DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE MINNESOTA DEPARTMENT OF CONSERVATION
DIVISION OF WATERS

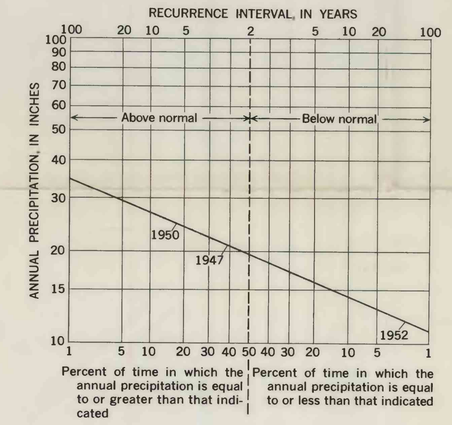
HYDROLOGIC INVESTIGATIONS
ATLAS HA-237 (SHEET 1 OF 4)

PHYSICAL SETTING AND WATER BUDGET

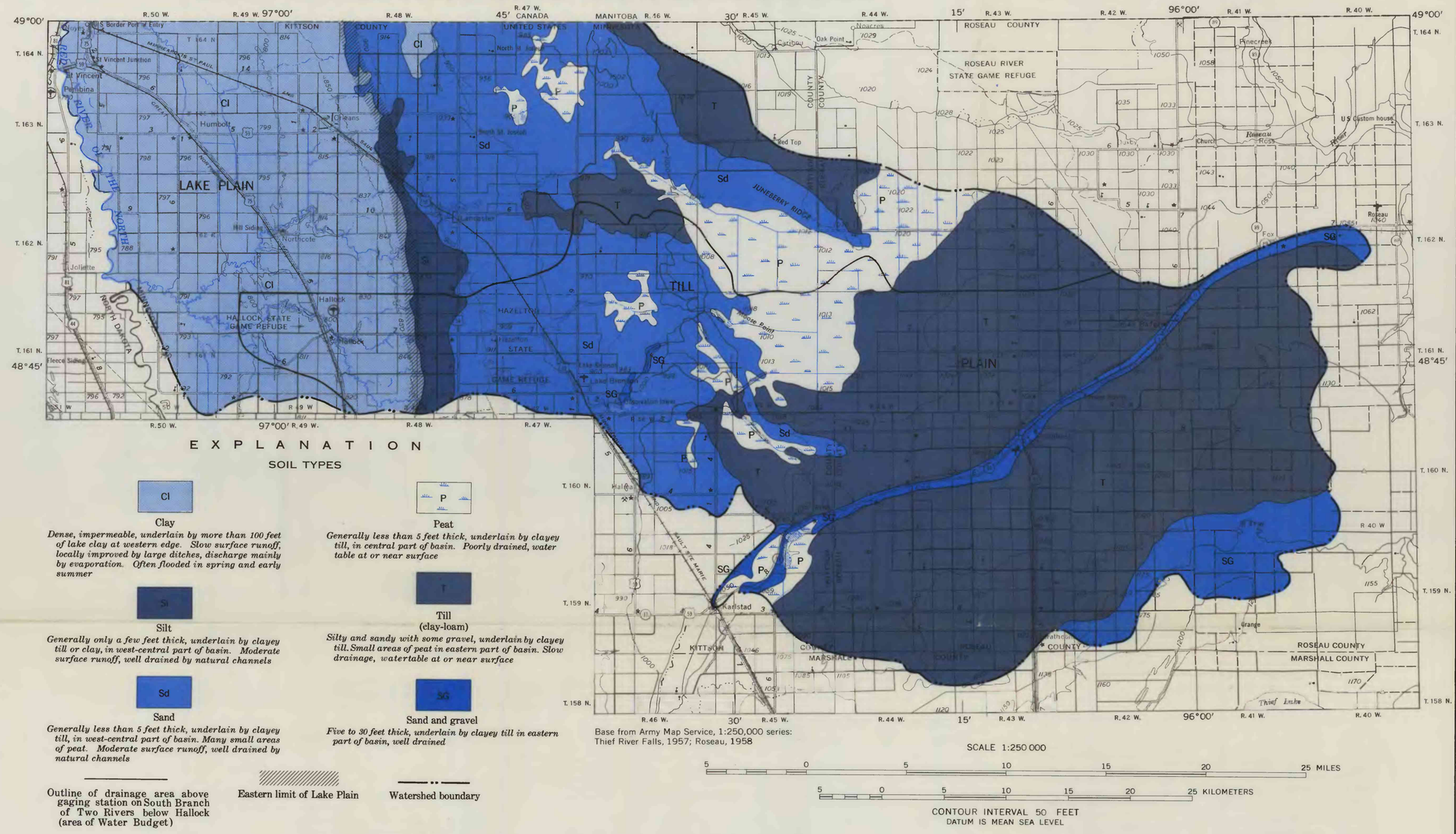
The Two Rivers watershed has a continental climate characterized by wide variation in temperature, scant winter precipitation and normally sufficient summer rainfall for farming. Thunderstorms are the principal source of precipitation during this period. Crop failures due to drought can be expected once every ten years. (U.S. Dept. of Commerce, Weather Bureau, 1959)

CLIMATIC SUMMARY.—*Modified from Minnesota Division of Waters, Bulletin 10* (1959)

Station			Roseau Power Plant	Hallock
Years of record			53	59
Temp. °F.		Maximum	107	109
		Mean annual	37.5	38.0
		Minimum	−52	−51
Precipitation, in inches	Annual	Maximum year	25.97 1925	30.92 1941
		Mean	19.26	20.07
		Minimum year	12.03 1933	11.79 1952
		Snowfall (unmelted)	34.1	30.4
	Mean	Apr–Sept	14.71	15.15
		Oct–Mar	4.55	4.92
	Max. 24 hour		5.07 9-2-57	6.50 9-4-00



FREQUENCY DISTRIBUTION CURVE OF ANNUAL PRECIPITATION AT HALLOCK SHOWS RECURRENCE INTERVALS OF THE YEARS SELECTED TO ESTIMATE WATER YIELD FOR ABOVE AVERAGE, NEAR AVERAGE, AND BELOW AVERAGE PRECIPITATION.— *Years selected were dependent upon available surface water records*



EXPLANATION

SOIL TYPES

Cl — Clay
Dense, impermeable, underlain by more than 100 feet of lake clay at western edge. Slow surface runoff, locally improved by large ditches, discharge mainly by evaporation. Often flooded in spring and early summer

P — Peat
Generally less than 5 feet thick, underlain by clayey till, in central part of basin. Poorly drained, water table at or near surface

Si — Silt
Generally only a few feet thick, underlain by clayey till or clay, in west-central part of basin. Moderate surface runoff, well drained by natural channels

T — Till (clay-loam)
Silty and sandy with some gravel, underlain by clayey till. Small areas of peat in eastern part of basin. Slow drainage, watertable at or near surface

Sd — Sand
Generally less than 5 feet thick, underlain by clayey till, in west-central part of basin. Many small areas of peat. Moderate surface runoff, well drained by natural channels

SG — Sand and gravel
Five to 30 feet thick, underlain by clayey till in eastern part of basin, well drained

Outline of drainage area above gaging station on South Branch of Two Rivers below Hallock (area of Water Budget)

Eastern limit of Lake Plain

Watershed boundary

Base from Army Map Service, 1:250,000 series: Thief River Falls, 1957; Roseau, 1958

SCALE 1:250 000

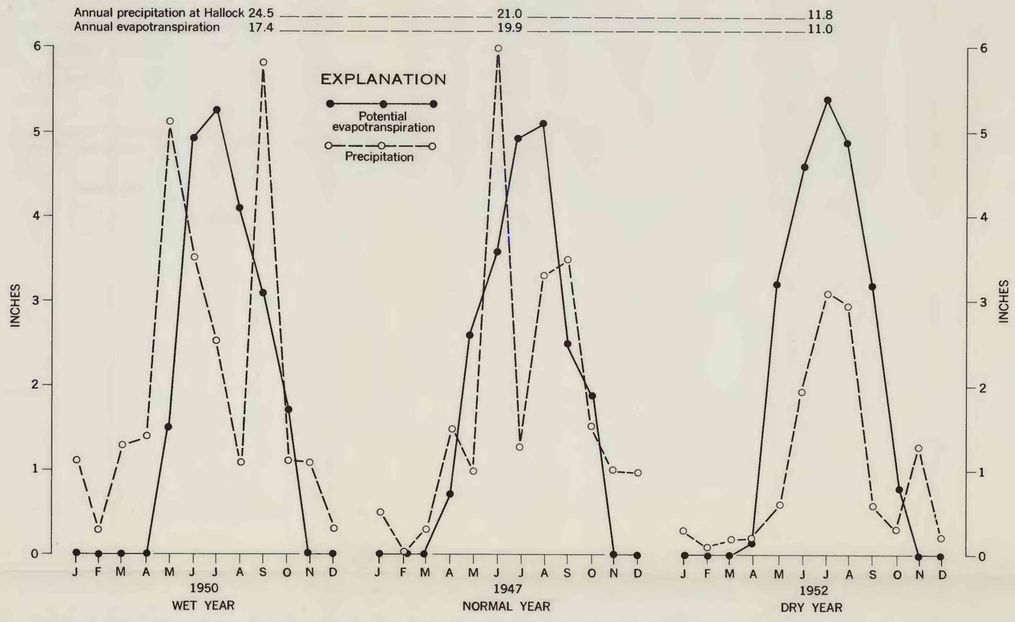
5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

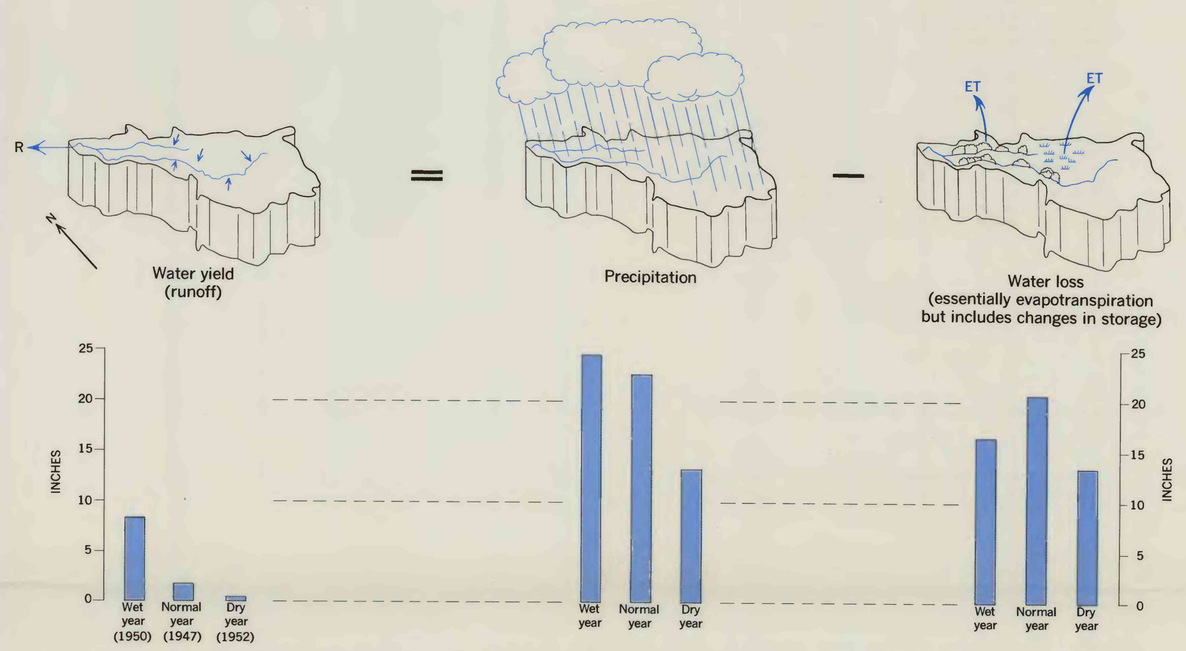
CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL

THE TWO RIVERS WATERSHED INCLUDES TWO PHYSIOGRAPHIC AREAS-A LAKE PLAIN AND A TILL PLAIN-WITHIN ITS 1,232 SQUARE MILES

It lies in parts of Kittson and Roseau counties and includes the drainage basins of the Two Rivers and Joe River. The flat lake plain which extends 15 to 20 miles east of the Red River of the North is extensively cultivated for small grains and sugar beets. The gently undulating till plain is cultivated largely for small grains and hay. The areas not under cultivation support a forest of poplar with some maple and oak. Oak is the predominate tree on the sandy ridges. The large peat areas are covered with brush and marsh grasslands. Outdoor recreational facilities in the watershed consist principally of the Lake Bronson Park, water-fowl hunting in the extensive marshlands, and deer and small game hunting in the forested areas



ACTUAL EVAPOTRANSPIRATION VALUES CALCULATED BY THORNTHWAITE'S METHOD (1948).—*Precipitation at Hallock and a 4-inch soil storage capacity were used. The values agree approximately with the water budget*

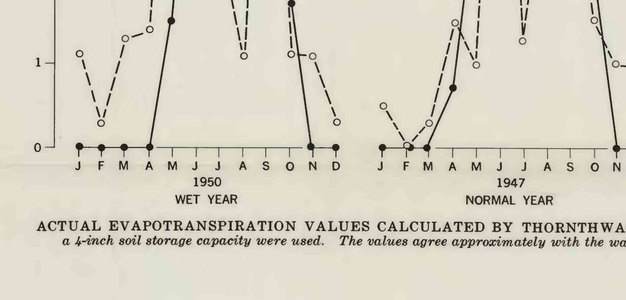


WATER BUDGET FOR MIDDLE BRANCH AND SOUTH BRANCH OF TWO RIVERS BASIN.—*A much greater relative variation is indicated in water yield than in precipitation or water loss. Because ground-water inflow and outflow is small, total water yield available depends on storage of runoff in surface or subsurface reservoirs. Assuming that these hydrologic characteristics are representative, the estimated yield of the entire watershed was 550,000 acre-feet in 1950; 121,000 acre-feet in 1947; and 17,000 acre-feet in 1952*

WATER USE AND SUMMARY

EXPLANATION

Availability		Quality
Surface water	Ground water	All water
Good—sufficient for municipalities, industries	Good—greater than 100 gpm	Good—suitable for municipal, industrial, domestic and agriculture purposes. May require treatment
Fair—sufficient for small municipalities provided storage is available	Fair—20 to 100 gpm	Fair—suitable for domestic and agricultural purposes, but dissolved solids concentration may be higher than 1000 ppm
Poor—undependable for municipalities	Poor—less than 20 gpm	Poor—unsuitable for domestic and agricultural purposes because of high chloride content



EXPLANATION

Total withdrawal in 1963 (million gallons)
13.4
Miscellaneous uses—includes sales to outside customers
Industrial and commercial use
Domestic use
Municipal supply from ground water
Municipal supply from surface water
No municipal supply
Municipal supply obtained from outside watershed

SEWAGE TREATMENT AND DISPOSAL

Travel of sewage effluent, if discharged into stream
Treated sewage discharged through sewer system
Untreated sewage effluent discharged from private systems, cesspools, drainfields, etc.
Watershed boundary

ALL COMMUNITIES IN THE WATERSHED, EXCEPT HALLOCK, USE GROUND WATER FOR MUNICIPAL SUPPLY.—*Only Hallock and Lancaster have sewage treatment facilities*

SUMMARY OF WATER RESOURCES

Source of water		Lake Plain		Till Plain	
		Availability	Quality	Availability	Quality
Surface water	Red River of the North	Source of industrial, municipal, and irrigation supplies. Lowest 7-day average discharge during a year of normal runoff is about 400 cubic feet per second(cfs). During exceptionally dry years, (recurrence interval about 20 years) lowest flow for a 7 day period is less than 50 cfs	Variable—Total dissolved solids ranges from 200 to 600 ppm. Relatively low total dissolved solids during high flows. Suitable for municipal, industrial, and agricultural uses, with treatment	Not present	
	Two Rivers	Natural flow will not provide dependable supply on North Branch, Middle Branch, or South Branch below Hallock. Source of supply for small municipalities and industries where storage is provided upstream. Small amounts of water, (generally less than 100 acre-feet,) may be stored behind low dams in river channel	Fair to good. During low flow, sodium content is as high as 70 parts per million (ppm)	Periods of no flow lasting several months may be expected from late summer through the winter months during most years. Lake Bronson reservoir, in the channel of the South Branch of Two Rivers, has a usable capacity of 3700 acre-feet	Suitable for agricultural and municipal uses
Ground water	Lake clay	Yields small quantities of water to large diameter wells	Unsuitable for domestic use at nearly all places because of high chloride content	Not present	
	Till	Thin sand lenses in buried till generally yield less than 5 gallons per minute (gpm)	Unsuitable for domestic use at most places because of high chloride content	Poor to fair. At most places yields sufficient water for domestic and stock uses. Sand lenses in the clayey till are predominantly small and isolated	Fair to good. Suitable for agricultural and municipal uses except locally near the western part of the Till Plain. Water is hard, high in sulfate and iron
	Surficial beach and shoreline deposits	Not present		Large ridges contain sufficient water for yields of 20 gpm or more to individual wells	Very hard, low chloride, suitable for irrigation
	Surficial channel outwash	Not present		Largest source of ground water in watershed. Yields of 1000 gpm can be developed in coarse, thick parts of the aquifer. Finer materials yield less than 100 gpm	Very hard, low chloride, low sulfate, suitable for irrigation
	Mapped buried sand and silt lenses	Not present		Moderate supplies of 30 gpm or more can be developed at places in these deposits	Very hard, high sulfate
	Cretaceous rocks	Not present		Poor to good generally, yield to wells range from 5 to 50 gpm. Locally more than 500 gpm may be obtained	Soft to moderately hard, highly mineralized near Lake Plain. High boron content
	Paleozoic rocks	Moderate to large quantities of water available	Poor—Highly mineralized, unsuitable for most uses	Present, but not a source of supply because the thickness of Paleozoic rocks is small	

CONCLUSIONS

1. Small to moderate supplies of ground water for domestic use, dairying, creameries, and small municipalities are available at most places in the Till Plain. Moderate to large amounts of highly mineralized ground water, unsuitable for nearly all uses, occurs in the bedrock aquifers below the Lake Plain.
2. The surficial channel outwash deposits extending northward in a belt from Karlstad through the watershed unit is the largest potential source of all the mapped aquifers in the watershed. Well fields in this aquifer near Lake Bronson could furnish large amounts of water for industrial use. The quality of the water also is suitable for irrigation of crops adapted to the region.
3. Water yield of the watershed is approximately equal to the annual surface runoff. Water yield ranges from 17,000 acre-feet during an exceptionally dry year to 550,000 acre-feet during a wet year. The average annual water yield is about 121,000 acre-feet. Utilization of any significant part of the water yield requires storage. However, suitable storage sites are few and small in the relatively flat impermeable watershed.
4. Yield from ground-water reservoir is small compared to surface water, but ground water is important for small local supplies.
5. Ground-water supplies for most small communities in the watershed are adequate for present rate of use. Additional amounts of water could be developed for all communities in the Till Plain although the source may be several miles from the village or town.

Communities in the Lake Plain are dependent upon surface water as a principal source of supply.

6. Regional differences in chemical characteristics of ground water indicate ground water movement.

Aquifers in the western part of the basin will yield highly saline water. Flushing of these aquifers by ground water moving from the west as a result of increased withdrawal would not significantly reduce mineralization of waters.

7. This report is based on a reconnaissance to determine areal availability and give a general appraisal of the water resources in the Two Rivers watershed unit. Detailed studies of water movement through the ground-water reservoir are needed for more exact determination of the amount of water immediately available and the specific effects of water management practices

ACKNOWLEDGEMENTS

We express our appreciation to the many well owners and well drillers in the area for their generous help in supplying information and basic data for this study.

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WATER RESOURCES OF THE TWO RIVERS WATERSHED, NORTHWESTERN MINNESOTA

By

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