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by

ASSAD BARARI
1970

GROUND-WATER STUDY

in the

LITTLE WHITE RIVER VALLEY
Mr. Howard North, Director
Lyman-Jones Water Development Association
P. O. Box 1
Murdo, South Dakota

Dear Mr. North:

At the request of the Lyman-Jones Water Development Association the South Dakota Geological Survey conducted a ground-water study in the Little White River Valley from the mouth of the river upstream to the City of White River. Included in this survey were: (1) a review of the geology as mapped by the South Dakota Geological Survey (Agnew, 1957); (2) electrical resistivity investigations at 26 stations conducted by Bruno Petsch; (3) supervised drilling of 20 test holes by Ferguson-Meador and Associates in the area; and (4) collection and analysis of 11 water samples.

The Little White River has formed a valley approximately 180 feet deep and one-half to a mile wide in the study area. The river has deposited alluvial sediments in the valley which vary from less than a foot to 21 feet thick (Test Hole 5, App. 1). In the study area, these alluvial sediments consist of sand ranging in size from fine to coarse and in some locations clay and sand are mixed together. The thickest alluvial deposit is at the junction of the Little White River Valley and the White River Valley. These deposits are mostly coarse to very coarse sand and approximately 15 feet of these deposits are water saturated. There is locally thicker and coarser material from the junction of the two valleys toward the White River. Twenty-three feet of alluvium ranging in size from medium sand to gravel was penetrated by Test Hole No. 3. The water saturated thickness of the material was 16 feet in this hole. Sediments in this area were deposited by both rivers.

Water in the alluvial deposits in these valleys is hydrologically connected to the respective streams flowing in the valleys. Since water in the White River has more dissolved chemicals than water in the Little White River, water from alluvium in the valley of the White River is poorer in quality. Compare Sample W1 (from alluvium in the White River Valley) with Samples W4, W5, and W10 (from alluvium in the Little White River Valley). There are some wells in the Little White River Valley which are getting an inferior quality water from the Pierre Shale; compare Samples W6, W7, and W8 (from the Pierre Shale) with Samples W4, W5, and W10 (from alluvium in the Little White River).

It is recommended that the Lyman-Jones Water Development Association do additional testing in the area outlined on the Data Map (fig. 2). This testing should include drilling a few additional test holes in the recommended area on Figure 2. The results of these test holes should provide information on size, sortment, and clay content of the sediments. Based on the data to be gathered from these additional test holes and in consideration of the distance from the White River, the best site for construction of a well for an aquifer test could then be decided.
A well for an aquifer test should be installed by a qualified driller north of the bridge. Several observation wells should be drilled in the area and an extensive aquifer test should be conducted for a minimum of 72 hours and probably, because of the special connection between the aquifiers, for a longer period. The drawdown in the observation wells should be measured during the pump test to calculate the hydraulic properties of the aquifer. Water samples should be collected for chemical analysis during the aquifer test to find out the chemical changes of the quality of water and also to find the effect of the induced recharge for an extensive period. In the event that the quality of water is not satisfactory by the end of the aquifer test, another aquifer test should be run in the southeast of the recommended area.

The results of the aquifer test(s) will afford a basis for deciding if the area will provide the required quantity and quality of water, determine the proper spacing of production wells, and obtain data for design of the wells.

Before a permanent well is drilled the Lyman-Jones Water Development Association should consult with the South Dakota Water Resources Commission to obtain water rights and a permit to drill a municipal well, and with the South Dakota Department of Health to determine biological and chemical suitability of the water.

For your information a generalized geologic map, data map, the results of chemical analyses of water, the logs of the test holes, a map showing resistivity stations, and resistivity readings are enclosed.

Sincerely,

[Signature]

Assad Barari
Research Geologist

For the State Geologist

AB:mk

Encs:
Fig. 1. Geologic Map of the Little White River Study Area
Fig. 2. Data Map of the Little White River Study Area
Fig. 3. Map Showing Location of Resistivity Stations
Table 1. Chemical Analyses of Water from the Little White River Study Area
Table 2. Resistivity Readings
Appendix 1. Logs of Test Holes in the Little White River Area
Table 1.-CHEMICAL ANALYSES OF WATER FROM THE LITTLE WHITE RIVER STUDY AREA

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¹ Modified for South Dakota by the Department of Health (written communication, Water Sanitation Section, March 20, 1968).
² 1.2 is optimum for South Dakota.

Source: WA, existing well in alluvium; TA, test hole in alluvium; R, Little White River; WP, existing well in Pierre Shale.

Samples were analyzed by the South Dakota Chemical Laboratory.

LOCATION OF WATER SAMPLES
(for map location, see Figure 2)


W₁. SW ¾ SW ¾ NW ¾ sec. 8, T. 4 S., R. 29 E., Road Side Park well.

W₂. NW ¾ NW ¾ NW ¾ NE ¾ sec. 9, T. 43 N., R. 28 W., Test Hole No. 2, water was collected from depth of 14 feet.
Location of water samples – continued.

W3. SE¾NE¼ sec. 9, T. 43 N., R. 28 W., water from Little White River.

W4. SE¾NW¼SW¼NE¼ sec. 15, T. 43 N., R. 28 W., Test Hole No. 9.

W5. SE¾SW¼SW¼NE¼ sec. 15, T. 43 N., R. 28 W., Test Hole No. 10.

W6. SE¾SW¼NW¼ sec. 5, T. 42 N., R. 28 W., Larry Hutchinson well.

W7. SE¾NE¼SW¼NW¼ sec. 24, T. 42 N., R. 29 W., Knife well, 47 feet deep.

W8. SW¼SW¼NE¼SW¼ sec. 23, T. 42 N., R. 29 W., Joseph Larvie well, 48 feet deep.

W9. SW¼SW¼SW¼NW¼ sec. 23, T. 42 N., R. 29 W., Little White River water.

W10. NE¾NE¼NE¼SW¼ sec. 34, T. 42 N., R. 29 W., White River City Well No. 2.

W11. SE¾NE¼SE¼SW¼ sec. 34, T. 42 N., R. 29 W., White River City Well No. 1.
### Table 2. RESISTIVITY READINGS
(for map location, see Figure 3)

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</table>

1 All readings are in Ohm-centimeters, Wenner arrangement of electrode spacing.
2 Electrode spacing for Stations 1 and 2 is 5, 10, 15, 20 etc. feet (adjustment of instrument and training of crew).
APPENDIX 1

LOGS OF TEST HOLES IN THE
LITTLE WHITE RIVER AREA
(for location, see Figure 2)

Test Hole No. 1
Location: SE\%SE\%SW\%SE\% sec. 4, T. 43 N., R. 28 W.
Surface elevation: 1785\textsuperscript{1} feet
Depth to water: 10 feet

0- 1 Topsoil
1-12 Clay, yellowish-brown
12-20 Clay and gravel
20-25 Gravel
25-28 Shale, dark-gray

Test Hole No. 2
Location: NW\%NW\%NW\%NE\% sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1782 feet
Depth to water: 6 feet

0- 1 Topsoil
1- 4 Sand, light-brown, medium
4-20 Sand, coarse to very coarse
20-25 Sand and gravel
26-28 Clay

Test Hole No. 3
Location: SW\%SE\%NW\%NE\% sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1782 feet
Water table: 7 feet

0- 1 Topsoil
1- 7 Sand, medium
7-14 Sand, medium to coarse
14-23 Sand and gravel
23-24 Shale, gray

Test Hole No. 4
Location: NE\%NE\%SE\%NW\% sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1783 feet
Water table: 7 feet

0- 4 Clay
4- 8 Sand, gray, medium-fine
8-18 Sand, medium
18-21 Sand, coarse, some pebbles
21-25 Shale, gray

\textsuperscript{1} Elevations for the test holes are taken from U. S. Geological Survey 7\% minute, 10 feet contour interval map and should not be considered as an exact elevation of the test hole location.
Test Hole No. 5
Location: SE\%NE\%SW\%NE\% sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1791 feet
Depth to water: 6 feet

0-8 Sand, light-brown, grading to gray, coarse, well-sorted
8-18 Sand, coarse
18-21 Sand, coarse to very coarse, some clay
21-26 Clay, gray

Test Hole No. 6
Location: SE\%SE\%SE\%NE\% sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1799 feet
Depth to water: 6 feet

0-1 Topsoil
1-5 Sand, medium
5-18 Sand, gray, medium, little clay
18-23 Shale

Test Hole No. 7
Location: NW\%NE\%NW\%NW\% sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1794 feet
Depth to water: 4 feet

0-2 Topsoil
2-4 Sand, fine, silty
4-9 Sand, brown, medium to coarse
9-27 Clay, dark-gray (shale)

Test Hole No. 8
Location: SW\%NE\%NE\%NW\% sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1794 feet
Depth to water: 4 feet

0-2 Topsoil
2-4 Sand, brown, fine to medium
4-12 Sand, brown changing to gray, medium
12-18 Clay, dark-gray (shale)

Test Hole No. 9
Location: SE\%NW\%SW\%NE\% sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1795 feet
Depth to water: 4 feet

0-2 Topsoil
2-7 Sand, fine, some clay
Test Hole No. 9 – continued.

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
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<tbody>
<tr>
<td>7-15</td>
<td>Sand, gray, medium to coarse</td>
</tr>
<tr>
<td>15-23</td>
<td>Clay, gray</td>
</tr>
</tbody>
</table>

Test Hole No. 10
Location: SE\%SW\%SW\%NE\% sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1798 feet
Depth to water: 6 feet

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
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<tbody>
<tr>
<td>0-1</td>
<td>Topsoil</td>
</tr>
<tr>
<td>1-7</td>
<td>Sand, some clay</td>
</tr>
<tr>
<td>7-15</td>
<td>Sand, medium to coarse, well sorted</td>
</tr>
<tr>
<td>15-17</td>
<td>Clay, gray</td>
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</table>

Test Hole No. 11
Location: SE\%NE\%NW\%SE\% sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1802 feet
Depth to water: 6 feet

<table>
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<td>Topsoil</td>
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<tr>
<td>1-5</td>
<td>Sand, brown, medium to coarse</td>
</tr>
<tr>
<td>5-17</td>
<td>Sand, gray, some pebbles</td>
</tr>
<tr>
<td>17-18</td>
<td>Shale</td>
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</tbody>
</table>

Test Hole No. 12
Location: SW\%NW\%SE\%SE\% sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1805 feet
Depth to water: 7 feet

<table>
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<tr>
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<th>Description</th>
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<tbody>
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<td>Topsoil</td>
</tr>
<tr>
<td>1-4</td>
<td>Sand, brown, fine</td>
</tr>
<tr>
<td>4-8</td>
<td>Sand, medium</td>
</tr>
<tr>
<td>8-17½</td>
<td>Sand, medium, little clay</td>
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<tr>
<td>17½-23</td>
<td>Clay, dark-gray (shale)</td>
</tr>
</tbody>
</table>

Test Hole No. 13
Location: SE\%SE\%NW\%NE\% sec. 22, T. 43 N., R. 28 W.
Surface elevation: 1813 feet
Depth to water: 8 feet

<table>
<thead>
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<th>Depth</th>
<th>Description</th>
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<tbody>
<tr>
<td>0-1</td>
<td>Topsoil</td>
</tr>
<tr>
<td>1-7</td>
<td>Sand, brown, fine</td>
</tr>
<tr>
<td>7-8</td>
<td>Sand, medium</td>
</tr>
<tr>
<td>8-19½</td>
<td>Clay, gray, soft drilling</td>
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<tr>
<td>19½-21</td>
<td>Shale</td>
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</tbody>
</table>

* * *
Test Hole No. 14
Location: NE\%4SE\%4NW\%4NE\%4 sec. 22, T. 43 N., R. 28 W.
Surface elevation: 1814 feet
Depth to water: 7 feet

0-1 Topsoil
1-4 Sand, brown, fine
4-6 Sand, medium, some clay
6-12 Sand, medium to coarse
12-15 Sand, some clay
15-18 Clay, gray, (shale)

Test Hole No. 15
Location: SW\%4NE\%4NW\%4NW\%4 sec. 27, T. 43 N., R. 28 W.
Surface elevation: 1822 feet
Depth to water: 5 feet

0-1 Topsoil
1-4 Sand, fine, some clay
4-13 Sand, medium to coarse
13-16 Clay, dark-gray

Test Hole No. 16
Location: SW\%4NW\%4SE\%4NE\%4 sec. 28, T. 43 N., R. 28 W.
Surface elevation: 1823 feet
Depth to water: 8 feet

0-1 Topsoil
1-5 Sand, fine
5-8 Sand, medium
8-12 Sand, coarse
12-13 Clay, gray
13-19 Sand and gravel
19-21 Shale

Test Hole No. 17
Location: SW\%4SE\%4SW\%4NW\%4 sec. 5, T. 42 N., R. 28 W.
Surface elevation: 1862 feet
Depth to water: 3 feet

0-2 Sand, brown, medium
2-5 Sand, coarse
5-9 Sand, gray, some pebbles
9-12 Shale

Test Hole No. 18
Location: NE\%4SW\%4NE\%4SW\%4 sec. 5, T. 42 N., R. 28 W.
Surface elevation: 1875 feet
Depth to water: dry hole
Test Hole No. 18 – continued.

0-1 Topsoil
1-4 Clay, brown
4-8 Shale, gray

* * *

Test Hole No. 19
Location: SE\(\frac{1}{4}\)NE\(\frac{1}{4}\)SW\(\frac{1}{4}\)NW\(\frac{1}{4}\) sec. 24, T. 42 N., R. 29 W.
Surface elevation: not measured
Depth to water: 7 feet

0-9 Sand, tan, medium coarse
9-11 Shale, gray

* * *

Test Hole No. 20
Location: NE\(\frac{1}{4}\)NE\(\frac{1}{4}\)NE\(\frac{1}{4}\)SW\(\frac{1}{4}\) sec. 34, T. 42 N., R. 29 W.
Surface elevation: not measured
Depth to water: 9 feet

0-5 Clay and sand, (built up area)
5-20 Sand, coarse
20-23 Shale, gray

* * *