

STATE OF SOUTH DAKOTA
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DEPARTMENT OF NATURAL RESOURCE DEVELOPMENT
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GEOLOGICAL SURVEY
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GROUND-WATER STUDY IN THE VICINITY OF BRANDON

by

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GROUND-WATER STUDY IN THE VICINITY OF BRANDON

At the request of the City of Brandon, the South Dakota Geological Survey began a ground-water study and water quality monitoring program in the summer of 1975. The purpose of this study was to determine the direction of ground-water movement in the area, find out if the development of homes south of town with private septic tanks could affect the City water, and if the water in the Big Sioux River could affect the quality of the water in the City wells located in section 3, Township 101 North, Range 48 West.

Brandon Water Company is a separate entity from the City. An agreement was reached between the Brandon Water Company and the City that the contract with the Survey be signed by the Mayor. A contract was signed between the East Dakota Conservancy Sub-District, the City of Brandon, and the Geological Survey.

The field work was conducted from June 17 through July 1, 1975. Fourteen (14) observation wells were constructed and ten (10) test holes were drilled in the area. The location of these observation wells and test holes are shown on figure 1 and the logs are contained in appendix A and B, respectively. Twenty-six (26) water samples were collected and analyzed. Table 1 shows the results of all water samples collected in the area. The samples in this table are designated by a number and a letter. The number refers to the location of the sample (fig. 2) and the letter designates the year that the sample was collected. Twenty-six (26) samples collected in 1975 are desig-

nated by the letter B in table 1.

In May, 1976, 12 water samples were collected and analyzed. The results of these samples are in table 1 and are designated by the letter C. Figure 3 and appendix C show the water level elevation in May, 1976.

Figure 4 shows the concentration of nitrate nitrogen in water samples collected in 1975 and 1976 in the area. Several of these samples had higher than the recommended limits of nitrate content.

Additional water samples were collected in September, 1977, and are designated by a letter D in table 1. In March of 1978 another set of samples were collected and analyzed. The results of these samples are designated by the letter E in table 1. Figure 5 shows the concentration of nitrate nitrogen in the samples collected in 1977 and 1978.

CONCLUSIONS

A sand and gravel deposit is located between the Big Sioux River and Split Rock Creek (fig. 6).

The City wells are located in NW $\frac{1}{4}$ section 3, Township 101 North, Range 48 West. The water level in the aquifer is generally higher than the water level in the Big Sioux River (figs. 3 and 7). With the available data it does not appear that the quality of the Big Sioux River could affect the City water. The water level in May, 1976, in the vicinity of the well field was higher than 1290 feet and the normal Big Sioux River level west of the well field is less than 1280 feet above the mean sea level (fig. 7).

Nitrate is present in most of the samples collected in the area. Nitrate (as nitrogen) levels in some samples exceed the limits of the National Interim Primary Drinking Water Regulations (table 1, and figs. 4 and 5). The source of high nitrate could be livestock next to wells in some cases and in others it could be the septic tanks. Some high nitrate (as nitrogen over 10 parts per million) was detected in the area south of the City well field. The water table map (fig. 3) shows that the general direction of the ground-water movement is from the north to the south with some local changes. Increased pumping in the City well field could, however, establish a gradient from the south to the well field area. An indication of this can be seen by comparing the water level in observation wells 11 and 12. In May, 1976, observation well 11 had a water level of 1294.77 and observation well 12 located south of observation well 11 had a water level of 1297.32 feet above sea level. The pumping by the City could move the water with high nitrate in the direction of the City wells and raise the nitrate to an unacceptable level.

REFERENCES CITED

- Steece, F. V., 1959, Geology of the Sioux Falls Quadrangle:
South Dakota Geological Survey map and text.
- U.S. Environmental Protection Agency, 1975, Water Programs:
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Federal Register, 40, no. 248.
- U.S. Environmental Protection Agency, 1977, Water Programs:
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Register, 42, no. 62.
- U.S. Geological Survey, 1962, Brandon Quadrangle S. Dak-Iowa.

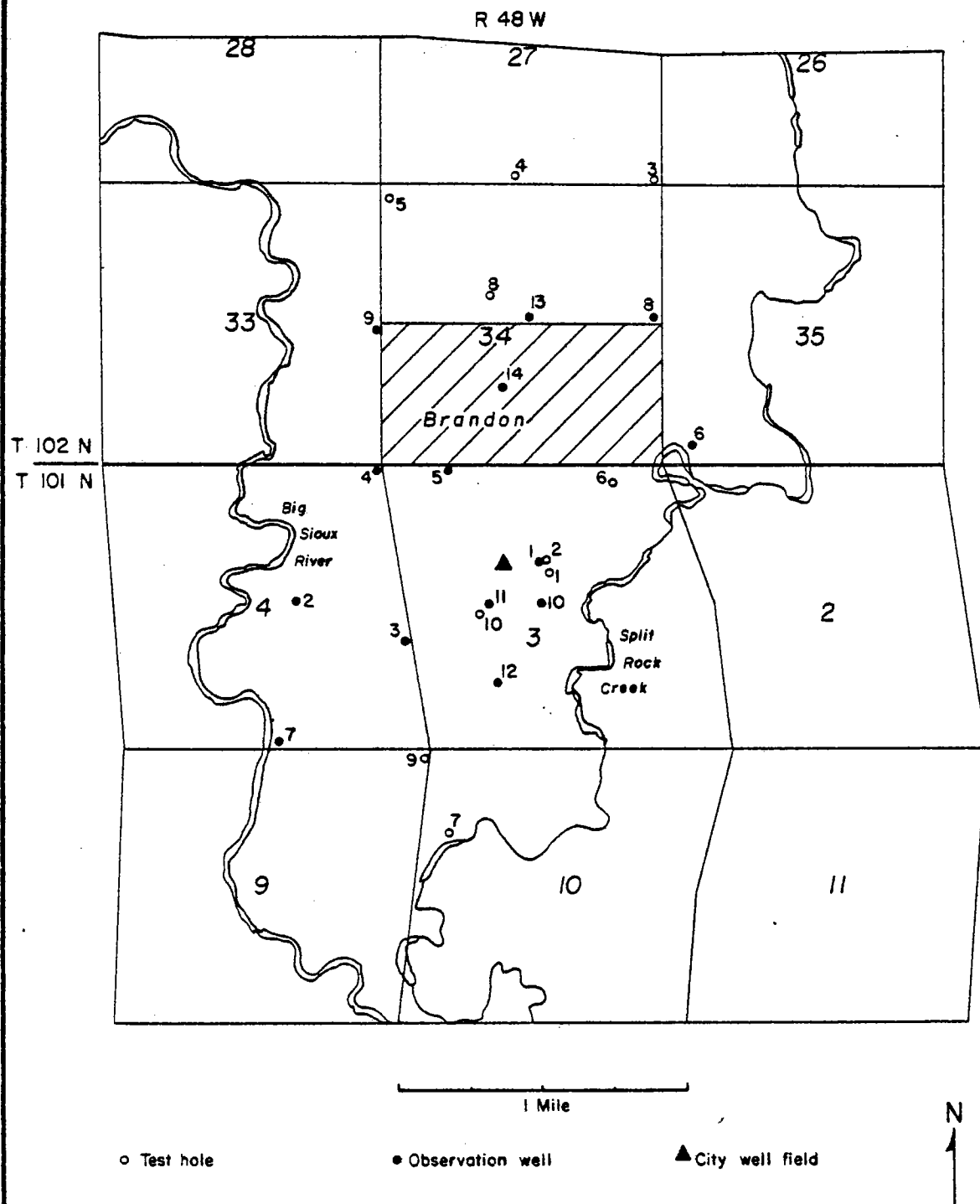
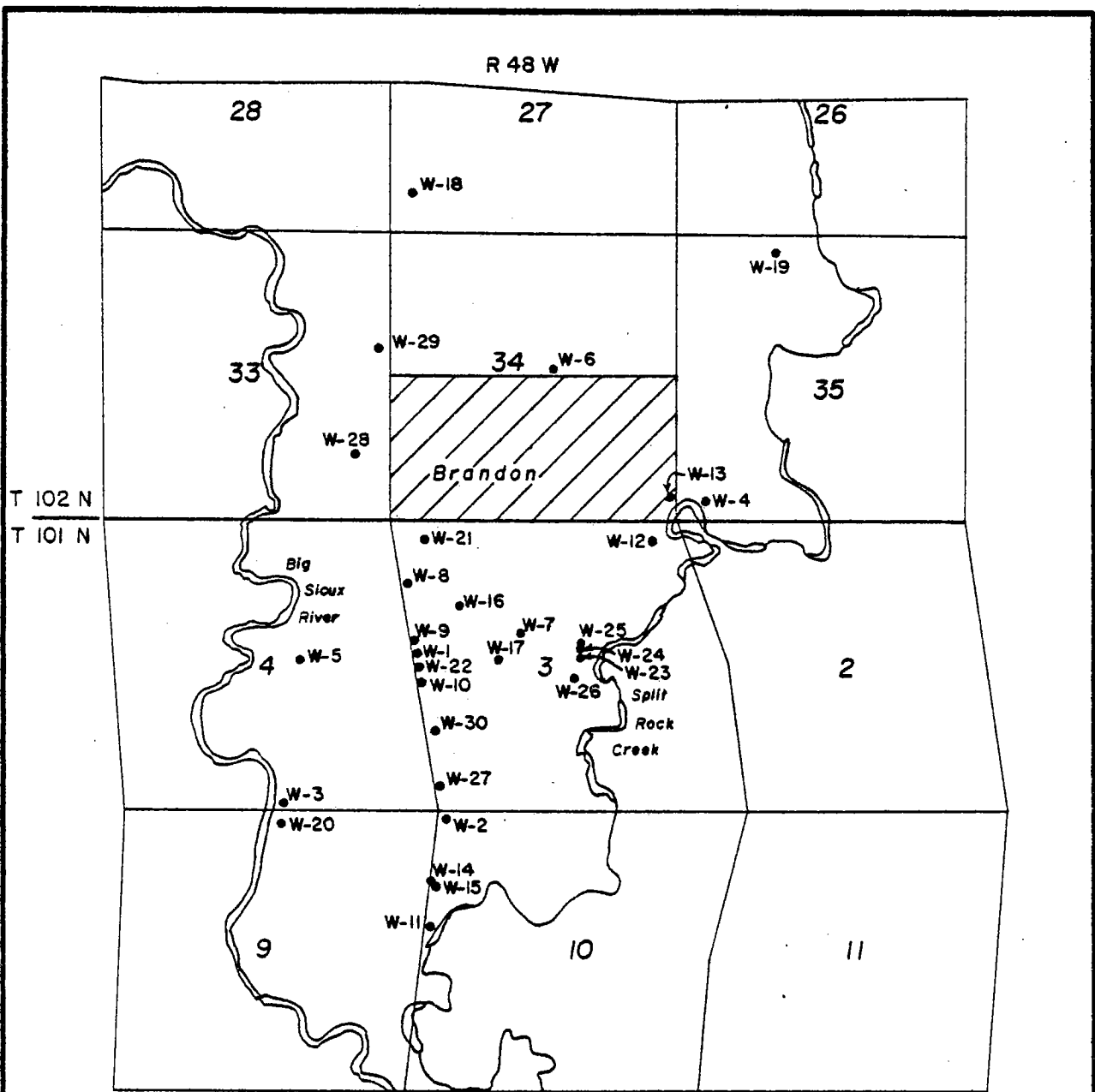


Figure 1

Map showing location of test holes and observation wells
in the Brandon area.



1 Mile

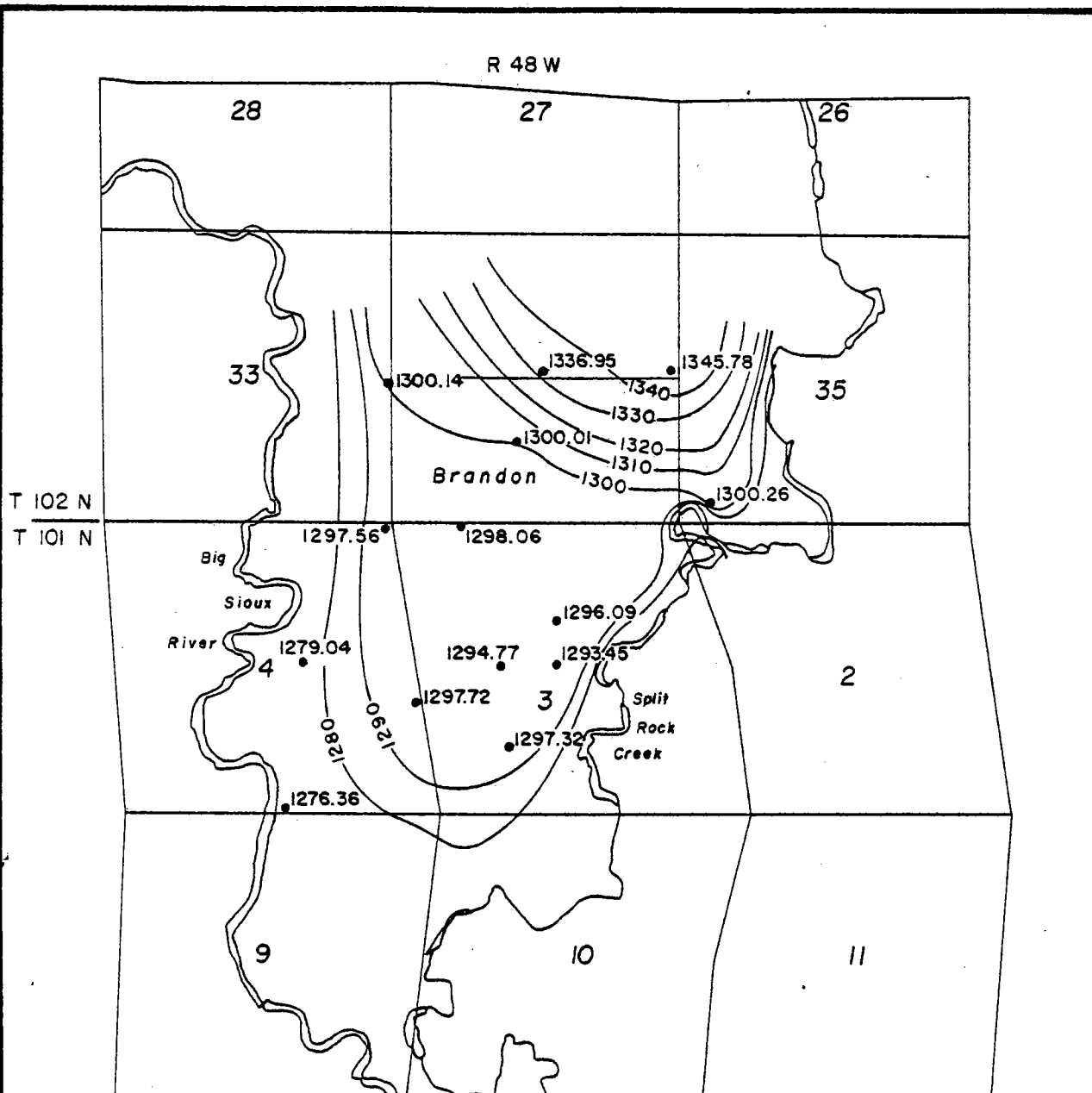
• Water sample



See Table I for water sample analyses.

Figure 2

Map showing location of water samples
in the Brandon area.



1300.01 • Observation well, number indicates water level in feet above mean sea level.
 Contour interval = 10 feet

Figure 3

Map showing water table contours in the Brandon area, May 1976.

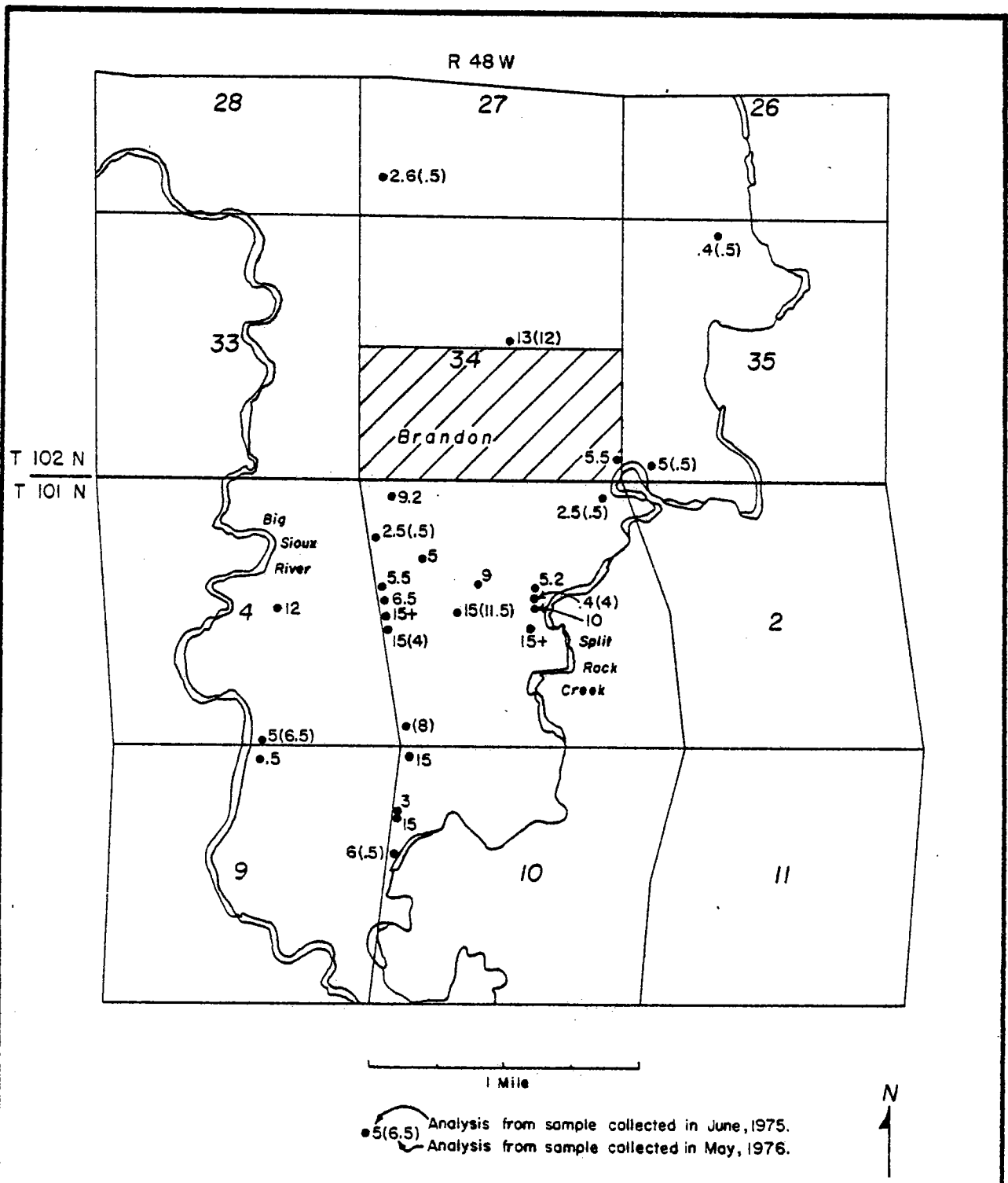


Figure 4

Map showing the concentration in parts per million of nitrate nitrogen in water samples collected in June, 1975 and May, 1976 from the Brandon area.

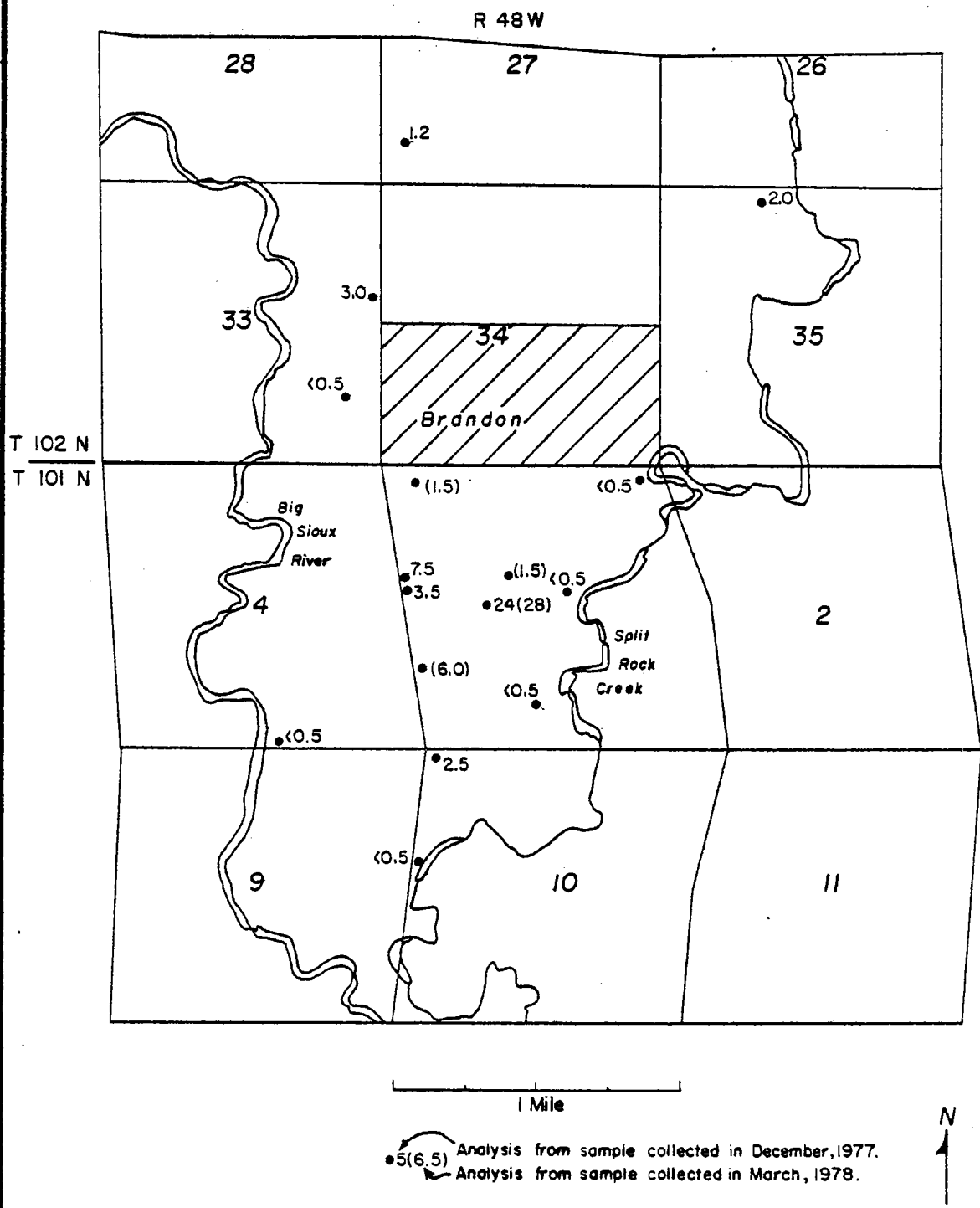
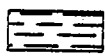
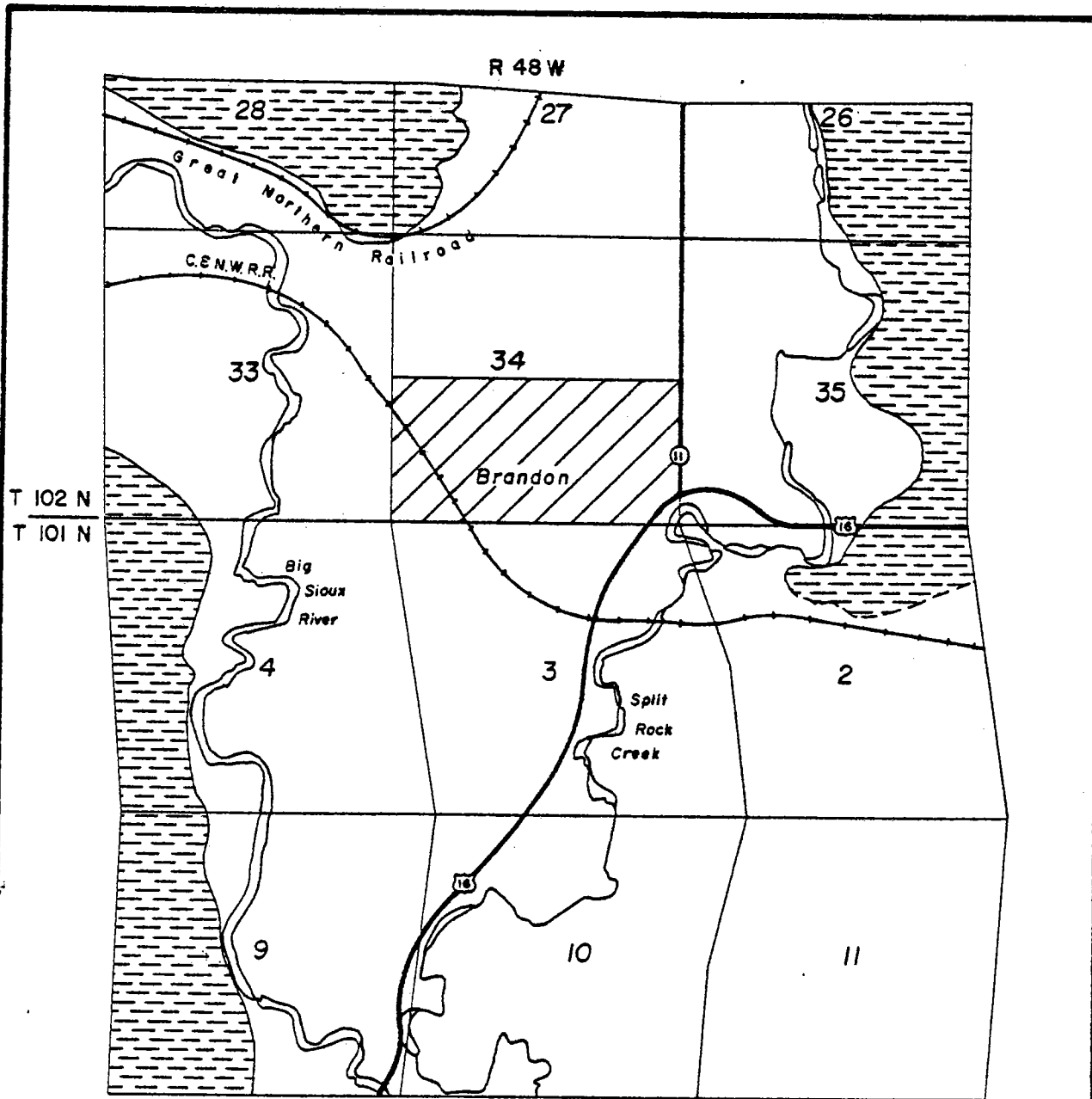


Figure 5

Map showing the concentration in parts per million of nitrate nitrogen in water samples collected in December, 1977 and March, 1978 from the Brandon area.



Till, clay with sand and gravel.



Alluvium, sand and gravel with some clay.

Figure 6

Generalized geological map of the Brandon area.

(Modified from F.V. Steece, 1958.)

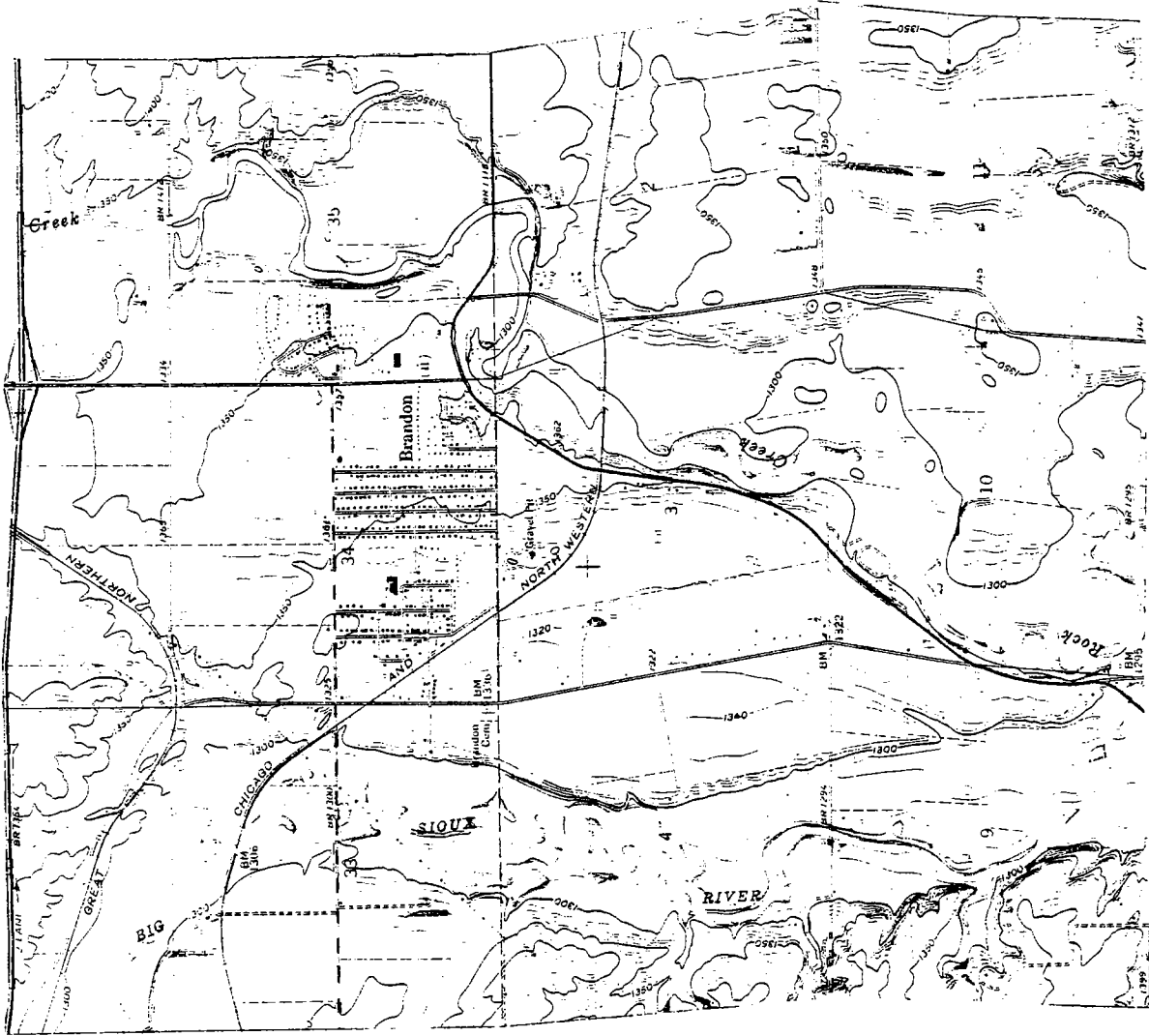


Figure 7

Topographic map of the
Brandon area, (U.S. Geo-
logical Survey, 1962 photo
revised 1976.)

Contour interval = 10 feet

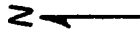


TABLE 1. Chemical analyses of water samples from the Brandon area

Sample	Parts Per Million									
	Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrate Nitrogen	Hardness CaCO ₃	Total Solids
A	---	----	----	250 ²	250 ²	0.3 ²	0.05 ²	10.0 ¹	----	500 ²
W 1B	120	10*	20	10*	20	0.2	0.1	6.5	380	260
W 2B	230	60	50	10	225	0.5	0.1	15.0	780	740
W 2D								2.5		
W 3B	260	60	80	32	410	4.0	1.0	5.0	980	1030
W 3C	115	90	50	39	315	1.8	1.0	0.5*	490	1160
W 3D								0.5*		
W 4B	250	25	60	10*	150	0.75	0.5	5.0	870	540
W 4C	80	50	28	7	80	0.05*	0.5	0.5*	315	690
W 5B	310	85	120	40	620	11.0	0.2	12.0	1260	1268
W 6B	20	70	25	10*	30	0.1*	0.3	13	152	428
W 6C	75	35	20	13	33	0.05*	0.05*	12	270	530
W 7B	180	20	35	10	280	0.1*	0.15	9	595	550

TABLE 1 -- continued.

W 7E										1.5		
W 8B	150	25	25	10	110	0.1*	0.5	0.1*	0.5	2.5	475	420
W 8C	65	18	29	10	25	0.05*	0.3	0.05*	0.3	0.5*	275	540
W 9B	120	10	15	10	105	0.1*	0.05*	0.1*	0.05*	5.5	360	450
W 9D										7.5		
W 9E										3.5		
W10B	130	10	25	10	120	0.1*	0.05*	0.1*	0.05*	15	425	450
W10C	40	35	19	8	30	0.05*	0.05*	0.05*	0.05*	4	175	420
W11B	170	30	40	10*	140	1.5	0.15	1.5	0.15	6	590	640
W11C	95	35	30	6	105	8.0	0.15	8.0	0.15	0.5*	360	725
W11E										0.5*		
W12B	105	10	25	10*	100	0.2	0.3	0.2	0.3	2.5	365	510
W12C	70	35	21	7	50	1.5	0.5	1.5	0.5	0.5*	260	620
W12D										0.5*		
W13B	105	25	25	10*	110	3.0	0.6	3.0	0.6	5.5	365	470
W14B	200	60	30	10*	170	2.7	0.05*	2.7	0.05*	3	620	550
W15B	280	150	20	130	20	0.05*	0.05*	0.05*	0.05*	15	780	770
W16B	170	20	40	20	100	1.0	0.3	1.0	0.3	5.0	590	575

TABLE 1 -- continued.

W25B	150	190	10*	15	20	0.05*	0.05*	5.2	390	400
W26B	150	90	10*	15	20	0.05*	0.05*	15	390	470
W27C	50	35	16	14	30	0.05*	0.05*	8	190	710
W28D							0.5*			
W29E							3.0			
W30D							6.0			

*Less than

Sample A

¹National Interim Primary Drinking Water Regulations, December 24, 1975
(enforceable limits)

²Proposed National Secondary Drinking Water Regulations, March 31, 1977,
(recommended limits)

W-1 to W-30 designate the locations of water samples (fig. 2).

Designation of water sample collection dates

B - 1975

C - May, 1976

D - September, 1977

E - March, 1978

Location of water samples collected in the Brandon area
(for map location, see fig. 2)

- W- 1 SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 36 feet to water, C. Parsons
- W- 2 NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T. 101 N., R. 48 W., 80 feet deep, 56 feet to water, C. R. Bennis
- W- 3 SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 101 N., R. 48 W., observation well 7, 13 feet to water after pumping
- W- 4 NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 102 N., R. 48 W., observation well 6, 11? feet to water
- W- 5 NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec, 4, T. 101 N., R. 48 W., V. E. Swanson
- W- 6 SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 102 N., R. 48 W., M. Carsrud
- W- 7 SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., Brandon City Well (north)
- W- 8 SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 60 feet deep, 35 feet to water, L. Schroeder
- W- 9 NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 40 feet deep, 35 feet to water, D. Greer
- W-10 NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 35 feet deep, 27 feet to water
- W-11 SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T. 101 N., R. 48 W., 103 feet deep, 70 feet to water, M. Magnuson
- W-12 NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 83 feet deep, 50 feet to water, L. Abrahamson
- W-13 SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 102 N., R. 48 W., 72 feet deep, H. Kapsch
- W-14 NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T. 101 N., R. 48 W., 35 feet deep, 15 feet to water (barn well), J. Bader
- W-15 NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T. 101 N., R. 48 W., 50 feet deep, 15? feet to water (house well), J. Bader
- W-16 NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 80 feet deep, 60 feet to water, E. Keppord
- W-17 SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., observation well 11, depth to water 17 feet

- W-18 NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 27, T. 102 N., R. 48 W., 120 feet deep, 80+ feet to water, T. Iverson
- W-19 NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T. 101 N., R. 48 W., 50 feet deep, E. Graff
- W-20 SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T. 101 N., R. 48 W., 22 feet deep, 20 feet to water, L. Narum
- W-21 SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 50 feet deep, J. McMahon
- W-22 SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 39 feet deep, 35 feet to water, M. Chase
- W-23 SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 80 feet deep, 60 feet to water, D. Branson
- W-24 NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 65 feet deep, 61 feet to water, D. Steffen
- W-25 NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W., 67 feet deep, D. Keck
- W-26 NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec, 3, T. 101 N., R. 48 W., 58 feet deep, R. Smith
- W-27 NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.
- W-28 NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 33, T. 102 N., R. 48 W.
- W-29 SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 33, T. 102 N., R. 48 W.
- W-30 SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec, 3, T. 101 N., R. 48 W., 35 feet deep, 27 feet to water, R. Grave?

APPENDIX A

Logs of observation wells in the Brandon area
(for map location, see fig. 1)

All observation wells were drilled by the South Dakota Geological Survey in 1975.

All elevations are in feet above mean sea level.

Observation Well 1

Location: SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation - top of pipe: 1326.84 feet

Depth to water: 38 feet

0- 1	Clay, dark-brown, silty, moist (topsoil)
1- 6	Clay, brown, silty dry
6- 30	Sand and gravel, brown, clayey, dry
30- 32	Sand, brown, fine to coarse, dry
32- 44	Gravel and sand, moist
44- 54	Sand and gravel, gray-green, very clayey

* * * *

Observation Well 2

Location: NW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 101 N., R. 48 W.

Elevation - top of pipe: 1302.64 feet

Depth to water: 23 feet

0- 3	Silt, dark-brown, sandy, moist
3- 7	Silt, dark-brown, sandy, clayey, moist
7- 10	Sand, brown, medium to coarse, clayey, moist
10- 12	Silt, dark-brown, clayey, moist
12- 15	Silt, brown, clayey, moist
15- 23	Sand, medium and gravel, clean, with a gravel and clay layer, dark-brown, hard
23- 29	Sand, gray-brown, slightly clayey, saturated
29- 36	Sand, brown, clean, saturated
36- 37	Gravel
37- 54	Clay, gray, silty

* * * *

Observation Well 3

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 101 N., R. 48 W.

Elevation - top of pipe: 1332.62 feet

Depth to water: 34 feet

0- 4	Clay, dark-gray, silty, moist (topsoil)
------	---

Observation Well 3 -- continued.

4- 7	Sand, brown, medium, clayey, moist
7- 30	Sand and gravel, clayey, moist
30- 41	Sand, brown, clayey, moist
41- 59	Clay, blue-gray, silty

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Observation Well 4

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 4, T. 101 N., R. 48 W.

Elevation - top of pipe: 1337.61 feet

Depth to water: 32 feet

0- 4	Clay, brown, silty, a few pebbles, dry (topsoil)
4- 27	Sand, brown, some gravel, clayey, dry
27- 44	Clay, brown, sandy, moist
44- 74	Clay, blue-gray, silty
74-105	Sand, blue, fine
105-114	Clay, blue-gray, silty

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Observation Well 5

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation - top of pipe: 1319.66 feet

Depth to water: 20 feet

0- 4	Silt, dark-brown, clayey, moist
4- 5	Silt, brown, clayey, moist
5- 12	Gravel with a silt layer, light brown-white, very dry
12- 14	Sand, very fine, with silt, light-brown, slightly moist
14- 16	Sand, very fine to coarse, with silt, brown, slightly moist
16- 21	Sand, very fine to coarse, with silt, light brown-white, slightly moist
21- 27	Sand, brown, medium to coarse, clayey, saturated
27- 33	Sand, brown, medium to coarse, clayey, mixed with gravel, saturated
33- 40	Sand, brown, medium to coarse, less clayey, saturated
40- 50	Sand, gray-brown, medium to coarse, slightly clayey, saturated
50- 77	Sand, gray, medium to coarse, clayey, saturated
77- 79	Clay, gray, silty

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Observation Well 6

Location: NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 102 N., R. 48 W.

Elevation - top of pipe: 1306.46 feet

Depth to water: 11 feet

0- 7	Silt, black-gray, clayey, moist
7- 11	Silt, dark-gray, clayey, moist
11- 14	Silt, dark-gray, clayey, saturated
14- 16	Gravel
16- 20	Silt, dark-gray, clayey, saturated
20- 30	Silt, dark-gray, clayey, slightly sandy, saturated
30- 35	Sand, dark-gray, clayey, saturated
35- 41	Sand, brown, silty, saturated
41- 44	Clay

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Observation Well 7

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 101 N., R. 48 W.

Elevation - top of pipe: 1295.96 feet

Depth to water: 15 feet

0- 5	Clay, dark-gray, silty, moist (topsoil)
5- 9	Gravel, tan, fine to medium, clayey, dry
9- 17	Sand and gravel, tan, very clayey, dry
17- 20	Sand and gravel, brown, silty, moist
20- 39	Sand and gravel, poorly sorted, saturated
39	Rock

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Observation Well 8

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 102 N., R. 48 W.

Elevation - top of pipe: 1355.43 feet

Depth to water: 15 feet

0- 5	Silt, dark-brown, clayey, moist
5- 15	Gravel, mixed with sand, brown to light brown, medium to coarse, dry
15- 22	Sand, brown, clayey, medium, saturated
22- 24	Sand, gray-brown, with clay
24- 34	Sand, brown, with clay
34- 52	Sand, gray, with clay
52- 55	Sand, mixed with gravel and clay
55- 60	Sand, gray, with clay
60- 64	Clay, gray

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Observation Well 9

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 33, T. 102 N., R. 48 W.

Elevation - top of pipe: 1322.34 feet

Depth to water: 22 feet

0- 2	Clay, dark-brown, sandy, silty, moist
2- 7	Gravel mixed with sand, brown to light brown, silty
7- 21	Sand, brown, with some gravel, moist
21- 37	Sand, brown, medium to coarse, with some gravel, saturated
37- 39	Clay, gray, silty

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Observation Well 10

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation - top of pipe: 1324.52 feet

Depth to water: 34 feet

0- 3	Sand, dark-brown, very fine, silty, clayey, moist
3- 6	Silt, brown, clayey, moist
6- 8	Sand, brown, medium to coarse, with some gravel, slightly clayey, moist
8- 11	Sand, light-brown, medium to coarse, some 2 to 4 mm gravel, silty, dry
11- 13	Sand, white-gray, medium to coarse, some 2 to 4 mm gravel, silty, dry
13- 15	Sand, brown, medium, clayey, moist
15- 16	Gravel
16- 22	Sand?
22- 35	Sand, brown, medium, clayey, moist
35- 44	Sand, brown, medium to coarse, clayey, saturated
44- 76	Sand, gray, medium to coarse, clayey, saturated
76- 84	Clay

* * * *

Observation Well 11

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation - top of pipe: 1311.77 feet

Depth to water: 17 feet

0- 2	Clay, brown, silty, a few pebbles, dry (topsoil)
2- 6	Gravel, brown, coarse, silty, dry
6- 9	Clay, mixed with sand and gravel, brown, moist
9- 15	Sand and gravel, moist

Observation Well 11 -- continued.

15- 22 Clay mixed with sand and gravel, moist
22- 28 Sand and gravel
28- 34 Clay, blue-gray, silty

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Observation Well 12

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation - top of pipe: 1317.08 feet

Depth to water: 20 feet

0- 7 Clay, dark gray-brown, silty, dry (topsoil)
7- 12 Sand mixed with gravel and silt, poorly sorted,
dry
12- 18 Sand, brown, medium, with pebbles, dry
18- 43 Sand and gravel, brown, clayey, moist
43- 54 Clay, blue-gray, silty

* * * *

Observation Well 13

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 102 N., R. 48 W.

Elevation - top of pipe: 1369.70 feet

Depth to water: 32 feet

0- 5 Silt and sand, fine, dark-brown, clayey, moist
5- 26 Sand, reddish-brown, medium to fine, moist
26- 30 Sand, reddish-brown, medium to fine, with
gravel, fine, moist
30- 32 Sand, brown, medium to fine, moist
32- 75 Sand, brown, medium to fine, saturated
75- 80 Sand, brown, medium to fine, with some gravel,
saturated
80- 84 Clay

* * * *

Observation Well 14

Location: SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, T. 102 N., R. 48 W.

Elevation - top of pipe: 1342.61 feet

Depth to water: 42 feet

0- 6 Silt, dark-brown, clayey, moist
6- 10 Sand, brown, clayey, moist
10- 14 Sand, brown, with gravel, clayey, moist
14- 20 Gravel and small granules, light-brown to
brown with sand, medium
20- 42 Sand, brown, medium to coarse, moist
42- 55 Sand, brown, medium to coarse, saturated
55- 97 Sand, gray, clayey
97- 99 Clay

* * * *

APPENDIX B

Logs of test holes in the Brandon area (for map location, see fig. 1)

All test holes were drilled by the South Dakota Geological Survey in 1975.

All elevations are in feet above mean sea level.

Test Hole 1

Location: SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation: 1315 feet

Depth to water: 29 feet

0-	1	Clay, black silty, moist (topsoil)
1-	3	Clay, brown, silty, dry
3-	54	Gravel and sand, brown, silty
54-	61	Sand and gravel, clayey, saturated
61-	69	Clay, blue-gray, silty

* * * *

Test Hole 2

Location: SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation: 1330 feet

Depth to water: 38 feet

0-	1	Clay, black, silty, moist (topsoil)
1-	6	Clay, brown, silty, dry
6-	12	Sand and gravel, brown, clayey, dry
12-	19	Sand, brown, fine, clayey, a few pebbles, dry
19-	34	Sand and gravel, brown, silty, dry
34-	46	Sand and gravel, moist
46-	59	Sand and gravel, brown, clayey, saturated
59-	91	Sand, gray-brown, very clayey
91-	100	Clay, gray, silty

* * * *

Test Hole 3

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 27, T. 102 N., R. 48 W.

Elevation:

Depth to water: 35 feet

0-	3	Silt, black, clayey, moist
3-	5	Clay, black, silty, moist
5-	6	Clay, dark-gray, silty, moist
6-	12	Clay, brown, silty, moist
12-	15	Sand and gravel, brown, coarse, moist

Test Hole 3 -- continued.

15- 28	Sand, brown, medium to coarse, moist
28- 35	Sand, brown, medium to coarse, saturated
35- 39	Sand, brown, medium to coarse, with some gravel, saturated
39- 44	Sand, brown, medium to coarse, slightly clayey, saturated
44- 56	Sand, gray, medium to coarse, clayey, saturated
56- 59	Clay

* * * *

Test Hole 4

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 27, T. 102 N., R. 48 W.

Elevation: 1365 feet

Depth to water: 15 feet

0- 19	Sand, brown, medium, dry
19- 35	Sand, gray-brown, clayey, saturated
35- 44	Clay, blue-gray, silty

* * * *

Test Hole 5

Location: NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 34, T. 102 N., R. 48 W.

Elevation: 1330 feet

Depth to water: 8 feet

0- 4	Clay, dark-gray, silty, moist (topsoil)
4- 7	Clay, light-gray, silty, moist
7- 29	Clay, tan, silty, moist
29- 39	Clay, blue-gray, silty

* * * *

Test Hole 6

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation: 1350 feet

Depth to water: 25 feet

0- 2	Clay, tan, silty, a few pebbles, dry
2- 3	Clay, tan, silty, some sand and gravel, dry
3- 6	Silt, sand, and gravel, tan, dry
6- 17	Sand, tan, medium to coarse, clayey, dry
17- 27	Sand, tan, medium, with pebbles, moist
27- 44	Clay, gray-brown, silty
44- 78	Clay, yellow-brown, silty, interbedded with sand and gravel, and clay, blue-gray, silty
78-133	Sand, medium, with a few coarse and fine grains

* * * *

Test Hole 7

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T. 101 N., R. 48 W.

Elevation: 1290 feet

Depth to water: 9 feet

0- 3	Clay, dark-brown, silty, dry (topsoil)
3- 10	Clay, dark gray-brown, silty, moist
10- 18	Clay, dark-brown, sandy, saturated
18- 24	Gravel, sand, and clay, gray-brown, saturated
24- 39	Clay, blue-gray, silty

* * * *

Test Hole 8

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 34, T. 102 N., R. 48 W.

Elevation: 1350 feet

Depth to water: 23 feet

0- 4	Clay, brown, some sand (topsoil)
4- 7	Clay, brown, silty, moist
7- 11	Sand, brown, clayey, moist
11- 19	Sand and gravel, brown, clayey, moist
19- 37	Sand, tan, medium, moist
37- 40	Sand, tan, medium, clayey, saturated
40- 54	Clay, tan, silty, interbedded with sand, orange, clayey
54- 69	Clay, blue-gray, silty

* * * *

Test Hole 9

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T. 101 N., R. 48 W.

Elevation: 1322 feet

Depth to water: not measured

0- 1	Clay, dark-brown, silty, moist (topsoil)
1- 11	Clay, brown, sandy, with pebbles, moist
11- 17	Clay, brown-green, silty, with pebbles, moist
17- 99	Clay, gray-green, silty, moist

* * * *

Test Hole 10

Location: SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 3, T. 101 N., R. 48 W.

Elevation:

Depth to water: not measured

0- 3	Silt, dark-brown, clayey, with gravel, moist
3- 4	Sand and gravel, brown, medium to coarse, dry
4- 8	Sand, white to light-brown, with silt and gravel, fine to coarse, dry
8- 17	Sand, brown, medium, silty, with some gravel, dry

Test Hole 10 -- continued.

17- 21	Sand, brown, medium, silty, with more gravel, dry
21- 26	Sand, brown, medium, silty, with some gravel, dry
26- 29	Sand, brown, medium, slightly silty, with some gravel, moist

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APPENDIX C

Water level measurements in the Brandon area

Observation Well	Elevation Top of pipe (in feet)	Measurement May, 1976 (in feet)	Water level May, 1976 (in feet)
1	1326.84	30.75	1296.09
2	1302.64	23.60	1279.04
3	1332.62	34.90	1297.72
4	1337.61	40.05	1297.56
5	1319.66	21.60	1298.06
6	1306.46	6.20	1300.26
7	1295.96	19.60	1276.36
8	1355.43	9.65	1345.78
9	1322.34	22.20	1300.14
10	1324.52	31.07	1293.45
11	1311.77	17.00	1294.77
12	1317.08	19.76	1297.32
13	1369.70	33.75	1336.95
14	1342.61	42.60	1300.01