STATE OF SOUTH DAKOTA
Nils Boe, Governor

SOUTH DAKOTA STATE GEOLOGICAL SURVEY
Duncan J. McGregor, State Geologist

Special Report 39

GROUND-WATER SUPPLY FOR THE CITY OF DELL RAPIDS, SOUTH DAKOTA

by
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INTRODUCTION

Present Investigation

This report contains the results of a ground-water study by the South Dakota Geological Survey from July 19 to August 27, 1965, in and around the city of Dell Rapids, Minnehaha County, South Dakota. The purpose of the study was to assess the ground-water resources in and around the city of Dell Rapids.

Dell Rapids now obtains its water from three wells within the city limits which are producing from the Sioux Quartzite. City wells 1, 2, and 3 are approximately 130, 540, and 570 feet deep, respectively, and the maximum combined production from the wells is 250 gallons per minute (gpm) which is inadequate much of the year. In addition, well no. 3, the most used well, has water of inferior quality. Thus, it was decided that a study be made of the ground-water conditions in and around the city of Dell Rapids.

A study was made of the ground-water conditions in an area of about 50 square miles around the city and consisted of drilling 95 test holes with the Survey's auger drill and 8 test holes with the Survey's rotary drill. Also included in the study was an inventory of all farm wells in the area, analyses of 56 water samples, and a review of the geology as previously mapped by Tipton (1959).

The study shows three aquifers in the Dell Rapids area that are potential sources of water: (1) the Sioux Quartzite, from which the city's present water supply is obtained, (2) a surface outwash found in the Big Sioux River valley, and (3) a buried outwash underlying the northern half of the study area.

The field work and preparation of this report were performed under the supervision of Lynn S. Hedges, ground-water geologist of the South Dakota Geological Survey.

The cooperation of the residents of Dell Rapids, especially Allen B. Brown, City Attorney, and Walt Crisp, Water and Sewer Superintendent, is greatly appreciated.

Location and Extent of Area

The city of Dell Rapids is located in north-central Minnehaha County in east-central South Dakota. Dell Rapids has a population of 1,863 (1960 census). The study area is in the Coteau des Prairies division of the Central Lowland physiographic province and includes a portion of south-central Moody County (fig. 1).

Climate

The climate is continental temperate and features wide variations in temperature with normally ample spring and summer rainfall and lighter winter precipitation. The mean annual temperature is 46.6 degrees Fahrenheit, and the average annual precipitation is 25.38 inches at the U. S. Weather Bureau Station in Sioux Falls, 20 miles to the south.

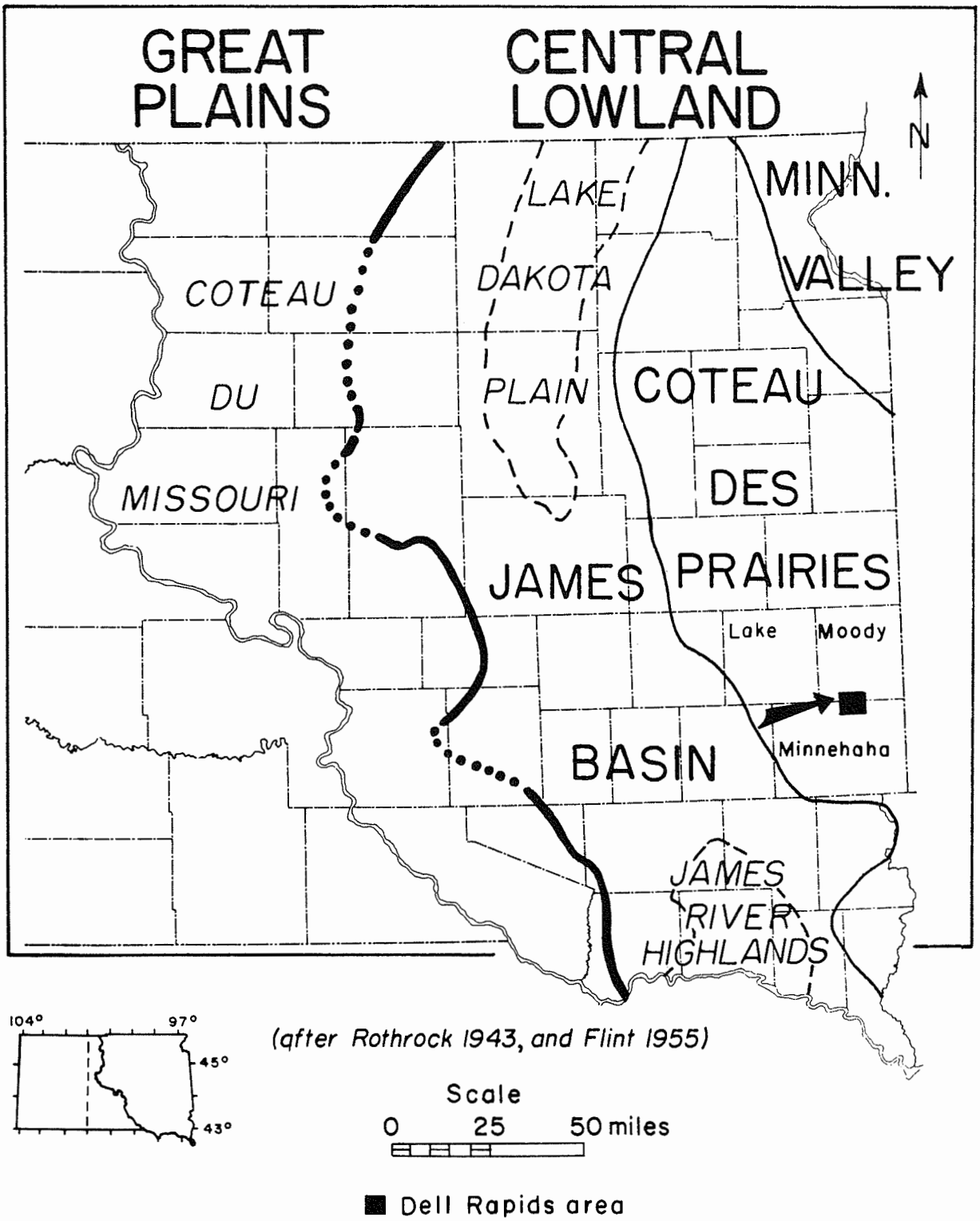


Figure 1. Map of eastern South Dakota showing the major physiographic divisions and location of the Dell Rapids area.

Topography and Drainage

The topography of the Dell Rapids area is characterized by hills and valleys with local relief of about 50 feet. The Big Sioux River valley is very gently undulating to flat and is incised about 75 feet below the rolling uplands.

The drainage of the area consists of an integrated drainage net controlled by the Big Sioux River and its tributaries.

Data-Point Numbering System

Data-collection points (wells, test holes, and water samples) are located in accordance with the United States Bureau of Land Management's system of land subdivision. The first numeral of a point designation indicates the township; the second, the range; and the third, the section in which the point is situated. Lowercase letters after the section number indicate location within the section; the first letter denotes the 160-acre tract; the second, the 40-acre tract; the third, the 10-acre tract; and the fourth, the $2\frac{1}{2}$-acre tract. The letters a, b, c, and d are assigned in a counter-clockwise direction, beginning in the northeast corner of each tract. For example, data-collection point 105-49-35badd (test hole 50, fig. 2) is in the $SE\frac{1}{4}SE\frac{1}{4}NE\frac{1}{4}NW\frac{1}{4}$ sec. 35, T. 105 N., R. 49 W., (see fig. 3).

GENERAL GEOLOGY

Surficial Deposits

The surficial deposits of the Dell Rapids area were deposited chiefly by glaciers in the Pleistocene Epoch of earth history. The glacial deposits are collectively termed drift. Drift is divisible into two broad lithologic groups: till and outwash.

Till (commonly called "boulder clay," "blue clay," or "gumbo") consists of unsorted and unstratified material that ranges in size from boulders to clay and was deposited directly from the ice. In the Dell Rapids area, loess (windblown material consisting mainly of silt-sized particles) generally covers the till and is up to 8 feet thick. The loess is not shown on the geologic map. Till is the major surficial deposit east and west of the Big Sioux River valley (fig. 2).

Outwash consists of stratified sand, gravel, and silt with minor amounts of clay which is deposited by meltwater from an ice sheet. A special category of outwash--valley train outwash deposits--is outwash material deposited in a pre-existing valley. Valley train outwash deposits are present at the surface throughout the Big Sioux River valley (except where covered by alluvium, or where it has been completely eroded away in or near the Big Sioux River channel) and will be referred to hereafter as "surface outwash." Outwash material which has been buried beneath other deposits is commonly referred to as "buried outwash." Such a deposit or series of deposits is present about one to two miles north of the city and includes the northern half of the study area. The till often

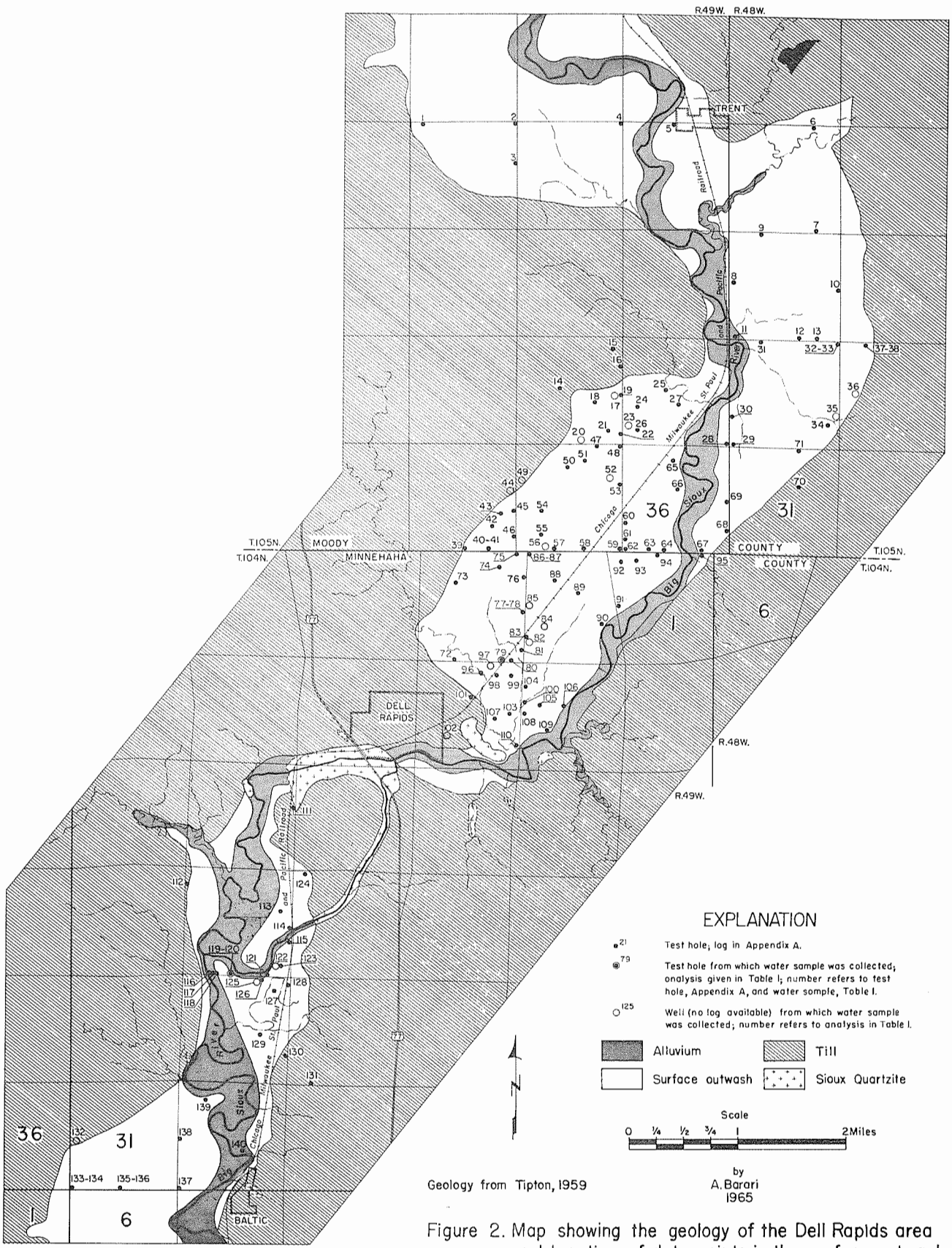


Figure 2. Map showing the geology of the Dell Rapids area and location of data points in the surface outwash.

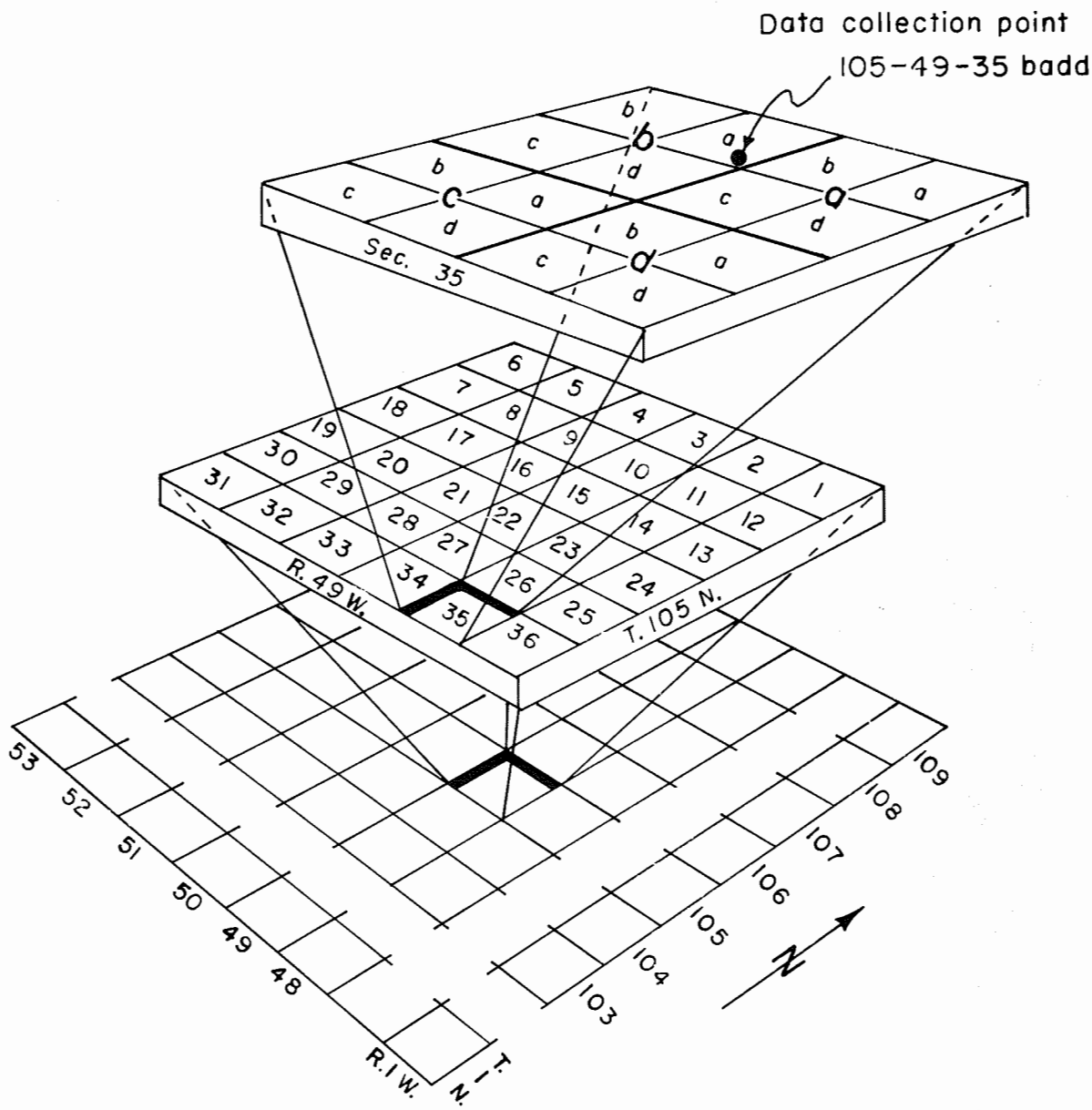


Figure 3. Data-point numbering system.

contains small discontinuous lenses of sand and gravel, but due to the limited areal extent and thinness of these deposits, they are referred to as sand and gravel lenses rather than outwash.

Alluvium consists of silt and clay-size particles with minor amounts of sand and gravel, deposited by streams since the glaciers melted away. Alluvium is present along the Big Sioux River channel (fig. 2).

Exposed and Subsurface Bedrock

The Sioux Quartzite of Precambrian age is exposed in and around Dell Rapids and in small areas south to Baltic (fig. 2). A test hole 2 miles north of the city showed that Sioux Quartzite is 230 feet below the ground level; another test hole $3\frac{1}{2}$ miles northeast of the city was drilled 440 feet deep and still had not penetrated quartzite.

In this area the Sioux Quartzite is an orthoquartzite consisting of fine grains of iron-coated quartz sand cemented with silica. The iron coating on the quartz grains imparts a pinkish or reddish color to the formation.

OCCURRENCE OF GROUND WATER

Principles of Occurrence

Ground water is defined as water contained in the voids or openings of rocks or sediments below the water table. Despite the common belief that ground water is found in "veins" crisscrossing the land in a discontinuous maze, it is known that water occurs almost everywhere in the ground at a depth below the surface which varies from a few feet to several tens or even hundreds of feet.

Almost all ground water is derived from precipitation. Rain or melting snow either percolates directly downward to the water table and becomes ground water, or drains off as surface water. Surface water either evaporates, escapes to the ocean by streams, or percolates downward to the ground-water table.

Recharge is the addition of water to an aquifer, and is accomplished in four main ways: (1) by downward percolation of precipitation that falls on the ground surface, (2) by downward percolation from surface bodies of water, (3) by lateral flow of ground water in transient storage, and (4) by artificial recharge.

Discharge of ground water from an aquifer generally is accomplished in four ways: (1) by evaporation and transpiration of plants, (2) by seepage into surface bodies of water, (3) by lateral movement of ground water in transient storage, and (4) by pumping from wells which constitutes the major discharge of ground water.

The porosity of a rock or soil is a measure of the contained open spaces, and is expressed as the percentage of open space to the total volume of rock. The porosity of a sedimentary deposit depends chiefly on: (1) the shape and arrangement of the particles, (2) the degree of assortment of its particles, (3) the cementation and compaction to which it has been subjected since its deposition, (4) the removal of mineral matter through

solution by percolating waters, and (5) the fracturing of a cemented rock, resulting in joints and other openings. If the material is poorly sorted, small particles occupy the space between the large ones, still smaller ones occupy the space between the small particles, and so on, with the result that the porosity is greatly reduced. Till is an unsorted material that ranges in size from boulders to clay, and usually has a low porosity, whereas outwash gravel and sand derived from the same source but sorted by running water, generally has a higher porosity. In a saturated rock, the porosity is the percentage of the volume of the rock that is occupied by water to the total volume of the rock.

Permeability is a measure of the rate at which water moves through a porous material. Water will pass through a material with interconnected pores, but will not pass through material with unconnected pores, even if the latter material has a high porosity. Therefore, permeability and porosity are not synonymous, but are related.

Sand and gravel generally has both a high porosity and permeability which allows the rapid movement of water through these materials.

Ground Water in Alluvium

Alluvium along the Big Sioux River (fig. 2) consists mainly of silt and clay and has a maximum thickness of about 20 feet. The alluvium contains ground water; however, the permeability is low due to the high silt and clay content. Thus, the alluvium does not readily yield large quantities of water to wells.

Ground Water in Glacial Deposits

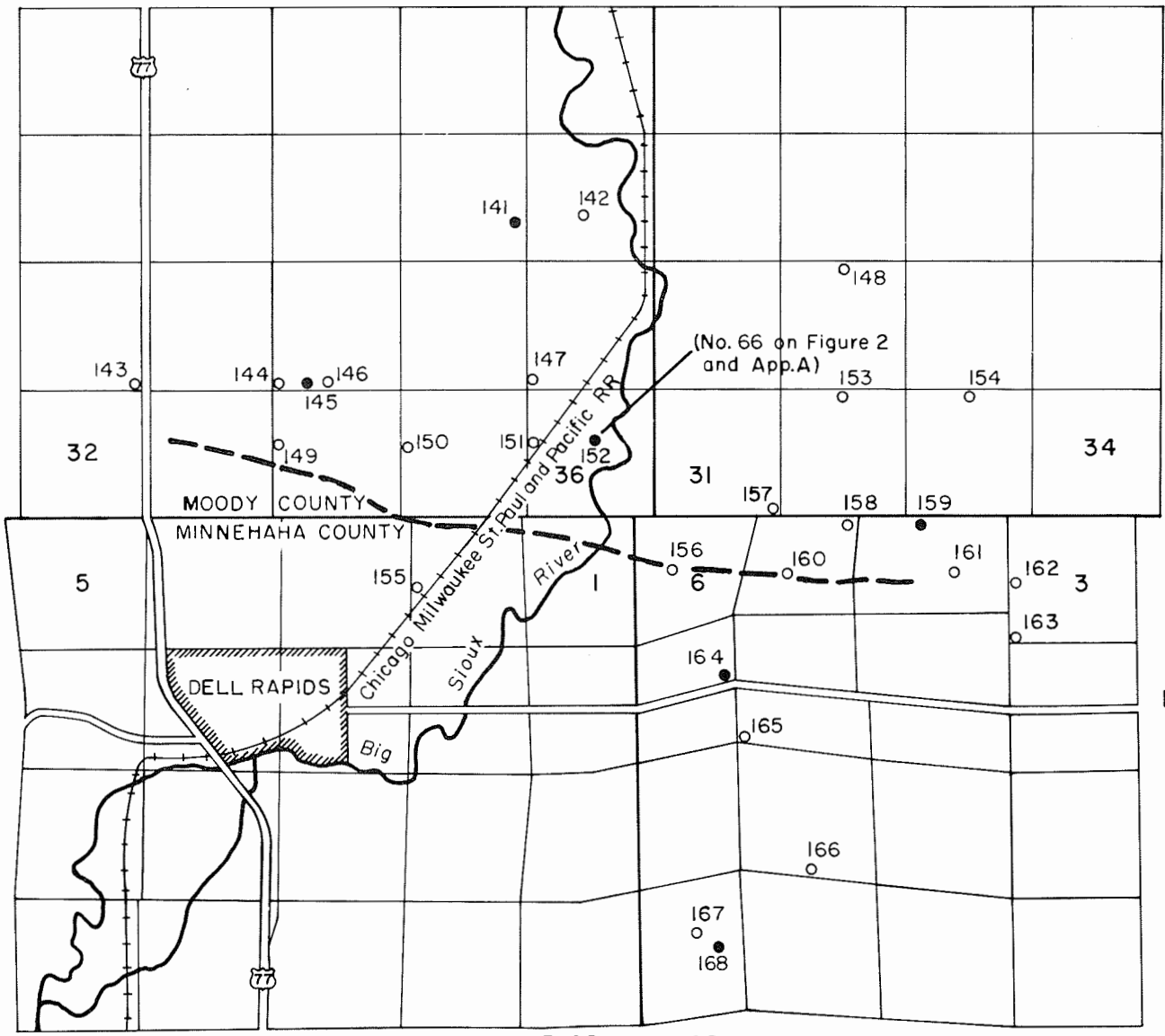
Till, because of its highly unsorted nature, has low permeability and does not yield water readily. Thus, till is not a favorable aquifer for high-yield wells. Outwash generally is a good source of ground water because its high permeability is favorable for development of high-yield wells.

There are two different outwash deposits in the Dell Rapids area: surface outwash (fig. 2) and buried outwash (fig. 4).

Surface Outwash

Surface outwash deposits (fig. 2) are found in the Big Sioux River valley and consist of stratified deposits of poorly sorted to well sorted sand and gravel. The surface is nearly level. Figure 5 shows the saturated thickness of this deposit.

Areas A and B (fig. 5) northeast of Dell Rapids contain saturated surface outwash deposits generally 10 to 20 feet thick. The maximum thickness in area A is 16 feet in test hole 21. Test holes 57 and 58 in area B contain 20 feet of saturated outwash. However, within one-half mile or less from each of these areas the thickness of saturated outwash thins to 10 feet or less; thus, the area of thickest sand and gravel is small. It is doubtful that either of these small areas could supply enough water for city wells



EXPLANATION

- ● Geological Survey test hole.
- ○ Private well

Numbers refer to test holes (App. A) or water sample (Table 2).

— — Buried outwash generally thin or absent south of this line; buried outwash generally 30 to 50 feet thick north of this line.

Scale

1 0 1 2 3 miles

by A. Barari

1965

Figure 4. Data map showing location of test holes and wells with water samples in the buried outwash.

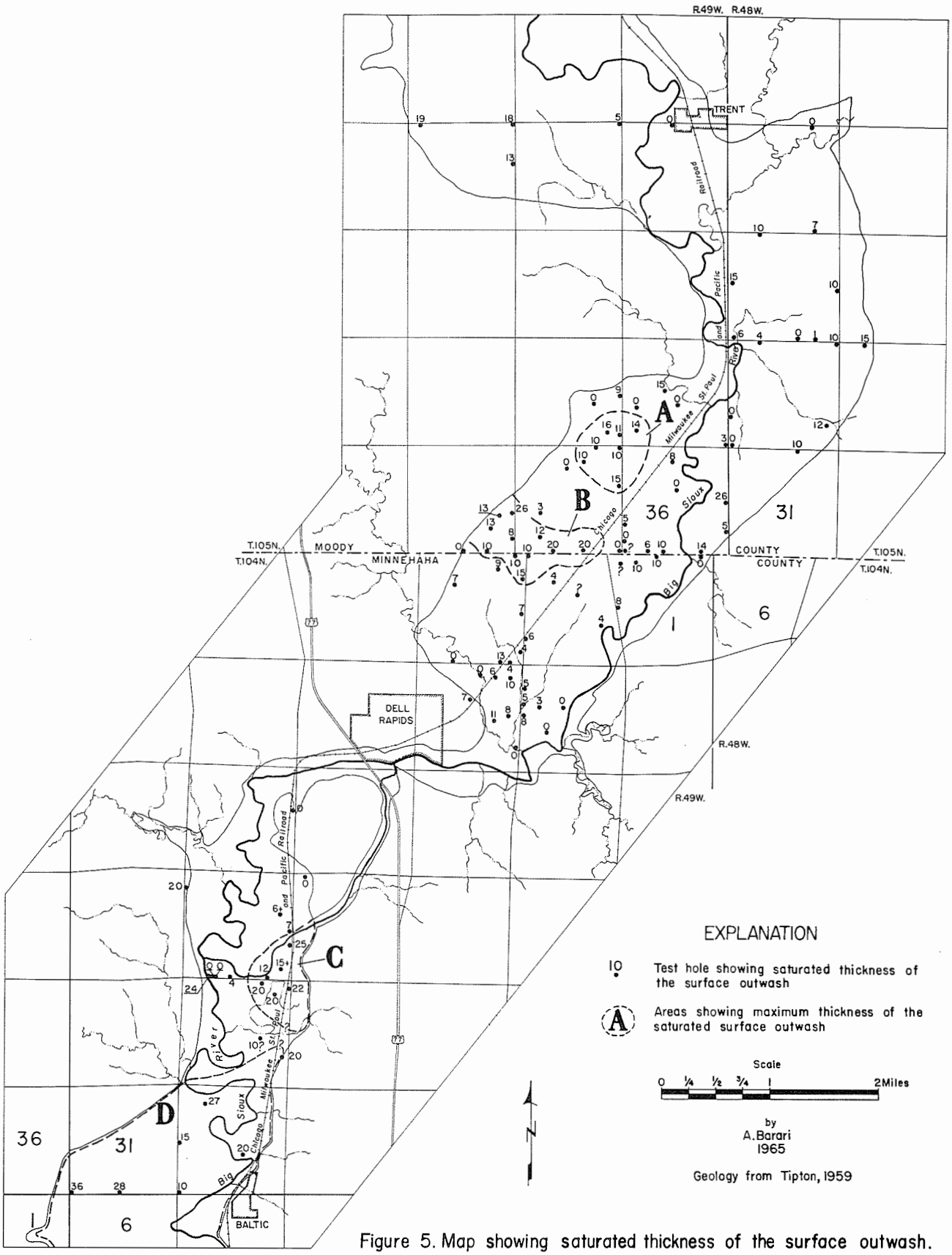


Figure 5. Map showing saturated thickness of the surface outwash.

using present conventional well construction techniques. Additional test drilling may show the area of maximum thickness to be larger than it appears to be. If this is true, several low-capacity wells might supply the city with water. Another possibility for water development in areas A or B would be the installation of a special water-gathering system such as an infiltration gallery or Ranney-type wells. In any instance, thorough feasibility and engineering studies would be required in areas A or B to determine if sufficient quantity of water is available to maintain a city-water supply.

The surface outwash southwest of Dell Rapids is as much as 25 feet thick in area C (fig. 5). Near the northeast corner of area C the Sioux Quartzite is at the surface. Other test holes drilled in area C hit the quartzite at various depths; thus, the surface of the quartzite is uneven. Where the quartzite is close to the surface, sand and gravel deposits are thin and where the quartzite is deeper these deposits are thicker. Such changes in thickness may take place in a few hundred feet or less. Therefore, it will probably be necessary to drill additional test holes in area C to determine if the aquifer here will supply enough water for one or more city wells.

Area D (fig. 5) is the largest area, with thick sand and gravel and is the area most favorable for future test drilling. Test holes 133, 134, 135, and 136 (figs. 2 and 5) have as much as 36 feet of saturated sand and gravel and would probably supply the city of Dell Rapids with a sufficient quantity of water.

Buried Outwash

The buried outwash deposits are variable in thickness because the surface of the underlying quartzite is uneven. These deposits occur as a series of sand and gravel beds separated by clay layers less than 100 feet above the Sioux Quartzite. The maximum thickness of the sand and gravel beds is 57 feet in test hole 145 (fig. 4 and app. A). The buried outwash is probably continuous and averages 30-50 feet thick in the northern one-half of the study area as indicated on figure 4 by the heavy dashed line. South of the dashed line the buried outwash is thinner and discontinuous due to the shallower, uneven eroded quartzite surface. Therefore, large-capacity wells could probably be developed in the northern part of the study area but not in the southern part of the study area.

The water in the buried outwash deposits is under artesian pressure and flows from wells in the Big Sioux River valley northeast of Dell Rapids. On the uplands east and west of the Big Sioux River valley, the water does not flow from wells in the buried outwash because of the higher elevation of the uplands.

Ground Water in the Sioux Quartzite

The occurrence of ground water in the Sioux Quartzite is controlled primarily by the presence or absence of joints in the rock. Where the rock is jointed, water will move freely through the rock. If no joints are

present, the rock is essentially impermeable to water. The quartzite at the surface and in the subsurface in the Dell Rapids area has a well-developed joint system, and wells completed in this formation are generally quite productive.

At Dell Rapids and southward in the Big Sioux River valley the Sioux Quartzite is exposed at the surface. Elsewhere in the study area the Sioux Quartzite is covered with as much as 440 feet of glacial drift. Where the Sioux Quartzite is found at or near the surface, recharge of water to the formation may occur directly from precipitation or indirectly from percolation through the thin overlying deposits. In those areas where the Sioux Quartzite is deeply buried, nearly all the recharge must be from water contained in sediments which are in contact with the formation.

Chemical Quality of Ground Water

Ground water always contains minerals in various quantities. The minerals are derived from: (1) the atmosphere as the water vapor condenses and falls, (2) the soil and underlying deposits as the water moves downward to the water table, and (3) deposits below the water table, where the water is circulating. In general, the more minerals that a water contains, the poorer is its quality.

Tables 1, 2, and 3 show the quality of water from the various aquifers in the Dell Rapids area as compared with the limits recommended by the U. S. Department of Public Health as modified by the South Dakota State Department of Health (sample A, tables 1, 2, and 3).

Table 1 shows the quality of water from the surface outwash and the sample locations are shown on figure 2. Inspection of the table shows a wide range of water quality from this aquifer. Each of the 19 samples analyzed contained hard water, 8 had an excess of sulfate, and 11 had an excess of total solids. Only 3 of the samples are high in iron content while 4 out of 9 samples tested have an excess of manganese.

Eight samples (17, 20, 23, 52, 85, 120, 122, and 125) are of good quality by South Dakota standards; seven of these are located in two general areas. The first area is represented by samples 17, 20, 23, and 52 in area A of figure 5, about 3 miles northeast of Dell Rapids. The second area is represented by samples 120, 122, and 125 (fig. 2) about two miles southwest of Dell Rapids and in or near to area C in figure 5.

Water samples 44, 49, and 56 (fig. 2) are close to area B on figure 5 and may be an indication of the quality of water to be expected in that area. These samples contain little or no iron and manganese but are high in total solids and sulfate.

Water sample 132 (fig. 2) is near the margin of area D on figure 5 and is high only in total solids. Much of the high total solids in this sample, however, is probably due to the excessive hardness, and reduction of the hardness content should result in good quality water. This same relationship is also true for other samples of the surface outwash water. Removal of the hardness from much of the surface outwash water would make it fall within the recommended limits for drinking water.

Table 1.--Chemical analyses of water samples from the surface outwash in the Dell Rapids area. (See fig. 2 for location of samples.)

Sample	Source	Parts Per Million											
		Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrate	Fluoride	pH	Hardness $CaCO_3$	Total Solids
A		---	---	50	250	500*	0.3	0.05	10.0	0.9-1.7**	---	----	1000*
17		92	15	37	trace	98	trace	0	3	0.6	7.5	380	538
20		136	22	61	14	302	0	0	9.2	0.6	7.5	590	908
23		119	11	40	19	192	0.04	0	11.2	0.4	7.7	460	714
35		265		78	14	900	trace				7.6	980	1865
36		356		54	104	350	trace				7.8	860	1578
44		310	33	165	105	500	trace	0	9	0.4	7.2	1400	2296
49		265		205	112	600	0.08				7.4	1500	2000
52		102	24	35	14	238	trace	0.1	5	0.6	7.6	400	650
56		212	32	85	59	444	0	0	4	0.4	7.2	880	1332
79		175	88	90	18	668	.06	.93	.2	0.7	7.4	805	1320
82		160		83	43	540	0				7.6	740	1115
84		240	155	114	59	982	0.04	1.1	2.2	0.6	7.5	1080	2000
85		102		36	12	216	0.04				7.6	400	600
97		213	22	66	10	618	0.44	0.4	0.4	0.4	7.6	800	1110
102		232		43	20	743	0.80				7.4	920	1430
120		84	12	38	26	90	.08	.56	.2	0.3	7.7	364	428
122		104		16	16	100	0				7.4	325	523
125		104		22	0	96	0.60				7.6	350	474
132		363	62	133	139	382	0	none	13.0	0.8	7.0	1450	1970

* Modified for South Dakota by the State Department of Health (written communication, February 5, 1962)

** Optimum

Sodium, manganese, nitrate, and fluoride analyzed by State Chemical Laboratory. All other constituents analyzed by South Dakota Geological Survey.

Location of Water Samples

SAMPLE NO.	LOCATION	DEPTH OF WELL	NAME OF OWNER
A	Drinking Water Standards, U. S. Department of Public Health (1961)		
17	105-49-26daab	37	J. Rave
20	105-49-26dcdc	30	F. Weelborg
23	105-49-25ccbc	40	A. Rave
35	105-48-30dadd	20	R. Nelson
36	105-48-29bcdc	21	G. Christensen
44	105-49-34addb	31	L. Allen
49	105-49-35bcbb	30	M. Zimmerman
52	105-49-35adba	16	J. Alberts
56	105-49-35ccdd	13	J. Merges
79	104-49-3ddc	21	WRC S-22
82	104-49-2ccbc	15	Q. Nemmers
84	104-49-2cbaa	32	M. Eulberg
85	104-49-2bccc	13	J. Nemmers
97	104-49-10abab	12-14	T. Hansen
102	104-49-10cacc	18	R. O'Brien
120	104-49-20cdd	35	USGS S-8
122	104-49-20ddbd	18	A. Thoreson
125	104-49-29abaa	18	L. Schwemle
132	104-49-31cbbb	18	T. Berg

Table 2.--Chemical analyses of water samples from the buried outwash in the Dell Rapids area. (See fig. 4 for location of samples.)

Sample	Source	Parts Per Million											
		Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrate	Fluoride	pH	Hardness $CaCO_3$	Total Solids
A	*	---	---	50	250	500**	0.3	0.05	10.0	0.9-1.7***	---	----	1000**
142	B	313		83	25	1442	1.2				7.0	1120	2670
143		413		100	41	959	trace				7.6	1440	2460
144		412		85	0	1260	2.0				7.6	1370	2710
146	B	412		127	12	1440	2.0				7.0	1545	2960
147		338		39	24	1500	0.08				7.1	1000	2075
148	B	196		51	22	600	0.04				8.0	700	1410
149	B	410	107	122	10	1454	4.8	1.6	3.6	0.8	7.1	1525	2000
150		400		135	14	1500	0.04				7.6	1550	2610
151	B	342	224	79	22	1372	trace	1.4	2.0	0.4	7.0	1175	2018
153	B	400		122	0	1440	0.5				7.2	1500	2820
154	B	422		128	trace	1680	5.0				7.4	1575	3020
155	B	257		78	35	985	1.6				7.4	962	1572
156	B	292		88	39	1020	trace				7.3	1080	2360
157	B	225		33	16	962	5.0				7.6	890	1820
158		212		115	177	138	0				7.0	1000	1532
160	B	450		152	12	1592	1.4				7.4	1750	3310
161	B	136		46	15	397	4.0				7.6	530	880
162	B	337		64	44	830	trace				7.5	1100	1970

(continued on next page)

Table 2.--continued

Sample	Source	Parts Per Million											
		Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrate	Fluoride	pH	Hardness $CaCO_3$	Total Solids
163		342		27	13	872	0				7.5	960	1265
165	B	261		92	8	932	trace				7.8	1030	1800
166		96		30	10	0	trace				8.2	364	668
167		205		51	112	337	trace				7.7	720	1580

* Those samples marked B are thought to be from the buried outwash; the source of the other samples is uncertain.

** Modified for South Dakota by the State Department of Health (written communication, February 5, 1962)

*** Optimum

Sodium, manganese, nitrate, and fluoride analyzed by State Chemical Laboratory. All other constituents analyzed by South Dakota Geological Survey.

Location of Water Samples

SAMPLE NO.	LOCATION	DEPTH OF WELL	NAME OF OWNER
A	Drinking Water Standards, U. S. Department of Public Health (1961)		
142	105-49-24ca	280	B. Cronk
143	105-49-29dd	60	J. Fitzgerald
144	105-49-27cc	90	V. Schwebach
146	105-49-27cd	160	L. Maseman
147	105-49-25cc	80	A. Rave
148	105-48-29ba	160	S. Trust
149	105-49-34bc	198	L. Elsinger
150	105-49-35bc	90	M. Zimmerman
151	105-49-36bc	153	H. Olson
153	105-48-32ab	210	R. Nelson
154	105-48-33ba	160+	F. Marshall
155	104-49-2cb	170	M. Eulberg
156	104-48-6bd	216	D. Knutson
157	105-48-31dd	308	M. Anderson
158	104-48-5aa	38	L. Anderson
160	104-48-5bd	160	L. Bach
161	104-48-4ac	289	W. Shelvqust
162	104-48-3bc	200	M. Evans
163	104-48-3cc	70	M. Muller
165	104-48-8cc	180	N. Jensen
166	104-48-17dc	26	J. Merry
167	104-48-19ac	58	K. Shefte

Table 3.--Chemical analyses of water samples from the Sioux Quartzite in the Dell Rapids area. (See fig. 6 for location of samples.)

Sample	Source	Parts Per Million											
		Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrate	Fluoride	pH	Hardness $CaCO_3$	Total Solids
A		---	---	50	250	500*	0.3	0.05	10.0	0.9-1.7**	---	----	1000*
169		370		111	11	1440	40+				7.3	1380	2860
170		466		78	13	1350	trace				7.7	1488	2365
171		422		97	10	1350	trace				8.0	1440	2405
172		331		121	trace	1320	0.4				7.2	1320	2700
173		232		64	15	710	trace				7.3	840	1225
174		126	18	39	22	216	0	0.6	11	0.4	7.2	475	656
175		173	31	54	18	446	trace	0.3	4	0.6	7.6	650	1042
175		180		52	48	468	trace				7.6	662	980
176		90		35	38	300	trace				7.2	370	617
177		80		25	25	84	trace				7.1	300	500
178		113		39	17	trace	0.06				8.2	440	808
179		225		81	35	840	trace				7.9	890	1810
180		236	50	66	27	692	trace	none	3.3	0.4	7.7	910	1618

* Modified for South Dakota by the State Department of Health (written communication, February 5, 1962)

** Optimum

Sodium, manganese, nitrate, and fluoride analyzed by State Chemical Laboratory. All other constituents analyzed by South Dakota Geological Survey.

Location of Water Samples

SAMPLE NO.	LOCATION	DEPTH OF WELL	NAME OF OWNER
A	Drinking Water Standards, U. S. Department of Public Health (1961)		
169	105-49-27bcba	315	M. Weinacht
170	105-49-31dada	480	B. Frantzen
171	105-49-32adcd	145	C. Mousel
172	104-49-3bccc	160	P. Masemann
173	104-49-9ad(Well #3)	520-570	Dell Rapids
174	104-49-10cc(Well #2)	540	Dell Rapids
175	104-49-10dc	150	quarry, L. G. Everist, Inc.
175	104-49-10dc	150	quarry, L. G. Everist, Inc.
176	104-49-16aaad	60	B. Halvorson
177	104-49-15bbcc	400	W. Strub
178	104-49-16daa	185	V. Buskerud
179	104-49-13dda	300	L. Merry
180	103-49-5ab(Baltic city)	160	city

Table 2 shows the analyses of water from the buried outwash in the Dell Rapids area and figure 4 shows the location of the water samples. Most of the samples from the lower part of the buried outwash (marked "B" under source on table 2) contain excess sulfate, iron, hardness, and total solids.

Table 3 shows the water analyses from the Sioux Quartzite and figure 6 shows the location of the water samples. Of those wells sampled in the study area, City well 2 and wells 176, 177, and 178 (area E, fig. 6) had better quality water than any other wells in quartzite. The quality of water in these wells is better because the quartzite is recharged nearby with surface water and precipitation where the rock is at the surface or is overlain by thin deposits of alluvium or outwash.

CONCLUSIONS AND RECOMMENDATIONS

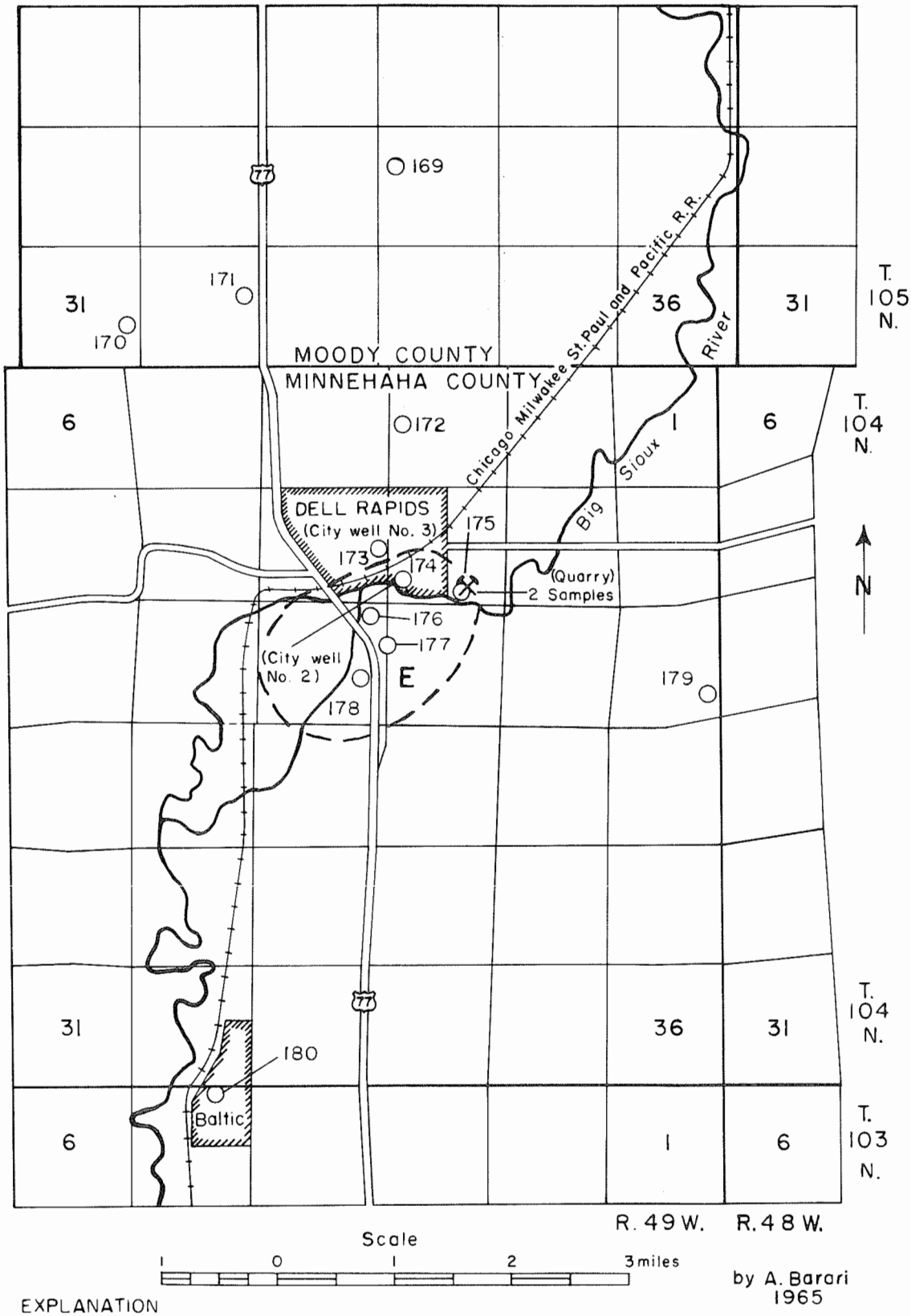
In the Dell Rapids area there are three aquifers which probably could supply enough water for a city supply. These are the Sioux Quartzite, the surface outwash, and the buried outwash.

Additional wells could be drilled in the Sioux Quartzite in area E (fig. 6) and should produce water similar in quantity and quality to City well 2. If possible, a new well or wells should be south of the Big Sioux River to minimize interference with the existing wells. Another possible source of water from the Sioux Quartzite is the water that is pumped from the quartzite quarry east of town. The water could be pumped directly from the quarry or a separate water-collecting system could be installed within the quarry. However, there are many engineering and public health problems that should be fully investigated before this water is used for a city supply.

An adequate water supply for the city of Dell Rapids could probably be obtained from the surface outwash deposits. The best area for development in this aquifer is area D (fig. 5) preferably near test holes 133, 134, 135, and 136 one mile to one and one-half miles west of Baltic. Areas A, B, and C (fig. 5) in the surface outwash may also be considered as possibilities; however, considerable more test drilling and pump testing would be required to determine if an adequate supply of water is available.

The third aquifer which would probably produce an adequate quantity of water for the city is the buried outwash north and east of the city. This aquifer contains poor-quality water and because of the distance from town a pipeline would be needed to pipe water to the city mains. In addition, more test drilling and pump testing would have to be done to determine the best location for a well in this aquifer.

Before development of any additional water supply it is recommended that the city contact a consulting engineering firm, licensed by the State of South Dakota to make economic and feasibility studies of the various water development proposals and to supervise and coordinate further test drilling and pump tests in possible developmental areas. Pump tests should be supervised by qualified and experienced engineers and should be carried out for a minimum of 72 hours. The city should also consult with the State Water Resources Commission with regard to obtaining water rights and a permit to drill a city well and the State Department of Health with regard to the biological and chemical suitability of any proposed water from a new source.



EXPLANATION

○ Location of water sample from the Sioux Quartzite. (Number corresponds to water sample number on Table 3.)

⚒ Sioux Quartzite Quarry

E Area of best quality of water in Sioux Quartzite

Figure 6. Map showing location of water samples from the Sioux Quartzite.

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Rothrock, E. P., 1943, A geology of South Dakota, Part I, The surface: S. Dak. Geol. Survey Bull. 13, pl. 2.

Tipton, M. J., 1959, Geology of Dell Rapids quadrangle, South Dakota: S. Dak. Geol. Survey, map and text.

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APPENDIX A

Logs of Test Holes and Wells in the Dell Rapids Area

(Some of the shallow test holes outside the boundary of the surface outwash shown on figure 2 are not shown on any figure in this report. The other test hole locations are plotted on figures 2 or 5.)

Test Hole No. 1
SDGS Auger
Location: 105-49-15bbba
Surface elevation: 1522 feet
Depth to water: 14 feet

0- 2	Topsoil, dark-brown
2-10	Clay, sandy
10-15	Clay, sandy, brown
15-34	Sand, very coarse, brown
34-	Rock?

* * * *

Test Hole No. 2
SDGS Auger
Location: 105-49-15aaaa
Surface elevation: 1517 feet
Depth to water: 14 feet

0- 4	Topsoil changing to very fine sand
4-19	Sand, fine; saturated at 14 feet
19-24	Sand, coarse to fine gravel
24-32	Sand, coarse
32-44	Till, yellowish-gray

* * * *

Test Hole No. 3
SDGS Auger
Location: 105-49-15adda
Surface elevation: 1570 feet
Depth to water: 11 feet

0- 2	Topsoil, dark-brown
2- 5	Sand, clayey, brown
5-24	Sand, some clay, brown, changing to coarse sand and very little clay
24-	Gravel, coarse; unable to penetrate

* * * *

Test Hole No. 4
SDGS Auger
Location: 105-49-14aaaa
Surface elevation: 1502 feet
Depth to water: 14 feet

0- 2	Topsoil
2-14	Sand, coarse; saturated at 14 feet
14-19	Gravel, fine
19-24	Clay, bluish-gray
24-29	Clay, yellow-green
29-34	No cuttings
34-39	Till, gray

* * * *

Test Hole No. 5
SDGS Auger
Location: 105-49-13abbb
Surface elevation: 1502 feet
Depth to water: 17 feet

0- 3	Topsoil
3- 9	Sand, coarse
9-17	Sand, medium; saturated below 14 feet
17-24	Till, gray

* * * *

Test Hole No. 6
SDGS Auger
Location: 105-48-18abaa
Surface elevation: 1512 feet
Depth to water: 14 feet

0- 4	Topsoil
4-14	Sand, medium, silty; saturated below 14 feet
14-34	Till, gray

* * * *

Test Hole No. 7
SDGS Auger
Location: 105-48-18ddcc
Surface elevation: 1510 feet
Depth to water: 8 feet
(continued on next page)

Test Hole No. 7--continued

0- 2	Topsoil, black
2- 5	Sand, clayey, dark-brown
5-15	Sand, clayey, brown
15-34	Clay, sandy

* * * *

Test Hole No. 8
SDGS Auger
Location: 105-48-19bccc
Surface elevation: 1493 feet
Depth to water: 10 feet

0- 2	Topsoil
2-25	Sand, clayey; changing to coarse sand
25-39	Clay

* * * *

Test Hole No. 9
SDGS Auger
Location: 105-48-19babb
Surface elevation: 1505 feet
Depth to water: 5 feet

0- 2	Topsoil, black
2- 9	Sand, clayey, brown; changing to coarse sand
9-10	Gravel, coarse
10-15	Sand, clayey, brown
15-34	Till

* * * *

Test Hole No. 10
SDGS Auger
Location: 105-48-19daaa
Surface elevation: 1505 feet
Depth to water: 10 feet

0- 2	Topsoil, black
2-20	Sand, clayey, brown
20-34	Till

* * * *

Test Hole No. 11
SDGS Auger
Location: 105-48-19cccd
Surface elevation: 1488 feet
Depth to water: 9 feet

0- 4	Topsoil
4- 9	Sand, fine, silty, saturated
9-13	Sand, medium
13-15	Sand, coarse; some fine gravel
15-24	Till, tan
24-29	Till, gray

* * * *

Test Hole No. 12
SDGS Auger
Location: 105-48-19dccd
Surface elevation: 1498 feet
Depth to water: no water

0- 2	Topsoil, black
2-12	Till, brown
12-34	Till, gray

* * * *

Test Hole No. 13
SDGS Auger
Location: 105-48-19ddcc
Surface elevation: 1502 feet
Depth to water: 40 feet

0- 1	Topsoil
1- 4	Gravel
4-10	Sand and gravel
10-40	Till, gray-brown; stopped by rock at 40 feet

* * * *

Test Hole No. 14
SDGS Auger
Location: 105-49-26bddc
Surface elevation: 1555 feet
Depth to water: 10 feet

0- 2	Topsoil, black
2-15	Clay, brown (loess)
15-29	Till

* * * *

Test Hole No. 15
SDGS Auger
Location: 105-49-26aaac
Surface elevation: 1545 feet
Depth to water: 20 feet

0- 3	Topsoil, black
3-34	Till; possibly loess from 3 to 7 feet

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Test Hole No. 16
SDGS Auger
Location: 105-49-26adaa
Surface elevation: 1535 feet
Depth to water: 15 feet

0- 5	Clay, brown (loess?)
5-10	Sand, clayey, brown
10-18	Sand, coarse, brown; some clay
18-29	Till

* * * *

Data Point No. 17
Private well; no log available

* * * *

Test Hole No. 18
SDGS Auger
Location: 105-49-26dbad
Surface elevation: 1530 feet
Depth to water: 15 feet

0- 2	Topsoil, black
2-13	Clay, brown (loess?)
13-34	Clay, black, compact, changing to grayish-brown till

* * * *

Test Hole No. 19
SDGS Auger
Location: 105-49-26daaa
Surface elevation: 1525 feet
Depth to water: 11 feet
(continued on next page)

Test Hole No. 19--continued

0- 2	Topsoil
2- 8	Clay, brown
8- 9	Rocks
9-21	Sand and rocks
21-34	Clay and pebbles (till)

* * * *

Data Point No. 20
Private well; no log available

* * * *

Test Hole No. 21
SDGS Auger
Location: 105-49-26ddbd
Surface elevation: 1515 feet
Depth to water: 10 feet

0- 2	Topsoil, dark-brown
2- 6	Loess
6-25	Sand, coarse, clayey; clay content decreasing with depth
25-26	Gravel, coarse
26-39	Clay and pebbles (till)

* * * *

Test Hole No. 22
SDGS Auger
Location: 105-49-26ddda
Surface elevation: 1515 feet
Depth to water: 10 feet

0- 2	Topsoil
2- 4	Clay, brown
4- 5	Gravel
5-10	Sand, clayey, brown
10-17	Sand, coarse
17-21	Gravel; changing to coarse sand
21-34	Clay

* * * *

Data Point No. 23
Private well; no log available

* * * *

Test Hole No. 24
SDGS Auger
Location: 105-49-25cbdb
Surface elevation: 1515 feet
Depth to water: 15 feet

0- 2	Topsoil, black
2- 9	Clay, sandy
9-34	Till

* * * *

Test Hole No. 25
SDGS Auger
Location: 105-49-25bddc
Surface elevation: 1522 feet
Depth to water: 15 feet

0- 3	Topsoil
3-35	Sand, coarse; some gravel
35-49	Clay

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Test Hole No. 26
SDGS Auger
Location: 105-49-25ccac
Surface elevation: 1505 feet
Depth to water: 5 feet

0- 2	Topsoil, black
2-19	Sand, coarse, brown
19-34	Till

* * * *

Test Hole No. 27
SDGS Auger
Location: 105-49-25dbcb
Surface elevation: 1512 feet
Depth to water: 15 feet

0- 5	Clay, brown
5-30	Clay, sandy, brown; changing to clayey sand
30-44	Clay

* * * *

Test Hole No. 28
SDGS Auger
Location: 105-49-25dddd
Surface elevation: 1495 feet
Depth to water: 9 feet

0- 3	Topsoil
3-12	Gravel, coarse; saturated below 4 feet
12-19	Till, yellowish-gray

* * * *

Test Hole No. 29
SDGS Auger
Location: 105-48-30cccc
Surface elevation: 1495 feet
Depth to water: not measured

0- 2	Topsoil, black
2- 4	Sand, medium, brown
4- 6	Gravel
6-10	Sand
10-25	Clay
25-	Hard rock; unable to penetrate

* * * *

Test Hole No. 30
USGS Auger
Location: 105-48-30cbcc
Surface elevation: 1495 feet
Depth to water: 7.8 feet

0- 1	Soil, black
1- 3	Gravel, fine to coarse, sandy
3-16.5	Till

* * * *

Test Hole No. 31
USGS Auger
Location: 105-48-30babb
Surface elevation: 1493 feet
Depth to water: 8 feet

0- 2	Soil, black
2-12	Sand, medium to very coarse; some fine gravel
12-16.5	Till

* * * *

Test Hole No. 32
SDGS Auger
Location: 105-48-30aaaa
Surface elevation: 1505 feet
Depth to water: 10 feet

0- 2	Topsoil, black
2- 9	Sand; some gravel, brown
9-11	Hard rock?
11-20	Sand
20-34	Clay

* * * *

Test Hole No. 33
USGS Auger
Location: 105-48-30aaaa
Surface elevation: 1504 feet
Depth to water: 2.1 feet

0 - 1	Soil, black
1 - 3	Sand, very fine to coarse, silty
3 -12	Gravel, silty, sandy
12 -14	Sand, medium to very coarse; gravel
14 -15.5	Gravel, fine to coarse, sandy
15.5-21.5	Till

* * * *

Test Hole No. 34
SDGS Auger
Location: 105-49-30ddab
Surface elevation: 1505 feet
Depth to water: 8 feet

0- 2	Topsoil, black
2- 5	Clay, brown
5-20	Sand, clayey, brown; clay content decreasing and sand becoming coarser with depth
20-39	Till

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Data Point No. 35
Private well; no log available

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Data Point No. 36
Private well; no log available

* * * *

Test Hole No. 37
SDGS Auger
Location: 105-48-29bbaa
Surface elevation: 1510 feet
Depth to water: 19 feet

0- 2	Topsoil
2- 9	Sand, fine
9-14	Gravel; some sand
14-24	Sand, fine to medium, saturated
24-34	Sand, fine
34-39	Sand, fine; some gravel
39-54	Till, gray

* * * *

Test Hole No. 38
SDGS Auger
Location: 105-48-29bbaa
Surface elevation: 1510 feet
Depth to water: 15 feet

0- 5	Topsoil, clayey, brown
5-30	Sand, clayey, brown
30-32	Rock?
32-44	Till

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Test Hole No. 39
SDGS Auger
Location: 105-49-34dccc
Surface elevation: 1515 feet
Depth to water: not measured

0- 4	Topsoil, black
4-40	Clay, dark-brown changing to gray

* * * *

Test Hole No. 40
SDGS Auger
Location: 105-49-34dcdd
Surface elevation: 1508 feet
Depth to water: 5 feet

0- 2	Topsoil, black
2- 4	Clay, brown
4-15	Sand, some clay, brown; changing to coarse sand with less clay

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Test Hole No. 41
USGS Auger
Location: 105-49-32dcdd
Surface elevation: 1508 feet
Depth to water: 5.7 feet

0- 2	Soil, black
2- 8	Gravel, fine, sandy and silty
8-19	Sand, medium to very coarse; some gravel
19-21	Gravel, very coarse, sandy
21-26	Sand, fine to medium; some gravel, silty
26-27	Till

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Test Hole No. 42
SDGS Auger
Location: 105-49-34ddbb
Surface elevation: 1512 feet
Depth to water: 7 feet

0- 2	Topsoil, black
2- 7	Loess
7-20	Sand, medium to coarse, clayey, brown
20-39	Clay and pebbles (till)

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Test Hole No. 43
SDGS Auger
Location: 105-49-34daca
Surface elevation: 1515 feet
Depth to water: 17 feet
(continued on next page)

Test Hole No. 43--continued

0- 2	Topsoil, black
2- 5	Clay, brown
5-15	Sand, clayey, brown
15-30	Sand, coarse; some clay
30-39	Clay, gray, and pebbles (till)

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Data Point No. 44
Private well; no log available

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Test Hole No. 45
SDGS Auger
Location: 105-49-34daad
Surface elevation: 1510 feet
Depth to water: 5 feet

0- 2	Topsoil
2- 5	Clay, brown; some pebbles
5-31	Sand, medium to coarse
31-39	Clay

* * * *

Test Hole No. 46
SDGS Auger
Location: 105-49-34ddad
Surface elevation: 1505 feet
Depth to water: 10 feet

0- 2	Topsoil, black
2- 5	Loess
5- 6	Rock
6-18	Sand, clayey, brown changing to gray
18-39	Clay and pebbles (till)

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Test Hole No. 47
SDGS Auger
Location: 105-49-35aabb
Surface elevation: 1515 feet
Depth to water: 6 feet
(continued on next page)

Test Hole No. 47--continued

0- 2	Topsoil, black
2- 4	Clay
4-16	Sand, coarse; clay
16-	Rocks; gravel, coarse

* * * *

Test Hole No. 48
SDGS Auger
Location: 105-49-35aaaa
Surface elevation: 1505 feet
Depth to water: 8 feet

0- 4	Clay, dark-brown
4-18	Gravel; sand, coarse; clay
18-34	Clay and pebbles (till)

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Data Point No. 49
Private well; no log available.

* * * *

Test Hole No. 50
SDGS Auger
Location: 105-49-35badd
Surface elevation: 1516 feet
Depth to water: 15 feet

0- 3	Topsoil, black
3- 5	Clay, dark-brown
5-10	Sand, coarse
10-29	Clay, dark-blue

* * * *

Test Hole No. 51
SDGS Auger
Location: 105-49-35abdb
Surface elevation: 1505 feet
Depth to water: 7 feet
(continued on next page)

Test Hole No. 51--continued

0- 2	Topsoil, dark-brown
2- 5	Sand, medium to coarse
5-11	Sand, coarse, and clay
11-12	Rocks; gravel
12-17	Sand, coarse; some clay
17-34	Clay and pebbles

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Data Point No. 52
Private well; no log available

* * * *

Test Hole No. 53
SDGS Auger
Location: 105-49-35adad
Surface elevation: 1502 feet
Depth to water: 5 feet

0- 2	Topsoil, dark-brown
2- 5	Clay, gray-brown
5-20	Sand, coarse; some gravel
20-32	Clay
32-	Hard material; unable to penetrate

* * * *

Test Hole No. 54
SDGS Auger
Location: 105-49-35cbda
Surface elevation: 1508 feet
Depth to water: 7 feet

0- 2	Topsoil, black
2- 5	Loess
5- 8	Sand, brown, clayey
8-10	Gravel
10-29	Clay and pebbles (till)

* * * *

Test Hole No. 55
SDGS Auger
Location: 105-49-35ccad
Surface elevation: 1505 feet
Depth to water: 10 feet

0- 4	Loess
4-22	Sand, medium to coarse, brown; some gravel
22-34	Clay and pebbles (till)

* * * *

Data Point No. 56
Private well; no log available

* * * *

Test Hole No. 57
SDGS Auger
Location: 105-49-35cdcd
Surface elevation: 1503 feet
Depth to water: 5 feet

0- 2	Topsoil, black, clayey
2- 4	Sand, fine to medium
4-10	Gravel, sandy, brown
10-25	Sand, coarse, brown
25-44	Clay

* * * *

Test Hole No. 58
USGS Auger
Location: 105-49-35dcdc
Surface elevation: 1497 feet
Depth to water: 5.4 feet

0- 2	Soil
2- 4	Sand, very fine to medium, silty
4-20	Gravel, fine to coarse, sandy
20-25	Gravel, fine; sand, medium to very coarse, silty and clayey
25-27	Till

* * * *

Test Hole No. 59
USGS Auger
Location: 105-49-35dddd
Surface elevation: 1492 feet
Depth to water: dry hole
(continued on next page)

Test Hole No. 59--continued

0- 2	Soil, black
2- 6	Sand, fine to coarse
6- 8	Gravel, fine to coarse; sandy quartzite pebbles common
8-11.5	Till

* * * *

Test Hole No. 60
SDGS Auger
Location: 105-49-36cbcc
Surface elevation: 1495 feet
Depth to water: 5 feet

0- 2	Topsoil
2- 5	Sand, medium, brown
5-10	Sand, medium to coarse
10-14	Clay, gray

* * * *

Test Hole No. 61
SDGS Auger
Location: 105-49-36cccb
Surface elevation: 1495 feet
Depth to water: none

0- 2	Topsoil
2- 3	Gravel, coarse
3- 4	Silt, black
4- 9	Clay, tan
9-19	Clay, sandy, light-blue
19-24	Till, gray

* * * *

Test Hole No. 62
SDGS Auger
Location: 105-49-36cccc
Surface elevation: 1490 feet
Depth to water: none

0-1	Topsoil, black
1-3	Rocks; gravel, coarse, unable to penetrate

* * * *

Test Hole No. 63
USGS Auger
Location: 105-49-36ccdd
Surface elevation: 1488 feet
Depth to water: 6 feet

0- 1	Soil, black
1- 3	Sand, fine to medium, silty
3- 8	Gravel, fine to coarse, sandy
8-10	Sand, medium to very coarse; gravel
10-12	Gravel, fine to coarse, sandy
12-16	Till

* * * *

Test Hole No. 64
SDGS Auger
Location: 105-49-36cddc
Surface elevation: 1487 feet
Depth to water: 7 feet

0- 4	Clay, black
4-17	Gravel; coarse sand
17-29	Clay

* * * *

Test Hole No. 65
SDGS Auger
Location: 105-49-36bada
Surface elevation: 1490 feet
Depth to water: 7 feet

0- 4	Topsoil, black
4- 6	Gravel
6-15	Sand, coarse; clay; clay decreasing; some gravel
15-34	Clay and pebbles

* * * *

Test Hole No. 66
SDGS Rotary
Location: 105-49-36accb
Surface elevation: 1490 feet
Depth to water: not measured

0- 2	Topsoil, black
2- 7	Clay, gray
7- 9	Rock

(continued on next page)

Test Hole No. 66--continued

9-12	Sand, coarse
12-25	Clay, gray
25-30	Clay, yellow
30-36	Clay, gray; placed and cemented casing at 22 feet
36-37	Sand; flow of water

* * * *

Test Hole No. 67
USGS Auger
Location: 105-49-36dcdd
Surface elevation: 1490 feet
Depth to water: 11 feet

0- 1	Soil, black
1- 5	Sand, fine to coarse
5-15	Gravel, fine to coarse; sand, medium to very coarse
15-23	Sand, medium to very coarse; gravel, fine to medium
23-25	Gravel, fine to coarse, sandy and silty
25-31.5	Till

* * * *

Test Hole No. 68
SDGS Auger
Location: 105-49-36ddaa
Surface elevation: 1500 feet
Depth to water: 14 feet

0- 3	Topsoil, black
3-25	Clay, sandy, brown
25-30	Sand, medium to coarse
30-70	Clay

* * * *

Test Hole No. 69
USGS Auger
Location: 105-49-36daaa
Surface elevation: 1495 feet
Depth to water: 8.4 feet

0- 2	Soil, black
2- 9	Sand, very fine to medium, silty and clayey
9-14	Sand, medium to very coarse; some gravel
14-24	Gravel, fine to medium; sand, medium to very coarse; much lignite or charcoal
24-34	Sand, medium to very coarse; gravel
34-41.5	Till

* * * *

Test Hole No. 70
SDGS Auger
Location: 105-48-31acca
Surface elevation: 1525 feet
Depth to water: 15 feet

0- 2	Topsoil, black
2- 5	Clay
5-30	Sand, clayey, brown
30-44	Till

* * * *

Test Hole No. 71
SDGS Auger
Location: 105-48-31abba
Surface elevation: 1505 feet
Depth to water: 11 feet

0- 3	Topsoil, black
3-10	Sand, coarse, clayey
10-11	Gravel, coarse
11-20	Sand
20-21	Gravel, coarse
21-34	Till

* * * *

Test Hole No. 72
SDGS Auger
Location: 104-49-3cdcd
Surface elevation: 1505 feet
Depth to water: no water

0-1	Topsoil, black
1-4	Loess
4-	Sioux Quartzite

* * * *

Test Hole No. 73
SDGS Auger
Location: 104-49-3bdba
Surface elevation: 1505 feet
Depth to water: 6 feet

0- 2	Topsoil, black
2- 6	Till
6-13	Gravel
13-29	Clay

* * * *

Test Hole No. 74
SDGS Auger
Location: 104-49-3abda
Surface elevation: 1505 feet
Depth to water: 10 feet

0- 2	Topsoil, dark-brown
2- 5	Clay, brown
5-10	Sand, coarse, clayey, brown
10-11	Gravel, fine
11-19	Sand, coarse; some gravel
19-44	Till

* * * *

Test Hole No. 75
SDGS Auger
Location: 104-49-3aaab
Surface elevation: 1504 feet
Depth to water: 10 feet

0- 2	Topsoil, black
2- 4	Clay, brown
4-10	Sand, medium; some clay
10-15	Sand, medium to coarse; some clay
15-20	Sand, coarse; some gravel
20-44	Clay

* * * *

Test Hole No. 76
SDGS Auger
Location: 104-49-3aadd
Surface elevation: 1505 feet
Depth to water: 5 feet

0- 2	Topsoil, black
2- 5	Loess
5- 8	Sand, clayey, brown
8-20	Sand, medium to coarse; some clay; clay content decreasing with depth
20-35	Clay

* * * *

Test Hole No. 77
SDGS Auger
Location: 104-49-3daaa
Surface elevation: 1495 feet
Depth to water: 5 feet
(continued on next page)

Test Hole No. 77--continued

0- 2	Topsoil, black
2- 5	Sand, clayey, brown
5-12	Sand, medium to coarse; gravel; some clay
12-29	Clay and pebbles (till)

* * * *

Test Hole No. 78
SDGS Auger
Location: 104-49-3daaa
Surface elevation: 1495 feet
Depth to water: 9 feet

0- 4	Alluvium, sandy, clayey, tan
4- 9	Sand, fine to medium, saturated
9-10	Gravel, very coarse
10-14	Clay, sandy
14-29	Till, gray

* * * *

Test Hole No. 79
WRC Auger (Water Resources Commission)
Location: 104-49-3ddc
Surface elevation: 1497 feet
Depth to water: 6 feet

0- 4	Loam
4- 9	Clay, yellow
9-18	Sand, fine
18-22	Gravel
22-32	Clay, blue; Sioux Quartzite at 32 feet

* * * *

Test Hole No. 80
SDGS Auger
Location: 104-49-3dddc
Surface elevation: 1492 feet
Depth to water: 7 feet

0- 2	Topsoil, black
2- 5	Clay, brown (loess)
5-11	Sand, medium
11-27	Clay and pebbles
27-	Sioux Quartzite?

* * * *

Test Hole No. 81
SDGS Auger
Location: 104-49-3ddad
Surface elevation: 1490 feet
Depth to water: 7 feet

0- 2	Topsoil, black
2- 7	Clay, brown (loess)
7- 9	Sand, medium to coarse; some clay
9-11	Sand, coarse; gravel
11-29	Clay and pebbles (till)

* * * *

Data Point No. 82
Private well; no log available

* * * *

Test Hole No. 83
USGS Auger
Location: 104-49-2cbcc
Surface elevation: 1495 feet
Depth to water: 6.6 feet

0- 1	Soil, black
1- 8	Sand, very fine to medium, silty
8-11	Gravel, fine to very coarse, sandy
11-13	Sand, medium to very coarse; some gravel
13-16.5	Till

* * * *

Data Point No. 84
Private well; no log available

* * * *

Data Point No. 85
Private well; no log available

* * * *

Test Hole No. 86
SDGS Auger
Location: 104-49-2bbbb
Surface elevation: 1498 feet
Depth to water: 9 feet
(continued on next page)

Test Hole No. 86--continued

0- 4	Topsoil
4- 9	Clay, silty, sandy
9-14	Gravel, medium to coarse, saturated
14-19	Gravel, coarse
19-20	Sand, coarse
20-44	Till, brownish-gray

* * * *

Test Hole No. 87
SDGS Auger
Location: 104-49-2bbbb
Surface elevation: 1498 feet
Depth to water: 10 feet

0- 2	Topsoil
2- 3	Clay, brown
3- 5	Sand, fine to medium
5-20	Sand, coarse
20-44	Clay

* * * *

Test Hole No. 88
SDGS Auger
Location: 104-49-2bdbb
Surface elevation: 1490 feet
Depth to water: 0

0-4	Clay, brown
4-8	Sand and gravel, coarse; unable to penetrate

* * * *

Test Hole No. 89
SDGS Auger
Location: 104-49-29dbaa
Surface elevation: 1495 feet
Depth to water: no water

0-2	Topsoil
2-5	Clay, pebbly, brown
5-6	Sand, fine to medium
6-9	Sand, coarse; some gravel; unable to penetrate

* * * *

Test Hole No. 90
SDGS Auger
Location: 104-49-2dabd
Surface elevation: 1480 feet
Depth to water: 7 feet

0- 3	Topsoil
3- 9	Sand, medium to coarse; some gravel
9-10	Hard rock
10-11	Sand, coarse?
11-40	Clay

* * * *

Test Hole No. 91
SDGS Auger
Location: 104-49-1bccc
Surface elevation: 1488 feet
Depth to water: 5 feet

0- 2	Topsoil, sand
2-13	Sand, medium to coarse; gravel
13-29	Clay, gray (till)

* * * *

Test Hole No. 92
SDGS Auger
Location: 104-49-1bbbd
Surface elevation: 1490 feet
Depth to water: 7 feet

0-2	Topsoil, sandy
2-9	Sand, medium to coarse; gravel

* * * *

Test Hole No. 93
SDGS Auger
Location: 104-49-1bbcc
Surface elevation: 1488 feet
Depth to water: 7 feet

0- 2	Topsoil, sandy, dark-brown
2-17	Sand, medium to coarse; gravel
17-29	Clay and pebbles (till)

* * * *

Test Hole No. 94
SDGS Auger
Location: 104-49-1baaa
Surface elevation: 1485 feet
Depth to water: 10 feet

0- 5	Clay, sandy, dark-brown
5-10	Sand, clayey, dark-brown
10-12	Gravel
12-20	Sand, medium to coarse
20-40	Clay, gray

* * * *

Test Hole No. 95
SDGS Auger
Location: 104-49-1aaba
Surface elevation: 1495 feet
Depth to water: 19 feet

0- 9	Alluvium, black
9-14	Sand, medium to coarse
14-19	Sand, coarse, saturated
19-34	Till, gray-brown

* * * *

Test Hole No. 96
SDGS Auger
Location: 104-49-10abbd
Surface elevation: 1495 feet
Depth to water: not measured

0-2	Topsoil
2-6	Clay
6-	Sioux Quartzite?

* * * *

Data Point No. 97
Private well; no log available

* * * *

Test Hole No. 98
SDGS Auger
Location: 104-49-10aabc
Surface elevation: 1495 feet
Depth to water: 5 feet
(continued on next page)

Test Hole No. 98--continued

0- 2	Topsoil
2-10	Sand, clayey, reddish-brown
10-11	Gravel
11-15	Till, gray
15-	Sioux Quartzite?

* * * *

Test Hole No. 99
SDGS Auger
Location: 104-49-10aaac
Surface elevation: 1492 feet
Depth to water: 5 feet

0- 3	Topsoil, black
3- 5	Clay
5-15	Sand, coarse, brown; some clay
15-34	Clay
34-	Sioux Quartzite?

* * * *

Test Hole No. 100
SDGS Auger
Location: 104-49-11bbcc
Surface elevation: 1490 feet
Depth to water: 5-10 feet (?)

0- 2	Topsoil, black
2-13	Sand, medium to coarse
13-49	Clay

* * * *

Test Hole No. 101
SDGS Auger
Location: 104-49-10accb
Surface elevation: 1495 feet
Depth to water: 10 feet

0- 5	Clay, brown
5-15	Sand, clayey, brown
15-17	Gravel, coarse
17-20	Clay
20-	Sioux Quartzite?

* * * *

Data Point No. 102
Private well; no log available

* * * *

Test Hole No. 103
SDGS Auger
Location: 104-49-10addc
Surface elevation: 1490 feet
Depth to water: 3 feet

0- 2	Topsoil
2- 5	Clay, sandy, gray
5-11	Sand, medium to coarse; some clay
11-35	Clay, and pebbles (till), tan
35-	Sioux Quartzite?

* * * *

Test Hole No. 104
SDGS Auger
Location: 104-49-11bccb
Surface elevation: 1486 feet
Depth to water: 8 feet

0- 3	Topsoil
3- 5	Clay, sandy, brown
5-13	Sand changing to gravel, brown
13-25	Clay, sandy
25-42	Clay
42-	Sioux Quartzite?

* * * *

Test Hole No. 105
SDGS Auger
Location: 104-49-11bcdb
Surface elevation: 1485 feet
Depth to water: 1 foot

0- 2	Topsoil, black
2- 5	Sand, clayey, brown
5- 8	Clay, sandy, brown
8-40	Clay

* * * *

Test Hole No. 106
SDGS Auger
Location: 104-49-11bddb
Surface elevation: 1485 feet
Depth to water: none

0 -4	Alluvium
4 -4.5	Gravel, fine
4.5-	Sioux Quartzite?

* * * *

Test Hole No. 107
SDGS Auger
Location: 104-49-10dabb
Surface elevation: 1485 feet
Depth to water: 5 feet

0- 2	Topsoil, black
2- 5	Clay, brown
5- 9	Sand; some clay, brown
9-10	Gravel
10-16	Sand, coarse; some clay
16-21	Till
21-	Sioux Quartzite?

* * * *

Test Hole No. 108
USGS Auger
Location: 104-49-11bccc
Surface elevation: 1485 feet
Depth to water: 5.1 feet

0- 2	Soil
2-10	Sand, medium to coarse; some gravel
10-13	Gravel, fine to medium, sandy
13-16.5	Till

* * * *

Test Hole No. 109
SDGS Auger
Location: 104-49-11cacb
Surface elevation: 1482 feet
Depth to water: 9 feet

0-2	Topsoil
2-	Sioux Quartzite?

* * * *

Test Hole No. 110
SDGS Auger
Location: 104-49-10ddaa
Surface elevation: 1482 feet
Depth to water: not measured

0-2	Topsoil
2-7	Clay, sandy; some gravel
7-	Sioux Quartzite?

* * * *

Test Hole No. 111
SDGS Auger
Location: 104-49-17adad
Surface elevation: 1495 feet
Depth to water: none

0-4	Alluvium
4-8	Till, brownish-gray
8-	Sioux Quartzite?

* * * *

Test Hole No. 112
SDGS Auger
Location: 104-49-20bbcb
Surface elevation: 1477 feet
Depth to water: 10 feet

0- 3	Topsoil, black
3-15	Clay, dark-brown
15-22	Clay, sandy, dark-brown
22-24	Rock?
24-30	Sand, medium to coarse; some clay
30-45	Clay, gray
45-	Sioux Quartzite?

* * * *

Test Hole No. 113
SDGS Auger
Location: 104-49-20adac
Surface elevation: 1485 feet
Depth to water: 10 feet

0- 2	Topsoil
2-14	Sand, clayey, brown
14-16	Rock; gravel; unable to penetrate

* * * *

Test Hole No. 114
USGS Auger
Location: 104-49-20daaa
Surface elevation: 1470 feet
Depth to water: 9 feet

0- 2	Soil, black
2-16	Sand, very fine to medium, silty, clayey
16-	Sioux Quartzite

* * * *

Test Hole No. 115
SDGS Auger
Location: 104-49-20dada
Surface elevation: 1475 feet
Depth to water: 10 feet

0- 2	Topsoil
2- 5	Clay, dark-brown
5- 7	Sand, medium to coarse
7-20	Sand, coarse
20-25	Sand, medium, some clay
25-35	Gravel
35-45	Clay
45-	Sioux Quartzite?

* * * *

Test Hole No. 116
USGS Auger
Location: 104-49-20ccdd
Surface elevation: 1465 feet
Depth to water: 7.1 feet

0- 1	Soil, sandy, brown
1- 8	Sand, fine to medium, silty
8-21	Sand, very fine to coarse; some gravel, silty; thin clay beds
21-22	Gravel, sandy and silty
22-26	Sand, very fine; some gravel, very silty and clayey
26-31	Sand, very fine to medium, very silty and clayey
31-56	Till
56-	Sioux Quartzite

* * * *

Test Hole No. 117
USGS Auger
Location: 104-49-20cdcc
Surface elevation: 1470 feet
Depth to water: none

0-1	Soil, sandy, light-brown
1-6	Sand, very fine to medium, silty
6-	Sioux Quartzite

* * * *

Test Hole No. 118
SDGS Auger
Location: 104-49-20cdcc
Surface elevation: 1475 feet
Depth to water: 10 feet

0- 1	Clay, brown
1-10	Clay, black
10-15	Clay, sandy, black
15-20	Till
20-	Sioux Quartzite?

* * * *

Test Hole No. 119
SDGS Auger
Location: 104-49-20cddd
Surface elevation: 1470 feet
Depth to water: none

0- 4	Topsoil
4- 9	Clay, silty, gray
9-17	Till, brownish-gray
17-	Sioux Quartzite?

* * * *

Test Hole No. 120
USGS Auger
Location: 104-49-20cddd
Surface elevation: 1470 feet
Depth to water: 10.68 feet

0- 2	Topsoil, black
2-15	Sand, fine, dark-brown, clayey
15-25	Sand, fine; gravel, fine, clayey, gray
25-35	Till (?)
35-	Sioux Quartzite

* * * *

Test Hole No. 121
SDGS Rotary
Location: 104-49-20ddcc
Surface elevation: 1473 feet
Depth to water: 8 feet

0- 2	Topsoil
2-20	Sand and gravel

* * * *

Data Point No. 122
Private well; no log available

* * * *

Test Hole No. 123
SDGS Rotary
Location: 104-49-20dddb
Surface elevation: 1475 feet
Depth to water: 10 feet

0- 2	Topsoil
2-15	Sand
15-25	Gravel

* * * *

Test Hole No. 124
SDGS Auger
Location: 104-49-21bbba
Surface elevation: 1480 feet
Depth to water: not measured

0- 2	Topsoil, black
2-10	Till
10-	Bedrock

* * * *

Data Point No. 125
Private well; no log available

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Test Hole No. 126
SDGS Auger
Location: 104-49-29abaa
Surface elevation: 1472 feet
Depth to water: 24 feet
(continued on next page)

Test Hole No. 126--continued

0-14	Alluvium
14-24	No cuttings; augered up water
24-29	Clay, silty, gray
29-44	Gravel, fine, silty
44-49	Sand, coarse, and fine gravel
49-	Rock (?), unable to penetrate

* * * *

Test Hole No. 127
SDGS Auger
Location: 104-49-29aabd
Surface elevation: 1480 feet
Depth to water: 3 feet

0- 2	Topsoil, black
2- 5	Clay, black
5-25	Sand, clayey
25-	Sioux Quartzite?

* * * *

Test Hole No. 128
USGS Auger
Location: 104-49-29aaaa
Surface elevation: 1470 feet
Depth to water: 8 feet

0- 2	Soil, black
2-23	Sand, very fine to medium, silty and clayey
23-26	Silt, sandy; some gravel
26-30	Gravel, very sandy and silty
30-	Sioux Quartzite

* * * *

Test Hole No. 129
SDGS Auger
Location: 104-49-29dbaa
Surface elevation: 1470 feet
Depth to water: 10 feet

0- 2	Topsoil, black
2-17	Clay
17-21	Hard rock?, unable to penetrate

* * * *

Test Hole No. 130
SDGS Auger
Location: 104-49-29dadd
Surface elevation: 1485 feet
Depth to water: 10 feet

0- 2	Topsoil
2- 5	Clay, brown
5-30	Sand, clayey, brown; changing to coarse sand and clay
30-32	Rock
32-44	Clay

* * * *

Test Hole No. 131
SDGS Auger
Location: 104-49-28ccdd
Surface elevation: 1505 feet
Depth to water: 10 feet

0- 3	Topsoil, black
3- 7	Clay, reddish-brown
7-14	Clay, sandy, reddish
14-	Gravel, rock?; unable to penetrate

* * * *

Data Point No. 132
Private well; no log available

* * * *

Test Hole No. 133
SDGS Auger
Location: 104-49-31cccc
Surface elevation: 1465 feet
Depth to water: 14 feet

0- 4	Topsoil
4- 9	Sand, fine
9-14	Sand, fine to medium, saturated
14-19	No cuttings
19-24	Sand, fine, clayey
24-29	No cuttings
29-34	Sand, medium
34-39	No cuttings
39-54	Till

* * * *

Test Hole No. 134
WRC Auger (Water Resources Commission)
Location: 104-49-31cccc
Surface elevation: 1465.1 feet
Depth to water: 9.1 feet

0- 9	Loam, heavy
9-43	Sand, fine
43-45	Gravel, coarse
45-	Sioux Quartzite

* * * *

Test Hole No. 135
SDGS Auger
Location: 104-49-31cddd
Surface elevation: 1465 feet
Depth to water: 7 feet

0- 2	Topsoil, black
2- 5	Clay, dark-brown
5-35	Sand, clayey, dark-brown; changing to coarse sand and gravel
35-44	Clay (till)

* * * *

Test Hole No. 136
SDGS Auger
Location: 104-49-31cddd
Surface elevation: 1465 feet
Depth to water: 17 feet

0- 4	Topsoil
4-17	Silt, sandy, grayish-brown
17-29	Sand, medium, saturated
29-34	Sand, medium to coarse
34-49	Sand, coarse; gravel
49-79	Till

* * * *

Test Hole No. 137
SDGS Auger
Location: 104-49-32cccc
Surface elevation: 1460 feet
Depth to water: 5 feet
(continued on next page)

Test Hole No. 137--continued

0- 2	Topsoil, black
2- 5	Clay, brown
5-15	Clay, sandy, gray
15-24	Sand, coarse; gravel
24-	Bedrock (?)

* * * *

Test Hole No. 138
SDGS Auger
Location: 104-49-32cbbb
Surface elevation: 1475 feet
Depth to water: 10 feet

0- 2	Topsoil, black
2-10	Till
10-25	Sand, clayey, gray; changing to coarse sand with some clay
25-	Sioux Quartzite?

* * * *

Test Hole No. 139
SDGS Auger
Location: 104-49-32bacb
Surface elevation: 1465 feet
Depth to water: 10 feet

0- 2	Topsoil, black
2-25	Sand, clayey, brown
25-28	Rocks
28-37	Sand, coarse; gravel
37-49	Clay

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Test Hole No. 140
SDGS Auger
Location: 104-49-32dbbd
Surface elevation: 1465 feet
Depth to water: 7 feet

0- 2	Topsoil, black
2-35	Sand, fine to medium, clayey, black; coarser sand and less clay at 15 feet
35-79	Till, gray

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Test Hole No. 141
SDGS Rotary
Location: 105-49-23dadd
Surface elevation: 1550 feet
Depth to water: not measured

0- 2	Topsoil, black
2- 7	Clay, brown to light-gray
7- 16	Gravel
16- 92	Clay, gray
92- 95	Gravel, with clay stringers
95-102	Clay, gray
102-104	Gravel
104-107	Clay, gray
107-132	Clay, olive
132-142	Clay, gray
142-145	Clay, gray, with gravel stringers
145-212	Clay, gray
212-225	Clay, gray, with gravel stringers
225-235	Gravel
235-250	Clay, gray, with gravel stringers
250-255	Clay, tan
255-275	Clay, green
275-301	Clay, gray
301-312	Clay, gray, with gravel stringers
312-320	Gravel
320-334	Gravel, with hard clay stringers
334-355	Clay, gray
355-357	Gravel
357-359	Clay, gray
359-376	Gravel
376-379	Clay, gray
379-383	Gravel
383-440	Shale?, gray

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Data Point No. 142
Private well; no log available

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Data Point No. 143
Private well; no log available

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Data Point No. 144
Private well; no log available

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Test Hole No. 145
SDGS Rotary
Location: 105-49-27cdcc
Surface elevation: 1575 feet
Depth to water: not measured

0- 4	Topsoil, black
4- 7	Clay, yellow
7- 10	Clay, gray
10- 58	Clay, yellow
58- 80	Clay, gray
80-108	Clay, reddish-brown
108-122	Clay, gray
122-132	Sand and gravel
132-145	Clay, brown, with sand stringers
145-173	Clay, gray
173-230	Gravel
230-	Sioux Quartzite

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Data Point No. 152
(See log of rotary test hole No. 66)

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Data Point No. 153
Private well; no log available

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Data Point No. 154
Private well; no log available

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Data Point No. 155
Private well; no log available

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Data Point No. 156
Private well; no log available

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Data Point No. 157
Private well; no log available

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Data Point No. 158
Private well; no log available

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Test Hole No. 159
SDGS Rotary
Location: 104-48-4baaa
Surface elevation: 1625 ± 25 feet
Depth to water: not measured

0- 3	Topsoil, black
3- 12	Clay, yellow
12- 15	Clay, light-brown
15- 17	Sand, fine
17- 40	Clay, grayish-brown
40- 65	Clay, brown
65-100	Clay, gray, with pebbles
100-115	Chalk?
115-130	Clay, light-brown
130-140	Clay, light-gray; with a few gravel stringers
140-150	Clay, gray
150-200	Clay, gray; with silt and gravel stringers
200-235	Clay, gray
235-265	Gravel
265-280	Clay, light-gray; with gravel stringers
280-290	Gravel
290-303	Clay, gray; with many sand and gravel stringers
303-316	Gravel, coarse
316-	Sioux Quartzite

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Data Point No. 160
Private well; no log available

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Data Point No. 161
Private well; no log available

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Data Point No. 162
Private well; no log available

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Data Point No. 163
Private well; no log available

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Test Hole No. 164
SDGS Rotary
Location: 104-48-7aaa
Surface elevation: 1607 feet
Depth to water: not measured

0- 18	Clay, yellow
18- 33	Clay, light-brown
33- 35	Clay, dark-gray
35- 43	Clay, yellow
43- 44	Sand, fine
44- 62	Clay, light-gray
62- 85	Clay, light-brown
85-105	Clay, brown, sandy
105-115	Clay, dark-gray
115-147	Clay, brown
147-148	Gravel
148-	Sioux Quartzite

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Data Point No. 165
Private well; no log available

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Data Point No. 166
Private well; no log available

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Data Point No. 167
Private well; no log available

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Test Hole No. 168
SDGS Rotary
Location: 104-48-19dab
Surface elevation: 1595 feet
Depth to water: not measured

0- 3	Topsoil, black
3- 32	Clay, yellow
32- 35	Clay, gray
35- 43	Clay, yellow
43- 60	Clay, gray
60- 75	Clay, pebbly, brown
75-102	Sand, some gravel
102-140	Clay, dark-gray
140-145	Sand
145-192	Clay, reddish-brown
192-	Sioux Quartzite

* * * *

APPENDIX B

Table 4.--Records of wells in the Dell Rapids area.

Type of well: D, drilled; B, bored; Sp, sand point; Du, dug
Use of water: S, stock; D, domestic

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	Depth of Well (in feet) in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
103-49-4aa$_1$	P. Riswold	B	16		16	glacial	D
103-49-4aa$_2$	P. Riswold	B	16-25		16-25	glacial	D
103-49-5ab$_1$	City of Baltic	D		250	250	quartzite	D
103-49-5ab$_2$	City of Baltic	D		160	160	quartzite	D
103-49-5ad	R. Brendsel	D	20	120	140	quartzite	D
104-48-3bc	H. Evans	D	200		200	glacial	D,S
104-48-3cc$_1$	M. Muller	B	40		40	glacial	D,S
104-48-3cc$_2$	M. Muller	B	70		70	glacial	D,S
104-48-4ab	W. Shelvquist	D	289		289	glacial	D,S
104-48-4cc	J. Muller	B	45		45	glacial	D,S
104-48-4cd$_1$	R. Silkerson	D	60		60	glacial	D
104-48-4cd$_2$	R. Silkerson	D	150		150	glacial	S
104-48-5aa	L. Anderson	D	38		38	glacial	
104-48-5bd	L. Bach	D	160		160	glacial	D,S
104-48-6bd	D. Knutson	D	216		216	glacial	D,S
104-48-7ad	A. Anderson		52		52	glacial	D
104-48-7cc	J. Merry	D	70	198	268	quartzite	D,S
104-48-8ad	H. Evans	D	106		106	glacial	D,S
104-48-8cc	N. Jensen	D	110		110	glacial	

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
104-48-8db$_1$	H. Hert	B	30		30	glacial	D,S
104-48-8db$_2$	H. Hert	B	30		30	glacial	D,S
104-48-9db	H. Alberts	B	45		45	glacial	D,S
104-48-16cc$_1$	E. Sittig	D	160		160	glacial	D,S
104-48-16cc$_2$	E. Sittig	D	30		30	glacial	S
104-48-17bd	M. Merry		30		30	glacial	D,S
104-48-17cc	R. Merry		52		52	glacial	D,S
104-48-17dc	J. Merry		26		26	glacial	D,S
104-48-18aa	A. Sieps	D	317		317	glacial	D
104-48-19ac$_1$	K. Shefte	B	58		58	glacial	D,S
104-48-19ac$_2$	K. Shefte	B	90		90	glacial	D,S
104-48-19bd	N. Hainje	D	185		185	glacial	D,S
104-48-20ab	A. Heeren	B	35		35	glacial	
104-48-20bc	W. Sieps	D	200	20	220	quartzite	D
104-48-28dd	C. Heesch		60		60	glacial	D,S
104-49-1aa	L. Randall	D	140		140	glacial	D,S
104-49-2bc	J. Nemmers	Du	13		13	glacial	D,S
104-49-2ca$_1$	M. Eulberg		32		32	glacial	D
104-49-2ca$_2$	M. Eulberg	D	170		170	glacial	S
104-49-2ca$_3$	Q. Nemmers	B	15		15	glacial	D
104-49-3bc	P. Maseman	D		160	160	quartzite	D,S

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	Depth of Well (in feet) in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
104-49-4da	B. Schmidt	D			140	quartzite	D,S
104-49-5dd	D. Schnieders	D			240		D,S
104-49-6aa	P. Ginsbach	D	140	10	150	quartzite	D,S
104-49-7dc	E. Erickson	D			230		D,S
104-49-9cc	D. Pierret	D			125	quartzite	
104-49-10ab	T. Hansen	Sp	13		13	glacial	D,S
104-49-10db	R. O'Brien	D	18		18	glacial	D,S
104-49-11db	R. Bohl	Sp			17	glacial	D
$104\text{-}49\text{-}11dc_1$	W. Langner	D			165	quartzite	D,S
$104\text{-}49\text{-}11dc_2$	M. Morse	D				quartzite	
104-49-12ca	T. Wall		170	100	270	quartzite	
104-49-12dc	D. Bunkers	D	?	?	180-200		D,S
104-49-13ac	P. Schwebach	D	140	32	172	quartzite	D,S
104-49-13cc	G. Geraets	D	50	200	250	quartzite	D,S
104-49-13da	L. Merry	D	130	170	300	quartzite	D,S
104-49-15ad	J. Fiegen	D			265	quartzite	D,S
104-49-15bb	W. Strub	D	6	394	400	quartzite	D,S
104-49-15ca	Schriver & Schrock	D		180	180	quartzite	D,S
104-49-16aa	B. Halvorson		10	50	60	quartzite	D
104-49-16da	V. Buskerud	D	85	100	185	quartzite	D
104-49-17ad	F. Lyng	D	16	55	71	quartzite	D,S

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	Depth of Well (in feet) in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
104-49-17cb	W. Loken	D			80		D,S
104-49-19bd	M. Floren	D	80	35	115	quartzite	D,S
104-49-18cd	I. Nelson	D	40	80	120	quartzite	D,S
104-49-20ab	M. Stoefen	D	12	48	60	quartzite	D,S
104-49-21bc	O. Landstad	D	6	81	87	quartzite	S
104-49-21cb	G. Gurgensen		32		32	glacial	D,S
104-49-21dc	C. Pedersen		72	112	184	quartzite	D
104-49-22cc	J. Sluiter	D			185		D,S
104-49-24ca	Arthur Rave	D			30		D,S
104-49-27aa	E. Burkard	D	100	90	190	quartzite	D,S
104-49-27cc	E. Mortvedt	B	32		32	glacial	S
104-49-28bb	V. Stoefen	D	26		26	glacial	D
104-49-28cc	N. Lyngaas	D	70-80		70-80	glacial	D,S
104-49-30aa	E. Odlane	D	100	60	160	quartzite	D,S
104-49-30ab	L. Schwemle	B	18		18	glacial	D
104-49-31ab	W. Nelson	Sp	18		18	glacial	D,S
104-49-31cb	T. Berg		18		18	glacial	D
104-49-32aa	R. Johnson	B	20-22		20-22	glacial	D,S
105-48-8cb$_1$	H. Halverson	B	25		25	glacial	D
105-48-8cb$_2$	H. Halverson	D	300		300	glacial	D,S
105-48-9cc	H. Kontz	D	80		80	glacial	D,S
105-48-16bb	L. Schrecengost	B	48		48	glacial	D,S

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	Depth of Well (in feet) in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
105-48-17aa	J. Hermanson	D	80		80	glacial	D,S
105-48-18ab	R. Hyde	D	150		150	glacial	D
105-48-20cb	R. Christensen	Sp	18		18	glacial	D,S
105-48-21bb	H. Janssen	B	50		50	glacial	D,S
105-48-28cb$_1$	H. Uhden	Du	33		33	glacial	
105-48-28cb$_2$	H. Uhden	B	40		40	glacial	S
105-48-29ab	S. Trust	D	160		160	glacial	D
105-48-29bc	G. Christensen	B	21		21	glacial	D,S
105-48-29dd	E. Anderson	B	37		37	glacial	D,S
105-48-30ab$_1$	G. Christensen	Sp	18-20		18-20	glacial	D
105-48-30ab$_2$	G. Christensen	D	60		60	glacial	
105-48-30da$_1$	R. Nelson	B	20		20	glacial	D
105-48-30da$_2$	R. Nelson	D	174		174	glacial	
105-48-31bb	M. Joneson	D	65			glacial	D,S
105-48-31dd	H. Anderson	D	300	8	308	quartzite	D
105-48-32ab$_1$	R. Nelson	D	210		210	glacial	
105-48-32ab$_2$	R. Nelson	D	45		45	glacial	
105-48-33ba$_1$	F. Marshall	D	160		160	glacial	S
105-48-33ba$_2$	F. Marshall	B	35		35	glacial	
105-48-33cb$_1$	C. Uhden	B	35		35	glacial	D
105-48-33cb$_2$	C. Uhden	B	70		70	glacial	S

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	Depth of Well (in feet) in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
105-49-2da$_1$	E. Nelson	D	80		80	glacial	S
105-49-2da$_2$	E. Nelson	Sp	15		15	glacial	D
105-49-2da$_3$	E. Nelson	Sp	15		15	glacial	D
105-49-4da$_1$	L. Collins	D	160		160	glacial	D
105-49-4da$_2$	L. Collins		12		12	glacial	
105-49-9ad$_1$	E. Jacobsen	D				glacial	S
105-49-9ad$_2$	E. Jacobsen	B				glacial	D
105-49-9dd$_1$	A. Dockstader	Sp	26		26	glacial	D
105-49-9dd$_2$	A. Dockstader	D	150		150	glacial	
105-49-9dd$_3$	A. Dockstader	Sp	26		26	glacial	D
105-49-10bc	E. Jacobsen	B	25		25	glacial	D
105-49-10dd	L. Krier	Sp	11-15		11-15	glacial	D,S
105-49-13ac	W. Eastman	Sp	24		24	glacial	D
105-49-13cb$_1$	L. Jorgensen	B	21		21	glacial	
105-49-13cb$_2$	L. Jorgensen	B	23		23	glacial	D
105-49-14ab	V. Whipkey	Sp	12-15		12-15	glacial	D
105-49-14bb$_1$	B. Knoll	Sp	12		12	glacial	D,S
105-49-14bb$_2$	B. Knoll	Sp	12		12	glacial	D,S
105-49-15dd	L. Burkard	D	165		165	glacial	D,S
105-49-16aa$_1$	W. Gordan	Sp	26		26	glacial	D
105-49-16aa$_2$	W. Gordan	D	150		150	glacial	

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	Depth of Well (in feet) in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
105-49-19dd$_1$	A. Ahlers	D	165		165	glacial	S
105-49-19dd$_2$	A. Ahlers	D	40		40	glacial	D
105-49-20dd$_1$	J. Klein	D	180	100	280	quartzite	
105-49-20dd$_2$	J. Klein	D	140		140	glacial	
105-49-21ad$_1$	L. Allen	D	190	10	200	quartzite	S
105-49-21ad$_2$	L. Allen	B	40		40	glacial	D
105-49-22bc	H. Heinricy	D	200-300		200-300	glacial	D,S
105-49-22da	F. Huss	D	100		100	glacial	D,S
105-49-22dd	M. Huss	D	100		100	glacial	S
105-49-23a	G. Olsen	B	30		30	glacial	D
105-49-23bb	N. Welbig	D	224		224	glacial	D,S
105-49-23cd$_1$	N. Schmidt		60		60	glacial	D
105-49-23cd$_2$	N. Schmidt		300		300	glacial	
105-49-23dc	N. Huss		331		331	glacial	S
105-49-24ca$_1$	B. Cronk	B	28		28	glacial	D,S
105-49-24ca$_2$	B. Cronk	D	280		280	glacial	D,S
105-49-25cb$_1$	A. Rave	D	80		80	glacial	S
105-49-25cb$_2$	A. Rave		40		40	glacial	D
105-49-25da$_1$	A. Lampson	D	50		50	glacial	D,S
105-49-25da$_2$	A. Lampson	D	50-60		50-60	glacial	D,S

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
105-49-25db$_1$	H. Bokker		20		20	glacial	D
105-49-25db$_2$	H. Bokker	D	114		114	glacial	S
105-49-26cd	R. Scherff	D	160		160	glacial	D,S
105-49-26da$_1$	J. Rave		60		60	glacial	
105-49-26da$_2$	J. Rave		37		37	glacial	D,S
105-49-26dc	F. Weelborg	Du	30		30	glacial	D,S
105-49-27bc	M. Weinacht	D	300	15	315	quartzite	D,S
105-49-27cc	V. Schwebach	D	90		90	glacial	D,S
105-49-27cd$_1$	L. Maseman	D	160		160	glacial	D,S
105-49-27cd$_2$	L. Maseman		25		25	glacial	
105-49-28cc	G. Fitzgerald	D	100	100	200	quartzite	S
105-49-29dd	J. Fitzgerald	B	60		60	glacial	D,S
105-49-30dd$_1$	H. Schnieders	B	50		50	glacial	D,S
105-49-30dd$_2$	H. Schnieders	D	230		230	glacial	
105-49-31da	B. Frantzen	D	180	300	480	quartzite	D,S
105-49-32dd	L. Fitzgerald	D	151	157	308	quartzite	
105-49-33bc	J. Mousel	D	140	125	265	quartzite	D,S
105-49-33cc	M. Bunkers	D	110		110	glacial	D,S
105-49-34ad	L. Allen	D	31		31	glacial	D,S
105-49-34bc	L. Elsinger	D	198		198	glacial	D,S
105-49-34cc$_1$	F. Schmidt	D	75	100	175	quartzite	D,S
105-49-34cc$_2$	F. Schmidt	B	42		42	glacial	D,S

Well Location	Owner or Tenant	Type of Well	Depth of Well (in feet) in Drift	Depth of Well (in feet) in Quartzite	Total Depth of Well (feet)	Geologic Source	Use of Water
105-49-35ad	J. Alberts	Sp	16		16	glacial	D,S
105-49-35bc$_1$	M. Zimmerman	D	30		30	glacial	D
105-49-35bc$_2$	M. Zimmerman	D	90		90	glacial	S
105-49-35cc	J. Merges		13		13	glacial	D,S
105-49-36bc$_1$	H. Olson		12		12	glacial	D
105-49-36bc$_2$	H. Olson		153		153	glacial	D
105-49-36bc$_3$	H. Olson		12		12	glacial	
105-49-36cb$_1$	G. Carlson		17		17	glacial	D
105-49-36cb$_2$	G. Carlson		50		50	glacial	S
105-49-36cb$_3$	G. Carlson		37		37	glacial	
106-48-7bb	E. Stombaugh	D	100		100	glacial	D
106-49-23ac	F. Gebhart	Du	10		10	glacial	D
106-49-25bb	M. Driver	Du	30		30	glacial	D,S
106-49-26aa$_1$	H. Hove	B	32		32	glacial	D,S
106-49-26aa$_2$	H. Hove	B	32		32		D,S