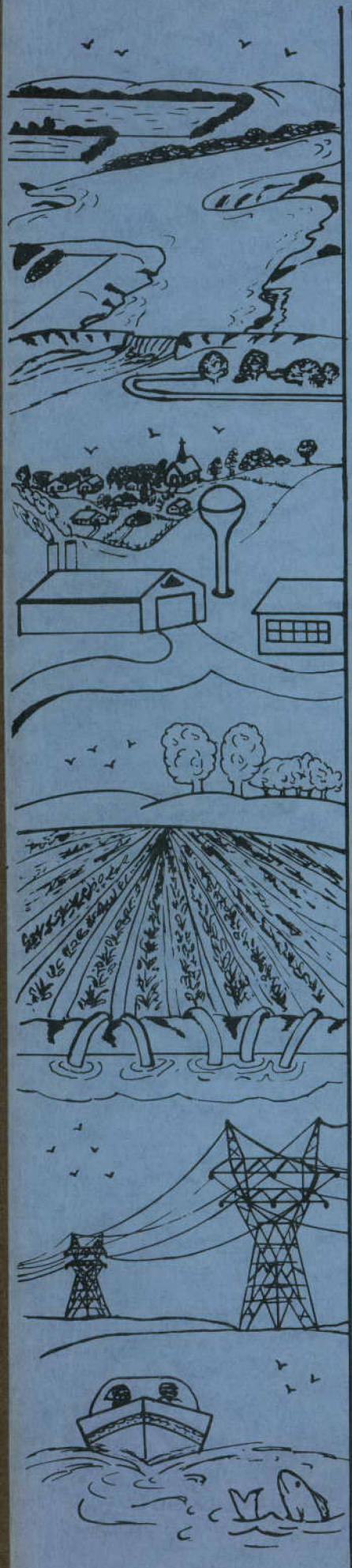

GEOHYDROLOGY OF THE SOURIS RIVER VALLEY IN THE VICINITY OF MINOT, NORTH DAKOTA GROUND WATER BASIC DATA

By
Wayne Pettyjohn and D. L. Hills
Geological Survey
United States Department of the Interior

NORTH DAKOTA GROUND WATER STUDIES

NO. 65

Prepared by the United States Geological Survey in cooperation with the North Dakota State Water Commission and the City of Minot

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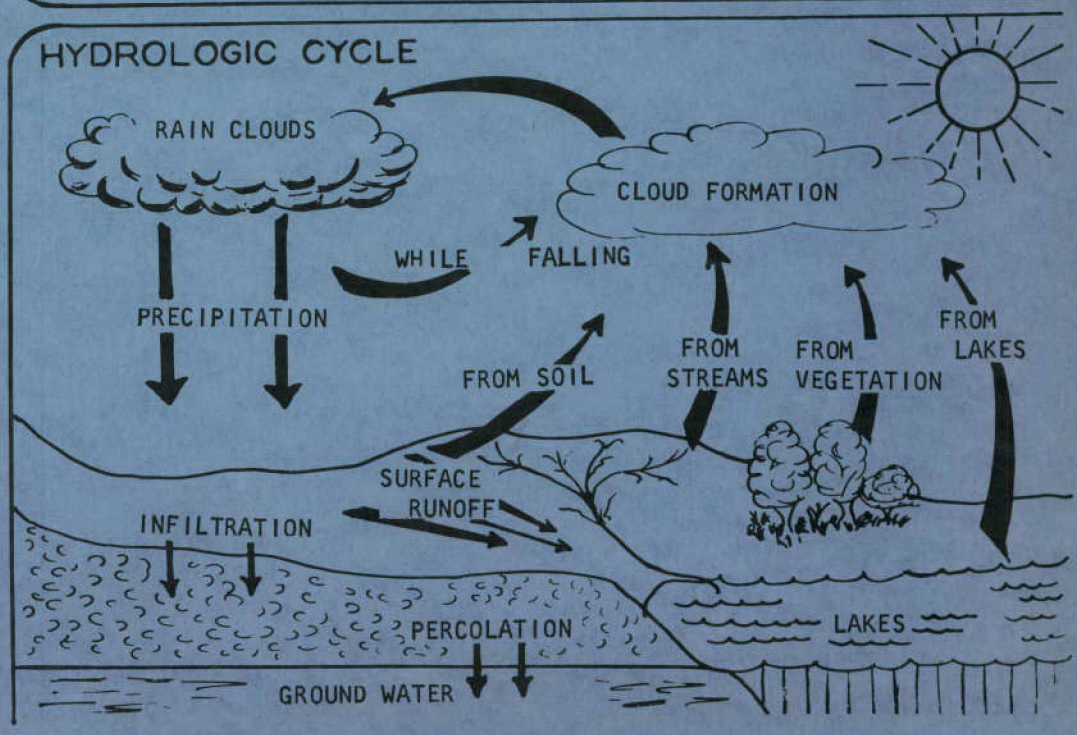

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GEOHYDROLOGY OF THE SOURIS RIVER VALLEY IN THE VICINITY OF MINOT, NORTH DAKOTA

GROUND WATER BASIC DATA

INTRODUCTION

The study of the geology and ground-water resources of the Souris River valley in the vicinity of Minot, North Dakota has been a cooperative program between the U. S. Geological Survey, the North Dakota Water Commission, and the city of Minot. The results of this study are to be published in four reports: a ground-water basic-data report and three interpretative reports describing the geology and hydrology, feasibility of artificial recharge, and the results of an electric analog computer study of the Minot aquifer.

The Minot area is in the northwestern part of the Central Lowlands physiographic province (fig. 1). More specifically, the Minot area includes that reach of the Souris River valley from its confluence with the Des Lacs River valley, to a point approximately 9 miles downstream from the eastern city limit of Minot, a total distance of about $18\frac{1}{2}$ miles. This area is in the north-central part of Ward County, North Dakota. The geohydrologic study of the Souris River valley in the Minot area is a part of the overall ground-water study of Renville and Ward Counties. Counties where ground-water studies have been completed or are in progress are shown on figure 1.

This report will be useful to landowners, well drillers, and persons interested in future sites for ground-water development. The usefulness of this report can be enhanced substantially by utilizing the interpretative report on the geology and hydrology of the Souris River valley in the vicinity of Minot, North Dakota in conjunction with the basic data.

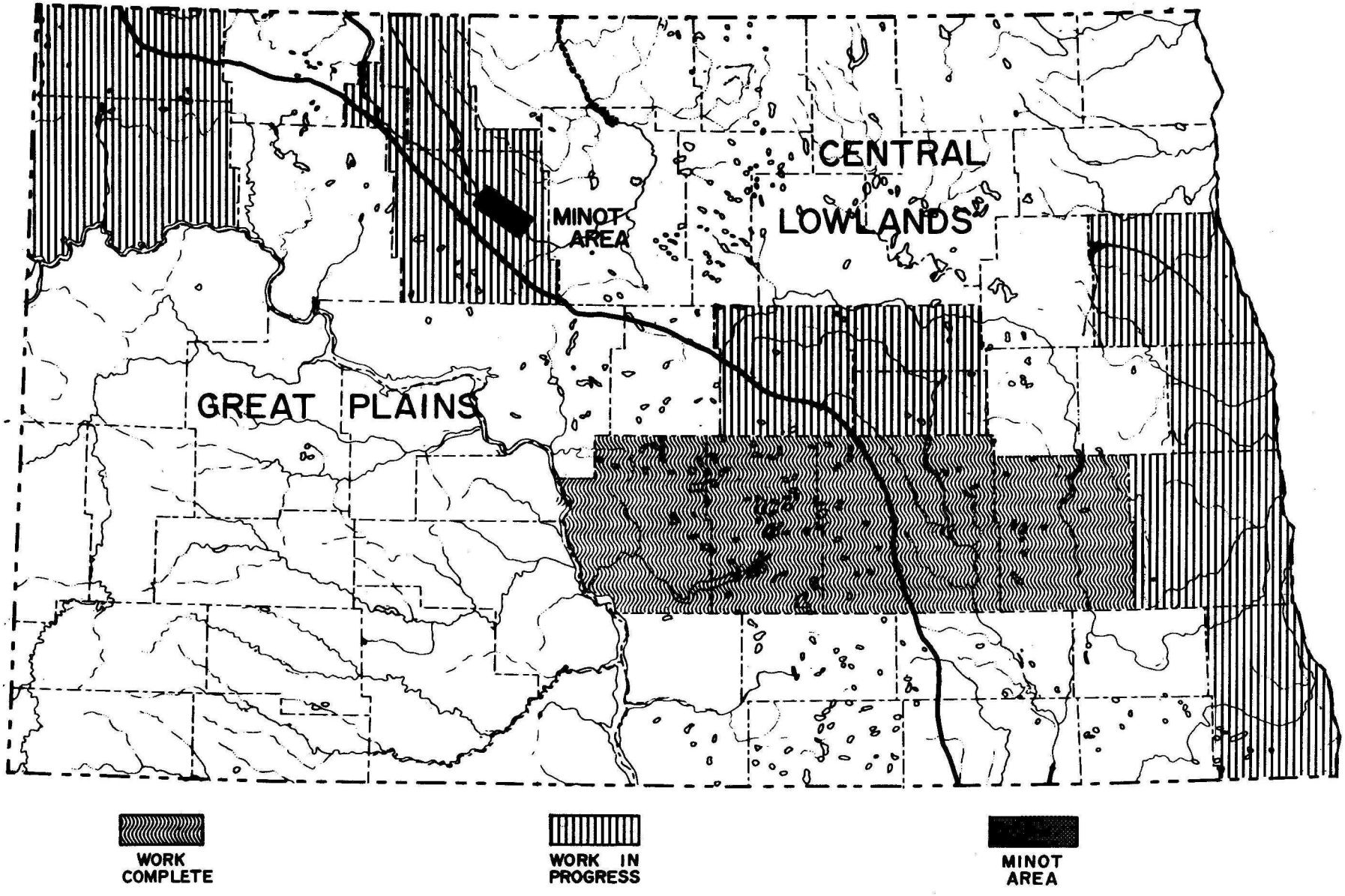

FIGURE I. MAP SHOWING PHYSIOGRAPHIC PROVINCES, LOCATION OF MINOT AREA, AND COUNTY GROUND-WATER STUDIES IN NORTH DAKOTA.

The data presented in this report were collected from November 1963 to December 1964. The logs of test holes were compiled from drillers logs, sample-analysis logs, and electric logs where available. Most of the test holes listed in this report were drilled by the North Dakota Water Commission's hydraulic rotary drill rig. Water samples from municipal wells and test holes were analyzed for chemical quality by the North Dakota State Laboratories in Bismarck.

Figure 2 illustrates the well and test-hole numbering system that is used in this report. The system is based on the U. S. Bureau of Land Management's grid system. The first number indicates the township north of a base line that is located in Arkansas. The second number denotes the range west of the Fifth Principal Meridian. The third number is the section in which the well is found. The lower-case letters immediately following the section number indicate the position of the well within the section. The letter "a" refers to the northeast quarter, "b" refers to the northwest quarter, "c" refers to the southwest quarter, and "d" refers to the southeast quarter. Succeeding letters refer respectively to the quarter-quarter section and the quarter-quarter-quarter section or 10-acre tract. If more than one well is present in a 10-acre tract, a number indicating the amount of wells will follow the last letter. For example, 155-83-15daa2 shows that two wells are present in the $SE\frac{1}{4}NE\frac{1}{4}NE\frac{1}{4}$ of Section 15, Township 155 North, and Range 83 West.

Figure 3 is a map of the area studied showing the location of test holes. Figure 4 is a map showing selected municipal, industrial and domestic or stock wells in the Minot area. Additional logs of test holes and wells, as well as data on chemical quality of water, may be found in the report by Akin (1947).

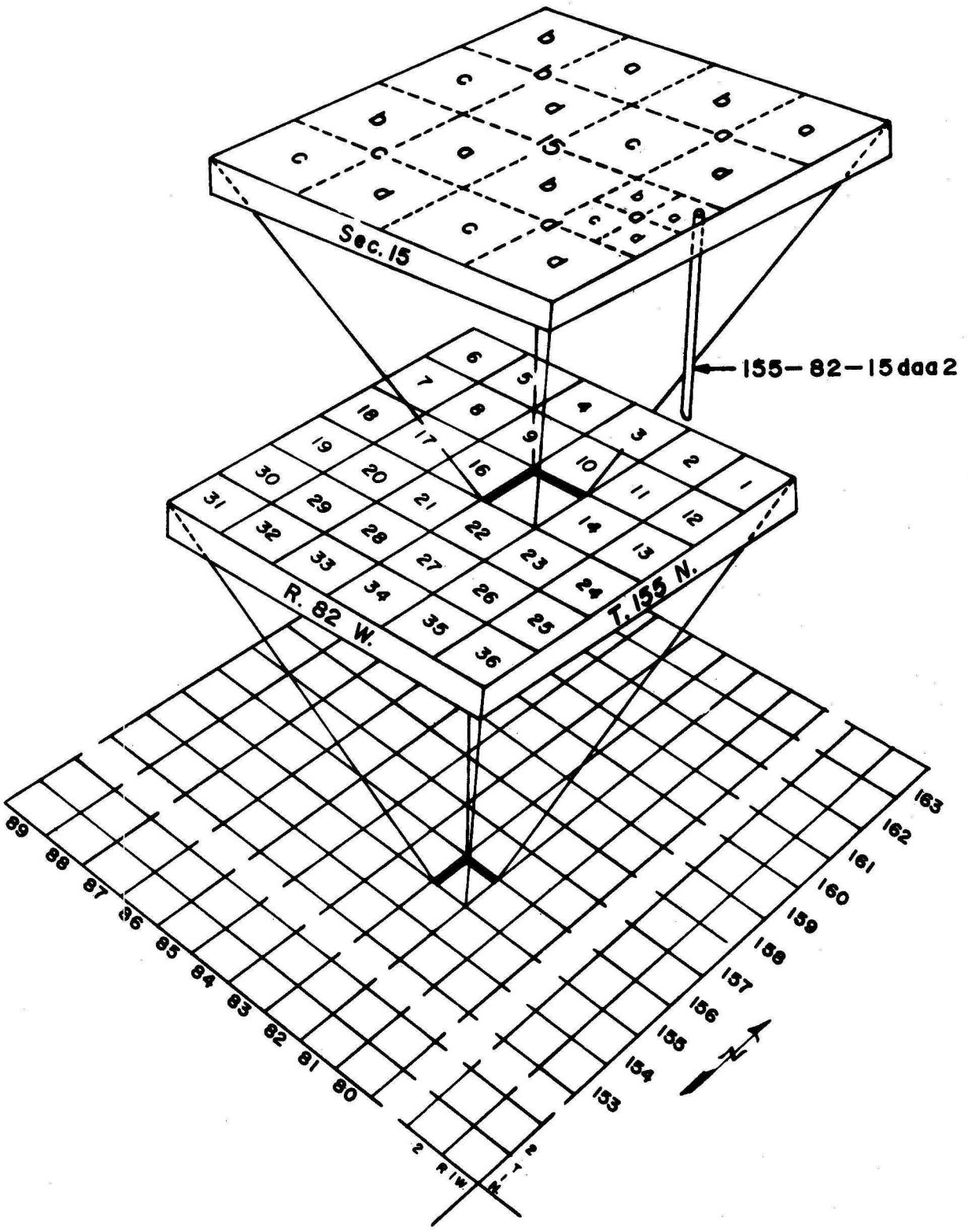

FIGURE 2--SYSTEM OF NUMBERING WELLS AND TEST HOLES.

The record of wells and test hole (table 1) indicates the depth to water in wells, subsurface conditions, and several other facts concerning wells and test holes in the area covered by this study (figs. 3 and 4).

The logs of test holes and wells in table 2 describe the subsurface geologic conditions and drilling characteristics of some of the rocks encountered during well or test hole construction.

Of special note are the terms, "taking water" and "lost circulation". Under normal circumstances a general rule to follow is that any zone of rock materials that will take water during hydraulic rotary drilling will also give up water to wells. Thus, during well drilling where permeable material is present, the water level in the mud pit will decline because drilling fluid is lost to the formation. If the formation penetrated is highly permeable, as a gravel deposit, circulation of the drilling fluid may be entirely lost to the formation. Lost circulation normally may be restored by adding bentonite or similar substances to the drilling fluid.

Top soil is included as glacial drift in table 2. This is not entirely satisfactory as surface soil is generally a product of recent weathering. On the other hand, the upper 30 to 40 feet of the glacial till is oxidized and the period of oxidation is the same as that which formed the top soil. The oxidized zone, however, is considered a glacial till. Inasmuch as the top soil and oxidized zone are the results of weathering of glacial drift throughout an indefinite period of time, these two lithologies are considered herein as a subdivision of glacial drift.

Table 3 lists the measurements of water-level fluctuations in observation wells. The chemical quality of water samples collected during the course of the study are shown in table 4.

The chemical quality of ground water is dependent upon the amount and types of dissolved gases, minerals, and organic material leached by water from enclosing rocks during movement from areas of recharge to areas of discharge. The major chemical characteristics of natural water are listed below:

Hardness. Hard water and soft water are terms that have no exact meaning because water considered hard in one region might be considered soft by inhabitants in another region. Hardness is usually associated with the effects that take place in the use of soap. Hard water requires the use of large amounts of soap and insoluble residues form in bath tubs and sinks. In addition, hard water causes scale to incrust water heaters, boilers, and pipes.

For the most part, hardness depends on the concentration of calcium (Ca) and magnesium (Mg), but other substances also form insoluble residues from soap. Hardness may be measured as parts per million (ppm) or as grains per gallon (17.12 ppm = 1 grain per gallon). Generally water having a hardness of less than 60 ppm is considered soft, 61 to 120 ppm is moderately hard, 121 to 180 ppm is hard, and more than 180 ppm is very hard.

Silica (SiO_2). Silica may be dissolved from nearly all rocks but usually only in small concentrations. Although silica may form a hard scale in pipes and boilers, it does not effect water for domestic purposes. Silica in natural water generally ranges between 1 and 30 ppm; however, concentrations of more than 100 ppm are fairly common (Hem, 1959, p. 57).

Iron (Fe). Iron compounds are very common in rocks and they are easily leached by ground water. Water having a low pH usually contains more iron than water having a higher pH. Concentrations of iron in excess

of 0.3 ppm will cause staining of laundry and utensils; it is usually objectionable for food processing, beverages, dying, bleaching, ice manufacturing, and many other processes.

Calcium (Ca). Calcium may be leached from all rocks, but limestone and dolomite fragments in the glacial drift provide the largest amount of calcium in the Minot area. Calcium is a major cause of hardness and forms scale on utensils and on boilers and pipes. The calcium content of ground water ranges from less than 10 ppm to several hundred parts per million.

Magnesium (Mg). Magnesium is a common metallic element that occurs in several rock types, such as dolomite, limestone, and granite. These rocks commonly occur in the glacial drift of the Minot aquifer. Magnesium is another major cause of hardness and, in conjunction with calcium, forms scale on pipes, water heaters, and utensils.

Sodium (Na). Sodium is readily leached from rocks and tends to remain in solution, in contrast to iron, calcium, and magnesium. Any appreciable quantity of the feldspar mineral group, such as is common in the Fort Union Formation, may provide high sodium concentrations to circulating ground water. In addition, sodium may be taken into solution if the transporting water comes in contact with sewage and (or) industrial wastes. Probably all natural water contains some sodium in concentrations ranging from 1 ppm to more than 100,000 ppm. The concentration of sodium is not especially important in water for domestic uses. On the other hand, persons having an abnormal sodium metabolism should consult their physicians concerning the planning of a sodium-free diet if the supply of drinking or culinary water has a high sodium content. A concentration of sodium in excess of 500 ppm, when combined with chloride, results in a

salty taste. Foaming in boilers may result if the sodium and potassium concentration exceeds 50 ppm.

Potassium (K). Potassium is usually less abundant than sodium in natural water although both elements have similar properties. In addition, potassium tends to form clay while sodium tends to remain in solution. Potassium concentrations commonly are less than 20 ppm. Potassium in water causes foaming in boilers.

Bicarbonate (HCO_3) and Carbonate (CO_3). Alkalinity is the capacity for a water containing certain elements to neutralize acid water. Concentrations of bicarbonate, carbonate, and (or) hydroxide are primarily responsible for alkalinity, but they act as a function of temperature, pH, and the concentration of other dissolved solids. Carbon dioxide in water dissolves rocks such as limestone and dolomite and produces bicarbonate and carbonate. These substances, when combined with calcium and magnesium, form a hard scale on boilers and release a corrosive carbon dioxide gas. Carbonate is not usually abundant in natural water, and bicarbonate has little significance except in large concentrations where the taste and corrosiveness may be affected. Alkalinity itself is not detrimental to humans.

Sulfate (SO_4). Sulfate is dissolved from rocks containing sulfur compounds. Sulfate, when combined with other elements, may produce a bitter taste. Large amounts of sulfate may produce a laxative effect on some people. The U. S. Public Health Service (1962) recommended that the sulfate concentration in public supplies should not exceed 250 ppm.

Chloride (Cl). Chloride is dissolved from rocks and soil and is present in large amounts in sea water. Chloride may also indicate

contamination by human and animal sewage as well as industrial effluents. Chloride may combine with sodium to produce a salty taste and large concentrations of chloride increase the corrosiveness of water. The U. S. Public Health Service (1962) recommended that the chloride content of public water supplies should not exceed 150 ppm.

Fluoride (F). Most fluoride has a low solubility and, hence, occurs only in small amounts in natural water. Fluoride in drinking water reduces the formation of dental caries if the water is consumed during the period of enamel calcification; it may also cause mottling of the teeth under certain conditions. The maximum fluoride concentration for public supplies varies with the annual average maximum daily air temperature. An excess of fluoride may produce endemic cumulative fluorosis and sketetal effects. The U. S. Public Health Service (1962) recommended a fluoride limit of 1.2 ppm for areas having an annual average maximum daily air temperature between 50.0 and 53.7° F.

Nitrate (NO_3). Nitrate may be leached from some rocks by circulating ground water, but the nitrate added by certain plants, plant debris such as lignite, animal excrement and sewage wastes, and inorganic nitrate fertilizers are probably the major contributors of nitrate to ground water. Nitrate concentrations in water in excess of 45 ppm, the maximum limit set by the U. S. Public Health Service (1962), have been considered as a cause of infantile methemoglobinemia (blue babies). Water containing less than 5 ppm of nitrate has no effect on ordinary uses.

Boron (B). Boron is usually a very minor constituent in natural water. Water that has a high sodium content commonly has a higher concentration of boron, but boron concentrations in excess of 10 ppm are rare. Water

containing boron is not considered hazardous for human consumption, but boron concentrations in excess of 0.5 ppm may prove injurious to many plants.

Dissolved Solids. The dissolved solids content of water consist chiefly of the total quantity of mineral matter present. Dissolved solids should not exceed 500 ppm in drinking water and concentrations in excess of 1,000 ppm are unsuitable for many purposes. On the other hand, some communities use water containing more than 4,000 ppm of dissolved solids because other supplies are not available.

Percent Sodium (% Na) and Sodium-Adsorption Ratio (SAR). The amount of dissolved sodium in water used for irrigation is important because a high sodium content may cause the development of undesirable soil properties. The effect is usually not significant, however, until the amount exceeds 50 percent of the total cations present. The sodium hazard in water is also expressed as the sodium-adsorption-ratio (SAR).

Specific conductance. The capacity for water to conduct an electric current is termed specific conductance. The ability to conduct a current varies with the temperature of the water and the concentration and degree of ionization of the components in the water. Specific conductance will indicate the quantity of constituents but will not indicate the relative concentrations of the various components.

Hydrogen-ion concentration (pH). The pH of water is a measure of alkalinity or acidity. A pH of 7 indicates a neutral solution; a pH greater than 7 indicates an alkaline solution, a pH less than 7 indicates an acidic solution. The pH is related to the corrosive properties of water--water with a low pH being most corrosive. A low pH may also characterize a sour-tasting water. Most ground water has a pH between 5.5 and 8.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota

Owner: USGS, United States Geological Survey; NDWC, North Dakota Water Commission.

Depth of well: Measured depths are given in feet, tenths, and (or) hundredths; reported depths are in feet.

Type of well: Bo, bored; Dr, drilled; Du, dug; Dv, driven, Je, jetted.

Depth to water: Measured depths are given in feet, tenths, and (or) hundredths; reported depths are in feet.

Use of water or well: D, domestic; I, industrial; N, not used; O, observation of water level; PS, public supply; R, recharge; S, stock; T, test hole.

Geologic source: Qg, gravel; Qs, sand; Tfu, Fort Union Formation.

Remarks: BR-20, bedrock at 20 feet (number indicates depth at which bedrock was encountered); C, chemical analysis is shown in table 4; L, log described in table 2; Wal, water reported to have alkaline taste; Wh, water reported to be hard; TD-240, total depth drilled; E-log, electric log available.

Location	Owner or name	Depth of well (feet)	Diameter or size (inches)	Type	Date completed	Depth to water below land surface (feet)	Date of measurement	Use of water or well	Geologic source	Elevation at land surface	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
154-82											
4aad	USGS test hole 2214	233	4	Dr	11-19-63	16.66	8-5-64	T,O	Qs,Qg	.....	TD-254, BR-233, E-log, L, C.
4aba	USGS test hole 2213	120	4	Dr	11-15-63	15.23	8-5-64	T,O	Qs,Qg	.....	TD-210, BR-157, E-log, L, C.
24aba	USGS test hole 2212	40	4	Dr	11-14-63	14.16	8-5-64	T,O	Qs,Qg	.....	TD-115.5, E-log, BR-102,L.
155-82											
19adb	Harrington Bros. Stock Y.	256	6	Dr	2-28-52	34	2-28-52	S	Tfu	1,570	Wal, L.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-82 (Cont.)											
19cbd	Parkview Trailer Court	120	8	Dr	1959	...	....	I	Qs,Qg	1,551	Wh.
19cdc	Eatmore Sausage Co.	115	4	Dr	1961	36	1963	I,S	Qs,Qg	1,560	..Do....
19dad	Dutch Mill Restaurant	300	5	Dr	.....	...	....	I	Tfu	1,560	Wal.
19dbd	USGS test hole 2216	107	4½	Dr	11-15-63	40	6-11-64	T,O	Qs,Qg	1,548	Wh, BR-107, L, TD-126, E-log, C.
19dda	Rueben Forsburg	96	4	Dr	.....	...	....	D	Qs	1,548	Wh, L.
20cccl	Robindale Mobile Park	60	24	Dr	4-64	20	4-28-64	D	Qs,Qg	1,552	Wh.
20ccc2	..do....	280	4	Dr	.....	140	3-5-64	I	Tfu	1,560	Wal, high natural gas.
20dcc	Siesta Motel	65	4	Dr	1955	...	....	D,I	Tfu	1,575	Wal, C.
22cdb	Highway 2 Truck Stop	39	..	Dr	.....	...	....	I	...	1,595	Wh.
23aab	G. Northern Railway TH	410	..	Dr	.....	...	....	T	...	.....	TD-410, L.
28ccc	..do....	135	..	Dr	.....	...	....	T	...	.....	TD-135, L.
29bcb	USGS test hole 2215	105	1¼	Dr	11-15-63	...	....	T,O	Qs,Qg	1,545	BR-105, L,C, TD-126, E-log.
29ccc	Pat's Motel	45	30	Du	1930	40	2-21-64	D	Qg	1,615	Wh.
30bbb	Anderson Blacksmith	42	36	Dr	1947	36	4-30-64	D,S	Qs	1,620	..Do....
30dcc	State Highway Dept. Weigh Scale	257	4	Dr	1961	...	....	D	Qs	1,715	Wh, L.
30dda	Frank Ehr	64	12	Dr	....	...	....	D	...	1,625	Wh.
31baa	Standard Oil Truck Stop	338	6	Dr	4-64	200	4-25-64	I	Qs	1,715	..Do....
31cda	Kenneth Huwe	65	24	Dr	....	...	....	D	...	1,722	..Do....
31dca	James Buelle	170	..	Dr	....	...	....	D	...	1,708	..Do....
155-83											
1ccb	Frank Linha	50	24	Dr	1956	20	4-29-64	D,S	Qs	1,712	Wh.
2cdd	William Selfors	58	24	Dr	1960	...	....	D	Qs	1,740	..Do....
2dad	Walter Ell	32	24	Dr	1958	25	1964	D	Qs	1,718	..Do....

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
2ddc1	Northland Mobile Park	275	5	Dr	.....	195	12-7-63	I	Tfu	1,725	Wal.
2ddc2	..do....	60	24	Dr	1960	25	12-7-63	D	Qs,Qg	1,725	Wh.
2ddd	Automatic Transmission	43	24	Dr	1963	10	4-29-64	I	Qs	1,714	..Do....
7bcb	NDWC test hole 1	42	4½	Dr	2-27-61	...	....	T	...	.....	TD-42,BR-9?,L.
11daa	Minot Outdoor Theatre	440	4	Dr	1949	220	1964	I	Qs	1,720	Wal.
11dad	Goheen Implement	40	..	Du	.....	...	....	N	Qs,Qg	1,718	Wh.
11dda	North Hill Texaco	70	..	Dr	.....	...	....	N	Qs,Qg	1,715	Wh, destroyed in 1950.
11ddd1	Morris Anderson	50	..	Dr	.....	...	....	N	Qs,Qg	1,712	Wh, destroyed in 1957.
11ddd2	..do....	70	..	Dr	.....	...	....	N	Qs,Qg	1,712	..Do....
12ccc	USGS test hole 2218	326	1¼	Dr	12-3-63	211	5-8-64	T,O	Qs,Qg	1,725	TD-399,BR-326 L, E-log.
12cdc	USGS test hole 2236	252	5	Dr	5-18-64	Dry	5-18-64	T	...	1,715	TD-252, L, BR-215, E-log.
12dcd	USGS test hole 2219	203	1¼	Dr	12-5-63	25.74	5-5-64	T,O	Qs	1,690	TD-231, BR-203, L, E-log.
14cab	Hebrew Cemetery	118	..	Dr	.....	...	....	I	Qs,Qg	1,580	L.
14ccb	USGS test hole A-2	127	..	Dr	1945	45	6-22-45	T	Qs	1,560	BR-108?,TD-127, Akin, 1947.
14ccd	Oak Park Shopping Center	150	5	Dr	.....	70	5-8-64	I	Qs,Qg	1,555	Wh.
14cda	City well 10	139	12	Dr	10-29-60	66.50	5-1-64	PS,O	Qs,Qg	1,550	Wh, L, C.
14cdd1	City well 3	158	12	Dr	1931	69.28	4-7-64	N	Qs,Qg	1,548	Wh, Akin, 1947.
14cdd2	City test 3	161	..	Dr	1938	...	....	T	Qs,Qg	1,553	Akin, 1947.
14cdd3	Test hole BW2	127	1¼	Dr	9-30-64	...	....	T	Qs	.....	TD-127, L.
14cdd4	Bored well 2	91	12	Bo	10-30-64	...	....	R	Qs	.....	TD-91, Recharge well, L.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
14dba1	USGS test hole 2233	170	1¼	Dr	5-14-64	80	6-11-64	T	Qs,Qg	1,568	Wh, BR-279?, TD-294, L, C.
14dba2	Minot State College	141	8	Dr	1956	69	1-17-64	D,I	Qs	1,562	Wh, TD-212, Water level affected by city well,L.
14dba3	..do....	200	8	Dr	1951	...	....	D,I	Qs	1,562	Rarely used, pumps sand.
14dbb	USGS test hole 2234	200	5	Dr	5-14-64	76.42	6-12-64	T	Qs,Qg	1,569	L, TD-200, E-log.
14dca	City well 9	148	12	Dr	10-5-60	68.50	5-1-64	PS,O	Qs	1,560	Wh, L, C.
14dcb	City observation well	132	3	Dr	7-17-60	68.01	10-31-63	T	Qs	1,555	Wh, L.
14dcc	City well 4	155	14	Dr	9-4-58	71.05	5-1-64	PS	Qs,Qg	1,548	Wh, Akin, 1947.
14ddd1	USGS test hole T-1	134	2	Dr	Renovated 1945	48	1946	T	Qs,Qg	1,555	BR-248?, TD-288, Akin, 1947.
14ddd2	City well 5	147	12	Dr	9-9-46	68.5	5-1-64	PS,O	Qg	1,554	Wh, L, C.
14ddd3	City well 6	139	16	Dr	12-14-47	69	5-1-64	PS,O	Qs,Qg	1,554	..Do....
15dcd	Granite Springs Water Co.	110	8	Dr	....	90	12-7-63	I	Qg	1,565	Wh.
15ddd1	Crystal Springs Water Co.	80	8	Dr	....	60.43	4-23-64	I	Qs	1,560	..Do....
15ddd2	..do....	92	5	Dr	....	...	....	I	Qs	1,558	..Do....
16ccd	NDWC test hole 12	84	4½	Dr	3-6-61	...	....	T	...	.....	TD-84, BR-74?, L.
16cdb1	..do.... 10	84	4½	Dr	3-14-61	...	....	T	...	.....	TD-84,BR-74?, L.
16cdb2	..do.... 11	52	4½	Dr	3-15-61	...	....	T	...	.....	TD-52, BR-43?
17bda	..do.... 2	105	4½	Dr	3-6-61	...	....	T	...	.....	TD-105, BR-96?
17dad	..do.... 9	126	4½	Dr	3-7-61	...	....	T	...	.....	TD-126, BR-116?
17dbb	..do.... 3	126	4½	Dr	2-7-61	...	....	T	...	.....	TD-126,BR-115?
17dcc	..do.... 4	126	4½	Dr	2-9-61	...	....	T	...	.....	TD-126,BR-117,L.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
20abb	NDWC test hole 5	105	4½	Dr	2-6-61	...	....	T	...	.....	TD-105, L.
20abc	..do.... 6	105	4½	Dr	2-9-61	...	....	T	...	.....	TD-105,BR-95,L.
20acc	..do... 7	94	4½	Dr	2-11-61	...	....	T	...	.....	TD-94,BR-90?,L.
20dbb	..do... 8	115	4½	Dr	2-11-61	...	....	T	...	.....	TD-115,BR-86?,L.
21addl	..do.... 17	10	4½	Dr	2-21-61	...	....	T	...	1,580	TD-10, rough drilling gravel, abandoned hole, L.
21add2	..do.... 18	34	4½	Dr	2-17-61	...	....	T	...	1,565	TD-34, rough drilling gravel, abandoned hole, L.
21bac	Minot Sand and Gravel	327	4	Dr	....	Flow	12-7-63	I	Tfu	1,565	Wal.
21cda	NDWC test hole 13	128	4½	Dr	2-5-61	...	....	T	...	.....	TD-128, rough drilling gravel, abandoned hole, L.
21daal	..do.... 19	54	4½	Dr	2-14-61	...	....	T	...	1,555	TD-54, rough drilling gravel, abandoned hole, L.
21daa2	City well 18	99	12	Dr	1961	68	5-1-64	PS,O	Qs,Qg	1,561	L, C, poor quality water, Wh, rarely pumped.
21dabl	Test hole GP1	12½	4	Dr	8-27-64	...	....	T	Qg	1,539	TD-12½, abandoned hole, L.
21dab2	Test hole GP2	65	4	Dr	9-3-64	1.83	9-9-64	T,O	Qs,Qg	1,539	TD-65,BR-48,L.
21dab3	Test hole GP3	58	4	Dr	9-4-64	...	....	T	.,.	1,560	TD-58,BR-43,L.
21dad	City test hole 14-T	114	5	Dr	1961	...	....	T	Qs,Qg	1,550	L, rough drilling.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
22aaa1	USGS test hole A-1	112	4	Dr	1945	41	1946	T,O Destroyed	Qs,Qg	1,555	BR-130?,TD-178, Akin, 1947.
22aaa2	Test hole P1	100	4	Dr	9-30-64	...	....	T,O	Qs	1,549.2	TD-100, L.
22aaa3	Test hole P2	40	4	Dr	9-30-64	...	....	T	Qs	1,546.1	TD-40, L.
22aaa4	Bored well 1	36	18	Bo	10-30-64	...	....	R	Qs	1,550	TD-36, recharge well, L.
22aba	USGS test hole B-1	93	2	Dr	1945	42	3-8-46	T,O Destroyed	Qs	1,560	BR-92?, TD-353, Akin, 1947, flow at 353.
22abc	City well 15	115	12	Dr	1961	72	5-1-64	PS	Qg	1,557	Wh, L, C.
22abd	USGS test hole B-2	59	4	Dr	1945	...	....	T	Qs	1,554	Akin, 1947.
22accl	City well 14	105	16	Dr	1961	70	5-1-64	PS,O	Qs,Qg	1,556	Wh, L, C.
22acc2	City test hole 12-AT	111	5	Dr	1961	...	....	T	Qs,Qg	1,555	L.
22adal	Test hole 11-T	140	5	Dr	1961	...	....	T	Qs,Qg	1,557	BR-120?, L.
22ada2	City well 12	120	16	Dr	1961	74	5-1-64	PS,O	Qs,Qg	1,555	Wh, L, C.
22adc	City well 13	115	16	Dr	1961	72.5	5-1-64	PS	Qs,Qg	1,557	..Do....
22addl	Northern States Power Co.	96	4	Dr	1960	70	1963	I	Qs	1,560	Wh, L.
22add2	USGS test hole A-3	128	4	Dr	1945	43	1946	T,O	Qs,Qg	1,557	Akin, 1947.
22bab	City test hole 13-AT	93	5	Dr	1961	...	....	T	Qs,Qg	1,583	BR-80, L.
22bccl	NDWC test hole 16	20	5	Dr	2-21-61	...	....	T	...	1,570	TD-20, rough drilling, gravel, abandoned hole, L.
22bcc2	Bored well 3	19	30	Bo	11-2-64	...	....	R	Qs,Qg	1,558	TD-19, recharge well, L.
22bcdl	City well 17	87	16	Dr	1961	67.5	5-1-64	PS	Qs,Qg	1,556	Wh, L, C.
22bcd2	Test hole R9	78	4	Dr	10-15-64	65.19	12-28-64	T,O	Qs,Qg	1,558.1	TD-78, L.
22bdb	City test hole 13-T	121	5	Dr	1961	...	....	T	Qs,Qg	1,557	L.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
22bdc	City well 16	111	16	Dr	1961	70	5-1-64	PS,O	Qs,Qg	1,556	Wh, L, C, TD-121.
22caa	Test hole R5	30	4	Dr	10-64	...	....	T	Qs,Qg	1,559.1	TD-30, L.
22cab1	Test hole R4	30	4	Dr	10-64	...	....	T	Qs,Qg	1,558.7	..Do....
22cab2	Bored well 5	35	36	Bo	12-23-64	...	....	R	Qs,Qg	1,559.3	Recharge well, L, TD-35.
22cba1	Test hole R2	30	4	Dr	10-64	...	....	T	Qs,Qg	1,559.2	TD-30, L.
22cba2	Test hole R3	30	4	Dr	10-64	...	....	T	Qs,Qg	1,559	TD-30, L.
22cba3	Bored well 4	36	24	Bo	12-22-64	...	....	R	Qs,Qg	1,559.1	TD-36, recharge well,L.
22cbb1	Test hole R1	30	4	Dr	10-64	...	....	T	Qs,Qg	1,556.9	TD-30, L.
22cbb2	Test hole R6	27	4	Dr	10-64	...	....	T	Qs,Qg	1,559.9	TD-27, L.
22cbb3	Test hole R8	68	4	Dr	10-1-64	52.25	10-8-64	T	Qs,Qg	1,555.4	TD-68, L.
23baa	City well 7	125	16	Dr	2-10-48	72.30	5-1-64	PS,O	Qs,Qg	1,555	Wh, L, C.
23bab1	City well 8	132.5	16	Dr	6-10-48	72.5	5-1-64	PS,O	Qs,Qg	1,555	..Do....
23bab2	USGS test hole 2227	118	1¼	Dr	5-11-64	68.7	6-1-64	T,O	Qs,Qg	1,550	TD-120, Wh, L, C.
23bab3	USGS test hole 2227A	21	1¼	Dr	5-11-64	11.27	6-1-64	T,O	Qs	1,550	TD-21, Wh, L, C.
23bba1	USGS test hole 2222	100	4½	Dr	5-1-64	69.86	5-26-64	T,O	Qs,Qg	1,550	TD-107, Wh, L, C.
23bba2	USGS test hole 2223	116	4½	Dr	5-4-64	71.28	5-26-64	T,O	Qs,Qg	1,550	TD-117, Wh, L.
23bba3	USGS test hole 2225	104	4½	Dr	5-5-64	67.75	5-26-64	T,O	Qs,Qg	1,550	TD-106, Wh, L, C.
23bba4	USGS test hole 2225A	21	1¼	Dr	5-5-64	7.72	6-1-64	T,O	Qs	1,550	TD-21, Wh, L, C.
23bba5	USGS test hole 2226	117	1¼	Dr	5-7-64	71.10	6-1-64	T,O	Qs,Qg	1,550	TD-117,Wh,L,C.
23bba6	USGS test hole 2226A	21	1¼	Dr	5-7-64	10.02	6-1-64	T,O	Qs	1,550	TD-21, Wh,L,C.
23bba7	USGS test hole 2241	102	1¼	Dr	5-22-64	65.71	6-1-64	T,O	Qs,Qg	1,550	TD-102,Wh,L,C.
23bba8	USGS test hole 2241A	18	1¼	Dr	5-21-64	11.06	6-1-64	T,O	Qs	1,550	TD-18,Wh,L,C.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
23bba9	Test core 3	46.2	1¼	Je	5-21-64	.....	....	T	Qs	.....	TD-46.2, L.
23bba10	Test core 4	18	4	Dr	6-5-64	12.93	6-5-64	T,O	Qs	1,554.2	TD-18, L.
23bbb1	USGS test hole 2220	56	4½	Dr	4-28-64	13.84	6-1-64	T,O	Qs,Qg	1,550	TD-114,Wh,L.
23bbb2	USGS test hole 2221	92	4½	Dr	4-30-64	68.21	5-26-64	T,O	Qs,Qg	1,550	TD-102.5,Wh,L.
23bbb3	USGS test hole 2224	101	4½	Dr	5-5-64	71.57	5-26-64	T,O	Qs,Qg	1,550	TD-110,Wh,L,C.
23bbb4	USGS test hole 2228	110	1¼	Dr	5-12-64	68.50	6-1-64	T,O	Qs,Qg	1,550	..Do....
23bbb5	USGS test hole 2228A	21	1¼	Dr	5-12-64	10.74	6-1-64	T,O	Qs	1,550	..Do....
23bbb6	USGS test hole 2231	21	1¼	Dr	5-14-64	13.86	6-1-64	T,O	Qs	1,550	TD-21,Wh,L.
23bbb7	USGS test hole 2232	21	1¼	Dr	5-14-64	17.31	6-1-64	T,O	Qs	1,550	TD-21,Wh,L,C.
23bbb8	Test hole P3	60	4	Dr	9-30-64	.....	....	T	Qs	1,551.3	TD-60,L.
23bbb9	Test hole P4	40	4	Dr	10-1-64	.....	....	T	Qs,Qg	1,550	TD-40,L.
23bbb10	Test hole P7	40	4	Dr	10-1-64	.....	....	T	Qs	1,553.1	TD-40,L.
23bbb11	Test hole P8	60	4	Dr	10-2-64	.....	....	T	Qs	1,554.2	TD-60,L.
23bbc1	USGS test hole 2229	100	1¼	Dr	5-13-64	70.22	6-1-64	T,O	Qs,Qg	1,550	TD-102,L,C.
23bbc2	USGS test hole 2229A	21	1¼	Dr	5-13-64	8.86	6-1-64	T,O	Qs	1,550	TD-21,L,C.
23bbc3	USGS test hole 2230	83	1¼	Dr	5-13-64	65.57	6-1-64	T,O	Qs,Qg	1,550	TD-96,L,C.
23bbc4	USGS test hole 2230A	21	1¼	Dr	5-13-64	4.92	6-1-64	T,O	Qs	1,550	TD-21, L.
23bbc5	USGS test hole 2235	100	1¼	Dr	5-15-64	71.37	6-1-64	T,O	Qs,Qg	1,550	TD-105, L.
23bbc6	Test hole P5	60	4	Dr	10-1-64	.....	....	T	Qs	1,553.8	TD-60,L.
23bbc7	Test hole P6	60	4	Dr	10-1-64	.....	....	T	Qs	1,549	..Do....
23bbc8	Test hole P9	60	4	Dr	10-2-64	.....	....	T	Qs	1,552.7	..Do....
23bbd	City well 11	130	16	..	1961	68.00	5-1-64	PS,O	Qs,Qg	1,554	Wh,L,C.
23bcb	USGS test hole 2237	96	1¼	Dr	5-16-64	70.14	6-1-64	T,O	Qs,Qg	1,550	TD-96, L.
23bda1	City test hole 12	137	5	Dr	1915	.....	....	T	Qs,Qg	1,555	Akin, 1947.
23bda2	City test hole 7	133 ?	5	Dr	1915	.....	....	T	Qs,Qg	1,555	..Do....
23bdd	City test hole 11BT	122	5	Dr	1961	.....	....	T	Qs,Qg	1,552	L.
23cbb	City test hole 11A	100	5	Dr	1961	.....	....	T	Qs,Qg	1,555	..Do....
23cbc	USGS test hole A-4	30	4	Dr	1945	16	3-8-46	T,O	Qs	1,554	BR-99,TD-266, Akin, 1947.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
24aaa1	USGS test hole 2217	110	1¼	Dr	12-2-63	52.97	5-5-64	T,O	Qs,Qg	1,560	TD-128, L.
24aaa2	USGS test hole 2217A	40	4½	Dr	12-2-63	13.94	5-5-64	T,O	Qs,Qg	1,560	L, test hole 2217A in 2217.
24bab1	Great Northern RR 1	144	..	Dr	2-11-28	48	1946	I	Qs,Qg	1,555	Wh,Akin, 1947.
24bab2	Great Northern RR 2	144.5	..	Dr	9-19-31	.....	....	I	Qs,Qg	1,555	..Do....
24bab3	Northern States Power Co. 1	100	..	Dr	1930	51	1946	I	Qs,Qg	1,555	..Do....
24bab4	Northern States Power Co. 2	109	..	Dr	1932	46	1946	I	Qs,Qg	1,555	..Do....
24bac1	Whites Creamery	70	6	Dr	....	68.00	12-14-63	N	Qs,Qg	1,565	Wh, well dry in 1964.
24bac2	..do....	194	..	Dr	10-3-63	Dry	.....	T	.....	1,550	L.
24bac3	Bridgeman Creamery	75	6	Dr	9-13-63*	69.00	9-13-63	N	Qs,Qg	1,565	Wh, well dry in 1964,*well deepened 6'
24bca	C. P. Hotel	165?	6	Dr	....	85.05	4-29-64	I	Qs,Qg	1,572	S,G, 110-165' TD-310,Wh,Wal.
24dab	Coca Cola Bottling Co.	195	12	Dr	....	115	3-6-64	I	Qs,Qg	1,550	Gravel, 160-195',Wh, pumps 24,000 gpd.
25bda	Sacred Heart Academy	714	..	Dr	1945	Dry	....	I	.....	1,735	.....
25cbb	Northern Bottling Works	215	..	Dr	....	...	....	I	.....	1,748	L, hard water at 105'.
25cdd	James Norton	466	4	Dr	....	...	....	N	Tfu	1,728	Wal, well developed but never used.
25ddd	USGS test hole 2240	483	5	Dr	5-22-64	...	....	T	...	1,710	L, hole caved 5-22-64, BR-411, TD-483.
26bbb1	Nash Finch Co.	303	3	Dr	....	F	4-23-64	I	Tfu	1,575	Wal,cap on well.
26bbb2	Atlas Sand & Gravel Co.	310	6	Dr	....	...	....	I	Tfu	1,575	Wal, flowed 7 gpm for 3 mos., water level drops in summer.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
26bbb3	Atlas Sand & Gravel Co.	320	6	Dr	....	25	1963	I	Tfu	1,575	Wal, flowed 7 gpm for 3 mos., L.
26bca	Knolls Village	375	4	Dr	....	...	....	D	Tfu	1,630	Wal,well flowed for short time following completion.
26bcb	Robert Cook	30	..	Dr	....	...	....	D	Qs	1,647	Wh.
26bcd	Virgil Forstad	455	4	Dr	1961	150	4-64	D	Tfu	1,760	Wal.
26bdd1	Dex Demaree	71	24	Dr	....	57	4-64	D	...	1,765	Wh.
26bdd2	Austin Williams	457	4	Dr	4-64	57	4-64	D	Tfu	1,765	Wal.
26cbb	John Shaparenko	475	4	Dr	1957	180	4-64	D	Tfu	1,740	..Do....
26ccd	USGS test hole 2238	168	5	Dr	5-18-64	Dry	....	T	...	1,747	BR-148,TD-168,L.
27aab	Spokle Trailer Court	41	18	Dr	1951	27	2-64	D	Qs	1,555	Wh,well may be dry in summer.
27aac	Behm's Propane Service	60	18	Dr	1962	...	....	D,I	Qs	1,595	Wh.
27aca	Northwestern Equipment Co.	39	18	Dr	....	...	....	I	Tfu	1,597	Wal.
27acc	Lindsay Bros. Co.	315	6	Dr	....	...	....	I	Tfu	1,635	Wal, well flowed when drilled.
27add	John Gunderson	30	..	Dr	1946	...	....	D	...	1,645	Wh.
27bbd	Joe Leholm	94	4	Dr	1957	...	....	D	Tfu	1,572	L, wal, producing from coal seam.
27bcc	Hohum Motel	340	4	Dr	1957	F	12-14-63	I	Tfu	1,645	Wal,well capped.
27bcd	Sandman Motel	371	4	Dr	....	...	....	I	Tfu	1,585	Wal.
27daa	KMOT-TV	475	4	Dr	1957	...	....	D	Tfu	1,685	..Do....
27ddd	Casa Motel	474	4	Dr	1960	160	4-64	I	Tfu	1,755	Wal,235',soft, dark colored water.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-83 (Cont.)											
28abc	Behm's Truck Stop	283	4	Dr	1963	F	4-64	I	Tfu	1,668	Wal, well capped.
28ada	Home Motel	310	4	Dr	....	...	....	D,I	Tfu	1,687	L,Wal,well flowed 5-7 gpm when drilled.
28baa	NDWC test hole 14	126?	4	Dr	2-3-61	...	....	T	...	.....	TD-126?,lost circulation,L, abandoned hole.
28bad	NDWC test hole 15	84	4	Dr	2-2-61	...	....	T	...	.....	TD-84,BR-58?,L.
33aad	John Holbach	530	4	Dr	1931	180	1963	D	Tfu	1,775	Wal.
35aaa1	USGS test hole 2239	473	5	Dr	5-19-64	Dry	5-19-64	T	...	1,732	L,BR-451, TD-473.
35aaa2	Hanson Drive-Inn	462	4	Dr	1959	100	1964	I	Tfu	1,732	Wal.
35aaa3	Chateau Lanes	225?	4	Dr	....	...	....	I	Qg	1,734	Wh.
35aaa4	Purity Dairy	280	4	Dr	1959	190	1959	I	Qs,Qg	1,728	L, Wh.
35aab	Central Power Co.	227	4	Dr	1960	215	1960	I	Qg	1,746	Wh.
35aad	Jordahl Animal Hospital	215	4	Dr	1959	180	1959	I	Qg	1,723	L, Wh.
36bcc	Joe's Place	310	4	Dr	1959	...	....	I	...	1,720	Wh, slight alkaline taste.
36cba	Father Praeller	290	4	Dr	1958	220	1958	D	...	1,738	Wh
36cbb	Drawz Stoker Mfg. Co.	276	4	Dr	1958	231	1958	I	...	1,744	Wh, 1960 well deepened to 470', wal, driller suggests large supply of water at 276'.
155-84											
1bcc	USGS test hole 1405	63	4	Dr	9-25-58	...	....	T	...	.....	L, BR-47.

TABLE 1.--Records of wells and test holes in the vicinity of Minot, North Dakota - Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
155-84 (Cont.)											
1bcd	USGS test hole 1404	147	4	Dr	9-25-58	...	....	T	...	.....	L, BR-127.
1bdd	USGS test hole 1403	73.5	4	Dr	9-25-58	...	....	T	...	.....	L, BR-63.
12adb	USGS test hole 1500	115	4	Dr	4-59	...	....	T	...	.....	L, BR-106.
12dda	USGS test hole 1498	105	4	Dr	4-21-59	...	....	T	...	.....	L, BR-88.
13aac	USGS test hole 1499	94.5	4	Dr	4-21-59	...	....	T	...	.....	L, BR-86.

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota

154-82-4aad
Test hole 2214

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	4	4
	Clay, silty and sandy, yellowish-gray	4	8
	Gravel, fine to medium; sand, fine to coarse	12	20
	Sand, fine to coarse; minor amounts of gravel and abundant lignite chips; taking water	10	30
	Gravel, fine to medium; sand, medium to coarse; many thin lignite zones; taking water, water appears oily	48	78
	Clay, silty, olive-gray	6	84
	Sand, fine to coarse, considerable amount of lignite; taking water	26	110
	Clay, silty, olive-gray	12	122
	Sand, medium to coarse; considerable amount of lignite; taking water	48	170
	Sand, fine to coarse, clayey	5	175
	Sand, medium to coarse	15	190
	Clay, sandy, light-olive gray	4	194
	Sand, medium to coarse; minor amount of clay; taking water	39	233
Fort Union Formation:			
	Clay, silty to sandy, dark-greenish-gray	21	254

154-82-4aba
Test hole 2213

Glacial drift:			
	Soil, black	1	1
	Clay, silty, dark-yellowish-brown	4	5
	Clay, silty, yellowish-gray	10	15
	Silt, clayey, dark-greenish-gray	5	20
	Clay, silty, olive-gray	61	81
	Gravel, fine to coarse, sandy; lignite, limestone and gravel chips; taking water, rough drilling	39	120

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

154-82-4aba, Continued
Test hole 2213

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift-Continued:			
	Sand, fine to coarse; fine gravel and lignite fragments	10	130
	Clay, sandy and gravelly, olive-gray; poor sample return	27	157
Fort Union Formation:			
	Clay, sandy, light-olive-gray	53	210

154-82-24aba
Test hole 2212

Glacial drift:			
	Soil, black	2	2
	Clay, silty, medium-gray	8	10
	Clay, silty, yellow-brown to olive-brown	10	20
	Clay, silty, olive-gray	10	30
	Sand, fine to coarse; gravel, fine; and sandy gray clay	10	40
	Silt, clayey, olive-gray; clay, dark-greenish-gray	10	50
	Clay, dark-greenish-gray	30	80
	Clay, dark-greenish-gray; sand, fine; lignite chips	12	92
	Clay, dark-greenish-gray; sand, fine to coarse; gravel and boulders	10	102
Fort Union Formation:			
	Sand, fine, light-olive-gray; shale, silty, dark-greenish-gray	13.5	115.5

155-82-19adb
Harrington Bros. Stockyard test hole a/

Glacial drift:			
	Clay	10	10
	Shale, dark (small amount of water)	2	12
	Clay, blue	22	34
	Shale, dark (small amount of water)	2	36
	Clay, blue	51	87

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-82-19adb, Continued
Harrington Bros. Stockyard test hole a/

Formation	Material	Thickness (feet)	Depth (feet)
Fort Union Formation (?):			
	Clay, gray	162	249
	Hard material	2	251
	Shale (water)	3	254
	Clay, blue	2	256

a/ Drilled by Great Northern Railway Company well drill crew, 1952

155-82-19dbd
Test hole 2216

Glacial drift:			
	Soil, black	1	1
	Clay, silty to sandy, yellow to olive-brown	9	10
	Sand, medium to coarse; gravel, fine, clayey	22	32
	Clay, sandy, dark-greenish-gray	7	39
	Clay, dark-greenish-gray; alternating with sand, very fine to fine	33	72
	Gravel, fine to medium; sand, coarse; gastropod and pelecypod fragments	35	107
Fort Union Formation:			
	Sand, very fine, light-greenish-gray, clayey	19	126

155-82-19dda
Rueben Forsburg a/

Glacial drift:			
	Brown clay	26	26
	Quicksand	2	28
	Sandy clay	6	34
	Blue clay	19	53
	Soft blue clay	11	64
	Sandy blue clay	1	65
	Blue clay	15	80
	Sandy clay	4	84

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-82-19dda, Continued
Rueben Forsburg a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift-Continued:			
	Sand and clay----------	1	85
	Quicksand----------	6	91
	Sand and water----------	5	96

a/ Log from L. H. Steman, Burlington, N. Dak.

155-82-23aab
Great Northern Railway Co. test hole a/

Glacial drift:			
	Clay----------	15	15
	Clay, mixed with sand----------	5	20
	Clay and gravel----------	5	25
	Clay----------	4	29
	Clay and gravel----------	21	50
	Clay----------	5	55
	Clay and rocks----------	5	60
	Clay, sandy----------	7	67
	Clay, sandy, trace of coal----------	3	70
	Clay, gravel, and sand----------	4	74
	Clay, sand, and rocks----------	7	81
	Rocks and clay----------	5	86
	Sand, very little clay----------	19	105
	Sand and clay----------	10	115
	Clay, sandy----------	28	143
	Hard - may be rock----------	1	144
	Clay and sand----------	6	150
	Clay----------	2	152
	Sand and clay - hard to drill----------	8	160
	Sand and clay - mostly clay----------	7	167
	Hard clay, very little sand----------	5	172
	Clay----------	153	325
	Black clay----------	18	343
	Dark clay----------	2	345
	Dark clay with streaks of sand----------	22	367
	Clay, becoming lighter and more sandy--	5	372
	Light clay with streaks of sand and a little rock----------	3	375
	Layer of hardpan, rock and clay--------	1	376
	Dark clay with sand and rock----------	2	378
	Hard clay with streaks of sand----------	32	410

a/ Log from J. H. Turner, Great Northern Railway Co.

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-82-28ccc
Great Northern Railway Co. test hole a/

Formation	Material	Thickness (feet)	Depth (feet)
	Black dirt and sand----------	10	10
	Sand and very little clay----------	10	20
	Blue clay and rock----------	15	35
	Gray clay----------	10	45
	Clay and sand----------	25	70
	Clay and sand mixed----------	25	95
	Clay, very little sand----------	17	112
	Gray clay----------	23	135

a/ Log from J. H. Turner, Great Northern Railway Co.

155-82-29bcb
Test hole 2215

Glacial drift:			
	Soil, black----------	2	2
	Clay, silty to sandy, light-olive-gray-	8	10
	Clay, dark-greenish-gray; minor amount of thin sand layers; numerous pelecypods at 18 feet----------	58	68
	Clay, silty and sandy, dark-greenish-gray; sand, fine to medium----------	15	83
	Sand, medium to coarse; gravel, fine to medium; boulder pavement at 99-100 feet----------	17	100
Fort Union Formation:			
	Sand, fine, light-greenish-gray, clayey; shale, olive-gray----------	26	126

155-82-30dcc
State Highway Department Weigh Station a/

Glacial drift:			
	Brown clay----------	25	25
	Sandy clay----------	8	33
	Gravel and clay----------	14	47
	Gravel and blue clay----------	3	50
	Sandy clay and quicksand----------	8	58

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-82-30dcc, Continued
State Highway Department Weigh Station a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift-Continued:			
	Blue clay and gravel, mixed	27	85
	Coal, gravel, hard clay, sand, water	3	88
	Hard sand	6	94
	Gravel and water	2	96
	Blue clay and gravel	10	106
	Sand and water	3	109
	Sandy blue clay	3	112
	Gravel and clay	8	120
	Sand, gravel, and water	3	123
	Gravel and clay	9	132
	Sandy blue clay	33	165
	Hard gravel and blue clay mixed	15	180
	Sandy blue clay	15	195
	Brown sandy clay	23	218
	Sandy blue clay	2	220
	Gravel and clay	2	222
	Brown sandy clay	2	224
	Quicksand	3	227
	Soft blue clay	3	230
	Blue clay	14	244
	Fine sand and water	13	257

a/ Log from L. H. Steman, Burlington, N. Dak.

155-83-7bcb
NDWC test hole 1

Glacial drift:			
	Clay, yellow	6	6
	Clay, silty; coal fragments	3	9
Fort Union Formation (?):			
	Coal	1	10
	Clay, silty, grayish-blue	24	34
	Clay, sandy, greenish-gray	8	42

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-12ccc
Test hole 2218

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Clay, silty to sandy, yellowish-brown--	5	5
	Clay, sandy, yellowish-brown to brownish-gray----------	41	46
	Clay, silty, olive-gray----------	9	55
	Gravel, fine to medium; sand, coarse to very coarse----------	2	57
	Clay, silty, olive-gray----------	3	60
	Gravel, fine to medium; sand, coarse---	21	81
	Clay, silty, olive-gray----------	6	87
	Sand, medium to coarse----------	3	90
	Clay, silty, olive-gray; sandy layers at 93-95 and 108-118; occasional boulder----------	101	191
	Sand, fine to medium, clayey, appears to be a boulder of the Fort Union Formation----------	17	208
	Clay, sandy, olive-gray----------	12	220
	Sand, fine to coarse; gravel, fine to coarse; clay, sandy, olive-gray; moderately rough drilling----------	84	304
	Gravel, fine to coarse, clayey; rough drilling----------	21	325
	Boulder, granite----------	1	326
Fort Union Formation:			
	Clay, sandy, dark-greenish-gray; thin layers of lignite----------	73	399

155-83-12cdc
Test hole 2236

Glacial drift:			
	Soil, dark-brown----------	1	1
	Clay, silty to sandy, yellowish-gray---	4	5
	Clay, silty to sandy, olive-brown------	33	38
	Sand, medium to coarse----------	4	42
	Clay, silty, olive-brown----------	2	44
	Gravel, fine to medium; sand, coarse---	3	47
	Clay, silty to sandy, olive-brown------	19	66

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-12cdc, Continued
Test hole 2236

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift-Continued:			
	Sand, fine to coarse, clayey	12	78
	Clay, silty, olive-brown; minor amount of sand in thin layers	7	85
	Clay, silty to sandy, olive-gray	46	131
	Clay, silty, olive-gray	67	198
	Gravel, fine to coarse	2	200
	Clay, silty, olive-gray to light-medium-gray; abundance of lignite chips from 210-215	15	215
Fort Union Formation:			
	Clay, sandy, light-greenish-gray; thin layers of lignite	37	252

155-83-12dcd
Test hole 2219

Glacial drift:			
	Soil, black	1	1
	Clay, sandy, yellowish-brown	13	14
	Clay, silty, olive-gray; minor thin sand layers	11	25
	Sand, fine to coarse	3	28
	Clay, silty, olive-gray; minor thin sand layers	3	31
	Sand, fine to coarse; clay, sandy, olive-gray	9	42
	Clay, silty, olive-gray; numerous thin sand layers	5	47
	Rock, granite; lost circulation	1	48
	Clay, sandy, olive-gray; abundance of lignite fragments	85	133
	Gravel, fine to medium	6	139
	Clay, silty, olive-gray; lignite fragments	6	145
	Gravel, fine to medium; minor amount of clay	15	160
	Clay, sandy, olive-gray; lignite fragments	13	173

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-12dcd, Continued
Test hole 2219

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift-Continued:			
	Gravel, fine to medium	2	175
	Clay, sandy, olive-gray; lignite fragments	23	198
	Gravel, fine to coarse; boulders; rough drilling	5	203
Fort Union Formation:			
	Clay, sandy, greenish-gray	28	231

155-83-14cab
Hebrew Cemetery a/

Glacial drift:			
	Yellow sandy clay	5	5
	Hard sand and clay	3	8
	Yellow sandy clay	22	30
	Hard sand	2	32
	Yellow sandy clay	2	34
	Hard sand	4	38
	Sand and gravel	3	41
	Sandy blue clay	11	52
	Black sandy clay	11	63
	Sand, gravel, and clay, mixed	23	86
	Sand	3	89
	Coarse sand	2	91
	Blue clay	5	96
	Rock	1	97
	Sand and clay	6	103
	Blue clay and sand	5	108
	Clay, sand and gravel mixed	3	111
	Sand and gravel, water	7	118

a/ Log from L. H. Steman, Burlington, N. Dak.

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-14cda
Minot city well 10 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Sand	40	40
	Clay, sandy; gravel	13	53
	Clay, boulders	2	55
	Clay, sandy	18	73
	Sand, fine	17	90
	Sand, fine; traces of lignite	29	119
	Sand, fine; gravel	16	135
	Sand; boulders	4	139

a/ Log from Minot City Engineer, modified

155-83-14cdd3
Test hole BW2

Glacial drift:			
	Clay, brownish-gray	8	8
	Sand, fine to coarse, brown; minor layers of clay between 14 and 14.5 feet, 19 and 19.5 feet, and 20 to 21 feet; scattered pelecypod valves	15	23
	Clay, silty and sandy, olive-gray	2	25
	Clay, olive-gray	25	50
	Clay, silty and sandy, olive-gray	10	60
	Clay, silty and sandy, olive-gray; minor layers of fine sand	7.5	67.5
	Clay, silty, olive-gray; scattered lignite fragments	10	77.5
	Clay, silty, olive-gray; layers of light-olive-gray fine sand	2.5	80
	Sand, fine to medium, light-olive-gray; abundance of lignite; thin clay layer at 92.5 feet; limestone boulder at 102 feet	35	115
	Sand, fine, olive-gray	2.5	117.5
	Sand, very fine, olive-gray; boulder at 125 feet	7.5	125
	Sand, medium; very uniform in size	2	127

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-14cdd4
Bored well 2

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	1	1
	Clay, silty and sandy, yellowish-brown	7	8
	Sand, fine to medium, silty, grayish-brown	2	10
	Sand, medium to coarse, reddish-brown; shell fragments	5	15
	Sand, coarse, silty, bluish-gray	1	16
	Clay, silty, dark-olive-gray	4	20
	Clay, silty and sandy, dark-olive-gray; abundance of decomposed organic material	13	33
	Clay, very sandy and silty, dark-olive-gray, slightly cohesive; abundance of decomposed organic material	5	38
	Clay, medium-gray, very cohesive; contains nodules of dark-olive-gray clay	7	45
	Clay, very sandy and silty, dark-olive-gray	6	51
	Sand, silty, dark-olive-gray; saturated, water-level rose to 40 feet below land surface	1	52
	Clay, silty, dark-olive-gray; minor amount of organic material; pungent odor	4	56
	Clay, silty and sandy, black	4	60
	Clay, silty, dark-olive-gray; interbedded with layers of sand	10	70
	Sand, fine to medium, very silty, dark-olive-gray, slightly cohesive; interbedded with layers of medium-brown sand	7	77
	Sand, fine to coarse, gray and brown; abundance of lignite	1	78
	Sand, black; gravel, black; predominately lignite	5	83
	Sand, medium, clean	8	91

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-14dbal
Test hole 2233

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Sand, very fine, clayey	3	5
	Clay, silty and sandy, yellowish-brown	8	13
	Gravel, fine to coarse; sand, medium to coarse	4	17
	Clay, silty, yellowish-brown	14	31
	Gravel, fine to medium	4	35
	Sand, fine to coarse, clayey	4	39
	Clay, silty, olive-gray; thin layers of sand and gravel; lignite fragments	33	72
	Sand, fine to medium; minor amount of clay	11	83
	Gravel, fine to coarse	3	86
	Clay, silty, olive-gray, pebbles	8	94
	Gravel, fine to coarse	2	96
	Clay, silty, olive-gray	6	102
	Clay, sandy, olive-gray; abundance of lignite fragments	43	145
	Gravel, fine to medium; sand, coarse	27	172
	Clay, silty, olive-gray; lignite fragments and thin layers between 240 and 273 feet	100	272
	Gravel, fine to coarse, rough drilling	6	278
Fort Union Formation:			
	Sand, clayey, greenish-gray	15	293

155-83-14dba2
Minot State College a/

Glacial drift:			
	Topsoil	0.5	0.5
	Gravelly yellow clay	5.5	6
	Sandy yellow clay	32	38
	Very sandy soft yellow clay	7	45
	Sandy gray clay, some very sandy with a little water	47	92
	Muddy sand and gravel, yellow	4	96
	Fine muddy sand, yellow	12	108

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-14dba2, Continued
Minot State College a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift-Continued:			
	Fine yellow sand	6	114
	Fine gray sand, some samples a little clayey and some a little coarser	18	132
	Gray sand, a little coarser	5	137
	Slightly clayey gray sand	3	140
	Gray sand	2	142
	Sandy blue clay	60	212

a/ Log from C. A. Simpson, Bisbee, N. Dak.

155-83-14dbb
Test hole 2234

Glacial drift:			
	Soil, black	2	2
	Sand, clayey and silty	8	10
	Sand, fine to coarse, clayey	7	17
	Clay, silty to sandy, yellowish-brown; numerous pebbles	20	37
	Clay, silty, olive-gray	3	40
	Gravel, fine to medium; sand coarse; clayey	7	47
	Clay, silty, olive-gray; minor gravel	5	52
	Sand, fine to coarse; gravel, fine to medium, clayey	28	80
	Sand, medium to coarse, taking water	34	114
	Boulder, limestone	3	117
	Clay, silty to sandy, olive-gray; abundant lignite fragments	25	142
	Gravel, fine to coarse; sand, coarse; abundant lignite fragments; taking water, rough drilling	40	182
	Clay, silty, olive-gray	18	200

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-14dca
Minot city well 9 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Clay, hard and soft	67	67
	Sand, "clean"	81	148
	Sand; rocky	7	155
	Sandy and clay	2	157
Fort Union Formation (?):			
	Clay, "blue"	5	162

a/ Log from Minot City Engineer, modified

155-83-14dcb
Minot city observation well a/

Glacial drift:			
	Topsoil and clay	10	10
	Clay; streak of sand	10	20
	Clay and sand interbedded	10	30
	Clay; streak of sand	35	65
	Sand; trace of clay	5	70
	Sand, fine	64	134
	Rocky, trace of hard clay	1	135
	Rocky and clay, hard	5	140
Fort Union Formation (?):			
	Shale	1	141

a/ Log from Minot City Engineer, modified

155-83-14ddd2
Minot city well 5 a/

Glacial drift:			
	Fill	4	4
	Clay and streaks of sand	107	111
	Coarse gravel and boulders	36	147

a/ Log from Minot City Engineer

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-14ddd3
Minot city well 6 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Fill	6	6
	Gumbo	2	8
	Sand	6	14
	Clay	68	82
	Mud, sticks and sea shells	5	87
	Clay	10	97
	Muddy sand and clay	13	110
	Clay and big gravel	3	113
	Big gravel	26	139

a/ Log from Minot City Engineer

155-83-16ccd
NDWC test hole 12

Glacial drift:			
	Soil, black	2	2
	Clay, silty, yellow; rock at 15 feet	31	33
	Clay, silty, gray; small amount of coal	41	74
Fort Union Formation:			
	Coal	3	77
	Clay, sandy, light-greenish-blue	7	84

155-83-16cdb1
NDWC test hole 10

Glacial drift:			
	Soil, black	1	1
	Gravel, medium to coarse; thin layers of clay	11	12
	Clay, silty, yellow; thin layers of gravel; small amount of coal	14	26
	Clay, silty, gray; thin coal layers	48	74
Fort Union Formation:			
	Clay, sandy, light-bluish-gray	10	84

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-16cdb2
NDWC test hole 11

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	1	1
	Clay, silty, yellow; thin layers of gravel	5	6
	Gravel, medium to coarse; thin layers of clay; coal fragments	9	15
	Clay, silty, yellowish-gray; coal fragments	7	22
	Clay, silty, gray	21	43
Fort Union Formation:			
	Clay, sandy, light-bluish-gray	9	52

155-83-17bda
NDWC test hole 2

Glacial drift:			
	Soil, black	1	1
	Clay, silty, yellow	4	5
	Clay, silty, yellow; small amount of coal	32	37
	Clay, silty, grayish-blue; coal fragments	11	48
	Gravel, medium to coarse	2	50
	Clay, silty, gray; coal fragments	35	85
	Gravel, medium to coarse	2	87
	Clay, silty, brown; coal specks	19	96
Fort Union Formation:			
	Clay, sandy, bluish-green	9	105

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-17dad
NDWC test hole 9

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Gravel, medium to coarse; thin layers of sand	9	11
	Clay, silty, yellow; coal fragments	15	26
	Clay, silty, gray; thin layers of sand; coal fragments	17	43
	Sand, medium to coarse	2	45
	Clay, silty, gray; thin layers of sand; coal fragments	39	84
	Clay, silty, gray; thin layers of coal; minor amount of sand	20	104
	Clay, silty, gray; sand layers; minor amount of coal	12	116
Fort Union Formation:			
	Coal	2	118
	Clay, sand, light-greenish-gray	8	126

155-83-17dbb
NDWC test hole 3

Glacial drift:			
	Soil, black	2	2
	Clay, sandy, yellow; coal fragments	10	12
	Sand, fine; thin layers of clay; coal fragments	20	32
	Clay, silty, blue; coal fragments	11	43
	Gravel, medium to coarse	5	48
	Sand, fine; thin layers of clay	5	53
	Clay, silty, gray; coal fragments	15	68
	Gravel, medium to coarse	5	73
	Clay, gray; coal fragments	42	115
Fort Union Formation:			
	Clay, sandy, light-bluish-gray	11	126

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-17dcc
NDWC test hole 4

Formation	Material	Thickness (feet)	Depth (feet)

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-17dad
NDWC test hole 9

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Gravel, medium to coarse; thin layers of sand	9	11
	Clay, silty, yellow; coal fragments	15	26
	Clay, silty, gray; thin layers of sand; coal fragments	17	43
	Sand, medium to coarse	2	45
	Clay, silty, gray; thin layers of sand; coal fragments	39	84
	Clay, silty, gray; thin layers of coal; minor amount of sand	20	104
	Clay, silty, gray; sand layers; minor amount of coal	12	116
Fort Union Formation:			
	Coal	2	118
	Clay, sand, light-greenish-gray	8	126

155-83-17dbb
NDWC test hole 3

Glacial drift:			
	Soil, black	2	2
	Clay, sandy, yellow; coal fragments	10	12
	Sand, fine; thin layers of clay; coal fragments	20	32
	Clay, silty, blue; coal fragments	11	43

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-20abc, Continued
NDWC test hole 6

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift-Continued:			
	Clay, silty, gray; thin sand layers----	22	86
	Rock----------	3	89
	Gravel, coarse; rough drilling---------	2	91
	Clay, silty, gray----------	4	95
Fort Union Formation:			
	Clay, sandy, light-bluish-gray---------	10	105

155-83-20acc
NDWC test hole 7

Glacial drift:			
	Soil, black----------	1	1
	Clay, sandy, yellow----------	5	6
	Gravel, medium to coarse----------	5	11
	Clay, silty, yellow; coal fragments----	10	21
	Clay, silty, blue; coal fragments------	11	32
	Clay, silty, gray; thin layers of sand and coal----------	10	42
	Clay, silty, gray; coal fragments------	48	90
Fort Union Formation:			
	Clay, sandy, light-blue----------	4	94

155-83-20dbb
NDWC test hole 8

Glacial drift:			
	Soil, black----------	1	1
	Clay, yellow----------	20	21
	Clay, silty, yellow; thin layers of sand----------	11	32
	Sand, coarse; thin layers of clay; coal fragments----------	11	43
	Clay, silty, gray; thin layers of sand; coal fragments----------	21	64
	Clay, silty, yellow----------	8	72
	Clay, silty, gray; coal fragments------	14	86
Fort Union Formation (?):			
	Coal----------	2	88
	Clay, silty, gray----------	21	109
	Clay, sandy, light-blue----------	6	115

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-21add1
NDWC test hole 17

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Gravel, coarse; boulders; rough drilling, lost circulation, abandoned hole	10	10

155-83-21add2
NDWC test hole 18

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Gravel, medium; boulders; thin layers of sand and clay	12	12
	Gravel, coarse; layers of sand and clay; rough drilling	17	29
	Gravel, coarse; boulders; layers of sand; rough drilling, lost circulation, abandoned hole	5	34

155-83-21cda
NDWC test hole 13

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Clay, sandy, yellow	10	12
	Clay, silty, yellow	7	19
	Gravel, medium to coarse; thin layers of sand	7	26
	Clay, silty, bluish-gray; coal fragments	34	60
	Gravel, medium to coarse; thin layers of sand	4	64
	Clay, silty, gray; coal fragments	21	85
	Sand, medium to coarse; thin layers of coal; coal fragments	10	95
	Gravel, medium to coarse; thin layers of clay	17	112
	Clay, sandy, gray; thin layers of sand; coal fragments	9	121
	Gravel, medium to coarse; rough drilling, lost circulation, abandoned hole	7	128

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-21daa1
NDWC test hole 19

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	1	1
	Clay, sandy, yellow	31	32
	Gravel, fine to medium; thin layers of sand; rough drilling	10	42
	Gravel, medium to coarse	5	47
	Rock	2	49
	Gravel, fine to medium; thin layers of sand; coal fragments; rough drilling, hole continued to cave, abandoned	5	54

155-83-21daa2
Minot city well 18 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Fine yellow sand and silt, some clay streaks	24	24
	Sand, gravel, clay	4	28
	Clay with gravel	24	52
	Sand, gravel, boulders	46	98
	Sand, gravel, boulders, with clay traces	3	101
	Clay with gravel	13	114

a/ Log from Minot City Engineer, modified

155-83-21dab1
Test hole G.P. 1

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Gravel, clayey; sand, clayey; rough drilling, lost circulation, abandoned hole	12.5	12.5

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-21dab2
Test hole G.P. 2

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Sand, clayey, slightly cohesive; gravel, clayey, slightly cohesive----------	3	3
	Sand, silty; gravel, silty----------	6	9
	Sand, clayey; gravel, clayey----------	0.5	9.5
	Sand, coarse, silty; gravel, fine, silty; thin layer of silt about 25 feet----------	18.5	28
	Clay, silty, olive-gray to olive-black--	4	32
	Clay, silty, olive-gray; cuttings appear to be thin bedded----------	6	38
	Clay, silty, light-olive-gray, some olive-black; numerous lignite and pink granite chips----------	6	44
	Clay, very silty, medium-olive-gray; numerous lignite and granite chips----	4	48
Fort Union Formation:			
	Sand, very fine, clayey, dark-greenish-gray; abundant lignite chips---------	17	65

155-83-21dab3
Test hole G.P. 3

Glacial drift:			
	Clay, silty and sandy, grayish-brown; flecked with lignite----------	13	13
	Clay, sandy, dusky-yellowish-brown; boulder at 16 feet----------	3	16
	Sand, medium to coarse; minor amount of fine gravel; flecked with lignite grains; boulder at 19 feet----------	4	20
	Gravel, fine to medium; sand, medium to coarse----------	5	25
	Clay, silty and sandy, dark-olive-gray, very cohesive----------	2.5	27.5
	Clay, silty, sandy, and gravelly, olive-black; scattered lignite fragments---	15.5	43
Fort Union Formation:			
	Clay, silty, olive-black and dusky-yellowish-brown; abundance of lignite	7	50
	Sand, very fine, clayey, medium-dark-gray; abundance of lignite----------	8	58

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-21dad
City test hole 14 T a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Fine yellow sand and silt, some clay streaks	24	24
	Sand, gravel, some clay	4	28
	Clay, gravel	24	52
	Sand, gravel	2	54
	Sand, gravel, boulders, some clay lenses last 10 feet	44	98
	Dirty sand, gravel	3	101
	Clay, some gravel	13	114

a/ Log from Minot City Engineer

155-83-22aaa2
Test hole P1 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Sand, very fine to fine, brown	15	15
	Sand, very fine to coarse; minor amount of fine gravel, pelecypod valves	2.5	17.5
	Sand, medium to very coarse, gray; minor amount of fine gravel	7.5	25
	Sand, very fine to medium	5	30
	Sand, medium to coarse; minor amount of fine gravel	5	35
	Gravel, fine; sand, fine to coarse; thin layer of clay	5	40
	Sand, fine to coarse; gravel, very fine; scattered lignite grains; boulder at 85 feet; lost circulation	60	100

a/ Log from Minot City Engineer, modified

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22aaa3
Test hole P2

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Sand, very fine to medium, silty, brown and gray	15	15
	Sand, fine to coarse, some fine gravel, gray; pelecypod valves	3	18
	Clay, silt, sand; blue	2	20
	Sand, fine to coarse, some fine gravel, gray	20	40

155-83-22aaa4
Bored well 1

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Clay, very sandy, medium-brown, slightly cohesive	6	6
	Sand, clayey, brown	4	10
	Sand, fine to medium, medium-brown; minor amount of clay	2	12
	Sand, medium, medium-brown; saturated	3.5	15.5
	Sand, fine to coarse, silty, bluish-gray; pelecypod valves; abundance of wood	2	17.5
	Sand, fine to medium,bluish-gray	1	18.5
	Sand, coarse, olive-gray; gravel, fine, olive-gray; abundance of pelecypod valves; abundance of lignite fragments	2.5	21
	Sand, fine to medium, silty, blue; abundance of lignite fragments	3	24
	Clay, silty, dark-olive-gray, very cohesive	4	28
	Sand, coarse, brown; minor amount of fine gravel	8	36

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22abc
Minot city well 15 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Sandy clay----------	20	20
	Dirty sand----------	30	50
	Clean sand----------	5	55
	Sand and gravel----------	5	60
	Coarse gravel----------	55	115
	Clay----------	2	117

a/ Log from Minot City Engineer

155-83-22acc1
Minot city well 14 a/

Glacial drift:			
	Gray sandy clay----------	10	10
	Yellow sandy clay----------	35	45
	Coarse gravel----------	45	90
	Sand with some gravel----------	16	106

a/ Log from Minot City Engineer

155-83-22acc2
Minot city test hole 12 AT a/

Glacial drift:			
	Sandy clay, silt----------	11	11
	Very fine sand, some clay and silt-----	27	38
	Mostly clay, some sand----------	16	54
	Sand (dirty)----------	3	57
	Clean coarse sand----------	15	72
	Clean sand, gravel----------	18	90
	Dirty (clay) sand, gravel----------	7	97
	Sandy clay, clay----------	14	111

a/ Log from Minot City Engineer

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22adal
Minot city test 11-T a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Clay, silt, sandy clay, some fine sand-	46	46
	Dirty medium to fine sand, some lignite	22	68
	Sand - some clean, clay lenses, lignite	10	78
	Clean coarse sand, gravel----------	7	85
	Mostly coarse gravel----------	9	94
	Very coarse, gravel, boulder, some sand	7	111
	Sand, gravel and boulders (clean)------	9	120
	Clay, gray, some fine silty sand-------	20	140

a/ Log from Minot City Engineer

155-83-22ada2
Minot city well 12 a/

Glacial drift:			
	Clay, silty, sandy clay, fine sand-----	46	46
	Dirty, medium to fine sand, some lignite----------	22	68
	Some clean sand, clay lenses, lignite--	10	78
	Clean, coarse sand and gravel----------	7	85
	Mostly coarse gravel, rough drilling---	9	94
	Very coarse gravel, boulders, some sand	17	111
	Sand, gravel and boulders----------	9	120
	Gray clay----------	20	140

a/ Log from Minot City Engineer

155-83-22adc
Minot city well 13 a/

Glacial drift:			
	Sandy clay----------	25	25
	Blue clay----------	50	75
	Sand and gravel----------	5	80
	Gravel----------	9	89
	Coarse gravel and boulders----------	25	114
	Sand----------	7	121
	Clay with gravel----------	2	123

a/ Log from Minot City Engineer

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22add1
Northern States Power Co. a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Gumbo	2	2
	Sandy clay	13	15
	Sand	15	30
	Gravel, muddy water	7	37
	Fine sand and muddy water	43	80
	Clay and sand	10	90
	Sand and water	6	96

a/ Log from L. H. Steman, Burlington, N. Dak.

155-83-22bab
Minot city test hole 13 AT a/

Glacial drift:			
	Clean, fine sand	70	70
	Sand, gravel, and boulders	10	80
Fort Union Formation:			
	Sandy clay, blue in color	13	93

a/ Log from Minot City Engineer

155-83-22bcc1
NDWC test hole 16

Glacial drift:			
	Gravel, medium to coarse; rough drilling	11	11
	Gravel, coarse; boulders; rough drilling, lost circulation, abandoned hole	9	20

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22bcc2
Bored well 3

Formation	Material	Thickness (feet)	Depth (feet)
	Fill----------	1	1
Glacial drift:			
	Sand, medium, brown----------	3	4
	Sand, fine to coarse, brown; minor amount of fine gravel; minor amount of lignite chips----------	1	5
	Sand, medium, reddish-brown; very uniform in size----------	1	6
	Sand, medium, reddish-brown; minor amount of cobbles----------	1	7
	Sand, medium, reddish-brown; very uniform in size----------	5	12
	Sand, medium to coarse, silty, brownish-gray; gravel, fine to medium, silty, brownish-gray; minor amount of boulders----------	7	19

155-83-22bcd1
Minot city well 17 a/

Glacial drift:			
	Clay----------	10	10
	Sandy clay----------	16	26
	Coarse gravel----------	46	72
	Fine gravel----------	8	80
	Fine gravel and sand----------	5	85
	Gravel with traces of clay----------	4	89
	Hard clay----------	2	91

a/ Log from Minot City Engineer

155-83-22bcd2
Test hole R9

	Fill----------	4	4
Glacial drift:			
	Clay, silty and sandy, olive-gray------	13	17

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22bcd2, Continued
Test hole R9

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift - Continued:			
	Clay, very sandy, olive-gray----------	6.5	23.5
	Sand, medium to coarse----------	.5	24
	Gravel, fine to medium; sand, coarse---	13	37
	Gravel, fine to medium----------	2	39
	Gravel, fine to medium, some coarse; sand, coarse; taking water, drilling fluid is muddy----------	14	53
	Sand, very fine to medium, silty, slightly cohesive----------	2	55
	Gravel with some sand----------	15.5	70.5
	Sand, fine to coarse, grayish, brown---	6	76.5
	Gravel with some sand, dark brown; abundance of lignite fragments-------	1.5	78

155-83-22bdb
Minot city test hole 13 T a/

Glacial drift:			
	Silt and sand----------	8	8
	Sand and gravel; rough drilling--------	32	40
	Sand, gravel; very rough drilling------	14	54
	Sand, gravel----------	31	85
	Coarse gravel, boulders, sand----------	26	111
	Clay, gravel----------	10	121

a/ Log from Minot City Engineer

155-83-22bdc
Minot city well 16 a/

Glacial drift:			
	Silt and clay----------	8	8
	Sand and gravel----------	32	40
	Small boulders, sand and gravel--------	45	85
	Coarse gravel, boulders----------	26	111
	Clay and gravel----------	10	121

a/ Log from Minot City Engineer

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22caa
Test hole R5 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2.5	2.5
	Sand, soil, and some clay	2.5	5
	Clay, sandy with silt	2.5	7.5
	Clay, blue	2.5	10
	Clay, grayish-blue	2.5	12.5
	Clay, sandy	2.5	15
	Clay, brown, blue	2.5	17.5
	Clay, yellow, some sand	2.5	20
	Sand, medium to coarse, some shells and coal; taking water at 21 feet	2.5	22.5
	Sand, coarse, red, clean	2.5	25
	Sand, coarse, with some gravel	2.5	27.5
	Gravel with coarse sand	2.5	30

a/ Log from Minot City Engineer, modified

155-83-22cabl
Test hole R4 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2.5	2.5
	Sand, silty	7.5	10
	Sand, fine	2.5	12.5
	Clay, sandy	5	17.5
	Sand, medium, with some shells	2.5	20
	Sand, medium to coarse	2.5	22.5
	Sand, coarse, with small gravel; drilling hard	2.5	25
	Gravel, medium, with some coarse sand	5	30

a/ Log from Minot City Engineer, modified

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22cab2
Bored well 5

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	1	1
	Sand, very fine to fine, very silty; thin layers of sandy clay between 7 and 12 feet	11	12
	Sand, fine, minor amounts of medium to coarse grains; pelecypod valves at 14 to 15 feet	3	15
	Clay, medium-olive-gray	2	17
	Sand, fine to medium, abundance of lignite	4	21
	Sand, coarse; gravel, fine	1	22
	Clay, silty and sandy, dark-olive-gray	3	25
	Clay, grayish-brown	1	26
	Gravel, clayey and silty	1	27
	Gravel, fine to medium, clayey and silty, brownish-black; sand, medium to coarse, clayey and silty, brownish-black; slightly cohesive; abundance of lignite; rough drilling	8	35

155-83-22cba1
Test hole R2 a/

Glacial drift:			
	Soil, black	2.5	2.5
	Soil, black, with a little silt	2.5	5
	Clay, sandy	5	10
	Clay, sandy, olive	2.5	12.5
	Sand, fine	2.5	15
	Clay, brownish; sand, fine	2.5	17.5
	Sand, medium to coarse, clean; taking water at 19 feet	2.5	20
	Sand, fine, brown	2.5	22.5
	Sand, coarse	3.5	26
	Sand, coarse; gravel, fine	4	30

a/ Log from Minot City Engineer, modified

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22cba2
Test hole R3 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	5	5
	Clay, olive, with some fine sand	2.5	7.5
	Clay, sandy	5	12.5
	Sand, fine, some clay	5	17.5
	Sand, medium to coarse, quite clean	2.5	20
	Gravel with a little sand; started taking a lot of water at 21 feet	5	25
	Gravel, fine to coarse	2.5	27.5
	Sand, coarse, with gravel; drilling rough	2.5	30

a/ Log from Minot City Engineer, modified

155-83-22cba3
Bored well 4

Glacial drift:			
	Soil, black	1	1
	Clay, very sandy and silty, medium-brown; interbedded with layers of gray and brown clay	18	19
	Clay, silty, dark-olive-gray, very cohesive	3	22
	Sand, medium to coarse, silty, dark-rusty-brown; minor amount of fine gravel; abundance of lignite	4	26
	Sand, medium to coarse, silty, dark-rusty-brown; gravel, fine to medium, silty, dark-rusty-brown; abundance of lignite	10	36

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22cbb1
Test hole R1 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	5	5
	Clay, silty, olive-brownish-gray, with fine sand	5	10
	Clay, brown, with fine sand	2.5	12.5
	Clay, silty and sandy, dark-olive-gray; small amount of dark material; some coal fragments between 17.5 and 20 feet	7.5	20
	Sand, coarse, brown, few coal fragments	2.5	22.5
	Sand, coarse; gravel, fine; coal fragments; started taking water at 24 feet; hit rock at 25 feet; larger gravel reported but not sampled	7.5	30

a/ Log from Minot City Engineer, modified

155-83-22cbb2
Test hole R6 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2.5	2.5
	Sand, silty	5	7.5
	Clay, sandy	2.5	10
	Sand, fine, with a little clay; clayey sand	2.5	12.5
	Sand, fine to coarse, brown, clean	2.5	15
	Sand, medium to coarse, some coal and shells; rough drilling and taking a lot of water between 20 and 22.5 feet	7.5	22.5
	Sand, coarse, brown; limestone boulder at 25 feet	2.5	25
	Sand, coarse; gravel, fine; rough drilling, taking a lot of water	2	27

a/ Log from Minot City Engineer, modified

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-22cbb3
Test hole R8

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, silty and sandy, black----------	2	2
	Clay, silty and sandy, dusky-yellowish-brown----------	16	18
	Clay, sandy and gravelly, dusky-yellowish-brown----------	4	22
	Sand, fine to coarse, silty, some fine gravel----------	2	24
	Sand, coarse; gravel, fine----------	20	44
	Sand, medium, brown----------	4	48
	Gravel, fine to coarse; sand, fine to coarse; abundance of lignite fragments between 64 and 68 feet---------	20	68

155-83-23baa
Minot city well 7 a/

Glacial drift:			
	Fill and topsoil----------	4	4
	Sandy clay----------	4	8
	Sand----------	8	16
	Clay----------	70	86
	Sand----------	4	90
	Coarse sand----------	10	100
	Fine sand----------	10	110
	Gravel----------	5	115
	Medium sand----------	7	122
	Sand and gravel----------	3	125

a/ Log from Minot City Engineer

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bab1
Minot city well 8 a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil	2	2
	Sand clay	6	8
	Sand	13	21
	Clay	42	63
	Sand and clay streaks	7	70
	Clay	20	90
	Muddy sand	10	100
	Sand	18	118
	Gravel and coarse sand	15.5	133.5

a/ Log from Minot City Engineer

155-83-23bab2
Test hole 2227

Glacial drift:			
	Soil, black	2	2
	Clay, silty and sandy, olive-gray	3	5
	Sand, very fine to fine, silty; minor thin layers of clay	8	13
	Sand, fine to coarse; pelecypod valves	10	23
	Clay, silty, olive-gray	12	35
	Sand, medium	7	42
	Clay, silty, olive-gray	4	46
	Silt, clayey, olive-gray	10	56
	Sand, fine to coarse; minor amount of fine gravel	13	69
	Sand, medium; minor amount of thin layers of clay	5	74
	Sand, medium to coarse; lignite fragments	43	117
	Gravel, fine to coarse; rough drilling	3	120

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bab3
Test hole 2227A

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil----------	2	2
	Clay, silty and sandy, olive-gray------	3	5
	Sand, very fine to fine, silty and clayey----------	8	13
	Sand, fine to coarse; pelecypod valves-	8	21

155-83-23bba1
Test hole 2222

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black----------	2	2
	Clay, sandy, dark-brown----------	6	8
	Sand, fine to medium, clayey----------	6	14
	Sand, very fine to coarse; abundant pelecypod valves at 20 to 22 feet----	9	23
	Clay, greenish-gray----------	9	32
	Sand, fine to coarse; taking water-----	18	50
	Sand, fine to very coarse; minor amount of fine gravel----------	8	58
	Gravel, fine to medium; clay, greenish-gray; taking water----------	4	62
	Sand, medium to coarse; minor amount of greenish-gray clay from 84 to 104 feet; abundance of lignite chips from 84 to 104 feet----------	42	104
	Gravel, fine to coarse; rough drilling-	3	107

155-83-23bba2
Test hole 2223

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black----------	4	4
	Sand, very fine to medium; minor amount of silt and clay----------	20	24
	Clay, silty, greenish-gray----------	8	32
	Sand, very fine to medium----------	2	34
	Clay, silty, greenish-gray----------	6	40

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bba2, Continued
Test hole 2223

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift - Continued:			
	Silt, sandy, greenish-gray----------	13	53
	Sand, fine to coarse, clayey; lignite fragments from 74 to 110 feet--------	57	110
	Gravel, fine to coarse; lost circulation, rough drilling----------	7	117

155-83-23bba3
Test hole 2225

Glacial drift:			
	Soil, black----------	2	2
	Sand, fine to coarse----------	20	22
	Clay, greenish-gray----------	11	33
	Sand, fine to coarse; interbedded with clay, greenish-gray----------	24	57
	Sand, very fine to very coarse; abundant lignite fragments; minor amount of clay----------	47	104
	Gravel, fine to coarse; lost circulation, rough drilling----------	2	106

155-83-23bba4
Test hole 2225A

Glacial drift:			
	Soil, black----------	2	2
	Sand, fine to coarse----------	19	21

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bba5
Test hole 2226

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Sand, very fine to medium, clayey	18	20
	Sand, coarse to very coarse; abundance of pelecypod valves	3	23
	Clay, greenish-gray	19	42
	Clay, sandy, greenish-gray; interbedded with thin layers of sand	15	57
	Sand, fine to coarse; gravel, fine to medium; minor amount of clay; abundance of lignite fragments	8	65
	Clay, sandy, greenish-gray	5	70
	Sand, fine to very coarse; minor amount of gravel; abundance of lignite fragments	4	74
	Sand, very fine to very coarse; lost circulation	42	116
	Gravel, fine to very coarse; rough drilling	1	117

155-83-23bba6
Test hole 2226A

Glacial drift:			
	Soil, black	2	2
	Sand, very fine to medium; clayey	18	20
	Sand, coarse to very coarse; abundance of pelecypod valves	1	21

155-83-23bba7
Test hole 2241

Glacial drift:			
	Clay, silty and sandy, yellowish-brown	13	13
	Sand, fine to coarse	5	18
	Clay, silty, olive-gray	7	25
	Sand, fine to medium	2	27
	Clay, sandy, olive-gray	3	30

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bba7, Continued
Test hole 2241

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift - Continued:			
	Sand, fine to coarse; minor amount of thin clay layers	5	35
	Clay, sandy, olive-gray	4	39
	Sand, fine to coarse	62	101
	Gravel, fine to coarse; rough drilling-	1	102

155-83-23bba8
Test hole 2241A

Glacial drift:			
	Clay, silty and sandy, yellowish-brown-	13	13
	Sand, fine to coarse	5	18

155-83-23bba9
Test core 3

Glacial drift:			
	No sample	13.8	13.8
	Clay, silty, light-olive-gray	3.9	17.7
	Clay, very sandy, light-olive-gray	2.3	20.0
	Clay, silty, light-olive-gray	0.6	20.6
	Sand, medium	0.6	21.2
	Clay, silty, light-olive-gray	1.8	23.0
	Sand, fine to medium, silty	6.0	29.0
	Clay, silty, light-olive-gray, very cohesive	1.5	30.5
	Sand, fine to medium	2.5	33.0
	Clay, very silty, light-olive-gray, very cohesive	4.0	37.0
	Sand, fine to coarse; stopped drilling at 46.2 feet, lost circulation	9.2	46.2

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bba10
Test core 4

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black----------	2	2
	Sand, very fine to coarse----------	16	18

155-83-23bbb1
Test hole 2220

Glacial drift:			
	Soil, black----------	2	2
	Sand, fine to coarse----------	18	20
	Clay, greenish-gray (core)----------	9.5	29.5
	Sand, fine to coarse (core)----------	27.5	57
	Clay, greenish-gray (core)----------	1.5	58.5
	Sand, fine to coarse (core)----------	16.5	75
	Sand, fine to medium; minor amount of silt and clay, greenish-gray; minor amount of lignite fragments (core)---	24	99
	Gravel, fine to coarse; lost circulation, mixed 6 bags of bentonite at 98 feet; very rough drilling----------	15	114

155-83-23bbb2
Test hole 2221

Glacial drift:			
	Soil, black----------	2	2
	Sand, very fine to coarse----------	18	20
	Clay, greenish-gray----------	10	30
	Sand, fine to coarse----------	30	60
	Sand, fine to coarse; minor amount of clay; abundant small lignite chips---	42	102
	Gravel, coarse; rough drilling---------	0.5	102.5

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bbb3
Test hole 2224

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Sand, very fine to medium	11	13
	Sand, very fine to coarse, clayey	6	19
	Sand, fine to coarse	2	21
	Clay, greenish-gray	13	34
	Sand, fine to coarse	30	64
	Sand, very fine to coarse, clayey; abundant lignite fragments	13	77
	Sand, very fine to medium, clayey	20	97
	Gravel, fine to coarse; lost circulation, rough drilling	13	110

155-83-23bbb4
Test hole 2228

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Silt, clayey and sandy, olive-gray	8	10
	Sand, fine to coarse	11	21
	Clay, dark-greenish-gray	6	27
	Sand, medium to coarse; slightly clayey between 73 and 94 feet; abundance of lignite fragments between 94 and 102 feet	75	102
	Gravel, fine	5	107
	Gravel, fine to coarse; rough drilling, lost circulation	3	110

155-83-23bbb5
Test hole 2228A

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Silt, clayey and sandy, olive-gray	8	10
	Sand, fine to coarse	11	21

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bbb6
Test hole 2231

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Sand, fine to medium	19	21

155-83-23bbb7
Test hole 2232

Glacial drift:			
	Soil, black	2	2
	Sand, fine to medium	19	21

155-83-23bbb8
Test hole P3

Glacial drift:			
	Soil; sand, very fine to medium, brown-	5	5
	Sand, fine to medium, brown	13	18
	Clay, brown; sand, fine to medium, gray	2	20
	Sand, fine to medium, gray	5	25
	Sand, fine to coarse, brownish-gray; some fine gravel between 35 and 40 feet; taking water	15	40
	Sand, very fine to medium, gray; abundance of lignite	20	60

155-83-23bbb9
Test hole P4

Glacial drift:			
	Clay, sandy, brown; some fine gravel	5	5
	Sand, fine, clayey, brown	5	10
	Sand, fine to medium, brown	6	16
	Clay, blue, very cohesive	3	19
	Sand, fine to very coarse; some very fine gravel	21	40

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bbb10
Test hole P7

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Clay, sandy, brown----------	5	5
	Sand, very fine to fine, brown---------	5	10
	Sand, fine to medium, brown----------	5	15
	Sand, medium to coarse, brown----------	10	25
	Sand, medium to coarse, brown; minor layer of clay, gray----------	5	30
	Sand, fine to coarse, gray----------	10	40

155-83-23bbb11
Test hole P8

Glacial drift:			
	Clay, silty and sandy, brown----------	10	10
	Sand, very fine to fine, clayey, brown-	10	20
	Sand, fine to coarse, brown----------	5	25
	Clay, gray; layers of very fine gravel-	5	30
	Sand, fine to coarse, gray----------	30	60

155-83-23bbc1
Test hole 2229

Glacial drift:			
	Soil, black----------	2	2
	Sand, fine to medium; abundance of pelecypod valves----------	8	10
	Sand, fine to coarse; few thin clayey layers----------	12	22
	Clay, olive-gray; numerous thin layers of fine sand; lignite fragments------	15	37
	Sand, fine to medium----------	5	42
	Clay, silty and sandy, olive-gray------	5	47
	Sand, fine to coarse; abundance of lignite fragments----------	52	99
	Gravel, fine to medium----------	3	102

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bbc2
Test hole 2229A

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black----------	2	2
	Sand, fine to medium----------	8	10
	Sand, fine to coarse; minor amount of clay----------	11	21

155-83-23bbc3
Test hole 2230

Glacial drift:			
	Soil, black----------	2	2
	Sand, very fine to fine----------	8	10
	Sand, medium; abundance of pelecypod valves----------	11	21
	Sand, fine to medium; clay, silty, olive-gray----------	15	36
	Sand, fine to coarse; abundance of lignite fragments from 70 to 94 feet-	58	94
	Gravel, fine to coarse; rough drilling-	2	96

155-83-23bbc4
Test hole 2230A

Glacial drift:			
	Soil, black----------	2	2
	Sand, very fine to fine----------	8	10
	Sand, medium; abundance of pelecypod valves----------	11	21

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bbc5
Test hole 2235

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Sand, fine to medium	18	20
	Clay, sandy, olive-gray; abundance of thin layers of sand	58	78
	Sand, fine to coarse; minor amount of clay	8	86
	Gravel, fine to medium; sand, medium to coarse	9	95
	Gravel, fine to coarse; abundance of lignite fragments; rough drilling	10	105

155-83-23bbc6
Test hole P5

Glacial drift:			
	Soil	1	1
	Sand, very fine to fine, brown	4	5
	Sand, fine to medium, brown	15	20
	Sand, fine to medium, gray	5	25
	Clay with layers of sand	5	30
	Sand, very fine to fine, some clay	5	35
	Sand, fine to coarse; gravel, very fine; taking a lot of water	5	40
	Sand, fine to coarse	5	45
	Sand, medium to coarse; gravel, very fine; taking a lot of water	15	60

155-83-23bbc7
Test hole P6

Glacial drift:			
	Sand, very fine to fine, brown	9	9
	Clay, sandy, brown	1	10
	Sand, clayey, brown	5	15
	Sand, clayey, gray	1	16
	Sand, fine to medium, some coarse, gray	3	19
	Clay, sandy, gray; thin layers of fine to medium sand	13	32
	Sand, fine to very coarse, gray; lignite fragments at 53 feet	28	60

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bbc8
Test hole P9

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil; sand, very fine, silty----------	5	5
	Sand, very fine, silty----------	15	20
	Sand, fine to medium, some coarse, brown----------	9	29
	Clay with fine gravel, gray----------	4	33
	Sand, fine to medium----------	2	35
	Sand, fine to medium, some coarse, some very fine gravel between 45 to 50 feet; taking water----------	25	60

155-83-23bbd
Minot city well 11 a/

Glacial drift:			
	Black soil----------	3	3
	Sandy clay----------	81	84
	Clay, some sand----------	6	90
	Dirty sand----------	9	99
	Coal----------	3	102
	Coarse sand----------	2	104
	Coarse gravel----------	21	125
	Gravel and fine sand----------	5	130

a/ Log from Minot City Engineer

155-83-23bcb
Test hole 2237

Glacial drift:			
	Soil, black----------	2	2
	Clay, silty, brownish-black----------	6	8
	Clay, silty, yellowish-brown----------	5	13
	Sand, fine to coarse----------	7	20
	Sand, fine to medium----------	3	23
	Clay, silty, olive-gray----------	7	30
	Sand, fine to medium----------	4	34
	Clay, silty, olive-gray----------	36	70

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-23bcb, Continued
Test hole 2237

Glacial drift - Continued:		
Clay, silty, olive-gray; sand, fine to medium; abundance of lignite fragments	15	85
Sand, fine to medium	4	89
Gravel, fine to coarse; rough drilling	7	96

155-83-23bdd
Minot city test hole 11 BT a/

Glacial drift:		
Fine silty sand	17	17
Sand	5	22
Black sand	6	28
Clay	60	88
Clay with small amount of gravel	9	97
Gravel and boulders	11	108
Gravel with some particles of clay	14	122

a/ Log from Minot City Engineer

155-83-23cbb
Minot city test hole 11 A a/

Glacial drift:		
Clay and silty sand	16	16
Silty sand	6	22
Gravel - intermixed with clay	8	30
Sand and clay	9	39
Clay and gravel	4	43
Clay	57	100

a/ Log from Minot City Engineer

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-24aaa1
Test hole 2217

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	1	1
	Clay, yellowish-gray	3	4
	Sand, very fine to fine	4	8
	Sand, very fine to very coarse; abundance of pelecypod valves	8	16
	Clay, silty, dark-greenish-gray	57	73
	Clay, sandy, brownish-gray	5	78
	Sand, fine to coarse; abundance of lignite fragments; many fragments of pelecypod valves	11	89
	Gravel, fine to very coarse; lost circulation from 100 to 128 feet; used 41 bags of bentonite; abandoned at 128 feet	39	128

155-83-24aaa2
Test hole 2217A

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	1	1
	Clay, yellowish-gray	3	4
	Sand, very fine to fine	4	8
	Sand, very fine to very coarse; abundance of pelecypod valves	8	16
	Clay, silty, dark-greenish-gray	24	40

155-83-24bac2
Whites Creamery test hole a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Fill	4	4
	Yellow clay	12	16
	Sandy gray clay	24	40
	Hard pan, rocks	8	48
	Gravel	19	67
	Clayey sand and gravel	4	71
	Sand and gravel	11	82

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-24bac2, Continued
Whites Creamery test hole a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift - Continued:			
	Blue clay----------	89	171
	Clayey sand----------	7	178
	Gravelly blue clay----------	16	194

a/ Log from C. A. Simpson, Bisbee, North Dakota

155-83-25cbb
Northern Bottling Works test hole a/

Glacial drift:			
	Clay----------	40	40
	Sand and water----------	10	50
	Blue clay----------	52	102
	Gravel and water----------	6	108
	Clay----------	7	115
	Gravel and water----------	5	120
	Sandy clay----------	15	135
	Blue clay----------	25	160
	Gravel and gas----------	45	205
	Clay----------	10	215

a/ Log from L. H. Steman, Burlington, North Dakota

155-83-25ddd
Test hole 2240

Glacial drift:			
	Clay, silty to sandy, yellowish-brown--	9	9
	Sand, fine to medium----------	2	11
	Clay, silty to sandy, yellowish-brown--	3	14
	Gravel, medium to coarse; sand, coarse; lost circulation----------	18	32
	Clay, silty to sandy, olive-gray-------	62	94
	Gravel, fine to medium; sand, medium to coarse----------	2	96
	Clay, silty and sandy, olive-gray------	1	97
	Gravel, fine to medium; sandy, coarse--	1	98

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-25ddd, Continued
Test hole 2240

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift - Continued:			
	Clay, silty, olive-gray	1	99
	Gravel, fine to medium; some lignite	3	102
	Clay, silty, olive-gray; lignite fragments	52	154
	Gravel, coarse to very coarse, clayey	35	189
	Clay, sandy, olive; interbedded with sand, medium to coarse	48	237
	Clay, slightly silty, olive-gray	13	250
	Clay, silty to sandy, olive-gray	67	317
	Clay, silty, olive-gray	19	336
	Clay, silty to very sandy, olive-gray; poor sample return	20	356
	Gravel, fine to very coarse; rough drilling	32	388
	Clay, silty, olive-gray to light-gray	53	441
Fort Union Formation:			
	Clay, sandy, brownish-gray to greenish-gray; thin layers of lignite	42	483

155-83-26bbb3
Atlas Sand and Gravel Co. a/

Glacial drift:			
	No samples	140	140
	Blue clay	30	170
Fort Union Formation (?):			
	Coal	3	173
	Clay	7	180
	Coal	5	185
	Sand	5	190
	Clay	5	195
	Sand	15	210
	Clay	10	220
	Sand	5	225
	Clay	20	245
	Hard clay	15	260
	Clay	25	285
	Brown clay	35	320

a/ Log from L. H. Steman, Burlington, North Dakota

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-26ccd
Test hole 2238

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Clay, sandy, yellowish-brown----------	11	11
	Sand, fine to medium----------	4	15
	Clay, silty, brownish-gray----------	3	18
	Sand, fine to medium----------	3	21
	Clay, silty, olive-gray----------	14	35
	Gravel, fine to medium----------	2	37
	Clay, silty, olive-gray; minor amount of lignite fragments----------	69	106
	Gravel, fine to coarse----------	4	110
	Clay, silty, olive-gray; minor amount of lignite fragments----------	28	138
	Gravel, fine to medium----------	4	142
	Clay, silty, olive-brown----------	6	148
Fort Union Formation:			
	Clay, sandy, light-greenish-gray; thin layers of lignite----------	20	168

155-83-27bbd
Joe Leholm a/

Glacial drift:			
	Hard clay----------	18	18
	Sand----------	9	27
	Yellow sand----------	11	38
	Dark clay----------	24	62
	Dark gravel and sand----------	13	75
Fort Union Formation (?):			
	Coal and sandy clay----------	5	80
	Coal and clay----------	5	85
	Blue clay----------	6	91
	Coal and water----------	3	94

a/ Log from L. H. Steman, Burlington, North Dakota

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-28ada
Home Motel a/

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Gray clay	12	12
	Yellow sandy clay	23	35
	Blue clay	34	69
Fort Union Formation:			
	Coal	18	87
	Clay	4	91
	Coal	3	94
	Clay	18	112
	Quicksand, water	2	114
	Black clay	12	126
	Brown clay	6	132
	Blue clay	6	138
	Quicksand	4	142
	Light blue clay	4	146
	Blue clay	14	160
	Clay	5	165
	Sand	3	168
	Clay	7	175
	Gray shale	15	190
	Clay	25	215
	Shale	3	218
	Clay	80	298
	Caprock	2	300
	Sand, water	10	310

a/ Log from L. H. Steman, Burlington, N. Dak.

155-83-28baa
NDWC test hole 14

Glacial drift:			
	Soil, black	2	2
	Clay, sandy	10	12
	Gravel, medium; sand	14	26
	Clay, sandy, greenish	6	32
	Clay, silty, gray; coal fragments	31	63
	Clay, silty; sandy layers	32	95
	Gravel; boulders; sand	20	115
	Clay, silty	6	121
	Lost circulation	5 ?	126 ?

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-28bad
NDWC test hole 15

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Clay, sandy, yellow	25	25
	Gravel, medium to coarse; minor amount of clay	2	27
	Clay, sandy, yellow	10	37
	Clay, gray; coal fragments	21	58
Fort Union Formation (?):			
	Coal	1	59
	Clay, sandy, blue	25	84

155-83-35aaa1
Test hole 2239

Glacial drift:			
	Clay, silty to coarse gravel, yellowish-brown	30	30
	Clay, silty, yellowish-brown; thin layers of fine to coarse sand and fine gravel	73	103
	Sand, coarse; gravel, fine	6	109
	Clay, sandy, olive-gray	39	148
	Gravel, fine to medium	3	151
	Clay, silty and sandy, olive-gray	42	193
	Clay, silty, brownish-gray; minor amount of fine sand	127	320
	Clay, silty to sandy, olive-gray; few boulders	129	449
	Boulder, granite	2	451
Fort Union Formation:			
	Sand, very fine, clayey, blue-greenish-gray	22	473

155-83-35aaa4
Purity Dairy

Glacial drift:			
	Yellow clay	15	15
	Sand	55	70
	Hard sand	23	93

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-83-35aaa4, Continued
Purity Dairy

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift - Continued:			
	Sand	37	130
	Blue clay	18	148
	Sand and water	3	151
	Hard sand	2	153
	Clay and gravel	5	158
	Clay and gravel	27	185
	Blue clay	65	250
	Black clay	15	265
	Blue clay and gravel	5	270
	Sand and water	10	280

a/ Log from L. H. Steman, Burlington, N. Dak.

155-83-35aad
Jordahl Animal Hospital a/

Glacial drift:			
	Yellow sand	18	18
	Gravel	7	25
	Yellow sand	5	30
	Blue clay	12	42
	Sand and water	1	43
	Blue clay	12	55
	Sandy blue clay	14	69
	Gray rock	5	74
	Gray sand	5	79
	Sand and water	7	86
	Clay and gravel	4	90
	Clay	35	125
	Rock	5	130
	Clay	6	136
	Rock	1	137
	Clay	11	148
	Boulder	1	149
	Clay	7	156
	Sand; gas at 158-162 feet at 6 pounds pressure	9	165
	Sand; coal; gas	15	180
	Fine gravel and water	27	207
	Gravel and water	10	217

a/ Log from L. H. Steman, Burlington, N. Dak.

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-84-1bcc
Test hole 1405

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Clay, yellow; gravel, fine----------	4	4
	Gravel, fine to coarse; sand, coarse; small amount of yellowish-gray clay--	12	16
	Clay, yellow-gray; gravel, fine--------	5	21
	Clay, silty and sandy, gray----------	26	47
Fort Union Formation:			
	Clay, sandy, gray, green, and brown----	16	63

155-84-1bcd
Test hole 1404

Glacial drift:			
	Clay, sandy, brown; lignite fragments--	12	12
	Sand, medium to coarse; shale and lignite fragments----------	11	23
	Clay, silty, greenish----------	12	35
	Sand, fine to medium; shale and lignite fragments----------	21	56
	Gravel, fine; sand, coarse----------	12	68
	Clay, slightly silty, greenish---------	15	83
	Gravel, fine to medium; sand, coarse---	33	116
	Sand, fine to medium; shale and lignite fragments----------	11	127
Fort Union Formation:			
	Clay, sandy, gray----------	20	147

155-84-1bdd
Test hole 1403

Glacial drift:			
	Soil, black----------	2	2
	Clay, yellowish-gray; gravel, fine-----	11	13
	Sand, fine to medium, becoming coarser at 31 feet, silty and clayey---------	21	34
	Clay, olive-gray; minor amount of coarse sand; abundant lignite--------	12	46
	Sand, coarse; abundant lignite---------	6	52
	Clay, olive-gray; gravel, fine to medium----------	11	63
Fort Union Formation:			
	Clay, sandy, gray----------	10.5	73.5

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-84-12adb
Test hole 1500

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black	2	2
	Clay, silty and sandy, light-brown	19	21
	Gravel, fine to medium; minor amount of gray clay	4	25
	Clay, silty and sandy, gray	7	32
	Sand, very fine to fine	11	43
	Clay, silty and sandy, gray	11	54
	Sand, fine to coarse; minor amount of gray clay	31	85
	Clay, sandy, olive-gray; shale and lignite fragments	21	106
Fort Union Formation:			
	Clay, sandy, gray	9	115

155-84-12dda
Test hole 1498

Glacial drift:			
	Soil, black	2	2
	Clay, silty and sandy, dark-gray; minor amount of fine gravel	9	11
	Clay, sandy, light-brown; lignite fragments	26	37
	Clay, sandy, greenish-gray; gravel, fine to medium	15	52
	Gravel, fine to medium, clayey	11	63
	Clay, greenish-gray; gravel, fine to medium	25	88
Fort Union Formation:			
	Clay, sandy, gray	17	105

TABLE 2.--Logs of wells and test holes in the vicinity of Minot, North Dakota -- Continued

155-84-13aac
Test hole 1499

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Soil, black----------	2	2
	Sand, fine to coarse, silty and clayey-	8	10
	Sand, fine to coarse----------	6	16
	Clay, sandy, light-brown; gravel, fine to medium----------	30	46
	Clay, olive-gray; gravel, fine to medium----------	22	68
	Clay, gray; lignite fragments----------	18	86
Fort Union Formation:			
	Clay, sandy, gray----------	8.5	94.5

TABLE 3.--Water levels in selected wells in the vicinity of Minot, North Dakota

Water levels are referred to land surface datum (lsd). MP means measuring point.

154-82-4aad. U.S.G.S. test hole 2214. Artesian observation well in glaciofluvial material; diam $1\frac{1}{4}$ in, depth 233 ft, plastic casing. MP - top of plastic casing 1.33 ft above lsd.

Date	Water level	Date	Water level	Date	Water level
Nov. 19, 1963	15.80	April 7, 1964	16.67	July 2, 1964	15.48
Jan. 8, 1964	15.65	May 5	16.47	Aug. 5	15.33
March 4	16.58	June 12	14.87	Sept. 14	15.50

154-82-4aba. U.S.G.S. test hole 2213. Artesian observation well in glaciofluvial material; diam. $1\frac{1}{4}$ in, depth 120 ft, plastic casing. MP - top of casing 1.65 ft above lsd.

Date	Water level	Date	Water level	Date	Water level
Nov. 15, 1963	13.27	April 7, 1964	14.93	Aug. 5, 1964	13.58
Jan. 9, 1964	13.67	May 5	13.98	Sept. 14,	13.79
Feb. 4	13.67	June 12	13.36		
March 4	15.65	July 2	13.20		

154-82-24aba. U.S.G.S. test hole 2212. Artesian observation well in glaciofluvial material; diam $1\frac{1}{4}$ in, depth 40 ft, plastic casing. MP - top of plastic casing 2.10 ft above lsd.

Date	Water level	Date	Water level	Date	Water level
Jan. 9, 1964	13.44	May 5, 1964	12.94	Aug. 5, 1964	12.07
Feb. 4	13.40	June 12	12.90	Sept. 14	12.58
March 4	13.69	July 2	12.63		

TABLE 3.--Water levels in selected wells in the vicinity of Minot, North Dakota -- Continued

155-82-19dbd. U.S.G.S. test hole 2216. Artesian observation well in glaciofluvial material; diam 4½ in, depth 107 ft, plastic casing. MP - top of plastic casing 1.40 ft above lsd.

Date	Water level	Date	Water level	Date	Water level
Nov. 21, 1963	34.16	April 7, 1964	39.56	July 2, 1964	38.62
Jan. 8, 1964	37.75	May 5	38.20	Aug. 5	39.20
Feb. 3	38.00	June 12	38.44	Sept. 14	38.34
March 4	38.28				

155-82-29bcb. U.S.G.S. test hole 2215. Artesian observation well in glaciofluvial material; diam 1¼ in, depth 105 ft, plastic casing. MP - top of plastic casing 1.47 ft above lsd.

Date	Water level	Date	Water level	Date	Water level
Nov. 19, 1963	27.58	April 7, 1964	28.72	July 2, 1964	28.17
Jan. 9, 1964	27.85	May 5	28.43	Aug. 5	29.22
Feb. 3	28.15	June 12	28.05	Sept. 14	28.40
March 4	28.53				

155-83-12ccc. U.S.G.S. test hole 2218. Artesian observation well in glaciofluvial material; diam 1¼ in, depth 325 ft, plastic casing. MP - top of plastic casing 1.30 ft above lsd.

Date	Water level	Date	Water level	Date	Water level
Feb. 14, 1964	217.50	May 5, 1964	207.70	Aug. 5, 1964	216.70
March 4	215.54	June 12	214.90	Sept. 14	218.27
April 7	215.45	July 2	216.03		

155-83-12dcd. U.S.G.S. test hole 2219. Artesian observation well in glaciofluvial material; diam 1¼ in, depth 203 ft, plastic casing. MP - top of plastic casing 0.91 ft above lsd.

Date	Water level	Date	Water level	Date	Water level
Jan. 8, 1964	33.73	March 4, 1964	frozen	June 12, 1964	
Feb. 4	27.42	May 5	24.83	Well destroyed	

TABLE 3.--Water levels in selected wells in the vicinity of Minot, North Dakota -- Continued

155-83-14cda. City of Minot well 10. Municipal artesian well in glaciofluvial material; diam 12 in, depth 139 ft, steel casing. MP - center of air-line gage 4.29 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1963	57	Aug. 30, 1963	58.5	April 1, 1964	62.0
March 30	56.5	Sept. 30	58.5	May 1	62.0
May 1	42.5 ?	Oct. 30	58.5	June 1	62.0
June 1	57.5	Jan. 2, 1964	60.5	July 1	65.0
July 1	56.5	Feb. 1	62.5	Sept. 1	60.2
July 29	58.5	March 2	62.5		

155-83-14dca. City of Minot well 9. Municipal artesian well in glaciofluvial material; diam 12 in, depth 152 ft, steel casing. MP - center of air-line gage, 4.30 ft above lsd. Measurements from air-line gage reported to nearest ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1963	56	Sept. 30, 1963	62	May 1, 1964	64
May 1	58	Oct. 30	60	June 1	64
June 1	58	Jan. 2, 1964	62	July 1	66
July 1	58	Feb. 1	64	Sept. 1	64
July 29	61	March 2	63		
Aug. 30	63	April 1	64		

155-83-14ddd2. City of Minot well 5. Municipal artesian well in glaciofluvial material, diam 12 in, depth 147 ft, steel casing. MP - center of air-line gage 4.65 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1963	59	Aug. 30, 1963	62.5	April 1, 1964	64.5
March 31	59.5	Sept. 30	62.5	May 1	64.5
May 1	59	Oct. 30	62.5	June 1	65.0
June 1	59.5	Jan. 2, 1964	62.0	July 1	63.5
July 1	59.5	Feb. 1	64.0	July 31	64.5
July 29	61.5	March 2	64.5	Sept. 1	64.5

TABLE 3.--Water levels in selected wells in the vicinity of Minot, North Dakota -- Continued

155-83-14ddd3. City of Minot well 6. Municipal artesian well in glaciofluvial material; diam 16 in, depth 139 ft, steel casing. MP - center of air-line gage 5.15 ft above lsd. Measurements from air-line gage reported to the nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1963	58.0	Aug. 30, 1963	60.0	April 1, 1964	64.0
March 31	58.0	Sept. 30	61.0	May 1	64.0
May 1	57.5	Oct. 30	61.0	June 1	65.0
June 1	58.0	Jan. 2, 1964	62.0	July 1	64.0
July 1	58.0	Feb. 1	63.5	July 31	65.0
July 29	59.5	March 3	63.5	Sept. 1	64.0

155-83-21daa2. City of Minot well 18. Municipal artesian well in glaciofluvial material; diam 12 in, depth 99 ft, steel casing. MP - center of air-line gage 5.03 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Nov. 30, 1961	43.0	July 29, 1963	62.0	March 2, 1964	62.5
Jan. 30, 1963	57.0	Aug. 30	62.5	April 1	63.0
March 30	59.0	Sept. 30	63.5	May 1	63.0
May 1	58.0	Oct. 30	64.0	June 1	63.5
June 1	60.5	Jan. 2, 1964	64.0	July 1	63.5
July 1	62.0	Feb. 1	63.0	July 31	63.0
				Sept. 1	64.0

155-83-22abc. City of Minot well 15. Municipal artesian well in glaciofluvial material; diam 12 in, depth 115 ft, steel casing. MP - center of air-line gage 4.74 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1961	43.0	Aug. 30, 1963	65.0	April 1, 1964	66.0
Jan. 30, 1963	59.0	Sept. 30	66.0	May 1	67.0
March 30	59.0	Oct. 30	66.5	June 1	69.0
June 1	61.5	Jan. 2, 1964	65.5	July 1	69.0
July 1	62.0	Feb. 1	64.5	July 31	70.0
July 29	64.5	March 2	66.0	Sept. 1	70.0

TABLE 3.--Water levels in selected wells in the vicinity of Minot, North Dakota -- Continued

155-83-22acc. City of Minot well 14. Municipal artesian well in glaciofluvial material; diam 12 in, depth 105 ft, steel casing. MP - center of air-line gage 4.83 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1961	44.0	Aug. 30, 1963	64.5	May 6, 1964	65.0
Jan. 30, 1963	57.5	Sept. 30	65.0	June 1	66.0
March 30	58.5	Oct. 30	64.5	July 1	66.0
May 1	58.5	Jan. 2, 1964	65.0	July 31	66.0
June 1	59.5	Feb. 1	64.0	Sept. 1	67.0
July 1	61.5	March 2	64.0		
July 29	63.5	April 1	65.0		

155-83-22ada2. City of Minot well 12. Municipal artesian well in glaciofluvial material; diam 12 in, depth 120 ft, steel casing. MP - center of air-line gage 5.20 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Nov. 30, 1961	49.0	Aug. 30, 1963	67.0	April 1, 1964	68.0
Jan. 30, 1963	59.0	Sept. 30	67.5	May 1	69.0
March 30	60.0	Oct. 30	68.5	June 1	71.0
May 1	60.0	Jan. 2, 1964	67.5	July 1	70.0
June 1	62.5	Feb. 1	68.0	July 31	72.0
July 1	62.5	March 2	68.0	Sept. 1	71.0
Aug. 1	63.0				

155-83-22adc. City of Minot well 13. Municipal artesian well in glaciofluvial material; diam 12 in, depth 115 ft, steel casing. MP - center of air-line gage 4.50 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1961	45.5	Aug. 30, 1963	67.0	April 1, 1964	67.5
Jan. 30, 1963	58.5	Sept. 30	68.0	May 1	68.0
March 30	59.5	Oct. 30	68.0	June 1	69.0
May 1	59.5	Nov. 30	67.0	July 1	69.5
June 1	61.5	Jan. 2, 1964	66.5	July 31	69.5
July 1	62.5	Feb. 1	66.5	Sept. 1	69.0
July 29	64.5	March 2	67.0		

TABLE 3.--Water levels in selected wells in the vicinity of Minot, North Dakota -- Continued

155-83-22bcd. City of Minot well 17. Municipal artesian well in glaciofluvial material; diam 12 in, depth 87 ft, steel casing. MP - center of air-line gage 4.75 ft above lsd. Measurements from air-line gage reported to nearest ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1961	41.0	Aug. 30, 1963	62.0	April 1, 1964	62.5
Jan. 30, 1963	56.0	Sept. 30	63.0	May 1	63.0
March 30	57.0	Oct. 30	63.0	June 1	63.5
May 1	57.0	Jan. 2, 1964	63.0	July 1	63.5
June 1	60.0	Feb. 1	62.5	July 31	63.0
July 1	60.0	March 2	62.5	Sept. 1	63.5
July 29	61.0				

155-83-22bdc. City of Minot well 16. Municipal artesian well in glaciofluvial material; diam 12 in, depth 111 ft, steel casing. MP - center of air-line gage 4.71 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1961	42.0	Sept. 30, 1963	66.0	May 1, 1964	65.5
Jan. 30, 1963	58.5	Oct. 30	66.5	June 1	66.5
March 30	62.0	Jan. 2, 1964	65.0	July 1	66.5
May 1	59.0	Feb. 1	64.5	July 31	66.5
June 1	58.5	March 2	64.5	Sept. 1	67.0
July 1	62.0	April 1	65.5		
July 29	65.0				
Aug. 30	65.0				

155-83-23baa. City of Minot well 7. Municipal artesian well in glaciofluvial material; diam 16 in, depth 125 ft, steel casing. MP - center of air-line gage, 5.45 ft above lsd. Measurements from air-line gage reported to nearest ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1963	60.0	April 1, 1964	67.0		
May 1	60.0	May 1	67.0		

TABLE 3.--Water levels in selected wells in the vicinity of Minot, North Dakota -- Continued

155-83-23babl. City of Minot well 8. Municipal artesian well in glaciofluvial material; diam 16 in, depth 132.5 ft, steel casing. MP - center of air-line gage 5.46 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 1, 1963	58.5	Sept. 30, 1963	64.5	May 1, 1964	67.0
March 31	64.5	Oct. 30	65.5	June 1	69.0
May 1	64.5	Nov. 30	65.5	July 1	66.5
June 1	60.0	Jan. 2, 1964	65.5	July 31	68.5
July 1	61.0	Feb. 1	67.0	Sept. 1	68.5
Aug. 1	61.5	March 3	67.0		
Aug. 30	63.5	April 1	67.0		

155-83-23bbdl. City of Minot well 11. Municipal artesian well in glaciofluvial material; diam 12 in, depth 130 ft, steel casing. MP - center of air-line gage 4.75 ft above lsd. Measurements from air-line gage reported to nearest 0.5 ft.

Date	Water level	Date	Water level	Date	Water level
Jan. 30, 1961	48.0	July 29, 1963	57.0	March 2, 1964	63.0
Jan. 30, 1963	55.0	Aug. 30	60.0	April 1	63.0
March 30	57.0	Sept. 30	62.0	May 1	63.0
May 1	56.0	Oct. 30	62.5	June 1	66.0
June 1	56.0	Jan. 2, 1964	62.0	July 1	1/ 71.05
July 1	57.0	Feb. 1	62.5	Aug. 1	1/ 72.25

1/ Measured with steel tape.

TABLE 3.-Water levels in selected wells in the vicinity of Minot, North Dakota -- Continued

155-83-24aaa1. U.S.G.S. test hole 2217. Artesian observation well in glaciofluvial material; diam $1\frac{1}{4}$ in, depth 110 ft, plastic casing. MP - top of plastic casing 1.50 ft above lsd. Well is inside the casing of U.S.G.S. test hole 2217A.

Date	Water level	Date	Water level	Date	Water level
Jan. 8, 1964	54.43	March 4, 1964	53.78	May 5, 1964	51.47
Feb. 3	frozen	April 7	52.00	June 12 -- Well destroyed	

155-83-24aaa2. U.S.G.S. test hole 2217A. Artesian observation well in glaciofluvial material; diam $4\frac{1}{2}$ in, depth 40 ft, plastic casing. MP - top of plastic casing 0.80 ft above lsd.

Date	Water level	Date	Water level	Date	Water level
Jan. 8, 1964	14.89	March 4, 1964	15.17	May 5, 1964	13.14
Feb. 3	frozen	April 7	12.88	June 12 -- Well destroyed	

TABLE 4.--Chemical analyses of water in the vicinity of Minot, North Dakota

[Analytical results in parts per million except as indicated]

No.	Location	Source of sample	Depth (feet)	Date of collection	Temperature (°F)	Silica (SiO_2)	Total iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Sum	Dissolved solids: Residue on evaporation at 180°C	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium-adsorption-ratio	Specific conductance (micromhos at 25°C)	pH
1	154-82- 4aad	TH 2214	233	11-15-63	42	22	0.35	109	28	137	9.6	569	0	195	17	0.5	1.5	0.00	800	800	388	0	43	3.0	1,300	8.1
2	154-82- 4aba	TH 2213	120	11-14-63	47	23	.28	48	19	165	10	451	10	165	14	.3	3.0	.00	679	674	200	0	63	5.1	1,090	8.4
3	155-82-19dbd	TH 2216	107	11-19-63	47	21	.76	55	14	261	12	645	7	133	79	.5	3.0	.00	904	949	196	0	..	....	1,510	8.3
4	155-82-20dcc	Siesta Motel	65	12-6-63	..	11	.53	11	5.5	540	13	895	17	421	35	.5	2.0	.38	1,500	1,540	50	0	95	33	2,380	8.5
5	155-82-29bcb	TH 2215	105	11-15-63	47	22	1.1	57	31	237	14	583	0	145	140	.4	2.0	.00	936	990	268	0	64	6.3	1,610	8.1
6	155-83-14cda	City 10	139	12-6-63	47	21	.30	78	27	259	14	687	0	110	146	.4	1.0	.00	994	1,010	304	0	64	6.4	1,670	8.0
7	155-83-14dba1	TH 2233	170	5-15-64	50	21	.32	168	60	309	14	797	0	381	219	.6	1.0	.18	1,570	1,750	665	120	50	5.2	2,240	8.0
8	155-83-14dca	City 9	148	12-11-63	47	22	1.2	93	87	305	12	747	0	181	338	.5	4.5	.00	1,410	1,460	590	0	52	5.5	2,520	8.1
9	155-83-14ddd2	City 5	147	12-6-63	47	21	.25	102	32	218	13	589	0	72	232	.2	.0	.00	980	1,010	388	0	54	4.8	1,710	7.7
10	155-83-14ddd3	City 6	139	12-6-63	47	22	.25	124	16	250	13	634	0	225	137	.3	1.5	.00	1,100	1,070	376	0	58	5.6	1,880	7.8
11	155-83-21daa2	City 18	99	12-11-63	47	10	2.3	13	2.9	345	.0	698	38	35	92	.8	.0	.00	882	961	44	0	94	23	1,590	8.6
12	155-83-22abc	City 15	115	12-11-63	48	19	.50	58	54	67	6.0	473	0	96	24	.3	.0	.00	558	603	370	0	28	1.5	1,030	8.0
13	155-83-22acc1	City 14	105	12-6-63	47	19	.60	38	26	315	9.0	878	0	44	97	.5	1.0	.00	982	1,000	202	0	76	9.6	1,580	8.1
14	155-83-22ada2	City 12	120	12-6-63	47	21	.48	52	34	188	11	581	0	165	29	.4	1.0	.00	788	793	270	0	59	5.0	1,300	7.9
15	155-83-22adc	City 13	115	12-11-63	46	18	.94	39	30	265	5.0	712	0	74	102	.5	.0	.00	885	1,000	220	0	72	7.8	1,590	8.2
16	155-83-22bcd1	City 17	87	12-6-63	47	19	.67	72	28	153	10	616	0	83	49	.3	1.0	.00	719	720	296	0	52	3.9	1,200	7.7
17	155-83-22bdc	City 16	111	12-11-63	46	16	1.5	78	39	205	15	751	19	26	112	.3	2.0	.00	884	1,010	354	0	54	4.7	1,640	8.4
18	155-83-23baa	City 7	125	12-11-63	47	21	.50	63	48	100	8.0	498	0	129	32	.2	1.0	.00	648	698	356	0	37	2.3	1,170	8.1
19	155-83-23bab1	City 8	132.5	12-6-63	45	21	1.0	66	26	235	16	717	0	96	81	.3	1.0	.00	896	881	272	0	64	6.2	1,350	8.0
20	155-83-23bab2	TH 2227	118	5-13-64	..	21	.38	84	29	115	4.6	470	7	130	40	.5	.0	.00	663	665	328	0	43	2.8	1,000	8.3
21	155-83-23bab3	TH 2227A	21	5-13-64	48	13	.13	112	28	107	6.8	495	0	179	33	.4	.0	.00	723	739	396	0	36	2.3	1,080	8.2
22	155-83-23bba1	TH 2222	100	5-12-64	50	15	.94	35	13	235	8.0	510	16	179	36	.7	.0	.38	789	787	142	0	77	8.6	1,200	8.6
23	155-83-23bba3	TH 2225	104	5-22-64	..	10	3.6	50	16	164	12	410	0	172	38	.4	20	.00	670	701	192	0	63	5.1	1,030	7.9
24	155-83-23bba4	TH 2225A	21	5-22-64	..	19	1.7	103	34	83	8.8	401	7	190	29	.5	2.0	.00	693	696	396	56	31	1.8	1,050	8.3
25	155-83-23bba5	TH 2226	117	5-22-64	..	20	1.0	93	34	122	6.6	478	0	186	43	.1	2.0	1.1	743	805	370	0	41	2.8	1,110	8.1
26	155-83-23bba6	TH 2226A	21	5-14-64	50	15	1.3	80	25	121	13	525	0	92	30	.5	30	.70	666	685	304	0	45	3.0	1,010	8.0
27	155-83-23bba7	TH 2241	102	6-19-64	..	16	.85	40	14	204	5.6	527	10	115	23	.6	4.8	.00	694	725	156	0	73	7.1	1,140	8.4
28	155-83-23bba8	TH 2241A	18	6-19-64	..	21	.66	104	43	73	8.3	492	0	153	25	.6	2.0	.00	676	699	435	32	26	1.5	1,090	7.7
29	155-83-23bbb3	TH 2224	101	5-12-64	46	15	.97	56	16	135	9.2	421	0	130	23	.5	.5	.15	593	619	204	0	58	4.1	875	8.1
30	155-83-23bbb4	TH 2228	110	5-12-64	48	20	.55	74	26	131	5.6	480	0	74	55	.5	.0	.43	622	633	290	0	49	3.3	1,010	8.2
31	155-83-23bbb5	TH 2228A	21	5-13-64	..	15	.43	56	18	112	8.6	428	0	86	21	.5	1.0	.00	529	547	212	0	52	3.3	800	8.2
32	155-83-23bbb7	TH 2232	21	5-22-64	..	19	.93	71	23	135	6.2	533	0	90	33	.4	2.5	.80	644	674	272	0	51	3.6	1,060	8.2
33	155-83-23bbc1	TH 2229	100	5-22-64	..	20	.72	86	19	85	5.5	456	0	81	20	.3	3.0	.75	545	567	292	0	38	2.2	871	8.2
34	155-83-23bbc2	TH 2229A	21	5-22-64	..	14	1.0	57	29	112	15	398	0	143	34	.2	2.0	.00	603	657	260	0	47	3.0	987	8.1
35	155-83-23bbc3	TH 2230	83	5-22-64	..	16	.47	77	32	89	7.0	577	0	23	21	.3	1.0	.85	551	573	324	0	37	2.2	926	8.2
36	155-83-23bbd	City 11	130	12-6-63	46	21	.57	67	30	152	11	573	0	128	29	.2	1.0	.00	722	720	290	0	52	3.9	1,210	7.9
37	155-83-23bbb	1/		5-18-64	77	7.6	.25	46	21	62	15	267	0	72	20	.5	50	.00	425	455	204	0	38	1.9	673	7.5
38	155-83-23bbb	2/		5-18-64	77	17	.24	127	54	87	17	543	0	259	27	.3	8.0	.00	863	876	540	95	25	1.6	1,240	7.4
39	155-83-23bbb	3/		5-18-64	69	2.8	.33	66	29	152	17	431	9	214	31	.4	5.0	.75	738	766	284	0	52	3.9	1,100	8.4

Water samples analyzed by the North Dakota State Laboratories Department

1/ Sample collected from an oxbow lake in Oak Park, Minot, N. Dak.

2/ Sample collected from an experimental recharge pit in Oak Park, Minot, N. Dak.

3/ Sample collected from the Souris River in Oak Park, Minot, N. Dak.

TH - U. S. Geological Survey test hole.

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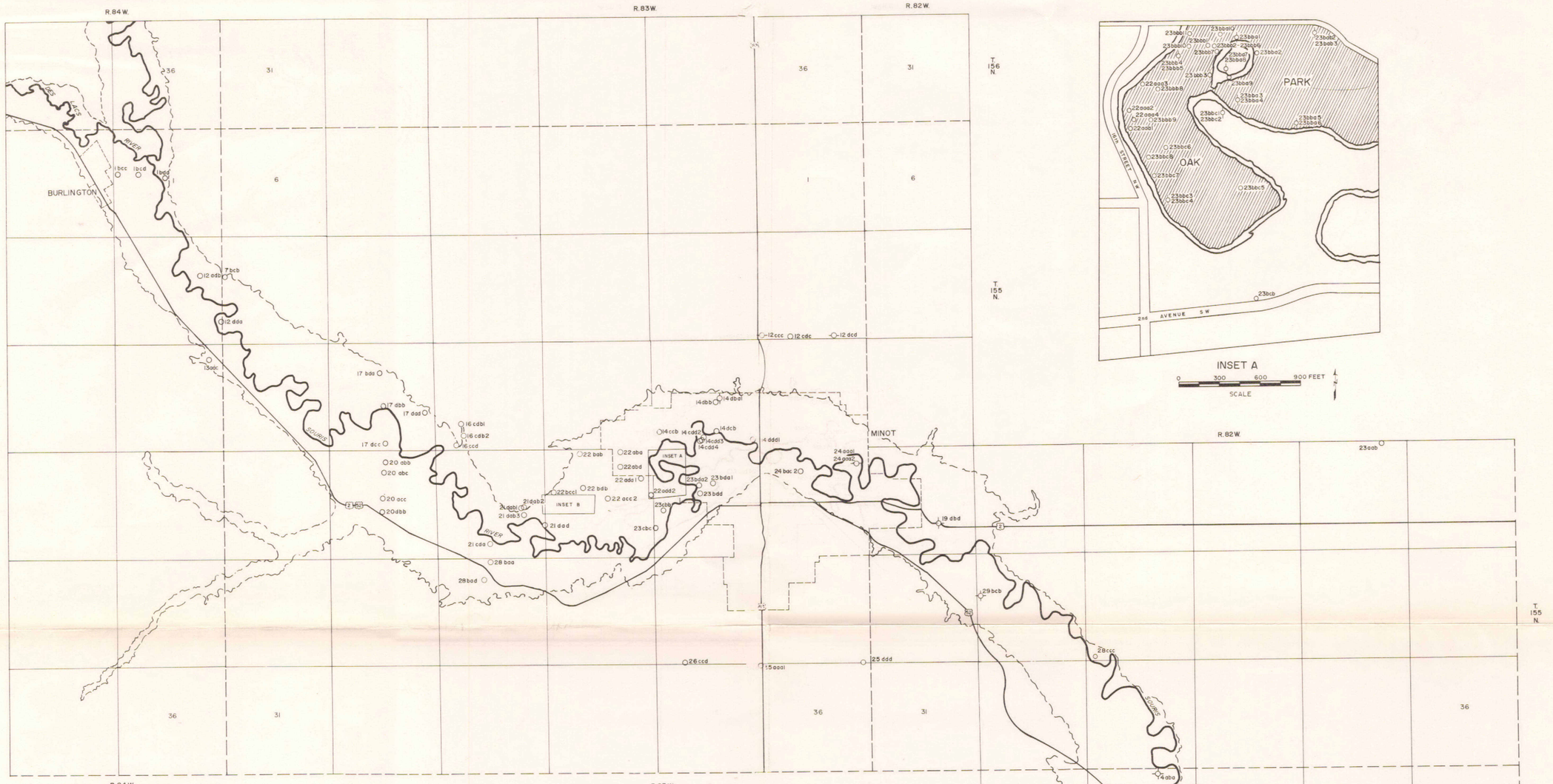

FIGURE 3. MAP SHOWING LOCATION OF TEST HOLES IN THE VICINITY OF MINOT, NORTH DAKOTA.

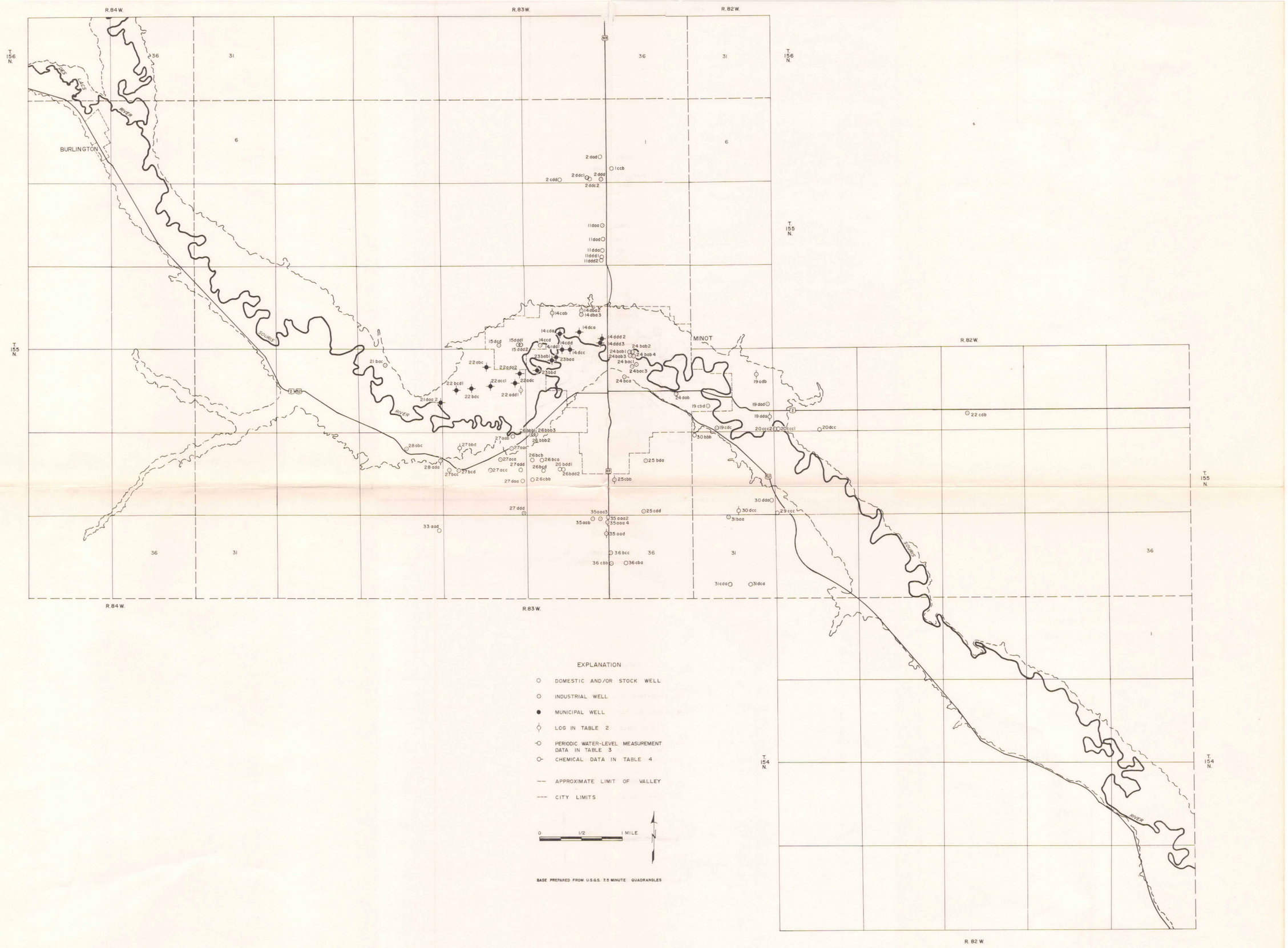

FIGURE 4. MAP SHOWING LOCATION OF SELECTED WELLS IN THE VICINITY OF MINOT, NORTH DAKOTA