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OPEN-FILE REPORT 75-UR

HYDROGEOLOGIC INVESTIGATION OF THE HERRICK FORMATION NEAR THE CITY OF HERRICK, SOUTH DAKOTA

by

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1996

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INTRODUCTION

The investigation was conducted in June 1990 and May and June 1991 by the South Dakota Geological Survey, a program within the Department of Environment and Natural Resources, at the request of the Herrick town council. The investigation was financed by the town of Herrick, the Southern Missouri Water Development District, and the South Dakota Geological Survey.

The purpose of the investigation was to determine concentrations of nitrate-nitrogen plus nitrite-nitrogen in ground water in an area surrounding the town of Herrick, South Dakota, and if necessary, assist the city in locating a potential site for a new municipal well. This report contains the results of the investigation that was conducted in the Herrick area (fig. 1). For this report, nitrate-nitrogen plus nitrite-nitrogen will be referred to simply as nitrate.

Acknowledgments

The author would like to acknowledge the cooperation provided by Jeff Bartling, Mayor of Herrick, Lori Bartling, Finance Officer, and Chuck Claussen, Water Superintendent. Their enormous assistance throughout the course of this investigation was greatly appreciated.

Present Herrick Water Supply

The city of Herrick (population 139) has two municipal wells, both of which pump water from the Herrick Formation. This water source is referred to as the Herrick aquifer. Both of the city wells are located in the southeast portion of the city (fig. 2). Municipal well 1 was drilled in 1903 to a depth of 40 feet and pumps at a rate of approximately 100 gallons per minute. Municipal well 2 was drilled in 1973 to a depth of 55 feet and pumps at a rate of approximately 80 gallons per minute. The city wells are approximately 300 feet apart and drawdown in each well is approximately 4 feet during pumping. The static water level averages approximately 27 feet below land surface in the municipal wells.

In the past, the city has blended water produced from these wells and used this water as the municipal water supply. Currently (July 1996), the city uses only one well as the municipal water supply. Water produced from the city wells is generally good (table 1), however, elevated nitrate concentrations are found in the water produced by these wells (table 1 and fig. 3). Figure 3 shows that nitrate concentrations in the blended water produced from the municipal wells fluctuate over time, but generally the concentrations have remained near 10 milligrams per liter (mg/L) since early 1987. The drinking water standard for public water systems is 10 mg/L for nitrate (U.S. Environmental Protection Agency, 1994).

METHODS AND PROCEDURES

Drilling and Well Installation

Drilling occurred twice during this investigation: June 7 through June 28, 1990, and May 28 through June 5, 1991. All test holes were advanced using the mud rotary drilling method. Twenty-two test holes were drilled (fig. 2 and app. A) and all were completed as monitoring wells.

Monitoring wells were constructed using 2-inch diameter, schedule 80, flush threaded, polyvinyl chloride casing and screen. Two monitoring wells are nested at each site to examine the water quality vertically within the aquifer. Data on screen length and well depth are presented in appendix A. A filter pack is present around all well screens, up to at least 4 feet above the top of the screen, and consists of native sediment that collapsed around the screen and/or a well sorted, washed, coarse sand that was placed around the well screen. Bentonite grout was then pumped into the annular space around the outside of the casing. The remaining annular space was filled with cement grout and finally topped with soil. A locking steel well protector was installed into the cement and secured shut with a padlock. These data are on file at the South Dakota Geological Survey

Water Level Measurements

The depth to water in the monitoring wells was measured on two or three occasions to the nearest 0.01 foot (table 2). Measurements were made using an electronic measuring device that emits an audible sound and provides a visual indicator upon contact with the water.

Well Development and Water Sampling

All monitoring wells were developed by pumping with compressed air. A minimum of 3 well volumes of water was removed from each well during development and normally 20 to 30 volumes were removed.

Water samples were collected from 21 monitoring wells installed for this investigation, from the 2 city wells, and from 4 private wells. Monitoring wells were sampled within 1 hour after well development. Thus, the development procedure also served as the water purging event for sampling purposes for the monitoring wells.

The temperature and specific conductance of the water were measured during well development. Water samples were collected only after the temperature and specific conductance of the water had stabilized for three consecutive measurements at 5-minute intervals, and only after a minimum of 3 well volumes had been evacuated.

Water samples from monitoring wells were collected using a bailer or a submersible pump. Water samples from private wells were collected from the farmstead's hydrant, house faucet, or hand pump. All development and sampling information are on file at the South Dakota Geological Survey.

HYDROGEOLOGIC SETTING

Surficial deposits in the study area are comprised mainly of the Quaternary age Herrick Formation. Directly underlying the Herrick Formation is the Cretaceous age Pierre Shale. Generally, the Herrick Formation consists of fluvial, coarse sand and gravel. The Pierre Shale is a marine sediment that consists of relatively impermeable clay. The Herrick Formation, an unconfined ground water system referred to as the Herrick aquifer, will readily yield water in the Herrick area.

RESULTS OF INVESTIGATION

The Herrick Formation was found to consist of fine to coarse, fluvial sand and gravel and is 51 to 71 feet thick in the study area (fig. 4). Saturated thickness of the Herrick Formation (fig. 4) varies from 21 feet in the southwest portion of the study area to 42 feet in the northwest portion of the study area. The water table surface slopes downward to the south-southeast (fig. 5).

Water samples were collected from 21 monitoring wells installed for this investigation, 2 municipal wells, and 4 private wells. All wells were installed in the Herrick Formation. Table 1 indicates that in the study area, the quality of water in the Herrick Formation is generally good. In water collected from the monitoring wells, total dissolved solids range in concentration from 176 to 504 mg/L, hardness ranges in concentration from 80 to 270 mg/L, and iron ranges in concentration from <0.01 to 0.14 mg/L. However, elevated nitrate concentrations have been reported in the Herrick municipal water supply and in water collected from several monitoring wells installed for this investigation.

Figure 6 and table 1 show nitrate concentrations in water collected from monitoring wells range from 0.89 to 23.9 mg/L. For reference, the drinking water standard for public water systems is 10 mg/L for nitrate (U.S. Environmental Protection Agency, 1994) and it has been suggested that nitrate concentrations greater than 3 mg/L may be the result of human activities (Madison and Brunett, 1984).

Nitrate concentrations in water collected from the Herrick aquifer were elevated in nearly all the monitoring wells installed for this investigation (fig. 6). Water collected from shallow wells (wells screened at, near, or through the water table) had nitrate concentrations ranging from 0.89 to 23.9 mg/L. Water collected from deeper wells (wells screened at or near the bottom of the aquifer) had nitrate concentrations ranging from 1.4 to 11.9 mg/L. Municipal well 1 had a nitrate concentration of 9.7 mg/L and municipal well 2 had a nitrate concentration of 11 mg/L.

In the Herrick area, agricultural land surrounds the city and each residence in Herrick has a septic system. Knowing the land use in the area coupled with the nitrate concentrations found in water collected from both the city wells and monitoring wells, it appears that the elevated nitrate concentrations in the Herrick area are caused by both point source and nonpoint source contamination.

DISCUSSION AND CONCLUSIONS

Elevated nitrate concentrations have been detected in ground water collected from the Herrick municipal water supply and from several monitoring wells located near the city of Herrick. Currently, it is not possible to recommend a location for a new municipal well in the Herrick aquifer, near the city,

with the assurance that it will produce water with an acceptable nitrate concentration after prolonged pumping. Because nitrate concentrations in the city wells have been just below, at, or just above the drinking water standard for public water supplies, monitoring of water collected from the city wells should continue.

In addition, stringent wellhead protection is necessary in this area to minimize the nitrate concentration in any present or future wells. The city might also consider implementing a municipal sewer system. Two other possible options to consider to improve water quality are to obtain water from the rural water system nearest the city or from the city of Burke, and to locate and develop a new wellfield at some location where nitrate contamination in the ground water is not a problem. Before a new wellfield is developed, additional investigation is required.

REFERENCES

Madison, R.J., and Brunett, J.O., 1984, *Overview of the occurrence of nitrate in ground water of the United States*, in *National water summary 1984 – Water-quality issues*: U.S. Geological Survey Water-Supply Paper 2275, p. 93-103.

U.S. Environmental Protection Agency, 1994, *Drinking water regulations and health advisories*, November 1994.

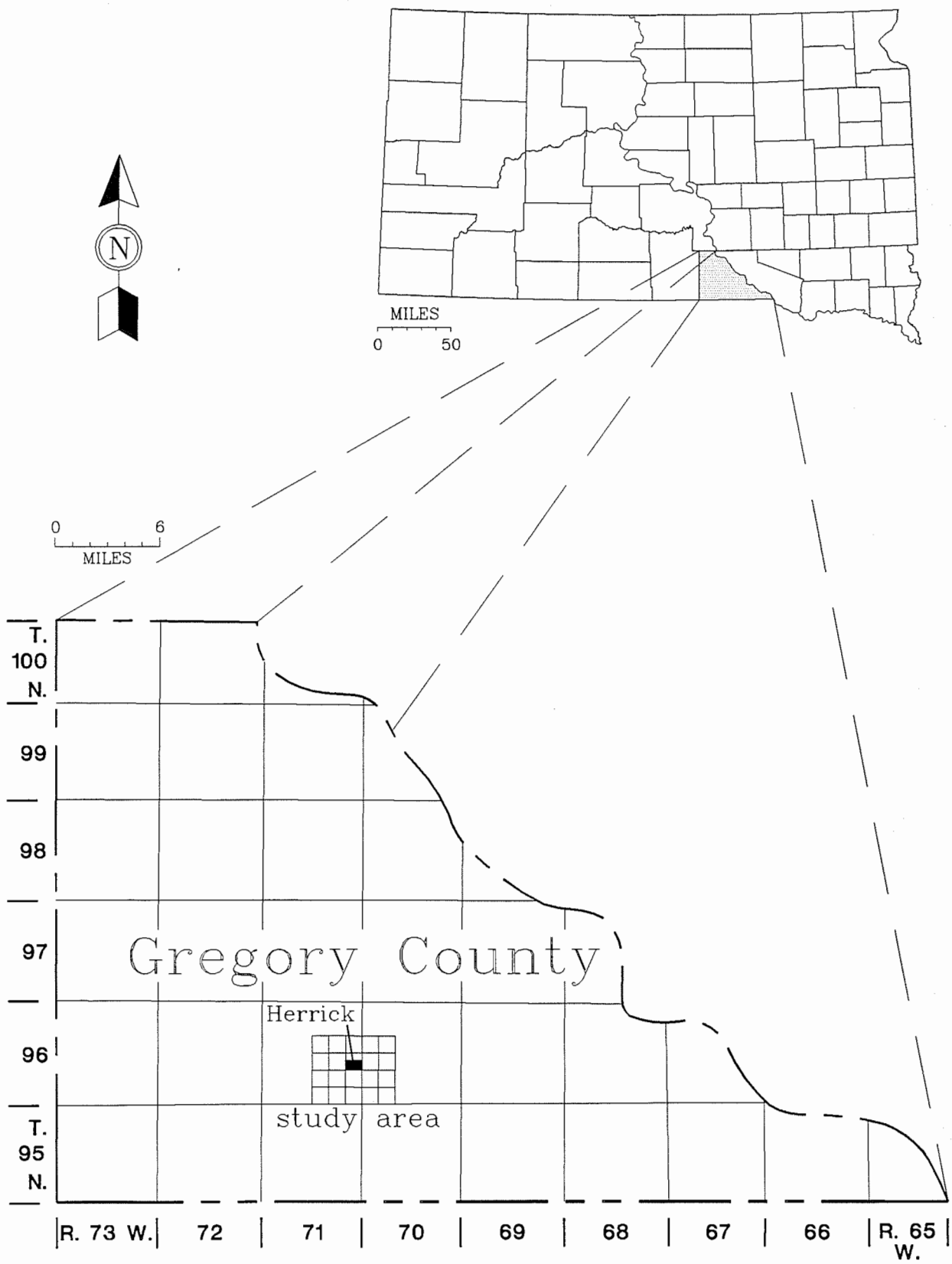


Figure 1. Location of the study area.

Figure 2. Locations of monitoring and municipal wells.

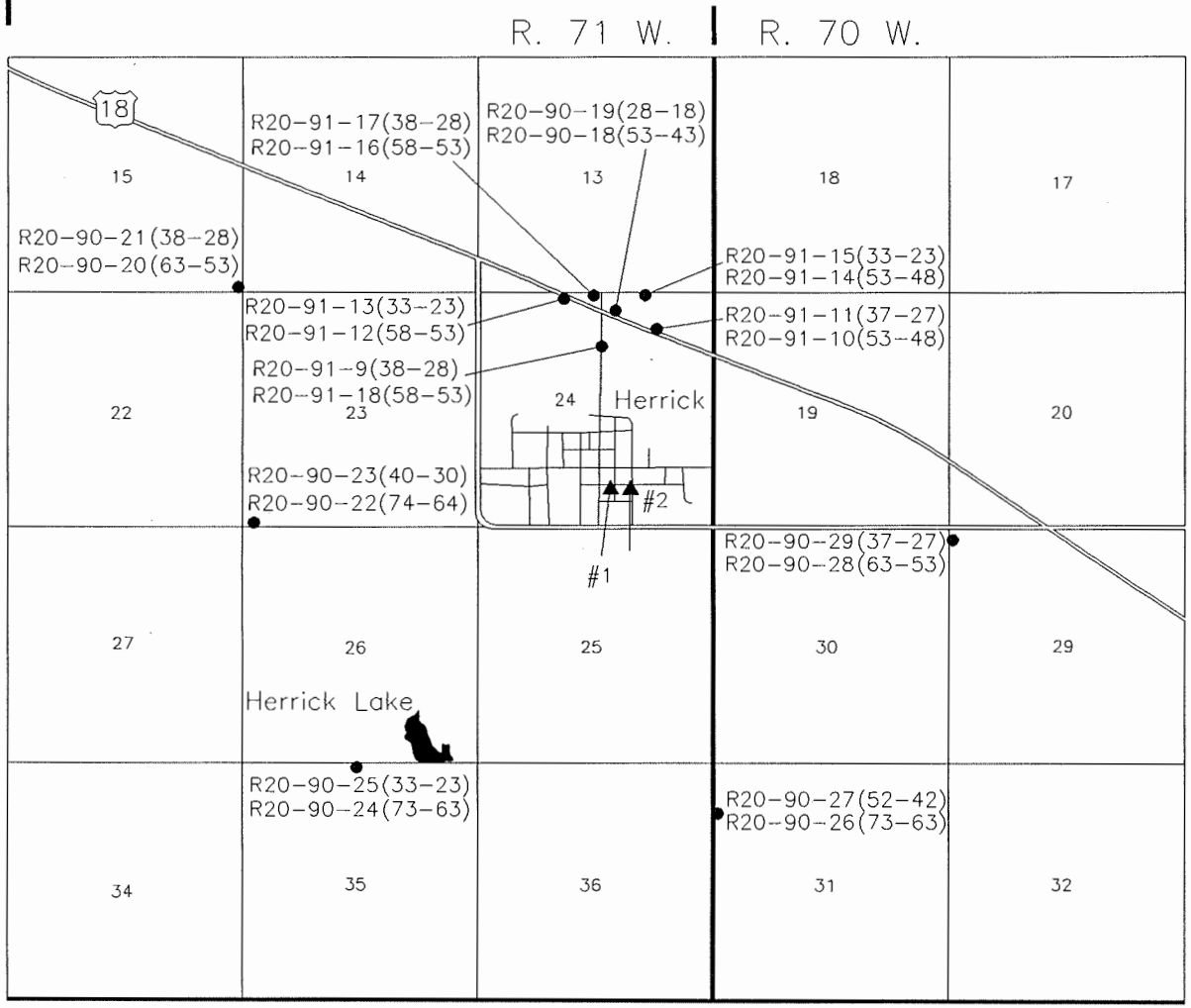


Figure 3. Nitrate concentrations in the Herrick water supply.

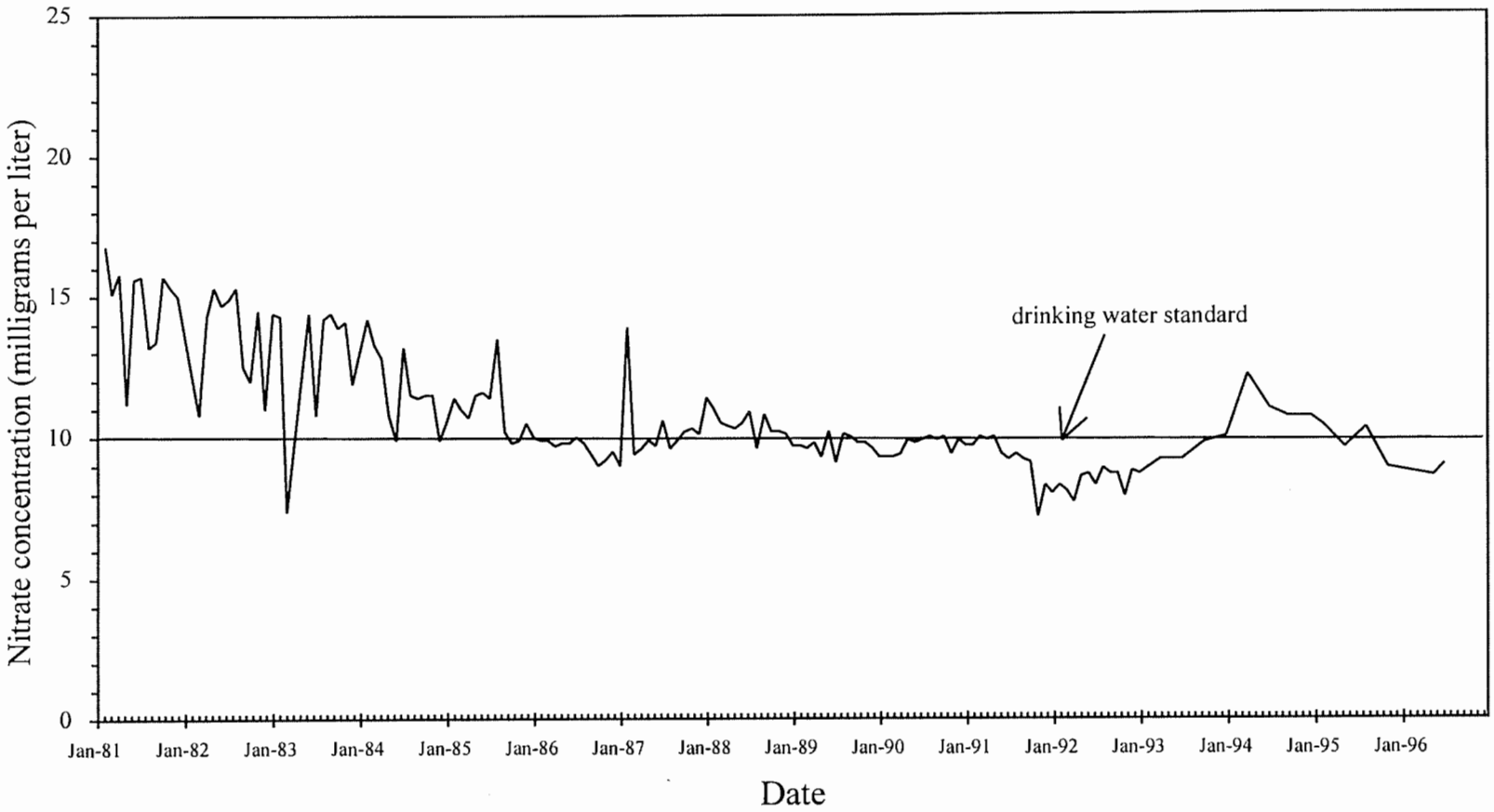
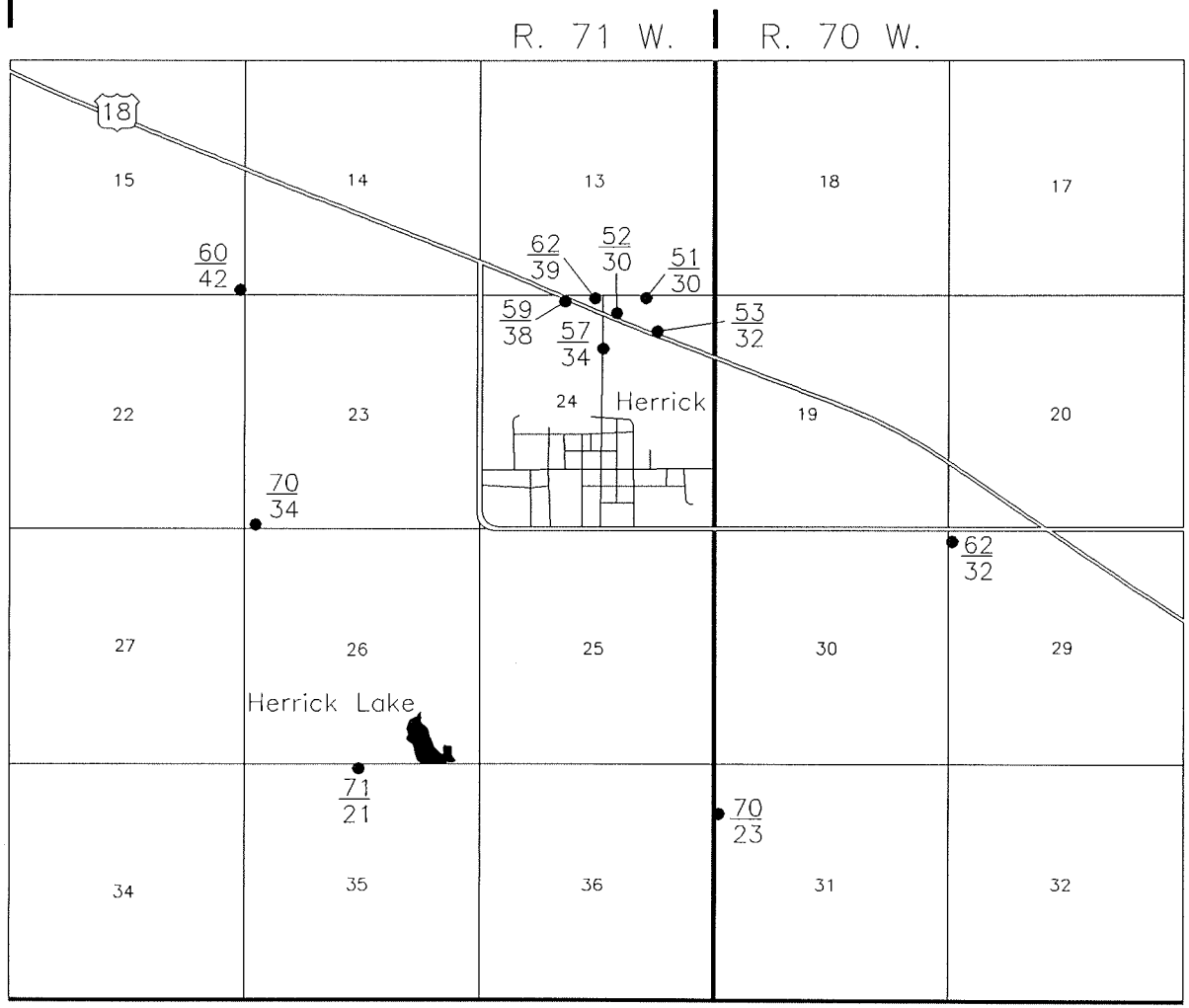


Figure 4. Total thickness and saturated thickness of the Herrick Formation.

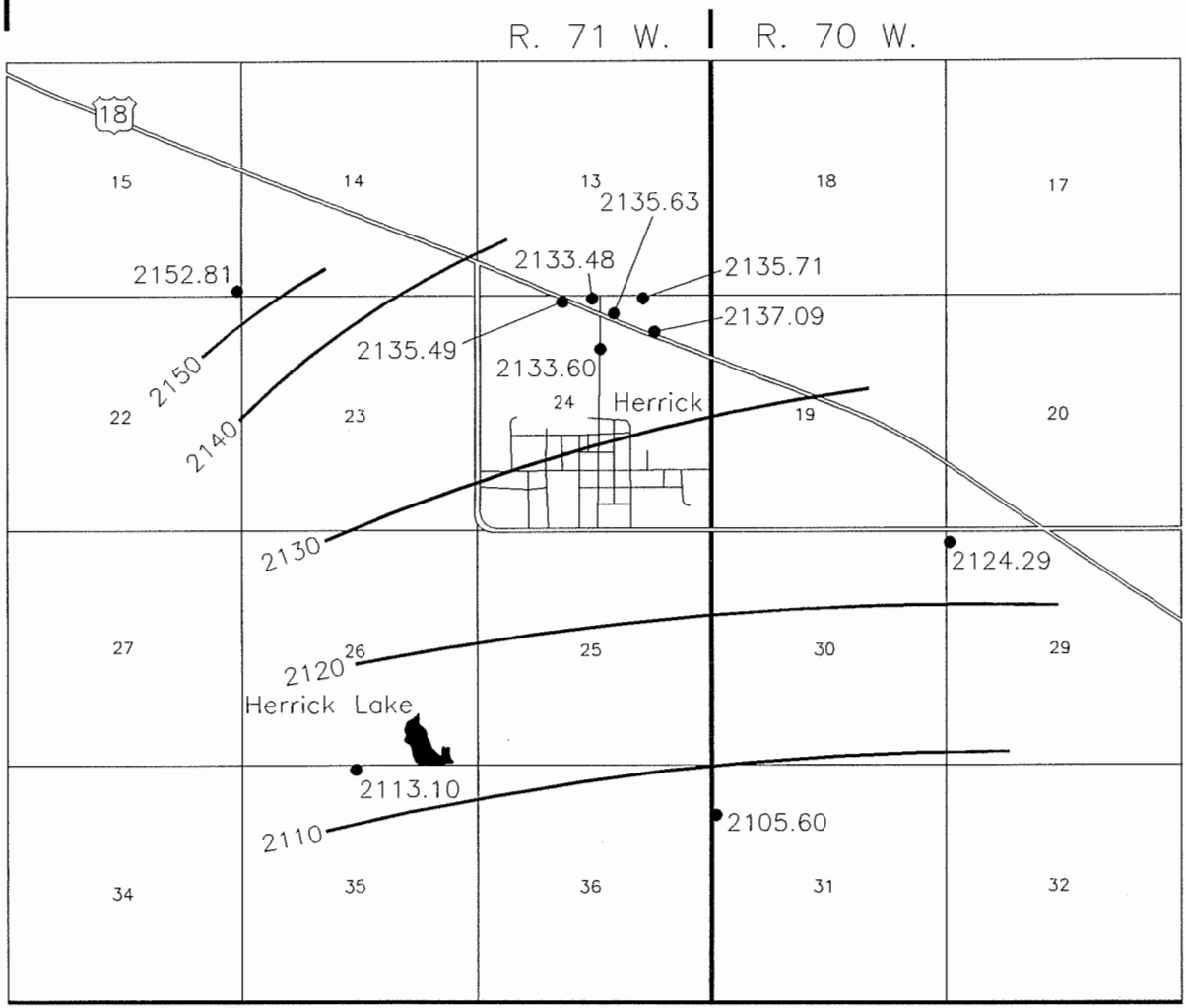


60/42 ● Monitoring well. Upper number is formation thickness. Lower number is saturated thickness, in feet.

N

0 1 MILE

Figure 5. Water level elevations in the Herrick aquifer on August 5, 1992.



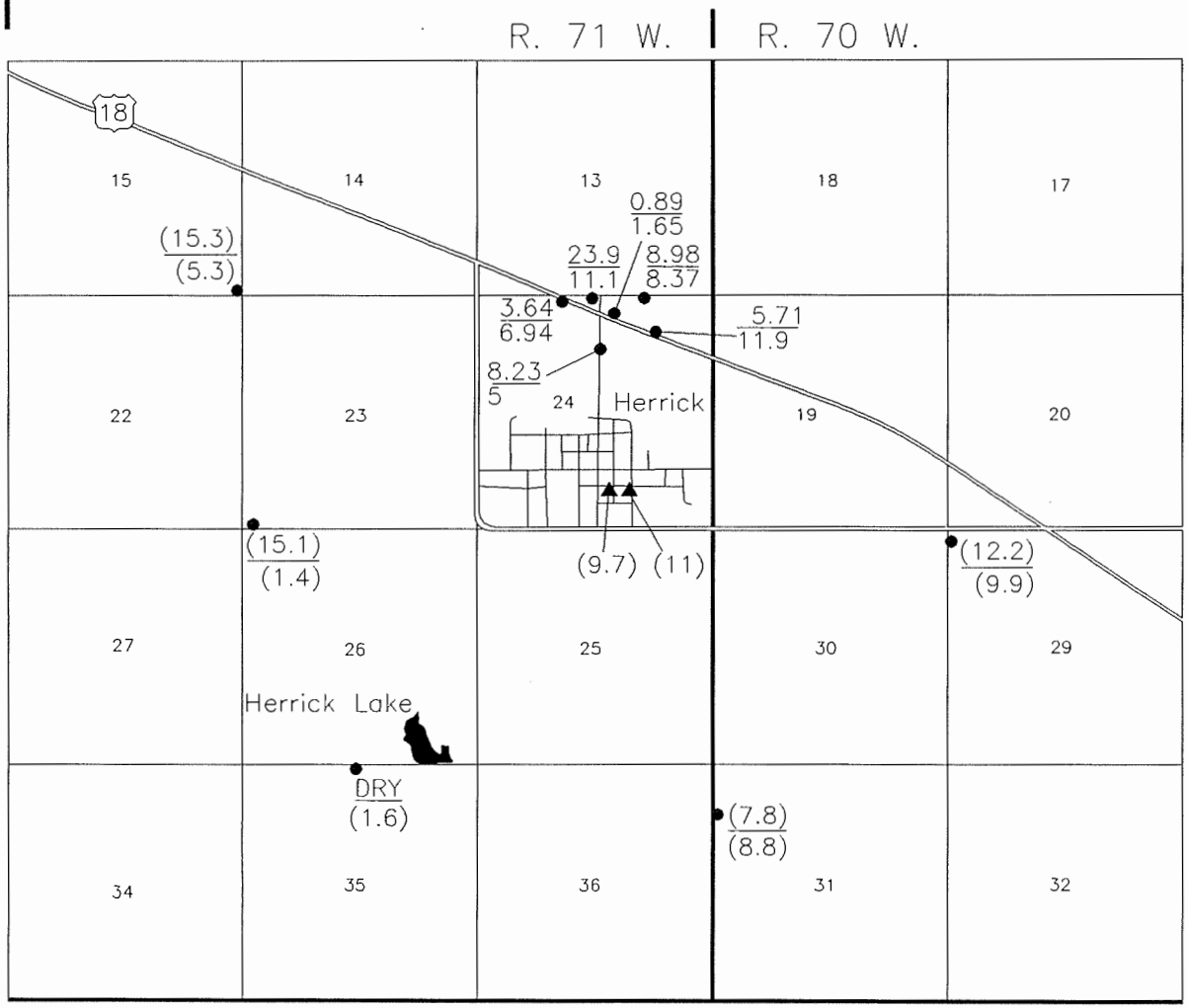
● 2124.29
Monitoring well. Number is elevation of water table in feet above mean sea level.

2150
Generalized contour line connecting points of equal elevation on the woter surface. Contour interval = 10 feet

N

0 1 MILE

Figure 6. Nitrate concentrations in the Herrick aquifer.



(15.3) / (5.3) ● Monitoring well. Number is nitrate concentration in milligrams per liter. Upper number corresponds to concentration in shallow well. Lower number corresponds to deeper well.

(9.7) ▲ Municipal well. Number is nitrate concentration in milligrams per liter.

Number in parentheses denotes samples collected August 1990. All other samples collected June 1991.

N

0 1 MILE

Table 1. Chemical analyses of water samples

Legal location	Well name	Date collected	Well depth[2]	Conductivity[3]	Selenium[4]	Parameters[1] and concentrations in milligrams per liter													
						Alk-T	HCO_3	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO_3-N + NO_2-N	SO_4	TDS	Hardness as $CaCO_3$
						--	--	--	250[5]	2.4[6]	0.3[5]	--	--	0.05[5]	--	10[6]	250[5]	500[5]	--
NE NW NW NW sec. 6, T. 96 N., R. 70 W.	Private	08/29/90	50	225	<1.0	71.6	87.4	26	10	0.17	0.69	2.4	4.5	0.03	7.2	4.9	<10.0	165	83
NW NW NW NW sec. 29, T. 96 N., R. 70 W.	R20-90-28	08/29/90	65	484	<1.0	152	185	51.4	19.9	0.37	0.03	8.6	9.2	0.01	25.8	9.9	<10.0	323	166
NW NW NW NW sec. 29, T. 96 N., R. 70 W.	R20-90-29	08/28/90	40	380	<1.0	109	133	42	11.3	0.23	<0.01	5.4	9	0.01	11.8	12.2	<10.0	262	142
SW SW NW NW sec. 31, T. 96 N., R. 70 W.	R20-90-26	08/28/90	75	296	<1.0	82.2	100	32.9	10.7	0.18	0.01	3.6	7.2	0.01	8.6	8.8	<10.0	207	112
SW SW NW NW sec. 31, T. 96 N., R. 70 W.	R20-90-27	08/28/90	55	316	<1.0	97.8	119	34.4	10.9	0.24	<0.01	2.8	8.6	<0.01	10.8	7.8	<10.0	210	121
SE SE SE SE sec. 15, T. 96 N., R. 71 W.	R20-90-20	08/27/90	65	473	<1.0	190	232	49	11.3	0.34	<0.01	11.2	8.7	0.02	34.1	5.3	<10.0	331	158
SE SE SE SE sec. 15, T. 96 N., R. 71 W.	R20-90-21	08/27/90	40	410	<1.0	126	154	47.5	10.7	0.2	<0.01	6.6	8.8	0.02	15.5	15.3	<10.0	296	155
NE NE NE NW sec. 23, T. 96 N., R. 71 W.	Private	08/29/90	79	1018	<1.0	223	272	138	58.8	0.12	0.22	10	19.5	0.02	23.5	42.5	60.8	720	425
SW SW SW SW sec. 23, T. 96 N., R. 71 W.	R20-90-22	08/28/90	75	395	1.1	176	215	52.1	10.8	0.22	<0.01	7.7	7.9	0.02	12.2	1.4	<10.0	272	163
SW SW SW SW sec. 23, T. 96 N., R. 71 W.	R20-90-23	08/28/90	42	478	<1.0	157	192	55.5	11.1	0.42	0.06	4.6	10.4	0.01	19.8	15.1	<10.0	334	181
NW SW NE NE sec. 24, T. 96 N., R. 71 W.	R20-91-10	06/11/91	55	431	NA	157	191	50	5.2	0.31	<0.05	7.8	9	<0.05	25	11.9	20	304	160
NW SW NE NE sec. 24, T. 96 N., R. 71 W.	R20-91-10	08/19/91	55	423	NA	163	199	49	4.3	0.32	<0.05	8	9.3	<0.05	25	11.4	18	306	160
NW SW NE NE sec. 24, T. 96 N., R. 71 W.	R20-91-11	06/11/91	39	384	NA	118	144	43	2.8	0.32	<0.05	5	11	<0.05	19	5.71	60	285	150
NW SW NE NE sec. 24, T. 96 N., R. 71 W.	R20-91-11	08/19/91	39	369	NA	115	140	45	2.8	0.24	<0.05	4.8	11	<0.05	12	5.94	54	272	160
NE NE NW NE sec. 24, T. 96 N., R. 71 W.	R20-91-14	06/12/91	55	401	NA	156	190	45	2.5	0.44	<0.05	7.3	9.4	<0.05	24	8.37	24	NA	150

Table 1 - continued.

Legal location	Well name	Date collected	Well depth[2]	Conduc-tivity[3]	Selen-ium[4]	Parameters[1] and concentrations in milligrams per liter													
						Alk-T	HCO_3	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO_3-N + NO_2-N	SO_4	TDS	Hardness as $CaCO_3$
						--	--	--	250[5]	2.4[6]	0.3[5]	--	--	0.05[5]	--	10[6]	250[5]	500[5]	--
NE NE NW NE sec. 24, T. 96 N., R. 71 W.	R20-91-15	06/12/91	35	460	NA	179	218	57	1.7	0.55	<0.05	6.3	12	<0.05	23	8.98	35	NA	190
SE NW NW NE sec. 24, T. 96 N., R. 71 W.	R20-90-18	08/24/90	55	376	<1.0	178	217	47	9.4	0.24	<0.01	7.9	7.4	0.02	18.5	1.5	<10.0	252	148
SE NW NW NE sec. 24, T. 96 N., R. 71 W.	R20-90-18	06/05/91	55	358	NA	184	224	47	2.3	0.28	<0.05	7.3	7.8	<0.05	17	1.65	4.2	231	150
SE NW NW NE sec. 24, T. 96 N., R. 71 W.	R20-90-19	08/27/90	30	532	<1.0	210	256	61.6	10.1	0.54	0.14	4.2	13.9	0.06	25.7	1	35.7	354	211
SE NW NW NE sec. 24, T. 96 N., R. 71 W.	R20-90-19	06/10/91	30	505	NA	235	286	61	5.6	0.68	0.05	6.1	15	<0.05	32	0.89	40	334	210
SW SW NW NE sec. 24, T. 96 N., R. 71 W.	R20-91-09	06/04/91	40	413	NA	147	140	40	4.7	0.58	<0.05	4.7	8.9	<0.05	37	8.23	39	288	137
SW SW NW NE sec. 24, T. 96 N., R. 71 W.	R20-91-18	06/10/91	60	368	NA	155	184	41	3.5	0.39	<0.05	7.1	7.7	<0.05	24	5	20	258	130
NE NE NE NW sec. 24, T. 96 N., R. 71 W.	R20-91-16	06/12/91	60	331	NA	119	144	44	1.7	0.24	<0.05	6.9	6.4	<0.05	12	11.1	12	NA	140
NE NE NE NW sec. 24, T. 96 N., R. 71 W.	R20-91-17	06/12/91	40	716	NA	180	219	76	27	0.44	<0.05	7.4	20	<0.05	39	23.9	65	504	270
SE NE NE NW sec. 24, T. 96 N., R. 71 W.	Private	06/05/91	--	498	NA	164	200	63	4	0.23	<0.05	7	14	<0.05	12	16.8	31	382	210
NE NW NE NW sec 24, T. 96 N., R. 71 W.	R20-91-12	06/12/91	60	374	NA	161	196	49	3.2	0.18	<0.05	8.6	7.7	<0.05	16	6.94	10	278	150
NE NW NE NW sec 24, T. 96 N., R. 71 W.	R20-91-12	08/19/91	60	371	NA	162	197	48	3.3	0.2	<0.05	8.8	7.7	<0.05	15	6.59	10	274	150
NE NW NE NW sec 24, T. 96 N., R. 71 W.	R20-91-13	06/11/91	35	387	NA	137	165	24	2.8	0.64	<0.05	5.1	7.2	<0.05	49	3.64	50	278	90
NE NW NE NW sec 24, T. 96 N., R. 71 W.	R20-91-13	08/19/91	35	324	NA	136	166	32	2.8	0.53	<0.05	4.2	9.1	<0.05	22	2.44	28	235	117

Table 1 - continued.

Legal location	Well name	Date collected	Well depth[2]	Conductivity[3]	Selenium[4]	Parameters[1] and concentrations in milligrams per liter													
						Alk-T	HCO_3	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO_3-N + NO_2-N	SO_4	TDS	Hardness as $CaCO_3$
						--	--	--	250[5]	2.4[6]	0.3[5]	--	--	0.05[5]	--	10[6]	250[5]	500[5]	--
SW NW SW SE sec. 24, T. 96 N., R. 71 W.	City well 1	08/28/90	51	434	<1.0	124	151	39.6	19.7	0.23	0.01	5.3	9.1	0.01	26.5	9.7	<10.0	284	136
SE NW SW SE sec. 24, T. 96 N., R. 71 W.	City well 2	08/28/90	55	461	<1.0	113	138	46.1	19.7	0.22	0.9	4.9	10.1	0.01	24.2	11	31.2	317	157
NE NE NE SE sec. 27, T. 96 N., R. 71 W.	Private	08/19/90	60	332	<1.0	132	161	42.9	12.6	0.4	0.03	2.4	5.8	0.02	13.2	2.3	<10.0	229	131
NE NE NE NW sec. 35, T. 96 N., R. 71 W.	R20-90-24	08/28/90	75	239	<1.0	98	120	25.7	8.5	0.21	<0.01	5.2	3.9	0.02	14.4	1.6	<10.0	176	80

[1] **Alk-T** - total alkalinity; **HCO_3** - bicarbonate; **Ca** - calcium; **Cl** - chloride; **F** - fluoride; **Fe** - iron; **K** - potassium; **Mg** - magnesium; **Mn** - manganese; **Na** - sodium; **NO_3-N + NO_2-N** - nitrate + nitrite as nitrogen; **SO_4** - sulfate; **TDS** - total dissolved solids; **Hardness as $CaCO_3$** - hardness as calcium carbonate.

[2] Well depth is presented in feet below top of casing.

[3] Numbers are presented in micromhos per centimeter.

[4] Numbers are presented in micrograms per liter.

[5] U.S. Environmental Protection Agency "Drinking Water Regulations and Health Advisories": November 1994 (Secondary maximum contaminant levels. Recommended limits.)

[6] U.S. Environmental Protection Agency "Drinking Water Regulations and Health Advisories": November 1994 (Maximum contaminant levels. Enforceable limits.)

NA - Parameter was not analyzed.

Table 2. Water levels in monitoring wells

Well Name	Date	Depth to water below casing top (feet)	Casing top elevation (feet above mean sea level)	Water elevation below casing top (feet)
R20-90-18	08/24/90	23.39	2162	2138.61
	06/05/91	25.00	2162	2137.00
	08/05/92	26.37	2162	2135.63
R20-90-19	08/27/90	23.36	2162	2138.64
	06/10/91	25.98	2162	2136.02
	08/05/92	26.37	2162	2135.63
R20-90-20	08/27/90	19.59	2175	2155.41
	08/05/92	22.19	2175	2152.81
R20-90-21	08/27/90	20.02	2175	2154.98
	08/05/92	22.62	2175	2152.38
R20-90-22	08/28/90	55.73	2172	2116.27
	08/05/92	inaccessible	2172	--
R20-90-23	08/28/90	38.24	2173	2134.76
	08/05/92	inaccessible	2173	--
R20-90-24	08/28/90	52.40	2166	2113.60
	08/05/92	52.90	2166	2113.10
R20-90-25	08/14/90	34.08	2166	2131.92
	08/05/92	dry	2166	--
R20-90-26	08/28/90	49.22	2157	2107.78
	08/05/92	51.40	2157	2105.60
R20-90-27	08/28/90	49.94	2158	2108.06
	08/05/92	52.40	2158	2105.60
R20-90-28	08/28/90	31.92	2157	2125.08
	08/05/92	32.71	2157	2124.29
R20-90-29	08/28/90	32.68	2158	2125.32
	08/05/92	33.44	2158	2124.56
R20-91-09	06/04/91	28.58	2162	2133.42
	08/05/92	28.03	2162	2133.97
R20-91-10	06/11/91	23.90	2162	2138.10
	08/19/91	23.76	2162	2138.24
	08/05/92	24.91	2162	2137.09
R20-91-11	06/11/91	23.90	2162	2138.10
	08/19/91	24.08	2162	2137.92
	08/05/92	25.26	2162	2136.74
R20-91-12	06/12/91	24.00	2162	2138.00
	08/19/91	25.32	2162	2136.68
	08/05/92	26.51	2162	2135.49
R20-91-13	06/11/91	24.50	2162	2137.50
	08/19/91	24.92	2162	2137.08
	08/05/92	26.13	2162	2135.87
R20-91-14	06/12/91	25.00	2162	2137.00
	08/05/92	26.29	2162	2135.71
R20-91-15	06/12/91	24.67	2162	2137.33
	08/05/92	26.26	2162	2135.74
R20-91-16	06/12/91	27.00	2162	2135.00
	08/05/92	28.52	2162	2133.48
R20-91-17	06/12/91	26.90	2162	2135.10
	08/05/92	28.41	2162	2133.59
R20-91-18	06/10/91	27.10	2162	2134.90
	08/05/92	28.40	2162	2133.60

APPENDIX A

Lithologic logs of monitoring wells

LEGAL LOCATION and LOCATION

The logs are listed by smallest township number, then the smallest range number, the smallest section number, and then by quarter section: NE = A; NW = B; SW = C; SE = D. A comparison of a **LEGAL LOCATION** and a **LOCATION** is as follows. A **LEGAL LOCATION** of SW SW NW NE sec. 24, T. 96 N., R. 71 W. is the same as a **LOCATION** of 96N-71W-24ABCC. In some locations, the smallest quarter section is followed by the number 1 or 2 which indicates that more than one log may exist for that particular location.

LATITUDE and LONGITUDE

The format is **DD.MMSS** where **D** is degrees, **M** is minutes, and **S** is seconds.

DRILLING COMPANY

SDGS is an abbreviation for South Dakota Geological Survey.

TOTAL DRILL HOLE DEPTH, SCREEN LENGTH, and TOTAL CASING AND SCREEN

The numbers are presented in feet.

CASING STICK-UP

The number is presented in feet above ground surface.

SCREEN TYPE and CASING TYPE

PVC is an abbreviation for polyvinyl chloride. **MFG.** is an abbreviation for manufactured and indicates a product that is commercially available. **SCH.** is an abbreviation for schedule; a term referring to the thickness of the casing wall. **SLOT SIZE** is the size, in inches, of the openings on the screen.

GROUND SURFACE ELEVATION

The number is presented in feet above mean sea level. **T** - the elevation was estimated using a 7.5 minute series topographic map.

CASING DIAMETER

The number is presented in inches.

County: GREGORY
Location: 096N-70W-29BBBB 1
Legal Location: NW NW NW NW sec. 29, T. 096 N., R. 70 W.
Latitude: 43.0640
Longitude: 99.0932
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-27-1990
Drilling Method: HOLLOWSTEM
Ground Surface Elevation: 2155 T
Total Drill Hole Depth: 63
Test Hole Number: R20-90-28
Water Rights Well:
SDGS Well Name: R20-90-28
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Screen Length: 10.0
Casing Type: PVC, SCH. 80
Casing Diameter: 2.0
Casing Top Elevation: 2157 T
Casing Stick-up: 2.00
Total Casing and Screen: 65.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screened interval from 63 to 53 feet; filter pack (native sediment) 63 to 19.5 feet; granular bentonite 19.5 to 16 feet; cement 16 feet to 0 feet; locking steel well protector installed. Screen and casing are flush threaded.

0	-	6	Sand and gravel, light-brown, medium sand to very fine gravel
6	-	11	Sand and gravel, brown, medium sand to very fine gravel
11	-	32	Sand and gravel, light-brown, medium sand to very fine gravel
32	-	61	Sand and gravel, brown, coarse sand to fine gravel
61	-	62	Sand and gravel, brown, very coarse sand to fine gravel, very clayey
62	-	63	Clay

County: GREGORY
Location: 096N-70W-29BBBB 2
Legal Location: NW NW NW NW sec. 29, T. 096 N., R. 70 W.
Latitude: 43.0640
Longitude: 99.0932
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-28-1990
Drilling Method: HOLLOWSTEM
Ground Surface Elevation: 2155 T
Total Drill Hole Depth: 38
Test Hole Number: R20-90-29
Water Rights Well:
SDGS Well Name: R20-90-29
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Screen Length: 10.0

Casing Type: PVC, SCH. 80
Casing Diameter: 2.0
Casing Top Elevation: 2158 T
Casing Stick-up: 3.00
Total Casing and Screen: 40.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screened interval from 37 to 27 feet; filter pack (native sediment) 38 to 24 feet; granular bentonite 24 to 18.5 feet; cement 18.5 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded.

0	-	6	Sand and gravel, light-brown, medium sand to very fine gravel
6	-	11	Sand and gravel, brown, medium sand to very fine gravel
11	-	23	Sand and gravel, light-brown, medium sand to very fine gravel
23	-	27	Sand and gravel, brown, medium sand to very fine gravel
27	-	38	Sand and gravel, brown, medium sand to fine gravel

County: GREGORY
Location: 096N-70W-31BBCC 1
Legal Location: SW SW NW NW sec. 31, T. 096 N., R. 70 W.
Latitude: 43.0537
Longitude: 99.1040
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-27-1990
Drilling Method: HOLLOWSTEM
Ground Surface Elevation: 2155 T
Total Drill Hole Depth: 74
Test Hole Number: R20-90-26
Water Rights Well:
SDGS Well Name: R20-90-26
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Screen Length: 10.0
Casing Type: PVC, SCH. 80
Casing Diameter: 2.0
Casing Top Elevation: 2157 T
Casing Stick-up: 2.00
Total Casing and Screen: 75.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screen interval from 73 to 63 feet; filter pack (native sediment) 74 to 23 feet; granular bentonite 23 to 20 feet; cement 20 to 1 foot; locking steel well protector installed. Screen and casing are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, yellow-brown to brown, silty
3	-	6	Sand and gravel, light-brown, medium sand to very fine gravel

6	-	20	Sand and gravel, brown, medium sand to very fine gravel
20	-	32	Sand and gravel, brown, medium sand to very fine gravel; some pebbles
32	-	55	Sand and gravel, brown, medium sand to very fine gravel
55	-	70	Sand and gravel, light-brown, medium sand to very fine gravel
70	-	73	Sand, brown, medium to coarse
73	-	74	Clay, gray, sandy

County: GREGORY
Location: 096N-70W-31BBCC 2
Legal Location: SW SW NW NW sec. 31, T. 096 N., R. 70 W.
Latitude: 43.0537
Longitude: 99.1040
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-27-1990
Drilling Method: HOLLOWSTEM
Ground Surface Elevation: 2155 T
Total Drill Hole Depth: 54
Test Hole Number: R20-90-27
Water Rights Well:
SDGS Well Name: R20-90-27
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Screen Length: 10.0
Casing Type: PVC, SCH. 80
Casing Diameter: 2.0
Casing Top Elevation: 2158 T
Casing Stick-up: 3.00
Total Casing and Screen: 55.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screen interval from 52 to 42 feet; filter pack (native sediment) 54 to 34 feet; granular bentonite 34 to 17 feet; cement 17 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, yellowish-brown to brown, silty
3	-	6	Sand and gravel, brown, medium sand to very fine gravel
6	-	32	Sand and gravel, light-brown, medium sand to very fine gravel
32	-	45	Sand and gravel, brown, medium sand to very fine gravel
45	-	54	Sand and gravel, light-brown, medium sand to very fine gravel

County: GREGORY
Location: 096N-71W-15DDDD 1
Legal Location: SE SE SE SE sec. 15, T. 096 N., R. 71 W.
Latitude: 43.0734
Longitude: 99.1304
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X

Date Drilled: 06-25-1990
Ground Surface Elevation: 2173 T
Total Drill Hole Depth: 64
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Casing Type: PVC, SCH. 80
Casing Top Elevation: 2175 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Drilling Method: HOLLOWSTEM

Test Hole Number: R20-90-20
SDGS Well Name: R20-90-20

Aquifer: HERRICK

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 65.0

Single Point Resistivity:
Extra:

Well Data: Screen interval from 63 to 53 feet; filter pack (native sediment) 64 to 20 feet; granular bentonite 20 to 18 feet; cement 18 to feet; locking steel well protector installed. Casing and screen are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, yellow-brown, sandy
3	-	8	Sand, light-brown, fine to medium
8	-	12	Sand, light-brown, fine to coarse
12	-	18	Sand, brown, medium to coarse; small pebbles present
18	-	19	Sand, brown, medium to coarse; some gravel present
19	-	27	Sand, brown-gray, fine to medium, clayey, silty
27	-	49	Sand, brown, fine, clayey, silty
49	-	53	Sand, brown, fine, silty
53	-	63	Sand, brown, fine, very silty
63	-	64	Clay

County: GREGORY
Legal Location: SE SE SE SE sec. 15, T. 096 N., R. 71 W.
Latitude: 43.0734
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: P. HAMMOND
Date Drilled: 06-26-1990
Ground Surface Elevation: 2173 T
Total Drill Hole Depth: 39
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Casing Type: PVC, SCH. 80
Casing Top Elevation: 2175 T
Casing Stick-up: 2.00

Location: 096N-71W-15DDDD 2

Longitude: 99.1304

Driller's Log:
Geologist's Log: X
Drilling Method: HOLLOWSTEM

Test Hole Number: R20-90-21
SDGS Well Name: R20-90-21

Aquifer: HERRICK

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 40.0

Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Single Point Resistivity:
Extra:

Well Data: Screen interval from 38 to 28 feet; filter pack (native sediment) 39 to 21 feet; granular bentonite 21 to 19 feet; cement 19 to 0 feet; locking steel well protector installed. Casing and screen are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, yellow-brown, sandy
3	-	18	Sand, brown, medium to coarse
18	-	19	Sand, light-brown to brown, fine to coarse
19	-	27	Sand, light-brown, fine to medium, somewhat silty
27	-	39	Sand, light-brown, fine to medium, silty, clayey

County: GREGORY
Legal Location: SW SW SW SW sec. 23, T. 096 N., R. 71 W.
Latitude: 43.0642
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: P. HAMMOND
Date Drilled: 06-26-1990
Ground Surface Elevation: 2171 T
Total Drill Hole Depth: 74
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Casing Type: PVC, SCH. 80
Casing Top Elevation: 2172 T
Casing Stick-up: 1.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 096N-71W-23CCCC 1
Longitude: 99.1302
Driller's Log:
Geologist's Log:
Drilling Method: HOLLOWSTEM
Test Hole Number: R20-90-22
SDGS Well Name: R20-90-22
Aquifer: HERRICK
Screen Length: 10.0
Casing Diameter: 2.0
Total Casing and Screen: 75.0
Single Point Resistivity:
Extra:

Well Data: Screen interval from 74 to 64 feet; filter pack (native sediment) 74 to 21.5 feet; granular bentonite 21.5 to 18 feet; cement 18 to 0 feet; locking steel well protector installed. Casing and screen are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, yellow-brown, sandy
3	-	5	Sand, brown, medium to coarse, clayey
5	-	23	Sand, light-brown to brown, coarse, pebbly
23	-	29	Sand, brown, coarse, pebbly

29	-	34	Sand, brown, fine to coarse
34	-	40	Sand, brown, fine to medium
40	-	52	Sand, brown, fine to medium, somewhat silty and clayey
52	-	60	Sand, brown, fine to coarse, clayey
60	-	65	Sand and gravel, brown, medium sand to very fine pebble gravel
65	-	70	Sand and gravel, brown to gray, medium sand to very fine pebble gravel, somewhat clayey
70	-	73	Sand and gravel, gray, medium sand to very fine gravel
73	-	74	Clay

County: GREGORY
Location: 096N-71W-23CCCC 2
Legal Location: SW SW SW SW sec. 23, T. 096 N., R. 71 W.
Latitude: 43.0642
Longitude: 99.1302
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-26-1990
Drilling Method: HOLLOWSTEM
Ground Surface Elevation: 2171 T
Total Drill Hole Depth: 43
Test Hole Number: R20-90-23
Water Rights Well:
SDGS Well Name: R20-90-23
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Screen Length: 10.0
Casing Type: PVC, SCH. 80
Casing Diameter: 2.0
Casing Top Elevation: 2173 T
Casing Stick-up: 2.00
Total Casing and Screen: 42.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screen interval from 40 to 30 feet; filter pack (native sediment) 43 to 28 feet, (0.65 to 0.75 mm quartz sand) 28 to 25.5 feet; granular bentonite 25.5 to 19 feet; cement 19 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, yellow-brown, sandy
3	-	5	Sand and gravel, brown, medium sand to very fine gravel
5	-	20	Sand and gravel, brown, coarse sand to very fine gravel
20	-	23	Sand, light-brown, medium to coarse
23	-	36	Sand and gravel, brown, coarse sand to very fine gravel, clayey
36	-	43	Sand, brown, fine to medium, clayey

County: GREGORY
Location: 096N-71W-24AACB
Legal Location: NW SW NE NE sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0725
Longitude: 99.1100
Land Owner:

Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: P. HAMMOND
Date Drilled: 05-30-1991
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 57
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Casing Type: PVC, SCH. 40
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Driller's Log:
Geologist's Log: X
Drilling Method: ROTARY

Test Hole Number: R20-91-10
SDGS Well Name: R20-91-10

Aquifer: HERRICK

Screen Length: 5.0
Casing Diameter: 2.0

Total Casing and Screen: 55.0

Single Point Resistivity:
Extra:

Well Data: Screen interval from 53 to 48 feet; filter pack (0.65 - 0.75 mm quartz sand) 57 to 43 feet; granular bentonite and formation collapse 43 to 9 feet; cement 9 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. North well of two, deeper well of two.

0	-	2	Topsoil, silty, sandy
2	-	8	Sand, very fine to coarse; quartz-feldspar sand
8	-	40	Sand, very fine to very coarse; small amount of clay
40	-	50	Sand and gravel, fine sand to very fine pebble gravel; small amount of clay
50	-	55	Sand, fine to very coarse; white clay pieces present
55	-	57	Clay, brownish-yellow to gray (weathered shale)

County: GREGORY
Legal Location: NW SW NE NE sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0725
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: P. HAMMOND
Date Drilled: 06-03-1991
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 37
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Casing Type: PVC, SCH. 40
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Well Maintenance Date:

Location: 096N-71W-24AACB 1

Longitude: 99.1100

Driller's Log:
Geologist's Log: X
Drilling Method: ROTARY

Test Hole Number: R20-91-11
SDGS Well Name: R20-91-11

Aquifer: HERRICK

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 39.0

USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential: Single Point Resistivity:
Natural Gamma: Extra:
Samples:

Well Data: Screen interval from 37 to 27 feet; filter pack (0.65 - 0.75 mm quartz sand) 37 to 23 feet; bentonite pellets 23 to 16 feet; cement 16 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. South well of two, shallow well of two.

0	-	2	Topsoil, silty, sandy
2	-	6	Sand and gravel, very fine sand to very fine pebble gravel; quartz-feldspar sand and gravel
6	-	26	Sand, very fine to very coarse; some silty clay
26	-	37	Sand and gravel, fine sand to fine pebble gravel; small amount of clay

County: GREGORY Location: 096N-71W-24ABAA
Legal Location: NE NE NW NE sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0732 Longitude: 99.1102
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON Driller's Log:
Geologist: P. HAMMOND Geologist's Log: X
Date Drilled: 06-04-1991 Drilling Method: ROTARY
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 57 Test Hole Number: R20-91-14
Water Rights Well: SDGS Well Name: R20-91-14
Other Well Name:
Basin: PONCA Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN. Screen Length: 5.0
Casing Type: PVC, SCH. 40 Casing Diameter: 2.0
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00 Total Casing and Screen: 55.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential: Single Point Resistivity:
Natural Gamma: Extra:
Samples:

Well Data: Screen interval from 53 to 48 feet; filter pack (0.65 - 0.75 mm quartz sand) 57 to 40 feet; granular bentonite 40 to 10 feet; cement 10 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. West well of two, deeper well of two.

0	-	2	Topsoil, silty, sandy
2	-	18	Sand and gravel, very fine sand to fine pebble gravel; quartz-feldspar sand and gravel
18	-	25	Sand and gravel, very fine sand to very fine gravel; with some olive-green clay
25	-	52	Sand, very fine to coarse
52	-	53	Sandstone; hard, dendritic
53	-	57	Clay, yellow-brown to brown (weathered shale)

County: GREGORY
Location: 096N-71W-24ABAA 1
Legal Location: NE NE NW NE sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0732
Longitude: 99.1102
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-04-1991
Drilling Method: ROTARY
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 37
Test Hole Number: R20-91-15
Water Rights Well:
SDGS Well Name: R20-91-15
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Screen Length: 10.0
Casing Type: PVC, SCH. 40
Casing Diameter: 2.0
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Total Casing and Screen: 35.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screen interval from 33 to 23 feet; filter pack (0.65 - 0.75 mm quartz sand) 37 to 18 feet; bentonite pellets from 18 to 12 feet; cement 12 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. East well of two, shallow well of two.

0	-	2	Topsoil, silty, sandy
2	-	15	Sand, very fine to coarse; quartz-feldspar sand
15	-	25	Sand, very fine to very coarse; some greenish-brown, silty clay
25	-	37	Sand, greenish-brown, very fine to medium

County: GREGORY
Location: 096N-71W-24ABBD 1
Legal Location: SE NW NW NE sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0727
Longitude: 99.1110
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-25-1990
Drilling Method: HOLLOWSTEM
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 56
Test Hole Number: R20-90-18
Water Rights Well:
SDGS Well Name: R20-90-18
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Screen Length: 10.0
Casing Type: PVC, SCH. 80
Casing Diameter: 2.0

Casing Top Elevation: 2162 T
Casing Stick-up: 2.00 Total Casing and Screen: 55.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential: Single Point Resistivity:
Natural Gamma: Extra:
Samples:

Well Data: Screen interval from 53 to 43 feet; filter pack (native sediment) 56 to 18 feet; granular bentonite 18 to 16 feet; cement 16 to 0 feet; locking steel well protector installed. Casing and screen are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, tan, silty
3	-	15	Sand, light-brown, medium to coarse
15	-	19	Sand, light-brown, medium to coarse; some pebbles
19	-	54	Sand, brown, fine to medium
54	-	55	Sand, brown, fine to coarse; some small gravel
55	-	56	Clay, gray

County: GREGORY Location: 096N-71W-24ABBD 2
Legal Location: SE NW NW NE sec. 24, T. 096 N., R. 71 W.
Latitude: 44.0727 Longitude: 99.1110
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON Driller's Log:
Geologist: P. HAMMOND Geologist's Log: X
Date Drilled: 06-25-1990 Drilling Method: HOLLOWSTEM
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 28 Test Hole Number: R20-90-19
Water Rights Well: SDGS Well Name: R20-90-19
Other Well Name:
Basin: PONCA Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH Screen Length: 10.0
Casing Type: PVC, SCH. 80 Casing Diameter: 2.0
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00 Total Casing and Screen: 30.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential: Single Point Resistivity:
Natural Gamma: Extra:
Samples:

Well Data: Screen interval from 28 to 18 feet; filter pack (native sediment) 28 to 14.5 feet; granular bentonite 14.5 to 11 feet; cement 11 to 0 feet; locking steel well protector installed. Casing and screen are flush threaded.

0	-	1	Topsoil, black
1	-	2	Clay, tan, silty

2	-	3	Sand, brown, medium to coarse; small pebbles
3	-	15	Sand, light-brown, medium to coarse
15	-	17	Sand, light-brown, medium to coarse; some pebbles
17	-	20	Sand, brown, medium to coarse, clayey; small rocks present
20	-	28	Sand, brown, fine to medium

County: GREGORY
Location: 096N-71W-24ABCC
Legal Location: SW SW NW NE sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0721
Longitude: 99.1116
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: M. THOMPSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 05-29-1991
Drilling Method: ROTARY
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 38
Test Hole Number: R20-91-09
Water Rights Well:
SDGS Well Name: R20-91-09
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Screen Length: 10.0
Casing Type: PVC, SCH. 40
Casing Diameter: 2.0
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Total Casing and Screen: 40.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screen interval from 38 to 28 feet; filter pack (0.65 - 0.75 mm quartz sand) 40 to 19 feet; granular bentonite 19 to 16 feet; cement 16 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. North well of two, shallow well of two.

0	-	2	Topsoil, sandy, silty
2	-	10	Sand, fine to very coarse; some brown clay; quartz-feldspar sand
10	-	20	Sand and gravel, fine sand to medium pebble gravel; some brown clay
20	-	30	Sand, fine to very coarse
30	-	40	Sand and gravel, fine sand to very fine pebble gravel

County: GREGORY
Location: 096N-71W-24ABCC 1
Legal Location: SW SW NW NE sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0721
Longitude: 99.1116
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-05-1991
Drilling Method: ROTARY
Ground Surface Elevation: 2160 T

Total Drill Hole Depth: 62
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Casing Type: PVC, SCH. 40
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Test Hole Number: R20-91-18
SDGS Well Name: R20-91-18

Aquifer: HERRICK

Screen Length: 5.0
Casing Diameter: 2.0

Total Casing and Screen: 60.0

Single Point Resistivity:
Extra:

Well Data: Screen interval from 58 to 53 feet; filter pack (0.65 - 0.75 mm quartz sand) 62 to 48 feet; granular bentonite 48 to 20 feet; cement 20 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. South well of two, deeper well of two.

0	-	2	Topsoil, silty, sandy
2	-	25	Sand, dark-brown, fine to very coarse; quartz-feldspar sand
25	-	59	Sand and gravel, very fine sand to fine gravel
59	-	60	Clay, white to very light-brown, silty
60	-	62	Clay, yellow-brown (weathered shale)

County: GREGORY
Legal Location: NE NE NE NW sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0732
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: P. HAMMOND
Date Drilled: 06-04-1991
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 67
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Casing Type: PVC, SCH. 40
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 096N-71W-24BAAA

Longitude: 99.1117

Driller's Log:
Geologist's Log: X
Drilling Method: ROTARY

Test Hole Number: R20-91-16
SDGS Well Name: R20-91-16

Aquifer: HERRICK

Screen Length: 5.0
Casing Diameter: 2.0

Total Casing and Screen: 60.0

Single Point Resistivity:
Extra:

Well Data: Screen interval from 58 to 53 feet; filter pack (0.65 - 0.75 mm quartz sand) 67 to 44 feet; granular bentonite 44 to 20 feet; cement 20 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. East well of two, deeper well of two.

0	-	2	Topsoil, black, silty
2	-	18	Sand and gravel, dark-brown, very fine sand to very fine pebble gravel; quartz-feldspar sand and gravel
18	-	45	Sand and gravel, light-brown, very fine sand to medium pebble gravel; some yellow-brown, silty clay
45	-	62	Sand, very fine to coarse; with some olive-green clay and claystone
62	-	64	Sandstone, white; hard, with dendritic features
64	-	67	Clay, yellow-brown to brown (weathered shale)

County: GREGORY
Location: 096N-71W-24BAAA 1
Legal Location: NE NE NE NW sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0732
Longitude: 99.1117
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-05-1991 Drilling Method: ROTARY
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 40
Test Hole Number: R20-91-17
Water Rights Well:
SDGS Well Name: R20-91-17
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Screen Length: 10.0
Casing Type: PVC, SCH. 40
Casing Diameter: 2.0
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Total Casing and Screen: 40.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screen interval from 38 to 28 feet; filter pack (0.65 - 0.75 mm quartz sand) 40 to 21 feet; bentonite pellets 21 to 17 feet; cement 17 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. West well of two, shallow well of two.

0	-	2	Topsoil, black, silty
2	-	18	Sand and gravel, dark-brown, very fine sand to fine pebble gravel; quartz-feldspar sand
18	-	26	Sand and gravel, light-brown, very fine sand to fine pebble gravel; some light-brown, silty clay
26	-	40	Sand and gravel, very fine sand to very fine pebble gravel; some silty, sandy, clay

County: GREGORY
Location: 096N-71W-24BABA
Legal Location: NE NW NE NW sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0731
Longitude: 99.1127

Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: P. HAMMOND
Date Drilled: 06-03-1991
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 63
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Casing Type: PVC, SCH. 40
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Driller's Log:
Geologist's Log: X
Drilling Method: ROTARY

Test Hole Number: R20-91-12
SDGS Well Name: R20-91-12

Aquifer: HERRICK

Screen Length: 5.0
Casing Diameter: 2.0

Total Casing and Screen: 60.0

Single Point Resistivity:
Extra:

Well Data: Screen interval from 58 to 53 feet; filter pack (0.65 - 0.75 mm quartz sand) 63 to 45 feet; bentonite slurry 45 to 12 feet; cement 12 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. East well of two, deeper well of two.

0	-	2	Topsoil, silty, sandy
2	-	19	Sand, very fine to very coarse; quartz-feldspar
19	-	28	Sand and gravel, fine sand to very fine pebble gravel; some light-brown, sandy clay
28	-	61	Sand, very fine to very coarse; with some brown to olive, sandy, silty clay
61	-	63	Clay, light-brown to greenish (weathered shale)

County: GREGORY
Legal Location: NE NW NE NW sec. 24, T. 096 N., R. 71 W.
Latitude: 43.0731
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: P. HAMMOND
Date Drilled: 06-04-1991
Ground Surface Elevation: 2160 T
Total Drill Hole Depth: 35
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.010 IN.
Casing Type: PVC, SCH. 40
Casing Top Elevation: 2162 T
Casing Stick-up: 2.00
Well Maintenance Date:

Location: 096N-71W-24BABA 1

Longitude: 99.1127

Driller's Log:
Geologist's Log: X
Drilling Method: ROTARY

Test Hole Number: R20-91-13
SDGS Well Name: R20-91-13

Aquifer: HERRICK

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 35.0

USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Single Point Resistivity:
Extra:

Well Data: Screen interval from 33 to 23 feet; filter pack (0.65 - 0.75 mm quartz sand) 35 to 20 feet; bentonite pellets 20 to 12 feet; cement 12 to 0 feet; locking steel well protector installed. Screen and casing are flush threaded. West well of two, shallow well of two.

0	-	2	Topsoil, silty, sandy
2	-	35	Sand and gravel, very fine sand to very fine pebble gravel; some brown, silty, sandy clay

County: GREGORY
Legal Location: NE NE NE NW sec. 35, T. 096 N., R. 71 W.
Latitude: 43.0548
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: P. HAMMOND
Date Drilled: 06-26-1990
Ground Surface Elevation: 2164 T
Total Drill Hole Depth: 75
Water Rights Well:
Other Well Name:
Basin: PONCA
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Casing Type: PVC, SCH. 80
Casing Top Elevation: 2166 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 096N-71W-35BAAA 1

Longitude: 99.1229

Driller's Log:
Geologist's Log: X
Drilling Method: HOLLOWSTEM

Test Hole Number: R20-90-24
SDGS Well Name: R20-90-24

Aquifer: HERRICK

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 75.0

Single Point Resistivity:
Extra:

Well Data: Screen interval from 73 to 63 feet; filter pack (native sediment) 75 to 40 feet; granular bentonite 40 to 20 feet; cement 20 to 0.5 feet; locking steel well protector installed. Casing and screen are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, yellow-brown, silty
3	-	6	Sand and gravel, brown, medium sand to very fine gravel
6	-	18	Sand and gravel, light-brown, medium sand to very fine gravel
18	-	22	Sand and gravel, light-brown to brown medium sand to very fine gravel, some medium gravel
22	-	27	Sand, brown-to yellow-brown, medium to coarse; some clay
27	-	31	Sand, yellow-brown, medium to coarse; some pebbles
31	-	33	Sand, brown, medium to coarse, somewhat clayey; some pebbles
33	-	45	Sand, brown, medium to coarse, clayey, silty

45	-	49	Clay, brownish-yellow, very sandy, silty
49	-	65	Sand, brown, fine to medium
65	-	74	Sand, brown, fine to medium, slightly clayey
74	-	75	Clay, gray

County: GREGORY
Location: 096N-71W-35BAAA 2
Legal Location: NE NE NE NW sec. 35, T. 096 N., R. 71 W.
Latitude: 43.0548
Longitude: 99.1229
Land Owner:
Project: HERRICK CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Driller's Log:
Geologist: P. HAMMOND
Geologist's Log: X
Date Drilled: 06-27-1990
Drilling Method: HOLLOWSTEM
Ground Surface Elevation: 2164 T
Total Drill Hole Depth: 33
Test Hole Number: R20-90-25
Water Rights Well:
SDGS Well Name: R20-90-25
Other Well Name:
Basin: PONCA
Aquifer: HERRICK
Management Unit:
Screen Type: PVC, MFG., SLOT SIZE 0.02 INCH
Screen Length: 10.0
Casing Type: PVC, SCH. 80
Casing Diameter: 2.0
Casing Top Elevation: 2166 T
Casing Stick-up: 2.00
Total Casing and Screen: 35.0
Well Maintenance Date:
USGS Hydrological Unit Code: 10150001
Electric Log Information:
Spontaneous Potential:
Single Point Resistivity:
Natural Gamma:
Extra:
Samples:

Well Data: Screen interval from 33 to 23 feet; filter pack (native sediment) 33 to 22 feet, (0.65 - 0.75 mm quartz sand) 22 to 20 feet; granular bentonite 20 to 16 feet; cement 16 to 0.5 feet; locking steel well protector installed. Screen and casing are flush threaded.

0	-	1	Topsoil, black
1	-	3	Clay, yellow-brown, silty
3	-	6	Sand and gravel, red-brown, medium sand to very fine gravel
6	-	20	Sand and gravel, brown to light-brown, medium sand to very fine gravel
20	-	23	Sand and gravel, light-brown to white, medium sand to very fine gravel
23	-	27	Sand and gravel, brown, medium sand to very fine gravel
27	-	31	Sand and gravel, yellow-brown, medium sand to very fine gravel
31	-	33	Sand, dark-brown, medium to coarse, clayey