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 fan 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. Hodges, 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 I. 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 2½-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 103-49-35padd (test hole 50, fig. 2) is in the SE1/4 SE1/4 NW1/4 sec. 35, T. 105 N., R. 49 W., (see fig. 3).

GENERAL GEOLOGY

Subsurface Deposits

The subsurface 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 subsurface deposit east and west of the Big Sioux River valley (fig. 2).

Outwash consists of sorted 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 Redfield (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 3½ 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 Del Ray area: (1) 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 or 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 Del Ray contain saturated surface outwash deposits generally 10 to 20 feet thick. The maximum thickness in area A is 15 feet in test hole 2. 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
Figure 4. Data map showing location of test holes and wells with water samples in the buried outwash.

EXPLANATION
- Geological Survey test hole
- Private well
Numbers refer to test holes (App. A) or water samples (Table 2).
- Buried outwash generally thin or absent south of this line;
buried outwash generally 30 to 50 feet thick north of this line.
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. 6) 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 esp. 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 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 1. Inspection of the table shows a wide range of water quality from this aquifer. Each of the 19 samples analyzed contained dissolved 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 123) 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 123 (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 352 (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.)

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* 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.
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* 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.
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<td></td>
<td>7.9</td>
<td>880</td>
<td>1810</td>
<td></td>
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</tr>
</tbody>
</table>

* 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.
<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>LOCATION</th>
<th>DEPTH OF WELL</th>
<th>NAME OF OWNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>169</td>
<td>105-49-27bcba</td>
<td>315</td>
<td>M. Weinacht</td>
</tr>
<tr>
<td>170</td>
<td>105-49-31dada</td>
<td>480</td>
<td>B. Frantzen</td>
</tr>
<tr>
<td>171</td>
<td>105-49-32adcd</td>
<td>145</td>
<td>C. Mousel</td>
</tr>
<tr>
<td>172</td>
<td>104-49-3bccc</td>
<td>160</td>
<td>P. Mosemann</td>
</tr>
<tr>
<td>173</td>
<td>104-49-9ad(Well #3)</td>
<td>520-570</td>
<td>Dell Rapids</td>
</tr>
<tr>
<td>174</td>
<td>104-49-10cc(Well #2)</td>
<td>540</td>
<td>Dell Rapids</td>
</tr>
<tr>
<td>175</td>
<td>104-49-10dc</td>
<td>150</td>
<td>quarry, L. G. Everist, Inc.</td>
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<tr>
<td>175</td>
<td>104-49-10dc</td>
<td>150</td>
<td>quarry, L. G. Everist, Inc.</td>
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<tr>
<td>176</td>
<td>104-49-16aaad</td>
<td>60</td>
<td>B. Halvorson</td>
</tr>
<tr>
<td>177</td>
<td>104-49-15bbcc</td>
<td>400</td>
<td>W. Strub</td>
</tr>
<tr>
<td>178</td>
<td>104-49-16daa</td>
<td>185</td>
<td>V. Buskerud</td>
</tr>
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<td>179</td>
<td>104-49-13dda</td>
<td>300</td>
<td>L. Merry</td>
</tr>
<tr>
<td>180</td>
<td>103-49-5ab(Baltic city)</td>
<td>160</td>
<td>city</td>
</tr>
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</table>
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 show a high content of chlorides.

Table 3 shows the water analyses from the Sioux Quartzite and figure 5 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.
Figure 6. Map showing location of water samples from the Sioux Quartzite.
REFERENCES CITED


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 3.)

Test Hole No. 1
SDGS Auger
Location: 105-49-15bba
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: 105-49-15adds
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: 105-49-14aaa  
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  
24-39  Clay, yellow-green  
29-34  No cuttings  
34-39  Till, gray  

Test Hole No. 5  
SDGS Auger  
Location: 105-49-13abb  
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: 105-45-18aaa  
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: 105-48-10decc  
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
13-34  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: 105-48-19bbbb
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: 105-48-19deaa
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: 105-48-19c00d
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: 105-48-19d00d
Surface elevation: 1498 feet
Depth to water: no water

0- 2  Topsoil, black
2-12  Till, brown
12-24  Till, gray

Test Hole No. 13
SDGS Auger
Location: 105-48-19d00c
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: 105-49-26b00c
Surface elevation: 1555 feet
Depth to water: 10 feet

6- 2  Topsoil, black
2-15  Clay, brown (loess)
15-29  Till

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

0- 3 Tonsil, black
3-34 Till: possibly loess from 3 to 7 feet

Test Hole No. 16
SDGS Auger
Location: 105-49-26eada
Surface elevation: 1335 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

Date Point No. 17
Private well; no log available

Test Hole No. 18
SDGS Auger
Location: 105-49-26bdad
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: 105-49-26eada
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: 105-49-16ddda
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: 105-49-25bdcd
Surface elevation: 1522 feet
Depth to water: 15 feet
0–3 Topsoil
3–35 Sand, coarse; some gravel
35–49 Clay

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: 105-49-25ddd
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: 105-48-30ccc
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: 105-48-30abb
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: 105-48-30
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: 105-48-30
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: 105-49-30
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

* * * *

Data Point No. 35
Private well; no log available
Data Point No. 36
Private well; no log available

* * * *

Test Hole No. 37
SDGS Auger
Location: 105-48-29bbas
Surface elevation: 1510 feet
Depth to water: 19 feet
0-2
Top soil
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: 105-48-29bbas
Surface elevation: 1510 feet
Depth to water: 15 feet
6-5
Top soil, clayey, brown
5-30
Sand, clayey, brown
30-32
Rock?
32-44
Till

* * * *

Test Hole No. 39
SDGS Auger
Location: 105-48-34dec
Surface elevation: 1515 feet
Depth to water: not measured
0-4
Top soil, 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

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

Test Hole No. 42
SDGS Auger
Location: 105-49-34ddhb
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)

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

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

* * * *

Data Point No. 44
Private well; no log available

* * * *

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)

* * * *

Test Hole No. 47
SDGS Auger
Location: 105-49-35eabb
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
4-15  Sand, coarse; clay
16-  Sand gravel, coarse

***

Test Hole No. 48
SDGS Auger
Location: 105-42-35aaa
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)

***

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

***

Test Hole No. 50
SDGS Auger
Location: 101-49-35badd
Surface elevation: 1516 feet
Depth to water: 13 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

<table>
<thead>
<tr>
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<th>Description</th>
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</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Topsoil, dark-brown</td>
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<tr>
<td>2-5</td>
<td>Sand, medium to coarse</td>
</tr>
<tr>
<td>5-11</td>
<td>Sand, coarse, and clay</td>
</tr>
<tr>
<td>11-12</td>
<td>Rocks; gravel</td>
</tr>
<tr>
<td>12-17</td>
<td>Sand, coarse; some clay</td>
</tr>
<tr>
<td>17-34</td>
<td>Clay and pebbles</td>
</tr>
</tbody>
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Data Point No. 52
Private well; no log available

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

<table>
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<tr>
<th>Depth</th>
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<tr>
<td>2-5</td>
<td>Clay, gray-brown</td>
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<tr>
<td>5-20</td>
<td>Sand, coarse; some gravel</td>
</tr>
<tr>
<td>10-32</td>
<td>Clay</td>
</tr>
<tr>
<td>32-</td>
<td>Hard material; unable to penetrate</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Depth</th>
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<tbody>
<tr>
<td>0-2</td>
<td>Topsoil, black</td>
</tr>
<tr>
<td>2-5</td>
<td>Loess</td>
</tr>
<tr>
<td>5-8</td>
<td>Sand, brown, clayey</td>
</tr>
<tr>
<td>8-10</td>
<td>Gravel</td>
</tr>
<tr>
<td>10-29</td>
<td>Clay and pebbles (till)</td>
</tr>
</tbody>
</table>
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: 105-49-35ddcd
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: 105-49-36cbbc
Surface elevation: 1495 feet
Depth to water: 8 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: 105-49-36cvcdb
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: 105-49-36cucc
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: 105-49-36 c Bound
Surface elevation: 1488 feet
Depth to water: 6 feet

0-1  Soil, black
1-3  Sand, fine to medium, gritty
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: 105-49-36 c d
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: 105-49-36 b d
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: 105-49-36 a c b
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: 105-49-36dcd
g
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
34-81.5 Till
### Test Hole No. 70
**SDGS Auger**
**Location:** 105-48-31acca  
**Surface elevation:** 1525 feet  
**Depth to water:** 15 feet  

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Topsoil, black</td>
</tr>
<tr>
<td>2-5</td>
<td>Clay</td>
</tr>
<tr>
<td>5-30</td>
<td>Sand, clayey, brown</td>
</tr>
<tr>
<td>30-44</td>
<td>Till</td>
</tr>
</tbody>
</table>

---

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

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>Topsoil, black</td>
</tr>
<tr>
<td>3-10</td>
<td>Sand, coarse, clayey</td>
</tr>
<tr>
<td>10-11</td>
<td>Gravel, coarse</td>
</tr>
<tr>
<td>11-20</td>
<td>Sand</td>
</tr>
<tr>
<td>20-21</td>
<td>Gravel, coarse</td>
</tr>
<tr>
<td>21-34</td>
<td>Till</td>
</tr>
</tbody>
</table>

---

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

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Topsoil, black</td>
</tr>
<tr>
<td>1-4</td>
<td>Loess</td>
</tr>
<tr>
<td>4-</td>
<td>Sioux Quartzite</td>
</tr>
</tbody>
</table>

---

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

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Topsoil, black</td>
</tr>
<tr>
<td>2-6</td>
<td>Till</td>
</tr>
<tr>
<td>6-13</td>
<td>Gravel</td>
</tr>
<tr>
<td>13-29</td>
<td>Clay</td>
</tr>
</tbody>
</table>

---
Test Hole No. 74
SDGS Auger
Location: 104-49-3akdo
Surface elevation: 1305 feet
Depth to water: 10 feet

0- 2 Torsol, 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 Torsol, 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 Torsol, black
2- 5 Loess
5- 8 Sand, clayey, brown
10-20 Sand, medium to coarse; some clay; clay content decreasing with depth
20-35 Clay

Test Hole No. 77
SDGS Auger
Location: 104-49-3dace
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: 104-49-3daca
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 Tilt, 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
21-32 Clay, blue; Sioux Quartzite at 32 feet

****

Test Hole No. 80
SDGS Auger
Location: 104-49-3uddc
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: 1492 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. 36
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  Sand, 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
4-9  Sand and gravel, coarse; unable to penetrate

* * * *

Test Hole No. 89
SDGS Auger
Location: 104-49-2bdaa
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
2- 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: 104-49-1bcce
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: 104-49-1bbed
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: 104-49-1bbbo
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: 104-49-1basa
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

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Topsoil</td>
</tr>
<tr>
<td>2-10</td>
<td>Sand, clayey, reddish-brown</td>
</tr>
<tr>
<td>10-11</td>
<td>Gravel</td>
</tr>
<tr>
<td>11-15</td>
<td>Till, gray</td>
</tr>
<tr>
<td>15-</td>
<td>Sioux Quartzite?</td>
</tr>
</tbody>
</table>

* * *

Test Hole No. 99

SDGS Auger

Location: 104-49-10aaac

Surface elevation: 1492 feet

Depth to water: 5 feet

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>Topsoil, black</td>
</tr>
<tr>
<td>3-5</td>
<td>Clay</td>
</tr>
<tr>
<td>5-15</td>
<td>Sand, coarse, brown; some clay</td>
</tr>
<tr>
<td>15-34</td>
<td>Clay</td>
</tr>
<tr>
<td>34-</td>
<td>Sioux Quartzite?</td>
</tr>
</tbody>
</table>

* * *

Test Hole No. 100

SDGS Auger

Location: 104-49-11bbcc

Surface elevation: 1490 feet

Depth to water: 5-10 feet (?)

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Topsoil, black</td>
</tr>
<tr>
<td>2-13</td>
<td>Sand, medium to coarse</td>
</tr>
<tr>
<td>13-49</td>
<td>Clay</td>
</tr>
</tbody>
</table>

* * *

Test Hole No. 101

SDGS Auger

Location: 104-49-10accc

Surface elevation: 1495 feet

Depth to water: 10 feet

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clay, brown</td>
</tr>
<tr>
<td>5-15</td>
<td>Sand, clayey, brown</td>
</tr>
<tr>
<td>15-17</td>
<td>Gravel, coarse</td>
</tr>
<tr>
<td>17-20</td>
<td>Clay</td>
</tr>
<tr>
<td>20-</td>
<td>Sioux Quartzite?</td>
</tr>
</tbody>
</table>

* * *
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), ten
35- Sioux Quartzite?

Test Hole No. 104
SDGS Auger
Location: 104-49-11bcdb
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: 104-49-11bcdh
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: 104-49-11bddd
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: 104-49-11bcce
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: 104-49-11cabc
Surface elevation: 1482 feet
Depth to water: 9 feet

0-2  Topsoil
2-   Sioux Quartzite?
Test Hole No. 110
SDGS Auger
Location: 104-49-10ddd
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: 104-49-17add
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: 104-49-20addac
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. 214
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
SDGSS Auger
Location: 104-49-20deda
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. 216
USGS Auger
Location: 104-49-20ccdd
Surface elevation: 1485 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: 104-49-20cdc
Surface elevation: 1470 feet
Depth to water: none

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Soil, sandy, light-brown</td>
</tr>
<tr>
<td>1-6</td>
<td>Sand, very fine to medium, silty</td>
</tr>
<tr>
<td>6-</td>
<td>Sioux Quartzite</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Clay, brown</td>
</tr>
<tr>
<td>1-10</td>
<td>Clay, black</td>
</tr>
<tr>
<td>10-15</td>
<td>Clay, sandy, black</td>
</tr>
<tr>
<td>15-20</td>
<td>Till</td>
</tr>
<tr>
<td>20-</td>
<td>Sioux Quartzite?</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>Topsoil</td>
</tr>
<tr>
<td>4-9</td>
<td>Clay, silty, gray</td>
</tr>
<tr>
<td>9-17</td>
<td>Till, brownish-gray</td>
</tr>
<tr>
<td>17-</td>
<td>Sioux Quartzite?</td>
</tr>
</tbody>
</table>

Test Hole No. 120
USGS Auger
Location: 104-49-20cddd
Surface elevation: 1470 feet
Depth to water: 10.66 feet

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Topsoil, black</td>
</tr>
<tr>
<td>2-15</td>
<td>Sand, fine, dark-brown, clayey</td>
</tr>
<tr>
<td>15-25</td>
<td>Sand, fine; gravel, fine, clayey, gray</td>
</tr>
<tr>
<td>25-35</td>
<td>Till (?)</td>
</tr>
<tr>
<td>35-</td>
<td>Sioux Quartzite</td>
</tr>
</tbody>
</table>

* * *
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: 104-49-21bbbe
Surface elevation: 1490 feet
Depth to water: not measured

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

** ** *

Data Point No. 125
Private well; no log available

** ** *

Test Hole No. 126
SDGS Auger
Location: 104-49-29abae
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: 104-49-28aabd
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: 104-49-29bcaea
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: 104-49-29dddd
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: 104-49-28cccc
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. 122
Private well; no log available

Test Hole No. 133
SDGS Auger
Location: 104-49-31cccc
Surface elevation: 1464 feet
Depth to water: 14 feet
0-4 Topsoil
4-9 Sand, fine
9-14 Sand, fine to medium, saturated
14-15 No cuttings
19-24 Sand, fine, clayey
24-29 No cuttings
29-34 Sand, medium
34-39 No cuttings
39-54 11l
Test Hole No. 134
WRC Auger (Water Resources Commission)
Location: 104-49-31ccc
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: 104-49-31ddd
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: 104-49-31ddd
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: 104-49-32bbb
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

** **

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, grey

** **
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

Data Point No. 142
Private well; no log available

Data Point No. 143
Private well; no log available

Data Point No. 144
Private well; no log available
Test Hole No. 145
SDGS Rotary
Location: 105-49-27c
c
Surface elevation: 1375 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

****

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

****

Data Point No. 153
Private well; no log available

****

Data Point No. 154
Private well; no log available

****

Data Point No. 155
Private well; no log available

****

Data Point No. 156
Private well; no log available

****

Data Point No. 157
Private well; no log available

****
Data Point No. 158
Private well; no log available

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
  65-105  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
  159-200  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

Data Point No. 160
Private well; no log available

Data Point No. 161
Private well; no log available

Data Point No. 162
Private well; no log available

Data Point No. 163
Private well; no log available
Test Hole No. 164
SDGS Rotary
Location: 104-48-7aaa
Surface elevation: 1607 feet
Depth to water: not measured

<table>
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<tr>
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<tbody>
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<td>Clay, light-brown</td>
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<tr>
<td>33-35</td>
<td>Clay, dark-gray</td>
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<td>35-47</td>
<td>Clay, yellow</td>
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<td>43-44</td>
<td>Sand, fine</td>
</tr>
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<td>44-62</td>
<td>Clay, light-gray</td>
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<td>62-85</td>
<td>Clay, light-brown</td>
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<td>85-105</td>
<td>Clay, brown, sandy</td>
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<td>Clay, dark-gray</td>
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<td>147-148</td>
<td>Gravel</td>
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<td>148-</td>
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* * * *

Data Point No. 165
Private well; no log available

* * * *

Data Point No. 166
Private well; no log available

* * * *

Data Point No. 167
Private well; no log available

* * * *

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

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<td>Sand</td>
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<td>145-192</td>
<td>Clay, reddish-brown</td>
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* * * *
### APPENDIX B

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

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<th>Well Location</th>
<th>Owner or Tenant</th>
<th>Type of Well</th>
<th>Depth of Well (in feet)</th>
<th>Total Depth of Well (feet)</th>
<th>Geologic Source</th>
<th>Use of Water</th>
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<td>In Quartzite</td>
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<td>Geologic Source</td>
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