

STATE OF SOUTH DAKOTA  
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DEPARTMENT OF NATURAL RESOURCE DEVELOPMENT  
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GEOLOGICAL SURVEY  
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Special Report 63

GROUND-WATER INVESTIGATION FOR THE CITY OF  
WOLSEY, SOUTH DAKOTA

by

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and

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## INTRODUCTION

### Present Investigation

This report contains the results of a special ground-water investigation conducted by the South Dakota Geological Survey from May 28 to June 29, 1974, in and around the city of Wolsey, Beadle County, South Dakota (fig. 1). The purpose of this investigation was to assist the city in locating an additional water supply.

Wolsey presently obtains its water from four wells drilled into the Dakota Formation. Total dissolved solids in water from these wells varies from 1950 to 2500 ppm. This supply is at present of adequate quantity but not the desired quality to fulfill city needs.

This ground-water survey included: (1) a review of the geology as mapped by Hedges (1968), (2) rotary drilling of 52 test holes, (3) an elevation survey of each test hole location, (4) a well inventory for the area, and (5) collection and chemical analyses of 22 water samples.

As a result of this study, two zones of buried outwash were found in the Wolsey area and both proved to be of poor chemical quality. These outwash zones are not recommended for the city's water supply. It is recommended that the feasibility of treating water from the Dakota Formation be studied to remove some of the excess chemicals and future wells be drilled to the upper zone of the Dakota Formation.

The cooperation of the residents of Wolsey and the town board, including Robert Myer, Charles Teply, and Rosella Dilley, is appreciated.

The project was financed by the South Dakota Geological Survey, the Oahe Conservancy Sub-District, and the city of Wolsey.

### Location and Extent of the Area

The city of Wolsey is located in west-central Beadle County in east-central South Dakota and has a population of 480 people. It lies in the James Basin Division of the Central Lowland physiographic province (fig. 1). The study area is approximately 4 square miles in size, measuring 2 miles north-south and 2 miles east-west.

### Topography and Drainage

The topography in the Wolsey area is represented by a gently rolling surface of end moraine with narrow belts of outwash and alluvium to the east and west. The most characteristic topographic feature is the trace of the Antelope Moraine which trends from

northwest to the southeast about 1 mile southwest of the city.

The drainage is controlled by Cain Creek which flows southeast and empties into the James River in south-central Beadle County.

## GENERAL GEOLOGY

### Surficial Deposits

Surficial deposits in the Wolsey area are collectively called drift and were deposited by glaciers during the Pleistocene Epoch of geologic time. Drift is subdivided into two basic lithologic groups: till and outwash. Till is a heterogeneous mixture of boulders, pebbles, and sand in a clay matrix deposited by glacial ice. Outwash is more homogeneous and consists primarily of sand and gravel with lesser amounts of silt and clay. It is often stratified and was deposited directly by meltwater streams originating from the glaciers.

Alluvium is a mixture of sand, silt, and clay and is deposited by present day streams. In the Wolsey area it is found around the margins of Cain Creek.

Figure 2 is a generalized geologic map of the Wolsey area and shows the distribution of these glacial deposits at the surface. Test holes drilled in the area indicate that the glacial drift thickness varies from 65 feet to 290 feet (app. A and fig. 3).

### Subsurface Bedrock

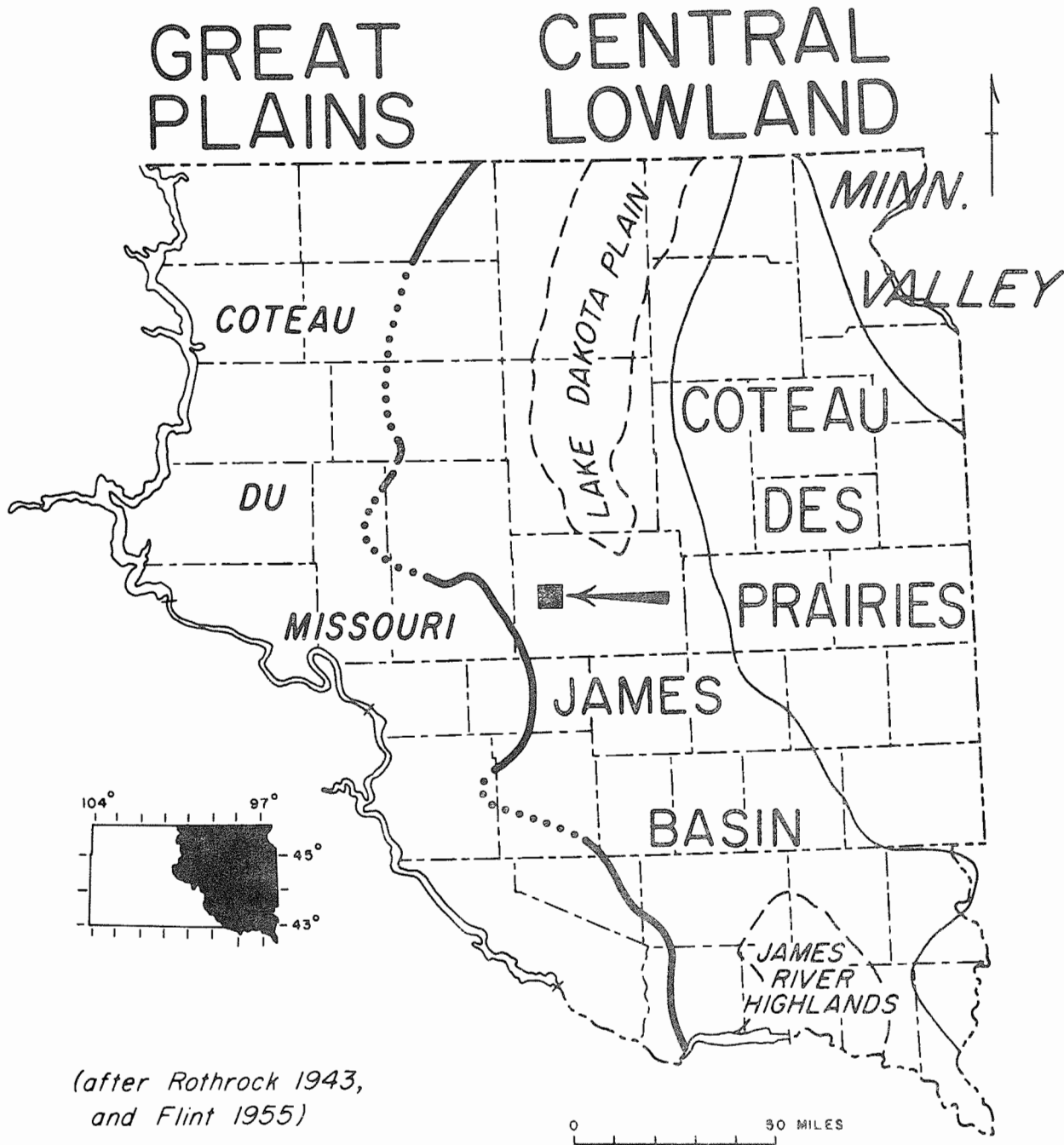
Sedimentary rocks of Cretaceous Age underlie the glacial deposits in the Wolsey area. These rocks are not found at the surface and can only be traced by their record from wells in the area.

The Pierre Shale was penetrated immediately below the Pleistocene drift. It is composed of a dark-gray to black fissile shale and underlies all of the Wolsey area. It is approximately 100 feet thick. The Pierre Shale is underlain in descending order by the Niobrara Marl, Carlile Shale, Greenhorn Limestone, Graneros Shale, and Dakota Sandstone.

The Niobrara Marl is a light- to dark-gray marl or chalk and is approximately 85 feet thick.

The Carlile Shale is a medium- to dark-gray shale with stringers of fine-grained sandstone. Locally, the Codell Sandstone member is present in the area. The top of the Carlile Shale lies nearly 300 feet below the surface in the Wolsey area and is approximately 190 feet thick.

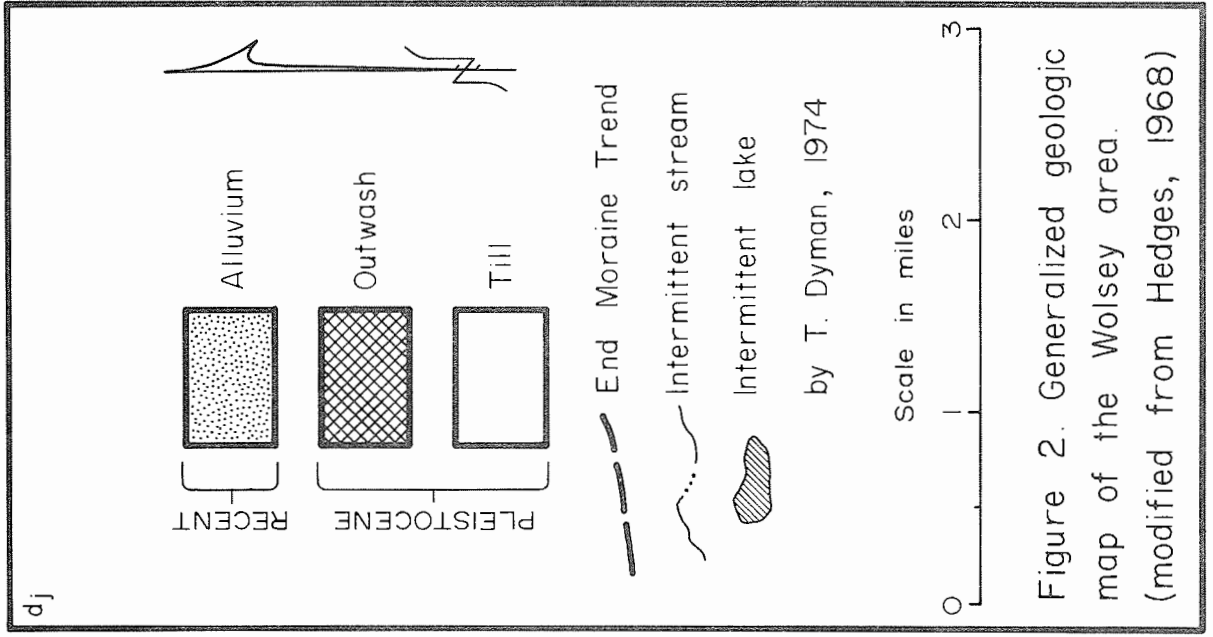
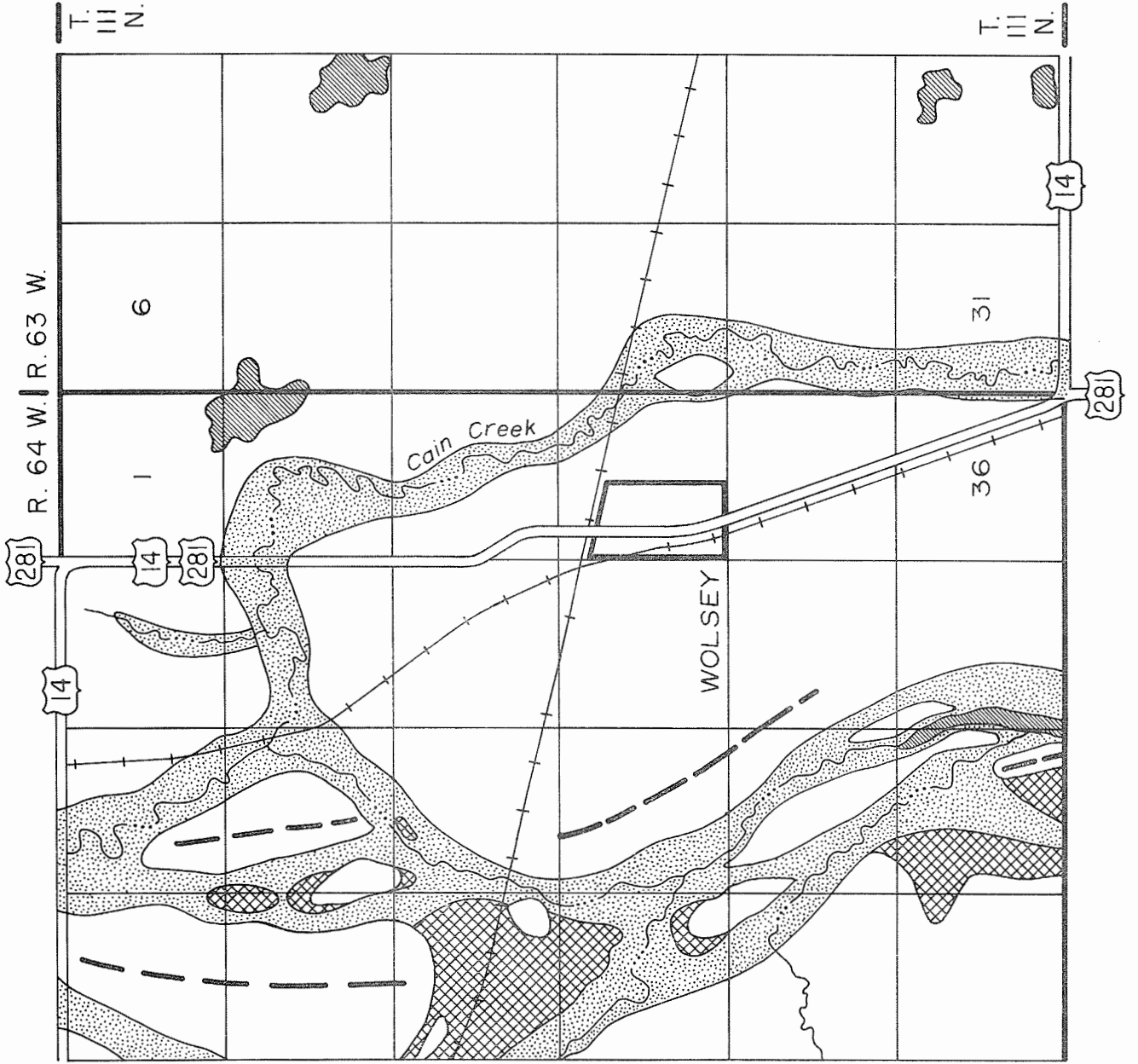
The Greenhorn Limestone is a light-gray to white limestone and is approximately 100 feet thick.



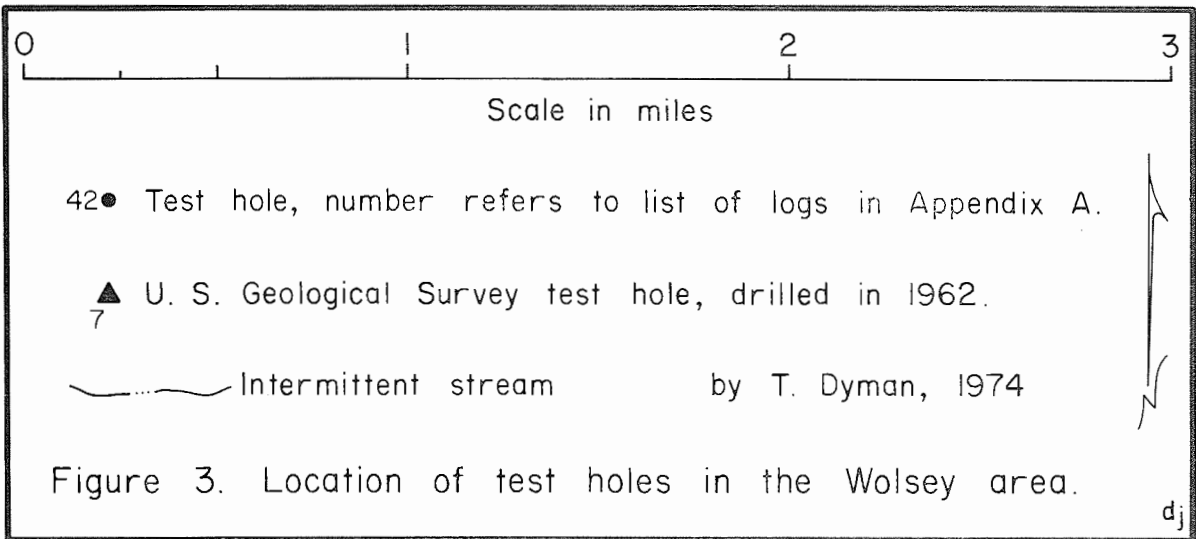
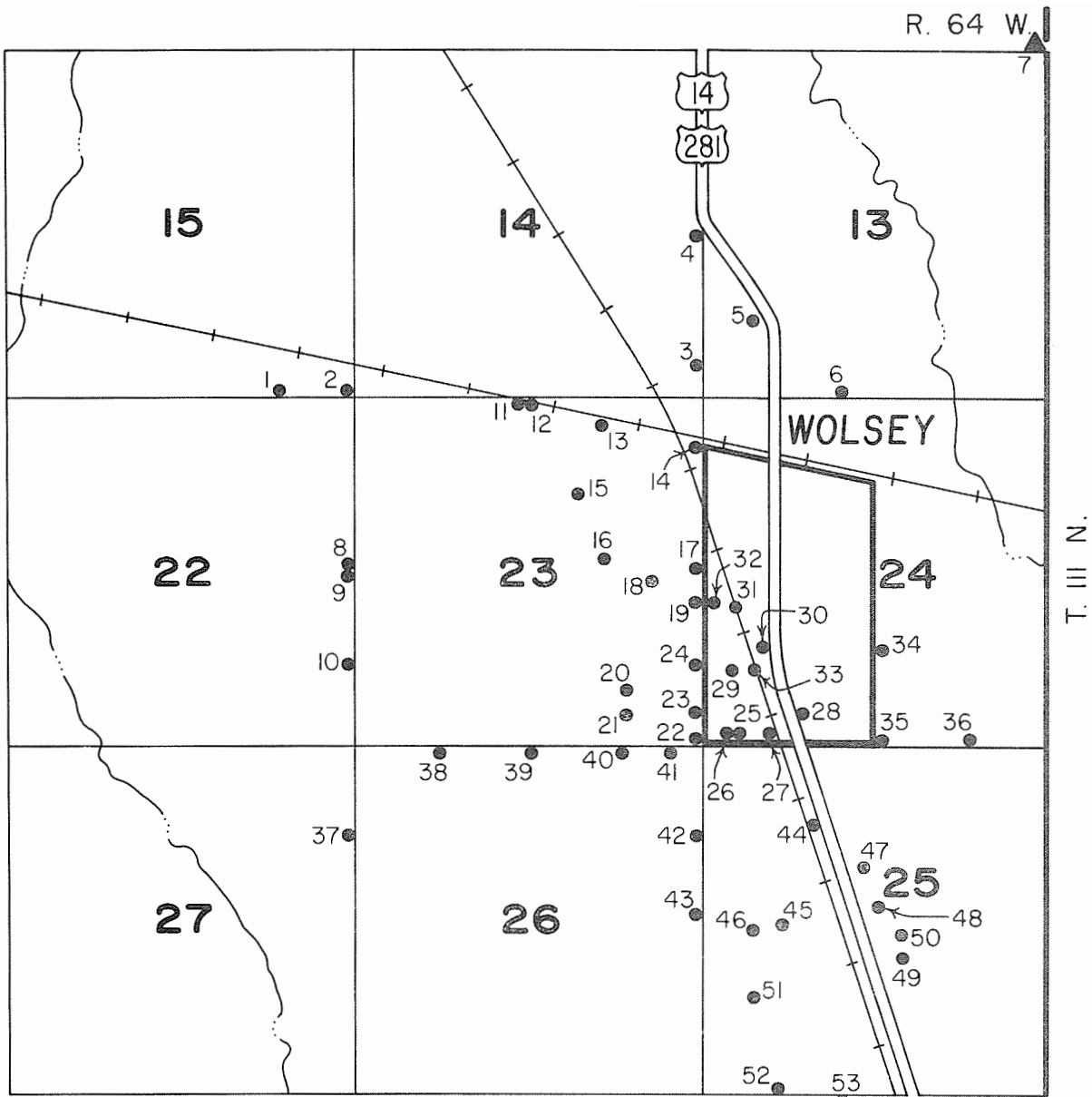
(after Rothrock 1943,  
and Flint 1955)

■ Wolsey study area

Figure 1. Major physiographic divisions of eastern South Dakota and location of the Wolsey area.



dj



The Graneros Shale is a sequence of gray, sandy shale and siltstone with thin sand zones. It is approximately 200 feet thick.

The Dakota Formation is the oldest sedimentary rock unit in the area. It is composed of a white, fine- to medium-grained sandstone with alternating beds of sandy shale and limestone. The Dakota Formation is approximately 300 feet thick in the Wolsey area and is underlain by Precambrian rock.

## OCCURRENCE OF GROUND WATER

### Principles of Occurrence

Ground water is defined as water contained within voids or openings in rocks or sediments below the water table. The water table represents the upper surface of the zone of saturation. The zone of aeration is the unsaturated zone above the water table where water moves downward under the influence of gravity. Water within the zone of saturation moves under the influence of the hydraulic head.

The popular belief that water is found in veins that discontinuously crisscross an area is incorrect. Water can be found nearly everywhere beneath the surface but at varying depths.

Most ground water is derived from precipitation. When rain or melting snow percolates downward to the water table, it becomes ground water. Water which drains off at the surface and is not carried downward, either evaporates or is carried to the oceans by streams.

Recharge is the addition of water to an aquifer and is accomplished in four ways: (1) by downward percolation of precipitation from the ground surface, (2) by downward percolation from surface water bodies, (3) by lateral underflow of water in transient storage, and (4) by artificial recharge from excessive irrigation, downward percolation from canals and man-made lakes, and water purposely added to supplement the ground-water supply.

Discharge is the removal of ground water from an aquifer and is accomplished in four ways: (1) by evaporation and transpiration by plants, (2) by seepage upward or laterally into surface bodies of water, (3) by lateral underflow of water in transient storage, and (4) by pumping from wells and reservoirs.

Porosity is a representation of the volume of voids or open spaces in a rock and is expressed as the ratio of the volume of these voids to the total volume of rock. Porosity in a sedimentary deposit chiefly depends on (1) the shape and arrangement of particles, (2) the degree of sorting of the particles, (3) cementation and compaction, (4) the amount of

material which has been removed by percolating ground water, and (5) rock fracturing resulting in joints. Provided that all other factors are equal, the grain size of a particular material will have little or no effect on the porosity.

The permeability of a rock is its ability to transmit fluids. Water will pass through a material with connecting pore spaces but will not pass through a material with unconnected pores even if the latter material has an equal or greater porosity. Some tills may have a high porosity but will yield little water because of their low permeability. It can be seen that porosity and permeability are related but not synonymous.

If an aquifer is present below a confining, impermeable bed and the water in a well rises to a level above the bottom of the confining bed, it is said to be artesian.

### Ground Water in Bedrock

Most of the wells in the Wolsey area obtain their water from the Dakota Sandstone. Four wells in this unit provide the city of Wolsey with its present supply. The Dakota Formation is one of the most extensive aquifers in South Dakota.

The Codell Sandstone member of the Carlile Shale is a locally important aquifer particularly in eastern Beadle County and to the south in Sanborn County. Electric logs of wells in the Wolsey area indicate that the unit is discontinuous. It is approximately 20 feet thick just to the south of Wolsey and may contain much shale. No wells in the Wolsey area receive their water from the Codell Sandstone, and test holes in the area did not penetrate this unit.

### Ground Water in Glacial Deposits

Till does not yield significant amounts of water because of its highly unsorted nature and low permeability; however, outwash has a higher permeability and can yield sizeable quantities of water when found over a large enough area.

Two sizeable surface outwash deposits exist 2½ miles to the west and southwest of the city, but because of this distance no attempt was made to test drill in the area. It is uncertain whether these deposits contain adequate quantities of water.

Buried outwash in the Wolsey area is very irregular but occurs in several distinct zones. The upper zone can be found to the west and south of Wolsey and reaches a maximum thickness of more than 40 feet. It is generally composed of a fine- to coarse-grained sand, but zones of sand and gravel occur locally.

The lower zone is found in an apparently

continuous gravel unit in the northeast and to the west and south of Wolsey.

### Quality of Ground Water

All ground water contains dissolved minerals in varying amounts. These minerals are derived in the following ways: (1) from the atmosphere as water vapor condenses and falls to the ground, (2) from the soil and underlying deposits as water moves downward to the water table, and (3) from deposits below the water table which contribute chemicals to the water. In general, poor quality water contains large concentrations of dissolved minerals.

Table 1 represents the chemical analyses of water samples taken in the Wolsey area and figure 4 illustrates their locations. Samples W-15 through W-18 which were taken from the four city wells are sulfate rich waters and have total solids more than the recommended limit. The two deeper city wells, however, produce water with a higher sulfate content. This water is harder and has a higher total dissolved solids content than the two shallower wells.

Of all the analyzed water samples, only W-5 and W-6 are of distinctively better quality than the city water supply. Both have sulfate values lower than the recommended limit.

### CONCLUSIONS AND RECOMMENDATIONS

In general, buried outwash in the Wolsey area provides water of poor chemical quality, but samples indicate that some water of improved quality was found to the northwest and southeast of the city. Present test hole data can provide no evidence to suggest that these locations provide sizeable quantities of water. Further test drilling would be required at a further distance from the city to verify the extent of additional buried outwash deposits. The increased distance may prove to be economically prohibitive.

Evidence regarding the Codell Sandstone in the Wolsey area indicates that the unit is discontinuous and may not provide water in sufficient quantity and quality for municipal use. It is not recommended to investigate the Codell Sandstone at this time.

The Dakota Formation is the present source of water for the city. Generally, the total dissolved chemicals is high in this water. It is recommended that the city of Wolsey consult an engineering firm regarding the cost of water treatment to remove some of the chemicals. It is also recommended that the future wells be drilled to the upper zone of the Dakota Formation and a pump test should be conducted to determine whether this zone could provide the city with a sufficient supply of water.

Another possible solution to the water problems is that the city join a rural water system. These systems are designed to serve good quality water to towns and the farms.

Before a permanent well is drilled, the city officials should consult the Division of Water Rights, Department of Natural Resource Development, Pierre, South Dakota, to obtain water rights and the Environmental Protection Agency to determine the biological and chemical suitability of the water.

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TABLE 1. Chemical analyses of water samples from the Wolsey area

Sample	Depth of well	Parts Per Million											Name				
		Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrate Nitrogen	Fluoride	pH	Hardness CaCO <sub>3</sub>		Total Solids			
A																	
W-1	45	285		90	250	500 <sup>1</sup>	0.3	0.05	10	0.9	7.2	1069	1000 <sup>1</sup>	Myer			
W-2	18	267	370	174	75	500	1.0	<0.1	13	1.7 <sup>2</sup>		1384	1860	Kohlmeyer			
W-3	32	190	38	130	261	1046	0.3		36			1009	2810	Struck			
W-4	35	51	415	49	203	264	0.2		60	2.0		330	1422	Balvin			
W-5	40	90	35	28	71	834	0.1		2	1.0		338	1554	Cemetery			
W-6	32	422	68	16	19	228	1.6		2	1.0		416	602	Heller			
W-7	55	293	185	293	23	436	0.1		10	1.0		2222	3652	Boyington			
W-8	62	175	120	167	120	2008	0.1		9	1.0		1420	2126	Kopp			
W-9	68	72	493	81	58	1044	2.5		0	1.0		647	1292	Boomsma			
W-10	105	250	290	87	15	574	0.6		5	0.0		797	1312	McBride			
W-11	50	435	942	27	39	567			5	1.0		291	1744	Salisbury			
W-12	33	314	400	303	344	574			0		7.4	910	1672	Bawdon			
W-13	930	112	467	36	40	900			33			2780	7186	Test Hole			
W-14	1220	356	165	423	287	3850			48			2030	3764	Klaschen			
W-15	1160	356	174	303	172	1874			1			423	2094	City Old Well			
W-16	100	114	246	33	152	1142	1.0		2	0.2		478	2056	City 1957			
W-17	39	550	970	80	111	1286	0.3		25	0.5		1210	2236	City 1959			
W-18	34	302	269	75	123	1250	0.8		2	1.4		1190	2240	City 1968			
W-19	36	300	121	52	21	734	0.1		10	1.7		491	1470	Minium			
W-20				420	275	3350	0.8		2		7.4	3100	5680	McGillvrey			
W-21				141	92	1570			2			1320	2728	Bootz			
W-22				127	77	1008			15			1260	2162	Schilling			

A - Drinking water standards, U.S. Public Health Service (1962).

<sup>1</sup> Modified for South Dakota by the Department of Health (written communication, Water Sanitation Section, September 24, 1968).

<sup>2</sup> 1.2 is optimum for South Dakota

**Location of water samples**  
(For map location, see fig. 4)

- W- 1. SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W., R. Myer.
- W- 2. NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 20, T. 111 N., R. 64 W., R. Kohlmeier.
- W- 3. NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 28, T. 111 N., R. 64 W., D. Struck.
- W- 4. SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 9, T. 111 N., R. 64 W., C. Balvin.
- W- 5. SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 19, T. 111 N., R. 63 W., Wolsey Cemetery.
- W- 6. SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 15, T. 111 N., R. 64 W., L. Heller.
- W- 7. NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W., F. Boyington.
- W- 8. SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 11, T. 111 N., R. 64 W., D. Kopp.
- W- 9. SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 12, T. 111 N., R. 64 W., J. Boomsma.
- W-10. NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 29, T. 111 N., R. 63 W., R. McBride.
- W-11. NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 32, T. 111 N., R. 63 W., R. Salisbury.
- W-12. NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 7, T. 111 N., R. 64 W., M. Bawdon.
- W-13. SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W., Test Hole 40.
- W-14. NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 26, T. 111 N., R. 64 W., F. Klaschen.
- W-15. SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W., City of Wolsey.
- W-16. SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W., City of Wolsey (1957).
- W-17. SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W., City of Wolsey (1959).
- W-18. SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W., City of Wolsey (1968).
- W-19. SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 12, T. 111 N., R. 64 W., B. Minium.
- W-20. SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W., D. McGiltvrey.
- W-21. NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 13, T. 111 N., R. 64 W., F. Bootz.
- W-22. NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 13, T. 111 N., R. 64 W., E. Schilling.

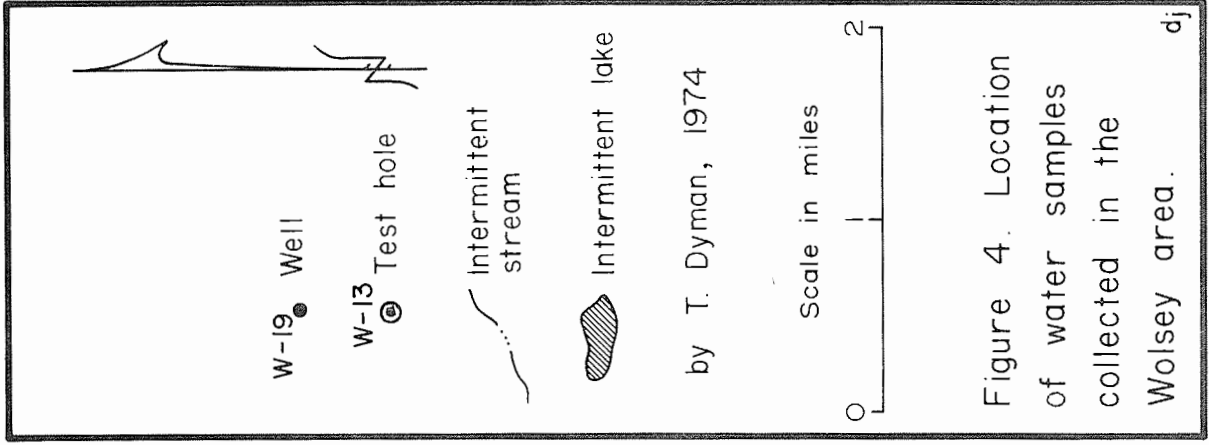
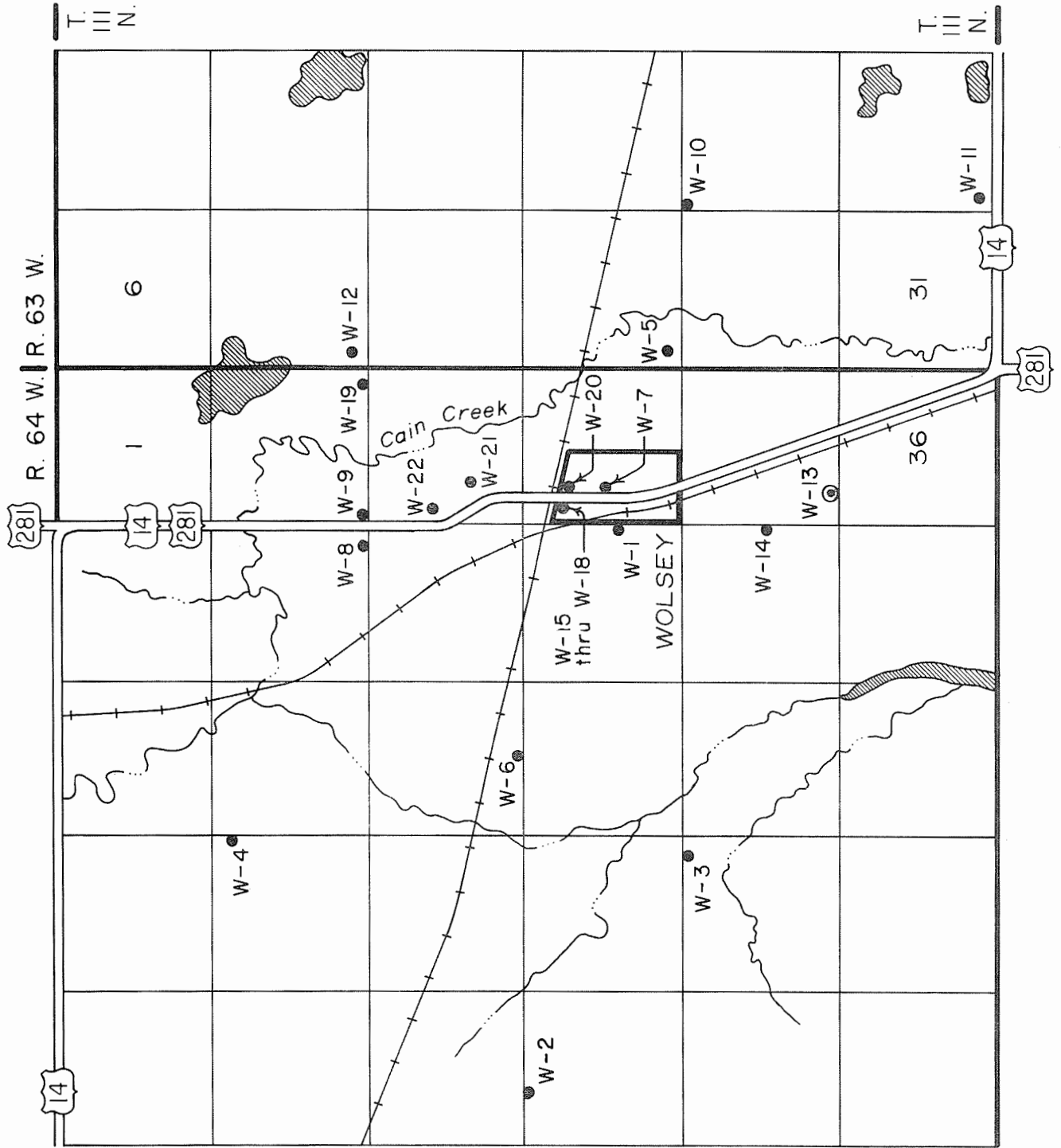


Figure 4. Location of water samples collected in the Wolsey area. dj

## APPENDIX A

### Logs of Test Holes in the Walsey Area (For map location, see fig. 3)

#### Test Hole 1 (SDGS Rotary)

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 15, T. 111 N., R. 64 W.

Surface elevation: 1355 feet

Depth to water: 20 feet

0- 12	Topsoil, sand, brown, silty, and clay
12- 26	Sand, brown, coarse
26- 62	Clay, gray, sandy, pebbly
62- 77	Shale, gray to black

\* \* \* \*

#### Test Hole 2 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 15, T. 111 N., R. 64 W.

Surface elevation: 1346 feet

Depth to water: 8 feet

0- 8	Topsoil, clay, yellow, sandy
8- 13	Clay, yellow, pebbly
13- 18	Clay?, sandy
18- 23	Sand and gravel
23- 28	Clay?, sandy, pebbly
28- 34	Sand, coarse, and gravel
34- 68	Clay, sandy, pebbly
68- 73	Clay, gray, sandy
73- 78	Shale, gray

\* \* \* \*

#### Test Hole 3 (SDGS Rotary)

Location: NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 14, T. 111 N., R. 64 W.

Surface elevation: 1347 feet

Depth to water: 5 feet

0- 23	Topsoil, clay, brown, sandy, pebbly
23- 35	Clay, brown to gray, sandy, pebbly, rocks
35- 48	Sand, fine to coarse, some pebbles and coal
48- 80	Clay?, sandy, pebbly
80-100	Shale, gray to black

\* \* \* \*

#### Test Hole 4 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 14, T. 111 N., R. 64 W.

Surface elevation: 1346 feet

Depth to water: 5 feet

0- 3	Topsoil
3- 38	Clay, brown to blue-gray, sandy, pebbly
38- 68	Clay, blue-gray, pebbly
68- 78	Shale, gray to black

\* \* \* \*

#### Test Hole 5 (SDGS Rotary)

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 13, T. 111 N., R. 64 W.

Surface elevation: 1344 feet

Depth to water: 14 feet

#### Test Hole 5 -- continued.

0- 26	Topsoil, clay, brown to gray, sandy, pebbly
26- 43	Clay?, sandy, pebbly
43- 68	Clay, blue-gray, pebbly
68- 88	Shale, gray to black

\* \* \* \*

#### Test Hole 6 (SDGS Rotary)

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 13, T. 111 N., R. 64 W.

Surface elevation: 1340 feet

Depth to water: 20 feet

0- 23	Topsoil, clay, brown, sandy, pebbly
23- 43	Sand, gray, medium
43- 62	Clay, gray, sandy, pebbly
62- 78	Shale, gray

\* \* \* \*

#### Test Hole 7 (USGS Test Hole drilled in 1962)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 12, T. 111 N., R. 64 W.

Surface elevation: 1348 feet

Depth to water: not measured

0- 2	Soil, blackish-brown, silty clay
2- 5	Sand, to silt, medium-brown, dry, contains clayey bands
5- 12	Sand, medium, to clay, medium-brown, contains sandy bands. Band of dark-brown very sandy, silty, clay at 8 feet. 3 inches of gravel at 9 feet. Drilled very easily from 10 to 12 feet.
12- 17	Clay, medium-brown, silty; almost no sand
17- 20	Clay, medium-brown to gray-brown to medium-gray--a transition zone, silty, some sand
20- 69	Clay, medium-gray, silty, some sand and pebbles, hard below 25 feet
69-100	Sand, medium to fine, some silt; contains a few clayey zones.
100-112	Shale, black, bentonite stringers. Tough drilling. Bit sample

\* \* \* \*

#### Test Hole 8 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 22, T. 111 N., R. 64 W.

Surface elevation: 1347 feet

Depth to water: 5 feet

0- 18	Topsoil, clay, yellow, sandy, pebbly
18- 38	Clay?, gray, sandy
38- 60	Clay, gray, sandy, pebbly
60- 68	Shale, gray to black

\* \* \* \*

#### Test Hole 9 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 22, T. 111 N., R. 64 W.

Surface elevation: 1348 feet

Depth to water: 6 feet

Test Hole 9 -- continued.

0- 4 Topsoil, clay, brown, silty  
 4- 8 Clay, yellow, sandy, pebbly  
 8- 22 Sand, brown to gray, medium  
 22- 26 Sand, coarse, and gravel  
 26- 48 Sand, coarse, rock

\* \* \* \*

Test Hole 10 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 22, T. 111 N., R. 64 W.  
 Surface elevation: 1367 feet  
 Depth to water: 14 feet

0- 13 Topsoil, clay, yellow, sandy  
 13- 50 Clay, brown to blue-gray, sandy, pebbly  
 50- 68 Clay?, sandy  
 68- 83 Clay, sandy, pebbly  
 83- 98 Shale, gray

\* \* \* \*

Test Hole 11 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1347 feet  
 Depth to water: 5 feet

0- 18 Topsoil, clay, brown, sandy, pebbly  
 18- 23 Sand and gravel, brown  
 23- 58 Sand, gray, fine to coarse, coal frag-  
 ments  
 58- 63 Clay?, sandy, shale pebbles  
 63- 78 Sand, coarse, and gravel, shale pebbles  
 78- 88 Clay?, gray, sandy, pebbly  
 88-105 Clay, gray, pebbly  
 105-108 Shale, gray to black

\* \* \* \*

Test Hole 12 (SDGS Rotary)

Location: NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1357 feet  
 Depth to water: 14 feet

0- 13 Topsoil, clay, yellow, sandy  
 13- 20 Clay, brown, pebbly  
 20- 23 Sand and gravel  
 23- 31 Sand, brown to gray, medium  
 31- 39 Clay, gray, sandy, pebbly  
 39- 52 Sand, gray, medium  
 52- 58 Clay, gray, sandy  
 58- 66 Clay, sandy, pebbly  
 66- 68 Sand, blue-gray  
 68- 80 Clay?, very pebbly  
 80- 82 Gravel  
 82- 88 Clay, blue-gray, pebbly  
 88-106 Gravel  
 106-110 Clay, gray  
 110-128 Shale, gray to black

\* \* \* \*

Test Hole 13 (SDGS Rotary)

Location: SE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1354 feet  
 Depth to water: 8 feet

Test Hole 13 -- continued

0- 2 Topsoil  
 2- 8 Sand, fine to medium, yellow-brown  
 8- 18 Clay, sandy, pebbly, yellow-brown  
 18- 24 Clay?, sandy, rocks  
 24- 57 Sand, medium  
 57- 68 Clay, sandy, pebbly, coal fragments  
 68- 88 Gravel  
 88-120 Clay?, pebbly, sandy  
 120-128 Shale, gray to black

\* \* \* \*

Test Hole 14 (SDGS Rotary)

Location: NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1346 feet  
 Depth to water: 5 feet

0- 5 Topsoil  
 5- 20 Clay, brown, pebbly  
 20- 40 Clay?, brown to gray, sandy, pebbly  
 40- 70 Clay?, gray, sandy, pebbly  
 70- 90 Clay, blue-gray, pebbly

\* \* \* \*

Test Hole 15 (SDGS Rotary)

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1357 feet  
 Depth to water: not measured

0- 13 Topsoil, clay, brown, sandy, pebbly  
 13- 23 Clay?, brown, sandy, pebbly  
 23- 29 Clay, blue-gray  
 29- 34 Sand and gravel, clean  
 34- 47 Clay, blue-gray, sandy, pebbly  
 47- 57 Sand and gravel, coal fragments  
 57- 70 Clay?, pebbly  
 70- 74 Sand and gravel  
 74- 88 Clay, pebbly  
 88- 96 Sand and gravel, small amount of clay  
 96-102 Clay, pebbly  
 102-128 Clay, blue-gray  
 128-138 Shale, gray to black

\* \* \* \*

Test Hole 16 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1353 feet  
 Depth to water: 13 feet

0- 9 Topsoil, sand, brown, silty  
 9- 33 Clay, brown to gray, sandy, pebbly  
 33- 56 Sand, gray, medium  
 56- 78 Clay, blue-gray, sandy, pebbly  
 78- 85 Sand and gravel, clean  
 85- 95 Clay, blue-gray, pebbly  
 95- 98 Shale, blue-gray to black

\* \* \* \*

Test Hole 17 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1341 feet  
 Depth to water: 14 feet

Test Hole 17 -- continued.

0- 18 Topsoil, clay, yellow to brown, sandy, pebbly  
 18- 38 Sand and gravel  
 38- 60 Clay, gray, very sandy and pebbly  
 60- 88 Clay?, sandy, pebbly  
 88- 98 Gravel  
 98-109 Clay?, pebbly  
 109-118 Shale, gray to black

\* \* \* \*

Test Hole 18 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1362 feet  
 Depth to water: not measured

0- 17 Topsoil, clay, brown, sandy and silty  
 17- 25 Sand and gravel, brown  
 25- 27 Clay?, sandy, pebbly  
 27- 31 Clay, blue-gray, pebbly, sandy  
 31- 45 Sand, blue-gray, fine to medium  
 45- 46 Clay, blue-gray  
 46- 55 Sand, blue-gray, fine to medium  
 55- 67 Clay, blue-gray, pebbly  
 67- 75 Sand and gravel  
 75- 84 Clay, gray, pebbly  
 84-102 Clay?, pebbly  
 102-109 Gravel  
 109-117 Clay, blue-gray (shale?)

\* \* \* \*

Test Hole 19 (SDGS Rotary)

Location: SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1357 feet  
 Depth to water: 21 feet

0- 18 Topsoil, sand, yellow-brown, clayey  
 18- 28 Sand, brown  
 28- 30 Clay, blue-gray  
 30- 36 Gravel  
 36- 40 Clay, blue-gray, pebbly  
 40- 61 Sand, medium  
 61- 64 Clay?, sandy  
 64- 70 Clay, blue-gray, pebbly  
 70- 78 Gravel  
 78- 88 Clay, pebbly, blue-gray  
 88- 96 Clay, blue-gray  
 96- 98 Shale, blue-gray to black

\* \* \* \*

Test Hole 20 (SDGS Rotary)

Location: SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1346 feet  
 Depth to water: 9 feet

0- 18 Topsoil, clay, yellow to gray, sandy, silty  
 18- 28 Clay, gray, silty, sandy  
 28- 43 Sand, coarse  
 43- 48 Clay, gray, sandy  
 48- 73 Sand, medium

Test Hole 20 -- continued.

73- 78 Clay, sandy  
 78- 88 Shale, gray-black

\* \* \* \*

Test Hole 21 (SDGS Rotary)

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1350 feet  
 Depth to water: 14 feet

0- 20 Topsoil, clay, brown, sandy, silty  
 20- 21 Sand, brown  
 21- 28 Clay, brown, sandy  
 28- 41 Clay, blue-gray, sandy, pebbly  
 41- 43 Sand, blue-gray, medium  
 43- 47 Clay, blue-gray, pebbly  
 47- 48 Sand, blue-gray  
 48- 63 Clay, sandy, pebbly  
 63- 68 Clay, blue-gray, rocks

\* \* \* \*

Test Hole 22 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1345 feet  
 Depth to water: not measured

0- 16 Topsoil, clay, sandy, pebbly  
 16- 18 Clay?, sandy, pebbly  
 18- 28 Sand, brown, medium to coarse  
 28- 38 Clay, pebbly, sandy  
 38- 48 Sand, blue-gray, medium  
 48- 84 Clay, pebbly, sandy  
 84- 88 Shale, gray

\* \* \* \*

Test Hole 23 (SDGS Rotary)

Location: NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1343 feet  
 Depth to water: not measured

0- 18 Topsoil, clay, yellow to brown, sandy, pebbly  
 18- 22 Sand and gravel  
 22- 43 Clay, blue-gray, pebbly  
 43- 58 Clay, blue-gray, sandy  
 58- 64 Sand, coarse  
 64- 68 Clay, blue-gray, sandy  
 68- 77 Clay, blue-gray, hard  
 77- 80 Shale, gray to black

\* \* \* \*

Test Hole 24 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 23, T. 111 N., R. 64 W.  
 Surface elevation: 1350 feet  
 Depth to water: not measured

0- 28 Topsoil, clay, yellow-brown to gray, sandy, pebbly  
 28- 43 Sand and gravel

Test Hole 24 -- continued.

43- 68 Sand, coarse  
 68- 78 Clay?, sandy, blue-gray  
 78- 88 Clay, blue-gray  
 88- 98 Shale, gray to black

\* \* \* \*

Test Hole 25 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1343 feet  
 Depth to water: not measured

0- 13 Topsoil, clay, yellow to brown, sandy,  
 pebbly  
 13- 22 Clay, brown to gray, sandy, pebbly  
 22- 38 Clay, gray  
 38- 41 Sand and gravel  
 41- 58 Clay, gray, sandy, pebbly  
 58- 86 Clay, gray  
 86- 98 Shale, gray to black

\* \* \* \*

Test Hole 26 (SDGS Rotary) (east side)

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1343 feet  
 Depth to water: 9 feet

0- 17 Topsoil, clay, brown to yellow, sandy,  
 pebbly  
 17- 29 Gravel, yellow-brown  
 29- 38 Clay, blue-gray, pebbly  
 38- 39 Gravel  
 39- 53 Clay, blue-gray, pebbly  
 53- 56 Sand and gravel, blue-gray  
 56- 67 Clay, blue-gray, pebbly  
 67- 74 Sand and gravel  
 74- 75 Clay, blue-gray, rock

\* \* \* \*

Test Hole 27 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1341 feet  
 Depth to water: 6 feet

0- 3 Topsoil  
 3- 8 Clay, yellow to brown, sandy  
 8- 10 Sand, brown, medium  
 10- 28 Clay, sandy, brown to blue-gray  
 28- 48 Clay, gray, sandy  
 48- 53 Clay, gray  
 53- 78 Sand and gravel, shale pebbles  
 78- 88 Shale, blue-gray

\* \* \* \*

Test Hole 28 (SDGS Rotary)

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1344 feet  
 Depth to water: 9 feet

0- 18 Topsoil, clay, yellow to gray, sandy,  
 pebbly  
 18- 23 Clay, gray, sandy

Test Hole 28 -- continued.

25- 38 Clay, gray, pebbly  
 38- 56 Clay, gray, sandy  
 56- 68 Clay?, sandy  
 68- 78 Sand, coarse  
 78- 86 Gravel  
 86-108 Shale, blue-gray

\* \* \* \*

Test Hole 29 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1348 feet  
 Depth to water: 12 feet

0- 13 Sand, silt and clay, yellow-brown  
 13- 22 Clay?, sandy, pebbly  
 22- 57 Clay?, sandy, pebbly, rock  
 57- 68 Sand and gravel  
 68- 88 Clay, pebbly, sandy, gray  
 88- 98 Shale, gray to black

\* \* \* \*

Test Hole 30 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1348 feet  
 Depth to water:

0- 11 Topsoil, clay, yellow, sandy  
 11- 33 Sand and gravel, brown to gray  
 33- 38 Sand, blue-gray, medium to coarse  
 38- 40 Gravel  
 40- 46 Sand, blue-gray, medium to coarse  
 46- 61 Gravel  
 61-108 Clay, blue gray, pebbly  
 108-128 Clay, pebbly (shale?)

\* \* \* \*

Test Hole 31 (SDGS Rotary)

Location: SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: not measured  
 Depth to water: not measured

0- 5 Topsoil, clay and sand, silty  
 5- 11 Clay, brown to yellow, silty, sandy  
 11- 18 Sand and gravel  
 18- 25 Clay?, sandy, pebbly  
 25- 29 Clay, blue-gray, pebbly  
 29- 30 Sand and gravel  
 30- 39 Clay, blue-gray  
 39- 43 Clay?, blue gray, sandy  
 43- 48 Gravel  
 48- 49 Clay?, blue-gray, pebbly  
 49- 55 Sand, coarse  
 55- 78 Clay?, sandy, pebbly

\* \* \* \*

Test Hole 32 (SDGS Rotary)

Location: SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1357 feet  
 Depth to water: 21 feet

0- 16 Topsoil, sand, brown, pebbly, clayey

Test Hole 32 -- continued.

16- 27 Sand and gravel, brown, rocks present  
 27- 40 Clay, gray, sandy, pebbly  
 40- 48 Sand and gravel  
 48- 58 Clay, pebbly, sandy  
 58- 72 Clay?, blue-gray, pebbly, sandy  
 72- 83 Sand and gravel  
 83- 96 Clay?, sandy, pebbly  
 96-110 Clay, gray  
 110-118 Shale, blue-black

\* \* \* \*

Test Hole 33 (SDGS Rotary)

Location: NW¼NE¼SW¼SW¼ sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1339 feet  
 Depth to water: 5 feet

0- 23 Topsoil, clay, yellow-brown, sandy  
 23- 60 Clay, blue-gray, sandy, pebbly  
 60- 77 Clay, blue-gray  
 77- 78 Shale, gray to black

\* \* \* \*

Test Hole 34 (SDGS Rotary)

Location: SW¼SW¼NW¼SE¼ sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1352 feet  
 Depth to water: 13 feet

0- 8 Topsoil, clay, brown, sandy, pebbly  
 8- 18 Clay?, sandy, pebbly  
 18- 33 Sand, fine to coarse  
 33- 38 Clay?, sandy, pebbly  
 38- 97 Clay, gray, pebbly  
 97-108 Shale, gray

\* \* \* \*

Test Hole 35 (SDGS Rotary)

Location: SW¼SW¼SW¼SE¼ sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1336 feet  
 Depth to water:

0- 13 Topsoil, clay, brown, sandy, pebbly  
 13- 23 Sand and gravel, brown  
 23- 78 Clay?, sandy, pebbly  
 78- 83 Sand, coarse  
 83- 91 Clay, pebbly  
 91- 98 Shale, gray to black

\* \* \* \*

Test Hole 36 (SDGS Rotary)

Location: SW¼SW¼SE¼SE¼ sec. 24, T. 111 N., R. 64 W.  
 Surface elevation: 1339 feet  
 Depth to water: not measured

0- 23 Topsoil, clay, yellow-brown, sandy,  
 pebbly  
 23- 38 Clay, gray, pebbly  
 38- 48 Clay?, pebbly  
 48- 83 Clay, gray, sandy, pebbly

\* \* \* \*

Test Hole 37 (SDGS Rotary)

Location: NE¼NE¼SE¼NE¼ sec. 27, T. 111 N., R. 64 W.  
 Surface elevation: 1354 feet  
 Depth to water: 12 feet

0- 13 Topsoil, sand, and clay, brown, thin  
 beds  
 13- 28 Sand, brown, few pebbles  
 28- 48 Clay, gray, sandy, pebbly  
 48- 59 Clay?, sandy, pebbly  
 59- 63 Clay, gray, pebbly  
 63- 78 Shale, gray to black

\* \* \* \*

Test Hole 38 (SDGS Rotary)

Location: NE¼NE¼NW¼NW¼ sec. 26, T. 111 N., R. 64 W.  
 Surface elevation: 1346 feet  
 Depth to water: 7 feet

0- 13 Topsoil, clay, sandy, pebbly  
 13- 18 Sand, brown, few pebbles present  
 18- 33 Clay, brown to gray, sandy, pebbly  
 33- 43 Clay?, sandy  
 43- 65 Clay, gray, pebbly  
 65- 68 Shale, gray

\* \* \* \*

Test Hole 39 (SDGS Rotary)

Location: NW¼NW¼NW¼NE¼ sec. 26, T. 111 N., R. 64 W.  
 Surface elevation: 1344 feet  
 Depth to water: 4 feet

0- 3 Topsoil, sand, brown, silty  
 3- 8 Clay?, brown, sandy  
 8- 18 Clay, brown to blue gray, sandy, pebbly  
 18- 33 Sand, blue-gray, fine to coarse  
 33- 39 Clay, blue-gray, sandy  
 39- 48 Sand, coarse, and gravel  
 48- 63 Clay, pebbly  
 63- 68 Shale, gray to black

\* \* \* \*

Test Hole 40 (SDGS Rotary)

Location: NW¼NW¼NE¼NE¼ sec. 26, T. 111 N., R. 64 W.  
 Surface elevation: 1348 feet  
 Depth to water: 5 feet

0- 3 Topsoil  
 3- 18 Clay, brown to gray, sandy, pebbly  
 18- 28 Clay?, sandy, pebbly  
 28- 60 Clay, blue-gray, sandy, pebbly  
 60- 74 Clay, blue-gray  
 74- 88 Shale, gray

\* \* \* \*

Test Hole 41 (SDGS Rotary)

Location: NW¼NE¼NE¼NE¼ sec. 26, T. 111 N., R. 64 W.  
 Surface elevation: 1347 feet  
 Depth to water: not measured



Test Hole 41 -- continued.

0- 17 Topsoil, clay, yellow-brown, sandy  
 17- 28 Clay?, sandy, pebbly  
 28- 43 Clay, blue-gray  
 43- 50 Sand and gravel  
 50- 63 Clay, blue-gray  
 63- 70 Shale, gray to black

\* \* \* \*

Test Hole 42 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 26, T. 111 N., R. 64 W.  
 Surface elevation: 1338 feet  
 Depth to water: 3 feet

0- 3 Topsoil  
 3- 13 Clay, brown, sandy, silty  
 13- 18 Clay, blue-gray  
 18- 56 Sand and gravel, gray, stratified  
 56- 78 Clay, gray, sandy, pebbly  
 78- 88 Shale, gray

\* \* \* \*

Test Hole 43 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 26, T. 111 N., R. 64 W.  
 Surface elevation: 1334 feet  
 Depth to water: 5 feet

0- 8 Topsoil, clay, brown, sandy  
 8- 53 Clay, brown to blue-gray, sandy, pebbly  
 53- 73 Clay, blue-gray, pebbly  
 73- 128 Clay, blue-gray

\* \* \* \*

Test Hole 44 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.  
 Surface elevation: 1338 feet  
 Depth to water: 4 feet

0- 20 Topsoil, clay, yellow, sandy, pebbly  
 20- 28 Sand, coarse, and gravel, brown  
 28- 58 Clay?, sandy, pebbly  
 58- 73 Sand and gravel  
 73- 80 Clay?, sandy, pebbly  
 80- 93 Clay, pebbly  
 93- 98 Shale, gray to black

\* \* \* \*

Test Hole 45 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.  
 Surface elevation: not measured  
 Depth to water: not measured

0- 22 Topsoil, clay, yellow to gray, sandy, pebbly  
 22- 28 Clay, blue-gray, sandy  
 28- 30 Clay, blue-gray, pebbly  
 30- 40 Clay, blue-gray  
 40- 45 Sand and gravel  
 45- 65 Clay, blue-gray, rocks  
 65- 66 Sand and gravel

Test Hole 45 -- continued.

66- 87 Clay, blue gray, pebbly, rocks  
 87- 98 Shale, gray

\* \* \* \*

Test Hole 46 (SDGS Rotary)

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.  
 Surface elevation: 1339 feet  
 Depth to water: not measured

0- 13 Topsoil, clay, brown, sandy, silty  
 13- 29 Clay, gray, pebbly, compact  
 29- 48 Sand and gravel, gravel increasing with depth  
 48- 80 Clay, sandy, pebbly  
 80- 98 Clay, pebbly  
 98-108 Shale, gray to black

\* \* \* \*

Test Hole 47 (SDGS Rotary)

Location: SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.  
 Surface elevation: 1337 feet  
 Depth to water: 5 feet

0- 8 Topsoil, clay, yellow-brown, silty  
 8- 53 Sand and gravel, brown to gray, coal, rocks  
 53- 69 Clay?, sandy, pebbly  
 69- 82 Clay, sandy, pebbly, rock

\* \* \* \*

Test Hole 48 (SDGS Rotary)

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.  
 Surface elevation: 1335 feet  
 Depth to water: 2 feet

0- 12 Topsoil, clay, yellow, pebbly  
 12- 58 Sand and gravel, yellow to gray, clean  
 58- 73 Clay?, gray, compact, sandy, pebbly  
 73-128 Sand, coarse, and gravel  
 128-153 Gravel, clean  
 153-285 Clay?, sandy, pebbly  
 285-290 Shale?

\* \* \* \*

Test Hole 49 (SDGS Rotary)

Location: SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.  
 Surface elevation: 1335 feet  
 Depth to water: 3 feet

0- 18 Topsoil, clay, brown, sandy, pebbly  
 18- 33 Clay?, brown to gray, sandy, pebbly  
 33- 68 Clay?, blue gray, sandy, pebbly  
 68- 78 Shale, gray

\* \* \* \*

Test Hole 50 (SDGS Rotary)

Location: NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.  
 Surface elevation: 1334 feet  
 Depth to water: 2 feet

Test Hole 50 -- continued.

0- 8 Topsoil, sand, brown, thin clay beds  
8- 33 Sand, brown to gray, medium  
33- 48 Clay?, sandy, pebbly  
48- 68 Clay, blue-gray, rock

\* \* \* \*

Test Hole 51 (SDGS Rotary)

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.

Surface elevation: 1340 feet

Depth to water: 9 feet

0- 17 Topsoil, clay, yellow-brown, sandy, silty  
17- 33 Clay?, sandy, pebbly  
33- 63 Clay, blue-gray, pebbly  
63- 74 Clay?, sandy, pebbly  
74- 80 Clay, blue-gray, pebbly  
80- 88 Slate, gray to black

\* \* \* \*

Test Hole 52 (SDGS Rotary)

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 25, T. 111 N., R. 64 W.

Surface elevation: 1337 feet

Depth to water: 11 feet

Test Hole 52 -- continued.

0- 8 Topsoil, sand, brown, silty  
8- 19 Clay, yellow, sandy  
19- 23 Clay, blue-gray, sandy, pebbly  
23- 48 Sand and gravel  
48- 58 Sand, blue gray, coarse  
58-103 Clay?, sandy, pebbly  
103-128 Clay, blue-gray, pebbly

\* \* \* \*

Test Hole 53 (SDGS Rotary)

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 36, T. 111 N., R. 64 W.

Surface elevation: 1329 feet

Depth to water: 5 feet

0- 13 Topsoil, clay, brown, silty, sandy,  
pebbly  
13- 48 Clay?, brown to gray, sandy, pebbly  
48- 70 Clay, blue-gray, pebbly  
70- 83 Clay?, pebbly  
83-122 Clay, gray, pebbly  
122-138 Clay, gray

\* \* \* \*

## APPENDIX B

### Well Records in the Wolsey Area

Source: S, buried sand and gravel; D, Dakota Sandstone  
 Use: D, domestic; S, stock; M, municipal

Name	Location	Depth of Well	Source	Use
Boomsma, J.	NW¼NW¼NW¼SE¼ sec. 1, T. 111 N., R. 64 W.	930	D	D,S
Langbehn, A.	SW¼SW¼SW¼SE¼ sec. 1, T. 111 N., R. 64 W.	890	D	D,S
Osmanson, P.	NE¼SE¼SW¼SW¼ sec. 2, T. 111 N., R. 64 W.	1230	D	S
Larson, H.	NW¼NW¼SE¼SE¼ sec. 4, T. 111 N., R. 64 W.	840	D	S
Larson, H.	NE¼NW¼NW¼SW¼ sec. 4, T. 111 N., R. 64 W.	820	D	D,S
Chapman, R.	NE¼NE¼SW¼NE¼ sec. 4, T. 111 N., R. 64 W.	800+	D,S	D,S
Balvin, C.	SE¼NE¼NE¼SE¼ sec. 9, T. 111 N., R. 64 W.	35	S	D,S
Kopp, D.	SE¼SE¼SE¼SW¼ sec. 11, T. 111 N., R. 64 W.	55	S	D
Boomsma, J.	SW¼SW¼SW¼SW¼ sec. 12, T. 111 N., R. 64 W.	62	S	D
Boomsma, J.	SW¼SW¼SW¼SW¼ sec. 12 T. 111 N., R. 64 W.	32	S	S
Minium, B.	SE¼SE¼SE¼SW¼ sec. 12, T. 111 N., R. 64 W.	100	S	D,S
Scott, E.	NE¼SE¼SE¼SE¼ sec. 13, T. 111 N., R. 64 W.	906	D	S
Bootz, F.	SW¼NE¼SW¼NW¼ sec. 13, T. 111 N., R. 64 W.	35	S	S
Schilling, E.	NW¼SW¼SW¼NE¼ sec. 13, T. 111 N., R. 64 W.	30	S	S
Schilling, E.	NW¼SW¼SW¼NE¼ sec. 13, T. 111 N., R. 64 W.	36	S	D
Frank, J.	NW¼NW¼NW¼SE¼ sec. 14, T. 111 N., R. 64 W.	860	D	D,S
Heller, L.	SE¼SW¼ sec. 15, T. 111 N., R. 64 W.	40	S	D,S
Kohimeyer, R.	NW¼NE¼NW¼NE¼ sec. 20, T. 111 N., R. 64 W.	18	S	D,S

Name	Location	Depth of Well	Source	Use
Kohlmeyer, R.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 21, T. 111 N., R. 64 W.	920	D	S
Klicker, H.	SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 22, T. 111 N., R. 64 W.	860	D	D,S
Frank, C.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 22, T. 111 N., R. 64 W.	854	D	D,S
Myer, R.	SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 23, T. 111 N., R. 64 W.	45	S	S
City of Wolsey	NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 111 N., R. 64 W.	910	D	M
City of Wolsey	NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 111 N., R. 64 W.	930	D	M
City of Wolsey	NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 111 N., R. 64 W.	1220	D	M
City of Wolsey	NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 111 N., R. 64 W.	1160	D	M
Boyington, F.	SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 24, T. 111 N., R. 64 W.	32	S	D
McGillivrey, D.	NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 111 N., R. 64 W.	39	S	S
Crandall, R.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 26, T. 111 N., R. 64 W.	800+	D	S
Klaschen, G.	SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 111 N., R. 64 W.	55	S	S
Klaschen, F.	SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 26, T. 111 N., R. 64 W.	33	S	D,S
Klicker, C.	SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T. 111 N., R. 64 W.	835	D	D,S
Klaschen, E.	SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 27, T. 111 N., R. 64 W.	900	D	D,S
Struck, D.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 28, T. 111 N., R. 64 W.	32	S	D
Struck, D.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 28, T. 111 N., R. 64 W.	985	D	D,S
Barker, R.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 28, T. 111 N., R. 64 W.	900	D	D,S
Barker, R.	SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 111 N., R. 64 W.	873	D	D,S
Boesel, F.	NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 33, T. 111 N., R. 64 W.	875	D	D,S
Klicker, C.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, T. 111 N., R. 64 W.	810	D	S

Name	Location	Depth of Well	Source	Use
Haeder, H.	NW¼NE¼NW¼NW¼ sec. 35, T. 111 N., R. 64 W.	895	D	D,S
Scheibe, W.	SE¼NE¼SW¼SW¼ sec. 35, T. 111 N., R. 64 W.	995	D	D,S
Timm, F.	NW¼NW¼NE¼SE¼ sec. 36, T. 111 N., R. 64 W.	810	D	D,S
Kaneb Pipeline Co.	NE¼ sec. 36, T. 111 N., R. 64 W.	885	D	D
Schamp, B.	NW¼ sec. 6, T. 111 N., R. 63 W.	930	D	D,S
Bawdon, M.	SW¼SW¼SW¼NE¼ sec. 7, T. 111 N., R. 63 W.	105	S	D,S
Tyler, R.	NW¼NE¼NW¼NE¼ sec. 7, T. 111 N., R. 63 W.	838	D	D,S
Tyler, R.	NW¼NE¼NW¼NE¼ sec. 7, T. 111 N., R. 63 W.	-----	D	S
Tyler, R.	NW¼NE¼NW¼NE¼ sec. 7, T. 111 N., R. 63 W.	-----	D	S
Broderson, J.	SW¼SE¼SE¼SE¼ sec. 7, T. 111 N., R. 63 W.	800	D	S
Broderson, J.	SW¼SE¼SE¼SE¼ sec. 7, T. 111 N., R. 63 W.	-----	D	D,S
Haeder, P.	SW¼SW¼SW¼SW¼ sec. 8, T. 111 N., R. 63 W.	100	S	D
Christopherson, A.	SE¼SE¼SW¼SE¼ sec. 17, T. 111 N., R. 63 W.	915	D	D,S
Christopherson, A.	SE¼SE¼SW¼SW¼ sec. 17, T. 111 N., R. 63 W.	880	D	S
Langbehn, N.	NW¼SW¼SW¼SW¼ sec. 18, T. 111 N., R. 63 W.	1108	D	D,S
Langbehn, N.	NW¼ sec. 18, T. 111 N., R. 63 W.	-----	D	S
Cemetery	SW¼SW¼ sec. 19, T. 111 N., R. 63 W.	-----	S	D
Haeder, R.	NE¼NW¼NE¼NW¼ sec. 20, T. 111 N., R. 63 W.	900	D	D
McBride, R.	NW¼NW¼NW¼NW¼ sec. 29, T. 111 N., R. 63 W.	68	S	D,S
Bult, J.	SW¼NW¼SW¼SW¼ sec. 29, T. 111 N., R. 63 W.	1000	D	D,S
Salisbury, R.	SW¼SW¼SW¼NE¼ sec. 32, T. 111 N., R. 63 W.	75	S	D,S