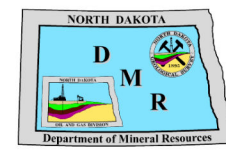
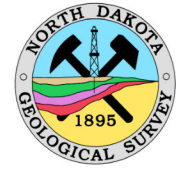


LANDSLIDE AREAS IN TRAIL COUNTY, NORTH DAKOTA

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LANDSLIDES IN TRAIL COUNTY

Landslides are masses of rocks and sediment that have tumbled or slid down a slope under their own weight. Landslides are one of the most common geologic hazards in North Dakota and can destroy buildings, roads, railroad tracks, pipelines, transmission lines, and other types of infrastructure. Landslides are generally characterized in the field by steep, near-vertical slopes (the scarp) that are upslope from a mound of displaced rock (the body). The body of the slide may be relatively intact, or it may be severely fragmented. Recent or relatively new landslides are generally characterized by a fresh (well-exposed rock) scarp and a sparsely vegetated body. Older slides are typically more difficult to identify in the field because the topography of the scarps and bodies may be smoother and more subdued due to weathering. Landslides are most readily identifiable from Light Detection and Ranging (LIDAR) data, supplemented with aerial imagery.

Landslides in Trail County were mapped from LiDAR data collected from 2019 to 2020 along with NAIP digital imagery from 2016 to 2022 and a complete set of historical aerial photographs flown in October of 1954 at a scale of 1:20,000. The aerial photographs were taken when leaves were on the trees which is unfortunate because groves of leaf-bearing trees tend to obscure landslides, especially small ones. On the other hand, leaves can sometimes make it easier to identify these features as trees and bushes are often aligned within very distinct parallel-, transverse-, and/or semi-circular depressions that generally occur within the body of the landslide. Using LIDAR elevation data allows us to see through most of the areas previously obscured by vegetation in the historical imagery and aerial photography and greatly increases our ability to identify additional landslide areas.

A total of 534 landslide areas were identified in Trail County. Most of these slide areas are found along the banks of major rivers in the county. Collectively, these landslide areas cover 2.2 square miles (1,432 acres) which is 0.25% of the county land area. Landslides are common along the Red and Goose Rivers. Most of the slides in Trail County (65%) cover less than two acres (Figure 1). On the larger side of the scale, 30 (5.6%) are larger than 10 acres with an average of 16 acres. Landslides in the Red River Valley are commonly concentrated along the cutbank meanders of major rivers due to the continued modification of the river channel by nearly consistent annual flooding (Figure 2). Landslide areas along the Minnesota side of the Red River were not mapped as a part of this work but do occur with similar frequency and extent of those mapped on the North Dakota side.

The Red River main stem forms the eastern border of Trail County and Minnesota and flows from south to north along a 63.5 mile highly circuitous route across a 31-mile linear distance. 28.8 miles (45%) of riverbank along the Red River is affected by slumping and has been mapped as landslide areas on the North Dakota side of the river. The Goose River enters the county seven miles northwest of Mayville and continues its 82 mile highly circuitous traverse across the central portion of the county flowing east through Mayville and Hillsboro, along a linear distance of 37 miles, before joining the Red River main stem 1.3 miles east of Caledonia. 32 miles of riverbank (39%) along the Goose River are affected by slumping and have been mapped as landslide areas.

Slopes fail for various reasons including the steepness or angle of the slope, rock or sediment type, bedding, and moisture content of the materials. Most landslides in eastern North Dakota are slumps caused by fluvial erosion at the base of riverbanks. Typically, these slumps fail as a single mass of material producing a well-defined head scarp. The failed mass is, however, not often a cohesive unit; tension cracks generally cause the failed material to splinter into smaller portions. Successive landslides may occur at the same location. Over time, the accumulated material from multiple, adjacent landslides can cover an area that is larger than the original slide.

The surface geology of Trail County consists dominantly of glaciolacustrine sediments associated with Glacial Lake Agassiz. These bedded, offshore silts and clays make up the Sherack and Brenna Formations along with river alluvium. Most landslides in the county occur within these three units, which are commonly exposed along the banks of the major rivers throughout the county (Figure 3). It is not uncommon for landslides to occur across multiple formations and displace several units. An area with many landslides suggests that the slopes in that area may be predisposed to future slides. Even when landslides are not identified in these types of settings, these areas often remain vulnerable to continued erosion and river bank instability and should be evaluated prior to the development of any civil works or energy infrastructure projects. When possible, these areas should be avoided.

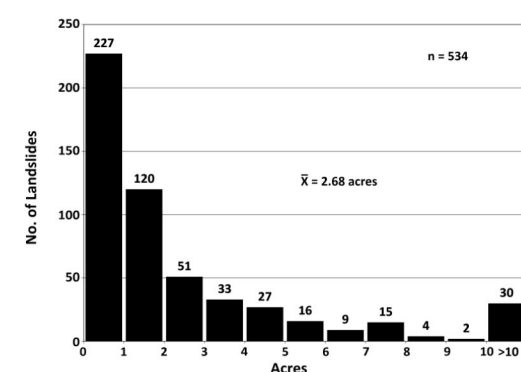


Figure 1. Distribution of landslides mapped in Trail County. The majority of slides (43%) cover less than one acre. There are many slides (6%) that are over ten acres in size.

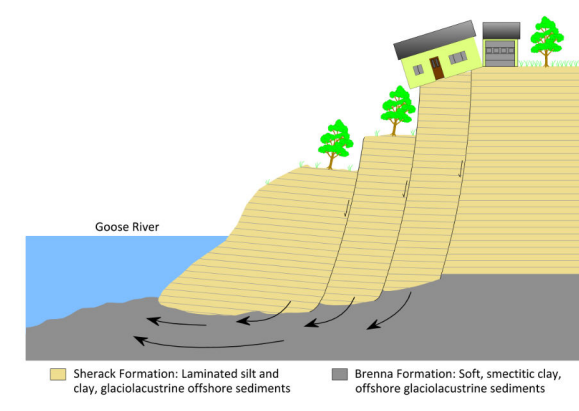
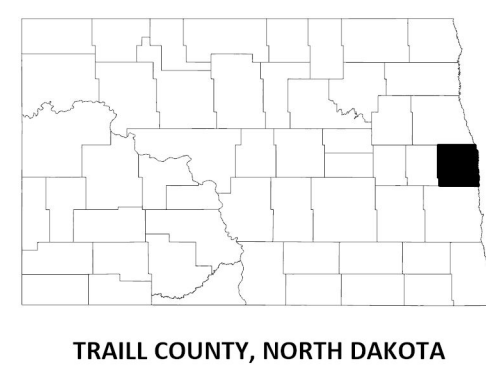
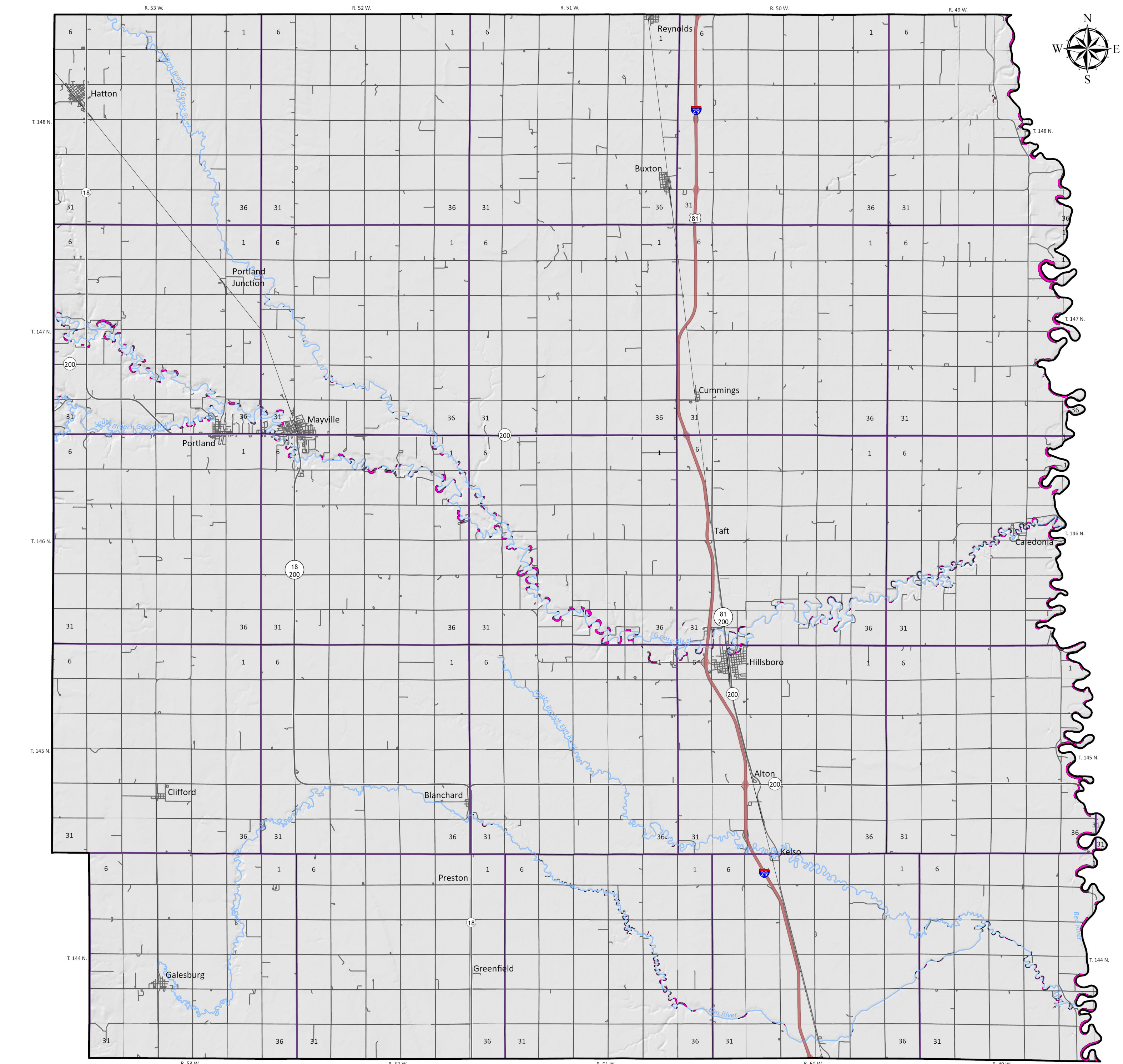


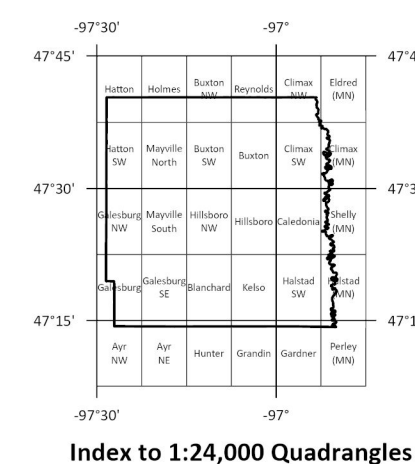
Figure 2. Mechanism of slumping within the glaciolacustrine sediments of the Sherack and Brenna Formations along the riverbanks of the Goose River. The underlying soft clays of the Brenna Formation can deform when lateral confining conditions are not present resulting in slumps along riverbanks.



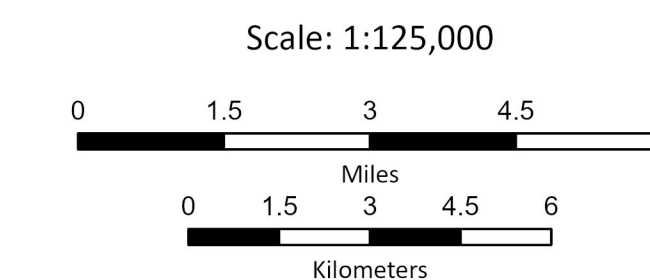
Figure 3. Example of riverbank slumping in central Trail County along the Goose River one mile southeast of the Norway bridge and seven miles west of Mayville. A well developed head scarp is visible near the property access road.



TRAIL COUNTY, NORTH DAKOTA



Index to 1:24,000 Quadrangles



Mercator Projection
Standard Parallel 47°15'0"N
North American 1983 Datum
Central Meridian 97°11'15"W

EXPLANATION

Qs Landslide Deposits

A mass of material that has moved downslope. Includes earth flows, slumps, and areas of soil creep.