KANSAS GEOLOGICAL SURVEY
OPEN-FILE REPORT 82-2

Geohydrology of Southwestern Butler County, Kansas:

A Preliminary Report

by

Howard G. O'Connor
Pamela Chaffee
Martha Link

KANSAS GEOLOGICAL SURVEY
1930 Constant Avenue
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Lawrence, KS 66047

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Prepared at the Request of the

Butler County Commissioners,

County Engineer, and County Zoning Administrator

Kansas Geological Survey

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May 1982

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Introduction

At the request of the Butler County Commission, a meeting was arranged with the Kansas Geological Survey to discuss what kinds of assistance or useful hydrogeologic information could be provided to the County Commissioners, County Engineer, and County Zoning Administrator to assist them in administering their responsibilities.

A meeting was held at the Kansas Geological Survey's Foley Geohydrology Center on march 23, 1982 attended by the following persons:

John Tipton - Butler County Zoning Administrator

Ted Farmer - Butler County Engineer

Tom M. Linot - Butler County Commission

J. W. Simmons - Butler County Commission

Eldon Phillips - Butler County Commission

William W. Hambleton, Director - Kansas Geological Survey

Jane Denne, Geologist - Kansas Geological Survey

Howard G. O'Connor, Geologist - Kansas Geological Survey

Manoutch Heidari, Civil Engineer - Kansas Geological Survey

Pat Cobb, Hydrologist - Kansas Geological Survey

The county officials described the rapid growth in the suburban and rural areas which are not served by public water supplies and sewers. Their problem is in knowing how to respond to developers and individuals who want to construct homes in the rural and small tract subdivision developments. The county officials needs are for reliable information about the soils, geology, and the quantity and quality of groundwater available so that they can develop meaningful rules, regulations, and policies which will protect the public health and property values and promote orderly growth. This information is needed for all of the county, but especially southwestern Butler County where small tract development is most rapid and problems are greatest.

Dr. Hambleton responded with a summary of the kinds of information that is available at the Kansas Geological Survey. The staff is fully committed to projects already in progress and institutional and funding restrictions are such that we could not move any staff into a Butler County research project now or in the very near future. He indicated some work was done in Butler county in the early and mid 1960's. Some of the data was published in USGS Water Supply Paper 1982, "Chemical Quality of Water in the Walnut River Basin, South-Central Kansas," but much of the groundwater data remains unpublished.

The county officials asked if the Kansas Geological Survey could provide any kind of interim report for the southwest part of Butler county, their area of greatest need, based only on data already available. Dr. Hambleton agreed to assign one staff member and one or more part-time graduate research assistants to prepare a preliminary report on the geohydrology of an area two townships wide by four townships tall (R3 and 4E, T26, 27, 28, and 29S) in the southwest part of Butler County as quickly as possible.

Following a review of the in-house data, it was agreed to prepare a brief interpretative report, supplemented by maps and tables. The interpretative report and any recommendations deemed advisable would be presented by one of the Kansas Geological Survey staff at a meeting with the Butler County officials as soon as possible and be available to answer questions.

A project proposal for a full-scale study of Butler County, together with a time schedule and cost estimate for the complete study would also be prepared. Dr. Hambleton indicated that Kansas law allows financial cooperative agreements between counties, through the county commissions, and the Kansas Geological Survey (KSA 76-326a). Cooperative financial support by the county would allow KGS to hire additional staff and allow an earlier start of the project.

Geologic Framework

The rocks which contain fresh or useable water are of Quaternary and Permian age. Quaternary rocks are relatively young rocks (less than 2 million years old) and are shown in Plate 1 as the alluvium in the stream valleys and as thin loess or wind laid silt deposits in parts of Township 26, 28, and 29S, R3E.

The thickness and water bearing characteristics of the alluvium and loess deposits are summarized in Table 1 and Figure 2.

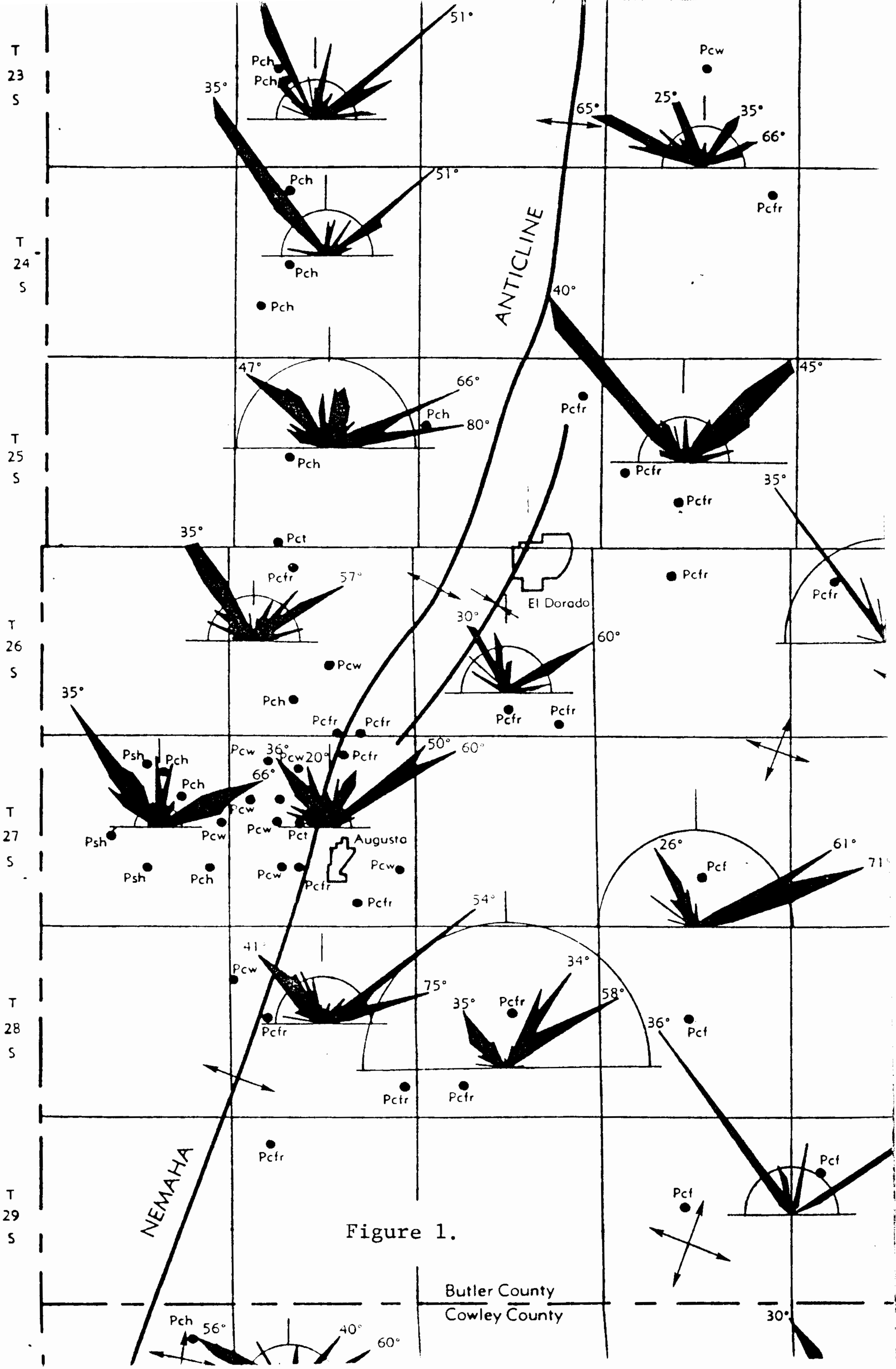
The Permian rocks, about 270 million years old, consist of more or less flat lying to gently sloping alternating layers of shale and limestone beds. They have a regional slope of about 20 feet per mile westward except along the Nemaha anticline (Fig. 1). The Permian rocks dip or slope more steeply westward along the west side of the Nemaha anticline and slope eastward along the east side of the anticline. The Nemaha anticline is the principal local structure in the study area.

The shale beds of the Wellington Formation (Sumner Group) consist principally of gray and greenish shale beds but also include thin limestone and gypsum beds. Below the Wellington Formation, in downward sequence are the

TABLE 1: Generalized Section of Outcropping Rock Units in Southwestern Butler County and Their Water-Bearing Characteristics

System	Series	Group	Formation	Thickness (ft)	Character	Water Supply
Quaternary	Pleistocene		Alluvium	0-50	Silt, clay, limestone and chert sand and gravel fragments.	Small (0-10 gpm) to moderate (10-100 gpm). Yields of generally good, but locally poor quality water in principal stream valleys. Locally polluted by past oil & gas activities.
			Loess	0-10	Wind laid deposits of silt on upland areas.	Lies above water table and yields no water to wells.
Permian	Middle Permian	Sumner	Wellington	0-100	Light gray and green silty shale contain thin limestone and gypsum beds. Contains the Hollenberg Limestone	Small to moderate quantities of generally hard water is obtained from permeable thin limestones and gypsum beds.
	Lower Permian		Nolans Limestone	20-30	Light-buff limestone & dolomite in upper part. Sandy dolomitic appearance; contains silicous geodes, locally chert nodules. Middle part blue to gray shale, lower few feet is gray limestone or limestone & shale.	Yields moderate quantities of groundwater to many wells from solution channels in the upper limestone bed.
			Odell Shale	30-40	Chiefly gray & green calcareous shale. Locally dolomitic in the upper and middle part.	Yields little groundwater to wells.
			Winfield Limestone	20-30	Light blue to white thin bedded limestone overlying massive light buff limestone; locally contains chert nodules.	Yields small to moderate supplies of water to wells from solution zones.

			Doyle Shale	85-95	Upper Gage Shale Member is gray, green, and red clay shale, calcareous at top. Thickness about 40-50 feet. Middle Towanda Limestone Member is about 5-15 feet thick, buff to gray, locally gypsiferous.	Yields small to moderate supplies from permeable zones in the Towanda Limestone. Water may be high in sulfate.
			Barneston Limestone	75-85	The upper Ft. Riley Limestone member is 45-55 feet thick & consists of both massive & thin bedded limestone. Lower Florence Limestone member is 25-35 feet thick, gray to buff limestone interbedded with chert.	Yields small to large supplies of water from fractures and solution channels. Supplies water to many
			Matfield Shale	60±	Upper and lower gray, green & maroon shale beds separated by about 15 feet of limestone and gray limey shale.	May yield small supplies of water to wells from the middle limestone beds.



T 23 S
T 24 S
T 25 S
T 26 S
T 27 S
T 28 S
T 29 S
ANTICLINE
NEMAHA
El Dorado
Augusta
Butler County
Cowley County

Figure 1.

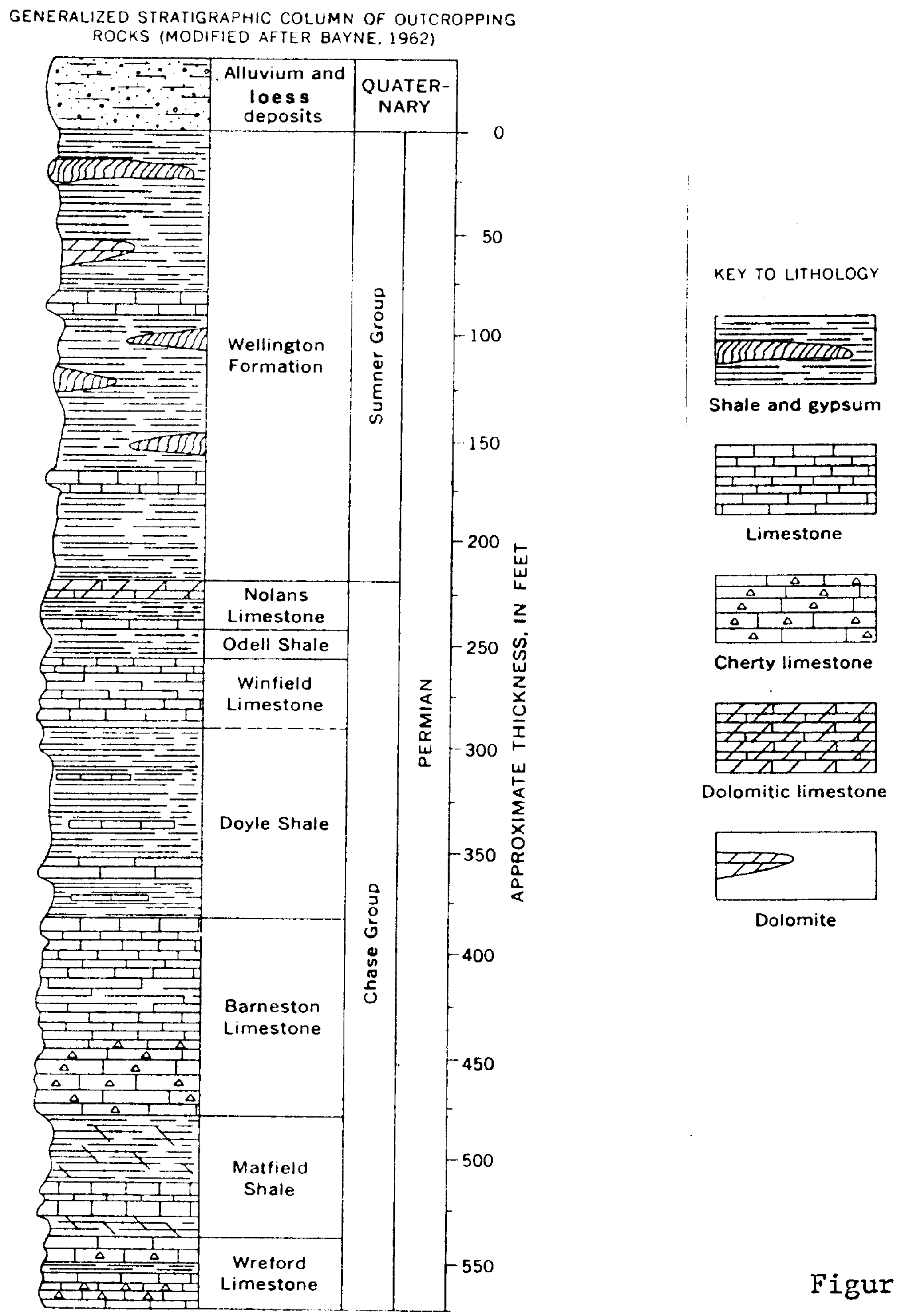

GENERALIZED STRATIGRAPHIC COLUMN OF OUTCROPPING ROCKS (MODIFIED AFTER BAYNE, 1962)
Alluvium and loess deposits
QUATERNARY
Wellington Formation
Sumner Group
Nolans Limestone
Odell Shale
Winfield Limestone
Doyle Shale
Barneston Limestone
Matfield Shale
Wreford Limestone
Chase Group
PERMIAN
0
50
100
150
200
250
300
350
400
450
500
550
APPROXIMATE THICKNESS, IN FEET
KEY TO LITHOLOGY
Shale and gypsum
Limestone
Cherty limestone
Dolomitic limestone
Dolomite

Figure 2.

Nolans Limestone, Odell Shale, Winfield Limestone, Doyle Shale, Barneston Limestone and Matfield Shale, all parts of the Chase Group of rocks (Fig. 2). These are the units considered to provide the domestic water supplies of the area. The thickness and general character of the rocks are shown in Table 1 and Figure 2.

Each of the major limestone units contains one or more zones having significant solution permeability and the Nolans and Barnestone Limestone contain zones having abundant chert or silicous concretions. The Towanda Limestone member of the Doyle Shale may be gypsiferous and locally contains solution permeability. The shale units consist of gray, green, tan and red silty to calcareous shales, thin limestones and locally gypsum beds, but below a depth of about 50 feet are considered relatively impermeable or of very low permeability with respect to vertical groundwater flow.

Regional Hydrology

Groundwater suitable for domestic and stock use occurs in both the unconsolidated Quaternary alluvial stream valley deposits, and the consolidated Permian limestone and shales at maximum depths ranging from about 100 to 175 feet. The limestone have two dominant sets of fractures trending northeast and northwest as shown on Figure 1. The ability of the fractures to store and transmit groundwater is greater where the rocks are at or near the land surface (< 30 feet) because various weathering processes tend to cause the fractures to open or to enlarge as a result of solution of the rock by moving groundwater. In addition, at depths below about 30 to 50 feet there are one or more primary permeable zones in nearly all of the thicker limestone units such as the Nolans, Winfield, Towanda and Barnestone limstones. Horizontal or nearly horizontal primary solution permeability zones developed soon after the limestones were deposited and consolidated, but before they were deeply buried. Because the primary horizontal solution zones in the limestones have not removed all of the limestone in the solutioned zone, every small diameter bore hole drilled through the solutioned zone may not penetrate a water filled solution channel or interconnected voids. These zones may contain rather significant quantities of water adequate for reliable domestic and stock supplies.

For example if we have a one-foot thick zone with 15 percent of the limestone removed by solution leaving 15 percent of the one-foot zone as void space filled with water in solution channels, we would have almost 50,000 gallons of water stored in this zone under each acre of land. Typically water wells which penetrate the primary solution zones may be expected to have small (1 to 10 gallons per minute [gpm]) to moderate (10 to 100 gpm) yields to properly constructed wells.

A review of more than 415 Water Well Records (WWC-5 forms) available for southwestern Butler County indicates many of the bore holes encounter 1, 2, or even 3 permeable water bearing zones. Four WWC-5 records are included as Figures 3-6 for reference. Figure 3 indicates three water-bearing zones were penetrated by this well; the upper water zone at 48 feet depth has been grouted out to exclude this water from the well. The lower two water-bearing zones have been hydraulically connected to contribute to the well yield by means of a permeable gravel pack around the casing from 58 to 138 feet depth and screen perforation intervals from 118 feet to 138 feet depth. Figure 6 shows a well which penetrates two water-bearing zones, at 65 feet and 104 feet. The water at 65 feet was grouted out of the well because this zone

WATER WELL RECORD Form WWC-5 KSA 82a-1212

ION OF WATER WELL	Fraction	Section Number	Township Number	Range Number
Butler	SE ¼ SE ¼ SW ¼	24	T 27 S	R 3 E/W

and direction from nearest town or city? 3½ Mi West Of Augusta | Street address of well if located within city?

ER WELL OWNER: B.J. Stoops
Address, Box # : R 3
, ZIP Code : Augusta Ks 67010

Board of Agriculture, Division of Water Resources
Application Number:

H OF COMPLETED WELL .138. ft. Bore Hole Diameter .8. in. to .138. ft., and .... in. to .... ft.

r to be used as: 5 Public water supply 8 Air conditioning 11 Injection well
nestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
ation 4 Industrial 7 Lawn and garden only 10 Observation well

atic water level .76. ft. below land surface measured on .1. month .21. day .81. year
st Data : Well water was .... ft. after .... hours pumping .... gpm
gpm: Well water was .... ft. after .... hours pumping .... gpm

OF BLANK CASING USED: 5 Wrought iron 8 Concrete tile Casing Joints: Glued X .. Clamped ......
Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded ....
PVC 4 ABS 7 Fiberglass .... Threaded ....
sing dia .5. in. to .118. ft., Dia .... in. to .... ft., Dia .... in. to .... ft.
eight above land surface .14. in., weight .... lbs./ft. Wall thickness or gauge No .160.16.

SCREEN OR PERFORATION MATERIAL: (7) PVC 10 Asbestos-cement
Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 11 Other (specify) ....
Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)

r Perforation Openings Are: 5 Gauzed wrapped (8) Saw cut 11 None (open hole)
Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes
ouvered shutter 4 Key punched 7 Torch cut 10 Other (specify) ....

erforation Dia .5. in. to .138. ft., Dia .... in. to .... ft., Dia .... in to .... ft.
erforated Intervals: From .118. ft. to .138. ft., From .... ft. to .... ft.
From .... ft. to .... ft., From .... ft. to .... ft.
ack Intervals: From .138. ft. to .58. ft., From .... ft. to .... ft.
From .... ft. to .... ft., From .... ft. to .... ft.

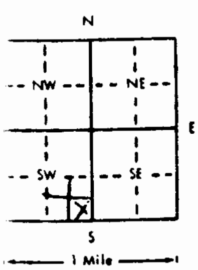
UT MATERIAL: 1 Neat cement (2) Cement grout 3 Bentonite 4 Other ....
Intervals: From .56. ft. to .46. ft., From .13. ft. to .3. ft., From .... ft. to .... ft.

he nearest source of possible contamination: 10 Fuel storage 14 Abandoned water well
eptic tank 4 Cess pool 7 Sewage lagoon 11 Fertilizer storage 15 Oil well/Gas well
ewer lines 5 Seepage pit 8 Feed yard 12 Insecticide storage 16 Other (specify below)
ateral lines 6 Pit privy 9 Livestock pens 13 Watertight sewer lines

from well .E. How many feet .75.? Water Well Disinfected? Yes .X. No
emical/bacteriological sample submitted to Department? Yes .... No .X. ; If yes, date sample
nitted .... month .... day .... year: Pump Installed? Yes .... No .X.
ump Manufacturer's name .... Model No. .... HP .... Volts ....
Pump Intake .... ft. Pumps Capacity rated at .... gal./min.
ump: 1 Submersible 2 Turbine 3 Jet 4 Centrifugal 5 Reciprocating 6 Other

RACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was
d on .1. month .21. day .81. year
ecord is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. .313.
er Well Record was completed on .1. month .23. day .81. year under the business
Brady Water Wells by (signature) Richard Brady

TE WELL'S LOCATION AN "X" IN SECTION



ON: Slope

FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	1	Top Soil			
1	6	Clay Redish brown			
6	8	clay yellow			
8	22	Limestone yellow			
22	53	Shale yellow Gray			
53	71	Shale Gray			
71	94	LimeStone yellow			
94	113	Shale yellow gray			Figure 3.
113	128	Shale Rusty Red			
128	138	Shale gray			

Groundwater Encountered 1. .48. ft. 2. .105. ft. 3 .128. ft. 4. .... ft. (Use a second sheet if needed)

TIONS: Use typewriter or ball point pen, *please press firmly* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three nsas Department of Health and Environment, Division of Water Well Contractors, Topeka, KS 66620. Send one to WATER WELL OWNER and for ... records.

OFFICE USE ONLY T 27 R 3 E/W SEC. 24 SE ¼ SE ¼ SW ¼

USE TYPEWRITER OR BALL POINT PEN—PRESS FIRMLY, PRINT CLEARLY.

WATER WELL RECORD
KSA 82a-1201-1215

Kansas Department of Health and Environment—Division of Environment (Water well Contractors) Topeka, Kansas 66620

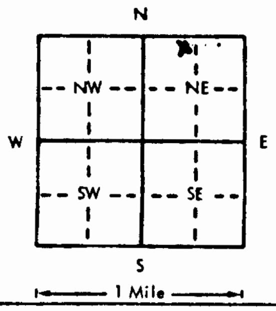
Location of well:	County	Fraction	Section number	Township number	Range number
	Butler	NE 1/4 NW 1/4 NE 1/4	26	T 17 S	R 3 (E) W

2. Distance and direction from nearest town or city: 4 1/4 West

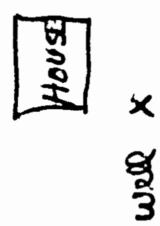
Street address of well location if in city: Augusta Kans

3. Owner of well: A. J. Laham
R.R. or street: 204 Sunflower
City, state, zip code: Augusta Kansas

4. Locate with "X" in section below:



Sketch map:



6. Bore hole dia. 10 in. Completion date 6-22-1976
Well depth 80 ft.

7. X Cable tool __ Rotary __ Driven __ Dug __ Hollow rod __ Jetted __ Bored __ Reverse rotary

8. Use: X Domestic __ Public supply __ Industry __ Irrigation __ Air conditioning __ Stock __ Lawn __ Oil field water __ Other

9. Casing: Material Galv Height: (Above) or below Surface 15 in.
Threaded ___ Welded GL Weight ___ lbs./ft.
RMP X PVC ___
Dia. 6 in. to 80 ft. depth Wall Thickness: inches or gage No. .175
Dia. ___ in. to ___ ft. depth

5. Type and color of material

Type and color of material	From	To
yellow Clay	0	13
grey lime	13	24
yellow lime	24	37
Blue Shale	37	49
grey lime.	49	68
Water	68	
grey lime.	68	80

(Use a second sheet if needed)

10. Screen: Manufacturer's name JFL
Type RMP Dia. 6
(Slot)/gauze 1/10 Length 20
Set between 60 ft. and 80 ft.
___ ft. and ___ ft.
Gravel pack? no Size range of material ___

11. Static water level: mo./day/yr.
41 ft. below land surface Date 6-22-1976

12. Pumping level below land surfaces:
___ ft. after ___ hrs. pumping ___ g.p.m.
___ ft. after ___ hrs. pumping ___ g.p.m.
Estimated maximum yield 20 g.p.m.

13. Water sample submitted: mo./day/yr.
___ Yes X No Date ___

14. Well head completion:
___ Pitless adapter 15 Inches above grade

15. Well grouted? yes
With: X Neat cement ___ Bentonite ___ Concrete
Depth: From 3 ft. to 13 ft.

16. Nearest source of possible contamination:
ft. 125 Direction N West Type Septic System
Well disinfected upon completion? X Yes ___ No

17. Pump: ___ Not installed
Manufacturer's name Goulds
Model number 10EJ HP 1/2 Volts 230
Length of drop pipe 75 ft. capacity 10 g.p.m.
Type:
X Submersible ___ Turbine
___ Jet ___ Reciprocating
___ Centrifugal ___ Other

Figure 4.

18. Elevation:

Topography:
___ Hill
___ Slope
X Upland
___ Valley

19. Remarks:

20. Water well contractor's certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Wike Well drilling 122
Business name License No.
Address R# 3 Box 128L Augusta Kans
Signed Murray Wike Date 6-22-1976
Authorized representative

T 17 — R 3 (E) W — Sec 26 — NE 1/4 NW 1/4 NE 1/4

Forward the white, blue and pink copies to the Department of Health and Environment

Form WWC-5

MI-1023

WATER WELL RECORD Form WWC-5 KSA 82a-1212

:ATION OF WATER WELL	Fraction	Section Number	Township Number	Range Number
y: BUTLER	SE ¼ NE ¼ NE ¼	33	T 27 S	R 3 E E/W

:e and direction from nearest town or city? 2 E. of Andover, Ks., Tunn So. 1¼ Mi. — Street address of well if located within city?

ATER WELL OWNER: Tom Weaver
Rt. Address, Box # : Rt. 3 — Board of Agriculture, Division of Water Resources
ate, ZIP Code : Augusta, Ks. — Application Number:

PTH OF COMPLETED WELL ...115... ft. Bore Hole Diameter ...11... in. to .... ft., and .... in. to .... ft.

ater to be used as: 5 Public water supply 8 Air conditioning 11 Injection well
omestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
rigation 4 Industrial 7 Lawn and garden only 10 Observation well

static water level ...18... ft. below land surface measured on ...5... month ...30... day ...80... year
Test Data : Well water was .... ft. after .... hours pumping .... gpm
eld .... gpm: Well water was .... ft. after .... hours pumping .... gpm

PE OF BLANK CASING USED: 5 Wrought iron 8 Concrete tile Casing Joints: Glued ..X.. Clamped ....
Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded ....
PVC 4 ABS 7 Fiberglass .... Threaded ....
:asing dia ...5... in. to ...30... ft., Dia .... in. to .... ft., Dia .... in. to .... ft.
height above land surface ...12... in., weight .... lbs./ft. Wall thickness or gauge No ....200.....

OF SCREEN OR PERFORATION MATERIAL: 7 PVC 10 Asbestos-cement
Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 11 Other (specify) ....
Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)

or Perforation Openings Are: 5 Gauzed wrapped 8 Saw cut .06 11 None (open hole)
Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes
Louvered shutter 4 Key punched 7 Torch cut 10 Other (specify) ....

-Perforation Dia ...5... in. to ...115... ft., Dia .... in. to .... ft., Dia .... in to .... ft.
-Perforated Intervals: From ...30... ft. to ...115... ft., From .... ft. to .... ft.
From .... ft. to .... ft., From .... ft. to .... ft.
Pack Intervals: From ...14... ft. to ...115... ft., From .... ft. to .... ft.
From .... ft. to .... ft., From .... ft. to .... ft.

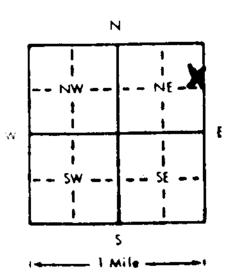
OUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other ....
d Intervals: From ...40"... ft. to ...14... ft., From .... ft. to .... ft., From .... ft. to .... ft.

s the nearest source of possible contamination: Septic System not Installed at this time. 10 Fuel storage 14 Abandoned water well
Septic tank 4 Cess pool 7 Sewage lagoon 11 Fertilizer storage 15 Oil well/Gas well
Sewer lines 5 Seepage pit 8 Feed yard 12 Insecticide storage 16 Other (specify below)
Lateral lines 6 Pit privy 9 Livestock pens 13 Watertight sewer lines

on from well .... How many feet ....? Water Well Disinfected? Yes ..X.. No
chemical/bacteriological sample submitted to Department? Yes .... No ...X... If yes, date sample
bmitted .... month .... day .... year: Pump Installed? Yes .... No ..X..
Pump Manufacturer's name .... Model No. .... HP .... Volts ....
of Pump Intake .... ft. Pumps Capacity rated at .... gal./min.
f pump: 1 Submersible 2 Turbine 3 Jet 4 Centrifugal 5 Reciprocating 6 Other

NTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was
ted on ...5... month ...30... day ...80... year
s record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. ...236...
ater Well Record was completed on ...6... month ...20... day ...1980... year under the business
of Harp Well & Pump Serv., Inc. by (signature) M. Arnold

CATE WELL'S LOCATION TH AN "X" IN SECTION X:



FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	4	Sandy Clay Topsoil			
4	18	Brown Clay			
18	26	Clay with Fine Sand			
26	62	Brown Shale			
62	80	Shale, Red			
80	115	Blue Shale			Figure 5.

TION:

s) Groundwater Encountered 1. ...18... ft. 2. .... ft. 3. .... ft. 4. .... ft. (Use a second sheet if needed)

CTIONS: Use typewriter or ball point pen, *please press firmly* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three ...as Department of Health and Environment, Division of Environment, Water Well Contractors, Topeka, KS 66620. Send one to WATER WELL OWNER and ...cords.

OFFICE USE ONLY — T 27 R 3 E/W SEC. 33 SE ¼ NE ¼ NE ¼

WATER WELL RECORD Form WWC-5 KSA 82a-1212

(L)OCATION OF WATER WELL	Fraction	Section Number	Township Number	Range Number
(Cou)nty: Butler	NE ¼ NW ¼ SE ¼	24	T 27 S	R 3 E/W

(Dist)ance and direction from nearest town or city? 3 W. ½ N. ¼ W of Augusta KS — Street address of well if located within city?

(W)ATER WELL OWNER: Lyndon H Roberts
St. Address, Box # : R3 Box 105 H
(City,) State, ZIP Code : Augusta KS 67010
Board of Agriculture, Division of Water Resources
Application Number:

(D)EPTH OF COMPLETED WELL 119 ft. Bore Hole Diameter 8.5 in. to 119 ft., and ... in. to ... ft.

Water to be used as: (1) Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering 10 Observation well 11 Injection well 12 Other (Specify below)

(Well')s static water level 85 ft. below land surface measured on 1 month 2 day 80 year

(Pump) Test Data : Well water was ... ft. after ... hours pumping ... gpm
(Est.) Yield ... gpm: Well water was ... ft. after ... hours pumping ... gpm

(T)YPE OF BLANK CASING USED: 1 Steel (2) PVC 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)
Casing Joints: Glued X ... Clamped ... Welded ... Threaded ...

(Blank) casing dia 5 in. to 99 ft., Dia ... in. to ... ft., Dia ... in. to ... ft.
(Casin)g height above land surface 14 in., weight ... lbs./ft. Wall thickness or gauge No ¼"

(TYP)E OF SCREEN OR PERFORATION MATERIAL: 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile (7) PVC 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)

(Scre)en or Perforation Openings Are: 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut (8) Saw cut 9 Drilled holes 10 Other (specify) 11 None (open hole)

(Scree)n-Perforation Dia 5 in. to 114 ft., Dia ... in. to ... ft., Dia ... in to ... ft.
(Scree)n-Perforated Intervals: From 99 ft. to 114 ft., From ... ft. to ... ft.
From ... ft. to ... ft., From ... ft. to ... ft.
(Grav)el Pack Intervals: From 114 ft. to 85 ft., From 55 ft. to 15 ft.
From ... ft. to ... ft., From ... ft. to ... ft.

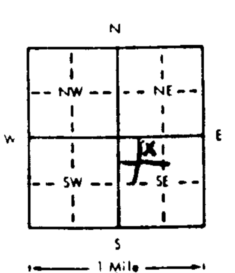
(G)ROUT MATERIAL: 1 Neat cement (2) Cement grout 3 Bentonite 4 Other
(Grout)ed Intervals: From 85 ft. to 55 ft., From 15 ft. to 4 ft., From ... ft. to ... ft.

(What) is the nearest source of possible contamination: (1) Septic tank (2) Sewer lines 3 Lateral lines 4 Cess pool 5 Seepage pit 6 Pit privy 7 Sewage lagoon 8 Feed yard 9 Livestock pens 10 Fuel storage 11 Fertilizer storage 12 Insecticide storage 13 Watertight sewer lines 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below)

(Direct)ion from well N How many feet 70' septic 9' line? Water Well Disinfected? Yes X No
(Was) a chemical/bacteriological sample submitted to Department? Yes X No ; If yes, date sample submitted 1 month 2 day 80 year: Pump Installed? Yes ... No X
Pump Manufacturer's name ... Model No. ... HP ... Volts ...
(Depth) of Pump Intake ... ft. Pumps Capacity rated at ... gal./min.
(Type) of pump: 1 Submersible 2 Turbine 3 Jet 4 Centrifugal 5 Reciprocating 6 Other

(C)ONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was (compl)eted on 1 month 4 day 80 year
(Th)is record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 363
(This) Water Well Record was completed on 1 month 4 day 80 year under the business (nam)e of Braddy Water Wells by (signature) Richard Braddy

(L)OCATE WELL'S LOCATION (W)ITH AN "X" IN SECTION (B)OX:



FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	2	[redacted] Fill Dirt			The water at 65' Has 4260 chloride and was cemented out for This Reason.
2	3	Top Soil			
3	5	clay brown			
5	11	clay Redish brown			
11	20	Limestone yellow			
20	40	Shale yellow green			
40	82	Shale with Limestone yellow			
82	103	Shale Rusty Red			
103	105	Limestone light gray			
105	119	Shale gray			

Figure 6.

(ELE)VATION: slope

(Depth)(s) Groundwater Encountered 1. 65 ft. 2. 104 ft. 3. ... ft. 4. ... ft.
(Use a second sheet if needed)

(INST)RUCTIONS: Use typewriter or ball point pen, *please press firmly* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three to Kansas Department of Health and Environment, Division of Environment, Water Well Contractors, Topeka, KS 66620. Send one to WATER WELL OWNER and (o)ne (for y)our records.

contained water having 4,760 mg/l chloride which would make it unfit for domestic use. The water in the 104 foot zone apparently was of satisfactory quality because it is used for domestic purposes.

Figure 4 describes an 80-foot well penetrating only one permeable water-bearing zone at 68 feet depth. The well was drilled with a cable tool or percussion drilling rig, drilling a 10-inch diameter hole. Six-inch diameter casing was set to the full depth of the hole. The anular space between the sides of 10-inch hole and the outside of the 6-inch casing was grouted between 3 and 13 feet depth and the remainder of the anular space from 13 to 80 feet was left open. The limestone logged at 13 to 37 feet includes the Nolans limestone known to have one or more permeable zones and at this depth probably contains permeable open fractures. It apparently lies above the local water table or includes an intermittent water table in wet years. Hindsight suggests this well should have been grouted from 3 to about 40 feet depth to preclude entrance of any shallow groundwater in years of above average precipitation when a shallow zone of saturation may be present and contribute potentially poor quality water to the well.

Figure 5 represents a well in which either the written location (sec 21) or the reported legal location (sec 33) is in error. Based on geologic mapping of the area at either the written location or legal location, one or more of the Permian limestones should have been penetrated by a well 115 feet deep.

The quality of water obtained from the aquifers in southwest Butler County has been shown graphically in USGS Water Supply Paper 1982. Dissolved solids in groundwater ranges from less than 500 mg/l (very good) to nearly 3,000 mg/l (marginally acceptable) in wells used for domestic and stock purposes. Dissolved nitrate concentrations are relatively low in most wells but are excessive for good drinking water in 10 to 20 percent of the wells. In some wells the dissolved sulfate (SO_4) exceeds the recommended limit of 250 mg/l for domestic water by 4 to 5 times, and probably reflects groundwater that is associated with dissolving gypsum beds. Groundwater high in sulfate also is very hard.

The chloride (Cl^-) content of groundwater generally is relatively low and below the recommended limit of 250 mg/l for drinking water in all of the groundwater aquifers except where they have been contaminated by oil field brines. Because of the extensive oil and gas developments in the years 1914 to 1945 when there were no regulations regarding disposal of oil field brines, both the area streams and many of the groundwater aquifers were extensively polluted. In general, the produced oil field brines are disposed of today in an acceptable way by deep disposal and the polluted streams and the quality of water in groundwater aquifers is improving as the brines are slowly flushed from the area aquifers.

Recharge and Discharge

Recharge occurs to the local aquifers primarily in response to local precipitation on the area. The area averages about 31 or 32 inches of precipitation annually. The amount of the precipitation that becomes groundwater recharge is not known, but has been estimated to be about 10 percent of the precipitation or about 3 inches annually. Plate 2 is a map showing the water table or potentiometric surface for southwestern Butler County and the location of water wells and stream elevations used for construction of the map. The water table or potentiometric surface generally is a relatively smooth surface which slopes toward the area streams. Groundwater discharge provides the base flow of the streams.

Some areas such as the vicinity of Sec. 24, T27S, R3E present anomalies that are difficult to understand. The high water levels appear to indicate anomalous recharge. In another area near Santa Fe Lake the water table or potentiometric surface could not be contoured in a meaningful manner. Some of the contours in the valley areas seem displaced or skewed.

Considering that the data used (>415 WWC-5 records) represented water levels taken at different times between 1975 and 1982, that some water well locations were inaccurate, that some water levels represent resultant water levels of two or more hydraulically connected aquifers, and that absolutely nothing was checked or verified by field work, the map was more successful then originally anticipated. No long-term hydrographs or historical water level records were available.

Summary and Recommendations

Southwestern Butler County is underlain by Quaternary alluvial deposits in the stream valleys which contain generally good quality groundwater except where the aquifers have been polluted by brines associated with past production of oil and gas. The alluvium generally provides small to moderate yields to wells 30 to 50 feet deep in the principal valley areas. The Quaternary loess deposits lie above the water table and are not aquifers.

The Permian rocks comprise alternating shale and limestone beds and include the Wellington Formation, Nolans Limestone, Odell Shale, Winfield Limestone, Doyle Shale, Barneston Limestone, and Matfield Shale that provide groundwater suitable for domestic and stock water supplies. Wells may be as deep as 175 feet. The Wellington Formation is fairly extensive at the surface in the western part of the study area. It contains thin limestone and gypsum beds which provide small to moderate yields of hard water and locally water high in SO_4 to domestic and stock wells.

The Nolans, Winfield, and Barneston limestones each contain one or more permeable water zones that produce small to moderate yields to wells where the permeable zones are below the water table or in the zone of saturation. The water quality ranges from very good to marginally acceptable in terms of dissolved solids, sulfate, and chloride values. Typically groundwaters associated with dissolving gypsum beds may have dissolved solids and sulfate values in the higher range of values but such water can be used if better is not available.

An evaluation of the available Water Well Records indicates many are incorrectly located, have poor lithologic descriptions, and the wells are constructed to meet the minimum standards set by the Kansas Department of Health and Environment rather than to best fit the problems of the local geology. Many of the wells hydraulically interconnect two or more aquifers allowing water to flow upward or downward from one water zone to another. Because the shallower zones typically have higher water levels or hydraulic heads the shallow aquifers tend to drain to the deeper aquifers. Wherever well density is low, such as one well per 80 acres, hydraulically connecting two or more aquifers may not cause a significant problem. Where well density becomes greater as in small tract developments, having one well per 1 to 5 acres, wells hydraulically connecting two more aquifers may have a significant affect and may partially, completely, or intermittantly drain the shallow aquifer. Where small tract developments occur that utilize septic tank systems for waste disposal, an additional dissolved solids load to the shallow aquifer may be imposed resulting in increased dissolved solids, nitrate, and chloride values. Techniques are available to calculate the kinds of residential spacing that should be maintained to provide acceptable increases in dissolved solids, nitrates and chloride to the shallow aquifer, but could not be determined in this preliminary report.

Well construction should receive more attention in small tract developments so that existing wells in the shallow aquifers are not drained and well construction should not allow hydraulic interconnection of aquifers by wells if such practices will cause detrimental effects to the local aquifers.

A number of local problems associated with past oil and gas activities, improper well plugging, hydraulic interconnection of aquifers, rate and direction of groundwater movement, water chemistry, aquifer properties (transmissivity and storage) need to be determined with a planned investigation that would involve field work, development of historical water level and water quality records, hydrographs, and recharge rate determinations. Depending on staffing and support for such a study, it is anticipated such a project would require 24 to 30 months for completion.

There is a need for an education and technical exchange program for the water well contractors to improve their understanding of problems and to provide better well construction and better quality Water Well Records.

Selected References

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