Minnesota Department of Natural Resources
County Atlas Program
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Hydrogeologic Cross Sections

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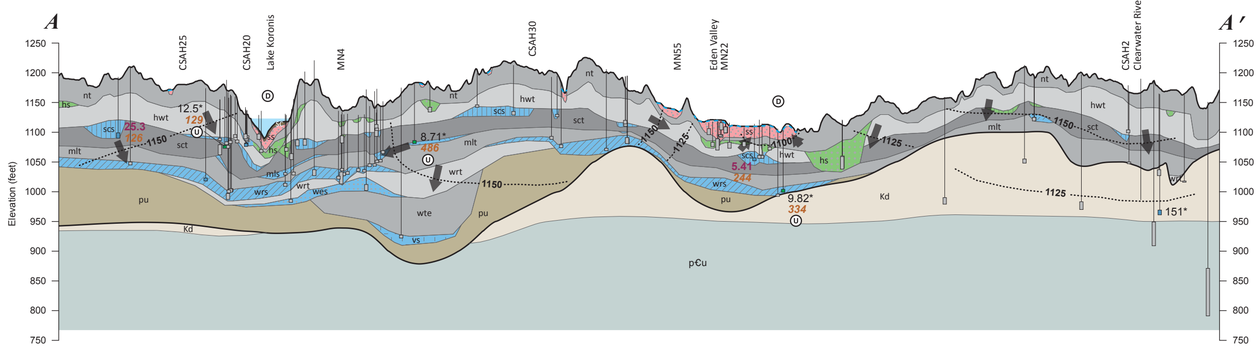
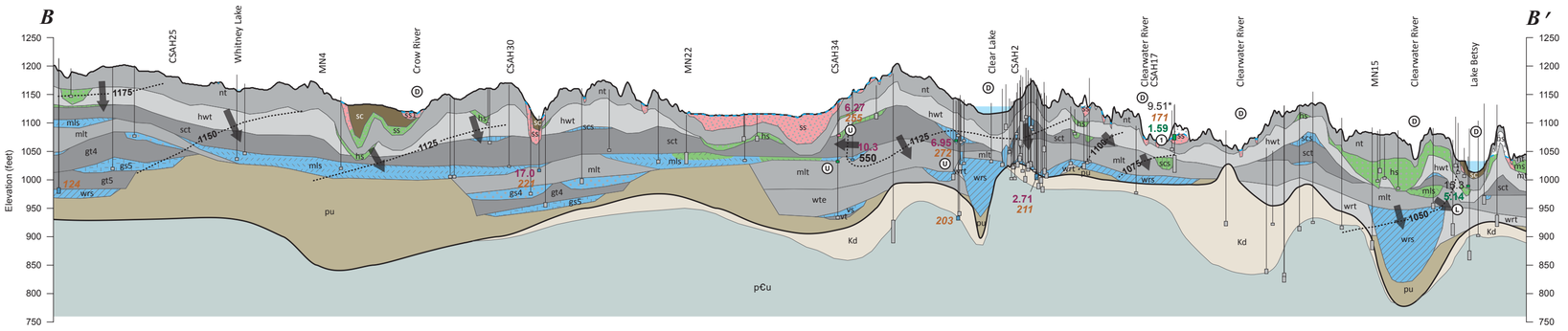
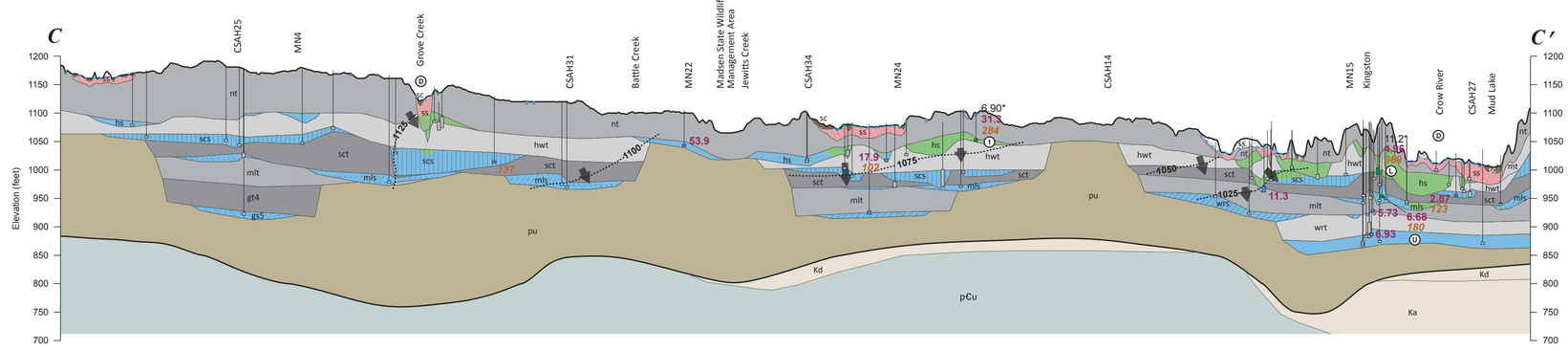
2019

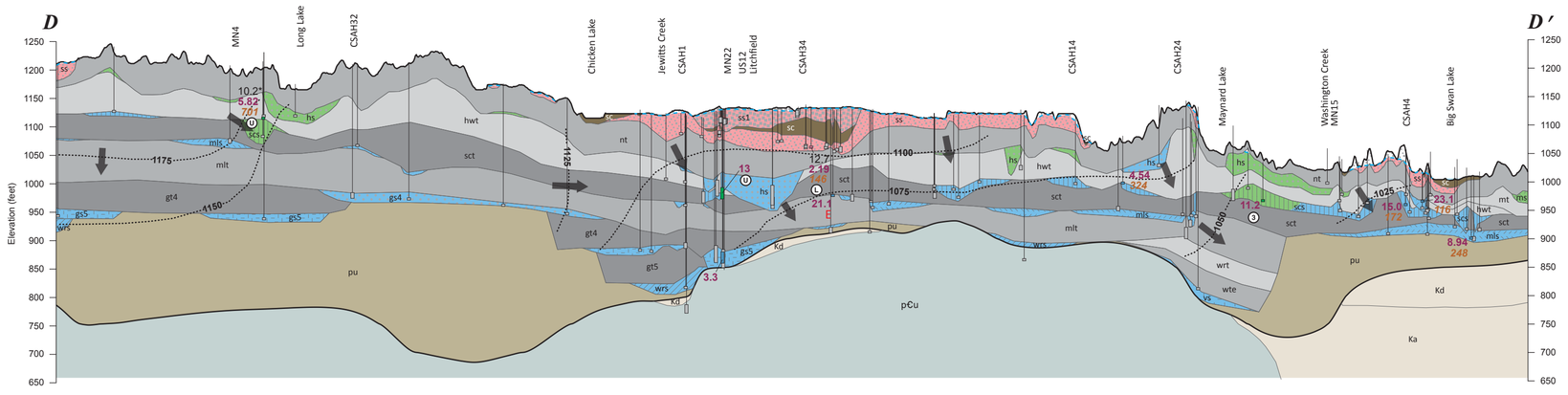
Groundwater Atlas of Meeker County
County Atlas Series C-35, Part B
Plate 7 of 8
Hydrogeologic Cross Sections
A–A′ through D–D′

To accompany atlas Report and Plates 6 and 8.









Buried sand aquifers are listed in each section from the surface down to include the deepest buried sand aquifer that may have detectable tritium. Additional aquifers discussed include those with relevant carbon-14 residence time.

Cross Section A–A′

A total of 8 wells were sampled for tritium along this cross section from wells ranging in depth from 62 to 203 feet.

The ss aquifer deposits occur at scattered locations on top of the nt aquitard with the most extensive deposits located near Eden Valley. Recent tritium-age water was mapped in this aquifer.

The hs aquifer buried sands were mostly mapped as mixed tritium-age water. One exception is from a well on the south shore of Lake Koronis where water may recharge from upgradient vintage tritium-age water entering from the southwest.

The scs aquifers were mostly mapped as vintage tritium-age water. Groundwater is generally moving vertically downward at most locations.

Exceptions are as follows. Mixed tritium-age water was found on the southwest shores of Lake Koronis where there is over 70 feet of overlying aquitard. Tritium was not expected and the source is unknown. Other areas are near Lake Koronis and MN 4 where overlying aquifers (ss and hs) enhance recharge rates to the scs aquifer. Another is on the far eastern side of the county and west of Clearwater River, where the overlying aquitards are thin.

Just east of Eden Valley there is a slight upward gradient where groundwater converges. Surficial (ss) and buried (hs) sands overlie the scs aquifer and there is minimal aquitard confinement. Mixed tritium-age water was expected at this location yet one sample had vintage tritium-age water. This is likely due to the upward groundwater flow that limits or prevents the downward migration of mixed and recent tritium-age water.

The mls aquifers were mapped as vintage tritium-age water. However, a sample collected east of MN 4 had mixed tritium-age water, with no known source. The presence of tritium is inconsistent with the pollution sensitivity and could not be explained by lateral recharge from adjacent higher sensitivity locations.

Cross Section B–B′

A total of 10 wells were sampled for tritium along this cross section from wells ranging in depth from 54 to 237 feet.

The ss aquifer deposits occur at scattered locations on top of the nt aquitard with the most extensive deposits located between MN 22 and CSAH 34. Recent tritium-age water was mapped in this aquifer.

The hs aquifer buried sands were mapped as mixed tritium-age water. Most recharge is through thin overlying aquitards, including several locations where overlying surficial sands enhance recharge to these shallow buried sands. The best example is just east of MN 22. A sample collected from a 54-foot-deep well on the far eastern portion of the cross section was found to have mixed tritium, anthropogenic chloride, and elevated nitrate.

The scs aquifer varies between vintage and mixed tritium-age water, with mixed showing up in locations where the overlying aquitards are thin or where overlying surficial (ss) or buried (hs) sands enhance groundwater recharge. Samples with elevated tritium concentrations from areas with very low pollution sensitivity suggests that this buried aquifer is better connected to the surface than indicated by currently available information, or that the well condition may be providing a pathway for water from other sources to enter the well.

The mls aquifer is typically well protected and mapped as vintage tritium-age water. Slightly east of CSAH 34 a sample had a carbon-14 residence time of over 550 years.

Mixed tritium-age water was mapped between MN 22 and CSAH 34, where the hwt aquitard is absent and there are locations where the sct aquitard is quite thin. Portions of the aquifer are overlain by a thick surficial sand aquifer (ss) and a buried sand aquifer (hs). Another area is just east of MN 15 in the far eastern portion of the county. There the overlying shallow buried hs aquifer is thick and extends to depths where it intercepts the deeper mls aquifer.

Cross Section C–C′

A total of 11 wells were sampled for tritium along this cross section from wells ranging in depth from 49 to 198 feet.

The ss aquifer deposits occur at scattered locations on top of the nt aquitard. Recent tritium-age water is mapped in this aquifer.

The hs aquifer is typically protected west of CSAH 34 where it was mapped as vintage tritium-age water. The exception is where the Grove Creek channel cuts through the nt aquitard and surficial sand is in direct communication with the buried hs aquifer.

East of CSAH 34 the nt aquitard thickness is variable and occasionally thin to absent. Surficial sand aquifers are often located above or in direct connection to the hs aquifers. Both of these factors contribute to enhanced recharge rates and mixed tritium-age water.

In **the scs aquifer** west of CSAH 14, the overlying thick aquitards effectively restrict groundwater movement so vintage tritium-age water was mapped.

East of CSAH 14 overlying aquitard thickness varies and may be thin to absent. Mixed tritium-age water was mapped where overlying surficial (ss) and buried (hs) sands allow water to recharge more quickly and to greater depths.

The mls aquifer is typically protected. This aquifer was mapped as vintage tritium-age water.

However, east of Kingston, a portion of the mls aquifer is overlain by a surficial sand aquifer (ss) and a thick buried sand aquifer (hs). Additionally, the hwt aquitard is absent and the sct and nt aquitards are thin. Mixed tritium-age water may be present in portions of this aquifer. A sample collected just east of Kingston at a location where the aquifer is better protected had a low mixed tritium age. The source is unknown, and the low level is not sufficient to change the vintage designation of the aquifer.

Cross Section D–D′

A total of 11 wells were sampled for tritium along this cross section from wells ranging from 56 to 278 feet deep.

The ss aquifer deposits occur at scattered locations on top of the nt aquitard with the most extensive and thickest deposits located between Jewitts Creek and CSAH 14 in the middle of the cross section. Recent tritium-age water was mapped in this aquifer. Recent tritium-age water was collected from a sample in the city of Litchfield at a location where the sand is thick, there is a buried lacustrine aquitard within the aquifer, and the well is pumping water from beneath the aquitard. This aquitard is mapped as laterally discontinuous so recharge is likely travelling laterally to the well beneath the lacustrine aquitard.

The ms aquifer immediately underlies the nt aquitard in two locations east of CSAH 4. Mixed tritium-age water was expected for both aquifers since they are both mapped with higher pollution sensitivity. However, the vintage tritium-age water sampled near CSAH 4 may indicate that weaker flow gradients or more competent aquitards limit recharge in this location.

The hs aquifer was mapped as mixed tritium-age water in most locations. Vintage tritium-age water was mapped in a few locations near Litchfield and another just west of CSAH 24 where there is sufficient overlying nt aquitard thickness.

The scs aquifer is mostly well protected so vintage tritium-age water was mapped. Exceptions include one sample collected just east of MN 4 that had a mixed tritium-age result. The presence of tritium was not expected so the scs aquifer may be better connected to the overlying and less protected hs aquifer than is suggested in the cross section. A second mixed tritium-age sample is located just east of Maynard Lake. The overlying hs aquifer enhances recharge to the western portion of the scs aquifer. A third sample was from a 156-foot-deep well near Litchfield. The low mixed tritium value was insufficient to change the mapped vintage tritium age. This well is also a high-capacity well where heavy pumping might have induced recharge to greater depths.

CROSS SECTION EXPLANATION

Aquifers and aquitards grouped by stratigraphy

Quaternary unconsolidated sediment

Interpreted tritium age is indicated by the background color. See Figure 5 in the report for geologic unit correlation.

Surficial sand and gravel

- ss1
- sc*
- ss

Buried aquifers and aquitards

- nt*
- ms
- mt*
- hs
- hwt*
- scs
- sct*
- mls
- mlt*
- gs4
- gt4*
- gs5
- gt5*
- wrs
- wrt*
- wes
- wte*
- vs
- vt*
- pu

*aquitard

Bedrock

- Kd — Dakota Formation
- Ka — Cretaceous undifferentiated
- p€u — Precambrian crystalline

Quaternary aquitards

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

Geologic unit code	Percent sand
mt, hwt, wrt	>50% and ≤60%
nt, mlt, wte	>40% and ≤50%
sct, gt4, gt5, vt	>30% and ≤40%

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

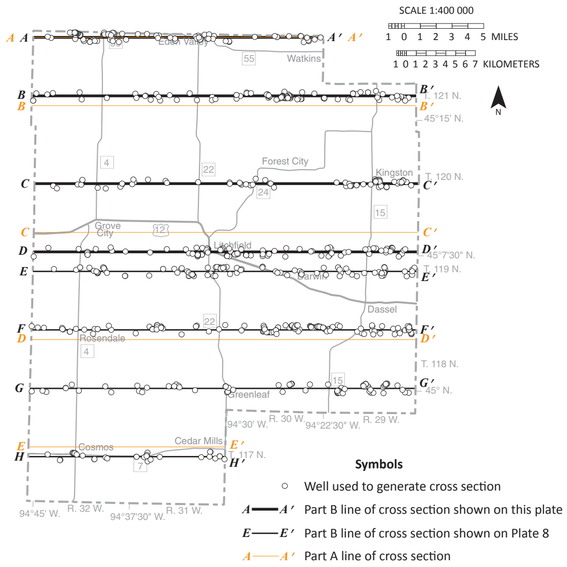
- 12.7 — Chloride: if shown, concentration is ≥5 ppm. (* naturally elevated)
- 23.1 — Arsenic: if shown, concentration is ≥2 ppb.
- 146 — Manganese: if shown, concentration is ≥100 ppb.
- 5.14 — Nitrate: if shown, concentration is ≥1 ppm.
- 550 — Carbon-14 (^{14}C): estimated groundwater residence time in years.
- E — Groundwater sample with evaporative signature
- General groundwater flow direction
- ····1100···· — Approximate equipotential contour; contour interval 25 feet
- Geologic contact
- Land or bedrock surface
- Water table

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 buried aquifer to an underlying buried aquifer.
- Ⓛ Groundwater flows laterally.
- Ⓤ Groundwater flowpath is unknown.
- Ⓓ Groundwater discharges to a surface-water body.

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 from the DNR County Atlas Program at mndnr.gov/groundwatermapping.

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Base modified from Minnesota Geological Survey, Meeker County Geologic Atlas, Part A, 2015.

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

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Prepared and published with the support of
the Minnesota Environment and Natural Resources Trust Fund and the Clean Water, Land and Legacy Amendment