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GROUND-WATER STUDY FOR THE CITY OF REDFIELD

by

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GROUND-WATER STUDY FOR THE CITY OF REDFIELD

This report contains the results of a ground-water investigation conducted by the South Dakota Geological Survey for the city of Redfield, Spink County, South Dakota. The field work was conducted from June 20 to July 28, 1977. The investigation involved the drilling of 61 auger test holes, 35 rotary test holes, making a well inventory, and collecting and analyzing 15 water samples.

In 1963 the South Dakota Geological Survey conducted a similar investigation in and around the city of Redfield and the results of that investigation are published in Special Report No. 24. In that investigation no abundant supply of good quality water was found and it was recommended that the city continue to use the waters of the Dakota Sandstones. At present, the city still obtains its water from these sandstones.

The locations of the test holes are plotted in figures 1 and 1a and the rotary and auger test hole logs are listed in appendices A and B, respectively. These test holes constitute a southward extension of the 1963 investigation. An observation well was constructed in hole number R-26 which pumped quite well with an air compressor. The concentration of test holes in sections 2 and 3, T. 115 N., R. 64 W., and sections 34 and 35, T. 116 N., R. 64 W. is the result of trying to define the extent of the sand and gravel in that area.

Figure 2 shows the locations of 15 water samples taken during the study and the results of the analyses of these samples are presented in table 1. The significance and recommended limits of the dissolved chemicals in drinking water are presented in table 2. The records of some of the wells in the area are listed in table 3. The present city water exceeds the recommended limits for sulfate, manganese, fluoride, and total dissolved solids. The water is also at the recommended limit for iron and is high in sodium (table 1, samples W8, W12, and W16). It is questionable whether sample W8 is representative of the city water supply because of the anomalously high values of some of the dissolved chemicals. Water

sample W9 in the recommended area was the first sample taken from the observation well after the construction and it proved to be extremely hard water high in iron and manganese. Samples W13, W14, and W15 were taken from this well at a later date to check these results and it was found that the water, although still quite hard and exceeding the recommended limits for iron and manganese, was lower in iron and manganese content and not nearly as hard as was indicated by sample W9.

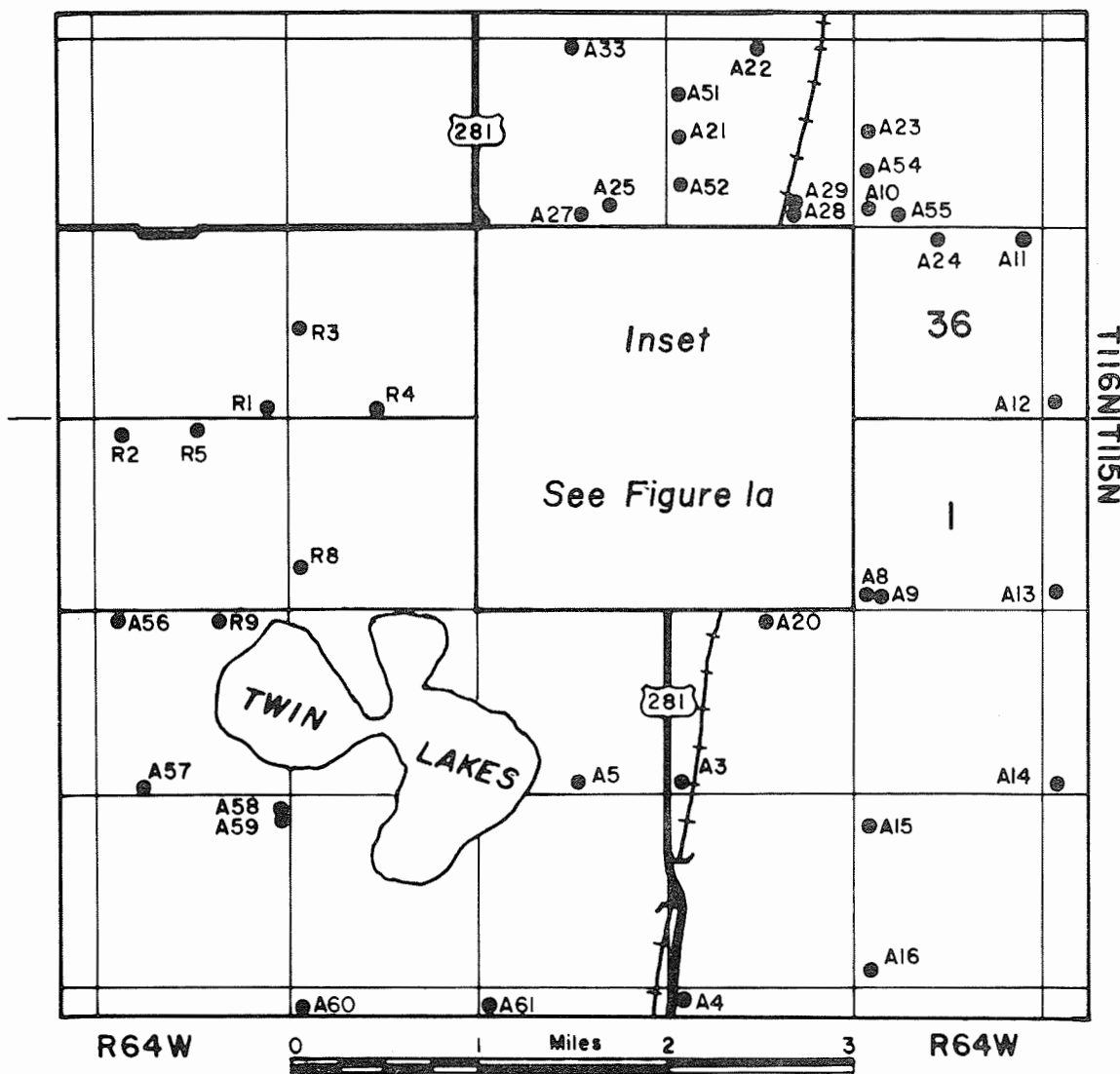
As a result of the present investigation, a shallow sand and gravel deposit was found 4 miles south of Redfield. Figure 3 shows the location and thickness of the saturated sand and gravel in this area. The average thickness is 32 feet. This was the only favorable area found for the development of a municipal water supply. As it was previously mentioned, some of the dissolved chemicals in the present city water supply and also in the water in the vicinity of the observation well 4 miles south of town exceed the recommended limits. Prior to the construction of any permanent facilities the economic feasibility of developing a water supply from 4 miles south of town must be determined and then if the city decides to develop a well field in this area, it is recommended that a pump test be conducted to determine the quantity of water which may be pumped from the aquifer. Water samples should also be collected and analyzed for quality.

Before a permanent well is drilled, the city officials should contact the Division of Water Rights, Department of Natural Resource Development, to obtain water rights and a permit to drill a municipal well and the South Dakota Department of Environmental Protection to determine the biological and chemical suitability of the water.

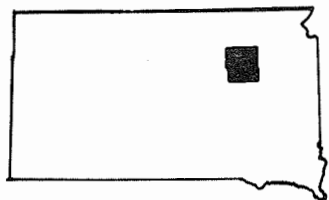
The project was financed by the South Dakota Geological Survey, the Oahe Conservancy Sub-District, and the city of Redfield.

This report was prepared by Derric Iles, 1978.

Figure 1
Map showing test hole locations

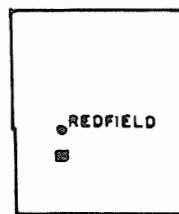


A - Auger



Index map of South Dakota showing location of Spink County.

R - Rotary

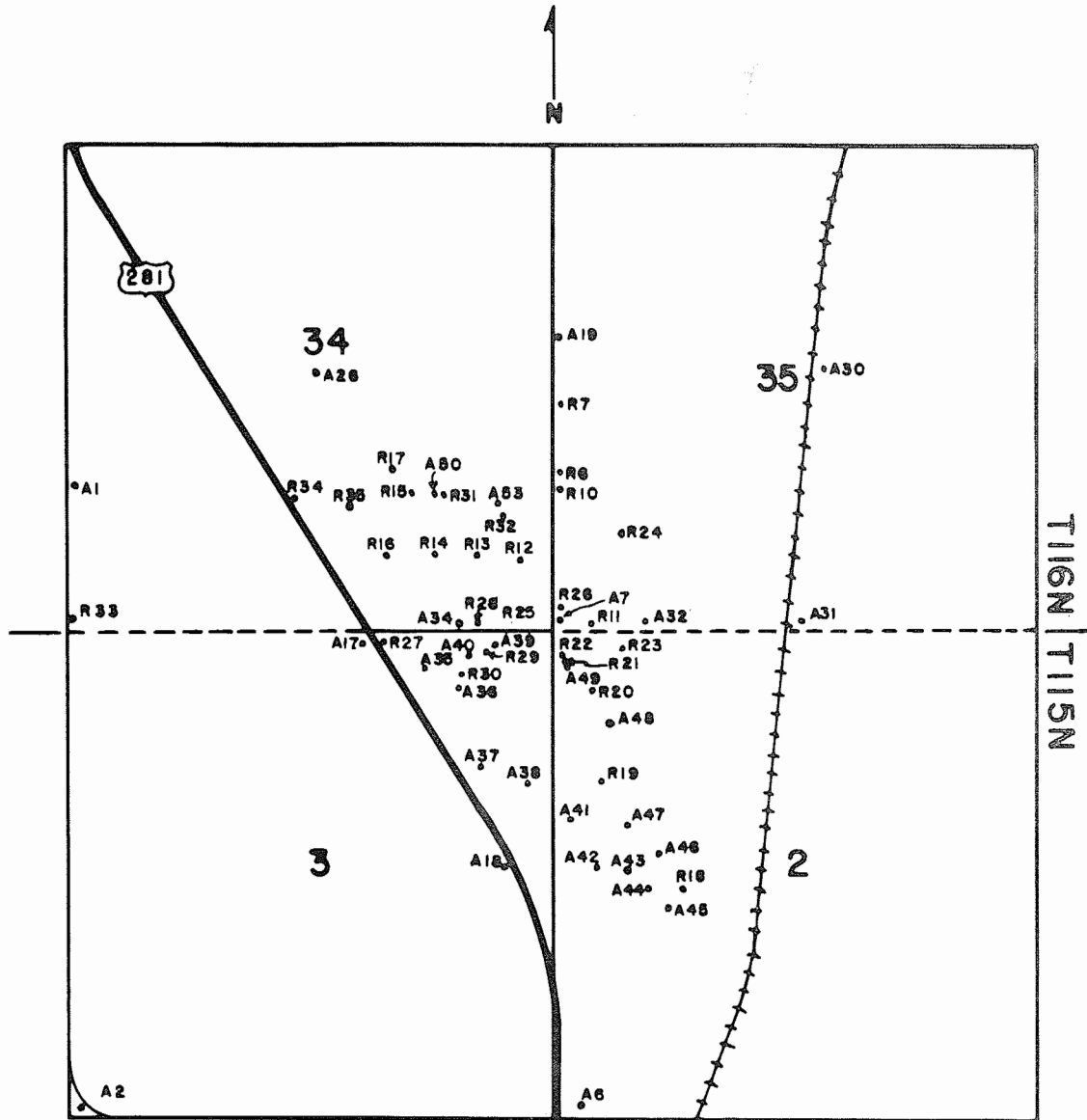


Index map of Spink Co. showing location of study area.



Figure 1a

Map showing test hole locations



R64 W

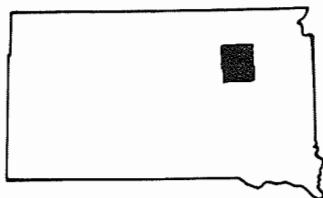
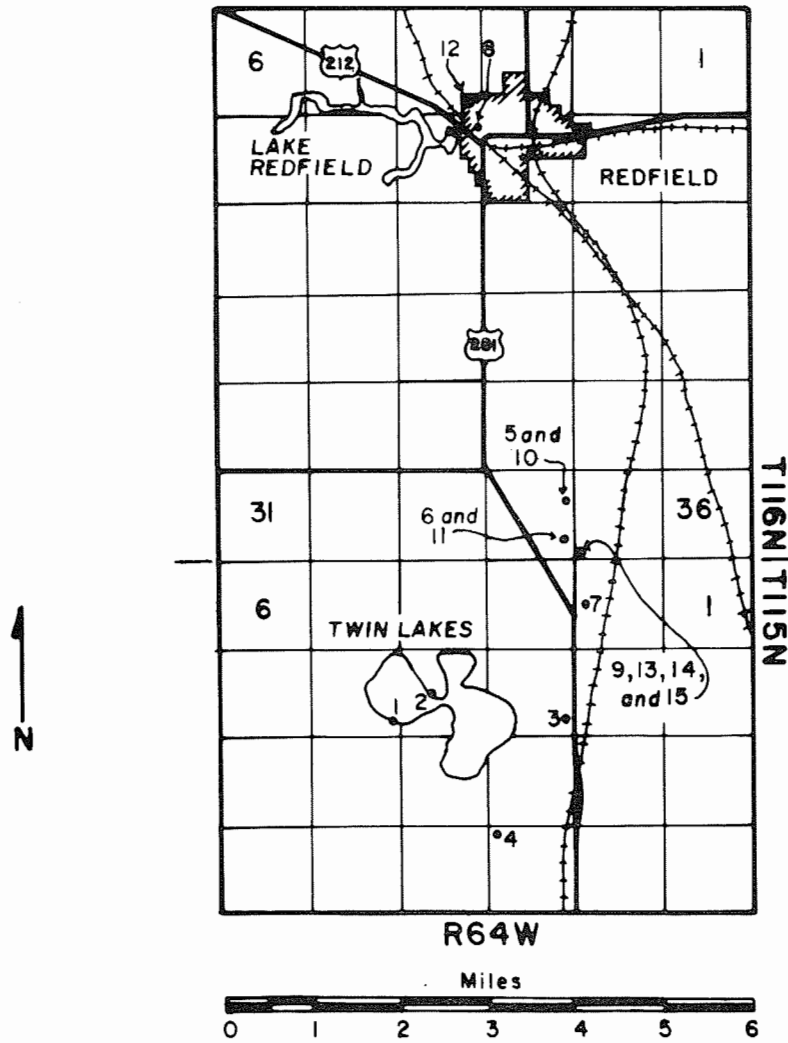
Scale 1:24,000

A - Auger

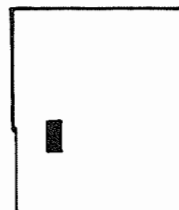
R - Rotary



Figure 2
Map showing water sample locations



Index map of South Dakota showing location of Spink County.



Index map of Spink Co. showing location of study area.

TABLE 1. Results of water analyses

Sample	Depth of Well (feet)	Parts Per Million										Conductivity	Total Solids	
		Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrate Nitrogen	Fluoride	Hardness CaCO ₃			
A		---	---	---	250	500 ¹	0.3	0.05	10.0	0.9	---	---	---	1000 ¹
W 1	0	---	---	---	>300	---	---	---	---	1.7 ²	---	---	---	4820
W 2	0	---	---	---	>300	---	---	---	---	---	---	---	---	4810
W 3	85	230	40	75	16	500	2.1	2.4	<0.5	---	---	---	---	1390
W 4	32	140	190	95	21	970	4.4	1.3	<0.5	---	---	---	---	1630
W 5	60	185	82	120	59	580	0.2	2.5	<0.5	---	---	---	---	1400
W 6	50	83	226	115	65	520	<0.05	<0.05	6	---	---	---	---	1450
W 7	<100	250	100	80	25	100	0.6	1.4	<0.5	---	---	---	---	950
W 8	1080	60	1860	25	200	840	0.9	<0.05	0.6	---	---	---	---	5600
W 9	60	230	60	106	31	250	1.65	1.35	<0.05	---	---	---	---	1140
W10	60	180	83	120	61	630	<0.05	2.75	<0.5	---	---	---	---	1550
W11	50	75	235	110	54	520	0.45	<0.05	3.4	---	---	---	---	1750
W12	1080	60	685	27	200	450	0.05	0.05	<0.5	---	---	---	---	3000
W13	60	155	30	39	20	120	0.6	1.05	<0.5	---	---	---	---	990
W14	60	158	30	39	20	100	0.8	1.25	<0.5	---	---	---	---	980
W15	60	160	30	39	20	90	0.95	1.05	<0.5	---	---	---	---	1010
W16 ³	1080	35	680	11	196	1030	0.3	0.1	<1	2.4	---	---	---	2179

A - Drinking water standards, U.S. Public Health Service (1962)

Samples W9, W13, W14, and W15 were collected from the observation well within the recommended area.

¹ Modified for South Dakota by the Department of Health (written communication, Water Sanitation Section, September 24, 1968).

Samples W1 and W2 were collected from Twin Lakes.

² 1.2 is optimum for South Dakota.

Samples W8, W12, and W16 were collected from the city wells of Redfield which draw water from the Dakota Sandstone. (Sample W8 - collected from Quona Motel.)

³ Sample W16 is the analysis presented in the South Dakota Public Water Supply Chemical Data prepared by the South Dakota Department of Environmental Protection (March, 1976).

Samples W3, W4, W5, W6, W7, W9, W10, W11, W13, W14, and W15 were collected from wells which draw water from shallow glacial outwash and sand lenses.

All water samples were collected in June and July of 1977 except W13, W14, and W15 which were collected in September of 1977 and W16 which was collected in January of 1975.

Location of water samples

- W 1 NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 8, T. 115 N., R. 64 W.
- W 2 NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 9, T. 115 N., R. 64 W.
- W 3 NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 10, T. 115 N., R. 64 W.
- W 4 SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 22, T. 115 N., R. 64 W.
- W 5 SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
- W 6 NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
- W 7 SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
- W 8 NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T. 116 N., R. 64 W.
- W 9 SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
- W10 SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
- W11 NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
- W12 SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 116 N., R. 64 W.
- W13 SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
- W14 SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
- W15 SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
- W16 NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T. 116 N., R. 64 W.

Table 2.--Significance of some chemical and physical properties of drinking water.

Chemical Constituents	Significance	Recommended Limits (ppm) ¹
Calcium (Ca) and Magnesium (Mg)	Cause most of the carbonate hardness and scale-forming properties of water by combining with carbonate and bicarbonate present in the water. Seldom can be tasted except in extreme concentrations.	Ca--None Mg--None
Sodium (Na)	Large amounts in combination with chloride will give water a salty taste. Large amounts will limit water for irrigation and industrial use.	None
Chloride (Cl)	Large amounts in combination with sodium give water a salty taste. Large quantities will also increase corrosiveness of water.	250
Sulfate (SO ₄)	Large amounts of sulfate in combination with other ions give a bitter taste to water and may act as a laxative to those not used to drinking it. Sulfates of calcium and magnesium will form hard scale. U. S. Public Health Service recommends 250 ppm maximum concentration.	500 ²
Iron (Fe) and Manganese (Mn)	In excess will stain fabrics, utensils, and fixtures and produce objectionable coloration in the water. Both constituents in excess are particularly objectionable.	Fe--0.3 Mn--0.05
Nitrate Nitrogen (N)	In excess may be injurious when used in infant feeding. The U. S. Public Health Service regards 45 ppm as the safe limit of nitrate (NO ₃) or 10 ppm nitrate nitrogen (N).	10
Fluoride (F)	Reduces incidence of tooth decay when optimum fluoride content is present in water consumed by children during period of tooth calcification. Excessive fluoride in water may cause mottling of enamel.	0.9-1.7 ³
pH	A measure of the hydrogen ion concentration; pH of 7.0 indicates a neutral solution, pH values lower than 7.0 indicate acidity, pH values higher than 7.0 indicate alkalinity. Alkalinity tends to aid encrustation and acidity tends to aid corrosion.	None
Hardness	Hardness equivalent to carbonate and bicarbonate is called carbonate hardness. Hardness in excess of this amount is noncarbonate hardness. Hardness in water consumes soap and forms soap curd. Will also cause scale in boilers, water heaters, and pipes. Water containing 0-60 ppm hardness considered soft; 61-120 ppm moderately hard; 121-180 ppm hard, and more than 180 ppm very hard. Good drinking water can be very hard.	None
Total Solids	Total of all dissolved constituents. U. S. Public Health Department recommends 500 ppm maximum concentration. Water containing more than 1000 ppm dissolved solids may have a noticeable taste; it may also be unsuitable for irrigation and certain industrial uses.	1000 ²

Modified from Jorgensen (1966).

¹ (ppm) parts per million.

² Modified for South Dakota by the South Dakota Department of Health (written communication, Water Sanitation Section, September 24, 1968).

³ 1.2 is optimum for South Dakota.

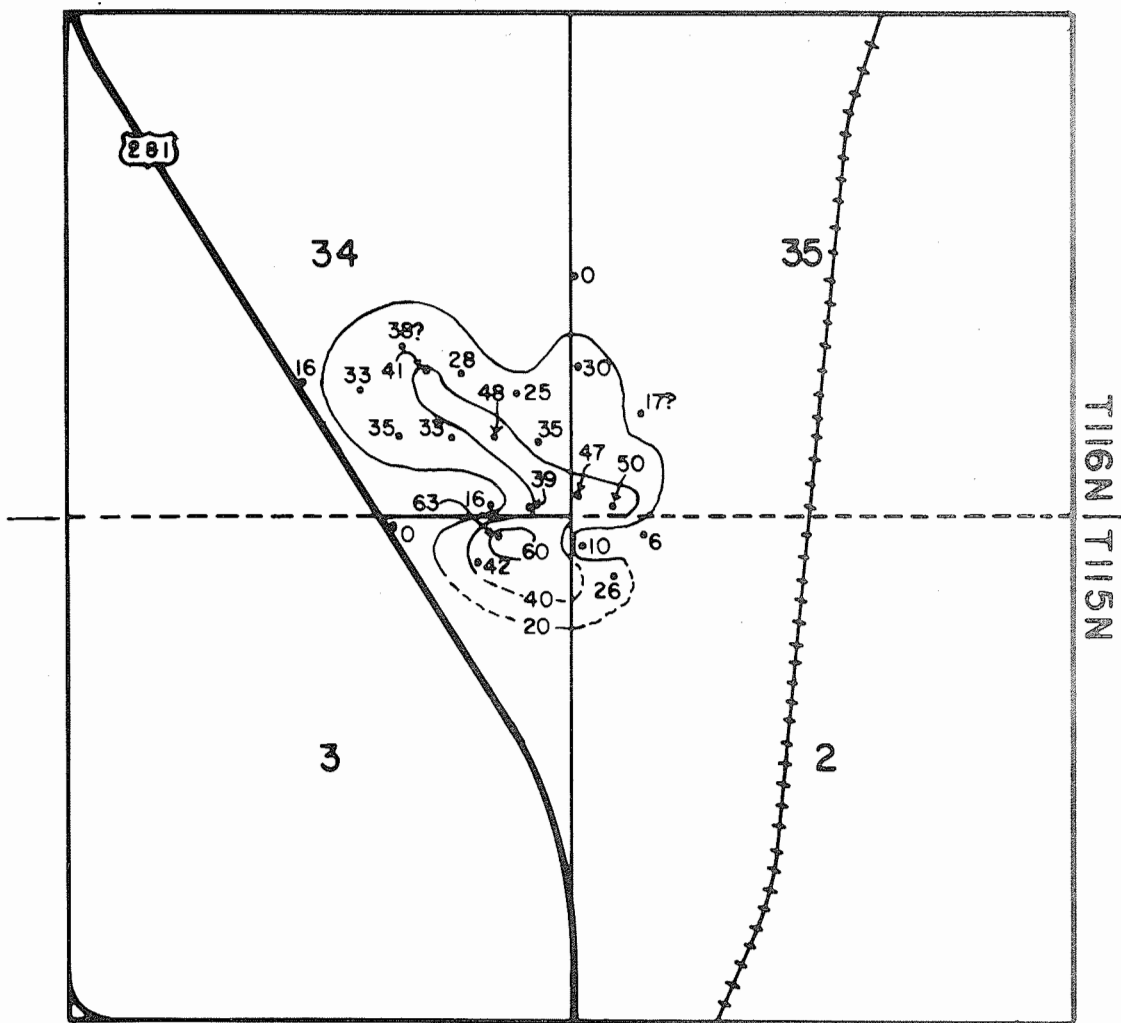
TABLE 3. Well records

Source: SS, sandstone; G, glacial outwash and sand lenses
 Use: D, domestic; S, stock

Location	Owner or Tenant	Depth of Well (feet)	Depth to Water (feet)	Source	Use
NW SE SE sec. 20, T. 116 N., R. 64 W.	Wagner, H.	850	----	SS	D&S
NE NW NW sec. 30, T. 116 N., R. 63 W.	Moore, M.	900	0	SS	D&S
SE NW sec. 26, T. 116 N., R. 64 W.	Wagner, H.	60	30	G	D&S
NW NW SE sec. 25, T. 116 N., R. 64 W.	Jessen, D.	850	----	SS	D&S
SW SW SW sec. 30, T. 116 N., R. 63 W.	Stout, D.	60	25	G	D&S
SE NE sec. 34, T. 116 N., R. 64 W.	Wagner, H.	1000	0	SS	D&S
SE NE sec. 34, T. 116 N., R. 64 W.	Wagner, H.	60	30	G	D&S
NE SE NE sec. 35, T. 116 N., R. 64 W.	Van Vleet, C.	75	15	G	S
NE SE NE sec. 35, T. 116 N., R. 64 W.	Van Vleet, C.	900	0	SS	D&S
NE SE SE sec. 34, T. 116 N., R. 64 W.	Wagner, H.	50	30	G	D&S
NE SE SE sec. 12, T. 116 N., R. 64 W.	Odland, R.	90	60?	G	D&S
NE SE SE sec. 12, T. 116 N., R. 64 W.	Odland, R.	120	90?	G	D&S
SW NW NE sec. 11, T. 115 N., R. 64 W.	Johnson, N.	90	45	G	D
SW NW NE sec. 11, T. 115 N., R. 64 W.	Johnson, N.	1020	----	SS	None
NE SE NE sec. 7, T. 115 N., R. 63 W.	Hilkemeier, M.	1200	0	SS	D&S
SE NE SW sec. 10, T. 115 N., R. 64 W.	Steinheuser, S.	80	40?	G	----
NE SE SE sec. 10, T. 115 N., R. 64 W.	Tomsha, H.	900+	5	SS	None
NE SE SE sec. 10, T. 115 N., R. 64 W.	Tomsha, H.	85	40?	G	D&S
NE NW NW sec. 14, T. 115 N., R. 64 W.	Tomsha, H.	1000	10	SS	S
NE NW NW sec. 14, T. 115 N., R. 64 W.	Tomsha, H.	80	30	G	D&S
NE NW NE sec. 14, T. 115 N., R. 64 W.	Schwichtenberg, R.	1110	6	SS	----
NE NE SE sec. 13, T. 115 N., R. 64 W.	Harms, E.	1040	0	SS	D&S
SW SW SW sec. 15, T. 115 N., R. 64 W.	Miller, E. ^A	86	35	G	D&S
NW NW NW sec. 22, T. 115 N., R. 64 W.	Beard, H.	1000	0	SS	None
NE NW NW sec. 22, T. 115 N., R. 64 W.	Beard, H.	80	55?	G	D
NE NW NW sec. 22, T. 115 N., R. 64 W.	Beard, H.	32	30?	G	D&S

Figure 3

Map showing thickness of saturated sand and gravel.



R64 W

• Test holes, number indicates thickness of saturated sand and gravel, in feet.

— Contour line, connects points of equal thickness, dashed where approximate. Contour interval 20 feet.

Miles



APPENDIX A

Logs of rotary test holes in the Redfield area (For map location, see figs. 1 and 1a)

Test Hole R-1

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 32, T. 116 N., R. 64 W.

Surface elevation: 1334 feet

Depth to water:

0- 2	Topsoil, black, dry
2- 10	Silt, light-brown, clayey, dry
10- 14	Clay, light- to dark-brown, sandy, fine (till)
14- 43	Sand, light-brown, medium to coarse, subangular, slightly clayey, dirty
43- 51	Sand, light-gray, medium, subangular, slightly clayey
51- 53	Sand, clayey, minor coal and lignite deposits
53- 61	Sand, gray, medium, subangular
61- 68	Gravel, medium, subangular to sub-rounded, clean
68- 79	Clay, gray, soft, silty
79- 80	Gravel, unknown size (estimate medium with 1 inch maximum diameter)
80- 92	Clay, light- to dark-gray
92	Rock, abandoned hole

* * * *

Test Hole R-2

Location: NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 5, T. 115 N., R. 64 W.

Surface elevation: 1294 feet

Depth to water:

0- 2	Topsoil, black, dry
2- 20	Clay, light-brown
20- 28	Clay, non-oxidized with some sand and gravel, rounded
28- 29	Gravel stringer, 1 inch diameter
29- 33	Clay, non-oxidized with some sand and gravel, rounded
33- 35	Gravel stringer, 1 to 2 inch diameter
35- 41	Sand, fine to medium, rounded to sub-angular, minor amounts of coal, grades to coarse
41- 58	Gravel, fine, subrounded, some coal and lignite
58- 80	Clay, with some sand, medium, rounded (till)
80	Rock, abandoned hole

* * * *

Test Hole R-3

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 33, T. 116 N., R. 64 W.

Surface elevation: 1306 feet

Depth to water:

0- 2	Topsoil
2- 15	Sand, fine, subrounded to rounded, very silty
15- 25	Sand, dark-brown, subrounded, very silty, some clay

Test Hole R-3 -- continued.

25- 27	Gravel stringer, size unknown
27- 31	Sand, fine, subrounded, silty
31- 65	Clay, unoxidized with sand, subangular, silty (till)
65- 66	Gravel stringer, 1 to 2 inch diameter
66- 80	Clay, unoxidized, some sand, coarse, subangular (till)
80-150	Clay, very shaley, sand, medium, sub-angular, silty, intermittent sand stringers at about 100 to 200 feet (till)

* * * *

Test Hole R-4

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33, T. 116 N., R. 64 W.

Surface elevation: 1324 feet

Depth to water:

0- 2	Topsoil, black, dry
2- 9	Silt, light-brown, alluvium, clayey, slightly sandy
9- 20	Silt, light- to dark-brown, black streaks, intermittent sand lenses, fine, rounded
20- 21	Gravel stringer, fine, subangular
21- 24	Clay, light-brown, sandy, silty (till)
24- 25	Gravel stringer, fine, subangular
25- 31	Sand, light-gray, medium to coarse, sub-rounded to subangular
31- 43	Clay, gray, unoxidized, sandy, silty (till)
43- 51	Gravel, fine to medium, subangular, 35 percent or more shale pebbles, some intermittent clay layers
51- 59	Clay, gray, unoxidized
59- 78	Gravel, fine to medium, subangular to subrounded, intermittent clay layers about 7 feet apart and 1 to 2 feet thick, gray
78-100	Clay, gray, unoxidized
100	Clay, gray, very hard

* * * *

Test Hole R-5

Location: NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 5, T. 115 N., R. 64 W.

Surface elevation: 1297 feet

Depth to water:

0- 2	Topsoil, black, dry
2- 8	Clay, brown, some sand, fine
8- 11	Clay, brown, abundant sand, fine, sub-rounded, silty
11- 19	Sand, fine to medium, subrounded, clayey, some coal
19- 35	Clay, unoxidized, sandy, fine, sub-rounded, silty, some medium gravel (till)
35- 37	Sand, medium, subrounded, gravel, fine, subrounded, silty, some clay
37- 83	Clay, unoxidized, sandy, medium, sub-rounded, gravelly, fine (till)
83- 84	Hard layer, unknown

Test Hole R-5 -- continued.

84-121 Clay, unoxidized, sandy, medium, sub-
rounded, gravelly, fine (till)
121-123 Sand, coarse, subangular, gravel, medium
to coarse, subangular
123-145 Clay, unoxidized, sandy, medium, sub-
rounded, gravelly, fine (till)
145-200 Grades into shale, dark-gray, very hard

* * * *

Test Hole R-6

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
Surface elevation: 1312 feet
Depth to water:

0- 2 Topsoil, black
2- 4 Sand, fine, rounded, silty, yellow-
brown
4- 14 Sand, coarse to very coarse, subrounded
to rounded, clean
14- 24 Gravel, coarse, intermittent layers of
clay, light-brown
24- 30 Unknown, severe water loss, loss of
circulation, used two trucks of
water, used 2 bags of bentonite,
plugged bit, abandoned hole

* * * *

Test Hole R-7

Location: NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
Surface elevation: 1310 feet
Depth to water:

0- 2 Topsoil, black
2- 10 Gravel, very coarse, 1 to 1½ inch diameter,
red brown cobbles
10- 42 Silt, light-brown, compact
42- 49 Clay, unoxidized, sandy, medium, sub-
rounded (till)
49- 53 Gravel, fine to medium, subangular to
subrounded
53-135 Clay, shaley, sandy, fine to medium
(till)
135 Rock, abandoned hole

* * * *

Test Hole R-8

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 4, T. 115 N., R. 64 W.
Surface elevation: 1305 feet
Depth to water:

0- 2 Topsoil, black, dry
2- 22 Sand, brown, fine to medium, subangular,
some silt
22- 24 Clay, white, some small shells, some
sand, very fine, grades to a
greenish color
24- 25 Clay, oxidized, sandy, medium, sub-
angular (till)
25- 50 Clay, unoxidized, sandy, medium,
subangular (till)
50- 51 Coal-lignite

Test Hole R-8 -- continued.

51-110 Clay, sandy, medium, subangular (till)
110 Obstruction, abandoned hole

* * * *

Test Hole R-9

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 8, T. 115 N., R. 64 W.
Surface elevation: 1334 feet
Depth to water:

0- 2 Topsoil, black, dry
2- 15 Sand, dark-brown, fine, subrounded
15- 26 Silt, light-brown, compact, equipment
breakdown, abandoned hole

* * * *

Test Hole R-10

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
Surface elevation: 1311 feet
Depth to water:

0 - 1 Topsoil, black
1 - 4 Sand, very coarse, subangular to sub-
rounded, clean
4 -14 Gravel, medium, subrounded, clean
14 -20 Silt, light yellow-brown, well sorted,
very dry, compact
20 -38 Gravel, medium, subrounded, shaley,
weathered, intermittent layers of
clays and compact silts, gray to
black, some traces of lignite
38 -45 Gravel, coarse, subrounded
45 -56 Clay, unoxidized, sandy, silty (till)
56 -57.5 Rock, put on rock bit
57.5-74 Clay, gray, unoxidized, sandy,
silty (till)
74 -74.5 Rock (limestone boulder??), severe
sudden water loss, hole acting like
a drain, abandoned hole

* * * *

Test Hole R-11

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
Surface elevation: 1310 feet
Depth to water:

0- 2 Topsoil, brown, dry
2- 5 Silt, brown, compacted, some sand,
medium
5- 7 Sand, fine to medium, subrounded, clayey
7- 21 Clay, brown, oxidized, very sandy, fine
to medium, subrounded (till)
21- 34 Sand, fine to medium, subrounded, very
silty with shale pebbles
34- 41 Sand, very coarse, subrounded
41- 51 Gravel, fine, subrounded, shale pebbles
51- 71 Gravel, fine to medium, subrounded to
rounded
71- 92 Clay, unoxidized, sandy, medium, (till)
92- 94 Gravel, coarse, 1 inch diameter
94-121 Clay, sandy, medium (till)
121-140 Shale??

* * * *

Test Hole R-12

Location: SE¼NE¼SE¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1303 feet
Depth to water:

- 0- 1 Topsoil, black
- 1- 5 Sand, medium, subrounded to subangular, silty
- 5- 18 Gravel, fine, subrounded, clean
- 18- 24 Clay, gray, unoxidized, sandy, silty, (till)
- 24- 40 Sand, fine to coarse, subrounded to rounded, interbedded, slightly silty
- 40- 59 Gravel, medium to coarse, subrounded
- 59-144 Clay, gray, unoxidized, sandy, silty (till)
- 144-160 Shale, gray, compact, hard

* * * *

Test Hole R-13

Location: SE¼NW¼SE¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1295 feet
Depth to water:

- 0- 1 Topsoil, black
- 1- 3 Silt, light-brown, clayey, sandy, fine
- 3- 10 Sand, medium to very coarse, subangular to subrounded, some gravel, fine
- 10- 21 Clay, gray, unoxidized, sandy, silty (till)
- 21- 32 Sand, very fine to silt, gray, rounded, silty and clayey
- 32- 69 Gravel, fine, rounded, clean
- 69-131 Clay, gray, unoxidized, sandy, silty (till)
- 131-140 Shale

* * * *

Test Hole R-14

Location: SW¼NW¼SE¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1302 feet
Depth to water:

- 0- 2 Topsoil, black, dry
- 2- 9 Sand, dark-brown, fine to very coarse, subangular to subrounded, unsorted
- 9- 19 Gravel, fine to medium, subrounded
- 19- 22 Clay, gray, unoxidized, sandy, silty (till)
- 22- 50 Gravel, fine to medium, subangular
- 50- 75 Shale, very silty and gritty

* * * *

Test Hole R-15

Location: SE¼SE¼NW¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

- 0- 1 Topsoil, black
- 1- 4 Clay, silty, light-brown to cream
- 4- 9 Clay, gray, unoxidized, sandy, silty (till)

Test Hole 15 -- continued.

- 9- 19 Sand, fine, rounded, silty, gray
- 19- 35 Sand, gray, fine to medium, rounded
- 35- 50 Gravel, fine to medium, rounded
- 50- 92 Clay, gray, unoxidized, sandy, silty (till)
- 92- 95 Boulders, assorted, estimated 4 to 5 inch diameter
- 95- 97 Sand, gray, medium, rounded
- 97-120 Clay, gray, unoxidized, hard, sandy, silty (till)
- 120-150 Clay, unoxidized, sandy, silty, shale, weathered (till)

* * * *

Test Hole R-16

Location: SW¼NE¼SW¼SE¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1305 feet
Depth to water:

- 0- 1 Topsoil, black
- 1- 9 Clay, light- to dark-brown, sandy, silty (till)
- 9- 16 Gravel, fine to very coarse, subangular to subrounded, unsorted
- 16- 26 Clay to silt, dark-gray, hard
- 26- 39 Sand, gray, fine, rounded
- 39- 61 Sand, coarse to fine gravel, rounded
- 61- 86 Clay, gray, unoxidized, sandy, silty, intermittent 1-foot thick gravel lenses, medium, subrounded to rounded (till)
- 86- 98 Clay, gray, unoxidized, sandy, coarse, rounded (till)
- 98-110 Clay, gray, unoxidized, hard, sandy, silty (till)
- 110-140 Shale, weathered
- 140-150 Severe water loss, probably due to fractures in shale

* * * *

Test Hole R-17

Location: NW¼SE¼NW¼SE¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

- 0- 2 Topsoil, black, dry
- 2- 9 Silt, light- to dark-brown, shells, sandy, medium, subrounded
- 9- 25 Gravel, fine, subrounded, clayey
- 25- 30 Clay, unoxidized, sandy, silty (till)
- 30- 40 Shale, black, silty, hard
- 40- 62 Sand, fine, subrounded to round
- 62-135 Clay, unoxidized, silty, sandy, medium, subrounded, hit rock and abandoned hole (till)

* * * *

Test Hole R-18

Location: NW¼NW¼NE¼SW¼ sec. 2, T. 115 N., R. 64 W.

Surface elevation: 1290 feet

Depth to water:

0- 1	Topsoil, black, sandy, moist
1- 9	Silt, brown, slightly sandy, medium, subrounded, many shells
9- 15	Silt, gray, clayey, sandy, fine to medium, subrounded
15- 23	Clay, light-brown, oxidized, sandy, medium, subrounded, silty (till)
23- 43	Clay, gray, unoxidized, silty, very sandy, medium, subrounded, some coal (till)
43- 49	Sand, light- to dark-brown, fine, subrounded to rounded, some coal
49- 85	Sand, fine, subrounded, very silty and compact, some coal
85-115	Clay, silty, very sandy, fine to medium, subrounded, some coal (till)
115-131	Clay, unoxidized, sandy, medium to coarse, subrounded, silty (till)
131-160	Shale, silty

* * * *

Test Hole R-19

Location: NE¼NW¼SW¼NW¼ sec. 2, T. 115 N., R. 64 W.

Surface elevation: 1290 feet

Depth to water:

0- 2	Silt, dark-brown, clayey
2- 7	Gravel, medium to coarse, subrounded, clean
7- 19	Sand, light-gray, medium to coarse, rounded
19- 24	Shale, block?
24- 30	Sand, gray, fine to medium, rounded
30- 44	Sand, gray, very fine, rounded
44- 56	Sand, gray, coarse, subangular to subrounded
56- 75	Silt, gray, clayey, shaley
75- 96	Silt, interbedded with lignite, layers 3 to 4 inches thick, 1 to 2 feet apart
96-102	Clay, gray, unoxidized, shaley, sandy, silty (till)
102-103	Hard layer, limestone?, white
103-110	Sand, gray, medium, subangular to subrounded, predominantly shale pebbles
110	Hard layer, limestone precipitate??, twisted bit off, weld gave out, abandoned hole

* * * *

Test Hole R-20

Location: SE¼NW¼NW¼NW¼ sec. 2, T. 115 N., R. 64 W.

Surface elevation: 1290 feet

Depth to water:

0 - 3	Silt to very fine sand, gray-green, clayey
3 - 9	Gravel, red-brown, subangular to subrounded, sandy, medium to coarse

Test Hole R-20 -- continued.

9 - 12	Clay, gray, unoxidized, sandy, silty (till)
12 - 14	Gravel stringer, medium, subangular
14 - 26	Sand, gray, medium, rounded
26 - 32	Sand, gray, fine to silty, clayey
32 - 33	Lignite layer, black, hard
33 - 48	Silt, gray, fine
48 - 50	Lignite, block, hard
50 - 63	Silt to shale?, gray, interbedded with lignite and clays, some sand, fine
63 - 71	Gravel, medium to coarse
71 -117	Clay, gray, unoxidized, lots of interbedded or mixed in randomly lignite, black, sandy, silty (till)
117 -117.5	Rock in till
117.5-133	Clay, gray, unoxidized, sandy, silty (till)
133 -150	Shale, dark-gray, very greasy, hard

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Test Hole R-21

Location: NW¼NE¼NW¼NW¼ sec. 2, T. 115 N., R. 64 W.

Surface elevation: 1290 feet

Depth to water:

0- 6	Silt, light-brown to gray-brown
6- 8	Gravel, red-brown, medium to very coarse, subrounded
8- 20	Sand, gray, coarse, subrounded
20- 30	Gravel to cobbles, estimate 2 to 3 inches diameter

* * * *

Test Hole R-22

Location: NW¼NW¼NW¼NW¼ sec. 2, T. 116 N., R. 64 W.

Surface elevation: 1290 feet

Depth to water:

0- 2	Topsoil, black, moist
2- 8	Silt, light-brown, sandy, medium, subrounded
8- 19	Clay, unoxidized, silty, sandy, medium, subrounded, gravelly, medium to coarse, subrounded (till)
19- 23	Gravel, coarse, 1 to 2 inches diameter
23- 29	Gravel, fine to coarse, subrounded
29-115	Clay, unoxidized, sandy, medium, subrounded, silty, some coal (till)

* * * *

Test Hole R-23

Location: NW¼NE¼NW¼NW¼ sec. 2, T. 115 N., R. 64 W.

Surface elevation: 1317 feet

Depth to water:

0- 2	Topsoil, black
2- 4	Sand, red-brown, fine, rounded
4- 32	Clay, light to red-brown, sandy, silty (till)
32- 38	Silt, gray, fine, clayey
38- 52	Clay, gray, unoxidized, sandy, silty (till)

Test Hole R-23 -- continued.

52- 58 Gravel, fine to medium, subangular to subrounded
 58- 60 Clay, gray, unoxidized, sandy, silty (till)
 60- 61 Rock in till, unknown composition
 61- 74 Clay, unoxidized, sandy, silty, intermittent, thin gravel stringers (till)
 74-124 Clay, unoxidized, slightly gravelly, sandy, silty (till)
 124-125 Rock, unknown composition
 125-134 Clay, unoxidized, shaley, sandy, silty (till)
 134-141 Shale, gray, weathered
 141-150 Shale, gray, hard

* * * *

Test Hole R-24

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
 Surface elevation: 1310 feet
 Depth to water:

0 - 2 Topsoil, black
 2 - 6 Clay, light- to dark-brown, sandy, silty (till)
 6 - 19 Silt, light-brown, well sorted, very clayey
 19 - 30 Gravel, fine to medium, subrounded to subangular
 30 - 32 Silt, light-gray, compact, very hard
 32 - 36 Silt, gray, well sorted, clayey
 36 - 42 Clay, gray, unoxidized, sandy, silty (till)
 42 - 48 Gravel, fine, rounded, clayey
 48 - 83 Clay, gray, unoxidized, silty, slightly sandy, occasional gravelly stringers, thin and far apart, about 5 feet (till)
 83 - 83.5 Rock, unknown composition
 83.5- 95 Clay, gray, unoxidized, sandy, silty (till)
 95 - 96 Gravel lense, unknown size
 96 - 96.5 Rock, limestone, white
 96.5-136 Clay, gray, unoxidized, sandy, silty (till)
 136 -150 Shale, blackish-gray, greasy, hard

* * * *

Test Hole R-25

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
 Surface elevation: 1295 feet
 Depth to water:

0- 21 Gravel, fine to medium, subrounded to subangular
 21- 24 Sand, gray, fine, rounded
 24- 31 Silt, gray, unoxidized, slightly sandy, fine, rounded
 31- 36 Sand, gray, fine to medium, subangular to subrounded, silty
 36- 43 Gravel, fine to medium, subangular to subrounded

Test Hole R-25 -- continued.

43- 46 Silt, gray, unoxidized, unsorted
 46- 51 Gravel, medium, subrounded
 51- 70 Clay, gray, unoxidized, gravelly, medium, subangular, sandy, silty (till)
 70-138 Clay, gray, unoxidized, sandy, silty (till)
 138-160 Shale or silt, greasy, very hard

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Test Hole R-26 (Observation Well)

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
 Surface elevation: 1295 feet
 Depth to water:

0- 1 Topsoil, black
 1- 3 Silt, light to red-brown, clayey
 3- 7 Gravel, fine, rounded
 7- 17 Sand, coarse, rounded
 17- 52 Gravel, medium to coarse, subangular to subrounded, much lignite, some pieces up to 4 inch diameter
 52-100 Clay, gray, unoxidized, sandy, silty (till)

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Test Hole R-27

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 115 N., R. 64 W.
 Surface elevation: 1320 feet
 Depth to water:

0- 12 Gravel, medium, subangular to subrounded
 12- 21 Silt, light-red-brown, clayey
 21- 53 Clay, gray, unoxidized, sandy, silty (till)
 53- 60 Silt, gray, clayey
 60- 80 Clay, gray, unoxidized, slightly gravelly, sandy, silty (till)
 80-150 Clay, gray, unoxidized, sandy, silty (till)

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Test Hole R-28

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
 Surface elevation: 1303 feet
 Depth to water:

0- 1 Topsoil, black
 1- 4 Sand, medium to coarse, subrounded, clean
 4- 19 Gravel, fine, subrounded, clean
 19- 30 Gravel, medium to coarse, subrounded, clean
 30- 35 Clay, gray, unoxidized, silty, sandy, fine (till)
 35- 60 Clay, gray, unoxidized, gravelly, medium, rounded, sandy, silty (till)

Test Hole R-28 -- continued.

60- 72 Clay, gray, unoxidized, sandy, silty,
large amounts of lignite plugging
suction screen (till)
72- 78 Gravel, gray, medium, subrounded, clayey
78-142 Clay, gray, unoxidized, sandy, silty
(till)
142-160 Shale?, bedrock?, no cuttings came up

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Test Hole R-29

Location: NE¼NW¼NE¼NE¼ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 2 Topsoil, black
2- 4 Silt, light-gray, many macroscopic
concoidal snail shells, white
4- 10 Sand, red-brown, medium to coarse,
subrounded
10- 21 Gravel, medium, subrounded
21- 48 Gravel, medium to coarse, subrounded
48- 67 Gravel, fine to very coarse sand
67- 85 Clay, gray, slightly gravelly, sub-
angular to subrounded, sandy,
silty (till)
85- 86 Rock, limestone
86-131 Clay, gray, unoxidized, sandy,
silty (till)
131-150 Shale?, bedrock?, gray, hard

* * * *

Test Hole R-30

Location: SE¼NW¼NE¼NE¼ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 2 Topsoil, black
2- 20 Sand, red-brown, coarse, subrounded
20- 22 Lignite, black, hard
22- 44 Sand, gray, medium to very coarse
44- 52 Silt, black, very fine, clayey
52-129 Clay, gray, unoxidized, sandy, silty
(till)
129-150 Shale, bedrock, gray, hard

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Test Hole R-31

Location: SW¼SW¼NE¼SE¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 1 Topsoil, black
1- 2 Silt, gray, clayey
2- 26 Sand, gray, very fine to fine,
unoxidized

Test Hole 31 -- continued.

26- 30 Sand, gray, medium, subrounded
30-120 Clay, gray, unoxidized, slightly
gravelly, sandy, silty, some
intermittent gravel lenses 1 to
2 feet thick, subangular to sub-
rounded (till)
120-130 Shale, bedrock, gray, hard

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Test Hole R-32

Location: SW¼SE¼NE¼SE¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 1 Topsoil, black
1- 3 Sand, medium to very coarse, subangular
to subrounded
3- 21 Gravel, blackish-brown, medium to
coarse, subangular to subrounded
21- 26 Sand, gray, fine to medium, clayey
26- 31 Silt, light to dark-gray, clayey, soft
31- 70 Clay, gray, unoxidized, some lignite,
black, sandy, silty (till)
70 Rock, impassable

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Test Hole R-33

Location: SW¼SW¼SW¼SW¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1377 feet
Depth to water:

0 - 1 Topsoil, brown
1 - 34 Clay, light-red to brown, oxidized,
sandy, silty (till)
34 - 45 Clay, dark-brown, oxidized, sandy
silty (till)
45 - 78 Clay, gray, unoxidized, sandy,
silty (till)
78 - 85 Clay, unoxidized, gravelly, fine to
medium, angular to subrounded,
sandy, silty (till)
85 - 85.5 Rock, limestone boulder?
85.5-113 Clay, gray, unoxidized, slightly
sandy, medium, silty (till)
113 -114 Lignite, black, hard
114 -131 Clay, gray, unoxidized, slightly
gravelly with intermittent sand
lenses 3 to 4 feet thick every
3 or 4 feet, silty (till)
131-133 Gravel stringer, medium
133-150 Clay, gray, unoxidized, slightly
gravelly, fine, sandy, silty
(till)

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Test Hole R-34

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.

Surface elevation: 1350 feet

Depth to water:

0- 1	Topsoil, black
1- 30	Clay, brown, oxidized, sandy, silty (till)
30- 62	Clay, gray, unoxidized, sandy, silty (till)
62- 78	Clay, gray, unoxidized, slightly gravelly and sandy, subrounded, silty (till)
78- 85	Clay, gravelly, medium to coarse, subrounded, sandy, silty (till)
85	Rock, unknown composition

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Test Hole R-35

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.

Surface elevation: 1310 feet

Depth to water:

0- 2	Topsoil, black, dry
2- 8	Silt, brown, clayey
8- 25	Silt, light-brown, clayey, sandy, medium to coarse, subrounded
25- 32	Silt, dark-gray, clayey, sandy
32- 58	Sand, fine to medium, subrounded to rounded, silty, slightly clayey
58- 65	Gravel, fine, subrounded to rounded
65- 74	Clay, gray, unoxidized, sandy, silty (till)
74- 75	Rock, unknown composition (limestone??)
75-132	Clay, gray, unoxidized, traces of lignite, sandy, silty (till)
132-140	Shale, gray, greasy, hard

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APPENDIX B

Logs of auger test holes in the Redfield area (For map location, see figs. 1 and 1a)

Test Hole A-1

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1325 feet
Depth to water: 19.5 feet

0- 8	Clay, medium to dark-brown, silty
8- 20	Sand, red, very clayey, dry
20- 25	Sand, medium-brown, very clayey, moist
25- 41	Sand, medium-brown, saturated
41- 46	Sand, light-gray, very dirty, medium
46- 71	Sand, brownish-gray, very dirty, medium
71- 77	Sand, silty and clayey
77- 80	Shale, gray, soft

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Test Hole A-2

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1309 feet
Depth to water: 19.5 feet

0 - 2	Sand, light-brown, silty, fine
2 - 5	Gravel, pea-size, subangular to rounded
5 - 12	Sand, brownish-red, fine to medium, some pebbles, subangular
12 - 15	Gravel, coarse to very coarse, rounded, intermixed sand and silt
15 - 17	Silt, medium-brown, very sandy
17 - 20	Clay, dark-brown, very sandy
20 - 24	Clay, medium-gray, less sandy
24 - 31	Clay, medium-gray, sandy, saturated
31 - 40.5	Sand, gray, medium, very dirty
40.5 - 55	Sand, light-gray, medium, very dirty
55 - 79	Sand, medium to coarse, rounded, dirty
79 - 85	Shale, gray, soft

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Test Hole A-3

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 11, T. 115 N., R. 64 W.
Surface elevation: 1312 feet
Depth to water: 24 feet

0- 2	Topsoil, black
2- 12	Sand, medium-brown, very fine, clayey
12- 19	Clay, medium-brown, silty, pebbly
19- 30	Sand, brownish-red, fine to medium, dry
30- 54	Sand, gray, medium, subangular to rounded
54- 60	Sand, gray, medium to coarse, subangular to rounded, cleaner
60- 65	Clay, gray, soft, sandy
65- 80	Clay, gray, silty, pebbly
80- 85	Shale, soft, pebbly

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Test Hole A-4

Location: NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 23, T. 115 N., R. 64 W.
Surface elevation: 1309 feet
Depth to water: 9 feet

0- 2	Topsoil, brown, clayey
2- 14	Sand, brownish-red, medium, subangular to rounded, clean
14- 22	Sand, medium-brown, medium, silty, clayey
22- 24	Sand, gray, silty
24- 33	Clay, gray, soft, saturated
33- 43	Clay, gray, very soft, sandy
43- 58	Silt, gray, soft, sandy, fine to medium
58- 63	Sand, gray, medium to coarse, angular to subrounded, pebbly
63- 78	Sand, coarse to very coarse, intermixed gravel, pebbly, dirty
78- 80	Shale, gray, very compacted

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Test Hole A-5

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 10, T. 115 N., R. 64 W.
Surface elevation: 1314 feet
Depth to water: 20 feet

0- 2	Topsoil, black
2- 25	Sand, brown, medium, very clayey, dry
25- 35	Sand, brown, medium, subangular to rounded, saturated
35- 48	Sand, gray, very fine to fine, subangular to rounded, dirty
48- 60	Sand, grayish-brown, fine to medium, dirty
60- 78	Clay, gray, soft, sandy
78- 80	Shale, gray, soft

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Test Hole A-6

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1315 feet
Depth to water: 10 feet

0- 2	Topsoil, black, sandy
2- 8	Gravel, coarse, dry
8- 14	Sand, medium-brown, very coarse, very dirty, gravelly
14- 25	Sand, dark-brown, very coarse, very dirty, saturated
25- 37	Silt, gray, pebbly
37- 50	Sand, very fine, silty, pebbly
50- 56	Clay, soft, sandy
56- 66	Sand, gray, medium, subangular to rounded, silty
66- 70	Shale, Pierre

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Test Hole A-7

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.
Surface elevation: 1291 feet
Depth to water: 7 feet

0- 2	Topsoil, black
2- 9	Clay, brown, sandy, pebbly

Test Hole A-7 - continued.

9- 25 Sand, brown, fine to medium, silty
 25- 54 Gravel, medium, angular to highly
 angular, silty
 54- 65 Gravel, sandy, clean?
 65- 75 Gravel, gray, sandy, silty
 75- 90 Clay, gray, soft, pebbly

Test Hole A-8

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 1, T. 115 N., R. 64 W.
 Surface elevation: 1300 feet
 Depth to water: 20 feet

0- 2 Topsoil, dark-brown
 2- 24 Clay, brown, dry
 24- 35 Sand, medium, saturated, dirty, large
 pebbles, very coarse
 35- 36 Gravel, coarse
 36- 44 Sand, medium, dirty
 44- 62 Silt, gray, clayey, sandy
 62- 63 Gravel, medium
 63 Boulder

Test Hole A-9

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 1, T. 115 N., R. 64 W.
 Surface elevation: 1300 feet
 Depth to water: 20 feet

0- 2 Topsoil, dark-brown
 2- 25 Clay, brown, dry
 25- 44 Sand, medium, dirty, saturated
 44- 55 Silt, clayey, sandy
 55- 60 Rock
 60- 63 Shale

Test Hole A-10

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 116 N., R. 64 W.
 Surface elevation: 1299 feet
 Depth to water:

0- 3 Topsoil, brownish-gray
 3- 11 Sand, reddish-brown, very silty,
 oxidized
 11- 20 Sand, medium, silty, saturated
 20- 44 Gravel, gray, medium, silty
 44- 56 Sand, gray, coarse, silty, pebbly
 56- 66 Silt, gray, pebbly
 66- 70 Shale, soft

Test Hole A-11

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 36, T. 116 N., R. 64 W.
 Surface elevation: 1275 feet
 Depth to water:

0- 3 Topsoil, dark-brown
 3- 13 Sand, brown, fine to medium, very
 clayey
 13- 55 Silt, grayish-green (possibly a lake
 deposit)

Test Hole A-12

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 116 N., R. 63 W.
 Surface elevation: 1271 feet
 Depth to water:

0- 2 Topsoil, brown, silty
 2- 8 Sand, fine, silty
 8- 55 Silt, greenish-gray (possibly a lake
 deposit)

Test Hole A-13

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 6, T. 115 N., R. 63 W.
 Surface elevation: 1295 feet
 Depth to water:

0- 2 Topsoil, dark-brown
 2- 5 Sand, yellow, fine, oxidized
 5- 13 Clay, brown, silty
 13- 44 Clay, gray, silty, saturated
 44- 62 Sand, light-brown, fine, very silty
 62- 80 Silt, light-gray, very clayey

Test Hole A-14

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 7, T. 115 N., R. 63 W.
 Surface elevation: 1305 feet
 Depth to water:

0- 2 Topsoil, dark-brown
 2- 10 Clay, brown, sandy
 10- 31 Clay, gray
 31- 49 Sand, light-gray, medium (grading to
 coarser), silty, saturated
 49- 65 Silt, light-gray, clayey

Test Hole A-15

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 115 N., R. 64 W.
 Surface elevation: 1289 feet
 Depth to water: 4.5 feet

0- 2 Topsoil, brown, clayey, sandy
 2- 6 Sand, brown, fine, saturated
 6- 31 Sand, gray, fine, saturated
 31- 72 Sand, gray, fine, silty
 72- 91 Sand, grayish-black, fine, silty
 91- 95 Shale

Test Hole A-16

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 13, T. 115 N., R. 64 W.
 Surface elevation: 1319 feet
 Depth to water: 14.5 feet

0- 2 Topsoil, black
 2- 8 Sand, red, medium, dry, oxidized
 8- 18 Clay, brown, silty
 18- 29 Sand, brown, medium, silty,
 saturated
 29- 37 Silt, grayish-green, sandy
 37- 65 Sand, gray, fine, silty
 65- 90 Silt, gray

Test Hole A-17

Location: NW¼NE¼NW¼NE¼ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1320 feet
Depth to water: 30 feet

- 0- 1 Topsoil, black
- 1- 14 Sand, reddish-brown, medium, dry, oxidized, pebbly
- 14- 85 Sand, brown, medium, (grading towards fine) silty, saturated
- 85-100 Sand, brownish-black, medium, silty

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Test Hole A-18

Location: SW¼SE¼SE¼NE¼ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1315 feet
Depth to water: 35 feet

- 0- 3 Sand, brown, very silty and clayey
- 3- 8 Gravel, very coarse, clayey
- 8- 28 Clay, brown, pebbly, dry
- 28- 35 Sand, brown, very fine, silty
- 35- 63 Sand, brown, very fine, saturated
- 63- 90 Silt, gray, sandy, medium

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Test Hole A-19

Location: NW¼SW¼SW¼NW¼ sec. 35, T. 116 N., R. 64 W.
Surface elevation: 1311 feet
Depth to water:

- 0- 10 Sand, reddish-brown, medium, oxidized, pebbly
- 10- 26 Sand, red, clayey, pebbly
- 26- 63 Sand, medium, saturated, pebbly
- 63- 73 Gravel, brown, medium, subangular, very dirty
- 73- 85 Silt, gray, soft, pebbly

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Test Hole A-20

Location: NE¼NW¼NW¼NE¼ sec. 11, T. 115 N., R. 64 W.
Surface elevation: 1300 feet
Depth to water:

- 0- 2 Topsoil, brown, sandy, clayey
- 2- 17 Clay, medium-brown, sandy, silty
- 17- 45 Sand, gray, fine to medium, saturated, fairly clean
- 45-100 Silt, gray

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Test Hole A-21

Location: NW¼NW¼NW¼SW¼ sec. 26, T. 116 N., R. 64 W.
Surface elevation: 1300 feet
Depth to water:

- 0- 2 Topsoil, brown, sandy
- 2- 17 Clay, brown, dry
- 17- 28 Clay, brown, very silty, pebbly, saturated at 25 feet
- 28- 66 Gravel, brown, fine to medium, angular, very silty

Test Hole A-21 -- continued.

- 66- 70 Silt?, boulder at 70 feet

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Test Hole A-22

Location: NW¼NW¼NW¼NE¼ sec. 26, T. 116 N., R. 64 W.
Surface elevation: 1315 feet
Depth to water:

- 0- 2 Topsoil, red, sandy
- 2- 30 Silt, red, oxidized, clayey, pebbly
- 30- 69 Sand, grayish-brown, fine to medium, saturated, dirty
- 69- 77 Clay, gray, silty

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Test Hole A-23

Location: SW¼SW¼SW¼NW¼ sec. 25, T. 116 N., R. 64 W.
Surface elevation: 1297 feet
Depth to water: 15 feet

- 0- 3 Topsoil, sandy, pebbly
- 3- 15 Sand, brown, clayey
- 15- 30 Silt, gray, clayey, dry
- 30- 42 Sand, gray, fine, saturated
- 42- 56 Gravel, fine, silty
- 56- 60 Silt, gray, very clayey

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Test Hole A-24

Location: NW¼NE¼NE¼NW¼ sec. 36, T. 116 N., R. 64 W.
Surface elevation: 1280 feet
Depth to water: 10 feet

- 0- 2 Topsoil, black, clayey
- 2- 16 Clay, brown, very silty
- 16- 21 Sand, medium, very silty, saturated
- 21- 55 Silt, gray, very clayey, sandy
- 55- 80 Silt, gray, soft

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Test Hole A-25

Location: SW¼NW¼SE¼SE¼ sec. 27, T. 116 N., R. 64 W.
Surface elevation: 1305 feet
Depth to water: 15 feet

- 0- 10 Silt, brown, sandy, dry
- 10- 20 Silt, gray, very clayey, saturated
- 20- 38 Sand, gray, very fine, very silty, saturated
- 38- 54 Silt, gray, sandy
- 54- 68 Sand, gray, medium (grading to coarse), very silty
- 68- 75 Silt, gray, sandy

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Test Hole A-26

Location: SE¼SE¼SE¼NW¼ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1332 feet
Depth to water:

- 0- 2 Topsoil, black

Test Hole A-26 -- continued.

2- 7 Clay, brown, silty, dry
 7- 40 Silt, brown, sandy, clayey, saturated
 at 15 feet

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Test Hole A-27

Location: NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 27, T. 116 N., R. 64 W.

Surface elevation: 1290 feet

Depth to water:

0- 4 Topsoil, black, clayey
 4- 21 Silt, gray, saturated
 21- 48 Silt, black, saturated
 48- 61 Sand, medium to coarse, silty
 61- 75 Silt, gray, very clayey

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Test Hole A-28

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 116 N., R. 64 W.

Surface elevation: 1315 feet

Depth to water:

0- 15 Clay, gray, silty, dry
 15- 36 Clay, brown, dry
 36- 45 Clay, gray, saturated
 45 Rock

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Test Hole A-29

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 116 N., R. 64 W.

Surface elevation: 1315 feet

Depth to water: 29 feet

0- 7 Silt, brown, sandy, dry
 7- 29 Clay, brown, silty, dry
 29- 42 Clay, gray, silty
 42- 56 Sand, gray, fine, saturated, silty
 56- 65 Sand, coarse, pebbly, silty
 65- 75 Silt, gray, clayey, pebbly

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Test Hole A-30

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.

Surface elevation: 1330 feet

Depth to water:

0- 10 Clay, brown, silty
 10- 11 Rock
 11- 24 Clay, brown, silty, dry
 24- 25 Rock
 25- 29 Clay, gray, silty
 29- 33 Sand, reddish-brown, very fine, dry
 33- 54 Silt, gray, pebbly
 54- 78 Sand, fine, silty
 78- 85 Silt, clayey

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Test Hole A-31

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.

Surface elevation: 1325 feet

Depth to water:

Test Hole A-31 -- continued.

0- 2 Topsoil, black, clayey
 2- 27 Clay, brown, soft, silty
 27- 40 Sand, very fine to fine, clayey
 40- 56 Sand, medium (grading to coarse)
 saturated
 56- 96 Silt, gray, very sandy, fine
 96-120 Clay, soft, very pebbly (rock at 105
 feet)

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Test Hole A-32

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 116 N., R. 64 W.

Surface elevation: 1315 feet

Depth to water: 12 feet

0- 4 Topsoil, black, clayey
 4- 12 Clay, brown, silty
 12- 34 Silt, blackish-gray, soft, saturated
 at 15 feet
 34- 39 Gravel, patchy, silty
 39- 70 Silt, gray, soft
 70- 75 Clay

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Test Hole A-33

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T. 116 N., R. 64 W.

Surface elevation: 1315 feet

Depth to water:

0- 3 Topsoil, black, clayey
 3- 14 Clay, brown, silty
 14- 17 Gravel, very coarse, boulders
 17- 60 Silt, gray, clayey
 60- 62 Gravel
 62- 75 Clay, gray, soft

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Test Hole A-34

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.

Surface elevation: 1305 feet

Depth to water: 11 feet

0- 2 Topsoil, brown, sandy
 2- 11 Sand, medium, very pebbly, dry
 11- 17 Silt, brown, soft, clayey
 17- 34 Sand, brown, medium to coarse, very
 clayey, silty, saturated
 34- 44 Sand, brown, silty and clayey, some
 gravel, coarse, well rounded
 44- 50 Gravel and boulder, very coarse, well
 rounded, $\frac{1}{2}$ inch to $1\frac{1}{2}$ inch
 diameter (average)
 50- 81 Gravel, medium to coarse, rounded
 81- 85 Clay

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Test Hole A-35

Location: SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 115 N., R. 64 W.

Surface elevation: 1305 feet

Depth to water: 15 feet

0- 4 Topsoil, black

Test Hole A-35 -- continued.

4- 15	Sand, brown, silty, dry
15- 49	Sand, brown, medium, saturated
49- 55	Sand, gray, medium, silty
55- 70	Silt, very clayey

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Test Hole A-36

Location: SE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water: 3 feet

0- 4	Topsoil, black, moist
4- 32	Sand, brown, medium, pebbly, saturated
32- 54	Sand, fine, silty, saturated
54- 60	Clay, gray, silty

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Test Hole A-37

Location: NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1300 feet
Depth to water: 15 feet

0- 2	Topsoil, black, dry
2- 9	Silt, brown, sandy, dry
9- 11	Rock and coarse gravel
11- 22	Clay, gray, silty, pebbly, dry
22- 58	Sand, gray, very fine, silty, saturated
58- 60	Clay

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Test Hole A-38

Location: SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 4	Topsoil, dark-gray, silty, wet
4- 14	Sand, brown, medium, saturated
14- 51	Sand, gray, very fine, silty, saturated
51- 65	Silt?

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Test Hole A-39

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 3	Topsoil, sandy, wet
3- 7	Clay, brown, silty, sandy
7- 29	Sand, brown, medium, rounded, pebbly, saturated
29- 34	Sand, coarse to very coarse, subrounded to rounded, pebbly
34- 75	Gravel, medium, sandy, rounded, pebbly
75- 80	Clay

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Test Hole A-40

Location: NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

Test Hole A-40 -- continued.

0- 3	Topsoil, black
3- 25	Sand, fine to medium, saturated
25- 41	Gravel, medium, sandy, saturated
41- 74	Sand, coarse, silty, pebbly

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Test Hole A-41

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 4	Clay, brown, silty, dry
4- 12	Silt, brown, dry
12- 52	Sand, gray, very fine to fine, saturated
52- 65	Silt, gray, sandy, clayey

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Test Hole A-42

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 3	Topsoil, gray, sandy, silty
3- 16	Silt, gray, sandy, wet
16- 38	Sand, very fine to fine, silty, pebbly, saturated
38- 74	Sand, fine to medium, silty, pebbly
74- 80	Silt, gray, sandy

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Test Hole A-43

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 3	Topsoil, brown, silty, sandy
3- 8	Sand, brown, medium, saturated
8- 55	Sand, brown, fine to medium, silty, saturated
55- 70	Silt, gray, soft, sandy

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Test Hole A-44

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 3	Topsoil, brown, silty
3- 16	Silt, light-tan, moist
16- 51	Sand, gray, very fine to fine, silty, saturated
61- 65	Silt, gray, soft, sandy

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Test Hole A-45

Location: SE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 3	Silt, brown, clayey
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Test Hole A-45 -- continued.

3- 14 Silt, light-tan, moist
14- 21 Silt, very clayey, sandy
21- 55 Silt, gray, pebbly, saturated
55- 65 Silt, gray, soft

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Test Hole A-46

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 3 Topsoil, brownish-black, clayey, dry
3- 9 Gravel, medium, silty, red
9- 30 Silt, brown, pebbly, saturated
30- 49 Sand, very fine, very silty
49- 75 Silt, gray, soft

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Test Hole A-47

Location: NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 3 Topsoil, black, dry
3- 13 Silt, light-tan, moist
13- 60 Sand, gray, very fine, silty, saturated
60- 75 Clay, gray, silty, pebbly, soft

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Test Hole A-48

Location: NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 2 Topsoil, dark-brown
2- 8 Clay, brown, silty, dry
8- 14 Silt, gray, clayey, saturated
14- 55 Sand, gray, very fine, very silty, saturated
55- 70 Silt, gray, many coarse pebbles

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Test Hole A-49

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 115 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 2 Topsoil, dark-brown
2- 9 Silt, light-tan, sandy, dry
9- 30 Sand, brown, very fine to fine, saturated
30- 65 Clay, sandy, silty?

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Test Hole A-50

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 3 Topsoil, black

Test Hole A-50 -- continued.

3- 77 Sand, gray, very fine to fine, silty, pebbly
77- 80 Gravel and rock

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Test Hole A-51

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 26, T. 116 N., R. 64 W.
Surface elevation: 1305 feet
Depth to water: 12 feet

0- 2 Topsoil, brown
2- 7 Sand, coarse, gravelly, dry
7- 28 Sand, red, medium, oxidized, dry, pebbly, silty, saturated at 16 feet
28- 36 Sand, gray, fine to medium, saturated
36- 41 Clay, gray, pebbly, silty
41- 68 Sand, gray, medium, very silty, gravelly
68- 72 Rock, gravel

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Test Hole A-52

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 26, T. 116 N., R. 64 W.
Surface elevation: 1313 feet
Depth to water: 22 feet

0- 18 Silt, red, slightly clayey, oxidized, dry
18- 39 Silt, gray, clayey, saturated
39- 68 Sand, gray, very fine to fine, very silty, saturated
68- 73 Silt, clayey, sandy

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Test Hole A-53

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 116 N., R. 64 W.
Surface elevation: 1290 feet
Depth to water:

0- 2 Topsoil, black, dry
2- 5 Clay, light-tan, very silty
5- 12 Gravel, light-brown, very silty, saturated
12- 30 Silt, brown, sandy, pebbly
30- 41 Silt, gray, sandy, pebbly
41- 70 Sand, gray, very fine to fine, silty, pebbly

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Test Hole A-54

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 116 N., R. 64 W.
Surface elevation: 1300 feet
Depth to water:

0- 3 Topsoil, brown, sandy
3- 13 Clay, brown, very soft, silty, dry
13- 24 Silt, brown, very sandy, saturated
24- 46 Sand, very fine to fine, silty, pebbly, saturated
46- 57 Sand, medium, silty, pebbly
57- 68 Clay, silty, sandy, pebbly

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Test Hole A-55

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 116 N., R. 64 W.

Surface elevation: 1297 feet

Depth to water:

0- 2	Topsoil, brownish-red, sandy
2- 11	Silt, red, sandy, oxidized, dry
11- 16	Clay, brown, soft, silty
16- 26	Sand, fine, very silty
26- 27	Boulders and rocks
27- 33	Sand, brown, medium, silty
33- 58	Sand, very coarse, pebbly
58- 70	Clay, gray, pebbly

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Test Hole A-56

Location: NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 115 N., R. 64 W.

Surface elevation: 1317 feet

Depth to water:

0- 2	Topsoil, brown, silty
2- 8	Silt, brown, clayey, dry
8- 44	Clay, gray, silty, dry
44- 59	Sand, fine (grading to medium), silty
59- 75	Sand, gray, medium to coarse, dirty
75- 80	Clay, gray, sandy

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Test Hole A-57

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 8, T. 115 N., R. 64 W.

Surface elevation: 1304 feet

Depth to water:

0- 10	Silt, gray, clayey, sandy
10- 27	Sand, gray, very fine to fine, silty, saturated
27- 70	Silt, gray, sandy, soft

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Test Hole A-58

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 17, T. 115 N., R. 64 W.

Surface elevation: 1313 feet

Depth to water:

Test Hole A-58 -- continued.

0- 7	Sand, red, silty, pebbly, oxidized, dry
7- 16	Clay, brownish-red, soft dry
16	Rock

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Test Hole A-59

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 17, T. 115 N., R. 64 W.

Surface elevation: 1313 feet

Depth to water:

0- 7	Sand, red, silty, very pebbly, oxidized, dry
7- 17	Clay, brown, soft, dry
17- 42	Clay, gray, dry
42- 63	Silt, gray, sandy, saturated

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Test Hole A-60

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 21, T. 115 N., R. 64 W.

Surface elevation: 1305 feet

Depth to water:

0- 2	Topsoil, silty, sandy
2- 17	Silt, brown, sandy, saturated at 11 feet
17- 81	Sand, gray, fine (grades to medium and clean), very silty
81- 85	Silt, very clayey, pebbly

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Test Hole A-61

Location: NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 22, T. 115 N., R. 64 W.

Surface elevation: 1320 feet

Depth to water:

0- 12	Sand, reddish-brown, medium, sub- angular to rounded, clean, dry
12- 45	Sand, brown, medium, slightly clayey, saturated
45- 65	Silt, gray, sandy

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