Minnesota Department of Natural Resources
County Geologic Atlas Program
mndnr.gov/groundwatermapping

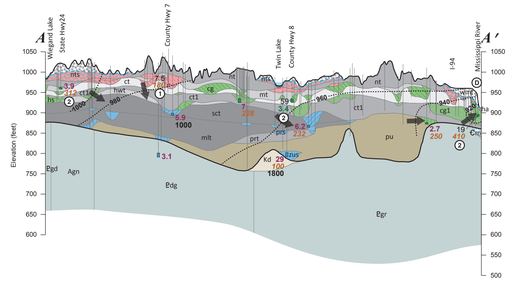
Hydrogeologic Cross Sections

By John D. Barry

2018

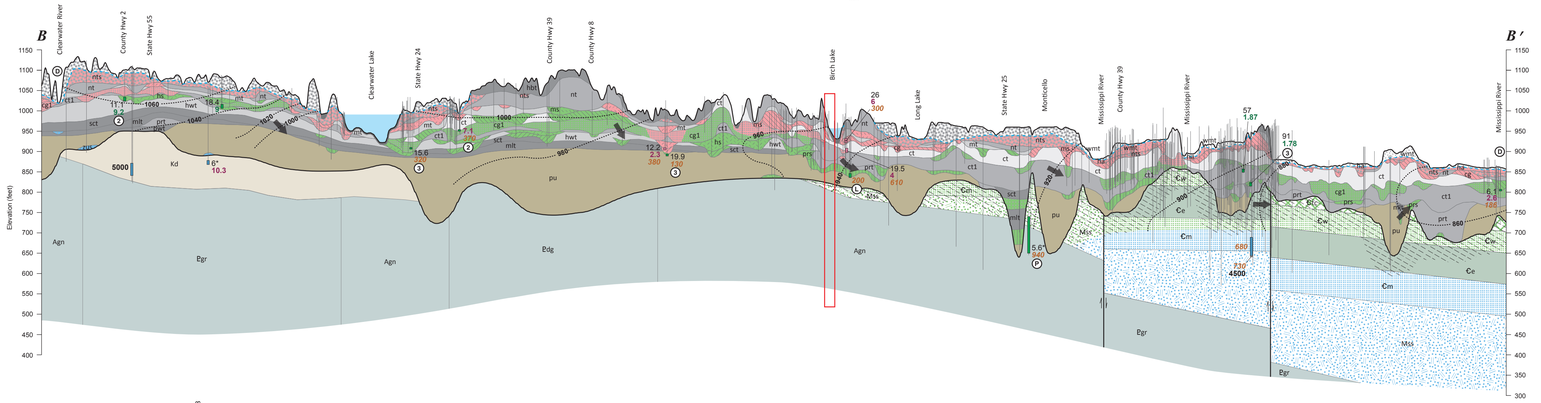
Geologic Atlas of Wright County
County Atlas Series C-30, Part B
Plate 8 of 9
Hydrogeologic Cross Sections
A–A′ through C–C′

To accompany the atlas Report, Plate 7, and Plate 9.



Cross Section A–A′

Three areas of coarse-textured sediments (sand and gravel) allow recent tritium-age water to migrate from the land surface to underlying shallow buried sand aquifers. In these areas, elevated chloride and nitrate were present. Elsewhere, loam till (sand, silt, and clay) lessens groundwater recharge and offers a level of protection to underlying aquifers. Aquifers deeper than approximately 100 feet below the land surface had vintage tritium-age signatures. Water collected from two wells in buried sand aquifers had calculated carbon-14 residence times of 1,000 (scs) and 1,800 (zus) years. Groundwater flow, depicted as equipotential lines, is both vertically downward and east toward the regional groundwater discharge zone, the Mississippi River. Local groundwater flow is toward lakes such as Wiegand Lake and Twin Lake and toward small streams.



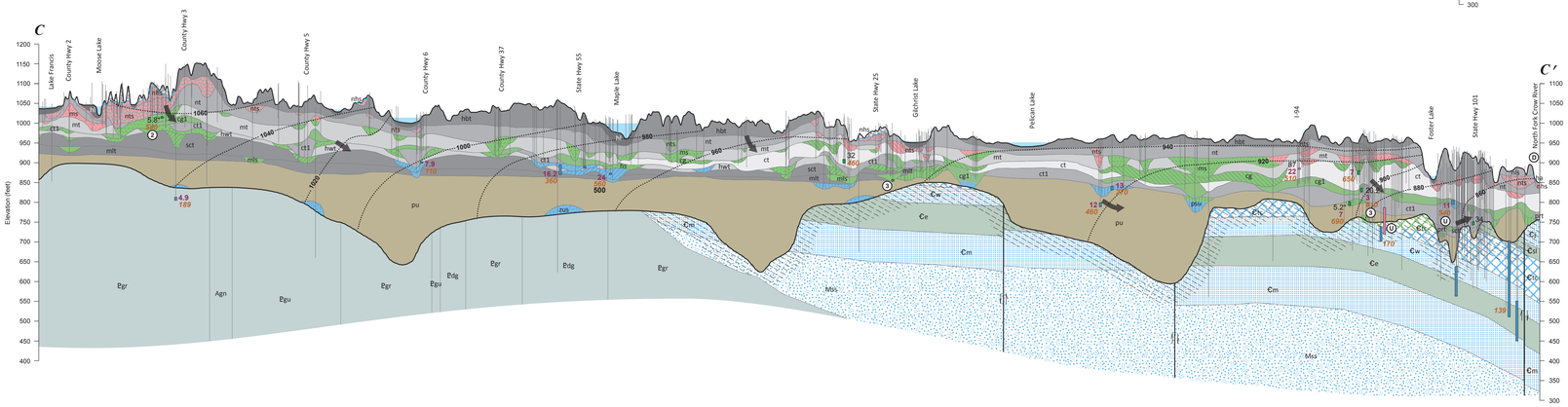
Cross Section B–B′

Many aquifers are connected along this cross section with no intervening till to impede vertical migration of water. The west and east sides of the cross section have a prevalence of coarse-textured sediments at the land surface that allow recent tritium-age water to migrate from the surface to underlying shallow buried sand aquifers. In the west portion, mixed tritium-age water was found at a depth of approximately 80 feet below the land surface. Vintage tritium-age water was sampled from two wells in Cretaceous deposits (Kd) that are roughly 200 to 250 feet below the land surface. The water from the well near County Highway 2 had a calculated carbon-14 residence time of 5,000 years.

In the central portion of the cross section, more permeable till units and areas of overlapping aquifers allow recent and mixed tritium-age water to migrate to depths of approximately 100 feet below the land surface.

On the east side of the cross section, mixed tritium-age signatures were present to depths 150 to 200 feet below the land surface. This is likely due to coarse sand deposits at the land surface and the higher relative hydraulic conductivity of the intervening till of the Cromwell Formation (ct). In this area, recent and mixed tritium-age water was present in aquifers above the Mt. Simon. In the Mt. Simon, vintage tritium-age water had a calculated carbon-14 residence time of 4,500 years. Near Monticello, high-volume groundwater appropriation appears to have brought mixed tritium-age water to depths greater than would be expected without pumping.

Groundwater flow depicted as equipotential lines is both vertically downward and east toward the regional groundwater discharge zone, the Mississippi River. Local groundwater flow is toward lakes such as Clearwater and Long lakes and toward smaller rivers and streams such as the Clearwater River.



Cross Section C–C′

Loam till is the dominant geologic material at the land surface along this cross section. However, near Moose Lake and County Highway 2 coarse-textured deposits allow recent tritium-age water to migrate from the surface to underlying shallow buried sand aquifers. In these locations, aquifers are connected or have few intervening tills to impede vertical migration of water.

Recharge along the rest of the cross section is more limited, as the loamy till of the Heiberg Member (hbt) has relatively low hydraulic conductivity. Vintage tritium-age water was present on the west side of the line at depths exceeding 150 feet. Water collected from a buried sand aquifer (scs) near Maple Lake had a calculated carbon-14 residence time of 500 years.

East of I-94, recent and mixed tritium-age signatures were common in buried sand aquifers at depths of approximately 150 to 200 feet below the land surface. In general, vintage tritium-age water was present in the bedrock aquifers. Recent tritium-age water was found at depth in a well west of Foster Lake that was inconsistent with the tritium ages determined from surrounding wells; the reason for its occurrence was unclear.

Groundwater flow depicted as equipotential lines is both vertically downward and east toward the regional groundwater discharge zone, the North Fork Crow River. Local groundwater flow is toward lakes such as Maple and Pelican lakes and toward smaller rivers and streams such as the North Fork Crow River.

CROSS SECTION EXPLANATION

Aquifers and aquitards grouped by stratigraphy

Interpreted tritium age is indicated by background color

Interpreted tritium age is indicated by pattern color

Quaternary unconsolidated sediment
(see Figure 6 in the report for geologic unit correlation)

Surficial sand and gravel
- includes ha, wmt

Buried aquifers and aquitards
- hl*
- hbt*
- nhs, nts
- nt*
- ms
- mt*
- cg
- ct*
- cg1
- ct1*
- hs
- hwt*
- scs
- sct*
- mls
- mlt*
- prs
- prt*
- pwt*
- psu
- pu
- zus

*aquitard

Bedrock
- Kd Dakota
- Cj Jordan
- Csl St. Lawrence Formation*
- Cdc Upper Tunnel City
- Cw Wonewoc
- Ce Eau Claire Formation*
- Cm Mt. Simon
- Mss Mesoproterozoic (includes Hinckley, Fond du Lac, and Solor Church)
- Precambrian crystalline bedrock (includes Agn, Edg, Egd, Egr, Egu)

*aquitard

Quaternary aquitards

Grouped by texture ranging from highest to lowest sand content indicating relative hydraulic conductivity.

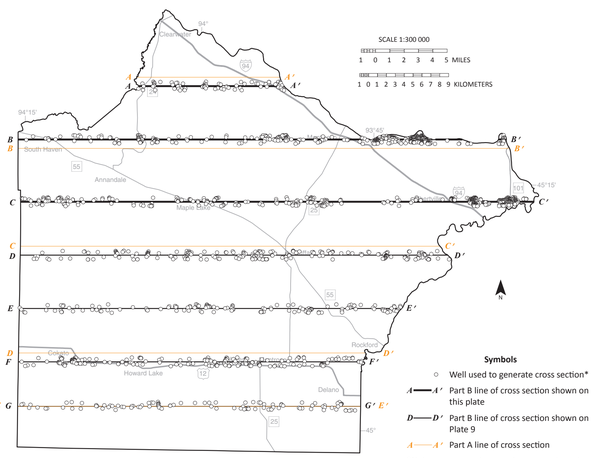
Geologic unit code	Percent sand
ct	>60%
hwt, mt	>50% and ≤60%
ct1, nt, prt	>40% and ≤50%
hbt, pwt, sct, mlt	>30% and ≤40%
hl	≤30%

Tritium age

Darker color in small vertical rectangle (well screen symbol) indicates tritium age of water sampled in well. Lighter color indicates interpreted age of water in aquifer.
- Recent: water entered the ground since about 1953 (8 to 15 tritium units [TU]).
- Mixed: water is a mixture of recent and vintage waters (greater than 1 TU to less than 8 TU).
- Vintage: water entered the ground before 1953 (less than or equal to 1 TU).
- Well not sampled for tritium.

Symbols and labels
- 32 Chloride: if shown, concentration is ≥5 ppm. (* indicates naturally elevated values)
- 24 Arsenic: if shown, concentration is ≥2 ppb.
- 180 Manganese: if shown, concentration is ≥100 ppb.
- 9.2 Nitrate: if shown, concentration is ≥1 ppm.
- 5000 Carbon-14 (^{14}C): if shown, estimated groundwater residence time in years.
- General groundwater flow direction
- 900 Approximate equipotential contour; contour interval 20 feet
- Geologic contact
- Land or bedrock surface
- Water table
- Direction of fault movement, arrows indicate relative movement
- Enhanced-permeability zone

Groundwater conditions
- (1) Water from the surface moves through a thin layer of overlying fine-grained material to an underlying aquifer.
- (2) Groundwater moves from an overlying surficial aquifer to a buried aquifer.
- (3) Groundwater moves from an overlying buried aquifer to an underlying buried aquifer.
- (L) Groundwater flows laterally.
- (P) Tritium concentrations may be artificially elevated by high capacity pumping.
- (U) Groundwater flowpath is unknown.
- (D) Groundwater discharges to a surface-water body.



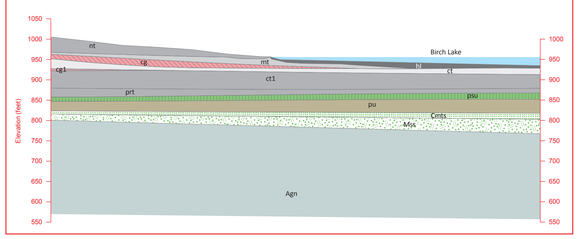
Symbols
- Well used to generate cross section*
- A—A′ Part B line of cross section shown on this plate
- D—D′ Part B line of cross section shown on Plate 9
- A—A′ Part A line of cross section

*Not all wells are displayed in cross section view due to the high density of wells.

Note about the vertical exaggeration

The cross sections use a vertical exaggeration 50 times greater than the horizontal scale. The geologic units are otherwise difficult to see at a one-to-one scale.

For comparison, this inset depicts a portion of cross section B–B′ with no vertical exaggeration to illustrate the true thicknesses of the units. The inset location is indicated by the red rectangle near Birch Lake.



SCALE 1:100 000
VERTICAL EXAGGERATION X 50
1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 6 7 8 9 KILOMETERS

This map was compiled and generated in a geographic information system. Digital data products are available on the DNR County Geologic Atlas Program page (mndnr.gov/groundwatermapping).

This map was prepared from publicly available information. Every reasonable effort has been made to ensure the accuracy of the factual data on which this map interpretation is based. However, the DNR does not warrant the accuracy, completeness, or any implied uses of these data. Users may wish to verify critical information. Sources include both the references in the report and information on file in the offices of the Minnesota Geological Survey and the DNR. Every effort has been made to ensure the interpretation shown conforms to sound geologic and cartographic principles. This map should not be used to establish legal title, boundaries, or locations of improvements.

Base modified from Minnesota Geological Survey, Wright County Geologic Atlas, Part A, 2013.

Universal Transverse Mercator projection, zone 15N, North American Datum of 1983. North American Vertical Datum of 1988.

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