GROUND-WATER QUALITY

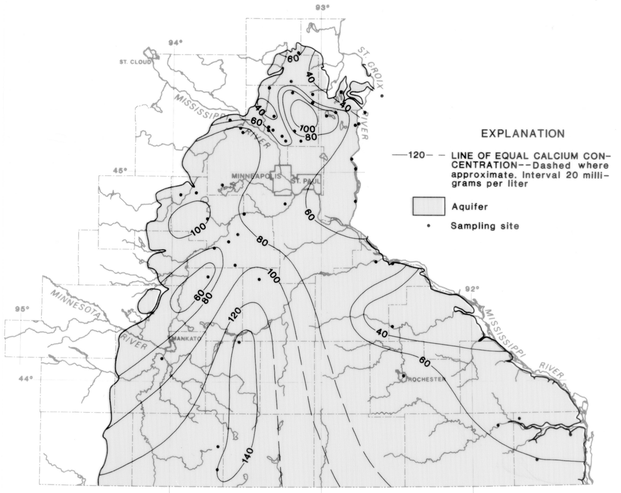

Figure 10.--Calcium concentration

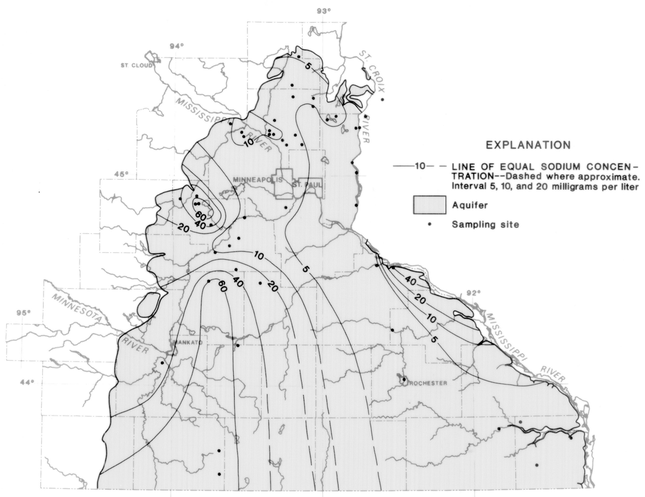

Figure 11.--Sodium concentration

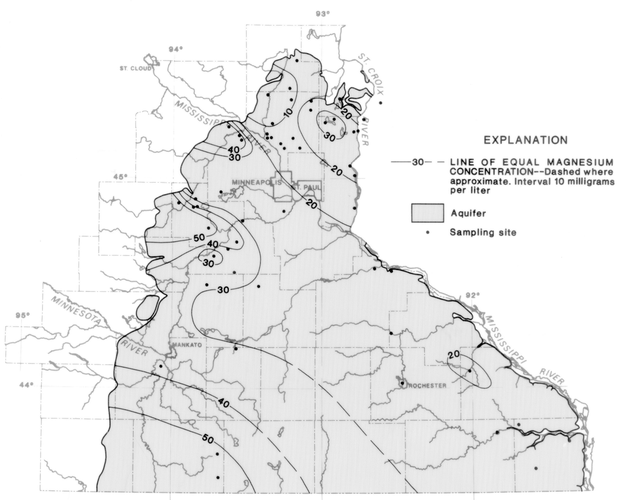

Figure 12.--Magnesium concentration

WATER QUALITY

The quality of water in the Ironton-Galesville aquifer is generally acceptable for municipal, industrial, and domestic uses. The mean, median, and range of selected chemical constituents and physical properties of water from the aquifer are given in table 2. The values in this table are based only on selected water-quality analyses stored in the U.S. Geological Survey National Water Data Storage and Retrieval System (WATSTORE). Values used in preparation of the ion-concentration maps (figs. 9-15), however, are based on data from WATSTORE, from the Storage and Retrieval System (STORET) maintained by the U.S. Environmental Protection Agency, and from the Minnesota Department of Health. Most of the data were collected during 1960-80.

Dissolved Solids

Dissolved-solids concentration, a measure of the dissolved substances in water, is a common indicator of suitability for various uses. Water with less than 500 mg/L dissolved solids is generally satisfactory for domestic and industrial uses.

Concentrations of dissolved solids in the Ironton-Galesville aquifer range from about 200 to 1,000 mg/L (fig. 9). The lowest value is in the northern part of the aquifer, where the rocks are at or close to land surface. High values are in the southwestern part, where the aquifer receives highly mineralized leakage from overlying Cretaceous deposits.

Water Types and Major Ions

Ground water is commonly classified on the basis of relative concentrations in milliequivalents of major cations and anions. Water from the Ironton-Galesville aquifer is predominantly of the calcium magnesium bicarbonate type, as shown by the water-type patterns in figure 9. This type of water is common in recharge areas and generally throughout the upper part of the ground-water system in Minnesota (Winter, 1974).

The concentrations of the major ions, except for bicarbonate and chloride, generally increase toward the southwest (figs. 10-15). Bicarbonate ion increases toward peak values closer to the center of the study area. The decrease in bicarbonate concentration in the southwest corner is where the dominant anion is sulfate (Anderson and others, 1974b). The concentration of chloride ion increases from low values in the central region to higher values in the north and southeast. Highly mineralized leakage from overlying Cretaceous deposits and the general pattern of lateral flow away from the southwest are influences on the ion-concentration patterns. Gradual dilution of the ground water is probable as it moves from recharge areas in the southwest to the major rivers. The areas with similarly high concentrations of calcium and bicarbonate ions attest to the predominance of these ions in the aquifer.

Water-Quality Problems

Most of the Ironton-Galesville aquifer is protected from near-surface pollutants by overlying confining beds. However, faults and buried valleys that intersect the aquifer and fractures in the confining layers are potential pathways for entry of contaminants. Contamination is also possible through multiaquifer wells and deteriorated or improperly grouted well casings. Most known instances of contamination of bedrock aquifers in southeast Minnesota are in the Twin Cities area (Reeder and Norvitch, 1974; Hult and Schoenberg, 1981).

Iron, manganese, chloride, sulfate, and dissolved-solids concentrations locally exceed standards recommended by EPA for public supply (table 2), particularly in the southwest area where the aquifer receives leakage from overlying Cretaceous deposits. High sulfate and iron concentrations and hardness also limit use of the water for municipal and industrial supplies in the extreme southeast corner of the State (Anderson and others, 1974b; Broussard and others, 1975).

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Table 2.--Summary of representative water-quality analyses for selected constituents and properties from the aquifer

[Values are given in milligrams per liter, except as indicated; micromhos per centimeter, μmho/cm; microgram per liter, μg/L]

Constituent or property	Recommended maximum or range for public supply 1/	Number of analyses	Mean	Median	Minimum	Maximum
Specific conductance (μmho/cm at 25°C)	—	24	534	471	240	918
pH (units)	6.5-8.5	28	—	7.6	7.1	8.0
Temperature, water (°C)	—	20	10.8	10.0	7.0	20.0
Hardness as $CaCO_3$	—	27	280	250	140	550
Noncarbonate hardness	—	26	65	8	<1	430
Calcium, dissolved (Ca)	—	28	75	66	39	150
Magnesium, dissolved (Mg)	—	23	28	23	7.3	51
Sodium, dissolved (Na)	—	27	16	7.0	2.6	63
Sodium percentage	—	23	7	5	<1	25
Potassium, dissolved (K)	—	24	4	2	0.9	19
Bicarbonate (HCO_3)	—	23	350	310	160	630
Carbonate (CO_3)	—	16	<1	<1	<1	<1
Sulfate, dissolved (SO_4)	250	28	53	18	.3	400
Chloride, dissolved (Cl)	250	27	4.7	1.3	<.1	61
Fluoride, dissolved (F)	—	27	0.3	0.2	.1	1.4
Silica, dissolved (SiO_2)	—	22	16	16	6.3	27
Dissolved solids (residue on evaporation at 180°C)	500	25	365	286	162	1,000
Nitrate, dissolved as N	10	16	.50	.18	.02	2.3
Boron, dissolved as B, μg/L	—	21	40	<10	<10	600
Iron, dissolved as Fe, μg/L	300	26	1,300	780	20	6,200
Manganese, total as Mn, μg/L	50	26	120	70	<1	570

1/ U.S. Environmental Protection Agency, 1975, p. 59566-59587; p. 17143-17147.

CONVERSION FACTORS

For use by readers who prefer to use metric units, conversion factors for terms used in this report are listed below:

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
square mile (mi^2)	2.590	square kilometer (km^2)
gallon (gal)	3.785	liter (L)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
foot per day (ft/d)	0.305	meter per day (m/d)

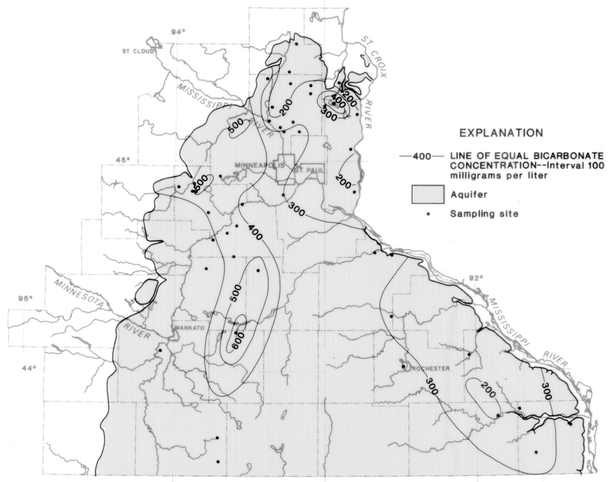

Figure 13.--Bicarbonate concentration

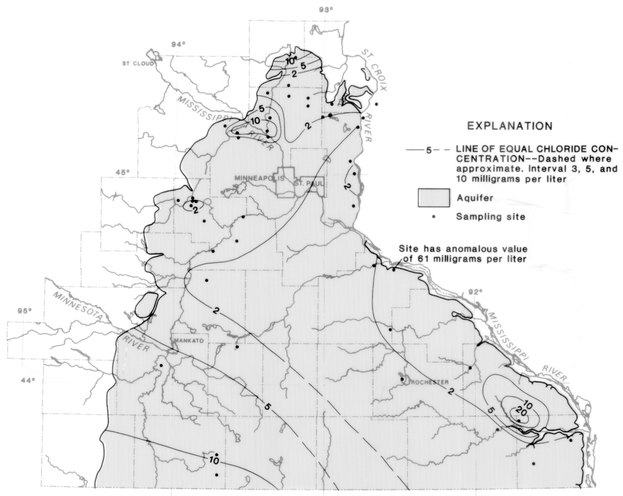

Figure 14.--Chloride concentration

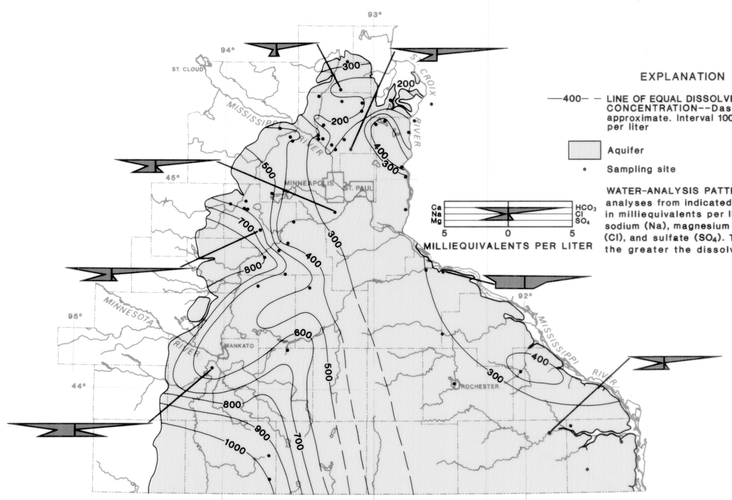

Figure 9.--Dissolved-solids concentration

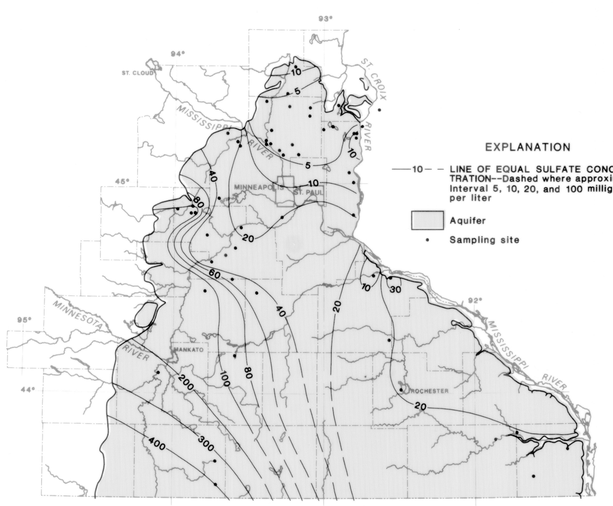

Figure 15.--Sulfate concentration

0 10 20 30 40 MILES
0 10 20 30 40 50 60 KILOMETERS

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE IRONTON-GALESVILLE AQUIFER, SOUTHEAST MINNESOTA

BY
J. F. RUHL, R. J. WOLF AND D. G. ADOLPHSON, 1982

Base from U. S. Geological Survey
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