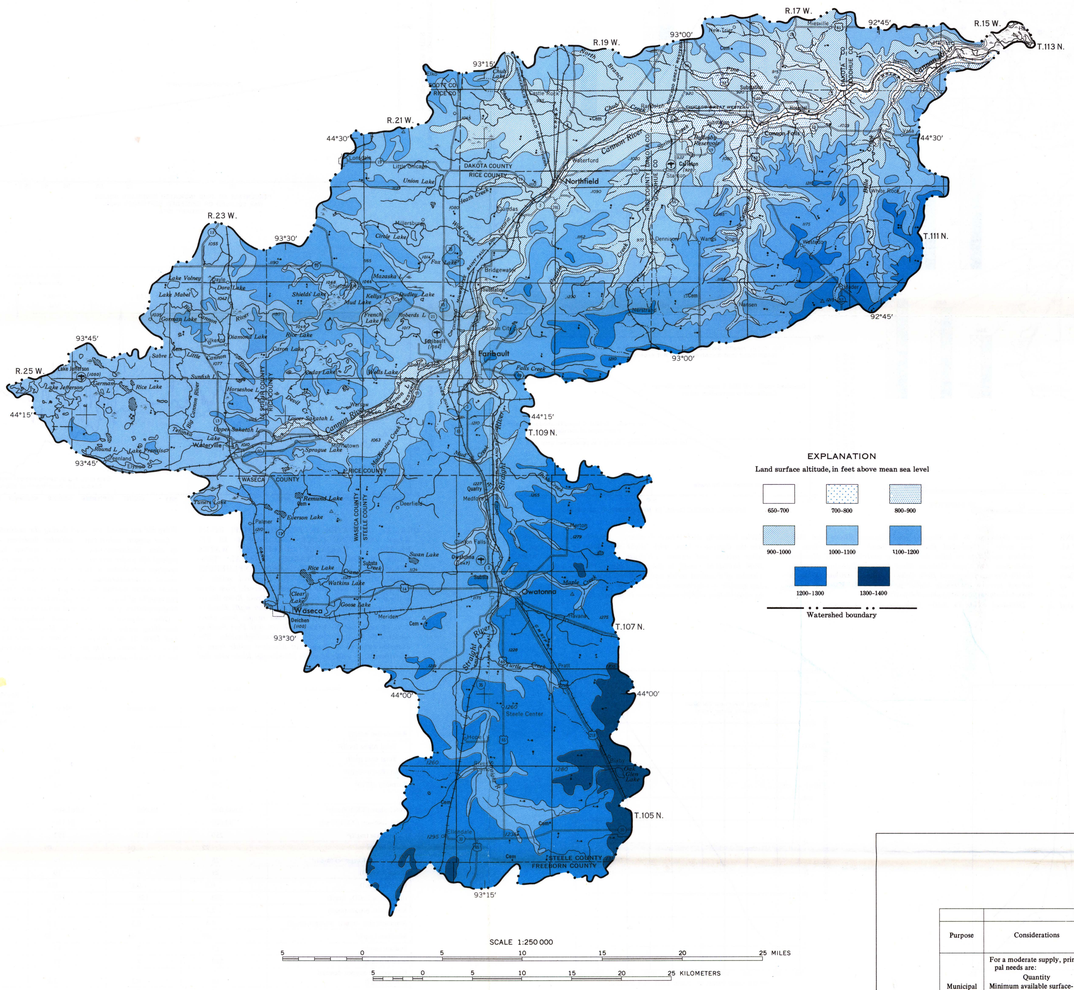
PREPARED IN COOPERATION WITH THE
MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS, SOILS, AND MINERALS



# INTRODUCTION




THE 1,462 SQUARE MILES OF LAND SURFACE IN THE CANNON RIVER WATERSHED VARIES CONSIDERABLY FROM AREAS OF LOW HILLS AND PLAINS TO AREAS DOMINATED BY STREAMS DEEPLY INCISED INTO BEDROCK.—*Much of the south-central part of the area consists of a till plain that ranges in altitude from 1,100 to 1,200 feet above mean sea level. This plain is bordered by end moraines that form ridges on the east, west, and south. The eastern moraine marks the maximum easterard extent of the Wisconsin glacier, rising to more than 1,200 feet above sea level and forming ridges 50 to 100 feet above the till plain. In the northwest, the end moraine ridges are less obvious but extend directly north across the Cannon River valley.*

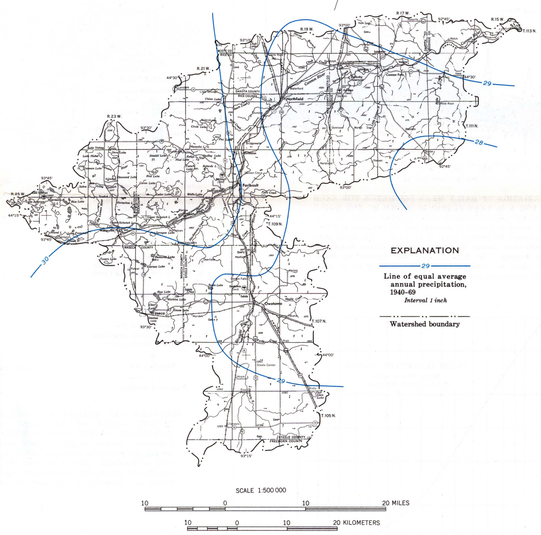
*The end moraine ridges were cut by glacial melt water, which also deepened the pre-existing Cannon River valley. This deeply incised valley captures some of the streams that flow westward off the end moraines.*

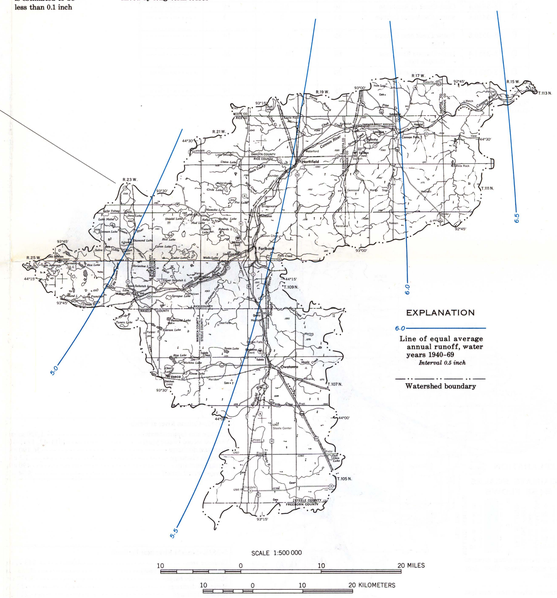
*East of the end moraines, pre-Wisconsin age glacial deposits are relatively thin and deeply weathered and eroded.*

*Large glacial melt-water valleys, around Cannon Falls and extending several miles to the west and southwest, are characterized by broad valley floors underlain by outwash sand and gravel. The Cannon River flows out of the watershed and enters the Mississippi River at about 660 feet altitude.*

# WATER BUDGET

30 inches PRECIPITATION (Average annual, 1940–69) = 5.5 inches RUNOFF (Average annual, from stream-gaging records, water years 1940–69) + 24.5 inches EVAPOTRANSPIRATION (Obtained by difference in water budget) ± 0 UNDERFLOW (The difference between ground-water flow into and out of the watershed is estimated to be less than 0.1 inch) ± 0 CHANGE IN STORAGE (Long-term gains in ground-water, surface-water, and soil-moisture storage are assumed to be nearly balanced by long-term losses)




WATER ENTERING THE WATERSHED AS PRECIPITATION IS APPROXIMATELY EQUAL TO SURFACE RUNOFF PLUS EVAPOTRANSPIRATION.—*The maps show that precipitation decreases but runoff increases from west to east. Runoff increase may be due to thinner glacial deposits in the east and to greater discharge of ground water to the stream valleys in the deeply incised downstream end of the watershed. The amount of underflow entering the watershed from the southeast and southwest is assumed about equal to the underflow leaving the watershed to the south and to the north. No significant areas of ground-water decline are known, indicating that the volume of water in storage is fairly constant.*

# SUMMARY

EVALUATION OF WATER RESOURCES

| Purpose | Considerations | Surface water: Cannon River | Surface water: Large lakes | Surface water: Small lakes and minor streams | Ground water: Pleistocene: Glacial sand and gravel | Ground water: Ordovician: Maquoketa, Dubuque, and Galena Formations | Ground water: Ordovician: St. Peter Sandstone | Ground water: Ordovician: Prairie du Chien Group | Ground water: Cambrian: Jordan Sandstone | Ground water: Cambrian: St. Lawrence and Franconia Formations | Ground water: Cambrian: Ironton, Galesville, and Mount Simon Sandstones |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipal and industrial supply | For a moderate supply, principal needs are: Quantity Minimum available surface-water supply of 1 cfs or wells yielding 250 gpm. Quality Dissolved-solids content less than 500 mg/l. Hardness less than 180 mg/l. | Adequate supply. — Requires treatment. | Adequate supply from some lakes for limited use. — Requires treatment. | Many adequate with development of storage facilities. — Requires treatment. | — Inadequate supply except for a few outwash areas. Susceptible to pollution. | Adequate in southern part of watershed where present. — Hard water, dissolved solids high. Susceptible to pollution, especially through sinkholes.. | Generally adequate supply where deeply buried. — Locally low yields due to very fine sand. Very hard water. Iron high, sulfate and dissolved solids high locally. | Generally adequate supply from limestone and dolomite. Locally New Richmond sandstone yields adequate supply. — Yield varies areally because of distribution of fractures. Susceptible to pollution where near the surface, requires treatment. Very hard water. Iron high. | More than adequate supply throughout area of occurrence. — Very hard water. Iron high; sulfate high locally. | Locally adequate supply from sandstone layers. — Very hard water. Iron high. Deeply buried in southwest area. | Adequate supply throughout the area. — Very hard water. Iron high. Deeply buried in southwest area. |
| Rural domestic and stock supply | For an adequate farm supply, needs are: Quantity Minimum of 5 gpm. Quality Dissolved-solids content less than 1,000 mg/l. | Adequate supply. — Available only to riparian lands. Requires treatment for domestic use. | Adequate supply. — Available only to riparian lands. Requires treatment for domestic use. | Adequate for stock. — Available only to riparian lands. Requires treatment for domestic use. | Locally adequate supply in southwest part of watershed. — Thin or absent in most areas. Very hard water. Iron generally high. | Adequate supply where present. — Hard water. | Adequate supply throughout area of occurrence. Generally acceptable quality. — Very hard water. Iron high. | Adequate supply. Generally acceptable quality. — Very hard water. Iron high. | Adequate supply. Generally acceptable quality. — Very hard water. Iron high. | Adequate supply. Generally acceptable quality. — Very hard water. Iron high. | Adequate supply. Generally acceptable quality. — Very hard water. Iron high. Deeply buried. |
| Irrigation supply | For an average farm, needs are: Quantity Minimum available surface water supply of 2 cfs during growing season or wells yielding 250 gpm. Quality Dissolved-solids content less than 2,000 mg/l. Suitability of water quality for irrigation as indicated by classification of U.S. Dept. of Agriculture. | Adequate supply. — Available only to riparian lands. | Adequate supply from some lakes. Limited use from others. — Available only to riparian lands. | Adequate supply for limited limited use from some. — Available only to riparian lands. | Locally adequate supply in outwash areas. Acceptable quality. — Exploratory drilling needed to define aquifer. | Adequate locally in southern Steele County. Acceptable quality. — Yield varies areally because of distribution of fractures. | Generally adequate supply except near valley outcrops. Acceptable quality. | Adequate supply except near valley outcrops. Acceptable quality. — Yield varies areally because of distribution of fractures. | Adequate supply. Acceptable quality. | Locally adequate supply. Acceptable quality. | Adequate supply. Acceptable quality. |
| Fish and wildlife habitat | Adequate depth and quality of water for fish in lakes and streams. Adequate cover for wildlife habitat is provided by: Wetlands – lakes or potholes surrounded by marsh areas. Stream – marsh and woodland along banks. | Suitable for wildlife along banks. Suitable for fish. — Occasional high water. | Excellent migratory waterfowl resting and feeding areas. Excellent wildlife habitats in marsh areas and along shores. Fish population fairly abundant. | Good migratory waterfowl resting and feeding areas. Excellent habitat along shores and banks. — Fluctuating water stage. | | | | | | | |
| Recreation | Adequate access to lakes and streams. Availability of areas suitable for hunting, fishing and other water sports. Available resorts, lake cottages, and campgrounds. Esthetic values and absence of pollution. | Suitable for hunting, fishing, and canoeing. — Occasional high water. | Suitable for hunting, fishing, and water sports widely distributed. Public access generally available. | Many suitable for hunting and trapping widely distributed. — Most are shallow and may go dry. | | | | | | | |

EXPLANATION

Good
Fair
Poor

Adequate supply, generally acceptable quality. — Advantages
Very hard water. Iron high — Disadvantages

Overall evaluation for purpose and considerations indicated.

MUNICIPAL WATER SUPPLY

| Municipality | Estimated population served (1970) | Water use: Annual industrial use (thousand gallons) | Annual domestic use (thousand gallons) | Total annual pumpage (thousand gallons) | Average daily pumpage (thousand gallons) | Per capita domestic use (gallons per day) | Aquifer: Name | Thickness penetrated (feet) | Water system: Number of wells | Approximate well depth (feet) | Usual pumping rate (gallons per minute) | Specific capacity (gallons per minute per foot of drawdown) | Daily plant capacity (thousand gallons) | Quality (milligrams per liter): Iron (Fe) | Sulfate ($SO_4$) | Chloride (Cl) | Dissolved solids, calculated | Hardness, as $CaCO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cannon Falls | 2,072 | --------- | 47,300 | 47,300 | 129 | 62 | Jordan | 105 | 2 | 640 | 500 | 42 | 1,325 | 0.19 | 23 | 2.3 | 330 | 290 |
| Elko | 115 | --------- | 2,900 | 2,900 | 8 | 70 | Prairie du Chien Jordan | 167 | 1 | 487 | 200 | 7.6 | 288 | .59 | 40 | 3.0 | 440 | 410 |
| Ellendale | 569 | 2,400 | 21,700 | 24,100 | 66 | 104 | Maquoketa to Galena | 100 | 2 | 400 | 150 | 7.5 | 468 | 1.8 | <.5 | 3.0 | 330 | 290 |
| Elysian | 445 | --------- | 5,900 | 5,900 | 16 | 37 | St. Peter | 23 | 1 | 317 | 54 | ------ | 78 | ------ | --- | --- | --- | --- |
| Faribault | 16,595 | 66,000 | 594,000 | 660,000 | 1,800 | 98 | Jordan to Ironton-Galesville | 100 | 1 | 750 | 1,650 | 15 | 9,986 | .62 | 25 | 1.1 | 358 | 330 |
| | | | | | | | Prairie du Chien Jordan | 300 | 4 | 410 | 1,000 | 46 | | .68 | 35 | 1.0 | 370 | 330 |
| Hope | 120 | 4,200 | 2,100 | 6,300 | 17 | 48 | Galena | 121 | 1 | 230 | 88 | ------ | 127 | 1.1 | 18 | .3 | 380 | 330 |
| Kilkenny | 182 | 730 | 6,600 | 7,330 | 20 | 99 | Jordan | 72 | 1 | 380 | ------ | ------ | 133 | .06 | 25 | 1.1 | 480 | 390 |
| Lonsdale | 622 | --------- | 16,300 | 16,300 | 45 | 72 | Ironton-Galesville to Mount Simon | 300 | 2 | 760 | 215 | 8.0 | 454 | 2.5 | 35 | <1 | 540 | 370 |
| Medford | 690 | --------- | 28,500 | 28,500 | 78 | 113 | St. Peter Prairie du Chien | 480 | 1 | 588 | 170 | ------ | 345 | .70 | <1 | <.5 | 500 | 420 |
| Morristown | 659 | --------- | 14,000 | 14,000 | 35 | 53 | St. Peter | 84 | 1 | 184 | 250 | ------ | 360 | 3.1 | 33 | 1.2 | 460 | 390 |
| Nerstrand | 231 | --------- | 3,600 | 3,600 | 10 | 43 | Prairie du Chien | 245 | 1 | 478 | 65 | ------ | 94 | .03 | 30 | 2.5 | 300 | 270 |
| New Trier | 153 | --------- | 2,200 | 2,200 | 6 | 39 | Jordan | 105 | 1 | 560 | 150 | 30 | 216 | <.02 | 18 | 5.9 | --- | 200 |
| Northfield | 10,235 | --------- | 271,000 | 271,000 | 743 | 73 | Prairie du Chien Jordan | 260 | 2 | 400 | 1,000 | 24 | 4,608 | .18 | 29 | <1 | 370 | 230 |
| | | | | | | | Jordan | 45 | 1 | 418 | 1,200 | ------ | | .33 | 19 | 1.5 | 240 | 300 |
| Owatonna | 15,341 | 299,000 | 751,000 | 1,050,000 | 2,900 | 134 | Prairie du Chien Jordan | 300 | 5 | 700 | 1,150 | 40 | 8,208 | .12 | 28 | 1.1 | 277 | 240 |
| Waterville | 1,539 | --------- | 34,500 | 34,500 | 95 | 61 | St. Peter | 86 | 1 | 300 | 250 | 10 | 720 | 2.6 | 0 | 4.4 | --- | 270 |
| | | | | | | | Jordan | --- | 1 | 615 | 250 | 12 | | ------ | --- | --- | --- | --- |
| Total | 49,568 | 372,330 | 1,801,600 | 2,173,930 | 5,968 | 100 | | | | | | | | | | | | |

WATER USE 1970
(million gallons)

| Use \ Source | Ground water | Surface water | Total |
|---|---|---|---|
| Public supply | | | |
| Domestic (population 50,000) | 1,800 | 0 | 1,800 |
| Industrial | 370 | 0 | 370 |
| Rural supply | | | |
| Domestic (population 34,000) | 93 | 0 | 93 |
| Livestock | 680 | 120 | 800 |
| Irrigation | 74 | 36 | 110 |
| Self supplied | | | |
| Industrial | 3,400 | 60 | 3,460 |
| Thermoelectric power | 6 | 26,000 | 26,006 |
| Watershed total (population 84,000) | 6,423 | 26,216 | 32,639 |

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Base from U.S. Geological Survey
Saint Paul, 1953–63,
Mason City, 1953, 1:250,000

Interior—Geological Survey, Reston, Va.—1974

# WATER RESOURCES OF THE CANNON RIVER WATERSHED, SOUTHEASTERN MINNESOTA

By
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1974

For sale by U.S. Geological Survey
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