



Occurrence of Ground Waters
of Low Hardness and of
High Chloride Content in
Lyon County, Minnesota

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*Prepared in cooperation with the Division of Waters,
Minnesota Department of Conservation*



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INTRODUCTION

The ground water in Lyon County and elsewhere in southwestern Minnesota is generally hard and low in chloride. It is the purpose of this report to describe briefly the occurrence in Lyon County (pl. 1) of waters of low hardness and of high chloride content. The waters are found largely in Cretaceous sandstone.

The data were collected in conjunction with a countywide study of the geology and ground-water resources that is being made as part of a statewide investigation in cooperation with the Division of Waters, Minnesota Department of Conservation. The work is under the direct supervision of the junior author, who is district geologist for Minnesota.

Hardness and chloride determinations were made with field-testing kits at the time data were obtained on most of the farm wells in the county. Tests were made on wells that were reported to yield relatively soft or "salty" water.

GEOLOGIC CONDITIONS

The basement rock in northern, northeastern, and eastern Lyon County is Precambrian granite that has been deeply weathered. It is covered by a thin, extensive regolith which, in this area, consists of colluvial deposits and weathered materials, some of which were transported and reworked during the Cretaceous.

Upper Cretaceous strata overlie the granitic basement rock and are covered with glacial drift. They are mostly flat lying and are composed largely of thick beds of soft bluish-gray shale alternating with thin beds

of loosely consolidated sandstone. The strata were deposited in a basin whose axis bisects the county from northwest to southeast. The Cretaceous strata are about 450 feet thick near the center of the depositional basin and gradually pinch out against its flanks. In the vicinity of the northeast flank of the basin, thin, discontinuous beds of sandstone occur at depths of about 100 to 300 feet. The sandstones are composed of subangular to subrounded quartz grains and are not more than a few feet thick. In places, they are in contact with the underlying regolith.

OCCURRENCE OF GROUND WATER

The Cretaceous sandstones are the principal sources of ground water in the report area. The glacial drift, being very thin in this area, is relatively unimportant. A few domestic wells of small yield obtain water from the regolith at depths of 300 to 550 feet.

Water in the Cretaceous aquifers occurs under artesian conditions. Static water levels in most farm wells range from 20 to 70 feet below the land surface, but there are some flowing wells along the southwest edge of the area. The sandstones containing water of low hardness and of high chloride content generally occur between depths of about 100 and 300 feet.

The accompanying map shows the approximate extent of areas in Lyon County where soft and moderately hard waters occur. Soft water is defined in this report as having a hardness of less than 70 ppm (parts per million), and moderately hard water, 70 to 120 ppm. Soft and moderately hard waters occur in areas totaling about 130 square miles, including about 20 square miles in which soft water alone is found. The chloride

content of water in these areas ranges from about 50 to 500 ppm, the average being about 250 ppm.

In the north-central part of the county the map shows the approximate limits of an area of about 50 square miles in which the chloride content of the ground water from Cretaceous rocks ranges from 500 to 2,000 ppm and more. The area overlaps only in small part with that of water of low hardness. Variations in chloride concentration are shown by isochlors—lines connecting points where equal chloride concentrations occur. The areas of maximum concentration (more than 2,000 ppm) are in the vicinity of sec. 2, T. 113 N., R. 43 W., and secs. 2, 3, 4, and 5, T. 113 N., R. 42 W.

Most of the waters of relatively high chloride content in north-central Lyon County are found at about the same depths as the waters of low hardness to the east and northeast (100 to 300 feet), but locally they may also occur in the underlying regolith at greater depths. Except for the waters of highest chloride content, which are used for stock, most of the waters in this part of the county are used for both domestic and stock supplies.

Although the map appears to indicate rather definite limits for the areas shown, relatively soft water and water of high chloride content have been found locally outside these areas. Examples of this are the wells at the following locations: sec. 11, T. 109 N., R. 41 W.; sec. 1, T. 110 N., R. 42 W.; sec. 35, T. 111 N., R. 41 W.; secs. 16 and 28, T. 112 N., R. 42 W.; and sec. 6, T. 113 N., R. 43 W.

Despite the high artesian head, there is a considerable lowering of the water level when farm wells are pumped at rates of 4 to 7 gallons per minute. Apparently the sandstones have a low coefficient of transmissibility.

CONCLUSIONS

The report area was near the margins of the Cretaceous sea where marine, nearshore, and continental sediments were deposited. It is probable that the strata originally contained water ranging from fresh to salty. When the Cretaceous seas receded, fresh water infiltrated and moved underground, diluting the water in the more permeable strata. The water apparently was softened by natural ion exchange where it came in contact with clay minerals which were derived from the weathered granitic rock mass to the northeast and which became saturated with absorbed sodium where the strata contained salt water.

Because the chemical data shown on the accompanying map were obtained by field methods of analysis, the quality and occurrence of the ground water can be described in only a general way. To describe the quality in detail, would require numerous laboratory analyses.

Ground waters of the same quality probably occur in the Cretaceous aquifers of adjacent areas in Redwood and Yellow Medicine Counties. Elsewhere in southwestern Minnesota where the same geologic environment prevails, it is a reasonable assumption that similar ground-water conditions may be found.



EXPLANATION

Area of soft (hardness <70 ppm) and moderately hard (hardness 70-120 ppm) water

Area of soft water (hardness <70 ppm)

1000

Isochlor, dashed where inferred; figure is chloride concentration, in parts per million

WELLS

Figure near well is depth, in feet below land surface. Depths shown to tenths of a foot are measured; all others are reported. Where no figure appears, depth is unknown. "F" indicates flowing well

⊕ Yields soft water

○ Yields moderately hard water

● Yields water containing more than 500 ppm of chloride

⊕ Yields soft water containing more than 500 ppm of chloride

● Yields moderately hard water containing more than 500 ppm of chloride

MAP SHOWING APPROXIMATE EXTENT OF AREAS WHERE GROUND WATERS OF LOW HARDNESS AND OF HIGH CHLORIDE CONTENT OCCUR IN LYON COUNTY, MINNESOTA

SCALE 1:125 000
0 1 2 3 4 5 6 MILES