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MAJOR AQUIFERS IN DEUEL AND HAMLIN
COUNTIES, SOUTH DAKOTA

by

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DEFINITION OF TERMS

Alluvium: This is a material deposited in stream valleys by running water and is usually high in silt. Very seldom does alluvium contain significant amounts of sand and gravel.

Artesian aquifer: An artesian aquifer is one in which the hydraulic head rises above the top of the aquifer.

Aquifer: A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Bedrock: Solid rock underlying unconsolidated rock material such as shale, limestone, quartzite, etc.

Fresh water: Water containing less than 1,000 mg/l dissolved solids.

Glacial aquifer: A water-bearing formation composed of materials derived from a glacier. In this report it is mainly unconsolidated sand and gravel deposited as outwash from a glacier.

Glacial drift: A collective term applied to all material in transport by glacial ice and deposited by glacial ice. It includes till.

Glacial outwash: This is sand, gravel, silt, and clay which is deposited by water from melting ice. For the purposes of this report, outwash is restricted to sand and gravel.

Hardness: Dissolved calcium and magnesium salts that reduce the lathering ability of soap and form scale in boilers and pipes. Hardness is reported as calcium carbonate and is classified by the U.S. Geological Survey as follows:¹

Properly-constructed well: One constructed to admit a maximum amount of water from an aquifer without excessive loss of head at the well. This generally requires installing a well screen or perforating the casing and installing a gravel pack opposite the depth interval of the aquifer. It also requires pumping the well in such a manner as to remove drilling mud and other fine-grained material from the aquifer adjacent to the well.

Saline water: Water containing more than 1,000 mg/l dissolved solids--slightly saline 1,000 to 3,000 mg/l; moderately saline 3,000 to 10,000 mg/l.

Till: An unsorted, unstratified mixture of clay, silt, sand, gravel, and boulders deposited by a glacier.

Water table: That surface in an unconfined water body at which the pressure is atmospheric. Generally this is the upper surface of the zone of saturation, except where the surface is formed by a poorly permeable body.

1	Milligrams per litre (mg/l)	Grains per gallon (gpg)
Soft	0- 60	0- 3.4
Moderately hard	61-120	3.5- 7.0
Hard	121-180	7.1-10.5
Very hard	More than 180	More than 10.5

ABSTRACT

Four major glacial sand and gravel outwash aquifers--local glacial, Big Sioux, Prairie Coteau, and Altamont--are present in Deuel and Hamlin Counties in northeastern South Dakota.

Local glacial aquifers underlie about 50 square miles (130 square kilometres), are generally less than 20 feet (6 metres) thick, and may yield from 50 to 150 gallons per minute (3 to 9 litres per second) to domestic, stock, and public-supply wells. The water in the aquifer is fresh and a calcium bicarbonate type.

The Big Sioux aquifer underlies about 180 square miles (466 square kilometres), averages about 30 feet (9 metres) in thickness, and may yield as much as 1,000 gallons per minute (63 litres per second) to domestic, stock, irrigation, and public-supply wells. The water in the aquifer is fresh and varies from a calcium bicarbonate to a calcium sulfate type in different areas.

The Prairie Coteau aquifer occurs throughout most of Deuel and Hamlin Counties. The combined thicknesses of sand and gravel beds encountered in test holes ranged from 3 to 144 feet (1 to 44 metres). This aquifer may yield as much as 250 gallons per minute (16 litres per second) to domestic, stock, and irrigation-supply wells. The water in the aquifer is slightly saline and varies from a calcium sulfate to a calcium bicarbonate type in different areas.

The Altamont aquifer underlies about 800 square miles (2,100 square kilometres), averages about 35 feet (11 metres) in thickness, and may yield as much as 500 gallons per minute (32 litres per second) to stock wells. The water in this aquifer is slightly saline and varies from a sodium sulfate to a calcium sulfate type in different areas.

The Dakota aquifer, the major bedrock aquifer, is composed of fine- to medium-grained sandstone which is from 60 feet (18 metres) to as much as 113 feet (34 metres) thick. The water in the aquifer is of

poor quality for domestic use and certain other uses as it is moderately saline and of a sodium sulfate type. The water is used for stock and public water supply, but is unsuitable for irrigation.

The best possibilities for obtaining large-capacity wells such as those generally needed for irrigation are in the Big Sioux and Prairie Coteau aquifers where they are greater than 20 feet (6 metres) thick.

INTRODUCTION

This Information Pamphlet is one of a series of reports on water-resource studies of South Dakota counties. It is designed to acquaint the reader with the general distribution, quantity, and quality of ground water available from the major aquifers in Deuel and Hamlin Counties. A comprehensive report to be published later will contain the basic data collected during the study and much additional information on the hydrology and geology of the area.

Information in this report is based on data (figs. 1 and 2) collected by the United States Geological Survey and the South Dakota Geological Survey during the period 1971-75.

Copies of this publication and other county reports may be obtained from the South Dakota Geological Survey as they become available. Persons wishing additional information about the hydrology and geology may contact the U.S. Geological Survey in Huron or the South Dakota Geological Survey in Vermillion.

The English units used in this report may be converted to metric units by the following conversion factors:²

GLACIAL AQUIFERS

Local Glacial Aquifers

Local glacial aquifers underlie an area of about 50

² Multiply English Unit	By	To Obtain Metric Unit
feet (ft)	0.3048	metres (m)
gallons (gal)	3.785	litres (l)
gallons per minute (gal/min)	0.063	litres per second (l/s)
miles (mi)	1.609	kilometres (km)
square miles (mi ²)	2.590	square kilometres (km ²)

mi² (130 km²) in several isolated areas (fig. 3). These aquifers are composed mostly of exposed sand and gravel outwash on slopes and in valleys but may contain some alluvial silt and sand. Alluvium generally overlies the outwash in drainage channels.

The aquifers are of varied thicknesses. They are generally less than 20 ft (6 m) thick, except in the Round Lake area (fig. 3) and at numerous isolated sites. Large differences in thickness may occur within short distances.

Yields may range from 50 to 150 gal/min (3 to 9 l/s) of water to properly-constructed wells in the thickest parts of the aquifers. Water occurs under water-table conditions in the exposed outwash and under artesian conditions in the buried outwash. Depth to water was 12 ft (4 m) in the Five Ponds area (T. 115 N., R. 53 W., sec. 1) and 9 ft (3 m) in the Gary area (T. 115 N., R. 47 W., sec. 17) in 1974.

Water from these aquifers generally is fresh and a calcium bicarbonate type. Total dissolved solids average 480 mg/l (milligrams per litre) and range from 320 to 620 mg/l. Hardness averages 400 mg/l and ranges from 270 to 470 mg/l.

The water is used for public supply in the towns of Gary and Toronto, and is suitable for irrigation.

Big Sioux Aquifer

The Big Sioux aquifer (fig. 3) underlies an area of about 180 mi² (466 km²) mostly in the valleys of the Big Sioux River and its tributaries. It is mainly composed of meltwater stream deposits, but in several areas such as near Dry Lake, Lake Marsh, and the town of Clear Lake, it is composed of hilly slope outwash (fig. 3). Outwash sand and gravel generally occur along the present drainage, and may be partly combined with alluvial silt and sand. The aquifer is generally overlain by alluvium in the Big Sioux River valley and underlain by till.

The thickness of the outwash in the Big Sioux River-Lake Poinsett area averages about 30 ft (9 m) and ranges from 5 to 123 ft (2 to 37 m). It occurs at the land surface or at a depth of 1 to 4 ft (0.3 to 1.2 m) covered by alluvium. In the Lake Marsh area the outwash thickness averages 30 ft (9 m) and ranges from 2 to 65 ft (1 to 20 m). Near the town of Clear Lake the outwash thickness averages 20 ft (6 m) and ranges from 3 to 88 ft (1 to 27 m) (fig. 3).

The Big Sioux aquifer may yield as much as 1,000 gal/min (63 l/s) of water to properly-constructed wells. Water in the aquifer occurs under water-table conditions. The depth to water is generally less than 10 ft (3 m) below land surface except in the hilly slope area where it is greater.

The most abundant ions in the water are generally calcium and bicarbonate; however, in some areas, calcium and sulfate are the most abundant ions. The water generally is fresh--the dissolved solids in the water average 740 mg/l and range from 346 to 1,500 mg/l. Hardness of water averages 520 mg/l (very hard) and ranges from 270 to 1,000 mg/l.

The water from the Big Sioux aquifer generally is of good quality for domestic, stock, municipal, and irrigation use and is used extensively for those purposes.

Prairie Coteau Aquifer

The Prairie Coteau aquifer occurs throughout most of Deuel and Hamlin Counties (fig. 4). Figure 4 shows the locations of test holes where sand and gravel beds were encountered. This buried aquifer complex consists of many lenticular outwash sand and gravel bodies which occur at various depths in the glacial drift. The aquifer commonly overlies the Altamont aquifer and underlies the Big Sioux aquifer and local glacial outwash aquifers. The combined thicknesses of these gravel beds range from 3 to 144 ft (1 to 44 m).

The Prairie Coteau aquifer may yield as much as 250 gal/min (16 l/s) of water to properly-constructed wells. Water in the aquifer occurs under artesian conditions. Depth to water was monitored in only one observation well (T. 115 N., R. 48 W., sec. 21) tapping the aquifer; here, the depth to water was 147 ft (45 m) below land surface in 1974.

Water from the Prairie Coteau aquifer is predominantly of calcium sulfate type in some areas and calcium bicarbonate type in other areas. Based on 12 chemical analyses, it is slightly saline--total dissolved solids average 1,830 mg/l and range from 636 to 2,950 mg/l; very hard--hardness averages 1,036 mg/l and ranges from 240 to 1,800 mg/l; and it has a sodium content averaging about 26 percent.

The water is used for irrigation, domestic, and municipal supplies in some areas but because of the wide range in quality it may not be suitable for these uses in other areas. It is used for stock throughout the area.

Altamont Aquifer

The Altamont aquifer underlies an area of about 800 mi² (2,100 km²) in Deuel and Hamlin Counties (fig. 5). It is the lowermost or basal outwash body in the glacial drift. The thickest body of glacial drift in South Dakota (878 ft or 268 m) was found in northwestern Deuel County.

The aquifer consists mainly of irregularly layered

beds of outwash sands and gravels in the drift. The outwash lies upon the bedrock--Upper Cretaceous Pierre Shale and Niobrara Marl³--except in a few areas where it lies upon a thin layer of till on top of the bedrock.

The thickness of the aquifer ranges from 3 to 101 ft (1 to 31 m) and averages 35 ft (11 m) and the depth to the top of the aquifer ranges from 151 to 821 ft (47 to 250 m) and averages about 475 ft (145 m) below land surface.

The Altamont aquifer may yield as much as 500 gal/min (32 l/s) of water to properly-constructed wells. Water in the aquifer occurs under artesian conditions. The depth to water in observation well T. 114 N., R. 47 W., sec. 32, tapping the aquifer, was 146 ft (45 m) below land surface in 1974. The water in this well rises 313 ft (95 m) above the top of the aquifer.

Water from the Altamont aquifer is predominantly sodium sulfate in northwestern Hamlin County and calcium sulfate or sodium sulfate water in eastern Deuel County. Based on four chemical analyses, the water is slightly saline--total dissolved solids average 1,710 mg/l and range from 914 to 2,530 mg/l; is very hard--hardness averages 535 mg/l and ranges from 310 to 780 mg/l; and has a sodium content ranging from 19 to 82 percent and averaging 52 percent.

The quality of the water from the Altamont aquifer ranges from poor to unsatisfactory for domestic, municipal, and irrigation use. Although there has been very little development for stock wells, this use appears to be a good possibility for future development.

BEDROCK AQUIFERS

The Dakota aquifer is the major ground-water source in the bedrock. It probably underlies the entire area and occurs at depths of 1,240 to 1,330 ft (378 to 405 m) in western Hamlin County and about 1,040 ft (317 m) in southern Deuel County. It consists of white fine- to medium-grained and loosely- to well-consolidated sandstone that ranges in thickness from 60 ft (18 m) in southeastern Deuel County to 113 ft (34 m) in southwestern Hamlin County. Yields range from 50 to 150 gal/min (3 to 9 l/s) to properly-constructed wells.

³The stratigraphic nomenclature used in this report is that of the South Dakota Geological Survey and does not necessarily follow the usage of the U.S. Geological Survey.

Depth to water was 305 feet (93 m) in an observation well in T. 113 N., R. 55 W., sec. 23 in 1974. The aquifer is under artesian conditions, and water in this well rose 950 ft (299 m) above the top of the aquifer.

The water from the Dakota aquifer is of poor quality for human consumption; therefore, domestic and municipal use is limited. It is unsuitable for irrigation, but usable for stock. Based on four chemical analyses, the water is moderately saline--the total dissolved solids average 3,070 mg/l and range from 2,390 to 3,900 mg/l. The water is a soft to moderately hard sodium sulfate type. Hardness averages 75 mg/l and ranges from 35 to 140 mg/l; sodium content average about 97 percent.

Other bedrock aquifers may be present in the Niobrara Marl and Carlile Shale, although neither formation has been developed in this area. Both formations probably have little potential, although the chalk of the Niobrara Marl and the fine-grained sandstone stringers in the Carlile Shale have been developed in other parts of South Dakota.

GROUND-WATER SUPPLIES FOR LARGE-CAPACITY WELLS

The best possibilities for obtaining ground-water supplies for large-capacity wells such as those generally needed for irrigation are in the areas shown in figure 3 where the aquifer thickness is greater than 20 ft (6 m). Before large-capacity wells are properly constructed, a test hole should be drilled at the selected location to determine the thickness of the aquifer and to provide samples for determining the grain size of the aquifer material. This information will help in the selection of the proper slot size and length of screen to be used in the proper construction of the test well. Pumping the test well shows the yield of the aquifer at that locality and provides a water sample for chemical-quality analysis. A knowledge of the type of soil and subsoil and the topography are also important in determining the suitability of the land for irrigation, and in selecting the most suitable irrigation system.

Ground-water supplies for irrigation are obtained from the Big Sioux and Prairie Coteau aquifers. Local glacial aquifers may have a potential for supplying irrigation wells, especially in the Round Lake area. The Altamont aquifer probably has the poorest potential because it is too deep and the water is poor quality for irrigation.

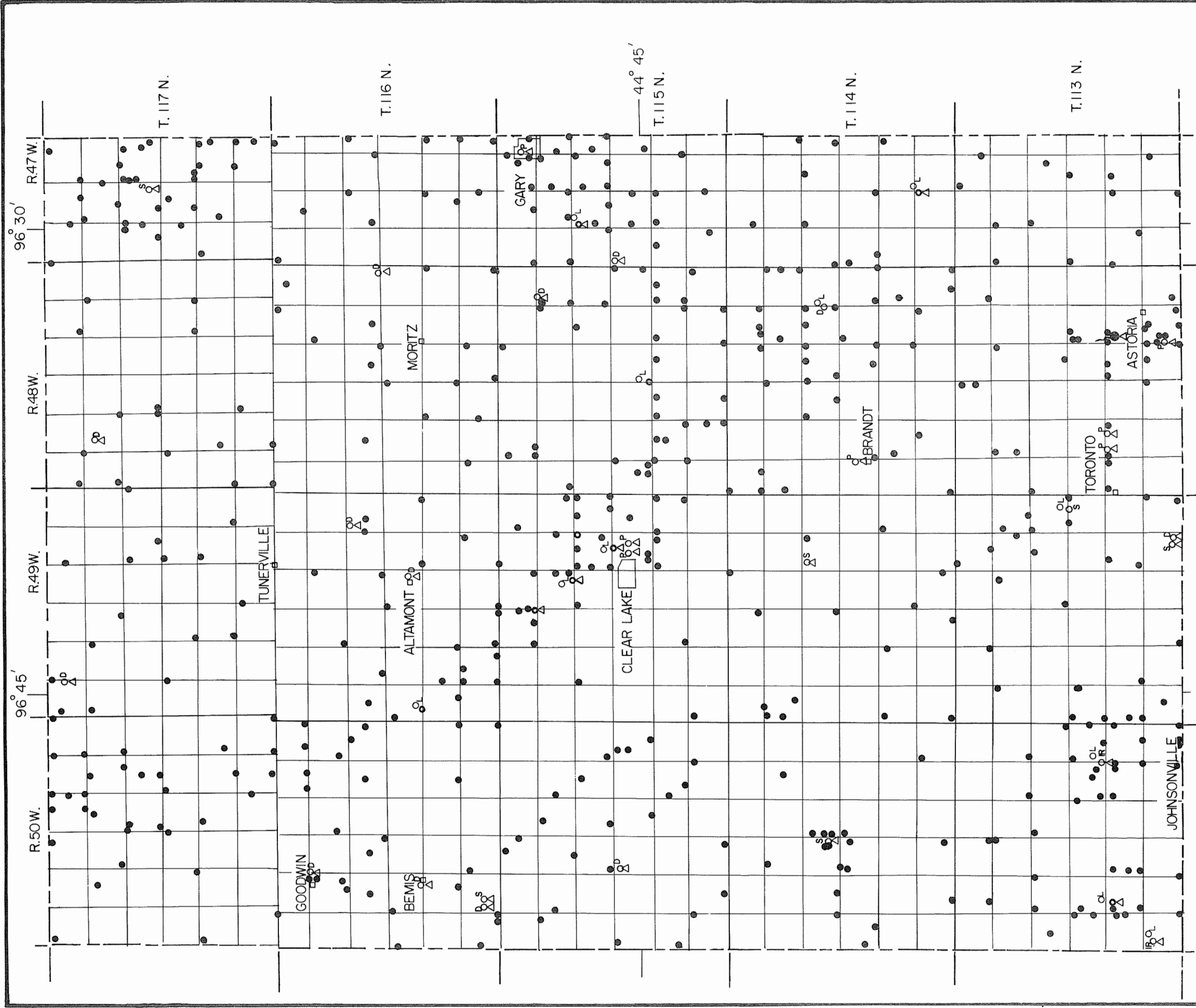
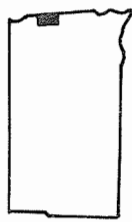


Figure 1.--Map showing locations of test holes and wells in Deuel County.

EXPLANATION

- TEST HOLE-Geologic log available.
- OBSERVATION WELL - Water-level measurement site.
- L LOG-Geologic, electric, or drillers log available.
- △ QUALITY-OF-WATER SITE- Chemical analysis of water.
- D WELL USED FOR DOMESTIC - WATER SUPPLY
- S WELL USED FOR STOCK - WATER SUPPLY
- P WELL USED FOR PUBLIC - WATER SUPPLY
- X DESTROYED WELL.
- SPRING - Spring used for domestic-water supply. The tail points in the direction of flow.
- IR WELL USED FOR IRRIGATION - WATER SUPPLY



Index map of South Dakota showing location of Deuel County.

Base from U.S. Geol. Survey 1:250,000 quads

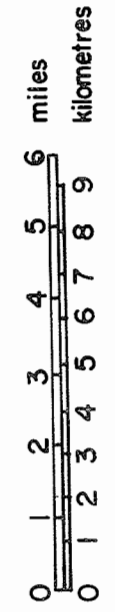
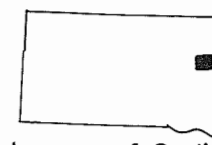
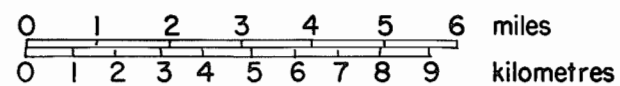


Figure 2.-- Map showing locations of test holes and wells in Hamlin County.

EXPLANATION

- TEST HOLE- Geologic log available.
- OBSERVATION WELL - Water-level measurement site.
- L LOG-Geologic, electric, or drillers log available.
- △ QUALITY-OF-WATER SITE - Chemical analysis of water sample.
- D WELL USED FOR DOMESTIC-WATER SUPPLY
- S WELL USED FOR STOCK-WATER SUPPLY
- P WELL USED FOR PUBLIC-WATER SUPPLY
- ⊙ UNUSED WELL
- ✕ DESTROYED WELL
- IR WELL USED FOR IRRIGATION-WATER SUPPLY

Base from U.S. Geol. Survey 1:250,000 quadrangles



Index map of South Dakota showing location of Hamlin County.

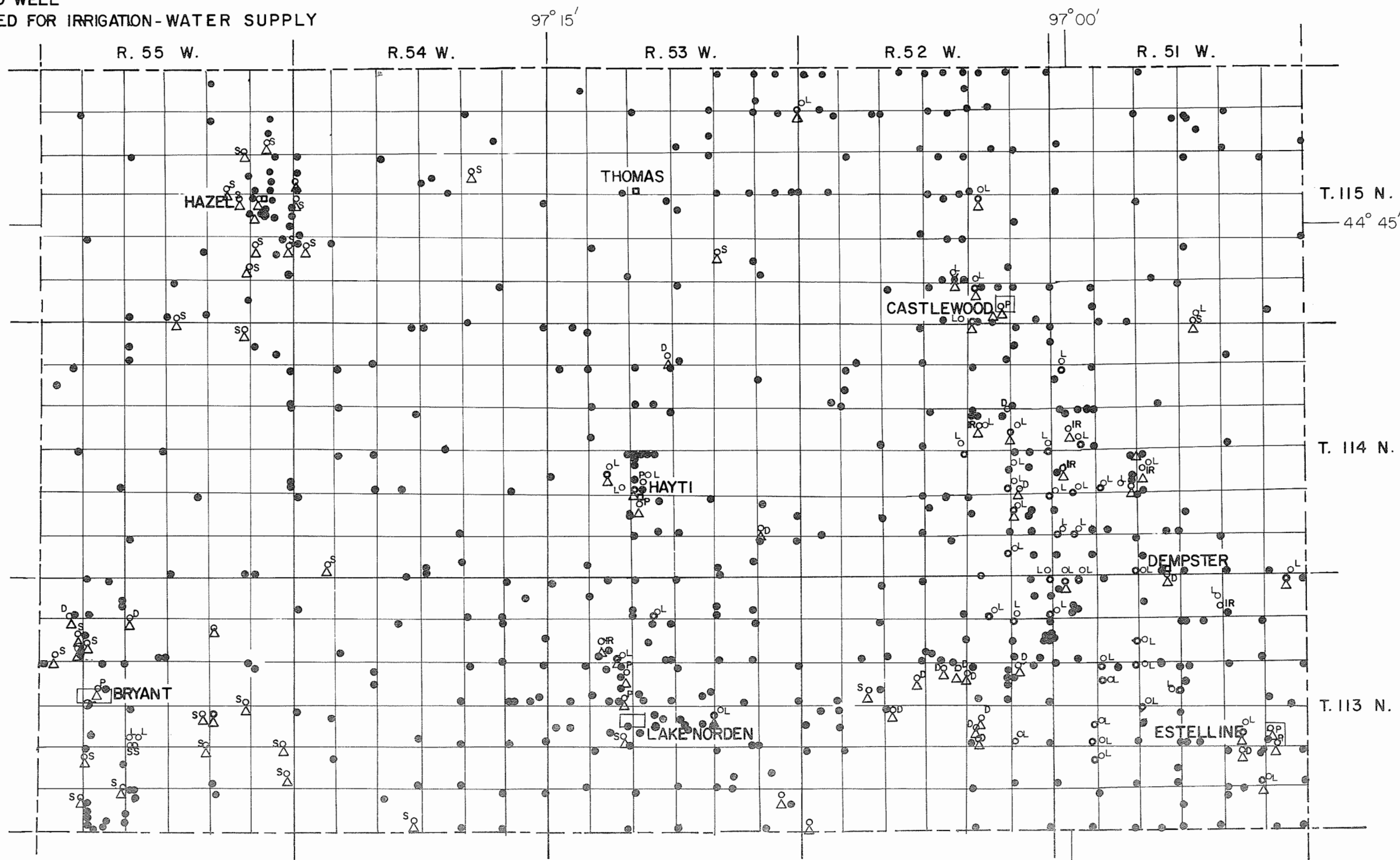
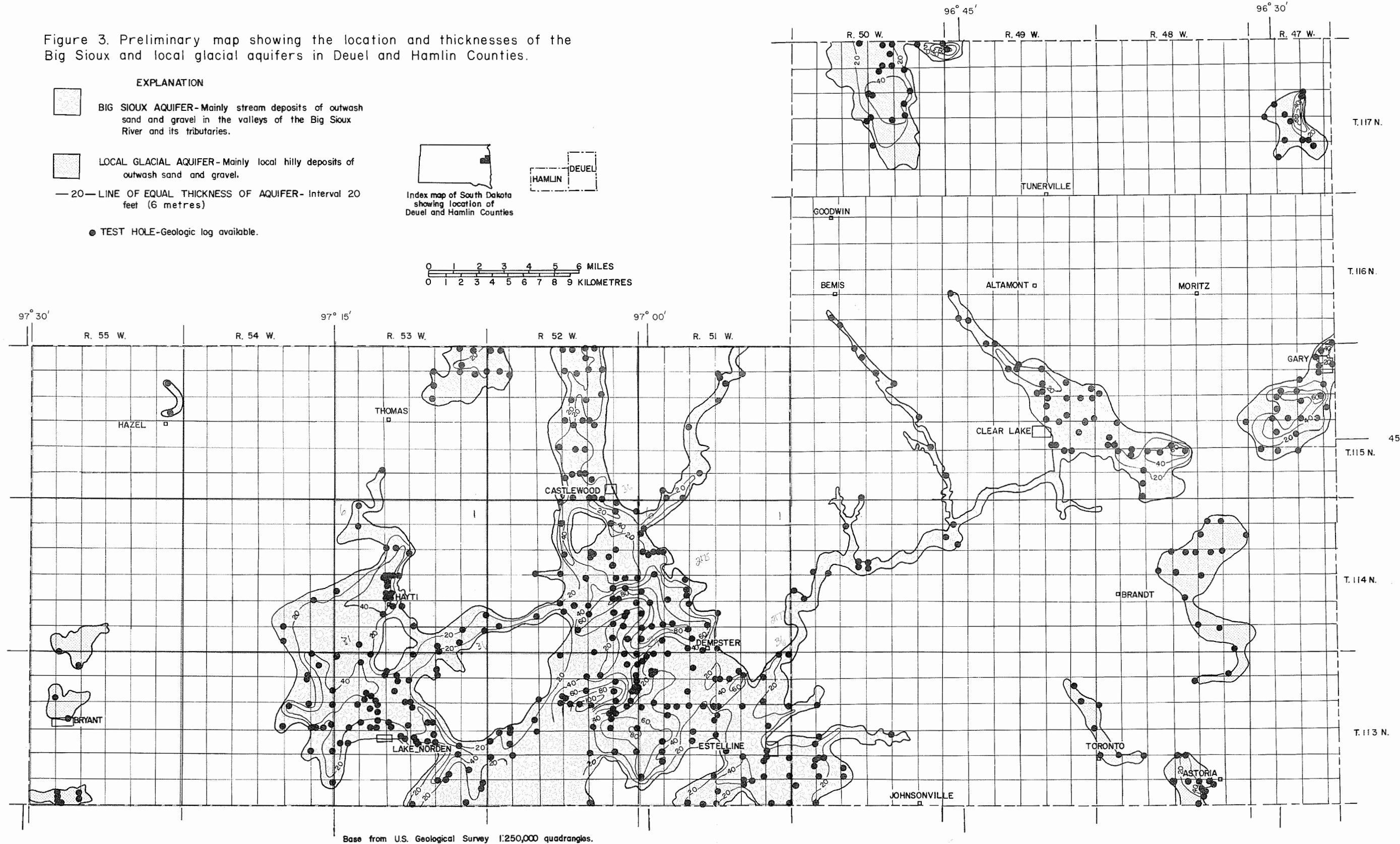




Figure 3. Preliminary map showing the location and thicknesses of the Big Sioux and local glacial aquifers in Deuel and Hamlin Counties.



EXPLANATION

 **BIG SIOUX AQUIFER**-Mainly stream deposits of outwash sand and gravel in the valleys of the Big Sioux River and its tributaries.

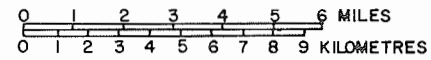
 **LOCAL GLACIAL AQUIFER**-Mainly local hilly deposits of outwash sand and gravel.

— 20 — **LINE OF EQUAL THICKNESS OF AQUIFER**- Interval 20 feet (6 metres)

● **TEST HOLE**-Geologic log available.



Index map of South Dakota showing location of Deuel and Hamlin Counties



Base from U.S. Geological Survey 1:250,000 quadrangles.

Figure 4.-- Preliminary map showing the locations of test holes in the Prairie Coteau aquifer in Deuel and Hamlin Counties.

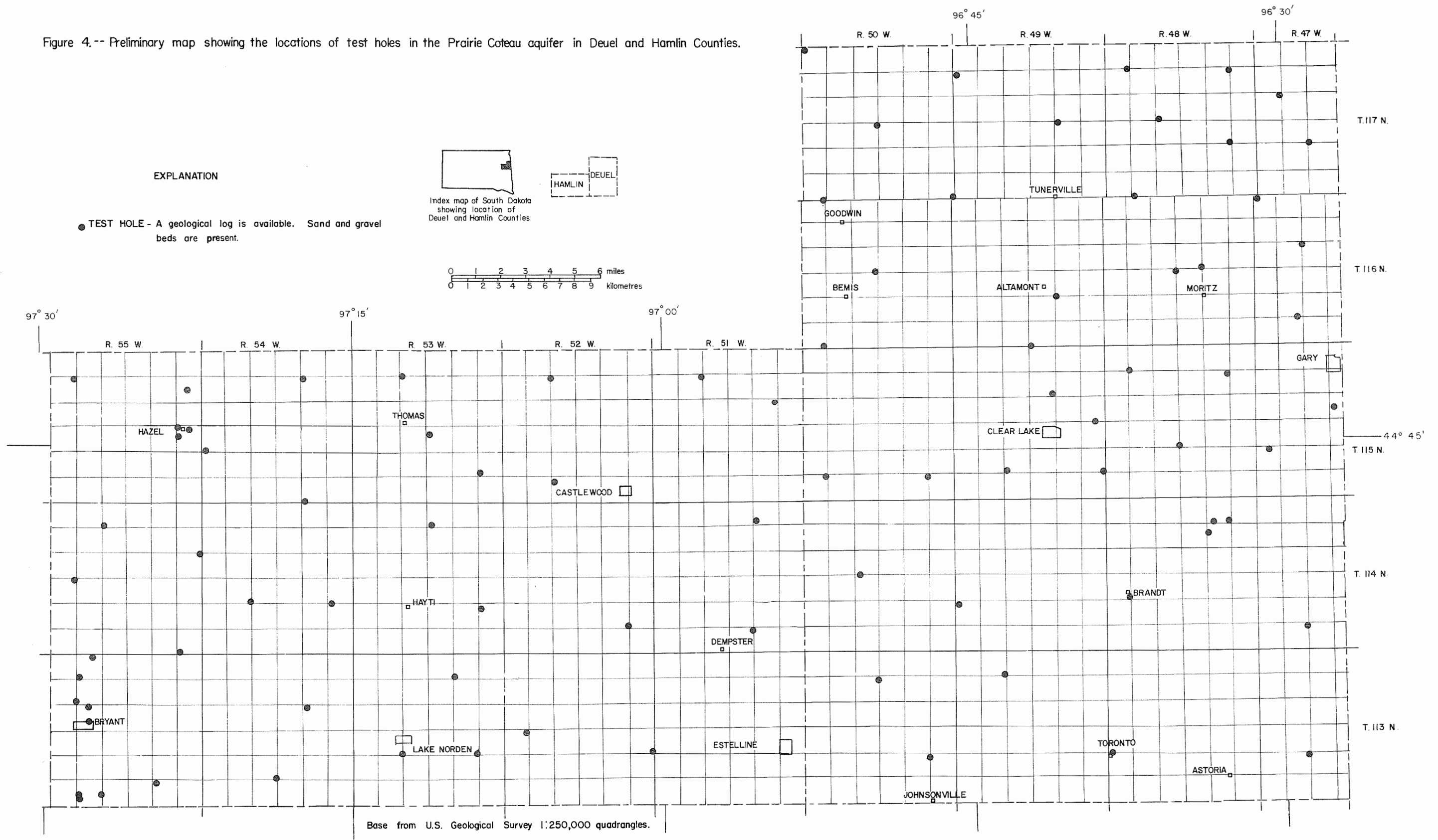
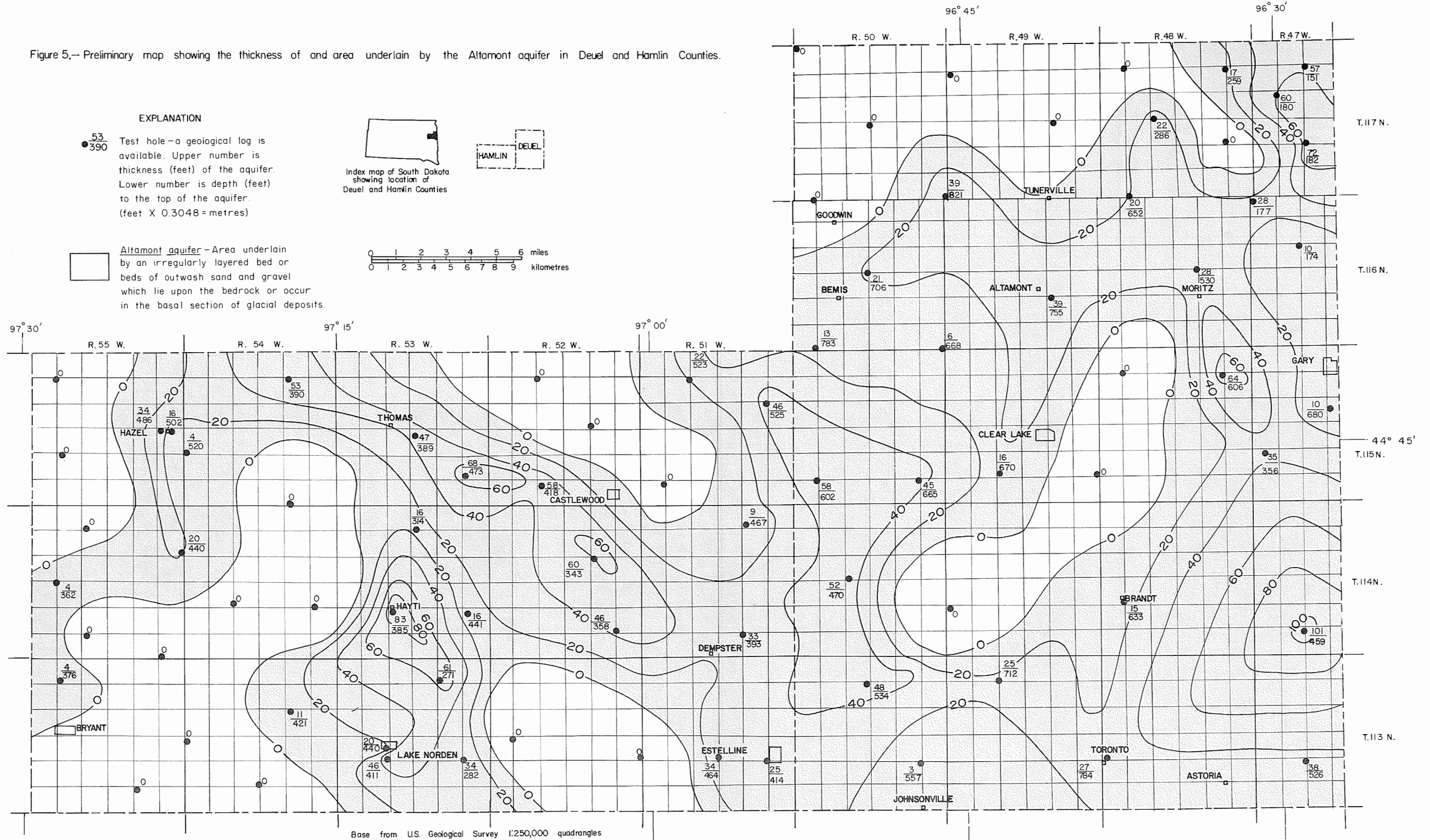
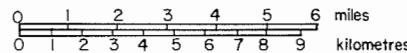
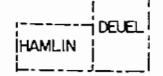
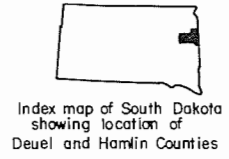


Figure 5.-- Preliminary map showing the thickness of and area underlain by the Altamont aquifer in Deuel and Hamlin Counties.



EXPLANATION

● ⁵³/₃₉₀ Test hole—a geological log is available. Upper number is thickness (feet) of the aquifer. Lower number is depth (feet) to the top of the aquifer. (feet X 0.3048 = metres)



□ Altamont aquifer—Area underlain by an irregularly layered bed or beds of outwash sand and gravel which lie upon the bedrock or occur in the basal section of glacial deposits.

Base from U.S. Geological Survey 1:250,000 quadrangles