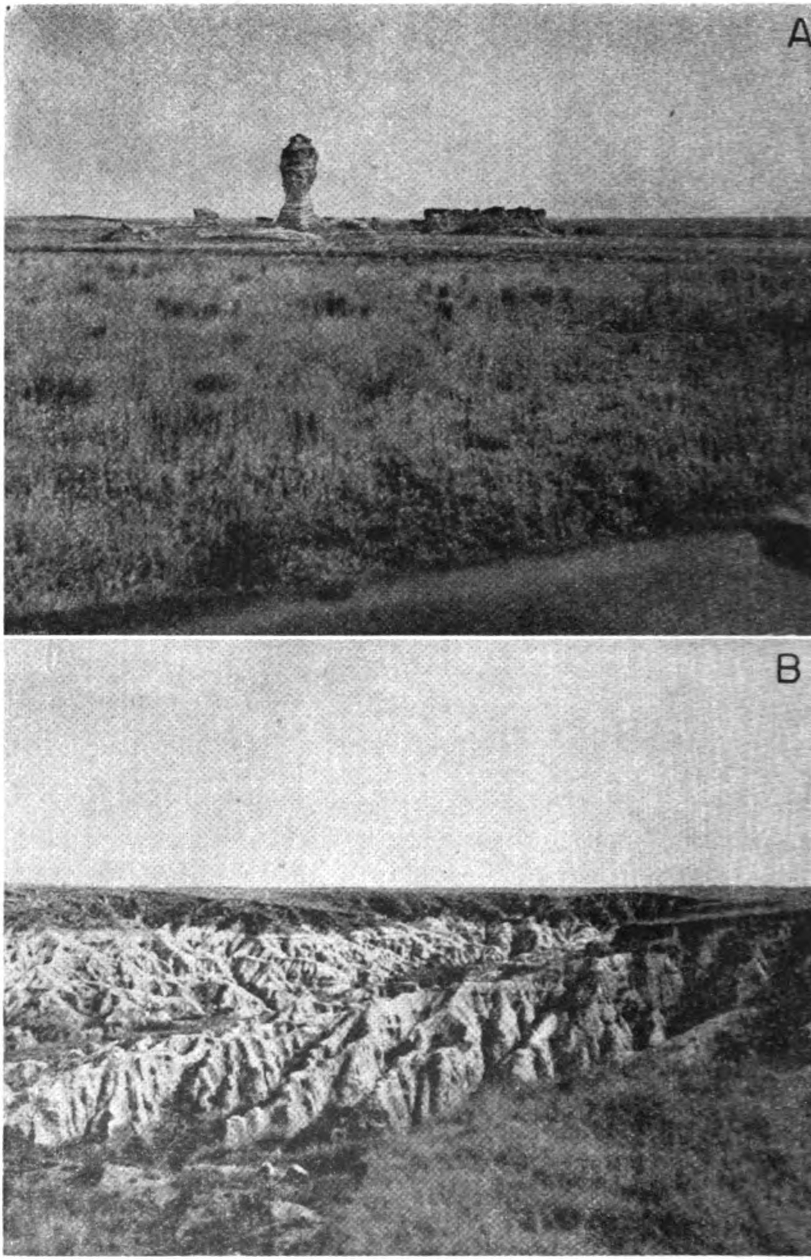

PLATE 6.—A, "Sphinx" in southwestern Gove County caused by differential erosion of the Smoky Hill chilk member of the Niobrara formation. **B**, Typical badlands topography on the Smoky Hill chalk member of the Niobrara formation in the western half of sec. 30, T. 15 S., R. 30 W., Gove County.

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Measured section of Smoky Hill chalk in sec. 17, T. 15 S., R. 34 W., Logan County.

	Thickness, feet
Covered slope containing fragments of chalk, some silicified, scattered in the soil	10.0
Chalk, slightly shaly in lower part, in thick beds weathering to a platy structure, orange to buff weathering buff to light gray. A thin bentonite parting occurs 10.6 feet above the base. Also local, thin red beds in lower part	16.5
Chalk, massive, blocky, orange to buff, containing a thin bentonite zone,	5.5
Bentonite, mottled gray to orange	0.3
Shale, chalky, thin bedded, soft, orange to buff, weathering to a platy structure somewhat lighter in hue	3.0
Chalk, in very thick massive beds having blocky, thin shale and bentonite partings; dense, resistant, contains some fossil oysters	9.0
Chalk, shaly, in beds 0.6 to 1.2 feet thick, orange to buff, weathering to soft slabs	6.8
Shale, chalky, thin bedded to massive, containing prominent local gypsum layers; light orange; differential weathering of the beds. Prominent vertical joints contain soft filling. Pelecypods and fish scales found in this zone	27.0
Chalk, shaly, contains abundant discoidal ferruginous concretions arranged in layers. Bedding planes and cracks filled with gypsum. This zone weathers light gray and buff, is thin bedded, and dissected by innumerable small fractures; some small carbonaceous seams. A dense, limy, more resistant zone 14 to 16 feet above base of section. Some bentonitic and limonitic zones and accompanying flat gypsum concretions. The chalk is softer, more massive, and less silty in the upper part and has prominent gypsum layers	58.0
Base of section is covered.	
Total section measured	136.1

From the eastern limit of the area to the eastern part of Wallace County, the Niobrara formation is exposed along the valley walls of Smoky Hill River and along the tributaries that intersect the steeper part of the bluffs of the main valley. In the western part of the area, near the town of Wallace, the Niobrara formation is overlain by the Pierre shale.

In upland areas the Niobrara formation is mantled by the Tertiary Ogallala formation and by loess of the Quaternary. In the stream valleys, channels cut into the formation are filled with alluvium and Sanborn and Meade deposits. In many places in the Smoky Hill River valley and in a few of its tributaries, broad graded surfaces slope up gently and uniformly from a low terrace, or some intermediate level, to the steep bluffs along the fringes of the upland. These surfaces are underlain by the Niobrara formation mantled by alluvial wash and locally by loess. Frye and Smith

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(1942) suggested that these surfaces originated from planation by small side streams, back-weathering of bluffs, rill cutting, and sheet wash.

The Smoky Hill chalk member of the Niobrara formation is not a major aquifer in the Ladder Creek area, but supplies water to a few wells in areas where no other water-bearing rocks are present except at great depth. The water is very hard, may be unpalatable, and only meager supplies are obtained. No irrigation or municipal supplies are derived from this chalk. The Niobrara formation is an effective aquiclude, confining most of the ground water to permeable materials overlying it.

The Smoky Hill chalk member contributes some ground water to the alluvium and streams of valleys incised into it, but the water is strongly mineralized. For this reason, water for household use on many farmsteads in these valleys must be hauled from other areas. The water derived indirectly from the Smoky Hill chalk member is used only for livestock.

Pierre Shale

The Pierre shale is a dark-gray fissile shale interbedded with bentonite, limonite, gypsum, and lenticular limestone and contains numerous septarian concretions (Pl. 7). A part of the stratigraphic section was studied and measured by C. R. Johnson and N. W. Biegler a few miles south of Wallace, Kansas.

Measured section of Pierre shale in sec. 7, T.14 S., R. 38 W., Wallace County.

	Thickness, feet
Base of Ogallala formation	
Shale, yellow and brown mottled, limestone concretions near contact; fish scales interspersed	10.5
Shale, gray and fissile, having white, powdery material in fractures. Weathers to a lighter gray	11.6
Shale, gray and brown, fissile, containing lenticular silty limestone concretions as much as 7 inches in diameter	1.0
Shale, fissile, blue gray	6.5
Bentonite, having yellow limonitic shale partings	0.5
Shale, blue gray, containing lenticular limestone bodies as much as ½ foot thick and 6 feet long	3.5
Shale, blue gray and fissile, containing abundant bentonite stringers. A limonitic, resistant persistent bed ½ inch thick lies at base	10.2
Shale, brown, limonite; containing many limy concretions as much as 3 inches in diameter	0.6
Shale, blue gray, weathering yellow brown and earthy, fissile; bentonite stringers as much as ½ inch thick are common; contains fish scales. Gypsum crystals in platy aggregates are numerous	29.0
Total section measured	73.4

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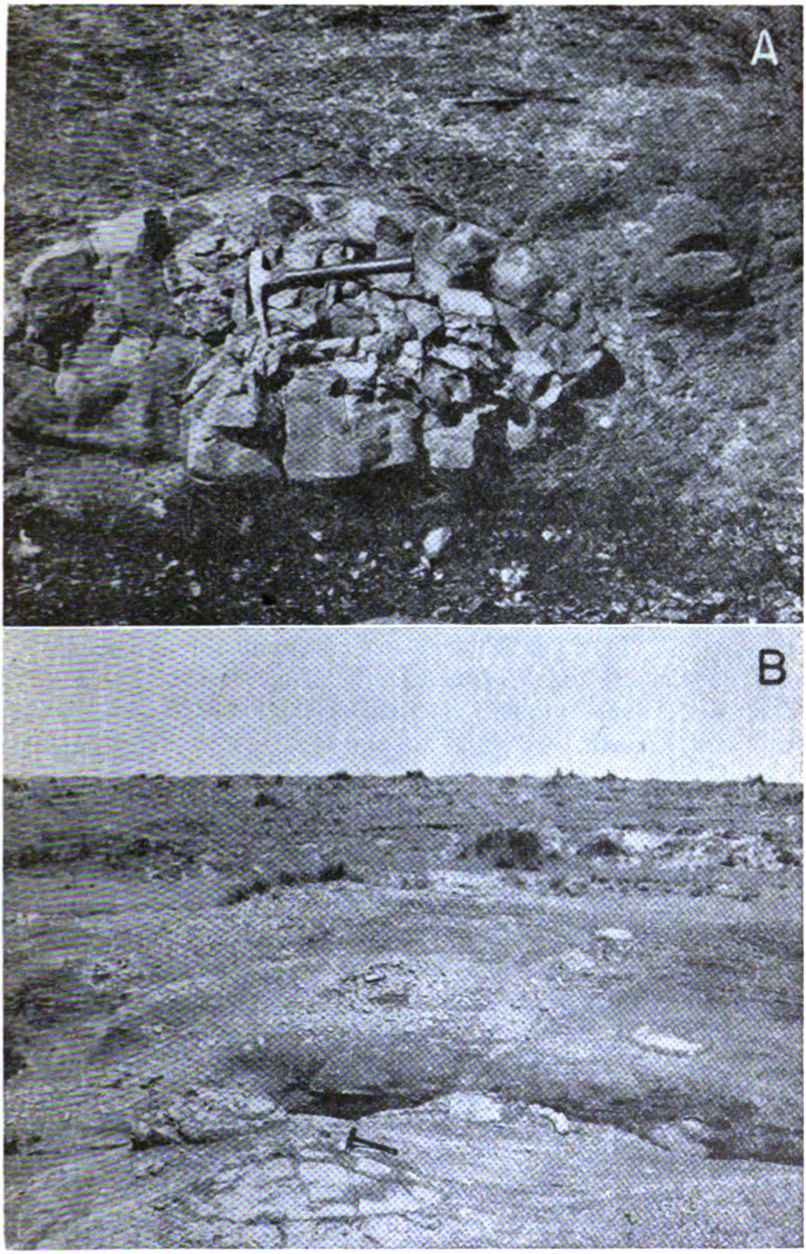

PLATE 7.—A, Septarian concretion in the Pierre shale in the SE¼ NW¼ sec. 36, T. 13 S., R. 40 W. B, Exposure of Pierre shale in Wallace County, showing weathering of the septarian concretions from the enclosing shale.

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The above section probably is comparable to the middle part of the Pierre shale described by Elias (1931).

The Pierre shale crops out in Wallace County and western Logan County where the Ogallala formation has been removed by erosion. In eastern Logan County there are isolated outcrops where the Cretaceous rocks have been faulted. Low rolling slopes are developed on exposures of the Pierre shale.

The thick Pierre shale is not a source of ground water for wells in the area. The formation serves as an aquiclude, confining the ground water to the formations above it.

Tertiary System—Pliocene Series

Ogallala Formation

The deposition during the Cretaceous was followed by uplift and erosion during the earlier epochs of the Tertiary. Many of the marine deposits of the earlier period were stripped off by erosion, and by the beginning of Pliocene time a drainage pattern was well developed on the Cretaceous rocks. The main channels of this drainage system enter the area as two branches that join approximately 8 miles southwest of Sharon Springs in Wallace County (Pl. 1). This channel extends southeastward across the rest of Wallace and Wichita Counties, and then eastward across Scott and Lane Counties. The channel is joined by still another tributary channel trending eastward across northern Greeley County.

The Ogallala formation (Pl. 8A) was laid down as the heterogeneous deposits of streams following these channels and consists of gravel, sand, silt, clay, and a durable fresh-water limestone. The stratification is lenticular, and individual beds are difficult to trace lithologically. Many of the sand and gravel beds, especially in the lower part, are unconsolidated. Typical of the formation are the beds referred to by drillers as "mortar beds", "caliche", and "gyp-rock", which are silt, sand, gravel, and cobbles poorly sorted and weakly cemented with calcium carbonate. A zone of limy material near the top of the formation contains siliceous concretions or nodules. In places the cement binds a large part of the zone, making a very weather-resistant bed. At the top of the formation a hard fresh-water "algal" limestone has been deposited. The following section measured by C. R. Johnson and N. W. Biegler in Wallace County is typical.

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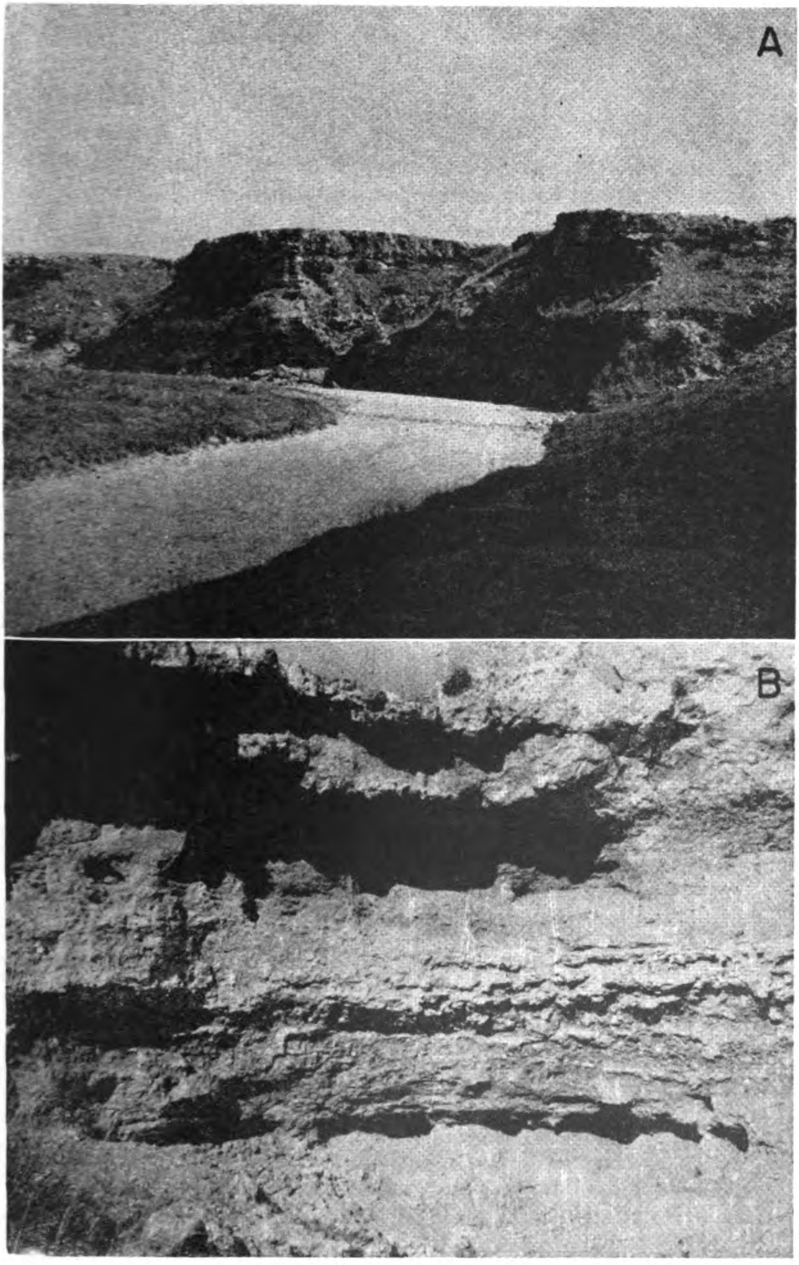

Plate 8.—A, Typical bluffs of the Ogallala formation along Ladder Creek near the Wallace-Greeley County line in sec. 36, T. 15 S., R. 39 W.; view facing southeast. **B,** Exposure of Ogallala formation in cliff.

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Measured section of the Ogallala formation in sec. 7, T. 14 S., R. 38 W., Wallace County.

	Thickness, feet
Soil zone	0.7
Silt and brownish sand, containing limestone fragments	1.0
Ogallala formation	
Algal limestone, *Chlorellopsis bradleyi*, pink to white, weathering to large cobbles and boulders, hard and resistant	2.0
Limestone, dense, hard, gray to white, contains many siliceous concretions and pieces of agate; whorls and knobs are typical of the structure of the limestone; some small quartz and feldspar pebbles; some lenticular bodies of siliceous material as much as 6 feet in length, weathering into blocks. Entire zone forms a prominent ridge	23.2
Sand, fine to coarse, cementation varying laterally from none to fairly dense; round, sandy unconsolidated bodies surrounded by well cemented rock; virtually no sorting or bedding; general color of this zone is reddish buff, light in hue, becoming more red at top. Fossil roots are very abundant, and hackberry seeds are found 3 feet above base of zone	18.5
Gravel, coarse, and sand, well cemented, gray, containing large bodies of uncemented material; poorly sorted and showing extreme local variation both laterally and vertically; large tubular concretions common	9.3
Sand, medium to fine, silty, red to reddish brown; contains undulate masses of white limy material that in places constitute more than half of the zone and incorporate disseminated sand and fine gravel; some interbedded cemented sands. Fossil roots are common	4.0
Limestone conglomerate, dense, and sand, gravel, and cobbles dispersed through a light-colored matrix. The pebbles are quartz and feldspar, and both acidic and basic igneous rocks, all well rounded. Most of these pebbles are less than ½ inch in diameter, but some attain a size of 3 inches. There is very little sorting except for faint cross-bedding. The exposure is resistant, weathering to a vesicular texture and a buff color	11.6
Siltstone, massive, forms prominent ledge, contains spherical masses of gravel, lenses of silt, clay, and sand, and fossil roots	2.9
Clays, interbedded, and unconsolidated sands. Some of the sands are limonitic and very well sorted; some massive siltstones contain clayey masses	2.7
Sand, cemented, and fine gravel in lumpy, nodular masses; contains much unconsolidated fine sand	2.9
Sand, and some gravel, containing silt and clay, in massive beds, poorly cemented and sorted, and nodules or lumps of fine material. In a few places black sand and coarse gravel lenses and zones of cross-bedding and dense cementation, some limestone nodules and tubular concretions. A complete skeleton of a horse was collected approximately 12 feet above base of section. Zones of abundant fossil fruits about the size of hazel nuts. This part of the exposure is light tan to grayish pink	26.7
Pierre shale	84.6
Total section measured	190.1

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The thickness of the formation differs from place to place because of the irregularity of the underlying Cretaceous surface and the erosion of the upper part of the Ogallala during the Pleistocene epoch. The maximum thickness of the Ogallala in the Ladder Creek area is about 250 feet, noted near the Colorado-Kansas line.

The Ogallala formation is the principal aquifer in the area. The selection of location of wells from which high yields are required, such as irrigation and municipal wells, generally is preceded by extensive test drilling to determine the most permeable parts of the aquifer and the greatest thickness of water-bearing materials.

Quaternary System—Pleistocene Series

Sanborn and Meade Formations Undifferentiated

During early Pleistocene time, a new drainage system developed on the surface of the Tertiary deposits. This Pleistocene drainage did not reach the same stage of maturity as the Tertiary drainage on the Cretaceous sediments. Even though many of these valleys cut entirely through the Tertiary deposits and are partly cut into the underlying chalk and shale, the interstream areas are only partly dissected and poorly drained. Most of the present drainage is inherited from this earlier Pleistocene drainage, the present valleys following the valleys initially incised by earlier streams. An exception is a deep valley trending southward through Scott City, which was cut by a Pleistocene stream but now is almost filled by fluviatile deposits and no longer contains a stream. This valley was filled during the same depositional cycle as that in which the other valleys existent at the time were partly filled. As the streams in these valleys cut down, materials laid down during earlier depositional cycles were left high on the valley walls as terraces and fillings of earlier channels. This cycle of downcutting was followed by eolian deposition of silt that mantled the entire area.

The Pleistocene deposits of the Ladder Creek area include two formations, the Meade and the Sanborn. The Meade formation is divided into an upper eolian unit of sandy silt and clay containing a persistent volcanic ash bed and lower unit of sand and gravel. The Sanborn formation overlies the Meade formation and consists of yellowish-gray loess containing sand and gravel at the base in some areas. Both formations are generally unconsolidated. The maximum combined thickness is 150 feet, noted in the buried valley north of Scott City. In this report the Sanborn and Meade formations are not differentiated, and inasmuch as the Meade is generally covered in the Ladder Creek area, it is not distinguished on the geologic map, Plate 1.

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Ground-water supplies are generally available from the Meade and Sanborn formations where sufficient saturated thickness of permeable material is present. Irrigation wells of large yield have been developed in them in the terraces of Smoky Hill River and in the large buried channel in Scott County. The Meade and Sanborn formations probably are generally more permeable than the Ogallala formation, but are thinner and of smaller areal extent. They rank second to the Ogallala formation as a source of ground water in the area.

The silty upland mantle of loess does not contribute water to wells, but the manner of deposition by wind action has created a poorly drained topography marked by many shallow depressions. These depressions collect water during heavy precipitation and may thus transmit considerable recharge to the underlying Ogallala formation in the Ladder Creek area.

Dune Sand

Dune sand and some associated silt have been derived by wind action from sandy parts of the upland Pleistocene deposits, especially where these deposits have been partly dissected by small upland ephemeral streams. Where vegetation is thin or where precipitation is not sufficient to support a grassy turf, the material is shifted by wind into new dunes.

Sand-dune areas are most prevalent in Greeley and Wallace Counties. Although small in extent, they form excellent recharge areas for underlying aquifers because of their high permeability and poor surface drainage. They lie above the zone of saturation, however, and therefore are not a source of water for wells in the area.

Alluvium

The main streams at one time cut channels into the bedrock, and in them have subsequently been deposited thick beds of fluviatile material to form the present valleys. These deposits include sand, gravel, silt, and clay, and they are generally unconsolidated, although some slight compaction has occurred in the deeper parts. Because of the nature of stream deposition, the constituent materials have been roughly sorted into discontinuous lenses or cross-bedded irregular masses of small extent. Generally the coarser gravels lie on the bedrock floors of the valleys. In places these gravels are extremely calcareous and become firmly cemented when dry. Thick beds of clay interbedded with sand are common beneath the floodplains, whereas thick beds of sand and gravel are generally present beneath the stream channels.

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Most of the sand and gravel in the alluvium is derived from the Ogallala formation or from Pleistocene deposits partly composed of reworked Ogallala. Fragments from the Niobrara formation, ranging from clay to large boulders, are common in the alluvium of valleys cut into the Niobrara formation, however. Septarian concretions found in the alluvium are derived from the Pierre shale. Fine clay in the alluvial material also may be derived from the Pierre.

The alluvium is an important aquifer in the Ladder Creek area. It fills valleys cut into the Ogallala formation, and the two formations are in hydraulic contact over wide areas. The alluvium lying between a stream and the Ogallala permits water from the Ogallala formation to discharge through the alluvium into the stream; conversely, when the stream is flooding in normally dry areas, the Ogallala formation is recharged from the stream by way of the alluvium. Thus, the alluvium serves as a conduit or medium for ground-water flow between the Ogallala formation and streams.

SURFACE WATER

Lakes

The many small lakes present in the area are formed by accumulation of precipitation in shallow depressions on the loess plains and by artificial impounding of streams.

Along the lower reaches of Ladder Creek three lakes are formed by dams built across the stream. The largest of these, Lake McBride, provides recreational facilities in the Scott County State Park (Pl. 9A). The stream is dammed in the NW¼ SW¼ sec. 1, T. 16 S., R. 33 W., and the lake extends about 2 miles upstream from this point. The part of the valley that the lake occupies is deep and has steep, rocky walls. Chalk of the Niobrara formation forms the valley floor, and the overlying Ogallala formation forms the walls. The lake is sustained partly by the flow of springs emanating from the valley walls near the contact of the Ogallala and Niobrara formations and partly by small spring-fed streams. The Upper and Lower Christy Lakes, a short distance upstream from Lake McBride, are privately owned and are smaller than Lake McBride.

The small lakes (Pl. 9B) on the loess plains are locally referred to as lagoons and, less commonly, as buffalo wallows. Surrounding each lagoon are wide turf-covered slopes gently inclined toward the lagoon but breaking into a short steep slope at the very edge of the lagoon.

The lagoons range in area from about 1 acre to 300 acres, and the gentle slopes adjacent to the lagoons cover considerably larger areas.

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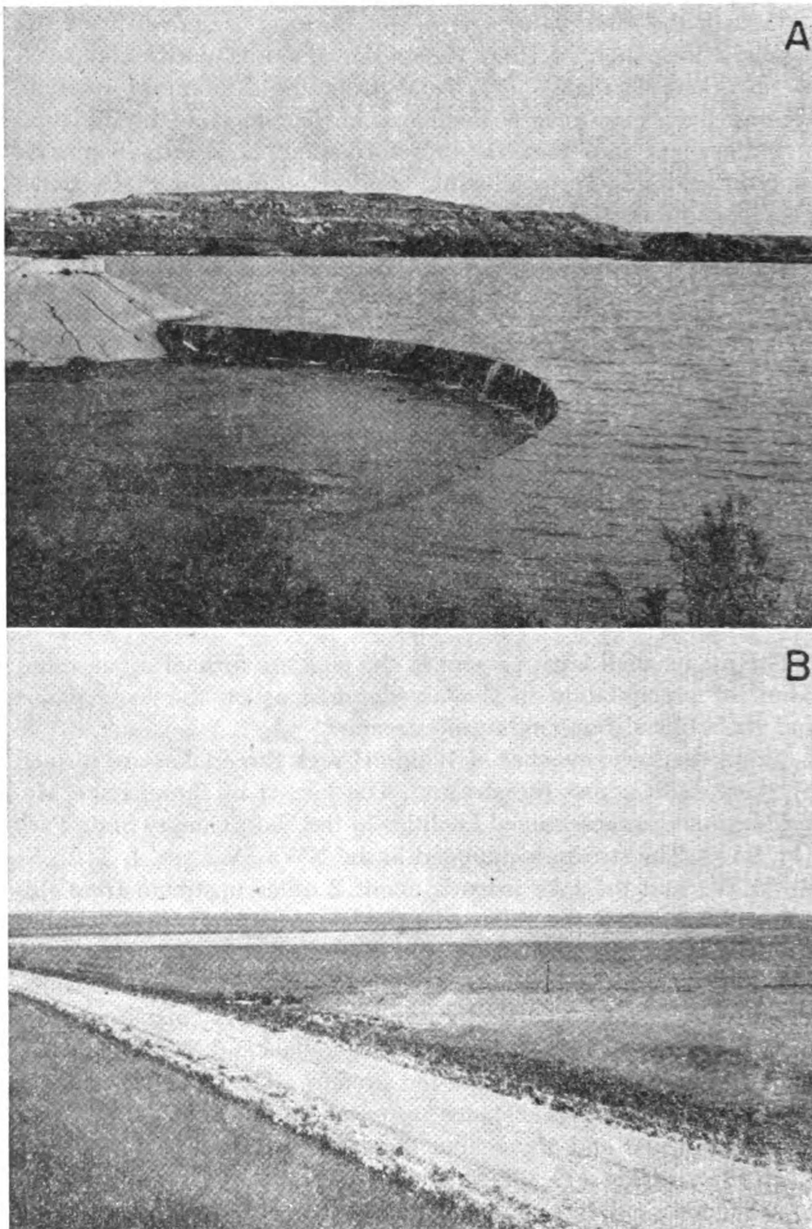

PLATE 9.—**A,** Lake McBride, Scott County State Park. View looking southeast from the spillway on the dam on Ladder Creek. Ogallala formation is in the background. **B,** Water-filled depression or "lagoon" in eastern part of sec. 8, T. 17 S., R. 32 W. Photographed June 1952; water stood several feet higher during most of 1951.

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In places small gullies have formed on these slopes, but erosion is not marked. Road ditches may carry water for several miles to some lagoons.

Streams

Twin Butte Creek

Twin Butte Creek heads in eastern Wallace County and flows eastward to join Ladder Creek in southeastern Logan County, a distance of 35 miles. The valley formed by Twin Butte Creek is deep and wide and is cut into the Cretaceous rocks along most of its length. Terraces are not well developed; pediment-like surfaces and buttes form the principal erosional features along this stream. Because very little of the land is level along its course, most of the valley is used for grazing. The water in the stream and in nearby wells is strongly mineralized and is used chiefly for livestock. Because the walls of the valley and the tributary draws are moderately steep, and the Cretaceous rocks are virtually impermeable, a large part of the precipitation in this valley runs off. Flood flows, therefore, are of short duration and large volume. Springs and seeps are common along the valley floor and walls, but few of these have been developed for water supplies, and most are merely seepage areas.

Following wet weather, Twin Butte Creek may discharge more than 1 cubic foot per second for several months, but the rate of discharge gradually diminishes until the flow almost ceases. During most of a year of high precipitation there is some discharge in the creek, but in dry years Twin Butte Creek flows only after heavy precipitation.

Chalk Creek

Chalk Creek heads in eastern Wallace County and flows roughly parallel to Twin Butte Creek along the Wichita-Logan County line. The stream is about 40 miles long, and the Chalk Creek valley resembles that of Twin Butte Creek. The stream flows over the Ogallala formation to a point about a mile west of the Scott County line, but downstream from that point the stream is incised into the Niobrara formation. The stream flow probably fluctuates with changes in ground-water levels, which regulate discharge of springs and seeps. Flood flows recharge the stream banks, especially in the area where the stream flows on the Ogallala formation. Such recharge is temporary, and the water is discharged back into the stream after flood runoff has passed.

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Hell Creek

Hell Creek begins in Scott County about 9 miles west of the Lane-Scott County line and 3 miles south of the Scott-Logan County line. The creek flows into Smoky Hill River 3 miles north of the Gove-Lane County line and 5 miles east of the Gove-Logan County line. The stream has cut a youthful valley in Cretaceous rocks. The valley walls are capped by the Ogallala formation and Pleistocene deposits. Springs maintain a base flow of 1 to 2 cfs in Hell Creek, but during the summer months high evapotranspiration may dissipate this discharge completely in many stretches.

Ladder Creek

Ladder Creek (Pl. 10) heads about 25 miles west of the Colorado-Kansas line, flows southeastward across Wallace County and western Wichita County, thence eastward across eastern Wichita County and western Scott County. Near the midline of Scott County the stream bends northward and flows due north into Logan County and then northeastward to its junction with Smoky Hill River. The stream flows a distance of 100 miles from the head of its longest tributary, North Fork, to Smoky Hill River. South Fork rises a short distance inside Colorado and flows eastward to the Wichita-Greeley County line, where it joins North Fork. An unnamed tributary heads in northwestern Greeley County and joins the main stream 6 miles east of the western border of Wichita County. Sand Creek joins Ladder Creek 6 miles west of the eastern border of Wichita County, after flowing in a southeastward direction from southeastern Wallace County. Twin Butte and Chalk Creeks join Ladder Creek a few miles upstream from its confluence with Smoky Hill River. North and South Forks of Ladder Creek are ephemeral and influent, but downstream a short distance from their junction Ladder Creek is an effluent stream except during extremely dry summers, when evapotranspiration is great enough to intercept any ground-water flow into the stream. Even after a succession of years of abnormally low precipitation, the stream flows during the winter months. The stream is usually dry upstream from the point of effluence except in seasons of heavy rainfall when runoff sustains flow. Twin Butte and Chalk Creeks are the only effluent streams that flow into Ladder Creek.

The greatest percentage of flow in wet seasons is provided by surface runoff from seasonal precipitation, which produces a large volume of discharge for a few days. This is illustrated by Figure 5,

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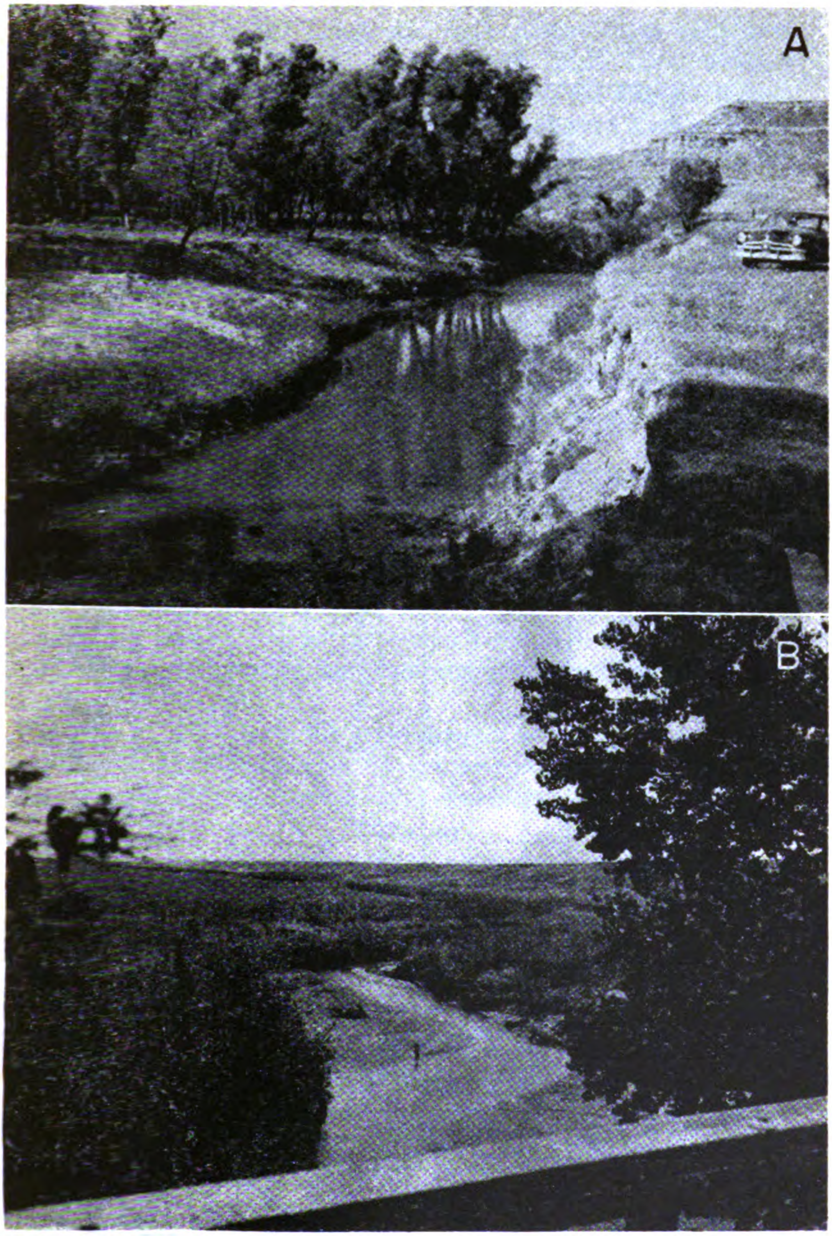

Plate 10.—A, View looking south at stream-gaging site L-7 north of Lake McBride on Ladder Creek, June 1952. **B,** View looking southeast downstream on Ladder Creek in western Wichita County.

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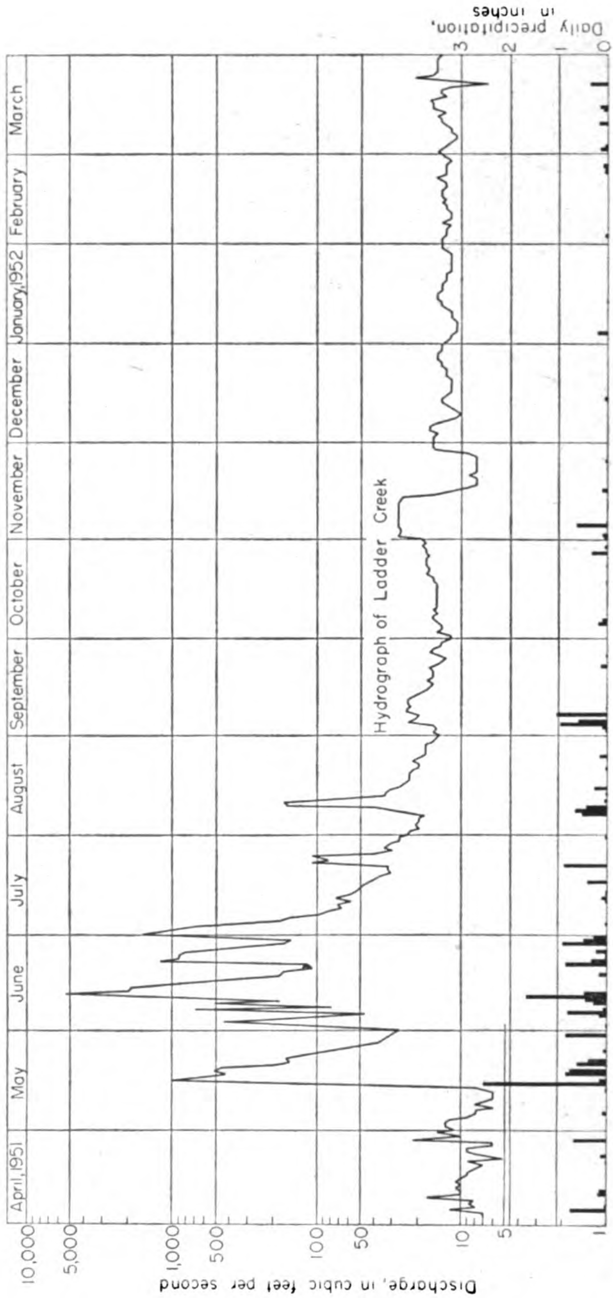

Fig. 5.—Hydrograph of discharge of Ladder Creek near Elkader compared with daily precipitation at Leoti for the period April 1951 to April 1952.

a hydrograph of Ladder Creek discharge plotted with daily precipitation at Leoti from April 1951 to April 1952. Leoti weather station has continuous records and is closest to the effluent section of Ladder Creek. The lakes in the lower reaches of Ladder Creek impound large quantities of runoff and release it slowly to the stream below the Lake McBride dam. Discharge into the stream from springs and seeps maintains the base flow. Springs are numerous in the Lake McBride area along the contact of the permeable Ogallala and the underlying Cretaceous rock where exposed in the hillsides. Some of these springs have been developed as sources of potable water.

Flow in Ladder Creek is maintained principally by ground-water discharge, although flooding from melting snow and ice and heavy seasonal rains increases stream flow periodically.

During the fall and winter, the discharge of Ladder Creek is fairly constant except when affected by freezing and thawing. A low winter flow results from a low stage of the water table; similarly, a high winter flow is dependent on a high stage of the water table. Very little water is consumed by evapotranspiration before reaching the stream, nor is there much runoff from precipitation during the winter; consequently the daily discharge of the stream remains fairly constant.

The gain of water from the ground-water reservoir is not uniform along the length of the stream. For this reason, Ladder Creek was gaged at eight sites to determine the distribution of flow. The sites

TABLE 3.—*Discharge measurements at stations on Ladder Creek, in cubic feet per second.*

Date	Station							
	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8
May 3, 1951	....	....	....	....	....	....	12.9	....
May 28-29	....	....	10.1	14.5	14.9	16.3	20.7	33.4
July 24	....	....	....	....	22.8	32.0	....	153.8
July 31	2.0	9.5	11.3	22.0	26.0	23.3	28.5	32.5
Nov. 19-20	1.4	2.6	6.3	9.1	10.0	12.6	.2*d*	4.1
Jan. 9-10, 1952*a*	1.3	3.0	6.4	7.1	7.0	11.6	13.0	10.0
Feb. 5*b*	....	....	....	7.9	8.3	7.2	8.7	14.2
Feb. 6-8*c*	1.0	1.7	4.5	6.6	7.6	8.9	....	....
Feb. 20	....	....	....	....	....	....	12.8	27.4
Mar. 18-19*c*	....	....	....	....	7.8	....	13.4	14.8

a. Measurements affected by freezing.
b. Measurements affected by high winds.
c. Because of prior weather conditions, the streamflow on these dates probably was derived from ground water.
d. No water flowing over Lake McBride dam because of previous artificial lowering of the lake level.

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are designated by the letter L and a numeral indicating its position in the series, L-1 being the site nearest the point of effluence and L-8 the site nearest the confluence of Ladder Creek and Smoky Hill River. The sites are not distributed uniformly along the length of the stream, but were established where the hydraulic characteristics of the stream change and where the stream was easily accessible by road. The locations of the gaging sites are shown on Plate 2. Table 3 contains the measured discharges of Ladder Creek in cubic feet per second at the various sites along its length.

Smoky Hill River

Smoky Hill River heads in Colorado and flows into the Ladder Creek area as it crosses the Kansas-Colorado border. In Kansas it flows eastward through Wallace, Logan, and Gove Counties. Terraces and pediments border the valley, and the flood plain is narrow. The stream has a braided channel filled with coarse sand, which meanders in a narrow zone in the central part of the valley. The channel is cut into Cretaceous rocks and filled with Pleistocene alluvial deposits. During winter, Smoky Hill River flows below its junction with Rose Creek south of Wallace in Wallace County, and during wet years, above the junction. During the summer, the river is generally dry above Ladder Creek because of evapotranspiration, although Rose Creek flows even during very dry summers.

The large volume of water that flows down this valley during floods inundates only the narrow flood plain. These floods are usually the cumulative result of floods of several tributaries, because a flood on any single tributary would result only in a high level of flow in the main channel. Probably a greater percentage of precipitation on the shorter tributaries becomes runoff because they head in bluffs of impervious Cretaceous rocks. Streams on the upland plains have lower gradients and mature valleys, and part of their flood runoff becomes ground water. A few depression springs and seeps from the Cretaceous rocks discharge a small quantity of ground water into the short tributaries.

Because the valley walls are generally impervious, little ground water is contributed directly to Smoky Hill River. Indirectly, however, all the ground water discharged into streams in the Ladder Creek area joins Smoky Hill River and flows from the area at the eastern boundary.

In the reaches of effluent flow there is little influent seepage from the stream other than the temporary storage of water in its banks. West of this area, however, the stream bed is dry most of the year,

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and any water flowing over this part recharges the ground-water supply in the permeable alluvium.

During the summer months, transpiration by vegetation growing in the flood plain dries up the stream over much of its length. For example, the gage on Rose Creek often records flow when the gage at Elkader shows none.

The flow of Smoky Hill River is not directly diverted at present (1952), but surface diversions from Rose Creek and future reduction of the ground-water discharge from the Ladder Creek area may substantially reduce the discharge of Smoky Hill River at Kansas highway 23.

Rose Creek

Rose Creek heads about 5 miles south of Sharon Springs in Wallace County and flows 8 miles to its junction with Smoky Hill River about 6 miles east of Sharon Springs. Rose Creek is a spring-fed stream and usually flows even in the driest summers.

Downstream from Rose Creek, Smoky Hill River flows continuously except occasionally in the summer months when the flow from Rose Creek is lost in the Smoky Hill River channel by evapotranspiration. An undetermined quantity of water is diverted from Rose Creek for irrigation.

Salt Creek

Salt Creek flows northward for about 10 miles from its point of origin 3 miles east of Healy in Lane County to its junction with Smoky Hill River. The regimen of this stream is similar to that of Hell Creek. Springs at the base of the Ogallala formation maintain a base flow not exceeding 1 cfs.

GROUND WATER

Aquifer Tests

The permeability of water-bearing materials can be determined by laboratory methods (summarized by V. C. Fishel in Wenzel, 1942, p. 56-58) or in the field using the formula developed by Theis (1935) and later described by Wenzel (1942, p. 94-96). From the final equation expressing the relation between the drawdown and the rate and duration of the discharge of a well completely penetrating a homogeneous, isotropic aquifer of infinite areal extent, Cooper and Jacob (1946) developed the following formula, converted to gallon-foot-day units:

$$T = \frac{264Q}{\Delta s} \log_{10} \frac{t_2}{t_1}$$

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where T is the transmissibility in gallons per day per foot; Q is the discharge of the well in gallons per minute; Δs is the change in drawdown in feet from time t_1 to t_2 expressed in minutes since pumping began.

The solution of the formula for T is facilitated by plotting on semilogarithmic paper the water-level measurements collected during the pumping period. The time of measurement is plotted on the logarithmic coordinate and the water level on the arithmetic coordinate. The points should plot as a straight line except for extremely small values of t. If $\log_{10} \frac{t_2}{t_1}$ is taken over one log cycle, the value of the logarithm becomes unity, and the value of Δs will be the difference in water level over one log cycle. The type-curve solution and the Theis recovery formula were used to check the results obtained by the preceding method.

Well 16-35-31da, an irrigation well in the Ogallala formation and owned by H. O. Burns, was pumped approximately 2,000 minutes beginning on August 23, 1952. During pumping and recovery periods, water levels in the pumped well were measured by an electric water-level gage. The measurements are given in Table 10. The rate of discharge as measured by a Collins flow gage averaged 810 gallons per minute. Maximum drawdown was 38.41 feet, and the specific capacity of the well was 22 gpm per foot of drawdown. A rate of 840 gpm was measured during the early part of the test and was used in computing the transmissibility from the graph (Fig. 6) because 840 gpm probably approximated the yield

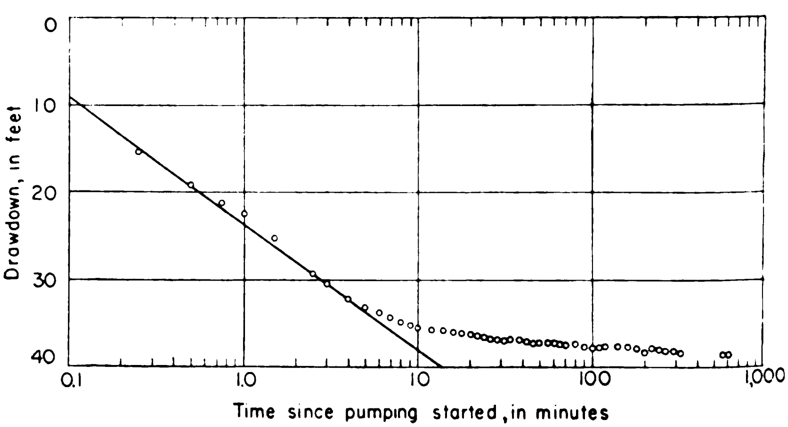

FIG. 6.—Graph of drawdown in well 16-35-31da owned by H. O. Burns.

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when the curve of water level versus time followed a straight line. The transmissibility was computed at about 15,000 gpd per foot.

Well 17-34-2dc, an irrigation well in the Ogallala formation and owned by C. W. Watkins, was pumped for about 30 hours beginning on October 8, 1951. Water levels in the well were measured during pumping and for 40 hours after pumping ceased. The measurements are tabulated in Table 13. The rate of discharge as measured by a Collins flow gage averaged 744 gpm, the maximum drawdown of water level was 19.15 feet, and the specific capacity of the well was about 39 gpm per foot of drawdown. The pumping rate during the period when the drawdown curve approximated a straight line was 762 gpm, and this yield was used in computing a transmissibility of about 40,000 gpd per foot from the plot of the

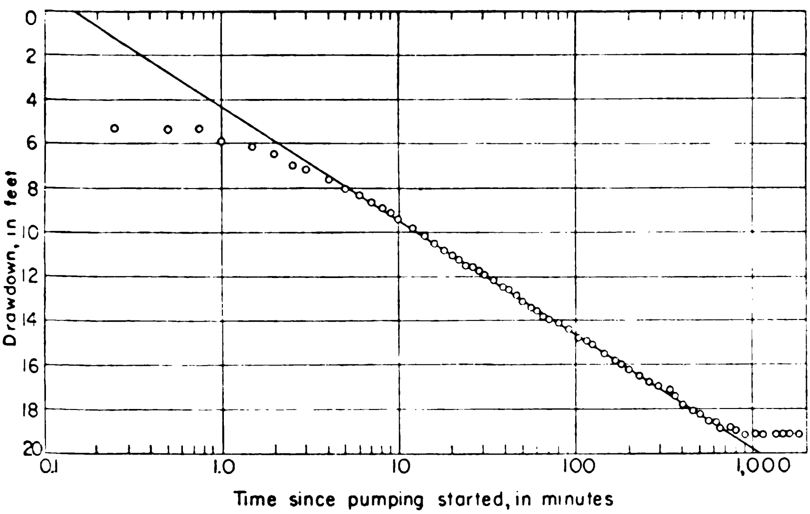

Fig. 7.—Graph of drawdown in well 17-34-2dc owned by C. W. Watkins.

drawdown data (Fig. 7). The plot obtained from the recovery data was not sufficiently near a straight line to permit use of the Theis recovery formula.

Well 18-32-7ac, an irrigation well in the Ogallala, Sanborn, and Meade formations and owned by S. W. Filson, was pumped for more than 27 hours beginning on August 28, 1951. Water levels in the pumped well were measured during the pumping period and for 15½ hours after pumping ceased. The measurements are given in Table 14. Discharge averaged 1,170 gpm as measured by a Col-

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lins flow gage, maximum drawdown was 23.71 feet, and specific capacity of the well was 49.4 gpm per foot of drawdown. Power failure stopped the pump for 40 minutes during the test, and an average discharge of 1,140 gpm, which takes into consideration the period of zero discharge, was used to compute the transmissibility. A transmissibility of about 130,000 gpd per foot was computed from

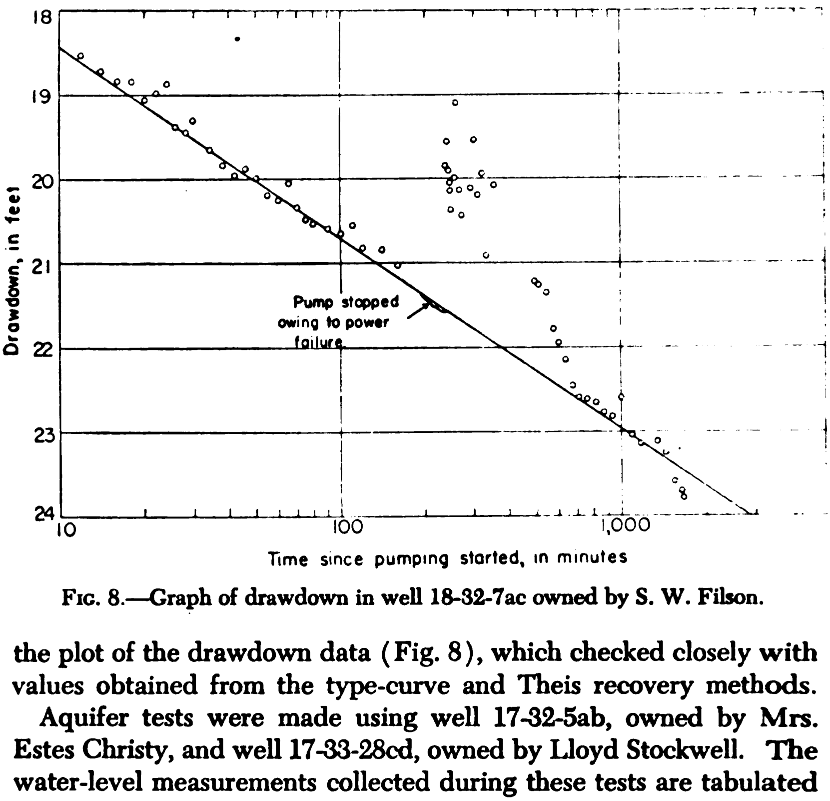

FIG. 8.—Graph of drawdown in well 18-32-7ac owned by S. W. Filson.

the plot of the drawdown data (Fig. 8), which checked closely with values obtained from the type-curve and Theis recovery methods.

Aquifer tests were made using well 17-32-5ab, owned by Mrs. Estes Christy, and well 17-33-28cd, owned by Lloyd Stockwell. The water-level measurements collected during these tests are tabulated in Tables 11 and 12. The values for transmissibility that were obtained could not be checked by another method; hence these two tests are not regarded as reliable.

Performance data for all the tests are summarized in Table 4. The transmissibility values for the Ogallala formation obtained from the two most reliable tests are 15,000 and 40,000 gpd per foot. The value for transmissibility for the combined Ogallala, Sanborn, and Meade formations is 130,000 gpd per foot.

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TABLE 4.—*Results of aquifer tests.*

WELL NUMBER	16-35-31da	17-32-5ab	17-33-28cd	17-34-2dc	18-32-7ac
Aquifer	Ogallala	Ogallala	Ogallala	Ogallala	Ogallala, Meade, and Sanborn
Drawdown at end of test (feet)	36.10	23.39	36.44	19.10	23.67
Average discharge (gpm)	810	450	775	744	1,170
Duration of pumping (minutes)	2,000 ±	1,480	660	1,805	1,651½
Specific capacity (gpm per foot of drawdown)	22.5	19.3	21.3	38.8	49.4
Transmissibility (gpd per foot)	15,000	....	....	40,000	130,000
Saturated thickness (feet)	102	100	100	90	165
Permeability (gpd per square foot)	150	....	....	440	800

DEPTH TO WATER

The measured depths to water range from slightly less than a foot to 246 feet (Pl. 2). The greatest depth to water is near the western edge of the area. The depth to water is generally less than 20 feet in the flood plains of the effluent streams and in the topographical depressions near Scott City. The water table is between 80 and 150 feet deep below most of the upland area and between 20 and 80 feet deep below the upland plain adjacent to effluent streams.

The depths to water in Chalk and Twin Butte Creek valleys and in the small tributary valleys of Smoky Hill River are 10 to 20 feet. In a few wells in southern Logan County, depth to water is less than 75 feet. In Ladder Creek valley westward from the Wichita-Greeley County line the depth to water is greater, reaching a maximum of 140 feet below the channel near the Colorado-Kansas border.

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Configuration of the Water Table and Movement of Ground Water

The configuration of the water table in the Ladder Creek area is shown in Plate 4 by means of contours referred to sea level. These contours are based on measurements of water levels in wells during the period May-August 1951. The configuration of the water table is determined chiefly by: (1) the shape of the underlying aquiclude; (2) local differences in permeability in the aquifer; (3) ground-water discharge into streams; (4) variations in the amount of recharge from precipitation that infiltrates through ephemeral stream valleys, depressions, and upland plains; and (5) discharge from wells.

The principal feature of the shape of the water table in the area is an eastward slope approximating the slope of the land surface and the buried surface of the Cretaceous rocks. The slope is about 10 feet per mile in western Wallace and Greeley Counties. From the middle of Greeley County east to the middle of Scott County the slope is nearly 13 feet per mile, and from here to the middle of Lane County, the slope is again 10 feet per mile.

Several unusual features contrast with the generally smooth easterly slope of the water table in the Ladder Creek area. One is an isolated water-table high, just east of the Lake McBride area, which is due to localized recharge from extensive upland plains that lack surface drainage. A second irregular feature is a general flattening of the water table in the vicinity of Scott City due to the presence of the permeable Pleistocene sand and gravel deposits. Another contributing factor may be a north-trending ridge on the Cretaceous surface, which may act as a barrier to the eastward movement of ground water.

In southwestern Wallace County, saturated materials are thin or absent, but not enough information is available to delineate the area accurately. The general shape and location are shown on Plate 5. Higher recharge from the present valley in the area probably is responsible for the presence of ground water in the vicinity of well 15-42-16ad.

In the western part of the Ladder Creek area the water-table contours are convex downstream at their crossing of certain minor upland drainage ways, indicating localized recharge in these areas. Examples are shown in T. 16 S., R. 40 W., and in T. 15 S., R. 39 and 40 W. (Pl. 4).

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The movement of water in the zone of saturation, or ground-water reservoir, is perpendicular to the contours drawn on the water table. Plate 4 shows that, except for local minor variations, ground water moves eastward in the Ladder Creek area. In areas adjacent to Ladder Creek in Wichita County, the water table slopes slightly to the northeast or southeast and contributes a small amount of water to Ladder Creek. In the western part of Scott County the water table slopes eastward at approximately the same gradient as Ladder Creek valley, and the gain in streamflow from ground water is negligible. Downstream from the point where the stream starts its northward path in the central part of Scott County, however, the ground-water contribution to the stream increases rapidly. In this section the stream flows below the level of the water table. The rate of movement of ground water in the Ogallala formation, estimated from data of the aquifer tests, probably ranges from about 40 to 400 feet per year.

In the Ladder Creek valley a fill of alluvial sand and gravel overlies the Ogallala formation. Although no test or quantitative data are available on the permeability of this sand and gravel, it is probably more permeable than the Ogallala materials. The test holes drilled in the Smoky Hill River valley penetrated large quantities of clean, coarse, saturated sand and gravel of relatively high permeability. Slichter (1905, p. 5) determined the average rate of movement of the underflow in similar deposits with similar water-table gradients in the Arkansas River valley to be 8 feet per day. By use of this figure for the velocity in the Smoky Hill River valley, the movement of water across section A-A′ (Fig. 9) is computed to be approximately 1 cfs. Less water moves across the sections near Elkader and Wallace (Fig. 9, sections B-B′ and C-C′).

Fluctuations of the Water Table

The water table fluctuates in response to recharge to or discharge from the ground-water body either by natural or by artificial means. Changes in atmospheric pressure also cause minor fluctuations in water level. In the Ladder Creek area typical long-term fluctuations in the water table are shown by the hydrographs of Figure 10. Well 18-33-12ad shows a gradual decline of water level from a depth of about 44.0 feet below the land surface in 1939 to 58.0 feet in 1949. After 1949 the water level rose sharply to a depth of 45.0 feet at the beginning of 1952. Well 18-33-12ad is an irrigation well, but it has not been pumped much in recent years. The water

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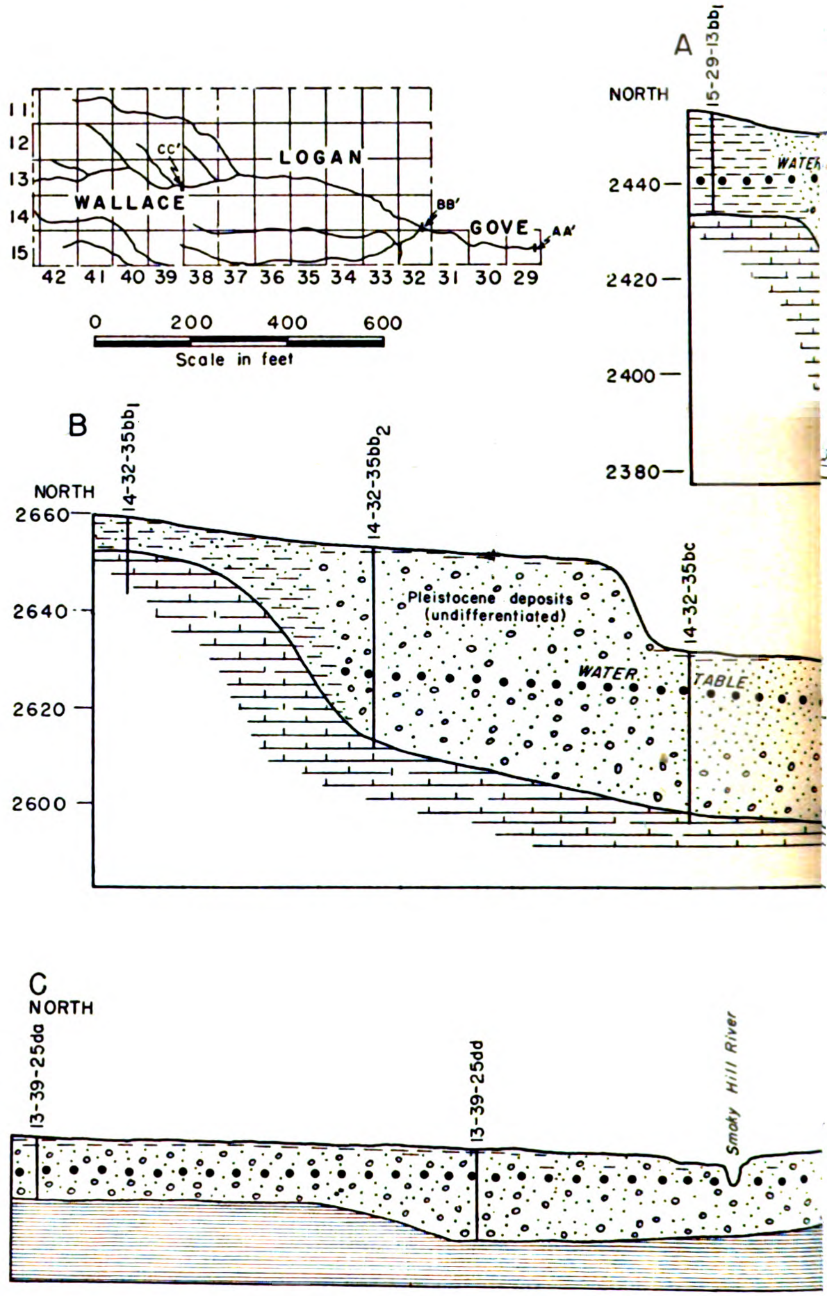

FIG. 9.—Geologic cross sectio

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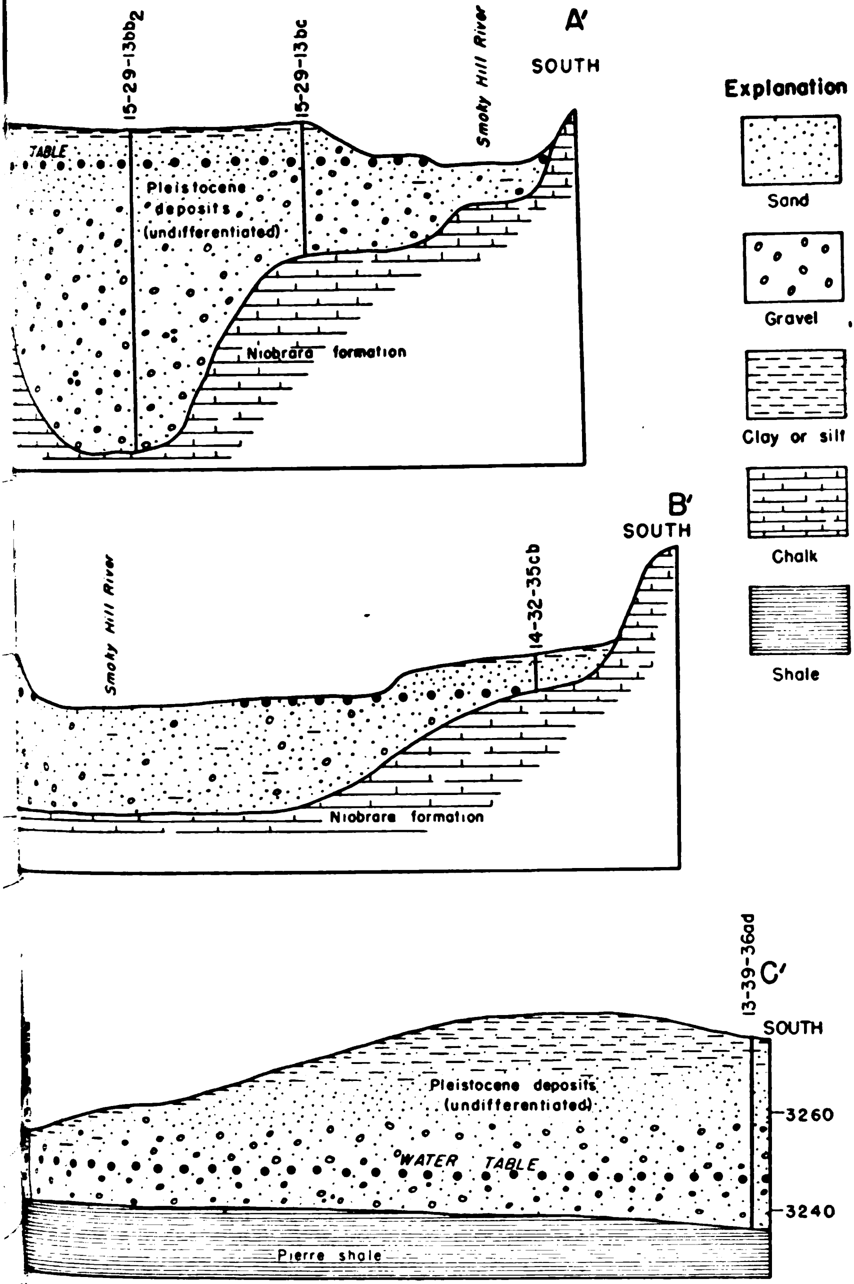

ross Smoky Hill River valley.

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level in this well is affected by pumping other nearby irrigation wells. In well 16-34-18dd the water level in 1951 was within 0.2 foot of the average water level for 1939, but records for most of the intervening period are lacking. This well is in an area of negligible pumpage for irrigation.

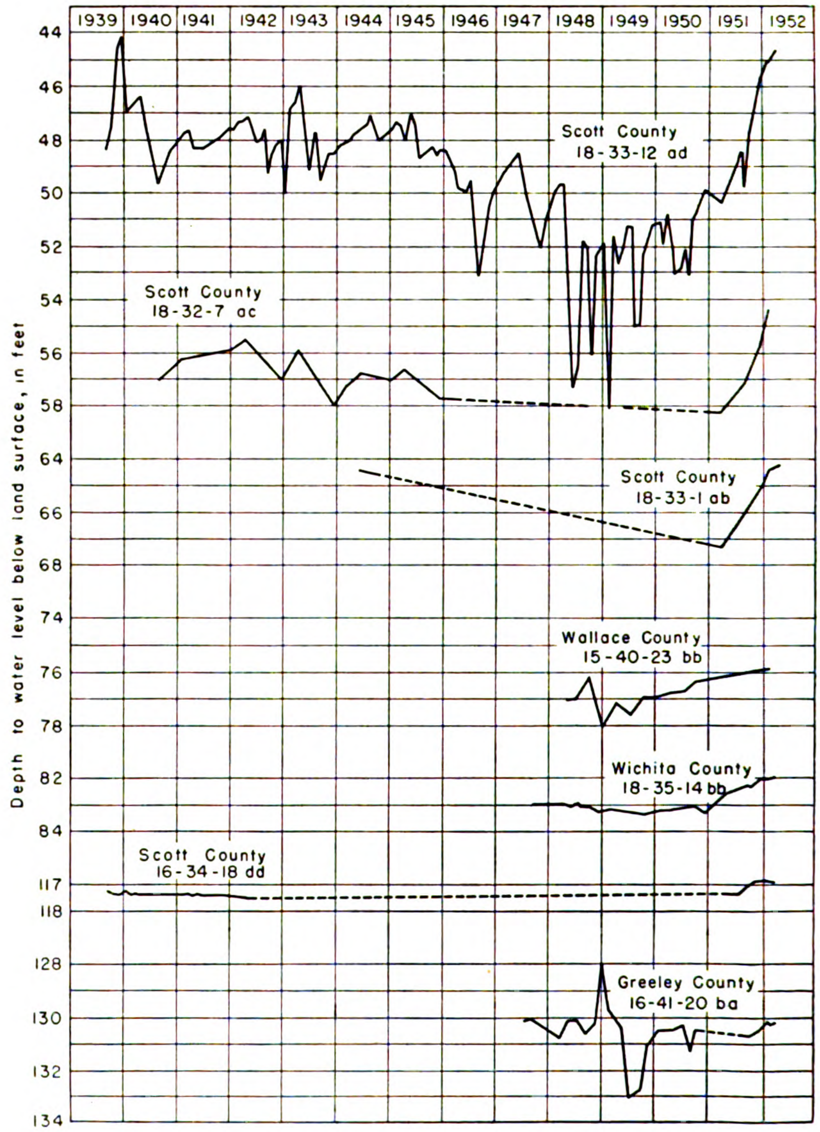

FIG. 10.—Hydrographs showing fluctuation of water levels in wells in the Ladder Creek area.

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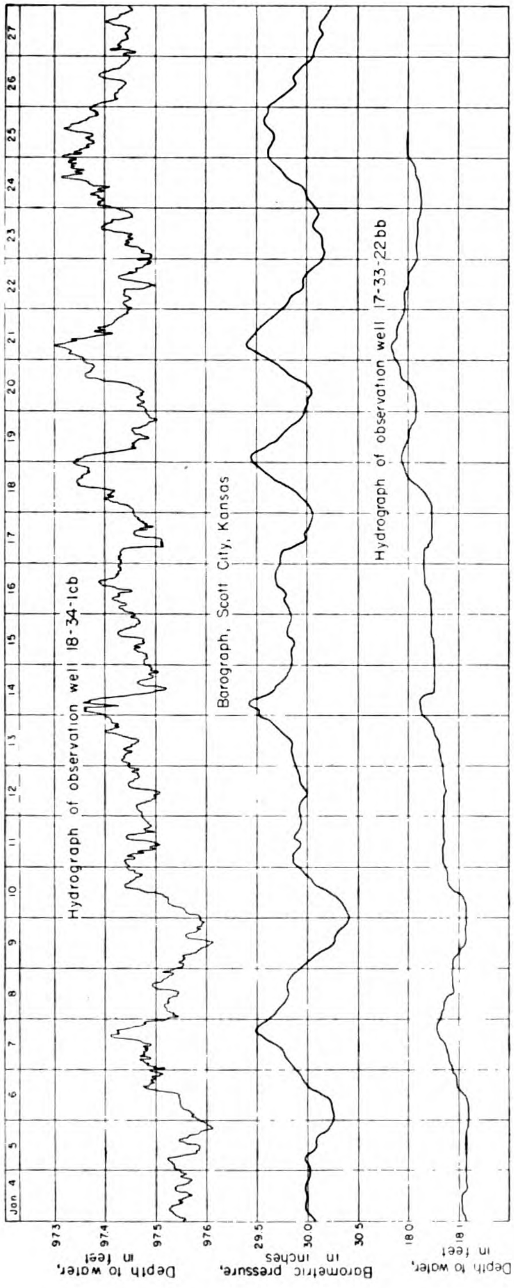

FIG. 11.—Comparison of water-level fluctuations with changes in barometric pressure from January 4 to 27, 1952.

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The water levels in most wells throughout the area were higher in 1952 than at any previous date of measurement, indicating that excessive precipitation in 1951 added more water to the ground-water reservoir than was discharged in the same period. Similarly, the gradual decline in well 18-33-12ad until 1949 represents a decrease in storage as a result of pumping for irrigation. A decline during this same period is evident in other wells near Scott City, where many irrigation wells have pumped water during part of the year.

Fluctuations in water level due to changes in atmospheric pressure are illustrated in Figure 11. Well 18-34-1cb² is an unused irrigation well having a depth to water of 97.5 feet and a total depth of 160.7 feet. The loess cover and adjacent impermeable beds in the Ogallala in the vicinity of this well form a reasonably effective confining layer virtually sealing the underlying aquifer. Changes in atmospheric pressure are exerted on the aquifer through the loess cover and impermeable beds in the Ogallala but are damped and are therefore less effective than the direct pressure changes applied to the water level in the open well casing. As a result, the water level in the well fluctuates as a partially effective barometer. The magnitude of this effect is appreciable in well 18-34-1cb², but in well 17-33-22bb, which is situated in Ladder Creek valley on a knoll of Ogallala materials that has no loess cover, the barometric effect is slight.

Recharge to Ground Water

Of the total precipitation that falls on the land surface, some is evaporated directly into the atmosphere, some is stored temporarily in the soil whence it subsequently evaporates and transpires, some runs off in surface streams, and some infiltrates to the zone of saturation and recharges the ground water.

In the Ladder Creek area, recharge results from infiltration into the aquifer in several different ways. Some water from precipitation percolates downward directly from the surface on which it falls. Some of the precipitation first collects in shallow undrained depressions and then percolates down to recharge ground water. Influent seepage from streamflow in the channels above the water table adds considerable recharge to ground water.

Infiltration acts under the force of gravity and molecular attraction. It is dependent upon the size and characteristics of soil particles and the duration and intensity of precipitation. Coarse-grained soils composed of sandy materials generally permit greater infiltration than fine-textured soils. Soils rich in organic content

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and uncultivated soils generally are favorable to infiltration. The rise in the water table due to recharge lags behind the rainfall because of the time required for the rainfall to infiltrate the soil and move downward to the water table. Recharge may occur upgradient on the water table from a well, and hence considerable time may be required for the recharge to affect the water level at the well.

In the uplands of the Ladder Creek area, runoff is low and water collects in the undrained depressions, from which some water evaporates and some infiltrates slowly into the underlying formations. On the upland surface, the depressions are the most favorable areas for recharge from infiltration and percolation. The central parts of the smaller depressions may be underlain by relatively impermeable compact soil and silt that permit little or no recharge by infiltration. In some ponds, the water may be completely evaporated. When heavy precipitation fills the depressions with water beyond the central silted area, however, recharge may be considerable. The larger depressions seem to admit water through seepage more readily than smaller ones. Probably much of the loess cover has been removed by erosion from the large depressions, and water infiltrating down has a more direct connection with permeable materials below. Evidence of recharge from depressional areas is demonstrated in the hydrograph of well 18-33-12ad (Fig. 10), which is situated in such an area.

A discussion of recharge in depressions in Scott County was previously presented by Waite (1947, p. 70-72). He referred to the work of White, Broadhurst, and Lang (1940), who made a study of similar depressions on the High Plains in Texas. From study of several hundred test holes in these depressions, White, Broadhurst, and Lang (1940, p. 7) found the following conditions:

> . . . The bottom of most of the depressions is covered with deposits of silt and soil, in places resembling gumbo and ranging from 2 to 10 feet in thickness. After the ponds become dry, fractures and crevices several feet in depth frequently develop in their beds. In some of the depressions small sinks, apparently developed by solution channelling in the underlying caliche deposits, are present. These crevices and solution channels may provide a pathway for the downward movement of water for a time after the ponds are filled, although they may become sealed after water has stood over them for several days. . . . In some of the ponds the rate of decline was small and apparently was due mostly to losses from evaporation. In others, it was quite rapid, amounting in some cases to 2 inches or more a day for 10 days or so after the rains and then gradually slowing down. . . .

The beds of caliche such as were found under some of the Texas depressions are not present in the Ladder Creek area. Recharge

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from ephemeral ponds in the depressions in the western part of the area affects the water table (Pl. 9) of the Ladder Creek area. During the spring of 1952 the water table would probably have shown more bulges than are indicated by the contours on Plate 4 owing to the effects of recharge from depressions filled by the heavy rains in 1951, but most of the water-level measurements upon which the contour map was based were made before the heavy rains in May and June 1951. Only a part of the measurements in Wallace and Greeley Counties were made in July and August, after the heavy rains.

Recharge to alluvium in stream valleys is greater over a unit area and more immediate in its effect on the water table than recharge on the upland surface. There is no loess mantle to impede infiltration, and soils developed on the relatively coarse alluvial materials are generally more permeable than upland soils. Heavy precipitation may cause recharge within several hours after a rain or, at most, within a few days in valley bottoms of the Ladder Creek area. On the sloping valley walls most of the rainfall becomes surface runoff unless soil and vegetation conditions are optimum for infiltration.

The annual recharge to ground water in western Kansas, and the High Plains generally, has received considerable attention by many hydrologists. Theis (1937) has shown that in the southern High Plains the average annual ground-water recharge is less than half an inch. In parts of Haskell, Gray, Seward, and Finney Counties recharge is computed to be about 0.27 inch annually (Frye, 1942, p. 66). Frye's computation is based on the assumption that recharge is equal to discharge from the aquifer, storage remaining constant.

In the Ladder Creek area the only readily determinable ground-water discharge is the streamflow in Ladder Creek. For 1951, discharge from wells was relatively small and may be disregarded. Discharge by springs and seeps that do not reach the stream and by evapotranspiration from the aquifer not affecting streamflow was not measureable. The Ladder Creek drainage basin has an area of approximately 1,385 square miles. Much of the upland area is undrained and runoff is low. The daily mean flow of Ladder Creek for the period April 1951 to April 1952 was 98 cfs. Of this, 83.7 cfs was estimated to be direct runoff and 14.3 cfs was ground-water runoff. The amount 14.3 cfs represents the discharge from the aquifer and, therefore, is approximately equal to the recharge if it is assumed that storage remains constant. The total 1951 precipi-

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tation, averaged for Scott City, Leoti, and Sharon Springs, was 26.90 inches. Computations based on these figures indicate that the quantities involved in the water budget of the Ladder Creek area during 1951 were of the order of magnitude given below.

	Inches
Evapotranspiration	25.94
Direct runoff	.82
Recharge (ground-water runoff)	.14
Total	26.90

In 1951 the recharge was somewhat higher than indicated above, and the storage in the aquifer increased. The aquifer in the Ladder Creek area is also replenished by ground-water inflow from the west; hence precipitation west of the area also contributes an undetermined quantity of water. Similar computations based on streamflow records for the upper Smoky Hill River basin at Elkader for a drainage area of 3,555 square miles give a recharge figure of 0.16 inch (approximately ⅙ inch) for 1951 and a smaller amount for a normal year.

Recharge from the return of water applied to the land for irrigation is estimated to approach 25 percent of the applied water in the Safford Basin, Arizona (Turner and others, 1941). In that locality the irrigation water is distributed in relatively long ditches over alluvial soils that are probably very permeable. Inasmuch as the upland plain in the Ladder Creek area is thickly mantled by loess and has a dense soil, recharge probably does not exceed an average of 10 percent of the applied water. On the irrigated lands in the flood plain of the area where the soils are more sandy and flooding of hay crops is practiced, the percentage of applied water that recharges the aquifer is likely to be somewhat greater.

Discharge of Ground Water

In the Ladder Creek valley, ground water is discharged from the zone of saturation by (1) evaporation from the water table where it is close to the land surface, (2) transpiration by vegetation, (3) discharge through springs and seeps, (4) discharge into surface streams, (5) withdrawal by wells, and (6) movement underground from the area.

Where the water table lies within a few feet of the land surface, ground water may evaporate from the capillary fringe overlying the zone of saturation. Where the water table lies within a few inches of the land surface, water may evaporate directly from the zone of saturation, especially from porous loose soils on warm dry days.

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The flood plains of streams and dry stream channels in the Ladder Creek area are particularly favorable for such evaporation. In upland areas evaporation from the zone of saturation is not possible, owing to the fact that the water table is several feet below the land surface. The amount of water evaporated directly from the ground-water reservoir is probably small compared to other means of ground-water discharge.

During the growing season, plants transpire ground water extensively in the major stream valleys in the area. In the Ladder Creek valley, cottonwood trees and many scattered fields of alfalfa transpire sufficient quantities of water to dissipate several inches, or even several feet, of water from storage in the aquifer adjacent to the stream channel. The lowering of the water table by transpiration greatly reduces the ground-water discharge into the stream, and the streamflow during the growing season in much of the area is chiefly direct runoff from storms. The base flow in the channel increases markedly in the fall and winter when transpiration ceases. Transpiration does not occur from the water table underlying upland areas, but the soil moisture lost by transpiration on the uplands must be replaced before any water can percolate downward to the water table.

The quantity of ground water discharged through springs and seeps in the Ladder Creek area is large but not accurately determinable. Data for several springs in the area are given in Table 5.

Springs occur at several places in the upper parts of Chalk and Twin Butte Creek valleys where the land surface and water table intersect. A spring in sec. 23, T. 13 S., R. 42 W., occurs at the origin of effluent flow in South Fork of Smoky Hill River. Downstream this flow is frequently dissipated by evapotranspiration and by seepage into sandy channel deposits. Local residents report that flow from the springs has been continuous at least since 1901. Two springs in Ladder Creek valley, 17-34-17dc and 17-33-15ac, can be classified as depression springs. In spring 17-34-17dc water issues from the Ogallala formation and in spring 17-33-15ac from alluvial valley fill, at points where the water table intersects the land surface. Probably there are other similar springs in the Ladder Creek valley.

Springs occur at many localities where the contact between the Ogallala formation and the underlying impermeable chalk of the Niobrara formation or the Pierre shale has been exposed by erosion. Such springs are found in Rose Creek valley and along Eagle Tail Creek, which flows through Sharon Springs. The springs along

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TABLE 5.—*List of springs in the Ladder Creek area.*

COUNTY AND LOCATION	Type	Water-bearing formation	Underlying impermeable formation	Topography	Openings	Yield in gpm*	Stream valley	Quality or remarks
Logan 13–37–23bb	Contact	Pleistocene	Niobrara	Edge of terrace	Numerous seeps	60–65 M	Smoky Hill	Formerly domestic supply (Hinshaw Spring)
Wallace 13–41–15da 13–41–14cb	Contact	Pleistocene	Pierre (?)	Valley	Numerous seeps	10 E	Smoky Hill	
Wallace 13–42–23d	Depression and contact	Pleistocene	Pierre	Stream channel	10–15	50–75 E	Smoky Hill	Flowing since 1901 at least
Wallace 14–39–8a	Contact	Pleistocene	Pierre	Draw in rolling upland	Numerous seeps	....	Rose Creek	
Wallace 14–39–9bb	Contact	Ogallala	Pierre	do	do	0.5–1.0 E	Rose Creek	
Wallace 14–39–17 14–39–20	Contact	Pleistocene Ogallala	Pierre	Valley	Numerous	....	Rose Creek	
Logan 15–33–5cd	Depression	Pleistocene	....	Valley floor	Numerous	....	Twin Butte Creek	Poor quality reported
Logan 15–34–28cd	Depression	Pleistocene	....	Valley floor	Numerous	....	Chalk Creek	Occasionally dry in summer
Lane, 16–30–20 Cen. N½	Contact ?	....	....	Valley	....	....	Hell Creek	See Prescott, 1951, p. 49
Scott, 16–33–1cc	Contact	Ogallala	Niobrara	Valley slope	....	....	Ladder Creek	Public supply
Scott 16–33–12ca	Contact	Ogallala	Niobrara	Valley	2	50 R	Ladder Creek	See Waite, 1947, Table 19. Formerly domestic use
Scott 16–33–13ba	Contact	Ogallala	Niobrara	Valley	Numerous	400 R	Ladder Creek	See Waite, 1947, Table 19. Public supply (Big Springs)

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Table 5.—*List of springs in the Ladder Creek area.—Concluded*

County and Location	Type	Water-bearing formation	Underlying impermeable formation	Topography	Openings	Yield in gpm*	Stream valley	Quality or remarks
Scott 16–33–13bd	Contact	Ogallala	Niobrara	Valley	....	....	Ladder Creek	Barrel Springs
Wichita 16–35–3	Depression	Pleistocene Ogallala	....	Valley	About 75	70–80 E	Chalk Creek	Flowing at least since 1901
Scott 17–33–15ac	Depression Contact	Ogallala	Impermeable clay in Ogallala	Stream channel	Numerous	2–3 E	Ladder Creek	
Scott 17–33–15ab	Depression	Ogallala	....	Valley	Concealed in pool	....	Ladder Creek	
Scott 17–34–17dc and 17cd	Depression	Pleistocene	....	Stream valley	Numerous	....	Ladder Creek	

* M, measured; E, estimated; R, reported

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Ladder Creek in the Scott County State Park issue from the Ogallala formation at its contact with the underlying impermeable Niobrara formation. One of these, called the Big Spring, is reported to yield 400 gpm. In the Lake McBride area in the Scott County State Park, the discharge of Ladder Creek increases considerably, owing in part to the increments of flow from springs in the main valley and similar smaller springs along tributary canyons. A part of the increase in streamflow in this area, however, probably results from movement of water from the Ogallala formation into the alluvial fill of the valley and thence into the stream.

Many springs rise in other tributaries of Smoky Hill River, particularly in Hell and Salt Creeks in the eastern part of the area. The contribution from the Ogallala formation by such spring discharge to the flow of Smoky Hill River east of Ladder Creek is considerable.

In the Lake McBride area some water from the ground-water reservoir is discharged to Ladder Creek through the alluvium. The zone of saturation contributes ground water to the entire effluent length of the stream in this manner. If this contribution to the stream flow is ultimately diverted by pumping for irrigation, there will be no base flow, and direct runoff alone, then, will constitute the discharge of the stream. Throughout the effluent part of Ladder Creek most of the ground-water discharge comes from the zone of saturation in the alluvium in the valley. Alluvium of the Ladder Creek valley has a maximum width of about 2,000 feet. The alluvial fill in the valley is 20 to 30 feet thick at the north end of Lake McBride and as much as 30 feet thick in western Scott County and in Wichita County. In a few places the alluvium is very thin or absent, and the Ogallala formation is exposed.

Withdrawal of ground water by wells in the Ladder Creek area is increasing annually. By the end of 1951, irrigation wells in the Ladder Creek area numbered 91. The total area irrigated was about 18,000 acres, and in a year of normal rainfall each irrigated acre requires approximately 1 acre-foot of water. Withdrawal of ground water by domestic and stock wells is negligible in comparison to withdrawal for irrigation. Leoti and Sharon Springs are the only cities in the area that use ground water for public supplies.

Discharge by underflow in the alluvium of Smoky Hill River at the eastern boundary of the area probably amounts to less than 1 cfs or less than 726 acre-feet per year.

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CHEMICAL QUALITY OF THE WATER

By ROBERT A. KRIEGER

The ground and surface waters of the Ladder Creek area were sampled at the 44 points shown on Figure 12, and the results of analyses of these samples are given in Table 6. The wells that were sampled are listed by well location number and under geologic source. The results in equivalents per million are given in Table 7.

CHEMICAL CONSTITUENTS IN RELATION TO USE

Hardness

The most important basic ion in the ground waters of the area is calcium. Calcium and magnesium are the cause of most hardness of water. These two ions combine with soap to form an insoluble curd or scum, and therefore the use of hard waters results in excessive soap consumption. Calcium in these waters ranged from 33 to 573 ppm and magnesium from 10 to 100 ppm. The bicarbonate ion, which is the principal anion in the ground water, ranged from 170 to 453 ppm. Hardness equivalent to the bicarbonate is carbonate ("temporary") hardness; the rest is noncarbonate ("permanent") hardness. Noncarbonate hardness results from the solution of compounds other than the bicarbonates of calcium and magnesium. Sulfate, chloride, and nitrate ranged from 17 to 1,760 ppm, 3.5 to 185 ppm, and 1.6 to 240 ppm, respectively. A high sulfate content may indicate that the water has dissolved gypsiferous materials.

Nitrate

Excessive nitrate content in water may be an indication of pollution. Whether polluted or not, water high in nitrate is undersirable for domestic supplies because of its toxic effect on some infants (Comly, 1945). According to Comly, waters containing nitrate amounting to more than 45 ppm should not be used in infant feeding. Only two samples analyzed (17-33-1bd and 16-32-32dc) had greater concentration of nitrate.

Fluoride

Fluoride in concentrations of about 1 ppm in drinking water used by children during the calcification of the teeth prevents or lessens the incidence of tooth decay; concentrations greater than 1.5 ppm may cause mottling of the enamel. Fluoride in waters of the Ladder Creek area ranged from 0.6 to 2.8 ppm.

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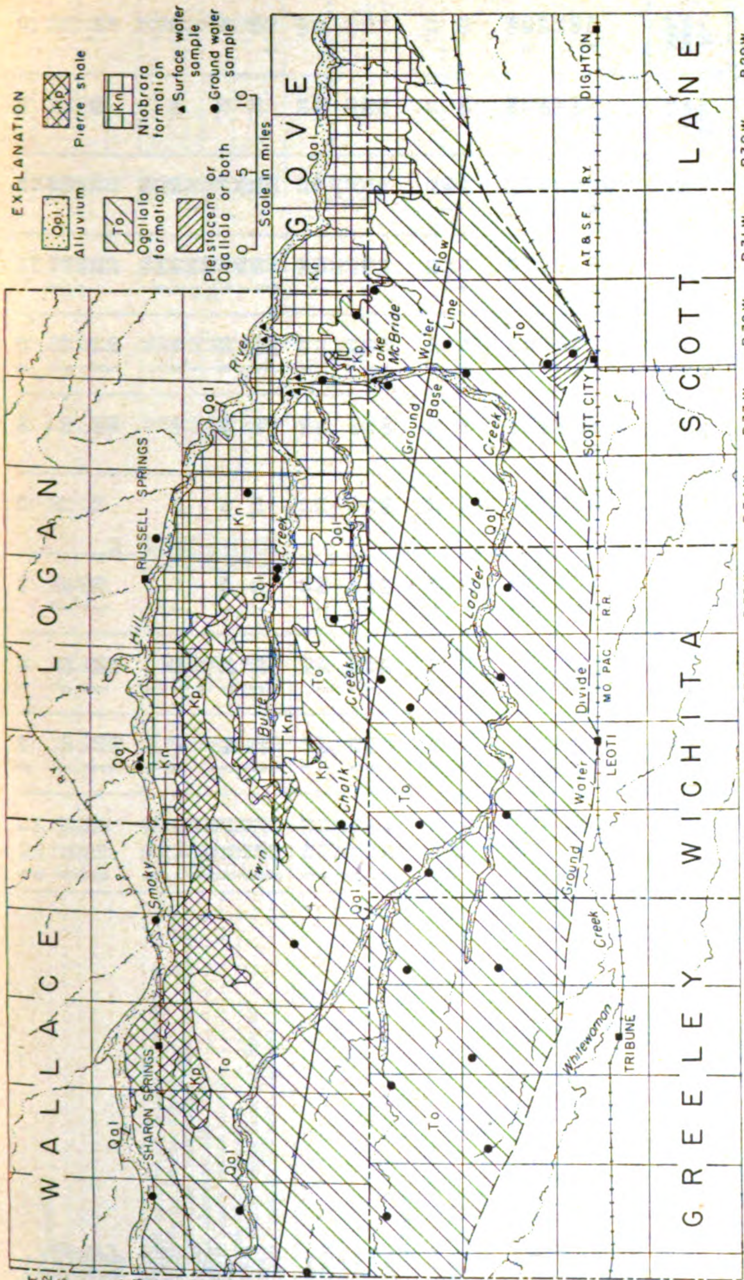

FIG. 12.—Water-sampling sites and generalized geologic map.

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TABLE 7.—*Chemical analyses of water, in equivalents per million*

SOURCE AND LOCATION	Date of collection	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)
Alluvium											
13-39-25aa	9-20-51	.....	.....	.....	.....	.....	.....	26.44	1.35	.....	.....
13-42-24cc	9-20-51	2.84	1.00	1.04	0.23	0.00	3.72	0.40	0.37	0.04	0.68
15-35-2ab	9-19-51	28.59	8.21	8.35	.46	.00	7.42	36.64	.65	.06	.60
15-35-32ad	9-19-51	12.77	6.35	7.48	.43	.00	5.70	16.03	5.22	.06	.11
16-38-20dd	9-21-51	3.24	1.72	1.65	.16	.00	5.18	.92	.42	.06	.04
17-33-1bd	9-19-51	5.34	4.18	4.09	.28	.00	5.97	2.33	1.35	.15	3.87
17-36-16aa	9-21-51	2.59	1.51	1.39	.14	.00	4.21	.83	.31	.08	.08
Sanborn and Meade formations											
13-37-23bb	9-20-51	4.04	1.72	3.17	.23	.00	4.18	4.41	.51	.06	.03
17-32-31cb	9-18-51	.....	.....	.....	.....	.....	.....	1.67	1.30	.....	.....
18-32-7ac	9-19-51	2.35	1.51	1.04	.13	.00	3.70	.81	.27	.11	.11
Ogallala formation											
14-42-23bc	9-20-51	1.75	.91	1.04	.09	.00	2.79	.58	.16	.05	.11
15-32-26da	9-18-51	2.69	1.49	1.00	.11	.17	3.21	1.25	.42	.05	.13
15-37-30cb	9-21-51	1.85	1.15	1.26	.10	.00	3.34	.60	.16	.09	.14
15-39-11bb	9-21-51	.....	.....	.....	.....	.....	.....	.67	.16	.....	.....
15-43-12dd	9-20-51	1.65	1.33	1.96	.12	.00	3.31	1.23	.25	.07	.21
16-32-2bc	9-18-51	2.79	.83	.40	.11	.00	3.21	.54	.24	.04	.09
16-32-32dc	9-18-51	4.19	1.73	1.81 (Na + K)		.23	2.95	2.46	.99	.....	1.10
16-33-1cc	9-19-51	2.79	1.33	1.22	.10	.00	4.06	.83	.27	.13	.13
16-33-18dd	9-19-51	.....	.....	.....	.....	.....	.....	.85	.24	.....	.....
16-36-3cc	9-21-51	2.64	1.78	1.48	.11	.00	3.52	1.46	.54	.15	.18
16-36-18ad	9-21-51	.....	.....	.....	.....	.....	.....	.92	.23	.....	.....
16-38-16bb	9-21-51	.....	.....	.....	.....	.....	.....	.85	.24	.....	.....
16-38-24bc	9-21-51	2.40	1.18	1.43	.12	.00	3.51	.83	.42	.08	.19
16-39-18da	9-20-51	.....	.....	.....	.....	.....	.....	1.06	.31	.....	.....
16-41-12bd	9-20-51	.....	.....	.....	.....	.....	.....	.67	.23	.....	.....
16-42-9ab	.....	2.00	.98	.73 (Na + K)		.30	2.80	.35	.10	.....	.16
17-34-3bb	9-19-51	2.10	1.32	1.30	.11	.00	3.44	.83	.25	.09	.14
17-35-22bb	9-21-51	.....	.....	.....	.....	.....	.....	1.25	.48	.....	.....
17-38-24ac	9-21-51	2.20	1.88	1.39	.11	.00	3.24	1.48	.56	.11	.13
17-39-17cb		.....	.....	.....	.....	.....	.....	1.77	.45	.....	.....
17-40-5cb	9-20-51	.....	.....	.....	.....	.....	.....	.54	.14	.....	.....
17-41-8cc	9-20-51	2.84	1.38	.61	.13	.00	3.75	.54	.18	.03	.32

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Niobrara formation											
13-34-29bd	9-19-51	4.54	2.26	2.26	.20	.17	4.08	3.68	.82	.03	.26
14-34-26aa	9-19-51	......	......	......	......	......	......	29.98	.68	......	......
15-32-19bd	9-18-51	23.80	6.80	4.00	.43	.00	4.42	27.69	.87	.09	.71
15-35-28bd	9-19-51	4.89	1.59	1.17	.10	.00	5.47	1.85	.14	.13	.04
Streams											
Ladder Creek at Greeley-Wichita County line	9-21-51	2.59	1.37	1.88		.47	3.36	1.46	.39	......	.16
Lake McBride on Ladder Creek	......	3.14	1.80	2.46		.53	3.97	2.17	.65	......	.08
Ladder Creek above confluence with Chalk Creek	9-19-51	2.99	1.93	2.66		.37	3.77	2.71	.68	......	.05
Chalk Creek above mouth	9-19-51	7.78	4.22	6.06		.00	1.66	14.84	1.55	......	.01
Twin Butte Creek above mouth	9-19-51	21.96	7.28	8.06		.00	1.44	34.35	1.49	......	.02
Ladder Creek above mouth	9-19-51	3.99	2.27	3.21		.23	3.82	4.62	.76	......	.04
Smoky Hill River below Hinshaw Spring	9-19-51	4.04	2.28	4.81		.00	3.39	7.04	.68	......	.02
Smoky Hill River at Elkader, Kansas	9-19-51	4.44	2.46	3.25		.00	2.59	6.77	.76	......	.03

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Boron

Boron is essential for normal plant growth, but it is beneficial only within narrow limits. The element is very toxic to many plants, and quantities in excess of the optimum will cause serious damage. A concentration of 1.0 ppm of boron in the soil waters may cause injury to many plants. Boron concentrations in the ground waters that were analyzed ranged from 0.05 to 0.25 ppm.

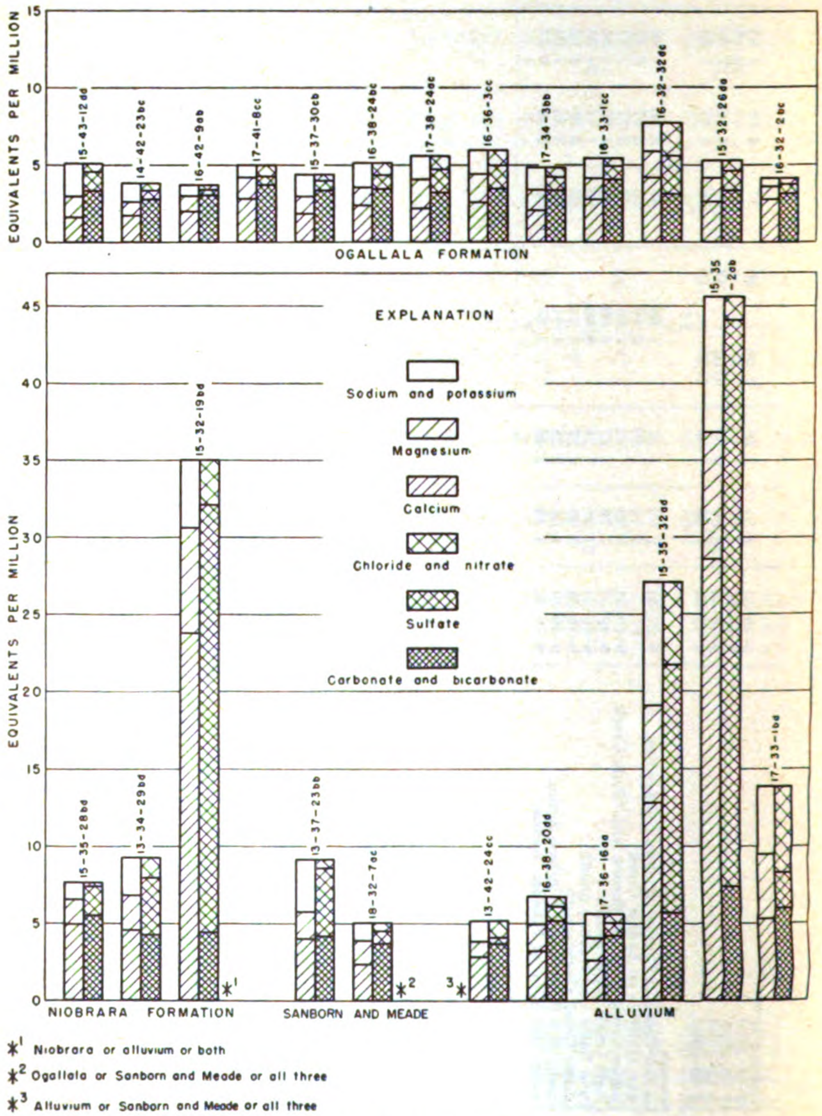

FIG. 13.—Principal mineral constituents in ground water.

Ionic Relations in the Water

The analyses in equivalents per million, expressions of the chemical combining weights of the ions, are given in Table 7 and are shown graphically in Figures 13 and 14.

Many natural waters that contain small or average amounts of dissolved solids are bicarbonate waters, but waters containing more than average amounts of dissolved materials contain much greater proportions of sulfate or chloride, and a correspondingly greater

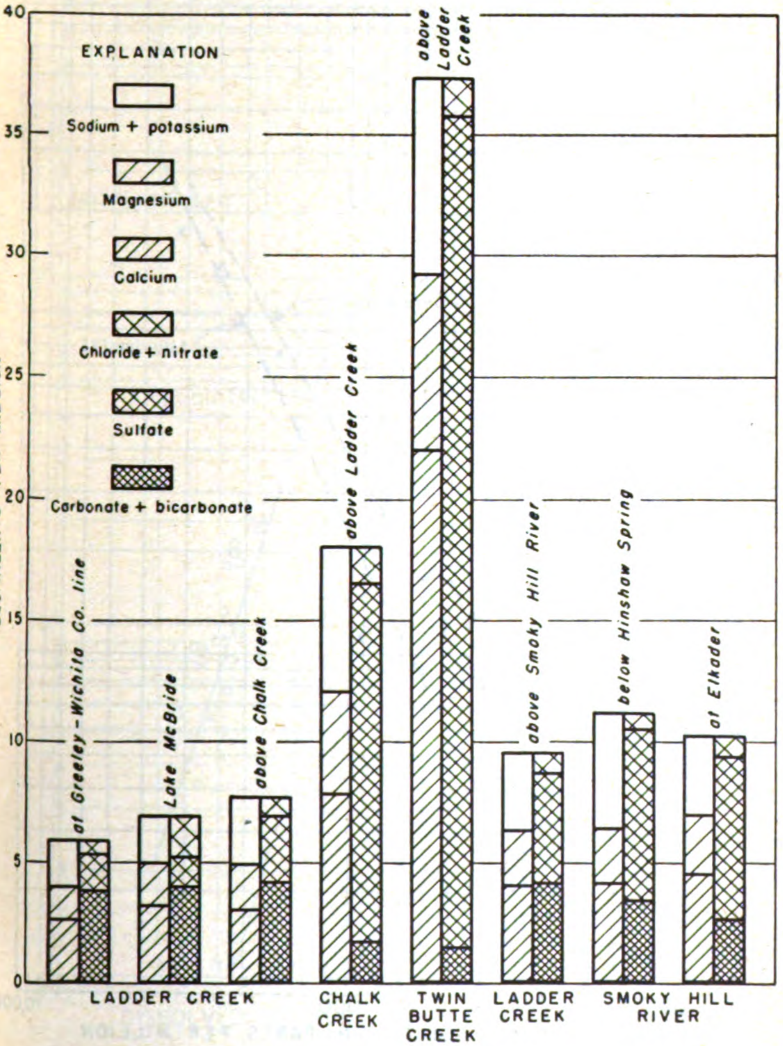

Fig. 14.—Principal mineral constituents in surface water.

amount of calcium or sodium. Gypsiferous waters are high in calcium and sulfate content. An example of gypsiferous water is that found in well 15-32-19bd (Fig. 13).

The relation between dissolved solids and sulfate is shown graphically in Figure 15. Sulfate makes up a larger part of the dissolved solids as the amount of dissolved solids increases. Although the data available for water from wells in the Niobrara formation are

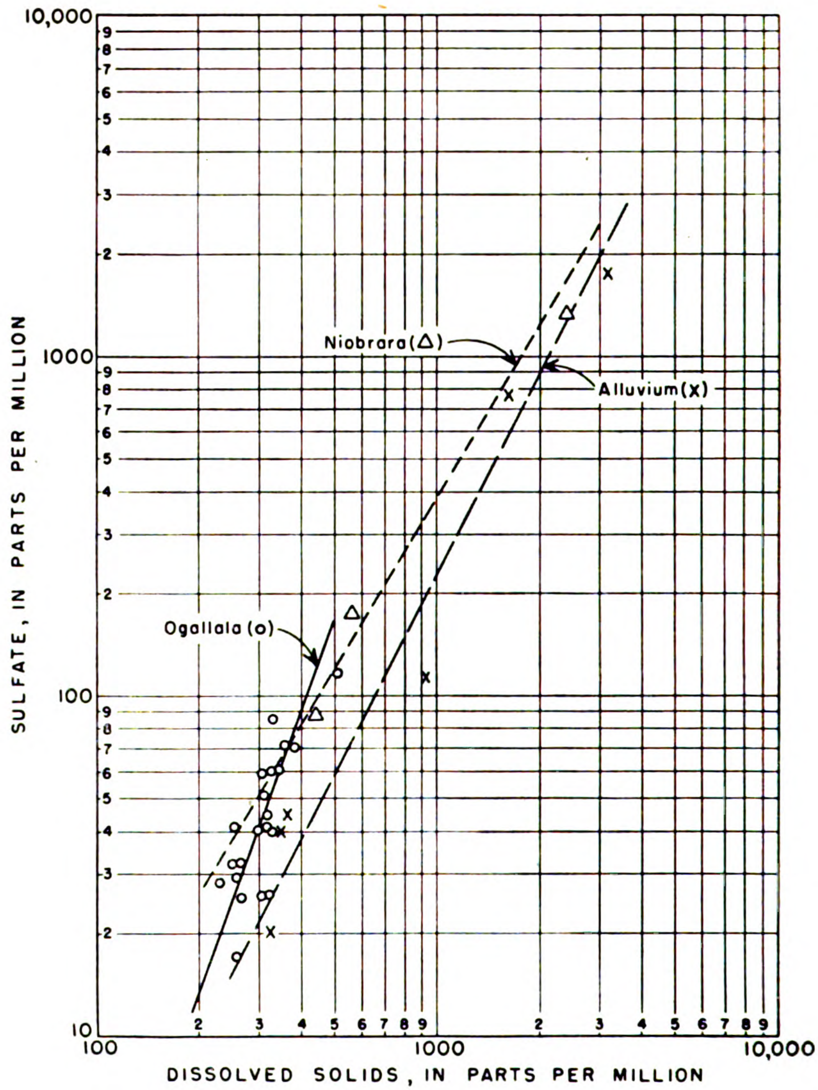

FIG. 15.—Relation of sulfate to dissolved solids in ground water.

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few, those available show that the relation of sulfate to dissolved solids is very similar to that in water from the alluvium. The proportion of sulfate to dissolved solids in the more concentrated waters from wells in the Ogallala formation is somewhat greater than in water from the Niobrara formation and alluvium.

In Figure 16, the relation between chloride and dissolved solids

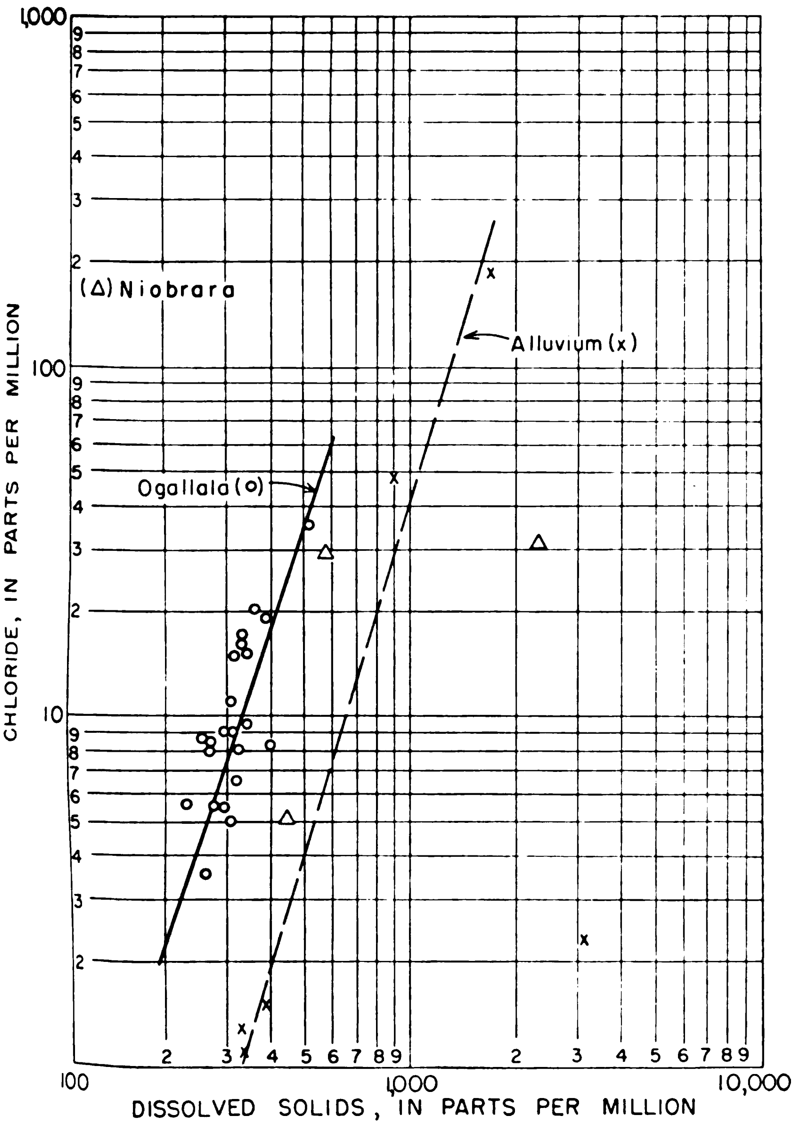

FIG. 16.—Relation of chloride to dissolved solids in ground water.

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in the ground waters is shown. The relation of chloride to dissolved solids of waters from the alluvium and the Ogallala formation is very similar.

Hardness of the waters from the Niobrara and Ogallala formations and the alluvium was very similar in relation to dissolved solids, as shown in Figure 17.

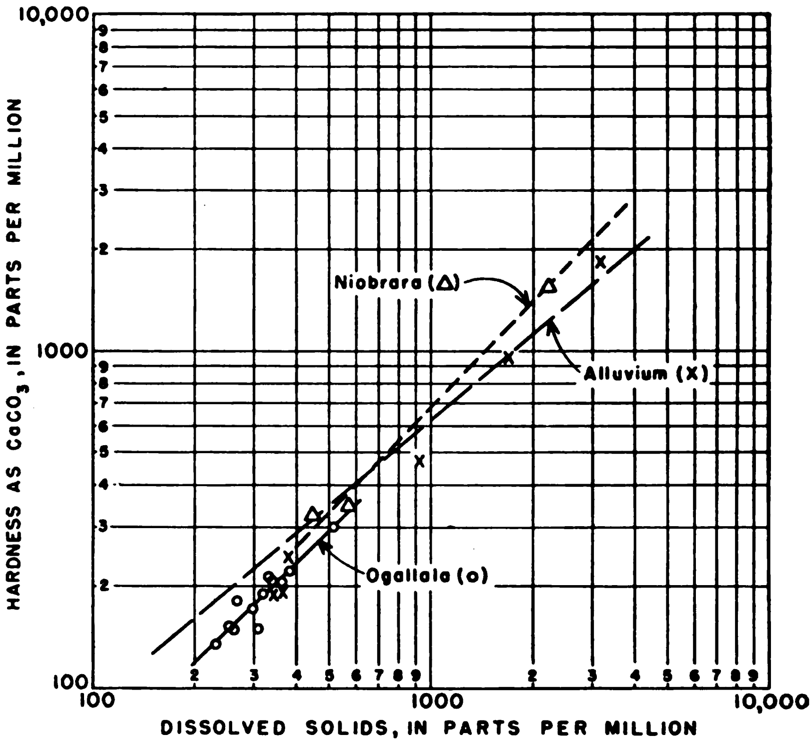

FIG. 17.—Relation of hardness as $CaCO_3$ to dissolved solids in ground water.

CHEMICAL QUALITY IN RELATION TO MOVEMENT OF GROUND WATER

The ground water moves east by south generally in the direction of a line drawn from the northwest corner of 15-42-6 to the southeast corner of 16-31-36 (Fig. 12). The location of each well along the base line, as indicated by a perpendicular drawn from the well to the base line, was plotted as abscissa, and the concentrations in parts per million of sulfate, chloride, and hardness were plotted as ordinates in Figures 18, 19, and 20, respectively.

The concentration of sulfate increases gradually from west to east (Fig. 18). In the Ogallala formation, the sulfate shows a relatively abrupt but slight increase between 20 and 30 miles from the western

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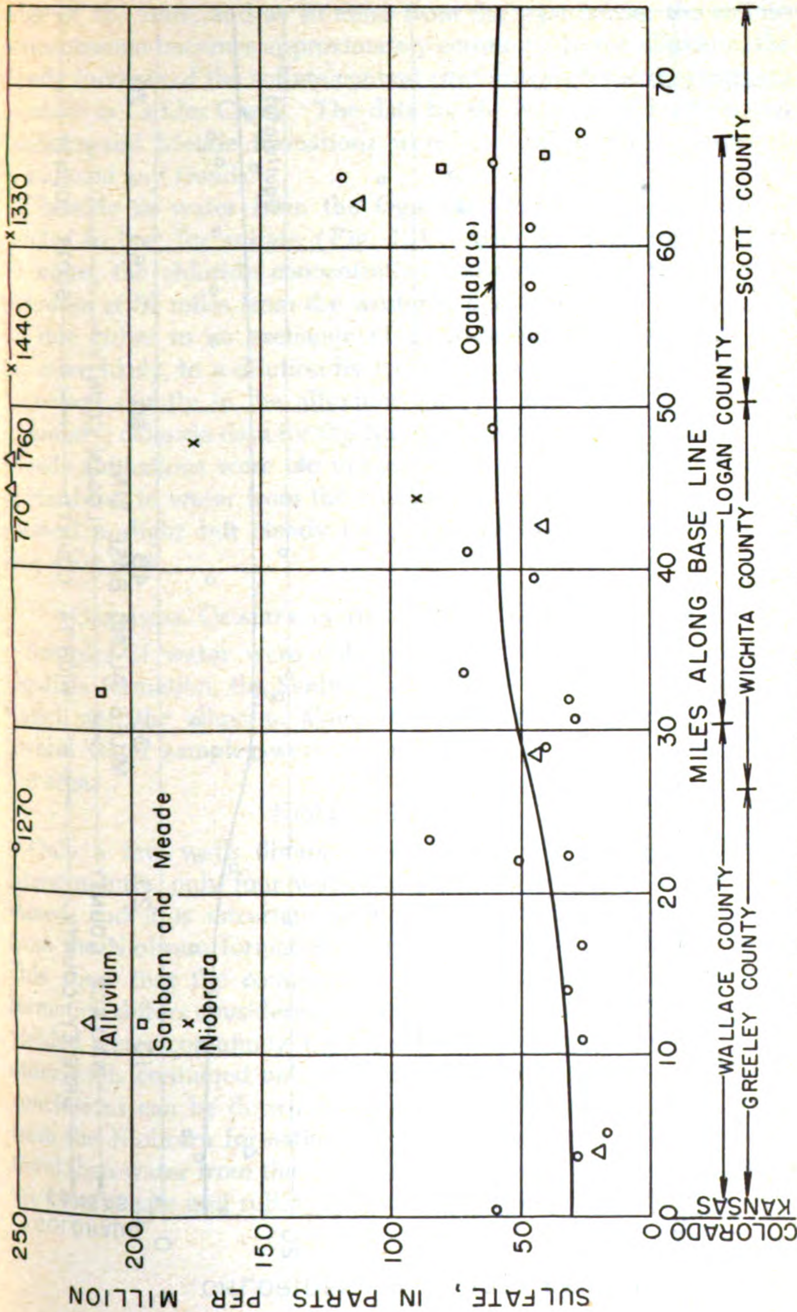

FIG. 18.—Sulfate content of ground water along direction of movement.

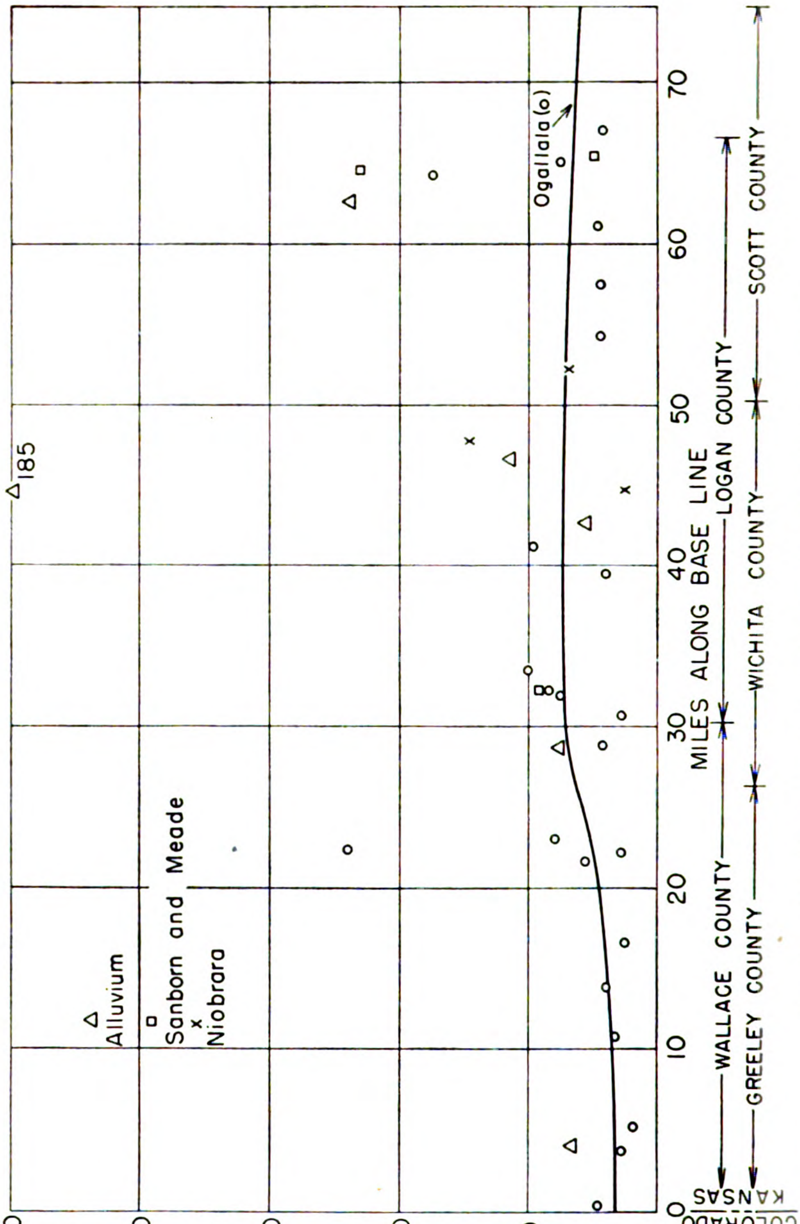

FIG. 19.—Chloride content of ground water along direction of movement

edge of the state, and at 40 miles from the west border the sulfate concentration becomes approximately constant. In the alluvium, the steady increase of the sulfate content conforms with the downstream increase in Ladder Creek. The data for the Niobrara formation and Sanborn and Meade formations were not sufficiently widespread to indicate any trends.

Chloride in water from the Ogallala formation showed trends similar to that for sulfate (Fig. 19). After the increase at 20 to 30 miles, the chloride concentration showed a slight tendency to decrease at 50 miles from the western edge of the state. This may be due either to an exchange of chloride ion for some other ion or, more likely, to a dilution by less concentrated waters. Chloride increased slightly in the alluvium with distance from the western boundary; chloride data for the Niobrara formation and Sanborn and Meade formations were too meager to show any significant trends.

Hardness in water from the Ogallala formation and the alluvium showed a slight but steady increase with distance from west to east (Fig. 20).

Chemical Quality in Relation to Geologic Source

Samples of water were obtained from the Niobrara formation, Ogallala formation, the Sanborn and Meade formations undifferentiated, and the alluvium along streams in the area. In addition, several water samples were obtained from the streams that drain the area.

Niobrara Formation

Only a few wells obtain water from the Niobrara formation. Consequently, only four water samples from this source were obtained, and it is uncertain whether well 15-32-19bd yields water from the Niobrara formation or alluvium or both. The data available show that the composition of the water from the Niobrara formation differs considerably from place to place. Well 14-34-26aa yielded water containing 1,440 ppm sulfate, but samples from two other wells contained only 177 and 89 ppm of sulfate. Insofar as conclusions can be drawn on the basis of three samples, the water from the Niobrara formation seems to contain more dissolved material than water from the Ogallala formation. The principal anions are bicarbonate and sulfate; calcium is the principal cation.

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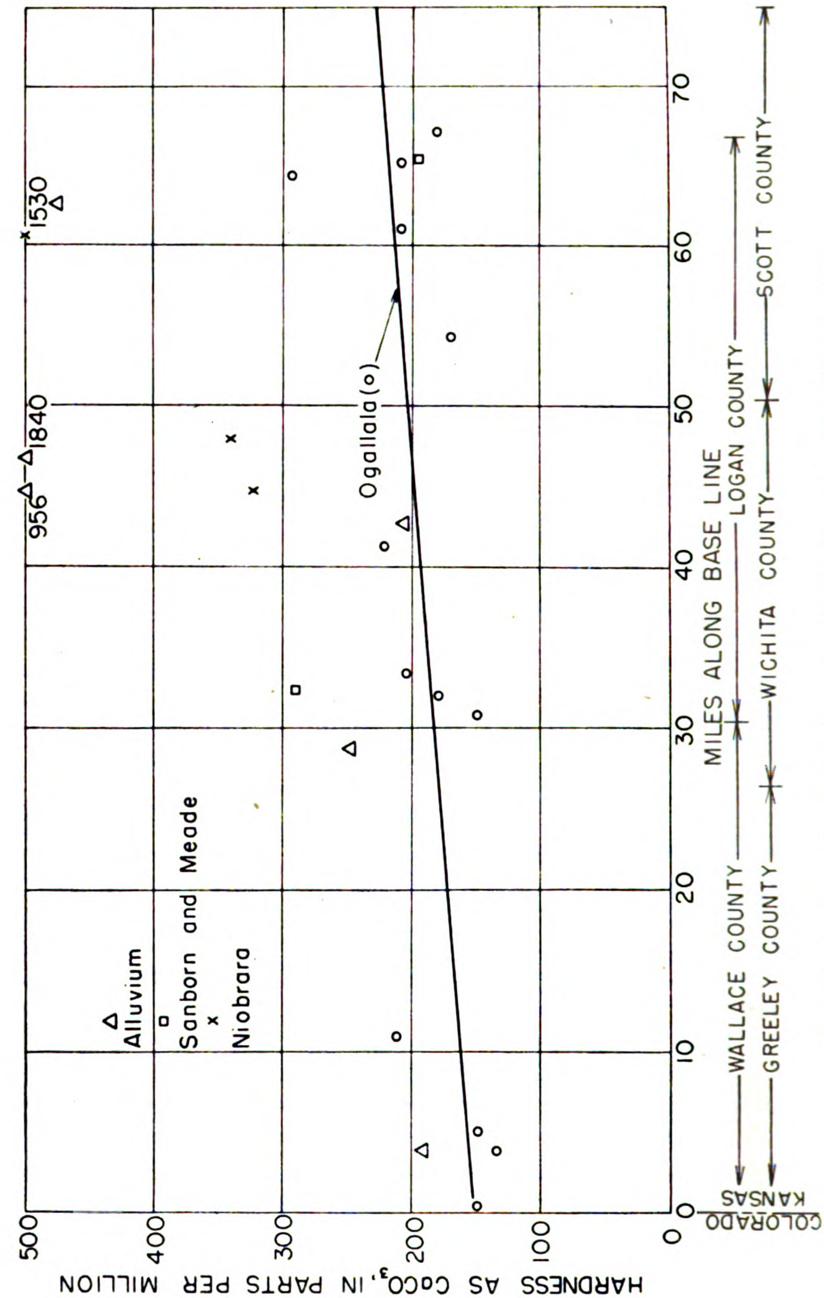

FIG. 20.—Hardness (as $CaCO_3$) of ground water along direction of movement.

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Ogallala Formation

The Ogallala formation is very calcareous; consequently, the action of dissolved carbonic acid produces a water whose dissolved material is relatively rich in calcium, magnesium, and bicarbonate. The total amount of dissolved material in water from the Ogallala formation, however, is generally less than that in water from other sources in the area. Calcium and bicarbonate are the principal ions in the water from the formation, ranging in concentration from 33 to 84 ppm and 170 to 248 ppm, respectively. The amount and proportions of dissolved material were nearly uniform, as shown in Figure 13. The Ogallala formation yields water of the best quality and most nearly uniform chemical composition of all the ground-water sources in the Ladder Creek area.

Sanborn and Meade Formations Undifferentiated

Two wells and one spring from which samples were obtained are believed to draw water from the Pleistocene deposits (Sanborn and Meade formations), although one of the wells, 18-32-7ac, may yield water from the Ogallala formation also. Water from this well contained 226 ppm of bicarbonate and 39 ppm of sulfate; water from the spring (13-37-23bb) contained 255 ppm of bicarbonate and 212 ppm of sulfate. The waters are hard.

Alluvium

The concentration of dissolved material in the six samples of water from the alluvium ranged from 324 to 3,190 ppm. Water in the alluvium along Ladder Creek was of better quality than that obtained from the alluvium in the valleys of Chalk and Twin Butte Creeks, as the samples from the latter two were gypsiferous in addition to containing considerable calcium bicarbonate. All the water is very hard.

Waters from the alluvium contained 0.7 to 2.8 ppm of fluoride, the maximum being somewhat more than the maximum limit set by the U. S. Public Health Service for acceptable public water supplies.

The streams in the Ladder Creek area were sampled at or near base flow stages. The chemical characteristics of the surface waters would then be similar to water from wells in the alluvium. Chalk and Twin Butte Creeks were high in sulfate and low in bicarbonate. The water in Smoky Hill River was somewhat gypsiferous and was of poorer quality than the water in Ladder Creek.

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Chemical Quality in Relation to Use

The Ladder Creek area provides water for irrigation, stock, and domestic use. Water from the Ogallala formation is the best for irrigation. It is low in boron, and values for percent sodium range from 10 to 39. The specific conductance of the samples analyzed ranged from 350 to 2,720 micromhos, but values for all except one sample were below 757 micromhos. Waters from the alluvium generally are less suitable for irrigation because of high salinity. Most waters from the Niobrara formation and from the Sanborn and Meade formations can be used for irrigation but are less suitable than water from the Ogallala formation. No high-boron waters were found. All the waters are suitable for livestock except those containing excessive sulfate, which may be unpalatable.

The U. S. Public Health Service (1946), in setting up standards of quality for drinking water used on interstate carriers and for public supplies in general, stated that the following chemical substances should not exceed the stated concentrations:

	Concentration (ppm)
Iron and manganese together	0.3
Magnesium	125
Chloride	250
Sulfate	250
Fluoride	1.5

Total solids should not exceed 500 ppm, but 1,000 ppm is acceptable if water of better quality is not available. Most of the waters meet the U. S. Public Health standards with regard to all the ions except sulfate and fluoride. The largest number fail to meet the standards because of high fluoride concentrations; of 22 samples analyzed for fluoride, 11 contained more than 1.5 ppm.

IRRIGATION DEVELOPMENT

In the Ladder Creek area, irrigation from wells was not practiced extensively until after World War II. In the region to the south, in Scott and Finney Counties, irrigation was common before 1920. Between 1930 and 1940 several irrigation systems were installed north of Scott City, and many small shallow irrigation wells were drilled in Wichita and Wallace Counties in stream valleys. A typical irrigation system in the Ladder Creek area is shown in Plate 11.

Since 1940 the practice of intensive agriculture using irrigation from wells to augment the rainfall even in years of above-normal precipitation has been increasing. This permits the raising of such

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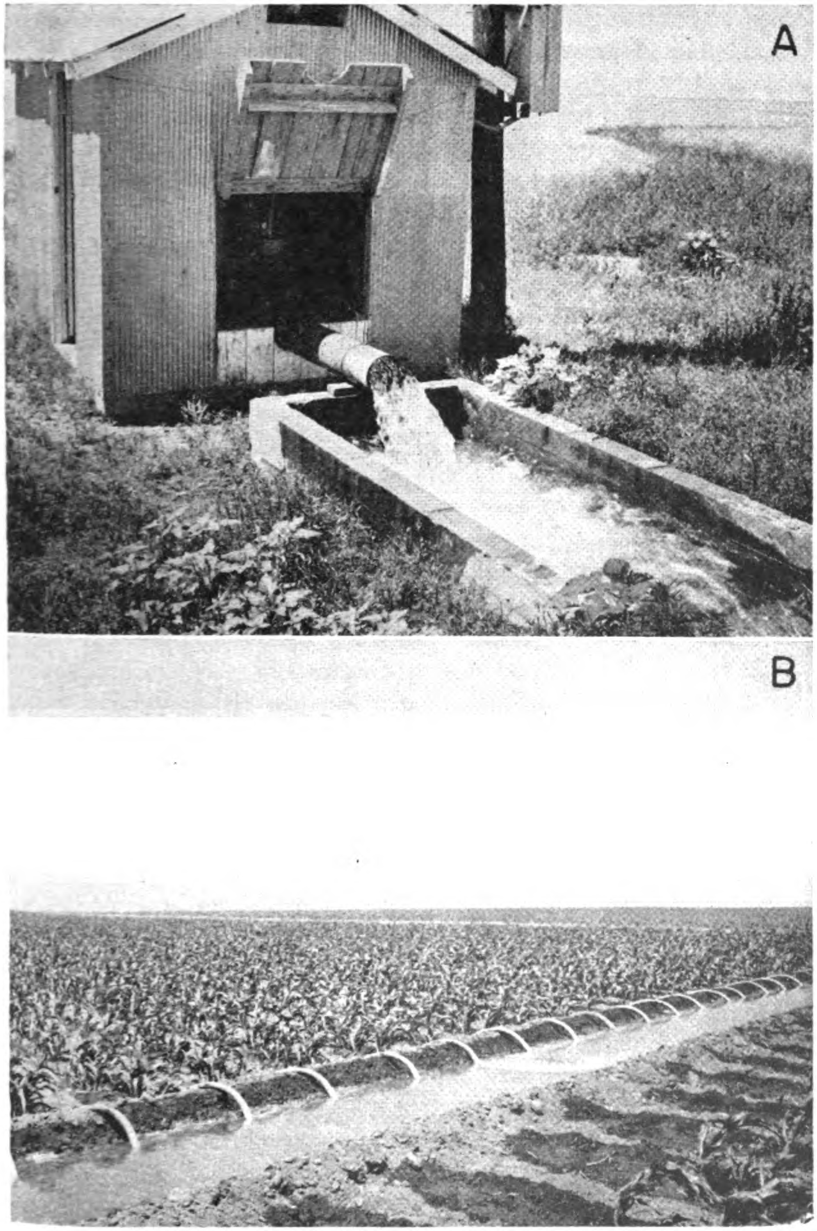

PLATE 11.—**A,** Irrigation well owned by S. W. Filson in the NW¼ sec. 36, T. 17 S., R. 33 W., Scott County, pumping at about 1,200 gpm. **B,** Water from well in **A** being siphoned from irrigation ditch into rows of corn nearly ¾ mile northeast of the well.

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crops as corn, sugar beets, alfalfa, and beans, and the use of irrigated, planted grassland as pasture. Irrigation agriculture yields a greater return than the planting of dry-land crops such as wheat and sorghum but requires the use of more water per unit area. In wet years, the pumping of those wells that irrigate dry-land crops is negligible, but those irrigating high-yield crops will pump large quantities of water even in years of above-normal rainfall.

In recent years the practice of test drilling to select those parts of the aquifer most suitable for well development has preceded the construction of irrigation wells because of the heterogeneous nature of the aquifer and the large range in thickness of the saturated material from nearly none to 160 feet. The wells are drilled chiefly

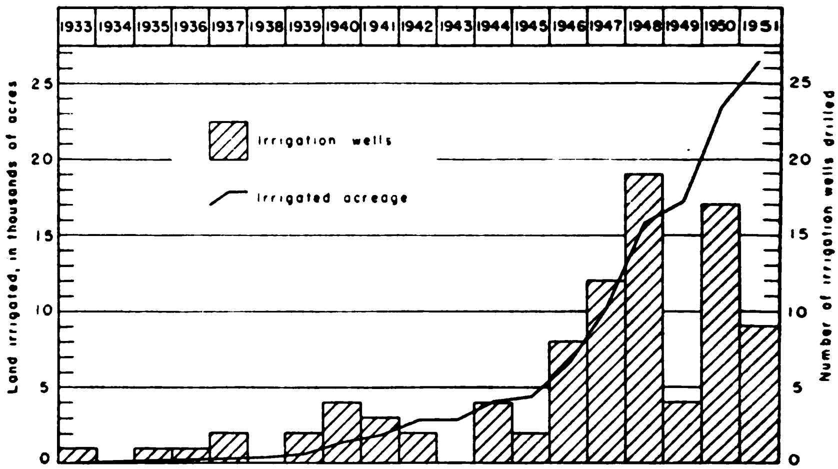

FIG. 21.—Graph showing irrigation development during 19-year period 1933 to 1951.

by hydraulic-rotary methods, cased with 16- to 24-inch steel casing perforated throughout most of the saturated zone, and gravel packed to facilitate the flow of water into the casing. Turbine pumps having two to five stages are commonly used, and these are powered by engines using a variety of fuels, chiefly diesel fuel, propane, or butane. The use of electricity and natural gas is restricted to the areas where these sources of power are readily available. Very few gasoline engines are used to power the newer installations.

Figure 21 shows graphically the increase of irrigated acreage during the period 1933-51. A series of drought years, or even

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years of normal precipitation, may stimulate a greatly increased rate of drilling of irrigation wells. The development of ground-water irrigation is related also to the farm economy and to the availability of pumping equipment, but these two factors will probably not adversely affect the use of ground water for irrigation in the near future.

Irrigation from wells in the area is still in the initial phases despite the great increase in the acreage of irrigated lands since 1945. The U. S. Bureau of Reclamation has estimated that 435,000 acres of land is suitable for irrigation in the area, of which only about 26,000 acres, or about 6 percent, was developed by the end of 1951. Of this 26,000 acres only 18,000 acres is irrigated annually.

The development of additional ground-water irrigation in the Ladder Creek area depends on the amount of water that can be pumped perennially from the ground-water reservoirs. This amount depends in turn on the long term rate of ground-water replenishment from precipitation, from infiltration from streams, and from movement of ground water into the Ladder Creek area from adjacent areas.

The construction of new wells and the additional development of irrigation from ground water must also be limited to those areas where the saturated water-bearing materials have a fairly large thickness. The saturated thickness of the water-bearing Tertiary and Quaternary deposits overlying Cretaceous bedrock is shown areally in Plate 5. The isopachous contours showing saturated thickness were prepared by superimposing the water-table contour map (Pl. 4) on the map showing the configuration of the surface of the Cretaceous rocks (Pl. 1) and drawing the contours through points of equal thickness. The water-bearing materials have a thickness of as much as 160 feet in northern Greeley County and southern Wallace County about 12 miles east of the Colorado-Kansas line. Between contour lines representing zero thickness of saturated material the water table probably is absent.

RECORDS OF WELLS

Descriptions of the wells inventoried in the Ladder Creek area are given in Table 8. All reported information was obtained from the owner or tenant. Measured depths of wells are given to the nearest tenth of a foot below measuring point; reported depths are given in feet below land-surface datum. Measured depths to water level are given to the nearest tenth or hundredth of a foot; reported

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depths are given in feet. An explanation of the well-numbering system is given on page 11.

Wells inventoried in the Ladder Creek area total 714, distributed by counties as follows:

County	Number of wells
Gove	9
Greeley	68
Lane	37
Logan	84
Scott	248
Wallace	98
Wichita	170

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Table 8.—*Records of wells in the Ladder Creek area—Gove County*

Well Number	Owner or tenant	Type of well (3)	Depth of well, feet (4)	Diameter of well, in.	Type of casing (5)	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift (7)	Use of water (8)	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet (9)	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
15-29-13bb[1]	U. S. Geological Survey	J	20.4	.75	P	Sandy and gravelly clay	Sanborn and Meade	N	N	Top of casing	1.0	2,455.3	14.39	2-11-52	
-13bb[2]	do.	J	67.5	.75	P	Sand, gravel	Alluvium	N	N	do.	1.5	2,449.7	8.58	2-11-52	
-13bc	do.	J	27.5	.75	P	do.	do.	N	N	do.	2.5	2,452.0	10.84	2-11-52	
15-30-26dd	F. A. Lewis	Dr	56.5	6	P	Chalk	Niobrara	J, E	D	Bottom of plank cover over pit	.3	....	50.64	12-18-51	
15-31-11cc	R. D. Miller	Dr	38.5	6	P	Sand, gravel	Sanborn and Meade	Cy	N	Edge of casing	.0	....	23.34	7-5-51	
-16aa	Mrs. H. L. Bartlett	Du	7.5	24	R	do.	do.	Cy, W	S	Top edge of steel ring	.5	....	3.09	7-5-51	
-18ba	Leah Bantley	Dr	13.0	5.5	P	do.	do.	Cy, W	S	Side of casing	2.0	....	9.34	7-5-51	
-26ba	Fick Bros.	Dr	23.0	5.5	P	do.	Alluvium	N	N	Top edge of casing	1.5	....	8.52	7-5-51	
-32cd	O. H. Hamit	Du	17.0	48	R	do.	do.	Cy, W	S	Side of pump base	....	....	5.03	7-5-51	

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TABLE 8.—*Records of wells in the Ladder Creek area—Greeley County*

WELL NUMBER	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
16-39-1bd	J. F. Weaver	Dr	....	6	P	Sand, gravel	Alluvium	Cy, W	S	Top of casing	0.5	3,435.0	14.05	5-20-51	
-3da	do	Dr	100+	6	P	do	Ogallala	N	N	do	1.0	3,513.4	73.91	5-20-51	
-4ad	do	Dr	64	6	P	do	do	Cy, N	N	do	.0	3,517.4	62.29	5-20-51	
-6cb	E. Bates	Dr	68	6	P	do	Alluvium and Ogallala	Cy, W	S	Base of pump	.5	3,539.9	42.87	5-28-51	
-7aa	do	Dr	50	6	P	do	do	Cy, W	S	Top of casing	.5	3,509.7	24.82	5-28-51	
-7dd	do	Dr	....	6	P	do	Ogallala	Cy, W	S	Top of pump base	1.0	3,541.4	60.33	5-28-51	
-8ca	H. A. Johnson	Dr	33	6	P	do	Alluvium and Ogallala	N	N	Top of casing	1.4	3,507.1	29.07	5-20-51	
-9bc	R. M. McAllaster	Dr	46	6	P	do	do	Cy, W	S	Tin cover	1.0	3,492.2	27.15	5-20-51	
-10aa	C. L. Reimer	Dr	24	6	P	do	do	N	N	Top of casing	.5	3,456.4	17.09	5-20-51	
-10ba	Sarah J. Sides	Dr	54	6	P	do	Ogallala	Cy, W	N	do	1.0	3,479.8	36.98	5-20-51	
-10cd	Greeley County	Dr	104.6	6	P	do	do	Cy, H	D	do	.2	3,523.7	82.80	5-20-51	
-12bd	J. F. Weaver	Dr	19.0	6	P	do	Alluvium	Cy, W	S	do	.5	3,429.2	15.30	11-27-51	
-12dd	T. F. Rozean	Dr	15.8	6	P	do	do	N	N	do	.4	3,416.6	10.92	5-20-51	Caved 2/6/52
-18da	E. Bates	Dr	118	6	P	do	Ogallala	Cy, W	D, S	do	.5	3,580.4	105.85	5-28-51	
-24bd	R. M. McAllaster	Dr	81	6	P	do	do	Cy, W	S	do	1.0	3,472.9	65.68	5-28-51	
-26ad	G. C. Zink	Dr	105.8	6	P	do	do	Cy, W	D, S	do	.4	3,493.7	85.34	5-28-51	
-28da	G. H. Mitchell	Dr	90	6	P	do	do	Cy, W	N	Metal cover	.0	3,626.4	86.25	5-28-51	
16-40-2cb	A. Sell	Dr	51.5	6	P	do	do	N	N	Top of casing	.2	3,567.2	38.32	7-13-51	
-2da	T. M. Boulware	Dr	53.2	6	P	do	do	Cy, W	S	Hole near pump base	.2	3,550.3	36.29	5-28-51	
-6bb	H. Hoffman	Dr	112	6	P	do	do	N	N	Top of casing	.0	3,672.2	102.83	7-13-51	
-9cb	Ben Raines et al	Dr	....	6	P	do	do	Cy, W	S	do	.5	3,676.9	125.50	7-13-51	
-10aa	A. Sell	Dr	63.0	6	P	do	do	Cy, W	S	Hole between planks	1.0	3,591.5	59.33	7-13-51	
-14da	T. H. Oschner	Dr	128	6	P	do	do	Cy, W	S	Top of casing	.5	3,613.4	110.90	5-28-51	
-18ac	Sebastian	Dr	214	....	P	do	do	T, D	I	Hole in base of pump	.5	3,694.0	120.83	11-20-50	Reported yield 1,200, drawdown 45.
-27cc	Earnest Kysar	Dr	75	6	P	do	do	Cy, C, W	N	Top of casing	.5	3,604.3	69.91	7-13-51	
-28bb	O. L. Wilson	Dr	98.2	6	P	do	do	Cy, W	N	do	1.9	3,636.6	84.21	1-8-52	
-35ab	Brunswig	Dr	118.5	18(?)	P	do	do	N	N	Hole in barrel	3.0	3,570.0	77.26	4-2-51	Recorder well

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16-41-12bd	J. A. Hoffman	Dr	198.9	6	P	do.	do.	Cy, W	D, S	Top of casing	2.0	3,675.1	94.78	7-18-51	
-14da	do.	Dr	132.9	6	P	do.	do.	Cy, W	S	Hole in cover	.8	3,707.3	124.52	7-18-51	
-20ba	James Howell	Dr	153.0	6½	P	do.	do.	N	N	Top of casing	.0	3,741.0	130.83	7-18-51	
-26dd	Schneider	Dr	160.4	6	P	do.	do.	Cy, W	S	Hole between planks	1.1	3,706.0	136.80	7-16-51	
-30bb	A. J. Dyke	Dr	142	6	P	do.	do.	Cy, W	S	Hole beneath pump	.0	3,763.0	138.76	7-18-51	
-32aa	R. F. Nolan	Dr	195.8	6	P	do.	do.	Cy, W	D	Hole beneath cover	1.8	3,770.9	164.26	7-18-51	
16-42-2bb	H. Agur	Dr	260	......	P	do.	do.	T, D	I	....	......	....	....	....	
-9ab	R. Sloan	Dr	213.1	6	P	do.	do.	Cy, W	S	Top of casing	.2	3,824.0	169.78	7-16-51	
-10dd	L. A. Young	Dr	198	6	P	do.	do.	N	N	do.	.5	....	179.56	7-16-51	New well
-12ad	M. E. Markwell	Dr	....	2½	P	do.	do.	Cy, W	D	do.	.0	3,769.0	146.81	7-18-51	
-18dd	M. R. Rusco	Dr	212	6	P	do.	do.	Cy, W	D	Hole in pump base	2.5	3,862.2	194.69	7-18-51	
-22ac	L. A. Young	Dr	230	18	P	do.	do.	T, E	I	Top of casing	.5	....	175.38	4-2-51	Reported yield 1,000.
-22ba	do.	Dr	237	18	P	do.	do.	T, E	I	....	......	....	....	....	Reported yield 1,000.
16-43-14cb	Luther and Warren	Dr	250	6	P	do.	do.	Cy, G	D, S	Hole in pump base	1.0	3,928.2	247.30	7-16-51	
-26aa	F. W. Halber et al.	Dr	210	5	P	do.	do.	Cy, N	N	Top of casing	.4	3,894.4	205.60	7-16-51	
17-39-1cc	F. H. Kingman	Dr	71	......	P	do.	do.	Cy, W	S	Top of pump base	1.0	3,451.0	50.78	5-28-51	
-6aa	L. R. Kiefer	Dr	112	6	P	do.	do.	Cy, W	N	Top of casing	.5	3,544.3	107.54	5-28-51	
-10dd	D. G. Mitchell	Dr	120	6	P	do.	do.	Cy, H	N	do.	.5	3,506.6	101.52	5-28-51	
-16dc	Grace Burgard	Dr	118.8	6	P	do.	do.	Cy, W	N	Top of concrete curb	1.2	3,544.0	114.75	5-28-51	
-17cb	H. R. Green	Dr	110	6	P	do.	do.	Cy, W	S	Top of casing	.5	3,547.1	102.14	5-28-51	
-20da	E. Legard	Dr	121	6	P	do.	do.	Cy, W	N	do.	.5	3,542.4	108.77	5-28-51	
17-40-1da	A. E. Smith	Dr	140	6	P	do.	do.	N	N	do.	.5	3,579.6	132.60	5-28-51	
-5cb	C. P. Woods	Dr	161.6	6	P	do.	do.	Cy, W	S	Hole in pump base	1.2	3,651.4	145.53	7-18-51	
-14aa	C. C. Doty	Dr	147	6	P	do.	do.	Cy, W	S	Top of casing	.5	3,593.8	130.55	7-18-51	
-16dc	E. T. Wears	Dr	148	6	P	do.	do.	Cy, W	N	Base of pump	1.0	3,626.6	137.42	7-18-51	
-22cc	R. V. Gibson	Dr	150.2	5	P	do.	do.	Cy, W	N	Top of casing	.1	3,620.8	138.92	7-18-51	
-30bc	A. Sell	Dr	156.1	6	P	do.	do.	Cy, N	N	do.	.6	3,648.5	132.94	7-18-51	
-31ca	A. E. Smith	Dr	146	6	P	do.	do.	Cy, W	S	do.	1.0	3,647.0	130.64	7-18-51	
-34bb	H. Gibson	Dr	134	6	P	do.	do.	Cy, W	N	Edge of plank	.0	3,577.3	92.55	7-18-51	
-36bd	H. G. Oschner	Dr	139	6	P	do.	do.	Cy, W	N	Top of casing	1.0	3,578.9	119.22	5-28-51	
17-41-8cc	Grace H. Bjork	Dr	117.7	6	P	do.	do.	N	N	do.	.0	3,750.3	115.90	7-18-51	
-12dd	A. Sell	Dr	199.6	6	P	do.	do.	Cy, W	S	do.	1.0	3,701.0	194.32	7-18-51	
17-42-2ab	D. Steel	Dr	169	6	P	do.	do.	Cy, W	S	do.	1.0	3,818.0	162.40	7-18-51	
18-39-1cc	Gerald White	Dr	....	......	......	do.	do.	T, D	I	(not measurable)	......	....	....	....	
-4da	W. T. Rauch	Dr	112.0	6	P	do.	do.	Cy, W	S	Top of casing	1.0	3,509.5	103.32	5-28-51	
-10ad	C. Richardson	Dr	133.1	6	P	do.	do.	Cy, W, H	D, S	do.	.4	3,491.0	109.54	5-28-51	
-19ab	Mrs. Robert Pringle	Dr	83.0	6	P	do.	do.	Cy, W	S	do.	.5	3,502.6	71.92	5-28-51	
-21dd	J. S. Davison	Dr	142.2	6	P	do.	do.	Cy, W	D, S	do.	3.1	3,502.3	112.85	5-28-51	
18-40-4cb	H. G. Oschner	Dr	161	......	P	do.	do.	T, E	I	Hole in pump base	1.0	3,615.3	125.80	9-19-51	Reported yield 400.
-11bb	W. Byerly	Dr	86.8	6	P	do.	do.	Cy, W	S	Top of casing	.5	3,545.1	70.80	7-18-51	
-13ad	W. H. Mallory	Dr	83.8	6	P	do.	do.	Cy, W	S	do.	.5	3,521.8	70.05	7-18-51	

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TABLE 8.—*Records of wells in the Ladder Creek area—Lane County*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
16-29-3bc	M. Magie et al.	Dr	25.1	6	P	Silt and sand	Alluvium	Cy, W	N	Top of casing	.0	2,599.3	23.38	12-18-51	
-17dd	C. Gano Munns	Dr	26.2	6	P	Silt	do.	Cy, W	I	do.	1.3	2,718.1	19.50	12-18-51	
-26bb	C. J. Van Pelt	Dr	97.4	6	P	....	Ogallala	Cy, W, H	S	do.	1.0	2,801.3	83.89	12-18-51	
-28da	Ross Jasper	Dr	170.0	18	P	Sand, gravel	do.	T, B	I	Hole, base of pump	.3	2,812.3	93.53	9-1-48	
-28db	do.	Dr	155.0	16	P	do.	do.	N	N	Top of casing	.5	....	91.48	12-18-51	
-30ab	H. S. Jennison	Dr	46.4	6	P	do.	do.	Cy, W, H	S	do.	.6	2,773.0	36.92	12-18-51	
-31bd	B. I. Dickey	Dr	77.1	6	P	do.	do.	Cy, W	S	do.	1.0	2,782.3	51.90	12-18-51	
-33bc	C. Gano Munns	Dr	98.0	6	P	do.	do.	Cy, W, H	N	do.	.5	2,812.8	88.70	12-18-51	
16-30-8cb	Clifford E. Cooley	Dr	18.5	6	P	do.	Alluvium	Cy, H, G	D	do.	1.2	2,659.3	6.80	12-18-51	
-11cc	J. E. Lewis	Du	9.8	96	C	do.	do.	N	N	Top of curb	.0	2,678.4	6.80	12-18-51	
-13ad	N. J. Harper	Dr	115.0	6	P	do.	Ogallala	Cy, W, H	S	Top of casing	.9	2,833.5	100.39	12-18-51	
-17da	Carl Mathes	Du	19.1	23	P	do.	do.	Cy, W	D, I	do.	3.0	2,760.3	11.05	11-16-51	
-21bc	R. F. Hagans	Dr	147.5	6	P	do.	do.	Cy, W, H	S	do.	-4.5	2,866.4	114.40	11-16-51	
-22ab	Clayton Bentley	Dr	36.5	6	P	do.	do.	Cy, W	S	do.	1.0	2,747.1	26.39	11-16-51	
-25cc	B. I. Dickey	Dr	119	6	P	do.	do.	Cy, W, H	N	do.	.5	2,837.9	108.34	12-18-51	
-27ad	Leah Bentley	Dr	119.1	6	P	do.	do.	Cy, W, H	N	do.	.7	2,844.7	106.15	11-16-51	
-30dd	C. E. Simonsen	Dr	156.0	6	P	do.	do.	Cy, W, H	S	do.	.6	2,879.2	114.86	11-16-51	
-32dd	Joella M. Hagans	Dr	134.7	6	P	do.	do.	Cy, W, H	S	do.	.4	2,879.4	110.45	11-16-51	
-35cc	E. Z. Gano	Dr	129.0	6	P	do.	do.	Cy, W, H	N	do.	.3	2,844.8	106.60	11-16-51	
17-29-5bc	Ray Dodge	Dr	114.0	6	P	do.	do.	Cy, W	N	do.	.2	2,822.5	90.97	12-18-51	
-5dd	Fred Schmieg	Dr	117.7	6	P	do.	do.	Cy, W	S	do.	.5	2,819.3	92.55	12-18-51	
-19ba	Samuel I. Zink	Dr	87.8	6	P	do.	do.	Cy, W	S	do.	.8	2,831.0	78.04	10-31-51	
-20ba	Emmett L. Shay	Dr	110.5	6	P	do.	do.	Cy, W	S	do.	.8	2,810.6	63.39	10-31-51	
17-30-3ba	Healy Cemetery	Dr	113.0	6	P	do.	do.	Cy, W, H	D	do.	.1	2,848.6	104.26	11-16-51	
-5dd	Clara M. Mikesall	Dr	111.0	6	P	do.	do.	Cy, W	N	do.	.0	2,882.3	102.52	11-16-51	
-13cb	F. L. Burmeister	Dr	94.0	6	P	do.	do.	Cy, G	S	do.	.1	2,859.4	85.09	10-31-51	
-14bc	Thelma Wilkens	Dr	112.7	6	P	do.	do.	Cy, W	S	do.	.5	2,859.2	84.72	10-31-51	
-16aa	Roy F. Hagans	Dr	105.0	6	P	do.	do.	Cy, W	S	do.	.7	2,867.3	87.97	10-31-51	
-21cd	C. H. Merriweather	Dr	82.5	6	P	do.	do.	Cy, W	S	do.	.6	2,871.4	75.13	10-31-51	
-23cc	M. M. Cowley	Dr	95.0	6	P	do.	do.	Cy, N	N	Hole in pump	1.2	2,858.7	75.62	10-31-51	
-25da	Carl E. Simonson	Dr	51.0	6	P	do.	do.	Cy, W	S	Top of casing	.7	2,823.8	49.20	10-31-51	
-33bc	W. Krug	Dr	87.0	6	P	do.	do.	Cy, W, H	S	do.	2.3	2,876.6	74.03	10-31-51	
-35bb	J. M. Edmundson	Du	70.0	36	......	do.	do.	Cy, H, G	S	do.	1.3	2,854.2	66.04	10-31-51	
18-30-1bc	Mrs. Etta Grunwald	Dr	80.0	6	P	do.	do.	Cy, W, H	S	do.	.3	2,850.2	69.02	10-31-51	
-2cd	S. J. Sharp	Dr	81.0	6	P	do.	do.	Cy, W	N	do.	.3	2,861.0	75.88	10-31-51	
-4dd	John T. Shull	Dr	79.5	6	P	do.	do.	Cy, W, H	N	do.	.7	2,874.7	75.05	10-31-51	
-7aa	Lorene O. Stormont	Dr	104.0	6	P	do.	do.	Cy, W	S	do.	.0	2,896.9	77.52	10-31-51	

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TABLE 8.—*Records of wells in the Ladder Creek area—Logan County*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
13-33-32dd	Z. E. Ross	Dr	25	6	P	Sand, gravel	Alluvium	Cy, W	N	Edge of casing	1.0		8.08	6- 1-51	
13-34-29bd	G. H. Newcom	Du		36	C	Chalky shale	Niobrara	Cy, W	S	Crack in plank	.5		10.73	6- 4-51	Well intersects spring that seeps on hill below well.
-34aa	do.	Du	14	6	P	Sand, gravel	Alluvium	Cy, W	N	Edge of cylinder	3.0		8.48	6- 4-51	
13-35-35ac	H. Jordan	Dr	18	5	P	do.	do.	Cy, W	S	Edge of casing	1.1		6.95	7- 5-51	
-36bd	Wycoff Bros.		30	6	P	do.	do.	Cy, W	S	do.	2.0		10.81	6- 4-51	
13-36-20cc	Charles Lamb	Dr	32	16	P	do.	do.	VC, B	I	do.	1.0		6.42	7-18-51	Reported yield 1,200.
-25aa	C. C. Ware and J. R. Haren	Dr	13	12	P	do.	do.	Cy, W	S	do.	2.6		5.30	7- 5-51	
-28ba	Lutheran Church	Dr	35.0	5.5	P	do.	Sanborn and Meade	Cy, H	D	do.	1.0		20.3	7- 5-51	
-32bc	T. Fotopoulus	Du	29.5	36	C	do.	do.	Cy, G	N	Top wood cover	1.0		19.52	7- 2-51	
-34dd	W. Haverfield	Du	13	36	C	do.	Alluvium	Cy, W	N	Edge of steel drum	2.0		9.07	7- 5-51	
13-37-10cc	Wm. McMillen	Dr	18	5.5	P	do.	Sanborn and Meade	Cy, W	S	Edge of casing	.9		6.65	7- 2-51	
-13dd	O. Poppe et al.	Dr	16	5.5	P	do.	Alluvium	Cy, W	S	do.	1.7		6.02	7- 2-51	
-15ac	Wm. McMillen	Dr	45.1	18	P	do.	do.	T, T	I	Top edge of hole, pump base	.5		9.84	7-18-51	
-15bc	W. P. Kirkham	Dr	40.4	16	P	do.	do.	T, T	I	Bottom edge of pump base	.5		7.50	7-18-51	
-16ac	Wm. Teichman	Dr	63.5	20	P	do.	Sanborn and Meade	T, T	I	Top of hole in pump base	1.5		35.43	7-18-51	
-18dd	T. J. Bussen	Dr	41.0	6	P	do.	do.	Cy, H	D	Edge of casing	.3		33.83	7- 2-51	
-28bb	D. Unruh	Dr	11	6	P	do.	do.	Cy, G	S	do.	.1		6.1	7- 2-51	
14-32-34da	G. C. Wren	Dr	14	6	P	do.	do.	Cy, W	S	do.	.0		7.06	7- 5-51	
14-33-6cc	Tuck Smith	Dr	38	6	P	do.	do.	Cy, W	S	do.	.5		20.96	5-31-51	
-8db	L. Bertrand	Du	11	36	R	do.	do.	N	N	do.	.5		8.69	5-31-51	
-30ca	R. C. Gates	Du	22	36	C	do.	do.	Cy, W	S	Top of wooden plank	.5		15.04	5-31-51	
-33ac	J. J. Clark	Du	50	36	R	do.	do.	Cy, W	S	Edge of plank	.5		28.58	5-31-51	

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TABLE 8.—*Records of wells (Logan County—continued)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
14-34-8bc	Urttie Walz	Du	......	36	R	Sand, gravel		Cy, W	S	Edge of casing	2.0	......	48.89	6-1-51	
-25aa	A. L. Kendrick	Du	156.0	6	P	Chalk	Niobrara	Cy, W	S	Edge of pump base	0.5	......	58.87	5-31-51	
-29bb	Benson	......	70.0	......	......	Sand, gravel	Sanborn and Meade	Cy, W	S	Edge of plank	.5	......	48.45	6-1-51	
14-35-5cd	F. E. Ausmus	Du	48.0	......	N	do.	do.	Cy, H	N	Edge of pipe hole	1.0	......	43.1	7-5-51	
-23bd	H. Unruh	Du	53.0	36	R	do.	do.	Cy, W	S	Edge of plank	.5	......	41.39	6-1-35	
-33ba	C. C. Ware	Du	17.0	6	P	do.	Alluvium	Cy, W	S	Edge of casing	1.0	......	5.64	6-4-51	
14-36-14cd	R. L. Wycoff	Du	43.0	36	W	do.	do.	Cy, G	S	Pump base, crack in plank	.1	......	5.75	7-5-51	
-29dc	R. Herschberger	Du	43.4	40	C	do.	Sanborn and Meade	Cy, W	N	Edge of concrete casing	2.5	......	25.42	6-12-51	
-34cd	P. D. Rishel	Dr	52.0	5.5	P	do.	do.	Cy, W	S	Edge of casing	1.0	......	30.64	6-14-51	
14-37-2ba	W. Purviance	Du	13.5	50	R	do.	do.	Cy, W	S	Edge of plank in draw-pipe hole	.0	......	3.83	6-26-51	
-14aa	Federal Farm Mtg. Corp.	Du	26.3	......	R	do.	Ogallala, Sanborn and Meade	N	N	Side of E-W bar	1.0	......	23.95	6-26-51	
-20ba	W. Purviance	Du	13.0	48	C	do.	Alluvium	N	N	Crack in center of wood cover	1.2	3,347.1	5.75	6-14-51	
-24cd	G. H. Jones	Du	10.5	60	C	do.	do.	Cy, W	D, S	NW corner of inspection hole	1.5	......	6.0	6-26-51	
-28cb	U. S. Geological Survey	J	20.0	.75	P	do.	do.	N	N	Top of casing	3.5	......	11.4	1-15-52	
-29da	Carroll Purvines	Dr	19.7	6	P	do.	do.	Cy, W	S	Edge of casing	2.0	3,303.8	8.00	6-14-51	
15-32-4aa	R. B. Christy	Dr	10.3	5.5	P	do.	do.	Cy, H	D	do.	1.5	2,646.0	7.42	5-29-51	
-5cc	R. A. Turley	Dr	21.5	6	P	do.	Sanborn and Meade	Cy, W	S	do.	.0	2,670.0	14.27	5-29-51	
-9ba	E. G. Rohrbough	......	21.0	......	......	do.	do.	Cy, W	S	Edge of 2"x6" plank	.3	2,692.0	17.74	5-29-51	
-10bb	W. C. Wright	......	18.0	6	......	do.	Alluvium	C, G	D	Edge of hole, under tin cover	.0	2,670.8	9.57	5-29-51	
-16ca	C. A. Been	Dr	14.8	......	......	do.	do.	Cy, W	S	Edge of hole under pump	2.5	2,725.2	6.48	5-29-51	

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-19bd	H. T. Young	Dr	21	6	P	do.	Niobrara or Alluvium or both	Cy, W	D, S	Edge of casing	.5		17.35	4-27-51
-26da	A. E. Ryan	Dr	83.5	6	P	do.	Ogallala	Cy, W	S	do.	.5	2,953.0	81.08	7- 5-51
-27cb	R. B. Christy	Dr	67.0	6	P	do.	do.	Cy, W	S	do.	.5	2,978.5	63.87	7- 5-51
-33bc	R. B. Christy	Dr	137.0	6		do.	do.	Cy, W	S	do.	.5	3,013.5	126.50	5-29-51
15-33-3da	L. D. Delaney	Du	8.8			do.	Sanborn and Meade	N	N	Edge of hole in concrete	.0		7.08	5-31-51
-5ac	D. L. Staats	Dr	42.4	6	P	do.	Alluvium	Cy, W	S	Bottom edge of plank over pit	1.0		21.48	5-29-51
-7cb	W. A. Wood	Dr	27.0	8	P	do.	do.	Cy, W	S	Edge of casing	1.0		2.98	6- 1-51
-8bc	Dean Staats	Dr	42.6	6	P	do.	do.	Cy, W	S	do.	1.5		12.35	5-31-51
-11bd	L. D. Delaney	Dr	22.6	5	P	do.	do.	Cy, W	S	do.	.0		15.73	5-31-51
-13cb	U. S. Geological Survey	J	23.0	.75	P	do.	do.	N	N	Top of ¾" pipe	2.0	2,756.8	15.12	12-11-51
-22ad	R. S. Irvin	Du	14.0	5.50	P	do.	Sanborn and Meade	Cy, W	S	Edge of casing	.3	2,780.0	9.98	5-31-51
-33cc	J. R. Hollister	Dr	36.5	5.50	P	do.	Ogallala	N	N	do.	.0	2,982.0	26.71	5-31-51
-34ca	Geo. Epler	Dr	12.0	5.50	P	do.	do.	Cy, W	S	Top of board under pump plate	.0	2,931.0	2.95	5-31-51
15-34-3cc	Shara Clayberg	Dr	30.0	6	P	do.	Alluvium	Cy, W	S	Edge of casing	.5		12.70	6- 1-51
-4cd	do.	Dr	12.0	6	P	do.	Sanborn and Meade	N	N	do.	.5		8.09	6- 1-51
-26ac	P. V. Warren	Dr	22.0	6	P	do.	do.	Cy, W	S	Top of west plank next to pipe	1.0	2,926.8	10.07	6- 1-51
-27da	Logan County	Dr	23.5	6	P	do.	do.	Cy, W	D	Edge of casing under pipe	.3	2,944.3	11.45	6- 1-51
-28dd	W. A. Wood	Dr	25.5	6	P	do.	do.	Cy, W	S	Edge of hole in concrete	.0	2,908.4	19.65	6- 1-51
-30cd	L. F. Palen	Dr	40.8	5	P	do.	do.	Cy, W	S	Edge of casing	.5	3,061.7	28.42	6- 5-51
-32ca	Zita Palen	Dr	38.5	5	P	do.	Sanborn and Alluvium	Cy, W	S	do.	.5	3,027.4	16.47	6- 5-51
15-35-2ab	G. F. Hamilton	Dr	37.0	6	P	do.	Alluvium	Cy, W	S	do.	1.5		9.68	6- 4-51
-6ba	Foot Hills Corp.	Du	30.8	24	C	do.	Sanborn and Meade	Cy, W	S	Edge of south 2 x 4	.6		11.8	6-12-51
-12ba	T. P. Wright	Du		6	P	do.	do.	Cy, W	S	Hole under well cover	.5		13.48	6- 1-51
-19cc	G. W. Biman	Dr	86	12	P	Sand, gravel, and chalk	Ogallala, Niobrara	N	N	Edge of casing	.6	3,250.3	28.82	6- 8-51
-25cd	J. S. Palen	Dr	22.8	5	P	Sand, gravel	Sanborn and Meade	Cy, W	S	do.	.1	3,066.2	10.38	6- 5-51
-28bc	H. F. Johnson	Dr	65.0			do.	do.	N	N	Top west edge of stone masonry	2.0	3,201.6	39.64	6- 5-51
-28bd	do.	Dr	70.0		P	Chalk	Niobrara	Cy, W	S					
-32ad	do.	Dr	18.0	6	P	Sand, gravel	Alluvium	N	N	Edge of casing	.0		10.10	6- 5-51

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TABLE 8.—*Records of wells (Logan County—concluded)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
15-36-16dd	M. E. Wood	Dr	92.0	5.5	P	Chalk	Niobrara	Cy, W	D	Edge of casing	1.0	3,338.2	75.59	6- 6-51	
-20cd	J. K. Granville	Du	68.0	36	R	Sand, gravel	Ogallala	Cy, W	S	Edge of metal disk on pump base	1.0	3,330.9	51.76	6- 6-51	
-23bd	E. H. Smith	Dr	72.0	5.5	P	Sand, gravel, and chalk	Ogallala and Niobrara	Cy, W	S	Edge of casing	.1	3,281.4	33.29	6- 8-51	
-32dd	J. F. Gerstberger	Dr	18.7	6	P	Sand, gravel	Sanborn, Meade, and Ogallala	N	N	do.	.0	3,251.6	10.11	6- 6-51	
-34ca	E. H. Smith	Dr	31.0	5	P	do.	Alluvium, Sanborn, and Meade	Cy, W	S	do.	.5	......	10.21	6- 6-51	
-36db	L. H. Strickert	Dr	18.9	6	P	do.	do.	Cy, W	S	do.	.0	3,196.2	6.06	6- 8-51	
15-37-1ba	R. B. Christy	Dr	23.0	5	P	do.	Sanborn and Meade	Cy, W	S	Edge of steel disk around pipe	.1	3,205.6	13.56	6-14-51	
-4cb	Carrell Purvines et al.	Du	17.0	......	......	do.	Alluvium	Cy, W	D, S	Crack between boards	1.0	3,312.1	10.17	6-14-51	
-10cd	Gert. Toley	Du	51.0	......	N	Sand, gravel, and shale	Ogallala and Pierre	N	N	Edge of stone finish	.0	......	41.69	6-14-51	
-18cd	R. C. Burton	Dr	69.0	6	P	do.	do.	Cy, W	D, S	Edge of casing	1.4	3,467.2	60.66	6-14-51	
-22dd	R. L. Sargent	Du	47.0	48	R	Sand, gravel	Ogallala	N	N	Edge of iron wheel hub	.0	3,389.6	44.85	6- 8-51	
-24db	Mary Blau	Du	87.0	48	R	Sand, gravel, and shale	Ogallala and Pierre	N	N	Edge of stone casing	.2	3,380.7	68.66	6- 8-51	
-30cb	Ben H. Atkinson	Dr	73.0	6	P	Sand, gravel	Ogallala	Cy, W	D	Edge of casing	.8	3,439.4	49.53	6- 8-51	
-33dd	E. A. Niswenger	Dr	73.5	6	P	do.	do.	N	N	do.	1.7	3,391.2	70.05	6-26-51	

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TABLE 8.—*Records of wells in the Ladder Creek area—Scott County*

WELL NUMBER	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
16-31-2bd	R. W. Haverfield	Dr	61.5	6	P	Sand, gravel	Alluvium	N	N	Top of casing	1.0	2,815.6	23.97	6-1-51	New well.
-10aa	T. H. Yates	Dr	71.7	6	P	do.	do.	Cy, W	S	do.	1.0	2,854.6	36.38	6-1-51	
-10cb	J. R. and E. Fisk	Dr	67.7	6	P	do.	do.	Cy, W	S	Top of casing	1.0	2,864.8	49.59	6-1-51	
-11ab	R. Harper	Dr, B	27.5	24	......	do.	do.	Cy, W	S	Top edge of concrete slab	1.0	2,815.0	18.56	6-1-51	
-17bc	R. B. Christy	Dr	109	5½	P	do.	Ogallala, Sanborn, and Meade	Cy, W	S	Top of casing	.5	....	96.57	6-4-51	
-17dd	S. Scheuerman	Dr	125	6	P	do.	do.	Cy, W	S	Top of casing and concrete	.5	2,931.0	118.43	5-23-51	
-18bc	L. R. Jewell	Dr	142	5½	P	do.	do.	Cy, W	S	Top of casing	....	2,956.4	124.28	6-4-51	
-23cb	Jno. Herbek	Dr	143	5½	P	do.	do.	Cy, W	S	do.	.0	2,906.5	116.75	6-4-51	
-25ac	D. W. Stewart	Dr	136	6	P	do.	do.	Cy, W	S	do.	1.0	2,890.8	114.04	6-4-51	
-29aa	A. Janssen	Dr	132	6	P	do.	do.	Cy, H	N	do.	1.0	2,929.9	117.32	5-21-51	
-29bc	Gene Harper	Dr	....	18	......	do.	do.	T, B	I	Top of hole in pump base	.0	2,945.4	124.82	5-23-51	
-29dc	Norman Harper	Dr	....	18	......	do.	do.	T, B	I	Edge of opening vert. cyl. housing	.5	2,942.2	123.58	6-1-51	
-31bc	L. Eaton	Dr	179	18	P	do.	do.	T, D	I	do.	.5	2,959.0	127.55	5-21-51	Reported yield 427
-33da	C. H. Scheuerman	Dr	93	6	P	do.	do.	Cy, W	S	Top of casing	1.0	2,885.9	76.15	6-5-51	
-35ab	A. R. Thon	Dr	15.6	5½	P	do.	Alluvium	N	N	do.	.4	2,807.7	11.88	6-4-51	
16-32-2bc	Roy G. Browning	Dr	135	6	P	do.	Ogallala or Sanborn and Meade	Cy, W, G	D	do.	.5	2,976.7	123.08	5-31-51	
-4dd	O. F. Hoema	Dr	156	5½	P	do.	do.	Cy, W	S	do.	.5	2,992.1	141.70	5-25-51	
-6bb	H. T. Young	Dr	153	5½	P	do.	do.	Cy, W	S	do.	1.0	3,001.8	136.95	5-31-51	
-9aa	W. Steinberg	Dr	....	5½	P	do.	do.	N	N	do.	.5	2,981.7	136.28	5-24-51	
-12cd	H. F. Brown	Dr	137	6	P	do.	do.	Cy, W	S	do.	1.0	2,967.8	130.61	5-31-51	
-14bb	B. Hawkinson	Dr	154	6	P	do.	do.	Cy, W, H	D	do.	.5	2,976.3	136.19	5-31-51	
-15bc	R. W. Hoema	Dr	177	5	P	do.	do.	N	N	do.	4.5	2,993.4	150.1	5-25-51	
-16bc	L. L. Fouser	Dr	177	5½	P	do.	do.	Cy, W	S	do.	.5	3,000.3	159.74	5-25-51	
-22cb	O. F. Hoema	Dr	180	5½	P	do.	do.	Cy, W	S	Top of concrete	.5	2,989.9	143.32	5-25-51	
-22cc	do.	Dr	167	6	P	do.	do.	Cy	D	Top of casing	1.0	2,990.3	142.78	5-21-51	

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TABLE 8.—*Records of wells (Scott County—continued)*

Well Number	Owner, or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed		Method of lift	Use of water	Measuring point			Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
						Character of material	Geologic source			Description	Distance above land surface, feet	Height above mean sea level, feet			
16-32-24ac	W. Steinberg	Dr	153	5½	P	Sand, gravel	Ogallala, Sanborn, and Meade	Cy, W	S	Top of casing	1.0	2,961.0	126.98	6- 4-51	
-31ba	R. B. Christy	Dr	110	6	P	do.	do.	Cy, W	S	do.	1.0	2,950.7	85.13	5-26-51	
-32ca	Mrs. Estes Christy	Dr	96.5	8	P	do.	do.	Cy, W	S	do.	1.0	2,954.4	79.32	5-31-51	
-32dc		Dr	127	6	P	do.	do.	Cy, W	S						
-33bc	Dorothy M. Whitney	Dr		6	P	do.	do.	Cy, W	S	do.	.5	2,982.3	115.84	5-21-51	
-35dc	L. Eaton	Dr	153.5	6	P	do.	do.	Cy, W	N	do.	.5	2,978.3	130.80	5-21-51	
16-33-4dd	Mabel Stevens	Dr	160	5½	P	do.	do.	Cy, W	S	do.	.2	3,051.9	135.47	4-27-51	
-6cc	R. Beasley	Dr	41.3	5½	P	do.	Alluvium	N	N	do.	1.4	3,003.9	39.10	5- 1-51	
-8cb	J. R. Hollister	Dr	176	18	P	do.	Ogallala, Sanborn, and Meade	T, G	I	Base of pump	.6	3,084.2	130.28	4- 6-51	
-12dd	Broadview Park Co.	Dr		5½	P	do.	do.	Cy, W	S	Top of casing	.5	2,863.9	38.63	4-27-51	
-14db	Agnes Schowalter	Dr	174	6	P	do.	do.	Cy, W	S	do.	.5	3,004.3	144.57	4-25-51	
-17bb	Geo. Epler	Dr	173	18	P	do.	do.	T, G	I	Hole in pump base	.0	3,080.1	131.13	4- 5-51	
-18dd	P. J. Heidland	Dr	141	6	P	do.	do.	Cy, W	D	Top of casing	.4	3,087.1	128.78	5-26-51	
-21bb	S. Dirks	Dr	158.4	5½	P	do.	do.	N	N	do.	1.0	3,080.5	146.33	5-25-51	
-24ac	R. B. Christy	Dr		6	P	do.	Sanborn and Meade	Cy, W	D	do.	.0	2,859.3	16.02	4-27-51	
-24da	U. S. Geological Survey	J	20.0	0.75	P	do.	do.	N	O	Top of pipe	1.0	2,856.2	10.79	1-10-52	
-25ba	R. B. Christy	Dr			P	do.	do.	Cy, G	S	Top of casing	.5	2,886.7	14.20	1-10-52	
-30cb	R. L. Fairleigh	Dr			P	do.	Ogallala	Cy, W	D	do.	1.0	3,100.1	121.12	4-26-51	
-34cd	E. Unruh	Dr	124.0		P	do.	do.	N	N	do.	.5	3,033.0	114.15	4-25-51	
16-34-5ad	Roy Tucker	B	8.5	6	P	do.		N	N	do.	.0	3,029.4	6.09	4-26-51	
-9cc	do.	Dr	181.0		P			T	I	Top of concrete	.0	3,145.5	121.81	4- 6-51	
-10cb	A. E. Koehn	Dr	128.0	6	P	Sand, gravel	Ogallala	Cy, W	S	Top of casing	1.5	3,129.7	117.94	4-26-51	
-11ad	H. S. Mix	Dr	137.8	6	P			Cy	N	do.	1.0	3,109.3	126.85	4-26-51	
-12db	J. H. Sweeney	Dr			P	Sand, gravel	Ogallala	T, E	I	Base of pump	.5	3,104.9	129.79	4- 5-51	
-13bb	F. Kottwitz	Dr	191.0	18	P	do.	do.	T, D	I	Notch, south side of casing	.0	3,103.7	130.56	4- 5-51	Yield estimated, 900.
-14dd	S. Dirks	Dr		6	P	do.	do.	Cy, H	D	Top of casing	.2	3,112.0	123.92	4-26-51	
-15cc	J. S. Notestine	Dr		16	P	do.	do.	T, D	I	End of discharge pipe	.8	3,135	125.91	8-14-51	Measured yield, 938.
-18dd	Lily Miller	Dr	140.1	6	P			Cy	N	Top of casing	.4	3,158.9	117.71	4-26-51	

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-22bb	Scott County School	Dr	144.0	6	P			N	N	do.	.0	3,132.2	116.93	4-26-51	
-25bb	G. Fitzgerald	Dr		6	P	Sand, gravel	Ogallala	Cy, W	D	do.	.0	3,109.2	120.20	5-1-51	
-28cb	W. B. Blakey	Dr	121.0	6	P			N	N	Top of concrete casing	.6	3,145.2	114.50	4-26-51	
-31da	R. B. Christy	Dr	122.2	6	P			Cy, W	S	Broken pump base	1.4	3,161.4	115.27	5-1-51	
-36dd	C. O. Beeson	Dr		6	P	Sand, gravel	Ogallala	Cy, W, H	D	Bolt on south side of casing	.3	3,098.1	116.64	4-26-51	
17-31-1da	*Anna Vogleman*	Dr	121.7	6	P	do.	do.	Cy, W	N	Top of casing	1.0	2,897.5	103.60	6-4-51	
-7ab	Serena Schoonover	Dr	147.0	6	P	do.	do.	Cy, W	S	do.	.0	2,960.5	126.01	5-21-51	
-8ab	M. V. Torrence	Dr		6	P	do.	do.	Cy, W	N	do.	.0	2,953.4	129.54	5-21-51	
-13bb	A. A. French	Dr	101.5	6	P			Cy, W	N	do.	.5	2,901.2	94.25	6-5-51	
-16dd	P. R. Brees	Dr	110.5	6	P			Cy,G	S	Hole in pump base	1.5	2,938.9	102.24	6-5-51	
-17da	Burdett Patton	Dr	195	18	P	Sand, gravel	Ogallala	T, G	I	do.	.0	2,950.6	111.84	5-23-51	
-18ba	W. Rodenburg	Dr	132.0	6	P	do.	do.	Cy, W	N	Top of casing	.5	2,962.5	118.12	5-21-51	
-24bc	J. M. French	Dr	96.0	6	P	do.	do.	Cy, W	S	Hole in pump base	1.0	2,908.4	89.11	6-5-51	
-25bc	Alvin Rodenburg	Dr	170	16	P	do.	do.	T, D	I	Top of concrete curb	.0	2,914.0	88.19	3-30-51	Yield measured 650, drawdown 30.
-29ad	Huck Bros.	Dr	120	8	P	do.	do.	Cy, W	D, S	Top of casing	.5	2,946.2	91.57	5-23-51	
-29dc	do.	Dr	190	18	P	do.	do.	T, D	I	Base of pump		2,954.8	97		Yield estimated, 1,350, drawdown 25
-30cd	C. W. Durrant	Dr	110	4.5	P	do.	do.	Cy, W	S	Top of casing	.5	2,965.6	99.59	5-14-51	
-35cc	Glenn Ramsey	Dr				do.	do.	T, D	I	Hole in pump base	1.0	2,925.0	86.70	3-30-51	
17-32-5ab	Effie M. Christy	Dr	208	18	P	do.	do.	T, D	I	do.	1.0	2,985.0	107.79	5-21-51	Yield measured, 436.
-5ad	do.	Dr		6	P	do.	do.	Cy, H	D	Top of casing	.5	2,973.4	89.44	5-21-51	
-8aa	R. B. Christy	Dr	98.7	6	P	do.	do.	Cy, W	N	do.	.0	2,970.2	82.20	5-21-51	
-9ba	R. R. Robb	Dr		6	P	do.	do.	Cy, N	N	do.	.5	2,985.9	102.38	5-21-51	
-11cc	O. H. Schmitt	Dr	125.0	6	P	do.	do.	Cy, W	N	do.	1.0	2,986.6	115.24	5-21-51	
-11da	do.	Dr		6	P	do.	do.	Cy, W	S	Top of curb	.0	2,977.1	122.73	5-21-51	
-14cc	J. Wiechmann	Dr		6	P	do.	do.	Cy, H	N	Top of casing	1.0	2,992.1	113.42	5-21-51	
-16cc	A. H. Janssen	Dr		6	P	do.	do.	Cy, W	S	do.	1.0	2,987.0	88.29	5-17-51	
-18ac	G. W. Ward	Dr	103.0	6	P	do.	do.	Cy, W	S	do.	.5	2,981.2	75.34	5-31-51	
-19dc	F. L. Shuck	Dr	75.0	6	P	do.	do.	Cy, W	N	do.	.0	2,982.5	70.98	5-17-51	
-22da	F. C. Brookover	Dr	167	16	P	do.	do.	T, G	I	Hole in pump base	.2	2,982.7	100.09	5-21-51	Estimated yield, 400.
-23dc	L. See	Dr		6	P	do.	do.	Cy, N	N	Top of casing	.5	2,978.6	99.58	5-23-51	
-26cc	F. C. Brookover	Dr	180	18	P	do.	do.	T, G	I	Hole in pump base	1.3	2,983.6	97.72	5-23-51	Estimated yield, 1,250, drawdown 37
-27ac	do.	Dr	180	18	P	do.	do.	T, G	I	do.	.5	2,987.0	97.77	5-24-51	Estimated yield, 1,050, drawdown 46
-27dc	V. White	Dr	180	18		do.	do.	T, G	I	do.	1.0	2,986.4	97.36	5-24-51	Yield, 1,250, drawdown 30
-28aa	C. L. Pfenninger W. C. Pfenninger	Dr		6	P	do.	do.	Cy, W	D	Top of casing	.0	2,988.4	95.20	5-21-51	
-30cc	John Wiedimann	Dr	140	16	P	do.	do.	T, E	I	Hole in pump base	1.0	2,983.0	70.27	3-27-51	Estimated yield, 850.
-31cb	O. B. Younger	Dr	82.0	6	P	do.	Sanborn and Meade	Cy, W	N	Top of casing	.0	2,976.0	63.14	5-17-51	

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TABLE 8.—*Records of wells (Scott County—continued)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
17-32-32ca	J. W. Deeds	Dr	....	6	P	Sand, gravel	Ogallala	Cy, W	S	Top of casing	1.0	2,996.7	91.76	5-24-51	
-33ac	J. G. Melchert	Dr	121.0	6	P	do.	do.	N	N	do.	.5	....	83.75	6- 1-51	
-34cc	Mary Barta	Dr	....	6	P	do.	do.	Cy, H	N	do.	1.0	2,974.1	75.05	5-10-51	
-35aa	Cora Crowell	Dr	....	6	P	....	....	N	N	do.	.0	2,968.4	88.87	5-11-51	
-36ab	Marvin Durrant	Dr	182	18	P	Sand, gravel	Ogallala	T, D	I	End of discharge pipe	.5	2,976.5	96	3-30-51	Estimated yield, 900, drawdown 69 after 24 hours.
17-33-1bd	J. H. Weichmann	Du	15	6	P	do.	Alluvium	P, H	S	Base of pump	2.0	2,905.6	12.80	4-27-51	
-5cc	Hurbeck Krebs	Dr	....	6	P	do.	Ogallala	Cy, W	S	Top of casing	.5	3,080.3	116.78	4-26-51	
-16ba	W. Carpenter	Dr	121.0	6	P	do.	do.	Cy, W	N	do.	.5	3,069.7	117.61	4-25-51	
-21bd	U. S. Geological Survey	J	21.0	0.75	P	do.	Alluvium	N	O	do.	2.0	2,967.1	16.25	1-10-52	
-21ca	do.	Dr	76.5	0.75	P	do.	Ogallala	N	O	do.	.7	3,001.5	54.04	9-17-51	
-21cd	do.	Dr	111.0	0.75	P	do.	do.	N	O	do.	1.5	3,037.2	91.65	9-17-51	
-21da	Mabel Herron	Dr	40.0	6	P	do.	do.	Cy, W	N	do.	.5	2,974.7	26.62	4-25-51	
-21db	U. S. Geological Survey	Dr	30.6	0.75	P	do.	do.	N	O	do.	1.0	2,975.3	22.63	9-21-51	
-22bb	W. Herron	Dr	....	6	P	do.	do.	N	O	do.	.5	....	18.06	11-11-51	Recorder well.
-23cc	Lloyd Rudolf	Dr	205	18	P	do.	do.	T, B	I	Hole in pump base	1.5	3,018.8	99.95	4- 6-51	Reported yield, 910.
-25cc	S. W. Filson	Dr	124	16	P	do.	do.	T, E	I	do.	1.6	2,992.3	75.36	4- 3-51	Reported yield, 1,100.
-27bb	F. P. Geist	Dr	....	6	P	do.	do.	Cy, W	D, S	Top of casing	1.2	2,980.4	33.64	4-25-51	
-27dd	Wayne Rudolph	Dr	208	18	P	do.	do.	T, B	I	Hole in pump base	1.5	3,019.0	94.24	4- 5-51	Yield 1,350, drawdown 31.
-28cd	Lloyd Stockwell	Dr	190	16	P	do.	do.	T, G	I	do.	1.5	3,036.9	91.42	4- 2-51	Yield 776, drawdown 36 after 11 hours.
-30bd	Ross Shirk	Dr	182	18	P	do.	do.	T, B	I	do.	1.0	3,082.4	111.25	7-17-51	
-31ab	Levi Koehn	Dr	170	18	P	do.	do.	T, G	I	do.	.0	3,079.8	109.73	4- 3-51	Reported yield 700, drawdown 40.
-32bb	N. Buehler	Dr	178	18	P	do.	do.	T	I	....	....	....	....	....	Reported yield 1,200.
-33db	Floyd Krebs	Dr	165	....	P	do.	do.	T, G	I	Hole in pump base	1.0	3,023.1	82.61	4- 2-51	

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-36ba	S. W. Filson	Dr	230		P	do.	Sanborn and Meade	T, E	I	do.	.5	2,995	79.15	4- 3-51	Reported yield 1,200.
-36ca	F. W. Krause	Dr	140	16	P	do.	do.	T, E	I	do.	1.2	2,990.8	74.45	4- 3-51	
17-34-2dc	C. W. Watkins	Dr	205		P	do.	Ogallala	T, D	I	do.	.5	3,108.3	111.75	4-26-51	
-3bb	Clyde Long	Dr	132	6	P	do.	do.	Cy, W	D	Top of casing	1.0	3,132.6	113.37	5- 1-51	
-8ad	F. H. Paulsen	Dr	115.0			do.	do.	Cy, W	S	do.	.0	3,142.4	107.10	5- 1-51	
-13bc	R. B. Christy	Dr		6	P	do.	Alluvium	Cy, W	N	do.	.5	3,028.2	34.83	4-26-51	
-16ac	B. Nelson	Dr	208			do.	Ogallala	T, D	I	Hole in pump base	.8	3,134.3	106.83	4-26-51	
-17cd	M. F. Barnhart	Dr	71.5	6		do.	do.	N	N	Top of casing	.5	3,094.7	51.50	5- 1-51	
-19db	Griffith Ranch	Dr	87.0	6	P	do.	do.	Cy, W	S	do.	.5	3,135.3	82.50	5- 2-51	
-21ad[1]	U. S. Geological Survey	J	21.5	0.75	P	do.		N	O	do.	4.0	3,039.2	13.27	12- 5-51	
-21ad[2]	do.	J	40.8	0.75	P	do.		N	O	do.	2.5	3,042.1	16.22	12- 5-51	
-23bc	B. Must	Dr				do.	Ogallala	Cy, W	D	do.	.0	3,039.6	32.99	4-27-51	
-25dd	A. Drake, et al.	Dr	113.0	6		do.	do.	Cy, W	N	do.	.5	3,084.7	104.45	5- 1-51	
-28ad	A. Herinck	Dr	112.2	6	P	do.	do.	N	N	do.	1.2	3,125.2	101.79	4-25-51	
-30bc	Mrs. E. B. Spangler	Dr	99.5	6	P	do.	do.	Cy, W	N	do.	.0	3,160.8	92.51	5- 2-51	
-33ad	W. C. Wessler	Dr	115.0	6	P	do.	do.	Cy, W	N	do.	.5	3,129.3	101.07	4-26-51	
18-31-2dd	Chas. Ramsey	Dr	93.7	6	P	do.	do.	Cy, H, G	S	do.	.0	2,915.2	80.44	5-23-51	
-5cd	A. A. French	Dr	95.5	6	P	do.	do.	Cy, W	S	do.	.5	2,950.5	90.68	6- 5-51	
-6bc	Edna Heyde	Dr		6	P	do.	do.	Cy, W	S	do.	1.0	2,956.6	84.69	5-17-51	
-15aa	R. B. Christy	Dr	93.5	6	P	do.	do.	Cy, W	N	Top edge of cover	.5	2,925.5	78.54	6- 5-51	
-18bc	Alf. Jannsen	Dr		6	P	do.	do.	Cy, W	S	Top of casing	.5	2,964.4	85.61	5-17-51	
-20ab	R. B. Christy	Dr	93.2	6	P	do.	do.	Cy, W	S	do.	.5	2,951.3	82.46	5- 8-51	
-23cb	W. Steinberg	Dr	76.5	6	P	do.	do.	N	N	Top of concrete curb	2.0	2,920.7	70.98	6- 5-51	
-26aa	O. Eitel	Dr	82.2	6	P	do.	do.	Cy, W	S	Top of casing	.5	2,916.8	65.85	5- 8-51	
-31cd	R. B. Christy	Dr	120.9	6	P	do.	do.	N	N	do.	1.0	2,982.5	95.76	5- 8-51	Well caved at 100 ft., 2-4-52.
-32aa	V. M. Stucky	Dr	107.5	6	P	do.	do.	Cy, W	N	do.	1.7	2,968.9	93.49	5- 8-51	
18-32-6aa	W. L. Deeds	Dr	121.1	6	P	do.	Sanborn, Meade, and Ogallala	Cy, W	S	do.	.0	2,981.0	70.26	5-17-51	
-7ac	S. W. Filson	Dr	98	18	P	do.	Ogallala, Sanborn, and Meade	T, E	I	Hole in pump	1.5	2,971.9	59.67	3-27-51	Reported yield 1,400, drawdown 26.
-7bb	Clarence Dickut	Dr	218	18	P	do.	do.	T, G	I	do.	1.5	2,966.0	51.06	3-27-51	Yield 2,120, drawdown 91 after 30 hours.
-7cb	do.	Dr	100	18	P	do.	do.	T, E	I	do.	1.5	2,975.1	64.41	3-27-51	Yield 880, drawdown 30 after 24 hours.
-7dc	S. W. Filson	Dr	100	18	P	do.	do.	T, E	I	do.	2.0	2,972.1	58.96	3-27-51	Reported yield 1,100, drawdown 35.
-9aa[1]	U. S. Geological Survey	Dr	110.3	0.75	P	do.	Ogallala	N	O	Top of casing	1.5	2,977.0	74.10	9-20-51	
-12ac	J. A. Showalter	Dr		6	P	do.	do.	Cy, W	S	do.	.5	2,970.6	89.91	5-17-51	
-15ad	E. G. Carpenter	Dr		6	P	do.	do.	Cy, W	S	do.	.0	2,989.6	93.67	5-17-51	

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TABLE 8.—*Records of wells (Scott County—continued)*

Well number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed		Method of lift	Use of water	Measuring point			Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
						Character of material	Geologic source			Description	Distance above land surface, feet	Height above mean sea level, feet			
18-32-17ab[1]	Ed Pittman	Dr	107.5	18	P	Sand, gravel	Ogallala, Sanborn, and Meade	T, G	I	....	....	....	....	3-27-51	Reported yield 1,200, drawdown 20-25.
-17ab[2]	do.	Dr	65.6	6	P	do.	do.	Cy, H	N	Top of casing	.5	2,970.0	59.00	3-27-51	
-17cc	J. E. Kirk	Dr	81.0	18	P	do.	do.	T, E	I	do.	.5	2,962.0	48.25	3-27-51	Reported yield 1,000, drawdown 22.
-17db	W. Pittman	Dr	162	18	P	do.	do.	T, G	I	....	....	....	....	3-27-51	Estimated yield 1,400, drawdown 21.
-18aa	S. W. Filson	Dr	100.9	19 (?)	P	do.	do.	T, E	I	Hole in pump	1.9	2,970.4	57.26	3-27-51	Reported yield 1,400, drawdown 24.
-18dc	R. W. Kirk	Dr	86.8	18	P	do.	do.	T, E	I	do.	1.0	2,968.7	52.16	3-27-51	Reported yield 900.
-19ad	D. C. Armstrong	Dr	....	18	P	do.	do.	T, E	I	do.	1.2	....	45.87	3-22-51	
-19bd	Geo. W. Moore	Dr	130	18	P	do.	do.	T, E	I	do.	.5	2,962.9	47.11	3-22-51	Estimated yield 1,000, drawdown 20 after 2 hours.
-19cb	Jesse Bright	Dr	75	18	P	do.	do.	T, E	I	Top of pump base	1.0	2,960	40.94	3-30-51	Yield 1,180, drawdown 20.
-20cc	J. M. Harris	Dr	109	24	P	do.	do.	T, N	N	Hole in pump	.5	2,956.0	37.14	3-22-51	
-21bd	J. E. Kirk	Dr	125.9	19	P	do.	Ogallala	T, G	I	do.	.5	2,975.4	65.74	3-27-51	
-21db	A. Strickert	Dr	126	16	P	do.	do.	T, G	I	do.	1.0	....	60.44	3-27-51	Yield 600.
-22bb	A. E. Bradstreet	Dr	....	6	P	do.	do.	Cy, W	S	Top of curb	.0	2,978.2	73.65	5-17-51	
-23ac	Ira Riney Estate	Dr	105.5	8	P	do.	do.	N	N	do.	1.5	2,975.7	87.45	6- 5-51	
-29ac	V. M. Harris	Dr	....	....	....	do.	Ogallala, Sanborn, and Meade	T, E	I	Hole in pump	.0	2,948.9	25.20	3-22-51	Reported yield 600, drawdown 16 after 12 hours.
-29ba	do.	Dr	115.0	16	P	do.	do.	T, G	I	do.	.0	2,953	30.27	3-22-51	
-29bb	V. M. Harris	Dr	122.8	16	P	do.	do.	T, G	I	do.	1.0	....	32.61	3-22-51	
-30ab	R. B. Christy	Dr	....	16	P	do.	do.	N	N	Hole in cover on casing	1.0	....	41.61	4- 2-51	

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-30ac	do.	Dr	123	18	P	do.	do.	T, E	I	Hole in pump	.5	2,947.8	34.37	9- 3-40	Reported yield 1,500, drawdown 56 after 48 hours.
-30ba	C. Hughes	Dr	110	18	P	do.	do.	T, G	I	do.	.0	....	43.48	3-30-51	Estimated yield 1,200, drawdown 63.
-30bb	do.	Dr	211	16	P	do.	do.	T, G	I	do.	.0	2,962	45.93	3-30-51	Reported yield 1,900, drawdown 60 after 8 hours.
-30cb	do.	Dr	69.5	24	C	do.	do.	T, E	I	Top of casing	1.0	2,941.2	28.70	4- 2-51	Reported yield 800.
-30cc	do.	Dr	78.1	24	C	do.	do.	T, E	I	Hole in pump	.0	2,940.5	18.04	4- 2-51	Reported yield 1,200.
-31ac	R. Beach	Dr	89.0	18	P	do.	do.	T, E	I	do.	.5	....	8.85	4- 2-51	Reported yield 950.
-31dc	do.	Dr	23.9	6	P	do.	do.	Cy, W	N	Top of pipe clamp	.8	2,934.6	7.76	5- 8-51	
-34cc	Frank Brooks	Dr	53.5	6	P	do.	Ogallala	Cy, N	N	Bottom edge of cover	.0	2,959.4	37.79	5- 8-51	
18-33-1ab	Wm. Mollson	Dr	220	16	P	do.	Ogallala, Sanborn, and Meade	T, E	I	Hole in pump	1.0	2,984.9	68.33	4- 3-51	Measured yield 1,430, drawdown 22.
-3cc	W. E. Witt	Dr	180	18	P	do.	Ogallala	T, G	I	do.	.0	3,008.2	74.86	4- 3-51	Drawdown 40.
-4ab	Jesse Witt	Dr	150	18	P	do.	do.	T, G	I	do.	.0	3,019.8	81.08	4- 2-51	
-4ca	George Mulch	Dr	127	16	P	do.	do.	T, G	I	do.	.3	3,017.0	75.69	4- 2-51	Reported yield 800.
-5cc	Norman Buehler	Dr	119.5	16	P	do.	do.	T, G	I	do.	.3	3,041.0	77.74	4- 2-51	Reported yield 600.
-5db	do.	Dr	123	18	P	do.	do.	T, G	I	do.	.0	3,030.3	76.34	4- 2-51	Reported yield 400.
-8cb	O. Buehler	Dr	126	18	P	do.	do.	T, G	I	do.	.5	3,040.8	82.04	4- 6-51	
-9bb	George Mulch	Dr	129	18	P	do.	do.	T	I	....	....	....	....	....	
-11ab	H. Parkinson	Dr	199	....	....	do.	do.	T, E	I	Hole in pump	1.5	2,981.5	61.64	4- 2-51	Reported yield 1,400.
-11dd	do.	Dr	183	18	P	do.	do.	T, E	I	....	....	....	....	....	Reported yield 1,600, drawdown 40 after 76 hours.
-12aa	H. Richter	Dr	240	18	P	do.	Ogallala, Sanborn, and Meade	T, E	I	Hole in pump	1.0	2,965.3	58.12	4- 2-51	
-12ad	do.	Dr	83	12	P	do.	do.	T, E	I	do.	.0	2,964.3	50.36	4- 3-51	Reported yield 375, drawdown 24.
-12dd	H. P. Palmer	Dr	212	....	....	do.	do.	T, E	I	do.	1.0	2,971	57.69	3-22-51	Reported yield 700.
-13ab	S. W. Filson	Dr	93.3	18	P	do.	Ogallala	T, E	I	do.	1.8	2,972.8	56.31	4- 4-51	Reported yield 1,435, drawdown 14.4.
-13ca	J. C. Scheideman	Dr	69.6	18	P	do.	do.	T, E	I	Top of casing	1.0	2,959.0	45.86	4- 4-51	Reported yield 900.

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TABLE 8.—*Records of wells (Scott County—continued)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
18-33-13db	J. E. Kirk					Sand, gravel	Ogallala	T	I						
-14ab	V. M. Harris	Dr	160.0			do.	do.	T, E	I	Hole in pump	1.0	2,972	57.52	4- 3-51	
-14bd	H. Parkinson	Dr	125	16	P	do.	do.	T, E	I	do.	1.0	2,978.1	58.88	4- 2-51	Reported yield 1,000.
-14cb	W. D. Luke	Dr	133	18	P	do.	do.	T, E	I	Top of curb	.5	2,959.2	36.40	4- 2-51	
-14da	F. W. Krause	Dr	71	18	P	do.	do.	T, E	I	Top of casing	.0	2,964.4	43.33	4- 2-51	Reported yield 800, drawdown 18.
-14dd	H. Sharpe	Dr	72	16	P	do.	do.	T	I						Reported yield 875, drawdown 24.
-15cc	B. H. Kimball	Dr	91	16	P	do.	do.	T, E	I	Hole in pump	1.6	2,969.3	39.95	4- 2-51	
-15da	C. D. Luke	Dr	110	18	P	do.	do.	T, E	I	Top of casing	.5	2,978.6	54.85	4- 2-51	
-19ba	P. J. Kuipp	Dr	127.5	16	P	do.	do.	T, E	I	Hole in pump	1.3	3,057	84.07	4-12-51	Drawdown 22 after 2 hours.
-19bc	do.	Dr				do.	do.	T, E	I	do.	1.5	3,062.7	84.49	4-12-51	Reported yield 1,100.
-20cc	C. Hughes	Dr	117	24	C	do.	do.	T, G	I	do.	2.0	3,035.8	80.10	4-12-51	Drawdown 36.
-20dc	do.	Dr		16	P	do.	do.	T, G	I	do.	.4	3,022	90.20	4-23-51	
-21ac	A. H. Cheney	Dr				do.	do.	T, E	I	Top of curb	1.5		64.56	4-13-51	
-21cc	C. Hughes	Dr	138.2	18	P	do.	do.	T, G	I	Hole in pump	1.0	3,021.1	80.60	4-13-51	Reported yield 2,000, drawdown 27 after 504 hours.
-21db	Mary S. Hutchins	Dr				do.	do.	T, E	I	do.	1.5		64.27	4-13-51	
-22ac	G. H. Cheney	Dr	123.5	24	P	do.	do.	T, E	I	do.	2.0	2,961.1	33.59	4-13-51	
-22bc	Howard Cheney	Dr				do.	do.	T, E	I	Edge of pump	1.0		33.73	4-13-51	
-23ab	O. R. Robinson	Dr	151	18	P	do.	do.	T, E	I	Hole in pump	1.0		36.17	4- 9-51	Reported yield 1,500, drawdown 32 after 4 hours.
-23ad	do.	Dr	104	18	P	do.	do.	N	N	Top of casing	1.0	2,961.0	37.60	4- 9-51	
-23cb[1]	G. E. Peters	Dr				do.	do.	T, G	I	Hole in pump	.0		34.32	4- 9-51	
-23cb[2]	do.	Dr		16	P	do.	do.	T, G	I					4- 9-51	
-23da	O. R. Robinson	Dr		18	P	do.	do.	T, E	I	Top of casing	.5		49.14	4- 9-51	Reported yield 1,060.

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-24ca	C. A. Steele	Dr	......	......	......	do.	Ogallala, Sanborn, and Meade	T, E	I	Hole in pump	1.0	2,975.7	59.69	4- 9-51	
-25ba	Vernon and V. Harris	Dr	92.0	24	C	do.	do.	T, G	I	do.	.5	2,962.4	45.63	4- 9-51	Reported yield 1,140, drawdown 63.
-25bb	do.	Dr	......	......	......	do.	do.	T, N	N	do.	1.5	......	56.19	4- 9-51	
-26da	U. S. Geological Survey	Dr	60	8	P	do.	Ogallala	N	O	Top of casing	......	2,950.0	21.46	11-14-51	Recorder well.
-29ab	R. J. Taylor	Dr	128.4	18	P	do.	do.	T, G	I	Hole in pump	1.0	3,023.6	77.76	4-23-51	Reported yield 1,600, drawdown 30 after 24 hours.
-29bb	do.	Dr	147	18	P	do.	do.	T, G	I	do.	.5	......	90.27	11-14-51	Reported yield 800, drawdown 12.
-34bd	Austin Been	Dr	130	16	P	do.	do.	T, E	I	Top of casing	.5	2,966.9	41.96	4-19-51	Reported yield 1,100, drawdown 45.
-34db	do.	Dr	110	16	P	do.	do.	T, G	I	......	......	2,950	25	42	Reported yield 600, drawdown 60.
-35aa	W. R. Proudfoot	Dr	80	16	P	do.	do.	T, E	I	Hole in pump	1.5	2,940.5	17.99	4-18-51	Reported yield 1,010, drawdown 40.
-35cb	C. T. Hutchins	Dr	135	16	P	do.	do.	T, E	I	Top of curb	.5	2,943.0	20.40	4-19-51	Reported yield 700.
-35dd	do.	Dr	112	18	P	do.	do.	T, E	I	Hole in pump	.5	2,939.4	19.86	4-19-51	Reported yield 500.
-36ab	M. K. Armentrout	Dr	81.0	18	P	do.	do.	T, E	I	do.	1.0	2,938.0	17.77	4-11-51	Reported yield 2,100, drawdown 34.
-36ba	C. A. Steele	Dr	72.8	18	P	do.	do.	T, E	I	do.	1.0	2,938.5	17.60	4-11-51	Reported yield 725, drawdown 25 after 12 hours.
-36bd	M. K. Armentrout	Dr	......	......	......	do.	do.	T, E	I	do.	1.0	......	15.23	4-18-51	
-36cd	S. H. Hull	Dr	74	18	P	do.	do.	T, E	I	do.	1.0	2,940.4	19.50	4-19-51	
18-34-1cb[1]	Max Buehler	Dr	165	18	P	do.	do.	T, G	I	do.	.0	3,093.9	97.37	4- 4-51	Reported yield 650.
-1cb[2]	do.	Dr	160.7	18	P	do.	do.	N	O	Top of casing	.0	......	97.55	1- 4-52	Recorder well.
-2ad	Russel Unruh	Dr	175	18	P	do.	do.	T, G	I	do.	.0	3,097.5	99.97	4- 4-51	
-6dd	A. C. Felt	Dr	95.0	6	P	do.	do.	Cy, W	N	do.	2.0	3,147.3	86.28	4-25-51	
-9cd	Frank Rose	Dr	98.0	6	P	do.	do.	N	N	do.	.0	3,133.2	90.48	4-27-51	
-15ad	A. C. Felt	Dr	132	......	......	do.	do.	Cy, W	D, S	do.	1.0	3,116.1	94.73	4-27-51	
-16ab	August Chivilicek	Dr	150	18	P	do.	do.	T	I	......	......	3,132	......	......	Reported yield 700.
-16cd	......	Dr	97.9	8	P	do.	Ogallala	N	N	Top of curb	.0	3,136.5	91.92	4-25-51	
-18bd	Rex A. Brush	Dr	150	......	......	do.	do.	T, G	I	......	......	3,158	......	......	Reported yield 620.
-19cc	A. M. Krupp	Dr	102.1	6	P	do.	do.	N	N	Top of casing	.1	3,158.1	83.25	4-19-51	
-20aa	E. F. Davis	Dr	......	6	P	do.	do.	N	N	do.	.0	......	87.00	4-23-51	
-21da	M. E. Boulware	Dr	95.8	6	P	do.	do.	N	N	Top edge of collar	.4	3,122.5	84.65	4-19-51	

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TABLE 8.—*Records of wells* (*Scott County—concluded*)

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
18-34-23cc	A. H. Diller	Dr	148	18	P	Sand, gravel	Ogallala	T, B	I	Hole in pump	.5	3,112.3	91.76	4- 4-51	Reported yield 1,000, drawdown 58.
-24cc	C. Hughes	Dr	144	18	P	do.	do.	T, G	I	do.	.5	3,098.6	96.73	4- 4-51	Reported yield 670, drawdown 37.
-25ab	do.	Dr	143	14	P	do.	do.	T, G	I	do.	.5	....	91.29	4-12-51	Reported yield 1,400, drawdown 40 after 24 hrs.
-25bb	do.	Dr	141.5	18	P	do.	do.	T, G	I	do.	.0	3,092.0	90.32	4-23-51	
-29bc	Glenn Novak	Dr	140	18	P	do.	do.	T, D	I	do.	.5	3,150.8	88.22	4-19-51	Reported yield 1,000, drawdown 28 after 3 weeks.
-29db	Frank Novak	Dr	142	18	P	do.	do.	T, D	I	Top of casing	.0	....	90.20	4-19-51	Reported yield 1,550, drawdown 40 after 3 weeks.
-31bd	W. N. Robinson	Dr	134.3	24	P	do.	do.	T, E	I	Hole in pump	5	3,165.7	91.12	4-19-51	
-32ab	Frank Novak	Dr	147	18	P	do.	do.	T, D	I	do.	1.0	3,158.0	92.15	4-19-51	Reported yield 1,260, drawdown 28 after 188 hrs.
-32bc	Glenn Novak	Dr	140	18	P	do.	do.	T, D	I	do.	1.5	....	91.03	4-19-51	Reported yield 1,150, drawdown 11.
-33db	M. M. Cutler	Dr	137	18	P	do.	do.	T, B	I	do.	1.0	....	91.87	4- 4-51	Reported yield 950, drawdown 25 after 30 days.
-34bb	L. Keyse	Dr	160	16	P	do.	do.	T, B	I	do.	.9	3,131.0	89.78	4- 4-51	
-34bc	do.	Dr	....	....	....	do.	do.	T, G	I	do.	1.0	3,128.6	90.90	4- 4-51	

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TABLE 8.—*Records of wells in the Ladder Creek area—Wallace County*

WELL NUMBER	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed		Method of lift	Use of water	Measuring point			Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
						Character of material	Geologic source			Description	Distance above land surface, feet	Height above mean sea level, feet			
13-38-25bb	C. C. Loek	......	......	36	C	Sand, gravel	Alluvium	VC, N	N	Top of concrete cover	1.0	3,178.0	6.88	7-19-51	
-27cd	L. E. Pearce	Dr	22.8	6	P	do.	do.	N	N	Edge of casing	.0	3,227.0	15.37	7-20-51	
13-39-19ac	J. T. Finley	Dr	54	18	P	do.	do.	T, T	I	do.	1.0	3,386.0	8.43	7- 9-51	Reported yield 950, drawdown 40.
-25aa	Wayne Moore	Dr	20	18	P	do.	do.	VC, E	I	Edge of concrete	1.0	......	6.00	7-17-51	Reported yield 300, drawdown 12 after 3 months.
-25ac	do.	Dr	30	18	P	do.	do.	T, T	I	Hole in pump	.5	......	5.86	7-17-51	Reported yield 1,000, drawdown 16 after 3 days.
-25da[1]	L. O. Stanley	Dr	53	16	P	do.	do.	T, T, G	I	......	......	3,261.0	8	7-17-51	Reported yield 850.
-25da[2]	U. S. Geological Survey	J	12.9	0.75	P	do.	do.	N	O	Top of casing	2.0	3,354.8	9.19	11-28-51	
-25dd	do.	J	20.0	0.75	P	do.	do.	N	O	do.	3.0	3,253.1	9.11	11-29-51	
-26cb	B. T. Armstrong	Dr	......	20	P	do.	do.	C, D	I	Top of curb	-0.5	3,290.0	4.06	7-20-51	Reported yield 1,800, drawdown 8 to 9.
-28bc	O. D. Duphorne	Dr	11	16	P	do.	do.	VC, G	I	Top of casing	-4.0	3,335.7	4	7-17-51	Reported yield 600.
-33bb	Clarence Tilton	Dr	62.2	12(?)	P	do.	Sanborn and Meade	T, G	I	Hole in pump	.5	3,334.8	19.03	7-17-51	Reported yield 800, drawdown 13.
-36aa	U. S. Geological Survey	J	15.0	0.75	P	do.	Alluvium	N	O	Top of casing	1.5	3,252.5	7.71	11-28-51	
-36ad	do.	J	41.0	0.75	P	do.	Sanborn and Meade	N	O	do.	2.0	3,275.6	36.85	11-28-51	
13-40-10ab	Jess Mumma	Dr	44.5	20	P	do.	do.	T, T	I	Hole in pump	2.0	3,425.0	15.80	7- 9-51	Reported yield 1,200, drawdown 9 after 3 weeks.
-10bb	T. Jackson	Dr	47	16	P	do.	do.	T, T	N	Edge of casing	1.0	3,431.2	16.85	7- 9-51	
-23aa	C. E. Koons	Dr	41.5	6	P	do.	......	Cy, W	N	do.	.5	3,399.4	29.07	7- 9-51	
-28ad	J. S. Wisehart	Dr	29.2	6	P	do.	......	N	N	do.	2.0	3,442.1	21.06	7-13-51	
-36bb	G. Holland	Dr	34.9	6	P	do.	......	Cy, W	S	Hole in pump	1.0	3,415.5	29.09	7-13-51	

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TABLE 8.—*Records of wells (Wallace County—continued)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
13-41-10dc	Harmon Whitney	Dr	27	6	P	Sand, gravel	Sanborn	Cy, W	S	Edge of casing	1.0	3,572.7	• 23.32	7- 9-51	
-12cd	Ira Chisum	Du	11	24	P	do.	Alluvium	Cy, W	S	do.	1.0	3,519.3	7.59	7- 9-51	
-20dc	R. V. Baelor	Dr	54.0	6	P	do.	Ogallala, Sanborn, and Meade	Cy, W	S	Hole in pump	.3	3,686.5	30.83	7- 9-51	
-32cb	H. N. Holland	Dr	128.0	6	P	do.	Ogallala	Cy, W	S	Edge of casing	1.0	3,789.3	117.32	7- 9-51	
-34ab	Dick Handy	Du	22.0	......	......	do.	Sanborn and Meade	Cy, H	N	Edge of well	2.0	....	24.2	7- 9-51	
13-42-20ad	David Paul	Dr	102.0	6	P	do.	Ogallala	Cy, W	S	Edge of casing	2.0	3,821.5	91.84	7- 9-51	
-22ad	L. E. Samuel	Dr	....	6	P	Sand, gravel	Sanborn and Meade	Cy, W	S	Edge of casing	1.5	3,708.8	18.34	7- 9-51	
-24cc	L. Wahler	Dr	16.0	6	P	do.	Alluvium	Cy, W	S	do.	.5	3,679.0	14.01	7- 9-51	
-28dc	R. B. Riger	Dr	160	6	P	do.	Ogallala	Cy, W	S	do.	.5	3,858.2	141.66	7- 9-51	
-31ad	F. J. Armstrong	Dr	165	6	P	do.	do.	Cy, W	N	do.	.2	3,874.8	143.39	7- 9-51	
13-43-24da	F. Alvord	Dr	58.0	6	P	do.		Cy, W	D	Edge of cover	1.0	3,814.4	56.10	7- 9-51	
14-38-9ab	C. F. Pearce	Dr	10.1	6	P	do.	Alluvium	N	N	Edge of casing	2.0	3,335.0	6.88	7-18-51	
-21dc	H. F. Schemm	Dr	93.5	6	P	do.	Ogallala	Cy, W	S	Hole in pump	1.0	3,526.0	82.91	7-16-51	
-29dd	do.	Dr	76.0	6	P	do.	do.	Cy, W	N	do.	.5	3,529.9	73.20	7-17-51	
-30cc	L. Fry	Dr	120.0	6	P	do.	do.	Cy, W	S	Edge of casing	1.0	3,565.0	100.07	7-17-51	
14-39-9cc	A. B. Noalis	Dr	20.0	6	P	do.	Sanborn and Meade	Cy, H	D, S	do.	.0	3,410.4	16.34	7-17-51	
-17dc	H. A. Clark Estate	Dr	19.5	6	P	do.	Alluvium	N	N	do.	.4	3,456.0	13.1	7-17-51	
-22da	J. Severin	Dr	135.0	6	P	do.	Ogallala	Cy, G, W	N	do.	.4	3,599.0	130.06	7-16-51	
-24ad	O. E. Bradley	Dr	120.0	6	P	do.	do.	Cy, W	S	do.	1.4	3,572.8	108.29	7-17-51	
-28bc	Ken Buck	Dr	123.0	6	P	do.	do.	Cy, W	D, S	do.	1.0	3,574.3	107.87	7-17-51	
14-40-5ba	C. C. Pierce	Dr	15.8	6	P	do.	Sanborn and Meade	Cy, W	S	do.	2.0	3,487.8	12.21	7- 9-51	
-10cd	J. C. Heise	Dr	139.5	6	P	do.	Ogallala	Cy, W	S	do.	1.0	3,668.5	126.20	7-13-51	
-13bd	O. Walker	Dr	31.0	6	P	do.	Sanborn and Meade	Cy, W	S	Edge of casing cover	1.0	....	19.05	7-13-51	
-18cb	S. Hinkle	Dr	71.0	6	P	do.	Ogallala	Cy, W	S	Edge of casing	1.0	3,661.2	67.68	7-11-51	
-25ac	I. N. Bricker	Dr	44.4	6	P	do.		Cy, W	S	do.	.5	....	36.31	7-16-51	

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-28ba	C. Forsbeck	Dr	140	6	P	do.	Ogallala	Cy, N	N	do.	1.0	3,686.5	118.24	7-13-51	
-32cc	W. E. Barstow	Dr	173.0	6	P	do.	do.	Cy, W	S	do.	1.0	3,704.1	118.35	7-16-51	
14-41-9aa	C. C. Pierce	Dr	56.6	6	P	do.	do.	Cy, W	S	do.	1.0	3,701.6	46.28	7- 9-51	Pumping.
-16db	J. B. McCready	Dr	165	16	P	do.	do.	N	N	do.	.5	3,741.9	87.98	4- 3-51	
-16dc	J. B. McCready	Dr	254			Sand, gravel	do.	T, D	I						Reported yield 1,400.
-20cb	G. E. Harper	Dr	85.0	6	P	do.	do.	N	N	Edge of casing	1.0	3,747.4	81.19	7-13-51	
-26ba	M. F. Wallace	Dr	91.0	4	P	do.	do.	Cy, W	D, S	do.	1.0	3,699.0	76.55	7-13-51	
-28dc	J. F. Slaven	Dr	115.0	6	P	do.	do.	Cy, W	S	do.	1.0	3,749.2	107.66	7-13-51	
14-42-7dd	J. W. Batterfield	Dr	200.0	6	P	do.	do.	Cy, W	S	Hole in base	.5	3,900.3	178.46	7- 9-51	
-10aa	A. J. Hosely	Dr	148.0			do.	do.	Cy, W	D	Edge of casing	.0	3,839.7	135.91	7-11-51	
-16cd	C. E. Waugh	Dr	164.0	6	P	do.	do.	Cy, W	S	do.	.5	3,825.8	126.55	7-19-51	
-23bc	C. E. Waugh	Dr	180.0	6	P	do.	do.	Cy, W							
-24bb	A. Waugh	Dr	109.0	6	P	do.	do.	Cy, W	N	Edge of casing	1.0	3,793.7	103.85	7-11-51	
-26db	J. Goodwin	Dr	108.0			do.	do.	Cy, H	N	do.	.5	3,784.1	96.05	7-13-51	
-28cd	Wheat Farming Co.	Dr	143.0	6	P	do.	do.	Cy, W	D	do.	.5	3,832.7	124.09	7-13-51	
-32bc	Lee Walding	Dr	137.0	6	P	do.	do.	Cy, W	N	do.	.0	3,853.8	131.37	7-13-51	
14-43-24bd		Dr	182.2	6	P	do.	do.	Cy, W	N	Hole in pump	.3	3,899.6	166.53	7-13-51	
15-38-6cd	H. Bolen	Dr	105.0	6	P	do.	do.	Cy, W	N	Top of well cover	1.0	3,550.0	89.06	6-14-51	
-9bb	C. Bolen	Dr	93.5	6	P	do.	do.	Cy, W	N	Edge of casing	.5	3,523.1	74.70	6-14-51	
-15bb	Wallace Co.	Dr	93.5	6	P	do.	do.	Cy, H	D, S	do.	.5	3,510.5	82.81	6-14-51	
-20cb	J. E. Allison	Dr	93.5	6	P	do.	do.	N	N	do.	1.5	3,536.0	90.67	6-14-51	
-21cd	Walt Hale	Dr		6	P	do.	do.	Cy, W	N	Edge of concrete	1.0	3,509.5	80.63	6-14-51	
-26bc	G. L. Barton	Dr	88.0	6	P	do.	do.	N	N	Edge of casing	.5		68.96	6-14-51	
-31cd	C. L. Reimer	Dr	61.0	6	P	do.	do.	Cy, H	N	do.	1.0	3,493.0	49.19	5-20-51	
15-39-2bc	Frazier Farms	Dr	121.5	6	P	do.	do.	Cy, N	N	do.	1.0	3,588.0	109.98	7- 2-51	
-6ca	Ben Kindsvater	Dr	187.0	12-18	P	do.	do.	T, D	I	Hole in pump	1.0	3,618.0	99.07	7-20-51	Reported yield 1,500.
-8ac	Wm. Mai	Dr	222	18	P	do.	do.	T, D	I	do.	.5	3,616.0	113.74	7-16-51	Reported yield 1,000, drawdown 58 after 60 hours.
-10da	Frazier Farms	Dr	136.0	6	P	do.	do.	Cy, W	S	Edge of casing	.5	3,580.0	98.88	7- 2-51	
-26bb	R. Mangrove		92.0			do.	do.	N	N	do.	1.5	3,568.8	91.41	7- 2-51	
-29aa	H. C. Wilson	Dr	67.5	6	P	do.	do.	N	N	do.	1.0	3,572.6	65.43	7- 2-51	
-31dd	Oscar Bearce	Dr	87.0	6	P	do.	do.	Cy, W	S	do.	.5	3,584.2	81.86	7- 2-51	
15-40-4cd	Heise and Heise	Dr	93.4	6	P	do.	do.	Cy, W	N	do.	1.0	3,660.3	92.68	7-13-51	
-12da	R. L. Bricker	Dr	232	12-18	P	do.	do.	T, D	I	Hole in pump	1.5	3,630.0	107.00	7-16-51	Reported yield 2,000.
-15da	J. C. Heise	Dr	101.0	6	P	do.	do.	Cy, H	N	Edge of casing	.5	3,641.2	82.66	7- 2-51	
-20ab	W. H. McNeil	Dr	115.0			do.	do.	Cy, N	N	Top of curb	.0	3,681.7	103.60	7-13-51	
-22dd	Wm. Mai	Dr	98.5			do.	do.	Cy, W	S	Edge of casing	1.0	3,642.0	89.02	7- 2-51	
-24bb	E. Burnett	Dr	87.0	6	P	do.	do.	Cy, H	S	Top of curb	2.0	3,611.0	61.27	7- 2-51	
-32aa	H. H. Pribbeno	Dr	115.5	6	P	do.	do.	Cy, W	N	Edge of casing	.5	3,657.0	93.50	7-13-51	
-35da	Ethel Burnett	Dr	100	6	P	do.	do.	Cy, W	S	do.	1.5	3,598.0	61.19	7-16-51	
15-41-2aa	A. R. Lewis	Dr	195	6	P	do.	do.	Cy, W	D, S	do.	.5	3,763.0			
-6da	C. W. Walter	Dr	148.0	6	P	do.	do.	Cy, W	D, S	do.	.5	3,793.0	129.35	7-13-51	
-10bb	F. O. Branberg	Dr	165	6	P	do.	do.	Cy, W	D, S	do.	.0	3,790.0	153		
-12da	Fred Llaassen	Dr	120.0	6	P	do.	do.	N	N	do.	1.0	3,695.2	108.69	7-17-51	

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TABLE 8.—*Records of wells (Wallace County—concluded)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
15-41-14ca	F. H. Barstow	Dr	116.0	6	P	Sand, gravel	Ogallala	Cy, W	S	Edge of casing	5.0	3,706.7	99.8	7-17-51	
-18ca	David Westerberg	Dr	156	6	P	do	do	Cy, W	S	do		3,795.9	150		
-21ba	W. H. Akers	Dr	142.0	6	P	do	do	Cy, W	S	do	.3	3,758.8	137.63	7-13-51	
-25aa	Ethel Akers	Dr	131.0	6	P	do	do	Cy, W	S	do	0.5	3,698.6	109.27	7-17-51	
-28cd	Dale Simonson	Dr	171.0	6	P	do	do	Cy, W	N	Hole in base	1.0	3,761.5	150.31	9-13-51	
-36ca	S. H. Kueck	Dr	123.0	6	P	do	do	N	N	Edge of curb	.5	3,692.3	104.02	7-13-51	
15-42-2cb	Wm. Charles		156.0			do	do	Cy, W	D	Edge of pump base	.5	3,842.2	151.73	7-13-51	
-16ad	Meyer and Peterman		163.0	6	P	do	do	Cy, W	N	Edge of casing	.0	3,863.2	153.10	7-13-51	
-30bc	W. T. Miller Estate	Dr		6	P	do	do	Cy, W	S	do	.5	3,093.3	198.37	7-18-51	
-34bc	do	Dr	225.0	6	P	do	do	Cy, W	S	do	.3		199.41	7-18-51	
-36dc	H. Agut	Dr	270			do	do	T, D	I	Hole in pump	.5	3,834.1	194.43	4- 3-51	Reported yield 1,075.
15-43-12dd	Federal Farm Mtg.	Dr	218.0	6	P	do	do	Cy, W	D	Edge of casing	1.0	3,923.9	207.35	7-13-51	

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TABLE 8.—*Records of wells in the Ladder Creek area—Wichita County*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, feet	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
16-35-1dc	E. M. Carson	DD	......	......	P	Sand, gravel	Ogallala	Cy, W	S	Top of casing	3.0	3,134.2	80.63	4-26-51	Dug well modified with new cased well.
-3da	Blair Kough	Dr	11.3	6	P	do.		Cy, H	D	do.	1.5	3,098.2	7.43	5- 7-51	
-6aa	O. T. Redding	Dr	67	5½	P	do.		Cy, H	S	do.	2.0	3,192.4	59.37	5- 7-51	
-7cb	F. W. Winthrow R. Winthrow	Dr	86.0	6	P	do.	Ogallala	Cy	N	do.	.5	3,220.4	74.81	5- 7-51	
-8aa	Blair Kough	Dr	82.0	5½	P	do.		Cy, W	S	do.	.5	3,182.6	62.65	5- 9-51	
-10cc	M. Hargrove	Dr	109	5½	P	do.	Ogallala	Cy, W	S	Top of lower plank	1.0	3,191.3	101.53	5- 7-51	
-20cc	F. F. Miller	Dr	189	18	P	do.	do.	T, D	I	Hole in pump base	.5	3,231.7	103.74	5- 7-51	
-22ad	V. M. Stucky	Dr	124	5½	P	do.	do.	Cy, W	S	Top of casing	1.0	3,194.2	113.06	5- 7-51	
-24aa	F. L. Carson	Dr	126	5½	P	do.	do.	Cy	N	do.	.5	3,167.8	113.30	5- 7-51	
-24cc	L. Hallinger	Dr	117	6	P	do.	do.	Cy	N	do.	.0	3,180.0	113.56	5- 4-51	
-26da	F. H. Taylor	Dr	120.8	6	P	do.	do.	Cy, W	N	do.	-0.2	3,182.7	110.82	5- 4-51	
-28db	Arthur Wiles	Dr	109	5½	P	do.	do.	N	N	do.	1.0	3,208.1	105.54	5- 4-51	
-31da	H. O. Burns	Dr	201	18	P	do.	do.	T, B	I	Hole in pump	.4	3,230.2	98.21	5- 7-51	Measured yield 760, measured drawdown 37.
-32dd	H. F. Sutton	Dr	116	6	P	do.	do.	Cy, H	N	Top of casing	.5	3,213.4	103.65	5- 4-51	
-34cb	G. S. Barr	Dr	112	6	P	do.	do.	Cy	N	Hole in pump base	1.5	3,204.0	108.88	5- 4-51	
16-36-2ca	L. F. Harper	Dr	135	18	P	do.	do.	T, D	I	do.	.5	3,268.3	93.48	5- 9-51	
-3cc	R. Hobson	Dr	130	18	P	do.	do.	T, D	I	Hole in pump	1.0	3,285.0	87.60	5- 9-51	
-3dc	L. F. Harper	Dr	138.2	18	P	do.	do.	T, D	I	Hole in pump base	.2	3,278.0	86.99	5- 9-51	
-4cc	G. E. Withroder	Dr	......	......	P	do.	do.	T, D	I	do.	.5	3,301.8	......	5- 9-51	Pumping.
-7bc	R. Hobson	Dr	130	18	P	do.	do.	T, D	I	do.	.0	3,326.7	82.68	6-14-51	Reported yield 500.
-13cb	L. M. Flel	Dr	135	6	P	do.	do.	Cy, W	D	Top of lowest plank	.3	3,245.7	81.80	5- 9-51	
-14bc	B. I. Lake	Dr	95.0	6	P	do.	do.	Cy, W	S	Between planks	.5	3,251.5	76.57	5- 9-51	
-17ab	R. D. Buell	Dr	......	......	P	do.	do.	T, D	I	Hole in pump base	.5	3,300.1	83.95	6-14-51	Pumping.
16-36-18ad	R. Hobson	Dr	58.7	6	P	Sand, gravel	Ogallala	Cy, W	S	Top of plank	1.2	3,267.0	40.70	5- 9-51	
-20ad	E. C. Edwards	Dr	......	6	P	do.	do.	Cy, W	S	Top of casing	.5	3,250.1	37.35	5- 9-51	
-21bd	R. E. Landon	Dr	......	5	P	do.	Alluvium	Cy, W	S	do.	1.5	3,222.7	14.44	5- 9-51	

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TABLE 8.—*Records of wells (Wichita County—continued)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
16-36-26bb	Ila Hudson	Dr	130	5	P	Sand, gravel	Ogallala	Cy, W	S	Pump base	.5	3,229.5	51.26	5- 9-51	
-28dd	Earnest Hooker	Dr		5	P	do.	do.	Cy, W	D, S	Top of casing	.3	3,279.9	81.35	5- 9-51	
-29cd	O. B. Stiles	Dr	105.8	6	P	do.	do.	Cy, W	D, S	do.	.1	3,308.1	87.07	5- 9-51	
-34ad	W. J. Miller	Dr		5	P	do.	do.	Cy, W, G	S	Pump base	2.0	3,267.3	92.58	5- 9-51	
-36bb	H. O. Burns	Dr	23.4	6	P	do.	do.	Cy, W	S	Hole in curb	1.0	3,174.0	16.37	5- 9-51	
16-37-1cb	Phillips Shell	Dr		6	P	do.	do.	Cy, W	D	Top of casing	.5	3,334.9	75.85	5- 2-51	
-2bc	K. Woods	Dr	80.3	6	P	do.	do.	Cy, W	D, S	do.	.2	3,354.0	67.56	5- 2-51	
-4ba	H. A. Barr	Dr		6	P	do.	do.	Cy, W	D	do.	.5	3,367.2	73.36	5- 2-51	
-6aa	E. R. Langley	Dr	97	6	P	do.	do.	Cy, W	D, S	Edge of plank	1.0	3,399.8	76.60	5- 2-51	
-8ba	M. E. C. Langley	Dr		6	P	do.	do.	Cy, W	S	Base of pump	.0	3,382.9	69.63	5- 2-51	
-9da	G. W. Dickey	Dr	112	6	P	do.	do.	Cy, W	S	Top of casing	.5	3,368.6	73.74	5- 2-51	
-13bb	C. Pearson	Dr			P	do.	do.	T, D	I	Hole in pump base	.0	3,330.6	77.65	6-14-51	Pumping.
-13cd	Chester Pearson	Dr		5	P	do.	do.	Cy, W	S	Top of casing	.5	3,287.7	44.11	5- 2-51	
-14cc	I. B. Ganson	Dr		6	P	do.	do.	Cy, W	S	do.	.0	3,357.0	82.64	5- 2-51	
-18dd	Maude B. Adams	Dr	85.3	6	P	do.	do.	Cy, W	S	do.	1.0	3,384.3	68.76	5- 8-51	
-22dd	E. Lewis					do.	do.	Cy, W	N	Crack between planks	.5	3,356.3	84.93	5- 8-51	
-25db	M. Hoffman	Dr		5	P	do.	do.	Cy, H	D	Top of casing	.8	3,330.9	87.92	5- 9-51	
-26ab	R. Hobson	Dr	96.3	6	P	do.	do.	Cy, W	N	do.	.5	3,350.0	87.83	5- 9-51	
-30ac	H. E. Thurston	Dr			P	do.	do.	T, D	I	Hole in pump	.5	3,392.4	81.24	3-29-51	
-31cc	A. Berning	Dr		6	P	do.	do.	Cy, W	S	Top of casing	.5	3,379.4	77.99	5-28-51	
-32cc	D. Perry	Dr	87.0	6	P	Sand, gravel	Ogallala	Cy, H	N	Top of casing	.6	3,378.2	83.97	5- 8-51	
16-38-5bc	S. M. Woodbury	Dr		6	P	do.	do.	Cy, W	S	do.	.5	3,474.6	71.05	5-20-51	
-9dd	G. M. Woodbury	Dr	83.9	6	P	do.	do.	Cy, H	D	do.	.5	3,437.1	71.49	5-19-51	
-10ab		Dr			P	do.	do.	T, D	I	Hole in pump base	1.0	3,446.1	78.56	3-29-51	
-12cd	L. Nelson	Dr	90.3	6	P	do.	do.	Cy, W	N	Top of casing	.5	3,413.1	74.32	5-19-51	
-15ab	I. H. Doyle	Dr	134	12	P	do.	do.	T, D	I	Edge of pump base	1.0		81.37	9-11-51	
-15dd		Dr	72.0	6	P	do.	do.	Cy, W	N	Top of casing	.3	3,418.4	67.90	5-19-51	
-16ac	V. Watt	Dr			P	do.	do.	T, D	I	Hole in pump base	1.0	3,440.6	73.75	3-29-51	Reported yield 2,000
-16bb	do.	Dr	200		P	do.	do.	T, D	I	do.	1.0	3,440.4	65.31	3-29-51	Reported yield 1,600.

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-17bb	G. M. Woodbury	Dr	105.7	6	P	do.	do.	Cy, H, W	S	Top of casing	.9	3,460.9	69.94	5-20-51	
-20dd	Anna L. Schrader	Dr	30	6	P	do.	Alluvium	Cy, G, W	D	do.	-4.8	3,387.3	16.94	5-19-51	
-21bc[1]	U. S. Geological Survey	J	16.3	.75	P	do.	do.	N	O	do.	2.5	3,371.3	10.00	11-30-51	
-21bc[2]	do.	J	22.7	.75	P	do.	do.	N	O	do.	3.0	3,371.8	10.47	11-30-51	
-24bb	J. H. Mitchell	Dr	210		P	do.	Ogallala	T, D	I						Reported yield 1,800.
-24bc	do.	Dr	78	6	P	do.	do.	Cy, W	S	Hole in pump base	1.0	3,406.0	74.25	5-20-51	
-27cc	E. H. Dirks	Dr	28	5	P	do.		Cy, W	S	Top of casing	.5	3,369.9	21.10	5-19-51	
-30dd	E. F. Moore	Dr	102	6	P	do.		Cy, W	N	do.	1.4	3,445.0	65.57	5-28-51	
-32dc	J. J. Bauck	Dr		6	P	do.	Ogallala	N	N	do.	.5	3,444.2	81.38	5-17-51	
-35cb	E. L. Brandner	Dr	69.5		P	do.	Alluvium	T, T	I						
17-35-7aa	U. S. Geological Survey	J	15.8	.75	P	do.	do.	N	O	Top of casing	2.5	3,134.4	12.07	12-4-51	
-7ad	do.	J	31.2	.75	P	do.	do.	N	O	do.	2.0	3,131.6	10.84	2-6-52	
-8ab	E. H. Smith	Dr		6	P	do.		N	N	do.	.0	3,128.6	14.05	5-4-51	
-8da	P. P. McKey	Dr		14	P	do.		VC, G	I	Top of concrete	.0	3,122.0	15.26	5-4-51	
-13aa	A. Hargrove	Dr	116.2	6	P	Sand, gravel	Ogallala	N	N	Hole in cover	.8	3,152.9	91.80	5-2-51	
-17cc	C. C. Roth	Dr	100	5½	P	do.	do.	Cy, W	S	Top of casing	.5	3,208.1	90.36	5-2-51	
-18ac	Arthur Shumard	Dr	195	18	P	do.	do.	T, B	I	Hole in pump base	.0	3,225.7	96.94	5-4-51	Reported yield 900, drilled to shale.
-22bb	Wichita Co.	Dr	117.5	5	P	do.	do.	Cy, H	D	Top of casing	.2	3,200.1	100.04	4-20-51	
-27bc	Beeson	Dr		5½	P	do.	do.	Cy, W	D	do.	2.0	3,191.0	85.56	5-4-51	
-28cc	C. F. Moulton	Dr	99	12	P	do.	do.	N	N	Hole in center of cover	1.0	3,207.3	89.42	4-18-51	
-30cb	G. Knobbe	Dr	218	18	P	do.	do.	T, D	I	Base of concrete	.0	3,235.2	94.12	4-19-51	Reported yield 1,160, drawdown 55.
-31cc	Tony Baker	Dr	200	18	P	do.	do.	T, B	I	Hole in pump base	.5	3,234.0	92.41	4-11-51	Reported yield 1,100.
-36bb	E. Wikoff	Dr	200		P	do.	do.	T, G	I	do.	1.0	3,177.3	96.13	4-11-51	
17-36-2bc	K. E. Sentney	Dr	117.7	6	P	do.	do.	Cy, W	N	Base of pump	.5	3,266.4	98.81	5-9-51	
-4ca	M. B. Wood	Dr	116	6	P	do.	do.	Cy, W	S	Top of casing	2.0	3,274.4	88.91	5-8-51	
-5cd	J. Teshmuper	Dr	99.2	6	P	do.	do.	Cy, W	N	do.	1.0	3,292.3	94.29	5-8-51	
-8cc	H. L. Washington	Dr	87.0	6	P	(?)		Cy, W	S	do.	1.0	3,266.8	67.38	5-8-51	
-10ad	Wichita Co.	Dr	29.0	6	P	Sand, gravel		Cy, H	D	do.	.0	3,188.3	24.54	5-8-51	
-11aa	Bertha Schwindt	Dr	35	6	P	do.		Cy, W	D, S	Base of pump	.5	3,172.0	23.85	5-9-51	
-11dd	J. Schwindt	Dr	111	5½	P	do.	Ogallala	Cy, W	N	Top of casing	.5	3,246.7	101.01	5-8-51	
-16aa	C. S. Heath	Dr	22.0	5½	P	do.		Cy, W	S	do.	.0	3,191.2	16.86	5-2-51	
-17da	J. Schwindt	Dr	33.0		P	do.		J, E	D	do.	-7.1	3,204.7	18.02	5-8-51	
-19dd	J. Schwindt	Dr	106	10	P	do.	Ogallala	T, B	I				10		
-20da	J. Gerstberger	Dr	130		P	do.		T, B	I	Hole in side of pump	.5	3,238.7	48.72	4-20-51	
-23bc	J. Schwindt	Dr	240		P	do.	Ogallala	T, B	I	do.	.0	3,258.4	100.14	4-20-51	Reported yield 1,000, drawdown 23.

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TABLE 8.—*Records of wells (Wichita County—continued)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
17-36-26db	L. Mathes	Dr	221					T, D	I						Reported yield 900.
-27bb	H. Asmussen	Dr	122	6	P	Sand, gravel	Ogallala	Cy, W	S	Top of casing	1.0	3,266.7	94.71	5- 2-51	
-28ba	J. Gerstberger	Dr	202	18	P	do.	do.	T, B	I	Hole in pump base	.3	3,277.6	95.17	4-19-51	Reported yield 1,000.
-31ad	G. A. Rowton	Dr	107.5	5½	P	do.	do.	N	N	Top of casing	2.5	3,295.1	92.59	5- 2-51	
-33bd	W. F. Ihde	Dr		5	P	Sand, gravel	Ogallala	N	N	Bolt near casing	.0	3,275.2	90.96	4-19-51	
-35ab	Lloyd Mathes	Dr			P	do.	do.	T, D	I	Hole in pump base	.0	3,251.3	94.01	4-19-51	Reported yield 900.
17-37-1cb	John M. Neyer	Dr	91.1	6	P	do.	do.	N	N	Top of casing	.70	3,327.7	81.96	5- 2-51	
-3bc	A. E. Lewis	Dr	101.4	6	P	do.	do.	Cy, W	N	Base of pump	3.3	3,357.9	86.00	5- 8-51	
-7aa	Leonard Kiefer	Dr		6	P	do.	do.	N	N	Top of casing	1.0	3,368.1	81.67	5- 8-51	
-8ba	do.	Dr	180		P	do.	do.	T, D	I	Hole in pump	1.0	3,365.4	85.15	3-29-51	
-8cc	do.	Dr		6	P	do.	do.	Cy, H	N	Top of casing	.5	3,327.2	44.97	5- 8-51	
-10ad	A. E. Lewis	Dr		6	P	do.	do.	Cy, W	N	Base of pump	1.0	3,324.9	77.28	5- 2-51	
-13bb[1]	U. S. Geological Survey	J	21.1	0.75	P	do.	Alluvium and Ogallala.	N	O	Top of casing	2.5	3,246.2	10.67	11-30-51	
-13bb[2]	do.	J		0.75	P	do.	do.	N	O	do.	3.5	3,246.4	12.07	11-30-51	
-22bb	E. Langley	Dr		6	P	do.	Ogallala	Cy, H	N	Base of pump	1.0	3,283.8	25.44	5- 8-51	
17-38-2ba	Leslie Crouch	DD	120.7		C, P	do.		VC, G	I	Top of curb	1.2	3,347.1	16.83	3-29-51	Reported yield 800.
-4ab	Mary Kiefer	Dr	87.5	6	P	do.	Ogallala	Cy, W	N	Top of casing	.7	3,431.4	82.88	3-29-51	
-6bd	J. A. Bryan	Dr	109.5	6	P	do.	do.	Cy, W	S	Base of pump	.9	3,463.7	86	5-17-51	Pumping.
-12dc	John Bauck	Dr			P	do.	do.	T, G	I	do.	.5	3,330.1	21.70	5- 8-51	
-13ab	L. E. Gorsuch	Dr		6	P	do.	Alluvium	Cy, W	N	Discharge hole	1.5	3,318.8	10.69	5- 8-51	
-14cc	John Bauck	Dr	99.2	6	P	do.	Ogallala	Cy, H	N	Top of casing	.2	3,407.8	84.92	5-17-51	
-17da	L. Oldham	Dr		6	P	do.	do.	Cy, W	N	do.	1.5	3,432.2	85.55	5-17-51	
-18dd	F. H. Klayman	Dr	110	6	P	do.	do.	N	N	Top of culvert metal	.8	3,453.4	94.38	5-17-51	New pump being installed. Water for domestic use.

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-24ac	John Bauer	Dr	210		P	do.	do.	T, B	I	Hole in pump base	.5	3,393.7	86.76	3-29-51	
-26bb	do	Dr		6	P	do.	do.	Cy, W	N	Top of casing	.3	3,410.5	88.70	5-17-51	
-31dd	R. M. Shaw	Dr		6	P	do.	do.	Cy, W	S	Edge of disk cover	.8	3,452.4	95.39	5-17-51	
-36cc	H. F. Grusing	Dr	100.1	6	P	do.	do.	Cy, N	N	Top of casing	.4	3,399.3	89.91	5-14-51	
-35-2ac	Leo Meeker	Dr			P	Sand, gravel	Ogallala	T, G	I	Hole in pump base	.0	3,177.8	87.50	4-18-51	
-5bb	Jos. Hermann	Dr				do.	do.	T, —	I						
-8bb	T. Boulware	Dr	187	20	P	do.	do.	T, E	I	Top of casing	.0	3,218.2	85.51	4-11-51	
-9ac	Anthony Beming	Dr	119.2	22	P	do.	do.	T, G	I	Hole in pump base	1.0	3,200.5	83.05	4-19-51	
-13bb	A. C. Felt	Dr	95.0	6	P	do.	do.	Cy, W	N	Top of casing	.5	3,166.4	78.77	4-27-51	
-13cb	A. H. Conrardy	Dr	135	18	P	do.	do.	T, G	I	Hole in side of pump	1.0	3,166.2	77.78	4-11-51	
-14bb	A. C. Felt	Dr	95.2	5	P	do.	do.	N	N	Top of casing	.2	3,183.6	82.67	4-30-51	
-14dc	A. H. Conrardy	Dr	155		P	do.	do.	T, G	I	Hole in pump base	.0	3,171.4	80.14	4-11-51	
-17dd	Catholic Church	Dr	108.2	6	P	do.	do.	Cy, H	D	Top of casing	.5	3,207.8	80.99	4-19-51	
-27cb	F. Kohl	Dr	140	16	P	do.	do.	T, —	I						Reported yield 800.
-27cc	F. Kohl	Dr	144	18	P	do.	do.	T, B	I	Hole in pump base	.3	3,196.2	83.52	4-18-51	Reported yield 800.
-27dc	Don Hutchins	Dr	145	18	P	do.	do.	T, D	I	do.	.0	3,190.6	85.30	4-18-51	Reported yield 1,100.
-31dd	V. L. Nuss	Dr	82	6	P	do.	do.	Cy, W	N	Edge of tin cover	1.0	3,213.3	80.05	4-18-51	
-32bb	Victor Kerschen	Dr		6	P	do.		Cy, W	S	Top of casing	1.0	3,160.7	28.43	4-18-51	
-33bc	A. A. Gerstberger	Dr		6	P	do.	Ogallala	Cy, W	S	do.	1.0	3,171.1	48.99	4-18-51	
-34ab	Don Hutchins	Dr	143	18	P	do.	do.	T, B	I	Hole in pump base	.0	3,192.0	84.89	4-18-51	Reported yield 2,200.
-36bc	B. V. Conrardy	Dr	132.0	18	P	do.	do.	T, D	I	do.	.5	3,170.1	81.44	4-18-51	Measured and reported yield 1,192.
-36cb	Peter Kessler	Dr	129.2	16	P	do.	do.	T, D	I	Hole in side of pump	.0	3,173.4	84.98	4-18-51	
18-36-3da	P. E. Metheney	Dr		5	P	do.	do.	Cy, W	S	Top of casing	.5	3,247.5	84.34	4-19-51	
-9bb	F. Kostner	Dr	200	18	P	do.	do.	T, B	I	Hole in side of pump	1.0	3,281.4	81.62	4-20-51	Reported yield 900.
-14bd	Ruth Zinn	Dr	69.0	6	P	do.	do.	Cy, W	N	Top of casing	2.6	3,233.1	58.56	4-19-51	
-15dd	O. W. Mickel	Dr	165	18	P	do.	do.	T, —	I						Reported yield 750.
-16dc	A. L. Walk	Dr		6	P	do.	do.	N	N	Top of casing	.5	3,269.0	76.23	4-18-51	
-18dd	R. E. Gwin	Dr	174	18	P	do.	do.	T, B	I	Hole in pump base	1.0	3,296.2	83.45	4-20-51	Reported yield 945.
-24ac	Alva Kreitzer	Dr	60	6	P	do.	do.	Cy, W	S	Top of casing	.3	3,200.4	53.31	4-18-51	
-24ba	do.	Dr	120		P	do.	do.	T, G	I		1.0	3,211.5	70	4-18-51	Reported yield 120.
-31ab	F. E. Clark	Dr		6	P	Sand, gravel	do.	Cy, H	N	Top of casing	.5	3,286.8	75.74	4-18-51	
-36cc	E. L. Richardson	Dr	100+	6	P	do.	do.	Cy, W	S	do.	1.0	3,219.6	71.30	4-19-51	
18-37-2ad	J. E. Fisher	Dr	157	6	P	do.	do.	Cy, W	S	do.	.5	3,320.8	85.14	5- 2-51	
-3bd	D. F. Jaeger	Dr		10	P	do.	do.	T, T	I	Base of pump	1.0	3,345.6	85.80	3-22-51	
-4da	Joe C. Graber, Jr.	Dr	94.1	6	P	do.	do.	Cy, W	N	Top of curb	1.8	3,351.0	87.55	5-14-51	
-13ac		Dr		6	P	do.	do.	Cy, W	N	Top of casing	.0	3,300.4	70.70	5- 2-51	

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TABLE 8.—*Records of wells (Wichita County—concluded)*

Well Number	Owner or tenant	Type of well	Depth of well, feet	Diameter of well, in.	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Distance above land surface, feet	Measuring point: Height above mean sea level, feet	Depth to water level below measuring point, feet	Date of measurement	REMARKS (Yield given in gallons a minute; drawdown in ft.)
18-37-16ad	H. Rolf	Dr	85.0	6	P	Sand, gravel	Ogallala	Cy, W	N	Top of casing	.0	3,344.4	77.17	5-14-51	
-19aa	H. Barr	Dr	200	18	P	do.	do.	T, B	I	Hole in side of pump	.7	3,370.2	86.32	3-27-51	Reported yield 1,200.
-23cb	Trix Jones	Dr	97.5	6	P	do.	do.	Cy, W	N	Base of pump	.0	3,323.0	70.22	3-27-51	
-27ca	Phil Teeter	Dr	131.7	6	P	Sand, gravel	do.	Cy, W	S	Top of casing	.6	3,398.8	86.17	4-23-51	
-28ac	H. A. Gibson	Dr	178.5	18	P	do.	do.	T, B	I	do.	1.0	3,345.4	81.51	3-22-51	Reported yield 1,015.
-34bb	G. Wikoff	Dr	135	12	P	do.	do.	T, G	I	Hole in pump base	1.0	...	59.26	7-12-51	Reported yield 1,100.
-34bc	do.	Dr	58	...	P	do.	...	T, G	I	...	...	...	19	3-27-51	Reported yield 550.
18-38-1cb	Robt. Hill	Dr	203	...	P	do.	Ogallala	T, D	I	...	...	...	105	3-22-51	Reported yield 1,200.
-8cb	Jessie P. Seville	Dr	61.5	6	P	do.	Alluvium	Cy, W	N	Top of casing	2.6	3,392.0	38.40	5-17-51	
-9dd	W. Reimer	Dr	...	6	P	do.	Ogallala	Cy, W	S	do.	.5	3,432.4	91.23	5-17-51	
-14cd	Weslie W. Krey	Dr	47.3	6	P	do.	...	Cy, W	D, S	do.	.7	3,356.9	41.73	4-23-51	
-17aa	W. Reimer	Dr	49.0	6	P	do.	...	Cy, W	N	do.	1.5	3,393.2	45.29	5-17-51	
-19cc	Gorsuch and Sons	Dr	176	18	P	do.	Ogallala	T, E	I	Top of pipe near pump	1.0	3,464.6	109.34	3-27-51	
-20ac	J. A. Reimer	Dr	168	6	P	do.	do.	T, E	I	Hole in pump base	3.0	3,439.8	93.52	3-27-51	Reported yield 550.
-20ad	do.	Dr	170	6	P	do.	do.	T, E	I	...	...	...	...	...	Reported yield 550.
-20bc	Gorsuch and Sons	Dr	175	18	P	do.	do.	T, D	I	Hole in pump base	1.0	3,443.1	98.64	3-27-51	
-27dd	L. D. Baum	Dr	75.8	6	P	do.	do.	N	N	Top of casing	.0	3,385.8	63.57	4-23-51	
-30bc	Gorsuch and Sons	Dr	...	...	...	do.	do.	T, E	I						
-30bd	do.	Dr	...	...	...	do.	do.	T, D	I	...	...	...	...	...	
-31db	John Durham	Dr	148.0	16	P	do.	do.	T, B	I	Hole in pump base	1.0	3,454.5	103.64	4- 1-51	Reported yield 700.
-36dd	A. Krenzel	Dr	...	6	P	do.	do.	Cy, H	N	Top of casing	.5	3,374.8	79.03	3-27-51	

3. B, bored well; DD, dug and drilled well; Dn, driven well; Dr, drilled will; Du, dug well; J, jetted well; Sp, spring.
4. Reported depths below land surface are given in feet; measured depths are given in feet and tenths below measuring points.
5. C, concrete (block, tile, or pipe); P, iron or steel pipe; R, rock; T, clay tile; W, wood.
7. Method of lift: C, horizontal centrifugal; Cy, cylinder; F, natural flow; J, jet; N, none; P, pitcher pump; T, turbine; VC, vertical centrifugal. Type of power: B, butane or propane; D, diesel; E, electric; G, gas engine; H, hand operated; T, tractor; W, windmill.
8. D, domestic; I, irrigation; In, industrial; N, not being used; O, observation; P, public supply; S, stock.
9. Measured depths to water level are given in feet, tenths, and hundredths; reported depths to water level are given in feet.

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RECORDS OF WATER LEVELS IN OBSERVATION WELLS

The measurements of the water levels in 79 wells in the Ladder Creek area are given in Table 9. This table includes measurements from the beginning of record for each well through March 1952.

Water-level measurements collected in the aquifer tests are tabulated in Tables 10, 11, 12, 13, and 14.

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Table 9.—*Water-level measurements in observation wells, in feet below land surface*

Greeley County

Date	Water level	Date	Water level	Date	Water level
16-39-10aa					
May 20, 1951	16.59	Jan. 24, 1952	16.19	Mar. 24, 1952	16.25
Dec. 14	16.17	Feb. 22	16.16		
16-40-35ab—Lowest daily water level from recorder charts for the period November 1951 through March 1952.					
Nov. 8, 1951	74.10	Dec. 25, 1951	74.12	Feb. 9, 1952	74.15
Nov. 9	74.11	Dec. 26	74.12	Feb. 10	74.17
Nov. 10	74.09	Dec. 27	74.09	Feb. 11	74.15
Nov. 11	74.08	Dec. 28	74.09	Feb. 12	74.15
Nov. 12	74.10	Dec. 29	74.12	Feb. 13	74.17
Nov. 13	74.10	Dec. 30	74.08	Feb. 14	74.17
Nov. 14	74.09	Dec. 31	74.14	Feb. 15	74.16
Nov. 15	74.11	Jan. 1, 1952	74.13	Feb. 16	74.15
Nov. 16	74.12	Jan. 2	74.12	Feb. 17	74.15
Nov. 17	74.10	Jan. 3	74.11	Feb. 18	74.17
Nov. 18	74.09	Jan. 4	74.13	Feb. 19	74.17
Nov. 19	74.08	Jan. 5	74.15	Feb. 20	74.16
Nov. 20	74.07	Jan. 6	74.13	Feb. 21	74.17
Nov. 21	74.10	Jan. 7	74.14	Feb. 22	74.18
Nov. 22	74.10	Jan. 8	74.15	Feb. 23	74.18
Nov. 23	74.10	Jan. 9	74.16	Feb. 24	74.18
Nov. 24	74.10	Jan. 10	74.13	Feb. 25	74.18
Nov. 25	74.12	Jan. 11	74.15	Feb. 26	74.17
Nov. 26	74.10	Jan. 12	74.14	Feb. 27	74.16
Nov. 27	74.10	Jan. 13	74.13	Feb. 28	74.20
Nov. 28	74.10	Jan. 14	74.16	Feb. 29	74.20
Nov. 29	74.10	Jan. 15	74.14	Mar. 1	74.17
Nov. 30	74.09	Jan. 16	74.13	Mar. 2	74.17
Dec. 1	74.08	Jan. 17	74.17	Mar. 3	74.18
Dec. 2	74.11	Jan. 18	74.12	Mar. 4	74.18
Dec. 3	74.10	Jan. 19	74.16	Mar. 5	74.19
Dec. 4	74.10	Jan. 20	74.14	Mar. 6	74.19
Dec. 5	74.10	Jan. 21	74.15	Mar. 7	74.19
Dec. 7	74.12	Jan. 22	74.16	Mar. 8	74.18
Dec. 8	74.11	Jan. 23	74.15	Mar. 9	74.17
Dec. 9	74.11	Jan. 24	74.15	Mar. 10	74.18
Dec. 10	74.10	Jan. 25	74.14	Mar. 11	74.22
Dec. 11	74.09	Jan. 26	74.15	Mar. 12	74.22
Dec. 12	74.09	Jan. 27	74.15	Mar. 13	74.21
Dec. 13	74.08	Jan. 28	74.15	Mar. 14	74.22
Dec. 14	74.17	Jan. 29	74.15	Mar. 15	74.20
Dec. 15	74.11	Jan. 30	74.15	Mar. 16	74.19
Dec. 16	74.09	Jan. 31	74.15	Mar. 17	74.19
Dec. 17	74.10	Feb. 1	74.16	Mar. 18	74.19
Dec. 18	74.09	Feb. 2	74.15	Mar. 19	74.21
Dec. 19	74.09	Feb. 3	74.16	Mar. 20	74.23
Dec. 20	74.09	Feb. 4	74.14	Mar. 21	74.28
Dec. 21	74.10	Feb. 5	74.16	Mar. 22	74.28
Dec. 22	74.12	Feb. 6	74.15	Mar. 23	74.27
Dec. 23	74.12	Feb. 7	74.16		
Dec. 24	74.11	Feb. 8	74.16		
16-41-20ba					
Aug. 5, 1947	130.10	Mar. 4, 1949	129.70	Sept. 21, 1950	131.24
Sept. 6	130.07	May 24	130.38	Oct. 14	130.50
Mar. 22, 1948	130.75	July 20	133.02	Sept. 13, 1951	130.71
May 19	130.15	Sept. 28	132.71	Oct. 20	130.57
June 24	130.06	Nov. 23	131.02	Dec. 6	130.40
July 14	130.15	Jan. 25, 1950	130.55	Jan. 24, 1952	130.12
Sept. 20	130.65	Mar. 21	130.55	Feb. 22	130.21
Nov. 12	130.33	May 11	130.44	Mar. 24	130.14
Jan. 6, 1949	127.96	July 26	130.25		
17-39-10dd					
May 28, 1951	101.02	Oct. 20, 1951	100.69	Feb. 22, 1952	100.68
Aug. 10	100.89	Dec. 6	100.79	Mar. 24	100.68
Sept. 11	100.80	Jan. 24, 1952	100.64		

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TABLE 9.—*Continued*

Lane County

Date	Water level	Date	Water level
16-28-29cd			
Aug. 14, 1948	82.15	Dec. 18, 1951	80.30
16-28-30ac			
Aug. 14, 1948	78.50	Dec. 18, 1951	76.69
16-29-3bc			
Sept. 2, 1948	24.23	Dec. 18, 1951	23.38
16-29-17dd			
Sept. 1, 1948	20.14	Dec. 18, 1951	18.20
16-29-26bb			
Sept. 1, 1948	85.94	Dec. 18, 1951	82.89
16-29-28da			
Sept. 1, 1948	93.23		
16-29-30ab			
Sept. 2, 1948	38.25	Dec. 18, 1951	36.32
16-29-31bd			
Sept. 1, 1948	52.04	Dec. 18, 1951	50.90
16-29-33bc			
Sept. 1, 1948	89.32	Dec. 18, 1951	88.20
16-30-8cb			
Aug. 27, 1948	8.00	Dec. 18, 1951	6.80
16-30-11cc			
July 24, 1948	7.00	Dec. 18, 1951	6.80
16-30-13ad			
July 21, 1948	101.00	Dec. 18, 1951	99.49
16-30-17da			
Aug. 27, 1948	9.79	Nov. 16, 1951	8.05
16-30-22ab			
Sept. 2, 1948	27.45	Nov. 16, 1951	25.39
16-30-27ad			
Sept. 1, 1948	107.48	Nov. 16, 1951	105.45
16-30-30dd			
Aug. 27, 1948	116.15	Nov. 16, 1951	114.26
16-30-32dd			
Sept. 9, 1948	111.58	Nov. 16, 1951	110.05
16-30-35cc			
Sept. 2, 1948	108.00	Nov. 16, 1951	106.30
17-29-5bc			
Sept. 1, 1948	92.16	Dec. 18, 1951	90.77

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TABLE 9.—*Continued*

Lane County—Concluded

Date	Water level	Date	Water level
17-29-19ba			
Aug. 27, 1948	76.78	Oct. 31, 1951	75.24
17-29-20ba			
Aug. 27, 1948	63.86	Oct. 31, 1951	62.59
17-30-3ba			
Aug. 27, 1948	108.42	Nov. 16, 1951	104.16
17-30-5dd			
July 26, 1948	107.98	Nov. 16, 1951	102.52
17-30-13cb			
July 24, 1948	86.54	Oct. 31, 1951	84.99
17-30-14bc			
Aug. 26, 1948	86.36	Oct. 31, 1951	84.12
17-30-16aa			
Aug. 26, 1948	88.56	Oct. 31, 1951	87.27
17-30-21cd			
Aug. 25, 1948	75.95	Oct. 31, 1951	74.53
17-30-23cc			
July 24, 1948	76.13	Oct. 31, 1951	74.43
17-30-25da			
Aug. 25, 1948	49.62	Oct. 31, 1951	47.50
17-30-33bc			
Aug. 25, 1948	72.50	Oct. 31, 1951	71.73
17-30-35bb			
Aug. 11, 1948	66.29	Oct. 31, 1951	64.74
18-30-1bc			
July 21, 1948	69.68	Oct. 31, 1951	68.72
18-30-2cd			
Aug. 26, 1948	76.72	Oct. 31, 1951	75.58
18-30-4dd			
Aug. 25, 1948	75.12	Oct. 31, 1951	74.35
18-30-7aa			
Aug. 26, 1948	78.61	Oct. 31, 1951	77.52

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TABLE 9.—*Continued*

Logan County

Date	Water level	Date	Water level	Date	Water level
14-37-28cb					
Jan. 24, 1952	8.13	Feb. 22, 1952	8.41		
14-37-29da					
June 14, 1951	6.00	Sept. 11, 1951	5.26	Jan. 24, 1952	5.98
July 11	4.57	Oct. 20	6.67	Feb. 22	6.16
Aug. 10	4.44	Dec. 6	6.78	Mar. 24	5.85
15-35-28bc					
June 5, 1951	37.64	Sept. 11, 1951	36.29	Jan. 24, 1952	37.27
July 11	36.41	Oct. 20	36.54	Mar. 25	37.59
Aug. 10	35.89	Dec. 13	36.33		
15-37-22dd					
June 8, 1951	44.85	Sept. 11, 1951	44.90	Jan. 24, 1952	45.00
July 11	44.77	Oct. 20	44.96	Feb. 22	45.01
Aug. 10	44.85	Dec. 6	44.93	Mar. 24	44.46

Scott County

Date	Water level	Date	Water level	Date	Water level
16-31-29aa					
May 21, 1951	116.32	Sept. 12, 1951	116.26	Jan. 24, 1952	115.97
July 12	116.30	Oct. 20	116.05	Mar. 25	116.00
Aug. 10	116.33	Dec. 13	115.99		
16-32-9aa					
May 24, 1951	135.78	Aug. 10, 1951	135.76	Dec. 13, 1951	135.70
June 7	135.84	Sept. 12	135.84	Jan. 24, 1952	135.66
July 11	135.80	Oct. 20	135.58	Mar. 24	135.77
16-33-21bb					
April 25, 1951	145.33	Aug. 10, 1951	145.23	Dec. 13, 1951	144.87
June 7	145.12	Sept. 12	145.32	Jan. 24, 1952	144.80
July 11	145.25	Oct. 20	145.05	Mar. 25	145.01
16-33-24ac					
April 27, 1951	16.02	Aug. 10, 1951	14.45	Dec. 13, 1951	15.70
June 7	14.43	Sept. 12	15.33	Jan. 24, 1952	15.62
July 11	12.51	Oct. 20	15.67	Mar. 25	15.69
16-34-18dd					
Sept. 22, 1939	117.30	Oct. 25, 1940	117.38	Mar. 1, 1942	117.43
Sept. 30	117.34	Nov. 15	117.43	Mar. 28	117.41
Nov. 6	117.43	Dec. 31	117.41	April 29	117.50
Dec. 11	117.38	Feb. 22, 1941	117.42	April 26, 1951	117.31
Jan. 15, 1940	117.19	Mar. 12	117.38	June 7	117.35
Feb. 23	117.42	April 25	117.44	July 11	117.32
Mar. 19	117.35	May 25	117.33	Aug. 10	117.15
April 18	177.40	June 25	117.41	Sept. 12	117.03
May 20	117.38	Oct. 1	117.44	Oct. 19	116.86
June 24	117.36	Oct. 27	117.45	Dec. 13	116.81
July 25	117.38	Nov. 26	117.37	Jan. 24, 1952	116.79
Aug. 26	117.39	Jan. 2, 1942	117.44	Mar. 25	116.85
Sept. 21	117.40	Jan. 24	117.42		
17-31-24bc					
June 5, 1951	89.11	Oct. 19	86.27	Jan. 24, 1952	86.20
Aug. 10	Pumping	Dec. 13, 1951	Pumping	Mar. 24	86.19
Sept. 12	86.34				

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Table 9.—*Continued*

Scott County—Continued

Date	Water level	Date	Water level	Date	Water level
17-32-5ab					
May 21, 1951	106.79	Aug. 10, 1951	106.90	Dec. 13, 1951	105.58
June 7	106.72	Sept. 12	106.10	Jan. 24, 1952	105.50
July 11	106.56	Oct. 20	105.78	Mar. 24	105.37
17-33-21ca					
Sept. 17, 1951	53.54	Jan. 24, 1952	54.46	Mar. 24, 1952	54.52
Dec. 13	54.35				
17-33-21cd					
Sept. 17, 1951	90.15	Jan. 24, 1952	90.63	Mar. 24, 1952	90.69
Dec. 13	90.58				
17-33-21db					
Sept. 21, 1951	21.63	Jan. 24, 1952	22.39	Mar. 19, 1952	22.34
Dec. 13	22.43	Feb. 5	22.19	Mar. 24	22.45
17-33-22bb—Lowest daily water level taken from recorder charts—Scott County.					
Nov. 30, 1951	18.06	Dec. 29, 1951	18.07	Feb. 26, 1952	18.12
Dec. 1	18.06	Dec. 30	18.07	Feb. 27	18.10
Dec. 2	18.05	Dec. 31	18.10	Feb. 28	18.08
Dec. 3	18.08	Jan. 1, 1952	18.11	Feb. 29	18.09
Dec. 4	18.07	Jan. 2	18.12	Mar. 1	18.09
Dec. 5	18.05	Jan. 3	18.12	Mar. 2	18.08
Dec. 6	18.08	Jan. 4	18.12	Mar. 3	18.10
Dec. 7	18.12	Jan. 5	18.11	Mar. 4	18.11
Dec. 8	18.12	Jan. 6	18.11	Mar. 5	18.11
Dec. 9	18.12	Jan. 7	18.08	Mar. 6	18.10
Dec. 10	18.12	Jan. 8	18.08	Mar. 7	18.10
Dec. 11	18.11	Jan. 9	18.11	Mar. 8	18.09
Dec. 12	18.09	Jan. 10	18.11	Mar. 9	18.07
Dec. 13	18.09	Jan. 11	18.07	Mar. 10	18.09
Dec. 14	18.12	Jan. 12	18.07	Mar. 11	18.09
Dec. 15	18.14	Jan. 13	18.07	Mar. 12	18.09
Dec. 16	18.11	Jan. 14	18.05	Mar. 13	18.09
Dec. 17	18.10	Jan. 15	18.05	Mar. 14	18.12
Dec. 18	18.11	Jan. 16	18.05	Mar. 15	18.12
Dec. 19	18.08	Jan. 17	18.05	Mar. 16	18.11
Dec. 20	18.10	Jan. 18	18.05	Mar. 17	18.07
Dec. 21	18.10	Jan. 19	18.01	Mar. 18	18.07
Dec. 22	18.10	Jan. 20	18.01	Mar. 19	18.07
Dec. 23	18.12	Jan. 21	17.99	Mar. 20	18.09
Dec. 24	18.12	Jan. 22	18.01	Mar. 21	18.10
Dec. 25	18.12	Jan. 23	18.02	Mar. 22	18.10
Dec. 26	18.13	Jan. 24	18.02	Mar. 23	18.10
Dec. 27	18.13	Jan. 25	18.00	Mar. 24	18.09
Dec. 28	18.07	Feb. 25	18.12		
17-33-27dd					
April 5, 1951	92.74	Aug. 10, 1951	93.55	Dec. 13, 1951	92.33
June 7	92.65	Sept. 12	93.47	Jan. 24, 1952	92.00
July 11	92.56	Oct. 19	93.03	Mar. 24	91.80
17-34-28ad					
April 25, 1951	100.59	Sept. 12, 1951	100.24	Jan. 24, 1952	100.06
July 12	100.56	Oct. 19	100.09	Mar. 24	100.11
Aug. 10	100.46	Dec. 13	100.09		
18-31-15aa					
June 5, 1951	78.04	Sept. 12, 1951	76.11	Feb. 4, 1952	76.18
June 7	78.08	Oct. 19	76.06	Mar. 25	76.20
July 7	78.06	Dec. 13	77.26		
Aug. 10	76.05	Jan. 24, 1952	78.08		

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TABLE 9.—*Continued*

Scott County—Continued

Date	Water level	Date	Water level	Date	Water level
18-32-7ac					
Sept. 1940	57.12	Dec. 1943	58.05	Mar. 27, 1951	58.17
Feb. 1941	56.25	Mar. 1944	57.19	Aug. 20	57.15
Jan. 1942	55.90	June	56.79	Nov. 1	55.83
April	55.51	Jan. 1945	57.06	Feb. 4, 1952	54.28
Dec.	56.99	April	56.63		
April 1943	55.86	Dec.	57.70		
18-32-7dc					
Sept. 1940	57.03	April 1943	55.41	Dec. 1945	57.75
Oct.	57.59	Dec.	57.79	Mar. 27, 1951	56.96
Feb. 1941	56.06	Mar. 1944	57.05	Nov.	54.01
Jan. 1942	55.68	June	56.46	Feb. 4, 1952	52.51
April	55.16	Jan. 1945	56.78		
Dec.	56.24	April	56.23		
18-32-9aa					
Sept. 11, 1951	72.77	Dec. 13, 1951	72.02	Feb. 4, 1952	71.78
Oct. 19	72.40	Jan. 24, 1952	71.89	Mar. 24	71.57
18-33-1ab					
June 16, 1944	64.48	Nov. 13, 1951	65.13	April 26, 1952	64.22
April 3, 1951	67.33	Feb. 6, 1952	64.38		
18-33-5cc					
June 16, 1944	75.15	Nov. 13, 1951	78.82	April 26, 1952	79.90
April 2, 1951	77.44	Feb. 6, 1952	77.74		
18-33-12ad					
Sept. 11, 1939	48.09	Mar. 18, 1944	48.03	Aug. 16, 1948	51.80
Sept. 30	47.50	April 24	47.83	Sept. 20	51.95
Nov. 6	44.63	June 13	47.56	Oct. 13	56.02
Dec. 11	44.29	July 19	47.41	Nov. 10	52.34
Jan. 16, 1940	46.89	Aug. 10	47.10	Dec. 15	53.30
Feb. 12	46.74	Oct. 19	47.99	Jan. 5, 1949	51.80
Mar. 19	46.49	Nov. 28	47.84	Feb. 17	58.09
April 18	46.38	Dec. 11	47.72	Mar. 4	51.60
May 20	47.42	Jan. 10, 1945	47.55	April 14	52.57
Aug. 26	49.60	Feb. 22	47.34	May 24	52.05
Nov. 16	48.42	Mar. 7	47.42	June 17	51.19
Dec. 31	48.11	April 5	47.94	July 20	51.26
Feb. 22, 1941	47.75	May 24	47.05	Aug. 11	54.95
Mar. 12	47.64	June 21	47.36	Sept. 28	54.87
April 25	48.30	July 26	48.46	Oct. 12	52.25
June 25	48.29	Oct. 23	48.26	Nov. 23	51.54
Oct. 1	47.97	Nov. 23	48.62	Dec. 16	51.23
Oct. 27	47.84	Dec. 7	48.45	Jan. 24, 1950	51.06
Nov. 26	47.68	Jan. 16, 1946	48.40	Feb. 23	51.90
Jan. 2, 1942	47.55	Mar. 20	48.98	Mar. 21	50.74
Jan. 13	47.72	April 25	49.79	April 25	52.02
Mar. 1	47.32	June 8	49.93	May 11	53.01
Mar. 21	47.30	July 8	49.56	June 26	52.82
April 28	47.18	Sept. 6	53.07	July 25	52.08
June 25	48.07	Oct. 3	51.82	Aug. 16	52.99
July 25	47.94	Nov. 8	50.64	Sept. 13	50.95
Aug. 12	47.64	Dec. 18	49.93	Oct. 9	50.70
Sept. 17	49.24	Jan. 16, 1947	49.58	Nov. 14	50.22
Oct. 7	48.48	Feb. 6	49.37	Dec. 11	49.84
Nov. 19	48.20	Mar. 5	49.15	April 3, 1951	50.36
Dec. 15	48.14	April 4	48.84	July 12	48.82
Jan. 11, 1943	49.96	May 2	48.72	July 19	48.56
Feb. 11	46.79	June 6	48.52	Aug. 3	48.51
Mar. 19	46.62	Aug. 5	50.09	Aug. 17	49.39
April 12	46.00	Oct. 14	51.59	Sept. 1	49.71
July 4	49.07	Nov. 4	51.96	Oct. 2	47.75
Aug. 7	47.72	Dec. 11	50.76	Nov. 13	46.27
Sept. 16	49.52	Jan. 14, 1948	50.23	Dec. 13	45.62
Oct. 21	48.92	Feb. 22	49.93	Jan. 24, 1952	45.02
Nov. 11	48.58	Mar. 22	49.67	Feb. 6	45.05
Dec. 15	48.52	April 14	49.65	Mar. 24	44.52
Jan. 22, 1944	48.23	June 15	57.32		
Feb. 22	48.12	July 13	56.42		

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Table 9.—*Continued*

Scott County—Concluded

Date	Water level	Date	Water level	Date	Water level
18-34-1cb1					
June 16, 1944	95.99	Feb. 6, 1952	97.53	April 25, 1952	97.41
April 4, 1951	97.37				
18-34-1cb2—Lowest daily water level from recorder charts.					
Nov. 10, 1951	97.53	Dec. 31, 1951	97.72	Mar. 1, 1952	97.27
Nov. 11	97.48	Jan. 1, 1952	97.72	Mar. 2	97.30
Nov. 12	97.45	Jan. 2	97.68	Mar. 3	97.33
Nov. 13	97.50	Jan. 3	97.66	Mar. 4	97.34
Nov. 14	97.51	Jan. 4	97.57	Mar. 5	97.32
Nov. 15	97.58	Jan. 5	97.61	Mar. 6	97.32
Nov. 16	97.62	Jan. 6	98.59	Mar. 7	97.30
Nov. 17	97.62	Jan. 7	97.52	Mar. 8	97.27
Nov. 18	97.52	Jan. 8	97.55	Mar. 9	97.28
Nov. 19	97.51	Jan. 9	97.62	Mar. 10	97.29
Nov. 20	97.47	Jan. 10	97.59	Mar. 11	97.29
Nov. 21	97.49	Jan. 11	97.51	Mar. 12	97.36
Nov. 22	97.54	Jan. 12	97.51	Mar. 13	97.40
Nov. 23	97.55	Jan. 13	97.47	Mar. 14	97.38
Nov. 24	97.55	Jan. 14	97.52	Mar. 15	97.39
Nov. 25	97.56	Jan. 15	97.48	Mar. 16	97.51
Nov. 26	97.56	Jan. 16	97.46	Mar. 17	97.49
Nov. 27	97.53	Jan. 17	97.52	Mar. 18	97.52
Nov. 28	97.53	Jan. 18	97.46	Mar. 19	97.55
Nov. 29	97.65	Jan. 19	97.50	Mar. 20	97.55
Nov. 30	97.82	Jan. 20	97.48	Mar. 21	97.51
Dec. 1	97.90	Jan. 21	97.45	Mar. 24	97.51
Dec. 2	97.68	Jan. 22	97.50	Mar. 25	95.50
Dec. 3	97.66	Jan. 23	97.49	Mar. 26	97.52
Dec. 4	97.57	Jan. 24	97.43	Mar. 27	97.51
Dec. 5	97.90	Jan. 25	97.38	Mar. 28	97.46
Dec. 6	97.95	Jan. 26	97.45	Mar. 29	97.40
Dec. 7	98.02	Jan. 27	97.46	Mar. 30	97.41
Dec. 8	98.02	Jan. 28	97.46	Mar. 31	97.47
Dec. 9	98.00	Jan. 29	97.41	April 1	97.47
Dec. 10	97.95	Jan. 30	97.40	April 2	97.45
Dec. 11	97.93	Jan. 31	97.39	April 3	97.43
Dec. 12	97.89	Feb. 1	97.43	April 4	97.46
Dec. 13	97.88	Feb. 2	97.38	April 5	97.42
Dec. 14	97.98	Feb. 3	97.42	April 6	97.41
Dec. 15	97.97	Feb. 4	97.42	April 7	97.33
Dec. 16	98.86	Feb. 5	97.44	April 16	97.33
Dec. 17	98.87	Feb. 6	97.42	April 17	97.33
Dec. 18	96.87	Feb. 7	97.37	April 18	97.30
Dec. 19	97.80	Feb. 8	97.39	April 19	97.28
Dec. 20	97.82	Feb. 9	97.36	April 20	97.27
Dec. 21	97.82	Feb. 10	97.39	April 21	97.31
Dec. 22	97.81	Feb. 11	97.35	April 22	97.32
Dec. 23	97.84	Feb. 12	97.30	April 23	97.31
Dec. 24	97.77	Feb. 13	97.36	April 24	97.31
Dec. 25	97.81	Feb. 14	97.38	April 25	97.30
Dec. 26	97.82	Feb. 15	97.36	April 26	97.26
Dec. 27	97.78	Feb. 27	97.27	April 27	97.25
Dec. 29	97.67	Feb. 28	97.27	April 28	97.26
Dec. 30	97.62	Feb. 29	97.35	April 29	97.26
18-34-16cd					
April 25, 1951	91.92	Sept. 12, 1951	91.32	Jan. 24, 1952	91.57
June 7	91.93	Oct. 19	91.68	Mar. 24	91.46
Aug. 10	91.68	Dec. 13	91.57		

Wallace County

Date	Water level	Date	Water level	Date	Water level
14-39-24ad					
Sept. 13, 1951	106.85	Dec. 6, 1951	106.94	Feb. 22, 1952	106.81
Oct. 20	106.91	Jan. 24, 1952	106.74	Mar. 24	106.80
14-41-20cb					
July 13, 1951	80.19	Jan. 24, 1952	79.40	Mar. 24, 1952	79.46
Dec. 6	79.79	Feb. 22	79.50		

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TABLE 9.—*Concluded*

Wichita County

Date	Water level	Date	Water level	Date	Water level
16-35-34cb					
May 4, 1951	107.38	Sept. 11, 1951	107.28	Jan. 24, 1952	107.23
June 7	107.35	Oct. 20	107.95	Mar. 24	107.18
Aug. 10	107.37	Dec. 13	107.20		
16-77-22dd					
May 8, 1951	84.43	Sept. 11, 1951	84.21	Jan. 24, 1952	84.08
June 7	84.40	Oct. 20	97.12	Feb. 22	84.10
Aug. 10	84.28	Dec. 6	84.18	Mar. 24	84.18
16-38-15dd					
May 19, 1951	67.60	Sept. 11, 1951	67.24	Jan. 24, 1952	Caved
June 7	67.50	Oct. 20	67.30		
Aug. 10	67.20	Dec. 6	70.02		
17-35-28cc					
April 18, 1951	88.42	Sept. 11, 1951	86.88	Jan. 24, 1952	86.93
June 7	88.38	Oct. 20	86.81	Mar. 24	86.79
Aug. 10	87.19	Dec. 13	86.89		
77-36-2bc					
May 9, 1951	98.31	Sept. 11, 1951	97.61	Jan. 24, 1952	98.16
June 7	97.90	Oct. 20	97.91		
Aug. 10	97.77	Dec. 13	97.53		
17-37-7aa					
May 8, 1951	80.67	Sept. 11, 1951	80.14	Jan. 24, 1952	80.08
June 7	80.56	Oct. 20	80.09	Feb. 22	80.13
Aug. 10	80.23	Dec. 6	80.16	Mar. 24	80.09
18-35-14bb					
Aug. 19, 1947	83.00	April 14, 1949	83.28	Dec. 11, 1950	83.27
Sept. 17	82.96	June 17	83.26	April 30, 1951	82.47
April 19, 1948	82.95	Aug. 11	81.33	June 17	82.42
June 15	83.05	Oct. 12	83.37	Aug. 10	82.29
July 23	82.91	Dec. 16	83.30	Sept. 11	82.20
Aug. 16	83.03	Feb. 24, 1950	83.18	Oct. 20	82.26
Oct. 14	83.04	April 26	83.18	Dec. 13	81.99
Dec. 15	83.28	Aug. 16	83.09	Jan. 24, 1952	81.96
Feb. 17, 1949	83.22	Oct. 10	83.01	Mar. 24	81.88
18-36-16dc					
April 18, 1951	75.78	Sept. 11, 1951	75.29	Jan. 24, 1952	75.00
June 7	75.71	Oct. 20	75.18	Feb. 22	74.94
Aug. 10	75.43	Dec. 6	75.13	Mar. 24	74.89
18-38-17aa					
May 17, 1951	43.79	Jan. 24, 1952	41.88	Mar. 24, 1952	42.10
Dec. 6	41.64	Feb. 22	42.13		

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RECORDS COLLECTED DURING AQUIFER TESTS

In all the aquifer tests, measurements of drawdown below static water level in the pumping well were made by an electric water-level gage. Time was determined by stopwatch. Yield of the wells was measured by means of a Collins flow gage.

TABLE 10.—*Aquifer test using well 16-35-31da in Wichita County, made Aug. 23 to Aug. 24, 1952. Measurements were made in the pumped well.*

Time since pumping started (minutes)	Drawdown below static water level (feet)	Yield (gpm)	Time since pumping started (minutes)	Drawdown below static water level (feet)	Yield (gpm)
1/4	15.43	....	50	37.10	....
1/2	19.21	....	55	37.14	....
3/4	21.18	....	60	37.25	....
1	22.49	....	65	37.33	....
1 1/2	25.46	....	70	37.39	....
2	28.87	....	80	37.32	836
2 1/2	29.42	....	90	37.70	....
3	30.29	....	100	37.82	....
4	32.19	....	110	37.71	....
5	33.13	....	120	37.62	832
6	33.84	....	140	37.71	....
7	34.41	....	160	37.71	....
8	34.80	....	180	37.93	836
9	35.12	....	200	38.19	....
10	35.42	....	220	37.97	....
12	35.67	....	240	38.02	827
14	35.85	....	260	38.07	....
15	.....	840	290	38.08	....
16	35.97	....	315	.....	827
18	36.07	....	320	38.28	....
20	36.25	....	540	.....	829
22	36.43	....	560	38.54	....
24	36.61	....	600	38.41	....
26	36.73	....	730	.....	818
28	36.89	....	1,380	36.65	776
30	36.95	....	1,440	36.56	769
34	36.91	....	1,560	36.09	....
35	.....	828	1,590	.....	760
38	36.95	....	1,620	36.09	....
42	37.02	....	1,740	36.10	760
46	37.12	....			

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TABLE 11.—*Aquifer test using well 17-32-5ab in Scott County, made Sept. 24 to Sept. 25, 1951. Measurements were made in pumped well.*

Time since pumping started (minutes)	Time since pumping stopped (minutes)	Drawdown below static water level (feet)	Yield (gpm)
0	....	0	0
125	....	......	486
185	....	......	472
247	....	......	467
380	....	......	454
450	....	......	449
660	....	......	448
1480	0	23.39	436
1480½	½	16.19	0
1481	1	12.71	
1481½	1½	13.17	
1482	2	13.16	
1482½	2½	12.82	
1483	3	12.45	
1484	4	11.70	
1485	5	11.02	
1486	6	10.48	
1487	7	10.04	
1488	8	9.65	
1489	9	9.37	
1490	10	9.06	
1492	12	8.52	
1494	14	8.12	
1496	16	7.80	
1498	18	7.51	
1500	20	7.26	
1502	22	7.05	
1504	24	6.84	
1506	26	6.63	
1508	28	6.49	
1510	30	6.32	
1514	34	6.03	
1518	38	5.80	
1522	42	5.58	
1526	46	5.43	
1530	50	5.21	0
1535	55	5.00	
1540	60	4.82	
1545	65	4.67	
1550	70	4.51	
1560	80	4.23	
1570	90	4.00	
1620	140	3.10	
1640	160	2.90	
1660	180	2.70	
1680	200	2.51	
1710	230	2.30	
1740	260	2.10	
1770	290	1.95	
1800	320	1.82	
1840	360	1.69	
1880	400	1.54	
1920	440	1.47	
1960	480	1.37	
2000	520	1.30	
2040	560	1.24	
2080	600	1.14	
2140	660	1.06	
2200	720	0.99	
2260	780	0.95	
2320	840	0.89	
2380	900	0.88	
2560	1080	0.78	
2710	1230	0.77	
2920	1440	0.75	

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TABLE 12.—*Aquifer test using well 17-33-28cd in Scott County, made on Sept. 21, 1951. Measurements were made in pumped well.*

Time since pumping started (minutes)	Time since pumping stopped (minutes)	Drawdown below static water level (feet)	Yield (gpm)	Time since pumping started (minutes)	Time since pumping stopped (minutes)	Drawdown below static water level (feet)	Yield (gpm)
¼	...	17.20	...	(Pump stopped)			
½	...	23.40	...	660¼	¼	10.93	0
¾	...	25.50	...	660½	½	4.87	...
1	...	27.40	...	661½	1½	4.81	...
1½	...	29.10	...	662	2	5.24	...
2	...	30.30	...	662½	2½	5.07	...
2½	...	30.90	...	663	3	4.86	...
3	...	31.60	...	664	4	4.50	...
4	...	32.00	...	665	5	4.26	...
5	...	32.50	...	666	6	4.06	...
6	...	32.90	...	667	7	3.84	...
7	...	33.30	...	668	8	3.71	...
8	...	33.50	...	669	9	3.60	...
9	...	33.60	...	670	10	3.49	...
10	...	33.70	...	672	12	3.35	...
12	...	33.80	...	674	14	3.28	...
14	...	33.95	...	676	16	3.19	...
16	...	34.10	...	678	18	3.05	...
18	...	34.15	...	680	20	3.00	...
20	...	34.25	...	682	22	2.91	...
22	...	34.40	...	684	24	2.85	...
24	...	34.70	...	686	26	2.79	...
26	...	34.40	...	688	28	2.75	...
28	...	34.20	...	690	30	2.72	...
30	...	34.15	...	694	34	2.64	...
34	...	34.40	...	698	38	2.55	...
38	...	34.50	...	702	42	2.48	...
40	...	...	787	706	46	2.41	...
42	...	34.85	...	710	50	2.36	...
46	...	34.90	...	715	55	2.29	...
50	...	34.95	...	720	60	2.22	...
55	...	34.90	...	725	65	2.17	...
60	...	34.96	...	730	70	2.13	...
65	...	34.95	...	740	80	2.03	...
70	...	34.96	...	750	90	1.94	...
80	...	35.02	...	760	100	1.88	...
90	...	35.11	...	770	110	1.81	...
100	...	35.29	...	780	120	1.75	...
120	...	35.22	782	800	140	1.64	...
140	...	35.39	...	820	160	1.54	...
160	...	35.43	...	840	180	1.46	...
180	...	35.43	776	860	200	1.39	...
200	...	35.43	...	890	230	1.30	...
230	...	35.46	...	920	260	1.22	...
240	...	...	778	950	290	1.14	...
260	...	35.45	...	980	320	1.08	...
290	...	35.48	...	1020	360	0.99	...
300	...	...	775	1060	400	0.93	...
320	...	35.56	...	1100	440	0.86	...
360	...	35.65	...	1140	480	0.80	...
400	...	35.79	...	1180	520	0.75	...
420	...	...	767	1220	560	0.70	...
440	...	36.01	...	1260	600	0.66	...
480	...	36.03	...	1320	660	0.60	...
520	...	36.04	...	1380	720	0.55	...
540	...	...	770	1440	780	0.50	...
560	...	35.84	...				
600	...	36.17	775				
655	...	...	770				
660	...	36.44	...				

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TABLE 13.—*Aquifer test using well 17-34-2dc in Scott County, made Oct. 8 to Oct. 9, 1951. Measurements were made in the pumped well.*

Time since pumping started (minutes)	Time since pumping stopped (minutes)	Drawdown below static water level (feet)	Yield (gpm)
¼		5.32	
½		5.35	
¾		5.30	
1		5.93	
1½		6.10	
2		6.48	
2½		6.97	
3		7.15	
4		7.62	
5		8.05	
6		8.37	
7		8.66	
8		8.94	
9		9.19	
10		9.45	
12		9.83	
14		10.18	
16		10.53	
18		10.83	
20		11.03	
22		11.28	
24		11.47	
26		11.56	
28		11.72	
30		11.88	
34		12.16	
38		12.44	
42		12.66	
46		12.88	
50		13.38	
56		13.38	
60		13.50	
65		13.69	
70		13.87	
80		14.07	
91		14.38	
103		14.78	
113		14.92	
120		15.08	760
145		15.52	
166		15.82	
180		15.96	
200		16.22	
230		16.49	
240			756
260		16.70	
290		16.89	
330			747
338		17.11	
360		17.37	
390			768
400		17.73	
464		18.06	
470			764
500		18.18	
520		18.25	
565		18.48	
610		18.55	
660		18.82	767
720		18.83	
792		18.96	
840		18.92	764
900		19.14	
960		19.15	
1020		19.09	754
1080		19.15	
1140		19.12	
1195			
1200		19.10	
1260		19.15	
1315			740
1320		19.14	
1450		19.10	
1560		19.11	
1680		19.09	
1800		19.10	720
1805		19.10	
	(Pump stopped)		
1805¼	¼	15.92	0
1805½	½	14.87	
1805¾	¾	14.57	
1806	1	14.57	
1807	2	14.47	
1807½	2½	14.36	
1808	3	14.27	
1809	4	14.15	
1810	5	14.06	
1811	6	13.89	
1812	7	13.76	
1813	8	13.65	
1814	9	13.55	
1815	10	13.47	
1817	12	13.12	
1819	14	13.12	
1821	16	13.01	
1823	18	12.82	
1825	20	12.70	
1829	24	12.45	
1831	26	12.34	
1833	28	12.26	
1835	30	12.17	
1841	36	12.07	
1845	40	11.67	
1849	44	11.50	
1853	48	11.28	
1857	52	11.17	
1861	56	10.91	
1865	60	10.77	
1871	66	10.52	
1875	70	10.47	
1885	80	10.12	
1899	94	9.68	
1905	100	9.52	
1915	110	9.20	
1925	120	8.93	
1948	143	8.27	
1965	160	7.75	
1985	180	7.29	
2005	200	6.99	
2035	230	6.57	

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TABLE 13.—*Concluded*

Time since pumping started (minutes)	Time since pumping stopped (minutes)	Drawdown below static water level (feet)	Yield (gpm)
2078	273	6.17	......
2095	290	5.99	......
2125	320	5.72	......
2165	360	5.49	......
2205	400	5.21	......
2265	460	4.93	......
2325	520	4.65	......
2385	580	4.40	......
2445	640	4.18	......
2511	706	3.99	......
2571	766	3.87	......
2631	826	3.70	......
2691	886	3.55	......
2745	940	3.45	......
2805	1000	3.33	......
2865	1060	3.20	......
2925	1120	3.06	......
3015	1210	2.88	......
3125	1320	2.62	......
3245	1440	2.40	......
3365	1560	2.21	......
3492	1687	2.10	......
3605	1800	1.99	......
4225	2420	1.53	......

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TABLE 14.—*Aquifer test using well 18-32-7ac in Scott County, made Sept. 28 to Sept. 29, 1951. Measurements were made in pumped well.*

Time since pumping started (minutes)	Time since pumping stopped (minutes)	Drawdown below static water level (feet)	Yield (gpm)
12	....	18.53	......
14	....	18.72	......
16	....	18.85	......
18	....	18.85	......
20	....	19.07	......
22	....	18.99	......
24	....	18.87	......
26	....	19.38	......
28	....	19.45	......
30	....	19.31	......
34	....	19.67	......
38	....	19.84	......
42	....	19.96	......
46	....	19.88	......
50	....	19.98	......
55	....	20.20	......
60	....	20.26	......
65	....	20.06	......
70	....	20.36	1190
75	....	20.49	......
80	....	20.53	......
90	....	20.60	......
100	....	20.67	......
110	....	20.46	......
120	....	20.82	......
130	....	......	1177
140	....	20.84	......
160	....	21.03	......
194	(Pump stopped)		0
195	1	4.16	......
197	3	4.44	......
198½	4½	4.06	......
199½	5½	3.80	......
200½	6½	3.65	......
201½	7½	3.51	......
202½	8½	3.39	......
203½	9½	3.29	......
204½	10½	3.21	......
205½	11½	3.13	......
207	13	3.02	......
208	14	2.92	......
210	16	2.83	......
212	18	2.72	......
214	20	2.61	......
216	22	2.51	......
218	24	2.42	......
220	26	2.34	0
222	28	2.25	......
224	30	2.19	......
226	32	2.12	......
228	34	2.05	......
230	36	1.98	......
235	(Pump started)		
236	....	19.85	......
238	....	19.56	......
241	....	19.90	......
243	....	20.06	......
245	....	20.14	......
250	....	20.39	......
255	....	19.99	......
260	....	19.10	......
265	....	20.14	......
270	....	20.42	......
290	....	20.11	......
300	....	19.55	......
310	....	20.19	......
320	....	19.95	......
330	....	20.91	......
350	....	20.08	......
490	....	21.21	......
510	....	21.26	......
540	....	21.37	......
570	....	21.78	......
600	....	21.95	......
630	....	22.15	......
660	....	......	1175
670	....	22.47	......
710	....	22.60	......
750	....	22.61	......
810	....	22.66	......
870	....	22.77	......
930	....	22.82	......
990	....	22.60	......
1010	....	......	1166
1060	....	......	1154
1110	....	23.07	......
1115	....	......	1166
1170	....	23.14	......
1200	....	......	1164
1260	....	23.15	......
1350	....	23.12	......
1355	....	......	1158
1440	....	......	1156
1441	....	23.26	......
1530	....	......	1164
1531	....	23.60	......
1620	....	......	1165
1621	....	23.71	......
1651	....	23.67	......
1651½	....	......	......
	(Pump stopped)		
1651¾	¼	9.00	0
1652	½	8.49	......
1652¼	¾	8.20	......
1652½	1	8.01	......
1652¾	1¼	7.74	......
1653	1½	6.91	......
1653¾	2¼	6.88	......
1654½	3	6.75	......
1655½	4	6.45	......
1656½	5	6.25	......
1657½	6	6.10	......
1658½	7	5.95	......
1659½	8	5.83	......
1660½	9	5.72	......
1661½	10	5.63	......
1663½	12	5.56	......
1665½	14	5.45	......
1667½	16	5.33	......
1669½	18	5.23	......

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TABLE 14.—*Concluded*

Time since pumping started (minutes)	Time since pumping stopped (minutes)	Drawdown below static water level (feet)	Yield (gpm)	Time since pumping started (minutes)	Time since pumping stopped (minutes)	Drawdown below static water level (feet)	Yield (gpm)
1671	20	5.14	......	1906	255	2.61	......
1673	22	5.06	......	1921	270	2.51	......
1675	24	5.01	......	1951	300	2.43	......
1677	26	4.94	......	1981	330	2.31	......
1679	28	4.87	......	2021	370	2.25	......
1681	30	4.81	......	2061	410	2.16	......
1685	34	4.70	......	2101	450	2.10	......
1689	38	4.59	......	2161	510	2.01	......
1693	42	4.49	......	2221	570	1.96	......
1697	46	4.41	......	2311	660	1.91	......
1701	50	4.32	......	2341	690	1.85	......
1706	55	4.22	......	2431	780	1.76	......
1711	60	4.13	......	2461	810	1.76	......
1716	65	4.03	......	2491	840	1.72	......
1721	70	3.94	......	2521	870	1.70	......
1726	75	3.86	......	2571	920	1.67	......
1731	80	3.79	......				
1741	90	3.65	......				
1751	100	3.53	......				
1761	110	3.43	......				
1771	120	3.34	......				
1791	140	3.19	......				
1811	160	3.04	......				
1831	180	2.91	......				
1891	240	2.64	......				

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LOGS OF WELLS AND TEST HOLES

On the following pages are given the logs of 118 wells and test holes in the Ladder Creek area. The logs include 93 sample logs of holes drilled or jetted by the State and Federal Geological Surveys and 25 logs from drillers. The locations of the test holes and wells are shown on Plate 1. The logs are distributed by counties as follows:

County	Sample logs	Drillers logs
Gove	3	..
Greeley	11	..
Lane	7	..
Logan	7	..
Scott	29	18
Wallace	22	..
Wichita	14	7

13-39-25da2. *Sample log of test hole in the NE¼ SE¼ sec. 25, T. 13 S., R. 39 W., Wallace County, jetted November 28, 1951. Surface altitude, 3,254.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, fine, light brown; contains some sand	0.5	0.5
Sand, quartz, fine to coarse; contains some silt	1.5	2
Sand and gravel, quartz; contains a few mafic minerals	10.8	12.8
CRETACEOUS—Gulfian		
Pierre shale		
Shale, chalky, hard, gray; contains disseminated black flecks	.1	12.9

13-39-25dd. *Sample log of test hole in the SE cor. sec. 25, T. 13 S., R. 39 W., Wallace County, jetted November 29, 1951. Surface altitude, 3,253.1 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, sandy, light brown	1.5	1.5
Sand, quartz, medium to coarse	5.5	7
Sand, quartz, and some gravel; contains some gray clay	13.0	20
CRETACEOUS—Gulfian		
Pierre shale	0	20

13-39-36aa. *Sample log of test hole in the NE cor. sec. 36, T. 13 S., R. 39 W., Wallace County, jetted November 28, 1951. Surface altitude, 3,252.5 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Clay, sandy, light brown	2	2
Sand, quartz, very fine to very coarse	5	7

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	Thickness, feet	Depth, feet
Gravel, fine to coarse, and some silt; contains large quartz pebbles at base	3	10
Sand and gravel, quartz, poorly sorted	5	15
CRETACEOUS—Gulfian		
Pierre shale	0	15

13-39-36ad. *Sample log of test hole in the SE¼ NE¼ sec. 36, T. 13 S., R. 39 W., Wallace County, jetted November 29, 1951.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Clay, silty, dark brown	1.5	1.5
Sand, quartz, poorly sorted; contains silt and gray to buff calcareous clay streaks	8.5	10
Sand, quartz, and grains of mafic minerals	10	20
Sand, coarse, and fine gravel; contains mostly quartz, but mafic minerals are common	13	33
Sand, coarse, and gravel, chiefly quartz but some mafic minerals	8	41
CRETACEOUS—Gulfian		
Pierre shale	0	41

13-42-17cc. *Sample log of test hole in the SW¼ SW¼ sec. 17, T. 13 S., R. 42 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,764.2 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Sand, coarse to fine; contains some gravel, fine to medium, and clay	10	10
Sand, coarse to fine	2	12
CRETACEOUS—Gulfian		
Pierre shale		
Shale, gray	8	20

13-42-30da. *Sample log of test hole in the NE¼ SE¼ sec. 30, T. 13 S., R. 42 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,874 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt and clay, black	3	3
Clay and silt, tan gray	4	7
TERTIARY—Pliocene		
Ogallala formation		
Clay, limy, silty, light tan to tan brown	10	17
Clay, sandy, brown	4	21
Clay, limy, light tan	12	33
Clay, sandy, tan	2	35
Clay, very limy, light tan	3	38
Clay, very sandy, tan brown	2	40
Clay, limy, light tan	9	49

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	Thickness, feet	Depth, feet
Clay, light tan to tan; contains imbedded sand, fine to coarse	11	60
Sand, fine to coarse, very clayey, tan brown	7	67
Sand, clayey, fine to medium, tan	5	72
Sand, medium to coarse, and fine to coarse gravel; contains some clay	19	91
Clay, very sandy, light tan to brown	7	98
Sand, medium to coarse, and fine gravel; contains some clay	10	108
Sand and gravel, medium to coarse, and some clay	10	118
Sand, medium to coarse, and fine to medium gravel	10	128
Sand, medium to coarse, and fine to coarse gravel	10	138
Sand and gravel; medium to coarse sand, and fine to coarse gravel; contains some silty clay	8	146
Clay, sandy, tan	10	156
Sand, fine to coarse, clayey, tan	8	164
Clay, sandy, tan brown	11	175
Clay, tan brown and light gray	5	180
Sand, medium to coarse, and fine gravel; contains some clay	10	190
Sand, medium to coarse; contains some clay	10	200
Sand, fine to coarse, clay parting at 205, sandy, tan	10	210
Clay, sandy, tan	10	220
Clay, tan to gray, sandy; interbedded with sand, fine to coarse	10	230
Clay, sandy, tan to gray; contains some fine to coarse sand and fine gravel	30	260
Clay, sandy, tan	40	300
CRETACEOUS—Gulfian		
Pierre shale		
Shale, yellow gray to yellow green	6.5	306.5
Shale, gray	3.5	310

14-32-35bb₁. *Sample log of test hole in the NW cor. sec. 35, T. 14 S., R. 32 W., Logan County, jetted and hand-augered October 25, 1951. Surface altitude, 2,659,9 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Silt, sandy, hard, brown	1	1
Sand, limy, medium to coarse, and fine to coarse quartz gravel	6	7
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, gray	1	8
Chalk, brownish gray; contains some silt	1	9
Chalk, brownish gray; contains dark-gray to black spots and some silty streaks	6	15
Chalk, silty, brownish gray; contains angular fragments of hard chalk and some angular sand grains,	.7	15.7
Chalk, hard, clayey, dark gray	.2	15.9

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14-32-35bb$_2$. *Sample log of test hole in the SW¼ NW¼ NW¼ sec. 35, T. 14 S., R. 32 W., Logan County, jetted October 25, 1951. Surface altitude, 2,653.9 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, sandy, hard, brown	2	2
Sand, quartz, poorly sorted, moderately rounded	2	4
Sand, quartz, coarse, and fine gravel cemented with calcium carbonate	37	41
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, sandy, brownish gray	1.7	42.7

14-32-35bc. *Sample log of test hole in the NW¼ SW¼ NW¼ sec. 35, T. 14 S., R. 32 W., Logan County, jetted October 26, 1951. Surface altitude, 2,631.9 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, sandy, hard, light brown	2	2
Sand, quartz, slightly cemented, fine to medium, moderately well sorted and rounded	3	5
Sand, quartz, coarse, and fine to coarse gravel, moderately well sorted and rounded, slightly cemented	15	20
Sand, quartz, coarse, and fine to coarse gravel, poorly sorted, containing much fine material	14	34
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, hard, gray	2.5	36.5

14-32-35cb. *Sample log of test hole in the NW¼ SW¼ sec. 35, T. 14 S., R. 32 W., Logan County, jetted October 26, 1951. Surface altitude, 2,627.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Silt, sandy, hard, light brown	2	2
Sand, quartz, medium to coarse, well sorted, and moderately well rounded; felsic minerals present	4.5	6.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, hard, gray	.3	6.8

14-38-33cc. *Sample log of test hole in the SW¼ SW¼ sec. 33, T. 14 S., R. 38 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,526.2 feet.*

	Thickness, feet	Depth, feet
Road fill; clay, gray	1.5	1.5
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, tan gray, and some tan clay	14.5	16

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	Thickness, feet	Depth, feet
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty to limy, tan	2	18
Clay, silty, very limy, light tan to white	3	21
Silt to fine sand, cemented, limy and nodular, tan	3.5	24.5
Sand, fine to medium, some nodular and silty, light tan to gray white	4.5	29
Clay, silty to very silty and limy, light tan to light gray	2	31
Silt to fine sand, cemented, tan brown; contains interbedded sand stringers	6	37
Sand, fine to coarse, and brown silty clay, limy	7	44
Clay, limy, gray to tan gray; contains some imbedded sand	12	56
Sand, fine to medium, silty, tan gray; contains some clay	9	65
Sand, fine to coarse, fine to medium gravel, and some light-tan clay	18	83
CRETACEOUS—Gulfian		
Pierre shale		
Shale, bentonitic, green to gray; contains some white clay	8	91
Shale, silty, yellow	14	105
Shale, gray	5	110

14-40-15dc. *Sample log of test hole in the SW¼ SE¼ sec. 15, T. 14 S., R. 40 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,660.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silty, and clay, black	1	1
Silt and some clay, tan to tan gray	14.5	15.5
Sand, fine to coarse; contains imbedded silty to clayey limy nodules	2.5	18
TERTIARY—Pliocene		
Ogallala formation		
Limestone, silty, medium hard, white	2	20
Sand, fine to coarse; contains imbedded silt and clay, tan to light gray	5	25
Sand, cemented, fine, silty, tan brown; contains some coarse to medium sand	10	35
Sand, fine to coarse, silty, cemented, tan brown	16	51
Sand, coarse to fine; contains some fine to coarse gravel and some silty clay	9	60
Sand, fine to coarse, and some clayey sand	4	64
Clay, silty, gray tan; contains some tan limey clay	6	70
Clay, sandy, brown; contains some imbedded sand	8.5	78.5
Sand, fine to coarse, and fine gravel; contains yellow-tan silt and clay	16.5	95

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	Thickness, feet	Depth, feet
Clay, silty, blue, blue gray, and tan green	4	99
Clay, sandy, tan yellow	5	104
Sand, fine to coarse, and fine gravel; contains some tan-yellow clay	14	118
Clay, silty, tan yellow to tan brown; contains some interbedded sand and fine to coarse gravel	10	128
Sand and clay, interbedded, brown to tan yellow	10	138
Sand, fine to coarse, and some clayey sand, tan brown,	19	157
Clay, sandy, tan brown	11	168
Sand, fine to coarse; contains some clay	16	184
Clay, gray brown; contains some sand	11	195
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	8	203
Shale, dark gray	3	206

14-41-31cc. *Sample log of test hole in the SW¼ SW¼ sec. 31, T. 14 S., R. 41 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,809.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	2.5	2.5
Silt and some clay, tan to tan gray	7	9.5
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty to sandy, tan brown to light tan. Light-tan clay is limy, contains imbedded sand and gravel	8.5	18
Sand and gravel; contains some silt	3	21
Sand, tan gray; contains some white soft clayey limy nodules	14	35
Clay, limy, tan to tan gray; contains some silty limy nodules and sand	10	45
Clay, silty, limy, tan to gray brown	9	54
Clay, sandy, red brown; contains thin stringers of sand	11	65
Sand, fine to coarse; interbedded with clay, limy and sandy, light tan	18	83
Clay, sandy, tan brown; contains imbedded sand	14	97
Clay, sandy, light tan to gray; contains some imbedded sand	4	101
Sand, fine to coarse, and fine gravel; contains some tan silt	8	109
Sand, fine to coarse, and fine to medium gravel; contains thin stringers of tan-brown clay	11	120
Sand, coarse, and fine to coarse gravel	12	132
Clay, silty and sandy, brown	5	137
Sand and gravel; contains some clay	10	147
Sand and gravel	10	157

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	Thickness, feet	Depth, feet
Sand and gravel; contains some clay	10	167
Sand, coarse, and fine to coarse gravel	29	196
Clay, limy, silty, light gray; contains some interbedded sand	10	206
Sand, medium to coarse, and fine gravel; contains some tan-gray and light-gray clay	9	215
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	2	217
Shale, dark gray	3	220

14-42-8cb. *Sample log of test hole in the SW¼ NW¼ SW¼ sec. 8, T. 14 S., R. 42 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,900.2 feet.*

	Thickness, feet	Depth, feet
Road fill and clay, tan gray	10	10
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, partly clayey, tan gray	11	21
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, blocky, limy, brown and tan gray; contains some imbedded sand	4	25
Clay, silty to sandy, gray brown; contains some fine to medium sand	6	31
Sand, clayey and silty, brown; contains some brown sandy clay	8	39
Sand and gravel, fine to coarse; contains some clay in lower part	11	50
Sand and gravel, fine to coarse; contains some clay stringers	10	60
Sand, coarse, and fine to coarse gravel; clayey at 62 to 65 feet	10	70
Sand and gravel, fine to coarse; contains some silty clay	10	80
Sand and gravel, fine to coarse; contains some silty clay and limy silt	5	85
Clay, silty, tan	7	92
Sand, fine to medium; contains some brown silt	10	102
Sand, fine to coarse, and fine gravel; partly silty	14	116
Clay, sandy, tan gray; contains imbedded coarse sand and fine gravel	11	127
Sand, medium to coarse, and fine gravel; contains some imbedded clay	15	142
Clay, silty and sandy, tan brown	4	146
Clay, medium to coarse, and fine to medium gravel; contains some clay at 149 to 151 feet	10	156
Sand, clayey, brown; contains some gravel	10	166
Clay and sand, interbedded, brown	17	183

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	Thickness, feet	Depth, feet
Sand and gravel	32	215
Clay, silty to sandy, tan brown; contains some sand	13	228
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow gray	19.5	247.5
Shale, gray	2.5	250

14-42-20cc. *Sample log of test hole in the NW¼ SW¼ SW¼ sec. 20, T. 14 S., R. 42 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,837 feet.*

	Thickness, feet	Depth, feet
Road fill and soil, gray brown to black	4	4
QUATERNARY—Pleistocene		
Sanborn formation		
Clay, silty, tan brown	2	6
TERTIARY—Pliocene		
Ogallala formation		
Clay, limy, light tan to tan; contains some imbedded sand	2	8
Clay, very limy, light tan	3	11
Clay, silty to sandy, tan brown	10	21
Clay, very sandy, tan brown	18	39
Silt, limy, very hard, white	2	41
Silt and clay, cemented, sandy, tan and brown	9	50
Sand, fine to coarse, and fine to medium gravel; contains some brown clay and silt	14	64
Clay, sandy, tan to tan brown	7	71
Sand, coarse to medium, and fine gravel; contains bedded tan clay	11	82
Clay, silty to sandy, tan gray	3	85
Clay, sandy, brown	9	94
Sand, fine to coarse; contains tan clay stringer at 94 feet	50	144
Sand and clay, interbedded, tan	7	151
Sand and gravel, fine to coarse; contains some clay	19	170
Gravel and sand, fine to coarse	3	173
Clay, tan gray; contains imbedded sand and gravel	6	179
Sand, fine to medium; contains some clay	7	186
Clay, sandy to silty, gray	7	193
Sand, coarse to fine; contains some clay	10	203
Sand, coarse to fine; contains fine gravel and clay	70	273
Sand and clay interbedded, tan	12	285
Sand, coarse to fine, and medium gravel	12	297
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty to compact, yellow tan	6	303
Shale, dark gray	4.5	307.5

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14-42-32cc. *Sample log of test hole in the SW¼ SW¼ sec. 32, T. 14 S., R. 42 W., Wallace County, drilled by State Gelogical Survey, 1951. Surface altitude, 3,876.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	3	3
Silt, partly clayey, tan gray	9	12
Sand, coarse to fine	7	19
TERTIARY—Pliocene		
Ogallala formation		
Clay, sandy and limy, tan to light gray	8	27
Clay, sandy, tan brown	2	29
Sand, coarse to fine, and fine gravel	8	37
Clay, sandy to limy, tan gray	2	39
Sand, fine to medium	11	50
Sand, fine to coarse	3	53
Clay, tan brown; contains imbedded sand, and silty limy stringer	9	62
Gravel, fine to very coarse, and coarse sand	6	68
Bentonite, white	7.5	75.5
Clay, sandy, gray brown	4.5	80
Sand, coarse to fine; contains some clay	8	88
Clay, silty, brown	3	91
Sand, fine to coarse, and fine gravel	16	107
Clay, sandy, tan, gray, and brown	11	118
Sand, fine to coarse, and fine gravel	7	125
Clay, silty, limy, tan to light gray	10	135
Clay, silty and limy, tan to light gray; contains some sandy clay	12	147
Sand, fine to coarse	19	166
Clay, silty, tan gray	5	171
Sand, coarse to fine, and fine gravel	22	193
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	2	195
Shale, clayey, dark gray	3	198

15-29-13bb$_1$. *Sample log of test hole in the NW cor. sec. 13, T. 15 S., R. 29 W., Gove County, hand-augered December 5, 1951. Surface altitude, 2,454.3 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Clay, silty, calcareous, hard, light brown; contains isolated patches of very fine quartz sand	3	3
Clay, calcareous, light greenish buff; contains some poorly sorted, subrounded sand and gravel	3	6
Clay, calcareous, pale greenish buff; contains some silt	13.5	19.5

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	Thickness, feet	Depth, feet
Clay, calcareous, white; contains much sand and gravel	.5	20
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, hard, light gray, some dark-brown streaks that are nearly white when dry, and many disseminated black flecks	.4	20.4

15-29-13bb$_2$. *Sample log of test hole in the SW¼ NW¼ NW¼ sec. 13, T. 15 S., R. 29 W., Gove County, jetted December 6, 1951. Surface altitude, 2,448.2 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, dark brown	2	2
Sand, quartz, fine to coarse; contains some slightly calcareous clay	13	15
Sand and gravel, quartz; contains some calcareous clay and chalk fragments	16	31
Sand and gravel, quartz; contains calcareous silt	9	40
Sand and gravel, quartz; contains some calcareous pale-greenish-gray clay	21	61
Sand, fine to coarse; contains some quartz pebbles and calcareous, pale-greenish-gray clay	6.4	67.4
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, gritty, hard, pale gray to buff	.1	67.5

15-29-13bc. *Sample log of test hole in the SW¼ SW¼ NW¼ of sec. 13, T. 15 S., R. 29 W., Gove County, jetted December 5 and 6, 1951. Surface altitude, 2,449.5 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Sand, quartz and some mafic minerals, fine to coarse; contains some silt	1	1
Sand, quartz and some mafic minerals, medium to coarse; contains some silt	6	7
Sand, fine to coarse, and fine to coarse gravel; contains a few chalky fragments	20.5	27.5

15-33-11ab. *Sample log of test hole in the SE¼ NW¼ NE¼ sec. 11, T. 15 S., R. 33 W., Logan County, jetted and driven December 7, 1951.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Clay, light brown; contains some silt and calcareous matter	2	2
Silt, sandy, and clay; grayish brown, slightly calcareous	5	7

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	Thickness, feet	Depth, feet
Sand and gravel; chiefly quartz but contains some felsic and mafic minerals and some silt	12	19
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, hard, gray; contains many disseminated black flecks	.2	19.2

15-33-13cb. *Sample log of test hole in the NW¼ SW¼ sec. 13, T. 15 S., R. 33 W., Logan County, jetted December 11, 1951. Surface altitude, 2,754.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, dark brown; contains quartz sand and some felsic and mafic minerals	2.5	2.5
Sand, fine; contains silt, angular calcareous pebbles, and felsic gravel	3.5	6
Sand, quartz, medium to very coarse; contains a few scattered felsic and mafic minerals; contains a few calcareous fragments at 18 to 22 feet	16	22
Sand, coarse, and fine to medium gravel; contains gray clay and many chalky grains	1	23
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, hard, gray; contains disseminated black flecks,	.1	23.1

15-36-19bb. *Sample log of test hole in the NW¼ NW¼ sec. 19, T. 15 S., R. 36 W., Logan County, drilled by State Geological Survey, 1951. Surface altitude, 3,372 feet.*

	Thickness, feet	Depth, feet
Soil, silt, and clay, black	2	2
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, tan gray; contains some tan clay	10	12
Silt, tan gray and brown; contains some tan clay	7	19
TERTIARY—Pliocene		
Ogallala formation		
Clay, limy to silty, tan to light tan	10.5	29.5
Sand, fine to coarse, and tan, silty to sandy, imbedded clay	5.5	35
Sand, fine to coarse; contains some limy to sandy clay,	14	49
Opaline quartzite	5.5	54.5
Sand, fine to coarse, and some clay	6.5	61
Sand, fine to coarse, and tan-yellow clayey silt	5	66
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow to yellow orange	5.5	71.5
Chalk, clayey, gray	2	73.5

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15-38-17da. *Sample log of test hole in the NE¼ SE¼ sec. 17, T. 15 S., R. 38 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,508.7 feet.*

	Thickness, feet	Depth, feet
Road fill	4.5	4.5
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	1	5.5
Silt, tan gray; contains some clay	8.5	14
Silt, brown; contains fine sand	5	19
TERTIARY—Pliocene		
Ogallala formation		
Clay, sandy, tan	5	24
Sand and gravel, fine to coarse, and some tan sandy clay	6	30
Sand, fine to coarse, and fine gravel; contains some cemented fine sand and some opaline chert	18	48
Clay, sandy, limy, light tan; contains imbedded fine to coarse sand	5	53
Clay, sandy, gray green	3	56
Clay, limy to sandy, light tan to brown	9	65
Clay, silty to very sandy, tan brown	6	71
Sand and gravel	8	79
Sand and clay, interbedded, limy, light tan	8	87
Clay, silty, gray	4	91
Sand, fine, and limy clay, tan to gray	6	97
Clay, silty to sandy, brown	5	102
Sand, fine	16	118
Sand and sandy clay	4	122
Sand, fine to coarse; contains some yellow and tan clay,	12	134
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	7	141
Shale, silty, dark gray	3	144

15-38-33cd. *Sample log of test hole in the SE¼ SW¼ sec. 33, T. 15 S., R. 38 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,505.2 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	2	2
Silt, tan gray	15	17
Clay, silty, tan gray	1	18
Clay, silty, tan brown to light tan	11	29
TERTIARY—Pliocene		
Ogallala formation		
Silt, light gray to white	10	39
Silt and silty clay, tan brown	8	47
Clay, very silty, interbedded with fine to coarse sand; light gray	9	56

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	Thickness, feet	Depth, feet
Sand, fine to coarse, cemented, silty, brown	11	67
Sand, fine to coarse, and gravel; contains some clay	10	77
Sand, fine to coarse; contains some clay at 74 and at 76 feet and some gravel	17	94
Clay, sandy, brown; interbedded with sand	10	104
Clay, sandy, light gray	2	106
Sand, fine to coarse; contains some fine to medium gravel	11	117
Clay, silty, tan to tan gray; contains some imbedded sand	18	135
Sand, fine to coarse; contains some brown silt and tan-brown clay	35	170
Clay, sandy, blocky, limy, light gray	5	175
Sand, fine to coarse; contains some tan-brown clay	10	185
Sand, fine to coarse; contains some blocky clay	10	195
Sand, fine to coarse	31	226
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow to white	3.5	229.5
Chalk, silty, gray	3.5	233

15-39-20dd. *Sample log of test hole in the SE¼ SE¼ sec. 20, T. 15 S., R. 39 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,572.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	3	3
Silt and some clay, tan gray	11	14
TERTIARY—Pliocene		
Ogallala formation		
Clay, tan to tan brown	8	22
Clay, sandy, tan; contains imbedded fine to coarse sand	6	28
Clay, limy, green blue to gray	1.5	29.5
Sand, fine to coarse, tan brown to light tan	3.5	33
Clay and calcareous silt; light tan to light gray	4	37
Sand, fine to medium, and tan to light-tan clay	11	48
Clay, sandy, tan brown	7	55
Sand, very fine, silty, tan gray	12	67
Sand, fine to coarse, and some fine gravel	30	97
Sand, coarse to fine; contains some fine gravel	10	107
Sand, coarse to fine; contains some fine gravel and clay	10	117
Sand, coarse to fine; contains some gravel	4	121
Sand and clayey sand, limy, tan	4	125
Sand, fine to coarse, and fine gravel; contains some clay	14	139
Clay, sandy, limy, tan and light tan	9	148

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	Thickness, feet	Depth, feet
Sand, fine to medium; contains some coarse sand and clay	10	158
Sand, fine to coarse; contains some gravel and tan to light-tan sandy clay	20	178
Sand, fine to coarse; contains some fine to medium gravel and tan to light-tan sandy clay	24	202
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	5.5	207.5
Shale, clayey, dark gray; contains some blue clayey shale	2.5	210

15-40-11bb. *Sample log of test hole in the NW¼ NW¼ sec. 11, T. 15 S., R. 40 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,614.6* feet.

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	1	1
Silt, tan gray; contains some clay	4	5
Sand, fine to medium, and tan silt	9	14
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, tan gray	2	16
Sand, fine to coarse	8	24
Clay and silt, sandy, tan to white	5	29
Clay, sandy, tan, and tan-brown clayey sand	2	31
Clay, sandy, gray green	2	33
Sand, fine to coarse, clayey, tan brown	3	36
Sand, fine to coarse, and fine gravel, limy; contains some clay	20	56
Clay, silty and limy, tan gray to light gray	4	60
Clay, sandy to very sandy, brown	8	68
Sand, fine to coarse; contains some clay	13	81
Sand, fine to medium, and gray clay, interbedded	11	92
Sand and gravel, fine to coarse	9	101
Clay, limy, tan to light tan	6	107
Sand, fine to coarse, and fine to medium gravel; contains some clay	13	120
Sand, fine to coarse, and fine to medium gravel; contains some clay	11	131
Clay, silty to sandy, tan	5	136
Sand, fine to coarse	17	153
Clay, limy, light tan to tan	5	158
Clay, silty to very silty, limy, light tan, and fine to medium sand, interbedded	10	168
Sand, fine to medium, and tan limy clay	10	178
Sand, fine to coarse; contains some brown sandy clay,	10	188
Sand, fine to coarse	39	227

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	Thickness, feet	Depth, feet
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	5	232
Shale, clayey, gray	3	235

15-40-23cc. *Sample log of test hole in the SW¼ SW¼ sec. 23, T. 15 S., R. 40 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,646.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	2.5	2.5
Silt, tan gray	11	13.5
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, tan gray	5.5	19
Clay, limy, tan; contains imbedded sand in lower part,	10	29
Silt to fine sand, cemented, limy, white to tan	5	34
Silt and clay, very sandy, cemented, tan to light tan; contains some coarse sand grains	17	51
Clay, silty to sandy, green gray	1.5	52.5
Sand, fine to coarse, and fine to coarse gravel	23.5	76
Clay to clayey sand, tan gray; contains imbedded gravel	10	86
Sand, fine to coarse, clayey, tan gray	10	96
Clay, sandy, tan to tan brown; contains imbedded medium to coarse sand	11	107
Sand, fine to coarse, clayey in parts, tan gray	7	114
Clay, sandy, tan gray	4	118
Sand, fine to coarse; contains some tan sandy clay	10.5	128.5
Clay, sandy, tan gray	4.5	133
Clay, tan, and fine sand, interbedded	17	150
Sand, fine to coarse, and fine gravel	17	167
Sand, fine to medium, and sandy clay; brown to tan gray	9	176
Sand, fine to coarse; contains some tan to light-tan clay	66	242
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	6	248
Shale, silty, very soft, gray to dark gray	9	257

15-41-2aa. *Sample log of test hole in the NE¼ NE¼ sec. 2, T. 15 S., R. 41 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,758.3 feet.*

	Thickness, feet	Depth, feet
Road fill and soil, silt, and clay, black	2.5	2.5
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, tan gray; contains some clay	8	10.5

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	Thickness, feet	Depth, feet
TERTIARY—Pliocene		
Ogallala formation		
Clay, limy, silty, light tan to light brown	16.5	27
Silt and fine sand, clayey, cemented, brown to tan brown	11	38
Sand and gravel, fine to coarse; contains interbedded cemented fine tan-brown sand and silt	18	56
Sand, fine to coarse; contains tan to tan-brown silty sand	6	62
Sand, fine to coarse, and fine gravel; contains some tan clay	12	74
Clay, sandy, brown; contains imbedded sand and gravel	7	81
Sand and gravel, fine to coarse	11	92
Clay, silty, tan brown; contains some imbedded sand	8	100
Clay, sandy, brown	10	110
Clay and sand, interbedded, tan brown; contains some light-tan to light-gray limy silt	7	117
Sand, coarse, and fine to medium gravel; contains some silt	10	127
Sand, coarse, and fine to medium gravel; contains silt and silty to compact clay	10	137
Sand, coarse, and fine to medium gravel	20	157
Sand, coarse, and fine to medium gravel; contains some clay	17	174
Clay, limy to silty, tan white	5	179
Clay, sandy, containing interbedded sand and gravel, gray brown	10	189
Sand, fine to coarse, and some fine gravel; contains some gray-brown sandy clay	20	209
Sand, fine to coarse, and some fine gravel; contains some clay	10	219
Sand, fine to coarse, and fine gravel	40	259
Sand, fine to coarse; contains some fine gravel and tan-brown silt	30.5	289.5
Sand, fine to coarse, interbedded with gray-white sandy clay	5	294.5
CRETACEOUS—Gulfian		
Pierre shale		
Shale, clayey, dark gray	5.5	300

15-41-19cc. *Sample log of test hole in the SW¼ SW¼ sec. 19, T. 15 S., R. 41 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,840.4 feet.*

	Thickness, feet	Depth, feet
Road fill	1.5	1.5
QUATERNARY—Pleistocene		
Sanborn formation		
Silt and clay, tan	7.5	9

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	Thickness, feet	Depth, feet
TERTIARY—Pliocene		
Ogallala formation		
Clay, very limy, light tan to white	7	16
Sand and gravel, fine to coarse	6	22
Clay and clayey sand, limy, tan to light tan	22.5	44.5
Sand, medium to coarse, and fine gravel; contains brown sandy clay	7.5	52
Sand and clay, interbedded	16	68
Sand and gravel, coarse to fine; contains some brown sandy clay	7	75
Clay, silty to sandy, gray brown	21	96
Clay, sandy, tan brown; contains imbedded medium to fine sand and a silty limy stringer at 105 feet	12	108
Clay and fine to medium sand, interbedded	7	115
Sand, fine to coarse	4	119
Sand, fine to coarse, clayey, brown, and light-gray limy clay, interbedded	4	123
Clay, silty, limy, tan gray to light tan	8	131
Sand, fine to medium, clayey, tan	9	140
Sand, fine to coarse, clayey, tan brown	10	150
Sand and sandy clay, tan to tan brown; contains stringer of limy clay at 155 feet	10	160
Sand, fine to coarse, and fine gravel; interbedded with gray-brown sandy clay	10	170
Sand and gravel	17.5	187.5
Bentonite, white	.5	188
Clay, limy to sandy, brown to gray	4	192
Clay, sandy, brown, imbedded with fine to coarse sand	34	226
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	11	237
Shale, clayey, dark gray	3	240

15-41-23dd. *Sample log of test hole in the SE¼ SE¼ sec. 23, T. 15 S., R. 41 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,714.9 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, dark gray to black	2	2
Silt, tan to tan gray; contains some tan clay	8	10
TERTIARY—Pliocene		
Ogallala formation		
Clay and silt, sandy, limy, tan to light tan	12	22
Sand, fine, silty, cemented, brown	6	28
Silt and clayey sand, limy, tan to light tan and gray white	10	38
Clay, limy, silty, light tan	2	40

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	Thickness, feet	Depth, feet
Sand, silty to clayey, tan brown to tan; contains some light-tan limy clay	10	50
Sand, very silty to clayey, tan brown to tan	10	60
Clay and gravel, interbedded, brown to tan gray; contains some fine to medium sand	8	68
Sand and gravel, fine to coarse; contains some clay	15	83
Clay, sandy to silty, brown to gray brown	16.5	99.5
Clay, gray tan to tan brown; contains some imbedded fine gravel	20.5	120
Sand, medium to fine, clayey, tan; contains some clay,	10	130
Sand, fine to medium, and sandy clay, tan to light tan,	12	142
Sand, fine to coarse, and fine silty gravel	10	152
Sand, fine to coarse; contains limy clay	9	161
Sand, fine to coarse, and fine to medium gravel	29	190
Sand, fine to coarse, and clayey sand, interbedded	30	220
Sand, fine to coarse; contains some clay	10	230
Sand, fine to medium, silty	10	240
Sand, fine to coarse, silty	7	247
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty, yellow	10	257
Shale, clayey, dark gray	3	260

15-42-20bb. *Sample log of test hole in the NW¼ NW¼ sec. 20, T.* 15 S., R. 42 *W., Wallace County, drilled by State Geological Survey, 1951.* Surface altitude, *3,904.9 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, gray tan	1.5	1.5
Silt, clayey, tan gray	12.5	14
TERTIARY—Pliocene		
Ogallala formation		
Clay, containing imbedded sand and gravel, limy, tan brown to light gray	4	18
Sand, medium to coarse, and fine to medium gravel	10	28
Gravel, very coarse; contains some coarse sand	9	37
Clay, sandy, limy, light gray and tan to tan brown	10	47
Clay, sandy, tan brown	10	57
Clay, very sandy, tan brown	15	72
Sand, coarse; contains some clay	8	80
Sand, coarse, and fine to medium gravel; contains some tan clay	3	83
Clay, sandy, tan to tan gray	9	92
Sand, fine, and some tan clay	31	123
Clay, very sandy and limy; contains some imbedded coarse and medium sand	4	127
Sand, fine to coarse, and fine to medium gravel	13	140
Sand, fine to coarse, and fine to medium gravel; contains some clay	10	150

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	Thickness, feet	Depth, feet
Sand, fine to coarse, and fine to medium gravel; contains some imbedded tan sandy clay	20	170
Sand, fine to coarse, and fine to coarse gravel; contains some interbedded tan-brown clay	10	180
Clay, limy, tan to light gray	7	187
Sand, fine to coarse, and fine to medium gravel, clayey, tan brown	20	207
Sand, fine to coarse, and fine to medium gravel, clayey, tan, brown, and yellow	10	217
Sand and gravel, fine to coarse; contains some yellow silty clay	8	225
CRETACEOUS—Gulfian		
Pierre shale		
Shale, clayey, dark gray	2	227

15-42-32dc. *Sample log of test hole in the SW¼ SE¼ sec. 32, T. 15 S., R. 42 W., Wallace County, drilled by State Geological Survey, 1951. Surface altitude, 3,882.6 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, tan gray to dark gray	2.5	2.5
Silt and clay, tan to tan gray	6.5	9
Sand, fine to medium fine, silty, tan	8	17
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty and sandy, limy, light tan to tan and tan brown	11	28
Clay, medium hard, gray tan	2	30
Sand, fine to coarse; contains some clay	6	36
Clay, limy to silty, tan; contains some sand	21	57
Sand and gravel, coarse to fine	8	65
Sand, fine to coarse, and clay, interbedded, tan brown,	6	71
Sand, fine to coarse, and fine to coarse gravel	7	78
Clay, silty, brown	6	84
Clay, silty to sandy, tan brown; contains some imbedded sand	4	88
Clay and clayey sand; contains some light-tan limy clay	13	101
Clay, very sandy, brown to red brown	4	105
Sand, fine to coarse	2	107
Clay, sandy, limy, tan brown and light tan to gray	4	111
Sand, coarse to fine; contains some tan clay	6	117
Clay, limy and silty, light gray	4	121
Sand, coarse to fine; contains some gravel and light-tan limy clay	10	131
Sand, coarse to fine; contains some coarse to fine gravel	15	146
Clay, sandy, limy, tan to light tan	11	157

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	Thickness, feet	Depth, feet
Sand, coarse, and fine to medium gravel; contains some limy clay	14	171
Sand, coarse, and fine to medium gravel, clayey	8	179
Clay, limy and sandy, tan gray to light gray	7	186
Sand, fine to coarse, fine to medium gravel, and tan-gray to gray-green sandy clay	11	197
Clay, sandy, tan gray; contains some imbedded sand and gravel	11	208
Sand, very fine	6	214
Sand and clay, interbedded, tan to light tan	13	227
Sand, medium to coarse, and fine to medium gravel; contains some clay	25	252
CRETACEOUS—Gulfian		
Pierre shale		
Shale, silty to sandy, yellow	3.5	255.5
Shale, clayey, gray	2.5	258

16-30-29aa. *Sample log of test hole in the NE cor. sec. 29, T. 16 S., R. 30 W., Lane County, drilled by State Geological Survey, September 1948. Surface altitude, 2,872.7 feet; depth to water level, 116.5 feet September 18, 1948.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, sandy, light brown	2	2
TERTIARY—Pliocene		
Ogallala formation		
Clay and sand	8	10
Clay and silt, calcareous, light tan to gray	7	17
Caliche	10	27
Caliche and medium sand, thin alternating layers	7	34
"Mortar bed"; contains sand and caliche	10	44
Sand, fine, and calcareous brown silt	4	48
"Mortar bed"; contains sand and gravel	10	58
Silt and fine sand, brown	2	60
Silt; contains sand and gravel	3	63
"Mortar bed"; contains sand and gravel	27	90
Sand, coarse to fine; contains some gravel	10	100
Silt and very fine sand, light brown	16	116
Sand, fine to coarse	4	120
Sand, very fine, and brown clay	10	130
Clay, light gray, and fine sand	10	140
Sand, fine to medium	10	150
Gravel, rock fragments and quartz grains, coarse, subangular	6	156
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow to tan	4	160

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16-31-29dc. *Drillers log of test hole in the SW¼ SE¼ sec. 29, T. 16 S., R. 31 W., Scott County. Norman Harper, owner, Weishaar and Son, driller. Surface altitude, 2,947 feet.*

	Thickness, feet	Depth, feet
Clay	20	20
"Jip" [caliche]	22	42
Sand "jip"	28	70
Clay	51	121
Sand, fine	16	137
"Jip" and clay	6	143
Sand and gravel	24	167
Shale	13	180

16-32-9bb. *Sample log of test hole in the NW¼ NW¼ sec. 9, T. 16 S., R. 32 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,002.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black; contains some sand	2	2
Clay, compact to silty, dark gray	1	3
Clay, silty, tan to tan gray	3	6
Silt, tan gray to gray green	11.5	17.5
Clay, limy, silty, light tan	3.5	21
Silt, clayey to fine sandy, limy, nodular, tan to light gray	4	25
TERTIARY—Pliocene		
Ogallala formation		
Silt and fine sand, very limy, cemented, white	6	31
Sand, silty, cemented, fine to medium, brown to tan brown	17	48
Sand, fine to coarse; contains some fine to coarse gravel	3	51
Clay, sandy, tan yellow	4	55
Clay, sandy, red brown	4	59
Clay and silty caliche, sandy, interbedded, light tan	11	70
Clay, silty to sandy, brown to dark brown	5	75
Sand, fine to coarse; contains brown clay	7	82
Clay, silty and sandy, tan brown and light tan	10	92
Sand, coarse to fine; contains some gray clay	12	104
Sand, coarse to fine; contains some tan silt	22	126
Sand and gravel, clayey, gray	9	135
Sand, fine to coarse; contains some yellow silt	13.5	148.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, silty, tan yellow and yellow	8.5	157
Chalk, clayey, gray; contains some blue chalk	3	160

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16-32-20dd. *Sample log of test hole in the SE¼ SE¼ sec. 20, T. 16 S., R. 32 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,003 feet.*

	Thickness, feet	Depth, feet
Road fill and soil	3.5	3.5
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, tan gray to gray green	14.5	18
Silt and clay, limy, light tan	8	26
TERTIARY—Pliocene		
Ogallala formation		
Silt, very limy, white, and tan sandy clay	2	28
Sand, coarse to fine, and some tan sandy clay	3	31
Silt and sand, clayey, limy, tan to light tan	6	37
Silt and fine sand, very limy, cemented, white	2	39
Sand, cemented, tan to brown; contains some silty caliche	9	48
Silt and fine sand, limy, tan to light tan; contains some tan to light-tan limy clay	9.5	57.5
Sand, medium to fine, and silt	3.5	61
Sand and silt, fine, limy, light tan; contains some imbedded coarse to medium sand	17	78
Clay, silty, limy, tan and tan gray; contains some interbedded cemented fine limy sand	5	83
Clay and sand, silty, interbedded, gray	1.5	84.5
Clay, silty and sandy, tan and tan brown; contains some imbedded coarse sand	7.5	92
Sand and clay, interbedded, brown	7	99
Sand, fine to medium; contains some tan clay	8	107
Clay, silty, tan yellow	14	121
Sand, fine to coarse, and some silt	9	130
Sand, fine to coarse, and some silt; contains some fine gravel	10	140
Sand, fine; contains some soft silty limestone	10	150
Sand, fine; contains some silty limestone	10	160
Sand, fine to medium; contains some brown silt	10	170
Sand, fine to coarse, and fine to medium gravel	9	179
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow	7.5	186.5
Chalk, clayey, gray	1.5	188

16-32-24cc. *Sample log of test hole in the SW¼ SW¼ sec. 24, T. 16 S., R. 32 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 2,971.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	4.5	4.5
Silt, tan gray	11	15.5

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	Thickness, feet	Depth, feet
Silt and clay, limy, tan to light tan; imbedded coarse to fine sand	8.5	24
TERTIARY—Pliocene		
Ogallala formation		
Clay, very limy, light tan to white; contains some imbedded sand	5	29
Clay and silt, limy to very limy, nodular, tan to light tan	10	39
Sand, fine, cemented, brown; contains some limy silty clay	3	42
Silty to clay, limy, tan to white; contains some imbedded sand	6.5	48.5
Clay, sandy, tan gray	2.5	51
Clay, silty, limy, tan to white; contains some imbedded sand	3	54
Clay, sandy, tan gray	1	55
Silt, very limy, white	2	57
Clay, sandy, tan to brown	1.5	58.5
Sand, coarse to fine	5	63.5
Silt, clayey, limy, tan to white; partly nodular and sandy	24.5	88
Clay, silty to limy, tan to brown; contains some sand	3	91
Clay, silty, brown	10	101
Clay, silty, brown; contains some sandy clay	16	117
Sand, coarse to fine, and fine gravel; contains some gray clay	4	121
Sand, coarse to fine; contains some clay	10	131
Sand, fine to coarse; contains some tan sandy clay	29	160
Sand, fine to coarse, and fine to medium gravel	15	175
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow	4	179
Chalk, clayey, gray	1	180

16-33-17bb. *Drillers log of well in the NW¼ NW¼ sec. 17, T. 16 S., R. 33 W., Scott County; irrigation well, George Epler, owner, Ben Hasz, driller. Surface altitude, 3,080 feet.*

	Thickness, feet	Depth, feet
Top soil	23	23
"Gyp" [caliche]	7	30
"Gyp" rock and clay	66	96
Clay and rock, sandy	37	133
Sandstone	7	140
Sand, tight, fine	9	149
Sand, loose, fine	4	153
Sandstone and sand	5	158
Clay, sandy	4	162
Gravel	12	174
Shale	2	176

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16-33-18aa. *Sample log of test hole in the NE¼ NE¼ sec. 18, T. 16 S., R. 33 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,081.4 feet.*

	Thickness, feet	Depth, feet
Road fill and soil; silt and clay, black	4.5	4.5
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, gray green; contains some fine sand	16.5	21
Silt and clay; contains some very limy tan to light-tan fine sand	9.5	30.5
TERTIARY—Pliocene		
Ogallala formation		
Limestone, silty, medium hard, white	3.5	34
Sand, fine to medium, limy, and tan silty clay	5	39
Clay, limy, tan and chalky white	3	42
Silt, limy	15	57
Sand, fine, cemented with silty and clayey caliche, tan to brown	18	75
Sand, silty, fine to medium, brown	3.5	78.5
Sand, coarse to medium fine; contains some light-tan limy silt	26.5	105
Clay, silty, yellow; contains some medium and fine sand, imbedded	3	108
Sand, fine to medium	40	148
Sand, fine to medium, and some coarse sand	10	158
Sand, medium to coarse	13.5	171.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow	4.5	176
Chalk, clayey, medium hard, gray	4	180

16-33-25ac. *Sample log of test hole in the SW¼ NE¼ sec. 25, T. 16 S., R. 33 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 2,877 feet.*

	Thickness, feet	Depth, feet
Road fill	2.5	2.5
QUATERNARY—Pleistocene		
Sanborn and Meade formations		
Clay, silty, black	2.5	5
Clay and silt, tan brown; contains some coarse sand	10	15
Sand, fine and medium fine	10	25
Sand, fine to medium	3	28
Clay, blue gray; contains some sand	11	39
Silt, sandy to clayey, tan to tan brown; contains some coarse imbedded sand	14	53
Sand, fine to medium	11	64
Sand, fine to medium; contains some clay	10	74
Sand, coarse to fine; contains some clay	10	84
Sand, coarse to fine, and fine to medium gravel	7.5	91.5

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	Thickness, feet	Depth, feet
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow; contains some imbedded coarse sand	8.5	100
Chalk, clayey, gray	2	102

16-33-29bc. *Sample log of test hole in the SW¼ NW¼ sec. 29, T. 16 S., R. 33 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,086.3 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, dark gray and black	3.5	3.5
Silt; contains some fine sand	17.5	21
TERTIARY—Pliocene		
Ogallala formation		
Clay and silt, limy, tan, light tan, and white	9	30
Clay, silty, limy, light tan to white	17	47
Sand, coarse to medium	11	58
Caliche, clayey and silty, soft to medium soft, white	19	77
Sand, medium to coarse; contains some tan-brown silty clay	20	97
Sand, medium to coarse; contains some tan-brown clay	11	108
Sand, medium fine to coarse, blocky, and brown clay; contains some interbedded silty limestone	10	118
Sand, medium fine to coarse	42	160
Sand, medium fine to medium coarse, and tan-brown clay	10	170
Sand, medium fine to medium coarse	8.5	178.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow	16.5	195
Chalk, clayey, medium hard, gray	5	200

16-34-9cc. *Drillers log of well in the SW¼ SW¼ sec. 9, T. 16 S., R. 34 W., Scott County; irrigation well, Roy Tucker, owner; Ben Hasz, driller. Surface altitude, 3,145.5 feet.*

	Thickness, feet	Depth, feet
Top soil	19	19
"Gyp" [caliche] and sand rock	4	23
Rock	1	24
Sand rock and "gyp"	17	41
Sand	3	44
Sand rock and "gyp"	2	46
Rock	4	50
Sand rock and "gyp"	13	63
Sand, loose	16	79
Sand rock, "gyp", streaks of rock	16	95
Rock	4	99

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	Thickness, feet	Depth, feet
Clay	4	103
Sand, fairly loose	13	116
Sand, loose, coarse	6	122
Clay, yellow	8	130
Sand, fairly loose	5	135
Clay, sandy	10	145
Sand, loose, fine	1	146
Clay, sand streaks	10	156
Shale	0	156

[Incomplete; total depth 181 feet]

16-34-13bb. *Drillers log of irrigation well in the NW¼ NW¼ sec. 13, T. 16 S., R. 34 W., Scott County; Frank Kottwich, owner; Ben Hasz, driller. Surface altitude, 3,103.7 feet.*

	Thickness, feet	Depth, feet
Top soil	23	23
"Gyp" [caliche]	16	39
"Gyp" rock	21	60
Clay, sandy	10	70
Sand rock	4	74
Hard rock	3	77
Clay, sandy	15	92
Sand rock and clay	41	133
Sand, bright, fine, and clay, streaks of sand rock	22	155
Gravel streaks, clay at 164 feet	25	180
Clay	8	188
Shale	0	188

16-34-16aa. *Sample log of test hole in the NE¼ NE¼ sec. 16, T. 16 S., R. 34 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,131 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	5	5
Clay, tan brown; contains some silt	9	14
Silt, gray green; contains some tan clay	5	19
Clay, silty, tan brown	7.5	26.5
TERTIARY—Pliocene		
Ogallala formation		
Clay and silt, limy, tan brown to light gray; contains some silty limestone concretions	8.5	35
Silt, limy, medium soft, white, and silty light-tan clay,	18	53
Clay, very sandy, tan; contains coarse to medium sand and imbedded fine gravel	7	60
Clay and silt, limy, light tan; contains imbedded sand,	10	70
Clay to fine sand, cemented; contains tan silty limestone	10	80
Clay, silty and sandy, tan brown to brown; contains some light-tan limy clay	10	90

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	Thickness, feet	Depth, feet
Sand, fine to coarse; contains some clay	10	100
Sand, coarse to medium	4.5	104.5
Sand, fine, limy; contains imbedded coarse sand, medium gravel, and some limy tan clay	6.5	111
Clay, silty and limy, tan	4	115
Sand, fine to medium fine; contains some brown silt	11	126
Sand, fine to medium; contains some tan to light-tan limy clay	10	136
Sand, fine to medium	20	156
Sand, medium to coarse	18	174
CRETACEOUS—Gulfian		
Pierre shale		
Clay and weathered shale, yellow	5	179
Shale, clayey, medium hard, gray	5	184

16-34-17bc. *Drillers log of test hole in the SW¼ NW¼ sec. 17, T. 16 S., R. 34 W., Scott County; H. T. Witham, owner; Weishaar and Son, driller.*

	Thickness, feet	Depth, feet
Clay	37	37
"Jip" [caliche] and clay	35	72
"Jip" and sand	25	97
Sand, fine	17	114
Sand rock	3	117
Sand, fine	15	132
"Jip"	23	155
Sand, fine, dirty	32	187
"Jip" and clay	5	192
Sand, fair	10	202
Shale	3	205

16-34-27cc. *Sample log of test hole in the SW¼ SW¼ sec. 27, T. 16 S., R. 34 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,128.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	2.5	2.5
Silt, gray green to tan gray; contains some fine sand	9.5	12
Clay; contains some tan silt	7	19
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, limy, light tan to white	9	28
Sand, fine, cemented, and limy clay and silt interbedded; tan to light tan	7	35
Clay, limy, tan; interbedded with silty caliche	6	41
Sand, medium to fine	6	47
Clay to silt, limy, nodular; contains some medium to coarse sand	11	58
Silt and limy fine sand; contains some tan clay	14	72

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	Thickness, feet	Depth, feet
Clay, silty, gray to tan gray	5	77
Sand, coarse to fine; contains some tan limy clay	4	81
Sand and silt, clayey, brown; contains some medium sand	5	86
Clay, tan to brown, and coarse to fine sand	11	97
Sand, medium to coarse, and fine to medium gravel; contains some tan limy clay	14	111
Sand, medium to fine; contains some limy clay	39	150
Sand, medium to fine, and brown silty clay	10	160
Sand, fine to medium, and tan to light-tan limy silt	10	170
Sand, fine to medium	17	187
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow	13.5	200.5
Chalk, clayey, medium hard, gray	7.5	208

16-35-1dd. *Sample log of test hole in the SE cor. sec. 1, T. 16 S., R. 35 W., Wichita County, drilled by State Geological Survey, September 1947. Surface altitude, 3,174.5 feet.*

	Thickness, feet	Depth, feet
Road fill	4	4
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, clayey, light brown	21	25
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, calcareous, white	5	30
"Mortar bed" and caliche	20	50
Caliche, very sandy, white	20	70
Sand, fine to medium, compact, slightly calcareous, brown; contains coarse sand and fine to medium gravel	10	80
Gravel, fine to medium, and coarse sand	9	89
Sand, fine, brown	12	101
Sand, coarse to medium; contains fine partly cemented brown sand	19	120
Sand, medium to coarse; contains fine to coarse gravel,	10	130
Sand, coarse to medium; contains fine gravel and sand,	23	153
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, soft, yellow brown	9	162
Chalk, gray	18	180

16-35-31da. *Drillers log of irrigation well in the NE¼ SE¼ sec. 31, T. 16 S., R. 35 W., Wichita County; H. O. Burns, owner, Ben Hasz, driller. Surface altitude, 3,229.8 feet.*

	Thickness, feet	Depth, feet
Top soil	20	20
Gypsum rock [caliche] and clay	25	45

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	Thickness, feet	Depth, feet
Gypsum rock	13	58
Sand	3	61
Sandstone	14	75
Clay	15	90
Clay, sandy	37	127
Sand, fine	19	146
Rock	7	153
Sand, fine	21	174
Clay, sandy	3	177
Sand	3	180
Gravel	19	199
Clay, yellow	2	201

16-35-36dd. *Sample log of test hole in the SE¼ SE¼ SE¼ sec. 36, T. 16 S., R. 35 W., Wichita County, drilled by State Geological Survey, August 1947. Surface altitude, 3,170.3 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, black	3	3
Silt, brown	6	9
Clay and silt, compact, brown	11	20
TERTIARY—Pliocene		
Ogallala formation		
Clay, silt, and fine sand, compact, calcareous, tan	17	37
Gravel, fine, and coarse sand	2	39
"Mortar bed", hard, white	3	42
Silt, sandy, calcareous, tan	7	49
"Mortar bed", white to tan	21	70
"Mortar bed", sandy, white to tan	20	90
Sand, coarse to medium; contains silt and fine sand	40	130
Sand, coarse to medium; contains fine sand and fine caliche fragments	20	150
Sand, medium; contains clayey silt and fine sand	10	160
Sand, coarse to medium	20	180
Gravel, fine, and coarse sand	10	190
Gravel, medium to fine	8	198
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, gray	9	207

16-36-4cc. *Sample log of test hole in the SW¼ SW¼ SW¼ sec. 4, T. 16 S., R. 36 W., Wichita County, drilled by State Geological Survey, September 1947. Surface altitude, 3,301.7 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	4	4
Silt, light brown	19	23

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	Thickness, feet	Depth, feet
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, white	4	27
Clay, silty; contains sand and gravel	5.5	32.5
"Mortar bed", hard, calcareous, white to brown	20.5	53
Gravel, medium to fine, and coarse sand	3	56
Sand, coarse to medium; contains fine gravel	4	60
Sand, coarse, and fine gravel; contains medium to coarse gravel	10	70
Sand, coarse, and fine gravel; contains medium to fine sand	10	80
Sand, coarse, and fine gravel; contains medium gravel,	1.5	81.5
Sand, fine, and brown sticky silt	1.5	83
Gravel, fine, and coarse sand	6	89
Sand, fine, and compact brown silt	4	93
Sand, coarse, and fine gravel	7	100
Sand, coarse to medium; contains fine sand and silt	10	110
Limestone, impure, hard, white	2	112
Sand, coarse, and fine gravel	10	122
Clay, sandy, yellow	3	125
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, yellow	7	132
Chalk, clayey, gray	3	135

16-37-33cc. *Sample log of test hole in the SW¼ SW¼ SW¼ sec. 33, T. 16 S., R. 37 W., Wichita County, drilled by State Geological Survey, 1950. Surface altitude, 3,367.3 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, black	2	2
Silt, tan	8	10
Silt, reddish brown	3	13
TERTIARY—Pliocene		
Ogallala formation		
Silt and clay, sandy, calcareous, cream colored	7	20
Caliche, cream colored to reddish brown	32	52
"Mortar bed"	16	68
Sand, fine to coarse	3	71
"Mortar bed", soft	19	90
Silt, clay, and very fine to fine sand, brown	13	103
Sand, fine to very coarse; contains a few pebbles	17	120
Sand, fine to very coarse; contains silt and clay	10	130
Sand, fine to coarse; contains silt and clay and very coarse sand	10	140
Sand, fine to coarse; contains very coarse sand and a few pebbles	45	185
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow	5	190
Chalk, gray	3	193

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16-38-16bb. *Sample log of test hole in the NW¼ NW¼ NW¼ sec. 16, T. 16 S., R. 38 W., Wichita County, drilled by State Geological Survey, October 1947. Surface altitude, 3,444.9 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, hard, black	3	3
Silt, hard, light brown	15	18
TERTIARY—Pliocene		
Ogallala formation		
Clay, sandy, light tan	3	21
Silt and fine sand, clayey, calcareous, brown to light tan	8	29
Gravel, coarse to fine, and coarse sand	12	41
Silt and fine sand, clayey, calcareous, brown	15	56
Sand, coarse to medium, and fine to coarse gravel	10	66
Silt and fine sand, clayey, calcareous, light tan	4	70
Silt and fine sand, clayey, light green	10	80
Silt and fine sand, clayey, brown; contains medium to coarse sand	42	122
Sand, medium to coarse, and fine to coarse gravel; contains some clayey light-tan fine sand and silt	8	130
Sand, coarse, and fine to coarse gravel	8	138
Silt and fine sand, plastic, calcareous, yellow brown	2	140
Sand, medium to coarse, and fine to coarse gravel; contains clayey yellow-brown silt and fine sand	10	150
Sand, medium to coarse, and fine to coarse gravel	12	162
Sand, medium to coarse, and fine to medium gravel; contains some clayey yellow-brown silt, and fine sand at 174 to 178 feet	18	180
Sand, fine to coarse, and fine to coarse gravel	10	190
Sand, fine to coarse	16	206
Silt and fine sand, clayey, yellow	1	207
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow	2	209
Chalk, gray	1	210

16-40-24aa. *Sample log of test hole in the NE¼ NE¼ NE¼ sec. 24, T. 16 S., R. 40 W., Greeley County, drilled by State Geological Survey, 1947. Surface altitude, 3,592.1 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	3	3
Silt, light brown	15	18
TERTIARY—Pliocene		
Ogallala formation		
Caliche, hard, light tan	16	34
Sand, medium to coarse, and fine to coarse gravel	6	40
"Mortar bed"; contains a small amount of caliche and coarse gravel	10	50
"Mortar bed"	10	60

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	Thickness, feet	Depth, feet
Sand, fine to coarse, and fine to coarse gravel, partly consolidated; contains some tan clay	10	70
Sand, fine to coarse, and fine gravel; contains some brown sandy clay	10	80
Sand, coarse, and fine to coarse gravel; contains gray clay at 87 to 90 feet	10	90
Sand, coarse, and fine to coarse gravel	11	101
Sand, coarse to medium, and fine to coarse gravel; contains tan clay	9	110
Sand, fine, and silt, sticky, clayey; contains some coarse sand and fine to coarse gravel	12	122
Clay, sandy, light tan	8	130
Clay, fine sand, and silt, light tan	8	138
Sand, fine to coarse, and fine gravel; contains a small amount of clay	12	150
Sand, coarse to medium, and fine to medium gravel	10	160
Sand, coarse to medium, and fine to coarse gravel	10	170
Gravel, coarse to fine, and yellow clay	4	174
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, gray	6	180

16-41-15cc. *Sample log of test hole in the SW¼ SW¼ SW¼ sec. 15, T. 16 S., R. 41 W., Greeley County, drilled by State Geological Survey, 1947. Surface altitude, 3,703.9 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	2	2
Silt, light brown	12	14
TERTIARY—Pliocene		
Ogallala formation		
Sand, medium to fine; contains a small amount of coarse sand	2	16
Clay and silt, calcareous, tan	4	20
Clay, calcareous, gray	8	28
Sand, medium to coarse	7	35
Clay, calcareous, gray	13	48
Sand, medium to coarse	1	49
Clay, gray	1	50
Clay, gray; contains some coarse sand and fine gravel,	6	56
Clay, gray; contains clayey fine sand and silt	4	60
Clay, white to light tan	6	66
Silt and fine sand, clayey, brown	4	70
Silt and fine sand, clayey, light tan; contains some coarse sand	5	75
Silt and fine sand, clayey, brown; contains medium to coarse sand and fine gravel	12	87
Sand, medium to coarse, and fine to coarse gravel	3	90

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	Thickness, feet	Depth, feet
Silt and fine sand, clayey, brown; contains medium to coarse sand	7	97
Sand, coarse, and fine to medium gravel; contains tan clayey fine sand and silt	3	100
Sand, coarse, and fine to coarse gravel	6	106
Silt and fine sand, clayey; contains medium to coarse sand and fine to coarse gravel	4	110
Sand, coarse, and fine to coarse gravel; contains some clayey silt and fine sand	10	120
Silt and fine sand, plastic, light tan; contains medium to coarse sand and fine gravel	10	130
Silt and fine sand, clayey, light tan; contains some medium to coarse sand	20	150
Sand, fine to coarse, and silt; contains fine gravel	12	162
Clay, hard, calcareous, green	1	163
Sand, fine to coarse, and silt	7	170
Sand, fine to coarse, and fine to medium gravel; contains green to white clay	10	180
Sand, fine to coarse, and fine to medium gravel	10	190
Sand, medium to coarse, and fine gravel	10	200
Sand, coarse, and fine to medium gravel; contains some medium sand	20	220
Sand, fine to coarse	24	244
Sand, coarse, and fine to medium gravel; contains some yellow clay	6	250
Sand, medium to coarse, and fine to coarse gravel	7	257
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow	3	260
Chalk, gray	4	264

16-42-19bb. *Sample log of test hole in the NW¼ NW¼ NW¼ sec. 19, T. 16 S., R. 42 W., Greeley County, drilled by State Geological Survey, 1947. Surface altitude, 3,873.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	1	1
Silt, sandy, hard, light brown	9	10
TERTIARY—Pliocene		
Ogallala formation		
Caliche, hard, sandy; "algal limestone" at top	10	20
Caliche, hard, sandy, gray; contains some gray clay	8	28
"Mortar bed"	60	88
Sand, fine to coarse	6	94
Silt and fine sand, clayey, light tan; contains medium to coarse sand and fine to coarse gravel	16	110
Sand, medium to coarse, and fine to coarse gravel	20	130

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	Thickness, feet	Depth, feet
Sand, coarse, and fine to coarse gravel; contains clayey silt and fine sand	10	140
Sand, medium to coarse, and fine gravel	10	150
Sand, medium to coarse, and fine to coarse gravel	13	163
Sand, coarse, and fine to medium gravel; contains some light-tan clay and silt	13	176
Clay and silt, light tan; contains some coarse sand and fine to medium gravel	4	180
Silt and fine sand, clayey, light tan; contains some medium sand	30	210
Sand, medium to coarse; contains some fine sand, silt, and fine gravel	10	220
Sand, coarse, and fine to medium gravel	5	225
Sand, medium to coarse, and fine gravel	2	227
Sand, coarse, and fine to medium gravel; contains sandy, yellow-brown clay	3	230
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow brown	7	237
Chalk, blue gray	3	240

17-29-9aa. *Sample log of test hole in the NE¼ NE¼ NE¼ sec. 9, T. 17 S., R. 29 W., Lane County, drilled by State Geological Survey, September 1948. Surface altitude, 2,810.6 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, light brown	1	1
Silt and clay, tan; contains gastropod shells	11	12
TERTIARY—Pliocene		
Ogallala formation		
Clay, calcareous, sandy, pink tan	6	18
Caliche, tan	10	28
"Mortar bed", brown	16	44
"Mortar bed" and medium sand, brown	9	53
Sand, medium to coarse	11	64
Clay, very sandy, pink tan	6	70
Sand, fine to coarse	9.5	79.5
Clay, sandy, pink tan; contains sand and gravel and some thick "mortar beds"	8	87.5
Sand, fine to medium	12.5	100
Sand, fine to medium, and yellow clay	10	110
Sand, fine to medium, and pink-gray clay	20	130
Sand, fine to coarse; contains green-gray clay	10	140
Sand, fine	10	150
Sand, fine to coarse; contains some gravel and clay	14	164
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow gray	6	170

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17-29-22bb. *Sample log of test hole in the NW¼ NW¼ NW¼ sec. 22, T. 17 S., R. 29 W., Lane County, drilled by State Geological Survey, September 1948. Surface altitude, 2,806.5 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, light brown to dark gray	2.5	2.5
Silt and clay, brown to dark gray; contains some sand and gravel, calcareous in lower half	9.5	12
TERTIARY—Pliocene		
Ogallala formation		
Clay, calcareous, light gray; contains some gravel and caliche pebbles	8	20
Caliche	6	26
"Mortar bed", buff to brown, noncalcareous; contains some gravel	13	39
Sand, quartz, medium to coarse	4	43
Gravel, fine to medium, cemented with caliche	2	45
"Mortar bed", calcareous, light tan	5	50
Sand and gravel; contains a 2-inch chert-like "mortar bed" at 55 feet	10	60
"Mortar bed", light gray; contains some thin clay beds,	5	65
Sand, quartz, medium to coarse, semirounded	8.5	73.5
Clay, calcareous, sandy, pinkish tan	6.5	80
Sand, medium to coarse; contains some clay	6.5	86.5
Gravel, medium; contains clay and mortar beds	3.5	90
Clay, calcareous, light gray; contains some gravel	7	97
Sand, medium to coarse; contains some "mortar beds",	3	100
Sand, medium; contains some clay and thin "mortar beds"	9	109
Sand, quartz, very fine	9	118
Sand, quartz, fine to medium	7	125
Sand, medium	15	140
Sand, fine to medium	4.5	144.5
Sand, medium to coarse; contains some clay	6.5	151
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, tan to yellow	4	155
Chalk, dark gray to black	5	160

17-29-33aa. *Sample log of test hole in the NE¼ NE¼ NE¼ sec. 33, T. 17 S., R. 29 W., Lane County, drilled by State Geological Survey, September 1948. Surface altitude, 2,812.1 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, light brown	1.5	1.5
Silt and clay, soft, brown	11.5	13
TERTIARY—Pliocene		
Ogallala formation		
Clay, silt, and fine sand; contains some caliche	9	22
"Mortar bed", tan to gray	8	30

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	Thickness, feet	Depth, feet
"Mortar bed", hard, light tan; contains some siliceous cement	4.5	34.5
"Mortar bed", pale green, and sand	11.5	46
Sand, fine	7	53
"Mortar bed", light brown; contains some gravel	8	61
Sand, medium; contains some fine gravel and thin "mortar beds"	14	75
"Mortar bed", very chalky, white	5	80
"Mortar bed", light brown, and pink-gray clay	5	85
"Mortar bed", light brown, and fine sand	10	95
Sand, fine to coarse; contains some fine gravel and a "mortar bed"	8	103
Sand, fine	11	114
Gravel, fine to medium	3.5	117.5
"Mortar bed", calcareous, gray; contains some sand	7.5	125
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow, gray	5	130

17-30-4bb. *Sample log of test hole in the NW¼ NW¼ NW¼ sec. 4, T. 17 S., R. 30 W., Lane County, drilled by State Geological Survey, September 1948. Surface altitude, 2,873.2 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, light brown	2	2
Silt and clay, calcareous, tan; contains many gastropod shells	13	15
TERTIARY—Pliocene		
Ogallala formation		
Clay and silt, sandy, white	7	22
Clay, sandy, calcareous, light grayish green, and white caliche	8	30
Caliche, dense, light gray; contains some sand	5	35
"Mortar bed", red to brown; contains fine sand	11.5	46.5
Sand, very fine, and clay; contains some caliche and medium sand	3.5	50
Sand, quartz, medium, and thin "mortar beds"	8	58
Clay, very sandy, pale green	3	61
Sand, "mortar beds", and gravel	9	70
"Mortar beds", white	8	78
"Mortar beds", pale tan, and fine sand	3	81
Clay, very sandy, pink tan; contains some thin hard "mortar beds"	4	85
"Mortar bed", fine to medium, pink tan	12	97
Sand, fine; contains some pink-tan clay	4	101
Clay, buff tan; contains some calcareous sand	9	110

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	Thickness, feet	Depth, feet
Clay, buff tan; contains some sand and silt	10	120
Sand, quartz and feldspar, very fine to coarse, angular,	9	129
Clay, calcareous, sandy, light tan	15	144
Sand, fine to medium	10	154
Gravel, fine, rounded	6	160
Gravel, fine to medium, rounded	10	170
Sand, quartz, fine to medium	5	175
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow tan	5	180
Chalk, greenish brown	2	182

17-30-17dd. *Sample log of test hole in the SE¼ SE¼ SE¼ sec. 17, T. 17 S., R. 30 W., Lane County, drilled by State Geological Survey, September 1948. Surface altitude, 2,874.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, black to brown	4.5	4.5
Silt and clay, light tan; contains many gastropod shells,	11.5	16
Clay and silt, calcareous, light tan; contains some sand	4	20
TERTIARY—Pliocene		
Ogallala formation		
Clay, calcareous, light tan; contains some sand and caliche	6	26
Sand, very fine, cemented with clay; contains some caliche	4	30
Sand, very fine; contains clay, some "mortar beds", and caliche	3	33
Caliche, white; contains some gravel	4	37
Sand and clay, calcareous; contains some fine gravel	3	40
Sand, quartz, medium	6	46
"Mortar bed" and light-tan fine sand	2	48
Sand, very fine; contains pale greenish-gray clay	3	51
Sand, medium to coarse	9	60
Sand, medium to fine; contains some medium gravel and thin "mortar beds"	12	72
Clay, reddish tan; contains caliche, some gravel	3	75
"Mortar bed", light tan to gray	4	79
"Mortar bed", light gray	9	88
"Mortar bed", reddish brown	3	91
Clay, light tan; contains some gravel and caliche	9	100
Sand, medium, rounded, brown	54	154
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow to tan	5	159
Chalk, greenish black	1	160

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17-30-32aa. *Sample log of test hole in the NE¼ NE¼ NE¼ sec. 32, T. 17 S., R. 30 W., Lane County, drilled by State Geological Survey, September 1948. Surface altitude, 2,875.2 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, light brown	2.5	2.5
Silt and clay, calcareous, light tan	7.5	10
Silt and clay, calcareous, light tan; contains some gravel and caliche	7	17
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, calcareous, light tan to light gray	5	22
Clay, calcareous, sandy, light gray to tan	8	30
Caliche, white	2	32
Clay, reddish brown, calcareous; contains some very fine sand	5.5	37.5
Sand, feldspar and quartz, medium	21.5	59
Sand and thin light-gray "mortar beds"	6	65
Sand, medium to coarse	17	82
"Mortar bed", light gray, and clay	16	98
Clay, sandy, pinkish tan	2	100
"Mortar bed", light gray, and sand	9	109
Sand, medium to coarse	13	122
Clay, sandy, light gray, and "mortar bed"	14	136
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow tan	4	140

17-31-17da. *Drillers log of well in the NE¼ SE¼ sec. 17, T. 17 S., R. 31 W., Scott County; irrigation well, Burdett Patton, owner; Ben Hasz, driller. Surface altitude, 2,950.6 feet.*

	Thickness, feet	Depth, feet
Top soil and "gyp" [caliche]	42	42
Rock "gyp"	65	107
Sand rock	9	116
Sand rock and clay	24	140
Sand, fine, brown	6	146
Clay	3	149
Sand, fair, brown	12	161
Sand	18	179
Gravel, streaks of clay	13	192
Clay	3	195
Shale	0	195

17-31-29dc. *Drillers log of test hole in the SW¼ SE¼ sec. 29, T. 17 S., R. 31 W., Scott County; Huck Bros., owners, Weishaar and Son, driller. Surface altitude, 2,954.8 feet.*

	Thickness, feet	Depth, feet
Clay	32	32
Clay and "jip" [caliche]	9	41
"Jip" clay stone	26	67

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	Thickness, feet	Depth, feet
"Jip" hard stone	13	80
"Jip" and sandstone	22	102
Sand, tight	18	120
Sand and clay and "jip" stone	5	125
Sand, fair, tight, fine	10	135
Sand, good	12	147
Clay and fine sand	28	175
Sand, good	5	180
"Soapstone"	6	186
Shale	4	190

17-32-18cc. *Sample log of test hole in the SW¼ SW¼ sec. 18, T. 17 S., R. 32 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 2,988.5 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Soil, dark	3	3
Silt and fine sand, yellow tan; considerably harder near base	21	24
Sand, medium, to fine gravel, brown	4.5	28.5
Silt and fine sand, clayey, brown	2	30.5
Silt and fine sand, limy, grayish tan	1.5	32
Silt and fine sand, clayey, tan	2	34
Silt and fine sand, limy, grayish tan; darker near base; contains scattered caliche nodules	14	48
Clay, silty, dark gray	3	51
Silt and fine sand, light gray; contains abundant shell fragments	5	56
Silt and fine sand, medium gray; contains scattered caliche nodules, sand, gravel, and shell fragments,	8	64
Sand to fine gravel, light brown; contains abundant light-green-gray clayey silt and fine sand intermixed	4	68
Silt and fine sand, limy, light gray to tan	4	72
Clay, silty, tan	2	74
Sand, fine, clayey, brown	4	78
TERTIARY—Pliocene		
Ogallala formation		
Caliche, light gray, and clay, fine sandy, limy; hard beds 0.5 foot thick at top and at 81 feet	6	84
Silt and fine sand, limy; contains scattered sand, gravel, and caliche fragments	8	92
Sand and gravel, brown to gray; bottom part contains abundant caliche nodules, plastic silt, and fine sand,	6.5	98.5
Caliche, light gray, and clay, fine sandy, limy, white,	5	103.5
Clay, fine, sandy, limy, light gray; contains lenses of sand and gravel	7.5	111
Sand, coarse, to coarse gravel, brown; contains abundant pink quartz and granite pebbles	9	120

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	Thickness, feet	Depth, feet
Sand and gravel, semicemented	4	124
Caliche, hard, light gray, and fine-grained interbedded "mortar bed"	6	130
Caliche, hard, tan	5	135
Sand, fine, clayey, brown; contains lenses of sand and gravel and caliche; 1½-foot caliche bed at 145 feet,	15	150
Silt and fine sand, clayey, limy, light-gray; interbedded with hard caliche	22	172
"Mortar bed", soft, tan	4	176
Silt and fine sand, clayey, limy, tan	6	182
Sand, fine to coarse, brown, partly cemented	16.5	198.5
Silt and fine sand, plastic, limy, light gray and tan	3.5	202
Sand, fine, to fine gravel, brown	20	222
Sand, medium, to coarse gravel	15	237
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow	4	241
Chalk, gray to black	4	245

17-32-20aa. *Sample log of test hole in the NE¼ NE¼ sec. 20, T. 17 S., R. 32 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 2,987.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	2	2
Silt, tan gray to gray green; contains some tan-gray clay	11	13
Silt and clay, sandy, limy, tan to gray white	8	21
Silt and fine sand, very limy, light gray to white	14	35
Clay, silty to fine sandy, soft, tan brown	6	41
Sand, fine, silty, cemented, brown	6	47
TERTIARY—Pliocene		
Ogallala formation		
Clay and silt, medium hard, limy, light gray to white,	4	51
Clay, sandy, light gray to tan gray	3	54
Clay, sandy, red brown	5	59
Clay and silt, limy, tan to white; contains some sand,	14.5	73.5
Silt, limy, very hard, white	3	76.5
Clay and silt, limy, light tan to white; contains some sandy clay	6.5	83
Sand, fine to coarse, and fine gravel; contains some silty clay	8	91
Sand, fine to coarse, and fine to medium gravel; contains some clay	9	100
Sand, medium to coarse, and fine to coarse gravel	14	114
Clay, silty, tan yellow; contains imbedded fine to coarse sand	8	122
Sand, fine to coarse; contains interbedded clay	19.5	141.5
Clay, sandy, tan; contains some fine to coarse sand	7.5	149

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	Thickness, feet	Depth, feet
Clay, sandy and silty, tan yellow	7	156
Sand, fine to medium	12	168
Sand, fine to medium; contains some clay	20	188
Sand, fine to coarse; contains some tan sandy clay	8	196
Sand, fine to coarse, and fine to medium gravel; contains some tan sandy clay	19	215
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow	9	224
Chalk, clayey, gray	3	227

17-33-5cc. *Sample log of test hole in the SW¼ SW¼ sec. 5, T. 17 S., R. 33 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,084.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, dark gray	3.5	3.5
Silt and fine sand, green gray to tan gray	18	21.5
TERTIARY—Pliocene		
Ogallala formation		
Clay and silt, limy, tan to light gray	10.5	32
Sand, very fine, and silt, limy, light tan to white	12	44
Clay and silt, very limy, white; contains some tan-brown silty sand	7	51
Sand, coarse to fine	3.5	54.5
Silt and fine sand, lime cemented, tan to very light tan,	9.5	64
Sand, coarse to medium, cemented with limy silt, tan,	5	69
Sand, coarse to medium, and fine to medium gravel; imbedded in silt and limy clay	6	75
Clay and fine sand, silty, limy, tan	12	87
Sand, fine to coarse, cemented with clay	11	98
Clay, silty, green gray	3	101
Sand, fine to medium, cemented with clay, tan brown,	19	120
Sand, fine to medium; contains some tan silty clay	47	167
Clay, sandy, yellow to yellow tan	15	182
Sand, fine to medium	11	193
Sand, fine to coarse	14.5	207.5
CRETACEOUS—Gulfian		
Niobrara formation		
Clay and chalk, soft, yellow	.5	208
Chalk, clayey, medium soft, dark gray	2	210

17-33-21cd$_1$. *Sample log of test hole in the SE¼ SW¼ sec. 21, T. 17 S., R. 33 W., Scott County, drilled by State Geological Survey, 1951.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, clay, and sand, tan gray to black	3	3
Sand, fine to coarse, and fine to medium gravel	10	13
Sand and gravel; contains limy silt nodules	29	42

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TERTIARY—Pliocene	Thickness, feet	Depth, feet
Ogallala formation		
Silt, limy, white; contains coarse imbedded sand	6	48
Clay, blocky, tan brown, and nodular limy silt; contains imbedded sand grains	4	52
Sand and silt, brown	6	58
Sand, medium to fine, silty, limy, gray to tan gray	9	67
Clay and sand interbedded, limy, tan	5	72
Sand, fine to medium, cemented, tan brown	8	80

17-33-21cd₂. *Sample log of test hole in the SE¼ SE¼ SW¼ sec. 21, T. 17 S., R. 33 W., Scott County, drilled by State Geological Survey, 1951.*

QUATERNARY—Pleistocene	Thickness, feet	Depth, feet
Sanborn formation		
Soil, silt, and clay, black	1	1
Silt, gray tan to gray green	18	19
Clay, silty, tan brown	6	25
TERTIARY—Pliocene		
Ogallala formation		
Clay and silt, limy, tan to light tan	10.5	35.5
Silt, very limy, white	1.5	37
Clay, silty, tan, light tan, and white; contains some sand	4	41
Sand, fine, cemented, brown; contains some limy clay,	6	47
Sand, fine to coarse, and fine to medium gravel; contains some limy silt	14	61
Sand, fine to medium, cemented, tan brown; contains some light-tan limy clay	2	63
Silt and fine sand, limy, light gray	2	65
Clay, silty, limy, light tan; contains some imbedded coarse to fine sand	3	68
Clay, sandy and silty, limy, light gray	9	77
Silt, sandy, cemented, brown	2	79
Clay and sandy silt, interbedded, tan and tan brown	5	84
Sand, coarse to fine, and fine gravel; contains some light-tan sandy clay	6	90
Clay, gray brown to tan, and light-tan sandy silt	6	96
Sand, coarse to fine, and fine gravel	9	105
Sand, coarse to fine, and some fine to medium gravel	5	110

17-33-21db. *Sample log of test hole in the NW¼ SE¼ sec. 21, T. 17 S., R. 33 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 2,974.3 feet.*

QUATERNARY—Pleistocene	Thickness, feet	Depth, feet
Sanborn formation		
Soil, silt, and clay; contains some fine to coarse sand	2.5	2.5
Sand, coarse to fine; contains some silt, clay, and nodular limy silt	5.5	8
Sand, coarse to fine; contains some nodular limy silt	7	15

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	Thickness, feet	Depth, feet
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, blocky, brown to red brown; contains some coarse sand	7	22
Clay, silty, gray to tan gray; contains some sand	6	28
Sand, fine to medium; contains some silty sand	9.5	37.5
Sand, fine to medium, cemented, silty, and some fine to medium gravel	3.5	41
Sand, fine to medium, limy, silty, tan	17	58
Clay, yellow; contains some imbedded sand	9	67
Sand, fine to medium, silty, brown	20	87
Sand, fine to medium, brown	10	97
Sand, fine to medium, brown; contains some clay	12	109
CRETACEOUS—Gulfian		
Niobrara formation		
Chalk, silty to sandy, yellow	5	114
Chalk, clayey, medium hard, gray	3.5	117.5

17-33-36ba. *Drillers log of well in the NE¼ NW¼ sec. 36, T. 17 S., R. 33 W., Scott County; irrigation well, S. W. Filson, owner, Weishaar and Son, driller. Surface altitude, 2,994.5 feet.*

	Thickness, feet	Depth, feet
Soil	106	106
Sand	32	138
Clay	10	148
Rock	5	153
Clay and sand	12	165
Sand and fine clay	43	208
Sand, good	2	210
Sand, fine	10	220
Sand, good	8	228
"Soapstone" [shale]	2	230

17-34-2db. *Drillers log of test hole in the NW¼ SE¼ sec. 2, T. 17 S., R. 34 W., Scott County; Chas. Watkins, owner, Weishaar and Son, driller. Surface altitude, 3,097 feet.*

	Thickness, feet	Depth, feet
Clay	52	52
"Jip" [caliche] and clay	38	90
Clay, blue	48	138
Sand, fine, and claystone	10	148
Sand, fine, dirty	19	167
Clay and fine sandstone	23	190
Rock	4	194
Clay (shale)	4	198

17-34-5bb. *Drillers log of well in the NW¼ NW¼ sec. 5, T. 17 S., R. 34 W., Scott County; Roy R. Rose, owner, Weishaar and Son, driller.*

	Thickness, feet	Depth, feet
Clay	15	15
Clay and "jip" [caliche]	17	32

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	Thickness, feet	Depth, feet
"Jip" and claystone	43	75
Sand and clay	12	87
Clay and "jip"	8	95
Sand, dirty	11	106
Clay	4	110
Sand, fine, dirty	16	126
"Jip" and clay	3	129
Sand, dirty, fine	8	137
"Jip"	4	141
Sand, fine, and "jip"	11	152
Sand	5	157
Clay	9	166
Sand, fine, dirty	19	185
Sand	7	192
Clay	13	205
Shale	5	210

17-34-9aa. *Sample log of test hole in the NE¼ NE¼ sec. 9, T. 17 S., R. 34 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,123.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	3	3
Silt, gray green; contains some fine sand and tan clay,	10	13
Silt, gray green and brown; contains fine sand and tan clay	6	19
Clay, tan brown to tan; contains some silt	2	21
TERTIARY—Pliocene		
Ogallala formation		
Clay, silty, limy, light tan	4	25
Sand, medium to fine; contains much limy silt	4	29
Clay, limy, soft, light gray	9	38
Sand, medium to fine; contains some limy silt	4.5	42.5
Clay and silt, limy, tan to light tan	5.5	48
Silt and chalk; contains some imbedded coarse to fine sand	6	54
Silt, clayey, brown; contains some limy clay and fine sand	7	61
Sand, fine, clayey, limy, tan	11	72
Clay, limy, soft, tan	2	74
Sand, silty, fine to medium, brown	4	78
Clay and silt, limy, tan to very light tan; contains some imbedded coarse to medium sand	6	84
Sand and silt	5	89
Silt, gray tan to gray green	3	92
Silt, clay, and fine sand, tan to tan brown	6	98
Silt, soft, brown; contains some fine sand	9	107
Sand, fine to medium; contains some brown silt	14	121
Sand, fine to medium, and some tan silty clay	9	130

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	Thickness, feet	Depth, feet
Sand, fine to medium; contains some brown, tan, and gray silt	6	136
Sand, quartz, very fine to fine	46	182
CRETACEOUS—Gulfian		
Niobrara formation		
Chalk, silty, yellow	7	189
Chalk, clayey, gray	5	194

17-34-16ac. *Drillers log of well in the SW¼ NE¼ sec. 16, T. 17 S., R. 34 W., Scott County; irrigation well, Bernarr Nelson, owner, Ben Hasz, driller. Surface altitude, 3,134.0 feet.*

	Thickness, feet	Depth, feet
Top soil	25	25
"Gyp" [caliche]	15	40
"Gyp" rock	13	53
Sand rock	21	74
Sand	13	87
Sand and clay	23	110
Tight sand and clay	6	116
Hard "gyp" and sand	18	134
Fine sandy clay	13	147
Sand, bright, fine, and clay	13	160
Sand, bright, clay	18	178
Sandy clay to clay	9	187
Sand and clay	2	189
Sand, fair	6	195
Clay	1	196
Gravel, 4-foot streak of clay	8	204
Clay, yellow	4	208
Shale	0	208

17-34-17ca. *Drillers log of test hole in the NE¼ SW¼ sec. 17, T. 17 S., R. 34 W., Scott County; Marion Barnhard, owner, Weishaar and Son, driller.*

	Thickness, feet	Depth, feet
Clay	32	32
"Jip" [caliche]	8	40
Clay	8	48
"Jip"	14	62
Clay and "jip"	30	92
Sand, fine, and clay	15	107
Sand	2	109
Clay and "jip"	9	118
Sand, fine, and clay	24	142
Rock	2	144
Sand, fine, dirty	29	173
Sand, fine, and clay	11	184
Sand	6	190
"Soapstone" [shale]	10	200

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17-34-17dc. ***Drillers log of test hole in the SW¼ SE¼ sec. 17, T. 17 S., R. 34 W., Scott County; H. T. Whitham, owner, Weishaar and Son, driller. Surface altitude, 3,056 feet.***

	Thickness, feet	Depth, feet
Clay	4	4
Sand	2	6
"Jip" [caliche]	10	16
Clay	4	20
Sand, fine	9	29
"Jip" and sand	5	34
Rock	3	37
"Jip" and clay	6	43
Sand, fine, dirty	6	49
Clay	4	53
Sand, fine, dirty	21	74
Sand, fine	8	82
Clay	18	100
Sand	4	104
"Soapstone"	5	109
Shale	6	115

17-34-21ad3. *Sample log of test hole in the SE¼ NE¼ sec. 21, T. 17 S., R. 34 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,034.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Soil, clay, and some silt, black	2	2
Clay, silty, tan; contains some fine sand	5	7
Sand, fine to medium, silty	7	14
Clay, gray; contains some silt	6.5	20.5
Clay and silt, blue gray	3.5	24
TERTIARY—Pliocene		
Ogallala formation		
Sand, coarse to medium fine	8	32
Sand, fine, silty	4	36
Sand, fine to coarse, silty, tan yellow	17	53
Clay, soft, yellow	4	57
Clay, sandy, yellow tan to yellow	6	63
Sand, medium coarse to fine	11	74
Clay, mottled yellow to white; contains some imbedded sand	5	79
Sand, fine to coarse, light tan; contains some fine gravel	16.5	95.5
CRETACEOUS—Gulfian		
Niobrara formation		
Chalk, clayey, soft, yellow	4	99.5
Chalk, clayey, gray	4.5	104

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17-34-21dd. *Sample log of test hole in the SE¼ SE¼ sec. 21, T. 17 S., R. 34 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,124.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, clay, and silt, black	2.5	2.5
Clay and limy clay nodules, silty; contains some medium to coarse sand	2.5	5
Silt, gray green to tan gray; contains some fine sand and tan clay	7.5	12.5
Silt, brown to tan brown; contains some tan clay	5.5	18
Clay, limy, light tan and light brown	8	26
TERTIARY—Pliocene		
Ogallala formation		
Silt and clay, white to light tan	6	32
Silt and fine sand, very limy, tan to white	17	49
Sand, fine to coarse; contains some fine gravel	4	53
Clay, silty, limy, tan to light tan	4	57
Silt, limy; contains some white sand	9	66
Silt, limy; contains some white sand and gray silty clay	2	68
Clay and silt, very limy; contains some imbedded sand and gravel	2.5	70.5
Silt, limy, white; contains some imbedded gravel	4.5	75
Clay, soft, gray; contains some sand and limy silt	2	77
Clay and silt, limy, tan to light tan	9	86
Sand, coarse to fine; contains some tan limy clay	10	96
Sand, coarse to fine; contains some clay	12	108
Clay and silt, limy, light tan	8	116
Sand, fine to medium; contains some clay	2	118
Clay, tan to yellow tan; contains some coarse imbedded sand	3	121
Silt and clay, limy, sandy, light tan; contains imbedded sand	9	130
Clay, silty, soft, yellow to tan yellow; contains some sand	14	144
Sand, fine to medium; contains some yellow silty clay,	20	164
Sand, fine to medium; contains some clay	20	184
Sand, fine to coarse; contains some yellow clay	8	192
CRETACEOUS—Gulfian		
Niobrara formation		
Chalk, clayey, sandy, yellow	5.5	197.5
Chalk, clayey, gray	.5	198

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17-35-7ad. *Sample log of test hole in the SE¼ SE¼ NE¼ sec. 7, T. 17 S., R. 35 W., Wichita County, drilled by State Geological Survey, October 1947. Surface altitude, 3,132.1 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, dark brown	3	3
Silt, light brown	7	10
Clay, limy, gray	7	17
Clay, limy, blue	10	27
TERTIARY—Pliocene		
Ogallala formation		
Sand, fine to coarse; contains fine gravel	3	30
Gravel, fine to coarse; contains fine to coarse sand	14	44
Sand, fine, and clayey yellow-brown silt; contains medium to coarse sand at 48 to 50 feet	6	50
Sand, fine to coarse; contains fine gravel	30	80
Sand, fine to coarse, and fine gravel; contains some clayey yellow-brown fine sand and silt at 88 to 90 feet	10	90
Sand, medium to coarse; contains clayey yellow-brown silt and fine sand	10	100
Clay, sandy, limy, yellow	13	113
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, blue gray	5	118

17-35-36bb. *Drillers log of well in the NW¼ NW¼ sec. 36, T. 17 S., R. 35 W., Wichita County; irrigation well, E. Wicoff, owner, Weishaar and Son, driller. Surface altitude, 3,176.3 feet.*

	Thickness, feet	Depth, feet
Clay	18	18
"Jip" [caliche] and clay	14	32
"Jip"	8	40
Clay	5	45
Sand, hard	11	56
Sand, clay, and "jip"	16	72
Sand, light	4	76
Clay	6	82
"Jip"	3	85
Clay	4	89
Sand, fine, and clay	18	107
Clay	6	113
Sand, fine	5	118
Clay	8	126
Sand, fine	6	132
Sand, "jip", hard	13	145
Sand	17	162
Sand, fine, and clay	8	170
Sand, fine, dirty	7	177
Sand	2	179

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	Thickness, feet	Depth, feet
Clay	3	182
Gravel	10	192
"Soapstone"	6	198
Shale	2	200

17-36-9bb. *Sample log of test hole in the NW¼ NW¼ NW¼ sec. 9, T. 17 S., R. 36 W., Wichita County, drilled by State Geological Survey, September 1947. Surface altitude, 3,283.9 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	3	3
Silt, light brown; contains snail shells	15.5	18.5
Silt, sticky, light brown	1.5	20
TERTIARY—Pliocene		
Ogallala formation		
Caliche, white	10	30
Limestone, sandy, impure	8	38
Silt, sandy, brown to white	5	43
Caliche, hard, white; contains some opal	11	54
Silt, sandy, brown	9	63
Sand, medium	14.5	77.5
Silt, sandy, brown	2.5	80
Silt, sandy, sticky, brown; contains medium sand	44	124
Caliche, white	6	130
Sand, fine to medium	40	170
Sand, fine to medium; contains silt	12	182
Sand, coarse, and fine to medium gravel	6	188
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, weathered, yellow	4	192
Chalk, gray	4	196

17-36-16cb. *Sample log of test hole in the SW¼ NW¼ SW¼ sec. 16, T. 17 S., R. 36 W., Wichita County, drilled by State Geological Survey, September 1947. Surface altitude, 3,192.6 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, black	4	4
Silt, brown	2	6
Sand, fine to medium	4	10
Sand, coarse to medium; contains fine gravel	17	27
TERTIARY—Pliocene		
Ogallala formation		
Gravel, fine to medium; contains some coarse gravel	13	40
Gravel, fine, and coarse to medium sand	20	60
Sand, coarse to medium; contains fine gravel	40	100
Sand, coarse, and fine gravel	8	108

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	Thickness, feet	Depth, feet
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, weathered, yellow	12	120
Chalk, yellow	7	127
Chalk, blue gray	3	130

17-36-29aa. *Sample log of test hole in the NE¼ NE¼ sec. 29, T. 17 S., R. 36 W., drilled by State Geological Survey, September 1947. Surface altitude, 3,279.9 feet. Water level, 93.5 feet September 14, 1947.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	4	4
Silt, light brown	14	18
Silt, clayey, light brown	6	24
TERTIARY—Pliocene		
Ogallala formation		
Clay, calcareous, white	4	28
Caliche, hard, white	22	50
Caliche, white to brown	10	60
Sand, medium to fine, semiconsolidated, brown	10	70
Sand, medium to fine, semiconsolidated, brown; contains coarse sand	10	80
Sand, fine, and silt, brown; contains white caliche	13	93
Sand, medium to coarse, reddish brown; contains fine sand and silt	5	98
Sand, coarse to medium, pinkish; contains fine gravel and sand	12	110
Sand, coarse, and fine gravel; contains some medium to fine sand	11	121
Caliche, white	2	123
Sand, medium, pink	7	130
Sand, coarse to medium	7	137
Sand, fine, and silt, sticky	3	140
Sand, medium, pink	13	153
Sand, fine, semiconsolidated	3	156
Sand, medium, pink	31	187
Sand, coarse; contains fine gravel	11	198
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, weathered, yellow	2	200
Chalk, yellow	28	228
Chalk, gray	2	230

17-38-16cc. *Sample log of test hole in the SW¼ SW¼ SW¼ sec. 16, T. 17 S., R. 38 W., Wichita County, drilled by State Geological Survey, September 1947. Surface altitude, 3,434.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	2	2
Silt, sticky, light brown	12	14

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	Thickness, feet	Depth, feet
TERTIARY—Pliocene		
Ogallala formation		
Clay, white	4	18
Caliche, sandy, white	2	20
Caliche, sandy, white to light tan	8	28
Silt, sandy, light green	2	30
Caliche, white to light brown; contains medium to fine gravel and brown sandy silt	10	40
Silt, sandy, brown to light gray	10	50
Sand, medium to coarse, and fine gravel, partly cemented, brown	10	60
Sand, coarse to medium, and fine to medium gravel	7	67
Silt, sandy, brown; contains fine gravel	3	70
Silt, sandy, brown to light tan	10	80
Sand, fine, and silt	5	85
Silt, sandy, light brown	15	100
Sand, fine, and silt	8	108
Sand, fine, and silt, compact, brown	2	110
Sand, fine, and silt	5	115
Silt, sandy, white	13	128
Sand, fine to coarse	10	138
Silt, sandy, yellow	2	140
Sand, fine to medium, and silt; contains some coarse sand	10	150
Sand, fine to medium, and silt	7	157
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, yellow	10	167
Chalk, gray	3	170

17-39-19bb. *Sample log of test hole in the NW¼ NW¼ NW¼ sec. 19, T. 17 S., R. 39 W., Greeley County, drilled by State Geological Survey, October 1947. Surface altitude, 3,573.6 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	2	2
Silt, light brown	16	18
TERTIARY—Pliocene		
Ogallala formation		
Clay, white	4	22
"Mortar bed", hard, white	4	26
"Mortar bed", light brown	11	37
Sand, medium to coarse, and fine gravel	4	41
Sand, fine to coarse, and fine to coarse gravel; partly cemented at 50 to 60 feet	19	60
Sand, coarse, and fine to coarse gravel; contains some tan clay at 67 to 70 feet	10	70
Clay, sandy, tan	5	75
"Mortar bed", hard, tan	7	82
Sand, coarse, and fine to coarse gravel	5	87

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	Thickness, feet	Depth, feet
Clay, gray; contains a small amount of coarse gravel	2	89
Sand, medium to coarse, and fine to medium gravel	8	97
"Mortar bed"	13	110
Silt and fine sand, clayey; contains fine to coarse gravel	10	120
Silt and fine sand, sticky, clayey, and medium to coarse sand; contains a small amount of fine gravel	17	137
Sand, fine to medium	3	140
Sand, coarse, and fine to medium gravel	7	147
Sand, coarse, and fine to coarse gravel; contains light-tan clay	3	150
Sand, coarse, and fine to medium gravel	5	155
Gravel, fine to coarse; contains light-tan clay	5	160
Sand, coarse, and fine to coarse gravel; contains light-tan clay	10	170
Sand, medium to coarse, and fine to medium gravel	10	180
Sand, coarse, and fine to coarse gravel; contains yellow clay at 189 to 190 feet	10	190
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow	7	197
Chalk, gray	3	200

17-41-22bb. *Sample log of test hole in the NW¼ NW¼ NW¼ sec. 22, T. 17 S., R. 41 W., Greeley County, drilled by State Geological Survey, September 1947. Surface altitude 3,715.3 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	.5	.5
Silt, light brown	17.5	18
TERTIARY—Pliocene		
Ogallala formation		
Clay, light tan; contains some fine to medium gravel	2	20
Sand, medium to coarse	3	23
Clay, light tan	2	25
Sand, coarse, and fine gravel	5	30
Sand, coarse, and fine to medium gravel	10	40
Gravel, fine to medium	10	50
Clay, sandy, light tan; contains coarse to medium gravel	8	58
Silt, sandy, light tan	2	60
Clay, sandy, light brown; contains some fine to medium sand at 68 to 70 feet	10	70
Sand, coarse, and fine gravel	5	75
Sand, coarse, and fine to medium gravel; contains some clay and coarse gravel	5	80
Caliche, hard	5	85

	Thickness, feet	Depth, feet
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow brown	23	108
Chalk, gray	4	112

17-42-19cc. *Sample log of test hole in the SW¼ SW¼ SW¼ sec. 19, T. 17 S., R. 42 W., Greeley County, drilled by State Geological Survey, 1947. Surface altitude, 3,808.5 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
No sample recovered	30	30
TERTIARY—Pliocene		
Ogallala formation		
Sand, fine to coarse	1	31
Sand, coarse, and fine to coarse gravel	2	33
Sand, medium to coarse, and fine gravel; contains some clay	3.5	36.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, yellow	12	48.5
Chalk, blue gray	1.5	50

17-43-13dd. *Sample log of test hole in the SE¼ SE¼ SE¼ sec. 13, T. 17 S., R. 43 W., Greeley County, drilled by State Geological Survey, October 1947. Surface altitude, 3,819.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	1	1
Silt, light brown	15	16
TERTIARY—Pliocene		
Ogallala formation		
Clay, calcareous, gray	5	21
Sand, medium to coarse; contains some fine to coarse gravel	9	30
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow	4	34
Chalk, blue gray	4	38

18-31-15cc. *Sample log of test hole in the SW cor. sec. 15, T. 18 S., R. 31 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 2,929.7 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, dark, sandy	3	3
Silt and fine sand, soft, clayey, tan gray; contains abundant gastropod shells	11	14
Sand, fine, clayey, brown	2	16

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	Thickness, feet	Depth, feet
Silt and fine sand, clayey, brown; contains gastropod shells and cemented zones	2	18
TERTIARY—Pliocene		
Ogallala formation		
Caliche and clay, fine sandy, limy, light gray, more tan at base	18	36
Sand, fine, clayey, brown, and limestone, gravel, and caliche intermixed	7	43
Sand to coarse gravel, cemented, brown	6.5	49.5
Sand, fine, clayey, brown, and caliche fragments and pebbles; hard beds at 49½ feet and 51 feet	10.5	60
"Mortar bed", tan	5	65
Silt and fine sand, clayey, limy, tan to brown	5	70
Sand and gravel, partly cemented, brown; contains some intermixed sandy clay	7.5	77.5
Caliche, hard, light gray	1.5	79
"Mortar bed", fine grained, light gray to tan, and caliche	7	86
Sand, fine, clayey, light gray, and gravel	8	94
"Mortar bed", fine grained, light gray to tan	10	104
"Mortar bed", sand to coarse gravel, gray brown	7	111
Clay, limy, light gray, and sand and gravel	7.5	118.5
Sand and gravel, partly cemented	24.5	143
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, dull yellow	2	145
Chalk, clayey, dirty brown to black	5	150

18-32-9aa2. *Sample log of test hole in the NE¼ NE¼ sec. 9, T. 18 S., R. 32 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 2,973.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, silt, and clay, black	3	3
Silt, tan gray to gray green; contains some fine sand	12	15
Clay and silt, limy, tan to light tan	6	21
Silt and fine sand, limy, light tan	7	28
Sand, fine to coarse; contains some limy silt	2.5	30.5
TERTIARY—Pliocene		
Ogallala formation		
Sand and cemented fine sand. Hard layer at 34 feet, 1½ feet thick; contains some nodular sandy limestone	9.5	40
Clay and sand, cemented, interbedded, tan	8	48
Sand and clay, interbedded, limy; clay is tan to light tan	10	58
Clay, limy, silty, soft, light tan to gray white; contains some sand interbedded	8	66

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	Thickness, feet	Depth, feet
Clay and silt, limy, tan to light tan; contains imbedded coarse sand and fine gravel	3.5	69.5
Clay, sandy, tan brown, and fine sand, cemented	10.5	80
Sand, fine, cemented, tan brown; contains some tan sandy clay and brown silt	8.5	88.5
Sand, fine to coarse, limy, cemented	11.5	100
Sand, coarse to fine	10	110
Sand, coarse to fine; contains a ½-foot clay stringer at 117 feet	20	130
Sand, fine to coarse, and limy silt	13	143
Sand, coarse to fine; contains interbedded clay stringers, light tan to tan white	5	148
CRETACEOUS—Gulfian		
Niobrara formation		
Chalk, yellow tan; contains some coarse imbedded sand and white chalky clay	10	158
Chalk, clayey, yellow	5	163
Chalk, clayey, medium hard, gray	3.5	166.5

18-32-17cd. *Sample log of test hole in the SE cor. SW¼ sec. 17, T. 18 S., R. 32 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 2,956.6 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Soil, dark	1.5	1.5
Silt, sandy, tan	1.5	3
Soil, silty, black	3.5	6.5
Silt, limy, light gray to tan; contains lime-cemented nodules, snail shells, and shell fragments	4.5	11
Silt, clay, medium gray; contains shell fragments	17	28
Sand, fine, to fine gravel, brown gray	4	32
Sand, fine, to fine gravel and clayey silt, brown gray	6	38
Silt, fine sand, and limy clay, tan and gray	5	43
Silt and clay, limy, light gray	3	46
Silt and fine sand, plastic, limy, light gray; contains streaks of yellow-brown clayey sand and medium sand to fine gravel	8	54
Gravel, brown; contains a few thin beds of gray silt and clay	6	60
Gravel, brown; contains abundant waterworn caliche pebbles and some limy silt	7	67
TERTIARY—Pliocene		
Ogallala formation		
Caliche, light gray; contains some tan to brown cemented sand	8	75
Caliche, hard, light gray to white	5	80
Pebbles and fragments of "mortar bed", fine grained, unconsolidated, brown	4.5	84.5

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	Thickness, feet	Depth, feet
Gravel, poorly sorted, brown, partly consolidated at base; contains abundant pebbles of "mortar bed" and of caliche	15.5	100
"Mortar bed", gray	2	102
Sand, fine, to coarse gravel, brown	13	115
Sand and gravel, partly consolidated "mortar bed", brown	1.5	116.5
"Mortar bed", fine grained, light pink to tan	5.5	122
Sand and gravel partly consolidated, brown; contains abundant caliche fragments	14	136
Clay, hard, blocky, chocolate brown	1.5	137.5
Sand, medium, to coarse gravel, brown	9.5	147
"Mortar bed", fine grained, partly consolidated, tan	11	158
Silt, light tan	3	161
Sand, coarse, to coarse gravel, quartz	4.5	165.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, silty, yellow tan, some light gray	6.5	172
Chalk, clayey, brownish black to blue black	8	180

18-32-20aa. *Sample log of test hole in the NE cor. sec. 20, T. 18 S., R. 32 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 2,969.4 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Soil, silty, dark	2.5	2.5
Silt and sand, limy, light tan to light gray; contains a few caliche pebbles	9	11.5
TERTIARY—Pliocene		
Ogallala formation		
Caliche, gray to white; contains light-tan to light-gray limy silt and sand	12.5	24
"Mortar bed", brown and tan; some partly consolidated white limy material near base	36	60
Silt and sand, limy, tan; contains some gravel and fragments of "mortar bed"	6	66
Caliche, light gray to white and tan, and "mortar bed", fine grained	1.5	67.5
Sand, brown, and gravel, small pebbles of "mortar bed"	8.5	76
Silt, brown	8.5	84.5
Silt and sand, light gray and green gray	7.5	92
Silt and sand, green gray, and gravel; some small white caliche pebbles	11.5	103.5
Sand, gravel, and "mortar bed", partly consolidated, brown	6.5	110
Sand, medium, to medium gravel and "mortar bed" pebbles, brown	5	115
Silt and sand, brown	6	121

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	Thickness, feet	Depth, feet
Silt, sand, and fine to medium gravel, brown	9	130
Sand, medium, to medium gravel; contains many white caliche pebbles	8	138
Silt and sand, limy, light gray	2	140
Sand, medium, to medium gravel, brown	5	145
"Mortar bed", tan and light gray to white	6.5	151.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member •		
Chalk, clayey, cream colored	4.5	156
Chalk, clayey, light yellow; 3-inch bed of yellow-tan to green blocky chalk at 156 feet	4	160

18-32-20bb. *Sample log of test hole in the NW cor. sec. 20, T. 18 S., R. 32 W., Scott County, drilled by State Geological Survey, 1940. Surface altitude, 2,951.4 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Soil, sandy, limy, tan	1	1
Silt and clay, tan	15.5	16.5
Silt, clay, and scattered caliche, light gray	4.5	21
Sand, coarse, and fine gravel, brown	9	30
Clay, silty, pale green; contains abundant gastropod shells	3.5	33.5
Silt and clay, tan to brown	4.5	38
Silt, clayey, brown; contains some limestone and loose sand	9	47
Sand, fine, and silt and clay, tan to brown	7	54
Sand, fine, silty, and clay, limy, light green	4	58
Sand, fine, and silt and clay, tan to brown	2	60
Sand, medium, to fine gravel, tan; contains mostly quartz pebbles, some caliche pebbles	11	71
Clay, silty, light gray	2	73
Sand, fine, and silt and clay, tan to brown	4	77
Sand and gravel, brown; contains some silt, clay, and abundant rounded, waterworn caliche pebbles	11	88
Sand, fine, silt, and clay, tan and light gray; contains abundant rounded, waterworn caliche pebbles	2	90
TERTIARY—Pliocene		
Ogallala formation		
Caliche, light gray; contains a few thin softer beds	8	98
Sand, fine, pink brown, and clayey silt	1.5	99.5
Caliche, light gray, and tan cemented fine sand	4.5	104
Sand and gravel, brown; contains abundant caliche pebbles and pink-brown silt and fine sand	14	118
"Mortar bed", tan	3	121
"Mortar bed", cemented fine sand, brown	2.5	123.5
Sand, medium, to medium gravel	12.5	136
Clay, limy, light gray, caliche, and cemented fine sand	7	143

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	Thickness, feet	Depth, feet
Sand and gravel; contains a few thin beds of caliche and a "mortar bed"	7	150
Caliche, light gray and tan	7	157
Sand, fine; contains loose pink-brown fine to coarse sand	3	160
Sand, medium, to medium gravel, brown	11	171
Caliche, hard, light gray and tan	7	178
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow	17.5	195.5
Chalk, dirty gray brown	4.5	200

18-32-21ba. *Sample log of test hole in the NE cor. NW¼ sec. 21, T. 18 S., R. 32 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 2,975.0 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, dark	5	5
Silt and clay, tan; contains a few snail shells and shell fragments	10	15
TERTIARY—Pliocene		
Ogallala formation		
Caliche, light gray to white and tan	7	22
"Mortar bed", fine grained, tan	3	25
Sand, medium to coarse, cemented, green gray and brown; contains "mortar bed" and caliche pebbles,	7	32
"Mortar bed", brown	4.5	36.5
Sand, medium, to fine gravel, lime cemented, gray, brown, and yellow tan	6.5	43
"Mortar bed", hard, tan; contains fine to coarse sand,	4	47
Sand, fine, to medium gravel, brown	3	50
Sand, coarse, to medium gravel, brown	7	57
"Mortar bed", gray; contains coarse sand and fine gravel	6	63
Silt and sand, limy, light gray and light tan, and caliche	1.5	64.5
Sand, fine, to fine gravel, limy, light gray and brown	2	66.5
Clay, silty, blocky, hard, khaki colored	6.5	73
Sand, fine, to fine gravel, brown	6	79
Silt and sand, lime cemented, tan and gray	4	83
Sand, fine, to medium gravel, brown; contains "mortar bed" fragments	9	92
"Mortar bed", tan	14.5	106.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, clayey, white to yellow	2.5	109

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18-32-22bb. *Sample log of test hole in the NW cor. sec. 22, T. 18 S., R. 32 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 2,967.4 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, dark	5	5
Silt, tan	7	12
TERTIARY—Pliocene		
Ogallala formation		
Caliche, soft, light gray to pink tan	4	16
Caliche, hard, light gray to pink tan	9	25
Sand and gravel, partly cemented, brown	5	30
"Mortar bed", tan	3	33
Sand, fine, and medium gravel, brown; contains "mortar bed" fragments	4	37
"Mortar bed", brown	3	40
Sand, coarse, and medium gravel, brown; contains a "mortar bed"	7	47
"Mortar bed", brown	5	52
Sand, coarse, and coarse gravel, brown	7	59
"Mortar bed", fine grained, tan; contains some sand and gravel	11	70
Caliche, hard, white and light tan	14	84
"Mortar bed", tan; contains lime cement, sand, few fragments of Niobrara chalk	12	96
"Mortar bed", tan; contains coarse sand to medium gravel, abundant fragments of Niobrara chalk	6	102
"Mortar bed", soft, tan; contains fine to coarse sand	15	117
"Mortar bed", hard, tan; contains fine to coarse sand	6	123
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Shale, chalky, yellow and white	13	136
Chalk, clayey, silty, soft, brown and black; 3-inch coal bed at 139 feet	4	140
Chalk, clayey, silty, brown	7	147
Chalk and clay, dark gray to dark brown; contains fragments of bright-blue chalk	3	150

18-32-24bb. *Sample log of test hole in the NW cor. sec. 24, T. 18 S., R. 32 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 2,969.3 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, dark	4	4
Silt and fine sand, clayey, tan; contains fragments of gastropod shells	18	22

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	Thickness, feet	Depth, feet
TERTIARY—Pliocene		
Ogallala formation		
Caliche, light gray to tan	8	25
Caliche and clay, fine, sandy, limy, light gray	8.5	33.5
Sand, fine, clayey, brown	2	35.5
Clay, limy, light gray; contains fine sand and thin caliche beds	5.5	41
Sand, fine, clayey, brown	2	43
Sand, medium, to medium gravel, brown	9	52
"Mortar bed", tan	7	59
Sand, fine, clayey, brown	3	62
Sand, fine, clayey, and gravel, partly cemented, limy, brown and tan	8	70
Sand, coarse, and medium gravel, brown	15	85
"Mortar bed", fine grained, tan	2	87
Sand, fine, plastic, brown to tan	10	97
Caliche fragments, angular, hard	8	105
Caliche fragments, angular, hard, and sand and gravel,	2	107
Gravel, fine to coarse; contains abundant fragments of hard yellow-tan limestone	5	112
Sand, coarse, and fine gravel, partly cemented, brown to light gray	12	124
Caliche, light gray, and tan fine-grained "mortar bed",	6	130
Caliche, hard, light gray	5	135
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Clay, chalky, yellow and white	12	147
Chalk, clayey, dark brown to black	13	160

18-33-12aa. *Drillers log of well in the NE¼ NE¼ sec. 12, T. 18 S., R. 33 W., Scott County; Hershel Richter, owner, Weishaar and Son, driller. Surface altitude, 2,964.3 feet.*

	Thickness, feet	Depth, feet
Clay	54	54
Sand, hard	6	60
Clay, sandy	30	90
Sand	7	97
"Jip" [caliche], hard	8	105
"Jip" and clay	17	122
Sand	5	127
"Jip" and sand, hard	20	147
Sand	5	152
"Jip" and clay	13	165
Sand, fine	10	175
Sand and clay	12	187
Sand	33	220
Sand, fine, dirty	7	227
Clay, sandy	8	235
"Soapstone" [shale]	5	240

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18-33-12dd. ***Drillers log of test hole in the SE¼ SE¼ sec. 12, T. 18 S., R. 33 W., Scott County; Dr. P. Palmer, owner, Weishaar and Son, driller. Surface altitude, 2,970 feet.***

	Thickness, feet	Depth, feet
Clay	50	50
Sand	12	62
Clay	8	70
Sand	15	85
"Jip" [caliche]	40	125
Rock	2	127
"Jip" rock	3	130
Sand rock, hard	5	135
Sand and "jip"	5	140
"Jip"	25	165
"Jip" rock	10	175
Clay and "jip"	6	181
Sand, fine, fair	29	210
"Soapstone" [shale]	2	212

18-33-19aa. ***Sample log of test hole in the NE cor. sec. 19, T. 18 S., R. 33 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 3,049.9 feet.***

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, sandy, dark	1	1
Silt and sand, fine, clayey, tan	11	12
Silt, limy, gray to tan, and fine sandy clay; contains scattered caliche pebbles	12	24
TERTIARY—Pliocene		
Ogallala formation		
Caliche, hard, light gray to tan, limy, clayey, and silt and fine sand	9	33
Caliche, unconsolidated, and cemented fine to medium sand, brown	7	40
Sand, fine to medium, partly cemented, brown; contains some gravel	6.5	46.5
"Mortar bed", gray to tan	3.5	50
Sand and gravel, partly cemented, poorly sorted	2	52
"Mortar bed" and clayey fine sand	8	60
"Mortar bed"; contains some clayey fine sand	15	75
"Mortar bed", brown and tan, and fine-sandy brown clay	6	81
"Mortar bed" fragments, sand, and gravel; contains some plastic silt and fine sand	9	90
Sand and gravel, brown; contains some sandy clay and "mortar bed" fragments	4	94
"Mortar bed", brown; contains some sand, gravel, and fine sandy clay	10	104
Sand and gravel, partly cemented, brown; contains a few yellow fragments of Niobrara chalk	4	108

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	Thickness, feet	Depth, feet
Silt and sand, fine, limy, clayey, light gray to tan	6	114
"Mortar bed", gray and tan; contains abundant fragments of hard yellow Niobrara chalk, sand, and gravel	6	120
Silt and sand, fine, clayey, tan	4	124
Sand and gravel, brown	4.5	128.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Clay, silty, dull yellow	5.5	134
Chalk, clayey, dirty gray to blue black	6	140

18-33-23aa. *Sample log of test hole in the NE cor. sec. 23, T. 18 S., R. 33 W., Scott County, drilled by State Geological Survey, 1941. Surface altitude, 2,956.5 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn and Meade formations undifferentiated		
Soil, sandy, dark	4	4
Clay, silty, gray; contains a few caliche pebbles	4	8
Silt and sand, fine, clayey, light gray green; contains a few caliche pebbles	6	14
Clay, silty, dark gray to black	5	19
Sand and gravel, brown; contains some clayey silt and fine sand	3	22
Silt and fine sand, clayey, medium gray; contains waterworn caliche pebbles and fragments of gastropod shells at 40 to 48 feet	31	53
Sand and gravel, poorly sorted, brown; contains abundant waterworn caliche pebbles; predominantly coarse	13	66
Silt and fine sand, limy, clayey; contains waterworn caliche pebbles	6	72
TERTIARY—Pliocene		
Ogallala formation		
Caliche, light gray, limy, and clayey silt and fine sand; drilled fairly hard	9	81
Sand, medium, and medium gravel, brown; contains abundant caliche and limestone fragments; thin lenses of tan fine-grained "mortar bed" at 91 and 93 feet	16	97
"Mortar bed", tan to gray	4	101
Sand and gravel, brown; contains some fragments of "mortar bed"	6	107
Silt and fine sand, limy, clayey, light gray to tan; contains a few thin hard lenses of mortar bed	4	111
"Mortar bed"; contains thin beds of clayey limy silt and fine sand	5	116
Sand and gravel, brown; contains limy plastic silt and fine sand and abundant caliche	10	126

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	Thickness, feet	Depth, feet
"Mortar bed", hard at 126 to 127.5 feet, 128.5 to 129.5 feet, and 132 to 133.5 feet, interbedded with softer material	8	134
Sand, brown, to fine gravel; contains a few thin lenses of "mortar bed" at 134 to 136 feet, and a thin bed at 139 feet	10	144
"Mortar bed", tan; contains some sand and gravel intermixed	8	152
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Clay, silty, creamy tan; thin bed of dark-gray clay shale at 154 feet; more yellow with depth	20	172
Chalk, clayey, dirty gray to blue black	8	180

18-34-2cc. *Drillers log of test hole in the SW¼ SW¼ sec. 2, T. 18 S., R. 34 W., Scott County; Don Christy, owner, Weishaar and Son, driller.*

	Thickness, feet	Depth, feet
Clay	22	22
"Jip" [caliche]	21	43
Sand and "jip"	18	61
Rock	4	65
"Jip"	6	71
Clay and "jip"	15	86
Rock	5	91
"Jip" sandstone, fine, dirty	39	130
Sand, fine	2	132
Sand, fine, and "jip" stone	16	148
"Jip"	14	162
"Soapstone"	4	166
Shale	4	170

18-34-4aa. *Sample log of test hole in the NE¼ NE¼ sec. 4, T. 18 S., R. 34 W., Scott County, drilled by State Geological Survey, 1951. Surface altitude, 3,132.0 feet.*

	Thickness, feet	Depth, feet
Road fill and soil; clay and silt, black	3	3
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, tan gray; contains some fine sand	15	18
Clay, silty, tan to tan brown; contains some brown silt,	5	23
Clay, silty, limy, light tan	5	28
Clay, silty to sandy, gray to tan	2	30
TERTIARY—Pliocene		
Ogallala formation		
Clay, limy, tan to light tan	6.5	36.5
Silt and clay, limy, light tan to gray white	8.5	45
Clay, silty and sandy, tan	10	55

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	Thickness, feet	Depth, feet
Sand, coarse to fine; contains some fine to medium gravel and some limy clay	4	59
Caliche, silty, hard, light tan to white	20	79
Clay, sandy, tan brown; contains some limy silt	15	94
Sand, coarse to fine; contains imbedded tan-brown clay	5	99
Clay, sandy, tan	2.5	101.5
Clay, very sandy, brown	4.5	106
Sand, fine to medium, limy, silty	9	115
Sand, clayey, fine to medium, tan brown	10	125
Sand, medium to fine	11	136
Sand, fine to medium; contains some gray silt and some limestone	10	146
Clay, silty, yellow	12	158
Sand, fine to medium	12	170
Sand, fine to medium, silty	3	173
Clay, sandy, tan	2	175
CRETACEOUS—Gulfian		
Niobrara formation		
Clay and weathered shale, yellow to yellow green	6	181
Chalk, clayey, gray	3	184

18-34-5dc. *Drillers log of test hole in the SW¼ SE¼ sec. 5, T. 18 S., R. 34 W., Scott County; O. A. Clark, owner, Weishaar and Son, driller.*

	Thickness, feet	Depth, feet
Clay	25	25
"Jip" [caliche]	22	47
Sand, hard	8	55
"Jip", hard	7	62
Clay and "jip"	18	80
Sand, fine, and "jip"	15	95
"Jip"	17	112
Sand, tight	15	127
Clay	5	132
Sand, fine	34	166
Rock	3	169
"Soapstone"	5	174
Shale	6	180

18-34-18bb. *Drillers log of well in the NW¼ NW¼ sec. 18, T. 18 S., R. 34 W., Scott County; Rex Brush, owner, Weishaar and Son, driller. Surface altitude, 3,158 feet.*

	Thickness, feet	Depth, feet
Clay	18	18
Clay and "jip" [caliche]	13	31
Sand, hard	37	68
"Jip" and sand	10	78
Clay and "jip"	6	84
Sand, light	5	89

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	Thickness, feet	Depth, feet
Rock	2	91
Sand	27	118
Sand, hard	2	120
Sand	9	129
"Jip" and sandstone	7	136
Rock	3	139
Clay	3	142
Rock	2	144
"Soapstone"	4	148
Shale	2	150

18-34-22bb. *Sample log of test hole at the NW cor. sec. 22, T. 18 S., R. 34 W., Scott County, drilled by State Geological Survey, 1940. Surface altitude, 3,123.8 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Soil, sandy, dark brown	1	1
Silt and fine sand, limy, light tan	3	4
Silt and fine sand, tan to brown; contains abundant gastropod shells	13	17
Silt and fine sand, clayey, limy, light gray to brown	8	25
TERTIARY—Pliocene		
Ogallala formation		
Caliche, light gray; hard at 25 to 27 feet	12	37
Sand, medium to coarse, partly cemented, brown	4	41
Sand, medium, to medium gravel, partly cemented, brown; contains abundant black carbonaceous fragments	7	48
"Mortar bed", hard, gray	5	53
Sand to medium gravel, poorly sorted, brown to gray; thin semicemented beds at 56 and 58 feet	7	60
Sand, coarse, to medium gravel, brown; contains thin semicemented beds, coarser at 70 to 98 feet	38	98
Sand, fine, limy, clayey, soft, light gray to tan	3	101
Sand and gravel, semiconsolidated; fairly hard caliche bed at 108 feet; gray semicemented "mortar bed" at 116 to 120 feet	23	124
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellowish gray; contains some white bentonite	3	127
Chalk, soft and sticky, dull brown to black	8	135

18-35-2bb. *Drillers log of test hole in the NW¼ NW¼ sec. 2, T. 18 S., R. 35 W., Wichita County; Leo Meeker, owner, Weishaar and Son, driller. Surface altitude, 3,189 feet.*

	Thickness, feet	Depth, feet
Clay	25	25
"Jip" [caliche]	15	40
Clay	7	47

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	Thickness, feet	Depth, feet
Sand	9	56
"Jip"	9	65
Sand and "jip"	9	74
"Jip"	6	80
Clay	5	85
Sand, hard	20	105
"Jip"	6	111
Sand	6	117
"Jip" and clay	4	121
Sand, fine	20	141
Sand	11	152
Clay	6	158
Sand, dirty, fine	15	173
Sand, fine	5	178
Clay and "jip"	5	183
"Soapstone"	3	186
Shale	2	188

18-35-14dc. *Drillers log of test hole in the SW¼ SE¼ sec. 14, T. 18 S., R. 35 W., Wichita County; A. H. Conrady, owner, Weishaar and Son, driller. Surface altitude, 3,171.4 feet.*

	Thickness, feet	Depth, feet
Clay	42	42
Sand	18	60
Rock	2	62
"Jip" [caliche]	5	67
"Jip" rock	8	75
"Jip" and sand	20	95
Sand, dirty	10	105
Clay	7	112
Sand, dirty	10	122
Clay	33	155

18-36-9bb. *Drillers log of test hole in the NW¼ NW¼ sec. 9, T. 18 S., R. 36 W., Wichita County; Clark Kostner, owner, driller unknown. Surface altitude, 3,280.4 feet.*

	Thickness, feet	Depth, feet
Clay	15	15
"Jip" [caliche]	12	27
Clay and "jip"	49	76
Sand and "jip"	11	87
"Jip"	10	97
Sand, fine, dirty	21	118
Sand	6	124
"Jip", fine, and sand	18	142
Sand	3	145
Clay	5	150
Sand	5	155
Clay	20	175

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	Thickness, feet	Depth, feet
Sand and claystone	12	187
"Soapstone"	8	195
Shale	5	200

18-36-20aa. *Sample log of test hole in the NE¼ NE¼ NE¼ sec. 20, T. 18 S., R. 36 W., Wichita County, drilled by State Geological Survey, September 1947. Surface altitude, 3,274.5 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, hard, clayey, dark brown	4	4
Silt, light brown	6	10
Silt, clayey, light brown	8	18
TERTIARY—Pliocene		
Ogallala formation		
Clay, light gray	2	20
Caliche, soft, sandy, light gray	10	30
Sand, coarse to medium; contains fine to coarse gravel,	15	45
Clay	2	47
Sand, coarse to medium; contains fine gravel	3	50
Caliche, hard, white; contains opal	10	60
Caliche, hard, brown to white; contains silt and fine sand	14	74
Silt, sandy, brown	6	80
Sand, medium to fine, and silt	40	120
Sand, fine, and yellow silt	10	130
Sand, fine to medium, and silt	10	140
Sand, fine to coarse	10	150
Sand, coarse to medium; contains fine gravel	12	162
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow brown	9	171
Chalk, gray; contains a small amount of yellow shale,	2	173
Chalk, gray	7	180

18-37-19bb. *Drillers log of test hole in the NW¼ NW¼ sec. 19, T. 18 S., R. 37 W., Wichita County; Herb Barr, owner, Weishaar and Son, driller.*

	Thickness, feet	Depth, feet
Clay	32	32
Clay and "jip" [caliche]	10	42
"Jip"	6	48
Rock	4	52
"Jip" rock	8	60
Sand and "jip"	10	70
Rock	10	80
Clay	12	92
Sand and "jip"	4	96
Sand, tight	13	109
Clay	12	121

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	Thickness, feet	Depth, feet
Sand, fine, tight	17	138
Sand, little, tight	20	158
Clay	6	164
Sand, good	6	170
Clay	5	175
Sand	12	187
Clay	18	205
Shale	5	210

18-38-8aa. *Sample log of test hole in the NE¼ NE¼ NE¼ sec. 8, T. 18 S., R. 38 W., Wichita County, drilled by State Geological Survey, September 1947. Surface altitude, 3,424.1 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	2	2
Silt, light brown	8	10
Clay, light gray	3	13
TERTIARY—Pliocene		
Ogallala formation		
Sand, medium, red; contains silt and fine sand	9	22
Caliche, sandy, hard, white	13	35
Silt, sandy, hard, reddish brown	15	50
Sand, fine to coarse, and fine gravel, partly consolidated	8	58
Clay, silty, gray	2	60
Clay, silty, gray; contains sand	7	67
Clay and silt, brown; contains fine to medium sand	3	70
Silt, sandy, hard, brown	10	80
Silt, sandy, brown; contains clay	6	86
Sand, medium to fine	4	90
Sand, medium to coarse; contains fine sand	6	96
Silt and fine sand, clayey, light tan	2	98
Sand, medium to fine	2	100
Sand, medium to fine; contains coarse sand	6	106
Clay, soft, yellow	10	116
Sand, medium; contains fine sand	2	118
Sand, coarse, and fine to medium gravel	2	120
Clay, light tan	7	127
Clay, sandy, light tan	10	137
Sand, fine to medium	3	140
Sand, coarse to medium	5	145
Gravel, fine, and coarse sand	5	150
Sand, coarse to medium, and fine gravel	8	158
Clay, brown; contains fine gravel and coarse sand	2	160
Gravel, fine to medium; contains silty clay	7	167
Clay, calcareous, soft, brown	9	176
Sand, coarse to medium, and fine gravel	4	180
Sand, coarse, and fine gravel; contains layers of brown silty clay	10	190
Sand, coarse, and fine gravel	5	195

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	Thickness, feet	Depth, feet
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, soft, yellow	6	201
Chalk, gray	5	206

18-38-17aa. *Sample log of test hole in the NE¼ NE¼ NE¼ sec. 17, T. 18 S., R. 38 W., Wichita County, drilled by State Geological Survey, October 1947. Surface altitude, 3,355.5 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Alluvium		
Silt, sandy, light brown	.5	.5
Gravel, coarse to fine; contains coarse sand	19.5	20
TERTIARY—Pliocene		
Ogallala formation		
Sand, medium to coarse, and fine gravel	4	24
Clay, sandy, yellow brown; contains fine to coarse sand and fine gravel at 39 to 42 feet	18	42
Gravel, fine, and medium to coarse sand	7	49
Clay, sandy, yellow brown; contains fine to coarse sand at 54 to 59 feet	10	59
Gravel, fine to coarse; contains fine to coarse sand and clayey silt	11	70
Sand, coarse, and fine to coarse gravel	10	80
Gravel, fine to coarse; contains fine to coarse sand	10	90
Gravel, fine to medium; contains medium to coarse sand, light-brown clayey silt, and fine sand	13	103
Clay, sandy, yellow brown	3	106
Sand, medium to coarse, and fine to medium gravel; contains a small amount of clay	4	110
Gravel, fine to coarse; contains yellow-brown sandy clay in thin layers	12	122
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, gray	6	128

18-38-17dd. *Sample log of test hole in the SE¼ SE¼ SE¼ sec. 17, T. 18 S., R. 38 W., Wichita County, drilled by State Geological Survey, September 1947. Surface altitude, 3,422.2 feet.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	2	2
Silt, light brown	6	8
TERTIARY—Pliocene		
Ogallala formation		
Clay, sandy, white	2	10
Caliche, white; contains fine to medium gravel and coarse sand	10	20
Caliche, sandy, white; contains many dendrites and fragments of opal	10	30
Caliche, white; contains opal fragments	4	34

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	Thickness, feet	Depth, feet
Sand, medium to fine; contains coarse sand	6	40
Sand, fine to medium	10	50
Sand, fine to medium, and silt; contains gray clay	10	60
Sand, fine to coarse, silt, and fine gravel	7.5	67.5
Gravel, fine	2.5	70
Gravel, fine, and coarse sand	2	72
Clay, light brown; contains silt and fine sand	5	77
Sand, fine to medium; contains coarse sand	3	80
Sand, fine to medium; contains some coarse sand and fine gravel	10	90
Sand, fine to medium; contains some coarse sand	3	93
Clay, sandy, yellow; contains fine gravel	7	100
Sand, fine to medium; contains yellow clay	10	110
Sand, fine to medium; contains coarse sand	11	121
Clay, yellow	2	123
Sand, fine to medium	22	145
Sand, coarse to medium	5	150
Sand, coarse to medium; contains fine sand and fine gravel	8	158
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, soft, yellow	5	163
Chalk, gray	7	170

18-38-20bb. *Drillers log of well in the NW¼ NW¼ sec. 20, T. 18 S., R. 38 W., Wichita County; Walter R. Gorsuch, owner, driller unknown. Surface altitude, 3,441 feet.*

	Thickness, feet	Depth, feet
Soil	18	18
"Gyp"-like rock ["mortar bed"]	36	54
Sand	3	57
Hard rock	11	68
Clay	24	92
Sand, soft	3	95
Sand, hard	5	100
Sand, soft, with hard streaks	7	107
Clay, hard, yellow	2	109
Clay, soft, yellow	16	125
Sand	19	144
Sand, hard, and clay	2	146
Clay, white, and sand	4	150
Sand	9	159
Sand, hard, coarse	9	168
Sand, extra coarse	5	173
Clay, yellow	4	177
Shale, dark	2	179

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18-40-5da. *Sample log of test hole in the NE¼ SE¼ sec. 5, T. 18 S., R. 40 W., Greeley County, drilled by State Geological Survey, October 1947. Surface altitude, 3,615.8 feet. Water level, 121.1 feet October 4, 1947.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	.5	.5
Silt, light brown	10.5	11
TERTIARY—Pliocene		
Ogallala formation		
Caliche, light tan; contains a small amount of sand and gravel	6	17
Sand, coarse, and fine to coarse gravel; contains some clayey fine sand and silt	3	20
Sand, medium to coarse, and fine to coarse gravel	7	27
Silt and fine sand, clayey, white to light gray	1	28
Sand, medium to coarse, and fine to medium gravel	6	34
Sand, fine, and clayey silt; contains some medium to coarse sand and fine gravel	6	40
Sand, fine to coarse, partly consolidated	6	46
Sand, fine to coarse, and fine gravel; contains some brown clay and silt	9.5	55.5
Sand, fine, and sticky light-tan silt	4.5	60
Sand, fine to coarse, and fine to medium gravel; contains brown to gray clay	10	70
Sand, fine; contains partly cemented, medium to coarse sand	8	78
Silt and fine sand, sticky, light tan	2	80
Silt and fine sand; contains some medium to coarse sand and fine gravel	5	85
Sand, fine to coarse, and silt; contains fine gravel	5	90
Sand, coarse, and fine to coarse gravel	10	100
Sand, coarse, and fine to medium gravel; contains yellow clay at 107 to 122 feet	22	122
Sand, medium to coarse, and fine to medium gravel	10	132
Sand, coarse, and fine to coarse gravel	8	140
Gravel, fine to coarse	17	157
Gravel, coarse; contains some coarse sand and gray clay	3	160
Sand, medium to coarse, and fine gravel	5	165
Gravel, fine to coarse, and coarse sand	4	169
Gravel, coarse, and yellow clay	3.5	172.5
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, yellow	8.5	181
Chalk, gray	2	183

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18-40-8ba. *Sample log of test hole in the NE cor. NW¼ sec. 8, T. 18 S., R. 40 W., Greeley County, drilled by State Geological Survey, October 1947. Surface altitude, 3,631.3 feet. Water level, 130.6 feet October 6, 1947.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	1	1
Silt, light brown	16	17
TERTIARY—Pliocene		
Ogallala formation		
Caliche, soft, light tan	3	20
Caliche, soft, sandy, light tan to brown	10	30
"Mortar bed", light tan	19	49
Silt, sandy, clayey, light tan	7	56
Sand, fine to coarse, and fine to coarse gravel; contains some clayey fine sand and silt	5	61
Clay, sandy, limy, light tan	9	70
Silt and fine sand, clayey; contains some medium to coarse sand	10	80
Silt and clay, sandy, yellow brown; contains fine to coarse gravel at 90 to 100 feet	20	100
Silt and fine sand; contains some coarse sand and fine to medium gravel at 105 to 107 feet	10	110
Sand, fine, and silt; contains coarse sand and fine gravel and a small amount of yellow-brown clay	12	122
Clay, sandy, calcareous, yellow brown	15	137
Sand, medium to coarse; and fine to medium gravel	3	140
Sand, medium to coarse, and fine to coarse gravel; contains yellow clay	5	145
Sand, fine	2	147
Sand, coarse, and fine to coarse gravel; contains some yellow silt and clay at 150 to 152 feet	5	152
Clay, sandy, yellow; contains some coarse sand and fine to medium gravel	2	154
Sand, coarse, and fine to coarse gravel; contains some yellow clay	4	158
Silt and fine sand, sticky, brown	5	163
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Clay, calcareous, yellow to white	7	170
Chalk, soft, yellow	4.5	174.5
Chalk, soft, gray	2.5	177

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18-40-9ba. *Sample log of test hole in the NE cor. NW¼ sec. 9, T. 18 S., R. 40 W., Greeley County, drilled by State Geological Survey, October 1947. Surface altitude, 3,611.8 feet. Water level, 117.4 feet October 8, 1947.*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	3	3
Silt, light brown	8	11
Clay, calcareous, light tan	5	16
TERTIARY—Pliocene		
Ogallala formation		
Silt and clay, sandy, light tan	4	20
"Mortar bed"	8	28
Sand, coarse, and fine to coarse gravel	9	37
"Mortar bed"	8	45
Silt and fine sand, sticky, clayey; contains some coarse sand and fine to coarse gravel	5	50
Sand, fine to coarse, and fine to medium gravel; contains a small amount of silt	10	60
Sand, coarse, and fine to medium gravel	4	64
Clay, light brown; contains coarse sand and fine to coarse gravel	6	70
Sand, medium to coarse, and fine gravel; contains fine sand and silt and light-tan clay; contains more clay at 80 to 90 feet	20	90
Clay, yellow to light tan; contains some coarse to medium sand	20	110
Clay, tan	9	119
Sand, medium to coarse, and fine gravel; contains some yellow clay at 128 to 130 feet	11	130
Clay, sandy, yellow brown	6	136
Sand, coarse, and fine to medium gravel; contains some sandy yellow clay	14	150
Clay, sandy, yellow	10	160
CRETACEOUS—Gulfian		
Niobrara formation—Smoky Hill chalk member		
Chalk, soft, yellow	5	165
Chalk, gray	5	170

18-40-24aa. *Sample log of test hole in the NE cor. sec. 24, T. 18 S., R. 40 W., Greeley County, drilled by State Geological Survey, September 1947. Surface altitude, 3,542.9 feet*

	Thickness, feet	Depth, feet
QUATERNARY—Pleistocene		
Sanborn formation		
Silt, dark brown	2	2
Silt, light brown	25	27

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	Thickness, feet	Depth, feet
TERTIARY—Pliocene		
Ogallala formation		
Clay, sandy, white to light tan	2	29
Caliche, hard, white	11	40
Clay, silty, gray; contains a thin rust-colored layer at 40 feet	7	47
Silt, sandy; contains some fine gravel	3	50
Sand, fine to medium	8	58
Caliche, white	2	60
Silt, sandy, light brown	8	68
Sand, fine to medium	12	80
Sand, medium to coarse; contains some fine gravel	13	93
Silt and fine sand, clayey, light tan	7	100
Silt and fine sand, partly cemented, light tan to white,	9	109
CRETACEOUS—Gulfian		
Niobrara formation		
Chalk, soft, yellow	5.5	114.5
Chalk, gray	5.5	120

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AREAL GEOLOGY OF THE LADDER CREEK AREA, KANSAS,

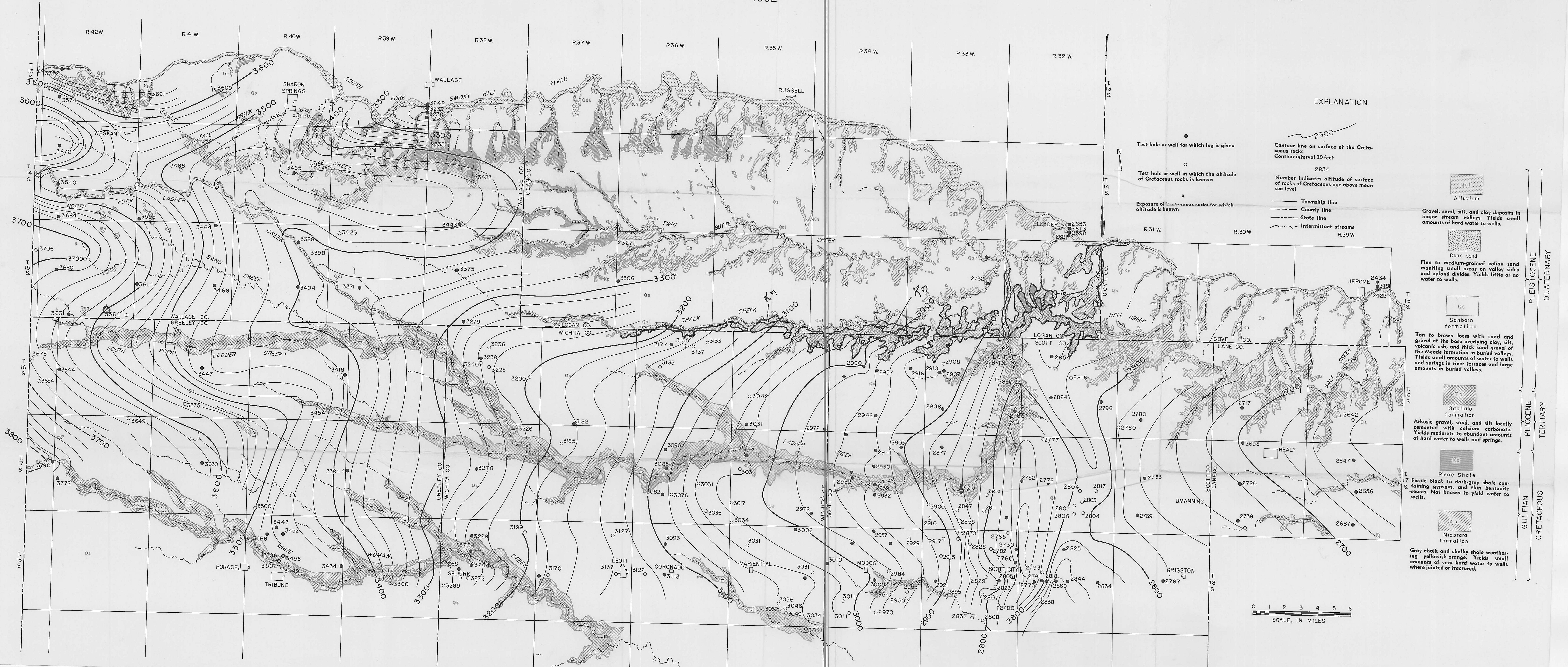
contours on the surface of rocks of Cretaceous age, and location of test holes and wells for which logs are given

by Edward Bradley and Carlton R. Johnson

1952

Bulletin 126

Plate I



State Geological Survey of Kansas

DEPTH TO WATER LEVEL IN THE LADDER CREEK AREA,

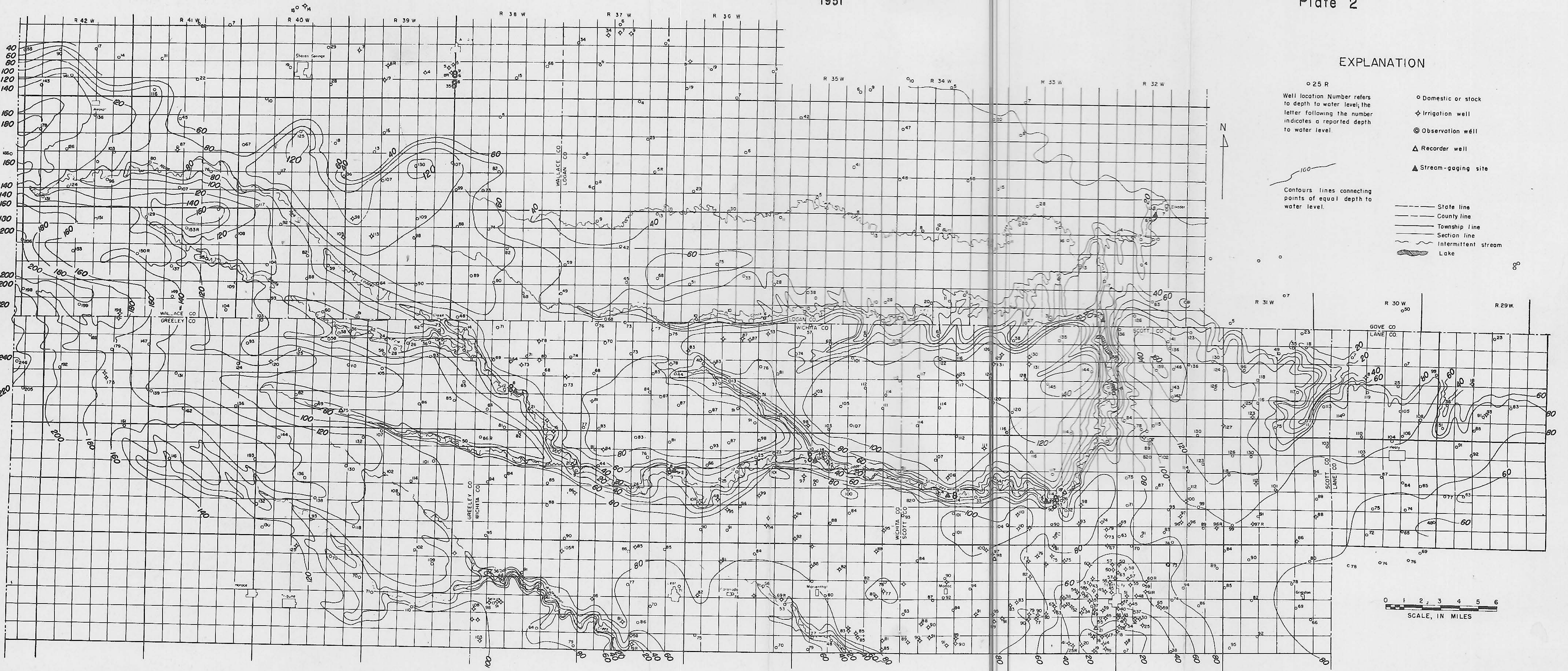
location of wells for which records are given, and stream-gaging sites on Ladder Creek

by Edward Bradley and Carlton R. Johnson

1951

Bulletin 126

Plate 2



STATE GEOLOGICAL SURVEY
OF KANSAS

Bulletin 126

Plate 3

GEOLOGIC CROSS SECTIONS ACROSS THE LADDER CREEK AREA

By Edward Bradley and Carlton R. Johnson

1951

MAP OF LADDER CREEK AREA

showing configuration of the water table

By Edward Bradley and Carlton R. Johnson

1951

State Geological Survey of Kansas

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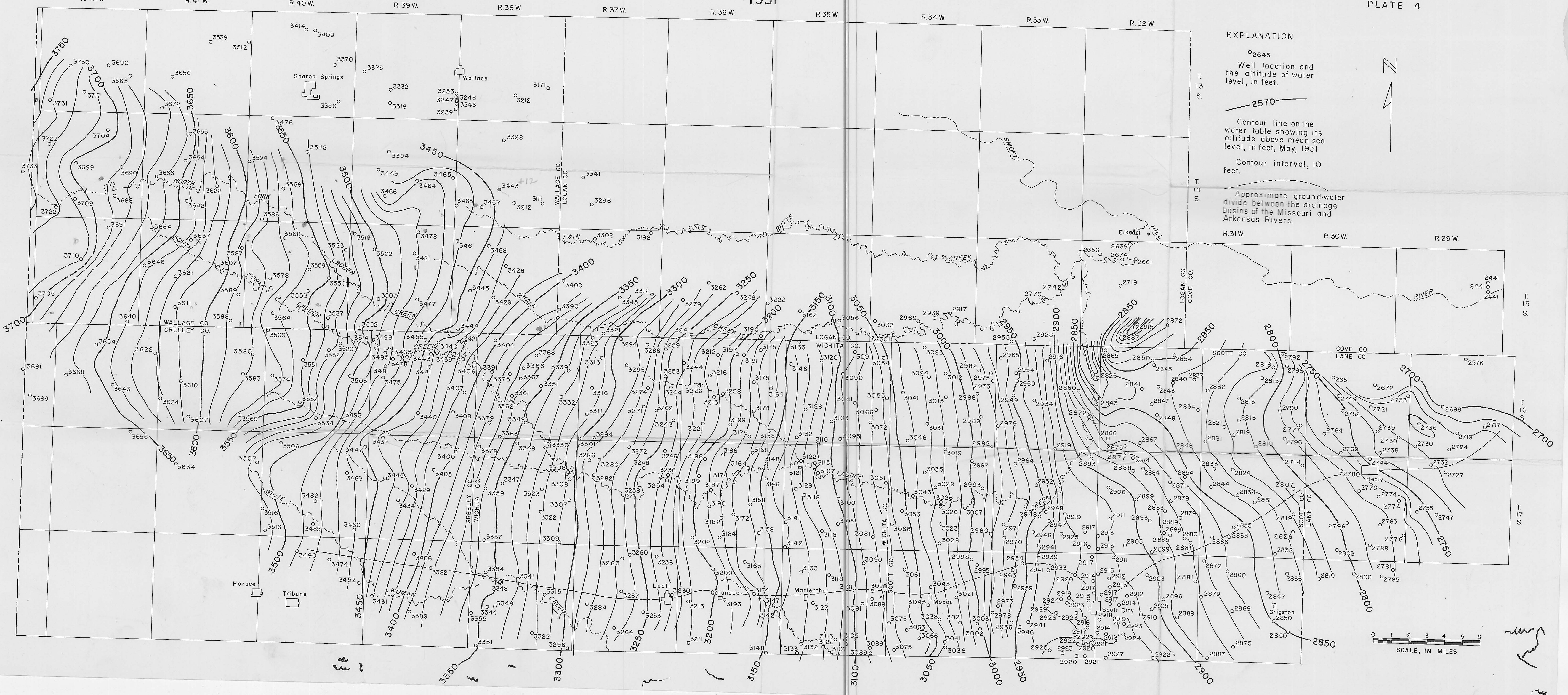
PLATE 4



State Geological Survey of Kansas

MAP OF LADDER CREEK AREA

showing thickness of water-bearing materials overlying Cretaceous bedrock

By Edward Bradley and Carlton R. Johnson

1951

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PLATE 5

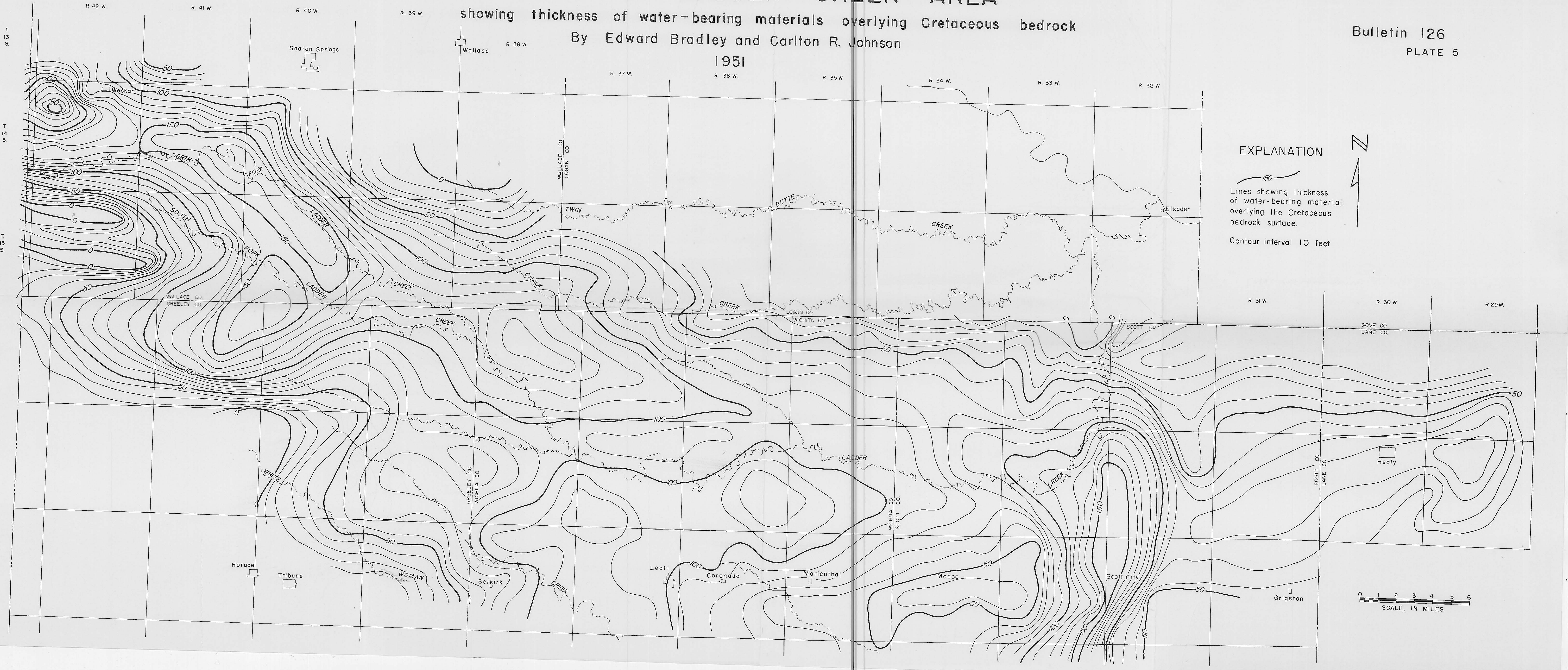

Table 6.—*Chemical analyses of water, in parts per million*

Location	County	Depth	Date of collection	Temperature (°F)	pH	Specific conductance (micromhos at 25°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Noncarbonate	Percent sodium
Alluvium																							
13-39-25aa	Wallace	20	9-20-51	57	...	2,720	...	...	...	...	...	...	...	...	1,270	48	...	...	...	...	...	...	...
13-42-24cc[1]	Wallace	16	9-20-51	58	7.6	498	31	1.2	57	12	24	8.8	0	227	19	13	0.7	42	0.09	324	192	6	20
15-35-2ab	Logan	37	9-19-51	55	7.2	3,260	...	...	573	100	192	18	0	453	1,760	23	1.2	37	...	3,190	1,840	1,470	18
15-35-32ad	Logan	18	9-19-51	55	7.3	2,300	42	.30	256	77	172	17	0	348	770	185	1.2	6.7	.25	1,700	956	671	28
16-38-20dd	Wichita	30	9-21-51	56	7.8	601	...	...	65	21	38	6.3	0	316	44	15	1.2	2.2	...	386	248	0	24
17-33-1bd	Scott	15	9-19-51	58	7.6	1,280	...	...	107	51	94	11	0	364	112	48	2.8	240	...	920	476	178	29
17-36-16aa	Wichita	22	9-21-51	56	7.6	506	...	...	52	18	32	5.4	0	257	40	11	1.6	5.2	...	334	205	0	25
Sanborn and Meade formations																							
13-37-23bb	Logan	Spring	9-20-51	55	7.6	863	21	.03	81	21	73	8.9	0	255	212	18	1.1	1.6	.17	581	288	79	35
17-32-31cb	Scott	82	9-18-51	58	...	687	...	...	...	...	...	...	...	...	80	46	...	...	...	...	...	...	...
18-32-7ac[2]	Scott	98	9-19-51	...	7.6	471	52	.04	47	18	24	5.0	0	226	39	9.5	2.0	7.0	.12	326	193	8	21
Ogallala formation																							
14-42-23bc	Wallace	180	9-20-51	58	7.7	350	31	.03	35	11	24	3.4	0	170	28	5.5	1.0	6.6	.10	230	133	0	27
15-32-26da	Logan	84	9-18-51	58	8.2	491	...	...	54	18	23	4.4	5	196	60	15	1.0	7.8	...	338	209	40	19
15-37-30cb	Logan	73	9-21-51	56	7.6	411	27	2.3	37	14	29	3.8	0	204	29	5.5	1.8	8.8	.14	258	150	0	29
15-39-11bb	Wallace	130	9-21-51	56	...	381	...	...	...	...	...	...	...	...	32	5.5	...	...	...	...	...	...	...
15-43-12dd	Wallace	218	9-20-51	...	7.7	484	17	1.4	33	16	45	4.6	0	202	59	9.0	1.4	13	.19	304	149	0	39
16-32-2bc[2]	Scott	135	9-18-51	59	7.7	394	38	.70	56	10	9.1	4.2	0	196	26	8.5	.8	5.4	.05	268	181	20	10
16-32-32dc[2]	Scott	127	9-18-51	58	8.4	757	...	...	84	21	42		7	180	118	35	...	68	...	a464	296	137	23
16-33-1cc	Scott	Spring	9-19-51	59	7.6	509	41	.04	56	16	28	4.1	0	248	40	9.5	2.4	8.3	.11	340	206	3	22
16-33-18dd[2]	Scott	141	9-19-51	61	...	440	...	...	...	...	...	...	...	...	41	8.5	...	...	...	...	...	...	...
16-36-3cc	Wichita	130	9-21-51	57	7.5	556	...	...	53	22	34	4.4	0	215	70	19	2.8	11	.19	384	221	45	25
16-36-18ad	Wichita	59	9-21-51	55	...	475	...	...	...	...	...	...	...	...	44	8.0	...	...	...	...	...	...	...
16-38-16bb	Wichita	200	9-21-51	58	...	386	...	...	...	...	...	...	...	...	41	8.5	...	...	...	...	...	...	...
16-38-24bc	Wichita	78	9-21-51	...	7.6	491	26	1.7	48	14	33	4.6	0	214	40	15	1.6	12	.17	316	179	4	28
16-39-18da	Greeley	118	9-20-51	58	...	457	...	...	...	...	...	...	...	...	51	11	...	...	...	...	...	...	...
16-41-12bd	Greeley	199	9-20-51	...	...	404	...	...	...	...	...	...	...	...	32	8.0	...	...	...	...	...	...	...
16-42-9ab	Greeley	213	...	59	8.6	384	...	...	40	12	17	...	9	171	17	3.5	...	9.9	...	a192	149	0	20
17-34-3bb	Scott	132	9-19-51	59	7.5	448	40	.04	42	16	30	4.4	0	210	40	9.0	1.8	8.5	.14	300	171	0	27
17-35-22bb	Wichita	118	9-21-51	58	...	492	...	...	...	...	...	...	...	...	60	17	...	...	...	...	...	...	...
17-38-24ac	Wichita	210	9-21-51	58	8.1	525	46	.03	44	23	32	4.2	0	198	71	20	2.0	7.8	.15	360	204	42	25
17-39-17cb	Greeley	110	...	59	...	505	...	...	...	...	...	...	...	...	85	16	...	...	...	...	...	...	...
17-40-5cb	Greeley	162	9-20-51	63	...	452	...	...	...	...	...	...	...	...	26	5.0	...	...	...	...	...	...	...
17-41-8cc	Greeley	118	9-20-51	58	8.1	461	41	.10	57	17	14	5.0	0	229	26	6.5	.6	20	.10	316	211	23	12
Niobrara formation																							
13-34-29bd	Logan	...	9-19-51	61	8.2	831	...	...	91	27	52	8.0	5	249	177	29	.6	16	...	568	340	128	24
14-34-26aa	Logan	156	9-19-51	59	...	2,410	...	...	...	...	...	...	...	...	1,440	24	...	...	...	...	...	...	...
15-32-19bd[3]	Logan	21	9-18-51	58	7.2	2,560	...	...	477	83	92	17	0	270	1,330	31	1.8	44	...	2,430	1,530	1,310	11
15-35-28bd	Logan	70	9-19-51	58	7.5	686	26	.24	98	19	27	3.8	0	334	89	5.0	2.4	2.7	.20	446	324	50	15
Streams																							
Ladder Creek at Wichita-Greeley County line	Wichita	...	9-21-51	55	8.7	539	...	...	52	17	43		14	205	70	14	...	10	...	b321	198	7	32
Lake McBride on Ladder Creek	Scott	...	...	66	8.6	681	...	...	63	22	57		16	242	104	23	...	5.0	...	b409	247	22	33
Ladder Creek above confluence with Chalk Creek	Logan	...	9-19-51	74	8.5	705	...	...	60	23	61		11	230	130	24	...	3.1	...	b425	246	39	35
Chalk Creek above mouth	Logan	...	9-19-51	76	8.2	1,620	...	...	156	51	139		0	101	713	55	...	.5	...	b1,160	600	517	34
Twin Butte Creek above mouth	Logan	...	9-19-51	77	8.0	2,850	...	...	440	89	185		0	88	1,650	53	...	1.2	...	b2,460	1,460	1,390	22
Ladder Creek above mouth	Logan	...	9-19-51	71	8.3	876	...	...	80	28	74		7	233	222	27	...	2.6	...	b556	313	110	34
Smoky Hill River below Hinshaw Spring	Logan	...	9-19-51	75	8.1	1,050	...	...	81	28	111		0	207	338	24	...	1.2	...	b685	316	146	43
Smoky Hill River at Elkader, Kansas	Logan	...	9-19-51	70	8.2	966	...	...	89	30	75		0	158	325	27	...	1.6	...	b626	345	215	32

1. Alluvium or Sanborn and Meade formations or all three.
2. Sanborn and Meade formations or Ogallala formation or all three.
3. Niobrara formation or alluvium or both.

a. Sum of determined constituents.
b. Sum of determined constituents.