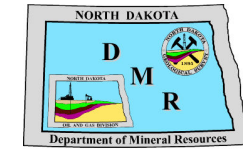


LANDSLIDE AREAS IN CASS COUNTY, NORTH DAKOTA

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LANDSLIDES IN CASS 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 Cass County were mapped from LIDAR data collected in 2008 along with NAIP digital imagery from 2016 to 2022 and a complete set of historical aerial photographs flown in August of 1959 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 888 landslide areas were identified in Cass County. Most of these slide areas are found along the banks of major rivers in the county. Collectively, these landslide areas cover 3.2 square miles (2,081 acres) which is less than 0.2% of the county land area. Most of the landslides occur along the Red, Sheyenne, Maple, and Wild Rice Rivers.

Most of the slides in Cass County (84%) cover less than four acres (fig. 1). On the larger side of the scale, 37 (4.2%) are larger than 10 acres with an average of 14 acres. Landslides are commonly concentrated along the cutbank meanders of major rivers due to the continued modification of the river channel by nearly consistent annual flooding. Landslide areas along the Minnesota side of the 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.

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 sedimentary geology of Cass County consists dominantly of glaciolacustrine sediments (bedded silts and clays) especially offshore clay deposits associated with Glacial Lake Agassiz. These sediments make up the Sherack and Brenna Formations along with river alluvium. The majority of landslides in the county occur within these three units, which are commonly exposed along the banks of the major rivers throughout the county. 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 riverbank instability and should be evaluated prior to the development of any civil works or energy infrastructure projects. When possible, these areas should be avoided.

The Red River main stem forms the eastern border of Cass County and Minnesota and flows along a 79.4 mile highly circuitous route within a 47.5 mile linear distance from the south to the north. 59 miles (74%) of riverbank are affected by slumping and have been mapped as landslide areas on the North Dakota side of the river. The Sheyenne River enters the county one mile south of Kindred and continues its 68 mile highly circuitous traverse across the southeastern portion of the county flowing north through Norman, Horace, West Fargo, and Harwood within a linear distance of 35 miles before joining the Red River main stem three miles north and 2.5 miles east of Harwood, North Dakota. 30 miles of riverbank (44%) are affected by slumping and have been mapped as landslide areas. The Maple River flows from the north to the south in western Cass County, briefly exists the county and then returns in eastern Cass County flowing northeastward to its confluence with the Sheyenne River over a highly circuitous path of 158 miles within a linear distance of 91 miles. Approximately 24 miles of riverbank (15%) along the Maple River are affected by slumping and have been mapped as landslide areas.

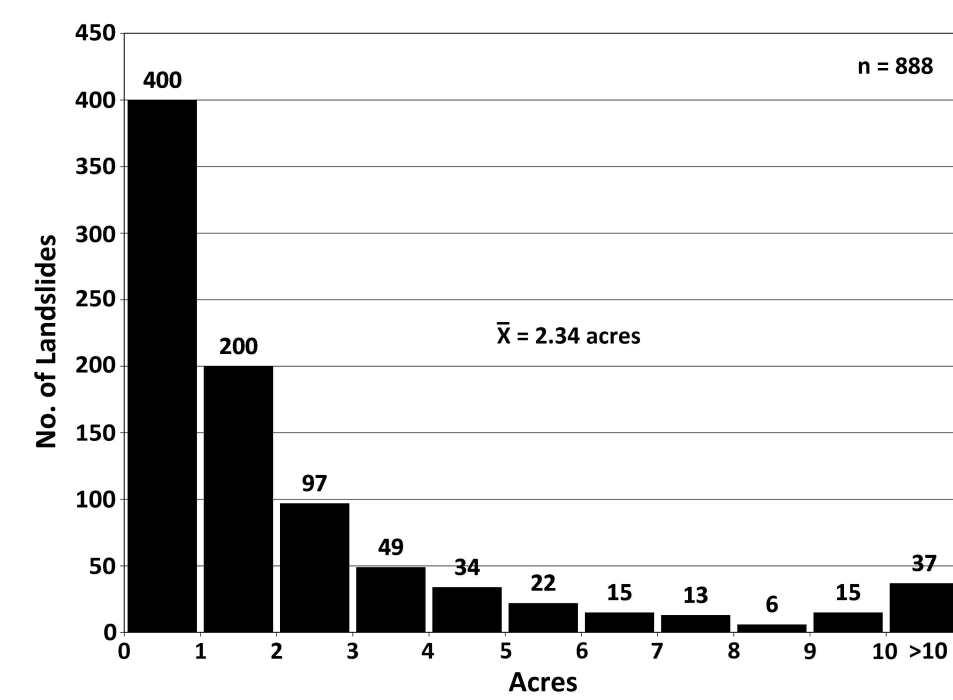


Figure 1. Distribution of landslide areas mapped in Cass County. Most landslide areas (84%) cover less than four acres. Some slides (4.2%) are over ten acres in size. The mean (x̄) landslide area size is 2.34 acres. The number of landslide areas in this distribution is 888.

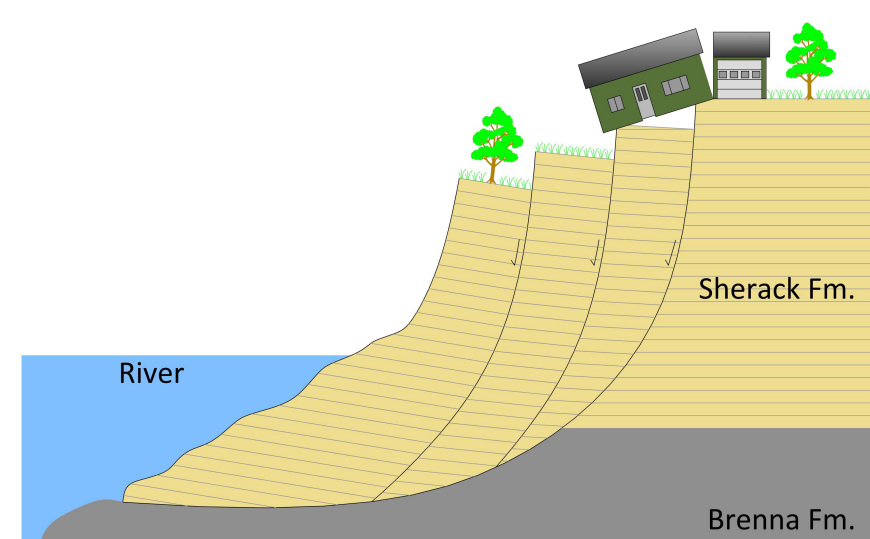
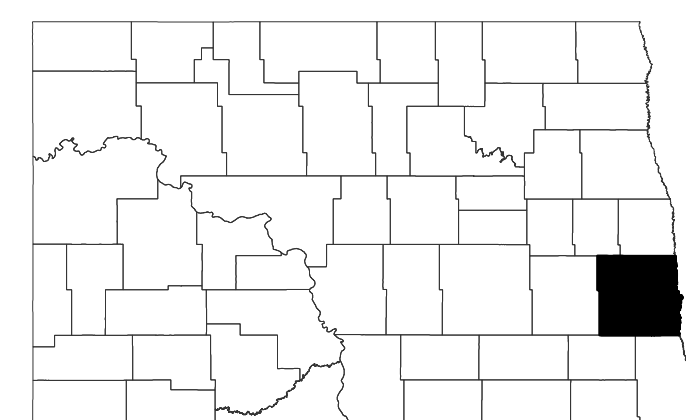
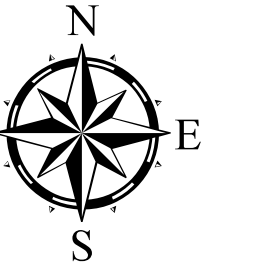
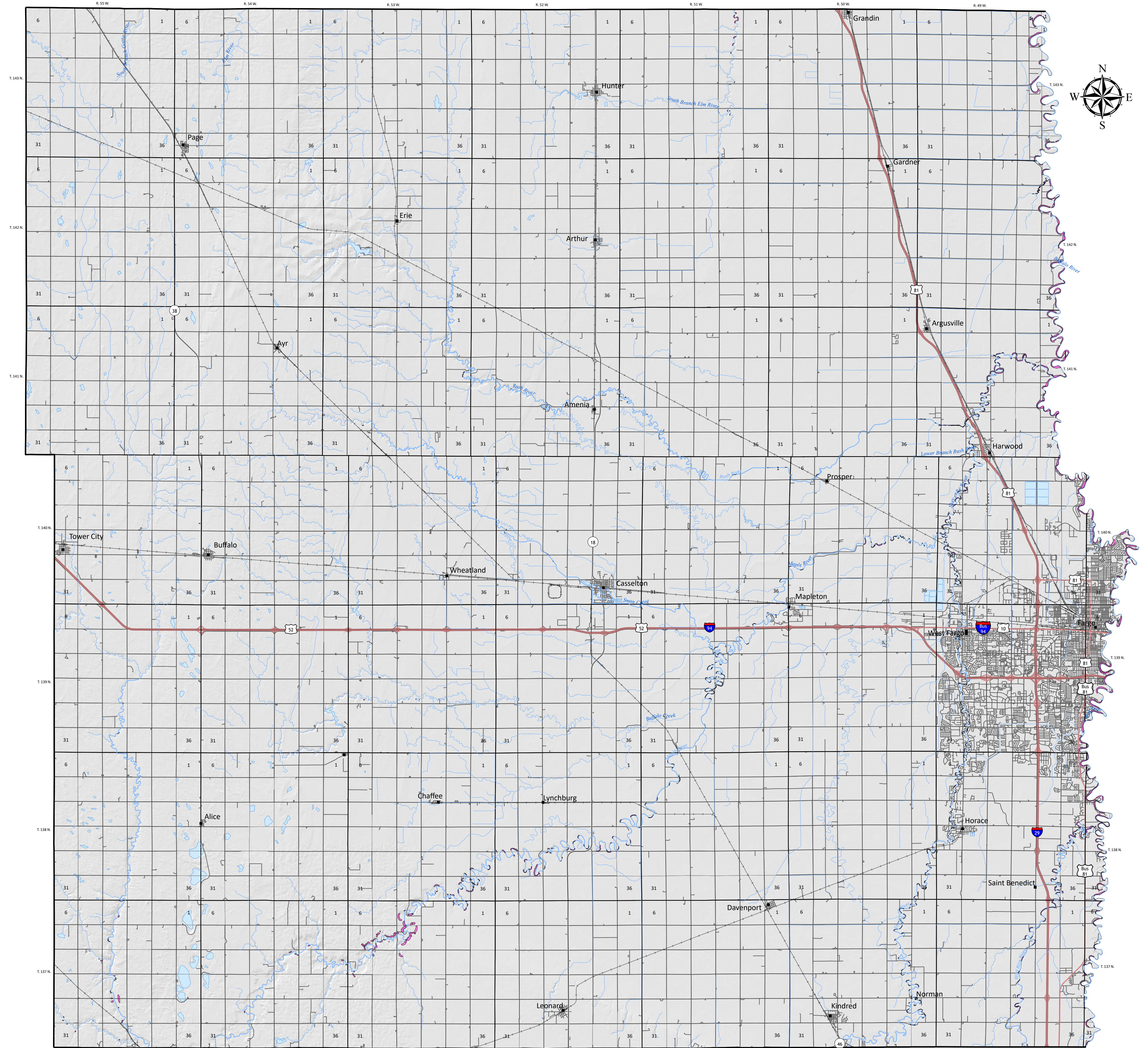
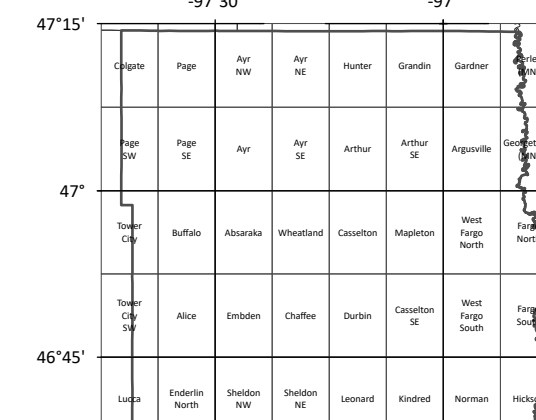


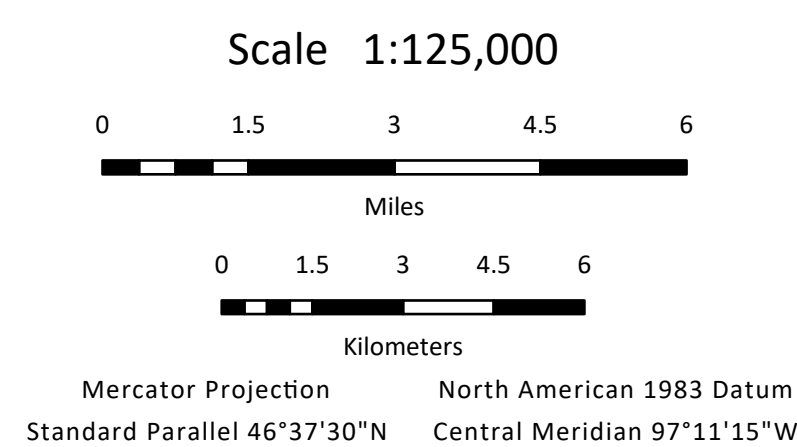
Figure 2. Illustration of the relationships between slumping riverbanks along rivers in Cass County and offshore glaciolacustrine sediment of the Sherack and Brenna Formations in North Dakota. The soft and expansive clays of the Brenna Formation deform and facilitate slumping of the overlying Sherack Formation and alluvium.



CASS COUNTY, NORTH DAKOTA



Index to 1:24,000 Quadrangles



EXPLANATION

- Qls** Landslide Deposits
A mass of material that has moved downslope. Includes earth flows, slumps, and areas of soil creep.