

**STATE OF SOUTH DAKOTA
William J. Janklow, Governor**

**DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Nettie H. Myers, Secretary**

**DIVISION OF FINANCIAL AND TECHNICAL ASSISTANCE
Kelly A. Wheeler, Director**

**GEOLOGICAL SURVEY
C.M. Christensen, State Geologist**

OPEN-FILE REPORT 72-UR

**NITRATE INVESTIGATION IN THE BIG SIOUX AQUIFER
NEAR THE CITY OF ESTELLINE**

by

LAYNE D. SCHULZ

**Science Center
University of South Dakota
Vermillion, South Dakota**

1996

CONTENTS

	Page
INTRODUCTION	1
Geologic setting	1
Method of investigation	1
Acknowledgments	1
RESULTS OF INVESTIGATION	1
Initial field work	1
Site specific field work	2
DISCUSSION AND CONCLUSIONS	2
REFERENCE	3

FIGURES

1. General geology of the Estelline, South Dakota, area	4
2. Locations of water sample collection points for the initial field work in 1994	5
3. Nitrate concentrations in the Big Sioux aquifer near the city of Estelline in 1994	6
4. Locations of water sample collection points for the site specific field work in 1995	7
5. Generalized well construction diagram for the nested well sites	8
6. Nitrate concentrations in the Big Sioux aquifer near the city of Estelline in July 1995	9

TABLES

1. Chemical analyses of water samples for the initial field work in 1994	10
---	----

Tables – continued.

2. Chemical analyses of water samples
for the site specific field work in 1995 12

APPENDIX

A. Lithologic logs of monitoring wells sampled by the
South Dakota Geological Survey for this investigation 14

INTRODUCTION

The city of Estelline, South Dakota, has two municipal wells which are completed in the Big Sioux aquifer. The city has experienced periodic high levels of nitrate plus nitrite as nitrogen in its drinking water supply which prompted a request for the South Dakota Geological Survey to investigate alternate areas within the Big Sioux aquifer where lower concentrations of nitrate might be found. In the remainder of this report, nitrate plus nitrite as nitrogen will be referred to as simply nitrate. This investigation was financed by the South Dakota Geological Survey, the East Dakota Water Development District, and the city of Estelline.

Geologic Setting

The city of Estelline is located in southeastern Hamlin County, South Dakota. The city lies within the valley of the Big Sioux River and directly over the Big Sioux aquifer. The sediments that fill the valley are composed of sand and gravel that make up the Big Sioux aquifer (fig. 1). The deposits that lie topographically higher along the valley walls are composed of till and upper level terrace deposits of sand and gravel. Till is an unsorted mixture of silt, sand, and gravel in a clay matrix.

Method of Investigation

Field work for this study was conducted in two phases. The first phase started on July 11, 1994, and continued through September 26, 1994. Field work for phase one included the collection and analysis of 23 water samples and the drilling of 3 monitoring wells. The second phase of this study began June 26, 1995, and proceeded through July 6, 1995. During this phase, 14 additional monitoring wells were completed and 20 water samples were collected and analyzed.

Acknowledgments

The author would like to acknowledge the cooperation provided by Estelline Mayor John West, Connie Jensen, Don Seeklander, Lyle Vohlken, Norman Zaft, and Loretta Lentz during the course of this investigation.

RESULTS OF INVESTIGATION

Initial Field Work

Phase one of the study concentrated on the area within a few miles surrounding the city of Estelline. During this phase, 10 monitoring wells, 2 city wells, 1 private well, and a construction dewatering site were sampled and analyzed for the concentration of nitrate. In addition, three new monitoring wells were completed, sampled, and analyzed for the same parameter. City well 1, city well 2, well CO-91-01, and well R20-84-217 were sampled more than once to confirm the nitrate concentrations in these wells. The locations of the water sample collection points are given in figure 2.

The concentration of nitrate and the date sampled are shown in figure 3. Values for nitrate ranged from a low of <0.04 milligrams per liter to a high of 18.3 milligrams per liter. The enforceable limit for public water supplies is 10 milligrams per liter set forth by the U.S. Environmental Protection Agency (1994). The well depths and results of water quality analyses for samples collected in phase one are given in table 1. The lithologic logs of the wells sampled for this study are given in appendix A.

At the conclusion of this portion of the study, it was decided that additional work was needed in an area that would potentially produce water with the lowest concentration of nitrate. Two areas were suggested for further exploration. One was approximately 2 miles north of the city of Estelline around well number R20-89-45 and the other area suggested was the north half of section 25, T. 113 N., R. 51 W. Preliminary data showed promise for these areas with relatively low concentrations of nitrate. The latter of the two sites was chosen for further investigation by the city of Estelline because of the close proximity to existing water distribution facilities.

Site Specific Field Work

Phase two of this study concentrated efforts in the north half of section 25, T. 113 N., R. 51 W. and the area surrounding section 25. The work plan included the construction of 14 additional monitoring wells and analysis of the ground water for nitrate. To analyze the water quality of the aquifer in more detail, these wells were placed in the aquifer at different depths. Seven sites were chosen to construct wells that would yield results from the base of the aquifer and the upper portion of the aquifer. The locations of these nested well sites along with the other wells sampled for this portion of the study are given in figure 4. Details of typical well construction for the nested wells are given in figure 5. Lithologic logs of the wells are given in appendix A.

The well depths and concentrations of nitrate in the nested wells, two city wells, two private wells, and two monitoring wells are given in figure 6 and table 2. Concentrations ranged from a low of <0.04 milligrams per liter to a high of 18.8 milligrams per liter. The data show that in those wells that were completed in the lower portion of the aquifer, the nitrate concentrations are relatively low compared to the nitrate concentrations in monitoring wells completed in the upper portion of the aquifer. This illustrates that the nitrate is concentrated in the upper portion of the aquifer in this area.

DISCUSSION AND CONCLUSIONS

The initial field work was conducted in an effort to identify possible areas surrounding the city of Estelline that would warrant further detailed study. Two areas were suggested for further investigation. The north half of section 25, T. 113 N., R. 51 W. was chosen for additional investigation by the city of Estelline. At seven sites, nested wells were constructed at various depths within or adjacent to section 25 to research in more detail the concentration of nitrate in the lower and upper portions of the aquifer. The data show that the nitrate concentrations were lower at the base of the aquifer compared to concentrations of nitrate in the upper portion of the aquifer. This leads to the conclusion that the nitrate is stratified in the aquifer in this area.

Although the nitrate concentration at the base of the Big Sioux aquifer in the north half of section 25 is low, it is believed that, with the present land use practices, long term pumping from the base of

the aquifer would induce water with higher concentrations of nitrate from the upper portion of the aquifer into a production well. This could eventually cause the concentrations of nitrate in a new water supply to rise above acceptable levels. Considering the present land use practices and the nitrate concentrations in the Big Sioux aquifer surrounding the city of Estelline, stringent wellhead protection must be implemented in this area to minimize the nitrate concentration in any present or future wells. In the absence of stringent wellhead protection, the city should consider an alternate source of water for its drinking water supply.

REFERENCE

United States Environmental Protection Agency, November 1994, *Drinking water regulations and health advisories*.

Figure 1. Generalized geology of the Estelline, South Dakota, area.

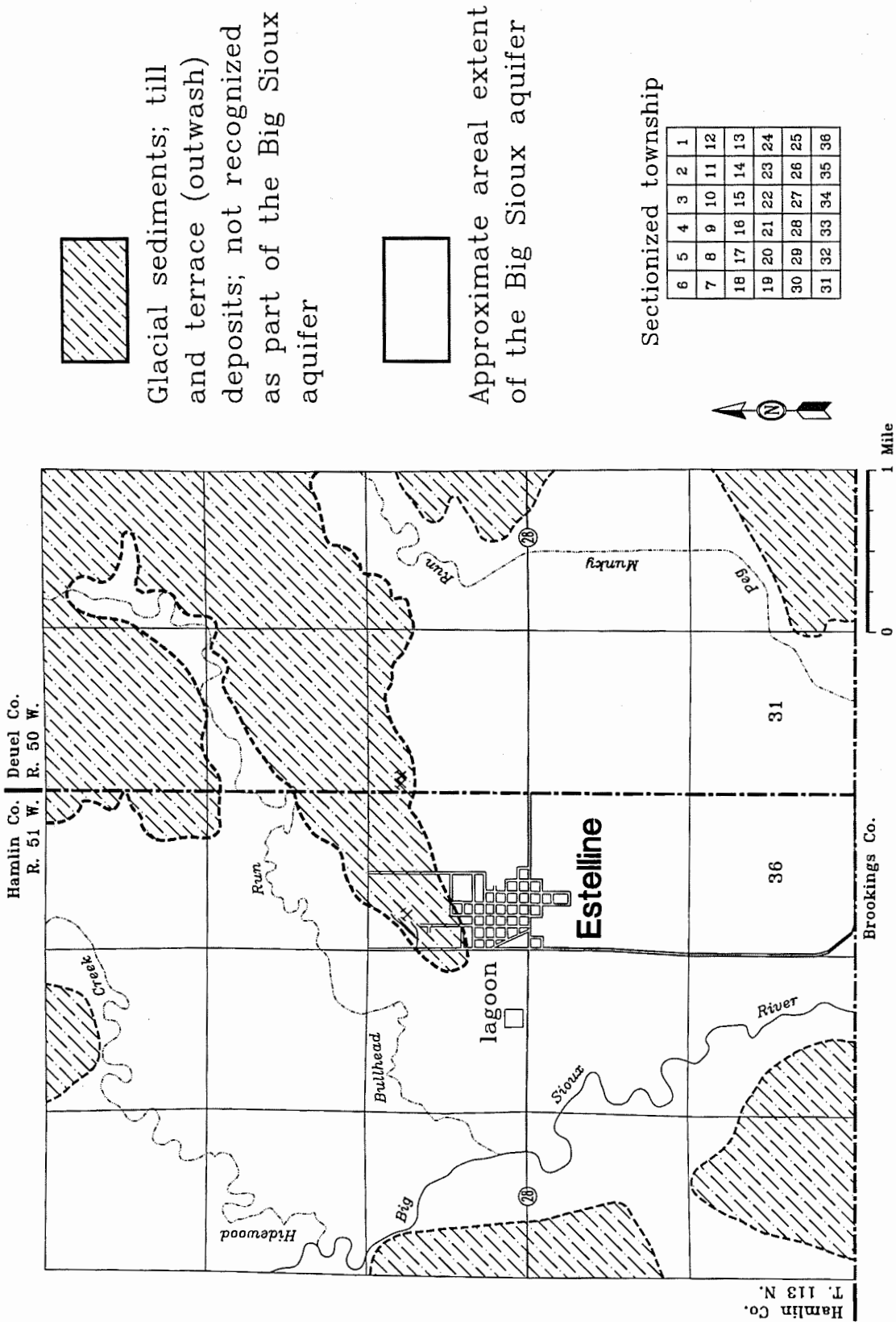
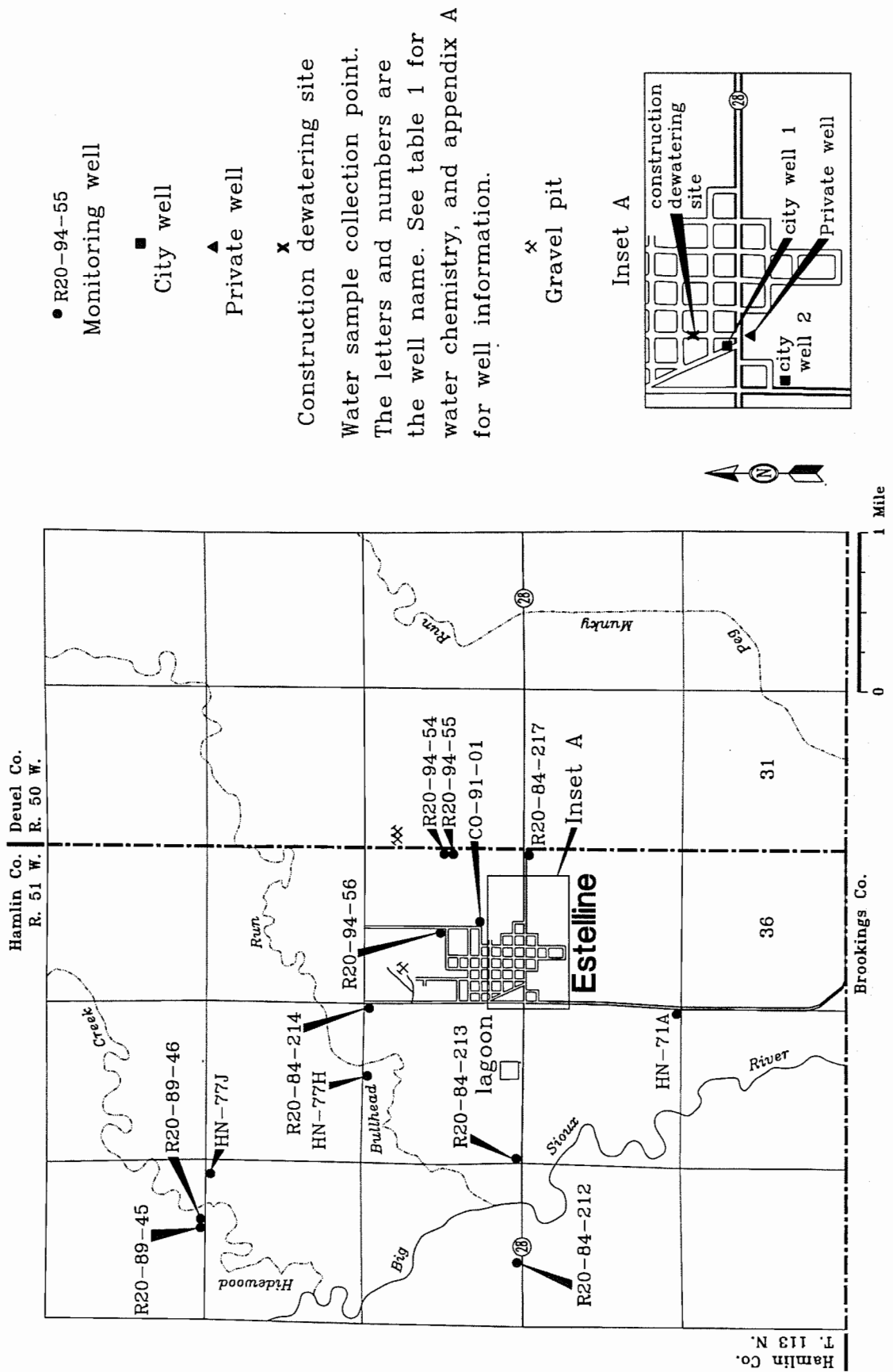


Figure 2. Locations of water sample collection points for the initial field work in 1994.



● R20-94-55

Monitoring well

■ City well

▲ Private well

x

Construction dewatering site

Water sample collection point.

The letters and numbers are the well name. See table 1 for water chemistry, and appendix A for well information.

x

Gravel pit

Inset A

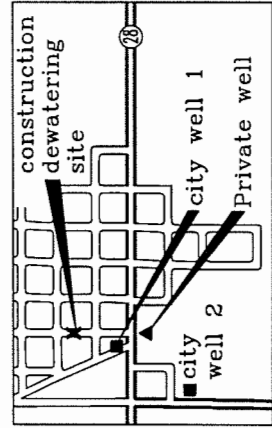


Figure 3. Nitrate concentrations in the Big Sioux aquifer near the city of Estelline in 1994.

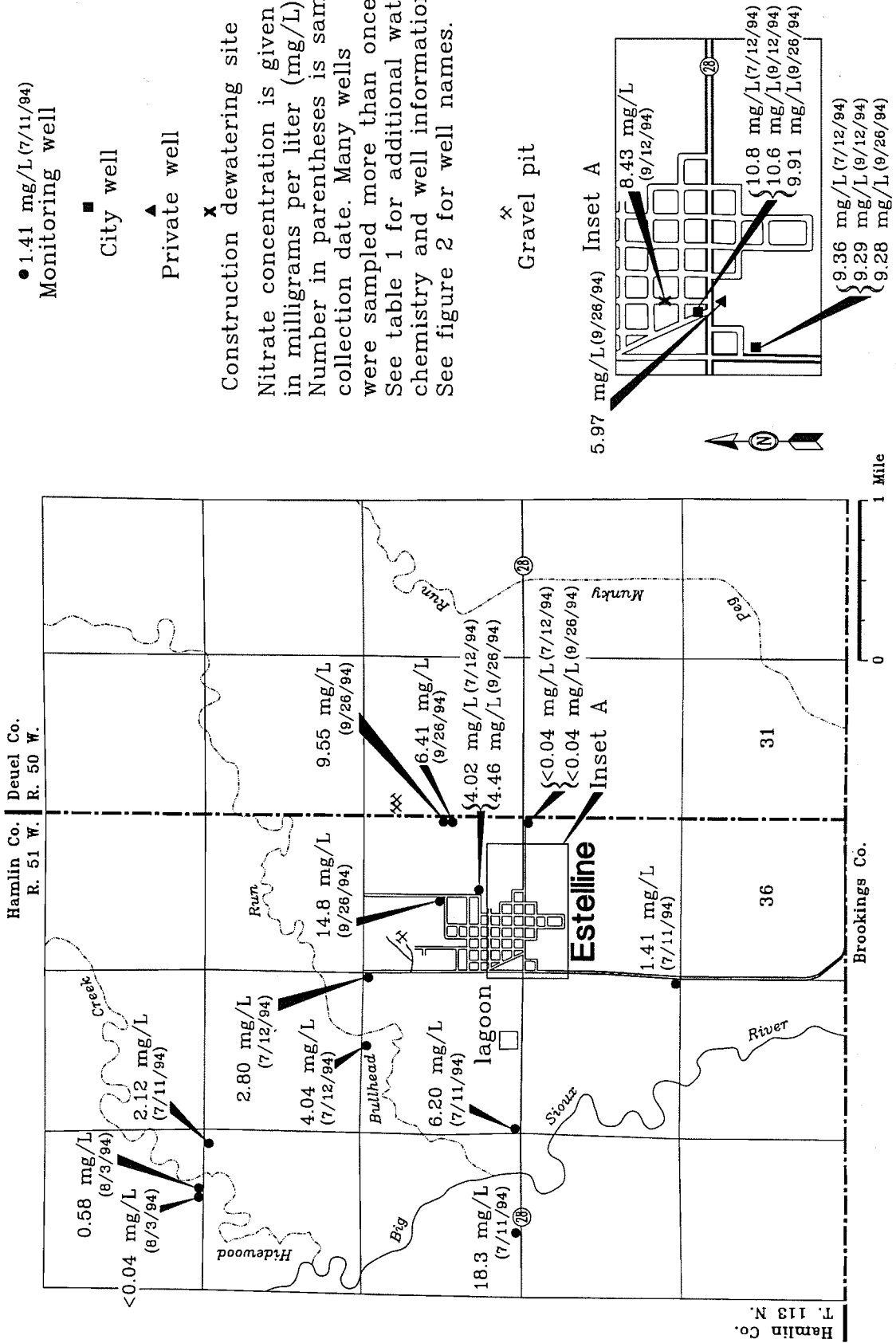
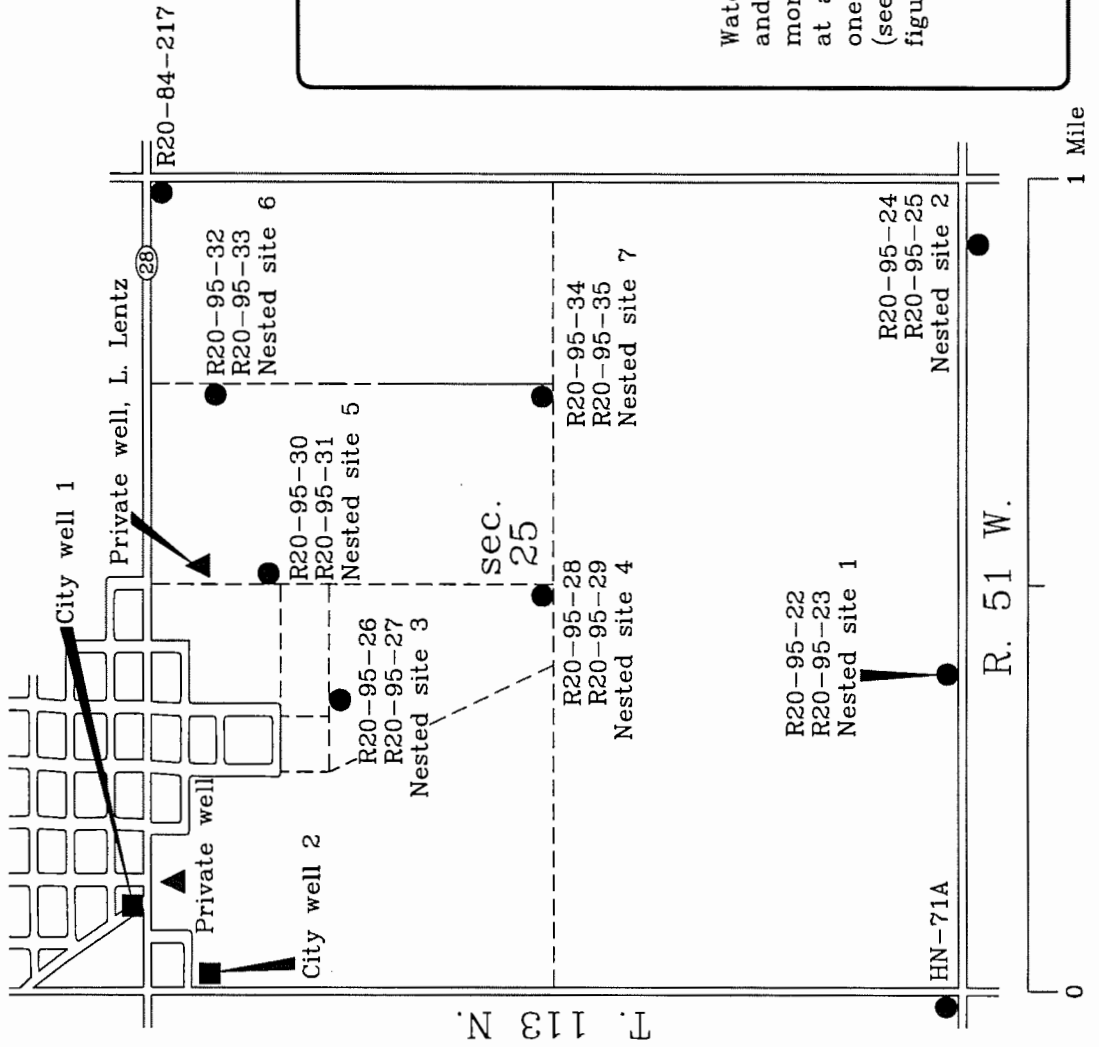


Figure 4. Locations of water sample collection points for the site specific field work in 1995.



● R20-95-33
Monitoring well

▲ Private well

■ City well

fence

Water sample collection point. Letter and numbers are well name. Where more than one well name appears at a location, the well site contains one deep well and one shallow well (see fig. 5). See appendix A and figure 6 for well depths.

Figure 5. General well construction diagram for the nested well sites.

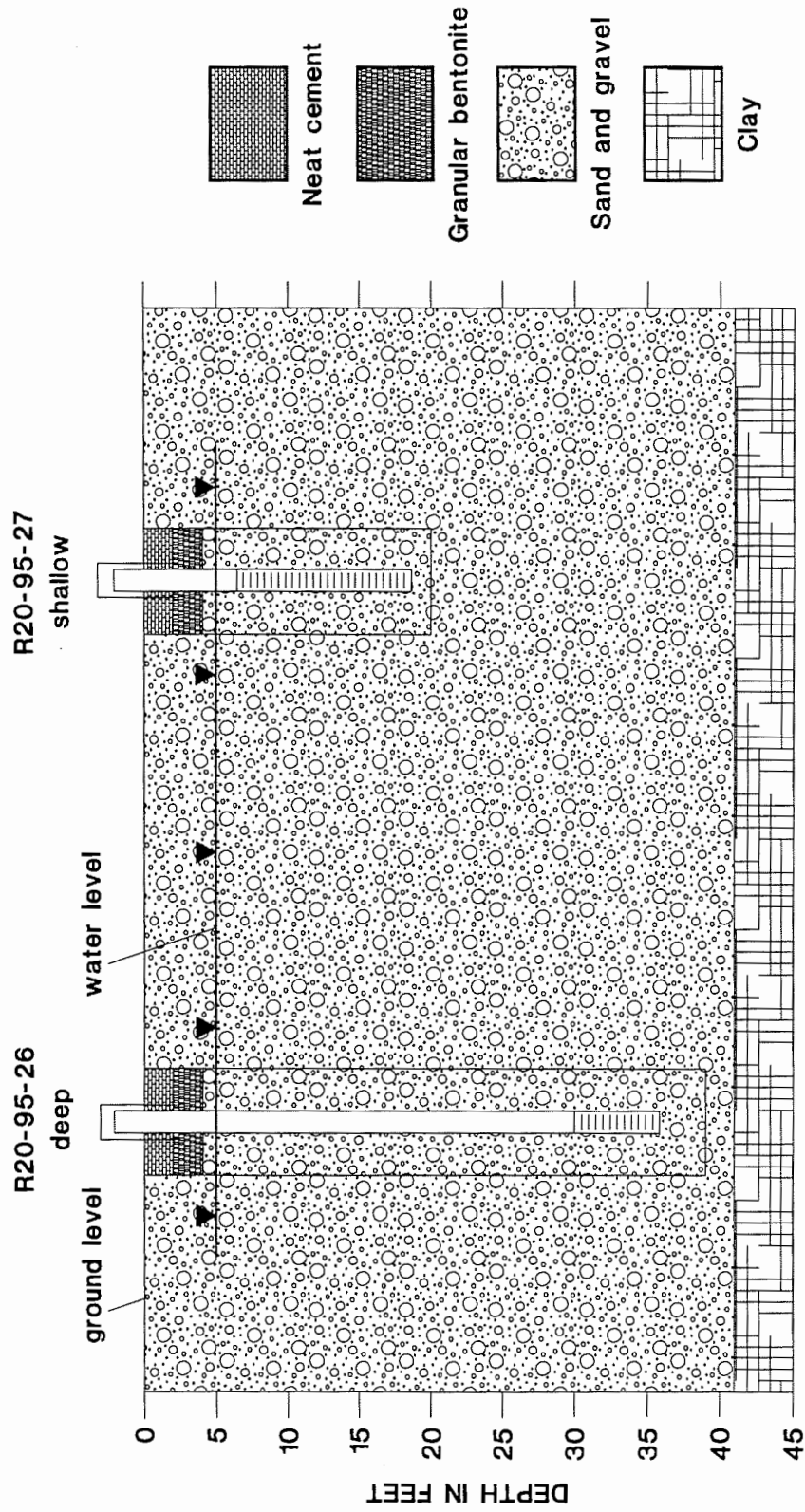


Figure 6. Nitrate concentrations in the Big Sioux aquifer near the city of Estelline in July 1995.

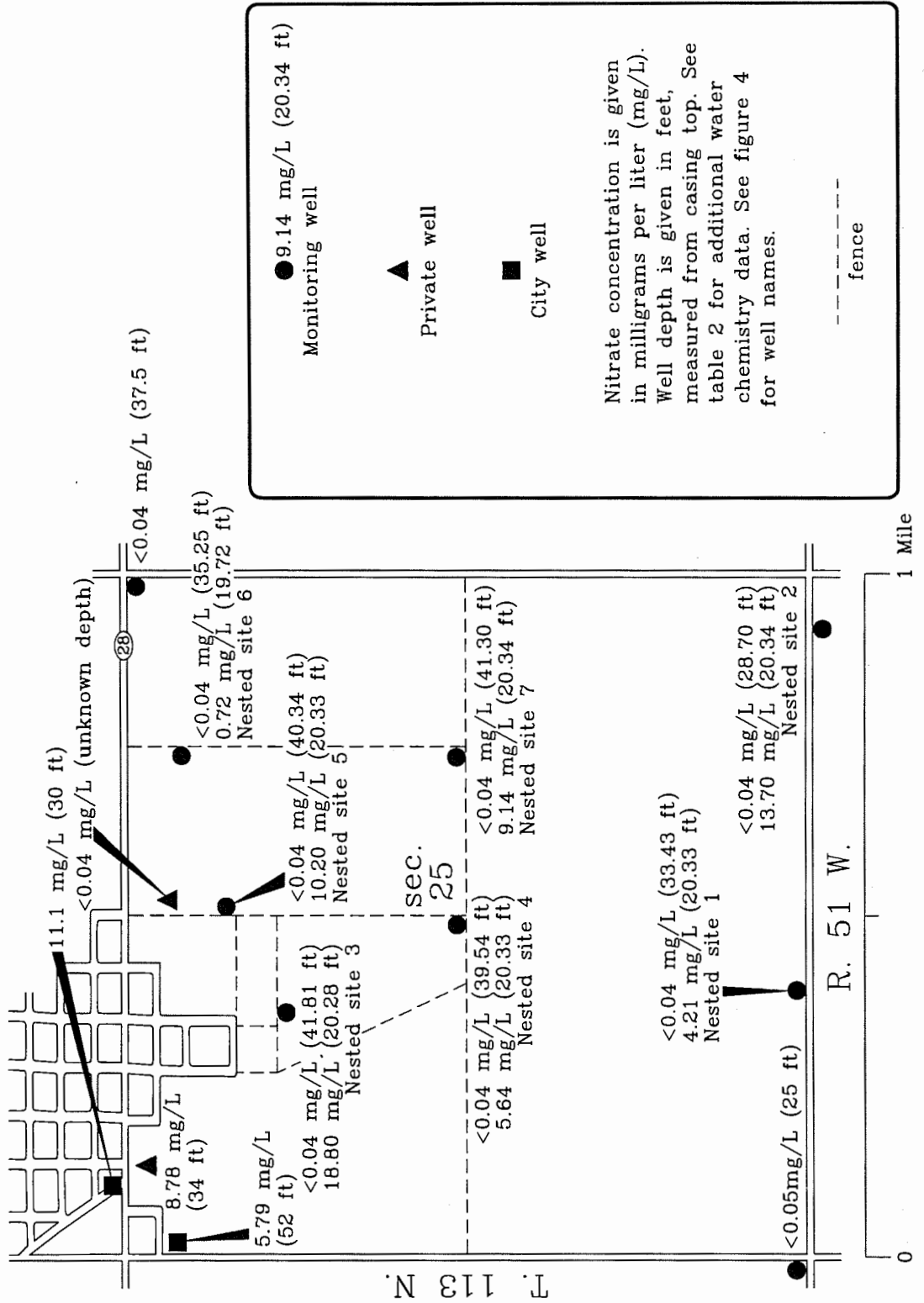


Table 1. Chemical analyses of water samples for the initial field work in 1994.

Legal location	Well name	Date collected	Well depth ²	Conductivity ³	Parameters ¹ and concentrations in milligrams per liter														
					Alk-T	HCO ₃	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO ₂ -N	NO ₃ -N	SO ₄	TDS	Hardness as CaCO ₃
					250 ⁴	250 ⁴	250 ⁴	250 ⁴	250 ⁴	0.3 ⁴	0.05 ⁴	0.05 ⁴	0.05 ⁴	0.05 ⁴	10 ⁵	10 ⁵	250 ⁴	500 ⁴	
SE SW SW sec. 24, T. 113 N., R. 51 W.	City well 1	7-12-94	30	740	285	347	100	16.1	1.29	<0.05	4.3	30	<0.05	12.0	10.80	62	462	370	
SE SW SW sec. 24, T. 113 N., R. 51 W.	City well 1	9-12-94	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.60	NA	NA	NA	NA	
SE SW SW sec. 24, T. 113 N., R. 51 W.	City well 1	9-26-94	30	740	280	341	97	16.0	1.28	<0.05	4.3	34	<0.05	11.0	9.91	71	473	380	
SW NW NW sec. 25, T. 113 N., R. 51 W.	City well 2	7-12-94	52	690	276	336	92	11.3	2.56	<0.05	2.9	31	<0.05	12.0	9.36	50	425	360	
SW NW NW sec. 25, T. 113 N., R. 51 W.	City well 2	9-12-94	52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.29	NA	NA	NA	NA	
SW NW NW sec. 25, T. 113 N., R. 51 W.	City well 2	9-26-94	52	670	265	323	85	10.0	1.68	<0.05	2.9	30	<0.05	11.0	9.28	50	425	340	
SE SE NE SW sec. 24, T. 113 N., R. 51 W.	CO-91-01	7-12-94	22	610	289	352	75	3.6	0.28	<0.05	1.6	33	<0.05	8.7	4.02	37	371	320	
SE SE NE SW sec. 24, T. 113 N., R. 51 W.	CO-91-01	9-26-94	22	610	283	345	75	3.7	0.28	0.18	1.6	34	<0.05	9.1	4.46	35	374	330	
NE SW SW sec. 24, T. 113 N., R. 51 W.	Dewatering pump ⁶	9-12-94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.43	NA	NA	NA	NA	
SE SE SE sec. 26, T. 113 N., R. 51 W.	HN-71A	7-11-94	25	790	294	358	104	20.5	0.16	<0.05	6.3	35	0.15	14.0	1.41	115	532	400	
NW NW NW sec. 23, T. 113 N., R. 51 W.	HN-77H	7-12-94	25	700	257	313	102	7.7	0.17	<0.05	3.4	31	<0.05	8.3	4.04	110	487	380	
NW NE NE sec. 15, T. 113 N., R. 51 W.	HN-77J	7-11-94	22	670	240	293	91	10.0	0.17	<0.05	4.3	30	<0.05	9.6	2.12	115	464	350	
NE NW NW sec. 25, T. 113 N., R. 51 W.	Private well	9-26-94	34	500	207	252	66	10.0	0.37	0.07	5.0	18	<0.05	9.8	5.97	25	313	240	

Legal location	Well name	Date collected	Well depth ²	Conductivity ³	Parameters ¹ and concentrations in milligrams per liter																		
					Alk-T	HCO ₃	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO ₂ -N	NO ₃ -N	SO ₄	TDS	Hardness as CaCO ₃				
					250 ⁴	2.4 ⁵	0.3 ⁴									0.05 ⁴			10 ⁵	250 ⁴	500 ⁴		
SW SE SE SW sec. 22, T. 113 N., R. 51 W.	R20-84-212	7-11-94	25.5	780	292	356	90	11.0	0.33	<0.05	1.4	45	<0.05	11.0	18.30	61	503	410					
SW SW SW SW sec. 23, T. 113 N., R. 51 W.	R20-84-213	7-11-94	42	760	270	329	106	11.0	0.18	<0.05	3.1	35	0.05	10.5	6.20	116	516	410					
NE NE NE NE sec. 23, T. 113 N., R. 51 W.	R20-84-214	7-12-94	41	780	276	336	109	9.2	0.20	<0.05	2.7	37	<0.05	9.3	2.80	138	538	420					
NE NE NE NE sec. 25, T. 113 N., R. 51 W.	R20-84-217	7-12-94	37.5	890	322	393	107	5.0	0.29	0.64	3.0	52	0.40	20.0	<0.04	180	630	480					
NE NE NE NE sec. 25, T. 113 N., R. 51 W.	R20-84-217	9-26-94	37.5	930	310	378	104	5.3	0.29	0.89	3.0	53	0.54	20.0	<0.04	187	634	480					
SE SW SW SE sec. 10, T. 113 N., R. 51 W.	R20-89-45	8-03-94	27	889	244	297	107	18.6	0.21	0.16	3.9	42	1.31	23.0	<0.04	220	619	440					
SE SW SW SE sec. 10, T. 113 N., R. 51 W.	R20-89-46	8-03-94	17	895	257	313	116	19.3	0.24	<0.05	3.8	40	<0.05	21.0	0.58	206	624	454					
NE NE NE SE sec. 24, T. 113 N., R. 51 W.	R20-94-54	9-26-94	28.7	580	237	289	67	7.1	0.34	<0.05	1.1	36	<0.05	6.4	9.55	37	356	320					
NE NE NE SE sec. 24, T. 113 N., R. 51 W.	R20-94-55	9-26-94	19.3	660	310	378	68	3.8	0.30	<0.05	0.8	51	<0.05	4.9	6.41	38	403	380					
SE SE SE NW sec. 24, T. 113 N., R. 51 W.	R20-94-56	9-26-94	43	810	306	373	104	9.8	0.34	<0.05	2.1	38	<0.05	19.0	14.80	75	536	420					

¹ Alk-T - total alkalinity; HCO₃ - bicarbonate; Ca - calcium; Cl - chloride; F - fluoride; Fe - iron; K - potassium; Mg - magnesium; Mn - manganese; Na - sodium; NO₂-N + NO₃-N - nitrate + nitrite as nitrogen; SO₄ - sulfate; TDS - total dissolved solids; Hardness as CaCO₃ - hardness as calcium carbonate.

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

³ Numbers are presented in micromhos per centimeter.

⁴ U.S. Environmental Protection Agency "Drinking Water Regulations and Health Advisories"; November 1994 (Secondary maximum contaminant levels, Recommended limits.)

⁵ U.S. Environmental Protection Agency "Drinking Water Regulations and Health Advisories"; November 1994 (Maximum contaminant levels, Enforceable limits.)

⁶ The dewatering pump was used to collect a sample at the construction dewatering site shown on figure 2.

NA - Parameter was not analyzed.

Table 2. Chemical analyses of water samples for the site specific field work in 1995.

Legal location	Well name	Date collected	Well depth ²	Conductivity ³	Parameter ¹ and concentrations in milligrams per liter													Hardness as CaCO ₃							
					Alk-T	HCO ₃	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO ₂ -N	NO ₃ -N + SO ₄	TDS								
					250 ⁴	2.4 ⁵	0.3 ⁴																		
SE SW SW sec. 24, T. 113 N., R. 51 W.	City well 1	07-06-95	30.00	790	300	366	99	15.0	0.21	<0.05	4.5	36.00	<0.05	10	11.10	50	462	395							
SW NW NW sec. 25, T. 113 N., R. 51 W.	City well 2	07-06-95	52.00	744	255	311	90	25.2	10.2	<0.05	3.5	33.00	<0.05	16	5.79	49	455	361							
SE SE SE sec. 26, T. 113 N., R. 51 W.	HN-71A	07-06-95	25.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	NA	NA	NA	NA						
NE NW NW sec. 25, T. 113 N., R. 51 W.	Private well	07-06-95	34.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.78	NA	NA	NA	NA						
SE NE NE sec. 25, T. 113 N., R. 51 W.	Private well L. Lentz	07-06-95	NA	633	275	335	0.26	11.6	0.07	<0.05	2.3	0.05	<0.05	159	<0.04	35	399	1							
NE NE NE sec. 25, T. 113 N., R. 51 W.	R20-84-217	07-06-95	37.50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.04	NA	NA	NA	NA						
SW SE SE sec. 25, T. 113 N., R. 51 W.	R20-95-22	07-05-95	33.43	772	271	330	82	9.1	0.30	0.98	2.9	44.00	0.37	16	<0.04	136	502	386							
SW SE SE sec. 25, T. 113 N., R. 51 W.	R20-95-23	07-05-95	20.33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.21	NA	NA	NA	NA						
NE NW NE sec. 36, T. 113 N., R. 51 W.	R20-95-24	07-05-95	28.70	888	265	323	98	5.2	0.24	0.74	3.3	49.00	0.77	23	<0.04	203	616	446							
NE NW NE sec. 36, T. 113 N., R. 51 W.	R20-95-25	07-05-95	20.34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13.70	NA	NA	NA	NA						
SE NW SE sec. 25, T. 113 N., R. 51 W.	R20-95-26	07-05-95	41.81	842	241	294	112	18.5	0.17	0.26	9.2	36	0.75	10	<0.04	183	596	428							
SE NW SE sec. 25, T. 113 N., R. 51 W.	R20-95-27	07-05-95	20.28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18.80	NA	NA	NA	NA						

Legal location	Well name	Date collected	Well depth ²	Conductivity ³	Parameter ¹ and concentrations in milligrams per liter														
					Alk-T	HCO ₃	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO ₂ -N	NO ₃ -N + SO ₄	TDS	Hardness as CaCO ₃	
					250 ⁴	2.4 ⁵	0.3 ⁴								0.05 ⁴	10 ⁵	250 ⁴	500 ⁴	
SE SE SE NW sec. 25, T. 113 N., R. 51 W.	R20-95-28	07-05-95	39.54	805	287	350	90	8.8	0.35	0.74	2.4	44	0.42	18	<0.04	149	532	406	
SE SE SE NW sec. 25, T. 113 N., R. 51 W.	R20-95-29	07-05-95	20.33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.64	NA	NA	NA	
SW SW NW NE sec. 25, T. 113 N., R. 51 W.	R20-95-30	07-06-95	40.34	843	254	310	111	21.3	0.28	0.31	2.8	37	0.79	14	<0.04	172	592	430	
SW SW NW NE sec. 25, T. 113 N., R. 51 W.	R20-95-31	07-06-95	20.33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.20	NA	NA	NA	
NE SE NW NE sec. 25, T. 113 N., R. 51 W.	R20-95-32	07-06-95	35.25	786	280	341	81	9.2	0.34	1.07	3.3	47	0.40	19	<0.04	130	505	396	
NE SE NW NE sec. 25, T. 113 N., R. 51 W.	R20-95-33	07-06-95	19.72	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.72	NA	NA	NA	
SE SE SW NE sec. 25, T. 113 N., R. 51 W.	R20-95-34	07-06-95	41.30	999	275	335	109	7.3	0.29	1.14	3.3	56	0.53	30	<0.04	258	750	503	
SE SE SW NE sec. 25, T. 113 N., R. 51 W.	R20-95-35	07-06-95	20.34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.14	NA	NA	NA	

¹ Alk-T - total alkalinity; HCO₃ - bicarbonate; Ca - calcium; Cl - chloride; F - fluoride; Fe - iron; K - potassium; Mg - magnesium; Mn - manganese; Na - sodium; NO₂-N + NO₃-N - nitrate + nitrite as nitrogen; SO₄ - sulfate; TDS - total dissolved solids; Hardness as CaCO₃ - hardness as calcium carbonate.

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

³ Numbers are presented in micromhos per centimeter.

⁴ U.S. Environmental Protection Agency "Drinking Water Regulations and Health Advisories": November 1994 (Secondary maximum contaminant levels. Recommended limits.)

⁵ U.S. Environmental Protection Agency "Drinking Water Regulations and Health Advisories": November 1994 (Maximum contaminant levels. Enforceable limits.)

NA - Parameter was not analyzed.

APPENDIX A

Lithologic logs of monitoring wells sampled by the South Dakota Geological Survey for this investigation

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 SE SE NE SW sec. 24, T. 113 N., R. 51 W. is the same as a **LOCATION** of 113N-51W-24CADD. 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. HM. is an abbreviation for homemade. SLOT SIZE is the size, in inches, of the opening 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: HAMLIN
 Legal Location: SE SW SW SE sec. 10, T. 113 N., R. 51 W.
 Latitude: 44.3606
 Land Owner:
 Project: BIG SIOUX NONPOINT SOURCE
 Drilling Company: SDGS
 Driller: D. IVERSON
 Geologist: P. HAMMOND
 Date Drilled: 07-19-1989
 Ground Surface Elevation: 1650.00 T
 Total Drill Hole Depth: 34.0
 Water Rights Well:
 Other Well Name:
 Basin: BIG SIOUX
 Management Unit: BROOKINGS
 Screen Type: PVC, SCH. 40, MFG.
 Casing Type: PVC, SCH. 40
 Casing Top Elevation: 1652.50 T
 Casing Stick-up: 2.50
 Well Maintenance Date:
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:
 Spontaneous Potential:
 Natural Gamma:
 Samples:

Location: 113N-51W-10DCCD
 Longitude: 96.5557

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

Test Hole Number: R20-89-45
 SDGS Well Name: R20-89-45

Aquifer: BIG SIOUX

Screen Length: 2.5
 Casing Diameter: 4.0

Total Casing and Screen: 27.5

Single Point Resistivity:
 Extra:

Well data: screened interval from 25 to 22.5 feet; filter pack (Grand Island Sand) from 34 to 25 feet; filter pack (native sediment) from 25 to 10 feet; granular bentonite from 10 to 6 feet; cement from 6 to 0.5 feet; locking steel well protector installed. Screen and casing are flush threaded. Western most well of two.

0	-	1	Topsoil, black
1	-	9	Silt and clay, dark-brown to gray, very sandy; moist
9	-	13	Sand, dark-brown to gray, fine, very clayey, pebbly; saturated
13	-	22	Sand, brown, fine to coarse, clayey
22	-	27	Sand and gravel, brown, medium sand to medium gravel
27	-	34	Clay, greenish-gray, silty, sandy, pebbly; sticky

County: HAMLIN
 Legal Location: SE SW SW SE sec. 10, T. 113 N., R. 51 W.
 Latitude: 44.3606
 Land Owner:
 Project: BIG SIOUX NONPOINT SOURCE
 Drilling Company: SDGS
 Driller: D. IVERSON
 Geologist: P. HAMMOND
 Date Drilled: 07-19-1989
 Ground Surface Elevation: 1650.00 T
 Total Drill Hole Depth: 17.0
 Water Rights Well:
 Other Well Name:
 Basin: BIG SIOUX
 Management Unit: BROOKINGS

Location: 113N-51W-10DCCD 1
 Longitude: 96.5557

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

Test Hole Number: R20-89-46
 SDGS Well Name: R20-89-46

Aquifer: BIG SIOUX

Screen Type: PVC, SCH. 40, MFG.
 Casing Type: PVC, SCH. 40
 Casing Top Elevation: 1652.00 T
 Casing Stick-up: 2.00
 Well Maintenance Date:
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:
 Spontaneous Potential:
 Natural Gamma:
 Samples:

Screen Length: 10.0
 Casing Diameter: 4.0
 Total Casing and Screen: 17.5
 Single Point Resistivity:
 Extra:

Well data: screened interval from 15.5 to 5.5 feet; filter pack (native sediment) from 17 to 9 feet; filter pack (Grand Island Sand) from 9 to 4 feet; granular bentonite from 4 to 3 feet; cement from 3 to 0.5 feet; locking steel well protector installed. Screen and casing are flush threaded. Eastern most well of two.

- 0 - 1 Topsoil, black
- 1 - 9 Silt and clay, dark-brown to gray, very sandy; dry
- 9 - 17 Sand, dark-brown to gray, fine to coarse, clayey; saturated

County: HAMLIN
 Legal Location: NW NE NE NE sec. 15, T. 113 N., R. 51 W.
 Latitude: 44.3604
 Land Owner:
 Project: USGS
 Drilling Company: HURON DRILLING
 Driller:
 Geologist: N. KOCH
 Date Drilled: 08-03-1977
 Ground Surface Elevation: 1660.00 T
 Total Drill Hole Depth: 35.0
 Water Rights Well: HN-77J
 Other Well Name: HNGS-4
 Basin: BIG SIOUX
 Management Unit: BROOKINGS
 Screen Type:
 Casing Type: PVC
 Casing Top Elevation:
 Casing Stick-up: 2.30
 Well Maintenance Date: 05-17-1983
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:
 Spontaneous Potential:
 Natural Gamma:
 Samples:

Location: 113N-51W-15AAAB
 Longitude: 96.5535
 Driller's Log: X
 Geologist's Log:
 Drilling Method: ROTARY
 Test Hole Number:
 SDGS Well Name:
 Aquifer: BIG SIOUX
 Screen Length:
 Casing Diameter: 1.5
 Total Casing and Screen: 22.0
 Single Point Resistivity:
 Extra:

Bottom of casing was taped shut and casing was slotted. Hole drilled for USGS Digital Model in Brookings, Deuel, and Hamlin Counties (WRI 80-100).

- 0 - 1 Topsoil
- 1 - 22 Gravel, coarse
- 22 - 28 Sand, brown, fine
- 28 - 35 Gravel, coarse

County: HAMLIN
Legal Location: SW SE SE SW sec. 22, T. 113 N., R. 51 W.
Latitude: 44.3424
Land Owner:
Project: BIG SIOUX HYDRO STUDY
Drilling Company: SDGS
Driller: L. HELSETH
Geologist:
Date Drilled: 07-26-1984
Ground Surface Elevation: 1650.00 T
Total Drill Hole Depth: 23.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit:
Screen Type: PVC, HM.
Casing Type: PVC
Casing Top Elevation: 1652.50 T
Casing Stick-up: 2.50
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

PVC slotted from 9 to 19 feet from ground surface.

0	-	3	Clay, yellow-brown, silty, pebbly (till)
3	-	19	Sand and gravel, brown, medium to coarse
19	-	23	Clay, yellow, silty, pebbly (till)

County: HAMLIN
Legal Location: NE NE NE NE sec. 23, T. 113 N., R. 51 W.
Latitude: 44.3514
Land Owner:
Project: BIG SIOUX HYDRO STUDY
Drilling Company: SDGS
Driller: L. HELSETH
Geologist:
Date Drilled: 07-26-1984
Ground Surface Elevation: 1665.00 T
Total Drill Hole Depth: 38.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit:
Screen Type: PVC, HM.
Casing Type: PVC
Casing Top Elevation: 1668.00 T
Casing Stick-up: 3.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202

Location: 113N-51W-22CDDC
Longitude: 96.5614

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

Test Hole Number: R20-84-212
SDGS Well Name: R20-84-212

Aquifer:

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 25.5

Single Point Resistivity:
Extra:

Location: 113N-51W-23AAAA
Longitude: 96.5419

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

Test Hole Number: R20-84-214
SDGS Well Name: R20-84-214

Aquifer:

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 41.0

Electric Log Information:

Spontaneous Potential:
Natural Gamma:
Samples:

Single Point Resistivity:
Extra:

PVC slotted 24 to 34 feet from ground surface.

0	-	2	Topsoil, black
2	-	5	Clay, yellow-brown (till)
5	-	34	Sand and gravel, medium to very coarse
34	-	38	Clay, yellow (till)

County: HAMLIN

Legal Location: NW NW NW NE sec. 23, T. 113 N., R. 51 W.

Latitude: 44.3514

Land Owner:

Project: USGS

Drilling Company: HURON DRILLING

Driller:

Geologist: N. KOCH

Date Drilled: 08-04-1977

Ground Surface Elevation: 1657.00 T

Total Drill Hole Depth: 35.0

Water Rights Well: HN-77H

Other Well Name:

Basin: BIG SIOUX

Management Unit: BROOKINGS

Screen Type:

Casing Type: PVC

Casing Top Elevation:

Casing Stick-up: 0.70

Well Maintenance Date: 05-17-1983

USGS Hydrological Unit Code: 10170202

Electric Log Information:

Spontaneous Potential:

Natural Gamma:

Samples:

Location: 113N-51W-23ABBB

Longitude: 96.5455

Driller's Log:

Geologist's Log: X

Drilling Method: ROTARY

Test Hole Number:

SDGS Well Name:

Aquifer: BIG SIOUX

Screen Length:

Casing Diameter: 1.5

Total Casing and Screen: 25.0

Single Point Resistivity:

Extra:

Bottom of casing has taped shut and casing was slotted. Hole drilled for USGS Digital Model in Brookings, Deuel, and Hamlin Counties (WRI 80-100).

0	-	2	Topsoil
2	-	21	Gravel, coarse
21	-	27	Sand, brown, fine
27	-	35	Gravel, coarse

County: HAMLIN

Legal Location: SW SW SW SW sec. 23, T. 113 N., R. 51 W.

Latitude: 44.3424

Land Owner:

Project: BIG SIOUX HYDRO STUDY

Drilling Company: SDGS

Location: 113N-51W-23CCCC

Longitude: 96.5530

Driller: L. HELSETH
Geologist:
Date Drilled: 07-26-1984
Ground Surface Elevation: 1647.00 T
Total Drill Hole Depth: 39.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit:
Screen Type: PVC, HM.
Casing Type: PVC
Casing Top Elevation: 1650.00 T
Casing Stick-up: 3.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

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

Test Hole Number: R20-84-213
SDGS Well Name: R20-84-213

Aquifer:

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 42.0

Single Point Resistivity:
Extra:

PVC slotted from 25 to 35 feet from ground surface

0	-	3	Clay, gray, silty, pebbly (till)
3	-	38	Sand and gravel, medium to coarse; rocks from 8 to 11 feet
38	-	39	Clay, gray (till)

County: HAMLIN
Legal Location: SE SE SE NW sec. 24, T. 113 N., R. 51 W.
Latitude: 44.3448
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 09-12-1994
Ground Surface Elevation: 1668.00 T
Total Drill Hole Depth: 43.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1670.40 T
Casing Stick-up: 2.40
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 113N-51W-24BDDD

Longitude: 96.5343

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

Test Hole Number: R20-94-56
SDGS Well Name: R20-94-56

Aquifer: BIG SIOUX

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 42.0

Single Point Resistivity:
Extra:

Well information: screened interval 43.00 to 33.00 feet below casing top; natural filter pack from 43.00 to 14.6 feet below land surface; granular bentonite from 14.6 to 1.5 feet below land surface; cement grout from 1.5 feet to ground level. One steel well protector installed.

0	-	2	Topsoil
2	-	6	Clay, yellow-brown, silty, gravelly (alluvium)
6	-	17	Sand and gravel, brown, medium sand, medium to coarse gravel; clean
17	-	40	Sand, brown, medium; clean
40	-	41	Sand and gravel, brown, medium sand, medium to coarse gravel
41	-	43	Clay

County: HAMLIN

Legal Location: SE SE NE SW sec. 24, T. 113 N., R. 51 W.

Latitude: 44.3435

Land Owner:

Project: BIG SIOUX WELLHEAD

Drilling Company: SDGS

Driller: D. JACOBSON

Geologist: J. GILBERTSON

Date Drilled: 05-21-1991

Ground Surface Elevation: 1650.00 T

Total Drill Hole Depth: 22.0

Water Rights Well:

Other Well Name:

Basin: BIG SIOUX

Management Unit:

Screen Type: PVC, MFG., SLOT SIZE 0.018 IN.

Casing Type: PVC, SCH. 40

Casing Top Elevation: 1653.00 T

Casing Stick-up: 3.00

Well Maintenance Date:

USGS Hydrological Unit Code: 10170202

Electric Log Information:

Spontaneous Potential:

Natural Gamma:

Samples:

Location: 113N-51W-24CADD

Longitude: 96.5342

Driller's Log: X

Geologist's Log:

Drilling Method: ROTARY

Test Hole Number: CO-91-01

SDGS Well Name: CO-91-01

Aquifer:

Screen Length: 10.0

Casing Diameter: 2.0

Total Casing and Screen: 22.0

Single Point Resistivity:

Extra:

Screen from 19 to 9 feet. Filter pack: native material from 22 to 18 feet, very coarse quartz sand from 18 to 7 feet, cement grout from 8 to 0 feet.

0	-	1	Topsoil, black
1	-	5	Clay, dark-tan, pebbly (till)
5	-	21	Gravel, fine
21	-	22	Clay, dark-tan, pebbly (till)

County: HAMLIN

Legal Location: NE NE NE SE sec. 24, T. 113 N., R. 51 W.

Latitude: 44.3446

Land Owner:

Project: ESTELLINE CITY STUDY

Drilling Company: SDGS

Driller: D. IVERSON

Location: 113N-51W-24DAAA

Longitude: 96.5308

Driller's Log:

Geologist: L. SCHULZ
Date Drilled: 09-12-1994
Ground Surface Elevation: 1659.00 T
Total Drill Hole Depth: 28.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1661.70 T
Casing Stick-up: 2.70
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Geologist's Log: X
Drilling Method: HOLLOWSTEM

Test Hole Number: R20-94-54
SDGS Well Name: R20-94-54

Aquifer: BIG SIOUX

Screen Length: 10.3
Casing Diameter: 2.0

Total Casing and Screen: 29.5

Single Point Resistivity:
Extra:

Well information: screened interval 29.48 to 19.13 feet below casing top; natural filter pack from 29.48 to 4.2 feet below land surface; granular bentonite to 3 feet below land surface; cement grout from 3 feet below land surface to ground level. One steel well protector installed. South well of two.

0	-	6	Clay, yellow-brown, silty, sandy (alluvium)
6	-	27	Sand and gravel, brown, medium sand, coarse gravel; clean
27	-	28	Clay

County: HAMLIN
Legal Location: NE NE NE SE sec. 24, T. 113 N., R. 51 W.
Latitude: 44.3446
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 09-12-1994
Ground Surface Elevation: 1659.00 T
Total Drill Hole Depth: 17.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1661.70 T
Casing Stick-up: 2.70
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 113N-51W-24DAAA 1

Longitude: 96.5308

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

Test Hole Number: R20-94-55
SDGS Well Name: R20-94-55

Aquifer: BIG SIOUX

Screen Length: 10.3
Casing Diameter: 2.0

Total Casing and Screen: 19.8

Single Point Resistivity:
Extra:

Well information: screened interval 19.77 to 9.47 feet below casing top; natural filter pack from 19.77 to 4.2 feet below land surface; granular bentonite to 3 feet below land surface; cement grout from 3 feet below land surface to ground level. One steel well protector installed. North well of two.

0	-	6	Clay, yellow-brown, silty, sandy (alluvium)
6	-	17	Sand and gravel, brown, medium sand, coarse gravel; clean

County: HAMLIN
Legal Location: NE NE NE NE sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3422
Land Owner:
Project: BIG SIOUX HYDRO STUDY
Drilling Company: SDGS
Driller: L. HELSETH
Geologist:
Date Drilled: 07-30-1984
Ground Surface Elevation: 1649.00 T
Total Drill Hole Depth: 35.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit:
Screen Type: PVC, HM.
Casing Type: PVC
Casing Top Elevation: 1651.50 T
Casing Stick-up: 2.50
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 113N-51W-25AAAA 2
Longitude: 96.5307

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

Test Hole Number: R20-84-217
SDGS Well Name: R20-84-217

Aquifer:

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 37.5

Single Point Resistivity:
Extra:

PVC slotted 21 to 31 feet from ground surface.

0	-	1	Topsoil, black
1	-	8	Clay, yellow-brown (till)
8	-	33	Sand and gravel
33	-	35	Clay, light-gray, sandy (till)

County: HAMLIN
Legal Location: SW SW NW NE sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3410
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 06-27-1995
Ground Surface Elevation: 1646.00 T
Total Drill Hole Depth: 40.0
Water Rights Well:

Location: 113N-51W-25ABCC
Longitude: 96.5340

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

Test Hole Number: R20-95-30
SDGS Well Name: R20-95-30

Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1648.00 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Aquifer: BIG SIOUX
Screen Length: 5.0
Casing Diameter: 2.0
Total Casing and Screen: 40.3
Single Point Resistivity:
Extra:

Well information: screened interval from 40.34 to 35.00 feet below casing top. Natural filter pack from 40 to 5.2 feet below land surface. Granular bentonite from 5.2 to 2.4 feet below land surface. Cement grout from 2.4 feet below land surface to ground level. One steel well protector installed. South well of two.

0	-	2	Topsoil
2	-	3	Clay, brown, sandy
3	-	39	Sand and gravel, brown, medium to coarse sand, medium to coarse gravel
39	-	40	Clay, gray, silty, sandy

County: HAMLIN
Legal Location: SW SW NW NE sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3410
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 06-27-1995
Ground Surface Elevation: 1646.00 T
Total Drill Hole Depth: 20.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1648.00 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 113N-51W-25ABCC 1
Longitude: 96.5340
Driller's Log:
Geologist's Log: X
Drilling Method: HOLLOWSTEM
Test Hole Number: R20-95-31
SDGS Well Name: R20-95-31
Aquifer: BIG SIOUX
Screen Length: 10.0
Casing Diameter: 2.0
Total Casing and Screen: 20.3
Single Point Resistivity:
Extra:

Well information: screened interval from 20.33 to 10.00 feet below casing top. Natural filter pack from 20 to 4.7 feet below land surface. Granular bentonite from 4.7 to 3.0 feet below land surface.

Cement grout from 3.0 feet below land surface to ground level. One steel well protector installed.
North well of two.

- 0 - 2 Topsoil
- 2 - 3 Clay, brown, sandy
- 3 - 20 Sand and gravel, brown, medium to coarse sand, medium to coarse gravel

County: HAMLIN
 Legal Location: NE SE NW NE sec. 25, T. 113 N., R. 51 W.
 Latitude: 44.3412
 Land Owner:
 Project: ESTELLINE CITY STUDY
 Drilling Company: SDGS
 Driller: D. IVERSON
 Geologist: L. SCHULZ
 Date Drilled: 06-27-1995
 Ground Surface Elevation: 1648.00 T
 Total Drill Hole Depth: 35.0
 Water Rights Well:
 Other Well Name:
 Basin: BIG SIOUX
 Management Unit: BROOKINGS
 Screen Type: PVC, MFG., SLOT SIZE = 0.018
 Casing Type: PVC, SCH. 40
 Casing Top Elevation: 1650.00 T
 Casing Stick-up: 2.40
 Well Maintenance Date:
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:
 Spontaneous Potential:
 Natural Gamma:
 Samples:

Location: 113N-51W-25ABDA
 Longitude: 96.5323
 Driller's Log:
 Geologist's Log: X
 Drilling Method: HOLLOWSTEM
 Test Hole Number: R20-95-32
 SDGS Well Name: R20-95-32
 Aquifer: BIG SIOUX
 Screen Length: 5.0
 Casing Diameter: 2.0
 Total Casing and Screen: 35.2
 Single Point Resistivity:
 Extra:

Well information: screened interval from 35.25 to 30.00 feet below casing top. Natural filter pack from 35 to 3.0 feet below land surface. Granular bentonite from 3.0 to 1.4 feet below land surface. Cement grout from 1.4 feet below land surface to ground level. One steel well protector installed.
North well of two.

- 0 - 2 Topsoil
- 2 - 3 Clay, brown, sandy
- 3 - 34 Sand and gravel, brown, medium to coarse sand, medium to coarse gravel
- 34 - 35 Clay, gray, silty, sandy

County: HAMLIN
 Legal Location: NE SE NW NE sec. 25, T. 113 N., R. 51 W.
 Latitude: 44.3412
 Land Owner:
 Project: ESTELLINE CITY STUDY
 Drilling Company: SDGS
 Driller: D. IVERSON
 Geologist: L. SCHULZ
 Date Drilled: 06-27-1995

Location: 113N-51W-25ABDA 1
 Longitude: 96.5323
 Driller's Log:
 Geologist's Log: X
 Drilling Method: HOLLOWSTEM

Ground Surface Elevation: 1648.00 T
Total Drill Hole Depth: 20.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1650.00 T
Casing Stick-up: 2.40
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Test Hole Number: R20-95-33
SDGS Well Name: R20-95-33

Aquifer: BIG SIOUX

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 19.7

Single Point Resistivity:
Extra:

Well information: screened interval from 19.72 to 9.40 feet below casing top. Natural filter pack from 20 to 3.0 feet below land surface. Granular bentonite from 3.0 to 1.4 feet below land surface. Cement grout from 1.4 feet below land surface to ground level. One steel well protector installed. South well of two.

0	-	2	Topsoil
2	-	3	Clay, brown, sandy
3	-	20	Sand and gravel, brown, medium to coarse sand, medium to coarse gravel

County: HAMLIN
Legal Location: SE SE SW NE sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3357
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 06-27-1995
Ground Surface Elevation: 1650.00 T
Total Drill Hole Depth: 43.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1652.00 T
Casing Stick-up: 2.20
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 113N-51W-25ACDD

Longitude: 96.5323

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

Test Hole Number: R20-95-34
SDGS Well Name: R20-95-34

Aquifer: BIG SIOUX

Screen Length: 5.0
Casing Diameter: 2.0

Total Casing and Screen: 41.3

Single Point Resistivity:
Extra:

Well information: screened interval from 41.30 to 36.00 feet below casing top. Natural filter pack from 43 to 5.1 feet below land surface. Granular bentonite from 5.1 to 2.2 feet below land surface. Cement grout from 2.2 feet below land surface to ground level. One steel well protector installed. North well of two.

0	-	2	Topsoil
2	-	3	Clay, brown, sandy
3	-	42	Sand and gravel, brown, medium to coarse sand, medium to coarse gravel
42	-	43	Clay, gray, silty, sandy

County: HAMLIN
Legal Location: SE SE SW NE sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3357
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 06-27-1995
Ground Surface Elevation: 1650.00 T
Total Drill Hole Depth: 20.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1652.00 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 113N-51W-25ACDD 1

Longitude: 96.5323

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

Test Hole Number: R20-95-35
SDGS Well Name: R20-95-35

Aquifer: BIG SIOUX

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 20.3

Single Point Resistivity:
Extra:

Well information: screened interval from 20.34 to 10.00 feet below casing top. Natural filter pack from 20 to 5.1 feet below land surface. Granular bentonite from 5.1 to 1.8 feet below land surface. Cement grout from 1.8 feet below land surface to ground level. One steel well protector installed. South well of two.

0	-	2	Topsoil
2	-	3	Clay, brown, sandy
3	-	20	Sand and gravel, brown, medium to coarse sand, medium to coarse gravel

County: HAMLIN
Legal Location: SE NW SE NW sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3404
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON

Location: 113N-51W-25BDBD

Longitude: 96.5350

Driller's Log:

Geologist: L. SCHULZ
 Date Drilled: 06-26-1995
 Ground Surface Elevation: 1649.00 T
 Total Drill Hole Depth: 42.0
 Water Rights Well:
 Other Well Name:
 Basin: BIG SIOUX
 Management Unit: BROOKINGS
 Screen Type: PVC, MFG., SLOT SIZE = 0.018
 Casing Type: PVC, SCH. 40
 Casing Top Elevation: 1651.00 T
 Casing Stick-up: 2.15
 Well Maintenance Date:
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:
 Spontaneous Potential:
 Natural Gamma:
 Samples:

Geologist's Log: X
 Drilling Method: HOLLOWSTEM
 Test Hole Number: R20-95-26
 SDGS Well Name: R20-95-26
 Aquifer: BIG SIOUX
 Screen Length: 5.3
 Casing Diameter: 2.0
 Total Casing and Screen: 41.8
 Single Point Resistivity:
 Extra:

Well information: screened interval from 41.81 to 36.55 feet below casing top. Natural filter pack from 42 to 6.8 feet below land surface. Granular bentonite from 6.8 to 2.8 feet below land surface. Cement grout from 2.8 feet below land surface to ground level. One steel well protector installed. East well of two.

0	-	2	Topsoil
2	-	23	Sand and gravel, brown, coarse sand, coarse to pebble gravel
23	-	24	Rocks
24	-	41	Sand and gravel, brown, coarse sand, medium to coarse gravel
41	-	42	Clay, gray, silty, sandy

County: HAMLIN
 Legal Location: SE NW SE NW sec. 25, T. 113 N., R. 51 W.
 Latitude: 44.3404
 Land Owner:
 Project: ESTELLINE CITY STUDY
 Drilling Company: SDGS
 Driller: D. IVERSON
 Geologist: L. SCHULZ
 Date Drilled: 06-27-1995
 Ground Surface Elevation: 1649.00 T
 Total Drill Hole Depth: 20.0
 Water Rights Well:
 Other Well Name:
 Basin: BIG SIOUX
 Management Unit: BROOKINGS
 Screen Type: PVC, MFG., SLOT SIZE = 0.018
 Casing Type: PVC, SCH. 40
 Casing Top Elevation: 1651.00 T
 Casing Stick-up: 2.00
 Well Maintenance Date:
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:
 Spontaneous Potential:

Location: 113N-51W-25BDBD 1
 Longitude: 96.5350
 Driller's Log:
 Geologist's Log: X
 Drilling Method: HOLLOWSTEM
 Test Hole Number: R20-95-27
 SDGS Well Name: R20-95-27
 Aquifer: BIG SIOUX
 Screen Length: 10.0
 Casing Diameter: 2.0
 Total Casing and Screen: 20.3
 Single Point Resistivity:

Natural Gamma:
Samples:

Extra:

Well information: screened interval from 20.28 to 10.00 feet below casing top. Natural filter pack from 20 to 6.3 feet below land surface. Granular bentonite from 6.3 to 2.1 feet below land surface. Cement grout from 2.1 feet below land surface to ground level. One steel well protector installed. West well of two.

0 - 2 Topsoil
2 - 20 Sand and gravel, brown, coarse sand, coarse to pebble gravel

County: HAMLIN
Legal Location: SE SE SE NW sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3357
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 06-27-1995
Ground Surface Elevation: 1647.00 T
Total Drill Hole Depth: 39.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1649.00 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 113N-51W-25BDDD

Longitude: 96.5343

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

Test Hole Number: R20-95-28
SDGS Well Name: R20-95-28

Aquifer: BIG SIOUX

Screen Length: 5.0
Casing Diameter: 2.0

Total Casing and Screen: 39.5

Single Point Resistivity:
Extra:

Well information: screened interval from 39.54 to 34.20 feet below casing top. Natural filter pack from 39 to 5.1 feet below land surface. Granular bentonite from 5.1 to 1.6 feet below land surface. Cement grout from 1.6 feet below land surface to ground level. One steel well protector installed. South well of two.

0 - 2 Topsoil
2 - 3 Clay, brown, sandy
3 - 38 Sand and gravel, brown, medium to coarse sand, medium to coarse gravel; becoming gray in color at around 25 feet
38 - 39 Clay, gray, silty, sandy

County: HAMLIN
Legal Location: SE SE SE NW sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3357
Land Owner:

Location: 113N-51W-25BDDD 1

Longitude: 96.5343

Project: ESTELLINE CITY STUDY
 Drilling Company: SDGS
 Driller: D. IVERSON
 Geologist: L. SCHULZ
 Date Drilled: 06-27-1995
 Ground Surface Elevation: 1647.00 T
 Total Drill Hole Depth: 20.0
 Water Rights Well:
 Other Well Name:
 Basin: BIG SIOUX
 Management Unit: BROOKINGS
 Screen Type: PVC, MFG., SLOT SIZE = 0.018
 Casing Type: PVC, SCH. 40
 Casing Top Elevation: 1649.00 T
 Casing Stick-up: 2.00
 Well Maintenance Date:
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:
 Spontaneous Potential:
 Natural Gamma:
 Samples:

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

Test Hole Number: R20-95-29
 SDGS Well Name: R20-95-29

Aquifer: BIG SIOUX

Screen Length: 10.0
 Casing Diameter: 2.0

Total Casing and Screen: 20.3

Single Point Resistivity:
 Extra:

Well information: screened interval from 20.33 to 10.00 feet below casing top. Natural filter pack from 20 to 5.4 feet below land surface. Granular bentonite from 5.4 to 2.0 feet below land surface. Cement grout from 2.0 feet below land surface to ground level. One steel well protector installed. North well of two.

0	-	2	Topsoil
2	-	3	Clay, brown, sandy
3	-	20	Sand and gravel, brown, medium to coarse sand, medium to coarse gravel

County: HAMLIN
 Legal Location: SW SE SE SW sec. 25, T. 113 N., R. 51 W.
 Latitude: 44.3332
 Land Owner:
 Project: ESTELLINE CITY STUDY
 Drilling Company: SDGS
 Driller: D. IVERSON
 Geologist: L. SCHULZ
 Date Drilled: 06-26-1995
 Ground Surface Elevation: 1647.00 T
 Total Drill Hole Depth: 35.0
 Water Rights Well:
 Other Well Name:
 Basin: BIG SIOUX
 Management Unit: BROOKINGS
 Screen Type: PVC, MFG., SLOT SIZE = 0.018
 Casing Type: PVC, SCH. 40
 Casing Top Elevation: 1649.00 T
 Casing Stick-up: 2.00
 Well Maintenance Date:
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:

Location: 113N-51W-25CDDC

Longitude: 96.5352

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

Test Hole Number: R20-95-22
 SDGS Well Name: R20-95-22

Aquifer: BIG SIOUX

Screen Length: 5.0
 Casing Diameter: 2.0

Total Casing and Screen: 33.0

Spontaneous Potential:
Natural Gamma:
Samples:

Single Point Resistivity:
Extra:

Well information: screened interval from 33 to 28 feet below casing top. Natural filter pack from 35 to 4.8 feet below land surface. Granular bentonite from 4.8 to 2.0 feet below land surface to ground level. One steel well protector installed. West well of two.

0	-	2	Topsoil
2	-	4	Clay, brown, sandy
4	-	34	Sand and gravel, brown, coarse sand, coarse gravel; gray in color toward bottom
34	-	35	Clay, dark-green, very silty

County: HAMLIN
Legal Location: SW SE SE SW sec. 25, T. 113 N., R. 51 W.
Latitude: 44.3332
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 06-26-1995
Ground Surface Elevation: 1647.00 T
Total Drill Hole Depth: 20.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1649.00 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

Location: 113N-51W-25CDDC 1

Longitude: 96.5352

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

Test Hole Number: R20-95-23
SDGS Well Name: R20-95-23

Aquifer: BIG SIOUX

Screen Length: 10.0
Casing Diameter: 2.0

Total Casing and Screen: 20.3

Single Point Resistivity:
Extra:

Well information: screened interval from 20.33 to 10.0 feet below casing top. Natural filter pack from 20 to 3.8 feet below land surface. Granular bentonite from 3.8 to 2.0 feet below land surface. Cement grout from 2.0 feet below land surface to ground level. One steel well protector installed. East well of two.

0	-	2	Topsoil
2	-	4	Clay, brown, sandy
4	-	20	Sand and gravel, brown, coarse sand, coarse gravel

County: HAMLIN
Legal Location: SE SE SE SE sec. 26, T. 113 N., R. 51 W.
Latitude: 44.3237
Land Owner:

Location: 113N-51W-26DDDD

Longitude: 96.5423

Project:
Drilling Company: USGS
Driller: C. HEANEY
Geologist: J. KUME
Date Drilled: 08-09-1971
Ground Surface Elevation: 1646.00 T
Total Drill Hole Depth: 37.0
Water Rights Well: HN-71A
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, HM.
Casing Type: PVC
Casing Top Elevation:
Casing Stick-up: 2.90
Well Maintenance Date: 05-17-1983
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:
Natural Gamma:
Samples:

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

Test Hole Number:
SDGS Well Name:

Aquifer: BIG SIOUX

Screen Length: 10.0
Casing Diameter: 1.3

Total Casing and Screen: 25.0

Single Point Resistivity:
Extra:

Casing slotted 10 feet.

0	-	2	Sand, light-brown; dirty, dry
2	-	6	Sand, brown, gravelly; dirty, dry
6	-	23	Sand and gravel, brown, fine to medium; dirty, wet
23	-	27	Sand and gravel, gray, fine to medium
27	-	37	Clay, gray, silty, pebbly (till)

County: HAMLIN
Legal Location: NE NW NE NE sec. 36, T. 113 N., R. 51 W.
Latitude: 44.3330
Land Owner:
Project: ESTELLINE CITY STUDY
Drilling Company: SDGS
Driller: D. IVERSON
Geologist: L. SCHULZ
Date Drilled: 06-26-1995
Ground Surface Elevation: 1647.00 T
Total Drill Hole Depth: 27.0
Water Rights Well:
Other Well Name:
Basin: BIG SIOUX
Management Unit: BROOKINGS
Screen Type: PVC, MFG., SLOT SIZE = 0.018
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1649.00 T
Casing Stick-up: 2.00
Well Maintenance Date:
USGS Hydrological Unit Code: 10170202
Electric Log Information:
Spontaneous Potential:

Location: 113N-51W-36AABA

Longitude: 96.5316

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

Test Hole Number: R20-95-24
SDGS Well Name: R20-95-24

Aquifer: BIG SIOUX

Screen Length: 5.0
Casing Diameter: 2.0

Total Casing and Screen: 28.7

Single Point Resistivity:

Natural Gamma:
Samples:

Extra:

Well information: screened interval from 28.70 to 23.36 feet below casing top. Natural filter pack from 27 to 4.4 feet below land surface. Granular bentonite from 4.4 to 1.6 feet below land surface. Cement grout from 1.6 feet below land surface to ground level. One steel well protector installed. West well of two.

0	-	2	Topsoil
2	-	4	Clay, brown, sandy
4	-	26	Sand and gravel, brown, coarse sand, coarse gravel; becoming gray in color toward the bottom
26	-	27	Clay, olive-green, silty; some sand

County: HAMLIN
 Legal Location: NE NW NE NE sec. 36, T. 113 N., R. 51 W.
 Latitude: 44.3330
 Land Owner:
 Project: ESTELLINE CITY STUDY
 Drilling Company: SDGS
 Driller: D. IVERSON
 Geologist: L. SCHULZ
 Date Drilled: 06-26-1995
 Ground Surface Elevation: 1647.00 T
 Total Drill Hole Depth: 20.0
 Water Rights Well:
 Other Well Name:
 Basin: BIG SIOUX
 Management Unit: BROOKINGS
 Screen Type: PVC, MFG., SLOT SIZE = 0.018
 Casing Type: PVC, SCH. 40
 Casing Top Elevation: 1649.00 T
 Casing Stick-up: 2.00
 Well Maintenance Date:
 USGS Hydrological Unit Code: 10170202
 Electric Log Information:
 Spontaneous Potential:
 Natural Gamma:
 Samples:

Location: 113N-51W-36AABA 1

Longitude: 96.5316

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

Test Hole Number: R20-95-25
 SDGS Well Name: R20-95-25

Aquifer: BIG SIOUX

Screen Length: 10.0
 Casing Diameter: 2.0

Total Casing and Screen: 20.3

Single Point Resistivity:
 Extra:

Well information: screened interval from 20.34 to 10.00 feet below casing top. Natural filter pack from 20 to 4.3 feet below land surface. Granular bentonite from 4.3 to 2.0 feet below land surface. Cement grout from 2.0 feet below land surface to ground level. One steel well protector installed. East well of two.

0	-	2	Topsoil
2	-	4	Clay, brown, sandy
4	-	20	Sand and gravel, brown, coarse sand, coarse gravel