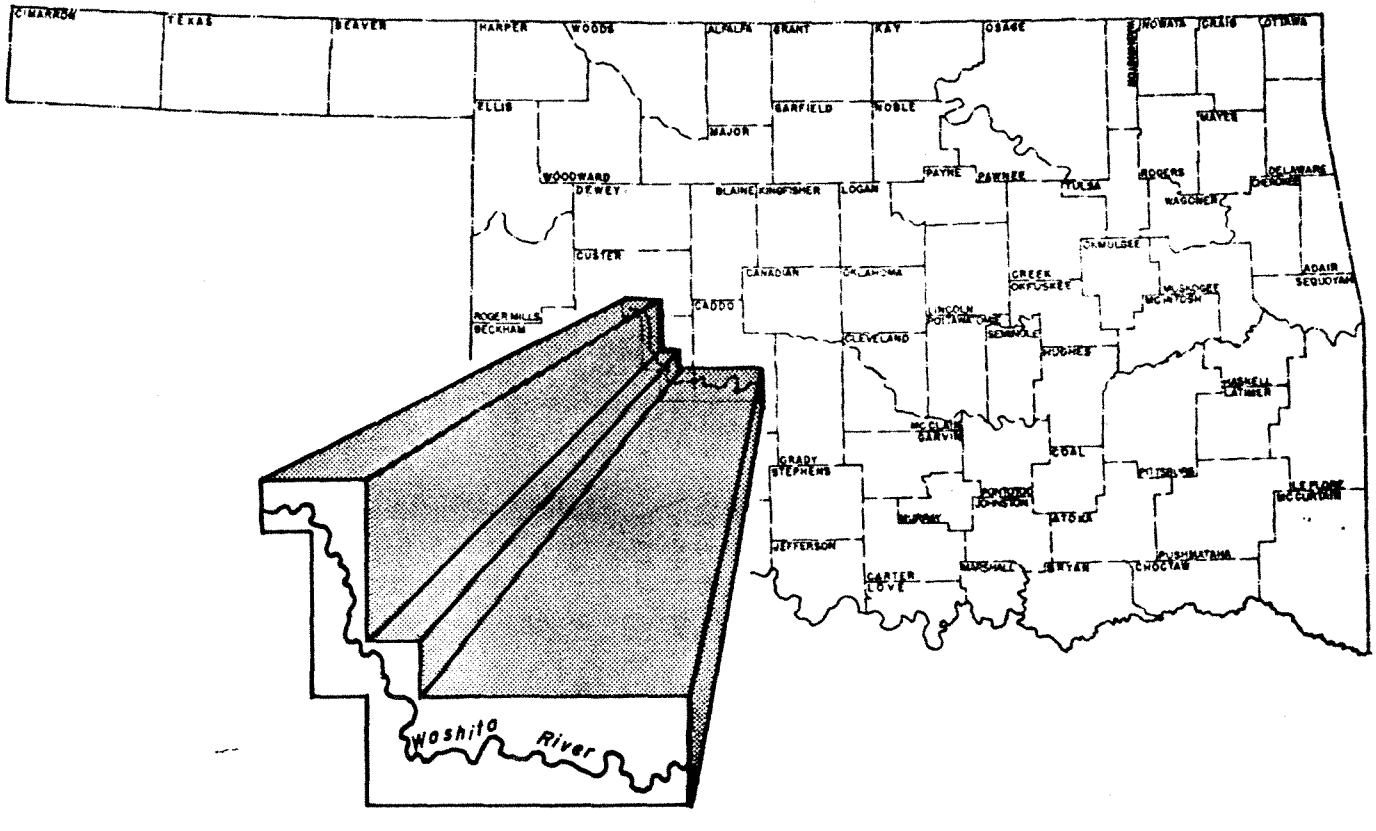
Ground Water In Alluvial Deposits - Washita Basin Clinton To Anadarko, Oklahoma



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The investigation described in this report was made by the Geological Survey in cooperation with the Bureau of Indian Affairs to determine the availability of ground water for irrigation on Indian lands in the Washita River valley. A report summarizing the results of the investigation was prepared and released to the open file in 1963.

Because of the importance of ground water in the area, the Oklahoma Water Resources Board requested permission to publish the report so that basic ground-water data useful in planning and developing the area,s water resources would be available to the general public.

Oklahoma Water Resources Board

GROUND WATER IN THE ALLUVIAL DEPOSITS OF THE WASHITA RIVER BETWEEN CLINTON AND ANADARKO, OKLAHOMA

By

D. L. Hart, Jr.

Open-File Report
Prepared by the U.S. Geological Survey

in cooperation with

the Bureau of Indian Affairs

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GROUND WATER IN THE ALLUVIAL DEPOSITS OF THE WASHITA RIVER BETWEEN CLINTON AND ANADARKO, OKLAHOMA

By D. L. Hart, Jr.

Abstract

The Washita River alluvial deposits between Clinton and Aandarko primarily are fine-grained sand and clay, and lesser amounts of coarser-grained material. These deposits range in thickness from 0 to 120 feet and average about 64 feet. Well yields range from only a few gallons per minute in some of the sandy clay beds to more than 240 gallons per minute (gpm) in sections where a higher percentage of coarse material has been deposited. Test pumping indicates that wells yielding 60 to 150 gpm could be developed in about 50 percent of the valley and wells yielding more than 150 gpm in about 10 percent. The higher yields generally occur along a relatively narrow buried channel where the alluvial deposits are thicker and coarser than the surrounding alluvium. This area is not discernible at the surface and must be located by test drilling.

Introduction

The investigation that was the basis for this report was made by the U.S. Geological Survey in 1962 in cooperation with the Bureau of Indian Affairs. A report describing the results of the investigation was prepared for use by the Bureau of Indian Affairs, Anadarko Area Office, in 1963. Because of the importance of ground water in the alluvial deposits of the Washita River, the Oklahoma Water Resources Board requested and was granted permission to publish the report in order to make available to the public basic ground-water data that will be useful in planning and developing the area's water resources.

The objective of the investigation was to determine the availability of ground water for irrigation in the Washita River alluvial deposits from Clinton to 4 miles east of Anadarko, Okla. The term "alluvial deposits" is used in this report to refer to deposits underlying the flood plain and the adjoining low terrace because they are interconnected and form a single hydrologic unit throughout this area. The area of this investigation includes the valley in parts of Caddo, Custer, Kiowa, and Washita Counties. The length of the river valley studied is about 78 miles although the river is considerably longer because of its many meanders.

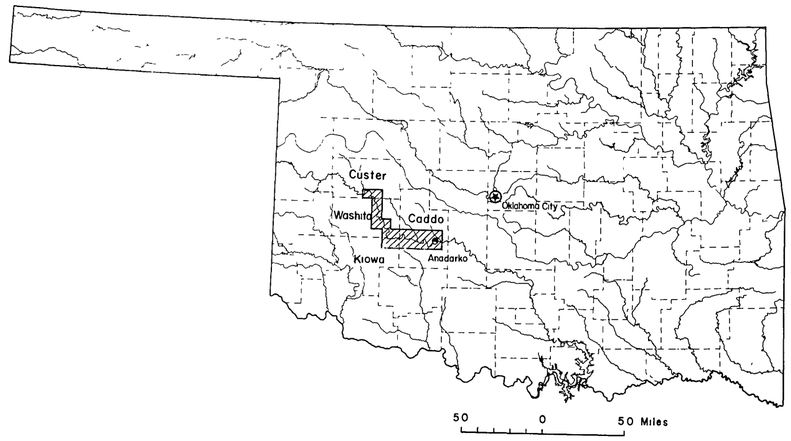
Fifty-seven test holes along 10 lines approximately perpendicular to the Washita River valley were drilled to determine the lithology and thickness of the unconsolidated material below the alluvial surfaces. Four of the wells ere test pumped to determine their specific capacities (fig. 1). The data obtained by test pumping were then related to areas where only test holes had been drilled so that yields could be estimated on the basis of grain size and saturated thickness. In addition, 5 test holes were dilled in the valleys of 2 tributaries of the Washita.

A 1958 open-file report, "Ground water in the alluvial deposits of the Washita River and its tributaries in Oklahoma," by A. R. Leonard, L. V. Davis, and B. L. Stacy of the U.S. Geological Survey, includes a brief discussion of the alluvial deposits and their water-bearing potential. The map showing the contact of the alluvium and the bedrock in this report is based on mapping by H. Tanaka, B. L. Stacy, and L. V. Davis that was included in the 1958 report.

Physical features.--The Washita River flows nearly southward from Clinton to Mountain View. In this reach the width of the alluvium averages about a mile and it has a surface gradient of 4.5 feet per mile. From Mountain View to Anadarko the river flows generally eastward, the average alluvial width is about a mile, and the surface gradient is 3.5 feet per mile. Downstream from Anadarko the valley widens to about 2 miles. The altitude of the flood plain near Clinton is about 1,475 feet and descends to about 1,150 feet east of Anadarko.

The river has entrenched a valley with broad meanders, 3 or 4 miles across, into the bedrock throughout much of its course and the present river channel forms a series of smaller meanders within its valley. The flood plain is relatively flat, averages alightly more than a half mile in width, and in most areas is flanked on one or both sides by terraces rising 10 to 15 feet above it. Locally the deposits beneath the terrace have been partly eroded and their upper surface slopes gently into the flood plain. The steep-banked river channel has cut into the flood plain to a depth of 15 to 25 feet and it generally ranges from 50 to 100 feet in width.

The contact of the alluvium and the bedrock is usually distinct because of the abrupt topographic change, but locally it may be obscured by a thin veneer of soil or dune sand. Steep valley walls are formed where the valley is incised through irregular layers of gypsum, primarily in Washita County, and through some of the more resistant sandstones in Caddo County.



Index Map

EXPLANATION

Qal / Pu — Contact of combined low terrace and alluvium (Qal) with undifferentiated Permian bedrock (Pu)

05 — Test hole—number correspond to log number in appendix and cross section

● 7 — Test well

B—B' — Geologic section across alluvial valley

1 0 1 2 3 4 miles
Scale

Prepared by U.S. Geological Survey in Cooperation with U.S. Bureau of Indian Affairs.

Geology after H H Tanaka, B L Stacy, and L V Davis, 1958

Figure I.— — Generalized Map of Washita River Alluvial Deposits Between Clinton and Anadarko Showing Test—Hole Locations

Test-hole numbering system.--The test holes shown on the map are numbered serially starting on the east side of the map and continuing to the west, and the log for each test hole may be found by looking at the corresponding test-hole number in the appendix. In the appendix, the test-hole serial number is followed by the well-description system in use by this office: township, range, section, and location within the section. The first lower-case letter following the section represents the quarter section in which the well is located, the second letter represents the quarter-quarter section, and the third the quarter-quarter-quarter section (fig. 2).

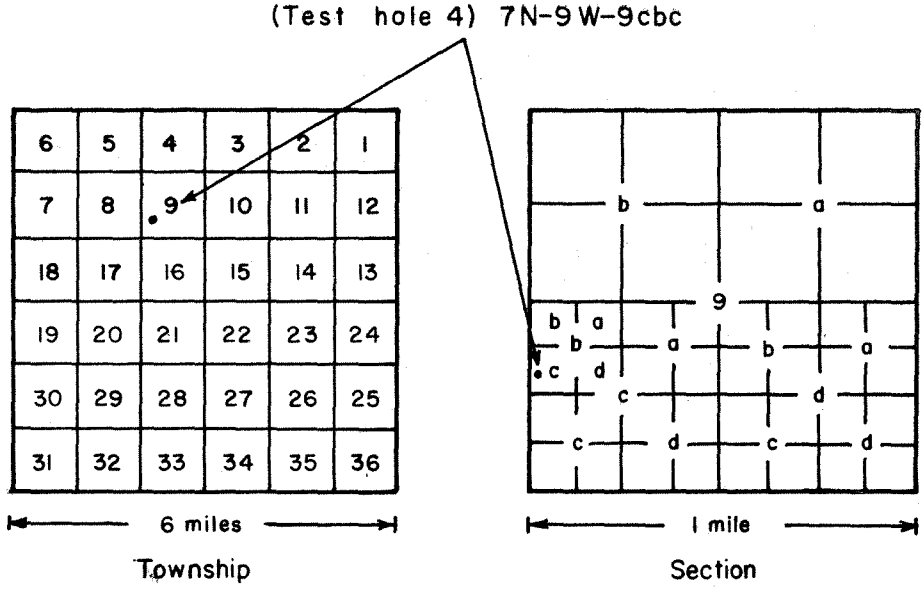


Figure 2—Test-hole numbering system

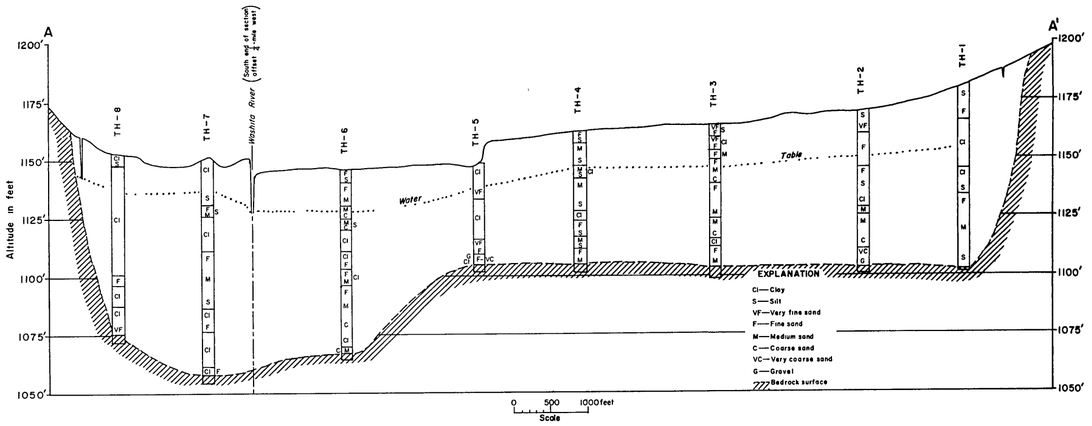


Figure 3—Geologic cross section A–A' across Washita River valley

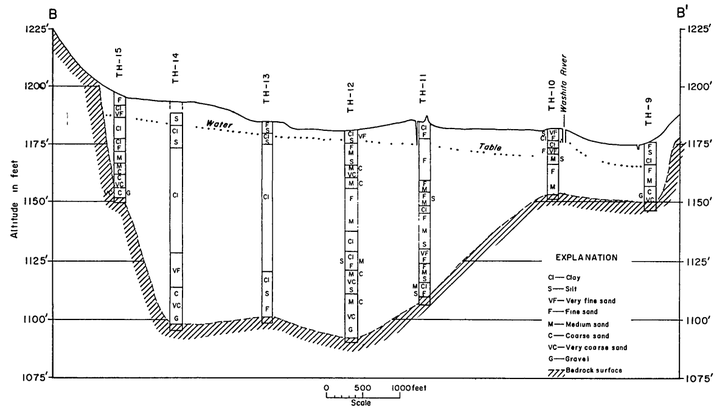


Figure 4—Geologic cross section B–B' across Washita River valley

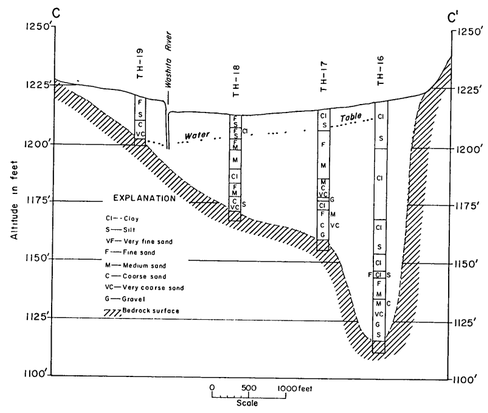


Figure 5—Geologic cross section C–C' across Washita River valley

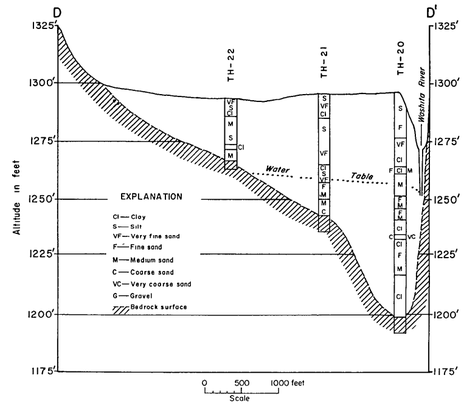


Figure 6—Geologic cross section D–D' across Washita River valley

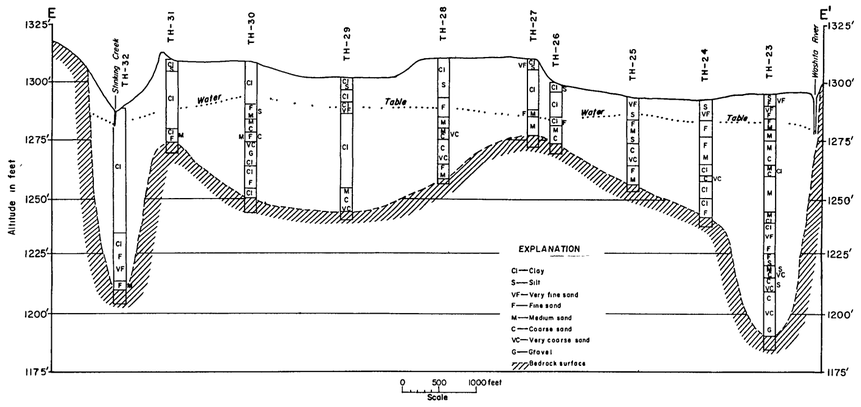


Figure 7—Geologic cross section E–E' across Washita River valley.

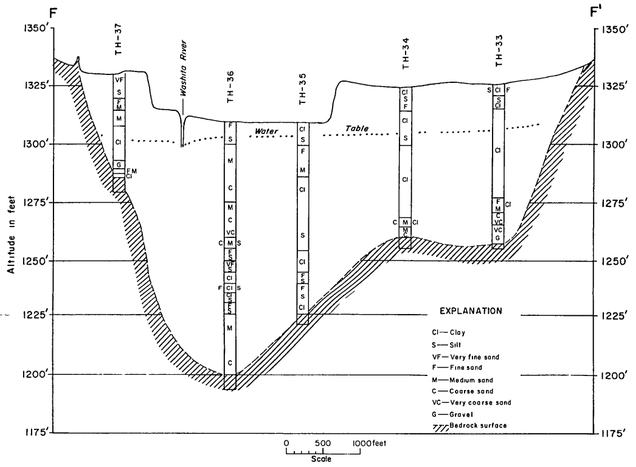


Figure 8—Geologic cross section F–F' across Washita River valley

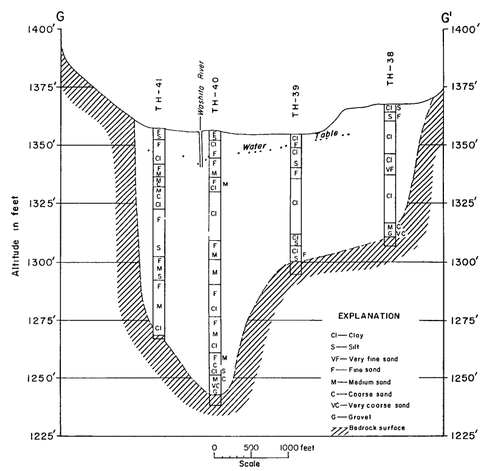


Figure 9—Geologic cross section G–G' across Washita River valley

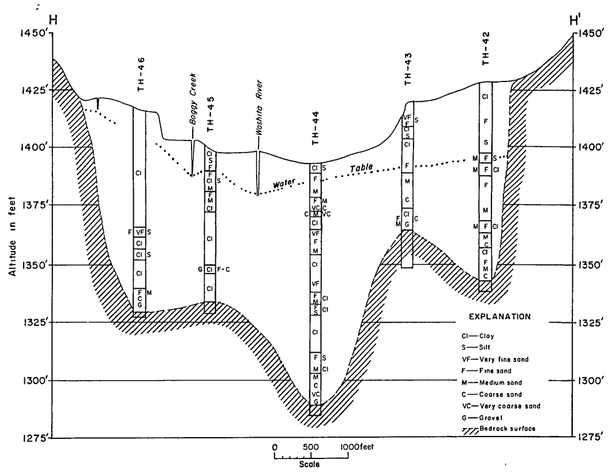


Figure 10—Geologic cross section H–H' across Washita River valley

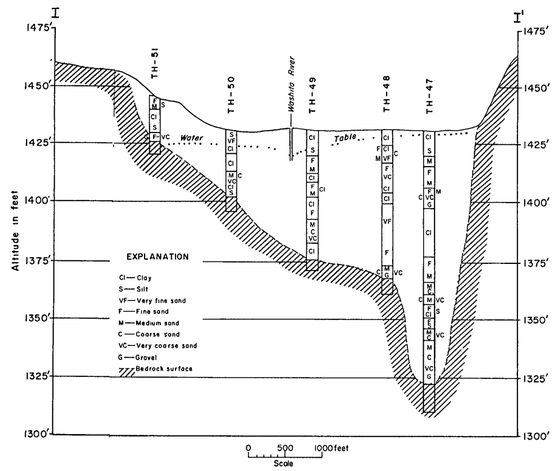


Figure 11—Geologic cross section I–I' across Washita River valley

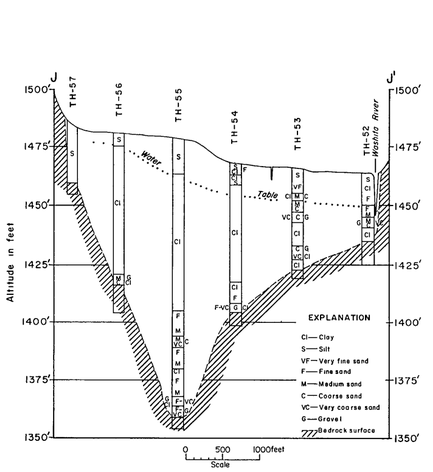


Figure 12—Geologic cross section J–J' across Washita River valley

Prepared by U.S Geological Survey in Cooperation with U S Bureau of Indian Affairs

General geology

Consolidated rocks.--The river valley from Clinton to Anadarko has been cut into Permian red beds which are composed mostly of shale, siltstone, fine-grained sandstone, and thin beds of gypsum. The Geologic Map of Oklahoma (Miser, 1954) shows the river flowing over three principal formations--the Cloud Chief Formation, the Rush Springs Sandstone, and the Marlow Formation in descending order. The Cloud Chief and the Marlow are relatively tight, impermeable rocks, while the Rush Springs is relatively permeable. The Rush Springs probably is the only formation in this area capable of transmitting a significant amount of water to the alluvial deposits.

Unconsolidated deposits.--The alluvial deposits are formed by the deposition of stream-transported material and may consist of clay, silt, sand, and gravel in any proportion. Generally these deposits are thicker along major streams than along smaller creeks.

The high-terrace deposits, like the alluvium, were laid down by streams and are lithologically similar to the alluvium, but the high-terrace deposits are older and usually topographically higher.

According to L. V. Davis (1955, p. 78) the alluvium and the terrace deposits of the Washita River have been laid down and eroded during at least three major cycles. The first cycle consisted of the erosion of the bedrock into a broad relatively shallow valley as the river moved laterally between its bedrock boundaries. Deposition of sand and gravel containing an abundance of quartz, quartzite, flint, chert, and jasper followed this period of erosion. This material suggests a source, such as the Tertiary deposits of the High Plains of western Oklahoma and the Texas Panhandle.

During the second cycle the river cut into the older alluvial deposits eroding much of them away and continued to deepen its channel into the bedrock. This cutting was followed by deposition not only of bedrock material but also reworked material deposited during the first cycle. For instance, along cross-section A-A', 4 miles east of Anadarko, a bedrock valley more than $1\frac{1}{2}$-miles wide was eroded to an altitude of about 1,105 feet during the second cycle (fig. 3). This erosion was followed by a period of deposition during which the bedrock valley was filled to an altitude of about 1,170 feet. Part of the fill (at test-hole 2, for instance) consisted of coarse material reworked from the older alluvial deposits. Most of it, however, consisted of finer-grained material derived from local bedrock.

During the third cycle the stream cut into the second-cycle alluvial deposits and in some places penetrated into the underlying bedrock. This latest period of erosion was again followed by the deposition of reworked alluvial deposits and bedrock material. Along cross-section A-A', the deepest part of the bedrock valley south of test-hole 5 may

represent the third cycle of erosion. If so, the valley was cut from the level of the second-cycle fill, about 1,170 feet, to a bedrock level of about 1,060 feet in a valley slightly more than a mile wide. Material was subsequently deposited in this latest valley filling to an altitude of about 1,150 feet, the present flood-plain level.

Most of the material deposited during the first cycle has now been either removed by erosion or reworked and deposited with younger deposits. The remnants of high-terrace deposits generally are separated from the younger material by bedrock outcrops and do not contribute water directly to the alluvium. The high-terrace material has not been delineated on the map. Deposits of the second and third cycles contain an abundance of fine-grained sand, silt, and clay, and the source of these probably is the local Permian rocks which they resemble closely. Generally the test holes penetrated upper and middle zones containing fine-grained material, while the deeper zones contained a much higher percent of coarse material. These conditions do not exist everywhere because of the lenticular nature of the depositional material. The gravel that was penetrated during test drilling generally was subrounded or subangular and a quarter of an inch or less in diameter, but some ranged up to an inch. The very coarse sand and gravel usually is buff or brown, while the finer material usually is red or reddish brown. One noticeable feature in most of the test holes is the lack of clean well-sorted sand (fig. 3 to 12). Clay, silt, and fine sand are interspersed throughout the thickness of the alluvial section greatly reducing the permeability of the water-bearing material. The high percentage of fine-grained material apparently is in contrast to the deposits west of Clinton where corase-grained material is more abundant and well yields are reported to be greater. The coarse material upstream from Clinton probably is derived from the High Plains deposits of extreme western Oklahoma and the Texas Panhandle, but also may have resulted because the steeper gradients in the area allowed the depositing stream to carry the fine-grained material further downstream. Probably the coarser material did not get carried as far downstream and the area east of Clinton received a valley fill mostly of fine-grained deposits derived from Permian red beds.

The average thickness of the alluvial material was 64 feet. The alluvial material ranges in thickness from a feather edge at its contact with the bedrock to 120 feet where the buried valley has been cut deeply into the bedrock. In each line that was test drilled at least 1 hole penetrated 90 feet or more of alluvial material.

Drill cuttings from 3 test holes in the Sugar Creek alluvium and 2 test holes in a small tributary northeast of Clinton showed the entire sections to be composed of clay, silt, and some very fine sand. The sand was very silty and had a very low permeability. Along Sugar Creek the maximum thickness of the alluvium was 108 feet and along the tributary northeast of Clinton it was 78 feet.

Aquifer properties

Test-hole cuttings show the alluvium to be mostly clay, silt, and fine sand, with lesser amounts of larger-grained sand and gravel. Sieve-size analyses (table 1) were made on samples taken from six text holes where the coarsest material was penetrated during the early phase of the test-drilling program to determine the slot size of the well screen to be used for the specific-capacity tests. Only the coarse zones in the middle and lower sections of these holes were analysed because the well screen was to be set near the bottom of the alluvium in each test. The 5 test holes chosen to be test pumped were numbers 12, 17, 40, 44, and 49.

Table 1.--Sieve-size analyses

Test-hole number	Interval sampled (feet)	Percent by weight					
		Gravel	Very coarse sand	Coarse sand	Medium sand	Fine sand	Clay, silt and very fine sand
16	80-90	2	3	22	58	9	6
16	90-100	10	14	32	30	8	6
16	100-103	20	16	26	20	8	10
17	30-35	4	5	39	40	9	3
17	35-45	17	13	29	21	12	8
17	45-55	11	16	30	34	6	3
20	35-45	1	1	2	36	51	9
20	45-55	4	3	7	39	28	19
20	60-65	25	21	28	18	4	4
23	75-80	5	6	19	44	19	7
23	80-105	6	10	30	38	12	4
23	105-110	31	10	14	18	14	13
36	85-95	2	4	30	52	6	6
36	95-110	2	8	26	48	13	3
40	100-105	6	9	31	35	11	8
40	105-114	6	13	33	33	10	5

Test-hole 12, near Anadarko, was reamed to a 14-inch diameter to a depth of 89 feet to accommodate a 10-inch casing and a well screen 8 inches in diameter. The well screen was set from 68 to 88 feet below land surface. Because of the high percentage of fine material at this location, a sand pack composed of medium to very coarse sand was poured between the screen and the wall of the hole. A sand pack prevents the fine material in the formation from plugging the screen openings, and it also decreased the entrance loss of the water moving into the well by increasing the permeability around the screen. After bailing and pumping to develop the well, it was pumped for 2 hours at 108 gpm (gallons

per minute), and it had a drawdown of slightly more than 23 feet. The pumping rate was later increased to 201 gpm which produced a drawdown of 55.2 feet after 7 hours of pumping.

Test-hole 17 was reamed and cased to a depth of 55 feet and the screen was set from 35 to 55 feet below land surface opposite coarse sand and gravel. The well developed easily by bailing and the test pump was installed. The well was further developed by surging with the pump, and testing was started with the static water level 10.5 feet below the top of the casing. The initial pumping rate was 205 gpm and after 5 hours pumping the rate was increased to 240 gpm. The final drawdown after 9 hours pumping was 36.7 feet.

Test-hole 40 was reamed and cased to a depth of 114 feet, and the well screen was set from 94 to 114 feet below land surface. During the initial bailing of the well fine material was drawn into the screen openings sealing them shut. Further attempts to develop the well failed and the casing and screen were pulled from the hole.

Test-hole 44 was reamed to a depth of 104 feet and 20 feet of well screen set on the bottom. After gravel packing and developing the well, pumping was started at a rate of 100 gpm which produced 29.2 feet of drawdown after 1 hour. When the rate was increased to 201 gpm, the drawdown increased to 59.8 feet. The test was stopped after 1 hour and 45 minutes because of the high-chloride content of the water.

The test at location 49 was more typical of the valley as a whole and was not picked to be the best site in the line of test holes as the previous tests had been. The depth of this well was 55 feet and the water level was 8.9 feet. The screen was set from 35 to 55 feet below the surface and the well was gravel packed. This well was pumped for 3 hours at 60 gpm and had a drawdown of 25.8 feet. At 80 gpm the drawdown was 39.7 feet, and at 92 gpm the pump broke suction as the water level in the well was drawn down below the level of the pump bowls set at 53.5 feet. The test was stopped after 3 hours and 30 minutes of pumping.

The specific capacity of the wells tested (discharge per foot of drawdown) ranged from 2 to 6.5 gpm (table 2). Although the specific capacity of an individual sand may be considerably higher than is indicated by table 2, this method of testing takes into consideration the total saturated zone and treats it as a homogeneous unit. In the case of the test on well 49, the lower sand, from 38 to 48 feet, would have a much higher specific capacity than is indicated and probably is contributing most of the water pumped from this well whereas the overlying fine sand and clay would have a much lower specific capacity and would contribute little water to the well.

Table 2.--Specific capacity of test wells.

Test-hole number	Maximum pumped (gpm)	Drawdown (dd) (feet)	Specific capacity $sc = \frac{gpm}{dd}$
12	201	55.2	3.6
17	240	36.7	6.5
40	...	...	...
44	201	69.7	2.9
49	80	39.7	2.0

Although the specific capacity of the better locations ranged from 2.9 to 6.5 gpm, a specific capacity of 2.0 gpm would be representative of most sites. Assuming an average specific capacity of 2 gpm and a saturated thickness of 35 to 50 feet, approximately 70 to 100 gpm might be expected from an average well. The yield would be smaller if the well was not equipped with a good well screen with proper slot size, gravel packed, and properly developed.

The quality of the ground water throughout the valley appears to be suitable for irrigation except for a small area in the vicinity of secs. 27 and 34, T. 10N., R. 16 W. The water sample from test-hole 44 had a chloride content of 5,650 ppm (parts per million) and a sodium content of 3,750 ppm making this water unusable. The contamination probably is caused by vertical and lateral seepage from the Cloud Chief Formation and may be confined to the deeper part of the valley as nearby wells located on the low terrace are being used for domestic supplies.

Conclusions

It is possible to develop wells yielding 60 to 150 gpm in about 50 percent of the area of the valley studied. Wells yielding 150 to 250 gpm could be developed in about 10 percent of the valley, where the deposits are thickest and generally coarse. There are no surface indications to show the location of the thicker and more coarse-grained section and it must be located by test drilling. The remainder of the valley will yield less than 60 gpm to wells because of the predominance of clay and fine-grained sand.

References cited

Davis, L. V., 1955, Ground-water resources and geology of Grady and northern Stephens Counties, Oklahoma: Okla. Geol. Survey Bull. 73.

Leonard, A. R., Davis, L. V., Stacy, B. L., 1958, Ground water in the alluvial deposits of the Washita River and its tributaries: U.S. Geol. Survey open-file report.

Miser, H. D., 1954, Geologic Map of Oklahoma: U.S. Geol. Survey and Okla. Geol. Survey

Appendix A.--Logs of test holes

Logs on the following pages record the materials penetrated in the drilling of 62 test holes. The test holes were drilled by the hydraulic-rotary method using a 6-inch drill bit. Each test hole was drilled through the alluvial material and into the bedrock. The bedrock is the consolidated material underlying the alluvium and generally is shale, siltstone, or sandstone in this area. At most places it is much harder than the alluvium, although a few holes penetrated bedrock that was badly weathered and very soft. The descriptions are a composite of the field logs prepared by the U.S. Geological Survey and the drill operator.

The test holes were assigned numbers (in parenthesis) serially in order from north to south in each line starting with the north hole on the easternmost cross section (A-A'). The formal number (i.e. 7N-9W-4cbc) describes the location as shown by figure 2 and described on page 2. The altitudes refer to ground level at the mouth of the test hole and are in feet above mean sea level. They were obtained by plane-table surveys using available topographic maps for control. The water levels were measured in feet below land surface several hours after drilling was completed.

	Thickness (feet)	Depth (feet)
(Test-hole 1) 7N-9W-4cbc. 12 feet east and 1,320 feet north of SW cor. Altitude, 1,181.		
Silt and fine sand, dark-brown	15	15
Clay, brown	21	36
Clay and silt, red	11	47
Sand, fine to medium, and silt, reddish-brown	32	79
Shale, red (bedrock)	1	80
(Test-hole 2) 7N-9W-8aaa. 40 feet south and 15 feet west of NE cor. Altitude, 1,6[illegible]9. Water level, 20 feet.		
Silt and very fine sand, brown	10	10
Sand, fine, brown	15	25
Sand, fine, silt, and clay, reddish-brown	17	42
Sand, medium, brown	3	45
Sand, medium to coarse, brown	5	50
Sand, coarse, trace of medium, brown	10	60
Sand, very coarse, and gravel	8	68
Shale, red (bedrock)	2	70

	Thickness (feet)	Depth (feet)
(Test-hole 3) 7N-9W-8add. 0.4 mile south and 15 feet west of NE cor. Altitude, 1,170. Water level, 19 feet		
Sand, very fine to fine, and silt, brown	5	5
Sand, very fine to fine, and clay, brown	6	11
Sand, fine to medium, buff	4	15
Sand, fine to coarse, buff	10	25
Sand, fine to medium, trace of clay, buff	15	40
Sand, medium to coarse, buff	9	49
Clay, buff	3	52
Sand, fine to medium, buff	10	62
Shale, red (bedrock)	4	66
(Test-hole 4) 7N-9W-9cbc. 1,590 feet north and 12 feet east of SW cor. Altitude, 1,162. Water level, 16 feet.		
Sand, fine, and silt, reddish-brown	5	5
Sand, medium, silty, buff	10	15
Sand, medium, silty, and clay, buff	5	20
Sand, medium, trace of coarse, and silt, buff	14	34
Clay, red	4	38
Sand, fine, and silt, brown	7	45
Sand, medium, and silt, gray	5	50
Sand, fine to medium, gray-brown	7	57
Shale, red (bedrock)	3	60
(Test-hole 5) 7N-9W-17aaa. 100 feet south and 300 feet west of NE cor. Altitude, 1,149. Water level, 9 feet.		
Clay and sand, very fine, brown	15	15
Clay, brown and reddish-brown	17	32
Sand, very fine to fine, brown	6	38
Sand, fine to very coarse, gravel, and clay, brown	5	43
Shale, red (bedrock)	3	46
(Test-hole 6) 7N-9W-17ada. 1,920 feet south and 100 feet west of NE cor. Altitude, 1,446. Caved at 18 feet.		
Sand, fine, and silt, brown	5	5
Sand, fine to medium, buff	10	15
Sand, medium to coarse, buff	5	20
Sand, medium to coarse, and silt, brown	10	25
Clay, brown	9	34
Clay, sandy, fine, brown	8	42
Sand, fine to medium, and clay, reddish-brown	7	49
Sand, fine to coarse, and clay, reddish-brown	26	75
Sand, medium to coarse, brown	3	78
Shale, red (bedrock)	3	81

	Thickness (feet)	Depth (feet)
(Test-hole 7) 7N-9W-17dbc. 20 feet north of intersection of quarter-section fence and south fence of railroad right-of-way. Altitude, 1,153. Water level, 15 feet.		
Clay, silty, reddish-brown	20	20
Sand, fine to medium, silty, brown	5	25
Clay, brown	15	40
Sand, fine to medium, silt, and trace of clay, brown	25	65
Clay and fine sand, gray	10	75
Clay, brown	15	90
Clay and fine sand, brown	3	93
Shale, red (bedrock)	4	97
(Test-hole 8) 7N-9W-17ddb. 10 feet east and 15 feet north of NE cor. of barn. Altitude, 1,153.		
Clay, silty, reddish-brown	15	15
Clay, reddish-brown	37	52
Sand, fine, reddish-brown	4	56
Clay, brown	9	65
Clay and very fine sand, brown	12	77
Shale, red (bedrock)	4	81
(Test-hole 9) 7N-10W-16dcd. 90 feet east of concrete well south of highway and 15 feet north of highway-center line. Altitude, 1,176. Water level, 12 feet.		
Sand, fine, silt, and clay, brown	10	10
Sand, fine to medium, buff	10	20
Sand, coarse to very coarse, gravel, buff	6	26
Shale, silty, red (bedrock)	4	30
(Test-hole 10) 7N-10W-16cdc. 90 feet north of highway-center line and 10 feet west of county-road center line. Altitude, 1,182. Water level, 12 feet.		
Sand, very fine to fine, silt, and clay, reddish-brown	5	5
Clay, reddish-brown	3	8
Sand, very fine to fine, reddish-brown	3	11
Sand, medium, trace of coarse, silty, reddish-brown	4	15
Sand, fine to medium, brown	13	28
Siltstone, red-orange (bedrock)	2	30

	Thickness (feet)	Depth (feet)
(Test-hole 11) 7N-10W-16ccc. 60 feet north of intersection of railroad and highway. Altitude, 1,182. Water level, 8 feet.		
Clay and fine sand, reddish-brown	7	7
Sand, fine, reddish-brown	18	25
Sand, fine to medium, brown	5	30
Sand, fine to medium, silty, reddish-brown	6	36
Clay, reddish-brown	3	39
Sand, fine to medium, silty, reddish-brown	15	54
Sand, very fine to fine, gray-brown	6	60
Sand, fine to medium, silty, gray	9	69
Clay and fine to medium sand, silty, reddish-brown	6	75
Shale, red (bedrock)	4	79
(Test-hole 12) 7N-10W-17dcd. 30 feet west and 6 feet south of gate 0.2 mile west of SE cor. Altitude, 1,181. Water level, 5 feet.		
Clay, silt, and sand, very fine, reddish-brown	5	5
Sand, fine to medium, silty, brown	10	15
Sand, medium to very coarse, brown	5	20
Sand, medium to coarse, brown	5	25
Sand, fine to medium, brown	18	43
Clay, brown	9	52
Clay, silt, and fine to medium sand, brown	8	60
Sand, medium to very coarse, silty, brown	10	70
Sand, medium to very coarse, and gravel, brown	19	89
Siltstone, red-orange (bedrock)	2	91
(Test-hole 13) 7N-10W-20abb. 25 feet south of highway center line and 90 feet west of telephone-pole 90. Altitude, 1,185; Water level, 7 feet.		
Sand, fine, and silt, brown	5	5
Clay, silty, brown	5	10
Clay, reddish-brown	54	64
Clay, silty, containing sand streaks, fine, brown	20	84
Shale, red and gray-green (bedrock)	3	87
(Test-hole 14) 7N-10W-17cdc. 20 feet south and 10 feet west of field gate 0.2 mile east of SW cor. Altitude, 1,189. Water level, 6 feet.		
Silt, brown	5	5
Clay and silt, reddish-brown	10	15
Clay, red, brown, and gray	45	60
Sand, very fine, brown	15	75
Sand, coarse to very coarse, and gravel, brown	15	90
Siltstone, red-orange (bedrock)	3	93

	Thickness (feet)	Depth (feet)
(Test-hole 15) 7N-10W-20bbb. 0.1 mile east and 15 feet south of NW cor. Altitude, 1,197. Water level, 10 feet.		
Sand, fine, reddish-brown	5	5
Clay, and sand, very fine, reddish-brown	5	10
Clay, brown and gray	9	19
Clay and fine sand, brown and gray	6	25
Sand, medium, buff	5	30
Sand, medium to coarse, buff	5	35
Sand, coarse to very coarse, buff	5	40
Sand, coarse to very coarse, and gravel, buff	4	44
Shale, silty, orange-red (bedrock)	3	47
(Test-hole 16) 7N-11W-11aab. 15 feet west and 8 feet north of 5th telephone pole from NE cor. Altitude, 1,219. Water level, 6 feet.		
Clay, silty, red	20	20
Clay, red	30	50
Clay, silty, brown	15	65
Clay, brown	7	72
Clay, silty, and very-fine sand, brown	3	75
Sand, fine to medium, brown	10	85
Sand, medium to very coarse, silty, and gravel, brown	18	103
Shale, orange-red (bedrock)	5	108
(Test-hole 17) 7N-11W-11aba. 30 feet west and 8 feet north of intersection of quarter-section line and section-line fence. Altitude, 1,215. Water level, 8 feet.		
Clay, silty, red	9	9
Sand, fine to medium, brown	21	30
Sand, medium to very coarse, brown	8	38
Gravel, brown	1	39
Clay, brown	4	43
Sand, fine to very coarse, and gravel, brown	13	56
Shale, red (bedrock)	5	61
(Test-hole 18) 7N-11W-3cdd. 30 feet north and 15 feet east of power pole near half-section line. Altitude, 1,213. Water level, 10 feet.		
Sand, fine, and silt, brown	5	5
Sand, fine, silt, and clay, brown	5	10
Sand, fine to medium, brown	5	15
Sand, medium, buff	8	23
Clay, brown	6	29
Sand, fine to medium, brown	6	35
Sand, coarse to very coarse, silty, buff	5	41
Shale, silty, red (bedrock)	4	45

	Thickness (feet)	Depth (feet)
(Test-hole 19) 7N-11W-11bba. 15 feet south of telephone pole near quarter-section line. Altitude, 1,220.		
Sand, fine, and silt, brown	10	10
Sand, coarse to very coarse, buff	8	18
Sandstone, fine-grained, red (bedrock)	3	21
(Test-hole 20) 8N-13W-28baa. 30 feet west and 30 feet south of north-quarter corner. Altitude, 1,298. Water level, 39 feet.		
Silt and very fine sand, reddish-brown	20	20
Sand, very fine, and clay, reddish-brown	12	32
Sand, fine to medium, and clay, brown	3	35
Sand, medium, trace of fine, reddish-brown	10	45
Sand, fine to medium, trace of clay, brown	5	50
Sand, fine to medium, trace of gravel, brown	5	55
Clay, brown	8	63
Sand, coarse to very coarse, trace of gravel, brown, red, and gray	2	65
Clay and fine to medium sand, reddish-brown	15	80
Clay, brown	18	98
Sandstone, fine-grained, red (bedrock)	7	105
(Test-hole 21) 8N-13W-28abc. 510 feet north and 6 feet east of center of section. Altitude, 1,296. Water level, 36 feet.		
Silt, clay, and very fine sand, reddish-brown	10	10
Silt and very fine sand, reddish-brown	20	30
Clay, silt, and very fine sand, reddish-brown	8	38
Sand, fine to medium, buff	7	45
Sand, medium to coarse, buff	9	54
Sandstone, fine-grained, reddish-brown (bedrock)	7	61
(Test-hole 22) 8N-13W-28acc. 630 feet south and 6 feet east of center of section. Altitude, 1,294. Dry at 27 feet.		
Sand, very fine, silt, and clay, reddish-brown	8	8
Sand, medium, silty, buff	12	20
Clay, red	2	22
Sand, medium, buff	5	27
Shale, red (bedrock)	4	31

	Thickness (feet)	Depth (feet)
(Test-hole 23) 8N-14W-36cbc. 2,250 feet north of the SW cor. Altitude, 1,296. Caved at 10 feet.		
Silt and very fine to fine sand, reddish-brown	5	5
Sand, very fine to fine, reddish-brown	5	10
Sand, fine, trace of medium, reddish-brown	5	15
Sand, medium, reddish-brown	5	20
Sand, medium to coarse, buff	10	30
Sand, medium to coarse, and clay streaks, brown	5	35
Sand, medium, brown	15	50
Sand, medium, and clay streaks, brown	5	55
Clay, and streaks of very fine to fine sand, silty, brown	15	70
Sand, fine, and silt, brown	5	75
Sand, medium to very coarse, silty, buff	5	80
Sand, coarse to very coarse, silty, buff	5	85
Sand, coarse to very coarse, and gravel, buff	20	105
Sandstone, fine-grained, reddish-brown (bedrock)	6	111
(Test-hole 24) 8N-14W-36ccb. 970 feet north of SW cor. Altitude, 1,294. Water level, 9 feet.		
Silt and sand, very fine, brown	8	8
Sand, fine, brown	7	15
Sand, fine to medium, buff	12	27
Clay, reddish-brown	5	32
Sand, coarse to very coarse, reddish-brown	2	34
Clay, gray	8	42
Clay and fine sand, brown	8	50
Sandstone, fine-grained, reddish-brown (bedrock)	5	55
(Test-hole 25) 8N-14W-36ccc. 60 feet north and 10 feet east of power-line pole at SW cor. Altitude, 1,294. Water level, 8 feet.		
Sand, very fine, and silt, reddish-brown	10	10
Sand, fine to medium, silty, reddish-brown	10	20
Sand, coarse to very coarse, trace of gravel, reddish-brown	9	29
Sand, fine to medium, brown	9	38
Sandstone, fine-grained, reddish-brown (bedrock)	3	41

	Thickness (feet)	Depth (feet)
(Test-hole 26) 7N-14W-1bbc. 110 feet north of northermost power-line pole on section line. Altitude, 1,300. Water level, 14 feet		
Clay and silt, brown	5	5
Clay, brown	10	15
Clay and fine sand, brown	4	19
Sand, medium, trace of coarse to very coarse, buff	8	27
Siltstone, reddish-brown (bedrock)	4	31
(Test-hole 27) 7N-14W-1bcb. 20 feet east and 180 feet north of warning sign for buried pipeline. Altitude, 1,310. Water level, 26 feet.		
Clay, silt, and very fine sand, brown	5	5
Clay, brown	17	22
Sand, fine to medium, brown	3	25
Sand, medium, buff	8	33
Siltstone, reddish-brown (bedrock)	5	38
(Test-hole 28) 7N-14W-1cbb. 60 feet south and 10 feet east of west quarter corner. Altitude, 1,309. Water level, 22 feet.		
Clay and silt, reddish-brown	17	17
Sand, fine, buff	8	25
Sand, medium, buff	5	30
Sand, medium to very coarse, buff	5	35
Sand, coarse to very coarse, buff	10	45
Sand, fine to medium, buff	7	52
Shale and fine sand, red and brown (bedrock)	2	54
(Test-hole 29) 7N-14W-1ccb. 6 feet east of road center line and 30 feet south of quarter-line fence. Altitude, 1,302. Water level, 14 feet.		
Clay and silt, reddish-brown	5	5
Clay, reddish-brown	5	10
Clay and very fine sand, reddish-brown	5	15
Clay, reddish-brown	32	47
Sand, medium to very coarse, and gravel, brown	10	57
Siltstone, reddish-brown (bedrock)	4	61

	Thickness (feet)	Depth (feet)
(Test-hole 30) 7N-14W-1ccc. 45 feet north and [illegible] feet east of SW cor. Altitude, 1,309. Water level, 17 feet.		
Clay, red	19	19
Sand, fine to medium, silty, reddish-brown	6	25
Sand, medium to coarse, buff	6	31
Sand, fine to coarse, and clay, buff and red	4	35
Sand, very coarse, gravel, and clay, red to brown	10	45
Clay and fine sand, red to brown	10	55
Clay, red	4	59
Sandstone, fine to medium, red (bedrock)	6	65
(Test-hole 31) 7N-14W-12bbc. 60 feet north and 20 feet east of intersection of railroad and section-line road. Altitude, 1,309. Water level, 22 feet (probably drilling mud).		
Clay, silty, reddish-brown	5	5
Clay, reddish-brown	25	30
Clay and fine to medium sand, reddish-brown	5	35
Sandstone, red (bedrock)	5	40
(Test-hole 32) 7N-14W-12bcb. 80 feet north and 10 feet east of center of Stinking Creek bridge. Altitude, 1,288. Water level, 0.0 feet. (Material too tight to drain drill mud, estimated water level about 10 feet.)		
Clay, reddish-brown, trace of brown and gray	55	55
Clay and very fine to fine sand, brown	20	75
Sand, fine to medium, and clay, reddish-brown	4	79
Sandstone, shaly, red (bedrock)	6	85
(Test-hole 33) 8N-14W-31dda. 30 feet east of third telephone pole north of cross roads. Altitude, 1,325. Water level, 19 feet.		
Silt, clay, and fine sand, brown	5	5
Silt and clay, red	5	10
Clay, red, trace of brown	39	49
Sand, fine to medium, and clay, brown	6	55
Sand, coarse to very coarse, trace of gravel, yellow	5	60
Sand, very coarse, and gravel, brown	9	69
Shale, silty, red (bedrock)	3	71

	Thickness (feet)	Depth (feet)
(Test-hole 34) 7N-14W-6aaa. 30 feet west of third power-line pole south of cross-road intersection. Altitude, 1,325. Water level, 20 feet.		
Clay, silty, and fine sand, brown and red	10	10
Clay, silty, red	20	30
Clay, red and brown	26	56
Sand, medium to coarse, and clay streaks, brown	4	60
Sand, medium to coarse, brown	5	65
Shale, silty, red (bedrock)	5	70
(Test-hole 35) 7N-14W-6ada. 0.25 mile south of test-hole 34 in west edge of tree line. Altitude, 1,310. Water level, 7 feet.		
Clay, silty, brown	10	10
Sand, fine to medium, buff	13	23
Clay, silty, brown	32	55
Clay, brown	9	64
Sand, fine, silty, brown	6	70
Sand, fine, silty, and clay streaks, brown	14	84
Shale, red and gray (bedrock)	5	89
(test-hole 36) 7N-14W-6daa. About 3,200 feet south and 18 feet west of the NE cor. Altitude, 1,310. Water level, 7 feet.		
Sand, fine, and silt, buff	10	10
Sand, medium, and trace of coarse, buff	25	35
Sand, medium to very coarse, buff	15	50
Sand, medium to coarse, silty, grayish-brown	5	55
Sand, fine, silty, reddish-brown	5	60
Sand, very fine, and silt, reddish-brown	5	65
Clay, reddish-brown	5	70
Clay, fine sand, and silt, reddish-brown	5	75
Clay, silty, reddish-brown	5	80
Sand, fine, silty, reddish-brown	5	85
Sand, medium to coarse, brown	25	110
Siltstone, red (bedrock)	6	116

	Thickness (feet)	Depth (feet)
(Test-hole 37) 7N-14W-6dda. 150 feet south of SW cor. of fence around farm house. Altitude, 1,335. Water level, 28 feet.		
Sand, very fine, and silt, brown	10	10
Sand, fine to medium, buff	5	15
Sand, medium, buff	7	22
Clay, reddish-brown	15	37
Gravel, reddish-brown	3	40
Sand, fine to medium, reddish-brown	2	42
Clay, red and green	2	44
Shale, red (bedrock)	7	51
(Test-hole 38) 8N-15W-3aaa. 270 feet south and 8 feet west of NE cor. Altitude, 1,367.		
Clay, silty, brown	2	2
Silt and fine sand, brown	4	6
Clay, reddish-brown	15	21
Clay and very fine sand, reddish-brown	8	29
Clay, reddish-brown	21	50
Sand, medium to very coarse, and gravel, reddish-brown	6	56
Siltstone, reddish-brown (bedrock)	5	61
(Test-hole 39) 8N-15W-3ada. 110 feet south and 8 feet east of northernmost power-line pole on flood plain. Altitude, 1,354. Water level, 3 feet.		
Clay, sandy, fine, brown	6	6
Clay, silty, brown	7	13
Sand, fine, reddish-brown	5	18
Clay, reddish-brown	24	42
Clay, silty, reddish-brown	5	47
Clay, silty, and very fine sand, reddish-brown	7	54
Shale, silty, reddish-brown (bedrock)	6	60
(Test-hole 40) 8N-15W-3add. 90 feet north and 4 feet west of NW cor. of bridge. Altitude, 1,356. Water level, 11 feet.		
Sand, fine, silty, brown	5	5
Clay and fine sand, reddish-brown	7	12
Sand, fine to medium, buff	8	20
Sand, fine to medium, and clay, buff	7	27
Clay, reddish-brown	20	47
Sand, fine to medium, reddish-brown	8	55
Sand, medium, buff	11	66
Sand, fine, and clay streaks, brown	14	80
Sand, fine to medium, and clay streaks, gray and buff	16	96
Sand, fine to coarse, clay, and silt, brown	9	105
Sand, medium to very coarse, and gravel, brown	9	114
Sandstone, fine-grained, shaley, reddish-brown (bedrock)	4	118

	Thickness (feet)	Depth (feet)
(Test-hole 41) 8N-15W-3dad. 70 feet north and 20 feet west of gate leading to barnyard. Altitude, 1,357. Water level, 10 feet.		
Sand, fine, and silt, brown	5	5
Sand, fine, and clay, brown to buff	10	15
Sand, fine to medium, buff	5	20
Sand, medium to coarse, gray	5	25
Sand, medium to coarse, and clay streaks, gray	10	35
Sand, fine, silty, buff to reddish-brown	20	55
Sand, fine to medium, silty, reddish-brown	10	65
Sand, fine to medium, and clay streaks, reddish-brown	24	89
Sandstone, fine-grained, reddish-brown (bedrock)	2	91
(Test-hole 42) 10N-16W-26cbc. 6 feet south of fourth REA pole east of pole BF43 (at terrace break). Altitude, 1,428. Water level, 33 feet.		
Clay and fine sand, and silt, brown	31	31
Sand, fine to medium, silty, brown	4	35
Sand, fine to medium, and clay streaks, buff	5	40
Sand, fine to medium, buff	20	60
Sand, fine to medium, and clay streaks, buff	5	65
Sand, medium to very coarse, and trace of gravel, buff	6	71
Clay and fine to coarse sand, reddish-brown	14	85
Siltstone, red (bedrock)	5	90
(Test-hole 43) 10N-16W-26ccc. 30 feet east and 10 feet south of REA pole BF43. Altitude, 1,418. Water level, 26 feet.		
Sand, very fine to fine, and silt, reddish-brown	10	10
Clay and silt, reddish-brown	5	15
Clay, sandy, fine, brown	14	29
Sand, medium to coarse, yellow	16	45
Clay and fine to coarse sand, and gravel, reddish-brown	9	54
Siltstone, red (bedrock)	6	60
Shale, red	10	70

	Thickness (feet)	Depth (feet)
(Test-hole 44) 10N-16W-27ddc. 150 feet east and 30 feet north of large, lone, elm tree on south side of road. Altitude, 1,394. Water level, 7 feet.		
Clay and silt, brown	4	4
Sand, fine to medium, trace of coarse sand and silt, buff	11	15
Sand, fine to very coarse, brown	5	21
Sand, medium to very coarse, trace of clay and gravel, brown	2	23
Clay, brown	5	28
Sand, very fine to medium, trace of clay, brown	11	39
Clay and streaks of very fine sand, brown	16	55
Sand, fine to medium, and clay, brown	5	60
Sand, fine, silt, and clay, brown	5	65
Clay, brown	16	81
Sand, fine to medium, silt, and clay, brown	9	90
Sand, medium to very coarse, and gravel, brown	14	104
Shale, red (bedrock)	4	108
(Test-hole 45) 10N-16W-34abb. 25 feet south of second REA pole west of Washita River bridge. Altitude, 1,399. Water level, 8 feet.		
Clay, silt, and fine sand, brown	9	9
Sand, fine to medium, clay and silt, brown	9	18
Sand, fine to medium, and clay, brown	9	27
Clay, brown	22	49
Clay, and fine to coarse sand, and gravel, red	3	52
Clay, red	12	64
Siltstone, red, and gypsum (bedrock)	6	70
(Test-hole 46) 10N-16W-27cdc. 10 feet north of road center line and 300 feet west of house. Altitude, 1,417. Water level, 11 feet.		
Clay, brown and reddish-brown	51	51
Sand, very fine to fine, and silt, brown	4	55
Clay, brown	5	60
Clay, silty, reddish-brown	5	65
Clay, red	12	77
Sand, fine to coarse, and gravel, red	1	78
Clay, red	9	87
Shale, red, and gypsum (bedrock)	3	90

	Thickness (feet)	Depth (feet)
(Test-hole 47) 11N-16W-26baa. 0.3 mile east and 10 feet south of the NW cor. Altitude, 1,431. Water level, 2 feet.		
Clay, and silt, dark-brown	11	11
Sand, medium, buff	4	15
Sand, fine to medium, trace of coarse, brown	10	25
Sand, fine to very coarse, and gravel, brown	9	34
Clay, red	20	54
Sand, fine to medium, brown	9	65
Sand, medium to coarse, brown	5	70
Sand, medium to very coarse, trace of gravel, brown	4	74
Sand, fine, silt, and clay, reddish-brown	6	80
Sand, fine, and silt, reddish-brown	5	85
Sand, medium to very coarse, trace of clay, brown	5	90
Sand, medium to very coarse, and gravel, brown	19	109
Sandstone and shale, red (bedrock)	11	120
(Test-hole 48) 11N-16W-26bab. 0.2 mile east and 10 feet south of NW cor. Altitude, 1,431. Water level, 3 feet.		
Clay, dark-brown	7	7
Sand, very fine to coarse, and clay streaks, brown	7	14
Sand, fine to very coarse, and clay streaks, brown	13	27
Clay, red	15	32
Sand, very fine to fine, reddish-brown	26	58
Sand, medium to very coarse, and gravel, brown	5	63
Shale, red (bedrock)	7	70
(Test-hole 49) 11N-16W-26bbb. 60 feet east and 8 feet south of NW cor. Altitude, 1,431. Water level, 10 feet.		
Clay and silt, brown	11	11
Sand, fine to medium, brown	7	18
Clay, reddish-brown	4	22
Sand, fine to medium, and clay, reddish-brown	7	29
Clay, contains fine sand, brown	9	38
Sand, medium to very coarse, and a trace of clay and gravel, brown	10	48
Clay, red	5	55
Shale and gypsum (bedrock)	5	60

	Thickness (feet)	Depth (feet)
(Test-hole 50) 11N-16W-22dcd. 8 feet north of road-center line and 60 feet east of tree line south of road. Altitude, 1,432. Water level, 7 feet.		
Silt, very fine sand, and clay, reddish-brown	10	10
Clay, brown	7	17
Sand, medium to very coarse, silt, and clay, brown	12	29
Shale and gypsum, red (bedrock)	7	36
(Test-hole 51) 11N-16W-27aba. 12 feet north of corner of cotton field and wheat pasture. Altitude, 1,445. Water level, 21 feet.		
Sand, fine to medium, and silt, reddish-brown	5	5
Clay and silt, reddish-brown	10	15
Sand, fine to very coarse, and gravel, reddish-brown	4	19
Sandstone, shale, and gypsum, red and white (bedrock)	6	25
(Test-hole 52) 12N-16W-30dbc. 150 feet south of south river bank, near N.-S. half-section line. Altitude, 1,466. Water level, 15 feet.		
Silt, clay, and fine sand, brown	15	15
Sand, fine to medium, and trace of coarse, buff	5	20
Sand, medium to very coarse, and gravel, buff	4	24
Clay, red	6	30
Shale, soft, red (bedrock)	5	35
Shale and gypsum, red and white	5	40
(Test-hole 53) 12N-16W-30dcb. 0.1 mile south of test-hole 52. Altitude, 1,467. Water level, 15 feet.		
Silt, and very fine sand, brown	12	12
Sand, medium to coarse, and clay, brown	3	15
Sand, medium to coarse, brown	5	20
Sand, coarse to very coarse, and gravel, brown	4	24
Clay, red	10	34
Sand, coarse to very coarse, gravel, and clay, brown	6	40
Clay, red	4	44
Gypsum and shale, white to brown (bedrock)	4	48

	Thickness (feet)	Depth (feet)
(Test-hole 54) 12N-16W-30dcc. 40 feet north and 10 feet west of field gate near intersection of section-line fence and Washita River. Altitude, 1,469. Water level, approximately 15 feet.		
Silt, clay, and fine sand, brown	5	5
Clay, and silt, reddish-brown	5	10
Clay, red	5	15
Clay and trace of fine to coarse sand, brown	5	20
Clay, brown and reddish-brown	31	51
Clay and fine sand, brown	7	58
Sand, fine, and clay, gray	3	61
Sand, fine to very coarse, gravel and clay, red and gray	3	64
Shale, red (bedrock)	4	68
Gypsum and shale	2	70
(Test-hole 55) 12N-16W-31abc. 60 feet south and about 200 feet west of barn. Altitude, 1,478. Water level, 17 feet.		
Silt, reddish-brown	15	15
Clay, red	59	74
Sand, fine to medium, brown	11	85
Sand, medium to very coarse, and trace of gravel and clay, brown	5	90
Sand, fine to medium, trace of gravel and clay, brown	9	99
Clay and fine to medium sand, gray-brown and red	12	111
Sand, fine to very coarse, gravel and clay, brown	4	115
Sand, fine to very coarse, and gravel, brown	5	120
Shale, red (bedrock)	7	127
(Test-hole 56) 12N-16W-31acb. About 0.3 mile south of section line on west edge of N-S field road near half-section line. Altitude, 1,481. Water level, 6 feet.		
Silt, brown	6	6
Clay, reddish-brown	55	61
Sand, medium to coarse, gravel, and clay, Brown	4	65
Shale, red (bedrock)	12	77
(Test-hole 57) 12N-16W-31acc. 8 feet north and 10 feet west of field gate near center of section. Altitude, 1,485.		
Silt, red	25	25
Shale, red (bedrock)	5	30

	Thickness (feet)	Depth (feet)
Test-hole 58) 8N-10W-15cdd. 120 feet west of field gate and 8 feet north of road-center line. Altitude, 1,198. Water level, 6 feet.		
Sand, very fine to fine, silty, brown	5	5
Clay, silt, and very fine sand, brown	5	10
Sand, very fine, and trace of clay, brown	10	20
Sand, very fine to fine, silty, reddish-brown	35	55
Sand, very fine to fine, silty, and clay, reddish-brown	25	80
Sand, fine, silty, reddish-brown	5	85
Shale, red and gray (bedrock)	5	90
(Test-hole 59) 8N-10W-15ccc. 6 feet east of asphalt road parallel to highway, and 30 feet north of small bridge. Altitude, 1,204. Water level, 10 feet.		
Sand, fine, silty, and clay, brown	25	25
Sand, very fine to fine, and silt, brown	30	55
Sand, very fine to fine, silt, and clay, reddish-brown	53	108
Shale, red and gray (bedrock)	3	111
(Test-hole 60) 8N-10W-16dcd. 50 feet west and 10 feet north of intersection of quarter line with section-line fence. Altitude, 1,201.		
Sand, very fine to fine, silty, dark-brown	5	5
Sand, very fine to fine, silt, and clay, brown and red	22	27
Shale and siltstone, soft, red, and gypsum, white (bedrock)	23	50
(Test-hole 61) 12N-10W-5abb. 30 feet west and 5 feet south of SW cor. of bridge. Water level, 15 feet.		
Silt, reddish-brown	10	10
Clay, brown	59	69
Sandstone, red, and dolomite, white (bedrock)	6	75
(Test-hole 62) 12N-16W-5baa. 20 feet west and 8 feet north of second telephone pole west of bridge.		
Silt and clay, reddish-brown	6	6
Clay, reddish-brown	72	78
Siltstone and shale, red (bedrock)	2	80