

LANDSLIDE AREAS IN WILLIAMS COUNTY, NORTH DAKOTA

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LANDSLIDES IN WILLIAMS 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 Williams County were mapped from LIDAR data collected from November 2016 to May 2017 along with NAIP digital imagery from August 2016 and a complete set of historical aerial photographs that were flown between June and September, 1958 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.

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 Williams County consists dominantly of sedimentary bedrock of the Fort Union Group, exposed along southern facing slopes of the Missouri River Valley, overlain by glacial sediments of the Coleharbor group. The Fort Union Group in Williams County contains the Tertiary Bullion Creek (lower Paleocene) and Sentinel Butte (upper Paleocene) Formations. The Quaternary Coleharbor Group (Pleistocene) consist dominantly of subglacial and ice-contact deposits. Most landslides in Williams County (75%) occur in the Fort Union Group along the southern facing slopes of the Missouri River Valley. The majority (66%) occur within the Sentinel Butte Formation while the remaining (9.3%) occur within the Bullion Creek Formation. Landslide areas are less common (27.8%) in the glacial sediments of the Coleharbor Group and the Oahe Formation (1.5%). Most of these slides cover less than 10 acres (fig. 1) and the largest slide area mapped in the county is approximately 84 acres in size.

Landslides are concentrated along drainages, ravines, and coulees, and within areas of high local topographic relief along the major hydrologic corridors like the Missouri 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.

Several historical abandoned coal mines occur in Williams County. These small coal mines, commonly referred to as wagon mines, are concentrated mainly in the southern portion of the county east and southeast of Williston. 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 present 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 slope wash typically cover the lower portion of a slope and extend horizontally from the base of a slope. Thick, smooth layers of slope wash 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 slope wash is thin or absent, or the beds are sufficiently jumbled to create subtle irregularities at the surface.

A total of 2,685 landslide areas, including 44 former AMLs where subsidence has occurred, were identified in Williams County. Some of these slides are complexes, consisting of multiple landslides that formed more than one event. Therefore, the number of individual landslides in the county may be slightly higher. Collectively, these landslide areas cover nine square miles (5,744 acres) or approximately 0.4% of the county. Most of the landslides occur within the Missouri River Valley.

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.

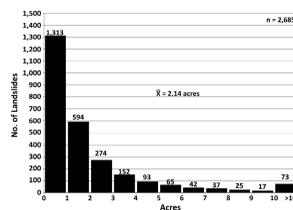
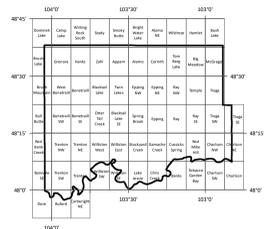
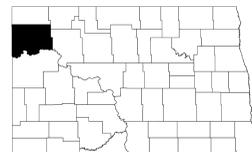
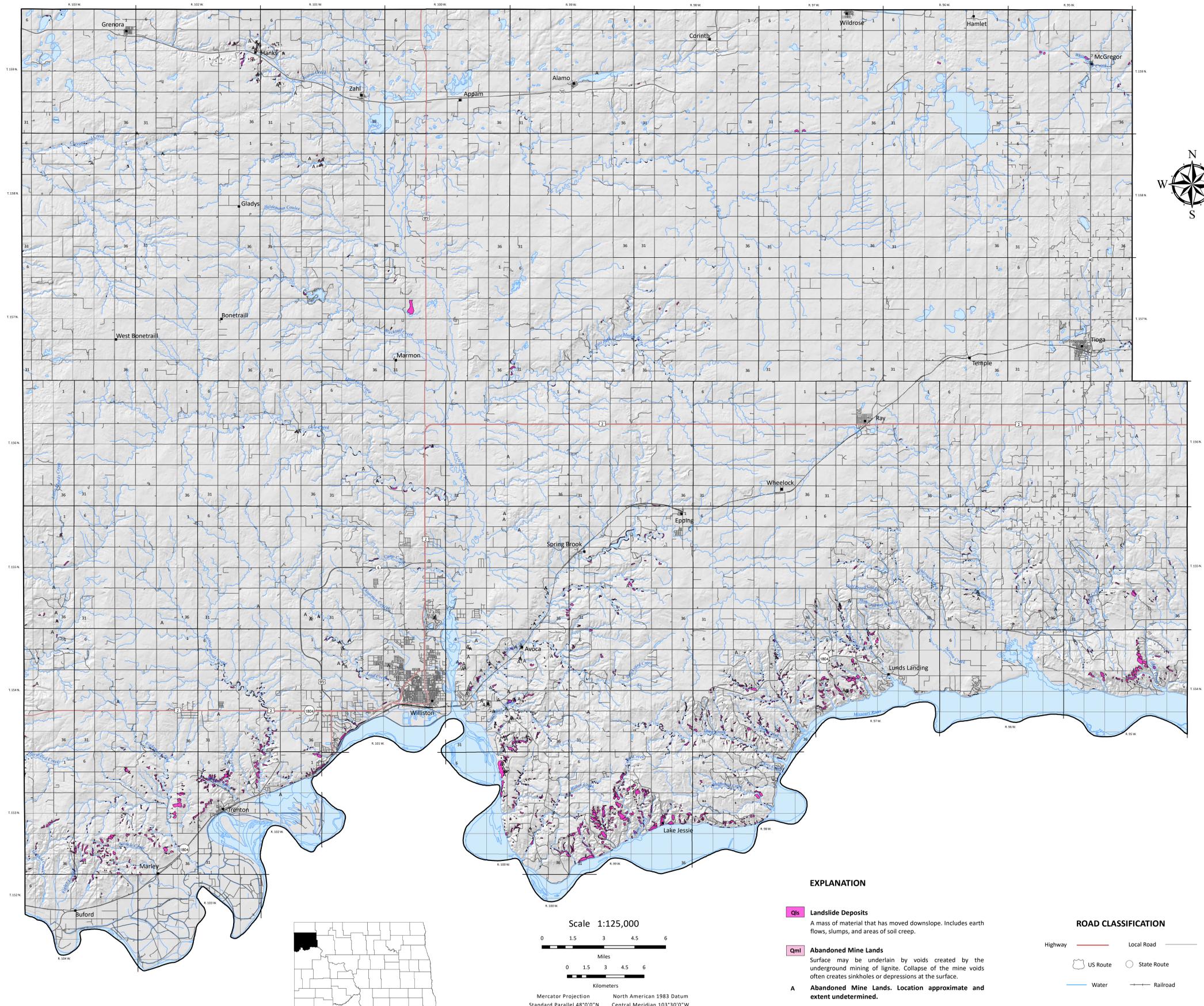


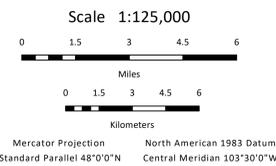
Figure 1. Distribution of landslides mapped in Williams County. The majority of slides (49%) cover less than one acre. There are many slides (3%) that are over ten acres in size.



Index to 1:24,000 Quadrangles



Williams 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.

ROAD CLASSIFICATION

- Highway
- Local Road
- US Route
- State Route
- Water
- Railroad