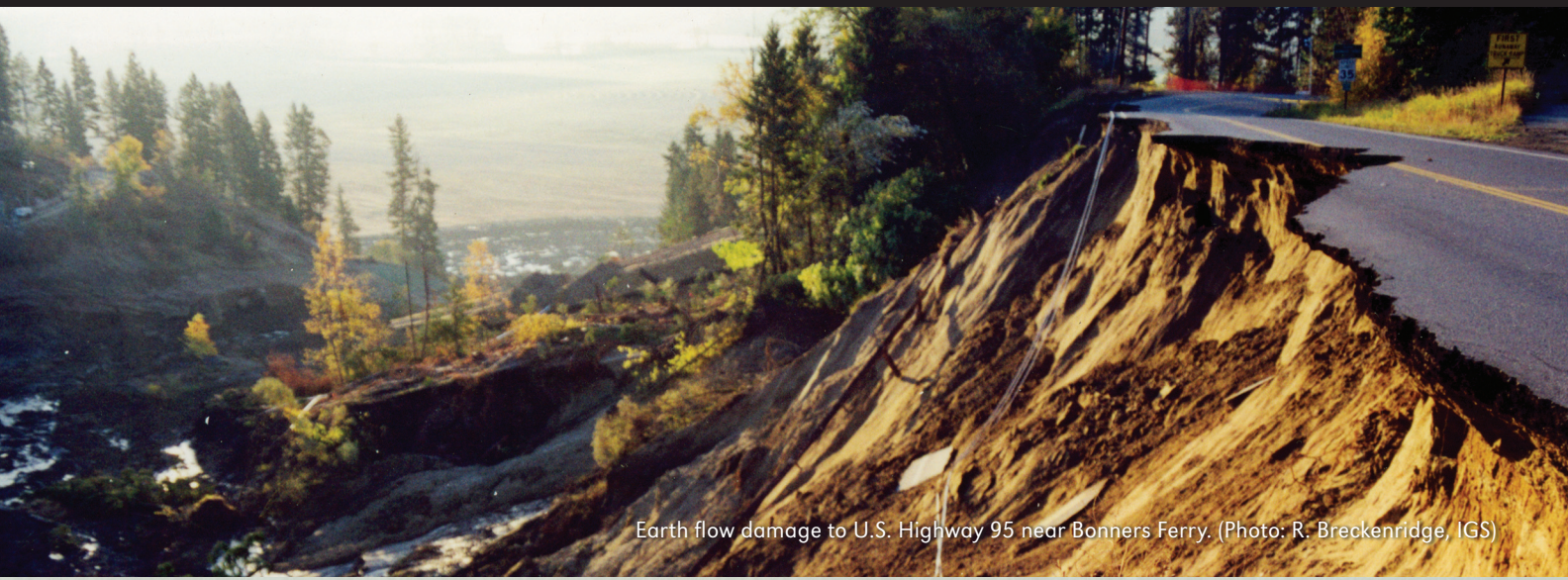
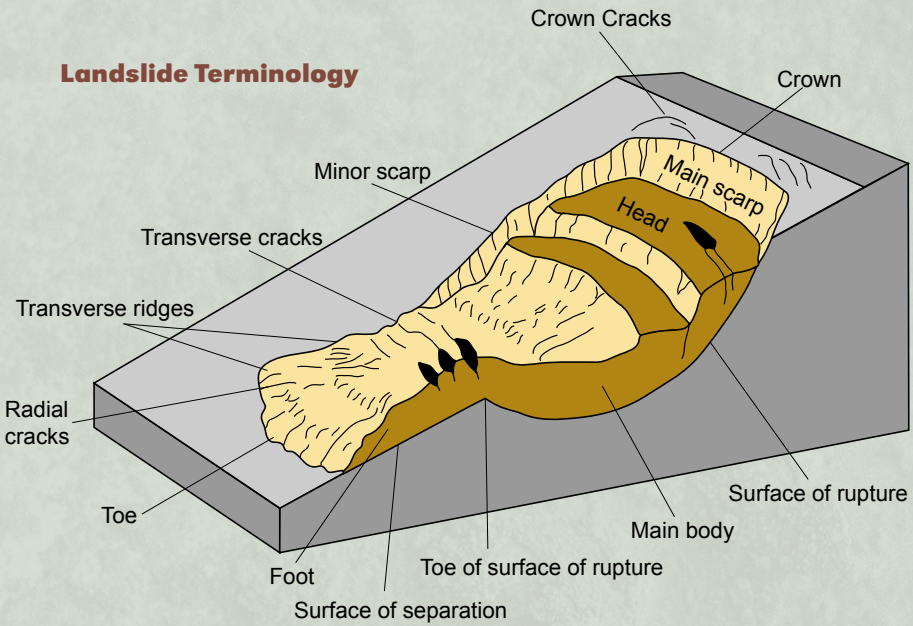
Landslide Hazards in Idaho

Idaho Geological Survey
Idaho Bureau of Homeland Security



Earth flow damage to U.S. Highway 95 near Bonners Ferry. (Photo: R. Breckenridge, IGS)



What are landslides?

Landslides are the sudden or steady movement of soil or rock down a slope. They occur every year in Idaho and can be devastating to property, services, highways, and wildlife habitat. They also can threaten lives. Understanding landslides is essential for reducing risks and avoid costly consequences. Both natural and man-made factors cause or contribute to these slope failures.

Types of Landslides

To explain cause-and-effect differences in slope failures, geologists have classified landslides by the type of movement and the size of the material involved.

Slides consist of blocks of material moving on well-defined shear planes. They are divided into **rotational slides** that move along a concave surface and **translational slides** that move parallel to the ground surface.

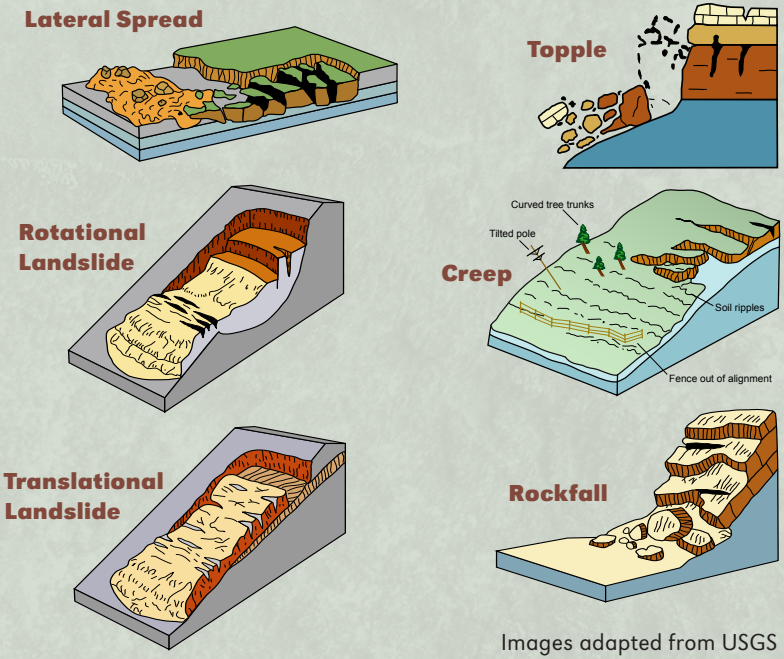
Falls are the sudden release of rocks or soils dropping freely through the air with little contact with other surfaces until impact.

Topples are similar to falls except that the initial movement involves a forward rotation of the mass.

Flows move entirely by shearing within the transported mass and act like viscous fluids.

Creep is the almost imperceptible movement of material down a slope.

Lateral spreads occur when liquefaction in underlying materials causes surface rocks or soils to move down gentle slopes.



Images adapted from USGS

On October 16, 1998, this large earth flow near Bonners Ferry caused extensive damage to U.S. Highway 95 and Union Pacific railroad tracks. Trucks, trains, school buses, and emergency services were blocked for several weeks causing severe economic losses. The flow occurred when highway construction undercut slopes composed of water saturated glacial and lake sediments. The deposits were formed during the last ice age when glaciers and large lakes covered much of the Idaho panhandle.

Photo: Jim Van Sky, Big Country Helicopters

Photo: IBHS

Debris flow damage to road caused by heavy winter precipitation on the Middle Fork Boise River near Atlanta.

Causes of Landslides

Landslides are caused by gravity acting on slopes. When gravitational stresses exceed the strength of rock or soil, slope failure occurs. Many landslides are initiated by triggering factors that increase stress and weaken slope materials. These triggers include:

- Heavy rains, rapid snowmelt, or irrigation that load slopes with water
- Natural erosion or human activities that increase slope angles or undercut the toes of slopes
- Shaking by earthquakes
- Removal of vegetation by wildfire, logging, agriculture, or overgrazing
- Loading of slopes with piles of rock, ore, or mining waste

Photo: J. Pierce, Boise State University

Debris flow deposits along Fourth of July Creek, near Stanley. The forest was burned by wildfire in the fall of 2006.

Photo: R.B. Colton, USGS

Lateral spreads at Hebgen Lake near West Yellowstone. Shaking from the August 18, 1959 magnitude 7.3 Hebgen Lake earthquake caused liquefaction of sediments beneath the road.

Landslides and Geology

Certain combinations of earth materials and steep topography increase the likelihood of slope failure. In Idaho, examples include basalt with sedimentary interbeds, altered volcanic rocks, fractured metamorphic rocks, glacial and lake deposits, and weathered granite.

Basalt lava flows exposed in canyons hundreds of feet deep occur throughout the Snake River Plain and Columbia Plateau. Large landslides tend to form where the basalts are underlain by unconsolidated sediments. In some cases, irrigation increases the landslide potential. At Salmon Falls Creek south of Buel, translational and rotational slides and multiple lateral spreads have occurred where basalt overlies lake and fluvial sediments.

Photo: B. Bannon, Idaho Transportation Department

On steep slopes in Idaho's river canyons, metamorphic rocks fractured by faulting and folding are prone to fail as falls, topples, and translational slides. Such landslides are common along the Salmon River and in Hells Canyon. This landslide near Lucille on the Salmon River was sporadically active between 1996 and 2005, sometimes burying both lanes of U.S. Highway 95.

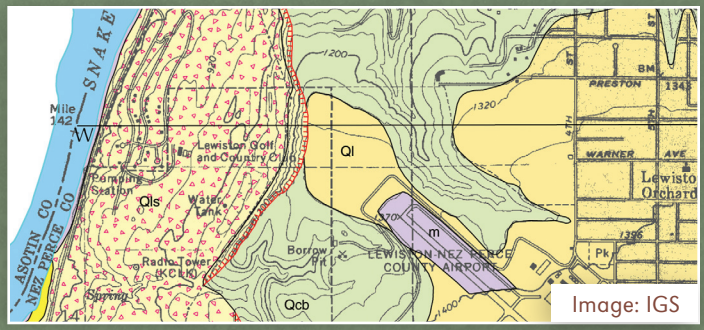
In the Lost River Range near Mackay, steeply dipping, altered volcanic rocks flowed out of the canyon onto the valley floor to form this prehistoric debris flow. The volcanic rocks were altered by hot fluids that reduced their strength. Shaking from earthquakes along nearby faults may also have played a role in causing this huge slope failure.

Photo: G. Meyer, University of New Mexico

These slope failures along the South Fork of the Payette River were triggered in the winter of 1996-97 by intense rainfall on a heavy snow pack. The slopes are underlain by weathered granite. In 1989, the area was burned by wildfire.Granite covers much of central Idaho. It weathers into marble-sized grains of quartz and feldspar called grus. When saturated by heavy precipitation from summer thunderstorms or prolonged winter rains, grus-covered slopes are prone to fail as debris flows. Removal of vegetation by wildfires or human activity exacerbates this situation.

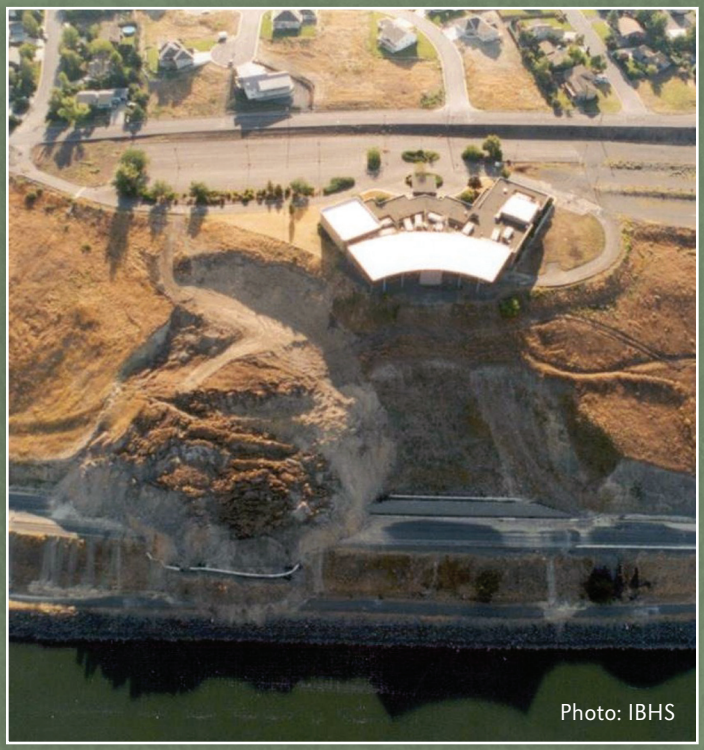
Studying Landslides

Scientific studies can identify landslide-prone areas and evaluate their risk. Large landslide complexes near Lewiston were identified by geological mapping. The slides formed along steep cliffs composed of basalt interbedded with sedimentary deposits. During the last ice age, catastrophic floods deposited gravel and sand on the tops of landslides and eroded the toes of slopes. These long-ago events may have triggered initial movements in the landslide complex. Between 1994-1998, a part of the slide directly below the Elks Lodge began to fail, threatening the building and temporarily blocking a major local road.

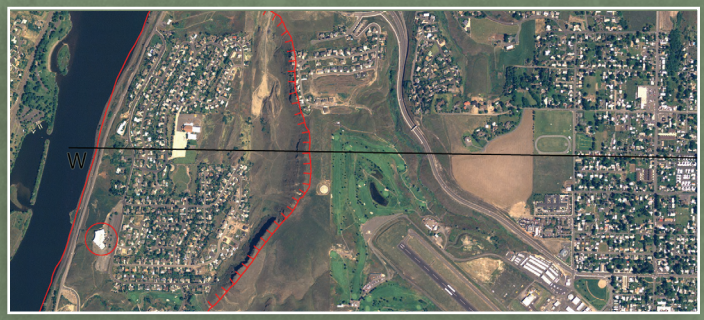


Geologic map of Lewiston landslide

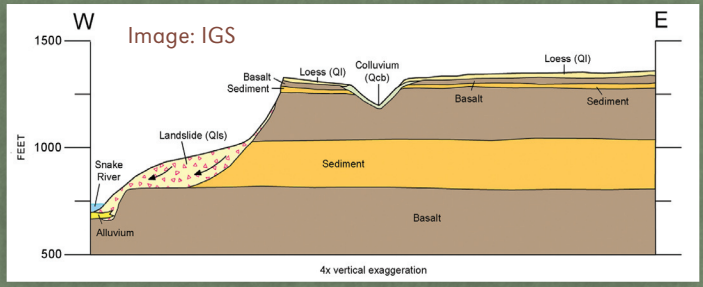
Geologic map of the landslide complex. Qls: landslide deposits; Qcb: basalt; Ql: loess deposits; m: man-made land at Lewiston airport.



Rotational debris slide in May 1998 on the toe of the main landslide complex. Landslides occurred intermittently in the area between 1994-1998. Sliding began after the road was widened at the toe of the slide. The white-roofed building is the Elks Lodge. The slide blocked a major local road and threatened to destroy the building.



Air photo of landslide complex along the Snake River near Lewiston. The landslide is outlined in red. Location of the geologic cross-section is shown by black line. The white building in lower left is the Elks Lodge, site of a smaller landslide.



Geologic cross section of Lewiston landslide showing basalts interbedded with sediment and the steep slopes caused by fluvial erosion. Many landslides in the Lewiston area have this geological setting.

Landslides and Floods

Many landslides in Idaho occur during or shortly after intense storms that cause flooding. These include thunderstorms in the summer or autumn, and heavy winter rains falling over prolonged periods. Intense rainfall falling on a thick snow pack and on lands recently burnt by wildfires are particularly dangerous.

The connection between flooding and landslides is illustrated by the events in the Boise foothills between 1959 and 1997. On August 19, 1959, a cloudburst in the Boise foothills created mud-rich floods that ran down streets and into storm sewers, basements, and an Idaho National Guard armory. Nearly 500 houses were damaged by mud up to 10 feet deep, and an area of over 160 acres was covered by silt. The source of the mud was easily erodible material on hillsides denuded of vegetation by a wildfire only three weeks before. In January 1969, a storm struck the same area and caused extensive damage, mostly from deposits of sediment. On September 11, 1997, a cloudburst dropped 0.40 inch of rain in nine minutes in the same foothills burned by a 1996 wildfire. The resulting flood of mud and debris damaged several homes and an elementary school. Presently, Boise operates sediment control structures on the drainages that were involved in these events. The structures are designed to channel flood water and mud away from residential and business districts into holding ponds and onto playing fields.

Flood control structures along Cottonwood Creek in Boise. Debris from Cottonwood Creek is routed into sediment retention pond and, if necessary, onto parking lot and playing fields.

Reducing Landslide Losses

- Learn to recognize existing landslides and landslide-prone areas.
- Avoid building on or near steep slopes.
- Many landslides occur during high intensity rainfall or prolonged periods of winter rain. Monitor news media for current conditions and check with the Idaho Transportation Department for road closures from landslides.
- Be especially alert when traveling. Bridges may be washed out or damaged, and culverts filled with debris. Never drive over flooded roads or across streams.
- Be aware that debris flow hazards may increase following wildfires because of the loss of vegetation.

For Further Information

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