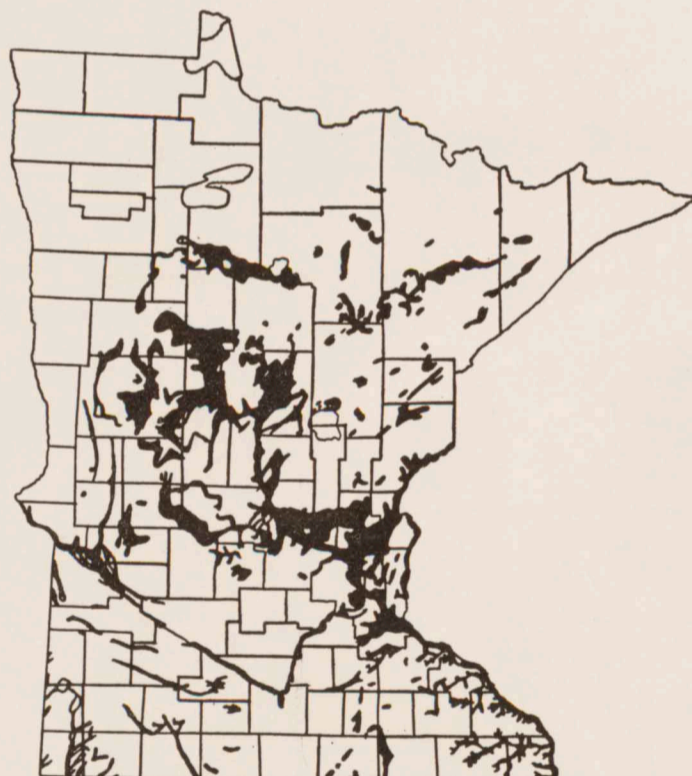
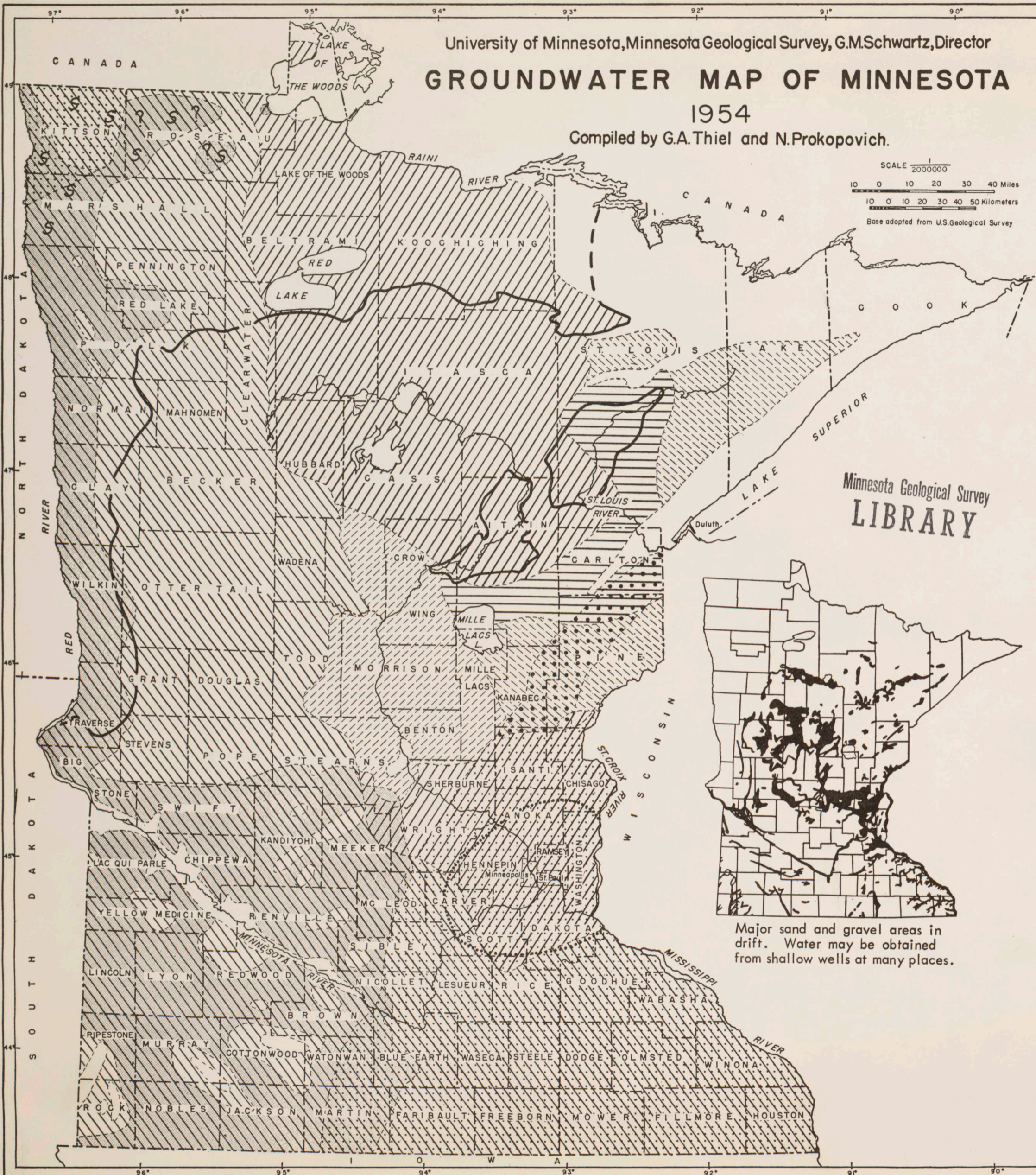


University of Minnesota, Minnesota Geological Survey, G.M. Schwartz, Director
GROUNDWATER MAP OF MINNESOTA
1954

Compiled by G.A. Thiel and N. Prokopovich.

SCALE $\frac{1}{2000000}$
10 0 10 20 30 40 Miles
10 0 10 20 30 40 50 Kilometers
Base adapted from U.S. Geological Survey

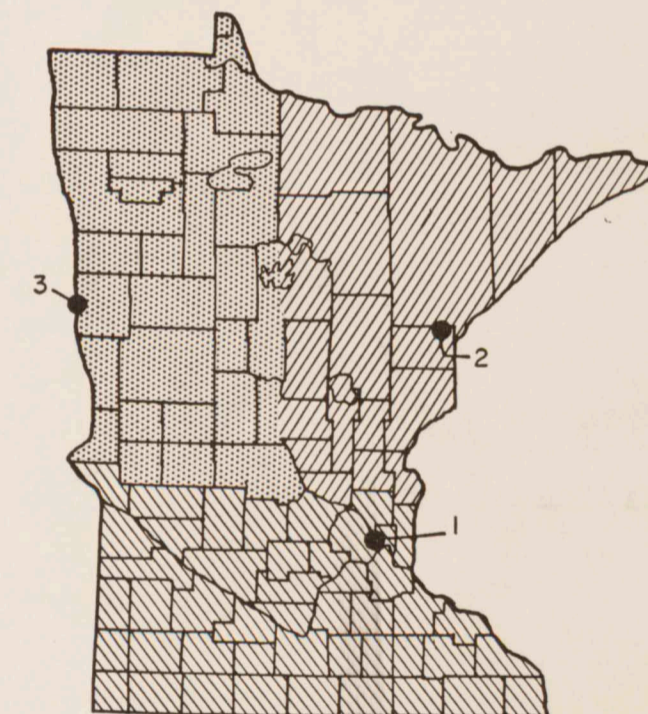


Major sand and gravel areas in drift. Water may be obtained from shallow wells at many places.

EXPLANATION

- MAJOR PROVINCES, SOMEWHAT SIMPLIFIED. BOUNDARIES ARE APPROXIMATE IN MANY PLACES. THE OVERLAPPING OF DIFFERENT PROVINCES IS SHOWN BY THE OVERLAPPING OF CORRESPONDING PATTERNS.
1. DRIFT-COVERING OVER PRECAMBRIAN BEDROCK (QUARTZITES, SLATES, SCHIST, IGNEOUS ROCKS, ETC.) IS THIN OR ABSENT. SHALLOW WELLS MAY OBTAIN WATER FROM DRIFT OR FROM UPPERMOST WEATHERED PART OF BEDROCK. THE POSSIBILITIES FOR OBTAINING WATER FROM DEEP HORIZONS IN PRECAMBRIAN ROCKS IN THIS AND FOLLOWING PROVINCES, EXCEPT NO. 11, ARE VERY LIMITED. IN THE MINNESOTA RIVER VALLEY THICK RESIDUAL CLAYS ARE COMMON UNDER RIVER ALLUVIUM, HOWEVER, GRANITE CROPS OUT AT THE SURFACE IN MANY AREAS.
 2. MOSTLY THICK BUFF OR GRAY CALCAREOUS DRIFT COVERING PRECAMBRIAN BEDROCKS. (FOR OVERLAPPING SEE NO. 8 AND 9.) THE DRIFT, IN GENERAL, CLAYEY AND HAS ONLY LOCAL SANDY WATER-BEARING LENSES WHICH YIELD HARD WATER. SOMEWHAT SOFTER WATER MAY OCCUR IN THE WEATHERED TOP OF PRECAMBRIAN ROCKS, BUT YIELD IS SMALL. SANDY VARIETY OF GRAY DRIFT OCCURS LOCALLY IN STEVENS AND POPE COUNTIES AND NORTHWARD INTO CLEARWATER COUNTY.
 3. OUTLINE OF GLACIAL LAKE AGASSIZ IN THE NORTHWESTERN PART OF MINNESOTA AND GLACIAL LAKES UPHAM AND AITKIN IN NORTH-CENTRAL MINNESOTA. LAKE SEDIMENTS MAY OCCUR ON THE TOP OF THE DRIFT AND LOCALLY HAVE GOOD WATER-BEARING BEDS.
 4. RED CALCAREOUS CLAYEY DRIFT OVER PRECAMBRIAN. LOCAL WATER-BEARING SANDY LENSES YIELD HARD WATER. SOMEWHAT SOFTER WATER MAY OCCUR IN THE WEATHERED TOP OF PRECAMBRIAN ROCKS, BUT YIELD IS SMALL. FOR OVERLAPPING SEE NO. 11.
 5. RED OR BROWN NON-CALCAREOUS SANDY DRIFT OVER PRECAMBRIAN ROCKS. SOFT WATER IS PRESENT IN ABUNDANCE IN MOST LOCALITIES. SOME WATER MAY BE OBTAINED FROM THE WEATHERED TOP OF PRECAMBRIAN ROCKS. FOR OVERLAPPING SEE NO. 9 AND 11.
 6. BUFF CALCAREOUS DRIFT (NO. 2) OVER RED OR BROWN MOSTLY NON-CALCAREOUS DRIFT (NO. 5). LOCALLY THE WEATHERED TOP OF PRECAMBRIAN IS ALSO WATER-BEARING. FOR OVERLAPPING SEE NO. 8, 9 AND 11.
 7. RED OR BROWN NON-CALCAREOUS DRIFT (NO. 5) OVER BUFF CALCAREOUS DRIFT (NO. 2) WHICH RESTS ON PRECAMBRIAN ROCKS.
 8. CRETACEOUS SAND (OR GRAVEL) OVERLAIN BY CRETACEOUS SHALE OCCUR BELOW THE DRIFT. THESE SANDY BEDS YIELD WATER ABUNDANTLY. ? - PRESENCE OF CRETACEOUS DOUBTFUL.
 9. PALEOZOIC AND PRECAMBRIAN WATER-BEARING SANDSTONES AND DOLOMITES. THE ST. PETER, JORDAN, DRESBACH AND HINCKLEY SANDSTONE FORMATIONS ARE EXCELLENT WATER PRODUCERS. SHALLOW WELLS MAY OBTAIN WATER FROM THE DRIFT.
 10. OUTLINE OF THE TWIN-CITY ARTESIAN BASIN.
 11. PRECAMBRIAN SANDSTONES OCCUR UNDER DRIFT. BOTH DRIFT AND SANDSTONE CONTAIN WATER. DRIFT IS VERY THIN OR ABSENT IN A FEW AREAS. WATER IN SANDSTONE IS GENERALLY SOFT.
 12. S SALTY WATER AT DEPTH.

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