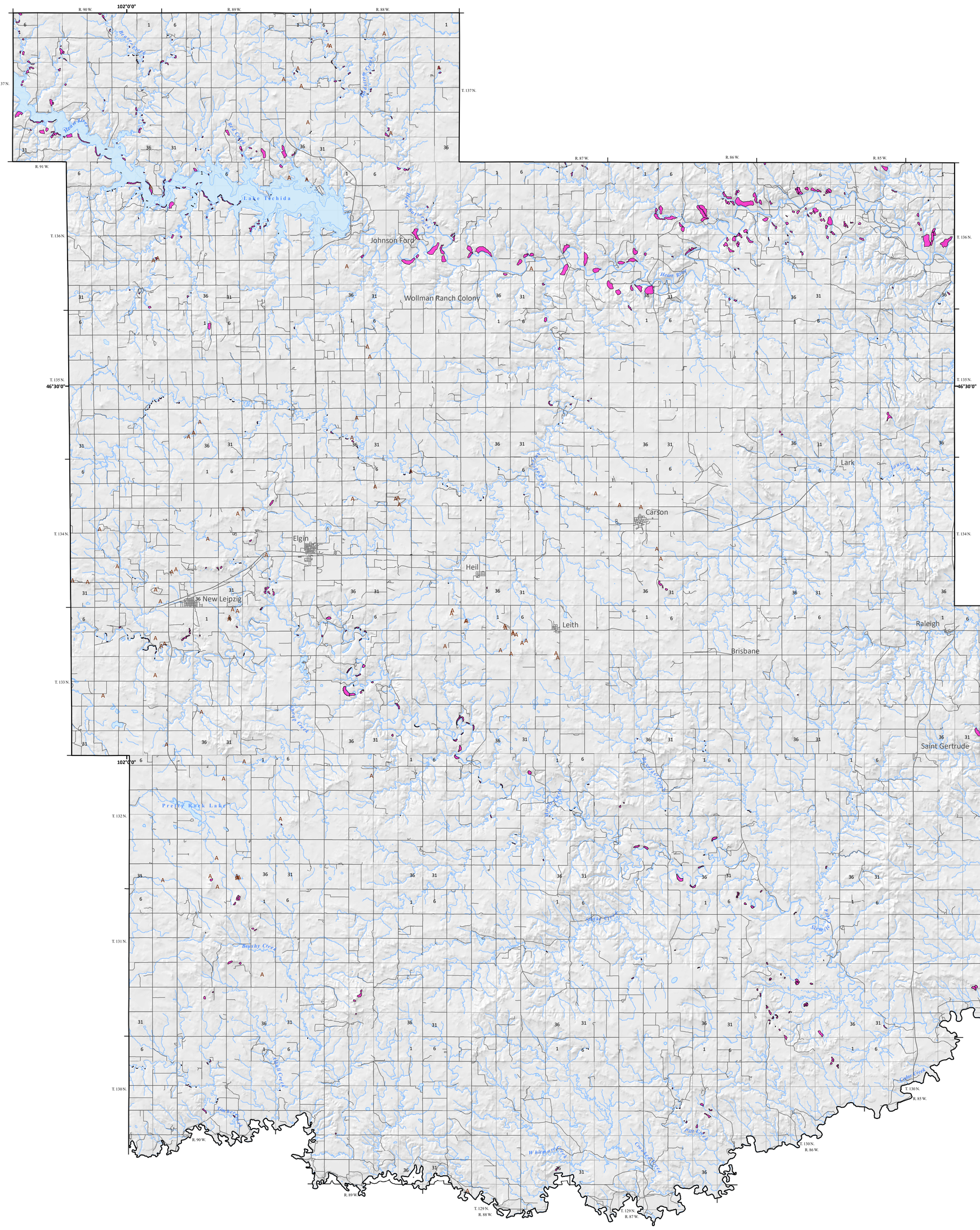
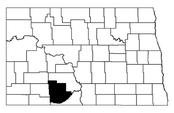
North Dakota Geological Survey
County Series: Grant - L

North Dakota Geological Survey
Edward C. Murphy, State Geologist

LANDSLIDE AREAS IN GRANT COUNTY, NORTH DAKOTA





Grant County, North Dakota

EXPLANATION

Qls **Landslide Deposits**

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

Qml **Abandoned Mine Lands**

Surface may be underlain by voids created by the underground mining of lignite. Collapse of the mine voids often creates sinkholes or depressions at the surface.

A **Abandoned Mine Lands. Location approximate and extent undetermined.**

Abandoned Mine Lands (AML) location data maintained by the North Dakota Public Service Commission's Abandoned Mine Lands Program.

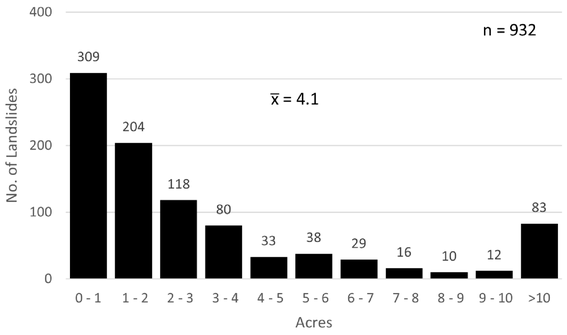


Figure 1. Distribution of landslides mapped in Grant County. The majority of slides (76%) cover less than four acres. Some slides (9%) are over ten acres in size. The mean ($\bar{x}$) landslides are over 4.1 acres. The number of landslide areas (n) in this distribution is 932.

Scale 1:125,000

0 1.5 3 4.5 6

Miles

0 1.5 3 4.5 6

Kilometers

Mercator Projection — North American 1983 Datum
Standard Parallel 46°0'0"N — Central Meridian 101°37'30"W

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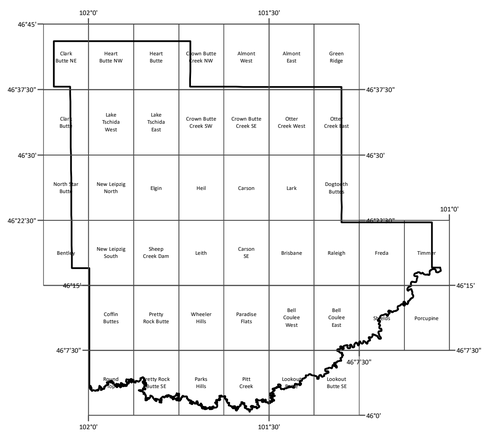
2022



Index to 1:24,000 Quadrangles

LANDSLIDES IN GRANT COUNTY

Landslides are masses of rocks and sediment that have tumbled or slid down a slope under their own weight. These geologic hazards 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. They may also be covered with vegetation and mature trees obscuring the underlying topography. Landslides are most readily identifiable from LiDAR data, supplemented with aerial imagery.

Landslides in Grant County were mapped from LiDAR data collected from March to May 2016 along with NAIP digital imagery from June 2016 and a complete set of historical aerial photographs that were flown from August to September 1957 at a scale of 1:20,000. It is unfortunate that these photographs were taken when leaves were on the trees 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. 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. The use of 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 932 landslide areas, along with 87 former AMLs, were identified in Grant County. Some of these slides are complexes, consisting of multiple landslides that formed from different events. Therefore, the number of individual landslides in this county is likely somewhat higher. Collectively, these landslide areas cover six square miles (3,781 acres) or approximately 0.36 % of the county. Most of the landslides occur along the Heart and Cannonball River and Cedar Creek drainages. The largest slide in Grant County covers 92 acres along the northern valley of the Heart River in the Cannonball Formation eight miles south of Almont. There are also several landslides concentrated in the rugged topography of the Rattlesnake Butte area 4.5 miles west of ND Highway 31 in southeasternmost Grant County.

Most of the slides in Grant County (76%) cover less than 4 acres (fig. 1). Only 9% range from 10 to 92 acres in size on the high end. Landslides are concentrated along drainages, ravines, and coulees, and within areas of high local topographic relief along the major hydrologic corridors like the Cannonball River. All, or portions, of the head of a ravine typically fail, presumably because headward erosion causes these areas to undergo some of the fastest rates of erosion, oversteepening slopes.

Slopes fail for various reasons including the steepness or angle of the slope, rock type, bedding, and moisture content of the rocks. Most landslides in western North Dakota are rotational slumps that have a well-defined head and toe. Typically, the part of the slope that breaks apart slides down the slope as a single unit and the beds tilt back in the direction of the slope. The failed mass of rock is, however, almost never 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 several thousand feet wide and several miles long.

The geology of Grant County consists dominantly of Tertiary age sedimentary bedrock of the Fort Union Group which contains marine mudstones and sandstones of the Cannonball along with terrestrial deposits of the Ludlow Formations, Bullion Creek and Sentinel Butte Formations, consisting of sandstones, siltstones, claystones, mudstones, and lignite. The Cretaceous Hell Creek Formation, consisting of somber colored fine-grained sand, silt, and carbonaceous and bentonitic clays occurs in the southern portion of the county along the Cannonball River and Cedar Creek hydrologic corridors. Most landslides in Grant County (59%) occur equally in the Cannonball (29%) and Bullion Creek (29%) Formations within the Heart, Cannonball, and Cedar Creek hydrologic corridors.

Numerous historical abandoned coal mines are also found in Grant County. These small coal mines, commonly referred to as wagon mines, are scattered mainly across the northwestern portion of the county near New Leipzig and northeast of Elgin. These features are mapped as Qml where mine workings or sinkholes from the collapse of underground voids are visible on the surface, but uncollapsed mine voids may occur in the subsurface beyond the boundaries of the mapped areas. Also included are locations with no obvious surface modification, but a mine is known to have been located in the area according to records compiled by the North Dakota Public Service Commission. It can be difficult to determine whether small surface irregularities along drainage slopes are old mines or slumps, further complicated as abandoned mines are susceptible to slope failure. Thus, some areas mapped as landslides may include the collapse of abandoned mine headwalls.

Small landslides, 10 acres or less in size, are common throughout the rugged topography of western North Dakota. Many of these, as well as larger landslides, are typically obscured by slopewash or colluvium. Layers or blankets of slopewash typically cover the lower portion of a slope and extend horizontally from the base of a slope. Thick, smooth layers of slopewash often completely obscure the broken, jumbled beds of landslide material. In some areas, smaller landslides, or landslides that are very old and have been inactive for a long period of time, are only visible if slopewash is thin or absent, or the beds are sufficiently jumbled to create subtle irregularities at the surface. An area with many landslides suggests that the local slopes may be predisposed to future slides in the area. Even when landslides are not identified in these types of settings, these areas often remain vulnerable to slope failure and should be evaluated prior to the development of any civil works or energy infrastructure projects and, when possible, be avoided.

Cartographic Compilation: Navin Thapa