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LANDSLIDES IN STARK 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 Stark County were mapped from LIDAR data collected from March to April 2016 along with NAIP digital imagery from 2016 to 2022 and a complete set of historical aerial photographs flown from July to August of 1965 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 840 landslide areas were identified in Stark County. Some of these slide areas 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 4.2 square miles (2,636 acres) or approximately 0.31% of the county. Most of the landslides occur along the Heart River Valley. The largest slide in Stark County covers 154 acres and is found on a northwest facing slope in the siltstones and claystones of the White River Group in the Little Badlands 12 miles southwest of Dickinson. There are also three large landslide areas 4.5 miles west of Scheffield in southwestern Stark County, also in the White River Group.

Most of the slides in Stark County (81%) cover less than four acres (fig. 1). On the larger side of the scale, only 41 landslide areas (4.9%) are larger than 10 acres. Landslides are commonly concentrated along drainages, ravines, and coulees, and within areas of high local topographical relief along the major hydrologic corridors like the Heart 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.

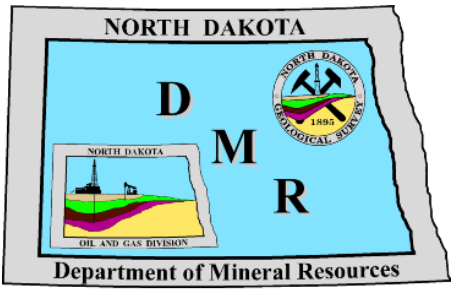
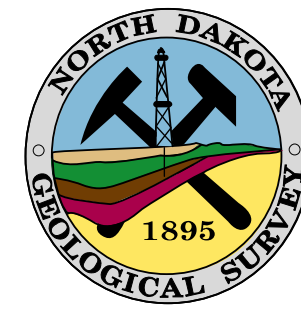
Several historical abandoned mine lands (AMLs) are found in Stark County, mostly in the northern half. These small coal mines, commonly referred to as wagon mines, are found somewhat concentrated near Richardton in the northeastern part of the county and north of Belfield, Zenith, and South Heart in the northwest. No collapse features from underground voids were visible on the surface, but uncollapsed mine voids may occur in the subsurface beyond the boundaries of the known AML locations since a mine is reported to have existed at these locations, 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.

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.

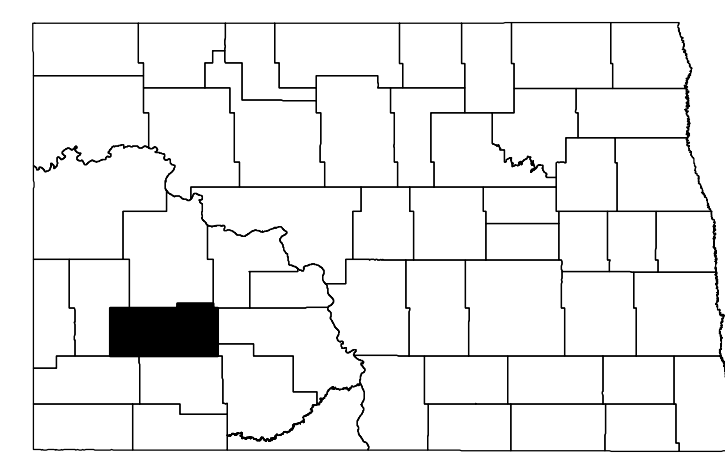
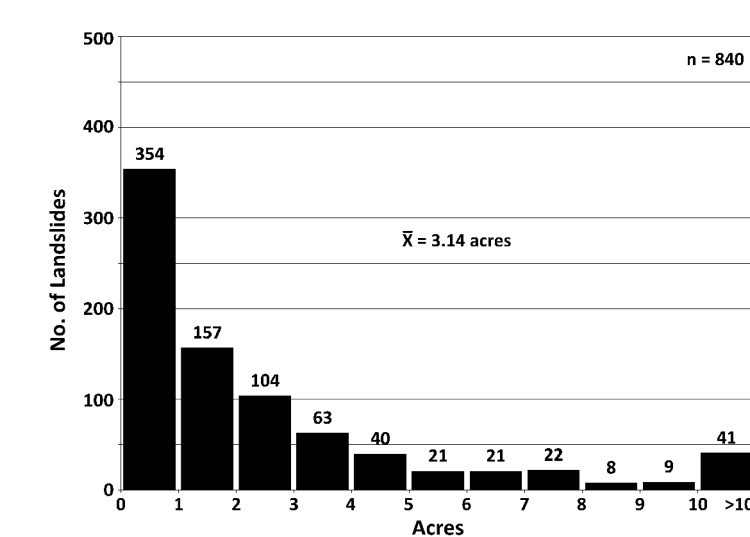
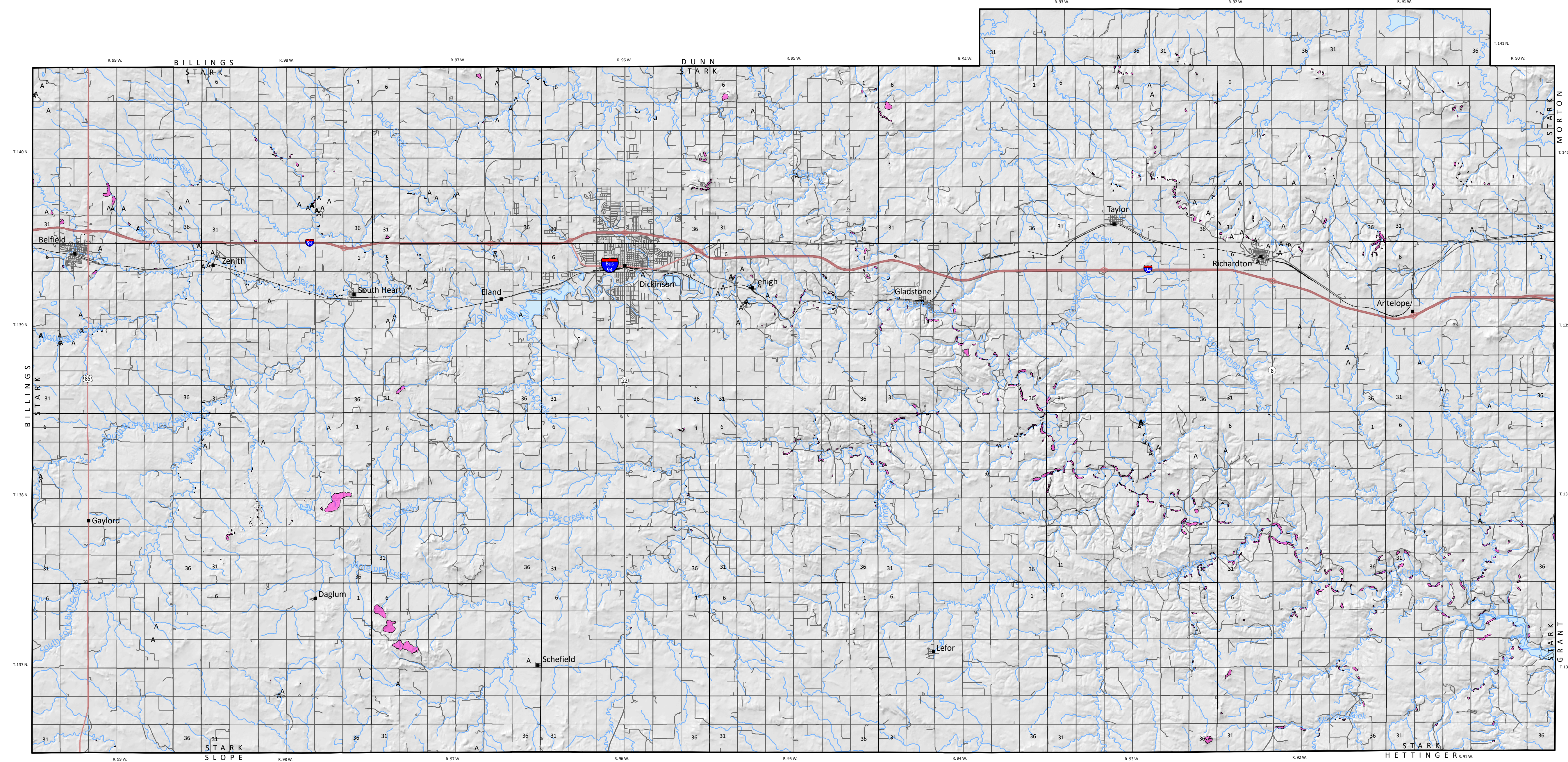
The failed mass of rock is, however, never a cohesive unit; tension cracks generally cause the failed material to splinter into smaller portions. Successive landslides may occur at the same location. Over time, the accumulated material from multiple, adjacent landslides can cover an area that is several thousand feet wide and several miles long.

The sedimentary bedrock geology of Stark County consists dominantly of Tertiary age bedrock of the upper Fort Union Group and White River Group. The primary surficial bedrock unit in Stark County is the Sentinel Butte Formation, with the older Bullion Creek Formation exposed along the Heart River in the southeast and the younger Golden Valley Formation underling a large portion of the uplands in the western half of the county. These formations are lithologically similar, consisting of sandstone, siltstone, mudstone, claystone, and lignite deposited in rivers, floodplains, and swamps during the late Paleocene and early Eocene. The White River Group sediments record a shift to higher energy streams and an influx of volcanic ash, represented by coarse sandstones, conglomerates, and bentonites of the Chadron Formation (Eocene) and tuffaceous mudstone, siltstone, and sandstone of the Brule (Oligocene) and Arikaree (Miocene) Formations, which comprise most of the tall, steep-sided buttes in the county. Most of the landslides in Stark County occur in the Sentinel Butte Formation (80%) with the remaining landslides occurring in the Golden Valley (9%), and Bullion Creek (6%) Formations, and White River Group (5%).

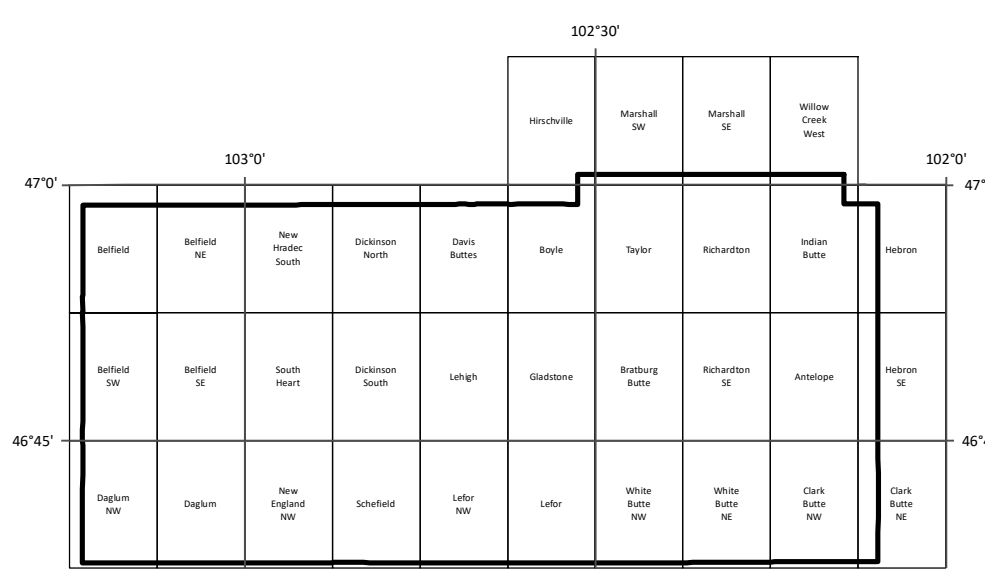
Small landslides, 10 acres or less in size, are common throughout the rugged topography of western North Dakota. Many of these, as well as larger landslides, can be obscured by slopewash or colluvium. Layers or blankets of slopewash typically cover the lower portion of a slope and extend horizontally from its base. Thick smooth layers of slopewash can 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 displaced to create subtle irregularities at the surface. 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 slope failure and should be evaluated prior to the development of any civil works or energy infrastructure projects and, when possible, be avoided.



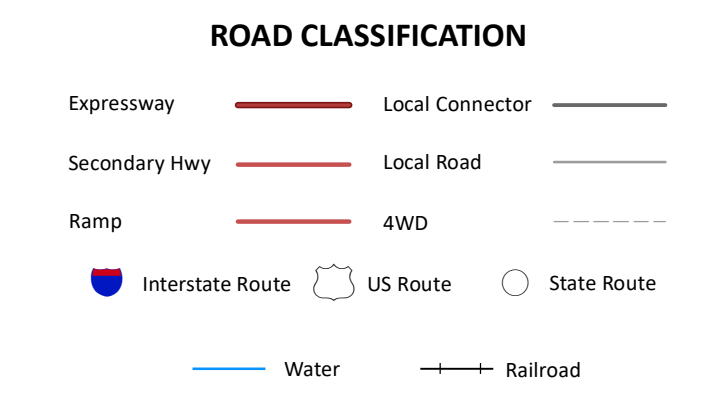
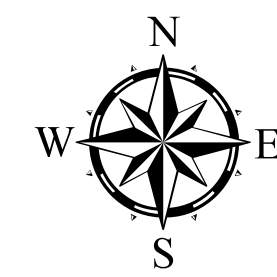
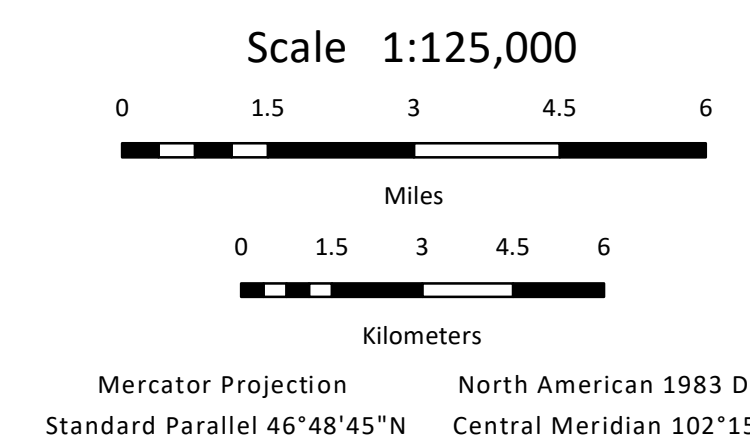
LANDSLIDE AREAS IN STARK COUNTY, NORTH DAKOTA



Stark County, North Dakota



Index to 1:24,000 Quadrangles



EXPLANATION

- Qs** **Landslide Deposits**
A mass of material that has moved downslope. Includes earth flows, slumps, and areas of soil creep.
- 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 landslide areas mapped in Stark County. Most landslide areas (81%) cover less than four acres. Some slides (4.9%) are over ten acres in size. The mean (x) landslide area size is 3.14 acres. The number of landslide areas (n) in this distribution is 840.