HYDROLOGIC AND RELATED DATA FOR WATER-SUPPLY PLANNING IN AN INTENSIVE-STUDY AREA, NORTHEASTERN WICHITA COUNTY, KANSAS

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 79-105

Prepared in cooperation with the
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Data are presented that result from an intensive geohydrologic study for water-supply planning in a 12-square-mile area in Wichita County, west-central Kansas. These data include records of wells, test drilling, chemical analyses, ground-water levels, rainfall, soil moisture, well yield, solar radiation, crop yield, and crop acreage. Interpretation of water-level and crop-related data indicates that water levels in the unconsolidated aquifer are declining at an average annual rate of about 1 to 2 feet per year (1950-78). This decline is the aquifer's response to pumping by irrigation wells for watering corn, wheat, grain sorghum, and other crops.

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HYDROLOGIC AND RELATED DATA FOR WATER-SUPPLY PLANNING IN AN INTENSIVE-STUDY AREA, NORTHEASTERN WICHITA COUNTY, KANSAS

By Jack Kume, L. E. Dunlap, E. D. Gutentag, and J. G. Thomas

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Lawrence, Kansas

1979

UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, SECRETARY

GEOLOGICAL SURVEY

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IN AN INTENSIVE-STUDY AREA, NORTHEASTERN WICHITA COUNTY, KANSAS

Jack Kume,* L. E. Dunlap,* E. D. Gutentag,* and J. G. Thomas**

ABSTRACT

Data are presented that result from an intensive geohydrologic study for water-supply planning in a 12-square-mile area in northeastern Wichita County, Kansas. These data include records of wells, test drilling, chemical analyses, ground-water levels, rainfall, soil moisture, well yield, solar radiation, crop yield, and crop acreage. Data indicate that water levels in the unconsolidated aquifer are declining at an average annual rate of about 1 to 2 feet per year (1950-78). This decline is the aquifer's response to pumping by irrigation wells for watering corn, wheat, grain sorghum, and other crops.

* U.S. Geological Survey

** Kansas State University

INTRODUCTION

This basic-data report serves two purposes: (1) to make available the basic geohydrologic and water-management data for use in studying and planning water-resources development, in increasing irrigation efficiency, and in conserving ground water and energy, and (2) to supplement an interpretive geohydrologic study.

This report is a product of an intensive investigation of the geology, hydrology, and water-resources management in a 12-square-mile area of intensive study north of Marienthal in Wichita County, Kansas (fig. 1). The study was done during 1976-78 by the U.S. Geological Survey in cooperation with the Western Kansas Groundwater Management District No. 1. Other agencies who were interested and gave assistance during the operation of this program were the Ozarks Regional Commission; the Kansas Water Resources Board; the Kansas State Board of Agriculture, Division of Water Resources; the Kansas State University; and the Kansas Geological Survey.

The data in this report include records of 53 selected irrigation and observation wells and test holes; lithologic logs of 10 test holes and private wells; chemical analyses from 8 representative wells; ground-water levels in 10 observation wells; amount of rainfall, soil moisture, well discharge, and solar radiation; and crop yield and acreage.

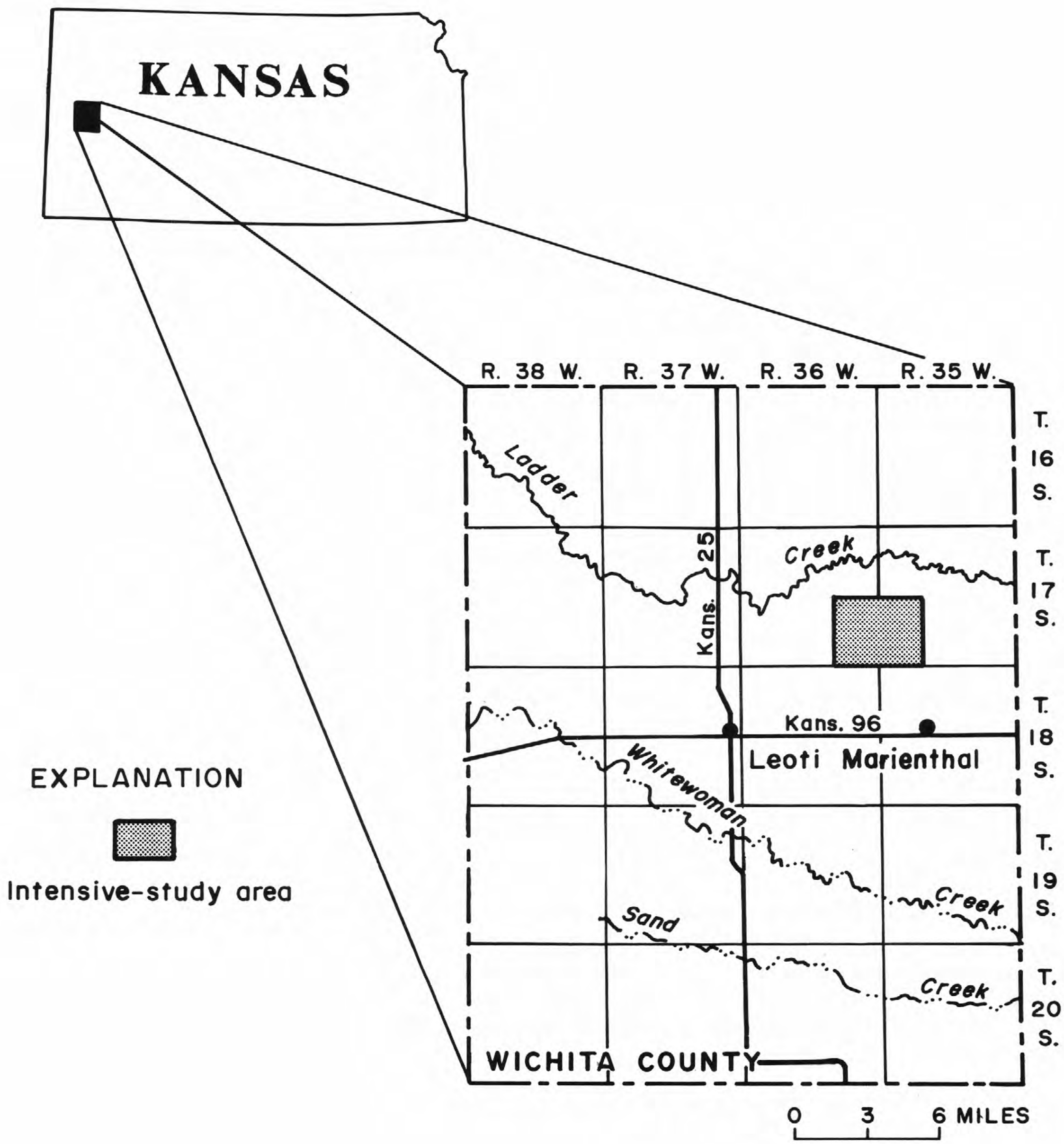

Figure 1.--Location of the intensive-study area.

Conversion Factors

For those readers who may prefer to use metric units rather than inch-pound units, the conversion factors for the International System (SI) of Units and abbreviations for terms used in this report are listed below:

To convert from inch-pound units	To SI units	Multiply by
<u>Length</u>		
inch (in)	millimeter (mm)	25.4
	centimeter (cm)	2.54
foot (ft)	meter (m)	.3048
mile (mi)	kilometer (km)	1.609
<u>Area</u>		
acre	square meter (m^2)	4,047.
square mile (mi^2)	square kilometer (km^2)	2.590
<u>Volume</u>		
gallon (gal)	liter (L)	3.785
cubic foot (ft^3)	cubic meter (m^3)	.02832
acre-foot (acre-ft)	cubic meter (m^3)	1,233.
<u>Flow</u>		
gallon per minute (gal/min)	liter per second (L/s)	.06309
gallon per minute per foot [(gal/min)/ft]	liter per second per meter [(L/s)/m]	.2070
cubic foot per second (ft^3/s)	cubic meter per second (m^3/s)	.02832
foot per day (ft/d)	meter per day (m/d)	.3048
square foot per day (ft^2/d)	square meter per day (m^2/d)	.0929

Well-Numbering System

The well-numbering system, as shown in figure 2, gives the data-site location for a well or test hole according to the Bureau of Land Management's system of land subdivision. In this system, the first set of digits of a well number indicates the township; the second set, the range east or west of the sixth principal meridian; and the third set, the section. The first letter after the section number denotes the 160-acre tract; the second, the 40-acre tract; and the third, the 10-acre tract. Where two or more wells are located in a 10-acre tract, consecutive numbers are added, beginning with 2, in the order in which data from the well were collected. Thus in Wichita County, the number 17-35W-15DAA means that the well is in the NE1/4NE1/4SE1/4 sec.15, T.17 S., R.35 W.

GEOHYDROLOGIC DATA

This report should be useful in predicting geohydrologic units and water-level conditions that might occur when drilling a new well. Information, such as the geologic unit and its water-yielding characteristics, is given in table 1. Specific data, such as depth of well, depth to water, yield, and so forth, are given in table 2 for selected wells and test holes. Lithologic logs of wells and test holes, most of which were drilled by the Kansas Geological Survey, are given in table 3. The location of wells, test holes, and weather stations used for the collection of hydrologic and climatic data in and near the intensive-study area are shown in figure 3. Thus, a proposed drilling site could be located in figure 3 and cross-referenced with the geologic section in table 1 and with the records and logs of nearby wells and test holes in tables 2 and 3.

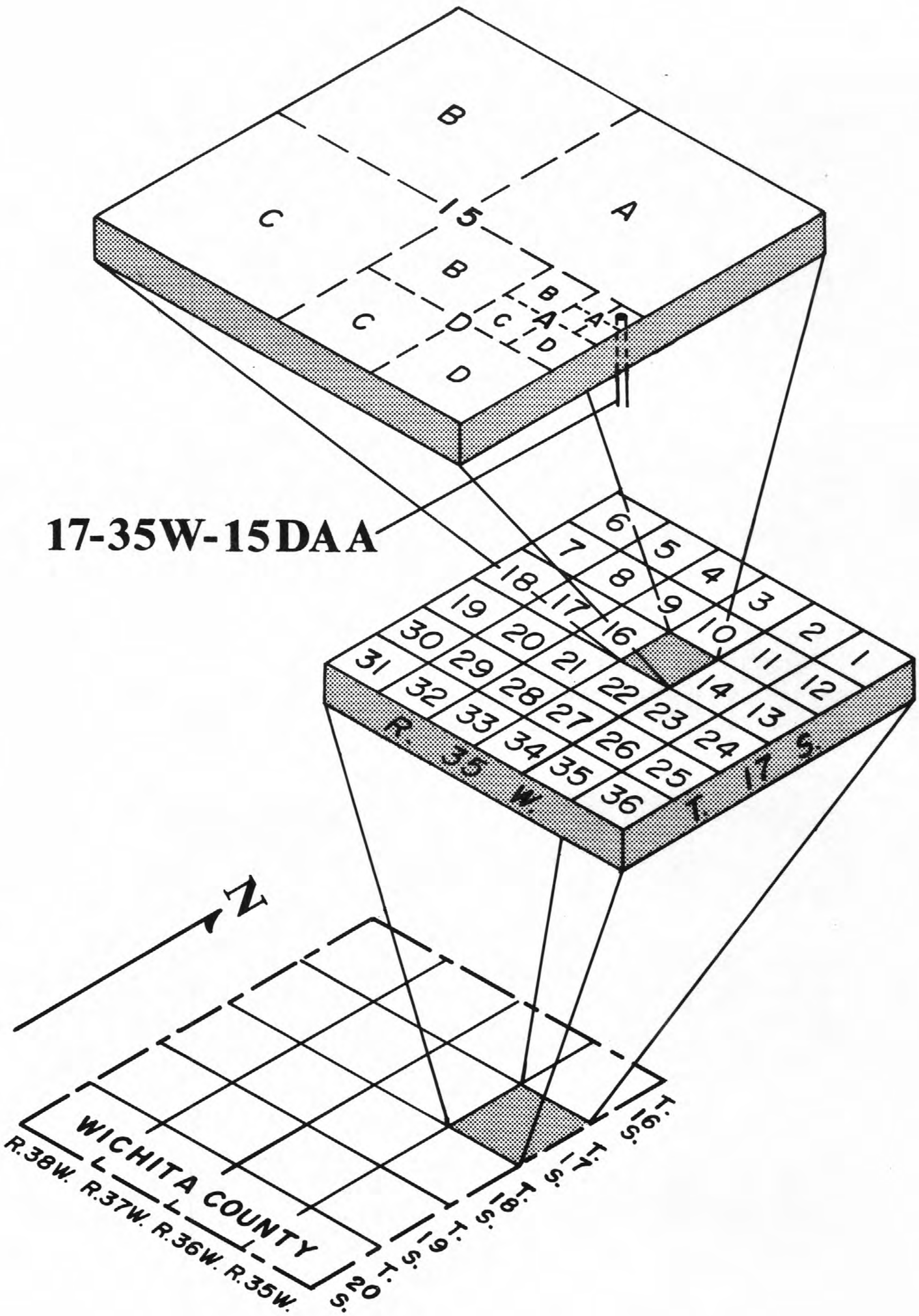

Figure 2.--Well-numbering system.

Table 1.--Generalized section of geologic units and their water-yielding characteristics

[The classification and nomenclature of the stratigraphic units used in this report are those of the U.S. Geological Survey and differ somewhat from those of the Kansas Geological Survey]

System	Series	Geologic unit		Thickness (ft)	Physical character	Water supply
Quaternary	Pleistocene	Undifferentiated deposits		15- 40	Silt, clayey, and silty clay; mostly eolian and unconsolidated. Sand, silty, fine- to medium-grained; unconsolidated basal unit.	Deposits are above the water table.
Tertiary	Miocene	Ogallala Formation		155-185	Sand, gravel, clay, silt, and caliche. Mortar beds, mostly unconsolidated, but cemented locally by calcium carbonate.	Principal unconsolidated aquifer in the report area. Yields moderate to large quantities of water to wells. Wells yield as much as 950 gal/min.
Cretaceous	Upper Cretaceous	Niobrara Formation	Smoky Hill Chalk Member	65	Shale and clay, chalky.	Yields little or no water to wells. Forms an impermeable base for the overlying Ogallala Formation.
			Fort Hays Limestone Member		Chalk, limestone, and chalky shale.	Not known to yield water to wells.

Table 2.--Records of selected wells and test holes in the Ogallala Formation

(1) Well-numbering system described in "Introduction."

(2) Depths of wells, in feet below land surface--no letter after number, measured; R, reported.

(3) Method of lift--T, turbine; N, none; SUB, submersible. Type of power--D, diesel; E, electric; NG, natural gas.

(4) Use--Irrigation; O, observation; N, none; T, test.

(5) Yield gal/min--Yield, in gallons per minute--no letter, measured during present study; A, measured prior to present study; R reported.

Well no. (1)	Owner or user	Year completed (19--)	Depth of well (ft) (2)	Diameter of casing (in)	Method of lift and type of power (3)
17-35W-15CDC	Louis Simons	--	204 R	--	T,NG
17-35W-17CCC	R. L. Simon	67	200 R	16	T,NG
17-35W-18ACB	Wesley Shumard	47	195 R	18	T,NG
17-35W-19BBB2	U.S. Geological Survey	77	194 -	--	N
17-35W-19BBC	L. Simons	--	--- -	--	T,NG
17-35W-19BCC	L. Simons	--	--- -	--	T,NG
17-35W-19CCC	L. + I. Simons	--	--- -	--	T,NG
17-35W-20ACD	Frank Schreck	68	204 R	16	T,NG
17-35W-20CCC	Herman Baker	64	199 R	16	T,NG
17-35W-20DCB	Herman Baker	71	203 R	16	T,NG
17-35W-20DCC	Herman Baker	71	195 -	--	N
17-35W-27CCC	L. C. Beeson	55	210 R	16	T,NG
17-35W-29BDC	Joe Zellner	57	218 R	--	T,NG
17-35W-29CBC	F. H. Biermann	63	221 R	--	T,NG
17-35W-29CBC2	U.S. Geological Survey	78	219 -	2	N
17-35W-30ABB	Herman Baker	54	212 R	16	T,NG
17-35W-30BBC	A. F. Baker	--	--- -	--	T,NG
17-35W-30CBB	Robert Mastel	47	218 R	18	T,NG
17-35W-30DCB	F. H. Biermann	47	219 R	--	T,NG
17-35W-31ABB	L. J. Baker	--	--- -	--	T,NG

(6) Altitude of land surface, in feet above mean sea level--measured during present study.

(7) Depth to water below land surface datum (LSD), in feet--measured depths of less than 100 feet given to the nearest 0.1 foot, 100 feet or more given to the nearest 1.0 foot; no letter, measured during recent study; R, reported.

(8) Date of water-level measurement--month and year.

(9) Chemical data--C, complete analysis given in table 4; CN, complete analysis available but not given in table 4.

Use (4)	Yield (gal/min) (5)		Altitude of land surface above mean sea level (ft) (6)	Depth to water below LSD (ft) (7)		Date of measurement (8)	Chemical data (9)	Acres irrigated
I,O	740	A	3,194	128	-	1/78	--	---
I	725	R	3,220	107	R	67	C	230
I,O	800	R	3,226	134	-	1/78	C	120
N,T	---	-	3,229	142	-	--	--	290
I	510	-	3,230	---	-	--	--	290
I	415	-	3,231	---	-	--	--	120
I	285	-	3,232	---	-	--	--	200
I	800	-	3,210	125	R	71	--	145
I	485	-	3,218	110	R	64	--	160
I	715	-	3,212	115	R	71	--	160
N,T	---	-	3,214	132	-	--	--	---
I,O	835	R	3,195	144	-	1/78	C	160
I	355	-	3,220	---	-	--	--	---
I	780	-	3,223	---	-	--	--	185
N,O	---	-	3,219	149	-	7/78	--	---
I	560	-	3,226	105	R	54	--	160
I	620	-	3,232	---	-	--	CN	---
I,O	625	-	3,235	156	-	1/78	--	160
I	905	-	3,227	---	-	--	--	210
I	250	-	3,227	---	-	--	--	---

Table 2.--Records of selected wells and test holes in the Ogallala Formation--Continued

Well no. (1)	Owner or user	Year completed (19--)	Depth of well (ft) (2)		Diameter of casing (in)	Method of lift and type of power (3)
17-35W-31BBB	Pahis + Zellner	--	---	-	--	T,NG
17-35W-31CBB	U.S. Geological Survey	77	191	-	--	N
17-35W-31CCB	C. + J. Wimmer	40	200	R	18	T,E
17-35W-31CCB2	C. + J. Wimmer	--	---	-	--	T,NG
17-35W-31DCA	B. + L. Baker	--	---	-	--	T,NG
17-35W-32ACC	Mrs. Harry Paul	55	205	R	16	T,NG
17-35W-32CBB	Joe Zellner	--	---	-	--	T,NG
17-36W-14DAD	H. R. Schwindt	--	---	-	--	T,NG
17-36W-23BAA	H. R. Schwindt	--	---	-	--	T,E
17-36W-23BCC	H. R. Schwindt	40	240	R	18	T,E
17-36W-23BCC2	H. R. Schwindt	--	---	-	--	SUB,E
17-36W-23CDB	H. R. Schwindt	--	---	-	--	T,NG
17-36W-24BCB	Albert Biel	72	205	R	18	T,NG
17-36W-24CBC	Gerald Smith	--	---	-	--	T,NG
17-36W-25AAA	U.S. Geological Survey	77	198	-	--	N
17-36W-25ACC	Gus Luebbers	76	---	-	--	D
17-36W-25BCB	Gus Luebbers	57	222	R	--	T,NG
17-36W-25CCD	R. L. Simons	56	211	R	16	T,NG
17-36W-25DCC	R. L. Simons	--	---	-	--	T,E
17-36W-26AAA	U.S. Geological Survey	77	197	-	--	N
17-36W-26CBB	Henry Asmussen	57	214	R	16	T,NG
17-36W-26CBB2	U.S. Geological Survey	78	192	-	2	N
17-36W-26DBB	Kent McKinney	--	221	R	--	T,E
17-36W-28BAC	J. F. Gerstberger	46	202	-	18	T,NG
17-36W-28CCC	B. Walk	56	212	R	16	T,NG
17-36W-33BCB	Eugene Berning	--	187	R	16	N
17-36W-35ABB	Kent McKinney	--	216	R	--	T,NG
17-36W-35BBC	Henry Asmussen	61	215	R	16	T,NG
17-36W-35CCC	Kent McKinney	--	---	-	--	T,NG
17-36W-35CDD	U.S. Geological Survey	77	186	-	--	----
17-36W-36BBB	R. E. Bergh	55	221	R	18	T,NG
17-36W-36CBB	Cloy Logan	66	207	R	--	T,NG
17-36W-36DAB	J. Wimmer	56	201	R	--	T,NG

Use (4)	Yield (gal/min) (5)	Altitude of land surface above mean sea level (ft) (6)	Depth to water below LSD (ft) (7)	Date of mea-sure-ment (8)	Chem-ical data (9)	Acres irri-gated
I	130 -	3,234	--- -	--	--	160
N,T	--- -	3,232	154 -	1/77	--	---
I	250 -	3,233	91.9-	4/51	C	100
I	145 -	3,233	--- -	--	--	---
I	255 -	3,221	--- -	--	--	---
I	210 -	3,212	100 R	55	--	---
I	340 -	3,220	--- -	--	--	---
I	--- -	3,250	--- -	--	C	---
I	270 -	3,251	--- -	--	--	---
I,O	320 -	3,258	152 -	1/78	--	---
I	170 -	3,258	--- -	--	--	---
I	545 -	3,253	--- -	--	--	---
I	475 -	3,245	105 R	52	--	200
I	750 -	3,245	--- -	--	--	---
N,T	--- -	3,230	148 -	1/77	--	---
I	514 -	-----	--- -	--	--	160
I	505 -	3,244	--- -	--	--	150
I	690 -	3,243	108 R	56	--	190
I	255 -	-----	--- -	--	--	90
N,T	--- -	3,243	158 -	1/77	--	---
I	560 -	3,254	--- -	--	--	250
N,O	--- -	3,219	155 -	4/78	--	---
I	300 -	3,251	--- -	--	--	---
I	490 -	3,277	94.9-	4/51	C	---
I	820 A	3,288	97 R	56	C	160
O	--- -	3,286	139 -	9/76	--	---
I	595 -	3,251	94.0-	5/51	--	---
I	550 -	3,257	--- -	--	--	180
I	295 -	3,254	--- -	--	--	---
N,T	--- -	3,248	125 -	1/77	--	---
I,O	750 -	3,246	154 -	1/78	C	310
I	330 -	3,242	--- -	--	--	---
I	385 -	3,231	90 R	56	--	70

Table 3.--Logs of wells and test holes in the intensive-study area

[Logs are for wells and test holes drilled by the Kansas Geological Survey, except where noted as drilled by a commercial driller. Altitudes are referenced to mean sea level datum and are reported to the nearest foot. Depth of drill hole and depth to water (if available) are reported in feet below land surface.]

WICHITA COUNTY

17-35W-19BBB2.--Drilled August 25, 1977. Altitude 3,229 feet. Depth to water 142 feet (1977).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Soil, silty clay loam, dusky-brown	3	3
Silt, clayey, sandy, gray-brown	3	6
Clay, silty, sandy, dark-yellow-brown	10	16
Silt, sandy, calcareous, very pale orange	8	24
Clay, silty, very sandy, very pale orange	7	31
Sand, silty, clayey, calcareous	7	38
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Caliche, and very coarse loosely cemented sand	8	46
Clay, sandy, light-brown	5	51
Sand, loosely cemented, fine to medium	8	59
Clay, sandy, calcareous, very pale orange	6	65
Sand, fine to very coarse	9	74
Sand, cemented, fine to coarse	3	77
Sand, fine to very coarse, interbedded with pale-yellow-brown silty clay	19	96
Sand, very fine to very coarse, some loosely cemented	11	107
Clay, sandy, very light brown	5	112
Sand, very fine to very coarse	8	120
Clay, light-brown, interbedded with cemented sand	6	126
Sand, very fine to very coarse, with thin layers of clay and cemented sand	16	142
Clay, silty, sandy, light-brown	4	146
Sand, silty, very fine to very coarse	3	149
Clay, silty, sandy, light-brown	1	150
Sand, silty, very fine to very coarse	11	161
Sand, medium to very coarse, and fine gravel	16	177
Gravel, fine, and fine to very coarse sand with a few thin clay layers	17	194
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Clay, grayish-orange	21	215
Shale, grayish-brown	7	222

17-35W-20DCC.--Drilled May 21, 1971 by a commercial driller. Altitude 3,214 feet. Depth to water 132 feet.

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Clay	29	29
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Caliche	3	32
Sand, coarse	7	39
Caliche	22	61
Sand, medium	14	75
Sand, coarse	4	79
Sand, fine, and clay	10	89
Sandstone	2	91
Sand, fine, and clay	34	125
Sandstone	1	126
Sand, fine, and clay	34	160
Sand, fine	7	167
Sand, fine, and clay	18	185
Sand, fine	4	189
Sand and gravel	6	195
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Shale, yellow	30	225

17-35W-20DDC.--Drilled May 21, 1971 by a commercial driller. Altitude 3,210 feet. Depth to water 128 feet (1971).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Clay	24	24
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Caliche	16	40
Sandstone	4	44
Caliche	25	69
Clay, sandy	31	100
Sandstone	6	106
Sand, fine, and clay	59	165
Clay	8	173
Sand, fine, and clay	12	185
Sand, fine, good	4	189
Sand, coarse	6	195
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Shale, yellow	25	220

17-35W-20DDD.--Drilled May 24, 1971 by a commercial driller. Altitude 3,209 feet. Depth to water 127 feet (1971).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Clay	29	29
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Caliche	2	31
Clay	4	35
Sand, coarse	8	43
Caliche	28	71
Clay, sandy	37	108
Sand, fine, and clay	15	123
Sandstone	5	128
Sand, fine, and clay	36	164
Clay	9	173
Sand, fine, and clay	8	181
Sand, fine	8	189
Sand, coarse	6	195
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Shale, yellow	20	215

17-35W-29CBC.--Drilled October 18, 1977. Altitude 3,219 feet. Depth to water 150 feet (1978).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Soil and sand, medium to coarse, dark-brown	2	2
Soil and sand, medium to coarse, with very fine light-brown gravel	4	6
Silt, clayey, and fine sand	2	8
Clay, silty, light-brown, and fine sand	3	11
Clay, silty, light-brown, caliche, cream-white clay, and fine sand	4	15
Clay, light-brown, and fine sand	3	18
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Caliche, fragments, white, and fine sand at 25 to 35 feet	14	32
Caliche, fragments, white, and white sandy clay	5	37
Sand, very fine to medium	2	39
Caliche, white, and very fine to very coarse subangular sand	2	41
Sand, very fine to very coarse, and very fine gravel, feldspar, and quartz	7	48
Sand, medium to very coarse, and fine subangular gravel	1	49
Caliche, fragments, and medium sand	1	50
Caliche, white to clear (siliceous), and dark dendritic mineral (manganese?)	19	69
Caliche, fragments, silica with black dendritic mineral, and very fine to coarse sand	10	79
Sand, very fine, and white to clear caliche, and clay	2	81
Clay, sandy, light-tannish-brown, and very fine to fine sand	6	87
Sand, silty, fine to medium	9	96
Sand, clayey, fine to medium, and caliche	9	105
Clay, sandy, very fine to fine, and caliche	4	109
Sand, very fine to medium, clay, and fine gravel	4	113
Sand, very fine to very coarse, fine gravel, and caliche	7	120
Clay, sandy, light-tan, very fine to coarse sand, and caliche fragments	2	122
Sand, very fine to medium, white clay, and fine gravel	11	133
Sand, very fine to coarse, light-brown clay, and caliche	2	135

	Thickness, in feet	Depth, in feet
Gravel, fine, and coarse to very coarse sand	11	146
Clay, silty, orange-brown, fine to medium sand, and fine gravel	19	165
Sand, clayey, fine to medium	6	171
Caliche and white clay	4	175
Clay, sandy, very fine to fine	3	178
Sand, very fine to medium, and silty white clay	6	184
Gravel, coarse	3	187
Sand, very fine to medium	5	192
Sand, very fine to very coarse, and fine to coarse gravel	5	197
Sand, fine	4	201
Sand, very fine to very coarse	3	204
Sand, coarse, and fine gravel	12	216
Gravel, fine, and coarse sand	3	219
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Clay, yellow	1	220
Clay, yellow, and black clay	5	225

17-35W-31CBB.--Drilled August 23, 1977. Altitude 3,232 feet. Depth to water 154 feet (1977).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Soil, silty, and dark-brown clay loam	3	3
Silt, light-brown, and some coarse sand	12	15
Silt, clayey, light-brown	3	18
Silt, clayey, very light brown, sandy	3	21
Clay, silty, very light brown	3	24
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Mortar bed, hard, light-tan to white, with white clay	8	32
Sand, coarse, cemented, interbedded with light-brown clay	12	44
Sand, coarse to very coarse	7	51
Sand, fine to very coarse, cemented, hard	8	59
Clay, silty, light-brown	3	62
Clay, light-brown, with very fine cemented sand	5	67
Clay, light-brown, sandy	5.5	72.5
Sand, fine to very coarse, alternating with light-brown clay	31.5	104
Sand, fine to very coarse, and fine gravel	2.5	106.5
Clay, very sandy, and some fine gravel	2	108.5
Sand, fine to very coarse	3.5	112
Clay, sandy, light-brown	4	116
Mortar bed, fine to very coarse cemented sand, and fine gravel	7	123
Sand, very fine to medium, and some fine gravel	5	128
Clay, sandy, and very fine to fine sand	6	134
Sand, fine to coarse	11	145
Silt, sandy, light-brown	2	147
Sand, silty, very fine to fine	8	155
Clay, silty, dark-yellow-orange, interbedded with very fine sand	27	182
Sand, fine to coarse	4	186
Sand, coarse to very coarse	5	191
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Clay, pale-yellowish-orange, sandy	5	196
Shale, weathered, dark-grayish-brown	14	210

17-36W-25AAA.--Drilled August 24, 1977. Altitude 3,230 feet. Depth to water 148 feet (1977).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Soil, silty, and medium-brown clay loam	5	5
Silt, clayey, sandy, olive-brown	5	10
Silt, clayey, yellow-brown	5	15
Silt, sandy, very light gray	8	23
Sand, silty, light-brown	6	29
Clay, sandy, calcareous, very light gray	4	33
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Mortar bed, and medium to very coarse cemented sand	2	35
Sand, medium to coarse	3	38
Sand, medium to very coarse, and fine gravel	5.5	43.5
Sand, cemented, very fine	3.5	47
Sand, very fine to medium, and some very fine gravel	9	56
Sand, fine, clayey	2	58
Mortar bed, and fine to coarse cemented sand	3	61
Clay, sandy, light-brown	3	64
Sand, medium to very coarse, clayey	6	70
Sand, fine to coarse	4	74
Sand, clayey, fine to very coarse	8	82
Sand, very fine to coarse, and fine gravel	6	88
Sand, clayey, very fine to very coarse	4.5	92.5
Sand, loosely cemented, very fine to coarse	6	98.5
Sand, clayey, very fine to medium	3.5	102
Clay, very sandy, light-brown	2.5	104.5
Sand, very fine to coarse, some cemented, alternating with sandy clay	30.5	135
Sand, medium to very coarse, and fine gravel	8	143
Clay, sandy, light-brown	7	150
Sandy, clayey, very fine to coarse	5	155
Sand, very fine to coarse, and some fine gravel	25	180
Sand, very clayey, medium to coarse	5.5	185.5
Sand, medium to very coarse, and some fine gravel	4.5	190
Sand, clayey, medium to coarse	3	193
Sand, coarse to very coarse, and fine gravel	5	198
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Clay, yellowish-orange, sandy	15	213
Shale, dark-gray-brown, soft	13	226

17-36W-26AAA.--Drilled August 25, 1977. Altitude 3,243 feet. Depth to water 158 feet (1977).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Soil, silty, and brown clay loam	3	3
Silt, clayey, light-brown	5	8
Silt, sandy, clayey, gray-brown	8	16
Sand, silty, fine to medium	6	22
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Caliche, sandy, clayey	6	28
Clay, sandy, white, interbedded with very fine to fine sand	8	36
Sand, fine to very coarse	7	43
Sand, medium to very coarse, loosely cemented	2	45
Sand, silty, fine to very coarse	2.5	47.5
Sand, medium to very coarse	3.5	51
Clay, sandy, medium-brown, interbedded with fine to very coarse sand	14	65
Sand, silty, fine to coarse	5	70
Sand, coarse to very coarse, and loosely cemented fine gravel	6	76
Sand, very fine to very coarse, interbedded with sandy pale-yellow-brown clay	35	111
Clay, sandy, medium-brown	4	115
Sand, silty, very fine to very coarse	9	124
Clay, sandy, medium-brown	5	129
Sand, very fine to very coarse, interbedded with pale-yellow-brown clay	13	142
Sand, very fine to very coarse, loosely cemented	6	148
Clay, silty, yellow-brown	3	151
Sand, silty, very fine to very coarse, some loosely cemented	8	159
Sand, very fine to very coarse, interbedded with silty brown clay	8	167
Sand, cemented	2	169
Sand, very fine to very coarse, and silty dark-yellow-orange clay	8	177
Clay, silty, dark-yellow-orange	7	184
Sand, medium to very coarse, and fine gravel	13	197
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Clay, pale-yellow-orange	14	211
Shale, firm, dusky-brown	24	235

17-36W-26CBB.--Drilled October 18, 1977. Altitude 3,254 feet. Depth to water 155 feet (1978).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Soil, silty, and dark-gray-brown clay loam	4	4
Clay, silty, medium-brown	1	5
Silt, clayey, tannish-brown	5	10
Silt, and some light-brown sand	8	18
Silt, clayey, very light brown, with fine sand	4	22
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Caliche, soft, sandy, with cemented fine sand	3	25
Sand, coarse to very coarse, caliche fragments, and very light brown clay	4	29
Sand, very fine to medium, pale-green, caliche fragments, and some gravel	5	34
Sand, very fine to very coarse, fine to medium gravel, gray-green silt, and caliche fragments	6	40
Caliche fragments, cemented sand, and fine to very coarse sand	10	50
Caliche fragments, small, with medium to very coarse sand	3	53
Caliche and sand, as above, with gravel	2	55
Sand, very fine to very coarse, fine gravel, and caliche fragments	3	58
Sand, cemented, fine to medium, caliche fragments, very fine to coarse friable sand, and some gravel	9	67
Sand, very fine to very coarse, and fine gravel	3	70
Clay, grayish-brown, very fine to very coarse sand, and gravel	4	74
Caliche fragments, grayish-green, very fine to very coarse silty sand, cemented fine sand, and fine to medium gravel	3	77
Sand, cemented, very fine, and pale-green caliche fragments	12	89
Sand, very silty, very fine to coarse, fine gravel, white clay, caliche fragments, and cemented sand	3	92
Silt and sand, cemented, very fine, with some coarse reddish-brown sand	3	95
Sand, very fine to very coarse, fine gravel, silt, and some cemented sand	3	98
Silt, clayey, sandy, greenish-brown, with some cemented gravel and sand	2	100

Table 3.--Logs of wells and test holes in the intensive-study area--Continued

	Thickness, in feet	Depth, in feet
Sand, silty, very fine to very coarse, fine gravel, and caliche fragments	2	102
Gravel, very fine to medium, and very fine to very coarse silty sand	6	108
Sand, very fine to very coarse, fine gravel, and silt	4	112
Silt, clayey, sandy, white, and caliche fragments	6	118
Sand, very silty, very fine to very coarse, and caliche fragments	2	120
Silt, cemented, very fine cemented and some friable sand, and gravel	5	125
Silt, sand, and gravel, as above, and caliche fragments	3	128
Silt, very sandy, and very fine cemented sand	3	131
Silt, cemented, and very fine light-brown sand, with some friable very fine to very coarse silty cemented sand	9	140
Sand, very fine to very coarse, silty, with some cemented sand	10	150
Sand, very fine to medium, silty, with some cemented sand	10	160
Sand, very fine to very coarse, and cemented silty sand	4	164
Sand, as above, coarser	6	170
Sand, very fine to coarse, silty	10	180
Sand, as above, with some fine gravel	4	184
Sand, as above, with very light brown silt	1	185
Sand, as above, with mostly very coarse sand, and fine gravel	2	187
Sand, very coarse, fine gravel, and yellow-brown silt	2	189
Gravel, fine to medium, and very coarse silty sand	3	192
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Clay, yellow	4	196

Table 3.--Logs of wells and test holes in the intensive-study area--Continued

17-36W-35CDD.--Drilled August 27, 1977. Altitude 3,248 feet. Depth to water 125 feet (1977).

	Thickness, in feet	Depth, in feet
QUATERNARY SYSTEM		
Pleistocene Series, undifferentiated		
Soil, silty, and dark-brown clay loam	3	3
Silt, clayey, grayish-orange	7	10
Silt, sandy, grayish-orange	4	14
Clay, silty, very light brown	3	17
Silt, clayey, light-brown	2.5	19.5
Silt, sandy, clayey, white to very light brown	4.5	24
Clay, sandy, calcareous, white to light-brown	8	32
Sand, very fine, cemented, light-brown, and white caliche	3	35
Sand, coarse to very coarse, subrounded	9	44
TERTIARY SYSTEM		
Miocene Series		
Ogallala Formation		
Mortar bed, hard, fine to very coarse cemented sand, and very fine to medium gray-white gravel	9	53
Clay, light-brown	2	55
Sand, medium to coarse, and hard cemented silt	8	63
Clay, sandy, silty, light-brown	7	70
Sand, medium to very coarse, and fine gravel, contains white cemented silt	6	76
Clay, sandy, light-brown	2	78
Sand, very fine to coarse, and fine clayey gravel	9	87
Mortar bed, hard, cemented, silty, sandy, gray-white	2	89
Sand, very fine to medium, slightly clayey, dark-reddish-brown	10	99
Sand, very fine to medium, clayey, dark-reddish-brown	17	116
Clay, silty, yellowish-brown, and very fine to coarse sand	9	125
Sand, very fine to coarse, clayey	10	135
Sand, fine to coarse, and some fine gravel	6	141
Sand, coarse, and fine gravel	5	146
Sand, medium to very coarse, clayey	6	152
Sand, medium to coarse, and fine gravel	4	156
Sand, fine to very coarse, alternating with yellowish-brown clay	20	176
Sand, fine to coarse, clayey	10	186
CRETACEOUS SYSTEM		
Upper Cretaceous Series		
Niobrara Formation -- Smoky Hill Chalk Member		
Clay, sandy, yellowish-orange	8	194
Shale, firm, dark-grayish-brown	16	210

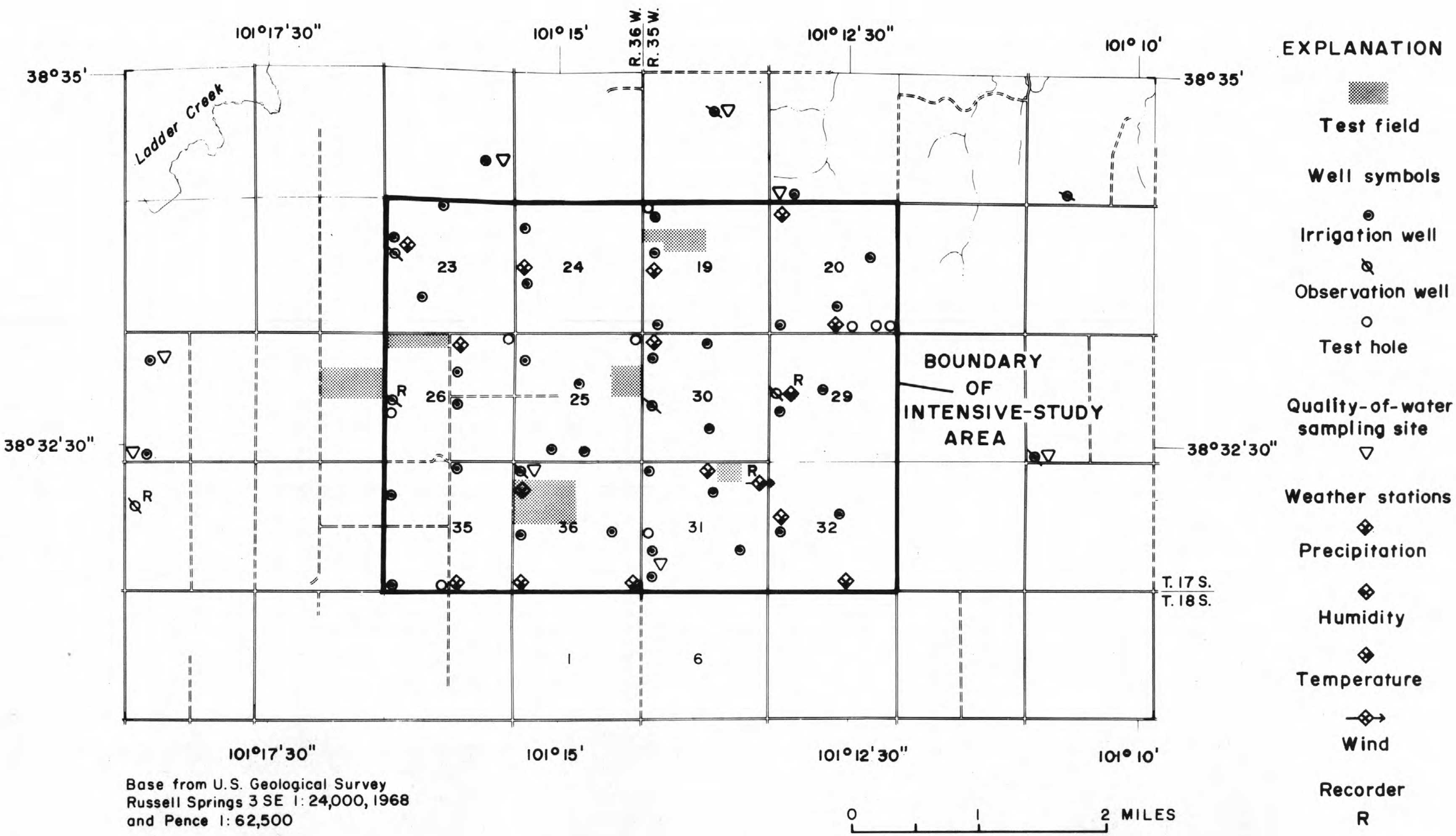

Figure 3.--Location of collection sites for geohydrologic and climatic data.

Information concerning the quality of water from the Ogallala aquifer is listed in table 4. Concentrations of the major dissolved constituents in water from wells are given in milligrams per liter (mg/L) and micrograms per liter (ug/L), and specific conductance is given in micromhos per centimeter (umhos/cm) at 25°C. The limits recommended by the Kansas State Board of Health (1973) for drinking-water standards are listed as follows:

Constituent	Recommended limits, in milligrams per liter	Recommended limits, in micrograms per liter
Dissolved solids	500	---
Iron (Fe)	.3	300
Manganese (Mn)	.05	50
Sulfate (SO_4)	250	---
Chloride (Cl)	250	---
Fluoride (F)	1.5	---
Nitrate (NO_3)	45	---

Concentrations of iron and fluoride in water from most of the wells in table 4 exceed these recommended limits.

Ground-water levels from observation wells in the Ogallala aquifer typifying the seasonal fluctuations and long-term trends of the area are available in table 5 and several published reports. Water-level records during 1966-70 are available in Broeker and McNellis (1973) and during 1971-75 in Broeker, McIntyre, and McNellis (1977). Water-level changes in west-central Kansas during 1950-74 are given by Pabst and Jenkins (1974). Depth to water in wells below LSD (land surface datum) is listed by Stullken and others (1974).

The changes in depth to water, water level, and saturated thickness of the Ogallala aquifer are shown in table 6 for various wells in and near the study area and for selected periods of time. Changes are related to a predevelopment year (designated as 1950), the year following an abnormally high rainfall and minimum pumpage (1966), and the project study years of 1977 and 1978.

CLIMATIC DATA

Weekly and monthly rainfall data collected at the recording gages within the intensive-study area are given in table 7. Table 8 gives the adjusted weekly rainfall at or near three of the six test fields (shown in figure 3) compared with National Weather Service records of rainfall at Garden City (about 40 miles southeast), Tribune (about 25 miles west), and Leoti (shown in figure 1).

Data on soil moisture measured on various days during 1978 at different sampling depths and at different locations in four test fields (fig. 3) are given in table 9.

The relation of applied irrigation water and the soil moisture used at different depths at test field 17-36W-27DBC is shown in figure 4.

Table 4.--Chemical analyses of water from selected wells in the Ogallala aquifer

[See figure 3 for location of the quality-of-water sampling sites]

Well no.	Depth (ft)	Date of collection	Temperature (C°)	Dissolved solids (mg/L residue at 180°C)	Dissolved silica (mg/L SiO_2)	Dissolved iron (ug/L Fe)	Dissolved manganese (ug/L Mn)	Dissolved calcium (mg/L Ca)	Dissolved magnesium (mg/L Mg)
17-35W-17CCC	200	6-19-72	----	355	39	110	0.0	48	24
17-35W-18ACB	195	8- 4-65	----	391	38	10	.0	53	23
17-35W-27CCC	210	4-19-72	----	360	38	30	.0	45	23
17-35W-31CCB	200	6-22-72	15.0	408	45	160	.0	56	24
17-36W-14DAD	---	6-22-72	16.0	392	39	60	.0	59	24
17-36W-28BAC	202	9-14-64	----	354	46	0	.0	46	24
17-36W-28CCC	212	6-22-72	15.0	374	48	60	.0	46	25
17-36W-36BBB	221	3- 1-72	----	370	49	60	.0	48	21
Average	206		15.3	376	43	61	.0	50	24

Well no.	Sodium and potassium (mg/L Na+K)	Bicarbonate (mg/L HCO_3)	Dissolved sulfate (mg/L SO_4)	Dissolved chloride (mg/L Cl)	Dissolved fluoride (mg/L F)	Dissolved nitrate (mg/L NO_3)	Hardness as $CaCo_3$ Total (mg/L)	Hardness as $CaCo_3$ Noncarbonate (mg/L)	Specific conductance (umhos/cm at 25°C)
17-35W-17CCC	36	231	58	24	2.2	8.0	220	28	540
17-35W-18ACB	48	271	63	25	1.6	5.8	230	4	610
17-35W-27CCC	38	193	80	23	2.0	9.7	210	49	520
17-35W-31CCB	39	193	88	37	1.7	13	240	80	590
17-36W-14DAD	44	278	64	25	1.9	2.0	250	18	610
17-36W-28BAC	36	198	72	21	2.0	8.9	210	52	530
17-36W-28CCC	37	198	80	25	2.0	7.5	220	56	540
17-36W-36BBB	36	193	78	22	1.8	8.0	210	48	540
Average	39	219	73	25	1.9	7.9	224	42	560

Table 5.--Ground-water levels in selected observation wells in the Ogallala aquifer

[Location of observation wells shown in figure 3]

17-35W-15CDC. Louis Simons. Irrigation well. Depth 204 feet. Measuring point, hole in southeast side of pump base, 0.8 foot above LSD. G = Measured by Kansas State Board of Agriculture.
Altitude of land surface 3,194 feet.
Highest water level 110.00 feet below LSD, Jan. 19, 1966.
Lowest water level 130.50 feet below LSD, Jan. 20, 1976.
Records available 1965-76.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 29, 1965	110.34	Jan. 18, 1968	118.55G	Jan. 18, 1971	116.59G	Jan. 22, 1974	119.53
Jan. 19, 1966	110.00G	Jan. 21, 1969	114.2 G	Jan. 17, 1972	118.10G	Jan. 14, 1975	121.94
Jan. 25, 1967	115.60G	Jan. 19, 1970	113.49G	Jan. 18, 1973	118.08	Jan. 20, 1976	130.50

17-35W-18ACB. Wesley Shumard. Irrigation well. Depth 195 feet, diameter 18 inches. Measuring point, hole in north side of pump base, at LSD. G = Measured by Kansas State Board of Agriculture.
Altitude of land surface 3,225.7 feet.
Highest water level 96.94 feet below LSD, May 4, 1951.
Lowest water level 128.77 feet below LSD, Jan. 19, 1976.
Records available 1951, 1965-76.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
May 4, 1951	96.94	Jan. 18, 1968	114.24G	Jan. 18, 1971	119.36G	Jan. 22, 1974	124.71
Jan. 29, 1965	122.76	Jan. 21, 1969	116.35G	Jan. 17, 1972	122.50G	Jan. 14, 1975	126.74
Jan. 19, 1966	110.8 G	Jan. 19, 1970	116.95G	Jan. 18, 1973	122.00	Jan. 19, 1976	128.77
Jan. 25, 1967	114.06G						

Table 5.--Ground-water levels in selected observation wells in the Ogallala aquifer--Continued

17-35W-27CCC. L.C. Beeson. Irrigation well. Depth 210 feet, diameter 16 inches. Measuring point, hole in east side of pump base, at LSD. G = Measured by Kansas State Board of Agriculture.
Altitude of land surface 3,195 feet.
Highest water level 91.00 feet below LSD, Jan. 1, 1955.
Lowest water level 139.96 feet below LSD, Jan. 19, 1976.
Records available 1955, 1965-76.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 1, 1955	91.00	Jan. 18, 1968	119.95G	Jan. 18, 1971	129.25G	Jan. 22, 1974	130.20
Jan. 19, 1965	113.00	Jan. 21, 1969	122.9 G	Jan. 17, 1972	131.55G	Jan. 14, 1975	139.10
Mar. 16, 1966	109.60G	Jan. 19, 1970	123.06G	Jan. 18, 1973	131.08	Jan. 19, 1976	139.96
Jan. 25, 1967	117.23G						

17-35W-29CBC2. U.S. Geological Survey. Observation well. Depth 219 feet, diameter 2 inches. Measuring point, top of casing, 3 feet above LSD.
Altitude 3,219 feet.
Records available 1978.

Date	Water level
Mar. 28, 1978	150.19
June 2, 1978	148.66
July 2, 1978	149.21

Table 5.--Ground-water levels in selected observation wells in the Ogallala aquifer--Continued

17-35W-30CBB. Robert Mastel. Irrigation well. Depth 218 feet, diameter 18 inches. Measuring point, east side of concrete base, at LSD. G = Measured by Kansas State Board of Agriculture.
Altitude of land surface 3,235.2 feet.
Highest water level 94.12 feet below LSD, Apr. 19, 1951.
Lowest water level 158.43 feet below LSD, Sept. 22, 1976.
Records available 1951, 1965-76.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Apr. 19, 1951	94.12	Jan. 18, 1968	130.73G	June 23, 1971	137.24G	Dec. 17, 1973	143.74
Jan. 29, 1965	130.8	June 19	131.76G	Sept. 29	140.20G	Jan. 22, 1974	138.98
June 16	119.34G	Sept. 16	135.50G	Dec. 28	138.07G	Mar. 14	143.82G
Sept. 28	130.42G	Jan. 20, 1969	133.2	Jan. 17, 1972	137.35G	June 18	149.29G
Jan. 19, 1966	126.6 G	Apr. 23	138.05G	June 27	146.20G	Dec. 11	153.26G
June 15	131.72G	Sept. 29	133.89G	Sept. 19	142.66G	Jan. 14, 1975	143.60
Sept. 27	128.32G	Dec. 23	137.05	Dec. 12	140.16G	Mar. 14	148.16G
Dec. 20	127.06G	Jan. 24, 1970	130.73G	Jan. 18, 1973	139.20	June 25	144.87G
Jan. 25, 1967	129.40G	Apr. 14	130.01G	Mar. 13	138.16	Jan. 19, 1976	150.74
June 14	128.05G	Sept. 21	136.28G	June 6	136.97	June 16	153.41
Sept. 19	131.23G	Jan. 18, 1971	134.68G	Sept. 18	143.77	Sept. 22	158.43
Dec. 18	131.79	Mar. 23	133.85G				

Table 5.--Ground-water levels in selected observation wells in the Ogallala aquifer--Continued

17-36W-23BCC. H. R. Schwindt. Irrigation well. Depth 240 feet, diameter 18 inches. Measuring point, hole in south side of pump, at LSD. G = Measured by Kansas State Board of Agriculture.
Altitude of land surface 3,258.1 feet.
Highest water level 89.00 feet below LSD, Apr. 19, 1940, July 25, 1947.
Lowest water level 147.24 feet below LSD, Jan. 19, 1976.
Records available 1940, 1947, 1951, 1965-76.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Apr. 19, 1940	89.00	Jan. 19, 1966	125.35G	Jan. 19, 1970	129.57G	Jan. 22, 1974	136.82
July 25, 1947	89.00	Jan. 25, 1967	128.10G	Jan. 18, 1971	133.38	Jan. 13, 1975	140.57
Apr. 20, 1951	100.14	Jan. 18, 1968	128.27G	Jan. 17, 1972	135.75	Jan. 19, 1976	147.24
Jan. 29, 1965	124.22	Jan. 21, 1969	130.8	Jan. 18, 1973	136.94		

17-36W-26CBB2. U.S. Geological Survey. Observation well with water-level recorder. Depth 192 feet, diameter 2 inches. Measuring point, top of casing, 2.5 feet above LSD.
Altitude 3,219 feet.
Records available 1978.

Date	Water level
Apr. 19, 1978	160.44
Apr. 28, 1978	155.22
July 5, 1978	152.55

Table 5.--Ground-water levels in selected observation wells in the Ogalla aquifer--Continued

17-36W-33BCB. Eugene Berning. Observation well with water-level recorder. Depth 187 feet, diameter 16 inches. Measuring point, top of casing, 0.5 foot above LSD. Continuous records available from Kansas State Board of Agriculture. EOM = end of month.
Altitude of land surface 3,286.0 feet.
Highest water level 112.35 feet below LSD, Mar. 30, 1966.
Lowest water level 177.22 feet below LSD, Mar. 15, 1967.
Records available 1965-76.

1965

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	......	......	......	......	......	114.12	113.92	118.51	116.67	116.59	115.21	114.36
10	......	......	......	......	......	113.94	115.85G	118.21	118.22	116.32	115.03	114.10
15	......	......	......	......	115.30	113.73	116.68	118.90	118.97	116.07	114.87	114.06
20	......	......	......	......	114.87	113.61	117.30	118.25	117.85	115.91	114.69	113.92
25	......	......	......	......	114.55	113.41	117.86	117.44	117.25	115.71	114.48	113.80
EOM	......	......	......	......	114.33	113.37	118.20	117.00	116.91	115.44	114.42	113.70

1966

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	113.69	113.00	112.89	......	113.95	113.32	116.12	117.63	115.83	115.32	114.70	......
10	113.62	113.1	112.66	......	113.50	115.70	115.80	116.97	115.77	115.22	114.70	......
15	......	112.9	112.64	......	113.54	115.38	117.42	116.63	115.73	115.15	......	......
20	......	112.9	112.61	......	113.37	115.92	117.58	116.39	115.62	114.90	......	114.60
25	113.30	112.8	112.50	......	113.27	116.46	116.78	116.15	115.63	114.90	......	114.59
EOM	......	......	112.35	114.34	113.26	117.06	116.50	115.98	115.50	114.80	......	114.60

Table 5.--Ground-water levels in selected observation wells in the Ogallala aquifer--Continued

1967

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	114.43	115.80	117.71	119.60	117.61	117.03	116.58	120.20	120.33	118.65	......	......
10	114.56	116.89	117.80	119.73	117.41	116.88	116.50	119.50	119.83	118.45	......	......
15	114.42	117.90	117.22	110.01	117.37	116.84	116.40	120.70	119.50	118.45	......	......
20	114.38	118.83	118.11	118.33	117.34	116.73	117.97	121.16	119.24	118.33	......	117.48
25	114.38	118.02	117.92	117.94	117.19	116.72	119.10	120.70	118.98	118.13	......	......
EOM	114.47	......	117.39	117.39	117.07	116.62	119.77	121.22	118.82	118.28	......	117.33

1968

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	117.32	119.15	120.38	118.29	120.25	118.85	121.39	121.71	121.75	119.96	......	118.86
10	117.21	119.93	119.78	118.32	119.84	118.83	121.71	122.33	121.26	119.68	......	118.80
15	117.24	120.70	......	118.24	119.61	118.74	122.06	121.60	120.90	119.62	......	118.80
20	117.21	121.00	......	120.22	119.36	118.61	122.45	122.04	120.68	119.48	119.00	118.73
25	117.06	121.60	......	120.99	119.23	119.78	122.55	122.79	120.38	119.38	118.87	118.64
EOM	117.05	......	118.40	120.86	119.03	120.65	122.57	122.27	120.13	119.28	118.82	118.75

1969

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	118.55	120.98	119.32	118.68	118.33	117.98	121.13	......	......	121.52	120.70	120.30
10	118.58	120.91	119.28	118.58	118.28	119.69	120.92	......	......	121.30	120.65	120.23
15	119.68	120.33	119.12	118.51	118.17	120.66	121.45	......	......	121.30	120.55	120.18
20	120.90	119.97	119.01	118.45	118.19	120.13	121.53	......	......	120.96	120.45	120.05
25	120.71	119.68	118.87	118.43	118.07	119.60	121.82	......	......	120.97	120.44	120.10
EOM	120.26	119.56	118.77	118.35	117.93	119.89	122.50	......	121.53	120.84	120.33	120.00

1970

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	120.00	......	122.46	122.90	123.96	121.75	123.90	126.21	125.78	124.00	123.25	123.10
10	119.78	......	123.06	123.60	123.46	121.52	124.50	126.46	125.22	123.89	123.20	123.03
15	119.78	......	123.50	124.10	123.00	121.27	124.90	126.76	125.01	123.85	123.15	122.90
20	119.87	119.64	119.76	123.78	124.38	122.70	122.60	125.33	126.89	124.52	123.70	123.08
25	119.80	121.30	123.37	......	122.38	122.90	125.59	126.98	124.65	123.70	123.03	122.84
EOM	119.62	121.82	122.80	124.30	124.26	122.00	122.65	125.90	127.17	124.23	123.50	122.86

Table 5.--Ground-water levels in selected observation wells in the Ogallala aquifer--Continued

1971

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	122.80	125.39	124.10	123.49	123.27	123.10	125.98	126.15	126.80	125.73	125.20	124.57
10	122.70	124.92	123.82	123.25	123.30	123.10	125.85	126.32	126.44	125.47	125.00	124.73
15	122.80	124.68	123.76	123.22	123.24	123.08	126.40	127.05	126.20	125.46	124.90	124.62
20	123.99	124.52	123.45	123.20	123.18	123.79	126.80	126.35	125.98	125.35	124.85	124.53
25	124.73	124.18	123.60	123.30	123.16	124.70	126.44	127.40	125.80	125.24	124.67	124.37
EOM	125.36	124.13	123.40	123.32	123.20	125.39	126.88	127.30	125.69	125.11	124.76	124.38

1972

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	124.44	124.27	125.48	128.02	126.50	126.45	127.26	128.25	......	127.71	127.10	126.80
10	124.53	124.43	126.20	127.63	126.44	126.46	127.07	128.58	......	127.62	127.11	126.61
15	124.44	124.36	126.90	127.16	126.45	126.40	128.61	129.46	......	127.40	126.89	126.65
20	124.52	124.30	127.49	126.88	126.43	126.32	128.96	129.57	128.30	127.34	126.93	126.52
25	124.40	124.36	127.75	126.60	126.41	127.83	128.98	......	128.00	127.26	126.67	126.50
EOM	124.30	124.17	128.40	126.50	126.38	127.60	128.58	......	127.82	127.20	126.75	126.40

1973

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	126.28	126.00	125.67	125.34	125.12	125.22	127.46	129.60	130.12	128.93	128.22	127.75
10	126.20	125.86	125.60	125.22	125.18	125.08	127.96	129.87	129.85	128.88	128.10	127.63
15	126.10	125.85	125.85	125.30	125.21	125.20	128.27	129.67	129.72	128.75	127.98	127.70
20	126.14	125.80	125.62	125.32	125.23	126.35	128.70	130.20	129.40	128.60	128.02	127.48
25	126.00	125.82	125.60	125.28	125.12	126.93	129.00	130.35	129.20	128.44	127.98	127.51
EOM	125.98	125.72	125.45	125.20	125.18	127.08	129.35	130.48	129.13	128.28	127.75	127.48

Table 5.--Ground-water levels in selected observation wells in the Ogallala aquifer--Continued

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 1, 1974	127.24	Oct. 1, 1974	132.68	June 1, 1975	131.85	Feb. 5, 1976	135.70
Feb. 1	126.93	Nov. 1	131.84	July 1	132.20	Mar. 5	136.91
Mar. 1	126.72	Dec. 1	131.10	Aug. 1	134.75	Apr. 5	136.65
Apr. 1	130.69	Jan. 1, 1975	130.75	Sept. 1	135.45	May 5	135.62
May 1	131.16	Feb. 1	131.85	Oct. 1	134.92	June 5	134.92
June 1	129.68	Mar. 1	133.85	Nov. 1	134.23	July 5	137.05
July 1	130.80	Apr. 1	133.82	Dec. 1	133.76	Aug. 5	138.04
Aug. 1	132.78	May 1	132.24	Jan. 5, 1976	133.28	Sept. 5	138.95
Sept. 1	134.35						

17-36W-36BBB. R.E. Bergh. Irrigation well. Depth 221 feet, diameter 18 inches. Measuring point, hole in west side of pump, 1.0 foot above LSD. G = Measured by Kansas State Board of Agriculture. Altitude of land surface 3,246 feet.
Highest water level 125.10 feet below LSD, Jan. 19, 1966.
Lowest water level 147.09 feet below LSD, Jan. 19, 1976.
Records available 1965-76.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 29, 1965	127.13	Jan. 18, 1968	130.59	Jan. 18, 1971	134.07G	Jan. 22, 1974	136.26
Jan. 19, 1966	125.10	Jan. 21, 1969	131.50	Jan. 17, 1972	135.50G	Jan. 14, 1975	141.45
Jan. 25, 1967	128.17	Jan. 19, 1970	129.88	Jan. 18, 1973	135.99	Jan. 19, 1976	147.09

Table 6.--Changes in depth to water in observation wells and in the saturated thickness of the Ogallala aquifer

[See figure 3 for location of observation wells]

Well number	Depth to water in 1977 (ft)	Water-level change 1976-77 (ft)	Water-level change 1966-77 (ft)	Water-level change 1950-77 (ft)	Average annual water-level change 1966-77 (ft/year)	Average annual water-level change 1950-77 (ft/year)	Saturated thickness in 1977 (ft)	Saturated thickness in 1950 (ft)	Percentage change in saturated thickness 1950-77
17-35W-15CDC	125.65	4.85	-15.65	-27.65	-1.42	-1.02	78.35	106.00	-26.08
17-35W-18ACB	134.36	-5.59	-23.56	-37.36	-2.14	-1.38	60.64	98.00	-38.12
17-35W-27CCC	140.99	-1.03	-31.39	-49.99	-2.85	-1.85	69.01	119.00	-42.01
17-35W-30CBB	154.44	-3.70	-27.84	-60.44	-2.53	-2.24	63.56	124.00	-48.74
17-36W-23BCC	153.10	-5.86	-27.75	-53.10	-2.52	-1.97	74.90	128.00	-41.48
17-36W-33BCB	137.17	-2.54	-23.86	-39.17	-2.17	-1.45	70.83	110.00	-35.61
17-36W-36BBB	152.76	-5.67	-27.66	-58.76	-2.51	-2.18	63.24	122.00	-48.16

Well number	Depth to water in 1978 (ft)	Water-level change 1977-78 (ft)	Water-level change 1966-78 (ft)	Water-level change 1950-78 (ft)	Average annual water-level change 1966-78 (ft/year)	Average annual water-level change 1950-78 (ft/year)	Saturated thickness in 1978 (ft)	Saturated thickness in 1950 (ft)	Percentage change in saturated thickness 1950-78
17-35W-15CDC	128.10	-2.45	-18.10	-30.10	-1.51	-1.08	75.90	106.00	-28.40
17-35W-18ACB	134.34	0.02	-23.54	-37.34	-1.96	-1.33	60.66	98.00	-38.10
17-35W-27CCC	144.18	-3.19	-34.58	-53.18	-2.88	-1.90	65.82	119.00	-44.69
17-35W-30CBB	156.24	-1.80	-29.64	-62.24	-2.47	-2.22	61.76	124.00	-50.19
17-36W-23BCC	152.46	0.64	-27.11	-52.46	-2.26	-1.87	75.54	128.00	-40.98
17-36W-33BCB	137.80	-0.63	-24.50	-39.80	-2.04	-1.42	70.20	110.00	-36.18
17-36W-36BBB	153.73	-0.97	-28.63	-59.73	-2.39	-2.13	62.27	122.00	-48.96

Table 7.--Records of recorder-gage rainfall data

Date	Weather gage 17-35W-29CBB Record April 24 to October 2, 1978 1978 Rainfall Weekly (inches)		Monthly (inches)	Weather gage 17-35W-31AAD Record May 31 to October 2, 1977 1977 Rainfall Weekly (inches)		Monthly (inches)
Apr. 24-25*	0.0	Apr. 24-30*	2.31	---		
Apr. 26-May 2	3.22			---		
May 3-9	1.90	May	4.57	---	May 31*	0.0
May 10-16	.86			---		
May 17-23	.85			---		
May 24-30	.05			---		
May 31-June 6	1.51	June	2.79	0.0	June	4.30
June 7-13	.12			.55		
June 14-20	.07			1.49		
June 21-27	.48			2.23		
June 28-July 4	.61	July	.49	.03	July	3.30
July 5-11	.29			.22		
July 12-18	0.0			2.63		
July 19-25	.04			.45		
July 26-Aug. 1	.16	Aug.	1.36	0.0	Aug.	3.80
Aug. 2-8	.69			.90		
Aug. 9-15	0.0			2.54		
Aug. 16-22	0.0			.06		
Aug. 23-29	.64			.09		
Aug. 30-Sept. 5	.03	Sept.	.11	.35	Sept.	.55
Sept. 6-12	0.0			.36		
Sept. 13-19	.02			0.0		
Sept. 20-26	.09			0.0		
Sept. 27-Oct. 2*	0.0	Oct. 1-2*	0.0	.05	Oct. 1-2*	0.0
TOTAL	11.63		11.63	11.95		11.95

* Weekly or monthly record not entirely available

Table 8.--Records of weekly rainfall amounts for Garden City, Tribune, and Leoti compared with rainfall amounts for three test fields in study area

Week	Weekly average for a 51-year period (inches)		1978 Rainfall (inches)				1977 Rainfall (inches)			
				Test fields*				Test fields*		
	Garden City	Tribune	Leoti	17-35W-31B	17-35W-19B	17-36W-26B	Leoti	17-35W-31B	17-35W-19B	17-36W-26B
June 7-13	0.74	0.61	0.21	0.12	0.12	0.12	0.65	0.52	0.65	0.71
June 14-20	.52	.56	.98	.40	.25	.32	.18	.15	.18	.07
June 21-27	.57	.55	.21	.15	.10	.09	1.15	3.78	3.53	2.45
June 28-July 4	.47	.57	.76	.46	.23	.32	0.0	.02	.01	T**
July 5-11	.58	.45	.58	.34	.22	.30	.30	.24	.19	.21
July 12-18	.51	.77	.04	.27	.04	.07	2.06	2.39	2.09	2.19
July 19-25	.60	.47	.44	.50	.70	.62	.46	.53	.84	.96
July 26-Aug. 1	.50	.53	.14	.27	.27	.16	0.0	.01	.01	.01
Aug. 2-8	.65	.64	.70	.53	.49	.62	1.40	1.01	.37	.93
Aug. 9-15	.66	.64	0.0	0.0	0.0	0.0	1.38	2.81	1.79	2.31
Aug. 16-22	.52	.39	0.0	0.0	0.0	0.0	.16	.09	.07	.16
Aug. 23-29	.46	.49	.60	.64	.70	.40	.10	.10	.12	.11
Aug. 30-Sept. 5	.45	.38	.70	.03	.06	.08	.23	.12	--	--
TOTAL	8.08	7.05	5.36	3.71	3.18	3.10	8.07	11.77	9.85	10.11

* These values were corrected by comparison of standard rain-gage readings and recording rain gages that were stationed adjacent to each other

** Trace

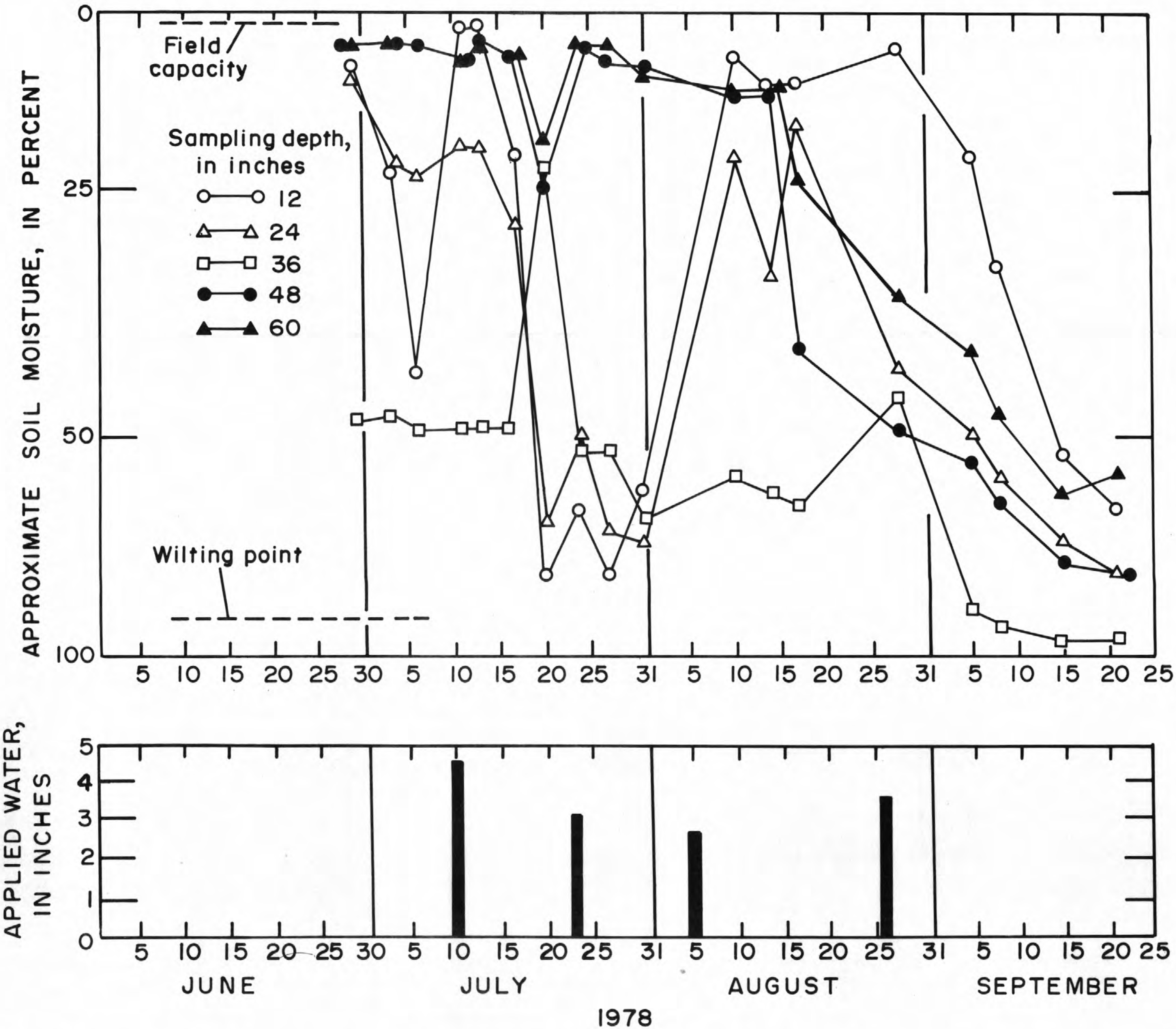

Figure 4.--Soil moisture used and irrigation water applied at test field 17-36W-27DBC.

Table 9.--Records of soil moisture in test fields

Location of test field	Sample depth (inches)	GRAVIMETRIC MOISTURE CONTENT (percentage by weight) 1978						
		July 10	July 11	July 20	July 30	July 31	Aug. 1	Aug. 14
17-35W-31ABA	12	15	--	--	--	--	29	17
	24	16	--	--	--	--	30	11
	36	17	--	--	--	--	31	12
	48	22	--	--	--	--	29	15
	60	22	--	--	--	--	29	15
17-35W-31ABB	12	16	--	--	--	--	22	17
	24	15	--	--	--	--	21	16
	36	16	--	--	--	--	21	16
	48	20	--	--	--	--	22	18
	60	22	--	--	--	--	25	20
17-35W-31ABC	12	22	--	--	--	--	37	12
	24	26	--	--	--	--	27	13
	36	24	--	--	--	--	27	--
	48	26	--	--	--	--	31	--
	60	--	--	--	--	--	--	--
17-35W-31ABD	12	25	--	--	--	--	23	--
	24	19	--	--	--	--	--	--
	36	21	--	--	--	--	--	--
	48	23	--	--	--	--	--	--
	60	23	--	--	--	--	--	--
17-36W-25AAC	12	19	--	16	--	--	28	13
	24	22	--	22	--	--	33	13
	36	25	--	24	--	--	32	12
	48	26	--	24	--	--	28	--
	60	24	--	23	--	--	31	--
17-36W-25AAD	12	18	--	21	--	--	27	14
	24	20	--	24	--	--	25	14
	36	21	--	25	--	--	26	14
	48	21	--	24	--	--	29	16
	60	21	--	25	--	--	35	17
17-36W-27ACA	12	--	16	--	--	--	--	--
	24	--	28	--	--	--	--	--
	36	--	21	--	--	--	--	--
	48	--	23	--	--	--	--	--
	60	--	23	--	--	--	--	--

Table 9.--Records of soil moisture in test fields--Continued

Location of test field	Sample depth (inches)	GRAVIMETRIC MOISTURE CONTENT (percentage by weight) 1978						
		July 10	July 11	July 20	July 30	July 31	Aug. 1	Aug. 14
17-36W-27ACB	12	--	17	--	--	--	--	--
	24	--	18	--	--	--	--	--
	36	--	21	--	--	--	--	--
	48	--	24	--	--	--	--	--
	60	--	26	--	--	--	--	--
17-36W-27ACC	12	--	--	19	--	23	--	14
	24	--	--	23	--	24	--	13
	36	--	--	25	--	22	--	13
	48	--	--	24	--	24	--	13
	60	--	--	25	--	28	--	15
17-36W-27ACD	12	--	--	18	--	22	--	--
	24	--	--	22	--	26	--	--
	36	--	--	--	--	27	--	--
	48	--	--	23	--	31	--	--
	60	--	--	24	--	29	--	--
17-36W-27ACD2	12	--	--	--	--	--	--	13
	24	--	--	--	--	--	--	12
	36	--	--	--	--	--	--	11
	48	--	--	--	--	--	--	11
	60	--	--	--	--	--	--	14
17-36W-27ADA	12	--	18	--	--	--	--	--
	24	--	21	--	--	--	--	--
	36	--	23	--	--	--	--	--
	48	--	23	--	--	--	--	--
	60	--	25	--	--	--	--	--
17-36W-27ADD	12	--	--	--	--	25	--	13
	24	--	--	--	--	25	--	16
	36	--	--	--	--	28	--	18
	48	--	--	--	--	35	--	20
	60	--	--	--	--	39	--	21
17-36W-27DAA	12	--	--	--	--	28	--	14
	24	--	--	--	--	--	--	--
	36	--	--	--	--	26	--	--
	48	--	--	--	--	22	--	13
	60	--	--	--	--	25	--	14

Table 9.--Records of soil moisture in test fields--Continued

Location of test field	Sample depth (inches)	GRAVIMETRIC MOISTURE CONTENT (percentage by weight) 1978						
		July 10	July 11	July 20	July 30	July 31	Aug. 1	Aug. 14
17-36W-27DAD	12	--	18	--	--	--	--	--
	24	--	20	--	--	--	--	--
	36	--	23	--	--	--	--	--
	48	--	20	--	--	--	--	--
	60	--	15	--	--	--	--	--
17-36W-27DBA	12	--	--	--	--	23	--	14
	24	--	--	--	--	22	--	12
	36	--	--	--	--	22	--	--
	48	--	--	--	--	26	--	--
	60	--	--	--	--	26	--	--
17-36W-27DBB	12	--	--	--	--	26	--	15
	24	--	--	--	--	26	--	14
	36	--	--	--	--	24	--	15
	48	--	--	--	--	27	--	15
	60	--	--	--	--	31	--	16
17-36W-27DBC	12	--	21	--	--	--	--	--
	24	--	24	--	--	--	--	--
	36	--	26	--	--	--	--	--
	48	--	24	--	--	--	--	--
	60	--	24	--	--	--	--	--
17-36W-27DBD	12	--	21	--	--	--	--	--
	24	--	23	--	--	--	--	--
	36	--	25	--	--	--	--	--
	48	--	24	--	--	--	--	--
	60	--	24	--	--	--	--	--
17-36W-36BAD	12	23	--	--	--	--	25	22
	24	26	--	--	--	--	24	11
	36	26	--	--	--	--	24	11
	48	27	--	--	--	--	29	11
	60	28	--	--	--	--	29	13
17-36W-36BBC	12	19	--	--	--	--	30	23
	24	25	--	--	--	--	55	24
	36	26	--	--	--	--	33	17
	48	27	--	--	--	--	41	17
	60	28	--	--	--	--	66	18

Table 9.--Records of soil moisture in test fields--Continued

Location of test field	Sample depth (inches)	GRAVIMETRIC MOISTURE CONTENT (percentage by weight) 1978						
		July 10	July 11	July 20	July 30	July 31	Aug. 1	Aug. 14
17-36W-36BCC	12	17	--	--	--	--	24	16
	24	20	--	--	--	--	24	10
	36	23	--	--	--	--	28	10
	48	23	--	--	--	--	29	11
	60	23	--	--	--	--	33	16
17-36W-36BDD	12	22	--	--	--	--	28	11
	24	24	--	--	--	--	30	16
	36	25	--	--	--	--	31	16
	48	25	--	--	--	--	33	17
	60	25	--	--	--	--	33	15

Records of measured irrigation-well discharges in gallons per minute, line pressures in pounds per square inch, and calculated power factors are shown in table 10. The power factor, or the energy consumed to pump 1 acre-foot of water, was determined for irrigation pumps powered by natural gas, electricity, or diesel fuel.

The power factor is useful in estimating the cost of applying various amounts of irrigation water and the relative efficiency of the pumping operation. Comparison of power factors also gives a rough indication of the capability of the pump. A high power factor generally indicates less efficiency than a low power factor. Some differences also may occur from site-to-site and from time-to-time as a result of differences in total head (pumping lift plus line pressure head). Power factors were computed using the following equations:

For natural gas-powered pump motors,

$$K_g = \frac{(1.955 \cdot 10^7)(V)(P_g)}{(Q)(T_g)},$$

where

- K_g = power factor, determined as cubic feet of natural gas to pump 1 acre-foot of water;
- V = cubic feet of natural gas consumed, in T_g seconds;
- P_g = conversion factor for correcting measured line pressure (between engine and meter) to a standardized base and altitude;
- Q = pump discharge, in gallons per minute;
- T_g = time, in seconds, to consume V cubic feet of natural gas.

For electric-powered pump motors,

$$K_e = \frac{(1.955 \cdot 10^4)(R)(K_h)}{(Q)(T_e)},$$

where

- K_e = power factor determined as kilowatthours to pump 1 acre-foot of water;
- R = revolutions of meter disc, in T_e seconds;
- K_h = constant for each meter (generally stamped on the nameplate of the instrument) giving the number of watthours represented by one revolution of the meter disc;
- Q = pump discharge, in gallons per minute;
- T_e = time, in seconds, for meter disc to make R revolutions.

For diesel-powered pump motors,

$$K_d = \frac{(3.259 \cdot 10^5)(G)}{60(Q)} = \frac{5431.7(G)}{Q},$$

where

- K_d = power factor determined as gallons of diesel fuel to pump 1 acre-foot of water;
- G = consumption of diesel fuel, in gallons per hour;
- Q = pump discharge, in gallons per minute.

Table 10.--Records of well production, line pressure, and power factors

Irrigation well[1/]	Pump discharge (gal/min) 1978	1977	1976	Pressure[2/] (lb/in^2) 1977	Power factor[3/] 1978	1977	1976	Power type[4/]
17-35W-19BBC	390	475	510	3	6,915	7,765	10,500	NG
17-35W-19BCC	430	345	415	2	9,985	7,765	10,500	NG
17-35W-19CCC	260	280	400	2	13,775	11,150	8,700	NG
17-35W-20ACD	1,080	870	585	2.5	4,825	6,325	9,200	NG
17-35W-20CCC	415	530	UTM[5/]	3.5	11,965	13,900	UTM	NG
17-35W-20DCB	UTM	775	950	1.5	UTM	6,280	6,065	NG
17-35W-29BDC	375	355	285	--	9,980	17,540	12,870	NG
17-35W-29CBC	560	850	580	--	UTM	4,290	7,475	NG
17-35W-30ABB	610	610	510	4.5	11,040	10,805	11,720	NG
17-35W-30BBC	485	620	475	--	12,600	9,855	11,900	NG
17-35W-30CBB	475	625	130	--	8,055	6,605	29,200	NG
17-35W-30DCB	785	910	690	--	UTM	4,290	7,475	NG
17-35W-31ABB	115	275	305	1	12,625[7/]	8,470	7,200	NG
17-35W-31BBB	UTM	140	265	--		30,985	14,440	NG
17-35W-31CCB	65	250	230	1	735	270	360	E
17-35W-31CCB2	215	160	75	1	11,200	13,565	33,800	NG
17-35W-31DCA	270	255	350	--		8,470	8,060	NG
17-35W-32ACC	260	210	---	--	15,800	19,685	---	NG
17-35W-32CBB	260	340	300	--	18,795	13,225	15,610	NG
17-36W-23BAA	485	295	UTM	14.5	230	645	UTM	E
17-36W-23BCC	565[6/]	240	UTM	4	155	525	UTM	E
17-36W-23BCC2		185	UTM	10	290	645	UTM	E
17-36W-23CDB	560	590	UTM	--	13,140	5,260	UTM	NG
17-36W-24BCB	505	515	475	2	6,055	5,580	7,230	NG
17-36W-24CBC	905	765	UTM	1	8,800	5,320	UTM	NG

Table 10.--Records of well production, line pressure, and power factors--Continued

Irrigation well[1/]	Pump discharge (gal/min)			Pressure[2/] (lb/in^2)	Power factor[3/]			Power type[4/]
	1978	1977	1976	1977	1978	1977	1976	
17-36W-25ACC	500	515	520	4.5	UTM	30	UTM	D
17-36W-25BBB	445	550	435	2	9,565	7,755	8,335	NG
17-36W-25CCD	700	750	885	1	8,370	6,285	5,955	NG
17-36W-25DCC	240	275	280	2.5	575	465	460	E
17-36W-26ACB	265	215	245	1	585	505	450	E
17-36W-26CBB	540	610	635	0	UTM	8,475	8,895	NG
17-36W-26DBB	---	300	385	2	---	535	400	E
17-36W-35ABB	510	595	565	--	11,750	5,930	8,470	NG
17-36W-35BBC	445	600	550	1.5	UTM	8,475	8,895	NG
17-36W-35CCC	220	320	275	0	21,735	16,960	16,230	NG
17-36W-36BBB	630	815	785	1.5	8,325	7,090	UTM	NG
17-36W-36CBB	UTM	UTM	330	--	UTM	UTM	11,640	NG
17-36W-36DAB	185	420	265	1	22,385	7,390	16,175	NG

1/ See figure 3 for location of irrigation wells

2/ Pressures in pounds per square inch (lb/in^2) in front of orifice plates on water meters

3/ In units of: K_g in (ft^3/acre-ft)
K_e in (kWh/acre-ft)
K_d in (gal/acre-ft)

4/ NG = natural gas, E = electric, D = diesel fuel

5/ UTM = Unable to measure

6/ Combined pump discharge for wells 17-36W-23BCC and BCC2

7/ Combined natural gas for both wells 17-35W-31ABB and BBB

CROP-PRODUCTION DATA

Data on weekly and monthly averages and ranges of solar radiation at Scott City (about 15 miles east of the study area) during 1978 are given in table 11. The solar radiation was measured with a pyranometer and is expressed in langley units per day (ly/d). Langley units are the calories of energy per square centimeter.

Records of average crop yields for the six test fields in the study area (fig. 3) during 1977-78 are given in table 12. The yields of corn and grain sorghum in bushels per acre (bu/acre) are compared with the 8-year average (1969-76) for Wichita County. Records of crop acreage per year during 1973-78 are given in table 13 for the intensive study area. The average acreage of each crop also is given for the period 1973-78.

Table 11.--Records of solar radiation at Scott City, Kansas

Period of record -- Apr. 7 to July 9, July 14 to July 18, and July 20 to Sept. 22, 1978

Date	Weekly average (ly/d)	Weekly range (ly/d)	Month	Monthly average (ly/d)	Monthly range (ly/d)
Apr. 7-11*	479	364-594	Apr. 7-30*	488	103-678
Apr. 12-18	371	103-626			
Apr. 19-25	579	378-678			
Apr. 26-May 2	414	66-642	May	518	66-726
May 3-9	370	139-726			
May 10-16	687	567-715			
May 17-23	525	229-713			
May 24-30	611	439-740			
May 31-June 6	462	323-565	June	604	172-734
June 7-13	643	172-734			
June 14-20	655	492-732			
June 21-27	626	347-705			
June 28-July 4	669	564-714	July	625	325-884
July 5-11	547	325-708			
July 12-18	691	573-884			
July 19-25	568	438-676			
July 26-Aug. 1	642	512-687	Aug.	536	194-657
Aug. 2-8	480	194-657			
Aug. 9-15	590	378-639			
Aug. 16-22	606	552-650			
Aug. 23-29	515	347-584			
Aug. 30-Sept. 5	484	264-567	Sept. 1-22*	497	334-565
Sept. 6-12	446	469-565			
Sept. 13-19	485	367-531			
Sept. 20-22*	389	334-464			

* Weekly or monthly record not entirely available

Table 12.--Records of average crop yields in test fields

[See figure 3 for location of test fields]

Test field location	1977 Corn (bu/acre)	1977 Grain sorghum (bu/acre)	1977 Above (+) or below (-) 8-year (1969-76) county average (bu/acre)	1978 Corn moisture (percent)	1978 Corn weight (lb/bu)	1978 Corn yield (bu/acre)	1978 Above (+) or below (-) 8-year (1969-76) county average (bu/acre)
17-35W-19B	74	---	-39	--	--	---	---
17-35W-31A	--	---	---	16.9	54.0	74.8	-38.2
17-36W-25A	153.1	---	+40.1	22.0	52.8	116.1	+ 3.1
17-36W-26B	--	112	+31.2	--	--	---	---
17-36W-27A	--	---	---	19.3	54.6	119.5	+ 6.5
17-36W-36B	121	---	+ 8	--	--	123.5	+10.5
Average	116.0	112	+10.1	19.4	53.8	108.5	- 4.5

Table 13.--Records of crop acreage in intensive-study area

Year	Crop acreage	Corn	Wheat	Grain sorghum	Barley	Millet	Sunflowers	Alfalfa	Soy-beans	Pinto beans	Fallow and no-crop acreage
1978	5,167	2,257	1,828	544	--	41	195	215	87	--	2,513
1977	5,319	2,885	1,670	644	--	--	---	120	--	--	2,361
1976	4,458	2,336	1,699	316	--	--	---	47	--	60	3,222
1975	5,751	2,964	1,866	787	12	--	---	122	--	--	1,929
1974	6,018	3,338	1,853	709	10	--	---	108	--	--	1,662
1973	5,469	2,989	1,668	604	11	--	---	197	--	--	2,211
Average	5,364	2,795	1,764	601	11	41	195	134	87	60	2,316

CONCLUSIONS

This data report, when used with the available literature, may be used in determining the extent of geologic formations, making an assessment of water resources, and planning an orderly development of water supplies. Interpretive information presently is available in reports of Wichita and Greeley Counties by Prescott, Branch, and Wilson (1954) and Slagle and Weakly (1976).

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