

GROUND-WATER RESOURCES OF THE ARKANSAS
VALLEY IN FORD COUNTY, KANSAS

by

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Groundwater resources of the Arkansas Valley in Ford
County, Kansas

By
Herbert A. Waite

*Subsequently, the City of
Wichita joined as a cooperating
agency in the "Equus Beds"
groundwater project.*

Introduction

In July, 1937, groundwater investigations were begun in Kansas by the Geological Survey, United States Department of the Interior, in cooperation with the Kansas Geological Survey, Dr. R. C. Moore, State Geologist, and with the Division of Sanitation of the Kansas Board of Health, Prof. Earnest C. Boyce, Chief Engineer. Work was begun in the "Equus Beds" area of south-central Kansas by D. G. Thompson and S. W. Lohman of the United States Geological Survey.

It was ^{planned} ~~Dr. Moore's~~ intention that work be started in western Kansas as soon as studies of critical areas in south-central Kansas had been completed. However, numerous inquiries were received in regard to the possibilities of utilizing groundwater for irrigation in parts of southwestern Kansas, as an aftermath of several years of severe drought. Accordingly, S. W. Lohman was instructed to make a brief investigation in Ford County, Kansas, in November, 1937, in order to determine the nature and extent of recent developments of water supplies from wells on the uplands of that county, and to determine what additional studies should be made in the near future. After a brief field investigation the following recommendations were made:

*by the United States Geological Survey
Kansas Geological Survey*

"A general investigation of ground-water conditions should be made that will cover not only Ford County, but also as much of the territory adjoining as is necessary to make an adequate interpretation of the geologic and hydrologic conditions in each locality as to occurrence, depth, and yield of the water-bearing beds and the depth to the static water level, and to determine so far as possible the safe yield of the water-bearing formation.

"A program of water-level measurements should be begun immediately to obtain observations before there is any significant change from natural conditions undisturbed by pumping for irrigation. The measurements should be continued in subsequent years and records should be obtained of the quantities of ground/water that are pumped each month or year, in order to determine the trends in movement of water level resulting from irrigation and to check preliminary conclusions as to the safe yield of the water-bearing formations. There is at present so little use of ground water for irrigation in Ford County and the adjacent territory that an unusual opportunity is offered to determine hydrologic conditions as unaffected by artificial withdrawal."

/ Lohman, S. W., Water supplies from wells available for irrigation in the uplands of Ford County, Kansas: Kans. Geol. Survey Min. Res. Circ. 9, p. 9, 1938.

In accordance with the above recommendations, the writer was assigned to the area October 1, 1938. A program of periodic water-level observations was begun immediately and about 30 wells were selected at strategic points over the entire county.

In October, 1938, shortly after the work began, an inter-agency conference was held in Dodge City in order to coordinate the efforts of Federal and State agencies that are concerned with problems relating to the water resources of western Kansas. Those present included R. C. Moore, State Geologist, H. P. Burleigh and J. S. Reger, of the Bureau of Agricultural Economics, United States Department of Agriculture, W. N. White, S. W. Lohman, and H. A. Waite, of the Geological Survey, United States Department of the Interior, Robt. V. Surha and Kenneth McCall, of the Division of Water Resources, State Department of Agriculture, and Roger Stewart, of the Farm Security Administration, of the United States Department of Agriculture. At this meeting the support of each State and Federal agency was pledged to the investigation being conducted by the Bureau of Agricultural Economics in planning a land-use program in the Arkansas Valley in western Kansas and eastern Colorado. Mr. H. P. Burleigh outlined the type of investigation that his organization desired and stressed the necessity of having the investigation completed as soon as possible in order that a preliminary report might be completed early in February, 1939. The writer was made responsible for that part of the Arkansas Valley that lies in Ford County. The present report, therefore, concerns that part of the Arkansas Valley that lies in Ford County.

The work was done under the general supervision of G. E. Meinzer, geologist in charge of the Division of Ground Water, of the Federal Geological Survey, and under the immediate supervision of S. W. Lohman, geologist in charge of ground-water investigations in Kansas. Through the courtesy of Mr. Burleigh, several members of the Bureau of Agricultural

Economics were assigned to assist in the work: Oliver Basinger, who assisted in the well inventory; J. L. Jones and C. J. Borden, who ran several lines of instrumental levels; and Tom Steele, who spent one day with the writer. Mr. Bruce Latta spent 4 days assisting in the inventory of wells. Mr. Walter N. White, engineer in charge of ground-water investigations in Texas, who is well acquainted with ground-water conditions on the High Plains in several states, offered many valuable suggestions in regard to the work.

Special acknowledgment is due to Fred Moon, Irrigation Specialist, Kansas Power Company, Dodge City, for giving freely of his time and knowledge of the area, for accompanying the writer in the field during much of the well inventory, and for assisting in compiling pumpage estimates on all electrical installations in the area; and to ~~Mr.~~ Fred Kirkpatrick, City Engineer, for furnishing a linen man of the City and for placing his office facilities at the disposal of the writer.

Acknowledgment for helpful information is also due especially to the following persons: State Senator J. C. Denious and Jay Baugh, Dodge City Daily Globe; Frank Dunkley, ^{member of the Kansas Mineral Industries Council,} secretary of the Dodge City Chamber of Commerce, and secretary of the Special Irrigation Committee of that organization, and C. C. Isely, chairman of the same Committee; P. H. Browne, of the Johnston Pump Company, Dodge City; Glenn Faulkner, County Engineer; Rex Reynolds, City Water Commissioner; A. M. Truman, Division Engineer, and Dave Kriegh, Draftsman, both of the Atchison Topeka and Santa Fe Railway offices at Dodge City; H. I. Christensen and Frank Westerman, of the Kansas Power Company's plant near Fort Dodge; E. E. Vance, Engineer in Charge of the Power Plant at the Kansas Soldiers Home at Fort Dodge; U. G. Balderston, Dodge City; Tom Stauth, Jim Johnson, Oscar Johnson, Shannon Johnson, J. R. Maas, Joseph F. Bauer and Roy Curry, drillers in the area; and to all of the well owners who kindly furnished helpful information concerning their wells.

Geology and ground/water conditions

Outline of geologic formations.- The geology of the Arkansas Valley in Ford County has been discussed in a general way in several earlier reports.

/ Lohman, S. W., Water supplies from wells available for irrigation in the uplands of Ford County, Kansas: Kans. Geol. Survey, Mineral Resources Circular 9, pp. 2, 3, 1938.

Smith, Harold T. U., Preliminary notes on Pleistocene gravels in southwestern Kansas: Kans. Acad. Sci., ~~Transactions~~ ^{U.S.}, Vol. 40, pp. 283-291, 1937.

The principal deposits in the area consist of the following: the alluvium, dune sand, terrace gravel, and loess, chiefly of Pleistocene age, and the Ogallala formation, of Pliocene age.

These deposits are underlain throughout most of the area by Cretaceous sediments, consisting of the Greenhorn limestone, the Graneros shale, and the Dakota sandstone. The most prominent exposures of Cretaceous sediments are along the north side of the Arkansas River Valley, just west of Ford. Here the Dakota sandstone is exposed just north of ^{U.S.} Highway 154, and the Greenhorn limestone has been well exposed by quarrying operations about 3 miles west of the Dakota outcrop (in sec. 14, T. 27 S., R. 23 W.). The Dakota sandstone is also exposed in at least two places north of the river, in sec. 35, T. 27 S., R. 22 W. One of these outcrops is known locally as the "Point of Rocks"; the other is a rather prominent scarp of sandstone known locally as the "Black Pool", from a small pool of standing water at the base of the outcrop. The presence of Cretaceous sediments underlying the area is known in some places from the records of oil and water wells. The Graneros shale has been penetrated in a number of wells in Ford County, a few of which are in the Arkansas Valley. Several irrigation wells in the valley on the south side of the river, east of Ford, are reported to reach sandstone tentatively believed to be the Dakota. (See logs on pages 6 and 7).

Log of L. A. Lamb's irrigation well (Well 38) located about $\frac{1}{2}$ mile south of Ford, Kansas (Log by memory from J. R. Maas, driller).

SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 4, T. 28 S., R. 22 W.

	Thick- ness (feet)	Depth (feet)
Sandy loam	6	6
Sandy loam with hard, white, limy nodules	22	28
Sand, mixture of quicksand cemented with whitish-blue sticky clay	6	34
Gravel, medium to coarse, with intermixed yellow clay and occasional clay balls	44	78
Sandstone (Dakota?) at total depth of		78

Note: A blank casing was sunk 40 feet into water-bearing stratum after which a bell was put on and the casing put down an additional 10 feet to total depth.

Log of J. J. Maas' irrigation well (Well 40) located about $2\frac{1}{2}$ miles southeast of Ford, Kansas (Log by memory from J. J. Maas, driller),

SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 10, T. 28 S., R. 22 W.

Sandy loam top soil	7	7
Loam, mixed with gyp nodules & hard dirt (Water at 24 feet)	17	24
Gravel, medium to large	18	42
Clay, yellow layer	1	43
Gravel, medium to large	23	69
Sandstone, (Dakota?) at total depth of		69

Log of E. V. Melia's irrigation well (Well 41) located about 3 miles southeast of Ford, Kansas/ (Log by memory from J. R. Maas, driller).

SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 11, T. 28 S., R. 22 W.

	Thick- ness (feet)	Depth (feet)
Sandy loam	5	5
Soft-dirt loam, with white, limy nodules	16	21
Clay, soggy, blue to yellow. (Water at 26 feet)	5	26
Quicksand	7	33
Gravel, large-size (buckshot to pea size, minimum of big cobbles)	36	69
Shale, blue, sticky	2	71
Sandstone, (Dakota?)	1	72
Sandstone, fine wash, brownish-yellow	5	77
Total depth		77

Log of city well (Well 120) at Dodge City, Kansas.

SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 35, T. 26 S., R. 25 W.

Sand, fine	8	8
Sand and gravel	28	36
Rock with streaks of fine sand	7	43
Clay	3	46
Sand	5	51
Clay	7	58
Sand, fine	18	76
Clay	7	83
Sand and gravel	64	147

Logs of test wells put down in the vicinity of the
 Kansas Power Co.'s plant in the NE $\frac{1}{4}$ sec. 4, T. 27 S., R.24 W.

8.

Test 1	Thickness (feet)	Depth (feet)
Top soil	1	1
Fine sand	2	3
Coarse sand	16	19
Medium sand and "magnesia"	9	28
Hard "magnesia" and clay	4	32
Hard "magnesia", clay and fine sand	52	84
Medium sand and "magnesia"	11	95
Coarse sand and "magnesia"	10	105
Coarse sand, gravel and "magnesia"	20	125

Static water level 5.5 feet.

Test 2	Thickness (feet)	Depth (feet)
Top soil	1	1
Fine sand	4	5
Coarse sand and gravel	13	18
Clay and fine sand and "magnesia"	12	30
Do.	8	38
Fine sand; streaks of "magnesia"	12	50
Clay and fine sand	1	51
Very hard "magnesia" and sandstone	2	53
Fine sand and "magnesia"	7	60

Static water level 5.5 feet.

Test 3	Thickness (feet)	Depth (feet)
Top soil	1	1
Fine sand	4	5
Coarse sand and gravel	13	18
Very hard "magnesia"	10	28

Static water level 5.25 feet.

Test 4	Thickness (feet)	Depth (feet)
Gumbo	2	2
Coarse sand and gravel	15	17
Very hard "magnesia"	8	25
Clay and "magnesia"	4	29
Fine sand and "magnesia"	29	58

Static water level 4 feet

Test 5	Thickness (feet)	Depth (feet)
Top soil	2	2
Coarse sand and gravel	15	17
"Magnesia"	11	28
Fine sand, "magnesia" and clay	22	50
Coarse sand and gravel	10	60

Static water level 5 feet.

Test 6	Thickness (feet)	Depth (feet)
Top soil	2	2
Gravel and coarse sand	16	18
"Magnesia"	2	20

Static water level 5 feet

Test 7	Thickness (feet)	Depth (feet)
Top soil	2	2
Clay balls	6	8
Gravel and coarse sand	16	24
"Magnesia"	2	26

Static water level 5.7 feet

Test 24	Thickness (feet)	Depth (feet)
Sand, fine	2	2
Sand, coarse, and some gravel	16	18
"Magnesia", fine sand and hard clay	74	92
Sand, coarse, "magnesia" and clay	20	112
Gravel and coarse sand, "magnesia" and clay	6	118
Sand, coarse, "magnesia" and clay	4	122
Sand, coarse, gravel and clay	20	142

Static water level 5 feet

Test 25	Thickness (feet)	Depth (feet)
Top soil	2	2
Sand, coarse, and gravel	16	18
Sand, fine, and "magnesia"	32	50
Sand, fine, "magnesia" and clay	41	91
Sand, coarse, and gravel, "magnesia", and clay	17	108
Sand, medium	9	117
Sand, coarse, gravel and "magnesia"	5	132
Sand, medium	8	140
"Magnesia"	1	141

Static water level 5 feet

Test 26	Thickness (feet)	Depth (feet)
Top soil	2	2
Sand, fine	6	8
Sand, coarse, and gravel (water)	10	18
Clay balls	40	58
Sand, medium	22	80
Sand, coarse, gravel, "magnesia" clay (water)	19	99
"Magnesia", very hard, "streaked"	1	100
Sand, coarse, and gravel (water)	9	109
"Magnesia", very hard, "streaked"	1	110
Sand, coarse, gravel, "magnesia", clay (water)	20	130
Magnesia, very hard	0.5	130.5
Sand, medium, and "magnesia"	7.5	138
Bottom rock		138

Static water level 4.6 feet

Test 27	Top soil	3	3
	Sand, medium	7	10
	Sand, coarse, and gravel	14	24
	"Magnesia" and clay	12	36
	Sand, very fine (quick)	27	63
	Sand coarse, gravel and "magnesia"	12	75
	Sand, coarse, gravel and "magnesia"	66	141
	"Magnesia"	9	150
	Rock	3	153

Static water level 8.3 feet

Test 28	Top soil	3	3
	Sand, coarse, and little gravel	21	24
	"Magnesia" and fine sand with clay	8	32
	Sand, fine, packed	18	50
	Clay and "magnesia", hard	8	58
	Sand, fine	2	90
	Sand, coarse, (medium)	25	115
	Sand, fine, clay and "magnesia"	8	123
	Sand, coarse	17	140
	Sand, fine and "magnesia"	3	143
	Sand, coarse, streaked with "magnesia"	13	156

Test 29	Thickness (feet)	Depth (feet)
Soil	2	2
Clay	4	6
Sand and gravel	17	23
Clay	19	42
Sand, fine with streaks of clay	21	63
Sand and gravel	8	71
Clay	4	75
Sand and gravel	8	83
Clay	2	85
Sand and gravel	67	142
Clay	1	143
Rock, hard	1	144

Test 30	Thickness (feet)	Depth (feet)
Soil	3	3
Sand and gravel	15	19
"Magnesia" rock	4	23
Clay	10	33
Fine sand	12	45
Sand, fine with clay streaks	15	60
Sand and gravel	11	71
Rock	8	79
Sand and gravel	4	83
Rock, hard	2	85
Sand and gravel	66	151

Test 31	Thickness (feet)	Depth (feet)
Clay	2	2
Sand and gravel	18	20
"Magnesia" rock	6	26
Clay	12	38
Sand, fine	10	48
Clay	3	51
Sand, coarse	11	62
Sand and gravel	6	68
Clay	2	70
Sand and gravel	84	154

Logs of abandoned city wells in Wright Park at Dodge City, Kansas.

NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T. 26 S., R. 25 W.
(West well)

	Thickness (feet)	Depth (feet)
Sand	24	24
Clay	8	32
Sand	12	44
Sandy clay	27	71
Clay	19	90
Sand	7	97
Clay	8	105
Gravel	3	108
Hardpan	2	110
Gravel (2nd-water gravel)	25	135

(East Well)

First water	26	26
Clay	35	61
Sand	8	69
Clay	23	92
Sand	5	97
Clay	9	106
Cement rock	4	110
Gravel (2nd-water gravel)	23	133

Log of irrigation well 23 located at the Kansas Soldiers Home,
Fort Dodge, Kansas

SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 27 S., R. 24 W.

Soil	2	2
Clay	10	12
Sand and gravel	15	27
Clay and "magnesia"	11	38
Sand, fine	19	57
Clay	3	60
Sand, fine	10	70
Sandy clay	8	78
Sand	8	86
Muck	4	90
Sand and gravel	31	121
Sand, packed	6	127
Sand and gravel	3	130
Clay	5	135
Sand, coarse	19	154

Total depth with plug, 153 feet
Driller: L. B. Byassee.

Alluvial deposits.- The alluvial sands and gravels comprising the floodplain of the Arkansas River are the most extensive deposits of the area under discussion and are the most productive source of water. Most of the irrigation wells in the valley obtain supplies from these deposits. The alluvium of the Arkansas Valley consists of silts, sands, and gravels that were deposited in the old valley cut by the Arkansas River. The sediments accumulated over a long period of time during which the channel shifted laterally several times, and it is believed that some deposition is still taking place. The thickness of the alluvium ranges from a few feet to 100 feet or more. The upper part of the valley fill is believed to be of Recent age. Smith suggests that in some places the basal

/ Iden, pp. 287.

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 part of the fill may possibly be of Tertiary age, and that "much of the fill, however, may well be of Pleistocene age, either contemporaneous with or younger than the terrace deposits." The basal "rock" reported in some of the driller's logs of test wells in the valley near Fort Dodge (see logs on pages 8 to 12) may possibly be of Ogallala age. In the log of an abandoned city well in Wright Park at Dodge City, (page 12) "cement rock", 4 feet in thickness, is reported at a depth of 110 feet, and this is underlain by 23 feet of "water gravel". Moreover, a well drilled by Tom Stauth on the south side of the river at Dodge City in October 1938 encountered hard rock at a depth of 117 feet. This well was drilled for A. J. Kline for a domestic supply in the NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 26 S., R. 25 W. (see log page 14). If described

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Log of A. J. Kline's 4-inch domestic well located on the south side of the river at Dodge City. (Log furnished by Tom Staath, driller).

NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 26 S., R. 25 W.

	Thickness (feet)	Depth (feet)
Soil	3	3
Sand, dry, mealy	4	7
Gravel	4	11
Clay	2	13
Gravel	4	17
Clay	1	18
Water gravel	4	22
Clay, streak	3	25
Water sand	4	29
Clay formation	61	90
Gravel, good	12	102
Quick sand	2	104
Water gravel	13	117
Hit rock (good and hard) at total depth		117

Static water level, 7 feet.

Log of Henry Hattrup's irrigation well (Well 44) located in the Arkansas Valley near the east county line. (Log by memory from the owner.)

SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 23, T. 26 S., R. 21 W.

	Thickness (feet)	Depth (feet)
Top soil	3	3
Sand, fine and dry	2	5
Gravel, dry	5	10
Gravel, water-bearing, good, medium to coarse	7	17
Sandy clay, fine	2	19
Gravel	10	29
Total depth 29 feet		

Log of W. A. Wetzel's irrigation well (Well 45) located in the Arkansas Valley near the east county line. (Log by memory from the owner.)

SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 25, T. 26 S., R. 21 W.

Sandy loam	4	4
Sand and gravel, dry	6	10
Sand and gravel, coarse, water-bearing	15	25
Sand, maximum of fines	13	38
Total depth 38 feet		

correctly, there is some evidence that this material may be ^{long in} the Ogallala formation. Additional information on the thickness of the alluvium and the character of the underlying material must be obtained before the age of the lower material can be determined.

There appears to be a marked difference in quality between the "first" and "second" waters in the valley, - the water in the upper part of these deposits is much harder than that in the lower part. Drillers and well owners in the area report the occurrence of a very persistent bed of clay, 20 to 40 feet thick, that separates the two waters; ^{this clay bed is} generally ~~being~~ encountered just below the upper water-bearing gravel.

At the present time the upper and lower waters stand at different levels, as determined from measurements of water level in both shallow and deep wells at two pumping plants about 2 miles east of Dodge City. At Well 210, measurements of static level in a deep well and shallow well located about 5 feet apart in the same pump pit indicated that on October 25, 1938, the water level in the shallow well stood 2.37 feet higher than the water level in the deep well. The shallow well was 12 inches in diameter and approximately 28 feet deep, whereas the deep well was 8 inches in diameter and about 125 feet deep. Similar measurements on October 25, 1938, at Well 207 revealed that the water in the shallow well stood about 2.39 feet higher than that in the deep well. Both of these wells are located in places that may be affected by heavy pumpage from deep wells located at Dodge City and in the vicinity of Fort Dodge.

✓ According to reports of drillers and residents of the area, the "second" water formerly stood slightly higher than the upper shallow water, although no measurements are available to prove these reports. It is possible that the heavy draft on the lower water-bearing beds created by municipal and industrial pumpage in and near Dodge City, together with heavy industrial pumpage at the Kansas Power Company's plant, 4 miles east of Dodge City, the pumping for irrigation at the two irrigation wells at the Kansas Soldiers Home at Fort Dodge, and from several deep irrigation wells in the area, has gradually lowered the head of the so-called "second" water. If so, it is highly important to make periodic water-level measurements in several deep wells in the area over a period long enough to ascertain whether there is a persistent downward trend, and if so to make some provision for reducing this decline in the future. With this in mind, at least two deep wells have been included with the wells selected for periodic water-level observation in the area. (See discussion on page 39.)

✓ The depth at which the "second" water is encountered in wells appears to increase toward the west. According to Oscar Johnson, a local driller, two wells drilled at Fort Dodge encountered the "second" water 90 feet below the "first" water. At Dodge City a well drilled by him encountered the "second" water at a depth of 100 feet below the "first" water. At Howell, near the west county line, the "second" water was encountered at a depth of 140 feet below the "first" water. Gravel was not encountered in wells at Cimarron at the horizon of the

"second" water and little or no water was found. Mr. Johnson reports that in most places larger yields are obtainable from the "second" water than from the upper shallow water. A well drilled by Mr. Johnson at Cimarron had a reported yield of only about 20 gallons a minute from the "second" water. Shale was reported at a depth of 180 feet in ^{this well} it. According to him, shale was reported at a depth of 180 feet in a deep well just east of the old plant of the Kansas Power Company in Dodge City. A flow of salt water at a depth of 650 feet was reported to have been sufficiently strong to lift the tools in the hole. This well was drilled to a total depth of about 980 feet, but no written log is available.

Dune sand.- Dune sand occurs in a belt of variable width that borders the south side of the Arkansas River throughout ^{Ford} ~~the~~ County. J.?
 The sand of these dunes ^{was} ~~were~~ probably derived from the floodplain of the river by prevailing northerly winds. One small area of dunes is found on the north side of the river north of Ford. Smith suggests that the dunes

/ Op cit. Ref. not clear. Smith??

on the north side of the river may have been derived from the underlying Tertiary (?) deposits, ^{and} this conclusion is in accord with the views of the writer. Smith believes that the dunes are of early Pleistocene age. Conditions for recharge of ground water appear to be very favorable in the area covered by this mantle of fine ^{dune} sand. As concluded by Slichter

/ Slichter, C. S., The underflow of the Arkansas Valley: U. S. Geol. Surv. Water-supply Paper No. 153, 1906.

the winds actually from mostly? prevailing winds from SW. RCM

"On the sandy bottom lands 60 percent of an ordinary rain reaches the water plane as a permanent contribution." It appears likely that a high percentage of the rainfall over the sandhills area reaches the water table as a permanent contribution.

Terrace gravel.- Deposits of fairly coarse gravel are found in a dissected terrace bordering the south side of the Arkansas River at a height of about 15 feet above the level of the floodplain. Several commercial gravel pits have been opened in these deposits in the area, notably on the south side of the river at Dodge City. Smith assigns these gravels to the Pleistocene and states that their topographic position and lithologic character strongly suggest post-Tertiary erosion and deposition.

Loess.- Although loess is not an important formation in the Arkansas Valley proper, its presence as a surficial mantle both north and south of the Arkansas River is noteworthy, particularly in analyzing the effect of rainfall penetration in these bordering areas. It is quite likely that the alluvium of the Arkansas Valley contains some reworked loess derived from the adjoining slopes. Smith suggests that loess of several different ages may be present in Ford County.

Ogallala formation.- The Ogallala formation is well exposed along the north side of the valley throughout the county. In some places south of the river the Ogallala is obscured by the sandhills and in other parts of the area it is covered by a thick mantle of loess.

missed

The "mortar beds" are well exposed on the north side of the river and as they are very resistant to erosion, they generally form abrupt bluffs. The Ogallala formation consists of interbedded clays, silts, sands and gravels, which in places have been cemented with ~~lime~~ ^{calcium carbonate} to form hard resistant layers. The degree of cementation, the thickness, and the persistence of particular beds range widely and there appears to be little uniformity in the formation as a whole. The harder, more indurated beds of the Ogallala generally occur in the upper part of the formation, in which lime cementation has been active, and in general the coarser, unconsolidated gravels and sands occur near the base of the formation. The base of the Ogallala formation probably lies well below the level of the valley floor in most parts of the area, except for a few places in the vicinity of Ford where there are isolated hills of the Dakota sandstone and the Greenhorn limestone.

The Ogallala formation probably attains thicknesses up to 150 feet along the Arkansas Valley in Ford County, although no actual measurements of thickness were made in the field. Smith suggests that "apparently"

/ Smith, Harold T. U., Memorandum on the geology of Ford County: Memorandum prepared especially for the benefit of the writer and based on field notes, October, 1938.

a pre-Ogallala divide passes through northern Clark or southern Ford County. The present Arkansas Valley may correspond roughly to a pre-Ogallala valley." If so, this would strengthen the suggestion made earlier in regard to the possibility that the Ogallala formation may actually be the source of the so-called "second" water in the Arkansas Valley. The alluvium of the Arkansas Valley in Ford County is confined

presumably by Ogallala sediments, with the exception of the Cretaceous "high" areas in the vicinity of Ford, consequently there may be some intermingling of the waters contained in the shallow valley fill with those in the deeper Ogallala gravels except in places where persistent beds of clay may intervene.

Profile sections. - In order to determine the direction of movement of the ground water with respect to the Arkansas Valley and the gradient of the water table, the three profile sections shown in figure 2 were constructed. The locations of these sections are shown in figure 1. The altitudes of measuring points at several wells and at all of the streams along each profile section were determined by instrumental levels from bench marks of the United States Coast and Geodetic Survey. These lines were chosen to intersect the largest possible number of wells and also to parallel, so far as possible, existing lines of bench marks. For this reason the profile sections do not cross the Arkansas Valley at exactly right angles, as desired, and any rigorous interpretation of these sections must take into account this slight deviation from a right angle.

The longest section, line A-B, parallels a section line about 5 miles east of Dodge City and extends from a point just north of the Hodgeman County line to Bloom, about one mile north of the Clark County line. This section is based on measurements at 6 wells north of the river, one well south of the river at Bloom, and on the altitudes of the water surfaces of Sawlog Creek and of the Arkansas River. Section A-B shows a definite ground-water divide about $4\frac{1}{4}$ miles north of the Arkansas

River that conforms approximately to the surface divide. The water table at the divide stands about 25 feet higher than the water surface of the Arkansas River, indicating a gradient toward the river of about 5.9 feet to the mile. The water surface in Sawlog Creek was found to stand 84.6 feet lower than that of the Arkansas River. The water table at Bloom, south of the river, stands approximately 5 feet lower than the water surface in the Arkansas River. No wells could be found between these two points, which could be measured, to determine whether a ground-water divide is also present on the south side of the valley. According to ~~M~~ Oliver Basinger, Bureau of Agricultural Economics, there appears to be a ground-water divide south of the river near Garden City, and it is possible that a similar divide will be found in Ford County when sufficient data are available.

The two shorter profile sections cross the valley just west of Dodge City (line C-D) and at Howell (line E-F). Measurements of water level were made in 8 wells along line C-D and in 3 wells along line E-F. These two sections show that water moves toward the valley from the north, but sufficient evidence is not available to definitely determine the direction of movement south of the river.

Fluctuations of the water table. - The water table in the Arkansas Valley rises in response to replenishment from several sources, including rainfall penetration on the sandy, flood plain, or bottom lands, the underflow down the valley and from the sides and seepage from the river. The Arkansas River has no tributaries that bring in surface water between

Lakin and the eastern edge of Ford County.

There are numerous factors controlling the decline of the water table in the Arkansas Valley, including the amount of water pumped from wells, the amount of water lost from the valley by plant transpiration and by evaporation, and the amount of water lost from the valley as underflow. In dry years ~~there is less water~~ ^{smaller quantities of} ~~are~~ ^{are} supplied to the underflow of the Arkansas Valley from rainfall penetration, and the losses by transpiration and evaporation are higher, calling for heavier draughts on the ground/water reservoir through increased pumpage from irrigation wells. Conversely, during wet years, the amount of water supplied to the underflow by rainfall and (losses from the Arkansas River) is increased, the losses from transpiration and evaporation are less, and the pumpage from irrigation wells is not as great.

not clear?

At the start of the present investigation approximately 37 wells ~~were~~ located at strategic points in Ford County ~~and~~ ^{were selected for making} periodic measurements of water levels, ~~in them were begun~~ ^{in order} to obtain information in regard to the fluctuation of the ground/water reservoir in the area. Of this number, 23 are located in the Arkansas Valley. The wells were measured twice monthly during the period of the field investigation. Beginning January 1939, they are to be measured monthly. Automatic water-stage recorders have been installed over three wells in Ford County. Two of these instruments are located on deep wells in the uplands, - the other is located in the Arkansas Valley, about one mile east of Fort Dodge. All semi-monthly measurements to date of the water levels in each of the 22 wells located in the valley are given on pages 26 to 30. At least 6 measurements of water level were made in most of these wells during

the period from October, 1938, to January 1, 1939. The minimum daily water levels taken from the recorder charts of the recorder well in the valley (Well 21) are tabulated on page 31.

The period of record is far too short to warrant an accurate interpretation of the fluctuations in water levels or to predict what may be the maximum range in fluctuation. The value of water level measurements is in direct proportion to the length and continuity of the records.

In the 7 observation wells in which the water levels stood less than 10 feet below the land surface, the maximum observed fluctuation was 1.25 feet (Well 4, which was pumped considerably in the fall of 1938) and the minimum fluctuation was 0.06 foot. There were net rises in water level in four of these wells and net declines in three wells.

In the eight observation wells in which the water levels stood 10 to 20 feet below the land surface, the maximum observed fluctuation in water level was 1.16 feet and the minimum was 0.02 foot. In six of the eight wells the maximum fluctuation in water levels was less than 0.05 foot. In six of these wells there were net gains of 0.2 to 0.38 foot, in one there was a net decline of 0.14 foot, and in the other well there was no net change.

In the four observation wells in which the water levels stood 20 to 30 feet below the land surface the maximum fluctuation was 0.81 foot, and the minimum was 0.16 foot. Net rises in water level of 0.16 to 0.77 foot were recorded at all of these wells.

In the one observation well in which the depth to water was between 30 and 40 feet, the maximum fluctuation and net rise in water level was 0.92 foot.

In the one observation well in which the depth to water was between 50 and 60 feet, the maximum fluctuation and net decline was 0.07 foot.

In the one observation well in which the depth to water was between 60 and 70 feet, the maximum fluctuation in water level was 0.15 foot and the net decline was 0.02 foot.

Semi-monthly water-level measurements in observation wells in the Arkansas Valley in Ford County, Kansas.

1. Albert Miller, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 16., T. 26 S., R. 26 W. Drilled well, diameter 16 inches, depth 23.1 feet. Measuring point - top of concrete curb, level with land surface.

Date	Depth to water (feet)	Date	Depth to water (feet)	Date	Depth to water (feet)
Oct. 5, 1938	7.35	Nov. 15, 1938	7.62	Jan. 3, 1939	7.24
Oct. 19, 1938	----	Dec. 2, 1938	7.54		
Nov. 1, 1938	7.71	Dec. 15, 1938	7.20		

4. Morris H. Thompson, NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 21, T. 26 S., R. 26 W. Drilled well, diameter 20 inches, depth 22.75 feet. Measuring point - top of round concrete curb, W. side, 0.4 feet above land surface.

Oct. 22, 1938	7.37	Nov. 15, 1938	8.62	Dec. 15, 1938	7.48
Nov. 1, 1938	----	Dec. 2, 1938	----	Jan. 3, 1939	7.74

3. Ward Byers estate, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 21, T. 26 S., R. 26 W. Drilled well, diameter 16 inches, depth 186.7 feet. Measuring point - top of round concrete cover, 1 foot above land surface.

Oct. 21, 1938	17.66	Nov. 15, 1938	17.73	Dec. 15, 1938	17.64
Nov. 1, 1938	17.66	Dec. 2, 1938	17.72	Jan. 3, 1939	17.46

6. Andrew Bogner, NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 22, T. 26 S., R. 26 W. Drilled well, diameter 20 inches, depth 26.7 feet. Measuring point - top of 1-inch hole in wooden platform, 1 foot above land surface.

Oct. 21, 1938	8.76	Nov. 15, 1938	8.96	Dec. 15, 1938	9.07
Nov. 1, 1938	8.85	Dec. 2, 1938	9.06		

13. Mrs. R. E. P. gton, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T. 27 S, R. 26 W. Drilled well, diameter 20 inches, depth 86.1 feet. Measuring point - top of 20-inch casing south side, 1.5 feet above land surface.

Date	Depth to water (feet)	Date	Depth to water (feet)	Date	Depth to water (feet)
Oct. 24, 1938	56.13	Nov. 15, 1938	56.16	Dec. 15, 1938	56.18
Nov. 1, 1938	56.14	Dec. 2, 1938	56.17	Jan. 3, 1939	56.20

54. John A. Matthews, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 29, T. 26 S., R. 25 W. Drilled well, diameter 36 inches, depth 19.45 feet. Measuring point - top of 36-inch galvanized iron casing in east side of pit, 7.4 feet below land surface.

Oct. 21, 1938	3.34	Nov. 15, 1938	3.00	Dec. 15, 1938	2.67
Nov. 1, 1938	3.14	Dec. 2, 1938	2.92	Jan. 3, 1939	2.56

14. Bert Johnson, SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30, T. 26 S., R. 25 W. Drilled well, diameter 16 inches, depth 165 feet. Measuring point - top of 16-inch galvanized iron casing in concrete pit, 13 feet below land surface.

Oct. 21, 1938	5.34	Nov. 15, 1938	5.28	Dec. 15, 1938	5.02
Nov. 1, 1938	5.34	Dec. 3, 1938	5.17	Jan. 3, 1939	4.97

17. John N. Clark, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33, T. 26 S., R. 25 W. Drilled well, diameter 16 inches, depth 166 feet. Measuring point - top edge of rectangular break in pump head, 1 foot above land surface.

Oct. 22, 1938	pumping	Nov. 1, 1938	17.92	Dec. 15, 1938	17.72
Oct. 24, 1938	17.99	Nov. 15, 1938	17.90	Jan. 3, 1939	17.67
		Dec. 2, 1938	17.93		

20. Ralph Williams, NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 10, T. 27 S., R. 25 W. Drilled well, diameter 40 inches, depth 97 feet. Measuring point - top of channel iron sill under pump, 0.75 foot above land surface.

Oct. 14, 1938	62.22	Nov. 15, 1938	62.20	Dec. 15, 1938	62.35
Nov. 1, 1938	62.25	Dec. 2, 1938	62.22	Jan. 3, 1939	62.24

103. F. H. Diehl, NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 34, T. 26 S., R. 24 W. Drilled well, diameter 20 inches, depth 23.5 feet. Measuring point - top of 20-inch concrete casing, north side, 0.8 foot above land surface.

Date	Depth to water (feet)	Date	Depth to water (feet)	Date	Depth to water (feet)
Oct. 5, 1938	7.19	Nov. 1, 1938	7.29	Dec. 15, 1938	7.18
Oct. 19, 1938	7.26	Nov. 15, 1938	7.29	Jan. 3, 1939	7.13
		Dec. 2, 1938	7.22		

197. H. Wilkinson, SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 32, T. 26 S., R. 24 W. Dug and drilled well, diameter 48 inches, depth 43.4 feet. Measuring point - top of rectangular concrete pit, 1.5 feet above land surface.

Oct. 25, 1938	34.53	Nov. 15, 1938	34.17	Dec. 15, 1938	34.05
Nov. 1, 1938	34.25	Dec. 2, 1938	34.02	Jan. 3, 1939	33.61

204. Jess Staggs, NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T. 26 S., R. 24 W. Drilled well, diameter 12 inches, depth 33.1 feet. Measuring point - top of 2 X 12 inch plank across curb level with land surface.

Oct. 10, 1938	23.18	Nov. 1, 1938	22.90	Dec. 15, 1938	22.37
Oct. 20, 1938	23.15	Nov. 15, 1938	22.74	Jan. 3, 1939	22.79
		Dec. 2, 1938	22.48		

202. William R. Cook, NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 32, T. 26 S., R. 24 W. Drilled well, diameter 20 inches, depth 41.25 feet. Measuring point - top of window sill, east side of pump house, 0.8 foot above land surface.

Oct. 25, 1938	28.75	Nov. 15, 1938	28.38	Dec. 15, 1938	28.09
Nov. 1, 1938	28.60	Dec. 2, 1938	28.20	Jan. 3, 1939	27.98

210 B. O. N. Nevins, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 23, T. 26 S., R. 24 W. Drilled well (one of a battery of 5 wells, deep well in pump house) diameter 8 inches, depth 125 feet. Measuring point - top of 8-inch iron casing in pit, 9.3 feet below surface.

Oct. 25, 1938	12.09	Nov. 15, 1938	12.29	Dec. 15, 1938	11.65
Nov. 1, 1938	12.46	Dec. 2, 1938	11.30	Jan. 3, 1939	11.45

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~~210~~ O. N. Nevins, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 23, T. 26 S., R. 24 . Drilled well (one of a battery of 5 wells). Diameter 12 inches, depth 18.35 feet. Measuring point top of concrete ring in pump house, 9.0 feet below land surface.

Date	Depth to water (feet)	Date	Depth to water (feet)	Date	Depth to water (feet)
Oct. 25, 1938	9.52	Nov. 15, 1938	9.37	Dec. 15, 1938	9.22
Nov. 1, 1938	9.48	Dec. 2, 1938	9.28	Jan. 3, 1938	9.18

§1. G. D. Cochran, NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 16, T. 27 S., R. 23 W. Drilled well, diameter 20 inches, depth 20.55 feet. Measuring point - top of concrete cover, east half, 0.5 foot above land surface.

Oct. 20, 1938	10.16	Nov. 1, 1938	10.36	Dec. 15, 1938	10.08
Oct. 26, 1938	10.26	Nov. 15, 1938	10.14	Jan. 3, 1939	9.78
		Dec. 2, 1938	-----		

33. G. D. Cochran, SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 23, T. 27 S., R. 23 W. Drilled well, diameter 20 inches, depth 19.1 feet. Measuring point - top of square concrete curb, south side, level with land surface.

Oct. 26, 1938	7.85	Nov. 15, 1938	8.01	Dec. 15, 1938	7.96
Nov. 1, 1938	----	Dec. 2, 1938	8.03	Jan. 3, 1939	7.93

38. L. A. Lamb, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 4, T. 28 S., R. 22 W. Drilled well, diameter 20 inches, depth 77 feet. Measuring point - top of 20-inch concrete casing, south side, 1.0 foot above land surface.

Oct. 10, 1938	28.49	Nov. 1, 1938	28.61	Dec. 15, 1938	28.44
Oct. 20, 1938	-----	Nov. 15, 1938	28.46	Jan. 3, 1939	28.35
		Dec. 2, 1938	-----		

41. E. V. Melia, S. $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 11, T. 2^a S., R. 22 W. Drilled well, diameter 20 inches, depth 71 feet. Measuring point - top of concrete ring casing, west side, level with land surface.

Date	Depth to water (feet)	Date	Depth to water (feet)	Date	Depth to water (feet)
Oct. 27, 1938	25.85	Nov. 15, 1938	25.78	Dec. 15, 1938	25.74
Nov. 1, 1938	25.84	Dec. 2, 1938	25.73	Jan. 3, 1939	25.69

47. Warner Jochems, NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 2, T. 27 S., R. 21 W. Drilled well, diameter 22 inches, depth 28.85 feet. Measuring point - top of 24-inch oil barrel casing, north side, 0.9 foot above land surface.

Nov. 3, 1938	9.59	Dec. 3, 1938	9.57	Jan. 3, 1939	9.53
Nov. 15, 1938	9.57	Dec. 15, 1938	9.55		

44. Henry Mattrup, SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 23, T. 26 S., R. 21 W. Drilled well, diameter 34 inches, depth 29 feet. Measuring point - top of 34-inch casing, east side, 0.8 foot above land surface.

Oct. 28, 1938	10.46	Nov. 15, 1938	10.45	Dec. 15, 1938	10.45
Nov. 1, 1938	10.46	Dec. 3, 1938	10.44	Jan. 2, 1939	10.46

46. Geo. W. Molitor, SW $\frac{1}{2}$ NW $\frac{1}{4}$ sec. 36, T. 21 S., R. 21 W. Drilled well, diameter 24 inches, depth 29.8 feet. Measuring point - top of 24-inch casing, south side, 1.0 foot above land surface.

Oct. 5, 1938	12.78	Nov. 1, 1938	12.83	Dec. 15, 1938	12.87
Oct. 20, 1938	12.81	Nov. 15, 1938	12.85	Jan. 3, 1939	12.92
		Dec. 3, 1938	12.89		

Well 21. Judge Karl Miller. NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 2, T. 27 S., R. 24 W. Drilled well, diameter 16 inches, depth 21.5 feet. Measuring point, top of concrete block curb, east side, which is 0.2 foot above the land surface. Equipped with 7-day automatic water-stage recorder. Minimum daily water levels from recorder charts, in feet below measuring point.

Date	Water level (feet)	Date	Water level (feet)	Date	Water level (feet)
Nov. 2, 1938	11.48	Nov. 26, 1938	11.69	Dec. 20, 1938	11.60
3	11.50	27	11.70	21	11.59
4	11.51	28	11.69	22	11.59
5	11.55	29	11.70	23	11.59
6	11.57	30	11.71	24	11.59
7	11.58	Dec. 1, 1938	11.71	25	11.58
8	11.56	2	11.72	26	11.60
9	11.56	3	11.72	27	11.59
10	11.58	4	11.71	28	11.58
11	11.59	5	11.70	29	11.60
12	11.62	6	11.68	30	11.60
13	11.63	7	11.67	31	11.61
14	11.65	8	11.65	Jan. 1, 1939	11.62
15	11.65	9	11.64	2	11.61
16	11.64	10	11.63	3	11.61
17	11.65	11	11.63	4	11.62
18	11.65	12	11.62	5	11.62
19	11.65	13	11.61	6	11.60
20	11.65	14	11.60	7	11.60
21	11.65	15	11.58	8	11.58
22	11.64	16	11.59		
23	11.65	17	11.59		
24	11.66	18	11.59		
25	11.68	19	11.59		

Irrigation water supplies

During the course of the present investigation an inventory was made of the irrigation wells in the Arkansas Valley in Ford County, and estimates were obtained of the total pumpage and number of acres irrigated in 1938. The detailed records of all irrigation, industrial, and municipal wells are tabulated at the end of this report. The wells are classified by townships and are numbered consecutively, the numbers corresponding to the well numbers in plates 1, 2, 3, and 4. The locations of wells in Dodge City and in adjacent subdivisions are shown in plates 2, 3, and 4. The locations of all other wells in the Arkansas Valley in Ford County, Kansas are shown in plate 1.

Most of the water pumped was applied to feed-crops, consisting principally of sorghums, cane, kaffir, and sudan. Other crops irrigated from wells included wheat and other small grains, sugar beets, alfalfa hay, garden truck, and miscellaneous crops.

A total of 187 irrigation wells were visited. As shown in table 1, the total reported area irrigated from these wells in 1938 was 2,814 acres, an average of about $17\frac{1}{2}$ acres to the plant. Most of the irrigation pumping plants in the vicinity of Dodge City are small and supply tracts of only 1 to 10 acres. Many of the small plants in the city are used for gardens, trees and lawns, and hence acreage figures for these plants are correspondingly small. Some of the larger plants, of which there are approximately 60, irrigate more than 100 acres. Most of the larger plants pump water for irrigating feed crops, and also small grains, alfalfa and sugar beets.

Table 1. Summary of total acreage irrigated with water from wells in the Arkansas Valley, Ford County, Kansas, listed by townships.

Township	Total number of wells	Number of wells not used in 1938	Number of wells not reported	Acres irrigated
T. 26 S., R. 26 W.	12	2	0	490
T. 27 S., R. 26 W.	1	0	0	10
T. 26 S., R. 25 W.	95	12	4	859
T. 27 S., R. 25 W.	13	1	0	178
T. 26 S., R. 24 W.	43	6	0	475
T. 27 S., R. 24 W.	4	1	0	175
T. 27 S., R. 23 W.	4	0	0	191
T. 28 S., R. 22 W.	8	0	0	319
T. 26 S., R. 21 W.	5	0	1	95
T. 27 S., R. 21 W.	1	0	0	8
T. 26 S., R. 20 W.	1	0	0	14
Totals	187	22	5	2,814

Note: The average acreage is 17.58 acres per well.

Irrigation wells at Kansas Soldiers Home. Two deep wells are used for irrigation at the Kansas Soldiers Home at Fort Dodge. A third deep well (No. 24), located in the power house, is used for a public water supply for the institution and homes (for a discussion of this well see page 49)⁵⁰. The two irrigation wells nos. 23 and 22) were drilled in 1930 and 1931 respectively. Well 23 is located northeast of the administration building and discharges directly into a large earthen reservoir. It is cased with 12-inch steel casing, is equipped with an 8-stage turbine powered by a direct-connected electric motor, and yields about 400 gallons a minute. Twenty-one cubic yards of gravel were used in gravel-packing this well. The reservoir is kept full at all times, and the impounded water is used for irrigating about 40 acres of Soldiers Home land and an additional 35 acres of leased land east of the grounds. The crops irrigated include 2 acres of intensified truck garden under sprinkler system, 4 acres of truck garden, 12 acres of wheat, 20 acres of alfalfa, and 35 acres of wheat on the leased land. Well 22 is located on high ground just west of the Soldiers Home grounds. It is 150 feet deep, is cased with 12-inch steel casing, and equipped with a turbine powered by a direct-connected electric motor. The well has a rated capacity of about 1,000 gallons a minute, but under average pumping conditions this rate drops to about 800 gallons. A 75-acre field of alfalfa hay to the south is irrigated from this well. The locations of all 3 wells are shown in plate 1.

Table 2. Total pumpage, by townships, from irrigation wells in the Arkansas Valley, Ford County, Kansas, in 1938.

Township	Total number of wells	Number of wells not used in 1928	Number of wells without pumpage estimate.	Number of wells figured for total pumpage.	Total pumpage (acre-feet)
T. 26 S., R. 26 W.	12	2	0	10	956
T. 27 S., R. 26 W.	1	0	0	1	14
T. 26 S., R. 25 W.	95	13	6	76	1614
T. 27 S., R. 25 W.	13	0	0	13	196
T. 26 S., R. 24 W.	43	6	4	33	1107
T. 27 S., R. 24 W.	4	1	0	3	277
T. 27 S., R. 23 W.	4	0	0	4	233
T. 28 S., R. 22 W.	8	0	1	7	233
T. 26 S., R. 21 W.	5	0	0	5	87
T. 27 S., R. 21 W.	1	0	0	1	15
T. 26 S., R. 20 W.	1	0	0	1	29
Totals	<u>187</u>	<u>22</u>	<u>11</u>	<u>154</u>	<u>4761</u>

An estimate of the quantity of water pumped annually by the irrigation plants in the Arkansas Valley in Ford County has been made, based upon reported estimates of pumpage obtained from each well owner. (Table 2) For wells that are pumped by electricity, pumpage estimates were computed from power records that showed the total number of kilowatt-hours consumed in 1938. Knowing the total annual consumption for an individual motor and the number of kilowatts per hour that a given motor uses it was possible to approximate the number of hours the pump was in operation by dividing the total consumption by the hourly rate. Mr. Fred Moon, Irrigation Specialist of the Kansas Power Company, assisted in working out the pumpage estimates based on power consumption. From such estimates of power consumption and discharge the total annual pumpage for irrigation in the Arkansas Valley has been computed by townships. The total quantity of water pumped for irrigation in 1938 was about 4,760 acre-feet.

The total annual pumpage for irrigation in the Arkansas Valley varies considerably from year to year. The amount of pumping from wells during any one year varies with the amount of precipitation and with the water requirements of the crops being irrigated. Not all wells are used each year, some standing idle because of the owner's lack of time or facilities, others being out of use because the type of crop did not require the application of supplemental water.

Yields of irrigation wells.- The yields of irrigation wells in the Arkansas Valley in Ford County range from less than 100 gallons a minute up to about 2,000 gallons. No discharge measurements were made in the field, but it is believed that the reported pumping rate in each case was sufficiently

reliable to insure reasonably accurate totals.

Well construction.- The irrigation wells in the Arkansas Valley in Ford County may be divided into two classes, - those which have been put down by professional drillers, and those which have been sunk by the owners. Almost all of the professional drilling has been done with cable-tool rigs. A new portable rotary rig has recently been introduced into the area, but so far it has been used principally for test holes and domestic wells. Most of the small irrigation wells in the vicinity of Dodge City have been put down by the owners themselves or by private individuals using home-made equipment.

The typical installation consists of one or more drilled wells with a centrifugal pump installed at the surface or, more generally, in a pit. The types of casing used vary widely, from the ordinary commercial type of galvanized iron, ranging in diameter from 6 to 36 inches, to home-made types, consisting of almost anything at hand and ranging from hot-water boilers with the heads knocked out and bolted end to end, to common 55-gallon oil barrels with the heads knocked out and lapped together end to end. Even tractor wheels have been used as well curbing in one or two wells. Many wells are curbed with concrete rings manufactured locally. These rings range in diameter from 12 to 24 inches and are about 4 inches thick. They are assembled, a few rings at a time, as the well is being drilled. Each ring rests flatly on the ring next below, the alignment being maintained by iron rods that act as guides and are part of the permanent well. Water enters the well through spaces between the rings. With this construction there appears to be less danger of the screen

openings becoming sealed off by encrusting materials than with common galvanized iron casing with punched perforations. Some farmers in the eastern part of the area, near the Edwards County line, have constructed their own concrete rings and have devised a rather ingenious method of sinking them. A metal shoe shaped like an inverted funnel is first placed in the hole and concrete rings are placed around the shoe, one above the other, on iron rods serving as guides. The bottom end of the funnel is larger in diameter than the outside diameter of the concrete rings, thus serving as a reamer in keeping the hole larger than the casing. As material is removed from the hole by sand bucket the casing and funnel-shoe follow down by their own weight. Sometimes additional weight in the form of sand bags is applied at the surface to facilitate downward movement of the casing.

Sand buckets and sand pumps of various types of construction are used in the valley for sinking wells. Where the water table is comparatively deep some wells are partly dug and partly drilled. Generally a pit is first dug to the water table and a hole is then drilled in the bottom of the pit. The sides of the pit are cribbed with wood or in some wells they are surfaced with concrete. The pump is generally installed over the casing on the floor of the pit.

A few of the smaller centrifugal pumps are connected directly to the casings of comparatively shallow driven wells ranging in diameter from $1\frac{1}{2}$ to 3 inches.

Some of the irrigation plants consist of two or more large wells connected to one pump, and commonly called "battery wells." When the wells are properly spaced the yield from a "battery well" system is considerably greater than that from a single well. The typical installation consists of two or more wells, 40 to 50 feet apart, along a straight line. When spaced too closely together mutual interference between wells may reduce the discharge of the plant until it is little if any larger than that from a single well.

Some wells are so constructed that they draw water from two distinct water-bearing beds, - from the shallow valley fill and also from gravels at depths of more than 100 feet. The presence of two separate water-bearing beds in the Arkansas Valley has long been recognized. The original city wells at Dodge City, drilled in 1906, for example, tapped the so-called "secondⁿ water^m" in order to obtain softer water. Some of the irrigation wells in the area also were drilled to depths in excess of 100 feet in order to test the adequacy of the lower supply. When wells were first drilled to "secondⁿ water^m" there was a popular belief that the efficiency of the wells would be increased if the upper water were cased off completely and only the "secondⁿ water^m" were used. Some of the well owners have altered their wells so that the water from both sources is obtained. However, several deep wells still draw water only from the lower aquifer.

Depth of wells. - Most of the wells in the valley are 20 to 30 feet deep, and many are only 10 to 20 feet deep. (See table 3, p. 40.) Only a few exceed 100 feet in depth, and only 15 of 187 wells whose

depths were measured are 40 to 100 feet in depth.

The irrigation wells range in diameter from $1\frac{1}{4}$ inches, for the driven wells, up to 4 feet. Most of the wells are 16 inches in diameter but many are 16 to 24 inches in diameter.

Table 3. Irrigation wells in the Arkansas Valley in Ford County, Kansas classified according to depth.

Less than 10 feet	2	110-120 feet	1
10-20 feet	39	120-130 feet	2
20-30 feet	68	130-140 feet	1
30-40 feet	17	140-150 feet	1
40-50 feet	7	150-160 feet	3
50-60 feet	1	160-170 feet	3
60-70 feet	2	180-190 feet	1
70-80 feet	3	Not reported	<u>34</u>
80-90 feet	1		
90-100 feet	1	Total	187

The practice of gravel packing of irrigation wells has been followed to some extent in the valley, but the custom is not universal. Some of the wells have been constructed by first sinking a blank casing, inside of which a perforated casing of smaller diameter is placed. The annular space between the two casings is then gradually filled with screened gravel as the outer casing is slowly pulled out. The yield of some of the wells not treated in this manner probably could be improved by installing a suitable gravel pack. In the vicinity of Dodge City most of the irrigated tracts are small, so that generally sufficient water can be obtained from wells without gravel packing. Most of the large irrigation wells are gravel packed.

Many of the wells would probably yield more water if they were deepened considerably so as to draw water from the entire thickness of gravel that underlies the valley. However, many of the farmers cannot afford to drill to the optimum depth.

Types of irrigation pumps.— Most irrigation pumping plants in the Arkansas Valley in Ford County are equipped with centrifugal pumps, largely of the horizontal type, and ranging in size from 1½ to 10 inches. Only nine of the 187 wells visited in connection with the inventory were of the vertical centrifugal type (See table 4, p. 475) A total of 11 wells in the valley are equipped with turbine pumps. One plunger and one force pump were observed, but doubtless there are other pumps of this type used for irrigation, most of which are probably powered by wind. Combine engines are most commonly used for pumping from wells for irrigation. These units have been removed from combine machinery and installed at the wells. Many of these are direct-connected to the pump shaft, the remainder are belted. In table 5, the combine engines are listed as stationary gasoline engines. Some are powered by old car engines, some by stationary gasoline engines, and a few by diesel engines. Fifty-five of the plants are operated by electricity.

River pumping plants. - There are 10 river pumping plants in the Arkansas Valley in Ford County, the locations of which are shown in plate 1. All of these pump from the Arkansas River, with the exception of plant 6, northwest of Ford, which pumps out of a small lake created by a dam across Mulberry Creek near its mouth. Plant 9 pumps out of an abandoned sand pit located on the north bank of the Arkansas River, a short distance southeast of Sears Siding. Plant 8 is located just above the diversion dam across the Arkansas River maintained by the Wilroads Rehabilitation Project.

Table 4. Sizes and kinds of irrigation pumps as determined by an inventory of pumping plants in the Arkansas Valley in Ford County, Kansas.

Kind	Size (inches)	Number	Kind	Size (inches)	Number
Centrifugal (horizontal type)	1 1/4	1	Centrifugal (vertical type)	4	1
	1 1/2	2		5	7
	1 3/4	1		6	1
	2	19	Total.....	Total.....	9
	2 1/2	11			
	3	48			
	4	26			
	5	14			
	6	29 ^{a/}			
	8	3			
10	3				
Total.....		157	Total.....		9
Turbine	8	2	Plunger Force None Removed	2	1
	12	1		2	1
	14	4			4
	Unknown	4			4
Total.....		11	Grand total.....		187

a/ Includes one irrigation well in Edwards County.

51

Table 5. Kinds of power used ^{to pumping} on irrigation wells in the Arkansas Valley in Ford County, Kansas, and ^{the} number of installations.

Gasoline engine	109 ^{a/}	Not known	1
Electric	55	Abandoned	1
Tractor	12		—
None	4		
Removed	3	Total	187

a/ Includes one well in Edwards County.

The water from this plant is used for irrigating some of the small tracts that cannot be reached by the gravity ditch. The total amount of water pumped in 1938 by river pumping plants was found to be about 734 acre-feet. (See table 6.) This figure is based upon reported estimates obtained from the owners of the plants. Approximately 600 acres were irrigated by river pumps in the area in 1938.

Table 6. Acreage irrigated, ^{with} pumped surface water, and estimated pumpage in the Arkansas Valley in Ford County, Kansas in 1938.

Pumping plant No.	Owner	Acres irrigated	Total pumpage (acre-feet)
1	Ray L. Shellheimer	52	44
2	M. E. Neal	69	55 ^{a/}
3	J. L. Riegèl	40	40 ^{a/}
4	Wm. C. Fowler	42	40
5	G. R. Hensley	42	20
6	J. C. Lovette	20	29
7	J. E. Burke	95	112
8	Wilroads Gardens (Rehabilitation Project)	100 ^{b/}	180
9	Chas. Staples	60 ^{a/}	66
10	Judge Earl Hill	75	148
	Total	591	734

^{a/} Estimated

^{b/} Approximately 300 acres are covered by ditch water from a diversion dam on the river and from a pump located on the river bank. The number of acres covered by the pump is indeterminate, therefore the figure shown in the table has been estimated.

Industrial water supplies

The Kansas Power Company is the largest single user of ground water in the Arkansas Valley. As shown in table 7, the total pumpage at their new plant about 4 miles east of Dodge City was 2,769 acre-feet in 1938, or nearly 3 times as much as the total pumpage for all other industrial purposes at Dodge City. The total annual pumpage by each of the industries using ground water in the Arkansas Valley in Ford County, Kansas in 1938 is shown in the same table.

The Atchison, Topeka and Santa Fe Railway at Dodge City is the second largest industrial user of ground water. Most of the water is used at the roundhouse for washing and filling locomotive boilers and cleaning and filling stationary boilers with smaller amounts being used for depot facilities, stockyards and miscellaneous purposes.

The Fairmount Creamery and the Dodge City Flour Mills are two of the largest private users of ground water. As shown in table 7, each of these firms pumps rather large quantities of water annually from private wells. The Dodge City Steam Laundry and the Dodge City Warehouse both pump smaller amounts each year, with the former using the larger quantity.

At present there is relatively little air-conditioning in Dodge City, although its use appears to be increasing. Most of the firms equipped with air-conditioning, including the theaters and the hotels, use city water for cooling. However, several firms have installed small wells for cooling purposes, including the Kansas Power

Table 7. Pumpage for industrial purposes in the Arkansas Valley
in Ford County, Kansas, in 1938

Owner	Use of water	Period	Number of wells	Total pumpage (acre-feet)
Kansas Power Co. (new plant)	Cooling condensers at plant.	1 year	3	2769
Atchison Topeka & Santa Fe Railway, at Dodge City	Roundhouse, loco- motive, depot facil- ities, etc.	11-1-37 to 11-1-38	2	363
Fairmount Creamery at Dodge City	Creamery facilities	1 year	1	269
Dodge City Flour Mills	Boiler and condenser supplies	6-1-37 to 6-1-38	4	253
J. S. Dillon Grocery Stores Inc., Dodge City	Air-conditioning	1 year	1	17.4
Kansas Power Company. (office building, Dodge City).	do.	do.	1	14.6
Duckwalls Inc. (department store, Dodge City).	do.	do.	1	12.2
Dodge City Steam Laundry.	Laundry facilities	do.	1	8.9
Dodge City Warehouse	Washing fruit, etc.	10-1-38 to 12-31-38	<u>1</u>	<u>.4</u>
	Total		15	3707.

Company in their downtown office building, Duckwall Stores, Inc., a downtown department store, and the J. S. Dillon Grocery store located in South Dodge City. As shown in table 7, the total volume of water developed by these three wells for air-conditioning purposes in 1938 was about 44 acre-feet. There are several smaller plants but well records and pumpage estimates were not obtained for them. These include plants installed in private homes using private wells, and one or two in smaller business houses and restaurants.

According to Mr. Kirkpatrick, city engineer at Dodge City, during several periods of extremely warm weather in the past three summers the sewage disposal plant at Dodge City has been taxed to capacity owing to the arrival of peak loads at the plant. The present capacity of the plant is 2 million gallons a day. At times when the inflow to the plant is in excess of this amount the excess is automatically by-passed to the Arkansas River without going through the plant. Much of this "overload" is doubtless water that has been used for air-conditioning.

The Kansas Power Company's plant located about 4 miles east of Dodge City is supplied by three wells 152 feet in depth. A fourth well was drilled but has not been equipped with a pump. The wells were drilled 30 inches in diameter, equipped with 24-inch Armco iron casing, and back-filled with graded, round gravel. Three of the wells are equipped with vertical deep-well turbine pumps direct-connected to 50 horsepower electric motors. The locations of all 4 wells are shown in figure 3. In 1931, when the wells were put down, each well yielded 2,050 to 2,150 gallons a minute, with a

50-foot drawdown. At the present time each individual well delivers approximately 1,800 gallons a minute, and the aggregate yield when two wells are pumped is about 3,400 gallons. Generally only one is pumped at a time. However, in the summer and during peak loads two wells are pumped about 8 hours a day at a total rate of about 3,400 gallons a minute. After 6 years of pumping (since May, 1932) the drawdown has increased from 50 feet to 59 feet. In the summer the peak load comes about noon, whereas in winter it comes about 6:00 P. M. The water is used for cooling condensers at the plant. The initial temperature of the water is about 57° F., but after the water has passed through the condensers its temperature is raised about 18° F. The warm water is discharged through a ditch into the Arkansas River. The water is reported to be medium hard.

The Atchison, Topeka and Santa Fe Railway obtains its water supply from 5 wells located near the round house at Dodge City. Of this number only two (wells 70 and 71) are used at the present time. The locations of all wells are shown in plate 3. Wells 70 and 71 are 148 feet deep. Columnar sections of these 2 wells are shown in figure 4. Well 70 is equipped with a deep well turbine, whereas well 71 is pumped by air lift. The wells are cased to a depth of 45 feet with 13-inch pipe, from 47 to 104 feet with 10-inch pipe, and from 104 to 148 feet with 8-inch pipe - the last 18 feet of which consists of a strainer. The wells furnish water to two separate steel standpipes 24 feet in diameter, and to two separate treating plants. One standpipe is located at the roundhouse, the other at the passenger yard.

The total consumption by the roundhouse and depot facilities during the period from Nov. 1, 1937 to Nov. 1, 1938 was 108,655,194 gallons. The balance of the total annual pumpage of 118,366,694 gallons, or 9,711,500 gallons, was used for washing and filling locomotive and stationary boilers, for passenger trains, stockyards, and shops.

The Fairmount Creamery obtains its entire water supply from one drilled well located at its plant in Dodge City. The well is 140 feet deep, is cased with 15-inch boiler-steel casing, and is equipped with a 4-inch turbine powered by an electric motor. The pump is in continuous operation for about 16 hours of every day and delivers about 250 gallons a minute. The total quantity of water used in 1938 is shown in table 7, page 44.

The Dodge City Flour Mill obtains its water supply from 2 deep and 2 shallow wells located at its plant in Dodge City. The locations of all wells are shown in plate 3. Wells 81 and 82 are 150 feet deep and are cased with 5-inch iron casing inside the original 6-inch casing. Wells 83 and 84 are about 30 feet deep, the former being equipped with 24-inch galvanized-iron casing, the latter with 16-inch galvanized-iron casing. Wells 82, 83, and 84 are inter-connected to one 4-inch horizontal centrifugal pump, and yield an aggregate of about 400 gallons a minute. The total discharge for one year from these 3 wells amounted to 50,760,000 gallons, all of which was used for cooling condensers. Well 81 is equipped with a deep-well, plunger pump and yields about 1,500 gallons an hour. A total of 31,725,000 gallons was pumped from this well

in 1938, all of which was used for boiler supply. The total pumpage from all four wells is given in table 7, page 44.

The J. S. Dillon Grocery Store in South Dodge City has 2 wells, one deep and one shallow. The deep well is used for air-conditioning and the shallow for disposal purposes. The deep well 121 is 128 feet deep and is equipped with a small electrically driven centrifugal pump that delivers about 75 gallons a minute. The well is used about 6 hours daily during the period from April to October. The Kansas Power Company uses a small well, 6 inches in diameter and 159 feet deep for air-conditioning its office building in Dodge City. The well is equipped with a small turbine powered by an electric motor. The pump is operated intermittently at a rate of about 50 gallons a minute. The total annual pumpage from this well is given in table 7, page 44.

A 6-inch well, 100 feet deep, furnishes a small supply for air-conditioning at Duckwall Stores Inc. in Dodge City. The well is equipped with a 2-inch centrifugal pump powered by an electric motor. About 40 gallons a minute are pumped during 6 months of each year. An estimate of the total annual pumpage for this well is given in table 7, page 44.

The Dodge City Steam Laundry in Dodge City develops its own water supply from one deep well No. 79. The well is 5 inches in diameter and 143 feet deep, and is equipped with a 2-cylinder plunger-type pump. An estimate of the total annual pumpage in 1938 is shown in table 7, page 44. This well is located not far from city well 77, as shown in plate 3.

It was reported by Mr. Balderston, owner of the laundry, that for 4 days during the summer of 1938 the water level in the well at the laundry was lowered below the bottom of the pump intake by the continuous pumping of city well 120. Presumably both wells are drawing from the same water-bearing bed. All of the water is softened before being used.

The Dodge City Warehouse installed a drilled well in September, 1938, in their plant. It is 6 inches in diameter and 34 feet deep, and is equipped with a small pressure pump that delivers about 500 gallons an hour. The well is to be used continuously for about 4 months of the year and about 3 hours daily during the remainder of the year. The estimated pumpage from this well from October to December 31, 1938 is given in table 7, page 44.

Public and institutional water supplies

Dodge City.- Dodge City (population 8,870) is the only municipality with a public water supply in the area under discussion. It is supplied by three drilled wells ranging in depth from 140 to 147 feet. (see log of city well 120 on page 7). Nine drilled wells with an average depth of 135 feet were put down in 1910 for municipal supply, but all nine have since been abandoned. The locations of the present city wells and the nine abandoned wells are shown in plate 3.

The present city wells are each equipped with turbines having a combined capacity of 2,800 gallons a minute. The water is pumped directly into the mains, and the excess is conducted by two centrifugal booster pumps into a steel standpipe with a capacity of 500,000 gallons. The standpipe is located on high ground near the margin of the valley at the north end of Dodge City. The domestic pressure ranges from 50 to 90 pounds to the square inch, whereas the fire pressure ranges from 90 to 125 pounds. Although each of the three turbines is equipped with master flow meters, mechanical difficulties with two of the meters made it impossible to get accurate pumpage figures for 1938. The total annual consumption in 1936 was 459,473,000 gallons, or an average of about 1,255,000 gallons a day. There are 238 fire hydrants and 325 valves in the system.

There are 40.86 miles of mains, not including mains that have since been laid to the sewage disposal plant east of the city and to the cemetery west of the city. The water is reported to be moderately hard.

Kansas Soldiers Home.- The Kansas Soldiers Home at Fort Dodge obtains its water supply from a single deep well located in the power plant.

Although there are 3 deep wells located on the premises, 2 of them are used entirely for irrigation. The well which furnishes the public supply is the oldest of the three and is also used as a source of supply for cooling the condensers at the power plant and for the ice plant. This well is 12 inches in diameter and 150 feet deep, is equipped with a turbine powered by a direct-connected electric motor, and yields about 300 gallons a minute. It is used about 12 hours a day during half of each year, and as much as 18 hours a day during the remainder of the year. The total quantity of water pumped from this well, during 1938, based on estimates of its use was found to be 95,310,000 gallons, or about 292 acre-feet.

Summary of total pumpage

The following table gives the approximate pumpage from wells for different purposes in 1938.

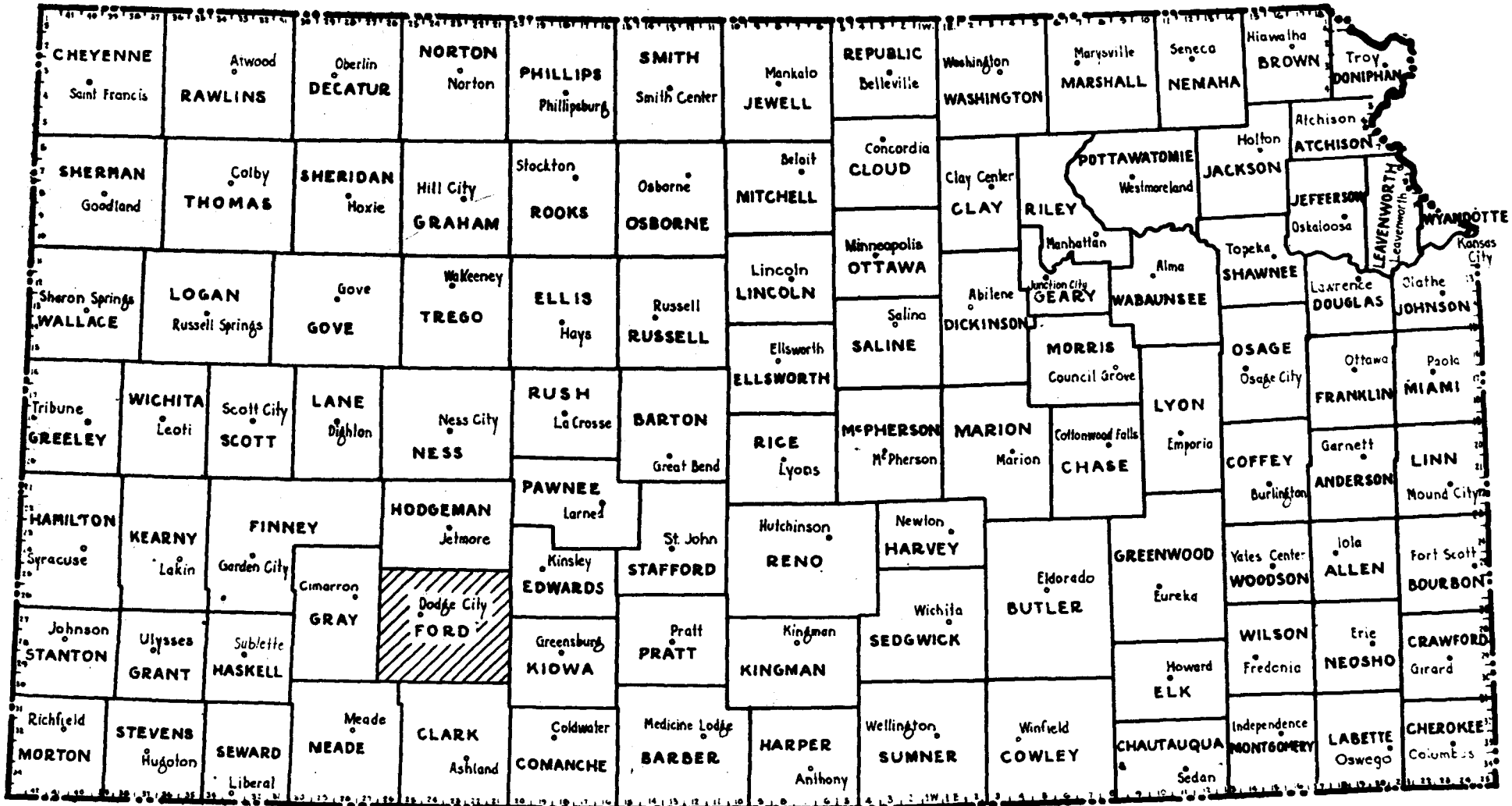
Table 8. Summary of total pumpage from wells in the Arkansas Valley in Ford County, Kansas, in 1938.

	Total pumpage (acre-feet)
Irrigation wells	4,760
Industrial wells	3,710
Municipal wells	<u>1,700</u>
Total	10,170

REMARKS _____



INDEX MAP OF KANSAS, SHOWING THE LOCATION OF FORD COUNTY



EGS
OF
39-2

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON

4

February 16, 1939.

Dr. R. C. Moore,
State Geologist,
University of Kansas,
Lawrence, Kansas.

Dear Doctor Moore:

There is transmitted to you herewith a copy of the report, "Ground-water resources of the Arkansas Valley in Ford County, Kansas," by H. A. Waite. If you have any suggestions as to corrections or alterations I should be glad to hear from you as soon as possible. I am withholding the release of the report until I hear from you. If it is satisfactory you may wish to telegraph me.

Very truly yours,
O. E. Meinzer
Geologist in Charge,
Division of Ground Water.

Enclosure

UNITED STATES
DEPARTMENT OF THE INTERIOR
MEMORANDUM FOR THE PRESS

FOR IMMEDIATE RELEASE
March 13, 1939.

"Ground water resources of the Arkansas Valley in Ford County, Kansas," a report by Herbert A. Waite, has just been released by the United States Geological Survey, Department of the Interior. The investigation upon which this report is based was made in cooperation with the Kansas Geological Survey. The report has not yet been published, but typewritten copies may be consulted at the office of the Kansas Geological Survey, Lawrence, Kansas, at the offices of the Geological Survey in Washington, D. C., and in Wichita and Topeka, Kansas, and at the Dodge City Chamber of Commerce, Dodge City, Kansas.

As an aftermath of several years of severe drought, the Kansas Geological Survey has received numerous inquiries in regard to the possibility of utilizing ground water for irrigation in parts of southwestern Kansas. A preliminary investigation made in Ford County in November 1937 revealed that irrigation wells were being drilled in parts of the High Plains in which the water table stands from 50 to more than 100 feet beneath the land surface. It was evident that a detailed study of ground-water conditions should be made in order to determine the occurrence, depth, and yield of water-bearing beds, the depth to the water level, the quantities of ground water that are pumped each month or year, the trend in movement of water levels resulting from irrigation, and the safe yield of the water-bearing formation.

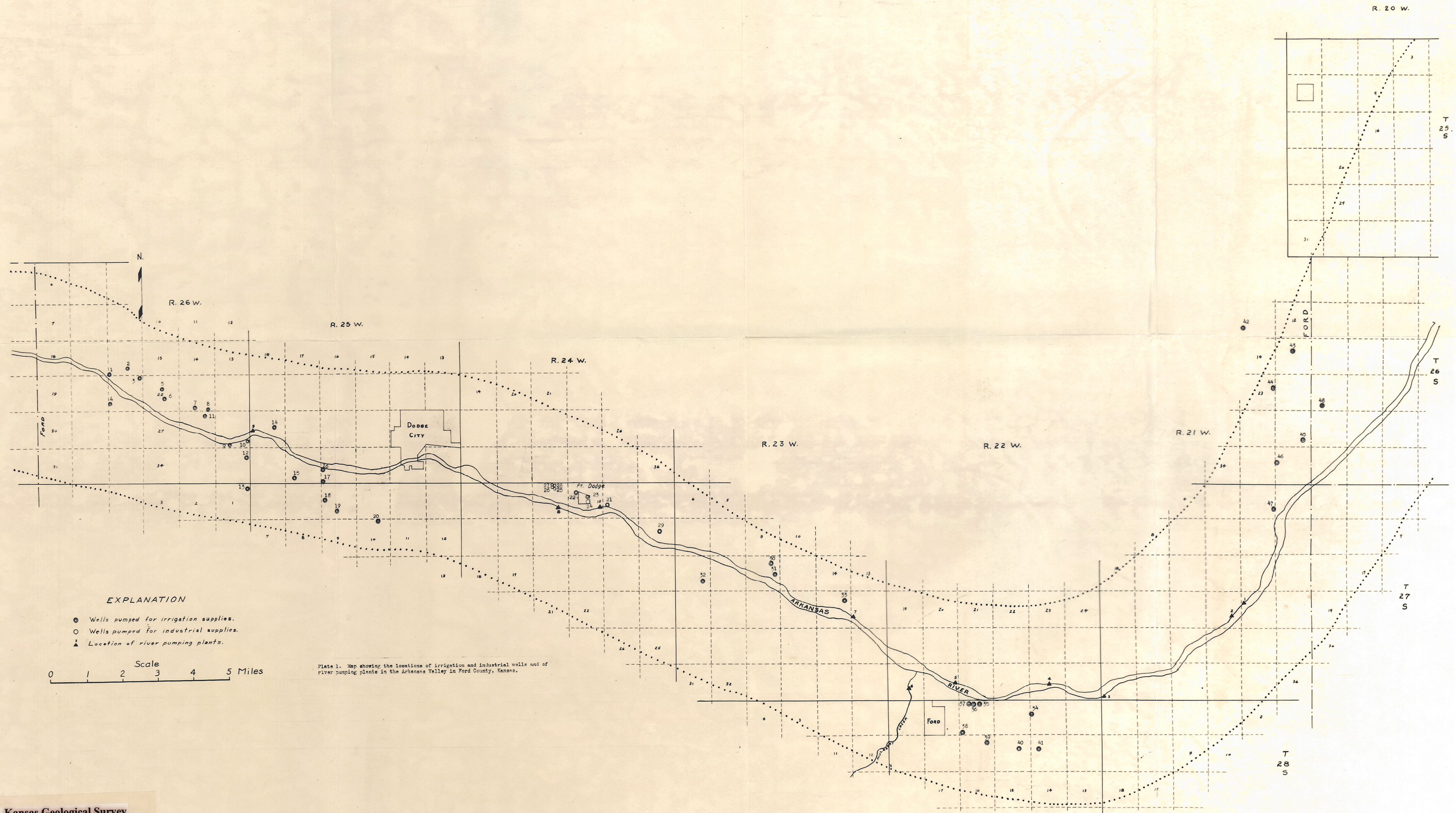
Ford County was selected as the first area to be studied in detail, and at the request of the Bureau of Agricultural Economics, United States Department of Agriculture, the first studies were made in the part of the county that lies in the valley of the Arkansas River. A report covering the entire county will be prepared after the investigation has been completed.

An inventory of the wells and pumping plants in the Arkansas Valley in Ford County revealed that the total pumpage of ground water in 1938 amounted to more than 10,000 acre-feet. About 4,760 acre-feet of water was pumped from 187 wells for irrigation; about 3,707 acre-feet was pumped for industrial uses; and about 1,702 acre-feet to supply Dodge City and the Kansas Soldiers Home at Fort Dodge. Tabulated records of all wells visited together with maps showing their locations and the logs of some of the wells are given in the present report.

Most of the ground water is pumped from Quaternary alluvium that underlies the valley. The alluvium consists of gravel, sand, and silt, and ranges in thickness from a few feet to 100 feet or more. There are two beds or zones of water-bearing material beneath much of the valley, referred to locally as the "first" and "second" waters. The waters from the two sources stand at slightly different levels and differ somewhat in quality. There is some evidence that the deeper beds containing the "second" water may be of Tertiary age. The Ogallala formation, the Tertiary age, crops out on both sides of the valley except in places where it is covered by dune sand, terrace gravel, or loess of Pleistocene age. The dune sand and terrace gravel occur mainly on the south side of the valley, but some dune sand is found also on the north side. A thin mantle of loess covers both sides of the valley. Cretaceous sediments crop out along the north side of the valley near Ford and are believed to underlie the Tertiary sediments in and near the valley.

The water in the alluvium is derived mainly from rainfall on the sandy bottom lands, underflow from upstream areas, and seepage from the Arkansas River at certain times of the year. One of the three north-south profiles of the water table shown in the report indicates a ground-water divide several miles north of the valley, from which the water table slopes toward the valley with an average gradient of about 6 feet to the mile, indicating that water percolates into the alluvium from the north. Sufficient data are not as yet available to indicate whether there is a similar divide south of the river. The belt of dune sand south of the river appears to afford a good catchment area, and it probably contributes water to the alluvium in the valley.

At the start of the investigation about 37 wells in different parts of Ford County were selected as observation wells, and periodic measurements of water levels in them were begun in order to obtain information in regard to the fluctuations in the ground-water reservoir. Descriptions of 23 of these wells, all in the Arkansas Valley, and the water-level measurements through January 1939 are given in the present report. The period of record is too short to warrant an accurate interpretation of the fluctuations in water level, but the program of measurements is to be continued and should prove valuable in future years.



EXPLANATION

- Wells pumped for irrigation supplies.
- Wells pumped for industrial supplies.
- ▲ Location of river pumping plants.

Scale
0 1 2 3 4 5 Miles

Plate 1. Map showing the locations of irrigation and industrial wells and of river pumping plants in the Arkansas Valley in Ford County, Kansas.

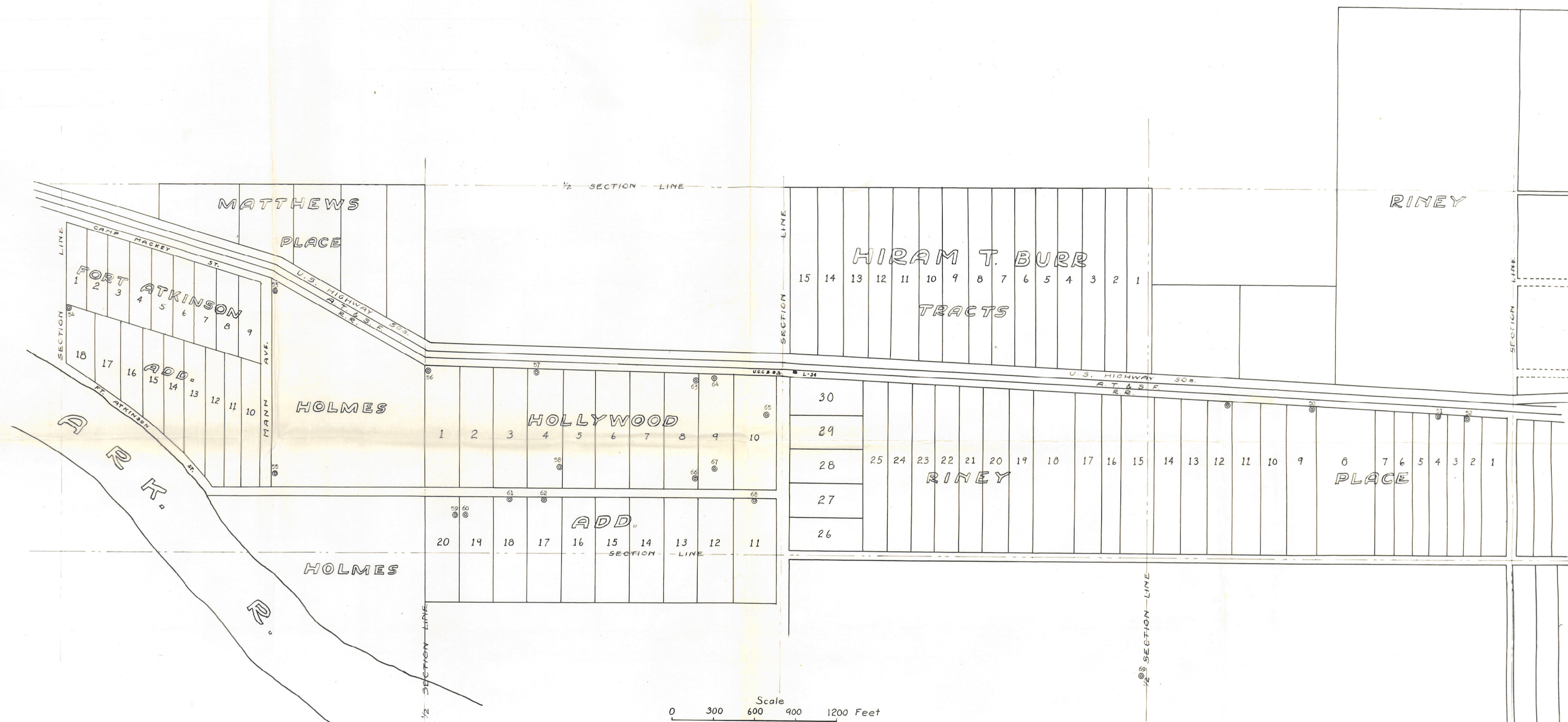
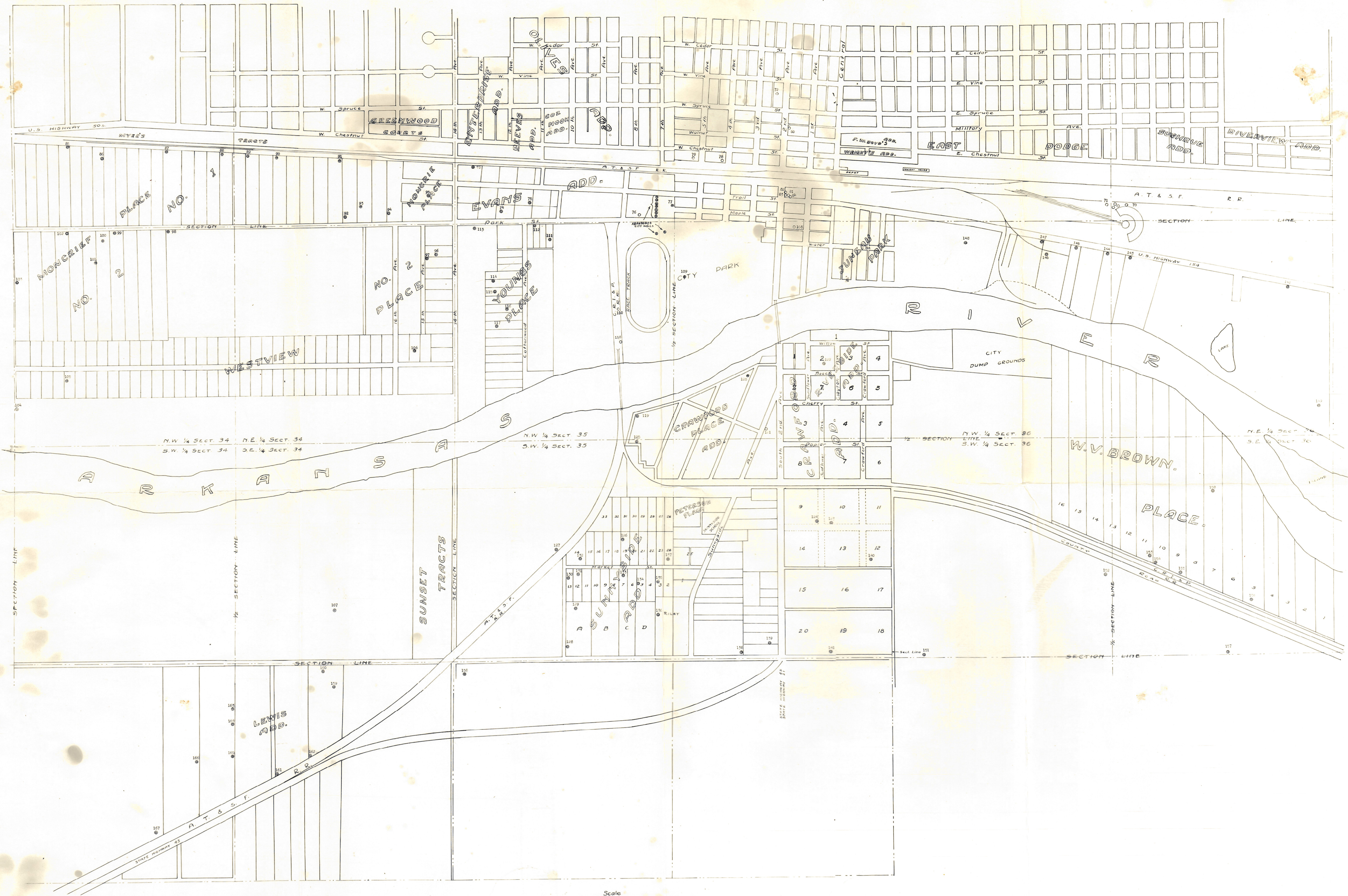


Plate 2. Map showing locations of irrigation wells in the subdivisions adjacent to the western city limits of Dodge City.

A R 1



Scale
0 300 600 900 1200 Feet

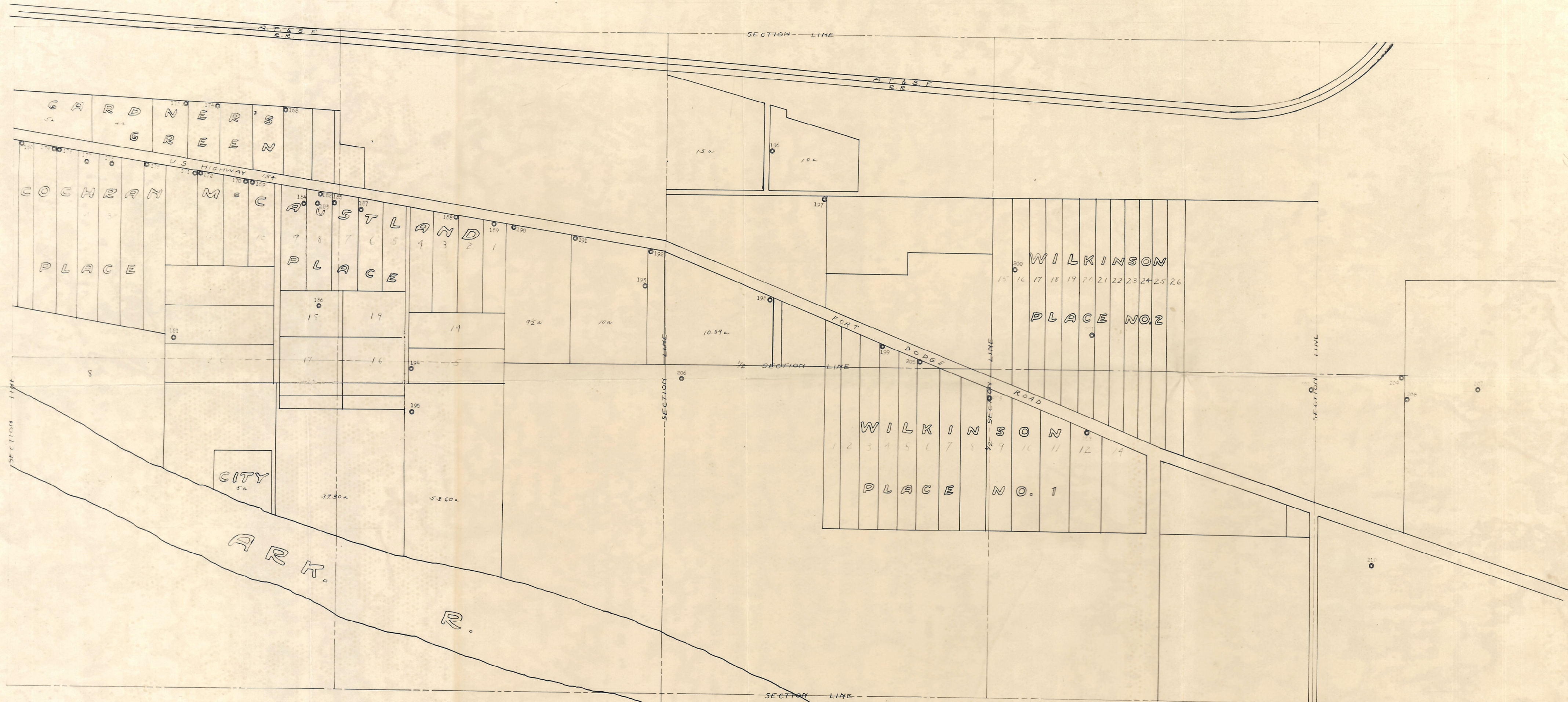
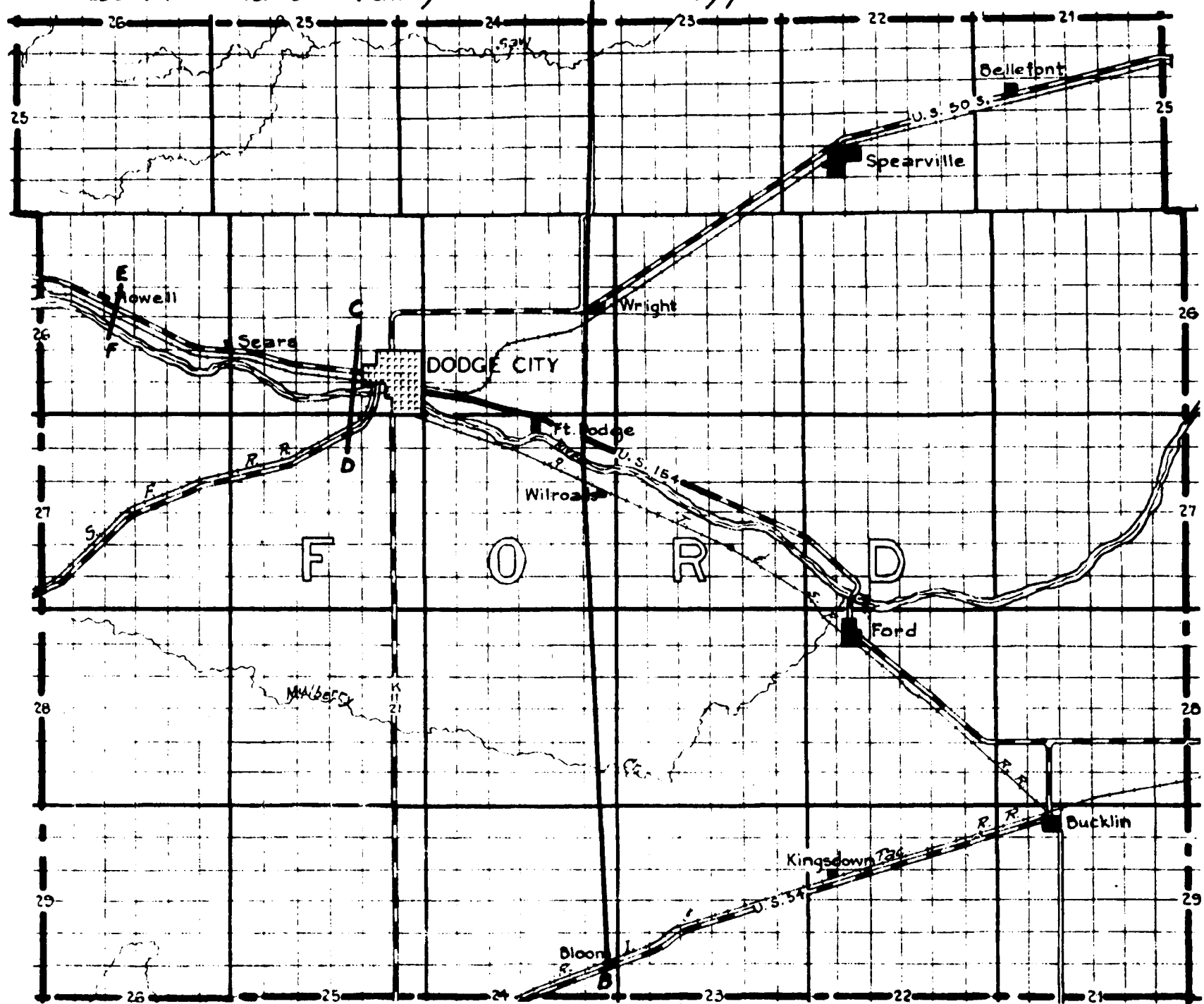


Plate 4. Map showing locations of irrigation wells in the subdivisions adjacent to the eastern city limits of Dodge City.

Fig. 1. Map showing the locations of three North-South profile sections across the Arkansas Valley in Ford County, Kansas:



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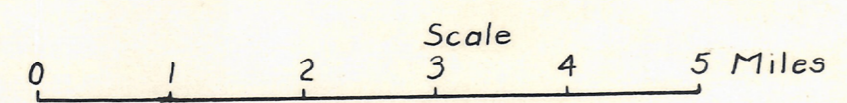
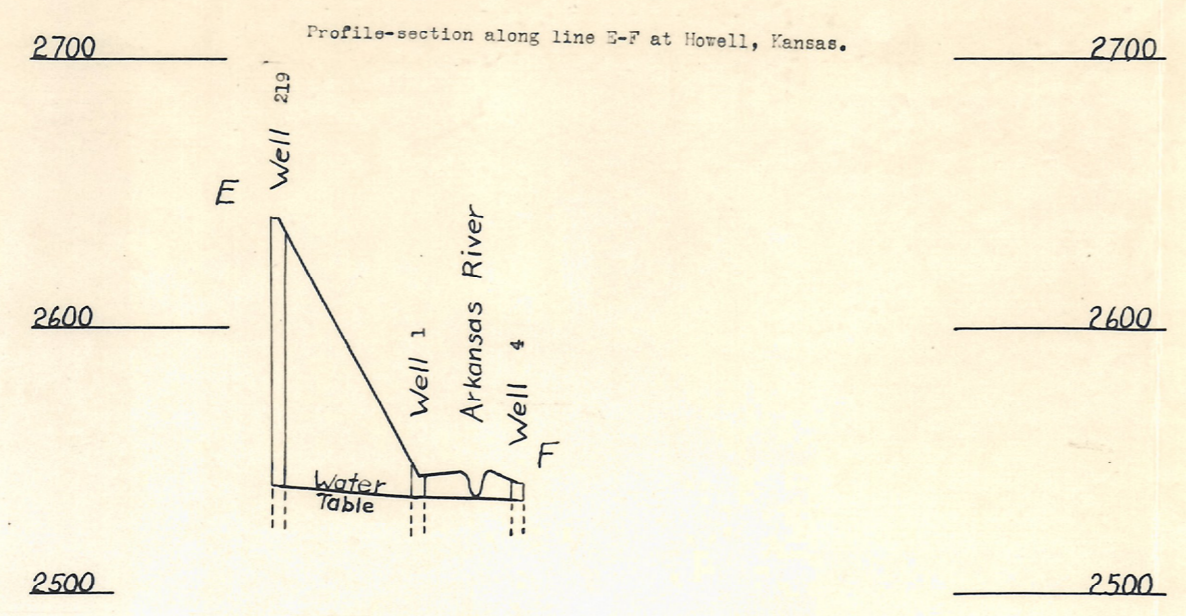
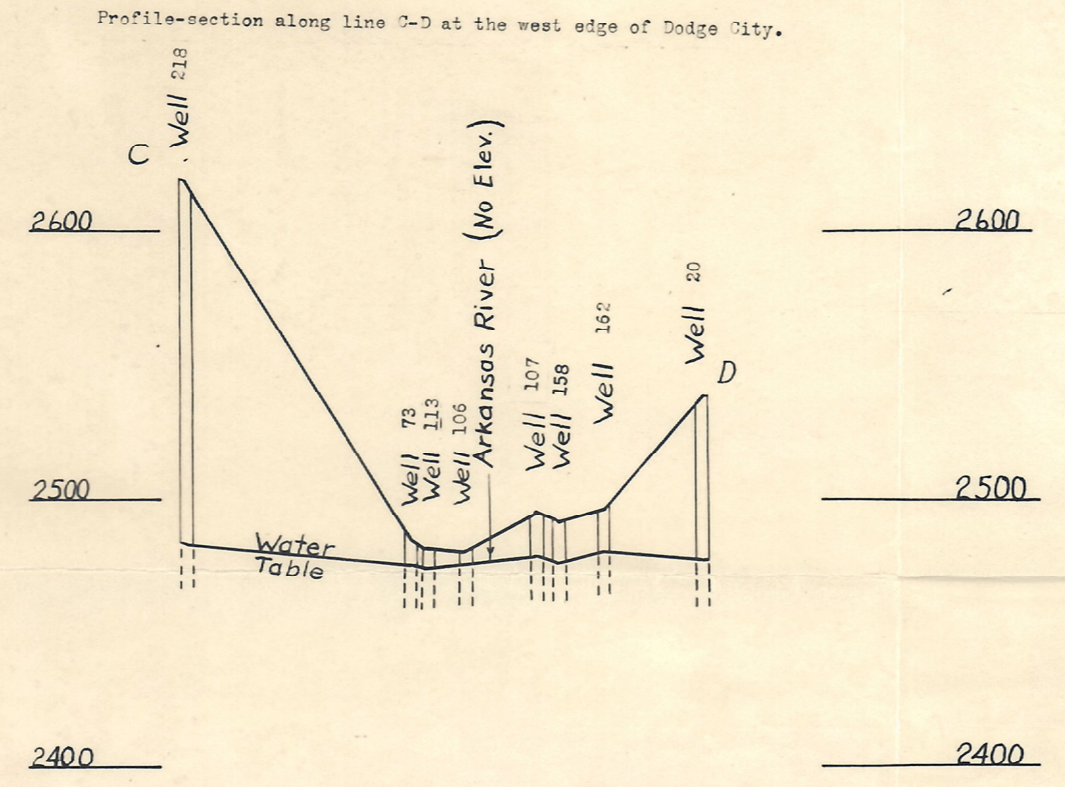
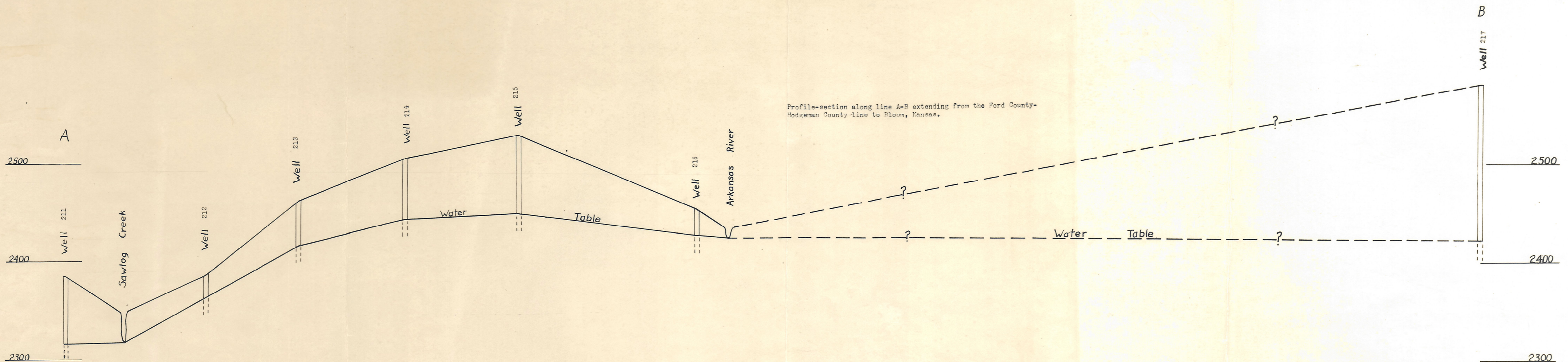


Figure 2. Profiles of the water table along 3 north-south profile sections in Ford County, Kansas.

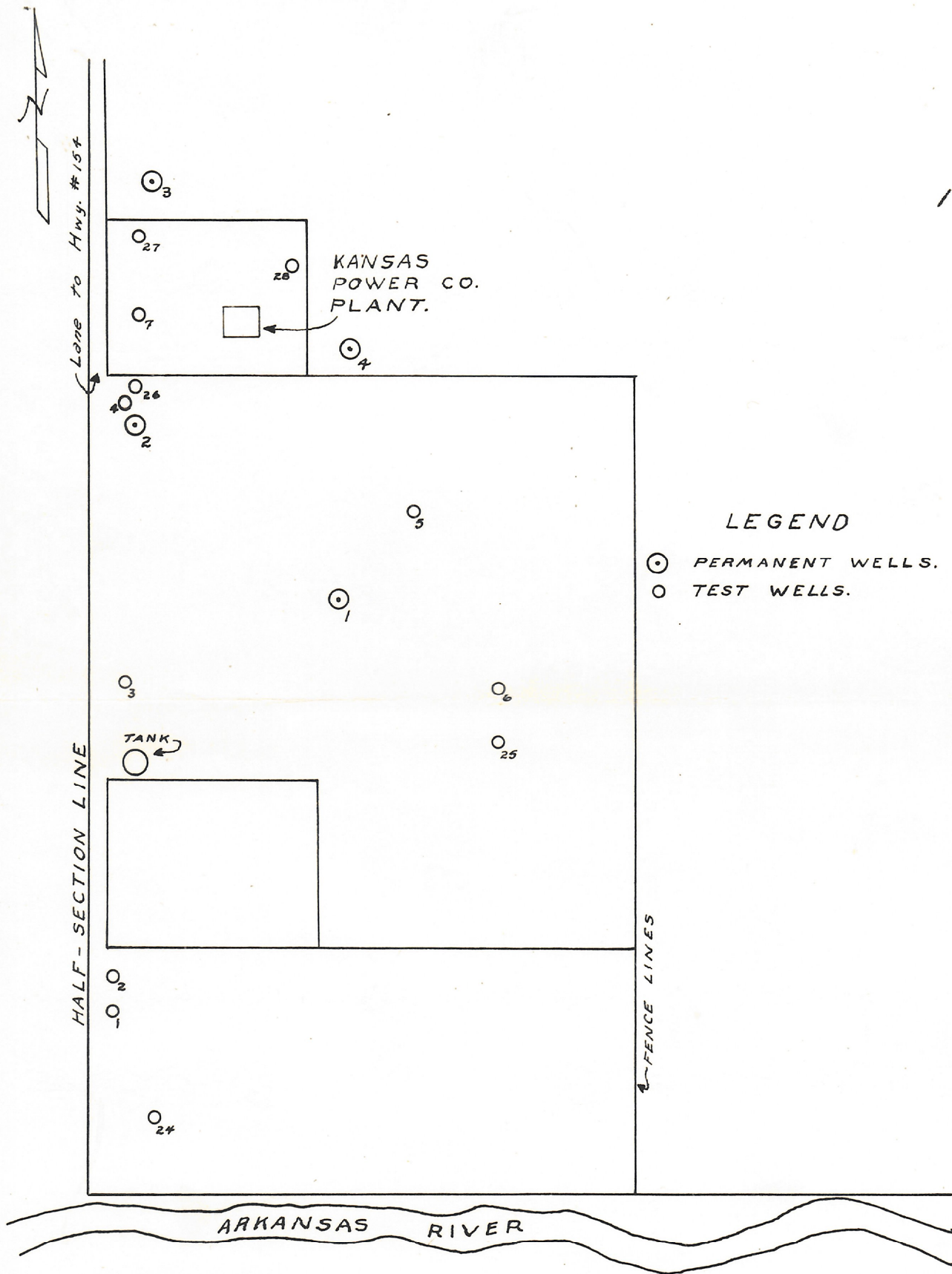


Figure 3. Sketch showing the locations of permanent wells and test wells of the Kansas Power Company at their new plant 4 miles of Dodge City, in the NE $\frac{1}{4}$ sec. 4, T. 27 S., R. 24 W.

Kansas Geological Survey
 Open-file Report 39-2
 figure 3

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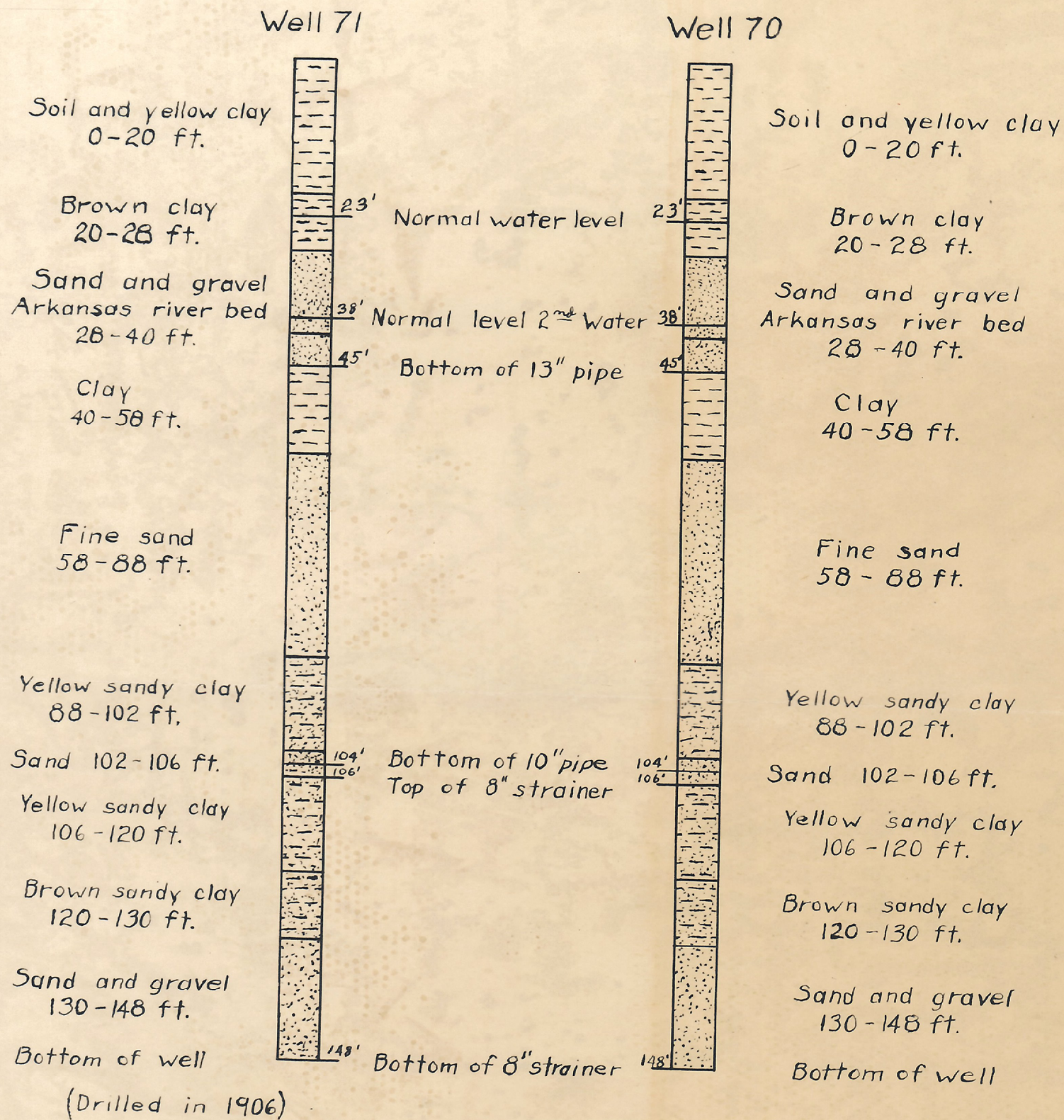


Figure 54. Log of wells 70 and 71 located at the Atchison Topeka and Santa Fe Railway roundhouse at Dodge City, Kansas.

RECORDS OF IRRIGATION, INDUSTRIAL AND MUNICIPAL WELLS
in
FORD COUNTY, KANSAS

Well No. on Plate 1	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/	Depth of well 2/ (feet)	Diameter of well (inches)	Type of casing 3/	Character of material	Geologic horizon	Distance of meas- uring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated capacity (gallons a minute)	Average pumping rate (estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks
	T. 26 S., R. 26 W.									SAND & GRAVEL	ALLUVIUM	0.0	7.35	10-5-38	C	8	1800	1200	E	I	100	BATTERY OF 6 16-INCH WELLS
1	SW 1/4 SW 1/4 sec. 16	ALBERT MILLER	OWNER	1925	VALLEY	DR.	23.1	16	G.I.	do	do	-	-	-	C	4	450	450	G	I	10	
2	SW 1/4 SE 1/4 sec. 16	do	do	1938	do	DR.	-	16	G.I.	do	do	-	-	-	C	4	450	450	G	I	NOT USED	BATTERY OF 5 DEEP WELLS
3	NE 1/4 NE 1/4 sec. 21	BUD WEBB	DENNIS DOTY	1922	do	DR.	186.7	16	O.W.	GRAVEL SAND & GRAVEL	OGALLALA	+1.0	17.66	10-21-38	C	10	1500	1500	D	I	75	BATTERY OF 5 SHALLOW WELLS
4	NW 1/4 SE 1/4 sec. 21	M.H. THOMPSON	-		do	DR.	22.7	20	C.R.	do	do	+0.4	7.37	10-22-38	C	8	2000	1200	G	I	10	BATTERY OF 5 SHALLOW WELLS
5	SW 1/4 NE 1/4 sec. 22	FRED HESSMAN	OWNER	1936	do	DR.	18.7	24	C.R.	do	do	0.0	8.40	10-21-38	C	5	600	600	G	I	40	BATTERY OF 3 SHALLOW WELLS
6	NW 1/4 SE 1/4 sec. 22	ANDREW BOGNER	do	1937	do	DR.	26.7	20	C.R.	do	do	+1.0	8.76	10-21-38	C	6	1200	1000	G	I	130	BATTERY OF 6 SHALLOW WELLS
7	SE 1/4 SW 1/4 sec. 23	R.R. KINER	-	1928	do	DR.	30.6	16	G.I.	do	do	+0.3	13.91	10-21-38	C	10	1800	1800	D	I	35	COULDN'T MEASURE
8	SE 1/4 SE 1/4 sec. 23	W.F. RHINEHART	HANNON JOHNSON	1937	do	DR.	165.0	8	I	GRAVEL SAND & GRAVEL	OGALLALA	-	-	-	C	6	1000	600	G	I	40	
9	SE 1/4 SW 1/4 sec. 25	ERVIN STRIEFF	-	-	do	DR.	21.6	20	C.R.	do	do	-8.1	1.75	10-22-38	C	6	1000	800	G	I	NOT USED	RECENTLY INSTALLED
10	NE 1/4 SE 1/4 sec. 25	ROGER SHUMARD	ROY CURRY	1938	do	DR.	29.7	20	C.R.	do	do	+0.6	8.34	10-22-38	V.C.	5	800	600±	T	I	20	
11	NE 1/4 NE 1/4 sec. 26	HOMER C. RUMSEY	BERT JOHNSON	1937	do	DR.	24.7	20	C.R.	do	do	-5.1	1.71	10-21-38	C	6	1000	900	G	I	30	
12	SE 1/4 NE 1/4 sec. 36	JOHN SHUMARD	OWNER	1938	do	DR.	48.0	22	O.B.	do	do	-	-	-	C	6	1000	700	G	I		
	T. 27 S., R. 26 W.									do	do	+1.5	56.13	10-24-38	T	12	1000	750	T	I	10	
13	NE 1/4 NE 1/4 sec. 1	R.E. PENNINGTON	GEO. SLOCUM	1938	VALLEY MARGIN	DR.	86.1	20	O.W.	do	do	+1.5	56.13	10-24-38	T	12	1000	750	T	I	10	
	T. 26 S., R. 25 W.									do	ALLUVIUM & OGALLALA	-13.0	5.34	10-21-38	C	5	500	500	E	I	20	
14	SE 1/4 NE 1/4 sec. 30	CHAS. STAPLES	BERT JOHNSON	1922	VALLEY	DR.	165.0	16 to 5	I	do	do	-13.0	5.34	10-21-38	C	5	500	500	E	I	20	
15	SW 1/4 SW 1/4 sec. 32	C.L. BULLOCK	OWNER	-	do	DR.	24.1	19	G.I.	do	ALLUVIUM	-8.0	4.03	10-24-38	C	4	500	500	T	I	28	
16	NW 1/4 SW 1/4 sec. 33	JOHN CLARK	BERT JOHNSON	1936	do	DR.	28.3	20	C.R.	do	do	-2.7	2.85	10-24-38	C	4	400	400	G	I	NOT USED	
17	SW 1/4 SW 1/4 sec. 33	do	do	1935	do	DR.	166.0	16 to 8	I	GRAVEL	OGALLALA	+1.0	17.99	10-24-38	T	-	800	550	G	I	59	UPPER SHALLOW WATER CASED OFF
	T. 27 S., R. 25 W.									SAND & GRAVEL	ALLUVIUM	-	-	-	C	6	1000	950	G	I	57	
18	SW 1/4 NW 1/4 sec. 4	CLARENCE ATEM	TOM STAETH	1937	do	DR.	57.0	48	T.W.	do	do	-	37±	-	V.C.	6	1000	800	T	I	15	
19	NE 1/4 SW 1/4 sec. 4	HANSON WIDUP	-	-	do	DR.	65.0	20	B.S.	do	do	-	37±	-	V.C.	6	1000	800	T	I	15	
20	NW 1/4 NE 1/4 sec. 10	RALPH WILLIAMS	TOM STAETH	1936	do	DR.	94.1	40 to 16	I	do	do?	+0.75	62.22	10-14-38	T	8	1200	770	T	I	65	

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Well No. on Plate 1	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/	Depth of well 2/ (feet)	Diameter of well (inches)	Type of casing 3/	Character of material	Geologic horizon	Distance of meas- uring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated capacity (gallons a minute)	Average pumping rate (estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks	
	T. 27 S., R. 24 W.																						
21	NW 1/4 SW 1/4 sec. 2	KARL MILLER KANSAS SOLDIERS HOME, FT. DODGE	—	—	VALLEY	DR.	21.6	16	G.I.	SAND & GRAVEL	ALLUVIUM	0.0	11.00	10-10-38	R	—	—	—	A	I	NOT USED	BATTERY OF 8 SHALLOW WELLS	
22	SW 1/4 NW 1/4 sec. 3	do	LAYNE WESTERN	1931	do	DR.	150	12	I	GRAVEL	OGALLALA	—	—	—	T	—	1000	800	E	I	75		
23	SW 1/4 NE 1/4 sec. 3	do	do	1930	do	DR	153	24 to 12	I	do	do	—	—	—	T	8-stage	400	400	E	I	75		
24	NW 1/4 SE 1/4 sec. 3	do	do	—	do	DR	150	12	I	do	do	—	—	—	T	do	300	300	E	P.S.		FT. DODGE HOMES & POWER PLANT NOT EQUIPPED WITH PUMP	
25	NW 1/4 NE 1/4 sec. 4	KANS. POWER CO	do	1931	do	DR	152	24	I	do	do	—	—	—	N	—	—	—	—	—			
26	do	do	do	1931	do	DR	152	24	I	do	do	—	—	—	T	?	2150	1700	E	Ind.			
27	do	do	do	1931	do	DR	152	24	I	do	do	—	—	—	T	—	2150	1700	E	do			
28	do	do	do	1931	do	DR	152	24	I	do	do	—	—	—	T	—	2150	1700	E	do			
29	SW 1/4 NE 1/4 sec. 12	VIC CARSON	—	1938	do	DR	15.5	16	G.I.	SAND & GRAVEL	ALLUVIUM	-0.5	4.75	10-26-38	C	4	400	400	G	I	25	BATTERY OF 2 SHALLOW WELLS	
	T. 27 S., R. 23 W.																						
30	SE 1/4 NE 1/4 sec. 16	C. VAN RIPER	—	—	do	DR	—	20	C.R.	do	do	-4.9	5.57	11-3-38	C	6	1200	900	E	I	60	BATTERY OF 3 SHALLOW WELLS	
31	NE 1/4 SE 1/4 sec. 16	G.D. COCHRAN	BERT JOHNSON	1935	do	DR	20.5	20	C.R.	do	do	+0.5	10.16	10-20-38	C	6	1200	900	G	I	60	BATTERY OF 3 SHALLOW WELLS	
32	NE 1/4 SE 1/4 sec. 18	P.H. YOUNG	—	1938	do	DR	30.0	20	G.I.	do	do	—	—	—	C	4	300	300	G	I	35		
33	SE 1/4 NE 1/4 sec. 23	G.D. COCHRAN	—	1930	do	DR	19.1	20	C.R.	do	do	0.0	7.85	10-26-38	C	6	800	800	G	I	36	BATTERY OF 6 SHALLOW WELLS	
	T. 28 S., R. 22 W.																						
34	SW 1/4 NW 1/4 sec. 2	MRS. CORA RICKARD	BERT JOHNSON	1934	do	DR	13.3	20	C.R.	do	do	-5.0	6.00	10-27-38	C	8	1200	500	G	I	10	BATTERY OF 7 SHALLOW WELLS	
35	NW 1/4 NE 1/4 sec. 4	RUSSELL RIEGEL	—	—	do	DR	19.9	20	C.R.	do	do	-8.7	3.60	10-27-38	C	6	1000	500	G	I	20	BATTERY OF 4 SHALLOW WELLS	
36	NE 1/4 NW 1/4 sec. 4	E.P. HOOVER	BERT HOOVER	1936	do	DR	15.3	19	G.I.	do	do	-10.0	5.42	10-27-38	C	3	300	250	T	I	18		
37	NE 1/4 NW 1/4 sec. 4	E.P. HOOVER	do	1936	do	DR	31.0	14	G.I.	do	do	—	—	—	C	2	125	125	G	I	6		
38	SW 1/4 SW 1/4 sec. 4	L.A. LAMB	ROY CURRY	1937	do	DR.	77.1	20	C.R.	do	do	+1.0	28.49	10-10-38	T	14	1200	1000	T	I	75		
39	NE 1/4 NE 1/4 sec. 9	T.P. RUSSELL	do	—	do	DR.	78.0	20	B.S.	do	do	+1.0	27.68	10-26-38	T	14	1500	900	T	I	80		
40	SW 1/4 NE 1/4 sec. 10	J.J. MAAS	OWNER	1937	do	DR	69.0	16	B.S.	do	do	0.0	24.49	11-15-38	T	14	1200	900	G	I	85		
41	SE 1/4 NW 1/4 sec. 11	E.V. MELIA	ROY CURRY	1937	do	DR	71.0	20	C.R.	do	do	0.0	25.85	10-27-38	T	14	1200	1000	G	I	25		

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Well No. on Plate 1	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/ 2/	Depth of well (feet)	Diameter of well (inches)	Type of casing 3/	Character of material	Geologic horizon	Distance of meas- uring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated capacity (gallons a minute)	Average pumping rate (estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks	
	T. 26 S., R. 21 W.																						
42	NW 1/4 SW 1/4 sec. 11	HARRY WETZEL	OWNER	1937	VALLEY	DR	45.4	36	G.I.	SAND & GRAVEL	ALLUVIUM	+0.7	27.82	10-27-38	V.C.	4	450	400	T	I	45		
43	SE 1/4 NW 1/4 sec. 13	HERMAN WETZEL	do	1938	do	DR	26.0	24	C.R.	do	do	+1.5	9.94	10-27-38	V.C.	5	500	500	G	I	2		
44	SE 1/4 NE 1/4 sec. 23	HENRY HATTRUP	do	1937	do	DR	29.3	34	S	do	do	+0.8	10.46	10-28-38	V.C.	5	400	400	G	I	28		
45	SE 1/4 SE 1/4 sec. 25	W.A. WETZEL	WETZEL BROS.	1938	do	DR	36.2	22	O.B.	do	do	+0.5	9.78	10-28-38	V.C.	5	500	500	G	I	20		
46	SW 1/4 NW 1/4 sec. 36	GEO. W. MOLITOR	—	—	do	DR	29.8	24	G.I.	do	do	+1.0	12.78	10-5-38	V.C.	5	800	750	G	I	NOT REPORTED		
	T. 27 S., R. 21 W.																						
47	NE 1/4 SE 1/4 sec. 2	CARL JOCHEMS	OWNER	1938	do	DR	28.9	22	O.B.	do	do	+0.9	9.59	11-3-38	V.C.	5	900	600	T	I	8		
	T. 26 S., R. 20 W.																						
48	SE 1/4 SW 1/4 sec. 19	R. SPECK	HARRY SPECK	1936	do	DR	15.9	20	G.I.	do	do	-4.0	8.38	10-28-38	C	6	600	500	G	I	14	LOCATED JUST ACROSS THE LINE IN EDWARDS COUNTY.	
	T. 26 S., R. 25 W.																						
Well No. on Plate 2																							
	T. 26 S., R. 25 W.																						
49	SW 1/4 SE 1/4 sec. 28	CHET WRIGHT	OWNER	1934	do	DR	14.8	20	C.R.	do	do	-8.5	4.21	12-1-38	C	3	300	300	G	I	9		
50	SW 1/4 SE 1/4 sec. 28	J.H. BURNETT	do	1935	do	DR	140.0	16	G.I.	GRAVEL	OGALLALA	—	—	—	C	6	1000	800	E	I	14		
51	SE 1/4 SE 1/4 sec. 28	J.T. RAKES	do	1935	do	DR	14.1	40	T.W	SAND & GRAVEL	ALLUVIUM	-9.9	1.80	11-23-38	C	5	600	600	G	I	15		
52	SE 1/4 SE 1/4 sec. 28	HAL SHUMWAY	—	1928	do	DR	—	16	G.I.	do	do	—	—	—	R	—	—	—	—	A	NOT USED		
53	NE 1/4 SW 1/4 sec. 29	J.P. McCOLLON	BERT JOHNSON	1936	do	DR	21.9	20	C.R.	do	do	-7.7	2.48	10-21-38	C	5	800	450	G	I	10		
54	SW 1/4 SW 1/4 sec. 29	JOHN MATTHEWS	OWNER	1934	do	DR	19.4	36	G.I.	do	do	-7.4	3.34	10-21-38	C	6	1000	1000	E	I	35		
55	SE 1/4 SW 1/4 sec. 29	J.P. McCOLLON	BERT JOHNSON	1935	do	DR	32.4	20	C.R.	do	do	+1.0	9.39	11-4-38	C	6	1000	1000	E	I	68		
56	SW 1/4 SE 1/4 sec. 29	PAUL STRAIN	OWNER	1938	do	DR	24.0	18	G.I.	do	do	—	—	—	C	3	300	300	G	I	4		
57	SW 1/4 SE 1/4 sec. 29	HARRY FINKLE	—	1936	do	DR	—	18	G.I.	do	do	—	—	—	C	3	300	250	G	I	NOT USED		
58	SW 1/4 SE 1/4 sec. 29	M.L. SHAW	OWNER	1937	do	DR	22.9	20	G.I.	do	do	+1.0	13.42	11-22-38	C	2	150	150	G	I	1/2		
59	SW 1/4 SE 1/4 sec. 29	J.A. DANIEL	BEN BERGKAMP	1938	do	DR	—	24	G.I.	do	do	—	—	—	C	2	150	150	G	I	5		
60	SW 1/4 SE 1/4 sec. 29	H.H. HAKEN	—	—	do	DR	—	10	G.I.	do	do	—	—	—	C	3	300	300	G	I	5		

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Well No. on Plate	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/	Depth of well 2/ (feet)	Diameter of well (inches)	Type of casing 3/	Character of material	Geologic horizon	Distance of measuring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated capacity (gallons a minute)	Average pumping rate (Estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks
	T. 26 S., R. 25 W.																					
61	SW 1/4 SE 1/4 sec. 29	JIM McDOWELL	OWNER	1938	VALLEY	DR	25.0	14	G.I.	SAND & GRAVEL	ALLUVIUM	-	-	-	C	3	300	300	E	I	5 1/2	
62	SW 1/4 SE 1/4 sec. 29	C.A. MULLENDORE	-	1930	do	DR	12.1	15	G.I.	do	do	-7.2	2.49	11-21-38	C	3	300	300	E	I	7 1/2	
63	SE 1/4 SE 1/4 sec. 29	M.H. LAPPIN	OWNER	1936	do	DR	25.5	18	G.I.	do	do	-	-	-	C	5	500	400	G	I	3	
64	SE 1/4 SE 1/4 sec. 29	W.H. COLEMAN	OWNER	1934	do	DR	-	12	G.I.	do	do	-14.0	6.83	11-22-38	C	3	300	300	G	I	2 1/2	
65	SE 1/4 SE 1/4 sec. 29	R.S. GLAZE	-	1932	do	DR	-	10	G.I.	do	do	-	-	-	C	1 1/2	125	125	E	I	1	
66	SE 1/4 SE 1/4 sec. 29	M.H. LAPPIN	OWNER	1935	do	DR	26.5	10	G.I.	do	do	-	-	-	C	2	200	150	G	I	2	
67	SE 1/4 SE 1/4 sec. 29	W.H. COLEMAN	OWNER	1932	do	DR	28.3	12	G.I.	do	do	+0.5	15.06	11-22-38	N	-	-	-	-	I	NOT USED	
68	SE 1/4 SE 1/4 sec. 29	DAYLE GONDER	BERT JOHNSON	1925	do	DR	27.2	16	G.I.	do	do	+1.5	14.92	11-21-38	C	4	450	400	G	I	3	
69	NE 1/4 NW 1/4 sec. 33	R.E. RINEY	-	-	do	DR	27.1	20	C.R.	do	do	+1.0	9.57	10-21-38	C	6	1000	1000	G	I	160	
Well No. on Plate 3																						
70	SW 1/4 SE 1/4 sec. 25	A.T. & S.F. RY.	-	1906	do	DR	148	13 to 8	I	GRAVEL	OGALLALA	-	-	-	T	-	-	-	E	Ind.	-	RAILROAD WELL, DODGE CITY ROUNDHOUSE
71	SE 1/4 SW 1/4 sec. 25	do	-	1906	do	DR	148	13 to 8	I	do	do	-	-	-	A.L.	-	-	-	?	do	-	DO.
72	NW 1/4 SE 1/4 sec. 26	KANS. POWER CO.	JIM JOHNSON	1937	do	DR	159	6	I	do	do	-	-	-	T	?	110	50	E	A.C.	-	
73	SW 1/4 SW 1/4 sec. 26	MRS. ALBERT WARREN	-	-	VALLEY	DR	20.4	22	O.B.	do	do	+0.7	11.35	11-29-38	C	2	200	150	G	I	3/4	
74	SW 1/4 SW 1/4 sec. 26	J.J. HOUSER	-	-	do	DR	18.1	16	G.I.	do	do	-5.32	3.50	11-29-38	C	2	150	150	G	I		
75	SW 1/4 SW 1/4 sec. 26	O.H. THOMPSON	-	-	do	DR	27.8	16	G.I.	do	do	0.0	12.40	11-29-38	C	4	400	400	G	I	1	
76	SE 1/4 SW 1/4 sec. 26	KANS. POWER CO.	-	-	do	DR	-	-	-	-	-	-	-	-	T	-	-	-	E	Ind.		STANDBY EQUIPMENT - SELDOM USED
77	SW 1/4 SE 1/4 sec. 26	DODGE CITY	LAYNE WESTERN	1930	do	DR	145	38	S	do	do	-	-	-	T		1300		E	P.S.		
78	SW 1/4 SE 1/4 sec. 26	DODGE CITY WAREHOUSE	FRED BAILEY	1938	do	DR	34	6	I	SAND & GRAVEL	ALLUVIUM				Pressure		500/HR		E	Ind.		
79	SW 1/4 SE 1/4 sec. 26	DODGE CITY STEAM LAUNDRY	-	1927	do	DR	143	5	I	GRAVEL	OGALLALA				P		?		G	do		
80	SE 1/4 SE 1/4 sec. 26	STORES CO.	-	1937	do	DR	100	6	I	do	do				C	2	40		E	A.C.		
81	SE 1/4 SE 1/4 sec. 26	DODGE CITY FLOUR MILLS	-	1917	do	DR	150	5	I	do	do				P		1500/HR		E	do		

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Well No. on Plate 3	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/	Depth of well 2/ (feet)	Diameter of well (inches)	Type of casing 3/	Character of material	Geologic horizon	Distance of meas- uring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated Capacity (gallons a minute)	Average pumping rate (estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks	
	T. 26 S., R. 25 W.																						
82	SE 1/4 SE 1/4 sec. 26	DODGE CITY FLOUR MILLS	—	1917	VALLEY	DR	150	5	I	GRAVEL	OGALLALA			BATTERY	C	4"	400		E	do		BATTERY OF 3 WELLS; ONE PUMP	
83	do	do	—	1917	do	DR	30	24	G.I.	SAND & GRAVEL	ALLUVIUM												
84	do	do	—	1931	do	DR	30	16	G.I.	do	do												
85	SW 1/4 SW 1/4 sec. 27	H. G. WRIGHT	—	1934	do	DR	17.7	16	G.I.	do	do	-4.5	7.83	11-28-38	C	4	500	500	G	I	3		
86	SW 1/4 SW 1/4 sec. 27	J. H. CROUCH	OWNER	1935	do	DR	24.4	12	G.I.	do	do	+0.3	12.42	11-28-38	C	2 1/2	200	200	G	I	3		
87	SE 1/4 SW 1/4 sec. 27	MADGE VICKERS	—	—	do	DR	20.9	16	G.I.	do	do	-12.4	5.84	11-29-38	C	3	300	300	E	I	17	BATTERY OF 3 SHALLOW WELLS	
88	SE 1/4 SW 1/4 sec. 27	GROVER HUNTER	—	1936	do	DR	33.7	20	O.B.	do	do	+0.4	21.32	11-29-38	C	3	300	300	E	I	5		
89	SW 1/4 SE 1/4 sec. 27	NORMAN ELLIOTT	—	—	do	DR	—	16	G.I.	do	do	—	—	—	C	4	300	300	E	I	6		
90	SW 1/4 SE 1/4 sec. 27	T. W. DOANE	—	—	VALLEY	DR.	17.5	14	G.I.	SAND & GRAVEL	ALLUVIUM	-11.4	3.15	11-29-38	N	—	—	—	—	I	NOT USED		
91	SW 1/4 SE 1/4 sec. 27	H. C. WRIGHT	—	—	do	DR.	12.0	16	G.I.	do	do	-8.4	5.26	11-29-38	C	4	400	350	E	I	2		
92	SE 1/4 SE 1/4 sec. 27	R. G. GORMAN	—	—	do	DR	22.8	10"	G.I.	do	do	+0.6	10.28	11-29-38	C	2	150	100	E	I	2 1/2		
93	SE 1/4 SE 1/4 sec. 27	W. C. BABCOCK	—	—	do	DR	24	—	—	do	do	—	—	—	C	3	300	300	G	I	1 1/2		
94	SE 1/4 SE 1/4 sec. 27	GODFREY SMITH	—	—	do	DR	18	—	—	do	do	—	—	—	C	3	300	300	G	I	2		
95	SE 1/4 SE 1/4 sec. 27	—	—	—	do	DR	14.5	14	G.I.	do	do	-5.0	4.39	11-29-38	C	3	300	300	G	I	?		
96	NE 1/4 NE 1/4 sec. 34	H. A. HART	—	1938	do	DR	5.3	24	O.B.	do	do	-3.5	2.20	11-29-38	P	2	75	75	G	I	2		
97	NE 1/4 NE 1/4 sec. 34	C. O. WOODSIDE	—	—	do	DR	18.0	24	G.I.	do	do	—	—	—	F	2	200	150	G	I	1		
98	NE 1/4 NW 1/4 sec. 34	BILL BADER	—	—	do	DR	29.9	20	C.R.	do	do	-8.0	3.33	11-29-38	C	6	800	750	E	I	40		
99	NW 1/4 NW 1/4 sec. 34	C. W. WILKERSON	—	1928	do	DR	14.4	16	G.I.	do	do	-10.0	3.68	11-29-38	C	6	700	650	E	I	25		
100	NW 1/4 NW 1/4 sec. 34	F. H. DIEHL	—	—	do	DR	—	—	—	do	do	—	—	—	C	3	300	300	E	I	2		
101	NW 1/4 NW 1/4 sec. 34	ALBERT SCHRAEDER	OWNER	1937	do	DR	—	19	G.I.	do	do	—	—	—	C	3	300	300	E	I	3		
102	NW 1/4 NW 1/4 sec. 34	ROY WELLS	—	—	do	DR	21.3	20	G.I.	do	do	+0.3	7.34	11-22-38	C	4	450	400	G	I	20		
103	NW 1/4 NW 1/4 sec. 34	F. H. DIEHL	ROY CURRY	1938	do	DR	22.2	20	C.R.	do	do	+0.8	7.19	10-5-38	V.C.	5	900	800	G	I	40		
104	SW 1/4 NW 1/4 sec. 34	ROY WELLS	—	—	do	DR	19.5	48	W.I.	do	do	-1.0	5.17	11-29-38	N	—	—	—	—	I	NOT USED		

RECORDS OF IRRIGATION, INDUSTRIAL AND MUNICIPAL WELLS
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Well No. on Plate 3	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/	Depth of well 2/ (feet)	Diameter of well (inches)	Type of well 3/	Character of material	Geologic horizon	Distance of meas- uring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated capacity (gallons a minute)	Average pumping rate (estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks	
	T. 26S. R. 25W.																						
105	SW 1/4 NW 1/4 sec. 34	HARRY HART	—	—	VALLEY	DR	8.6	16	G.I.	SAND & GRAVEL	ALLUVIUM	-2.5	3.38	11-29-38	C	5	750±	600	T	I	NOT USED		
106	SE 1/4 NE 1/4 sec. 34	do	—	—	do	DR	14.9	24	O.B.	do	do	-1.0	4.98	11-29-38	N	—	—	—	—	I	NOT USED		
107	SW 1/4 SE 1/4 sec. 34	C. M. STATES	BLACKY HIGGINS	1938	do	DR	150.0	24 to 8	B.S.	GRAVEL	ALLUVIUM & OGALLALA FM	0.0	15.81	10-24-38	C	6	800	800	E	I	40		
108	NE 1/4 NE 1/4 sec. 35	FAIRMOUNT CREAMERY	—	1928	do	DR	140	15	S	GRAVEL	OGALLALA				T	4"	250		E	do		COMBINATION OF FIRST & SECOND WATERS	
109	NE 1/4 NE 1/4 sec. 35	CITY OF DODGE CITY	LAYNE WESTERN	1927	do	DR	140	38	S	do	do				T		500		E	P.S.			
110	NE 1/4 NW 1/4 sec. 35	KANS. POWER CO.	—	—	do	DR	—	—	—						T				E				
111	NW 1/4 NW 1/4 sec. 35	L. R. DOONON	OWNER	—	do	DR	—	15	G.I.	SAND & GRAVEL	ALLUVIUM	—	—	—	C	3	300	200	G	I	NOT USED	STANDBY EQUIPMENT; SELDOM USED	
112	NW 1/4 NW 1/4 sec. 35	ALEX MULLENDORE	OWNER	—	do	DR	22.5	14	G.I.	do	do	+0.5	7.46	11-29-38	C	3	300	200	E	I	4 1/2		
113	NW 1/4 NW 1/4 sec. 35	R. E. BISBEE	OWNER	—	do	DR	20.6	14	G.I.	do	do	+1.5	9.07	11-29-38	C	2 1/2	275	250	G	I	2		
114	NW 1/4 NW 1/4 sec. 35	C. L. RALSTON	OWNER	—	do	DR	—	—	—	do	do	—	—	—	C	2 1/2	300	300	G	I	1 1/2		
115	NW 1/4 NW 1/4 sec. 35	E. E. AGALSON	OWNER	—	VALLEY	DR	12.8	12	G.I.	SAND & GRAVEL	ALLUVIUM	0.0	5.63	11-29-38	C	2	150	125	G	I	NOT USED		
116	NW 1/4 NW 1/4 sec. 35	E. S. PHILLIPS	OWNER	—	do	DR	—	14	G.I.	do	do	—	—	—	C	3	300	300	G	I	3 1/2		
117	NW 1/4 NW 1/4 sec. 35	E. E. INNES	OWNER	—	do	DR	—	10	G.I.	do	do	—	—	—	C	2	150	100±	G	I	NOT USED		
118	SE 1/4 NW 1/4 sec. 35	KANS. POWER CO.	—	—	do	DR	—	—	—						R				—	A	—	OUT OF USE	
119	SE 1/4 NW 1/4 sec. 35	O. T. CURRY	OWNER	1935	do	DR	20.1	20	C.R.	do	do	-3.9	4.38	12-1-38	C	3	300	250	G	I	1		
120	SW 1/4 NE 1/4 sec. 35	CITY OF DODGE CITY	LAYNE WESTERN	1932	do	DR	147	38	S	GRAVEL	OGALLALA	—	—	—	T		1000		E	P.S.	—		
121	SW 1/4 NE 1/4 sec. 35	J. S. DILLON GROCERY STORE	BERT JOHNSON	1937	do	DR	128	6	I	do	do	—	—	—	C	1 1/2	75		E	A.C.			
122	SE 1/4 NE 1/4 sec. 35	JOE HULPIEU	—	1938	do	DR	16.9	20	C.R.	SAND & GRAVEL	ALLUVIUM	-5.2	2.01	11-30-38	C	5	900±	820	E	I	13		
123	NE 1/4 SE 1/4 sec. 35	MRS. LENA BROWN	GEO. JOHNSON	1938	do	DR	25.0	20	C.R.	do	do	—	—	—	T	—	600	600	E	I	9		
124	NE 1/4 SE 1/4 sec. 35	CHAS. WILKERSON	MIKE JOHNSON	1937	do	DR	18.4	20	C.R.	do	do	-7.3	3.27	11-29-38	C	5	600	600	E	I	6		
125	NE 1/4 SW 1/4 sec. 35	JOHN SHUMARD	OWNER	1933	do	DR	22.4	16	G.I.	do	do	0.0	7.90	12-1-38	C	3	300	300	G	I	3		
126	NE 1/4 SW 1/4 sec. 35	A. J. FULLERTON	OWNER	1926	do	DR	—	14	B.S.	do	do	—	—	—	C	2	200	200	G	I	2 1/2		
127	NW 1/4 SW 1/4 sec. 35	W. F. MCCOY	OSCAR JOHNSON	1936	do	DR	138.0	16 to 8	I	GRAVEL	ALLUVIUM & OGALLALA FM	+1.0	11.16	11-30-38	C	6	1000	800	G	I	40	COMBINATION OF FIRST & SECOND WATERS.	

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	T. 26 S., R. 25 W.																					
128	SE 1/4 SW 1/4 sec. 35	CLYDE BURK	—	1927	do	DR	17.9	15	G.I.	SAND & GRAVEL	ALLUVIUM	0.0	10.24	11-30-38	C	2 1/2	200	200	G	I	2	
129	SE 1/4 SW 1/4 sec. 35	E.B. STEELE	OWNER	1938	do	DR	17.8	12	G.I.	do	do	+0.3	10.58	11-30-38	C	2	200	150	G	I	1	
130	SE 1/4 SW 1/4 sec. 35	A.N. THOMAS	—	1938	do	DR	—	1 1/4	G.P.	do	do	—	—	—	C	1 1/4	75	60	G	I	1/4	
131	SE 1/4 SW 1/4 sec. 35	FRANK GOFF	OWNER	—	do	DR	18.4	22	O.B.	do	do	+0.2	9.99	11-30-38	C	2	150	150	G	I	2	
132	SE 1/4 SW 1/4 sec. 35	F.R. WYATT	OWNER	1932	do	DR	—	14	G.I.	do	do	—	—	—	C	2	150	150	E	I	2	
133	SE 1/4 SW 1/4 sec. 35	J.H. WYATT	OWNER	1938	do	DR	10.9	12	G.I.	do	do	-4.8	4.12	11-30-38	C	2	200	200	G	I	1	
134	SE 1/4 SW 1/4 sec. 35	GEO. W. SUTTON	OWNER	—	do	DR	—	2	G.P.	do	do	—	—	—	C	2	200	200	G	I	NOT USED	
135	SE 1/4 SW 1/4 sec. 35	J.W. HOLBROOK	—	1932	do	DR	13.9	16	G.I.	do	do	-3.9	3.90	11-30-38	C	4	300	300	E	I	1 3/4	
136	SE 1/4 SW 1/4 sec. 35	P.O. RILEY	—	1937	do	DR	18.5	12	G.I.	do	do	+1.1	10.83	11-30-38	C	3	300	100	G	I	1	
137	SE 1/4 SW 1/4 sec. 35	RAY PARTRIDGE	CHAS. WALKER	—	do	DR	—	16	G.I.	do	do	—	—	—	C	1 1/2	100	100	E	I	1	
138	SW 1/4 SE 1/4 sec. 35	F.H. SHELOR	ROY CURRY	—	do	DR	—	20	C.R.	do	do	—	—	—	C	5	500	480	E	I	3	
139	SW 1/4 SE 1/4 sec. 35	CLYDE BURK	OWNER	1932	do	DR	25.5	15	G.I.	do	do	0.0	10.31	11-30-38	C	2 1/2	250	200	G	I	1	
140	SE 1/4 SE 1/4 sec. 35	LIGHTER & PIERCE	—	—	do	DR	26.8	14	G.I.	do	do	+1.1	10.10	11-30-38	C	2 1/2	250	200	G	I	1 1/2	
141	SE 1/4 SE 1/4 sec. 35	O.M. BARTON	BERT JOHNSON	1937	VALLEY	DR	23.1	20	C.R.	do	do	-6.3	2.92	11-29-38	C	6	1000	900	G	I	10	
142	NE 1/4 NE 1/4 sec. 36	ENDSLEY	—	1917	do	DR	28.3	16	G.I.	do	do	+0.5	16.16	11-16-38	C	3	300	250	G	I	NO REPORT	
143	NW 1/4 NE 1/4 sec. 36	C.L. MILLER	OWNER	1924	do	DR	33.4	12	B.S.	do	do	0.0	19.55	11-16-38	C	6	600	450	G	I	8	ONE OF THE OLDEST PLANTS IN FORD COUNTY
144	NE 1/4 NW 1/4 sec. 36	G.H. WILCOXEN	—	—	do	DR	29.1	16	G.I.	do	do	+1.0	18.32	11-16-38	C	6	800	600±	G	I	NO REPORT	
145	NE 1/4 NW 1/4 sec. 36	?	—	—	do	DR	28.8	16	G.I.	do	do	+1.0	15.21	11-16-38	C	2	200	150	G	I	NOT USED	
146	NE 1/4 NW 1/4 sec. 36	PAUL BAYS	OWNER	—	do	DR	—	16	G.I.	do	do	—	—	—	C	3	300	300	G	I	3	
147	NE 1/4 NW 1/4 sec. 36	GEO. LOCHMANN	—	—	do	DR	18.4	16	I	do	do	-8.7	6.68	12-1-38	C	3	300	300	G	I	3	
148	NW 1/4 NW 1/4 sec. 36	GEO. BEALL	R.J. KIRKPATRICK	—	do	DR	13.1	22	O.B.	do	do	-3.6	6.50	12-1-38	C	2 1/2	200	200	G	I	2	BATTERY OF 2 SHALLOW WELLS
149	SE 1/4 NE 1/4 sec. 36	ROLLIE KINER	ROY CURRY	1938	do	DR	14.1	20	C.R.	do	do	-6.7	2.64	11-16-38	C	5	500	500	G	I	5	
150	NW 1/4 SE 1/4 sec. 36	MRS. THOMPSON	—	—	do	DR	—	—	—	do	do	—	—	—	C	3	300	300	G	I	5	

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Well No. on Plate 3	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/	Depth of well 2/ (feet)	Diameter of well (inches)	Type of casing 3/	Character of material	Geologic horizon	Distance of measuring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated capacity (gallons a minute)	Average pumping rated (estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks
	T. 26 S., R. 25 W.																					
151	SW 1/4 SW 1/4 sec. 36	W. P. JONES	BERT JOHNSON	1935	VALLEY	DR	38.3	20	C.R.	SAND & GRAVEL	ALLUVIUM	+1.0	13.19	11-29-38	C	6	1000	800	G	I	22	
152	SE 1/4 SW 1/4 sec. 36	U. L. HOOD	—	1933	do	DR	—	10	G.I.	do	do	—	—	—	C	1 3/4	60	60	G	I	1/4	
153	SW 1/4 SE 1/4 sec. 36	W. F. MCCOY	HENRY	1937	do	DR	23.0	24	G.I.	do	do	—	—	—	C	5	600	400	G	I	5	
154	SW 1/4 SE 1/4 sec. 36	GUY MCCONNELL	—	1920	do	DR	21.9	16	G.I.	do	do	+0.2	8.92	11-29-38	C	5	900	600	G	I	5	
155	SW 1/4 SE 1/4 sec. 36	FRED PITMAN	—	1930	do	DR	23.4	16	G.I.	do	do	+1.5	23.4	11-29-38	C	4	500	500	G	I	5	BATTERY OF 3 SHALLOW WELLS
156	SE 1/4 SE 1/4 sec. 36	JOHN G. DONOVAN	OWNER	—	do	DR	—	22	O.B.	do	do	—	—	—	C	4	400	400	G	I	1	BATTERY OF 2 SHALLOW WELLS
157	SE 1/4 SE 1/4 sec. 36	M. E. O'CONNOR	WARREN BROWN	1920	do	DR	23.3	12	G.I.	do	do	+0.5	14.98	11-29-38	C	4	300	300	G	I	8	
	T. 27 S., R. 25 W.																					
158	NW 1/4 NW 1/4 sec. 2	OTIS BEESON	TOM STAUTH	1908	do	DR	24.8	15	G.I.	do	do	+0.3	16.10	10-24-38	C	6	300	300	G	I	13	BATTERY OF 3 SHALLOW WELLS
159	NW 1/4 NE 1/4 sec. 3	W. S. TACKLEY	OWNER	—	do	DR	23.3	14	G.I.	do	do	+1.0	13.07	11-30-38	C	4	400	375	E	I	5	
160	NW 1/4 NE 1/4 sec. 3	CHAS. BEALL	OWNER	1934	do	DR	25.0	12	G.I.	do	do	—	—	—	C	3	300	250	G	I	3 1/2	
161	SW 1/4 NE 1/4 sec. 3	SILAS POTTER	—	—	do	DR	—	—	—	do	do	—	—	—	C	2 1/2	250	250	G	I	4	
162	NW 1/4 NE 1/4 sec. 3	CHAS. BEALL	OWNER	1937	do	DR	29.4	42	T.W.	do	do	+1.6	17.37	12-1-38	C	3	300	300	G	I	4	
163	NE 1/4 NE 1/4 sec. 3	S. G. JOY	OWNER	1938	do	DR	19.6	22	O.B.	do	do	-5.5	8.92	11-30-38	C	2 1/2	250	250	G	I	2	
164	NE 1/4 NE 1/4 sec. 3	H. KRUGER	OWNER	—	do	DR	—	20	C.R.	do	do	—	—	—	C	4	350	200	G	I	4	
165	NE 1/4 NE 1/4 sec. 3	CARL WILLIAMS	OWNER	—	do	DR	—	14	—	do	do	—	—	—	C	2 1/2	250	250	G	I	4	
166	NE 1/4 NW 1/4 sec. 3	W. H. MONROE	—	—	do	DR	18.5	15	G.I.	do	do	-9.5	3.05	11-30-38	C	3	300	300	E	I	1 1/2	
167	SE 1/4 NW 1/4 sec. 3	CLYDE BURK	OWNER	1938	do	DR	47.3	19	G.I.	do	do	-1.0	24.69	11-4-38	C	6	1000	700	G	I	NOT COMPLETED	
	T. 26 S., R. 24 W.																					
168	NE 1/4 NW 1/4 sec. 31	NORBY PIPPITT	—	—	do	DR	—	16	G.I.	do	do	—	—	—	C	3	300	250	E	I	5	
169	NE 1/4 NW 1/4 sec. 31	ARTHUR G. SAHM	—	—	do	DR	20.1	10	G.I.	do	do	-10.4	7.86	11-12-38	C	3	350	300	G	I	5	
170	NE 1/4 NW 1/4 sec. 31	BOYCE	—	—	do	DR	—	16	G.I.	do	do	—	—	—	C	3	300	250	G	I	NOT USED	

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Well No. on Plate 4	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/	Depth of well 2/ (feet)	Diameter of well (inches)	Type of casing 3/	Character of material	Geologic horizon	Distance of meas- uring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated capacity (gallons a minute)	Average pumping rate (estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks
	T. 26S., R. 24W																					
171	NE 1/4 NW 1/4 sec. 31	VIRGIL HANNA	—	—	VALLEY	DR	27.9	12	G.I.	SAND & GRAVEL	ALLUVIUM	+0.6	19.88	11-12-38	C	3	250	250	G	I	4	
172	NE 1/4 NW 1/4 sec. 31	FRANK KENNEDY	—	—	do	DR	—	—	—	do	do	—	—	—	C	3	250	250	E	I	4	"POINT" WELL; NO OPEN CASING
173	NE 1/4 NW 1/4 sec. 31	TOM BARRETT	—	—	do	DR	37.4	16	G.I.	do	do	+0.5	25.17	11-12-38	C	3	250	250	E	I	10	
174	NE 1/4 NW 1/4 sec. 31	W.A. PIPPITT	—	1926	do	DR	34.4	16	G.I.	do	do	0.0	24.68	11-12-38	C	2	200	200	G	I	10	
175	NW 1/4 NW 1/4 sec. 31	?	—	—	do	DR	—	16	G.I.	do	do	—	—	—	C	3	?	?	—	A	NOT USED	DISCHARGE PIPE REMOVED
176	NW 1/4 NW 1/4 sec. 31	C.D. FREEMAN	—	—	do	DR	26.1	16	G.I.	do	do	+0.2	16.54	12-1-38	C	2 1/2	250	250	E	I	1 1/2	
177	NW 1/4 NW 1/4 sec. 31	J. L. JONES	—	—	do	DR	30.0	8	G.I.	do	do	—	—	—	C	2	200	150	G	I	1 1/2	
178	NW 1/4 NW 1/4 sec. 31	GEO. BROSIUS	—	—	do	DR	31.4	15	G.I.	do	do	+0.3	18.45	11-16-38	C	4	400	350	G	I	3	
179	NW 1/4 NW 1/4 sec. 31	C.A. REINERT	—	1936	do	DR	30.0	15	G.I.	do	do	—	—	—	C	3	150	150	G	I	3	
180	NW 1/4 NW 1/4 sec. 31	C.W. CROSS	—	1925	do	DR	47.0	15	G.I.	do	do	+1.5	17.29	11-16-38	C	3	365	300	E	I	4	
181	SE 1/4 NW 1/4 sec. 31	VIRGIL HANNA	—	1938	do	DR	14.6	24	G.I.	do	do	-2.0	5.21	11-10-38	C	6	500	500	G	I	24	
182	SE 1/4 NW 1/4 sec. 31	OSCAR E SMITH	OWNER	—	do	DR	—	20	O.B.	do	do	—	—	—	C	2	150	150	E	I	4	
183	SE 1/4 NW 1/4 sec. 31	HARRY BURNS	—	1935	do	DR	22.8	22	O.B.	do	do	+0.1	15.26	11-10-38	C	3	300	250	E	I	4	
184	SE 1/4 SW 1/4 sec. 31	WILL RICKEN	—	1925	do	DR	25.2	16	G.I.	do	do	0.0	15.59	11-10-38	C	3	300	300	E	I	4	
185	SE 1/4 NW 1/4 sec. 31	HENRY BESTEGAN	—	—	do	DR	21.8	14	G.I.	do	do	+0.5	15.52	11-10-38	C	3	300	200	E	I	6	
186	SE 1/4 NW 1/4 sec. 31	?	—	—	do	DR	—	12	G.I.	do	do	—	—	—	C	3	300	250±	G	I	4	
187	SW 1/4 NE 1/4 sec. 31	ALBERT KLINE	—	—	do	DR	18.2	16	G.I.	do	do	-6.1	6.43	11-10-38	C	3	300	300	E	I	10	
188	SW 1/4 NE 1/4 sec. 31	J. C. MAY	—	1930	do	DR	20.5	16	G.I.	do	do	-7.0	8.04	11-10-38	C	4	500	500	E	I	2 1/2	
189	SW 1/4 NE 1/4 sec. 31	E.P. CYPHERS	R. UDAN	1931	do	DR	24.4	16	G.I.	do	do	-2.0	14.41	11-10-38	C	3	300	300	E	I	2 1/2	
190	SE 1/4 NE 1/4 sec. 31	HERMAN FREEMAN	do	1935	do	DR	27.9	16	G.I.	do	do	+0.2	16.61	11-10-38	C	3	300	300	E	I	2	
191	SE 1/4 NE 1/4 sec. 31	MIKE PEDILLA	BERT JOHNSON	1936	do	DR	27.6	20	C.R.	do	do	+0.9	15.73	11-10-38	C	4	500	400	E	I	3	
192	SE 1/4 NE 1/4 sec. 31	MRS. M.A. OWENS	—	1925	do	DR	26.1	20	G.I.	do	do	0.0	15.55	11-10-38	C	3	300	300	G	I	NOT USED	
193	SE 1/4 NE 1/4 sec. 31	C.E. BOYER	OWNER	1922	do	DR	15.6	16	G.I.	do	do	-5.5	5.20	11-10-38	C	4	500	400	E	I	NOT USED	BATTERY OF 2 SHALLOW WELLS

RECORDS OF IRRIGATION, INDUSTRIAL AND MUNICIPAL WELLS
in
FORD COUNTY, KANSAS

Well No. on Plate 4	Location	Owner or tenant	Driller	Date completed	Topographic situation	Type of well 1/	Depth of well 2/ (feet)	Diameter of well (inches)	Type of casing 3/	Character of material	Geologic horizon	Distance of measuring point above or below ground surface (feet)	Depth to water level below measuring point (feet)	Date of measurement	Type of pump 4/	Size of pump (inches)	Rated capacity (gallons a minute)	Average pumping rate (estimated) (gallons a minute)	Kind of power 5/	Use of water 6/	Acres irrigated	Remarks
	T. 26 S., R. 24 W.																					
194	NW 1/4 SE 1/4 sec. 31	BRUNDAGE	BERT JOHNSON	1934	VALLEY	DR	21.8	20	G.I.	SAND & GRAVEL	ALLUVIUM	+0.5	10.19	11-10-38	C	3	350	300	G	I	1	
195	NW 1/4 SE 1/4 sec. 31	G.E. EAGAN	do	1934	do	DR	20.6	16	O.B.	do	do	+0.8	10.52	11-10-38	C	3	350	300	G	I	8	
196	NW 1/4 NW 1/4 sec. 32	JOHN GODFREY	OWNER	1932	do	DR	43.9	48 to 15	G.I.	do	do	+0.5	36.41	10-25-38	C	4	350	350	E	I	5 1/2	
197	SW 1/4 NW 1/4 sec. 32	H. WILKINSON	BERT JOHNSON	1915	do	DR	43.4	48	T.W.	do	do	+1.5	34.53	10-25-38	C	5	900	400	E	I	40	
198	SW 1/4 NW 1/4 sec. 32	BUNCH BROWN			do	DR	34.3	16	G.I.	do	do	+1.0	24.33	10-26-38	C	4	500	400	T	I	10	
199	SE 1/4 NW 1/4 sec. 32	WALKER ESTATE	TOM WALKER	1928	do	DR	29.3	16	G.I.	do	do	+0.5	24.85	11-9-38	R					I	NOT USED	
200	SW 1/4 NE 1/4 sec. 32	E.G. MOODY	OWNER	1934	do	DR	33.7	20	C.R.	do	do	+0.3	25.80	10-25-38	C	4	600	400	E	I	9	
201	SW 1/4 NE 1/4 sec. 32	J.E.D. HOMAN	J.O. JOHNSON		do	DR	30.8	20	C.R.	do	do	+0.6	22.90	11-9-38	C	3	350	300	E	I	5	
202	NE 1/4 SE 1/4 sec. 32	WM. R. COOK	OWNER	1934	do	DR	41.3	20	C.R.	do	do	+0.8	28.75	10-25-38	C	6	1000	800	G	I	35	
203	NW 1/4 SE 1/4 sec. 32	WM. AKERS	BERT JOHNSON	1935	do	DR	15.9	20	C.R.	do	do	-11.0	5.95	11-9-38	C	4	450	400	G	I	7	
204	NE 1/4 SW 1/4 sec. 32	FRED BONNERLING	do	1924	do	DR	29.3	12	C.R.	do	do	+1.0	20.79	11-9-38	C	5	500	500	G	I	10	BATTERY OF 3 SHALLOW WELLS
205	NE 1/4 SW 1/4 sec. 32	JESS STAGGS	JIM JOHNSON	1925	do	DR	33.1	12	C.R.	do	do	0.0	23.18	10-10-38	C	4	500	400	E	I	17	
206	NW 1/4 SW 1/4 sec. 32	VIC CARSON	DUKE & CARSON	1922	do	DR	24.4	20	C.R.	GRAVEL	ALLUVIUM & OGALLALA	+0.8	14.61	10-26-38	C	11	2800	1600	E	I	97	BATTERY OF 12 WELLS; 10 SHALLOW, 2 DEEP
207	NE 1/4 SW 1/4 sec. 33	J.M. HULPIEU		1938	do	DR	129.0	16	B.S.	GRAVEL	OGALLALA	0.0	31.26	10-25-38	T	8	1000	800	E	I	70	SHALLOW WATER TO BE CUT IN ALSO (1938)
208	NW 1/4 SW 1/4 sec. 33	do			do	DR	27.4	16	G.I.	SAND & GRAVEL	ALLUVIUM	0.0	24.60	10-25-38	R					A	NOT USED	BATTERY OF 6 SHALLOW WELLS
209	NW 1/4 SW 1/4 sec. 33	R.L. DILLEY	BERT JOHNSON	1921	do	DR	110.0	20	G.I.	GRAVEL	OGALLALA	+1.0	34.08	10-28-38	C	6	1000	500	E	I	15	BATTERY OF 2 WELLS; 1 DEEP & 1 SHALLOW
210	SW 1/4 SW 1/4 sec. 33	O.N. NEVINS	do		do	DR	125.0	12 & 8	G.I. & I	do	ALLUVIUM & OGALLALA	-9.3	12.09	10-25-38	C	6	800	750	E	I	29	BATTERY OF 5 WELLS; 2 DEEP & 3 SHALLOW
1/	Dr., drilled.																					
2/	Reported depths below the land surface are given in feet; measured depths in feet and tenths below measuring points.																					
3/	G.I., galvanized iron; O.W., oil well; C.R., concrete rings; I., iron; O.B., oil barrels; T.W., tractor wheels; W.I., wrought iron; B.S., boiler steel; G.P. galvanized pipe.																					
4/	C., horizontal centrifugal; V.C., vertical centrifugal; T., turbine; N., none; R., removed; P., plunger type; F., force; A.L., air lift.																					
5/	E, electric; G, gas engine; D, diesel; T, tractor.																					
6/	I, irrigation; A, abandoned; P.S., public supply; Ind., industrial supply; A.C., air conditioning.																					

RIVER DIVERSION PUMPING PLANTS

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

WATER RESOURCES BRANCH

RECORDS OF ~~WELLS~~ ^{RIVER PUMPS} IN FORD COUNTY KANSAS STATE

11

U. S. GOVERNMENT PRINTING OFFICE: 1929 6-7028

No.	1 LOCATION	2a OWNER OR NAME	2b DRILLER	2c Date completed	3 Topographic situation	4 Altitude above sea level	5 Type of well	6 Depth of well	7 Diameter of well	8 PRINCIPAL WATER-BEARING BED				9 Depth to which well is cased	10 WATER LEVEL		11a Method of lift	11b Capacity of pump SIZE	12a YIELD		12b DRAW DOWN		13 Use of Water	ACRES + Quality IRRIGATED	14b Temperature ° F.	15 Cost	REMARKS
										Depth to top of bed	Thick-ness	Character of material	Geologic horizon		Above (+) or below (-) surface or bench mark	Date of measurement			Rated CAPACITY	Date of measurement	TYPE Amount of POWER	Duration of test					
	<u>T. 27 S., R. 21 W.</u>					Feet		Feet	Inches	Feet	Feet																
1	NW 1/4 SW 1/4 sec. 23	KAY L. SHELLHEIMER			Valley											C	6"	G. P. M. 1000-1200		G		I	52			River diversion (10-12 foot head)	
2	SE 1/4 SE 1/4 sec. 22	M. E. NEAL			Valley											C	8"	1200-1500		G		I	65			River diversion	
3	SW 1/4 SW 1/4 sec. 31	J. L. RIEGEL			Valley											C	10"			G		I	40			River diversion	
	<u>T. 27 S., R. 22 W.</u>																										
4	SE 1/4 sec. 35	WM. C. FOWLER			Valley											C	8"	1200-1300		G		I	30-40			River diversion	
5	sec. 32	G. MOLITOR			Valley											C	6"	1200		G		I	42			River diversion	
6	SE 1/4 sec. 31	J. E. LOVETTE			Valley											C	6"			G		I	20			River diversion	
	<u>T. 27 S., R. 23 W.</u>																										
7	SW 1/4 sec. 24	J. E. BURKE			Valley											C	6"	1200		G		I	95			River diversion	
	<u>T. 27 S., R. 24 W.</u>																										
8	NW 1/4 SE 1/4 sec. 4	WILLROADS PROJECT			Valley											C	8"	1500		E		I	300			River diversion (used in conjunction with Willroads ditch.)	
	<u>T. 26 S., R. 25 W.</u>																										
9	NW 1/4 sec. 30	CHAS. STAPLES			Valley											C	5"	800		E		I	?(alfalfa)			River diversion	
	<u>T. 27 S., R. 24 W.</u>																										
10	NE 1/4 SE 1/4 sec. 3	JUDGE KARL MILLER			Valley											C	8"	2200		E		I	75			River diversion	