

# Offshore Glaciolacustrine Deposits of Glacial Lake Agassiz: The Brenna Formation in Trail County, North Dakota

Fred J. Anderson

2024

## LOCATIONS OF DRILLHOLES

This map displays the locations of drillholes in Trail County consisting of test holes, water wells, and deep foundation borings, used to map the geologic extent of the Brenna Formation in the shallow subsurface. The Brenna Formation consists of smectitic clay that was deposited as offshore deep-water sediments into glacial Lake Agassiz during latest Wisconsinan time. In Trail County, the Brenna Formation was incised by glaciofluvial deposits of the Poplar River Formation after deposition and is absent along a north-south trend in the middle of the deposit. It covers an area of 643 mi<sup>2</sup> (1,665 km<sup>2</sup>) across the eastern 4/5ths of the county. Lithologically, the Brenna Formation in Trail County contains, on average, 79% clay, 20% silt, with minor (0.4%) amounts of sand (Figure 1). The smectitic clay mineralogy of the Brenna Formation results in a soft and expansive clay that is problematic for surface engineered works as it has low, load-bearing properties.

### Drillhole Locations

- Test Hole
- Observation Wells
- NDDOT Geotechnical Borings
- Private Well
- Brenna Extent

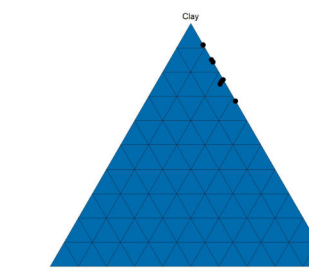
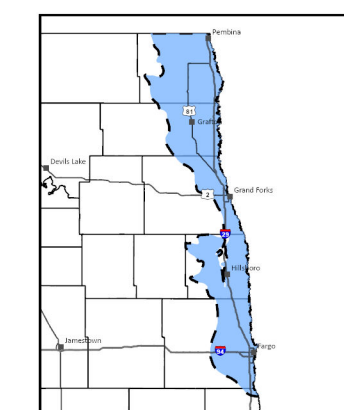
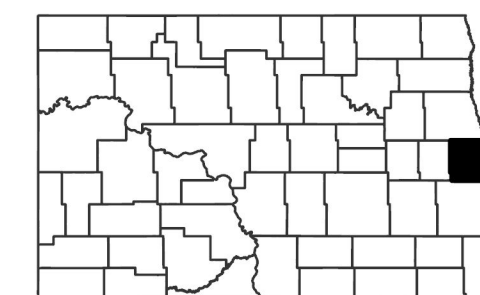


Figure 1. Ternary diagram of Brenna Formation lithology in Trail County.



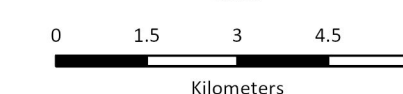
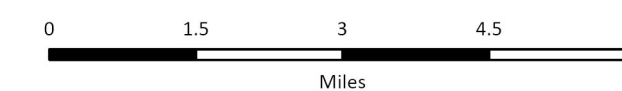
Location and extent of the offshore lake clays of the Brenna Formation in the Red River Valley of North Dakota.



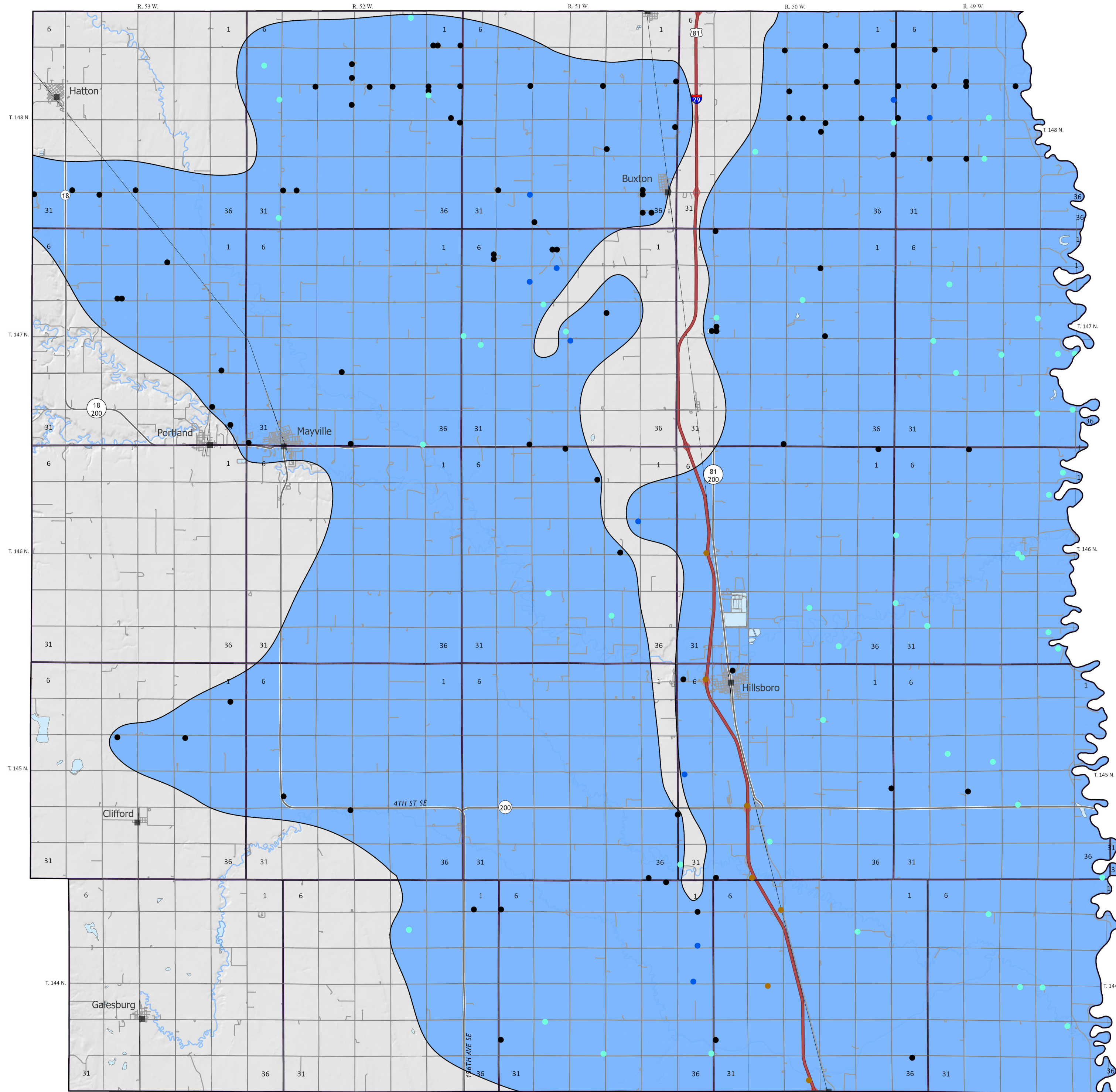
Trail County, North Dakota



Scale 1:125,000



Mercator Projection  
Standard Parallel 47°15'0"N  
North American 1983 Datum  
Central Meridian 97°7'30"W



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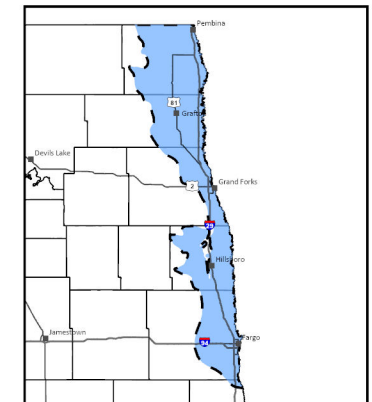
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## BRENNA FORMATION ISOPACH

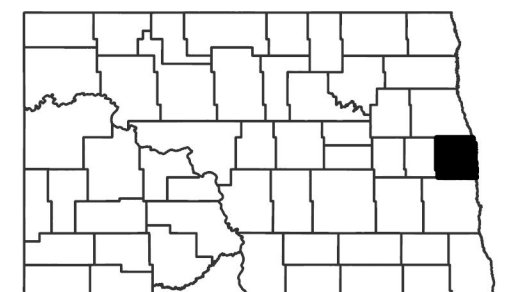
This map depicts the depth of the Brenna Formation in the shallow subsurface in Trail County. Depth to the top of the Brenna Formation is shown as colored contour intervals modeled from test hole, water well, and deep-foundation drilling data. The Brenna Formation was deposited across most of the county but is generally absent in the westernmost townships and along a north-south trend in the middle of the county where the formation was incised by the glaciofluvial deposits of the Poplar River Formation. The Brenna Formation covers an area of 643 square miles (1,665 km<sup>2</sup>) and generally occurs at depths of 20-30 feet (6.1 – 9.1 m) but may be as deep as 30 feet (9.1 m) south of Hillsboro.

### Depth Contour (feet bls)

- 10 - 20
- 20 - 30
- 30 - 40
- Estimated Contour



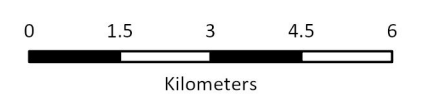
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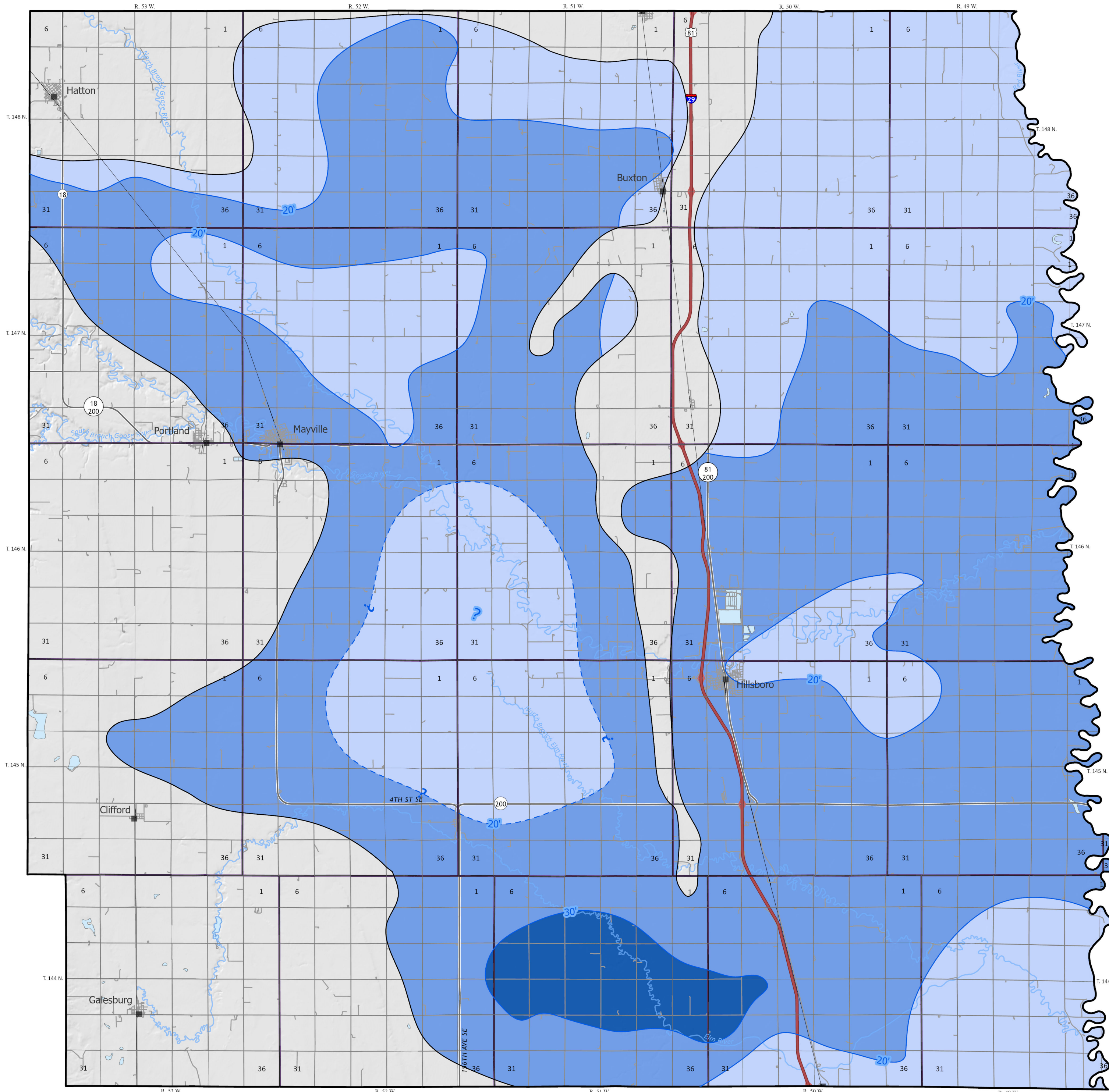
Trail County, North Dakota



Scale 1:125,000



Mercator Projection  
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# Offshore Glaciolacustrine Deposits of Glacial Lake Agassiz: The Brenna Formation in Traill County, North Dakota

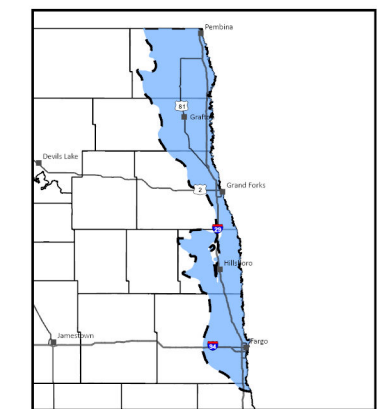
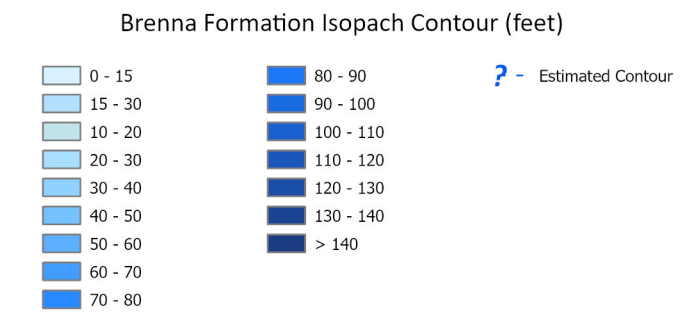
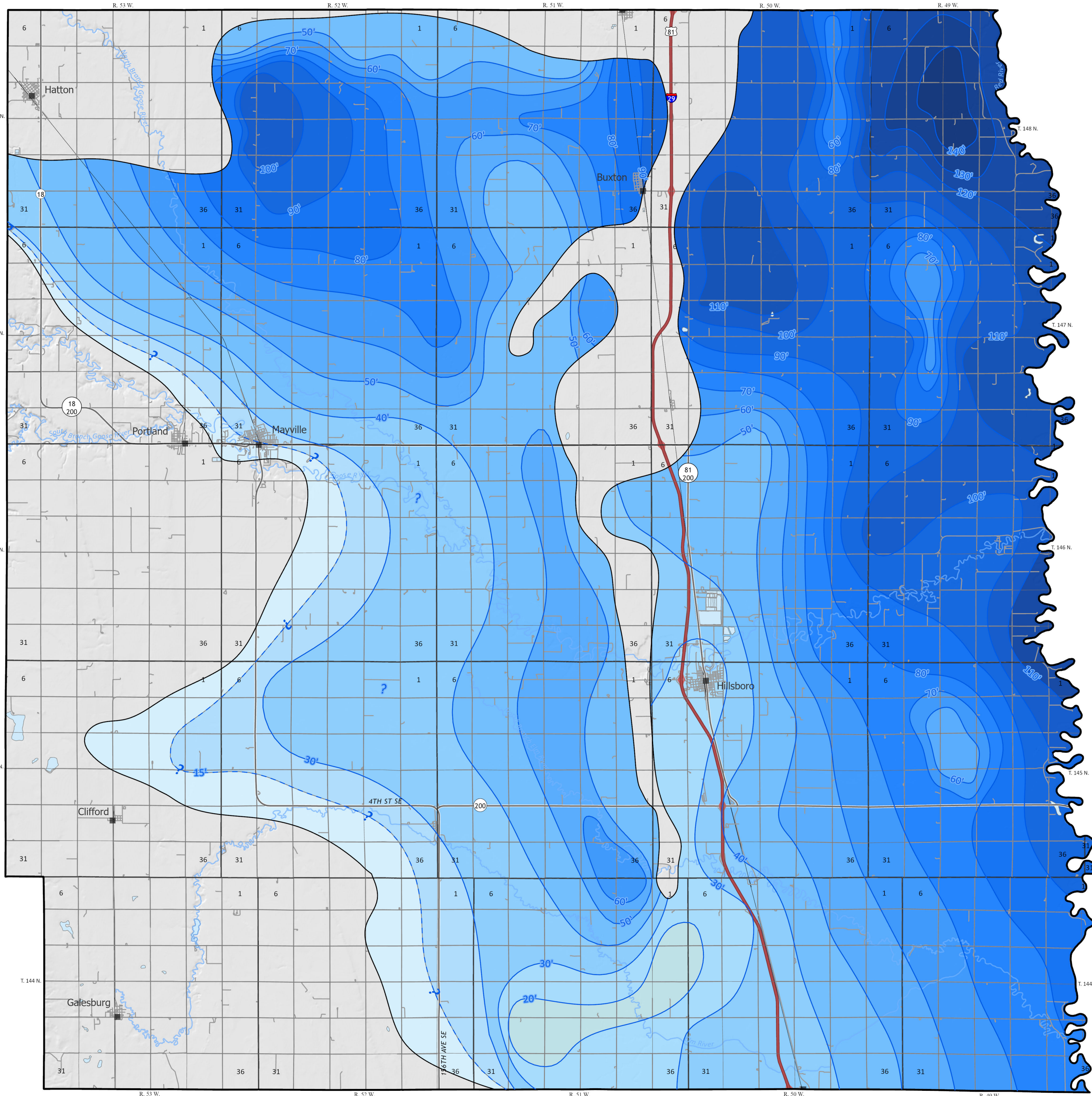
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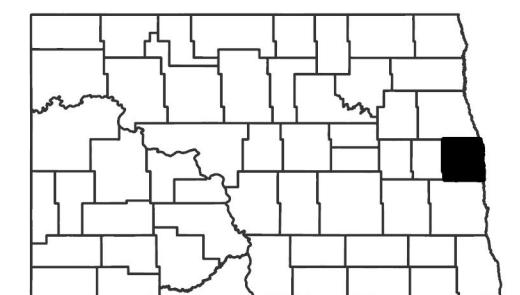
## DEPTH TO BRENNIA FORMATION

This map depicts the thickness of the offshore clay of the Brenna Formation in the shallow subsurface in Traill County as colored isopach contour intervals modeled from test hole, water well, and deep-foundation drilling data. The Brenna Formation was deposited across most of the county but is generally absent in the westernmost townships and along a north-south trend in the middle of the county where the formation was incised by the glaciofluvial deposits of the Poplar River Formation. The Brenna Formation covers an area of 643 square miles (1,665 km<sup>2</sup>) and generally thickens from the west to the east and in areas underlying the Red River can be over 110 feet (33.5 m). It is also apparently thick in the northwestern part of the county, but a lack of well control, particularly in the southwestern part of the county, make it difficult to discern accurate stratigraphic boundaries.

The thickness of the Brenna Formation as depicted here also includes the soft glaciolacustrine clay of the Argusville Formation which underlies the Brenna Formation in southern Traill County. The contact between these units is difficult to distinguish from drilling records alone as additional sedimentological and engineering properties analysis is needed to differentiate the two. The clay of the Argusville Formation is somewhat sandier and siltier than the overlying Brenna, but from an engineering properties perspective are similar in character and as such are modeled as a single unit on this map.

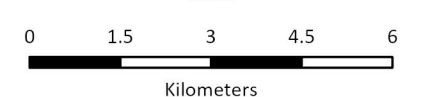


Location and extent of the offshore lake clays of the Brenna Formation in the Red River Valley of North Dakota.



Traill County, North Dakota

Scale 1:125,000



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Central Meridian 97°7'30"W