North Dakota Geological Survey
County Series: Barnes-L

North Dakota Geological Survey
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LANDSLIDE AREAS IN BARNES COUNTY, NORTH DAKOTA

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2022

LANDSLIDES IN BARNES 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, underground cables, 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 Barnes County were mapped from LiDAR data collected from October 2015 to November 2016 along with NAIP digital imagery from August 2016 and a complete set of historical aerial photographs that were flown in August 1959 at a scale of 1:20,000. It is unfortunate that these photographs were taken when leaves were on the trees because dense foliage can obscure small landslides. Some vegetation can aid in the identification of failed slopes, as trees and bushes are often aligned within very distinct parallel-, transverse-, and/or semi-circular depressions generally occurring within the body of the landslide. The use of bare-earth LiDAR imagery allows us to see surfaces that were previously obscured by vegetation in historical aerial photographs 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 material. Most of the large landslides found in 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 surface geology of Barnes County is predominately comprised of glacial sediments of the Coleharbor Group (Pleistocene) which overlies shale bedrock of the Pierre and Niobrara Formations in the shallow subsurface. The Coleharbor Group consists primarily of subglacial till and areas of coarse outwash. The Pierre and Niobrara Formations are relatively weak shales containing swelling clays and thus are prone to slumps and earthflows in the Sheyenne River Valley. The valley formed at the end of the last glacial period, as ice-dammed lakes to the north catastrophically emptied and large outburst floods carved a meltwater trench into the shale bedrock. As the walls of this trench are both steep and comprised of weak sediments, most landslides in Barnes County (61%) occur in shales along the slopes of the Sheyenne River Valley. Landslides are also found within the glacial sediments of the Coleharbor Group (42%) since the it directly overlies the Pierre Formation throughout the county. Landslide areas are less common (1.4%) in the fluvial sediments within the Oahe Formation (13%). The size of these slides is somewhat bimodally distributed in that 24% are less than 1 acre in size, while at the larger end 23% of the slides are greater than 10 acres (fig. 1). The largest slide area mapped in the county is approximately 292 acres in size.

Landslides are concentrated along the valley walls of the Sheyenne River meltwater trench where, in some locations, the entirety of the valley slope has slumped. Many of these larger slumps have a weathered morphology and may have occurred in the immediate aftermath of the outburst floods that carved the valley, approximately 14,000 years ago. Small landslides less than 10 acres are also common throughout the Sheyenne River Valley and have caused damage to roads, fiber-optic lines, and buildings.

A total of 1,275 landslide areas were identified in Barnes County. Several of these slides are larger slide complexes, consisting of multiple landslides that formed from multiple individual events. Therefore, the number of individual landslides in the county is likely somewhat higher. Collectively, these landslide areas cover 19.9 square miles (12,744 acres) or approximately 1.3 % of the county.

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.

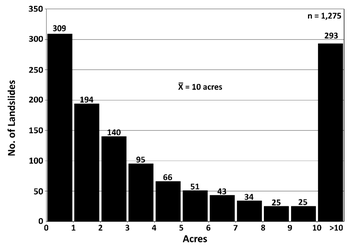
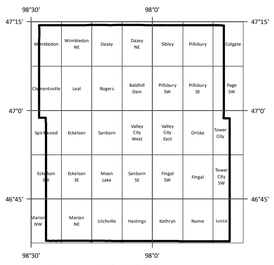
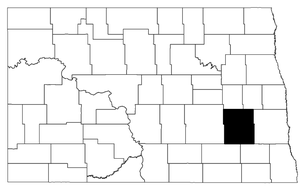


Figure 1. Distribution of landslides mapped in Barnes County.



Index to 1:24,000 Quadrangles



BARNES COUNTY, NORTH DAKOTA

Scale 1:125,000

0 1.5 3 4.5 6
Miles
0 1.5 3 4.5 6
Kilometers

Mercator Projection
Standard Parallel 46°37'30"N
North American 1983 Datum
Central Meridian 98°3'45"W

EXPLANATION

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

ROAD CLASSIFICATION

Expressway
Highway
Local Road
Interstate Route
US Route
State Route
Water
Railroad

Cartographic Compilation: Navin Thapa