GROUND WATER CONDITIONS IN THE VICINITY OF ASHLEY, MCINTOSH COUNTY, NORTH DAKOTA

By
P. G. Randich
Geological Survey
United States Department of the Interior

NORTH DAKOTA GROUND WATER STUDIES

NO. 37

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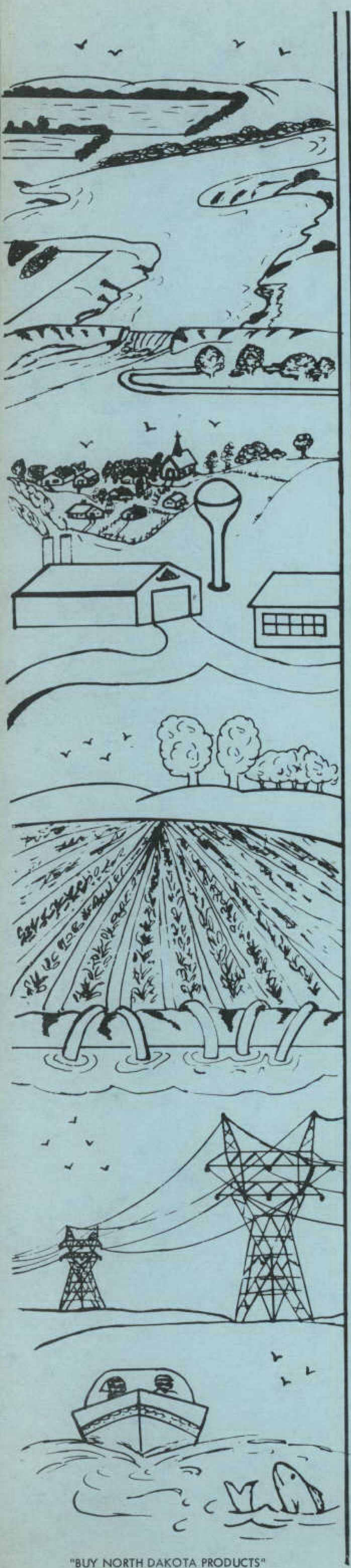

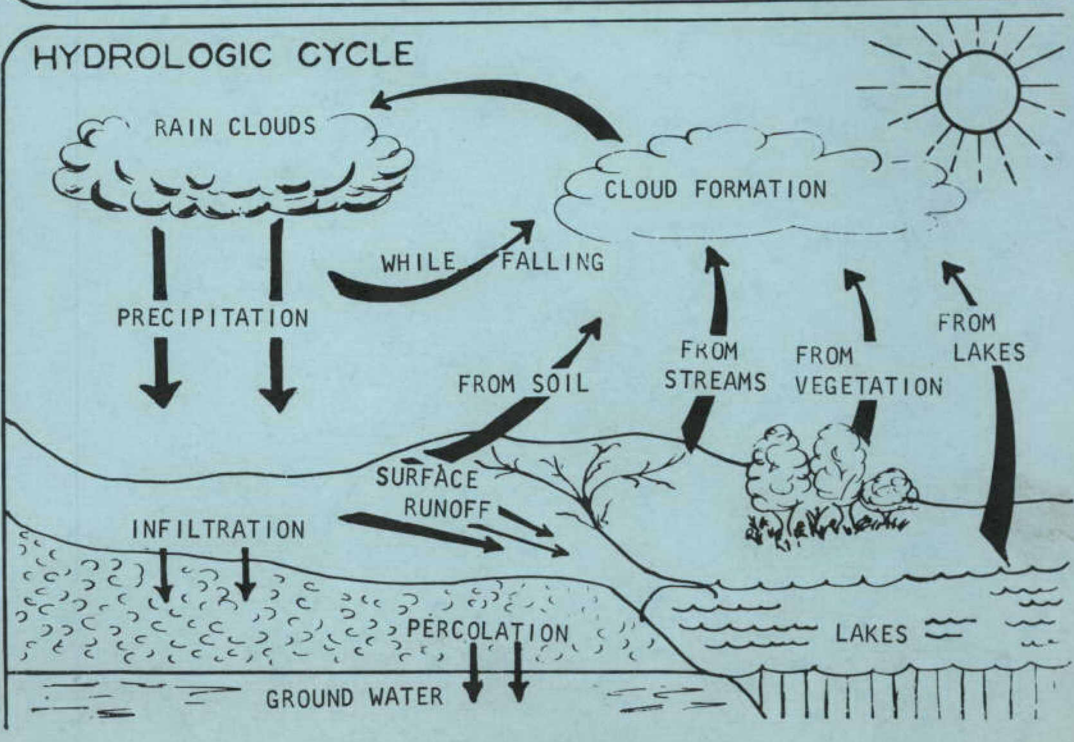

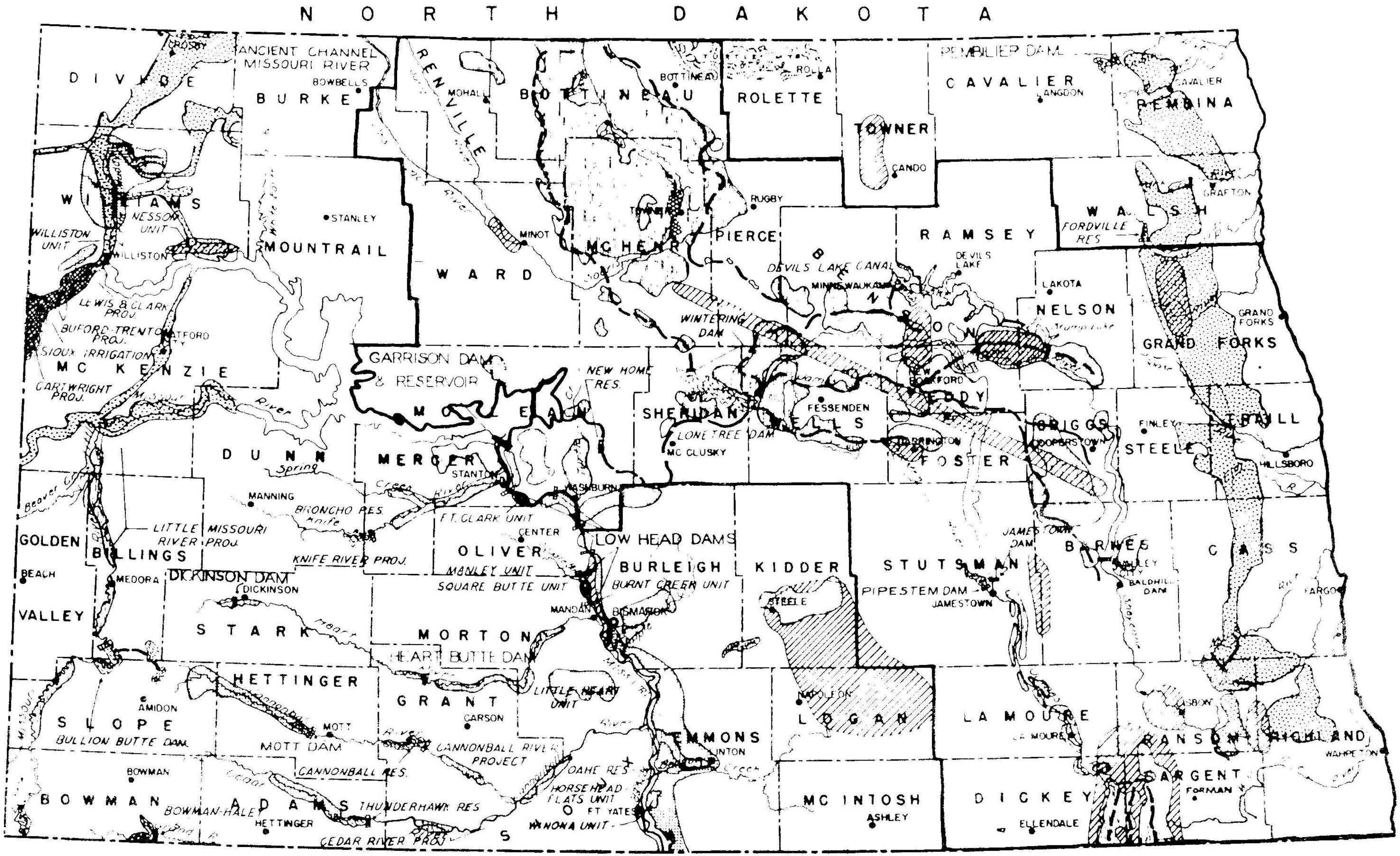

NORTH DAKOTA STATE WATER CONSERVATION COMMISSION

WATER RESOURCES DEVELOPMENT PLAN

- LANDS UNDER IRRIGATION
- AREAS CONSIDERED IRRIGABLE
- AREAS BEING INVESTIGATED
- PROPOSED FOR INVESTIGATION

DAM & RESERVOIR SITES: EXISTING; UNDER CONSTRUCTION OR PROPOSED

PROPOSED CANALS

GARRISON DIVERSION CONSERVANCY DISTRICT BOUNDARY

GROUNDWATER AQUIFERS

GROUND-WATER CONDITIONS IN THE VICINITY OF ASHLEY

McINTOSH COUNTY, NORTH DAKOTA

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GROUND-WATER CONDITIONS IN THE VICINITY OF ASHLEY

McINTOSH COUNTY, NORTH DAKOTA

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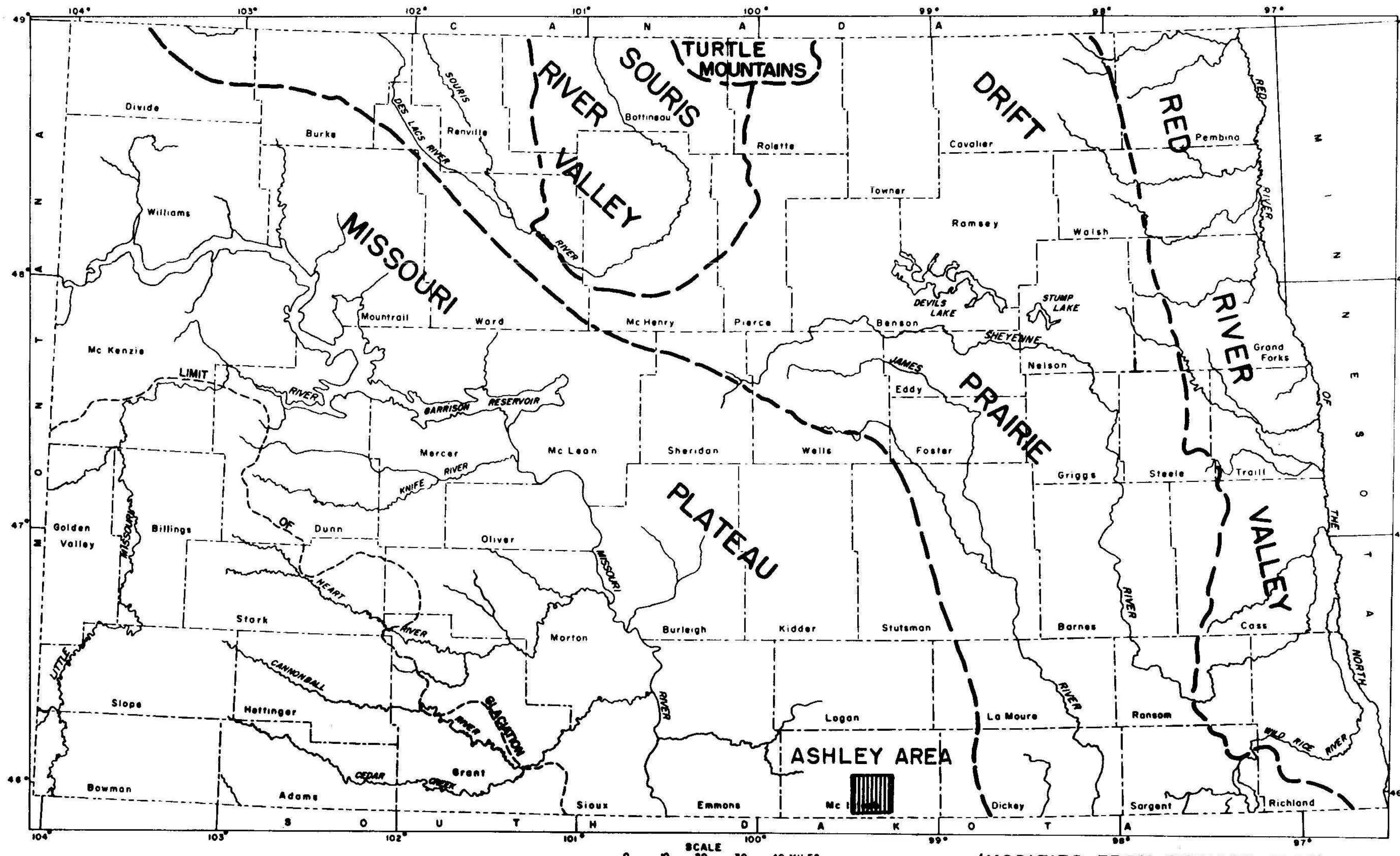
Introduction

In answer to a request by the mayor and city council of Ashley, N. Dak., a study of the ground-water conditions in and around Ashley was undertaken by Herbert H. Sand, Deputy State Water Geologist, (unpublished typewritten report in files of North Dakota Geological Survey, 1937). Since 1937 the city has constructed two wells (table 1, 130-69-31baa and 130-69-31aab); they produce sufficient water for the city's present (1961) needs from sand and gravel deposits in the glacial drift, but some of the mineral constituents of the water exceed the recommended limits of the U.S. Public Health Service (1946) for drinking water.

In April 1959 another request for a study of its water supply was submitted by the city council of Ashley to the North Dakota State Water Conservation Commission, and as a result the present investigation was begun in July 1959. The purpose of the study has been to determine the availability of ground water in the area and to try to locate additional ground water that might be less highly mineralized than that presently being used by the city. The investigation, one of several being made by the U.S. Geological Survey, Ground Water Branch, in cooperation with the State Water Conservation Commission and North Dakota Geological Survey, included inventory of wells, test drilling, and a geologic reconnaissance of the area. A drilling machine owned by the North Dakota State Water Conservation Commission was used to drill 15 test holes during the latter part of July and early August 1959.



(MODIFIED FROM SIMPSON, 1929)

FIGURE 1--MAP SHOWING PHYSIOGRAPHIC PROVINCES OF NORTH DAKOTA AND LOCATION OF THE ASHLEY AREA

The area described is in south-central McIntosh County and encompasses 132 square miles in and around the city of Ashley. It is in the Missouri Plateau section of the Great Plains province of Fenneman, (1931, p. 72). (See fig. 1.) State Highways 3 and 11 and a branch line of the Minneapolis, St. Paul and Sault Ste. Marie Railroad pass through Ashley. The average annual precipitation for 65 years for which data are available is 16.50 inches.

Well-numbering system

The well-numbering system, illustrated in figure 2, is based upon the location of the well in the federal system of rectangular surveys of the public lands. The first numeral denotes the township north and the second numeral denotes the range west, both referred to the Fifth principal meridian and base line; the third numeral denotes the section in which the well is located. The letters a, b, c, and d designate respectively the northeast, northwest, southwest, and southeast quarter sections, quarter-quarter sections, and quarter-quarter-quarter sections (10-acre tracts), as shown on figure 2. Consecutive terminal numerals are added if more than one well is shown in a 10-acre tract. Thus, well 130-69-7acb is in the NW$\frac{1}{4}$SW$\frac{1}{4}$NE$\frac{1}{4}$ sec. 7, T. 130 N., R. 69 W.

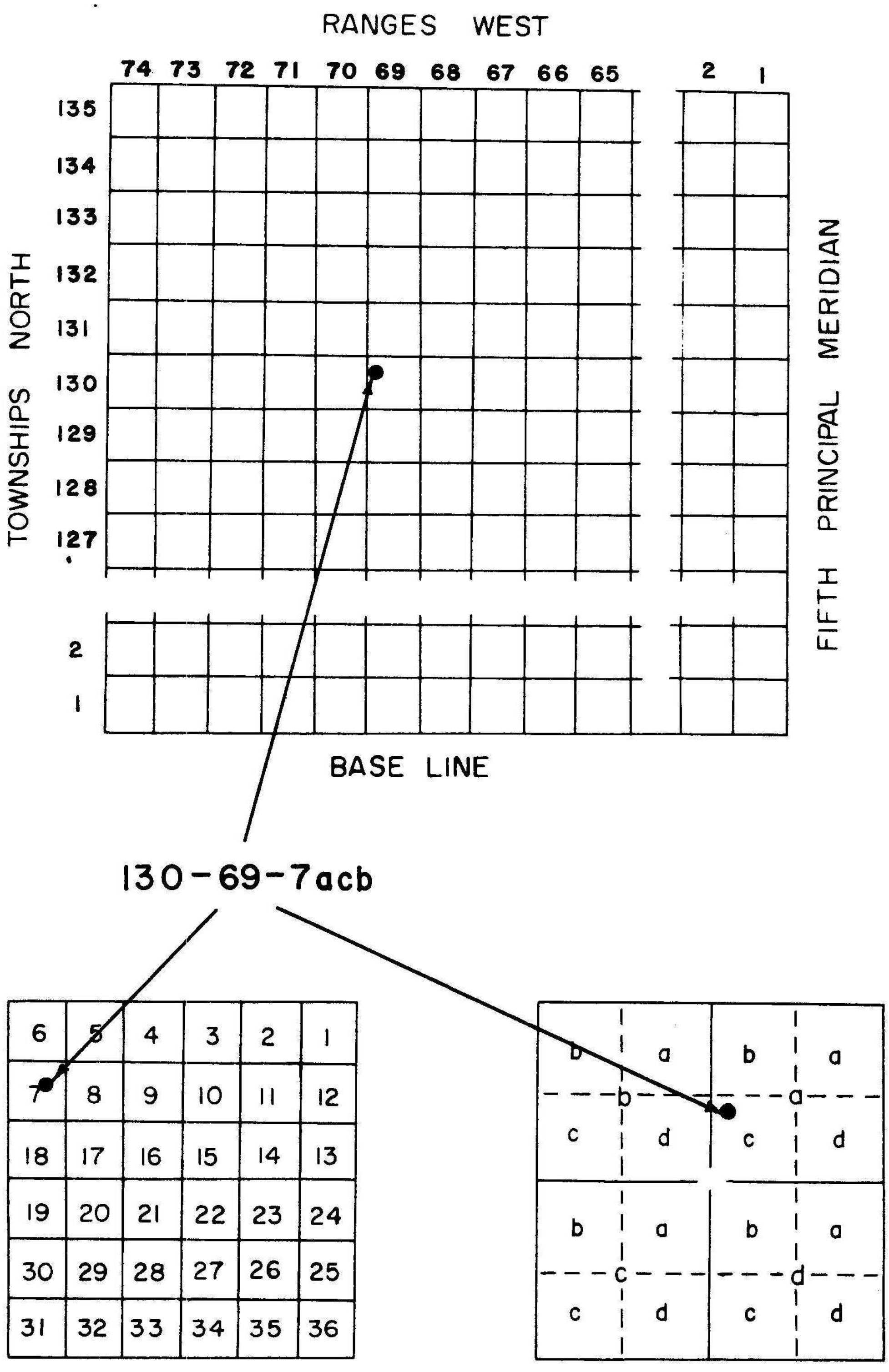


Figure 2 -- Sketch illustrating well-numbering system

Ground-water conditions and geology

The Ashley area is covered by glacial drift of Wisconsin age. The drift consists of till, outwash, lacustrine deposits, and deposits that may be kames. The drift at the surface may be divided into stagnation moraine, stagnation outwash, and glacial-lake beds. Lacustrine deposits northeast of Lake Hoskins may be either late Pleistocene or Recent in age.

The largest source of ground water in the Ashley area is from relatively thick glacial drift. Much of the drift consists of till. The thickness of the till -- which is made up of clay, silt, sand, gravel, andboulders -- ranges from 74 feet in test hole 1562 (130-70-13aaa) to at least 262 feet in test hole 1565 (130-69-30ccc) (fig. 3) and is probably thicker, as the drilling did not penetrate bedrock at this location. Isolated sand and gravel lenses occur within the till and range in thickness from 2 feet in test hole 1574 (130-70-23cdd) (table 2) to 20 feet in test holes 1564 (130-70-25aaa), 1566 (130-69-30ddc), and 1569 (130-69-31ddc). (See fig. 3.) The water-yielding deposits in test holes 1564, 1566, and 1569, which consist of fine to medium gravel, coarse sand, shale pebbles, and lignite fragments, are about 20 feet thick and occur at about 150 to 180 feet below the surface. They are probably hydraulically connected and thus may constitute a single aquifer; this aquifer, which yields the present (1961) Ashley water supply, is the best aquifer penetrated by test drilling.

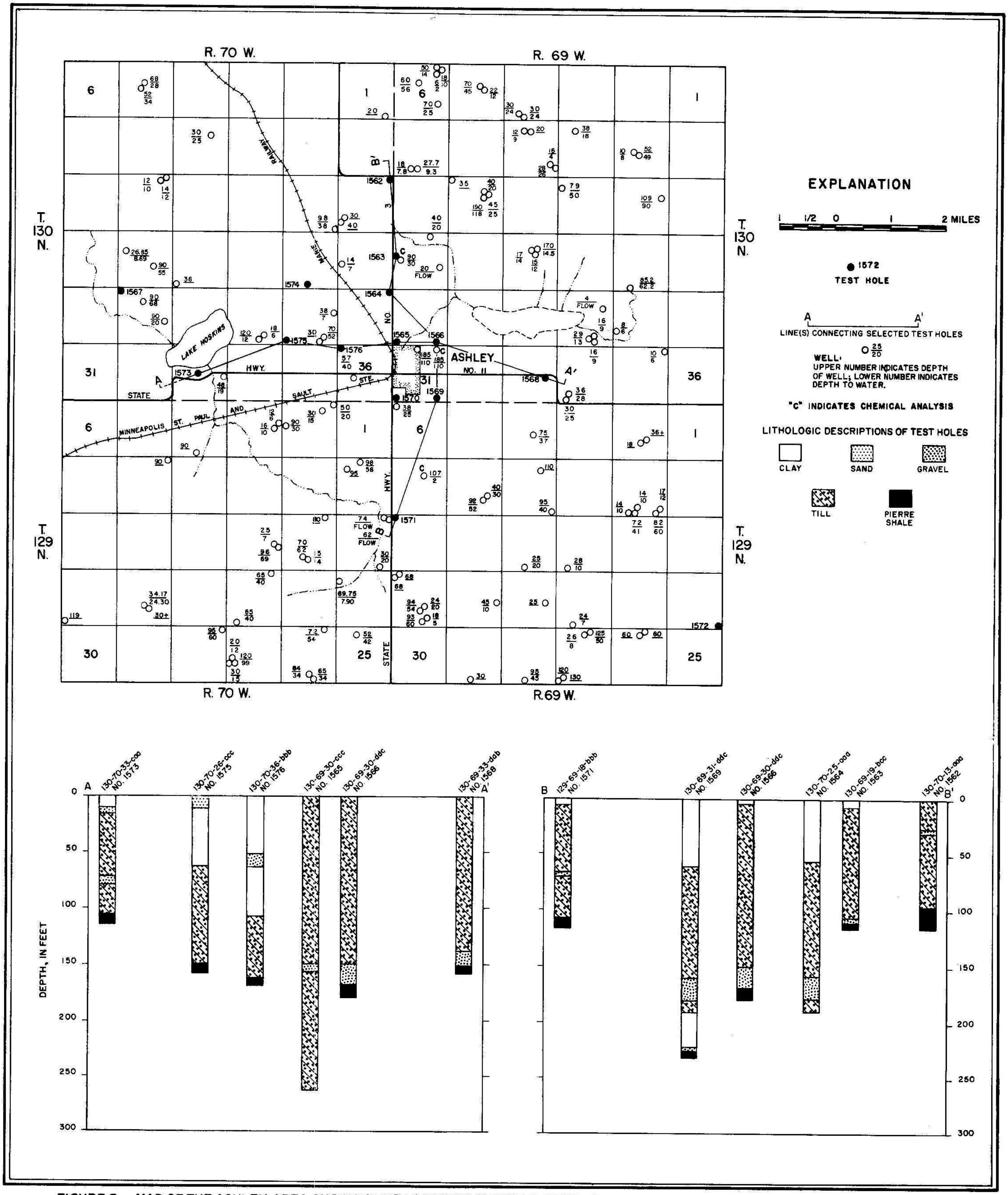


FIGURE 3 -- MAP OF THE ASHLEY AREA SHOWING THE LOCATION OF WELLS, TEST HOLES, AND GRAPHIC LOGS OF SELECTED TEST HOLES.

Test drilling in the stagnation outwash deposits showed that in general silt and clay are at or near the surface. A shallow sand and gravel layer was penetrated in test holes 1571, 1576, and 1573 (fig. 3), but it probably would yield sufficient water only for ordinary domestic and farm use.

The bedrock underlying the glacial drift -- the Pierre Shale of Late Cretaceous age -- was penetrated by 13 test holes. The depth of the Pierre below the land surface ranges from 74 feet in test hole 1562 (130-70-13aaa) to 224 feet in test hole 1569 (130-69-31ddc). The shale yields small amounts of highly alkaline water that is used for stock watering at a few places.

Ground water in bedrock formations underlying the Pierre generally is highly mineraliced also and, therefore, is unsatisfactory for most uses. The Dakota Sandstone of Early Cretaceous age, which is aobut 2,100 feet below the land surface in the Ashley area, yields relatively large quantities of saline water.

Water-level fluctuations in two private wells in the Ashley area have been published in Water-Supply Papers of the U.S. Geological Survey. The two wells, 130-69-7cd1 and 130-69-7cd2 (table 2) are shallow and draw water from till. Water levels in the wells range from less than 2 to about 15 feet, depending largely on seasonal fluctuations in replenishment and natural discharge. The records of the flucutations are in the following U.S. Geological Survey Water-Supply Papers: 845 (p. 357-8), 886 (p. 545), 908 (p. 264), 938 (p. 210), 946 (p. 251), 988 (p. 323), 1018 (p. 245), 1025 (p. 234), 1073 (p. 325), 1098 (p. 303), 1128 (p. 271), and 1158 (p. 318).

Quality of water

Chemical-analyses data (table 3) of water samples from wells in the Ashley area indicated that the quality of ground water is generally poor. The sampled wells all produce from water-bearing sand and gravel deposits within the glacial drift. The dissolved-solids content ranged from 790 ppm (parts per million) in well 130-69-19bcc1 to 2,440 ppm in well 129-69-7acb. The water was generally of the sodium sulfate and sodium sulfate bicarbonate types. Data from the analyses indicate that the range of hardness in the glacial-drift aquifers may be wide.

Conclusions and recommendations

Ground water occurs in and near Ashley in glacial drift and bedrock aquifers. Relatively shallow wells in the drift supply sufficient water for domestic and stock use. Larger supplies are withdrawn from a deeper water-yielding zone in the drift by wells used to supply the city of Ashley. Another potential source of water is from bedrock formations,particularly the Dakota Sandstone. Because the Dakota yields highly mineralized water and lies about 2,100 feet below the surface, it is not economically feasible to tap this source for domestic or public-supply use.

From existing knowledge it appears unlikely that ground water of much better quality than the present (1961) Ashley public supply can be found near the city. Therefore it may be worthwhile to consider treating the present supply.

Although probably adequate for the present (1961) needs, the quantity of water available from the source that supplies the Ashley municipal water-supply system may not be large enough to meet substantial increase in demand. Therefore periodic measurements should be made of the water level in the city wells or preferably in a nearby small-diameter observation well of the same depth. Relatively fixed water levels in such an observation well throughout a long period of time would indicate that the ground-water reservoir is not being depleted and that the municipal wells may remain in use at about the same pumping rate indefinitely. However, progressively declining water levels would indicate that the water is being mined and that the recharge is not sufficient to keep up with the withdrawal.

Depth to water: Measured water levels in feet and tenths or hundredths; reported water levels in feet.

Type of well: Dr, drilled; Du, dug; Dv, driven.

Location No.	Owner or name	Depth (feet)	Diameter or size (inches)	Type	Date completed
129-69					
2dbc1	Oscar Herman	36 +	24	Dr	1957
2dbc2	..do....	18	24	Dr	....
4dbb	Sam Wagemann	75	24	Dr	....
6bbb	Otto Rott	38	36	Dr	1954
7acb	Raymond Klipfel	107	24	Dr	....
8dbd1	August Maas	92	24	Dr	1954
8dbd2	..do....	40	24	Dr	....
9abd	Richard Vanourny	110	24	Dr	1954
9ddd	Willis Roeszler	95	24	Dr	1927
11cdc	G. T. Nitschke	14	48	Du	1959
11cdd1	..do....	72	24	Dr	1953
11cdd2	..do....	14	24	Dr	1959
11ddc1	John Martz	82	24	Dr	1909
11ddc2	..do....	17	24	Dr	1953
15ccd	Willis Roeazler	28	24	Dr	....
16cdd	Walter Ehley	25	24	Dr	1957
18bbb	Test hole 1571	115	5	Dr	8- 5-59
19bbb1	Albert W. Jenner	68	24	Dr	1934
19bbb2	..do....	68	24	Dr	....
19dbc1	Jacob Glaesman	94	24	Dr	1919
19dbc2	..do....	24	24	Dr	1924
19dc1	Henry Glaesman	93	24	Dr	1923
19dc2	..do....	18	24	Dr	....
20daa	Otto Funk	45	24	Dr	1958
21dab	Julius Klipfel	25	48	Du	....
22cdc	Howard Klipfel	24	48	Du	....
24ddd	Test hole 1572	115	5	Dr	8- 5-59
26abb1	C. W. Nitschke	60	36	Dr	....
26abb2	..do....	60	24	Dr	....

and Test Holes

Depth of well: Measured depths in feet and tenths; reported depths in feet.

Use of water: D, domestic; N, none; PS, public supply; S, stock, T, test hole.

Depth to water below land surface (feet)	Date of measurement	Use of water	Aquifer	Remarks
....	....	S	Sand	Supply adequate.
....	....	D	..do..	..Do....
37	....	D,S	......	..Do....
25	....	S	..do..	..Do....
2	....	S	......	Supply adequate; see chemical analysis.
52	....	D,S	..do..	Supply adequate.
30	....	D	..do..	..Do....
....	....	D,S	......	..Do....
40	....	D,S	......	..Do....
10	....	D,S	Gravel	..Do....
41	....	S	Sand	Supply inadequate, alkaline.
10	....	S	Gravel	Supply adequate.
60	....	D,S	Sand	Supply adequate, alkaline.
12	....	D,S	..do..	Supply adequate.
10	....	S	..do..	..Do....
20	....	D,S	......	Supply inadequate.
....	....	T	......	See log.
....	....	D	..do..	Supply adequate.
....	....	S	..do..	..Do....
54	....	S	Gravel	Supply adequate, alkaline.
20	....	D	Sand	Supply adequate.
60	....	S	Shale	Supply adequate, alkaline.
5	....	D,S	Sand	Supply adequate.
10	....	D,S	..do..	..Do....
	....	D,S	..do..	..Do....
....	....	D,S	..do..	..Do....
7	....	T	......	See log.
....	....	S	..do..	Supply inadequate, alkaline.
....	....	D,S	......	..Do....
....				

Location No.	Owner or name	Depth (feet)	Diameter or size (inches)	Type	Date completed
129-69 (Cont.)					
27abb1	Raymond W. Klipfel	26	30	Dr	1957
27abb2	..do....	125	16	Dr	1954
27ccc1	Fred Hoffman	120	24	Dr	1957
27ccc2	..do....	130	24	Dr	1957
28cdd	Caroline Hoffman	95	24	Dr	1934
29cdd	Ed Lippert	30	30	Du	1919
129-70					
2aaa	Kenneth Lynn	50	30	Dr	1958
2abd	..do....	30	30	Dr	....
2bc	..do....	90	24	Dr	1958
3add1	Max Wishek	16	48	Du	1949
3add2	..do....	12	36	Du	....
4cdd	Otto Rott	90	24	Dr	....
8aaa	Julius Pfeifle	90	24	Dr	1929
12baa	Christ Bender	98	30	Dr	1949
12bbd	Ben Bender	95	24	Dr	1951
13aaa1	John J. Rau	74	24	Dr	1942
13aaa2	..do....	62	24	Dr	1949
13ddc	..do....	30	24	Dr	....
14aab	Mrs. John Gross	80	24	Dr	1929
14cda1	Christ Gross	70	24	Dr	1919
14cda2	..do....	15	24	Dr	1929
15daa1	Edward Schauer	96	24	Dr	1941
15daa2	..do....	25	24	Dr	1941
19ccc	William Pfeifle	119	24	Dr	....
20dbc1	Gordon Hoffman	34.2	36	Dr	1958
20dbc2	..do....	30 +	30	Dr	....
22aab	Edward Schann	65	24	Dr	1928
22ccd	Oswald H. Weisser	85	36	Dr	1940
24bbc	Unknown	69.7	24	Dr	....
25ba	John W. Jenner	52	24	Dr	1919
26aab	Walter Retzer	72	36	Dr	1956
26dcc1	Julius Retzer	84	24	Dr	1950

and Test Holes -- Continued

Depth to water below land surface (feet)	Date of measurement	Use of water	Aquifer	Remarks
8	....	D,S	Sand	Supply inadequate, alkaline.
50	....	S	..do..	..Do....
....	....	D,S	......	Supply adequate.
....	....	S	......	..Do....
45	....	D,S	......	Supply adequate, alkaline.
....	....	S	..do..	Supply adequate.
20	....	D,S	..do..	Supply inadequate.
15	....	S	..do..	Supply adequate.
30	....	S	..do..	..Do....
10	....	S	..do..	..Do....
6	....	D	..do..	..Do....
....	....	S	......	..Do....
....	....	D,S	......	..Do....
58	....	D,S	..do..	..Do....
....	....	D,S	..do..	..Do....
Flow	....	S	..do..	Supply adequate, alkaline.
Flow	....	D,S	..do..	..Do....
20	....	S	..do..	Supply adequate.
....	....	S	......	Supply inadequate.
62	....	S	Shale	Supply inadequate, alkaline, high iron content.
14	....	N	Sand	Supply inadequate.
69	....	S	Gravel	Supply adequate, alkaline.
7	....	D	..do..	Supply adequate.
....	....	D,S	......	..Do....
24.30	7-21-59	D	Sand	..Do....
....	....	S	..do..	..Do....
40	....	S	..do..	..Do....
40	....	D,S	..do..	Supply adequate, high iron content.
7.90	7-20-59	N	......	
42	....	D,S	Shale	Supply adequate.
54	....	D,S	..do..	..Do....
34	....	S	..do..	..Do....

Location No.	Owner or name	Depth (feet)	Diameter or size (inches)	Type	Date completed
129-70 (Cont.)					
26dcc2	Julius Retzer	65	36	Dr	....
27cbc1	Art Gross	20	24	Dr	1956
27cbc2	..do....	120	24	Dr	1955
27cbc3	..do....	30	24	Dr	1955
28aaa	Orvil Fischer	95	30	Dr	1900
130-69					
4cdc1	Gottlieb Eszlinger	30	24	Dr	1943
4cdc2	..do....	30	24	Dr	1950
5acc1	John Bender	70	30	Dr	1953
5acc2	..do....	22	30	Dr	1945
6aab1	E. O. Strobel	6	72	Du	1953
6aab2	..do....	18	$1\frac{1}{2}$	Dv	....
6aab3	..do....	50	24	Dr	1945
6bda	Henry Eszlinger	60 +	30	Dr	1929
6dac	Enoch Strobel	70	24	Dr	1957
7cd1	Freida Forrest	18	..	Dr	....
7cd2	..do....	27.7	24	Dr	....
9bad1	Jacob Eszlinger	20	36	Du	....
9bad2	..do....	12	48	Du	1956
9dda1	Ida Gehring	16	24	Dr	1954
9dda2	..do....	28	36	Du	....
10bac	John A. Tschetter	38	36	Dr	1939
11caa1	John Schumacher	10	48	Du	1954
11caa2	..do....	52	24	Dr	1945
14ad	Rueben Helfenstein	109	24	Dr	1924
15bbc	Philip Eszlinger	79	24	Dr	1953
17aca1	Richard Schaeffer	190	3	Dr	1946
17aca2	..do....	40	24	Dr	1943
17aca3	..do....	45	24	Dr	1947
17bbb	Herbert Speidel	35	24	Dr	....
19aba	Jake Kost	40	24	Dr	1951
19bcc1	Julius Bender	90	24	Dr	1923
19bcc2	Test hole 1563	115	5	Dr	7-25-59
19da	John Bender	20	24	Dr	1939
21acb1	Jacob Fischer	17	10	Dr	1947
21acb2	..do....	15	30	Dr	1919

Depth to water below land surface (feet)	Date of measurement	Use of water	Aquifer	Remarks
34	....	N	Shale	
12	....	D	Sand	Supply adequate.
99	....	S	Gravel	..Do....
15	....	S	Sand	..Do....
60	....	D,S	......	..Do....
24	....	S	..do..	..Do....
24	....	D	..do..	..Do....
45	....	D,S	Gravel	..Do....
12	....	S	..do..	Supply inadequate.
2	....	S	Sand	Supply adequate.
10	....	D,S	..do..	..Do....
14	....	N	..do..	Supply inadequate.
56	....	D,S	..do..	Supply adequate.
25	....	S	..do..	..Do....
7.8	7-16-38	...	Till	Temperature 47.5°F.
9.3	....	S	Till	
....	....	S	Sand	Supply adequate.
9	....	D	..do..	..Do....
4	....	S	..do..	..Do....
26	....	D	..do..	Supply inadequate.
18	....	D,S	..do..	Supply adequate.
8	....	D,S	Gravel	..Do....
49	....	S	Sand	Supply inadequate.
90	....	D,S	......	Supply adequate.
50	....	D,S	..do..	..Do....
118	....	D,S	..do..	..Do....
20	....	S	..do..	Supply inadequate.
25	....	S	Gravel	Supply adequate.
....	....	D,S	......	..Do....
20	....	D,S	Sand	..Do....
30	....	D,S	......	Supply adequate; see chemical analysis.
....	....	T	......	See log.
Flow	....	D,S	..do..	Supply adequate.
14	....	D	..do..	..Do....
12	....	S	..do..	..Do....

TABLE 1.--Records of Wells

Location No.	Owner or name	Depth (feet)	Diameter or size (inches)	Type	Date completed
130-69 (Cont.)					
21acb3	Jacob Fischer	17.0	12	Dr	1947
23cdc	Unknown	85.2	24	Dr	1959
26cbc	August Nitschke	8	60	Du	....
27adb	Ervin Denning	4	48	Du	....
27dc1	Emil G. Schaffer	16	24	Dr	1949
27dc2	..do....	16	48	Du	....
27dc3	..do....	29	36	Dr	1957
30ccc	Test hole 1565	264	5	Dr	7-30-59
30ddc	Test hole 1566	178	5	Dr	8- 1-59
31aab	City of Ashley 1	185	4	Dr	....
31baa	City of Ashley 2	185	4	Dr	....
31ccc	Test hole 1570	189	5	Dr	8- 5-59
31ddc	Test hole 1569	231	5	Dr	8- 4-59
33dab	Test hole 1568	157.5	5	Dr	8- 4-59
34ccd1	Alvin Walz	36	24	Dr	1956
34ccd2	..do....	30	24	Dr	....
35aaa	Richard Nitschke	10	48	Du	1956

and Test Holes -- Continued

Depth to water below land surface (feet)	Date of measurement	Use of water	Aquifer	Remarks
14.5	....	S	Sand	Supply adequate.
62.2	7-14-59	S	......	
6	....	D,S	..do..	..Do....
Flow	....	D,S	..do..	..Do....
9	....	S	..do..	..Do....
9	....	D	..do..	..Do....
13	....	S	..do..	..Do....
....	....	T	......	See log.
....	....	T	......	..Do....
110	....	PS	..do..	Supply adequate; see chemical analysis.
110	....	PS	..do..	..Do....
....	....	T	......	See log.
....	....	T	......	..Do....
....	....	T	......	..Do....
28	....	D	..do..	Supply adequate.
25	....	S	..do..	..Do....
6	....	D,S	..do..	..Do....

TABLE 1.--Records of Wells

Location No.	Owner or name	Depth (feet)	Diameter or size (inches)	Type	Date completed
130-70					
1ddc	Edwin Kost	20	24	Dr	1954
5bdd1	Art Pfiefle	52	24	Dr	1944
5bdd2	..do....	68	24	Dr	1959
9aca	Reinhold Tszlel	30	24	Dr	....
13aaa	Test hole 1562	115	5	Dr	7-25-59
13ccb1	Raymond Tszlel	30	24	Dr	1957
13ccb2	..do....	40	24	Dr	1957
14ddd	Dave Tschetter	98	36	Dr	....
17aab1	Henry Kautz	14	48	Du	....
17aab2	..do....	12	48	Du	....
20bc	Reinhold Spitzer	26.8	24	Dr	1958
20db	..do....	90	36	Dr	....
21ccc	..do....	36	36	Dr	1940
23cdd	Test hole 1574	147	5	Dr	8- 6-59
24cbb	Herbert Neu	14	24	Dr	1956
25aaa	Test hole 1564	189	5	Dr	7-25-59
26add	Herbert Neu	38	24	Dr	1919
26ccc	Test hole 1575	157.5	5	Dr	8- 6-59
26dcd1	Mrs. Edna Geizler	70	24	Dr	....
26dcd2	..do....	30	24	Dr	1952
27dc1	Andrew Rothfusz	120	4	Dr	1936
27dc2	..do....	18	12	Dr	1948
29bbb	Test hole 1567	178.5	5	Dr	8- 4-59
29bda	Ray Baumann	90	36	Dr	1924
29da	Ervin Feil	90	36	Dr	1927
33caa	Test hole 1573	115	5	Dr	8- 6-59
33daa	Walter Kramer	48	24	Dr	1955
36bbb	Test hole 1576	168	5	Dr	8- 7-59
36cab	Fred Eszlinger	57	36	Dr	1954

and Test Holes -- Continued

Depth to water below land surface (feet)	Date of measurement	Use of water	Aquifer	Remarks
....	....	D,S	Sand	Supply adequate.
34	....	D,S	..do..	..Do....
28	....	D,S	..do..	..Do....
25	....	D,S	..do..	..Do....
....	....	T	......	See log.
....	....	D,S	..do..	Supply adequate.
....	....	S	..do..	Supply inadequate.
38	....	D,S	..do..	Supply adequate.
12	....	S	..do..	..Do....
10	....	D	..do..	..Do....
8.69	7-15-59	D,S	..do..	..Do....
55	....	S	......	..Do....
....	....	S	..do..	..Do....
....	....	T	......	See log.
7	....	S	..do..	Supply adequate.
....	....	T	......	See log.
7	.....	D,S	..do..	Supply adequate.
....	....	T	......	See log.
52	....	S	..do..	Supply adequate.
....	....	D	..do..	..Do....
12	....	S	..do..	
6	....	D	..do..	..Do....
....	....	T	......	See log.
68	....	S	......	Supply adequate.
20	....	D,S	......	..Do....
....	....	T	......	See log.
19	....	D,S	..do..	Supply adequate.
....	....	T	......	See log.
40	....	D,S	..do..	Supply adequate.

TABLE 2.--Logs of Test Holes

129-69-18bbb
Test hole 1571

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, brown	1	1
	Clay, silty, light-brown	4	5
	Till, clayey, light-brown; fine to medium gravel	10	15
	Till, clayey, sandy, gray; fine to medium gravel and shale pebbles	50	65
	Gravel, fine to coarse, coarse sand; and shale pebbles	4	69
	Till, clayey, gray; fine to medium gravel and shale pebbles	37	106
Pierre Shale:			
	Shale, gray	9	115

129-69-24ddd
Test hole 1572

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, silty, black	2	2
	Clay, very silty, light-brown	24	26
	Till, clayey, light-gray; fine to medium gravel and shale pebbles	37	63
	Till, clayey, grayish-brown; fine gravel; coarse sand and selenite crystals	32	95
Pierre Shale:			
	Shale, sandy, gray	20	115

TABLE 2.--Logs of Test Holes -- Continued

130-69-19bcc2
Test hole 1563

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, black	5	5
	Till, clayey, sandy, light-brown, fine gravel; coarse sand, and shale pebbles; calcareous	16	21
	Till, clayey, gray; fine gravel; shale pebbles; and lignite fragments; calcareous	84	105
	Gravel, fine to medium; coarse sand and shale pebbles; and lignite fragments	5	110
Pierre Shale:			
	Shale, gray, slightly calcareous	5½	115½

130-69-30ccc
Test hole 1565

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, black	1	1
	Till, clayey, sandy, light-brown; fine gravel	9	10
	Till, clayey, light-brown; fine gravel and shale pebbles	22	32
	Till, clayey, gray; fine gravel	41	73
	Till, clayey, gray; fine to medium gravel, abundant	11	84
	Till, clayey, gray; fine gravel; shale pebbles; and lignite fragments	64	148
	Gravel, fine to medium; shale pebbles; and lignite fragments	8	156
	Till, clayey, gray; fine gravel; shale pebbles; and lignite fragments	108	264

TABLE 2.--Logs of Test Holes -- Continued

130-69-30ddc
Test hole 1566

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, black........................	4	4
	Till, clayey, light-brown; fine to medium gravel......................	20	24
	Till, clayey, gray; fine to medium gravel; shale pebbles; and lignite fragments..........................	125	149
	Gravel, fine to medium, coarse sand; shale pebbles; and lignite fragments	18	167
Pierre Shale:			
	Shale, gray..........................	11	178

130-69-31ccc
Test hole 1570

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, black.................	4	4
	Till, clayey; sandy, light-brown; fine gravel........................	7	11
	Clay, silty, light-gray...............	63	74
	Till, clayey, gray; fine gravel; shale pebbles; and lignite fragments......	78	152
	Gravel, fine to medium................	3	155
	Till, clayey, gray; fine to medium gravel; shale pebbles; and lignite fragments..........................	26	181
Pierre Shale:			
	Shale, gray..........................	8	189

TABLE 2.--Logs of Test Holes -- Continued

130-69-31ddc
Test hole 1569

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, black	2	2
	Clay, sandy, light-brown	3	5
	Clay, sandy, silty, light-gray	55	60
	Till, clayey, gray; fine to medium gravel; shale pebbles and lignite fragments	99	159
	Gravel, fine to medium; shale pebbles; and lignite fragments	20	179
	Till, clayey, gray; fine gravel; shale pebbles; and lignite fragments	10	189
	Clay, sandy, gray	31	220
	Gravel, fine to medium	4	224
Pierre Shale:			
	Shale, gray	7	231

130-69-33dab
Test hole 1568

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, black	4	4
	Till, clayey, sandy, light-brown; fine to medium gravel	18	22
	Till, clayey, sandy, gray, fine to medium gravel; shale pebbles; and lignite fragments	115	137
	Gravel, fine to medium, coarse sand; shale pebbles; and lignite fragments	13	150
Pierre Shale:			
	Shale, gray	7½	157½

TABLE 2.-- Logs of Test Holes -- Continued

130-70-13aaa
Test hole 1562

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, black........................	1	1
	Till, clayey, light-brown; fine to medium gravel......................	14	15
	Till, clayey, gray; fine to medium gravel; and shale pebbles...........	11	26
	Gravel, fine to medium................	4	30
	Till, clayey, gray; fine to medium gravel; and shale pebbles...........	44	74
Pierre Shale:			
	Shale, light-gray, oxidized...........	21	95
	Shale, gray...........................	20	115

130-70-23cdd
Test hole 1574

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, black.................	4	4
	Clay, light-gray; fine to coarse sand	7	11
	Clay, sandy, gray.....................	9	20
	Sand, very fine to fine, silty........	11	31
	Clay, sandy, gray.....................	31	62
	Till, clayey, gray; fine to medium gravel; shale pebbles; and lignite fragments..........................	13	75
	Gravel, fine to medium; shale pebbles; and lignite fragments...............	2	77
	Till, clayey, gray; fine to medium gravel, shale pebbles and lignite fragments..........................	67	144
Pierre Shale:			
	Shale, gray...........................	4	148

TABLE 2.--Logs of Test Holes -- Continued

130-70-25aaa
Test hole 1564

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, black........................	4	4
	Clay, sandy, light-brown..............	22	26
	Clay, sandy, gray.....................	29	55
	Till, clayey, gray; fine to medium gravel; shale pebbles; and lignite fragments..........................	102	157
	Gravel, fine to coarse; shale pebbles; and lignite fragments...............	20	177
	Till, clayey, gray; fine to medium gravel; and shale pebbles...........	12	189

130-70-26ccc
Test hole 1575

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, black.................	4	4
	Sand, fine to medium, silty..........	7	11
	Clay, sandy, light-brown..............	5	16
	Clay, sandy, gray.....................	47	63
	Till, clayey; gray; fine to medium gravel; shale pebbles, and lignite fragments..........................	85	148
Pierre Shale:			
	Shale, clayey, gray...................	9½	157½

TABLE 2.--Logs of Test Holes -- Continued

130-70-29bbb
Test hole 1567

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, black.................	4	4
	Till, clayey, light-brown; fine gravel	8	12
	Till, clayey, gray; fine to medium gravel; and shale pebbles...........	156	168
Pierre Shale:			
	Shale, clayey, gray...................	10½	178½

130-70-33caa
Test hole 1573

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, black.................	2	2
	Clay, sandy, light-gray...............	9	11
	Gravel, fine to medium, coarse sand...	5	16
	Till, clayey, light-gray; fine to medium gravel; and shale pebbles...........	56	72
	Gravel, fine to coarse................	6	78
	Till, clayey, gray; fine to medium gravel; and shale pebbles...........	27	105
Pierre Shale:			
	Shale, clayey, gray...................	10	115

130-70-36bbb
Test hole 1576

Formation	Material	Thickness (feet)	Depth (feet)
Glacial drift:			
	Topsoil, sandy, black.................	4	4
	Clay, light-brown.....................	17	21
	Clay, light-gray......................	31	52
	Gravel, fine to medium, coarse sand; shale pebbles; and lignite fragments	11	63
	Clay, silty, olive-gray...............	44	107
	Till, clayey, gray; fine to medium gravel; and shale pebbles...........	55	162
Pierre Shale:			
	Shale, gray...........................	6	168

TABLE 3.--Partial Chemical

Analyzed by State Laboratories, Bismarck

Results in parts per million except as indicated

Location No.	Owner or name	Aquifer	Depth of well (feet)	Date of collection	Iron (Fe)	Sodium (Na)	Potassium (K)
129-69-7acb	Raymond Klipfel	Drift	107	July 1959	2.3	438	27
130-69-19bcc1	Julius Bender	..do..	90	...do....	.5	119	16
130-69-31aab	City of Ashley	..do..	185	...do....	3.9	178	13

Analyses of Ground Water

Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Percent sodium
48	1,170	122	.3	2.5	1.9	2,440	445	406	69
20	316	15	.3	1.7	.7	790	90	74	88
292	312	25	.7	.0	.9	812	198	0	94

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