

STATE OF SOUTH DAKOTA
George A. Mickelson, Governor

DEPARTMENT OF WATER AND NATURAL RESOURCES
John J. Smith, Secretary

DIVISION OF GEOLOGICAL SURVEY
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Open-File Report 52-UR

GROUND-WATER STUDY FOR THE CITY OF
HOVEN, SOUTH DAKOTA

by

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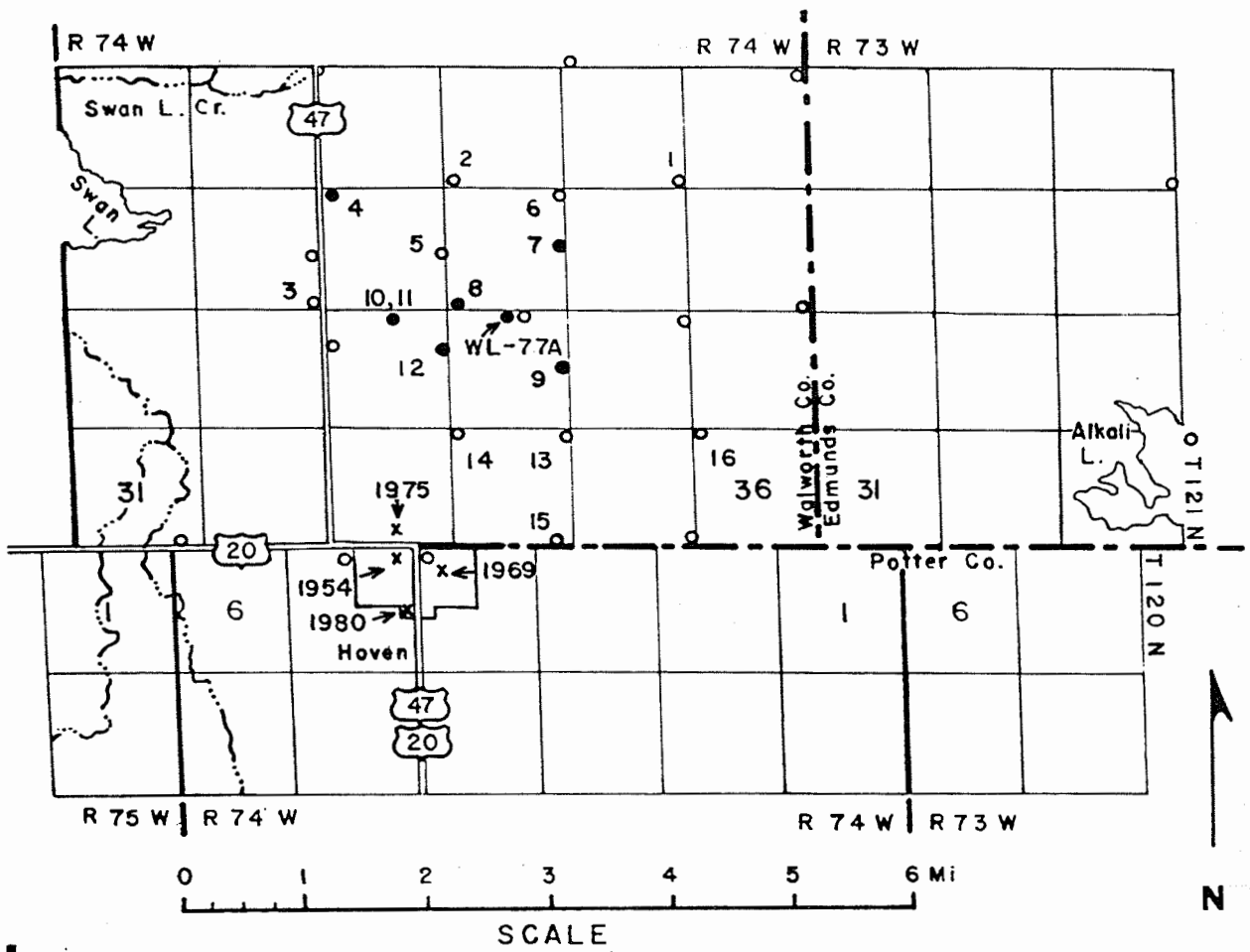
INTRODUCTION

This report contains the results of a ground-water investigation, conducted by the South Dakota Geological Survey, for the city of Hoven, Walworth County, South Dakota. Field work was conducted from May 27 to June 3, 1983, and on June 18 and 19, 1984. The investigation included the drilling of 16 rotary test holes at map locations (ML) 1 through 16 (fig. 1); the construction of six observation wells at ML 4, 7, 8, 9, 11 and 12 (fig. 1); and the collection and analysis of 10 water samples at ML 4, 7, 8, 9, 11, 12 and WL-77A. The investigation was financed by the South Dakota Geological Survey, the Oahe Conservancy Sub-District, and the city of Hoven.

BACKGROUND INFORMATION

Previous to this investigation, Hoven obtained its water from four wells (fig. 1), tapping the surficial Bowdle aquifer (fig. 2). The city has water rights for 1.11 cubic feet per second (cfs) or about 498 gallons per minute total from the Bowdle aquifer. The city felt that future needs may exceed these water rights, and therefore, asked the South Dakota Geological Survey to locate an additional source of good quality drinking water in the vicinity of Hoven.

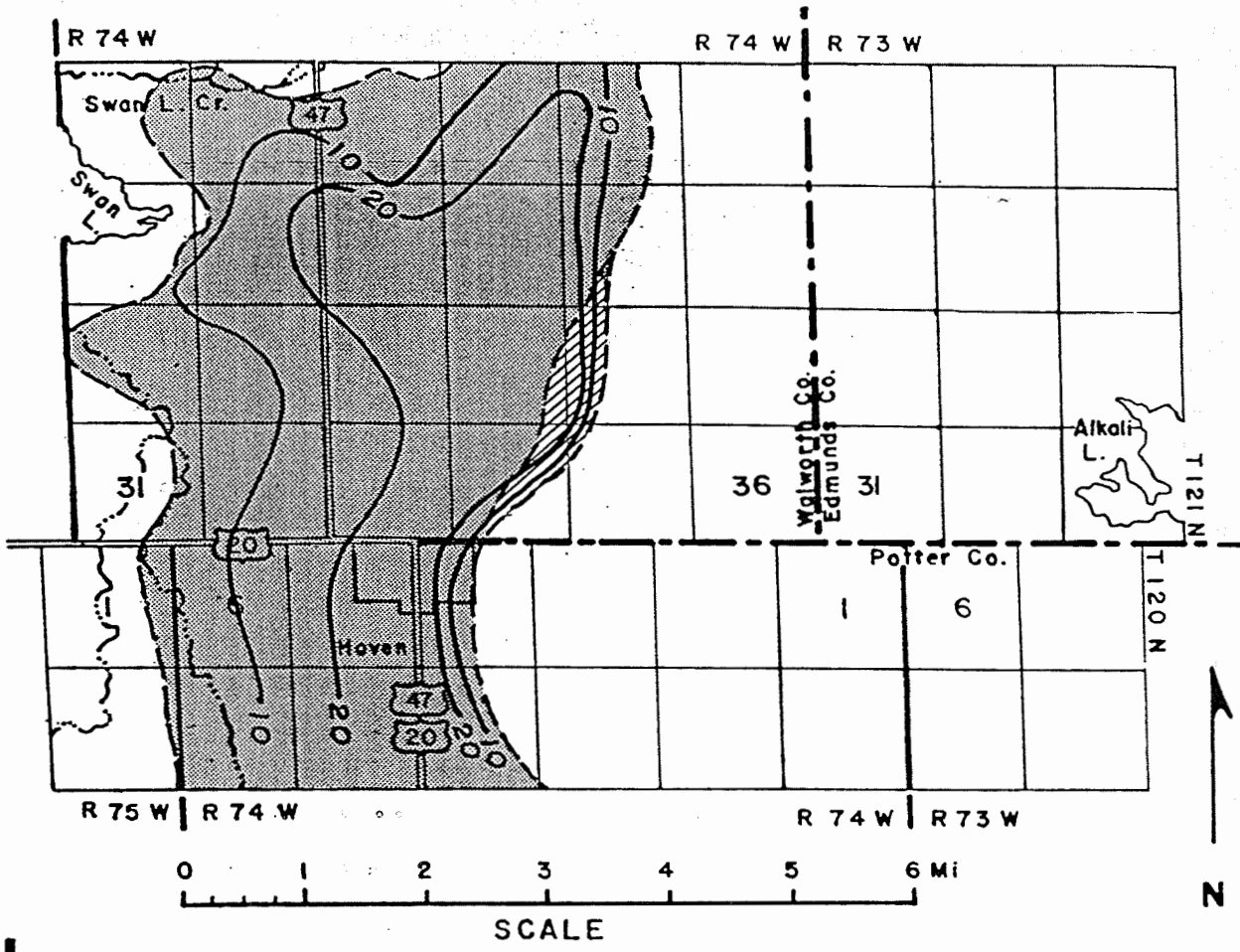
The prime target of the investigation was the deeper, buried, Onaka aquifer (Hedges and others, 1982) and the characterization of its extent, thickness and water quality (fig. 3). A well inventory conducted in 1975 by the U.S. Geological Survey for the Walworth County Study showed that virtually all the private wells located within the extent of the Bowdle aquifer (fig. 2) utilized that aquifer. The Walworth County Study also included an extensive test drilling program designed to study the geology (Hedges, 1987) and water resources (Kume and Howells, 1987) of the County. Several of the test holes drilled in the study area of this investigation encountered a buried aquifer. Kume (1979) refers to this aquifer as part of the Java aquifer, but later refers to it as a minor aquifer separate from the Java aquifer (Kume and





1980 x Hoven City Well - number is date installed.


- 4 • Observation Well
- 6 ○ Test Hole
- Those with numbers are listed in Appendix A by map location (ML) number. Logs of others are on file at the South Dakota Geological Survey.

Figure 1. Data Map.



- 

Line of equal saturated thickness (modified from Kume, 1979). Contour Interval = 10 feet.
- 

Approximate boundary of Bowdle aquifer (Kume, 1979).
- 

Buried segment of the Bowdle aquifer.

Figure 2. Saturated thickness and extent of the Bowdle aquifer in the study area.

Howells, 1987). Hedges and others (1982), however, have named this aquifer the Onaka aquifer, the name used in this report.

In May of 1977, the South Dakota Geological Survey installed an observation well (WL-77A) (fig. 1) in the Onaka aquifer. The Division of Water Rights, Department of Water and Natural Resources in Pierre, South Dakota, has monitored the well since that time. Water-quality data collected from well WL-77A show that water in the well is of generally good quality and comparable to the present city drinking water.

RESULTS OF INVESTIGATION

A test-drilling program was undertaken in the vicinity of observation well WL-77A to delineate the thickness and extent of the Onaka aquifer, and its proximity to the city. Figure 3 shows the results of the test drilling program.

The Onaka aquifer, approximately a mile in width and trending in an east-west direction, meanders to a point about a mile and a half north of Hoven. The aquifer thickens from north to south in the study area (fig. 3) reaching a maximum of 38 feet encountered in a test hole located in the NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 27, T. 121 N., R. 74 W. (Hedges, 1987).

Five additional wells were installed in the Onaka aquifer at ML 4, 7, 8, 11 and 12 (fig. 1). The observation wells were pumped with air and water samples were obtained to assess the overall water quality of the aquifer. Water-quality data for observation wells installed for this investigation, observation well WL-77A, and the city wells are listed in table 1.

In the study area, the Onaka aquifer lies, on the average, about 100 feet below land surface and averages about 20 feet in thickness. Depths to water ranged from about 7 feet in the observation well at ML 4 to about 37 feet in observation well WL-77A (June 19, 1984). These water levels indicate that the Onaka aquifer is under confined (artesian) conditions. The aquifer is bounded above and below by impermeable material and the ground water is under pressure which causes it to rise above the top of the aquifer in observation wells.

TABLE 1. Water Quality

(1) Chemical Constituents -- Parts per million																			
Well ID (2)	Location (3)	SDGS Lab ID (4)	Date Sampled	Depth Well (ft) (5)	Conductivity (mmhos) (6)	TDS	Hardness as CaCO ₃	Fe	Mn	SO ₄	NO ₃ -N	Na	Ca	Mg	K	Cl	F	HCO ₃	
OWAKA AQUIFER																			
ML4	121N-74W-2188BA	HVC-84-005	06/18/84	83	758	474	124	<0.05	0.60	102	<0.2	135	30	12	7.5	14	<0.06	362	
ML7	121N-74W-22ADDD	HVC-84-006	06/19/84	125	1051	804	363	1.36	1.76	278	<0.2	130	90	34	9.6	8	<0.06	408	
ML8	121N-74W-22CCCC	HVC-83-003	06/03/83	140	1308	868	155	0.09	0.90	210	<0.49	246	39	14	9.6	24	0.39	451	
ML8	121N-74W-22CCCC	HVC-84-008	06/19/84	140	1296	838	145	0.05	0.92	232	<0.2	255	35	14	10.0	21	0.35	484	
ML11	121N-74W-28ABBB2	HVC-84-007	06/19/84	123	1191	745	108	<0.05	0.77	176	<0.2	252	27	10	8.6	52	0.30	489	
ML12	121N-74W-28ADAD	HVC-83-004	06/03/83	135	1011	678	238	0.11	1.16	168	<0.49	141	66	18	8.6	11	0.30	390	
ML12	121N-74W-28ADAD	HVC-84-009	06/19/84	135	966	642	199	<0.05	1.34	162	<0.2	155	52	17	10.4	9	0.22	435	
ML-77A	121N-74W-27BAAB2	HVC-83-002	06/03/83	146	1222	820	233	0.19	1.25	269	<0.49	195	59	21	9.7	16	0.33	414	
ML-77A	121N-74W-27BAAB2	HVC-84-010	06/19/84	146	1104	738	274	<0.05	1.41	258	<0.2	187	77	20	10.3	15	<0.06	463	
BOULE AQUIFER																			
ML9	121N-74W-27ADDD	HVC-83-001	06/03/83	78	1060	748	406	0.04	1.32	210	<0.49	89	115	29	10.4	6	0.32	414	
City Wells																			
1980	120N-74W- 5ADD	-----	07/19/82	46	909	646	409	----	----	154	<0.2	40	114	30	7.1	39	----	309	
1969	120N-74W- 48BD	-----	04/28/76	65	-----	760	504	<0.1	1.4	199	2.8	58	141	37	8.0	18	3.2	445	
1954	120N-74W- 5AAB	-----	07/19/82	44	1010	765	474	<0.1	1.6	202	1.4	46	136	33	8.0	44	1.9	349	
1975	121N-74W-330CB	-----	07/21/76	46	-----	570	349	<0.1	1.5	132	<1.0	50	97	26	7.0	28	<0.05	378	
EPA LIMITS																			
						500	500	0.3	0.05	250	10					250	2.4		
						(7)	(7)	(7)	(7)	(7)	(8)					(7)	(8)		

(1): TDS - total dissolved solids; Fe - iron; Mn - manganese; SO₄ - sulfate; NO₃-N - nitrate-nitrogen; Na - sodium; Ca - calcium; Mg - magnesium; K - potassium; Cl - chloride; F - fluoride; HCO₃ - bicarbonate.
 (2): Map location (ML) number - corresponds to number on figure 1 and in appendix A.
 (3): See appendix A for explanation of location format.
 (4): South Dakota Geological Survey Chemistry Laboratory identification number.
 (5): Well depth is presented in feet below land surface.
 (6): mmhos - micromhos.
 (7): EPA recommended limits (U.S. Environmental Protection Agency, 1985b).
 (8): EPA enforceable limits (U.S. Environmental Protection Agency, 1985a).
 Samples collected from observation wells were air lifted.
 Data for Hoven City wells were obtained from the Division of Water Rights, Department of Water and Natural Resources, Pierre, South Dakota.

Water-quality data (table 1) show that the water from the Onaka aquifer is of generally good quality and comparable in quality to the water from the Bowdle aquifer. Concentrations of calcium and magnesium, and thus hardness, are lower in the Onaka aquifer, with concentrations of sodium somewhat higher than the Bowdle aquifer. Both the Bowdle and the Onaka aquifers, however, have water containing high concentrations of manganese, exceeding the recommended Environmental Protection Agency (EPA) limit of 0.05 parts per million (ppm).

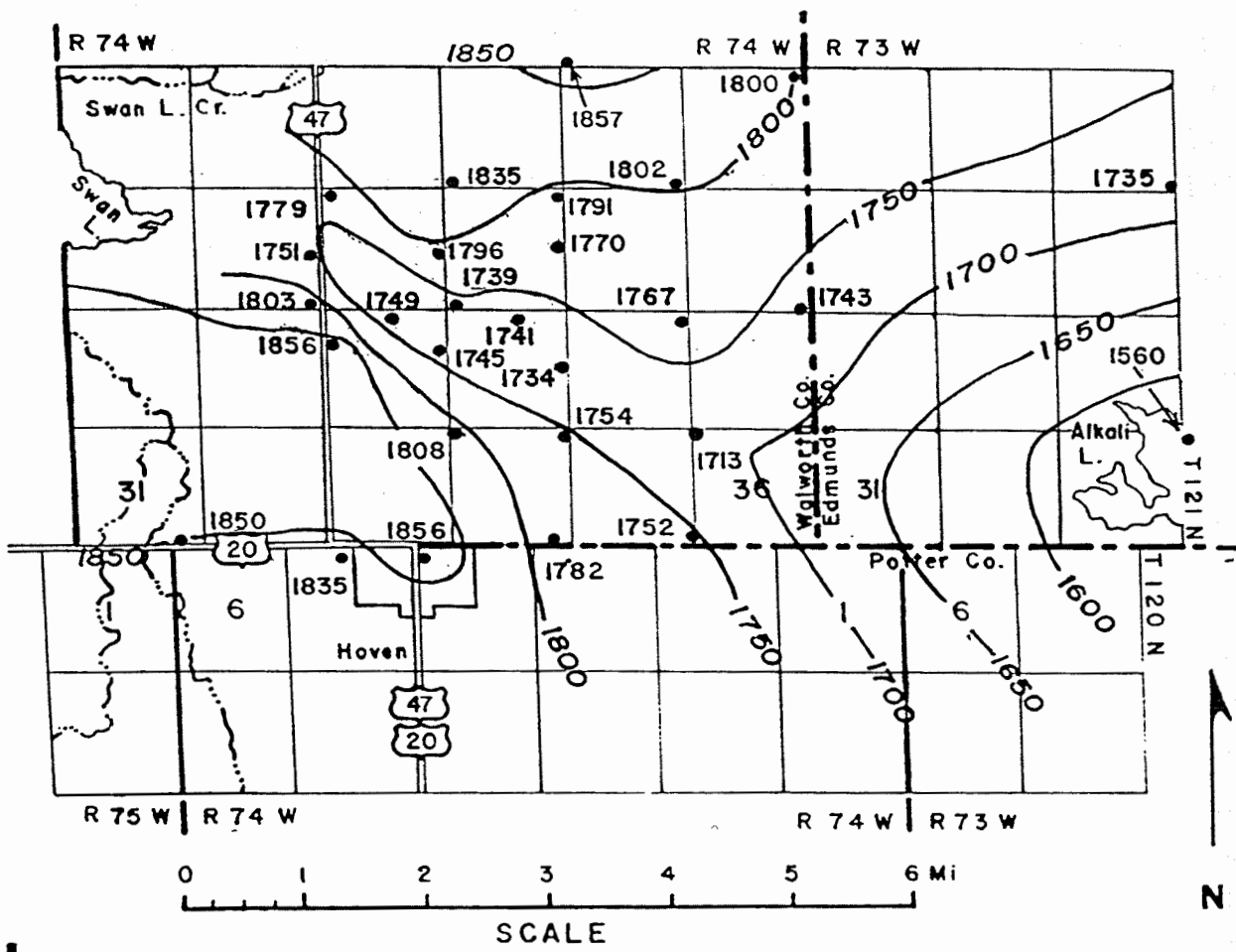
As a result of test drilling, it was also found that the Bowdle aquifer extends eastward, from the flat lands, beneath the hills of glacial till (fig. 2). Test holes at ML 9 and 13 encountered 32 feet and 28 feet of aquifer material, respectively. An observation well was installed in the test hole at ML 9. A water-level measurement taken in the well at ML 9 on June 6, 1983, shows the water level to be just below the top of the aquifer material (approximately 46 feet below land surface). Water-quality data show that water taken from the well at ML 9 has chemical constituents at concentrations similar to those of the Bowdle aquifer (table 1). These data support the interpretation that this is a buried portion of the surficial Bowdle aquifer.

As a result of this investigation, a better representation of the bedrock surface in the study area was obtained. Figure 4 shows the elevation of the bedrock surface above mean sea level. Bedrock in the study area is the Pierre Shale, a dark-gray to black shale. The Onaka and Bowdle aquifers are made up of glacially derived deposits of sand and gravel and lie above the bedrock surface.

RECOMMENDATIONS

From the data gathered during this investigation, it appears that the Onaka aquifer is a suitable source of additional drinking water for the city of Hoven.

To reserve a future supply of water, the city of Hoven should submit a future use application to the Division of Water Rights,



1802 ●

Data point - number is the elevation of the bedrock surface in feet above mean sea level.

1800

Line of equal bedrock surface elevation. Contour Interval = 50 feet.

Figure 4. Bedrock (Pierre Shale) surface contour map.

South Dakota Department of Water and Natural Resources, whose report would then be subject to approval by the Water Management Board.

If, in the future, this source is to be utilized, it is recommended that the area indicated in figure 3 be chosen for the location of an aquifer test. Concurrent with the planning of the aquifer test, the city should contact the Division of Water Rights, South Dakota Department of Water and Natural Resources about securing a water-right permit. The city should then hire a private company to drill a production well and any necessary observation wells, and conduct an aquifer test. If requested by the city, the South Dakota Geological Survey would help with the aquifer test and analyze the data. At least one water sample should be taken during the aquifer test and sent to the Office of Water Quality, Department of Water and Natural Resources, Pierre, South Dakota, to determine the biological and chemical suitability of the water.

REFERENCES

- Hedges, L. S., 1987, Geology of Walworth County, South Dakota: South Dakota Geological Survey Bulletin 30, 33 p.
- Hedges, L. S., Burch, S. L., Iles, D. L., Barari, R. A., and Schoon, R. A., 1982, Evaluation of groundwater resources, eastern South Dakota and upper Big Sioux River, South Dakota and Iowa; Tasks 1, 2, 3 and 4: Prepared by the South Dakota Geological Survey for the U.S. Army Corps of Engineers, Contract DACW45-80-C-0185.
- Kume, J., 1979, Aquifers in Walworth County, South Dakota: South Dakota Geological Survey Information Pamphlet 18, 4 p.
- Kume, J., and Howells, L., 1987, Water resources of Walworth County, South Dakota: U.S. Geological Survey Water-Resources Investigations Report 85-4015, 70 p.
- Schroeder, W., 1978, Sand and gravel resources in Walworth County, South Dakota: South Dakota Geological Survey Information Pamphlet 17, 29 p.

U.S. Environmental Protection Agency, 1985a, National interim primary drinking water standards - maximum contaminant levels for inorganic chemicals: Code of Federal Regulations, Title 40, Part 141, Section 141.11, p. 523-524.

_____ 1985b, National secondary drinking water regulations - secondary maximum contaminant levels: Code of Federal Regulations, Title 40, Part 143, Section 143.3, p. 584.

APPENDIX A

Logs of test holes and observation wells drilled for this investigation

MAP LOCATION (ML)

A number which is assigned to the log according to the order in which it is listed (see **LEGAL LOCATION and LOCATION**). This number corresponds to the numbers shown on figure 1.

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 **LEGAL LOCATION and LOCATION** is as follows. A **LEGAL LOCATION** of SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 28, T. 121 N., R. 74 W. is the same as a **LOCATION** of 121N-74W-28ADAD.

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 and SCREEN LENGTH

The numbers are presented in feet.

SCREEN TYPE and CASING TYPE

PVC - polyvinyl chloride

CASING TOP ELEVATION and GROUND SURFACE ELEVATION

The numbers are presented in feet above mean sea level. The elevations were estimated from topographic maps.

CASING DIAMETER

The numbers are presented in inches.

COUNTY: WALWORTH LOCATION: 121N-74W-14DDDD
MAP LOCATION: 1
LEGAL LOCATION: SE SE SE SE SEC. 14, T. 121 N., R. 74 W.
LATITUDE: 45.1722 LONGITUDE: 99.4348
LAND OWNER:
PROJECT: HOVEN CITY STUDY
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT DRILLER'S LOG:
GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
DATE DRILLED: 06-02-1983 DRILLING METHOD: ROTARY
GROUND SURFACE ELEVATION: 1894.00 T
TOTAL DRILL HOLE DEPTH: 110.0 TEST HOLE NUMBER: R2-83-30
USGS HYDROLOGICAL UNIT CODE: 10130106
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

0	-	2.0	CLAY, BROWN, SILTY; OXIDIZED (TOPSOIL)
2.0	-	17.0	SAND AND GRAVEL, BROWN; OXIDIZED, GRADES FROM A COARSE SAND TO A COARSE GRAVEL
17.0	-	25.0	SILT, GRAY, CLAYEY, SANDY; UNOXIDIZED
25.0	-	30.0	SAND AND GRAVEL, BROWN; OXIDIZED, GRADES FROM A COARSE SAND TO A COARSE GRAVEL
30.0	-	90.0	CLAY, GRAY, VERY SHALEY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
90.0	-	92.0	SAND AND GRAVEL, GRAY; UNOXIDIZED, GRADES FROM A FINE SAND TO A MEDIUM GRAVEL
92.0	-	110.0	SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD, GREASY (PIERRE SHALE)

* * * *

COUNTY: WALWORTH LOCATION: 121N-74W-15CCCC 2
MAP LOCATION: 2
LEGAL LOCATION: SW SW SW SW SEC. 15, T. 121 N., R. 74 W.
LATITUDE: 45.1723 LONGITUDE: 99.4608
LAND OWNER:
PROJECT: HOVEN CITY STUDY
DRILLING COMPANY: SDGS
DRILLER: M. THOMPSON DRILLER'S LOG:
GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
DATE DRILLED: 05-31-1983 DRILLING METHOD: ROTARY
GROUND SURFACE ELEVATION: 1890.00 T
TOTAL DRILL HOLE DEPTH: 95.0 TEST HOLE NUMBER: R2-83-24
USGS HYDROLOGICAL UNIT CODE: 10130105
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

0	-	1.0	CLAY, BLACK, SILTY (TOPSOIL)
1.0	-	32.0	GRAVEL, BROWN, FINE TO MEDIUM, SANDY; OXIDIZED

32.0 - 48.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 48.0 - 54.0 GRAVEL, BROWN, FINE, SANDY; OXIDIZED
 54.0 - 55.0 CLAY, YELLOWISH-WHITE, SILTY
 55.0 - 95.0 SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD,
 GREASY (PIERRE SHALE)

* * * *

COUNTY: WALWORTH LOCATION: 121N-74W-20DDDD
 MAP LOCATION: 3
 LEGAL LOCATION: SE SE SE SE SEC. 20, T. 121 N., R. 74 W.
 LATITUDE: 45.1632 LONGITUDE: 99.4726
 LAND OWNER:
 PROJECT: HOVEN CITY STUDY
 DRILLING COMPANY: SDGS
 DRILLER: M. JARRETT DRILLER'S LOG:
 GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
 DATE DRILLED: 06-01-1983 DRILLING METHOD: ROTARY
 GROUND SURFACE ELEVATION: 1872.00 T
 TOTAL DRILL HOLE DEPTH: 95.0 TEST HOLE NUMBER: R2-83-25
 USGS HYDROLOGICAL UNIT CODE: 10130105
 ELECTRIC LOG INFORMATION:
 SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
 NATURAL GAMMA: EXTRA:
 SAMPLES:

0 - 2.0 CLAY, BLACK, SILTY (TOPSOIL)
 2.0 - 19.0 SAND AND GRAVEL, BROWN; OXIDIZED, GRADES
 FROM A MEDIUM SAND TO A MEDIUM GRAVEL
 19.0 - 24.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 24.0 - 31.0 SAND AND GRAVEL, BROWN; OXIDIZED, GRADES
 FROM A MEDIUM SAND TO A COARSE GRAVEL
 31.0 - 55.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 55.0 - 69.0 SAND AND GRAVEL, BROWN; OXIDIZED, GRADES
 FROM A COARSE SAND TO A MEDIUM GRAVEL
 69.0 - 95.0 SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD,
 GREASY (PIERRE SHALE)

* * * *

COUNTY: WALWORTH LOCATION: 121N-74W-21BBBA
 MAP LOCATION: 4
 LEGAL LOCATION: NE NW NW NW SEC. 21, T. 121 N., R. 74 W.
 LATITUDE: 45.1721 LONGITUDE: 99.4719
 LAND OWNER:
 PROJECT: HOVEN CITY STUDY
 DRILLING COMPANY: SDGS
 DRILLER: M. JARRETT DRILLER'S LOG:
 GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
 DATE DRILLED: 06-01-1983 DRILLING METHOD: ROTARY
 GROUND SURFACE ELEVATION: 1865.00 T

TOTAL DRILL HOLE DEPTH: 110.0 TEST HOLE NUMBER: R2-83-27
 WATER RIGHTS WELL: SDGS WELL NAME: R2-83-27
 OTHER WELL NAME:
 BASIN: MISSOURI AQUIFER: ONAKA
 MANAGEMENT UNIT:
 SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 5.0
 CASING TYPE: PVC CASING DIAMETER: 2.0
 CASING TOP ELEVATION: 1867.00 T
 CASING STICK-UP: 1.60 TOTAL CASING AND SCREEN: 83.0
 WELL MAINTENANCE DATE:
 USGS HYDROLOGICAL UNIT CODE: 10130105
 ELECTRIC LOG INFORMATION:
 SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
 NATURAL GAMMA: EXTRA:
 SAMPLES:

DEPTH TO WATER APPROXIMATELY 7 FEET.

0	-	3.0	CLAY, BLACK, SILTY (TOPSOIL)
3.0	-	13.0	SAND AND GRAVEL, REDDISH-BROWN; OXIDIZED, GRADES FROM A COARSE SAND TO A COARSE GRAVEL
13.0	-	31.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
31.0	-	39.0	SAND AND GRAVEL, BROWN; OXIDIZED, GRADES FROM A MEDIUM SAND TO A MEDIUM GRAVEL
39.0	-	68.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
68.0	-	81.0	GRAVEL, BROWN, MEDIUM TO COARSE; OXIDIZED
81.0	-	86.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
86.0	-	110.0	SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD, GREASY (PIERRE SHALE)

* * * *

COUNTY: WALWORTH LOCATION: 121N-74W-21DAAA
 MAP LOCATION: 5
 LEGAL LOCATION: NE NE NE SE SEC. 21, T. 121 N., R. 74 W.
 LATITUDE: 45.1654 LONGITUDE: 99.4612
 LAND OWNER:
 PROJECT: HOVEN CITY STUDY
 DRILLING COMPANY: SDGS
 DRILLER: M. THOMPSON DRILLER'S LOG:
 GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
 DATE DRILLED: 06-02-1983 DRILLING METHOD: ROTARY
 GROUND SURFACE ELEVATION: 1882.00 T
 TOTAL DRILL HOLE DEPTH: 110.0 TEST HOLE NUMBER: R2-83-34
 USGS HYDROLOGICAL UNIT CODE: 10130105
 ELECTRIC LOG INFORMATION:
 SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
 NATURAL GAMMA: EXTRA:
 SAMPLES:

0 - 41.0 SAND AND GRAVEL, BROWN; OXIDIZED, GRADES
 FROM A COARSE SAND TO A COARSE GRAVEL
 41.0 - 121.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED, SMALL GRAVEL LAYERS AT 82,
 104, AND 118 FEET (TILL)
 121.0 - 138.0 SAND AND GRAVEL, BROWN; OXIDIZED, GRADES
 FROM A COARSE SAND TO A MEDIUM GRAVEL
 138.0 - 155.0 SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD,
 GREASY (PIERRE SHALE)

* * * *

COUNTY: WALWORTH LOCATION: 121N-74W-27ADDD
 MAP LOCATION: 9
 LEGAL LOCATION: SE SE SE NE SEC. 27, T. 121 N., R. 74 W.
 LATITUDE: 45.1607 LONGITUDE: 99.4500
 LAND OWNER:
 PROJECT: HOVEN CITY STUDY
 DRILLING COMPANY: SDGS
 DRILLER: M. THOMPSON DRILLER'S LOG:
 GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
 DATE DRILLED: 06-01-1983 DRILLING METHOD: ROTARY
 GROUND SURFACE ELEVATION: 1912.00 T
 TOTAL DRILL HOLE DEPTH: 200.0 TEST HOLE NUMBER: R2-83-28
 WATER RIGHTS WELL: SDGS WELL NAME: R2-83-28
 OTHER WELL NAME:
 BASIN: MISSOURI AQUIFER: BOWDLE
 MANAGEMENT UNIT: HOVEN NORTH
 SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 5.0
 CASING TYPE: PVC CASING DIAMETER: 2.0
 CASING TOP ELEVATION: 1915.00 T
 CASING STICK-UP: 3.00 TOTAL CASING AND SCREEN: 78.0
 WELL MAINTENANCE DATE:
 USGS HYDROLOGICAL UNIT CODE: 10130105
 ELECTRIC LOG INFORMATION:
 SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
 NATURAL GAMMA: EXTRA:
 SAMPLES:

0 - 2.0 CLAY, BLACK, SILTY (TOPSOIL)
 2.0 - 23.0 CLAY, YELLOWISH-BROWN, SILTY, SANDY,
 PEBBLY; OXIDIZED (TILL)
 23.0 - 43.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 43.0 - 75.0 GRAVEL, BROWN, MEDIUM TO VERY COARSE,
 COBBLY; OXIDIZED
 75.0 - 175.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 175.0 - 178.0 GRAVEL, BROWN, MEDIUM TO COARSE; OXIDIZED
 178.0 - 200.0 SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD,
 GREASY (PIERRE SHALE)

* * * *

COUNTY: WALWORTH LOCATION: 121N-74W-28ABBB 1
MAP LOCATION: 10
LEGAL LOCATION: NW NW NW NE SEC. 28, T. 121 N., R. 74 W.
LATITUDE: 45.1629 LONGITUDE: 99.4645
LAND OWNER:
PROJECT: HOVEN CITY STUDY
DRILLING COMPANY: SDGS
DRILLER: M. THOMPSON DRILLER'S LOG:
GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
DATE DRILLED: 06-02-1983 DRILLING METHOD: ROTARY
GROUND SURFACE ELEVATION: 1870.00 T
TOTAL DRILL HOLE DEPTH: 121.0 TEST HOLE NUMBER: R2-83-35
USGS HYDROLOGICAL UNIT CODE: 10130105
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

0	-	28.0	GRAVEL, BROWN, FINE TO MEDIUM, VERY SANDY; OXIDIZED
28.0	-	64.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
64.0	-	73.0	GRAVEL, BROWN, FINE, SANDY; OXIDIZED
73.0	-	76.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
76.0	-	81.0	GRAVEL, BROWN, FINE, SANDY; OXIDIZED
81.0	-	104.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
104.0	-	121.0	GRAVEL, BROWN, FINE TO COARSE, SANDY; OXIDIZED, HIT ROCK, ABANDONED HOLE

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COUNTY: WALWORTH LOCATION: 121N-74W-28ABBB 2
MAP LOCATION: 11
LEGAL LOCATION: NW NW NW NE SEC. 28, T. 121 N., R. 74 W.
LATITUDE: 45.1629 LONGITUDE: 99.4645
LAND OWNER:
PROJECT: HOVEN CITY STUDY
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT DRILLER'S LOG:
GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
DATE DRILLED: 06-03-1983 DRILLING METHOD: ROTARY
GROUND SURFACE ELEVATION: 1870.00 T
TOTAL DRILL HOLE DEPTH: 140.0 TEST HOLE NUMBER: R2-83-36
WATER RIGHTS WELL: SDGS WELL NAME: R2-83-36
OTHER WELL NAME:
BASIN: MISSOURI AQUIFER: ONAKA
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 5.0
CASING TYPE: PVC CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1872.00 T
CASING STICK-UP: 2.00 TOTAL CASING AND SCREEN: 123.0
WELL MAINTENANCE DATE:

USGS HYDROLOGICAL UNIT CODE: 10130105

ELECTRIC LOG INFORMATION:

SPONTANEOUS POTENTIAL:

SINGLE POINT RESISTIVITY:

NATURAL GAMMA:

EXTRA:

SAMPLES:

0	-	25.0	SAND AND GRAVEL, BROWN; OXIDIZED, GRADES FROM A COARSE SAND TO A MEDIUM GRAVEL
25.0	-	64.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
64.0	-	67.0	SAND AND GRAVEL, BROWN; OXIDIZED, GRADES FROM A COARSE SAND TO A FINE GRAVEL
67.0	-	104.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED, SMALL GRAVEL LENSES AT 73, 76 AND 85 FEET (TILL)
104.0	-	121.0	GRAVEL, BROWN, FINE TO COARSE; OXIDIZED
121.0	-	140.0	SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD, GREASY (PIERRE SHALE)

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COUNTY: WALWORTH

LOCATION: 121N-74W-28ADAD

MAP LOCATION: 12

LEGAL LOCATION: SE NE SE NE SEC. 28, T. 121 N., R. 74 W.

LATITUDE: 45.1611

LONGITUDE: 99.4612

LAND OWNER:

PROJECT: HOVEN CITY STUDY

DRILLING COMPANY: SDGS

DRILLER: M. THOMPSON

DRILLER'S LOG:

GEOLOGIST: D. TOMHAVE

GEOLOGIST'S LOG: X

DATE DRILLED: 06-03-1983

DRILLING METHOD: ROTARY

GROUND SURFACE ELEVATION: 1878.00 T

TOTAL DRILL HOLE DEPTH: 155.0

TEST HOLE NUMBER: R2-83-37

WATER RIGHTS WELL:

SDGS WELL NAME: R2-83-37

OTHER WELL NAME:

BASIN: MISSOURI

AQUIFER: ONAKA

MANAGEMENT UNIT:

SCREEN TYPE: PVC, MFG.

SCREEN LENGTH: 5.0

CASING TYPE: PVC

CASING DIAMETER: 2.0

CASING TOP ELEVATION: 1881.00 T

CASING STICK-UP: 3.00

TOTAL CASING AND SCREEN: 135.0

WELL MAINTENANCE DATE:

USGS HYDROLOGICAL UNIT CODE: 10130105

ELECTRIC LOG INFORMATION:

SPONTANEOUS POTENTIAL:

SINGLE POINT RESISTIVITY:

NATURAL GAMMA:

EXTRA:

SAMPLES:

0	-	1.0	CLAY, BLACK, SILTY (TOPSOIL)
1.0	-	38.0	GRAVEL, BROWN, FINE TO MEDIUM, VERY SANDY; OXIDIZED
38.0	-	111.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
111.0	-	133.0	GRAVEL, BROWN, FINE TO MEDIUM, SANDY;

133.0 - 155.0 OXIDIZED
SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD,
GREASY (PIERRE SHALE)

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COUNTY: WALWORTH LOCATION: 121N-74W-34AAAA
MAP LOCATION: 13
LEGAL LOCATION: NE NE NE NE SEC. 34, T. 121 N., R. 74 W.
LATITUDE: 45.1536 LONGITUDE: 99.4500
LAND OWNER:
PROJECT: HOVEN CITY STUDY
DRILLING COMPANY: SDGS
DRILLER: M. THOMPSON DRILLER'S LOG:
GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
DATE DRILLED: 05-27-1983 DRILLING METHOD: ROTARY
GROUND SURFACE ELEVATION: 1930.00 T
TOTAL DRILL HOLE DEPTH: 200.0 TEST HOLE NUMBER: R2-83-21
USGS HYDROLOGICAL UNIT CODE: 10130106
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

0 -	1.0	CLAY, BLACK, SILTY (TOPSOIL)
1.0 -	32.0	CLAY, YELLOWISH-BROWN, SILTY, SANDY, PEBBLY; OXIDIZED (TILL)
32.0 -	68.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
68.0 -	96.0	GRAVEL, BROWN, MEDIUM TO COARSE; OXIDIZED
96.0 -	176.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
176.0 -	200.0	SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD, GREASY (PIERRE SHALE)

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COUNTY: WALWORTH LOCATION: 121N-74W-34BBBB 1
MAP LOCATION: 14
LEGAL LOCATION: NW NW NW NW SEC. 34, T. 121 N., R. 74 W.
LATITUDE: 45.1536 LONGITUDE: 99.4611
LAND OWNER:
PROJECT: HOVEN CITY STUDY
DRILLING COMPANY: SDGS
DRILLER: M. THOMPSON DRILLER'S LOG:
GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
DATE DRILLED: 06-02-1983 DRILLING METHOD: ROTARY
GROUND SURFACE ELEVATION: 1886.00 T
TOTAL DRILL HOLE DEPTH: 110.0 TEST HOLE NUMBER: R2-83-32
USGS HYDROLOGICAL UNIT CODE: 10130105
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

0 - 1.0 CLAY, BLACK, SILTY (TOPSOIL)
 1.0 - 34.0 GRAVEL, BROWN, MEDIUM, VERY SANDY;
 OXIDIZED
 34.0 - 56.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 56.0 - 58.0 GRAVEL, BROWN, FINE TO MEDIUM, SANDY;
 OXIDIZED
 58.0 - 61.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 61.0 - 74.0 GRAVEL, BROWN, FINE, VERY SANDY; OXIDIZED
 74.0 - 78.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 78.0 - 110.0 SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD,
 GREASY (PIERRE SHALE)

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COUNTY: WALWORTH LOCATION: 121N-74W-34DDCD
 MAP LOCATION: 15
 LEGAL LOCATION: SE SW SE SE SEC. 34, T. 121 N., R. 74 W.
 LATITUDE: 45.1446 LONGITUDE: 99.4510
 LAND OWNER:
 PROJECT: HOVEN CITY STUDY
 DRILLING COMPANY: SDGS
 DRILLER: M. THOMPSON DRILLER'S LOG:
 GEOLOGIST: D. TOMHAVE GEOLOGIST'S LOG: X
 DATE DRILLED: 06-02-1983 DRILLING METHOD: ROTARY
 GROUND SURFACE ELEVATION: 1900.00 T
 TOTAL DRILL HOLE DEPTH: 140.0 TEST HOLE NUMBER: R2-83-33
 USGS HYDROLOGICAL UNIT CODE: 10130105
 ELECTRIC LOG INFORMATION:
 SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
 NATURAL GAMMA: EXTRA:
 SAMPLES:

0 - 4.0 CLAY, BLACK, SILTY (TOPSOIL)
 4.0 - 10.0 CLAY, YELLOWISH-BROWN, SILTY, SANDY,
 PEBBLY; OXIDIZED (TILL)
 10.0 - 16.0 GRAVEL, BROWN, FINE TO MEDIUM, SANDY;
 OXIDIZED
 16.0 - 28.0 CLAY, YELLOWISH-BROWN, SILTY, SANDY
 VERY GRAVELLY, COBBLY; OXIDIZED (TILL)
 28.0 - 58.0 CLAY, GRAY, SILTY, SANDY, VERY GRAVELLY,
 COBBLY; UNOXIDIZED (TILL)
 58.0 - 86.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 86.0 - 89.0 GRAVEL, BROWN, FINE, SANDY; OXIDIZED
 89.0 - 118.0 CLAY, GRAY, SILTY, SANDY, PEBBLY;
 UNOXIDIZED (TILL)
 118.0 - 140.0 SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD,
 GREASY (PIERRE SHALE)

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COUNTY: WALWORTH LOCATION: 121N-74W-36BBBB
MAP LOCATION: 16
LEGAL LOCATION: NW NW NW NW SEC. 36, T. 121 N., R. 74 W.
LATITUDE: 45.1536 LONGITUDE: 99.4342

LAND OWNER:

PROJECT: HOVEN CITY STUDY

DRILLING COMPANY: SDGS

DRILLER: C. SCHMIG

DRILLER'S LOG:

GEOLOGIST: D. TOMHAVE

GEOLOGIST'S LOG: X

DATE DRILLED: 05-27-1983

DRILLING METHOD: ROTARY

GROUND SURFACE ELEVATION: 1886.00 T

TOTAL DRILL HOLE DEPTH: 200.0

TEST HOLE NUMBER: R2-83-22

USGS HYDROLOGICAL UNIT CODE: 10130106

ELECTRIC LOG INFORMATION:

SPONTANEOUS POTENTIAL:

SINGLE POINT RESISTIVITY:

NATURAL GAMMA:

EXTRA:

SAMPLES:

0	-	10.0	GRAVEL, BROWN, MEDIUM TO COARSE, SANDY; OXIDIZED
10.0	-	166.0	CLAY, GRAY, SILTY, SANDY, PEBBLY; UNOXIDIZED (TILL)
166.0	-	173.0	GRAVEL, BROWN, FINE, VERY SANDY; OXIDIZED
173.0	-	200.0	SHALE, GRAY, CLAYEY; UNOXIDIZED, HARD, GREASY (PIERRE SHALE)

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